Riverton Limestone Mine - Progressive Rehabilitation and Closure Plan

Graymont Limited



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Acronyms

Acronym	Description
AEP	Annual Exceedance Probability
ARD	acid rock drainage
AMD	acid mine drainage
As	Arsenic
B	Boron
BoM	Bureau of Meteorology
°C	Degrees Celsius
Ca	Calcium
$CaCO_3$	Calcium Carbonate
Ca:Mg	Calcium: magnesium ratio
Cd	Cadmium
CLID	Contaminated Land Investigation Document
Cr	Chromium
cm	Centimetres
cmol/kg	Centimoles per kilogram
CEC	Cation exchange capacity
CPESC	Certified Professional in Erosion and Sediment Control
CO_3	Carbonate
CSIRO	Commonwealth Scientific and Industrial Research
Cu	Copper
Cth	Commonwealth
DAFF	Department of Agriculture Fisheries and Forestry
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DETSI	Department of Environment, Tourism, Science and Innovation
DNRME	(Former) Department of Natural Resources, Mines and Energy
DoR	Department of Resources
DSDILGP	Department of State Development, Infrastructure, Local Government and Planning
EA	Environmental Authority
EC	Electrical conductivity
ENSO	El Niño Southern Oscillation
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EP Regulation	*Environmental Protection Regulation 2019*
EOML	End of Mine Life
ERA	Environmentally Relevant Activities
ESP	Exchangeable sodium percentage

EV	Environmental value
FSL	Full Supply Level
GAI	Geochemical Abundance Index
GCL	Geosynthetic clay liner
GDE	Groundwater Dependent Ecosystems
GIS	Geographical Information Systems
ha	Hectares
$HC0_3$	Bicarbonate
Hg	Mercury
IA	Improvement area
ID	Identification
IQA	Institute of Quarrying Association QLD
K	Potassium
km	Kilometres
km^2	Square kilometres
Km/h	Kilometres per hour
kVA	Kilovolt-ampere
L	Litres
LGA	Local Government Area
LOM	Life of Mine
L/s	Litres per Second
m	Metres
mAHD	Australian Height Datum
mBGL	Below Ground Level
MCA	Minerals Council Australia
m/d	Metres per Day
m^3/d	Cubic Metres per Day
MERFP Act	*Mining and Energy Resources (Financial Provisioning) Act 2018*
Mg	Magnesium
mg/L	Total suspended solids
mg/kg	Milligrams per kilogram
MJ/ m^2	Megajoules per square metre
ML	Mining Leases
Mm	Millimetres
Mn	Manganese
MP	Member of parliament
MPa	Megapascals
MNES	Matter of National Environmental Significance
MSES	Matter of State Environmental Significance
Mtpa	Million tonnes per annum
Mya	Million years ago
NC Act	*Nature Conservation Act 1992*
Ni	Nickel
NLAA	National Lime Association Australia
NMD	Neutral mine drainage
TEC	Threatened Ecological Community

TSS	Total Dissolved Solids
Na	Sodium
NAF	Non-acid forming
NATA	National Association of Testing Authorities
Ni	Nickel
NO_3	Nitrate
NTU	Turbidity
NUMA	Non-use management areas
PAF	Potential acid forming
Pb	Lead
PET	Point evapotranspiration
pH	pH Unit
PIE	Public interest evaluation
PMLU	post mine land use
PMR	Protected Matters Report
PCB	Polychlorinated biphenyls
PRC Plan	Progressive Rehabilitation and Closure Planning
QA/QC	Quality Control and Quality Assurance
QFES	Queensland Fire and Emergency Services
QG	Queensland Government
QGlobe	Queensland Globe
QRC	Queensland Resource Council
QLD	Queensland
P	Phosphurous
RA	Rehabilitation Area
RAP	Remediation Action Plan
RE	Regional Ecosystem
RL	Relative Level
RM	Rehabilitation Milestone
ROM	Run of Mine
RPEQ	Registered Professional Engineers of Queensland
RPP	Rehabilitation Planning Part
S	Sulfur
SAQP	Soil Analysis and Quality Plans
SDRC	Southern Downs Regional Council
SESL	SESL Australia Pty Ltd
SQP	Suitably qualified person
Spp	Species
t	Tonnes
t/m^3	Tonnes per cubic metres
tpa	Tonnes per annum
tpd	Tonnes per day
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
UQ	University of Queensland
uS/cm	Electrical Conductivity

WRD	Waste Rock Dump
%	Percent
µS/cm	Micro Siemens per Centre Meter
VMP	Vegetation management plan
WQO	Water quality objectives
XRD	X-ray diffraction
XRF	X-ray fluorescence
Zn	Zinc

1. Rehabilitation Planning Part

1.1. Introduction

Graymont (NSW) Pty Ltd (Graymont) operate the Riverton Limestone Mine and Processing Plant (the project), located at Riverton about two kilometres (km) east of the border between Queensland (QLD) and New South Wales (NSW) (refer to **Figure 1**).

The project is located on two existing mining leases (MLs) held by Graymont, comprising of ML50142 and ML50220 (the site). Mining activities are authorised under Environmental Authority (EA) EPML00241213 and upheld by Graymont. The EA authorises the holder to extract between 100,000 and 500,000 tonnes of limestone per year.

This progressive rehabilitation and closure plan (PRC Plan) is designed to outline requirements associated with the rehabilitation of areas of disturbance resulting from mining operations undertaken within the MLs as identified in **Section 2.3.2**. The PRC Plan has been prepared to address the requirements of:

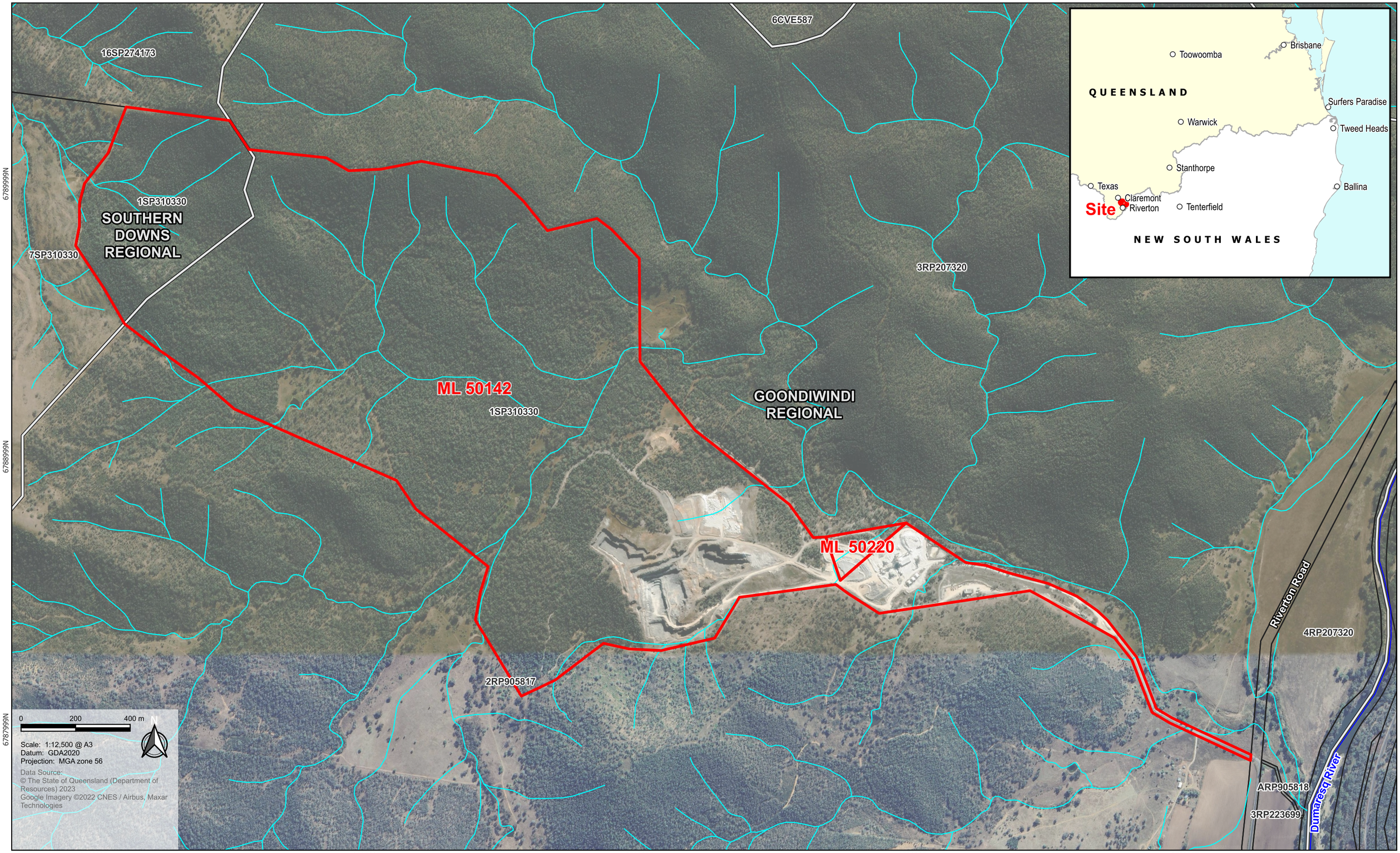
- The *Mining and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act)
- Sections 126B, 126C and 126D of the *Environmental Protection Act 1994* (EP Act)
- The Guideline Progressive Rehabilitation and Closure Plans (PRC Plan Guideline)
- Schedule 8A of the *Environmental Protection Regulation 2019*
- Conditions F2-1 – F2-4, F3-1 – F3-2 and F4-1 of the EA
- Information Request (IR) notice issued by the Department of Environment, Tourism, Science and Innovation (DETSI) dated 21 June 2023

The PRC Plan ensures the site has an agreed post mining land use and describes how rehabilitation of the area will be carried out progressively over the life of mine. The PRC Plan outlines the project planning and post-closure requirements, community consultation, post-mining land use, rehabilitation methods, risk assessment, monitoring and maintenance, and rehabilitation schedule.

1.2. Purpose of Plan

During operations areas of disturbance within the ML will be progressively rehabilitated to achieve a post-mining land-use (PMLU) in accordance with the EA. The purpose of this PRC Plan is to outline rehabilitation requirements that:

- Meet landholder expectations for final land use
- Achieve a decommissioned site that is safe, fit for purpose and non-polluting
- Eliminates residual impact or liability for community and future land holders following rehabilitation
- Achieves an appropriate post mining land-use for each nominated rehabilitation area
- Returns the agreed areas of the mine to an agreed upon condition



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP\Rev 2\Figure 1 Mining Leases and Cadastral Boundaries.qgz

Legend

- Site boundary
- Local Government Areas
- Cadastre (DCDB)

Watercourses

- Major
- Minor

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Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Figure 1
Mining leases and cadastral boundaries

2. Rehabilitation Planning Part

This section of the PRC Plan provides baseline information, site location details, a description of the site's operations and information on rehabilitation / improvement planning.

2.1. Baseline Information

Mining operations at Riverton commenced in the 1970s. As such, disturbance at the site pre-dates the requirement to collect baseline information. Consequently, the following sections have been prepared based on a combination of the limited historical (pre-1972) and current available information.

2.1.1. Surrounding Land-Use

Surrounding land-use is dominated by self-sustaining native vegetation with minor cattle and sheep grazing, with forestry land located proximate to site (QG, 2023a). Specifically, the immediately surrounding land comprises of:

- **North** – the north of site is bound by medium to high density native vegetation
- **South** – the south of site is bound by light to medium density native vegetation, with agricultural land (pasture) located to the south-west of site
- **East** – the immediate east of site comprises native vegetation, beyond which lies agricultural land (pasture/cropping) and the Riverton Road easement and Dumaresq River. Primary site access is to the east
- **West** – the west of site is bound by medium to high density native vegetation

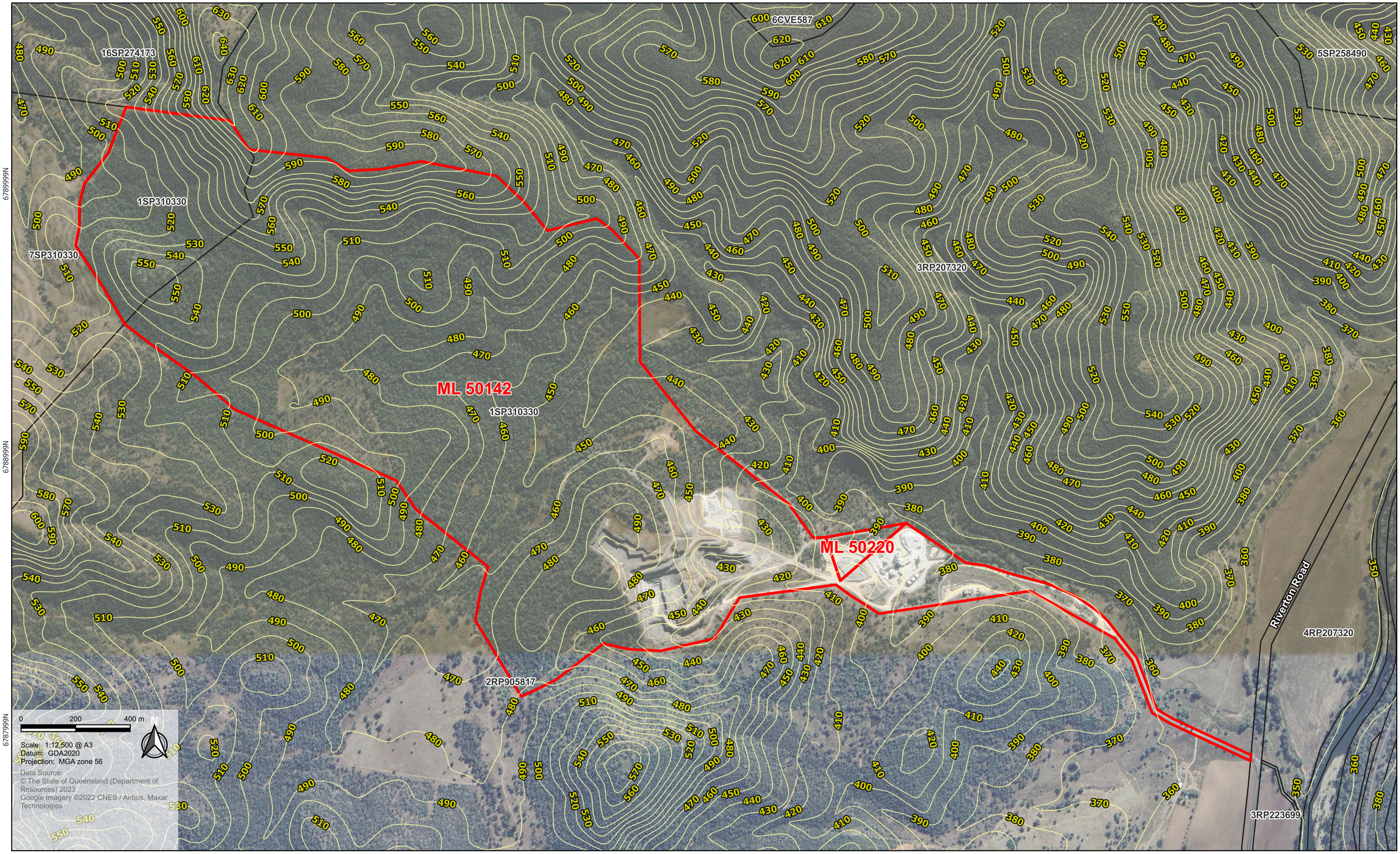
The project and surrounding areas are also zoned as rural under the Goondiwindi Regional Council Planning Scheme 2014 (GRC 2014) and Southern Downs Regional Council Planning Scheme 2018 mapping (SDRC 2018).

2.1.2. Site Topography

The topography of the area is steep to undulating, and the site is protected by foothills from the low-lying Dumaresq River (SLR Consulting 2019). The site is naturally undulating with steeper grades evident across areas subjected to mining activities; elevation at the site ranges from 360 metres Australian Height Datum (mAHD) to 490 mAHD.

The central portion of the site trends downwards towards the Dumaresq River to the east. Review of surrounding topography indicates that the remainder of the site trends up towards the surrounding areas to the north, west and south away from the site boundary, as shown in **Figure 2**.

Reference to the Queensland Government's (QG 2019a) QTopo database indicates the site is at a lower elevation, particularly where disturbance and mining activities are occurring. The site is surrounded by a 600 mAHD ridgeline in the north, south and west. The site is within a non-remnant area of Land Zone 11, defined as "hills and lowlands on metamorphic rock" (SLR Consulting 2019).



Legend

- Site boundary
- Cadastre (DCDB)
- Elevation contours (mAHD)

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Progressive Rehabilitation Closure Plan

Figure 2
Topography

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2.1.3. Climate and Natural Hazards

The site experiences a temperate to sub-tropical climate, characterised by hot and humid summers and cool to mild winters, with the majority of rainfall occurring in the warmer months between December and March. Relative humidity is generally higher in the mornings and in winter months. The prevailing wind direction is from the southwest and is greater during mid-autumn (April) to the end of winter (August).

Bureau of Meteorology (BoM) weather stations located proximate to the site include:

- Riverton (Site no. 041087)
  - Distance to site: <10 km north of site
  - Years operational: 1920 - 2023
  - Data recorded: Rainfall, solar exposure
- Texas Post Office (Site no. 041100)
  - Distance to site: 42 km north-west of site
  - Years operational: 1897 – 2023 (temperature recorded only since 1969)
  - Data recorded: Rainfall, temperature, solar exposure, wind speed

As the Riverton weather station stopped collecting data in 2006 it has not been utilised for the main climate statistics; the next most-proximate weather station (Texas Post Office) data has been adopted.

The Riverton region receives an average of 659 millimetres (mm) of rain per annum, of which 37 percent falls in the summer months (BoM 2024a). The area is dominated by ephemeral creeks, most of which are understood to be dry for the majority of the year. Frosts are common in winter months (Sibelco Australia 2014).

Evaporation rates influence soil moisture, rehabilitation success and mine water balance and is therefore relevant in the site's assessment. Mean solar exposure based on climatic data recorded at the two nearest meteorological stations indicates a seasonal trend with monthly values ranging from 11.2 megajoules per square metre (MJ/m2) during the winter (June) to 25.8 MJ/m2 in summer (January) (BoM 2024a). The mean annual evaporation is 1770 mm (Sibelco Australia 2014).

A summary of long-term climate data is provided in **Table 1**.

Table 1. Long term climate date (Source: BoM 2024a)

Month	Temperature (°C)		Mean daily solar exposure (MJ/m^2)	Mean Wind Speed (km/h)		Rainfall (mm)		
	Mean Min	Mean Max		9am	3pm	Mean Monthly	Highest Daily	Highest Monthly
January	18.8	33.9	26.0	9.0	11.9	88.5	161.8	367.6
February	18.4	32.8	23.4	9.0	11.1	75.5	171.0	299.2
March	16.2	31.2	20.4	8.7	11.2	58.7	955.6	348.7
April	12.0	27.4	17.0	8.6	10.9	34.5	61.0	261.8
May	8.1	22.9	13.4	8.5	11.4	39.6	58.6	151.4
June	4.7	19.4	11.4	8.5	11.4	40.1	83.2	156.1
July	3.8	18.9	12.5	8.7	11.4	41.0	70.1	154.7
August	4.6	21.0	15.8	8.9	13.7	33.6	51.0	130.6

September	8.0	24.6	19.5	9.2	13.8	39.6	70.4	196.6
October	11.9	28.1	22.7	10.2	13.1	60.8	94.7	199.0
November	15.0	30.5	24.9	9.7	12.4	67.2	70.4	187.5
December	17.4	32.8	26.1	9.7	12.4	80.3	100.6	228.6
Mean	**11.6**	**27**	**19.4**	**9.1**	**12.1**	**54.94**	**90.7**	**223.5**

2.1.3.1. Long term projections

Storms

Although there is no defined season or period when severe weather events are most likely to occur in Queensland, severe storms tend to more frequently occur during summer months (October to April) and periods of heatwave (Queensland Fire and Emergency Services (QFES) 2017). Severe storms can result in damaging or destructive wind gusts, flash flooding and large hailstones (greater than 4 centimetres (cm) in diameter) (QFES 2017).

The site has an average annual lightning ground flash density of five to six strikes per square kilometre per year (km^2/yr) and is located within a region that experiences on average 20 to 30 thunder days per year (BoM 2024b).

Cyclones

Tropical cyclones are low pressure systems that form over warm tropical waters (CSIRO & BoM 2015) usually from early November to late April (QFES 2017). In Queensland, tropical cyclones typically affect the Gulf of Carpentaria, Cape York Peninsula and eastern coastline extending from the north tip of Queensland to central coastal regions. However, there are records where tropical cyclones have moved inland from the north and east of Queensland (QFES 2017).

The number of tropical cyclones making landfall in Australia is influenced by a number of factors, however, tends to be strongly influenced by the El Niño Southern Oscillation (ENSO), with the Queensland coast experiencing three to four times as many cyclones during La Niña years compared to El Niño years (CSIRO 2021).

There have been no cyclones documented to occur within 50 km of the site since 1969, and only four within 100 km of the site. These occurred in the 1947 cyclone season (unnamed, north-west of the site), 1954 season (unnamed, east of the site) 1964 season (Cyclone Audrey, south of the site) and recently in the 2013 season (Cyclone Oswald, west of the site).

Impacts from tropical cyclones depend on the category, wind speed, rainfall intensity and duration, and riverine flooding as a result of prolonged deluges (QFES 2017; BoM 2023c). The average number of cyclonic wind gust events over 75 kilometres per hour (km/h) in 10 years is 0.1, with no cyclonic wind gust events occurring in excess of 150 km/h in the 30 years preceding 2014 (DAFF 2014). Although the potential for cyclone influence to occur exists, the intensity is likely to be a Category 1, with the potential for damage to mine infrastructure considered to be negligible to minor. Category 1 cyclones have a maximum mean wind of 63-68 km/h and typical strongest gusts of <125 km/h (BoM 2023c).

Floods

Riverton is located within the Border Rivers catchment, which drains an area of approximately 23,820 square kilometres (km^2) across Queensland and NSW. Several other towns are also located within the catchment including Stanthorpe, Goondiwindi, and Inglewood. The Dumaresq River to the east of the site is one of the three main tributaries of the Macintyre River, along with the Macintyre River in NSW and the Macintyre Brook. Flooding can occur along these river systems causing isolation of towns and rural areas. As a result, BoM operate a flood warning system using rainfall and river stage observations (BoM 2023d). A small portion of the projects southeastern extent is mapped as interacting with the State Planning Policy Flood hazard area - Level 1 - Queensland Floodplain assessment mapping (Department of State Development, Infrastructure, Local Government and Planning (DSDILP) 2024). The site is mapped within the general flood hazard area under the *Goondiwindi Regional Council Planning Scheme* (refer **Figure 3**) and is not mapped as a flood plain or flood hazard area under *Southern Downs Regional Council* mapping (SDRC 2021; GRC 2014).

A combination of Commonwealth (regulated and unregulated) and NSW environmental water has been delivered to the Border Rivers since 2011-2012 to support riparian vegetation, native fish outcomes and river and wetland connectivity (QG 2021e).

A study of drainage works for the site indicated that additional flood mitigation in the form of clean water diversions was required at the Riverton site (Lindsay Dynan 2019). These additional measures divert water around the Riverton site and into a farm dam to meet internal dam capacity up to and including the 50-year event (Lindsay Dynan 2019).

Bushfires

Bushfire risk is influenced by a combination of increased temperatures, higher winds, lower rainfall, and woody vegetation. The *Goondiwindi Regional Council Planning Scheme 2014* does not provide a Bushfire Hazard Risk Analysis overlay map for the site, however, the State-wide mapping of the Bushfire Hazard Area (Bushfire Prone Area) developed by Department of State Development, Infrastructure, Local Government and Planning (DSDILGP), indicates that the site is located within the New England Tableland Region bioregion. This bioregion is characterised by grassy open forests, shrubby open forests, open forest with limited ground fuel, sedgelands, rock pavement communities, riparian/fringing communities and vine thickets. As, winters are typically dry with little rain received, there is potential for a period of high fire danger going into spring when dry strong westerly winds can occur (QPWS 2013). The fire season starts in September, peaks in October, and continues to December. The site is mapped as medium to high potential bushfire intensity with some potential impact buffer, as shown in **Figure 3** (QG 2015; SDRC 2021).

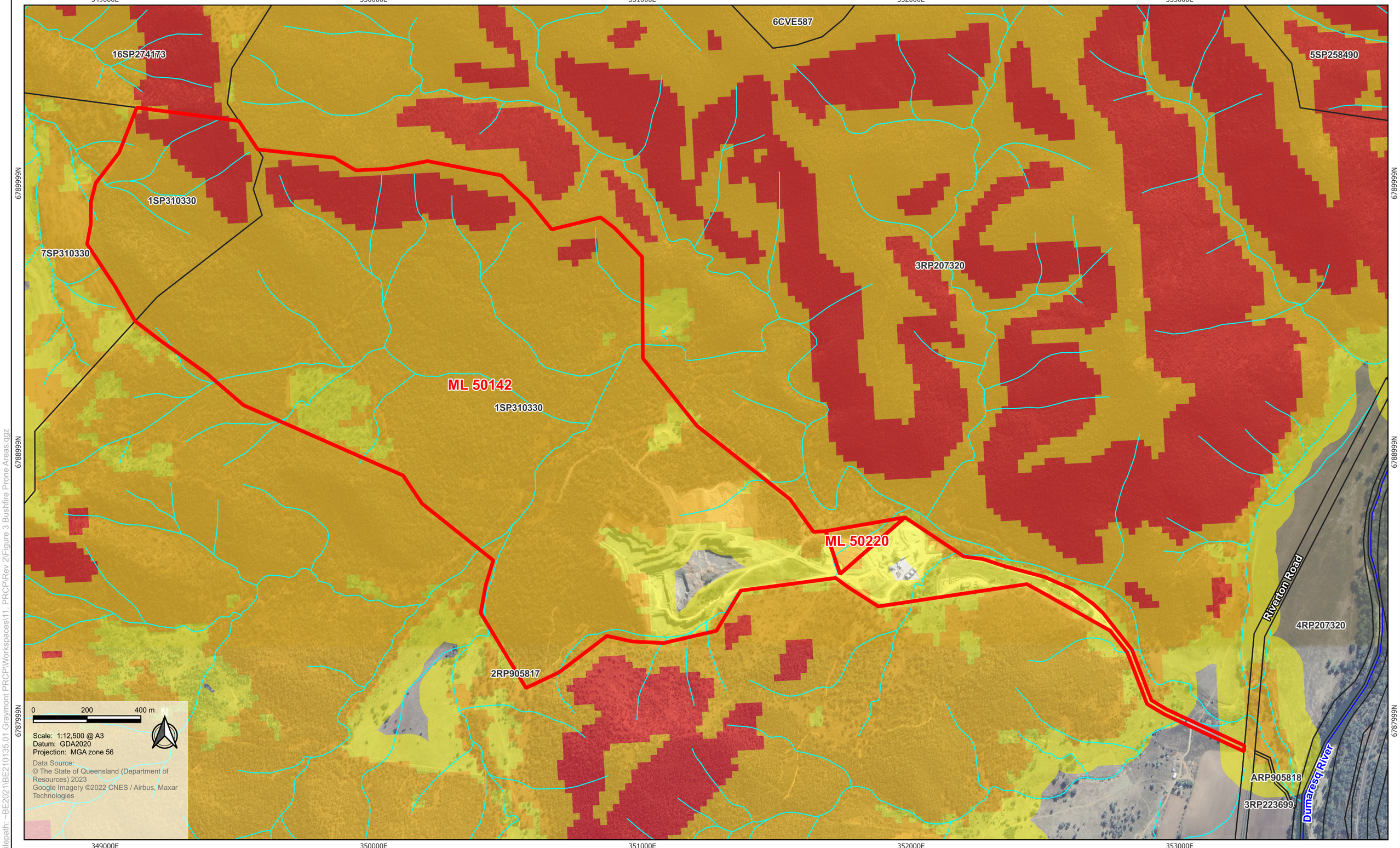
Earthquakes

Queensland is considered seismically active, with the highest hazard region lying along the eastern coast and near offshore regions (University of Queensland (UQ) 2018). Between 1977 and 2000, an average of 110 earthquakes per year have been recorded by the Queensland seismic network (ESSCC 2021); the majority of which were of a very low magnitude. Based on the data provided by the University of Queensland Seismological Observatory, it has been

determined that the potential for earthquakes to occur within or surrounding the site is low (UQ 2018).

Droughts

Queensland is particularly vulnerable to natural rainfall variability. Droughts are common in Queensland and generally associated with El Niño conditions. As of 3 March 2022, there were a total of 34 councils and three part-council areas drought-declared in Queensland (Queensland Government (QG) 2022). These declarations represented 64.7 percent of the land area of the state (QG 2022). As of 1 August 2024, there are no drought declared LGA in Queensland (QG 2024). The Southern Downs region had its drought declared status revoked on 1 April 2022 (QG 2022); the Goondiwindi region had its drought declaration status revoked on 1 May 2021 (QG 2021b).



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP\Rev 2\Figure 3 Bushfire Prone Areas.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Bushfire prone area (September 2014)

- High Potential Bushfire Intensity
- Medium Potential Bushfire Intensity
- Potential Impact Buffer

Watercourses

- Major
- Minor

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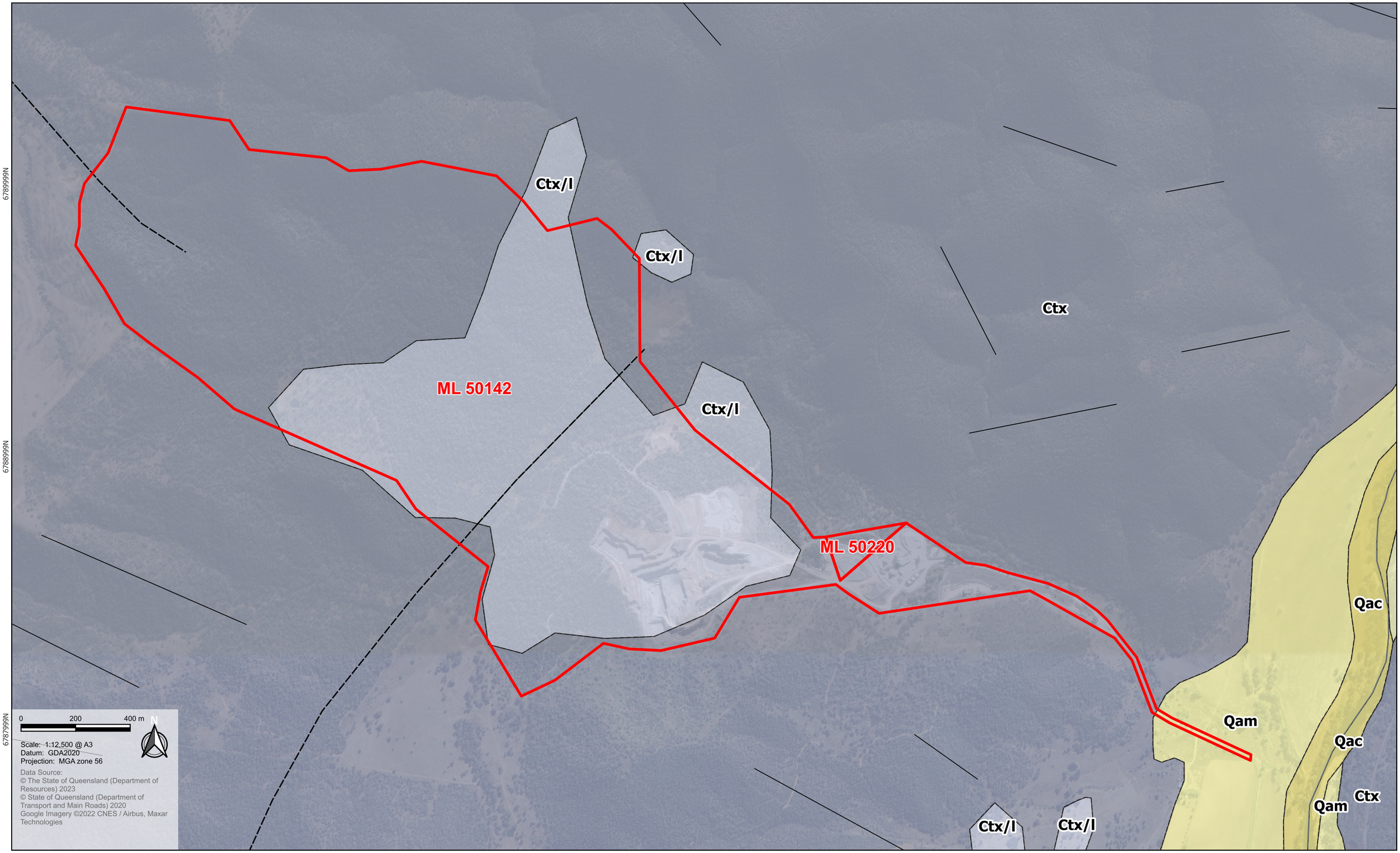
Figure 3
Bushfire prone areas

2.1.4. Geological setting

Sedimentary limestone is the dominant rock on the site and forms part of the geological unit referred to as the Texas Beds, a series of variably folded siliciclastic and carbonate sediments of Late Devonian to Carboniferous age (between 305 and 385 million years ago) (Sibelco Australia 2014). The lithology is described as thin to thick-bedded, volcaniclastic arenite, mudstone, siltstone, and slate; local phyllite; sporadic lenses of jasper, limestone, chert and volcanics; and mafic conglomerate (QG 2021b). There are two fossil sites mapped within the site (Ashford, field ID TXPD286) comprised of crinoids and corals in one small area. (QG 2021b). A portion of the site is described as variably crystallised, sparsely fossiliferous limestone; local-limestone and basal breccia (QG 2021b) (refer **Figure 4**).

Limestone is a sedimentary rock with the chemical composition of calcium carbonate or $CaCO_3$. The deposits within ML 50142 at Riverton are massive, near vertical and associated with clays and andesitic rocks together with surrounding sandstones and mudstones (Sibelco Lime 2016).



Legend

Site boundary

Detailed Surface geology (August 2022)

- Ctx: Texas beds - Stratified Unit (including Volcanic And Metamorphic) - Sedimentary Rock
- Qa: Qa-QLD - Stratified Unit (including Volcanic And Metamorphic) - Alluvium
- Qac: Qac-QLD - Stratified Unit (including Volcanic And Metamorphic) - Alluvium
- Qam: Qam-QLD - Stratified Unit (including Volcanic And Metamorphic) - Alluvium
- Ctx/l: Texas beds/l - Stratified Unit (including Volcanic And Metamorphic) - Carbonates (limestone Or Dolomite)

Detailed Structure geology (August 2022)

- Fault approximate
- Geological boundary approximate
- Lineament
- State or territory border

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Figure 4
Geology

2.1.5. Site hydrology and fluvial networks

2.1.5.1. Watercourses and waterways

The site is located in the upper Dumaresq River sub-basin, within the greater Border Rivers catchment, which eventually joins the Murray Darling River system (Sibelco Australia 2014). The Dumaresq River, along with the Macintyre River and Macintyre Brook in NSW, are the three main tributaries of the Macintyre River (BoM 2021d). The Dumaresq River is a seventh order mapped watercourse under the *Water Act 2000* and is mapped as a major (purple) waterway for water barrier works under the *Fisheries Act 1994* (QG 2021b).

Ephemeral creeks traverse the mining leases with small, constructed dams comprising the only permanent water bodies onsite (Sibelco Australia 2014). There is a major (purple) third order waterway that runs parallel to the ML's north-eastern boundary that joins the Dumaresq River to the east of the site. A site visit undertaken by Epic Environmental in October 2019 found that this was the only creek adjacent to the site that contained water at the time of the site visit. This is an intermittent, spring fed pool riffle system that has a well vegetated riparian zone and drains in a south-east direction (Sibelco Lime 2016). Due to the permanence of the water, the creek is likely to act as an important water source for native wildlife during drought times (Epic Environmental 2020).

Review of the Queensland waterways for waterway barrier works under the *Fisheries Act 1994* (viewed in Queensland Globe) indicates a low (green) first order waterway adjacent the sediment basins onsite and moderate (orange) second order waterway north of the site, as shown in **Figure 5**. Vegetation Management Reports identified two defined, unnamed first stream order watercourses bisecting the site, and a number of unnamed first and second stream order watercourses occurring north and south of the Site. DETSI Biomaps interactive mapping online revealed a number of 'buffered streams of conservation significance: Queensland Murray darling basin' intersect the site that correspond to the first stream order unnamed drainage features. There are also narrow bands of matters of state environmental significance (MSES) - High ecological significance wetlands mapped along the Dumaresq River corridor, approximately 1.6 km east of the site (Epic Environmental 2020).

345000E 348000E 351000E 354000E 357000E

6785999N

ML 50142

ML 50220

RN 77426

RN 77043

RN 71933

Mole River

Dumaresq River

Riverton Road

Little Plains Creek

Tea Tree Creek

Reedy Creek

0 500 1,000 m

N

Scale: 1:32,500 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

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Legend

- Site boundary
- Cadastre (DCDB)

Floodplain Extent (QFAO) Level 1

- Rapid hazard assessment

QLD waterways barrier works

- 1 - Minor
- 2 - Moderate
- 3 - High

Watercourses

- 4 - Major
- Major
- Minor

- Registered water bores

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Figure 5
Flooding, watercourses, waterways and registered groundwater wells

BE210135.01 Rev 2 25/10/2024

2.1.5.2. Catchment overview

Regional Catchment

Regionally, the site is located within the the Border Rivers catchment, one of the northern-most catchments of the Murray-Darling Basin (Murray Darling Basin Authority (MDBA) 2021). The Border Rivers catchment drains an area of approximately 23,820 km^2 across Queensland and NSW (BoM 2021d). The catchment's Macintyre, Dumaresq and Barwon rivers rise on the western slopes of the Great Dividing Range and run westward, gradually merging with each other to become the Barwon River on the floodplains upstream from Mungindi (MDBA 2021).

Local Catchment

The site is located within the southern extent of the Dumaresq River sub-basin, comprising an area of approximately 4,312 km^2 (QG 2021b; QG 2021e). The Dumaresq River receives flows from the Severn River, Pike Creek and Mole River, and forms the border between the states of Queensland and NSW at this location (QG 2021d).

2.1.5.3. Topography and drainage

The topography in the vicinity of the site is relatively flat and lies between 360 and 490 mAHD. It falls gently to the east to the Dumaresq River, running north to south adjacent to the site. Glenlyon Dam is located 5 km north of the site, and confluences with Dumaresq River upstream of the site, via Pike Creek (QG 2021b).

The intermittent water course that drains in a south-east direction across the site is fed by a series of drainage lines traversing the MLs. Of these drainage lines, it has been identified that a total of 11 local catchments, covering an area of 136 ha, have a direct impact on the extraction and processing activities on the site. Approximately 89 percent (269 ha) of the site area drains to the Dumaresq River, located 1.5 km to the east of the processing plant, and the remaining 9 percent (33 ha) of the site area drains north to the Glenlyon Dam catchment area (Sibelco Lime 2016).

2.1.5.4. Onsite water infrastructure

Onsite water infrastructure includes four existing sediment basins onsite, and water storage tanks along the southern extent of ML50142. One sediment basin is located to the south of the mine pit with the other three sediment basins located around the run-of-mine and plant infrastructure area across ML50220 and ML50142.

In 2020 stormwater and flood mitigation was proposed to minimise the release of sediment-laden water from the site, to ensure compliance with the site EA and protecting operations from inundation by floodwater. This comprised a clean water diversion levee constructed along the southern boundary of the site, a farm dam (for water storage, off-lease), and a drainage channel (on-lease) running from north to south, adjacent to the existing sediment basins onsite (Epic Environmental 2020).

2.1.5.5. Flooding

Streamflow of waterways and watercourses in the vicinity of the site are intermittent and/or disconnected until their confluence further downstream of the site. Wet season flows are driven by runoff caused by heavy rainfall associated with storms and/or cyclones.

The site is not within the flood warning area, and it is not located within a floodplain or flood hazard area under the *Goondiwindi Regional Council Planning Scheme* or *Southern Downs Regional Council mapping* (GRC 2014; SDRC 2021). The site is located adjacent to areas that can be affected by major floods. BoM operate a flood warning system for the MacIntyre and Weir Rivers using rainfall and river stage observations (BoM 2021d).

Review of FloodCheck Queensland (DoR 2023) indicates the site has not undergone historical flooding and is not likely to experience a one percent Annual Exceedance Probability (AEP) flooding event.

2.1.5.6. Wetlands

There are no internationally important wetlands within the vicinity of the site; the closest Internationally Important Wetland is located greater than 1000 km away. There are narrow bands of Matters of State Environmental Significance (MSES) - High ecological significance wetlands mapped along the Dumaresq River corridor. The closest of which is approximately 1.6 km east of the site (Epic Environmental 2020).

2.1.5.7. Existing surface water use

A combination of Commonwealth (regulated and unregulated) and NSW environmental water has been delivered to the Border Rivers since 2011-2012 to support riparian vegetation, native fish outcomes and river and wetland connectivity (QG 2021e). As the Border Rivers catchment is one of the northern-most catchments within the Murray Darling Basin, water use and distribution is highly regulated. Dams constructed in the catchment in the 1960s to 1970s for flood mitigation and irrigation water supply to the plains have since been highly regulated, with Glenlyon Dam on Pike Creek (upstream of Dumaresq River) regulating 88% of inflows. Water resources within Glenlyon Dam are shared between Queensland and NSW users (MDBA 2021).

The most notable water users in the Border Rivers catchment are urban centres and agriculture. Agricultural land uses in the Border Rivers catchment are dominated by cattle and sheep grazing in the tablelands and western plains, and dryland cropping on the slopes (MDBA 2021).

Waterways within and surrounding the site have intermittent flow, however segregated waterholes can persist between flood events without surface water inflow. Areas of the Dumaresq River are open to fishing, and Lake Glenlyon is used for recreational activities including swimming and fishing (MDBA 2021).

2.1.6. Hydrogeology

The EA does not consider monitoring of groundwater necessary given the low-risk of potential impact to groundwater resulting from mining operations. As such there is limited data available for the nature and characteristics of groundwater beneath the site. One registered sub-artesian

groundwater bore exists onsite (registered bore ID 74426) however; limited data is available for this bore (QG 2021b). The groundwater bores in proximity to the site do not penetrate the regional bedrock aquifer; all bores are shallow and usually target the alluvial aquifer system for irrigation purposes. The groundwater salinity varies from 'good quality' to saline, with a 'good quality' bore 41630002A identified 6.3 km south of the site on the alluvial section of Dumaresq River. This bore recorded 'good quality' water (electrical conductivity 533 µS/cm) and at a shallow depth, less than 10 m below ground, at approximately 340 mAHD (SLR Consulting 2019).

Investigations of the residual void and WRD onsite by Rocktest in 2019 and 2020 respectively found that no areas around the pit exhibited groundwater ingress or excessive erosion by overland flows (Rocktest 2019; Rocktest 2020). The current standing groundwater level is below 387 mRl (meters above Relative Level), a minimum of 10 m below the toe of the final WRD at 410 mRL and 27 m below the proposed final pit depth of 414 mRL (Rocktest, 2024). It is therefore determined that mining operations are likely to have a negligible risk on impacting groundwater.

2.1.6.1. Existing groundwater use

It is noted that downstream agricultural activities source water from groundwater bores, however, mining operations to date have not used or encountered groundwater.

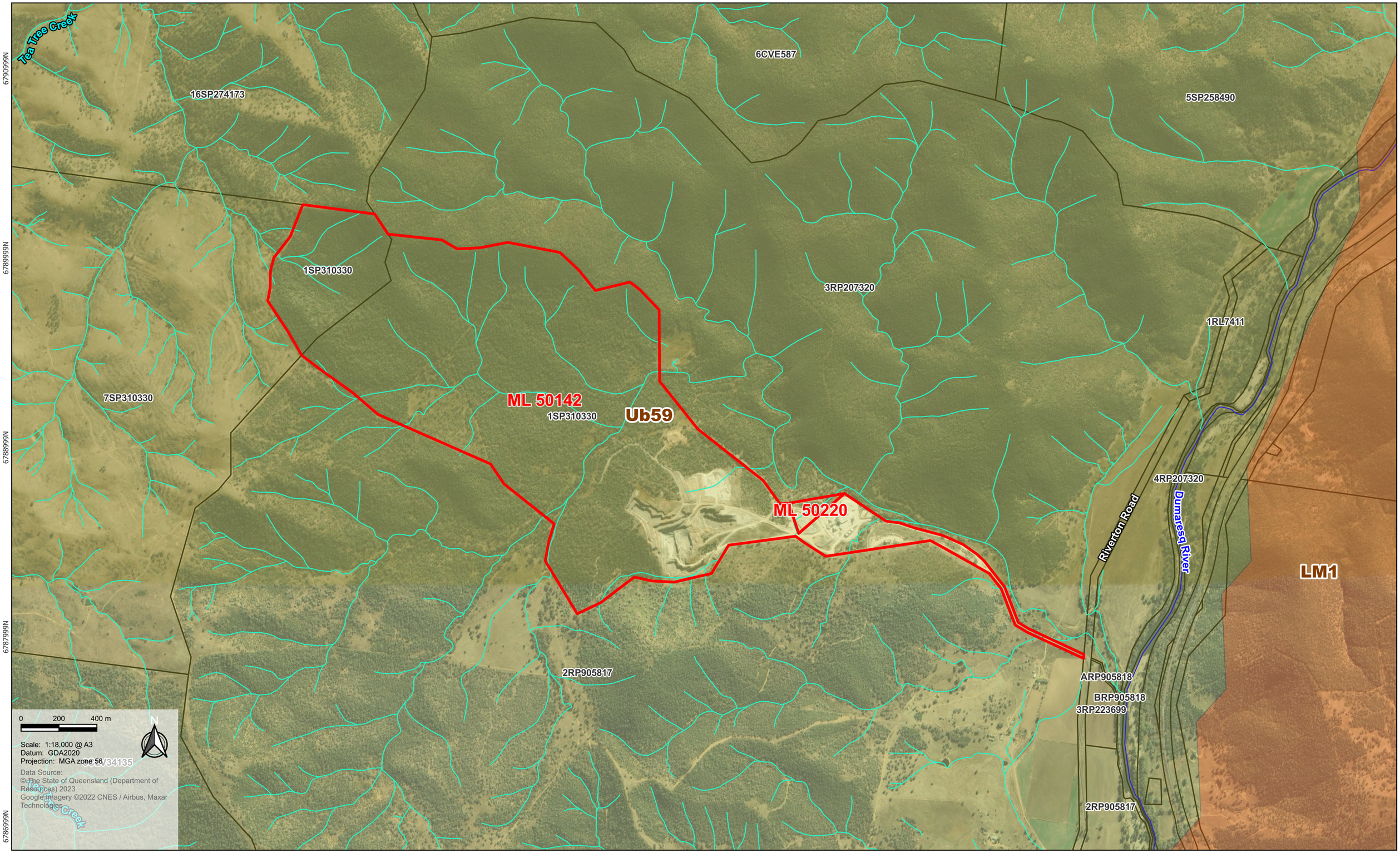
2.1.6.2. Springs and other Groundwater Dependent Ecosystems (GDEs)

State mapping shows the site contains a subterranean GDE in the form of cave ecosystems and aquifers in the undisturbed area of ML50142. The western extent of the site, and the waterway running in a south-east direction through the site are also shown on State mapping as containing surface ecosystems dependent on the sub-surface presence of groundwater with low confidence, in the form of deep-rooted regional ecosystems intermittently connected to limestone aquifers with fresh salinity (GQ 2021c).

2.1.7. Soil types, properties and productivity

The deposit of limestone at the site lies within the Texas Beds geological unit, comprising a sequence of limestone, mudstones, sandstone, and andesitic rocks which are thought to be Upper Devonian to Upper Carboniferous. The soils onsite are described as hard neutral and yellow mottled soils with shallow, gravelly loams and shallow, gravelly texture contrast soils by the Atlas of Australian Soils (SLR Consulting 2019; Isbell 2002). The land Capability Classification for the site is generally rated as Class VI to VII, indicating that the soil has excessive limitations that restrict use to marginal pasture (low stock rates), woodlands or wildlife (refer **Figure 6**) (Sibelco Australia 2014).

With regards to potential acid sulfate soils, it is noted that acid sulfate soils typically occur in areas of elevation below 20 m AHD, particularly in coastal areas. Queensland Globe mapping shows that acid sulfate soils are not applicable to the project site, with elevation of the site reported well above the range of acid sulfate soils.



Legend

- Site boundary
- Cadastre (DCDB)

Atlas of Australian Soils Map Unit

- LM1
- Ub59

Watercourses

- Major
- Minor

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Figure 6
Soil mapping units

2.1.8. Land stability

No information is available on pre-mining lease land stability. Reference to available topographical information and aerial imagery indicates the MLs were predominantly vegetated with undulating surface levels prior to mining commencing.

Geotechnical investigations undertaken by Rocktest in 2020 found the waste rock dump (WRD) to be moderately stable, with sufficient strength to ensure no large instabilities occurring during rainfall events in May 2009, January 2011, and August 2016 (Rocktest 2020). The mine pit was determined to be only marginally stable, readily destabilised by external forces. It was observed that the dominant modes of instabilities on all walls of the mine pit and WRD involved wedges of rocks up to bench scale sliding along pairs of steeply dipping joints (Rocktest 2019). Almost all of these events would have occurred during or soon after blasting activities.

Geotechnical investigation reports are provided in **Appendix I**.

2.1.9. Vegetation communities and ecological data

The vegetation surrounding the site is open forest, dominated by White Box (*Eucalyptus albens*) and White Cypress Pine (*Callitris glauca*) with some Kurrajong (*Brachychiton populneum*) and Wilga (*Geijera parviflora*). The understorey is dominated by a tall shrub layer that is relatively dense in some patches (i.e., closed canopy). The low shrub layer is mostly mid-dense open scrub occurring in small clearings of the mid stratum. The dominant shrubs being two species of *Olearia*, and *Beyeria viscosa.* The lowest stratum (< 1 m tall) is dominated by *Carrisa ovata*. Ground cover is mostly rock, bare soil, and litter, grass cover is sparse <20 percent (Martin 1996:5) (Sibelco Lime 2016).

The site is located within the New England Tableland bioregion and Nandewar Northern Complex subregion.

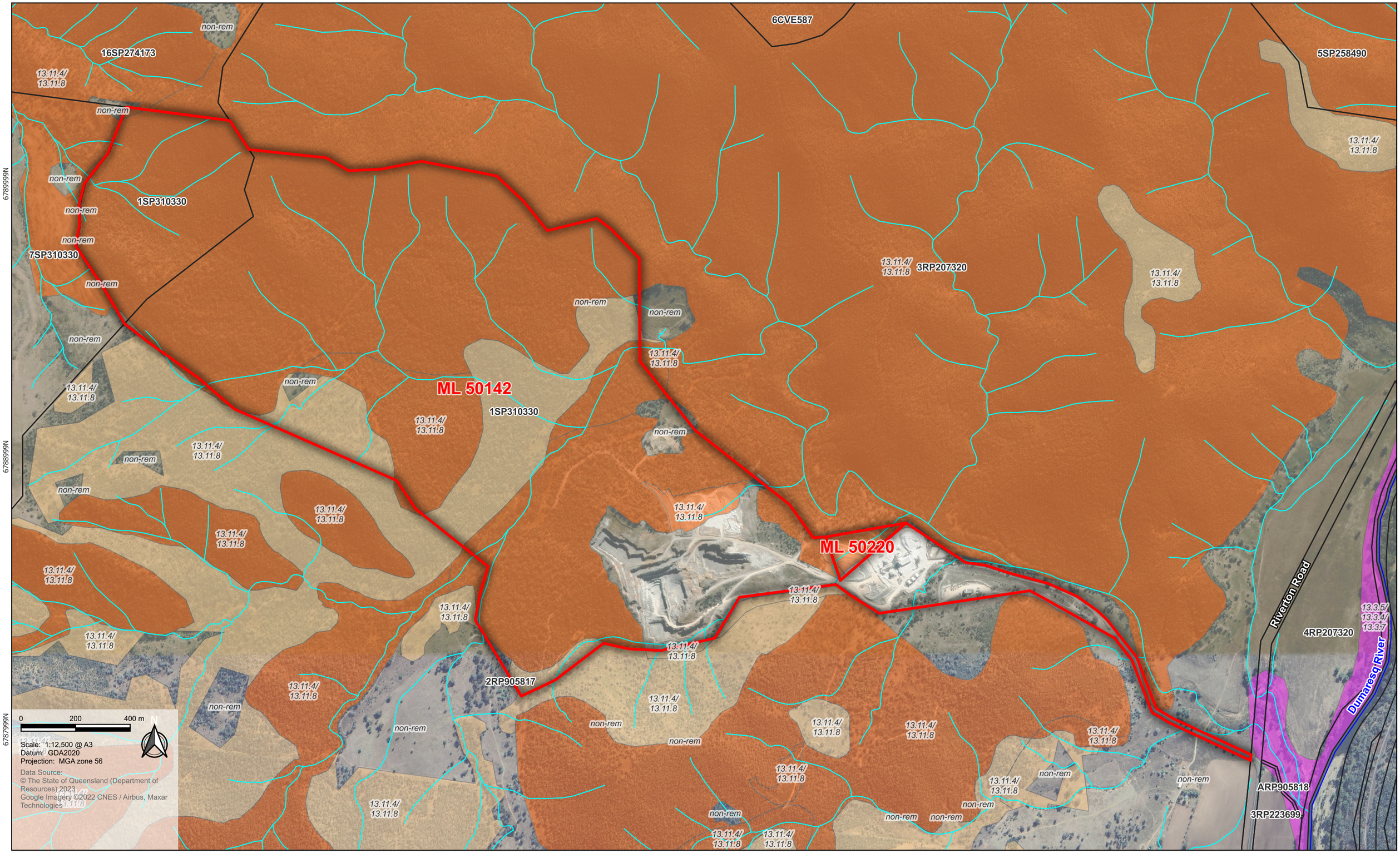
Regional Ecosystem (RE) verification undertaken confirmed that the vegetation community within the eastern extent of the site is representative of a homogenous community comprising RE 13.11.4 (refer **Table 2**). This RE is described as *Eucalyptus melanophloia, E. dealbata, E. albens +/- Callitris glaucophylla grassy woodland* (Queensland Herbarium 2021). The absence of *Eucalyptus melliodora* within the eastern extent of the site has determined that RE 13.11.8 is not present (Epic Environmental 2020). Further ground truthing would need to occur to discredit the presence of RE 13.11.8 in the western and northern extent of the site, therefore this area remains described as a mixed polygon RE 13.11.4 (95%) / RE 13.11.8 (5%). RE 13.11.8 is described as *Eucalyptus melliodora and/or Eucalyptus microcarpa/ E. moluccana woodland on metamorphic* (Queensland Herbarium 2024).

Table 2. Verified vegetation communities

RE assessment site	Verified RE Code and REDD short description[1]	Status under *Vegetation Management Act 1999*	Field description and condition
Lat/Long: -29.021, 151.480	Non-remnant	NA	Median canopy height and coverage: 23 m, 15% Median subcanopy height: 14 m Median Shrub layer 1 height: 7 m

Near water monitoring point W3a along southern access track			Median Shrub layer 2 height: 2 m Dominant canopy trees included *Angophora floribunda* and *Eucalyptus melanophloia.* Subcanopy was dominated by *Callitris glaucophylla.* Shrub layer 1 was dominated by *Geijera parviflora,* with *Schinus molle* present as an associate. Shrub layer 2 was dominated by *Notelaea microcarpa.* Native grass *Austrostipa verticillata* was dominant ground layer species. Small patch of vegetation confined to gully does not meet the minimum mapping thresholds to constitute a remnant vegetation patch. Approximately 20 m breaks between it and neighbouring remnant bushland to the north.
Lat/Long: -29.019, 151.475 Near water monitoring point W2 along northern access track	13.11.4 *Eucalyptus melanophloia* woodland on metamorphics	Least Concern	Median canopy height and coverage: 21 m, 30% Median subcanopy height: 15 m Median Shrub layer 1 height: 3.5 m Median Shrub layer 2 height: 1.5 m Dominant canopy trees included *Eucalyptus albens* and *Eucalyptus melanophloia.* Subcanopy was dominated by *Callitris glaucophylla.* Shrub layer 1 was dominated by *Beyeria sp.* Shrub layer 2 was dominated by *Carissa ovata.* The native grass *Austrostipa verticillata* was the dominant ground layer species. *Digitaria brownii* was recorded as an associate. Assessment site was located in representative location along proposed northern access track. Constitutes remnant vegetation with subcanopy thinned for timber harvesting. Large trees supporting tree hollows were widespread, but none/ very few are likely required to be removed.
Lat/Long: -29.022, 151.477 Vegetation within proposed sediment pond B area	13.11.4 *Eucalyptus melanophloia* woodland on metamorphics	Least Concern	Median canopy height and coverage: 16 m, 25% Median subcanopy height: 8 m Median Shrub layer 1 height: 3.5 m Dominant canopy trees included *Eucalyptus albens* and *Eucalyptus melanophloia.* Subcanopy was dominated by *Callitris glaucophylla.* Shrub layer 1 was dominated by *Notelaea microcarpa.* Native grass *Aristida calycina* was dominant ground layer species. Assessment site was located in sediment pond B. Fragmented patch of a remnant, sparse Eucalyptus woodland subject to edge effects from the surrounding mining operations. Patch just meets the minimum mapping thresholds (0.5 ha) to qualify as remnant vegetation.

Note:
[1] Short description sourced from REDD V12.0 (Queensland Herbarium 2021)



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP\Rev 2\Figure 7 Regional Ecosystems.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Regional Ecosystems v13

- Category A or B area containing endangered
- Category A or B area containing of concern
- Category C or R area containing of concern
- Non-remnant

Watercourses

- Major
- Minor

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Figure 7
Regional ecosystems

2.1.9.1. Threatened ecological communities

During an ecological assessment undertaken by Epic Environmental in 2019, the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Threatened Ecological Community (TEC) (White Box TEC) was not present within the eastern extent of the site, or the surrounding area to the east of the ML. Although *Eucalyptus albens* and *Eucalyptus microcarpa* were recorded onsite, none of the vegetation patches surveyed met the minimum requirements to be considered the TEC. This survey was restricted to the eastern extent of the site and therefore, does not eliminate the potential that this TEC is located elsewhere, as RE 13.11.4 and RE 13.11.8 are considered potentially analogous to the White Box TEC: RE 11.3.4 and 11.3.8. The TEC is considered a primary component of RE 11.3.8 and a smaller component of 11.3.4 (DCCEEW 2023). Therefore, any future clearing within the site will ensure a survey is undertaken to ground truth the presence of this TEC to determine whether an offset will be required. Further assessment of this TEC has been undertaken within the *Riverton Mine Ecological Assessment Report* (Epic 2024) (**Appendix J**).

2.1.9.2. Weed species

Non-native flora species identified during the site inspection included:

- *Alternanthera pungens*
- *Schinus molle*
- *Gomphocarpus physocarpus*
- *Ambrosia artemisiifolia*
- *Bidens pilosa*
- *Cirsium vulgare*
- *Conyza bonariensis*
- *Xanthium occidentale*
- *Harrisia martini*
- *Malvastrum americanum var. americanum*
- *Sida rhombifolia*
- *Oxalis corniculata*
- *Eragrostis tenuifolia*
- *Hyparrhenia hirta*
- *Melinis repens*
- *Verbascum thapsus*
- *Ailanthus altissima*
- *Glandularia aristigera*
- *Verbena rigida*

Of the above species, *Ambrosia artemisiifolia* and *Harrisia martini* are listed as restricted under the *Queensland Biosecurity Act 2014* (Category 3).

2.1.10. MNES and MSES

Review of the MSES mapping obtained through QGlobe (QG 2024) indicate areas of the site support category B regulated vegetation (endangered or of concern) through the centre, west

and north-west of the site, with areas of category c regulated vegetation (endangered or of concern) also running through the west of site. MSES vegetation is presented in **Figure 8**.

Review of the MNES report prepared by Department of Climate Change, Energy, the Environment and Water (DCCEEW) indicates several protected species are located within, or proximate (within 5 km) to the site (DCCEEW 2025). A summary of protected species is provided in **Table 3**. The full report is available within **Appendix J.**

Table 3. Matters of national environment significance

Type	Number Identified	Comment / Description
World Heritage Properties	None	-
National Heritage Places	None	-
Wetlands of International Importance (Ramsar)	3	• Banrock station wetland complex (1100 – 1200 km downstream of the site) • Riverland (1100 – 1200 km downstream of the site) • The Coorong, and lakes Alexandrina and Albert wetland (1300 – 1400 km downstream of the site)
Great Barrier Reef Marine Park	None	-
Commonwealth Marine Area	None	-
Listed Threatened Ecological Communities	4	Refer **Section 2.1.10.1**
Listed Threatened Species	64	Refer **Section 2.1.10.2**
Listed Migratory Species	12	Refer **Section 2.1.10.3**

2.1.10.1. Listed Threatened Ecological Communities

Four listed TEC may, or are likely to, occur within the site area, as detailed below:

May occur:

- Natural grasslands on basalt and fine-textured alluvial plains of northern NSW and southern Queensland – critically endangered
- New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands – Critically endangered
- Weeping Myall Woodlands - Endangered

Likely to occur:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – Critically endangered

2.1.10.2. Listed Threatened Species

Listed threatened species that are known or, or are likely to, occur within the site area are detailed in **Table 4**.

Table 4. Listed threatened species

Species	Common Name	Source	NC Act*	EPBC Act*
Mammals				
Dasyurus maculatus maculatus	Spotted-tail Quoll (southeast mainland)	PMR	E	E
Nyctophilus corbeni	Corben's Long-eared Bat	PMR	V	V
Petauroides volans	Greater Glider	PMR	E	E
Petrogale penicillata	Brush-tailed Rock-Wallaby	PMR	V	V
Phascolarctos cinereus	Koala	PMR	E	E
Birds				
Anthochaera phrygia	Regent Honeyeater	PMR	CR	CE
Aphelocephala leucopsis	Southern Whiteface	PMR	V	V
Calyptorhynchus lathami lathami	Glossy Black Cockatoo (southeastern)	PMR	V	V
Climacteris picumnus victoriae	Brown Treecreeper	PMR	V	V
Falco hypoleucos	Grey Falcon	PMR	V	V
Geophaps scripta scripta	Squatter Pigeon	PMR	V	V
Grantiella picta	Painted Honeyeater	PMR	V	V
Hirundapus caudacutus	White-throated Needletail	PMR	V	V
Lathamus discolor	Swift Parrot	PMR	V	CE
Melanodryas cucullata cucullata	Hooded Robin (southeastern)	PMR	E	E
Rostratula australis	Australian Painted Snipe	PMR	E	E
Stagonopleura guttata	Diamond Firetail	PMR	V	V
Fish				
Bidyanus bidyanus	Silver Perch	PMR	E	E
Maccullochella peelii	Murray Cod	PMR	LC	V
Reptile				
Uvidicolus sphyrurus	Border Thick-tailed Gecko	PMR	V	V
Flora				
Acacia macnuttiana	McNutt's Wattle	PMR	-	V
Acacia pubifolia	Velvet Wattle	PMR	-	V
Boronia granitica	Granite Boronia	PMR	-	E
Cadellia pentastylis	Ooline	PMR	V	V
Callistemon pungens	-	PMR	-	V
Dichanthium setosum	Bluegrass	PMR	-	V
Eucalyptus caleyi subsp. *ovendenii*	Ovenden's Ironbark	PMR	-	V
Eucalyptus mckieana	McKie's Stringybark	PMR	-	V
Lepidium peregrinum	Wandering Pepper-cress	PMR	-	E
Leucopogon confertus	Torrington Beard-heath	PMR	-	E
Macrozamia cranei	Crane's macrozamia	PMR	E	E
Rutidosis heterogama	Heath Wrinklewort	PMR	-	V
Thesium australe	Austral Toadflax	PMR	V	V

*Status abbreviations: CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, SLC = Special Least Concern, LC = Least Concern

2.1.10.3. Listed Threatened Ecological Communities

Listed migratory species that are known, or are likely to, occur within the site area are detailed in **Table 5**.

Table 5. Listed migratory species

Species and Status[1]	Common Name	Source	NC Act*	EPBC Act*
Migratory				
Apus pacificus	Fork-tailed Swift	PMR	SLC	M
Pandion haliaetus	Eastern Osprey	PMR/WildNet	SLC	M

*Status abbreviations: CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, SLC = Special Least Concern, LC = Least Concern

2.1.11. Fauna presence and populations

Located in the south-west corner of ML50142 is the Riverton Bat Cave which is a maternity and nursery cave for the Eastern Bent-wing Bat (*Miniopterus schreibersii*) subspecies *oceanensis*, and the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*). The cave has been recognised as of significant biological importance by researchers Dwyer and Hamilton (1965) and Toop (1990). In response to this recognition the Riverton Cave Area has been included in the Register of National Estate since 1992 and includes an area having a radius of 70 m centred on the cave entrance (Sibelco Lime 2016). The current EA restricts disturbance close to the Riverton Bat Cave under Schedule F Condition F5-4 of the EA:

No blasting or disturbance (except minor disturbance associated with accessing the cave for purposes of achieving compliance with this environmental authority) of vegetation is to occur within 215 metres of the Riverton Bat Cave entrance.

The site includes approximately 60 terrestrial invertebrates with limited rare or endangered species amongst them. Many native insect species are found in the area. The surrounding area is also subject to grazing by goats (*Capra aegagrus hircus)* and marsupials such as Swamp Wallaby (*Wallabia bicolor)* and Eastern grey Kangaroo (*Macropus giganteus*) (Sibelco Australia 2014)

A desktop ecological assessment undertaken by Epic in 2025 identified 25 threatened fauna species known or likely to occur within the site (**Appendix J**). This consisted of five mammals, 12 bird, one reptile, and two fish species. These species are all listed as Critically Endangered, Endangered, Vulnerable or Near Threatened under the EPBC Act and/or NC Act. A likelihood of occurrence assessment was undertaken and, of these species, only the Koala is considered 'likely to occur' within the site. Koala occurs in forests and woodland and feeds almost entirely on the leaves of eucalypts. Its distribution is linked to the presence and abundance of food species. They are most abundant on coastal plains and in foothills but do extend inland along watercourses with *Eucalyptus camaldulensis* (Martin et al. 2008; Krockenberger et al. 2012). Koalas have been seen feeding on or sitting in 120 species of tree but only about 20 of these can be considered primary food sources (Jackson 2015a). The food preferences of the Koala vary regionally (Martin et al. 2008). *Eucalyptus albens* and *E. melanophloia* are considered locally important food trees in the region (Youngentob et al. 2021).

An additional nine species, consisting of two mammal, six bird and one reptile species are considered as 'possibly occurring':

- *Bordered Thick-tailed Gecko – Vulnerable*
- *Squatter Pigeon (southern) – Vulnerable*
- *White-throated Needletail - Vulnerable*

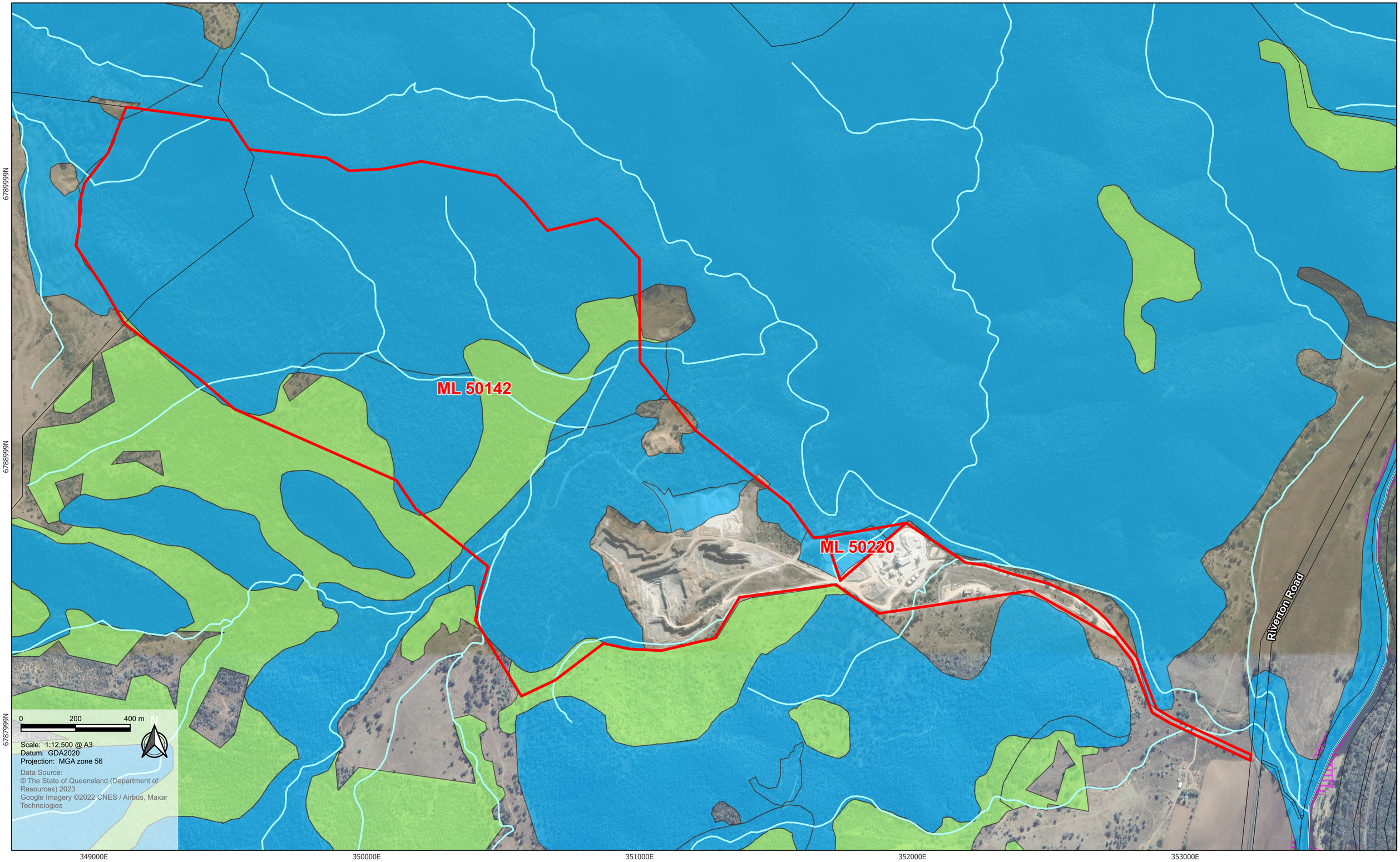
- *Hooded Robin (southeastern) - Endangered*
- *Brown Treecreeper - Vulnerable*
- *Southern Whiteface - Vulnerable*
- *Diamond Firetail – Vulnerable*
- *Corben's Long-eared Bat - Vulnerable*
- *Spotted-tail Quoll (southeast mainland) - Endangered*

Three migratory bird species were determined as 'possibly occurring' within or adjacent to the site:

- *Fork-tailed Swift*
- *Eastern Osprey*
- *Rufous Fantail*

Satin Flycatcher may occasionally occur within the site during the north-south migration periods in September/October and April/May. Fork-tailed Swift is almost entirely aerial in its foraging and resting habits when in Australia (i.e. they are rarely recorded roosting). They are found over a variety of habitats, including open areas, modified lands and the ocean but are most often observed over wooded areas (Higgins 1999). The airspace above the disturbance areas will only comprise ephemeral foraging habitat. Rufous Fantail migrates north in early autumn and returns to southern Australia in early spring to breed, wintering on Cape York Peninsula, the Torres Strait and New Guinea (Higgins et al. 2006; Menkhorst et al. 2017). It is common in suitable habitat along the eastern seaboard (Menkhorst et al. 2017) and breeds in rainforest at higher altitudes from the Atherton Tablelands southwards. It is generally absent from the uplands in autumn and winter, having moved to the lowlands. The species is most likely to occur in the area during the winter months.

None of the migratory species identified are at the limit of their range in the area or in an area where the species is thought to be declining. There is no evidence that habitat of 'critical importance' occurs for these species within or near the site. An ecologically significant proportion of the population of Satin Flycatcher and the northern race of the Rufous Fantail (which likely occurs with the site) comprise 1,700 birds and 1,500 birds respectively (Commonwealth of Australia 2015).



Legend

- Site boundary
- Cadastre (DCDB)
- Regulated vegetation (intersecting a watercourse)

Matters of State Environmental Significance

- High ecological significance wetlands
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)

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Figure 8
Matters of state environmental significance

2.1.11.1. Landscape connectivity and habitat corridors

A narrow band of Agricultural Land Class A is mapped along the eastern boundary of Lot 2 along the Dumaresq River corridor. It is approximately 1 km from the eastern extent of the site. There are also narrow bands of MSES - High ecological significance wetlands mapped along the Dumaresq River corridor. The closest is approximately 1.6 km east of the site, as shown in **Figure 8**.

2.1.12. Rehabilitation of landscape

The cumulative effects of climate change and human activities, both present and future, interact to undermine resilience and the continued persistence of certain biodiversity. It is therefore considered that likely changes to ecosystems and biodiversity will result from cumulative impacts, rather than from one single threat (Murphy et al. 2012). It appears that approaches to protecting or enhancing resilience that consider the cumulative impacts of both climate change and human activities are more likely to ensure better outcomes for ecosystems. Fundamental and potentially irreversible losses in ecosystem function become more likely as a result of intensive commodity production (Fischer et al. 2006). The site is likely to have resulted in the temporary loss of ecosystem function.

2.1.13. Pre-mining land use

Limited information on pre-mining land use is available. The site is understood to have been vacant prior to it being subjected to mining activities in the 1970's (QG 2021b). With reference to a 1970 aerial photo (State of Queensland 2009), the site appears to be heavily vegetated, with minor clearing for access tracks through the centre of the site, extending to the west from Riverton Road. Historically, the area was reportedly used for marginal grazing, and surrounding areas are mostly used for pasture-feeding goats (Sibelco Australia 2014).

2.1.14. Identification of Underlying Landholders

The underlying landholders for the site and the tenure type are identified in **Table 6**.

Table 6. Tenure and landholder details

Lot on Plan	Area	Tenure	Mining lease	Landholder
1 SP310330	299.3 ha	Freehold	ML50142 (299.1 ha)	Graymont (NSW) Pty Ltd
3 RP207320	742.6 ha	Freehold	ML50220 (2.49 ha)	Graymont (NSW) Pty Ltd

2.1.14.1. Native Title

Native Title is extinguished for the Freehold Land comprising the entire site, in accordance with the *Native Title Act 1993*.

2.1.15. Sensitive receptors

Sensitive receptors proximate to the site are identified in **Table 7** and presented in **Figure 9**.

Table 7. Sensitive receptors

Receptor	Type of receptor	Address
G. Towse	Private Residence / Agricultural Station	Riverton Road, Riverton
R & J Magner	Private Residence / Agricultural Station	North Riverton at 6779 Riverton Road, Riverton, QLD 4385
Eric & Christina DeJager	Private Residence / Agricultural Station	Sovereignton, Riverton
Mitchell Sargeant, Rachel Baker and John Sargeant	Private Residence / Agricultural Station	6497 Riverton Road, Riverton, QLD 4385
AP Farms Pty Limited	Private Residence / Agricultural Station	6047 Riverton Road, Riverton, QLD 4385
Glynvista	Private Residence / Agricultural Station	5993 Riverton Road, Riverton, QLD 4385
Pinegrove	Private Residence / Agricultural Station	5597 Riverton Road, Maidenhead, QLD
Old Mingoola	Private Residence / Agricultural Station	58 Mingoola Station Rd, Mingoola, QLD

340000E
350000E
360000E
6790000N
6780000N
Pinnacle Road
Glenlyon Dam Road
Riverton Road
Back Creek Road
QUEENSLAND
NEW SOUTH WALES
0 1 2 km
Scale: 1:75,000 @ A3
Datum: GDA2020
Projection: MGA zone 56
N
Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Legend

- Site boundary
- Cadastre (DCDB)
- State boundaries
- Roads and tracks
- Sensitive receptors

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Figure 9
Sensitive receptors

2.2. Site location

The site is predominantly located within the Goondiwindi Regional Council Local Government Area (LGA), with the north-eastern area of the site located within the Southern Downs Regional Council LGA. Regionally, the site is located approximately 35 km south-east of the township of Texas, and 70 km west of the township of Tenterfield in NSW, as shown in **Figure 9**. The site is located on top of the Great Dividing Range and is approximately one km from the nearest residence (Sibelco Australia 2014).

2.3. Project description

The information presented in this section was obtained from the Plan of Operations (2016-2020) for the site, prepared by the former lease holder, Sibelco Lime (NSW) Pty Ltd (Sibelco Lime 2016), and through anecdotal evidence provided during a site inspection undertaken during 8 and 9 March 2022.

2.3.1. Mining tenements

The mining operations are located wholly within ML50142 and ML50220, encompassing a total area of 301.82 ha. Further information is provided in **Table 8**.

Table 8. MLAs and total disturbance area

MLA	Area of ML (ha)	Total Authorised Disturbance EA (ha)
ML50142	299.33	52.08
ML50220	2.49	2.49
TOTAL	**301.82**	**54.57**

2.3.2. Primary mine features and infrastructure

Primary mine features / infrastructure within each ML include infrastructure areas (including workshops, hardstands supporting pre-fabricated administration offices, weighbridge), WRD operational open pit, stormwater management features (including sediment basins, levees), a topsoil storage area, cleared areas and laydown areas. Further detail on primary mine features present onsite are presented in **Table 9**.

Table 9. Primary mine features

Primary Mine Feature	Area (ha)
Residual Void (Pit Floor)	8.10
Residual Void (Terraced benches)	11.55
Clay waste ‘topsoil’ stockpile	1.05
Waste rock dump	6.64
Infrastructure	8.70
Roads and tracks	6.88
Sediment basins	2.32
Undisturbed areas	247.92

Laydowns	5.35
Cleared areas	3.42
Historical cleared areas	0.56
Total	**302.49**

2.3.3. Type of mining operation

Mining operations at the Riverton mine comprises conventional open cut benching techniques which are currently carried out on ML50142 at a rate of approximately 150,000 tonnes per annum (tpa). This results in production of between 100,000 and 115,000 tpa of limestone products used in glass and agriculture markets. The balance of mined material comprises clay, andesite, and clay contaminated limestone, which is removed as waste from the mine, and as scalps which are screened during crushing and screening activities.

Mining operations are undertaken by Graymont mining employees, with support from external specialist contractors as required (e.g. for drilling and blasting). Blasted limestone is generally loaded by excavator into articulated dump trucks and hauled to the run-of-mine (ROM) pad or fed directly into the primary crusher. Waste clay and clay contaminated limestone rock is excavated in campaigns and hauled either scalper or direct to the waste rock emplacement by dump truck (Sibelco Lime 2016).

2.3.3.1. Processing activities

Limestone ore at the Riverton operation is processed as follows. Primary and secondary crushing, screening, and fine grinding of limestone together with stockpiling, storage and packaging of ground limestone product is conducted in a site-based processing plant.

Limestone is initially passed through a “Pegson” 25 x 40 primary jaw crusher to achieve an approximately 75 mm maximum particle size. The crushed limestone is further sized in three tertiary crushing circuits depending on whether the limestone is for high quality “glass lime” manufacture or for general industrial and agricultural markets.

Two covered stockpiles feed limestone into the “Jacques” and “Allis” Circuits while <16 mm limestone aggregates is fed to the “Cage” Circuit to produce a wide range of ground limestone products. The “Cage” Circuit also feeds the ball mill circuit, which produces fine ground limestone products.

Typical limestone ($CaCO_3$) products include:

- *Calgrit*
- *Glass Lime (1 mm)*
- *Aglime, bulk and bagged (less than 1 mm)*
- *Fine and superfine Aglime (500 and 250 micron)*
- *Stonedust*
- *Special products*

These products are sold into industrial, mining, acid sulphate soils management and agricultural markets. The majority of crushing occurs during daylight hours, Monday to Friday,

however crushing is authorised to operate until 6 pm including weekends, depending on product stockpile levels.

2.3.4. Proposed duration of operation

Based on current estimates of limestone resources within the MLs and feasible rates of extraction, the reserves are anticipated to support mining operations for an additional 41 years; extraction operations are expected to cease in 2062. It is noted that the development of the milestones relevant to this PRC Plan are based on the current anticipated mine closure in 2062.

2.4. Design for closure

Transitional PRC Plans are not required to consider how aspects of the mine site have been designed for closure for existing or approved disturbance. Any further expansion of the Riverton disturbance area is considered to be minor in nature and unlikely to significantly change the current status of the site and as such design for closure is not considered to be required.

All future disturbance will be authorised by, and undertaken in accordance with, an approved EA.

2.4.1. Location of mine features / infrastructure

Locations of mine features/infrastructure areas detailed in the preceding sections are shown in **Figure 10**. It is acknowledged that if any changes are made to the mine features, infrastructure or operations, that all mine changes will be designed with closure in mind, in terms of:

- Protection of environmental values of the site and receiving environment, including MNES, MSES and Matters of Local Environmental Significance
- Surrounding land uses and proximity to sensitive receptors
- Proximity to any existing infrastructure
- The gradient of the footprint area, both for the direction of drainage from the landform and for the dumping costs
- Local and regional topography
- Surface and groundwater features (quality, quantity, seasonal variation)
- Geotechnical conditions (i.e., soil/rock characteristics) and suitability for the structure type (i.e., presence of structural features that could transmit seepage)
- Competing water and land uses
- Visual impact

2.4.2. Size, shape and design of mine features / infrastructure

The majority of mine features are pre-existing, and hence have not previously considered size, shape and design at closure. All future expansion of mine features and infrastructure, including the WRDs will be undertaken with design for closure in mind. Noting operations are proposed

to continue for several decades and opportunities to re-design WRD to best consider post-closure exist.

2.4.3. Mining methods

All mining methods incorporated at the site historically have been traditional open cut benching techniques. Any proposed additional mining will be undertaken with design for closure in mind, for instance: generation rates, source and deposition locations and transport routes of waste rock or overburden material.

2.5. Rehabilitation / improvement planning

The area for rehabilitation / improvement planning will encompass the entirety of the disturbed areas contained within ML50142 and ML50220; areas within the disturbance footprint will be rehabilitated to achieve the approved post-mine land description.

2.5.1. Objectives

The objectives of rehabilitation for ML50142 and ML50220 are outlined in the approved EA (refer **Appendix B)**.

Following the removal of limestone and cessation of mining operations, Graymont aims to return the site to a state agreed with relevant stakeholders and DETSI, achieving a balance of locally native ecological communities and stabilised residual voids. Areas not subject to significant disturbance or retained under an approved landholder agreement (i.e. areas outside the residual void and infrastructure areas) will generally be rehabilitated such that the land represents a traditional native ecosystem or novel planned native ecosystem which aims to return the site to a PMLU similar to what was likely to have occurred onsite prior to mining and being analogous to surrounding undisturbed areas. The objectives of mine rehabilitation are to:

- Create a landscape safe for humans and wildlife into the foreseeable future
- Create a stable landform with natural rates of erosion
- Establish vegetation communities that resemble those originally found onsite, which blend visually with the surrounding landscape and vegetation
- Establish functional, self-sustaining vegetation communities
- Establish ecosystems that resemble neighbouring undisturbed areas in their ability to respond to fire and droughts
- Ensure minimal post-mining impacts on surface catchments
- Provide water supply infrastructure for ongoing use by landowners
- Provide a stable non-polluting hardstand area for ongoing use by landowners

2.5.2. Overview of Rehabilitation Areas and Improvement Areas

There are a total of eight rehabilitation areas (RA), and one improvement area (IA) nominated for the site, these are summarised in **Table 10** and further detailed in the PRC Plan Schedule (**Appendix A**).

Table 10. Rehabilitation areas

Area ID	Area Description	Area (ha)
Improvement Areas		
IA1	**Residual Void - Terraced Mine Benches** – this incorporates the extent of the existing and proposed mining pit terraced mine bench disturbance.	11.55
Rehabilitation Areas		
RA1	**Topsoil stockpile** – this incorporates the extent of the clay waste 'topsoil' stockpile.	1.05
RA2	**Waste rock dump –** this incorporates the extent of the existing WRD footprint, and additional areas proposed for expansion.	6.64
RA3	**Infrastructure -** this incorporates the plant and run-of-mine infrastructure, workshop infrastructure and processing area; inclusive of all buildings, powerlines, conveyors, concrete pads, communications towers, laydown yards, processing plant and equipment, switchyard, sewage treatment plant and camp infrastructure.	8.70
RA4	**Roads and tracks** – this includes all pre-existing tracks and roads constructed during mining operations.	6.88
RA5	**Sediment basins**- this includes the current and proposed extent of disturbance area for all sediment basins, water storage tanks, stormwater diversion levees, and associated water infrastructure (pipelines, etc.).	2.32
RA6	**Laydown and Cleared areas** – Laydowns are classified as cleared areas, located centrally within the site utilised for ongoing operations for temporary storage of materials and equipment. Cleared areas includes all other lightly disturbed areas within the operational area of the Riverton mine not covered in another RA; inclusive of historical disturbance, edging habitat, and slightly disturbed vegetated areas between operational areas.	8.77
RA7	**Residual Void - pit floor and In-pit WRD -** this includes the extent of the existing and proposed mining pit floor disturbance which is split over two levels, a lower level and upper level, considered as one disturbance area within this report.	8.10
RA8	**Historical Cleared Areas –** this incorporates all areas cleared prior to the EA being approved in 2007 and not proposed for use in operation/mining activities.	0.56
Total Area		**54.57**

It is noted that undisturbed areas (including the western extent of ML50142) are not defined as a rehabilitation area or an improvement area as they are not considered to have been disturbed through operation of the mine. Areas that are excluded from the site rehabilitation are shown in **Figure 12**.

2.5.3. Rehabilitation by year

The broad rehabilitation areas have been outlined in **Figure 11** with a more detailed rehabilitation schedule (in hectares) outlined in the PRC Plan Schedule (refer **Appendix A**). Undisturbed areas that are not subject to rehabilitation are shown in **Figure 12**.

2.5.4. Identification of relevant activities

Level 1 mining project carried out using equipment and plant having a mineral ore throughput of more than 100,000 tonnes (t), but less than 500,000 t per year. Relevant mining activities

and the rehabilitation objectives are provided within Schedule F of the EA, summarised in **Section 4**.

All mine features as identified in **Section 2.4.2** are to be rehabilitated to achieve a beneficial use post-closure with the exception of the residual void terraced mine benches, which will be dedicated as a Non-Use Management Area (NUMA).

2.5.5. Duration of relevant activities

Mining operations are expected to continue through to 2062. All relevant activities identified in **Section 2.5.4**, including the residual void, WRDs, topsoil stockpile, laydown areas, cleared areas and infrastructure areas will be in use until such time as the mining operations cease. These areas will become progressively available for rehabilitation following mine closure.

2.5.6. Size and extent of relevant activities

Details on the size and extent of relevant activities within ML50120 and ML50220 are provided in **Section 2.3** and **Figure 10**.

2.5.6.1. Suitability of relevant areas for progressive rehabilitation

As the site operations consist of one operational pit and associated infrastructure will be required until mine-closure, progressive rehabilitation is generally not suitable for the majority of the identified mine features.

Should operations change significantly or down-scale leading up to mine-closure, some areas may become available for rehabilitation prior to closure. Areas will be deemed as available for rehabilitation are those that satisfy the following:

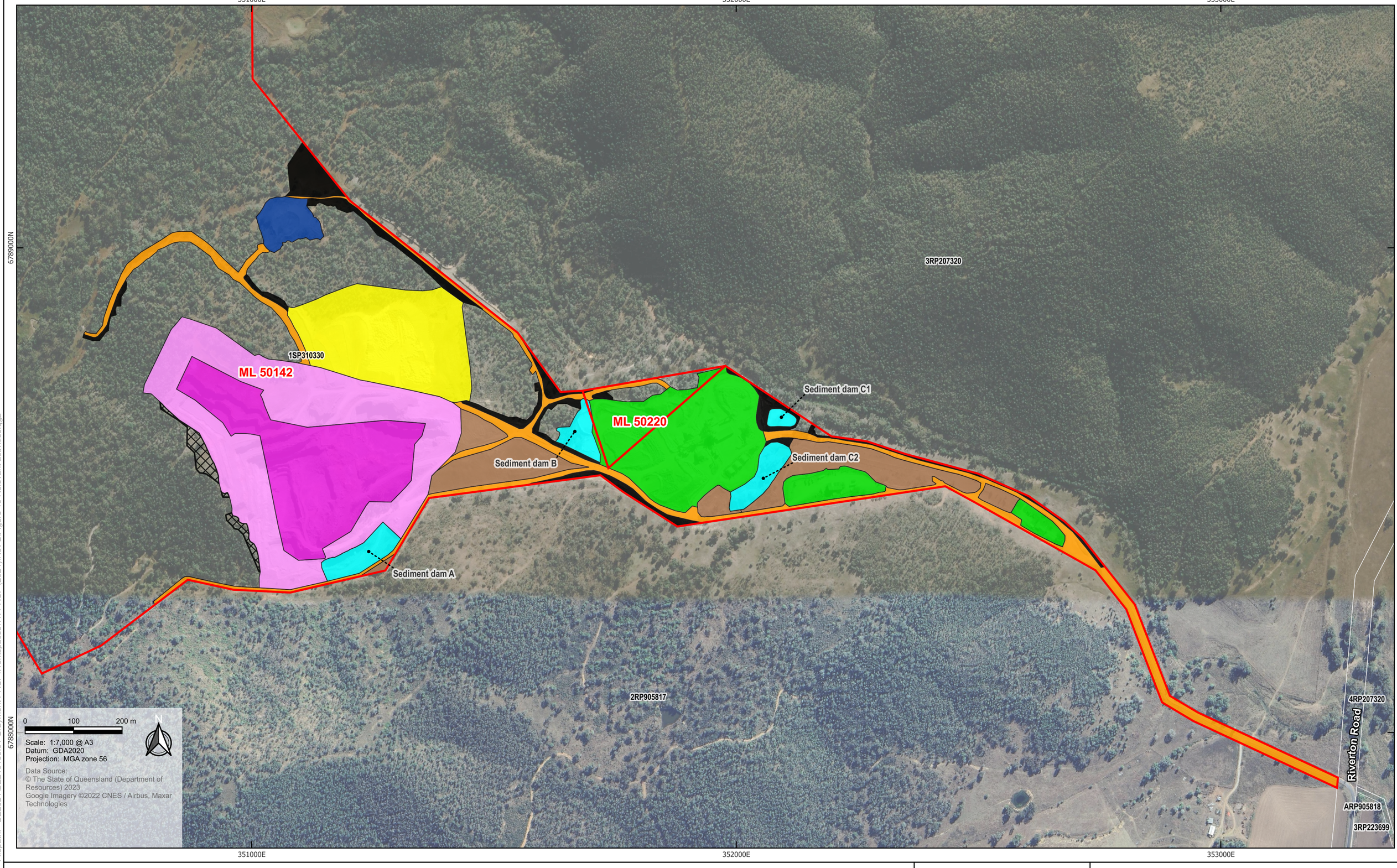
- Areas that are no longer designated operational areas
- Areas that are unlikely (in the short-term future) to be utilised for any mining activity or ancillary land-use

A breakdown of the likely timing of area availability for the rehabilitation areas defined in **Section 2.5.2** is provided in **Table 11.**

Table 11. Rehabilitation area availability

Rehab. area ID	Total area (ha)	Available area for Rehab. (ha)	Forecast availability date	Comment / justification
Improvement Areas				
IA1	11.55	11.55	10/12/2062	Extraction operations and associated mining activities are expected to cease in 2062. The residual void (single pit) terraced mine benches will therefore become available for rehabilitation upon cessation of extraction.
Rehabilitation Areas				
RA1	1.05	1.05	10/12/2064	The current clay / topsoil resource stockpile area will become available for rehabilitation once the clay / topsoil has been removed and utilised for site rehabilitation. It is expected this will occur two years following mine cessation (allowing for major earthworks / profiling).
RA2	6.64	6.64	10/12/2045	It is anticipated the Northern WRD will reach capacity in 2045. Rehabilitation will be able to commence thereafter.
RA3	8.70	8.70	10/12/2062	It is anticipated that the sites infrastructure areas (including processing plant, offices, sewage and water treatment areas etc.) will be required until cessation of mining operations occurs in 2062. It will therefore not be available for rehabilitation until 2062.
RA4	6.88	6.88	10/12/2065	Access tracks across the site will be required until operations and associated rehabilitation works have been completed. These areas are therefore unlikely to be available for rehabilitation until 2065.
RA5	2.32	2.32	10/12/2066	Sediment basins will be required to manage stormwater during the entirety of the mines operational period. Areas will therefore not become available for rehabilitation until 2062. Note: the PMLU for these areas is to remain a water supply infrastructure, which will manage stormwater throughout the rehabilitation phase beyond 2062.
RA6	8.77	1.85	10/12/2025	Approximately 1.85 ha of RA6 have been identified and isolated and is considered available for rehabilitation, with works having commenced across part of this area in 2021 and are due to continue through to 2026 (refer **Section 2.5.7**).
		6.92	10/12/2062	Laydown areas located centrally within the site, utilised in support of ongoing operations for temporary storage of materials and equipment. Laydowns will be required in support of operational activities until EOML. These areas will therefore be required until cessation of mining operations occurs in 2062. Rehabilitation will occur thereafter. Cleared areas include areas adjacent to access tracks, edging habitat and distinct pockets between operational areas. These areas do not represent a significant portion of the site. Retention of these areas until EOML will provide flexibility within the projects disturbance area which will facilitate movement of project activities throughout the LOM. Rehabilitation of these areas prior to rehabilitation of the surrounding areas is not considered a pragmatic approach (for financial viability and the ongoing maintenance of rehabilitation reasons).

Rehab. area ID	Total area (ha)	Available area for Rehab. (ha)	Forecast availability date	Comment / justification
				Retention of these areas until EOML will ensure the best chance of successful rehabilitation outcomes.
RA7	8.10	8.10	10/12/2063	Extraction operations and associated mining activities are expected to cease in 2062. The mining void (single pit) pit floor and In-pit WRD will therefore become available for rehabilitation upon cessation of extraction and after rehabilitation of IA1 has been achieved. It is anticipated that the In-pit WRD will be utilized until cessation of extraction occurs in 2062. The In-pit WRD will be used in the rehabilitation of the pit floor.
RA8	0.56	0.56	10/12/2025	Historical unauthorised clearing occurred between 1970 and 2006, prior to the EA taking effect on 22 February 2007 and the remaining area was cleared between 2007 to 2017 prior to Graymont acquiring the Project in 2018.Areas of historical clearing will not be utilised for the Project as they occur within the Riverton Bat Cave exclusion zone (refer **Section 2.1.11)** and as such, are available for rehabilitation.



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Figure 10 Relevant activities.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Relevant activities

- Cleared area
- Historical cleared area
- Infrastructure
- Laydown
- Pit floor
- Roads and tracks
- Sediment dams
- Terraced mine benches
- Topsoil
- Waste rock dump

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Figure 10
Relevant activities

2.5.7. Description of existing rehabilitation

As outlined in **Table 11** an area of approximately 1.85 ha is currently available for further rehabilitation. Rehabilitation of this area commenced in 2021, prior to issue and acceptance of this PRC Plan, the following works were undertaken.

- Profiling of surface to achieve target landform
- Planting of native vegetation across the rehabilitated area

Assessment of existing rehabilitation against the rehabilitation completion criteria is provided in **Section 2.5.7.1**.

2.5.7.1. Assessment of existing rehabilitation

As outlined in **Sections 2.5.7** and **Section 2.5.6.1**, and shown in **Figure 13**, rehabilitation has been undertaken across an area of approximately 1.85 ha within RA6 (the subject area) in late 2021; this rehabilitation was not certified (in accordance with Part 6 of the EP Act) at the time of completion.

As existing rehabilitation was undertaken prior to establishment of rehabilitation milestones, the subject area entered the PRC Plan Schedule at RM5, with an assessment undertaken to determine works undertaken were in line, or comparable to, the milestone criteria outlined in **Table 29**.

An inspection of completed works was undertaken on 9 March 2022 by an appropriately qualified environmental consultant, with an assessment against the relevant milestone criteria completed. Works throughout the subject area were not found to have been completed such that milestone criteria for each rehabilitation milestone was satisfied. An assessment of the subject area against the criteria defined for milestones RM5 and RM7 is provided in **Table 12**.

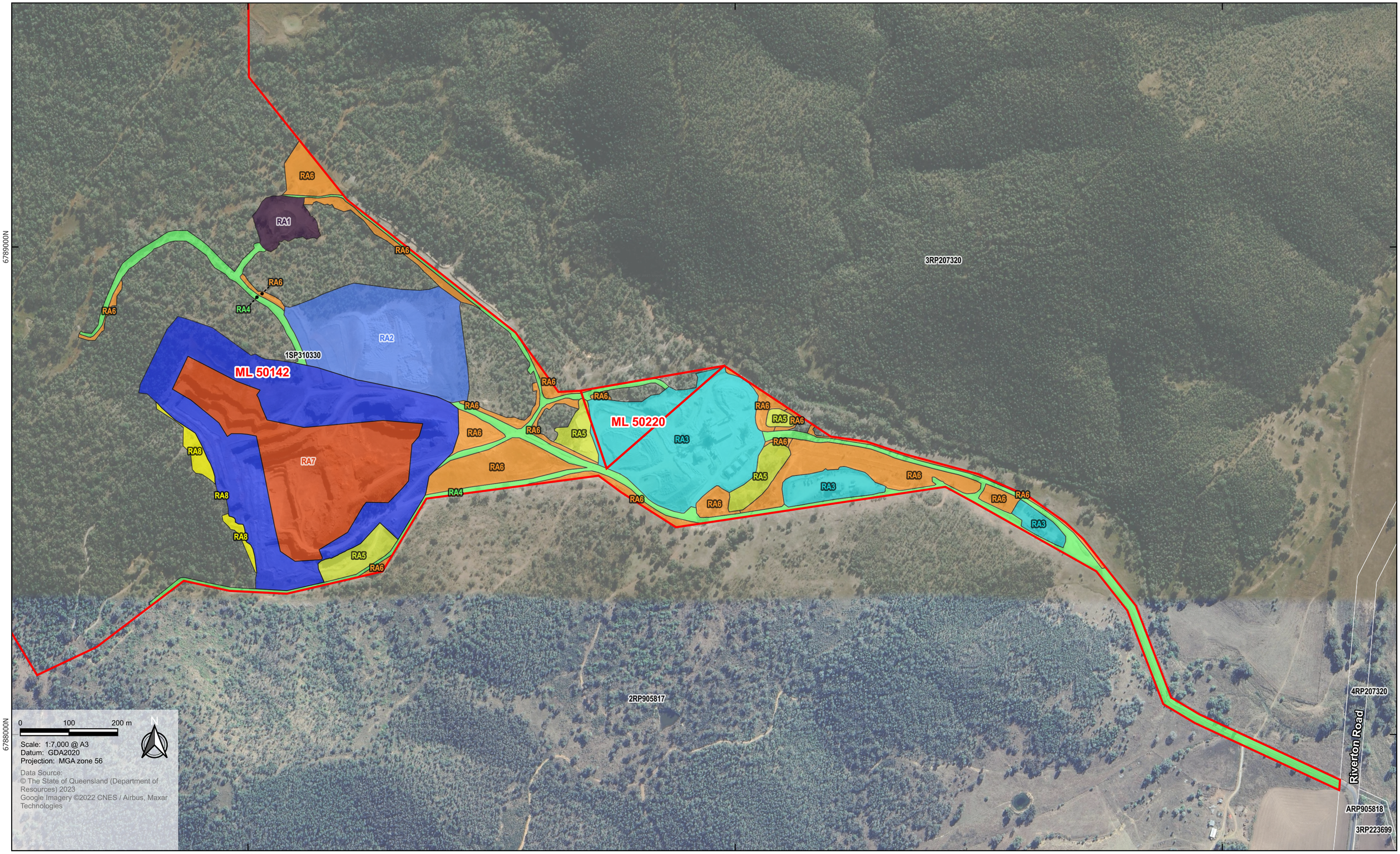
Despite the subject area initially being considered available for rehabilitation in 2021, on the basis rehabilitation rectification works are required, the duration of rehabilitation works in this area has been extended, as shown in **Table 11**. With works expected to commence on 10 December 2025.

Table 12. Assessment of existing rehabilitation (RA6)

Rehabilitation milestone		Milestone criteria	Assessment	Evidence
RM5	Landform development and reshaping / re-profiling of other areas	5a. A landform design report that incorporates the establishment of erosion and sediment control measures is prepared by an AQP	Incomplete	No erosion and sediment control plan has been prepared as part of the landform design report.
		5b. Effective and functioning Erosion and Sediment Control (ESC) systems in place, with associated design plans	Incomplete	As above
		5c. Major earthworks completed in accordance with final landform design including: i. Maximum final slope of 7° to 9° for RA 1	Incomplete	Assessment against landform report has not been made

Rehabilitation milestone		Milestone criteria	Assessment	Evidence
		ii. Maximum final slope of 3° to 4° for RA 3 in ML50142 and <18° in ML50220 iii. Maximum final slope of 0° - 5° for RA 6.		
		5d. Water drainage lines reinstated to allow natural water flows except where erosion or sediment control is recommended in RM5a.	NA	No natural drainage lines exist throughout existing rehabilitated areas.
		5e. Registered bore (ID 74426) will be decommissioned in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2020) or latest version.	NA	No bore present within the existing rehabilitated area
		5f. Former ROM and infrastructure area (RA3) assessed as stable and non-polluting by an AQP.	NA	Area available for rehabilitation does not include ROM or infrastructure area
		5g. An “As-Constructed Report ” prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance.	NA	No As-Constructed report has been prepared, or is required at this stage.
		5h. An independent AQP has certified the achievement of RM5a to RM5g.	NA	AQP certification not yet required.
RM7	Surface preparation (general)	7a. Localised erosion areas identified and repaired.	Incomplete	Evidence of erosion identified throughout area
		7b. Ripping undertaken and penetrates at least 300 mm into soil profile.	Incomplete	No evidence of ripping undertaken
		7c. Placement of topsoil 150 mm (minimum) using salvaged topsoil from site, across the disturbed area.	Incomplete	No evidence of topsoil placement being undertaken
		7d. Prior to applying topsoil, any weeds will be removed from the area by hand, ensuring complete removal of root system.	Incomplete	Weeds present throughout the area
		7e. Planting and roto-tilling of an initial green manure treatment, comprising of grain barley and inoculated clover is completed.	Incomplete	No evidence of roto-tiling undertaken
		7f. Assessment of growth media characteristics and the development of an amelioration and physical	Incomplete	No evidence of soil suitability assessment having been undertaken

Rehabilitation milestone	Milestone criteria	Assessment	Evidence
	treatment plan is completed by an AQP.		
	7g. Ameliorant and physical treatments such as fertiliser, lime, gypsum and/or organic matter are applied as identified in criteria RM7f.	Incomplete	No record of amelioration having occured
	7h. Soil health and suitability for target vegetation establishment assessed by an AQP prior to seeding to determine outcome of manure treatment and fertiliser application and confirms: pH in the range 6 - 8.5 ii. Electrical Conductivity (saturated extract) (dS/m) ≤2 (2,000 µS/cm); iii. Exchangeable sodium percentage (ESP) (%) < 6; iv. Emerson aggregate class: ≥4.	Incomplete	No evidence of soil suitability assessment having been undertaken



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Figure 11 Rehabilitation areas and improvement area.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Rehabilitation areas

- RA1: Topsoil stockpile
- RA2: Waste rock dump
- RA3: Infrastructure
- RA4: Roads and tracks
- RA5: Sediment basins
- RA6: Laydown and cleared areas
- RA7: Residual void - pit floor
- RA8: Historical cleared area

Improvement area

- IA1: Residual void - terraced mine benches

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Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Figure 11
Rehabilitation areas and improvement area

BE210135.01 Rev 2 04/08/2025

349000E
350000E
351000E
352000E
353000E
6790000N
6789000N
6788000N
6CVE587
16SP274173
5SP258490
1SP310330
7SP310330
3RP207320
ML 50142
1SP310330
ML 50220
Riverton Road
4RP207320
2RP905817
ARP905818
3RP223699
BRP905818
0
200
400 m
N
Scale: 1:12,500 @ A3
Datum: GDA2020
Projection: MGA zone 56
Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Figure 12 Undisturbed areas.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Undisturbed area

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Figure 12
Undisturbed areas

351000E
352000E
353000E
6789000N
6788000N
ML 50142
1SP310330
ML 50220
3RP207320
2RP905817
4RP207320
Riverton Road
ARP905818
3RP223699
0 100 200 m
N
Scale: 1:7,000 @ A3
Datum: GDA2020
Projection: MGA zone 56
Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Legend

- Site boundary
- Cadastre (DCDB)
- Existing rehabilitation area

epic
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Figure 13
Existing rehabilitation

2.5.7.2. Stormwater infrastructure

In 2020, a stormwater and flood mitigation program was proposed to minimise the release of sediment-laden water from the site, ensuring compliance with the site EA and protecting operational areas from inundation by off-site floodwater. The mitigation program comprised a levee constructed along the southern boundary of the site (partially off-lease), a farm dam (for water storage, off-lease), and a drainage channel (on-lease) (Epic Environmental 2020). Upstream clean water diversion channels and sediment dams were designed by Lindsay Dynan in 2018 to aid in minimising the release of sediment-laden water from the site (refer **Appendix N**). The following infrastructure was constructed by Graymont at the low point of the upstream catchment to manage clean water diversion, their locations are depicted in **Figure 14**.

- Embankment at the site boundary, designed to control the discharge point through the site
- A low flow pipe was installed to ensure regular conveyance of clean water
- A high flow weir was structed across the site access road
- A clean water drain was installed through the centre of the site, upslope of Sediment Dam C1
- Source sediment control was provided within the site, upslope of the clean water drain, comprising a sediment filter bund and a grassed buffer strip downslope of the sediment filter bund

Stormwater containment infrastructure located on site is detailed in **Table 1** and displayed in **Figure 10**.These features will be retained following mine closure through a landholder agreement (**Appendix D**).

Table 1. Design Specifications for Stormwater Containment Infrastructure

Feature ID	Catchment (m^2)	Volume (m^3) [4]
Sediment Dam A	97,000	13,750
Sediment Dam B	146,000	20,750
Sediment Dam C1/C2	98,000	14,000

[4] Based on 1 in 50 year design criteria, equivalent to 152 mm rainfall depth, volumetric runoff coefficient of 0.90. Includes storage zone and settling zone

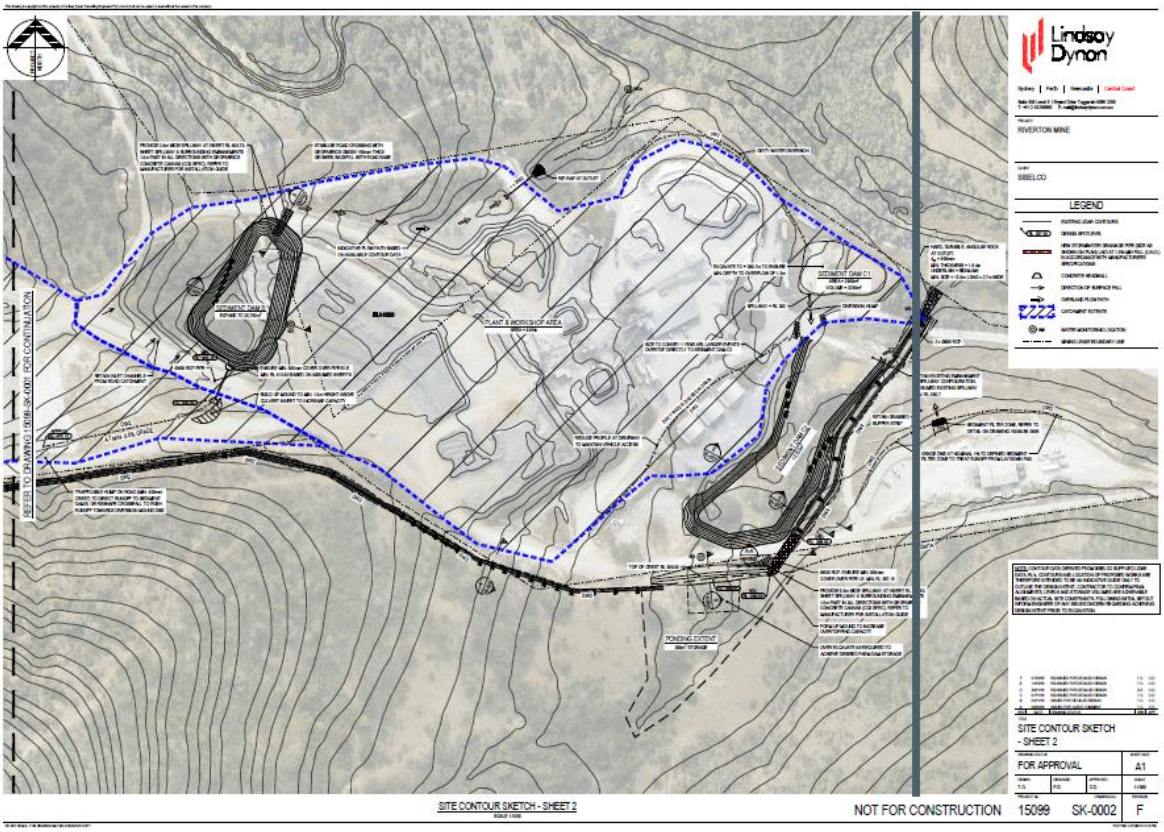


Figure 14 Water management infrastructure (Lindsay Dynan 2018)

3. Community Consultation

This section of the PRC Plan outlines information on stakeholders and community consultation. It is noted that post mining land use (including a NUMA) for the site has been approved under the EA and discussion of alternate PMLU/NUMA options is not required. This notwithstanding Graymont will seek to engage with the community and relevant stakeholders throughout the rehabilitation process, to ensure active consideration of post-closure concerns and opinions.

3.1. Riverton Stakeholder and Community Engagement Plan

The Riverton stakeholder and community engagement plan has been prepared to outline key objectives, performance indicators and methods adopted for engagement with the relevant stakeholders and surrounding community. Key objectives of the engagement process are:

- To ensure factual information about the site is widely available to those interested stakeholders
- Provide an opportunity for stakeholders to ask questions
- Identify areas of concern with respect to the facility and respond to these within a timely manner

- Build relationships with stakeholder groups within the area
- Demonstrate how community feedback is being used in the development and operation of the facility

3.1.1. Relevant stakeholders

For the purpose of this PRC Plan, the community area has been defined as the communities and surrounding areas of the town of Riverton and the Goondiwindi Regional Council and Southern Downs Regional Council LGAs. This area encompasses directly impacted landholders as well as members of the Riverton community and various organisations (including government, industry, service providers, adjoining landholders) who may have an interest in rehabilitation and the post mining land use of the site. **Table 2** provides a categorisation of the stakeholders as they relate to the identified stakeholder groups.

Table 2. Categorisation of relevant stakeholders

Category	Relevant stakeholder
Direct landholders	Landholders whose property the mine infrastructure may be located within. Property owners within the mine lease (ML50142 & ML50220).
Adjoining landholders	Residents located adjoining the site which may experience impacts during operation and rehabilitation (visual impact, noise, dust, traffic). Adjoining neighbours to mine lease (ML50142 & ML50220).
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 site. Police, emergency services, drug and alcohol services, housing, Indigenous, employment and social services. Many of these are provided by Southern Downs Regional Council and Goondiwindi Regional Council. All infrastructure and utilities providers that the site could have an impact on during operation, closure or rehabilitation.
Indigenous Stakeholders	Traditional owner groups, local land councils, other Indigenous organisations, where these are related to the site.
Business Operators and Representatives	Business operators and employees in the locality that may experience indirect impacts on business operations. Regional business groups, local accommodation operators and local Chambers of Commerce.
Special Interest Groups	Community organisations and groups such as local the Lions Clubs, Schools and Childcare facilities and environmental groups.
Local Community	Residents or visitors to the Southern Downs and Goondiwindi regions that may have an interest in the site.

Table 3 provides a list of stakeholders included in each of these groups that have been identified as relevant for this PRC Plan.

Table 3. Stakeholder group and identified stakeholders

Stakeholder group	Stakeholders
Direct landholders	Graymont is currently the only landholder for the land governed by ML50142 & ML50220.
Adjoining landholders	• There are two identified adjoining landholders. • G. Towse, Riverton Road, Riverton • R & J Magner, Sovereignton, Riverton
Federal, State and Local Government representatives and agencies	**Federal** • Member for Maranoa • Department of Agriculture, Fisheries and Forestry

	• Department of Climate Change, Energy, the Environment and Water
	State • Member for Southern Downs • Department of Environment, Science and Innovation • Department of Resources • Department of Regional Development, Manufacturing and Water • Office of the Coordinator General • Department of Seniors, Disability Services and Aboriginal and Torres Straight Island Partnerships
	Local Government • Goondiwindi Regional Council • Southern Downs Regional Council
Indigenous Stakeholders[1]	• Queensland South Native Title Services
Business Operators and Groups	• Retail businesses, including Metro Texas; Texas Takeaway and Restaurants; Newsagency; Australia Post; Grocery shops; hardware shops; CRT Wilshire & Co- Mingoola (in NSW) and local tourist accommodation including the Dumaresq Homestead, Roseneath Farm Stay, and Glenlyon Dam Tourist Park
Special Interest Groups	• Community associations such as Stanthorpe Country Women's Association, Rotary Club Goondiwindi, Lions Club Texas, and Stanthorpe Community Development Services • Various sporting and social groups such as G&S Bowhunting Safaris, Texas & District Memorial Bowling Club, Texas Gold Club, Texas Jockey Club, and Texas Amateur Swimming Clu. • Relevant groups associated with natural area management and species protection such as Southern Queensland Landscapes and the Queensland Parks and Wildlife Service • Emergency Service Committees such as the Texas Local Ambulance Committee and Fire Captain
Broader Community	Other interested members of the Toowoomba and Scenic Rim regions in Queensland and Inverell, Glen Innes, Severn, and Tenterfield regions in the NSW broader region.

[1] It should be noted that with respect to Indigenous community stakeholders, there are no native title determinations or claims over the site and no Aboriginal Cultural Heritage body registered for the area.

3.1.2. Stakeholder and community engagement

The Riverton stakeholder and community engagement plan outlines key methods for undertaking engagement. Identified methods include group meetings, public information sessions, community forums, facility briefings, phone calls, newsletters, fact sheets, letters, and complaint registers. The key methods for engagement adopted for relevant stakeholders is provided in **Table 4**.

Table 4. Stakeholder and community engagement

Stakeholders	Type of engagement					
	Passive			Active		
	Newsletter / community update	Letter	Complaints	Individual meetings	Information sessions	Phone calls
Goondiwindi Regional Council	✓	✓	✓		✓	✓
Southern Downs Regional Council	✓	✓	✓		✓	✓
Traditional Owners	✓	✓	✓	✓	✓	✓

Department of Environment, Tourism, Science and Innovation				✓		
Department of Resources				✓		
Department of Agriculture, Fisheries and Forestry				✓		
Department of Regional Development, Manufacturing and Water				✓		
Adjoining landholders	✓	✓	✓		✓	✓
Member for Maranoa (Cth)		✓		✓		
Member for Southern Downs (Qld)		✓		✓		

3.2. Consultation plan

A consultation plan was developed to document engagement planned with the community and stakeholders. The consultation plan is provided in **Table 5**.

Table 5. Consultation plan

Engagement type	Consultation frequency	Information to be included	How will comments / feedback be considered
Newsletter / community update	Annual	Closure and rehabilitation status updates	Feedback will be requested to be provided by email or phone and will be documented in the consultation register. Consideration of all feedback will be undertaken during site management meetings.
Letter	As required	Details of the closure activities that will have an indirect/direct impact on the stakeholder	Feedback will be requested to be provided by email or phone and will be documented in the consultation register. Consideration of all feedback will be undertaken during site management meetings.
Complaints	When received	Response to complaint matter	Reason for complaint and response provided will be documented in the consultation register. Consideration of the complaint will be undertaken during site management meetings.
Individual Meeting	As required	Closure and rehabilitation status updates	Meeting notes will be documented in the consultation register. Consideration of all matters raised at the meeting will be undertaken during site management meetings.
Individual Meeting (DETSI)	As required	Where an update to the PRC Plan or Schedule is required	Meeting notes will be documented in the community consultation register. Consideration of advice provided by DETSI will be considered in any update to the PRC Plan or Schedule.
Community Forums	Prior to closure	Closure and rehabilitation status updates	Feedback will be requested to be provided by email or phone and will be documented in the consultation register. Consideration of all feedback will be undertaken during site management meetings.
Phone calls	As required	Closure and rehabilitation status updates	Discussion notes will be documented in the consultation register. Consideration of all feedback will be undertaken during site management meetings.

3.3. Consultation register

A consultation register has been prepared to document details of engagement undertaken with stakeholders to date. The register is provided in **Table 6**, with supporting information provided in **Appendix H**.

Table 6. Consultation register

Date	Stakeholder	Type of consultation	Provided information	Issues raised	How were they considered?	Action items	Commitments
03/03/2023	Goondiwindi Regional Council	Letter	Overview of the Proponent, the site, the operations and rehabilitation outcomes including detail of proposed NUMA. Letter provided in Appendix H.	None	NA	NA	NA
03/03/2023	Southern Downs Regional Council	Letter		None	NA	NA	NA
03/03/2023	Mr James Lister (Member for Southern Downs)	Letter		None	NA	NA	NA
03/03/2023	Hon David Littleproud (Member for Maranoa)	Letter		None	NA	NA	NA
03/03/2023	Queensland Fire and Emergency Services	Letter		None	NA	NA	NA
03/03/2023	Queensland Ambulance Service	Letter		None	NA	NA	NA
03/03/2023	Fire and Rescue NSW	Letter		None	NA	NA	NA
03/03/2023	NSW Ambulance	Letter		None	NA	NA	NA
03/03/2023	G. Towse	Letter		None	NA	NA	NA
03/03/2023	R & J Magner	Letter		None	NA	NA	NA
03/03/2023	Magnerlands Pty Ltd	Letter		None	NA	NA	NA
03/03/2023	Mitchell Sargeant, Rachel Baker and John Sargeant	Letter		None	NA	NA	NA
03/03/2023	AP Farms Pty Limited	Letter		None	NA	NA	NA
03/03/2023	Glynvista	Letter		None	NA	NA	NA
03/03/2023	Pinegrove	Letter		None	NA	NA	NA
03/03/2023	Old Mingoola	Letter		None	NA	NA	NA

3.4. Consultation outcomes

Following the issue of the community consultation package to relevant stakeholders, no feedback was received from any of the stakeholders. In terms of the already established and approved PMLU/NUMA, no specific concerns were raised by any stakeholders.

3.5. Public Interest Evaluation

Under s136A of the EP Act a Public Interest Evaluation (PIE) is required where a NUMA is proposed. Transitional provisions within the EP Act state if the NUMA has been pre-approved within a land outcome document, i.e.: EA, the proponent is not required to:

- Justify the proposed NUMA
- Provide evidence to support the justification of the NUMA
- Go through the PIE process

NUMAs are defined under s112 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. The site contains a Residual Void - Terraced mine benches, this is an area of disturbance defined within the EA as a NUMA.

In consideration of the transitional provisions of the EP Act, there is no requirement to undertake a PIE.

4. Post-mining Land Use

PMLUs for ML50142 and ML50220 are informed by the rehabilitation outcomes defined within the EA. The proposed PMLUs for the two MLs, as outlined in Schedule F – Table 1a and 1b of the site-specific EA, are summarised in **Table 7** and displayed in **Figure 10**. It should be noted a transmission easement was instated following the granting of the resource EA; this PMLU is included within the summary however is not referenced within the resource EA.

Table 7. Final land use and rehabilitation approval schedule from Schedule F- Table 1a of the EA

Disturbance Type	Current Disturbance Area (ha)	Pre-mine land use	Post-mine land use	Slope Range
Residual Void(s)	8.1 (area of the pit floor)	Light grazing and fauna habitat	Native Ecosystem	0° to 5°
	11. 55 (area of the terraced benches)	Light grazing and fauna habitat	Non-use management area	Void wall competent rock max slope 70°; Void wall incompetent rock max slope 37°
Clay Waste 'Topsoil'	1.05	Light grazing and fauna habitat	Native ecosystem	7° to 9°
Waste Rock Dump	6.64	Light grazing and fauna habitat	Native ecosystem	16° to 20°

Disturbance Type	Current Disturbance Area (ha)	Pre-mine land use	Post-mine land use	Slope Range
Infrastructure	8.70	Light grazing and fauna habitat	Native Ecosystem	3° to 4° (ML50142) <18°(ML50220)
Roads and Tracks	6.88	Access	Retained Infrastructure	N/A
Sediment Pond	2.32	Light grazing and fauna habitat	Water Storage	N/A
Laydown Area	5.35	Light grazing and fauna habitat	Native Ecosystem	0° to 5°
Cleared Area	3.42	Light grazing and fauna habitat	Native Ecosystem	0° to 5°
Historical Cleared Area	0.56	Light grazing and fauna habitat	Native Ecosystem	0° to 5°
Total	**54.57**			

It is noted that as the landowner, Graymont has prepared a written agreement (dated 19 November 2025to retain the sediment pond and stormwater diversion infrastructure, and all access tracks and roads at the end of the mine life, included in **Appendix D**.

4.1. Legislation relevant to land-use of surrounding area

The site is zoned as rural land under the *Goondiwindi Regional Council Planning Scheme 2014* and *Southern Downs Regional Council Planning Scheme 2018* mapping (SDRC 2021; GRC 2014). The PMLU proposed for the site will be consistent with zoning under the respective LGA.

4.2. Assessment of PMLU options

As part of the assessment of PMLU options, it is acknowledged that land will need to be rehabilitated to a stable condition in accordance with s111A of the EP Act:

Land is in a stable condition if:

- The land is safe and structurally stable, and
- There is no environmental harm being caused by anything on or in the land, and
- The land can sustain a PMLU

The *Environmental Protection Regulation 2019* (EP Regulation) further states that each PMLU:

- Is viable, having regard to the use of land in the surrounding region, and
- Satisfies at least one of the following –

- The use is consistent with how the land was used before a mining activity was carried out on the land
- The use is consistent with a development approval relating to the land
- The use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the *Planning Act 2016*
- The use will deliver, or is aimed at delivering, a beneficial environmental outcome

The pre-mining land use is understood to have supported both grazing and fauna habitat. Fauna habitat is the pre-mining land use in the EA, as described in Schedule F – Table 1a and 1b. However, based on discussions with DETSI held on the 7 June 2024, it has been determined that both traditional and NOVEL Native Ecosystems are compatible PMLU's for the Project's disturbance areas as they align with the surrounding land use and the PMLU previously described within the *Environmental Management Overview Strategy* (1997) (EMOS).

The proposed PMLU of the rehabilitation areas is 'native ecosystem' s in accordance with the "Implications for leading practice" document, *Native ecosystem rehabilitation in Queensland* (OQMRC 2023). This PMLU was selected due to the biophysical limitations of the site, including nutrient deficiency and rocky substrates, and rehabilitation will be based on revegetating the area with predominantly native species and developing milestone criteria in relation to selected reference sites within the undisturbed areas of the Project's MLs to monitor success. Two analogue sites have been surveyed for comparison with revegetation areas to monitor the progress of revegetation works (refer **Appendix E**). It is important to note that these data are derived from sites supporting remnant and regrowth vegetation, which is consistent with the intended PMLU of native ecosystem. It is considered unnecessary to attain remnant status for the vegetation to be consistent with the intended PMLU. Shrub layer cover is expected to be less than analogue sites. A period of 10 years is likely to be sufficient to achieve a canopy cover within the range of the analogue sites (i.e. 15% canopy cover) with the exception of the pit floor, WRD and infrastructure area (grasses only). It is expected that within 10 years all other strata layers will also reach a degree of cover within the median range of the analogue site data.

This approach is consistent with methods described in the *Evaluating methods for assessing native ecosystem mine rehabilitation success technical paper* prepare by the Office of the Queensland Mine Rehabilitation Commissioner (2023). The return of the site to Native Ecosystem will ultimately provide a beneficial environmental outcome.

The site-specific EA acknowledges alternative PMLU's for the following disturbance areas on the site:

- Residual void terraced mine benches will be dedicated as a NUMA
- Infrastructure areas, cleared areas, laydown areas, the residual void (pit floor) and WRDs will revegetated to achieve a PMLU of 'Native Ecosystem', either traditional or NOVEL
- Roads and tracks will be retained as 'retained infrastructure'
- Sediment basins will be retained for 'water supply' in accordance with an approved landholder agreement (dated 19 November 2025)

No other legislation (at a State or Commonwealth level) has been identified as relevant to the land use of the surrounding area. There are also no development approvals relevant to the land.

As no changes are proposed to the pre-approved PMLUs identified, no assessment of other PMLU options has been completed.

The PMLU's proposed for the site are presented in **Figure 15**.

5. Non-Use Management Areas

NUMAs are defined under s112 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.

Schedule F (Table 1a) of the EA identifies the post-mine land description for the Residual Void Terraced Mine Benches as a NUMA. This area is presented in **Figure 15**.

The retention of the Residual Void Terraced Mine Benches following mine closure is authorised under the EA, with consideration to the following conditions:

- Condition F3-1: 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 2.

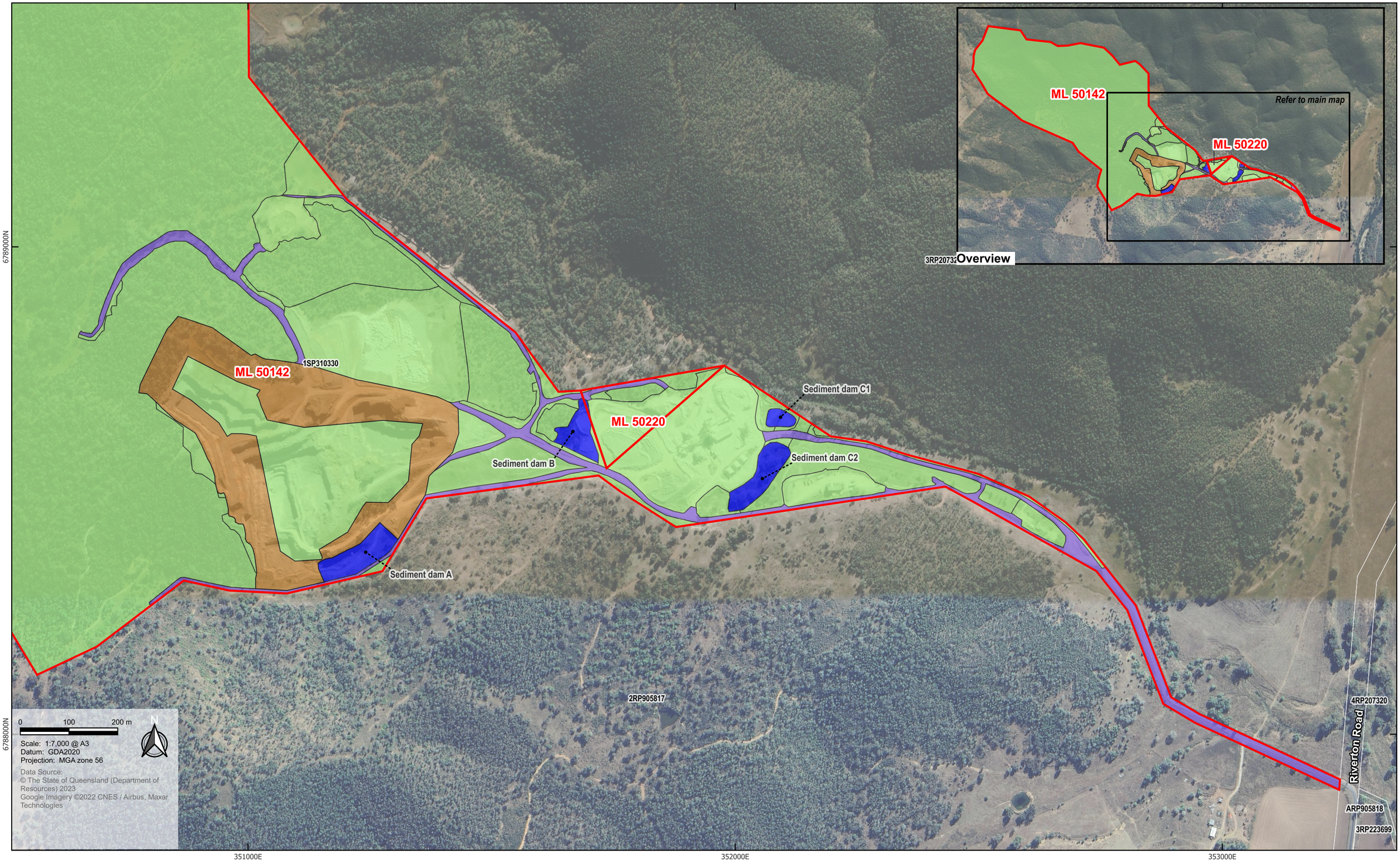
Table 8. Description of NUMA

Item	Description
Non-Use Management Area	Residual Void Terraced Mine Benches
Area	11.55 ha
Post-Mine Land Description (as per EA)	Non-use management area
Post-Mine Land Use	None Proposed

5.1. Assessment of alternative options

As the approved EA's post mining land-use description is a NUMA an assessment of alternative options is not required.

Figure 15 Post-mining land uses and non-use management areas



Legend

- Site boundary
- Cadastre (DCDB)

Non-use management areas

- Terraced mine benches

Post-mining land use

- Native ecosystem
- Retained Infrastructure
- Water storage

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Figure 14
PMLU and NUMA (operational areas)

6. Voids in Flood Plains

In accordance with s126(D)3 of the EP Act, if the subject lands applicable to this PRC Plan contains a void wholly or partially located within a flood plain, the PRC Plan schedule must provide for rehabilitation of this land. To determine whether the site is impacted by regional flooding, a flood model was developed by Engeny for the Project (refer **Appendix I**). It was determined that the proposed final landform areas are not anticipated to be influenced by regional flooding, with flooding within Dumaresq River estimated to reach RL 362 mAHD. The sediment basins are located at approximately RL 380 mAHD, and therefore, given the almost 20 m elevation difference between the site and outlet to Dumaresq River, it is not anticipated that regional flooding will affect the site.

7. Tailings Storage Facilities

There are no existing or proposed tailings storage facilities located at the site.

8. Rehabilitation Management Methodology

The rehabilitation management methodology section of the PRC Plan outlines the general rehabilitation practices and the various studies that contributed to the development of the rehabilitation management methodology. This section also provides an overview of the methodology's development and the proposed implementation measures for the nominated PMLU and NUMA.

8.1. General rehabilitation practices

As per the PRC Plan Guideline, this section outlines the range of information applicable to the PRC Plan which underpins its development and shapes the rehabilitation method. All proposed methods / techniques are designed to rehabilitate the land to a stable condition in a way that supports the rehabilitation milestones under the PRC Plan Schedule.

8.2. Hydrogeology

The requirement for groundwater monitoring is not included within the EA on the basis the potential risk posed to groundwater is considered minimal.

Regional groundwater is reported to be below 387 mAHD (Rocktest 2020). On the basis the lowest elevation of the final WRD and mining pit is 414 mAHD and 425 mAHD respectively, and the nature of material underlying the site (refer **Section 2.1.4**) it is not currently considered that groundwater is at risk of vertical infiltration of surficial contaminants resulting from mining operations.

Therefore, management measures to protect groundwater values are not considered necessary as part of the rehabilitation strategy.

8.3. Flooding

The site is not within the flood warning area. A small portion of the projects southeastern extent is mapped as interacting with the State Planning Policy Flood hazard area - Level 1 - Queensland Floodplain assessment mapping (DSDILP 2024). The site is also mapped within the general flood hazard area under the *Goondiwindi Regional Council Planning Scheme* and is located adjacent to areas that can be affected by major floods. BoM operate a flood warning system for the MacIntyre and Weir Rivers using rainfall and river stage observations (BoM 2021d).

Review of FloodCheck Queensland (DoR 2025) indicates the site has not undergone historical flooding and is not likely to experience a one percent Annual Exceedance Probability (AEP) flooding event.

Graymont commissioned Engeny in 2024 to undertake a Flood Assessment of the projects proposed final landform and Engeny undertook flood modelling of key waterways and the final landform surface to assess the final landforms susceptibility to flood runoff as well as its influence on flood runoff. This report has been provided in **Appendix I**.

Engeny developed the following models using software TUFLOW as part of this assessment:

- Hydrologic Model of the catchment to determine runoff hydrographs for 10 storm durations, applying Probable Maximum Flood (PMF) to the projects future mine domains and landforms key overland flow paths and to establish the potential flood risks to the stability of the final landform
- Hydraulic Model of the projects mine area and the downstream tributary waterways was developed to establish the flood risk profile in the final landform scenario. Engeny then applied model inflows and domains to represent overland flow paths as well as potential flood levels and ponded areas, which were used to determine the final landforms flooding extent

8.3.1. Final landform flood risk profile

The modelling undertaken by Engeny suggests that the proposed PMLUs and the project's final landform are not anticipated to be influenced by regional flooding as the site is located 20 m above flood levels within the creek system tributary adjacent to the site. The water surface level of the model outlet is approximately RL 362 mAHD and the sediment dams are located at approximately RL 380 mAHD. Therefore, runoff management is limited to local catchment runoff only (Engeny 2024).

The peak velocities within the overland flow paths, generated by the models are anticipated to reach 5 m/s, however this velocity is expected to occur irrespective of the works undertaken on site and is not as result of the current or proposed final landform of the project. However, due to peak velocities reaching 5 m/s it is important that the final landform design incorporates established erosion and sediment control measures to mitigate the risk of erosion. The model indicates that the risk of erosion should be carefully considered and included within the final landform design for the southern side of the Residual Void and the Infrastructure area and east of ML50220 (Engeny 2024).

Flood depth maps generated by Engeny suggest that ponding will occur at a non-free-draining basin within the Residual Void's pit floor. To remove the potential for ponding, Graymont will backfill this basin with 30,000 m^3 of waste rock, this will prevent any pooling and subsequent overflow eastward towards the overland flow path originating south of the Pit.

Recent works were undertaken by Graymont to install upstream diversion channels and sediment collection dams to mitigate potential ponding from local catchment runoff, by undertaking the following:

- Maximise diversion of clean water flows around the site
- Control the discharge point through the site, to the one location (W5)
- Ensure that internal dams have the capacity to withstand a 1 in 50-year flooding event

A summary of stormwater management infrastructure has been provided in **Section 2.5.7.2** of the PRC Plan and the specific design details and design drawings have been provided in (**Appendix N**).

8.4. Soil and cover material assessment

A soil investigation was undertaken by SESL Australia Pty Ltd (SESL) in 2021 to ascertain the chemical nature of the topsoil material located within the topsoil stockpile, and to inform the requirement for any additional amelioration or treatment necessary to facilitate vegetation growth across rehabilitated areas.

To supplement the SESL (2021) study, a detailed soil characterisation assessment was undertaken by Epic in 2023 to verify earlier investigations and provide a detailed characterisation of identified topsoil resources available to enact rehabilitation (Epic Environmental 2023). Based on information provided to Epic estimated a total volume of 36,000 m^3 of material is stockpiled to the north-west of site; it is understood this material is stored on the basis it will be used to facilitate rehabilitation across areas of site that will be required to support the PMLU, Native Ecosystem. This report was written with the intention of addressing the originally proposed PMLU of light grazing and fauna habitat. The PMLU has since been updated to Native Ecosystem, however the information contained within the soil report is considered relevant to achieving Native Ecosystem and therefore no changes were required.

The Epic report is provided in **Appendix G**, a summary of observations is presented in the preceding sections.

8.4.1. Quality and quantity of available resources

Quality

8.4.1.1. Epic Environmental Investigation (2023)

A total of 10 samples were selected from Stockpile 01 (samples denoted SPxx) for laboratory analysis to adequately characterise the topsoil material. Full results are provided in **Appendix G**, with a summary provided below:

- pH (laboratory analysis) ranged from 8.23 (SP01_02) to 8.84 (SP01_05_0.5), which can be classified as an alkaline to strongly alkaline soil.

- Soil electrical conductivity (EC) ranged from 0.096 dS/m (SP01-10) to 0.469 dS/m (SP01_02), which an average of 0.216 dS/m for all Stockpile 01 samples. The soil is classified as a low to moderate saline soil based on EC (Shaw 1988)
- Soil cation exchange capacity (CEC) ranged from 19 cmol/kg (SP01_10) to 40 cmol/kg (QC100 (SP01-01)), with an average CEC of 28 cmol/kg. The soil can be classified as having a moderate to high CEC (Landon 1991).
- Calcium: magnesium (Ca:Mg) ratios ranged from 14 (SP01_05_0.5) to 122 (SP01_09), with an average Ca:Mg ratio of 39. These ratios are very high indicating that Ca is more dominant than Mg (Baker and Eldershaw 1993)
- The level of extractable phosphorus ranged from 6.1 mg/kg (SP01_01) to 20 mg/kg (SP01_03), with an average concentration of 11 mg/kg. The concentration of extractable phosphorus is classified as moderated based upon Ahern et al. (1994)
- Emerson aggregate test ranged from class 2 to 4, with an average class of 3. Dispersion classes indicate that the soil slakes, with minimal dispersion
- Soil exchangeable sodium percentage (ESP) ranged from 0.41 % (SP01_05_0.5) to 3.49 % (SP01_03), with an average ESP of 1.46 %. The soil can be classified as a non-sodic soil based on the ESP levels (Baker and Eldershaw 1993).

8.4.1.2. SESL investigation (2021)

A total of three samples were subject to analytical testing for a range of analytes to determine suitability of the material for rehabilitation. A summary of results is provided in **Table 9**.

Table 9. Soil chemistry analysis

Analyte		Unit	Sample 1	Sample 2	Sample 3	Mean (n = 3)
pH		pH units	8.16	8.46	8.53	**8.38**
Electrical conductivity		dS/cm	0.51	0.3	0.25	**0.35**
Organic matter		% w/w	0.31	0.32	0.29	**0.31**
Cation exchange capacity	Sodium (Na)	Cmol (+)/kg	0.75	0.48	0.38	**0.54**
	Potassium (K)	Cmol (+)/kg	0.04	0.04	0.04	**0.04**
	Calcium (Ca)	Cmol (+)/kg	9.32	12.91	14.75	**12.33**
	Magnesium (Mg)	Cmol (+)/kg	0.17	0.13	0.27	**0.19**
	Total cation exchange capacity	Cmol (+)/kg	10.3	13.6	15.4	**13.10**
Plant available nutrients	Nitrate (NO_3)	mg/kg	29	17	12	**19.33**
	Phosphorus (P)	mg/kg	<5	<5	<5	**<5**
	Potassium (K)	mg/kg	15.7	16.5	14.5	**15.57**
	Sulfur (S)	mg/kg	25	16	14	**18.33**
	Calcium (Ca)	mg/kg	1,870	2,590	2,960	**2,473**
	Magnesium (Mg)	mg/kg	21	16	33	**23.33**
	Iron (Fe)	mg/kg	10.1	7.79	11.1	**9.66**
	Manganese (Mn)	mg/kg	3.6	7.4	18	**9.67**
	Zinc (Zn)	mg/kg	<0.65	<0.65	<0.65	**<0.65**
	Copper (Cu)	mg/kg	<0.64	<0.64	1.2	**1.20**
	Boron (B)	mg/kg	0.1	0.2	0.2	**0.17**

Quantity

Based on information provided it is estimated a total of 36,000 m^3 of topsoil resource is available for rehabilitation. With consideration to areas of the site requiring placement of topsoil, a material balance was prepared and is provided in **Table 10**.

In determining the volume of topsoil material required to facilitate rehabilitation across the site, the following assumptions were made:

- Topsoil placement will only be required across the following RA's:
  - **RA1** – Topsoil stockpile
  - **RA2** – WRD
  - **RA3** - Infrastructure
  - **RA4** – Roads and tracks
  - **RA5** – Sediment basin
  - **RA6** – Cleared areas and laydown areas
  - **RA7** – Residual void – pit floor and in-pit WRD
  - **RA8** – Historical disturbance areas
- A conservative approach has been taken, with material requirement calculations based on the assumption 100 percent of the RA requires placement of topsoil. In reality large portions of each RA are likely to have sufficient in situ topsoil and will not require placement of additional topsoil
- The topsoil characterisation assessment indicated approximately 79 percent of the stockpile contains soil, with the remaining 21 percent containing gravels, cobbles and boulders, resulting in 28,440 m3 of usable soil. It is noted this composition is a preliminary estimate only, with gravels and cobbles able to be utilised within rehabilitation and the potential for boulders to break up upon mechanical disturbance. The volume of 36,000 m3 has therefore been retained for the purposes of the material balance

Based on the information provided in **Table 10**, and despite maximising retention of topsoil, the current topsoil resources are not considered sufficient to facilitate the rehabilitation objectives outlined in **Section 2.5**. Therefore, topsoil will be sourced locally from nearby, commercial topsoil suppliers. It will be ensured that the soil sourced will have the similar characteristics to the topsoil located onsite, as described in **Sections 8.4.1.1** and **8.4.1.2**.

Table 10. Topsoil material balance

Topsoil Volume Available (m^3)	Area's Requiring Topsoil Placement	Surface Area Requirement Topsoil (m^2)	Total Surface Area Requirement Topsoil (m^2)	Depth of Topsoil Required (m)	Volume of Topsoil Required – calculated (m^3)	Volume Surplus or Deficit (m^3)
36,000[A]	RA1	10,500	338,200	0.15	50,730	Deficit of 14,730
	RA2	66,400				
	RA3	87,000				
	RA4	0				
	RA5	0				
	RA6	87,700				
	RA7	81,000				
	RA8	5,600				
	IA1	0				

[A] Does not include bulking factor, estimated to increase volume of available resource by between 5 – 10% once excavated from the stockpile

8.4.2. Location and accessibility of resources

The location of available topsoil resource, relative to areas in which it will be required, is presented in **Figure 11** (displayed as RA1 – topsoil stockpile). Accessibility is considered good, with the majority of hauling to be undertaken through existing haul routes.

8.4.3. Requirement for amelioration

8.4.3.1. Amelioration required for native ecosystem

SESL (2021) (**Appendix F**) indicated the material located within the topsoil stockpile is deficient in the majority of plant nutrients, and application of the fertiliser rates detailed in **Table 11** is recommended to facilitate suitable growth medium conditions. Amelioration should be applied at a depth of 100 mm below surface level. Further amelioration, comprising an initial green manure treatment and an initial planting seed mix, is required to ensure soil reaches a standard suitable for Native Ecosystem rehabilitation. This is detailed further within **Section 8.9** of this report which outlines the Vegetation Management Plan (**Appendix E**).

Table 11. Fertiliser application rates (SESL 2021)

Fertiliser	Application rate (kg/ha)
Monoammonium phosphate	200
Muriate of potash	400
Magnesium sulphate	400
Iron sulphate	50
Manganese sulphate	25
Zinc sulphate	15
Copper sulphate	10
Sodium tetraborate	10

8.4.4. Relationship between soils and vegetation

As identified in **Appendix F**, the topsoil resource available onsite is considered to have a land classification of C2, indicating it is suitable for supporting grazing pastures and with suitable amelioration, the topsoil available will also be suitable for supporting native vegetation.

8.5. Waste characterisation

At EOML the WRDs will comprise approximately 1,482,000 m^3 of mining overburden and waste rock resulting from operational processes comprises a combination of the following:

- **Unsuitable pit material** – Comprising highly- to moderately-weathered limestone and red-brown, low-plasticity silty-clay. Generally angular to very angular, ranging from clay (<0.075 mm) to boulder (>200 mm) sized particles

- **Crusher fines** – Comprising poorly sorted material with some gravels (2.36 – 63 mm), generally silt (<0.075 mm) to coarse sand (0.6 – 2.36 mm) sized particles. Angular, dry, non-cohesive material with no plasticity
- **Dump subgrade** – Comprising colluvial red-brown, low plasticity silty-clays of medium density (50 % by volume) with gravel to boulder sized inclusions (10 % by volume), and highly-weathered limestone (40 % by volume)

A summary of waste rock storage is provided in **Table 12**.

Table 12. WRD summary

Waste Rock Volume	WRD Feature	
	Northern WRD	**In-pit WRD**
Volume of waste rock existing (as of 23 April 2023)	550,000 m^3	0
Available Capacity (as of 23 April 2023)	314,000 m^3	618,000 m^3
Total waste rock at EOML	**864,000 m^3**	**618,000 m^3**
	1,482,000 m^3	

Sampling and analysis of the existing WRD was undertaken by SESL (2021) to determine the chemical and physical composition, and to determine potential risks posed through aggregation of the material within the stockpile. An assessment was subsequently carried out by Engeny in 2023 to determine preliminary risk profile of the material contained within the WRD and surrounding landform resulting from the use of waste rock. Both reports are provided in **Appendix M**.

Waste rock was also used as rock fill to construct the final design profile for the site, and as subgrade for access tracks in the north. A total of 60,000 m^3 was used for construction.

8.5.1. Waste rock sampling and analysis

The SESL (2021) assessment comprised the collection and analysis of eight composite samples, and one andesite sample. Samples were subjected to x-ray fluorescence (XRF) and x-ray diffraction (XRD) analysis by SESL's laboratory; the laboratory is a National Association of Testing Authorities (NATA) accredited laboratory (NATA reference 15633).

Table 13. Waste rock characterisation sampling

Sample location	Stockpile volume	Sampling undertaken
WRD	550,000 m^3	5 x composite samples analysed for XRF and XRD analysis
Rock fill / Access Track	60,000 m^3	3 x composite samples analysed for XRF and XRD analysis

8.5.2. Waste rock characterisation

Full results are provided in **Appendix F**. A summary of observations is provided in the following subsections.

XRD analysis was undertaken as outlined in **Table 14**. The XRD analysis did not identify acid generating materials upon weathering and therefore does not pose a risk to environmental receptors (SESL 2021).

Table 14. Summary of XRD Results

Sample ID	Location	Minerals
Andesite Sample1	WRD	• Extrusive volcanic rock. • Intermediate composition, relatively fine grained. • The abundance of quartz and plagioclase (albite) helps to define it as an andesite, though the relative absence of mafic minerals such as amphiboles and particularly pyroxenes place it on the felsic end of the spectrum.
SESL-WDS1	WRD	• Calcite rocks. • Fine-grained soil material, contains the white clay mineral kaolinite; orange-red colour is due to iron oxides.
SESL-WDS2	WRD	• Calcite rocks
SESL-WDS3	WRD	
SESL-WDS4	WRD	• Calcite rocks. • Fine-grained soil material, contains the white clay mineral kaolinite; orange-red colour is due to iron oxides.
SESL-WDS5	WRD	• Calcite rocks
SESL-OD2_Waste1	Rock Fill	
SESL-OD2_Waste2	Rock Fill	
SESL-OD2_Waste3	Rock Fill	

8.5.2.1. XRF Analysis

XRF analysis was undertaken, with results summarised in **Table 15**.

Table 15. Summary of XRF Results

Analyte	Minimum (mg/kg)	Maximum (mg/kg)	Average (mg/kg)	Average Crustal Abundance (mg/kg)
Major Ions/Nutrients				
Ca	7,060	376,800	148,602	41,000
Cl	320	734	531	500
K	335	24,000	9,571	21,000
P	813	5,000	2,817	1,000
S	241	933	530	700
Heavy Metals and Metalloids				
Ag	15	20	17	0.07
As	4	5	5	6
Bi	15	17	16	0.05
Cd	21	28	24	0.11
Co	15	187	111	8
Cr	13	241	84	70
Cu	9	58	29	50

Analyte	Minimum (mg/kg)	Maximum (mg/kg)	Average (mg/kg)	Average Crustal Abundance (mg/kg)
Fe	22	71,200	31,601	40,000
Hg	3	5	3	0.06
Mn	8	5,862	1,420	1,000
Mo	4	13	6	2
Ni	17	163	68	50
Pb	4	34	13	35
Rb	1	96	36	120
Sb	25	35	30	5
Se	1	3	2	0.4
Sn	29	40	35	4
Sr	21	161	77	250
Th	4	14	8	12
Ti	12	10,600	4,190	6,200
U	5	8	6	2
V	4	148	57	90
Y	1	55	24	30
Zn	3	347	105	90
Zr	3	197	97	250

The XRF analyses indicate that:

- Calcium and phosphate are present in average concentrations well above their average crustal abundance concentrations whilst chloride is present in an average concentration at its average crustal abundance concentration
- Sulfur is present in an average concentration well below its average crustal abundance concentration and when converted, the average concentrations vary between 0.02% and 0.09% which is well below the trigger value for potential acidity at 0.30%
- SESL concluded that the XRF analysis indicates low concentrations of heavy metals. Metals of primary concern (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn)) are negligible and presents very minimal risk of environmental contamination

However, when compared to their average crustal abundance concentrations, several heavy metals and metalloids of concern, including Cd, Co, Cr, Hg, Ni, Se and U are present in average concentrations exceeding their average crustal abundance concentrations.

By using the Geochemical Abundance Index (GAI), a measure of enrichment of elements in whole rock samples and which compares the actual concentration of an element in a sample with the median abundance for that element, to provide an indication of any elemental enrichments that may be of environmental importance, calculated by:

- GAI = log2[C/(1.5*S)] (truncated to integer increments through 0 to 6)
- where C is the concentration of the element in the sample and S is the median content for that element in the reference material

It is apparent that Cd, Co and Hg have GAI values of 3 or above, which is considered significant and such an enrichment may warrant further examination. In the absence of total metal and leachable metal analyses it is not possible to assess the significance of these apparent enrichment.

8.6. Landform design

Initial geotechnical assessments of the mine pit and WRD have been undertaken by Rocktest (2019, 2020, 2022, 2023, 2024), which have informed the final landform design. The final landform has been prepared to ensure long-term stability of the site (>100 years); the final landform report is included in **Appendix L**.

8.6.1. Landform visualisation

The final landform design for the Northern WRD, the pit, in-pit WRD and whole-of-site is displayed in three-dimensional images on **Figure 16**, **Figure 17**, **Figure 18** and **Figure 19** respectively (refer **Appendix L**). The final pit floor comprises two levels, a lower level (414 mRL) and upper level (455 mRL) discussed further within **Appendix K**.

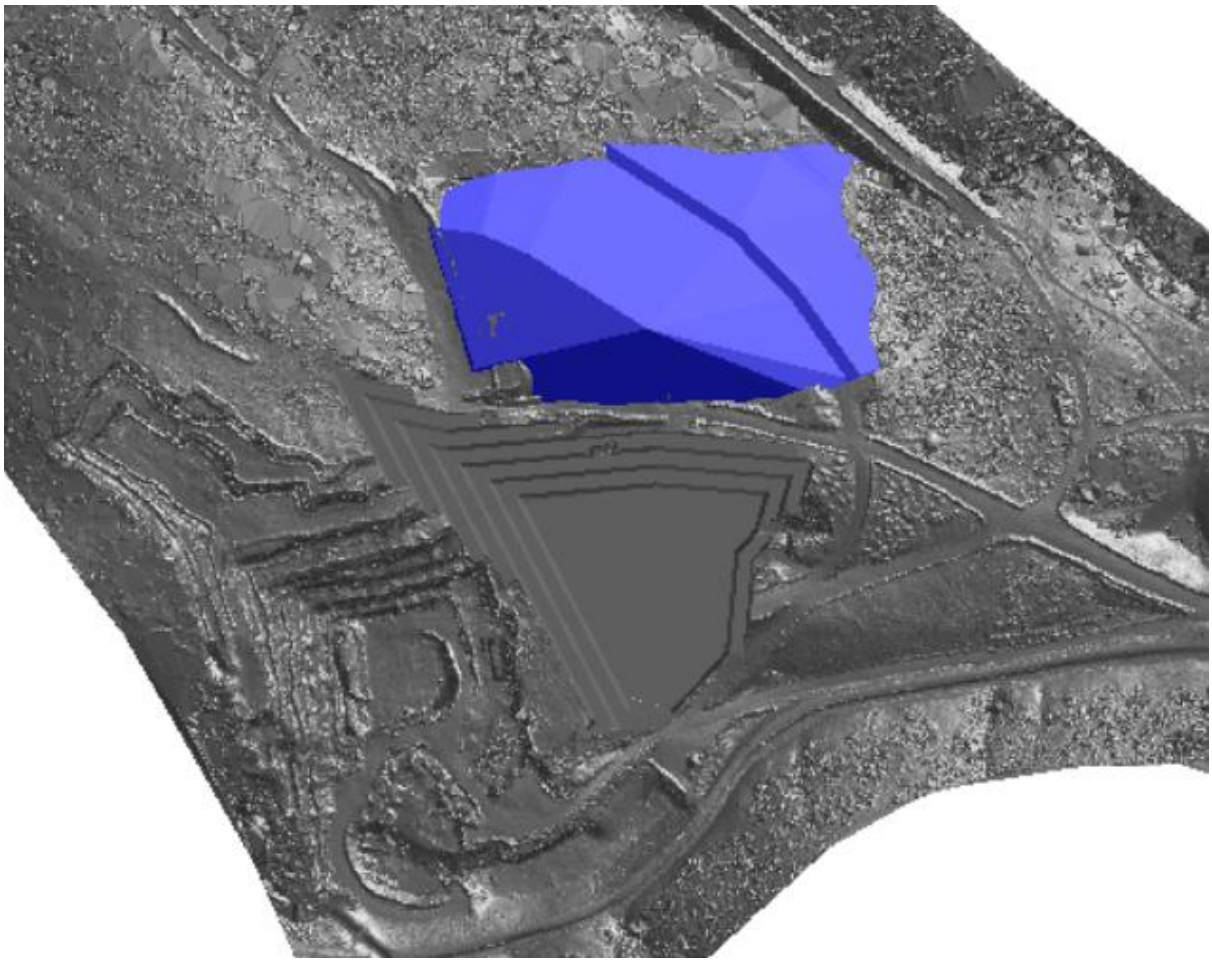

Figure 16 Pit Stage 1 and Northern WRD design

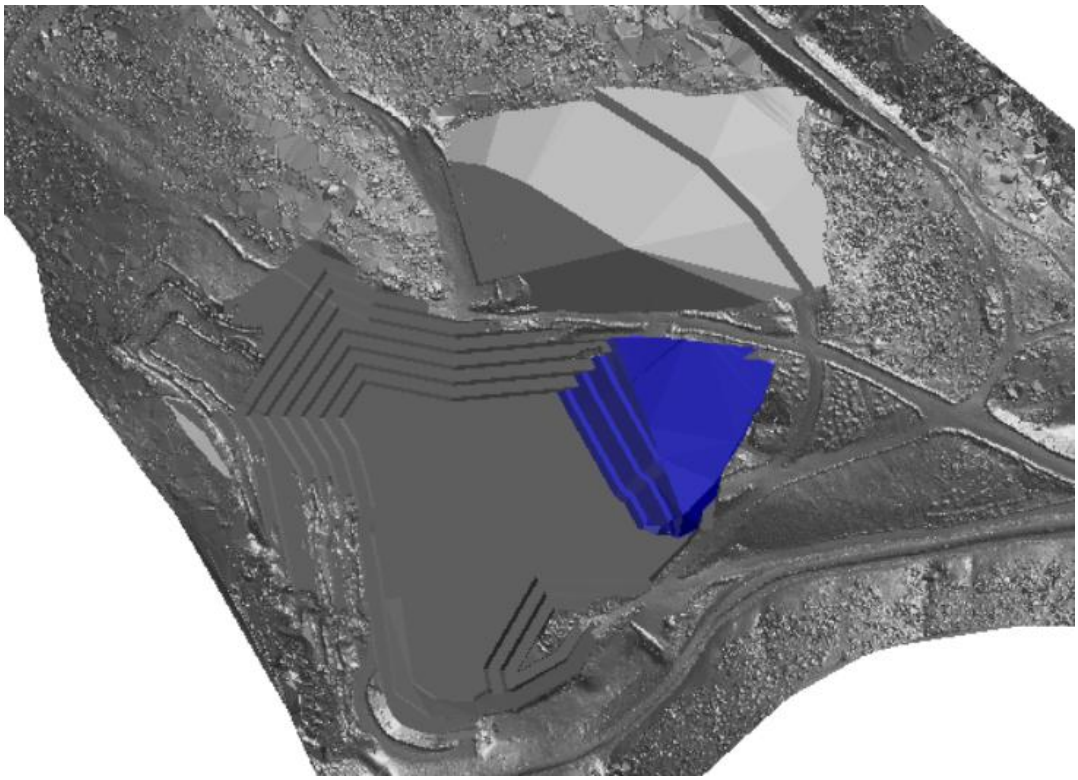

Figure 17 Pit Stage 2 and In-pit Backfill Stage 1

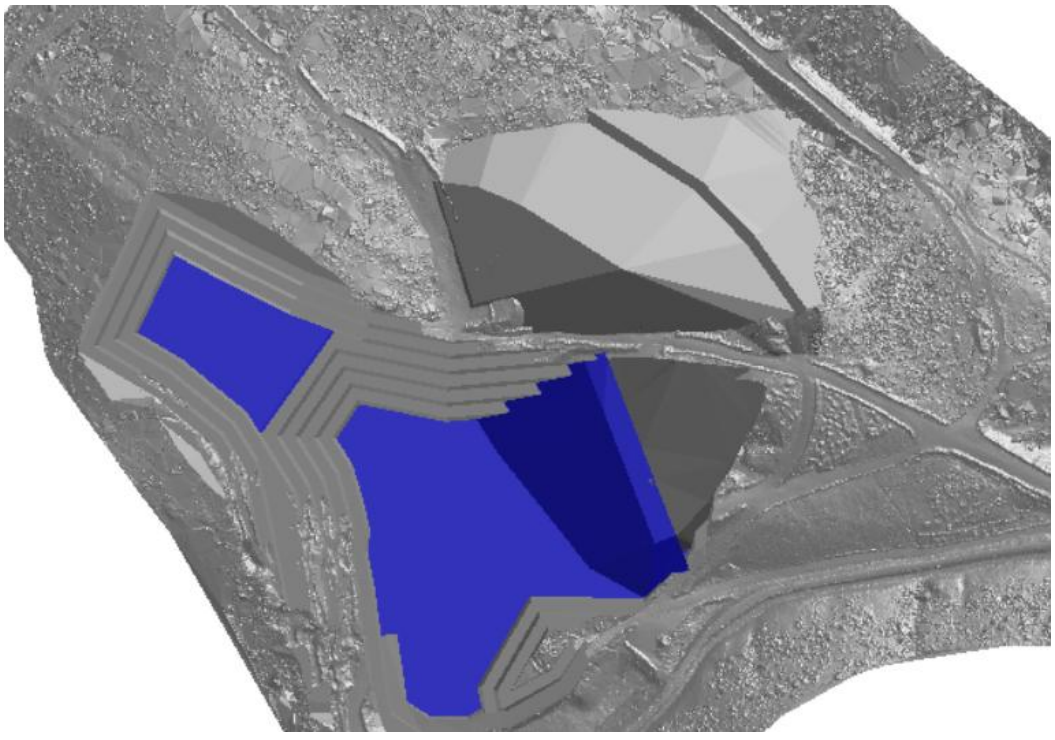

Figure 18 Pit Stage 3 and In-pit Floor Fill

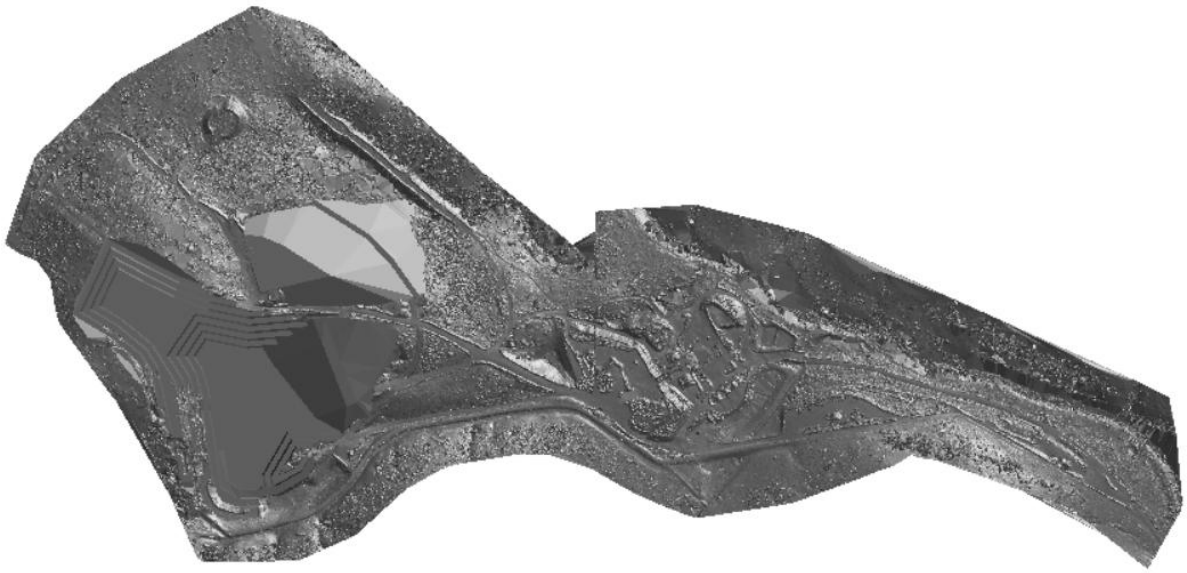

Figure 19 Concept landform

8.6.2. Landform structure

Dimensions of the residual void are provided in **Sections 8.11.** The Northern WRD is a sidehill fill type, the dumps dimensions at EOML are provided in **Table 16**. The WRD was constructed using a top-down method, the footing of the dump constructed on a shallow natural slope dipping at ≈10° towards the east (088°). The front slopes of the WRD are advanced in the same direction as the topography and no slope extends of will extend into a major drainage path (Rocktest 2024).

Table 16. Northern WRD Dimensions

Dimension Value	Value
Length of major axis footing	330 m
Length of minor axis footing	210 m
Maximum heights of WRD	65 m
Heights of benches	30 m
Number of benches	2
Width of berms (at 440 mRL)	10 m
Batter angles	18°
Overall slope angles	17°

8.6.3. Pit lining

On the basis that the residual void is located above the groundwater table, the void geometry will prevent water seepage being retained within the void (Rocktest 2024). A small area of the void was identified as non-free draining in the final landform flood model (Engeny 2024) however this will be backfilled with 30,000 m^3 waste rock to ensure it becomes free-draining and to prevent water seepage being retained. Lining the void to prevent air or water ingress is not considered required (Graymont 2023).

8.6.4. Water retention / shedding

Average annual point evapotranspiration (PET) data surpasses annual rainfall data yielding a ratio of 2.7. Indicating the site is unlikely to be significantly impacted by percolation (Engeny 2023). The majority of site is unsealed, with moderate vegetation established throughout the site and immediate surrounds. The site is not considered likely to shed significant volumes of water.

8.6.5. Long term stability

To ensure long-term stability recommendations provided by Rocktest (2024) will be implemented at the WRD, including:

- Minimising flows of water through the WRD, by:
    - Place a series of low equi-spaced contour bunds on the WRD batter. Contour bunds will comprise of (any of the following) coir logs held in place with wooden stakes
    - Coir logs to be placed in rows parallel with the slope contour and traversing the slope with 10m intervals where slope is greater than 10°
    - Erosion that develops during the rehabilitation period will be repaired with compacted clays as soon as they become obvious
    - During periods of rain, contour bunds will be inspected weekly for damage and if necessary, repair
    - Top surface of the WRDs must be maintained with a slope of 2% directed away from the batters
    - Routine maintenance is required to retain the grade because of ongoing settlement of the level
- Construct upper surface of the WRD to ensure rainfall runoff drains away from the crests of the slope towards the haul road adjacent to the residual void
- Paddock dumping on the flat at a minimum of 10 m away from the crests of any slope
- Using a dozer to spread as thin as practical in a horizontal lift
- Moisture condition the lift using the water cart
- Compact the lift by repeated passes of the dozer and trucks until no further displacement of the surfaces occurs with additional tracking. A minimum of 8 passes is usually required. A lack of wheel ruts with successive passes is an indicator that compaction is sufficient. Align the dozer perpendicular to the crest of a slope when tracking within 10 m of the crest
- Visually monitor the performance of the WRD slopes and ensure no ponding occurring on surfaces

Long-term stability recommendations provided by Rocktest (2024) will additionally be implemented for the residual void, including:

- Routine inspections behind pit wall crests for evidence of large-scale geotechnical instabilities such as cracking and subsidence developing
- Installing abandonment barriers discussed in detail in **Section 8.11.9**
- Preparedness to modify pit design and/or designs if any landform is found to have deviated from the design/performance required at EOML

8.7. Cover design

A cover system is required to be implemented across areas where the potential for contaminant leaching exists. This includes WRDs, tailings stockpiles, low-grade ore stockpiles etc. As identified in **Section 8.5**, the WRD presents a low risk for contaminant leaching, this notwithstanding an assessment of cover design options was undertaken; this assessment is provided in **Appendix M**, and summarised in the preceding sections.

The objective of the cover system is to:

- Limit oxygen ingress
- Limit net percolation/infiltration of rainfall
- Support the proposed PMLU
- Provide a stable and non-polluting surface

8.7.1. Cover system design

Six cover design options have been identified for assessment, as detailed by GARD INAP (2009), and outlined in **Table 17**.

Table 17. Soil Cover Design Options

ID	Design Description	Comment
Base	Natural, barren or oxidised growth medium	Basic cover to cap the wastes and serve as a growth medium.
I	Base case, but thicker	A thicker growth medium, but too thick a layer may allow deep drainage to below the root zone and into the wastes.
II	I, but including a capillary break	Cover II adds a capillary barrier (or break) beneath the growth medium, which may be desirable to limit the uptake of any salts from the underlying waste rock into the growth medium. A capillary barrier relies on a material that limits saturation and flow driven by capillary action and must be carefully selected and sized to ensure that it is effective and will remain so. Suitable capillary barriers may include clean gravel and clean sand. Run-of-mine waste rock would likely not be suitable for use as a capillary barrier, without crushing of coarse-grained particles and screening to remove fines.
III	I, but underlain by a compacted clay layer	The compacted clay layer provides a seal to hold-up rainfall infiltration for access by plants and to limit net percolation into the wastes.
IV	I, but underlain by an alternative sealing layer	A geomembrane or GCL could be used in the absence of clay.
V	Compacted layer sandwiched between two capillary breaks, without or with a growth medium	Designed specifically to cover sulfidic tailings at the net positive water balance site in Québec, Canada.

Risk categories for various mine aspects are provided in **Table 18**. On the basis assessment of waste rock has not identified any potentially acid forming material, the WRD is considered to be **low – medium risk**.

Table 18. Risk Categories and Design Considerations for Waste Rock Dumps (DES 2019)

Risk Category	Waste Rock Dump Feature / Description	Design Considerations
High	Potentially acid forming waste rock materials (PAF). Other highly reactive materials including (acid rock	• Engineering $2,000/ha • Working layer 0 m

	drainage (ARD) / acid mine drainage (AMD) / neutral mine drainage (NMD)). Observed contaminated seepage (PAF) capable of causing environmental harm.	• Capillary break 0.6 m • Low permeability layer 0.5 m • Top Rock Layer 1.5 m
Medium with low permeability layer	Waste rock material that could adversely impact on the proposed end land use and/or vegetation function if salinity or materials are exposed, e.g., hypersaline / sodic materials, highly dispersive clay materials. Significant (non-PAF) seepage capable of causing environmental harm. Located in high rainfall area.	• Engineering $2,000/ha • Working layer 0 m • Capillary break 0.3 m • Low permeability layer 0 m • Top Rock Layer 1.0 m
Medium	Waste rock material that could adversely impact on the proposed end land use and/or vegetation function if salinity or materials are exposed, e.g., hypersaline / sodic materials, highly dispersive clay materials. Seepage (non-PAF) capable of causing environmental harm.	
Low	Waste rock material that may have some impact on the proposed end land use and/or vegetation cover Minor (non-PAF) seepage.	• Engineering $1,500/ha • Working layer 0 m • Capillary break 0 m • Low permeability layer 0 m • Top Rock Layer 0.5 m
Very low	Benign waste rock materials Minor (non-PAF) seepage.	• Supervision / survey $500/ha • Working layer 0 m • Capillary break 0 m • Low permeability layer 0 m • Top Rock Layer 0 m

8.7.2. Cover system construction methodology

Basic construction methodology is provided in ERC Guide (DES 2019), as outlined in **Table 19**.

Table 19. Construction Methodology (DES 2019)

Layer	Intent
Working layer	• Not required for WRDs or heap leach pads • A “working rock layer” over tailings specified to provide a “stable surface” for the cap
Capillary break	• Capillary break layer to mitigate salt uptake into the vegetation surface
Low permeability layer	• Low permeability layer (typically clay) to prevent infiltration of surface water into the waste
Top rock layer	• Above the low permeability layer, presumably before the top layer is placed, and on slopes as armouring
Top layer	• Growth media (typically topsoil) and vegetation

8.7.3. Location and quantity of cover material

A material balance for cover soil has previously been provided (**Section 8.4.1**). This material balance considers soil resources required to enact rehabilitation. **Table 20** provides a summary of material required to support the construction of the cover for the WRD only, incorporating topsoil (growth medium – as per earlier section), in addition to waste rock and capillary break material.

Table 20. Cover Material Balance

Material Type	Layer Thickness (mm)	Volume (m^3)	Comment
NAF Waste Rock	1,000	66,400	Will be obtained from existing waste rock resources, with validation testing undertaken to ensure its suitability for use (NAF assessment)
Soil / Growth Medium	150	9,960	Located within topsoil stockpile onsite. Refer **Section 8.4.1** for more information.
Capillary Break	300	19,920	Will be sourced from existing waste rock stockpiles, with validation testing undertaken to confirm its suitability for use.

8.7.4. Proposed QA/QC for construction

Prior to, and during, implementation of the cover design, relevant material will be assessed for suitability and conformity with previously assessed material. A proposed analysis plan is included in **Appendix M**.

8.8. Water management

8.8.1. Environmental Values and water quality objectives

The EP Act and the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP Water) aim to provide ecologically sustainable development.

Environmental values (EVs) and water quality objectives (WQOs) are being progressively determined for Queensland waters. EVs define the uses of the water by aquatic ecosystems and for human uses (e.g. drinking water, irrigation, aquaculture, recreation). WQOs define objectives for the physical, chemical and biological characteristics of the water (e.g. nitrogen content, dissolved oxygen, turbidity, toxicants, fish).

The EPP water type for this area includes the “Dumaresq Floodplain” over the eastern access track and “Traprock Fresh Waters” over the Project site. The environmental values zone includes “Queensland Border Rivers and Moonie River Basins”. The Project site is mapped as having ‘Moderately Disturbed waters’ under the EPP Water, which is defined as waters in which the biological integrity of the water is adversely affected by human activity to a relatively small but measurable degree. The management intent for the site will be to maintain WQOs or improve towards WQOs.

EV to be considered will include the immediate area around the Graymont Riverton limestone mining leases and downstream via the Dumaresq River. As noted in the Geotechnical Assessment (Rocktest 2024), the current standing groundwater level is below 387 mRL, which is a minimum of 22 m below the toe of the final dump at 410 mRL. As mining activities sit well above the groundwater table at the site and there are no discharges or interactions with groundwater as a result of mining activities, this is not considered further.

The surface water monitoring and reporting process as conditioned in the EA (EPML00241213) provides a management tool for water management at the site. Historic surface water monitoring

has met the required limits set out in the EA. The EA notes conditions that there is to be no releases to groundwater at the site.

The Dumaresq River water supply is the main environmental value in the local area and due to the downstream connection with the Macintyre River, may indirectly impact on downstream EV's.

An assessment of environmental values of the receiving environment is provided in **Table 21**.

Table 21. Environmental values

Value	Icon	Description	Pathway/Receptor Linkage
Aquatic Ecosystems		The site is located approximately 1km north west of the Dumaresq River, a tributary to Macintyre River. Areas downstream may support aquatic ecosystems.	Possible
Irrigation		The site is not considered to impact irrigation use of Dumaresq River. The site is not in proximity to any irrigation bores.	Unlikely
Stock Water		The site is not considered to impact on the water used for livestock on Dumaresq River or Traprock.	Unlikely
Aquaculture		The site is not located in proximity to any aquaculture facilities.	Unlikely
Human Consumer		Areas downstream from the site may be utilised for the consumption of aquatic foods, including fish.	Possible
Primary Recreation		Areas adjacent to the site are not considered to have the potential for direct contact from activities including swimming and diving.	Low
Secondary Recreation		Areas adjacent to site are not considered to have the potential for indirect contact from activities such as paddling and boating.	Low
Visual Recreation		The site is located approximately 1km north west of the Dumaresq River, a tributary to Macintyre River. Potential contamination at the site is unlikely to be contributing to deterioration of the aesthetics of Dumaresq River or Traprock.	Low
Drinking Water		The site is located within a rural area, human consumption from Dumaresq River is not considered likely.	Low
Cultural and Spiritual Values		The site is not considered to impact on the cultural and spiritual values of Dumaresq River.	Low
Groundwaters (aquatic ecosystems, irrigation, farm supply/use, stock water, drinking water)		The site is located approximately 1km north west of the Dumaresq River, a tributary to Macintyre River. Mining activities occur above the groundwater table so any discharges to groundwater are unlikely.	Unlikely

8.8.2. Description of the contaminants that pose a risk to Environmental Values of the receiving environment

Limestone quarrying is a relatively low risk form of mining that does not involve any chemicals in processing activities. Graymont maintain a hazardous chemicals register for all products onsite, and besides the fuel tank, all chemicals are contained within the office or workshop for the purpose of machinery maintenance, cleaning, etc. Therefore, there is a low risk of impact to environmental values of the receiving water environment from contaminants onsite during closure. Due to the low-risk mining processes onsite, the source, pathway and fate of contaminants has not been investigated further.

8.8.3. Infiltration and seepage intervention and collection controls

As described in the Geotechnical Assessment (Rocktest 2024), the site is located within a regional contour high. The WRD is not within a permanent watercourse. Water within the body of the dump is likely to result predominantly from downward migration of rainwater that falls on the levels and overland flows of water from up contour of the dump.

The hydraulic conductivity of clays in the subgrade is lower than its value for the dumped materials. This difference may contribute to pore pressures developing at the dump-subgrade interface while downward flows of water continue. The pressures reduce the shear strength of surfaces through the dump.

An intense rainfall event can reduce the overall stability of the WRD if it results in pore pressures developing around the down contour toe of the dump. The reductions in the stability due to these events is generally small. This result is consistent with observation of no significant instability occurring during an intense rainfall event in 2011. However, the geotechnical analyses indicate that overall scale of failure is likely if high pore pressures develop at the interface between the mine waste and the subgrade. These pressures could develop if a significant proportion of the water that falls on the WRD during an intense rainfall event migrates through the dump and does not migrate into the subgrade but instead migrates along the interface between it and the mine waste to the toe of the dump.

Water infiltration into the WRD will be avoided to the greatest extent practical. As outlined in the Geochemistry Assessment and Cover Concept design (Engeny 2023) and Geotechnical Assessment, measures implemented to ensure this include (Rocktest 2024):

- Installation of a cover design across the extent of the WRDs to prevent vertical infiltration of water
- Grading of final landform across WRDs to prohibit water pooling and to facilitate runoff off the WRD surface
- Install bunds to shed to the north or down the haul road water from up contour (west) of the dump. Experience with flows associated with the recent extreme rainfall should provide guidance on flow paths up contour of the dump
- Bunds should have a minimum height of ≈1 m requiring a footprint of ≈3m. They should comprise a well graded mix of well compacted clays, silts, sands and rock to have strength, durability and low permeability

- Place a series of low (≈0.3 to 0.5 m) equi-spaced bunds across the contours of areas where water flows scour the surface to reduce the velocities of the flows. Bunds typically comprise:
- Coir logs or straw barrels held in place with wooden stakes
- Coarse permeable rocks
- Geofabric socks held in place with wooden stakes
- Bund spacings should not exceed 10m for gradients greater than 10°.
- Water that pools in depressions adjacent to the outside toes of bunds should be directed to contour lows along drains. Erosion that develop either side of a bund should be repaired with compacted clays as soon as it become obvious
- During periods of rain, inspect bunds weekly for damage and if necessary, repair
- Levels on dumps should be maintained with an uphill grade of 2% to the crest of the level to facilitate drainage away from the crest and so that truck do not have to back downhill. Routine maintenance is required to retain the grade because of ongoing settlement of the level

As stated in the Geotechnical Assessment, maintaining dump stability requires minimising flows of water through the WRD. Doing so requires the dump having as low a permeability and as high a density and hence strength as practical. Achieving these outcomes requires the materials being compacted to the greatest degree practical. To do so, they will be:

1. 'Paddock' dumped on the flat a minimum of 10 m away from the crests of any slope
2. Using a dozer, spread as thin as practical in a horizontal lift. Moisture condition the lift using the water cart if practical to do so
3. Compact the lift by repeated passes of the dozer and trucks until no further displacement of the surfaces occurs with additional tracking. A minimum of 8 passes is usually required. A lack of wheel ruts with successive passes is an indicator that compaction is sufficient. Align the dozer perpendicular to the crest of a slope when tracking within 10 m of the crest
4. Repeat the procedure with the next lift

8.8.4. Surface water diversions and long-term management requirements and treatment

A range of mitigation measures to control surface water diversions currently exist at the site, as follows:

- Stormwater diversion infrastructure has been installed to manage surface water (refer **Section 2.5.7.2** and **Appendix N**)
- Improvement of WRD and residual void stability in accordance with the recommendations identified in the geotechnical investigations undertaken in 2019 and 2020 (Rocktest 2019; Rocktest 2020)
- Weather conditions are monitored to ensure sufficient warning of severe weather events
- Erosion which may result from increased rainfall intensity and frequency will be managed in accordance with industry guidelines
- Topsoil is stripped and stockpiled separately to subsoils to reduce the loss of topsoil and allow for reuse in rehabilitation. The effective management of stockpiles will aid in the successful rehabilitation of the site, as well as prevent the loss of topsoil during storm, cyclone, and extreme weather events

These activities will continue to occur as part of closure.

Most rainfall events do not generate overland flows at the site. The water soaks into and evaporates from surfaces. Only intense and/or prolonged rainfall generates flows. Therefore, the proposed surface water diversion measures are considered appropriate to manage water flows over the site after closure and to ensure stability criteria of landforms can be maintained.

Inflows into the void through localised rainfall, pit wall runoff and groundwater inflow is considered likely, although is not likely to result in significant volumes. In any event the area of the pit floor is considered sufficiently large that evaporative losses from the surface will result in the pit floor remaining dry long-term (Rocktest 2024). During periods of heavy or prolonged rainfall, water flows along a natural low-lying drainage path located about 40 m southeast of the void. After these flow events, some water may pool in depressions along this drain. The surfaces of the pools are a minimum of 3 m below the crest of the southeast wall of the void, preventing any drainage water from entering. To further reduce this risk, a bund will be constructed between the drain and the southeast wall at the EOML (Rocktest 2024). Dewatering is not required.

During periods of heavy or prolonged rainfall, water follows a natural low-lying contour (referred to as a 'drain') located to the north and east of the WRD, however water does not pool in this drain after flow events. This drain also gathers seepage emerging from the base (toe) of the dump. The drain's lowest point, situated to the east of the dump, lies 10 m below the toe. Flows from within the drain will therefore not scour the toe of the WRD (Rocktest 2024).

Other recommended measures to control overland water flows include the following:

- Side drains will be required along the haul road if the drainage works increase the flows along it and if there is a possibility of these flows migrating into the dump
    - Crown the surfaces of the haul road to achieve cross-slopes of ≈3o (19H:1V)
    - Drains should be a minimum of 1.8 m wide (where possible) and ≈0.3 m deep
    - Drains should be lined with high permeability, coarse (no fines), durable crushed limestone
- If the haul road requires cross-drains to break and redirect flows:
    - Cross drain spacings should not exceed 20 m for gradients less the ≈8o (12%). Spacings should be ≈15 m for greater gradients
    - Cross-drains should be a minimum of 1.0 m wide and ≈0.3 m deep
    - Cross-drains should be filled with high permeability, coarse (no fines), durable crushed limestone
- Water pooling in wheel ruts on the levels must be avoided. Maintain crowned and well compacted trafficable routes to prevent rutting. Fill deep ruts with well compacted materials
- If high rainfalls are expected, seal off cracks that develop in the surfaces of levels, particularly within 10 m of crests, to prevent water ingress. Do so by compacting the areas around the cracks and replace any settled fill with clays. Note the location of the cracks with spray paint
- Drains should be inspected and maintained prior to rainfall events. Persons who routinely visit the dump should be made aware of this inspection and maintenance program

8.8.5. Dewatering requirements

The crests of the residual void walls are predominantly located at contour highs, and overland flows over most sections of the crests will not occur. Where overland flow is expected to occur into the void, it will be prevented through the establishment of an abandonment bund, surrounding the northwest, northeast and southeast walls and serve as a water diversion bund (Rocktest 2024).

During periods of heavy or prolonged rainfall, water flows along a natural low-lying drainage path located about 40 m southeast of the void. After these flow events, some water may pool in depressions along this drain. The surfaces of the pools are a minimum of 3 m below the crest of the southeast wall of the void, preventing any drainage water from entering. To further reduce this risk, a bund will be constructed between the drain and the southeast wall at the EOML (Rocktest 2024).

Under normal rainfall conditions, water entering the void will come from runoff down the walls of the void, groundwater inflow, and direct rainfall. However, the pit floor is large enough that evaporation and other outflows will consistently exceed these inflows, preventing the accumulation of significant water depths within the residual void (Rocktest 2024).

Inflows into the void through localised rainfall, pit wall runoff and groundwater inflow is considered likely, although is not likely to result in significant volumes. The surface area of the pit floor is sufficiently large to ensure that evaporative losses and other outflows will exceed the combined inflows, hence a significant depth of water will not develop on the floor (Rocktest 2024).

The lowest section of the pit floor will be at 414 mRL, which is 27 m above the standing groundwater level at ≈387 mRL, hence:

- The floor will remain dry after the EOML
- Significant flows of water will not seep from any wall and excess hydrostatic pressures will not develop within a wall

Dewatering is not considered required.

8.9. Revegetation

8.9.1. This section contains the revegetation plan / program and outlines the activities that will enable establishment of self-sustaining vegetation communities that are appropriate for the Native Ecosystem PMLU. A vegetation management plan (VMP) to address relevant aspects of Section 3.6.1 of the PRC Plan Guidelines has been prepared for the site and is provided in Appendix E.Revegetation program

In accordance with the EA and nominated RAs, approximately 33.82 ha of site is required to be revegetated to achieve the PMLU native ecosystem. Where practicable, revegetation works are to align with the ‘novel planned’ subclass in accordance with the “Implications for leading practice” document, *Native ecosystem rehabilitation in Queensland* (OQMRC 2023). A PMLU of novel planned native ecosystem was selected due to the biophysical limitations of the site, including nutrient deficiency and rocky substrates.

Revegetation works proposed for part of the residual void pit floor (within RA7), infrastructure areas (within RA3) and the waste rock dump (within RA2) will differ from those proposed for the remainder of the RAs due to safety, access and soil substrate constraints.

RA2

The WRD (within RA2) will be subject to placement of a cover system, designed to prevent vertical infiltration of rainfall into the waste rock material. As the planting of deep-rooted vegetation (i.e. trees) is not recommended due to the risk of cover penetration, the WRD will be vegetated with a novel ecosystem, with species types limited to native grass species, and avoidance of any deep-rooted vegetation.

RA3

The infrastructure area will be revegetated with grasses to aid in controlling floodwater flow (if the site is impacted by flooding in the future). Given the underlying substrate is predominantly rock, the success of deep rooting vegetation will be significantly impacted with revegetation efforts focused on restoring this area to native ecosystem dominated by native grass species.

RA7

Due to the risk of rockfall, to ensure the safety of workers involved in revegetation works access to some areas of the pit floor will be restricted. These areas will be limited to the abandonment bunds and areas between the abandonment bund and pit wall. The remainder of the residual void pit floor will be revegetated in accordance with the VMP.

8.9.2. Objectives

Following cessation of mining operations, Graymont's objective is to return certain portions of the site to land that is suitable for native ecosystem, comparable to the surrounding unmined areas[1]. The objectives of rehabilitation and revegetation are to:

- Create a landscape safe for humans and wildlife into the foreseeable future
- Create a stable landscape with natural rates of erosion
- Establish vegetation communities which blend visually with the surrounding landscape and vegetation
- Establish functional, self-sustaining vegetation communities
- Establish ecosystems that resemble neighbouring unmined areas in their ability to respond to fire and droughts
- Ensure minimal post-mining impacts on surface catchments

[1] Comparable by way of species composition not density. Non-mined areas surrounding site would be deemed too densely vegetated to satisfy PMLU of 'Native Ecosystem' therefore comparable sites from within the ML will only be used to determine species type not plant density or coverage.

8.9.3. Revegetation overview

Topsoil preparation and Initial Planting

To adequately prepare the surface to accept topsoil, RAs RA1, RA2, RA3, RA6, RA7 and RA8 will be ripped to a depth of 300 mm. All weeds across the rehabilitation area (with the exception of excluded areas within RA2 and RA7 are to be removed prior to topsoil placement by hand, ensuring complete removal of the root system followed by application of 150 mm topsoil.

Prior to planting the desired vegetation, the soil must be suitably prepared. Based on completed studies (SESL 2021, Epic 2023), amelioration will be applied to improve the suitability of topsoil as a growth medium. To address nutrient deficiencies, it is proposed that an initial planting of lime tolerant species (high pH tolerant) be planted across the site to build up organic matter within the soil. The initial planting will be completed in autumn following the spread of topsoil across the revegetation areas. The initial planting seed mix will include grain barley and inoculated clover. Prior to flowering the initial planting crop will be roto-tilled back into the topsoil as a green manure.

Following completion of the initial topsoil treatment with green manure, a low-dose application of low Phosphorus (P) fertiliser (less than 3% P) will be applied at a rate of 200-250 kg/ha. In order to prevent a flush of Nitrogen (N) that would promote weeds, a controlled release formulation is recommended, with a release time of 8-9 months. A controlled release formulation would also negate the need for repeat applications. Selected fertiliser will also include trace elements, particularly Zinc (Zn) which is highly deficient at the site (Epic 2023). Fertiliser will be applied using standard agricultural machinery similar, or in the case of the pit floor, projected via drone.

Prior to the planting of tubestock for shrubs and trees, native grass seeds of species common to the area will be sown into the topsoil in autumn. Repeat applications of herbicide spray should be applied prior to sowing native grass seeds. Standard agricultural machinery should be used to sow seeds at a rate of 25 kg per ha with the exception of the pit floor. Sowing native grass seeds within the pit floor will be completed with the use of drones.

Planting ProgramPlanting should occur in autumn, following significant rainfall, ensuring soil moisture levels are optimum at the time of planting.

Seedlings shall be sourced where possible from local provenance stock. Planting stock will be provided in forestry tubes with a minimum plant height of 20 cm and a well-developed root system (tubestock). Seedlings are to be healthy and displaying signs of active growth. Any plants displaying yellowing, disease, root curling or root bound are not to be planted, nor are any plants with weeds growing within forestry tubes. Seedlings are to be watered with a minimum of 10 L of water each at the time of planting and then watered as part of general maintenance requirements.

Trees and shrubs should be planted in rows at 5 m intervals, parallel to the sites contours; plants should be spaced at 2 m intervals to allow management access in between rows. Planting will involve planting the tube stock in a shallow depression, twice the size of the tube container, ensuring the root ball is just below the soil surface. A fertiliser tablet is to be placed adjacent to the root ball. A layer of mulch of 50 – 100 mm thick is to then be applied to the rehabilitated

area, ensuring mulch circles but does not touch the stem, both the use of ring and blanket mulching is acceptable. Shrubs and trees will be planted at a density of 12 plants per 100 m^2

It should be noted that the standard planting program will be implemented only in applicable RAs where a traditional native ecosystem can be established, excluding areas such as the pit floor exclusion zones. Further detail regarding the planting program has been provided in the VMP (**Appendix E**).

8.9.4. Revegetation limitations

A variety of factors can result in insufficient revegetation of the site. The following limitations have been identified as factors that could result in unsuccessful rehabilitation:

- **Poor seed establishment –** caused by unfavourable conditions being encountered on the site
- **Stock damage** – trampled juvenile plants and reduction in ground cover
- **Erosion** – loss of topsoil and scouring of land
- **Fire** – natural fires resulting in loss of planted stock
- **Weeds** – proliferation of weeds out competing native species

Mitigation measures for these limitations are being investigated further.

8.9.5. Ongoing weed management

It is important to devise an annual plan of action for the management of weeds. Areas of weed infestations will be mapped onto the site plan, and the desired goals will be established. This maximises the efficient resource use and at optimal times (prior to seeding). It is also important to review the success of weed control undertaken during the previous year, and make the necessary adjustments to improve success, if necessary. Weed management should be completed annually across all revegetation areas. Control of weeds can be achieved through mechanical or chemical methods. In general, chemical methods are preferred as they achieve greatest success per unit effort. Mechanical methods are only preferred when infestations are small, located in waterways and/or located among sensitive native species for which collateral impacts of sprays are unacceptable.

Due to safety concerns related to personnel accessing areas of the residual void pit floor, weed maintenance is not recommended for the pit floor. Because of this there is a likelihood that weeds such as non-native grasses will become established in the pit floor rehabilitation areas. Spot-spray application of herbicides via drone is not considered feasible at this time.

Further detail regarding weed management has been provided in the VMP (**Appendix E**).

8.10. Tailings storage facilities

Not applicable, there are no tailings storage facilities current or proposed for the site.

8.11. Voids

A geotechnical assessment was undertaken by Rocktest Consulting (2024) for the PRC Plan to consider safety measures, stability and recommendations for the design of the void at EOML. The geotechnical assessment including the stability analysis for the final design is provided in **Appendix K**, with final landform further described in **Appendix L**. The geotechnical assessment includes discussion on:

- Geotechnical assessment of all final landforms including consideration of stability, erosion, weathering, and hydrological events
- Final slope angles and design specifications of final voids, WRDs and abandonment bunds
- Geotechnical stability mechanisms, including void filling, reshaping, and void configuration through earthworks

8.11.1. Minimisation of final void

Final void dimensions will be determined based on balancing identified stability constraints (i.e. limiting angles of upper slopes to maintain stability) and minimising final void footprint (i.e. ensuring slopes aren't overly flat that additional material). A summary of approximate angles required to achieve this balance is provided in **Table 22**.

Table 22. Void wall angle

Wall Slope Angle	Implications
Competent Rock	
<50°	Angle too steep, inefficient operation requiring excess removal of overburden and unacceptable footprint area Vs material recovery ratio.
50 – 70°	Optimum balance of operational efficiency and safety/stability
>70°	Increased risk of instabilities and potential wall failure
Incompetent Rock	
<20°	Angle too steep, inefficient operation requiring excess removal of overburden and unacceptable footprint area Vs material recovery ratio.
20 – 37°	Optimum balance of operational efficiency and safety/stability
>37°	Increased risk of instabilities and potential wall failure

8.11.2. Void dimensions and slopes

Void dimensions at EOML are presented in **Table 23**.

Table 23. Void specifications at EOML

Dimension Value	Value
Trend of major axis	121°
Length of major axis at crest	535 m
Average length of minor axis at crest (west/east)	195/385 m
Maximum heights of walls (north/south/east/west)	65/79/19/34 m
Heights of benches	10 m
Maximum number of benches	10
Width of berms	10 m

Batter angles in unweathered rocks	70°
Batter angles in weathered rocks	14°
Inter-ramp angles	43°
Maximum overall slope angles (north/south/east/west)	33/37/32/31°
Ramp type / Minimum width	Linear / 10 m

8.11.3. Geotechnical and geochemical stability

An assessment of geotechnical stability was undertaken as part of the 2024 investigation (Rocktest 2024). The objectives for the assessment were to determine the void was both stable and safe, the following objectives were identified:

- Stability:
  - Walls and areas behind their crests are geotechnically stable
  - Landforms having very low probabilities of overall wall instability with high safety and environmental consequence
  - Void volume and surface area is minimised
  - Pit hydrology and hydrogeology are understood
- Safety
  - Structurally sound
  - Pit safe for persons and fauna
  - Crest locations are clearly defined

The assessment indicated that no wall scale instabilities, or inter-ramp scale instabilities have occurred since mining commenced. The most likely wall scale instabilities will occur on the top two benches, which daylight <10 m behind the crest. They are therefore unlikely to undermine the chain-link abandonment fencing instated 10 m behind the North and West crest. Inter-ramp scale stabilities may occur across all benches over the short to long term, with likelihood reducing over the long term as weathering occurs.

The proposed landform design satisfies the geotechnical related requirements for a PRC Plan and that stabilities of the pit walls are generally within the ranges typically considered acceptable in the civil and mining industries.

Long-term stability recommendations provided by Rocktest (2024) will be implemented for the residual void, including:

- Routine inspections behind pit wall crests for evidence of large-scale geotechnical instabilities such as cracking and subsidence developing
- Installing abandonment barriers discussed in detail in Section 8.11.9
- Preparedness to modify pit design and/or designs if any landform is found to have deviated from the design/performance required at EOML

This assessment ensures that the residual void can be considered safe, stable, is unlikely to cause environmental harm and is suitable for dedication as a NUMA.

8.11.4. Void hydrology

A small area of the void was identified as non-free draining in the final landform flood model (Engeny 2024) however this will be backfilled with 30,000 m^2 waste rock to ensure it becomes free-draining and to prevent water seepage being retained. As the void is not expected to retain water, water quality and long-term stratification has not been considered further. Minor overflow from the void is likely during periods of rain, with all runoff from the void area feeding into the onsite sediment basin.

During periods of heavy or prolonged rainfall, water flows along a natural low-lying drainage path located about 40 m southeast of the void. After these rainfall events, some water may pool in depressions along this drain. The surfaces of the pools are a minimum of 3 m below the crest of the southeast wall of the void, preventing any drainage water from entering the void. To further reduce this risk, a bund will be constructed between the drain and the southeast wall at the EOML (Rocktest 2024).

Under normal rainfall conditions, water entering the void will come from runoff from the walls of the void, groundwater inflow, and direct rainfall. However, the pit floor is large enough that evaporation and other outflows will consistently exceed these inflows, preventing the accumulation of significant water depths within the residual void (Rocktest 2024).

8.11.5. Groundwater modelling

As discussed in **Section 2.1.6**, groundwater is expected to be encountered approximately 27 m below the base of the void, at an elevation of 414 mAHD. As such the residual void is not expected to impact upon groundwater and further modelling is not considered required.

8.11.6. Water balance

The void is not expected to retain significant volumes of water and is therefore not considered a water storage feature. The void is not expected to impact upon the sites water storage volumes and/or water balance. Water quality of surrounding waterways is not expected to be impacted by the presence of the void as the void will be operating in a closed system, with all rainfall captured by the void feeding into the sites sediment basins.

8.11.7. Water quality

The void is not expected to retain water; therefore, water quality and long-term stratification of retained water has not been considered.

8.11.8. Void design plan

As previously stated, the residual void terraced mine benches are considered a NUMA. It is understood that residual voids, or the contents of residual voids, must not cause any environmental harm other than the environmental harm caused within the footprint of the residual void itself. As stated in Rocktest 2024 the stability of the pit walls, at EOML, are considered acceptable and does not need to be backfilled or rehabilitated beyond its final state to achieve this outcome. The residual void pit floor will be rehabilitated to a PMLU of Native

Ecosystem a bund will be placed 5 m from the bottom bench to restrict access to the area and minimise the risk of rockfalls.

8.11.9. Rehabilitation strategies

Through the geotechnical assessment, the void has demonstrated its stability through the short and long term. As required under the EP Act, dedication of the void as a NUMA does not waive the requirement for stability and safety to be considered. The following rehabilitation strategies have been applied to ensure this is achieved:

- Instatement of a hard rock abandonment bund surrounding the northwest, northeast and southeast wall of the void, consistent with the requirements of the Safety Bund around Abandoned Open Pit Mines Guideline (DIR 1997). The abandonment bund will be set back a minimum of 10 m behind the pit walls. Bunds will have the following approximate specifications:
  - Height: 2 m
  - Footing width: 6 m
  - Material: Well-graded coarse strong durable limestone of +25 mm
- Installation of a rockfall abandonment fence set back 10 m from crest of south-west wall, , consistent with the requirements of 43 (1) of the Mining and Quarrying Safety and Health Regulation 2017. This has been proposed in place of the abandonment bund detailed within **Appendix K** as this area is spatially constrained, falls within the Riverton Bat Cave 215 m exclusion zone which prohibits disturbance, and is deemed unsafe to undertake extensive work due to the uneven terrain. The rockfall fence will comprise the following approximate specifications:
  - 1.5 m high
  - 10 kilojoules (kJ) capacity
  - Post spacings of up to 10 m
- Dense remnant vegetation will be retained to the north and west of the pit, further restricting access to the void
- Instatement of 2 m hard rock toe bunds (“rock traps”) surrounding the base terraced mine bench, set back a minimum 10 m from the toe of the wall, this offset is required to meet the minimum Offset requirements of the guideline (Rocktest 2024)
- A fence will be constructed around the mine site to restrict access from unauthorised personnel
- Installation of safety signs around the perimeter of the residual void
- Batter slopes meet final design specifications
- Water drainage lines reinstated to allow natural water flow
- Certification from an appropriately qualified person (AQP) verifying design intent has been achieved

8.11.10. Underground mining

Not applicable, no underground mining is current or proposed at the site.

8.12. Built infrastructure

8.12.1. Overview

All built infrastructure will be decommissioned, demolished and/or disposed of upon closure of the site, with exception to the access tracks and eastern and western levees which are to be retained under an approved landholder agreement (refer **Appendix D**). Built infrastructure comprises all above and below ground infrastructure, including offices, amenities, workshop facilities, fixed and mobile plant, service pits and trenches.

8.12.2. Identification and decommissioning of built infrastructure

8.12.2.1. Identification of built infrastructure

Decommissioning of all buildings not intended to be retained following closure will involve the onsite demolition and removal of all buildings and related infrastructure (i.e. footings, stairwells, and handrails etc).

Prior to closure a detailed review of the dangerous goods and hazardous substances onsite will be undertaken to assist in the identification of suitable options for reuse, recycling, or disposal. This review will also determine the requirement for any specific management required during decommissioning, including management and removal of identified asbestos or silica containing materials.

Where feasible mobile and/or temporary amenities, including all prefabricated buildings, will be relocated to alternative sites prior to, and during closure as relevant, with general consideration given to the condition and potential for contamination of the asset prior to being demobilised from site.

It is understood on-site built infrastructure may change prior to closure of the site as operations upscale, downscale, or as building maintenance or improvement works are undertaken.

At the time of writing the following buildings are considered demountable and/or relocatable:

- Weighbridge office
- Administration offices
- Amenities block
- Crib / break room
- All fuel and water storage infrastructure.
- Bore (ID RN77426)

The following buildings are considered permanent in nature:

- Weighbridges and weighbridge huts
- Workshop and workshop office

8.12.2.2. Decommissioning of built infrastructure

Permanent buildings that aren’t to be retained will be demolished upon closure. Demolition is to be undertaken in a controlled manner with consideration given to the materials from which they were constructed. Where practicable, efforts will be made to segregate construction materials

with the view of maximising the beneficial reuse or recycling of such material. The proposed demolition strategy is outlined in **Table 24**.

Table 24. Demolition method (built infrastructure)

Item	Method	Disposal / Reuse
Concrete (slabs, footings etc)	All slabs and footings will be broken up on-site by excavator with rock-breaker attachment	• Crushed for re-use during rehabilitation. • Processed through licenced facility (concrete recycler)
Timber (treated)	To be selectively picked by excavator with grab attachment	• To be transported offsite for disposal at a licenced facility.
Timber (untreated)		• To be mulched onsite to facilitate rehabilitation
Steel and metals (including roofing iron, bracing, formwork)		• To be processed at an approved metal recycler
Plumbing (including PVC pipes, copper, and brass fittings)		• To be recycled/processed at an approved facility
Miscellaneous building materials (plasterboard, insulation, trace plastics)		• To be transported offsite for disposal
Hazardous materials (e.g.: asbestos/silica containing materials)	To be removed by licenced subcontractor.	• To be transported offsite for disposal at a licenced facility.

8.12.2.3. Decommissioning of onsite bore (RN77426)

The water licence associated with the on-site bore RN77426 (Authorisation Number 625968) will be surrendered and the bore decommissioned in consultation with the Queensland Department of Resources according to the preferred practices nominated in the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2020). The bore casing will be cut off at least 0.5 m below the surface. The bore will be decommissioned by fully grouting from the base of the bore to the surface.

8.12.2.4. Remediation following decommissioning

Following removal of all equipment from the infrastructure areas, the Proponent will implement a suitable remediation program that will comprise of:

- A contaminated land site investigation undertaken in accordance with Schedule B2 (Guideline on Site Characterisation) of the National Environmental Protection (Assessment of Site Contamination)
- Preparation of a remediation action plan (RAP) (if required)
- A validation program to confirm suitable remediation actions have been adequately implemented and the site is suitable for the final land use

Once the remediation works have been validated as appropriate, the infrastructure areas will be assessed to determine if final land use outcomes have been achieved.

8.12.3. Retained infrastructure

Infrastructure expected to be retained following closure is detailed in the following sections.

8.12.3.1. Access tracks

Access tracks throughout site will be retained following mine closure under a landholder agreement. In order to ensure the access tracks are stable and non-polluting they will be graded with localised repairs undertaken (where required). Tracks will be graded to facilitate run-off of surface water to an approved location in line with the stormwater management plan, and to minimise water pooling.

Where access tracks provide access within and into the Residual Void and to the upper surface and the toe of the northern WRD, they will be ripped to restrict access.

Appropriate erosion and sediment control measures, including instating drainage lines will be implemented to ensure stability in perpetuity.

In instances where access tracks have been built up through instatement of rock / bulk material, geotechnical stability will be assessed as part of the rehabilitation schedule.

8.12.3.2. Sediment basins

Sediment basins will be retained following mine closure under a landholder agreement. Prior to mine closure all sediment basins will be re-profiled if required to ensure construction aligns with design drawings, with any areas of localised erosion identified and rectified. Topsoil will be applied, and groundcover will be established throughout the footprint of the basin including the internal and external batter slopes to maintain stability.

8.12.3.3. Maintenance of retained infrastructure

Retained infrastructure will be maintained in accordance with the maintenance and monitoring program (**Section 11**).

8.12.3.4. Suitability of relevant areas for progressive rehabilitation

Retained infrastructure will be maintained in accordance with the maintenance and monitoring program (**Section 11**).

8.12.4. Fixed and mobile plant

All mobile plant will be relocated to alternative operational sites upon closure of the site, or completion of rehabilitation (where relevant). It is anticipated plant will commence being available for removal progressively during closure, as below:

- Excavators: required onsite to enact rehabilitation, to be demobilised once rehabilitation is complete
- Bulldozers: required onsite to enact rehabilitation, to be demobilised once rehabilitation is complete
- Crusher: will be removed upon conclusion of processing operations
- Mobile/fixed screen: will be removed upon conclusion of processing operations
- Trommel: will be removed upon conclusion of processing operations
- Articulated dump trucks: required onsite to enact rehabilitation, to be demobilised once rehabilitation is complete
- Rigid dump trucks: will be removed upon conclusion of processing operations

9. Risk Assessment

In accordance with section 126C(1)(f) of the EP Act, the RPP 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.

A risk assessment was undertaken in accordance with AS/NZS ISO 31000:2018 *Risk Management – guidelines* and *HB203:2006 Environmental risk management principles and processes*. The criteria adopted for assessing risk levels of identified hazards is shown in **Table 27**.

Analysis of the likelihood and consequence was conducted to determine the risk rating given against each hazard (refer **Table 25** and **Table 26**).

The risk assessment matrix in **Table 28** provides a summary of the hazard analysis and risk assessment as it relates to the PRC Plan. The risk assessment also identifies the risk of a stable condition for land not being achieved and includes mitigation measures outlining how this risk will be managed. The identified mitigation measures have been incorporated into the rehabilitation and closure planning outlined in the PRC Plan.

Table 25. Likelihood scale

Level	Descriptor	Definition
1	Rare	Unlikely to occur during a lifetime or very unlikely to occur
2	Unlikely	Could occur about once during a lifetime or more likely not to occur than to occur
3	Possible	Could occur more than once during site lifetime and more likely not to occur than to occur
4	Likely	Will probably occur in most circumstances
5	Almost Certain	Is expected to occur in most circumstances

Table 26. Consequence scale

Level	Descriptor	Definition
1	Insignificant	Very low environmental and health impacts confined to a small area within the site Prompt (typically within a shift) clean-up Negligible loss of human, social, financial, or built capital/wellbeing Negligible media coverage
2	Minor	Low environmental and health impacts confined within the site Short-term (typically within a week) clean-up Small but noticeable loss of human, social, financial, or built capital/wellbeing, can be easily rehabilitated Regulation breaches without fine or litigation Negative local media coverage Complaint from community
3	Moderate	Reversible off-site environmental health impacts, requiring short-term clean-up (weeks) Onsite medium term (months) clean-up Moderate, noticeable loss of financial or built capital/wellbeing Regulation breaches resulting in fine or prosecution Negative media coverage at local/regional level over more than one day
4	Major	Major, off-site, environmental and health impacts requiring medium-term clean-up (months) Onsite impact requiring significant clean-up effort (years) Substantial loss of financial or built capital/wellbeing, will attract public concern Major litigation at operation level Negative national media cover age
5	Extreme	Prolonged or severe, off-site, or regional environmental and health impacts requiring long-term clean-up (years) with irreversible residual damage Extreme permanent loss of, financial or built capital/ wellbeing, with anticipated major public outrage Major litigation or prosecution at parent company level Loss of environmental licence

Table 27. Risk assessment criteria

Likelihood	Consequence				
	Extreme 5	**Major 4**	**Moderate 3**	**Minor 2**	**Insignificant 1**
Almost Certain 5	Extreme (25)	Extreme (20)	Extreme (15)	High (10)	Moderate (5)
Likely 4	Extreme (20)	Extreme (16)	High (12)	Moderate (8)	Low (4)
Possible 3	Extreme (15)	High (12)	Moderate (9)	Moderate (6)	Low (3)
Unlikely 2	High (10)	Moderate (8)	Moderate (6)	Low (4)	Low (2)
Rare 1	Moderate (5)	Low (4)	Low (3)	Low (2)	Very low (1)

Table 28. Qualitative risk assessment – PRC Plan

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
Waste Rock Dump and Topsoil Stockpile	Native Ecosystem	Rehabilitation efforts do not result in self-sustaining land suitable for Native Ecosystem	High (12)	• Adaptive management of rehabilitation and re-seeding to bolster natural seed stocks. Regular monitoring with early intervention of rehabilitation failure • Rehabilitation maintenance following the revegation program outlined in the VMP	Moderate (9)
		WRD is an on-going source of acid and metalliferous drainage impacting groundwater and surface water quality.	Moderate (6)	• Waste dump geotechnical inspection and stability modelling undertaken by a suitably qualified expert • Visual inspection of surface water features to be undertaken to detect any potential indicators of AMD • Continued waste characterisation is proposed to demonstrate low potential for acid and metalliferous drainage	Low (4)
		Southern WRD becomes unstable and results in erosion and sedimentation impacting surface water quality, groundwater quality and land degradation	High (12)	• WRD slope angles designed by a suitably qualified and experienced geotechnical consultant • The construction and maintenance of the hard rock cover system has been certified by an appropriately qualified person and is consistent with the design specifications • Landform development and final landform slopes meet final design specifications. • Certification from a suitably qualified person verifying design intent has been achieved • One metre high armour rock bund placed 20 m behind upper level crest to control water flow and access • An appropriate cover system is installed with appropriate QA/QC measures in accordance with cover design specifications • Topsoil in stockpiles to be used for rehabilitation has been assessed and results reviewed by a Certified Professional Soil Scientist for this PRC Plan	Moderate (9)
		Flood events undermine the toe of the southern WRD resulting in erosion and sedimentation and instability impacting surface water quality, groundwater quality and land degradation	Moderate (6)	• WRD is not located within a floodplain and is not considered likely to be impacted by flooding • Continued hydrology modelling is proposed throughout remainder of site operations to assess changes to the risk of susceptibility of the site to flooding and determine if specific geotechnical considerations are required	Low (2)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
				• Specific geotechnical protections will be designed and constructed within the toe of the WRD if required	
		Topsoil is mismanaged, affecting rehabilitation success.	Moderate (9)	• Topsoil will be selectively sourced from onsite sources • Amelioration will be undertaken as required to ensure vegetation establishment	Moderate (6)
		Stable condition for land described as a PMLU not being achieved.	High (12)	• Ongoing assessment and monitoring of the stability of landscape in accordance with reference milestones • Areas outside the main void are undisturbed and are not considered likely to become destabilised • Design and construction of any additional works will be undertaken with consideration of achieving long-term geotechnical stability	Moderate (6)
		Stability of landscape not being achieved, meaning the PMLU cannot be achieved.	Moderate (6)	• The WRD and residual void will be stabilised to ensure structural integrity • All drainage features will be reinstated • All exposed areas will be rehabilitated to achieve a suitable level of ground cover to minimise the potential for scouring	Low (4)
		Weeds are not adequately controlled during rehabilitation.	Moderate (6)	• Weeds will be managed in accordance with the strategies outlined in the VMP	Low (4)
		Poor seed establishment, stock damage, erosion, fire and/or weeds.	High (12)	• Early detection of poor performance. Successful germination of grasses can be assessed at 6-18 months to determine viability • Provision of sufficient water • Correct management of topsoil • Exclusion of stock in active rehabilitation area/s until completion criteria met • Exclusion of stock from discrete areas (>9°) to prevent soil disturbance • Once completion criteria met, grazing intensity limited for first few years • Construction of silt traps or drainage sumps for erosion control • Exclusion of fire from rehabilitation areas during life of mine by maintaining existing firebreaks around revegetation areas	Moderate (6)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
				• Implementation of weed control and management comparable to reference sites and baseline survey results through a weed monitoring program as described in the VMP	
		Rehabilitation does not result in successful attainment of completion criteria.	High (12)	• Adaptive implementation of PRC Plan and regular monitoring with early intervention of rehabilitation failure	Low (4)
Residual Void Pit Floor (exclusion areas only)	Native Ecosystem	Rehabilitation efforts do not result in self-sustaining land suitable for Native Ecosystem	High (12)	• Adaptive management of rehabilitation and re-seeding to bolster natural seed stocks. • Regular monitoring (utilising remote survey techniques such as the deployment of drones) with early intervention of rehabilitation failure.	Moderate (9)
		Pit floor becomes unstable and results in erosion and sedimentation impacting surface water quality, groundwater quality and land degradation	High (12)	• Pit floor slope range is designed by a suitably qualified and experienced geotechnical consultant • Landform development and final landform slopes meet final design specifications. • Certification from a suitably qualified person verifying design intent has been achieved • Topsoil in stockpiles to be used for rehabilitation has been assessed and results reviewed by a Certified Professional Soil Scientist for this PRC Plan	Moderate (9)
		Water quality of the void impacts surface water and groundwater quality.	Moderate (6)	• Void has been assessed as unlikely to retain water, therefore is not considered to represent a risk to surface water or groundwater quality	Low (4)
		Retained pits and/or infrastructure pose a physical safety threat to humans or wildlife	High (12)	• Restricted site access • Maintenance of fencing • Maintenance of adequate signage	Moderate (8)
		Weeds are not adequately controlled during rehabilitation.	High (12)	• Weeds will be managed in accordance with the strategies outlined in the VMP. • Due to safety concerns related to personnel accessing the residual void pit floor, weed maintenance is not recommended for the pit floor. Because of this there is a likelihood that weeds such as non-native grasses will become established in the pit floor rehabilitation area. Spot-spray application of herbicides via drone is not considered feasible at this time.	Moderate (8)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
		Poor seed establishment, erosion, fire and/or weeds.	High (12)	• Early detection of poor performance. Assess retention of trees and shrubs, unable to determine successful germination of native grasses due to the restricted access to the site and only aerial survey techniques (drone) available • Provision of sufficient water • Correct management of topsoil • Exclusion of livestock permanently from the Pit Floor • Construction of silt traps or drainage sumps for erosion control • Exclusion of fire from rehabilitation areas during life of mine by maintaining a firebreak around ML	Moderate (6)
		Rehabilitation does not result in successful attainment of completion criteria.	High (12)	• Adaptive implementation of PRC Plan and regular remote monitoring (via drone) with early intervention of rehabilitation failure. • Landform is considered stable with self-sustaining vegetation cover that supports habitat areas with 5% canopy cover for pit floor	Moderate (6)
Residual Void Terraced Mine Benches	NUMA	Stability of landscape not being achieved, meaning the PMLU cannot be achieved.	Moderate (6)	• The WRD and residual void will be stabilised to ensure structural integrity • All drainage features will be reinstated • All exposed areas will be rehabilitated to achieve a suitable level of ground cover to minimise the potential for scouring	Low (4)
		Residual voids become geotechnically unstable which results in land degradation	Moderate (6)	• Geotechnical assessments have been conducted to assess the current stability and to inform the rehabilitation strategy for the residual void • Annual visual monitoring of batters during operations to demonstrate that they have remained stable • Batter slopes meet final design specifications • Certification from a suitably qualified person verifying design intent has been achieved • Abandonment bunds and residual void slopes have been assessed by a suitably qualified person as sufficient to maintain slope stability and protect from erosion for a minimum of five years after completion of rehabilitation	Low (4)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
		Residual voids become unstable due to erosion of slope batters which results in land degradation	Moderate (6)	• Drainage controls will be retained at closure and will be physically stable in the long term • Perimeter of chain-link abandonment fencing and remnant vegetation to the north and western extent of the residual void to be retained and the abandonment bund to be installed along the southern and eastern extent of the pit and safety signage installed around the residual void • Certification from a suitably qualified person verifying design intent has been achieved • Abandonment bunds and residual void slopes have been assessed by a suitably qualified person as sufficient to maintain slope stability and protect from erosion for a minimum of five years after completion of rehabilitation	Low (4)
		Water quality of the void impacts surface water and groundwater quality.	Moderate (6)	• Void has been assessed as unlikely to retain water, therefore is not considered to represent a risk to surface water or groundwater quality	Low (4)
		Retained pits and/or infrastructure pose a physical safety threat to humans or wildlife	High (12)	• Restricted site access • Maintenance of fencing • Maintenance of adequate signage	Moderate (8)
Access Tracks	Retained Infrastructure	Retained access tracks poses a physical safety threat to humans or animals.	High (12)	• All access tracks and roads will be graded to facilitate runoff of water and reduce erosion potential • Inspection of access tracks for erosion, degradation and stabilities will be undertaken in accordance with monitoring and maintenance program • Access tracks providing access to the residual void will be ripped at EOML to restrict access	Moderate (9)

Infrastructure	Native Ecosystem	Infrastructure decommissioning results in contamination.	High (12)	• Site investigation and remediation as required e.g.:
				  • contaminated land site investigation undertaken in accordance with Schedule B2 (Guideline on Site Characterisation) of the National Environmental Protection (Assessment of Site Contamination)
				  • preparation of a Remediation Action Plan (RAP) – if required
				• A validation program to confirm suitable remediation actions have been adequately implemented and the site is suitable for the final land-use
					Moderate (6)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
Historical disturbance areas	Native Ecosystem	Retained infrastructure poses a physical safety threat to humans or animals.	High (12)	• The rehabilitation strategy is to remove all mine assets and infrastructure, unless otherwise agreed through a Landholder Statement • All buildings and associated infrastructure including tanks and plant equipment to be demolished, and removed offsite to an appropriately licenced waste facility • Machinery not required for rehabilitation removed off-site.	Moderate (9)
		Rehabilitation efforts do not result in self-sustaining land suitable for Native Ecosystem	High (12)	• Adaptive management of rehabilitation and re-seeding to bolster natural seed stocks. Regular monitoring with early intervention of rehabilitation failure	Moderate (9)
		Stable condition for land described as a PMLU not being achieved.	High (12)	• Ongoing assessment and monitoring of the stability of landscape in accordance with reference milestones • Areas outside the main void are undisturbed and are not considered likely to become destabilised • Design and construction of any additional works will be undertaken with consideration of achieving long-term geotechnical stability	Moderate (6)
		Weeds are not adequately controlled during rehabilitation.	Moderate (6)	• Weeds will be managed in accordance with the strategies outlined in the VMP	Low (4)
		Rehabilitation does not result in successful attainment of completion criteria.	High (12)	• Adaptive implementation of PRC Plan and regular monitoring with early intervention of rehabilitation failure	Low (4)
		Poor seed establishment, erosion, fire and/or weeds.	High (12)	• Early detection of poor performance. Assess retention of trees and shrubs, unable to determine successful germination of native grasses due to the restricted access to the site and only aerial survey techniques (drone) available. • Provision of sufficient water • Exclusion of fire from rehabilitation areas during life of mine by maintaining a firebreak around ML	Moderate (6)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
General					
Climate Change – Progressive Rehabilitation	All	• Progressive rehabilitation success may be compromised during the site life through the loss of vegetation and increased erosion • The expected increase in average annual temperatures during the construction and operation phase of the site life is not expected to compromise the success of progressive rehabilitation • Changes in drought patterns, leading to reduced rainfall may inhibit plant growth • Damage from strong winds may result in unsuccessful rehabilitation planting • Changes in rainfall patterns, can result in major flooding • Rehabilitation failure due to bushfires, and harsher and more extreme fire weather • Unsuccessful rehabilitation planting resulting from climate change impacts may result in setbacks to the long-term closure planning program • Increased average temperature projections for year 2050 onward may have more influence on final rehabilitation depending on actual temperatures increases.	Moderate (6)	• Monitoring rehabilitated areas on a regular basis will ensure that original objectives set out in the PRC Plan are achieved. In the circumstance that rehabilitation activities do not achieve the desired outcomes in the PRC Plan, procedures will be reviewed and adapted to achieve compliance • Graymont will monitor changes to the climate over the life of the site and update rehabilitation strategies based on climate projections from BoM and CSIRO and expert advice from suitably qualified personnel, such as ecologists and soil scientists. This will maximise the probability of progressive and final rehabilitation success	Low (4)
Insufficient Monitoring and	All	• Inability to provide sufficient evidence that closure and rehabilitation activities have been	High (12)	• Ongoing review of Monitoring and Maintenance Program • Utilise historic monitoring reports/results for continual improvement and to identify areas which may require	Moderate (6)

Disturbance Area	Relevant PMLU	Risk	Risk Rating	Mitigation Measures	Residual Risk Rating
Maintenance Program		carried out in accordance with the approved PRC Plan • Potential for re-work that has not been provisioned for, resulting in financial loss • Delay in surrendering the EA		further work in order to achieve subsequent rehabilitation milestones	

10. Rehabilitation Milestones and Completion Criteria

10.1. Rehabilitation milestones

Rehabilitation milestones and criteria that need to be fulfilled to track progress against the PRC Plan Schedule have been provided in **Table 29** for ease of reference. It is noted that a requirement of the PRC Plan Guidelines is to include a reference map attached to the PRC Plan Schedule identifying the boundary of each rehabilitation area, this reference map is included in **Appendix B**.

10.1.1. Development of rehabilitation milestones, criteria and outcomes

The development of rehabilitation milestones and criteria have been informed by this PRC Plan and EA with input from various technical reports. One of these reports, the rehabilitation sequencing plan prepared by Graymont, was written as a conceptual, early-stage overview and therefore used a guide only.

Graymont, as the EA holder, is responsible for nominating indicators for assessing the success of the rehabilitation efforts. The milestone criteria are objective target levels or values that can be measured to quantitatively demonstrate achievement of milestones and ultimately the success of biophysical processes undertaken as part of the PRC Plan. To ensure that indicators remain relevant, monitoring of indicators will start as soon as possible and continue until the application to surrender the relevant area/s has been approved by the administering authority.

It is noted that the site has historically been subject to minor disturbance activities with pre-existing access tracks extending west through the site from Riverton Road. All areas that have been progressively mined will subsequently be rehabilitated to a stable landform with self-sustaining vegetation cover in accordance with the requirements outlined in the site-specific EA (Section F2-1). All access tracks, sediment basins, infrastructure, mining, and associated processing areas will be progressively rehabilitated in line with the relevant RAs.

Table 29. Rehabilitation milestones

Rehabilitation / **Improvement** Milestone	Rehabilitation / **Improvement** Area **(Relevant to Rehabilitation Milestones)**								
	RA1	**RA2**	**RA3**	**RA4**	**RA5**	**RA6**	**RA7**	**RA8**	**IA1**
RM1 – Infrastructure decommissioning and removal			■						
RM2 - Investigation and/or remediation of contaminated land		■	■				■		
RM3 - Landform development and reshaping / re-profiling of waste rock dump		■							
RM4 - Landform development and reshaping / re-profiling of Pit Floor and In-pit WRD							■		
RM5 - Landform development and reshaping / re-profiling of other areas	■		■		■	■			
RM6 - Installation of cover system		■					■		
RM7 - Surface preparation (general)	■	■	■		■	■	■	■	
RM8 - Revegetation (Native Ecosystem)	■					■		■	
RM9 - Revegetation (Native Ecosystem - NOVEL)		■	■				■		
RM10 - Achievement of surface requirement	■	■	■	■	■	■	■	■	
RM11 - Achievement of post-mining land use to stable condition (retained infrastructure, and water storage)				■	■				
RM12 - Achievement of PMLU to stable conditions (Native Ecosystem)	■					■		■	
RM13 – Achievement of PMLU to stable conditions (Native Ecosystem – NOVEL)		■	■				■		
MM1 - Landform development and reshaping / re-profiling of residual void terraced mine benches (NUMA)									■

10.2. Completion criteria assessment

Rehabilitation will be assessed against criteria outlined in **Section 10.1**. Final signoff and certification (where required) of rehabilitation works will be provided by Graymont within a final rehabilitation report, submitted upon completion of all rehabilitation works.

Assessment of rehabilitation completed against the completion criteria will be undertaken progressively throughout the rehabilitation works to allow for early detection of suitability and appropriateness of rehabilitation. Progressive assessment will also inform potential areas of improvement or efficiencies prior to continuation of rehabilitation across the balance of site.

10.3. Adaptive management

Rehabilitation must be adaptive in order to achieve completion criteria. Graymont will adaptively implement the PRC Plan to mitigate uncertainty that may arise throughout the process where the plan is not delivering completion criteria. The adaptive management cycle is based on core adaptive management principles.

Adaptively implementing the PRC Plan is critical to achieving the plan's objectives, for example where adjustment actions and arrangements to enhance effectiveness can be made to deliver improvements. To maintain an adaptive approach, Graymont will:

- Effectively schedule monitoring of newly rehabilitated areas on an annual basis to make informed decisions on risk management, auditing and reporting activities
- Collect and incorporate new data / information as a result of implementing the plan, with new findings from data collected or from new information derived from external sources
- Commit to periodically reviewing risks, including those in response to the changing risk level, new information, changing circumstances or the results from implementing corrective actions. A risk register will be prepared and maintained for the project, and reviewed annually to consider the results of all monitoring data obtained throughout the year.
- On an annual basis, undertake a review of the effectiveness of management measures with significant levels of uncertainty and relatively long implementation timeframes, upon which the plan is highly dependent; and review the plan as soon as possible when there are indications of rehabilitation failure/s

11. Monitoring and Maintenance

11.1. Monitoring and maintenance program

A monitoring and maintenance program has been developed for the project in accordance with Section 3.8 of the PRC Plan guideline. The program identifies and describes the monitoring systems that will be carried out to demonstrate how the rehabilitation milestones will be achieved. Each rehabilitation milestone will have a robust monitoring and/or assessment program, as stipulated in **Sections 11.2.1** to **11.2.13**.

11.2. Milestone monitoring

Monitoring and/or maintenance requirements for each milestone are provided in **Table 30** through **Table 43.**

Table 30. Milestone monitoring: RM1 Infrastructure decommissioning and removal

Item	Description
Rehabilitation Milestone	RM1 – Infrastructure Decommissioning and removal
Applicable Rehabilitation Areas	RA3
Schedule and Frequency of Monitoring	One visual inspection following completion of decommissioning and removal of infrastructure
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	• Visual inspection by an AQP
Indicators	• 1a. With the exception of any infrastructure to remain as part of the PMLU, or where infrastructure is agreed to be retained by a landholder agreement, the following criteria are completed: • 1b. All services disconnected in coordination with service providers and all associated service infrastructure removed from site. • 1c. All buildings and associated infrastructure demolished and removed off-site by appropriately licensed contractors to an appropriately licenced waste facility • 1d. Hazardous building materials have been identified, managed and removed by appropriately licenced contractors from buildings removed as part of mine closure. • 1e. Removal of fencing and signage relevant to decommissioned infrastructure. Not including final fencing / site securing. • 1f. Machinery not required for rehabilitation removed off-site. • 1g. All hardstand, concrete areas and roads (bitumen, blue metal, aggregate etc) removed • 1h. All waste not authorised to be disposed of on-site under Environmental Authority EPML00241213 removed • 1i. All drillholes, sediment ponds and sumps decommissioned • 1j An independent AQP has certified the achievement of RM1b to RM1i
Quality Assurance	Verification made by AQP that all infrastructure has been decommissioned in accordance with indicators provided above.
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Repeat of decommissioning steps to be undertaken if additional works are required or if additional infrastructure is identified.
Reporting	Completion of Infrastructure Decommissioning and Removal checklist

Table 31. Milestone monitoring: RM2 Investigation and/or remediation of contaminated land

Item	Description
Rehabilitation Milestone	RM2 – Investigation and/or remediation of contaminated land
Applicable Rehabilitation Areas	RA2, RA3, RA7
Schedule and Frequency of Monitoring	One investigation to be completed following completion of decommissioning and removal of infrastructure
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	• Contaminated land investigation completed by a suitably a by an AQP • Completion of intrusive soil investigation (if required) • Completion of water quality monitoring (if required)

Indicators	• 2a. An SQP undertakes a Preliminary Site Investigation and prepares a site investigation report that includes a review of previous activities to assess whether contamination has the potential to exist in a mine domain and whether further investigation is needed to be completed by a SQP. • 2b. If assessed as required under RM2a a Contaminated Land Investigation Document completed in accordance with the Environmental Protection Act 1994, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. • 2c. If required, remediation carried out and validation sampling will be completed. • 2d. Removal or onsite treatment of contaminated water (e.g. hydrocarbons, brine, metals etc.). • 2e. Removal and appropriate disposal of any contaminated materials in accordance with relevant regulations. • 2f. Suitably Qualified person (SQP) certifies that no contamination unsuitable for the PMLU remains or is occurring. • 2g. If there is residual contamination identified which can remain in situ safely, the site will be placed on a Contaminated Land Register and a Site Management Plan: • i. Is prepared and certified by an AQP • ii. Includes a statement by the landholder accepting responsibility to implement the Site Management Plan • 2h. An independent SQP has certified the achievement of RM2a to RM2g.
Quality Assurance	Verification made by AQP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Additional investigation required if verification cannot be provided.
Reporting	• A preliminary site investigation report - Outlining the nature and extent of any contamination likely to exist on site • A site validation report- Outlining the satisfactory completion of any required rehabilitation / remediation works undertaken (if relevant) • A site suitability statement – Providing assurance that the site is considered suitable for its intended PMLU. • A Site Management Plan which includes a statement by the landholder accepting responsibility to implement the Site Management Plan (if the site is determined to have residual contamination and is placed on the Contaminated Land Register).

Table 32. Milestone monitoring: RM3 Landform development and re-shaping / re-profiling (WRD)

Item	Description
Rehabilitation Milestone	RM3 – Landform development and reshaping / re-profiling of WRD
Applicable Rehabilitation Areas	RA2
Schedule and Frequency of Monitoring	• One visual inspection following completion of earthworks • One survey carried out upon completion of earthworks
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	Visual inspection by AQP (geotechnical engineer / RPEQ) Survey data to verify accordance with design plan
Indicators	• 3a. Erosion modelling undertaken by an AQP to inform the landform design and determine parameters required to achieve an erosionally stable state with a maximum erosion rate of ≤10 t/ha/yr.

	• 3b. Major earthworks completed in RA2 in accordance with final engineering and design plans provided by an AQP. • 3c. All material placed to achieve design levels and compacted in accordance with design specification. • 3d. One-metre-high armour rock bund placed 1 m behind upper-level crest to control water flow and access. • 3e. Where slope is >10° coir logs placed in rows traversing the slope with 10 m intervals to control erosion and sedimentation. • 3f. Landform constructed to meet final design specifications (Maximum final slope of 16° - 18°). • 3g. Certification from a AQP that design intent has been achieved • 3h. An "As-Constructed Report" prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance. • 3i. Constructed landform achieves geotechnical stability with a Factor of Safety (FOS) ≥ 1.5, which includes consideration of flood stress. • 3j. An independent AQP has certified the achievement of RM3a to RM3i.
Quality Assurance	Verification provided by AQP (geotechnical engineer / RPEQ)
Review	Verification and acceptance by Proponent
Corrective Actions / Contingency	Additional earthworks to be undertaken in the event final landform is not in accordance with design.
Reporting	• As-constructed design plans • Survey data • GIS files

Table 33. Milestone monitoring: RM4 Landform development and re-shaping / re-profiling (Pit Floor and In-pit WRD)

Item	Description
Rehabilitation Milestone	RM4 – Landform development and reshaping / re-profiling of Pit Floor and In-pit WRD
Applicable Rehabilitation Areas	RA7
Schedule and Frequency of Monitoring	• One visual inspection following completion of earthworks • One survey carried out upon completion of earthworks
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	Visual inspection by AQP (geotechnical engineer / RPEQ) Survey data to verify accordance with design plan
Indicators	• 4a. Major earthworks completed in accordance with final landform design (0 ° - 5 ° slope for Pit Floor and a 17 ° slope for In-pit WRD). • 4b. Waste rock will be used to backfill area of pit floor identified as a non-free draining basin. • 4c. All waste rock used for backfilling pit is assessed and determined to be material that does not cause acid, neutral or saline mine drainage. • 4d. Waste rock from the In-pit WRD will be ripped and used to backfill the pit floor to depth of 1 m. • 4e. Water drainage lines reinstated to allow natural water flows. • 4f. Installation of a 2m abandonment bund constructed from well-graded strong durable limestone of +25 mm, 10 m from the base terraced bench of residual void. These will have a footing width of 6 m and slope angles of 35°. • 4g. Certification from an AQP that the landform design intent has been achieved. • 4h. An "As-Constructed Report" prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance.

	• 4i. Constructed landform achieves geotechnical stability with a Factor of Safety (FOS) ≥ 1.5, which includes consideration of flood stress. • 4j. An independent AQP has certified the achievement of RM4a to RM4i.
Quality Assurance	Verification provided by AQP (geotechnical engineer / RPEQ)
Review	Verification and acceptance by Proponent
Corrective Actions / Contingency	Additional earthworks to be undertaken in the event final landform is not in accordance with design.
Reporting	• As-constructed design plans • Survey data • GIS files

Table 34. Milestone monitoring: RM5 Landform development and re-shaping / re-profiling (other areas)

Item	Description
Rehabilitation Milestone	RM5 – Landform development and reshaping / re-profiling of other areas
Applicable Rehabilitation Areas	RA1, RA3, RA5, RA6
Schedule and Frequency of Monitoring	• One visual inspection following completion of earthworks • One survey carried out upon completion of earthworks
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	• Visual inspection by AQP (geotechnical engineer / RPEQ) • Survey data to verify accordance with design plan
Indicators	• • 5a. A landform design report that incorporates the establishment of erosion and sediment control measures is prepared by an AQP. • 5b. Effective and functioning Erosion and Sediment Control (ESC) systems in place, with associated design plans. • 5c. Major earthworks completed in accordance with final landform design including: • i. Maximum final slope of 7° to 9° for RA1 • ii. Maximum final slope of 3° to 4° for RA3 in ML50142 and <18° in ML50220 • iii. Maximum final slope of 0° - 5° for RA6. • 5d. Water drainage lines reinstated to allow natural water flows except where erosion or sediment control is recommended in RM5a. • 5e. Registered bore (ID 74426) will be decommissioned in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2020) or latest version. • 5f. Former ROM and infrastructure area (RA3) assessed as stable and non-polluting by an AQP. • 5g. An “As-Constructed Report ” prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance. • 5h. An independent AQP has certified the achievement of RM5a to RM5g. •
Quality Assurance	Verification provided by AQP (geotechnical engineer / RPEQ)
Review	Verification and acceptance by Proponent
Corrective Actions / Contingency	Additional earthworks to be undertaken in the event final landform is not in accordance with design.
Reporting	• As-constructed design plans • Survey data • GIS files capturing the above as relevant

Table 35. Milestone monitoring: RM6 Installation of cover system

Item	Description
Rehabilitation Milestone	RM6 – Installation of Cover System
Applicable Rehabilitation Areas	RA2 and RA7
Schedule and Frequency of Monitoring	• Visual inspection daily throughout construction • Analytical testing to occur prior to construction commencing • Survey to be completed upon completion of each layer of cover material • Annual inspection (visual and survey)
Schedule and Frequency of Maintenance	• As required/identified during inspection
Monitoring Methodologies	• Visual inspection by a AQP (geotechnical engineer / RPEQ) • As constructed survey • Settlement survey • Analytical testing • Assessment against design documentation (Appendix J) (including assessment of analytical results)
Indicators	• • Applicable to RA2 and RA7 • 6a. Cover system design and performance criteria based on level of environmental risk has been prepared by an AQP. • 6b. Cover system has been installed as per design. • Applicable to RA2 • 6c. Placement of 1,000 mm of a confirmed NAF rock layer across extent of WRDs. • 6d. Compaction of NAF rock layer to form stable subgrade for subsequent material layers. • 6e. Installation of 300 mm capillary break across top surface of NAF rock layer. • Applicable to RA2 and RA7 • 6f. Placement of 150 mm growth medium / soil layer. • 6g. A cover system is installed with appropriate QA/QC measures. • 6h. The construction and maintenance design of the cover system / cap has been certified by an AQP that it is consistent with the cover design. • 6i. An independent AQP has certified the achievement of RM6a to RM6h.
Quality Assurance	Verification made by AQP/RPEQ that cover system has been designed and constructed in accordance with the design documentation.
Review	Review and verification by Proponent.
Corrective Actions / Contingency	• Rectification of localised erosion areas if identified • Continued monitoring and survey if settlement is observed • Rectification earthworks if settlement is determined to impact upon integrity of the cover system
Reporting	• Preparation of a Construction Quality Assurance (CQA) • Signed as-constructed plans • Post-inspection observation report

Table 36. Milestone monitoring: RM7 Surface preparation (general)

Item	Description
Rehabilitation Milestone	RM7 – Surface Preparation
Applicable Rehabilitation Areas	RA1, RA2, RA3, RA5, RA6, RA7, RA8
Schedule and Frequency of Monitoring	• One visual inspection following completion of earthworks

	• Assessment against soil health assessment following completion of earthworks • Annual inspection of surface to monitor for erosion
Schedule and Frequency of Maintenance	As required
Monitoring Methodologies	• Visual inspection by AQP at completion of works • Sampling and analysis of soil at completion of works • Six-monthly sampling and analysis of retained water (RA6 only)
Indicators	• • Applicable to RA1, RA2, RA3, RA6, RA7 and RA8 • 7a. Localised erosion areas identified and repaired. • 7b. Ripping undertaken and penetrates at least 300 mm into soil profile. • 7c. Placement of topsoil 150 mm (minimum) using salvaged topsoil from site, across the disturbed area. • 7d. Prior to applying topsoil, any weeds will be removed from the area by hand, ensuring complete removal of root system. • 7e. Planting and roto-tilling of an initial green manure treatment, comprising of grain barley and inoculated clover is completed. • 7f. Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP. • 7g. Ameliorant and physical treatments such as fertiliser, lime, gypsum and/or organic matter are applied as identified in criteria RM7f. • 7h. Soil health and suitability for target vegetation establishment assessed by an AQP prior to seeding to determine outcome of manure treatment and fertiliser application and confirms: • i. pH in the range 6 - 8.5 • ii. Electrical Conductivity (saturated extract) (dS/m) ≤2 (2,000 µS/cm); • iii. Exchangeable sodium percentage (ESP) (%) < 6; • iv. Emerson aggregate class: ≥4. • Applicable to RA5 only • 7i. Retained water management structures (sediment basins) have been certified by an appropriately qualified person as conforming to the design standard and specifications consistent with those in the Best Practice Erosion & Sediment Control series (IECA 2008) or latest version. • 7j. Annual visual monitoring of the sediment basin batters demonstrates that they have remained stable. Where unacceptable instability is recorded, advice has been sought from an AQP and remediation works have been undertaken as soon as is practicable. • 7k. Water quality monitoring (biannual) demonstrates that sediment dam water quality meets the water quality limits for livestock drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) or latest version. . • 7l. An independent AQP has certified the achievement of RM7a to RM7k. •
Quality Assurance	• Verification made by a AQP via a visual inspection • Assessment of soil against the requirements of the soil health assessment
Review	Review and verification by Proponent.
Corrective Actions / Contingency	• Rectification of erosion areas through application of additional topsoil • Application of amelioration if soil quality/characteristics are not assessed as suitable • Rectification of
Reporting	• Records of ripping being undertaken to a depth of 300 mm (minimum) • Application rates and type of amelioration applied to topsoiled areas • Records of location, depth and date of topsoil placement, including conformance survey indicating depth of 150 mm has been achieved • Records of any localized erosion repaired, and details of mitigation applied to prevent reoccurrence • Certification soil is considered healthy and suitable (once amelioration is applied) for target species as assessed by a suitably qualified person

	• GIS files capturing the above as relevant

Table 37. Milestone monitoring: RM8 Revegetation (Native Ecosystem)

Item	Description
Rehabilitation Milestone	RM8 – Revegetation (Native Ecosystem)
Applicable Rehabilitation Areas	RA1, RA6, RA8
Schedule and Frequency of Monitoring	Monitoring to be undertaken as per the VMP
Schedule and Frequency of Maintenance	Maintenance to be undertaken as per the VMP
Monitoring Methodologies	• Visual inspection by AQP • Flora, Fauna and Weed survey by suitably training ecologist • Assessment against the VMP by suitably trained ecologist
Indicators	• • 8a. Vegetation management plan prepared by an AQP and endorsed via an independent AQP peer review for all disturbance areas that considers species composition and density and rehabilitation outcomes. • 8b. Repeat applications of broad-scale non-residual herbicide will be applied in preparation for sowing native grass seeds. • 8c. Seeding Native grass seeds will be planted in year two of rehabilitation in the Autumn months (March-May) at a rate) of 25 kg per ha, using the seed mixture described in the PRCP Schedule, Table 2 • 8d. A combination of tree species as described in PRCP Schedule, Table 2, will be planted at densities as specified in vegetation management plan. • 8e. Timing of seeding (sowing) and planting will occur in autumn following significant rain and when the soil moisture levels are optimal. • 8f. A watering regime will be followed for a minimum of eight weeks, with a minimum of 10 litres per plant twice weekly in the first week, and once per week for a minimum of eight weeks. • 8g. A monitoring and maintenance program established for rehabilitation areas and undertaken annually, on commencement of revegetation. • 8h. If monitoring identifies over-grazing as a limitation to rehabilitation success, animal proof fencing will be needed (e.g. hinge-lock wallaby fencing and /or rabbit proof netting). Similarly, if livestock are identified within the revegetation areas, stock fencing may be required. • 8i. An annual fauna monitoring program established and undertaken using the following recommended survey methods: • Diurnal bird surveys and reptile searches • Deployment of passive bat echo-location call recording devices (e.g. ANABAT) • Spotlighting surveys for nocturnal mammals, reptiles, and birds. • 8j. Existing firebreaks maintained along edge of revegetation zones until rehabilitation complete. • 8k. An independent AQP has certified the achievement of RM8a to RM8j
Quality Assurance	Verification made by a AQP (ecologist) that revegetation has been completed in accordance with the VMP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Corrective actions to be enacted as per VMP
Reporting	• Records of the assessment shall be retained, and include the following: - Records of date and duration of seeding events, and across which locations it was carried out - Records of the type, number and location of tubestock planted - Records of the seed mix applied and seeding density adopted - Certification planting has been undertaken in accordance with the VMP by a suitably qualified person

	- Annual monitoring report containing description of corrective actions taken to address die-off, erosion, weed incursions and over browsing (if required) and progression of rehabilitation - Annual fauna monitoring report providing report on species observed onsite and available habitat • GIS files capturing the above as relevant.

Table 38. Milestone monitoring: RM9 Revegetation (Native Ecosystem – NOVEL)

Item	Description
Rehabilitation Milestone	RM9 – Revegetation (Native ecosystem - NOVEL)
Applicable Rehabilitation Areas	RA2, RA3, RA7
Schedule and Frequency of Monitoring	Monitoring to be undertaken as per the VMP
Schedule and Frequency of Maintenance	Maintenance to be undertaken as per the VMP
Monitoring Methodologies	• Visual inspection by AQP • Aerial Flora survey by AQP (ecologist) • Assessment against the VMP by AQP (ecologist)
Indicators	• 9a • 9a. Vegetation management plan prepared by an AQP and endorsed via an independent AQP peer review for all disturbance areas that considers species composition and density and rehabilitation outcomes. • 9b. Repeat applications of broad-scale non-residual herbicide will be applied in preparation for sowing native grass seeds. • 9c. Native grass seeds seeded using the seed mixture described in PRCP Schedule, Table 2 at a minimum rate of 25 kg/ha. • 9d. To achieve a 'novel planned' native ecosystem, a combination species using those described in the PRCP Schedule, Table 2 will be planted at densities as specified in vegetation management plan. • 9e. An annual monitoring and maintenance program established on commencement of revegetation. • 9f. Existing firebreaks maintained along edge of revegetation zones until rehabilitation complete. • 9g. Independent AQP has certified the achievement of RM9a to RM9f.
Quality Assurance	Verification made by AQP (ecologist) that revegetation has been completed in accordance with the VMP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Corrective actions to be enacted as per VMP
Reporting	• Records of the assessment shall be retained, and include the following: - Records of date and duration of seeding events, and across which locations it was carried out - Records of the type, number and location of seed bombs utilised to undertake seed bomb program - Records of the seed mix applied and seeding density adopted - Certification seed bombing has been undertaken in accordance with the VMP by AQP • GIS files capturing the above as relevant.

Table 39. Milestone monitoring: RM10 Achievement of surface requirement

Item	Description
Rehabilitation Milestone	RM10 – Achievement of surface requirement
Applicable Rehabilitation Areas	RA1, RA2, RA3, RA4, RA5, RA6, RA7, RA8

Schedule and Frequency of Monitoring	• Annual monitoring for assessment of erosion and sediment control (RA2 and RA5) • Inspection of erosion and sediment control measures implemented surrounding the sediment basins by a CPESC to ensure there are stable and non-polluting (RA6) • Six-monthly sampling and analysis of retained water (RA6)
Schedule and Frequency of Maintenance	• As required based on findings on inspections
Monitoring Methodologies	• Geotechnical assessment to determine site suitability for the proposed land use • Annual inspection by AQP/Certified Professional in Erosion and Sediment Control/ RPEQ • Certification from a AQP that the sediment basins (RA6) is stable and non-polluting. • Visual inspection by AQP/Certified Professional in Erosion and Sediment Control/ RPEQ at mine closure and completion of rehabilitation works
Indicators	• • 10a. Species used in revegetation remain present and show evidence of natural recruitment. Evidence of flora recruitment from rehabilitation monitoring data. • 10b. Species diversity similar to analogue sites (Appendix Table 3) for all RAs except RA2. • 10c. Species diversity should be consistent with the vegetation management plan for RA2. • 10d. Excluding RA2 and RA7 a BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual'. • 10e. The relevant Biocondition assessment criteria collected under RM10d complies with the criteria described under RM10f - RM10m. • 10f. Weed presence is less than 5% of total vegetative cover excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10g. Absence of ecosystem altering weeds excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10h. Total vegetative groundcover ≥50% excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10i. Total groundcover (combination of vegetative cover, other organic material (i.e. sticks leaf litter) and inorganic material (i.e. rocks)) ≥70% excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10j. Tree height >50% of tree height described in median cover range at analogue sites excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10k. Non-native cover is 5% of vegetative ground cover excluding pit abandonment bunds and areas between bunds and pit walls. • 10l. Canopy cover >15% as per median cover range at analogue site excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10m. Shrub layer cover >10% as per median cover range at analogue site excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. • 10n. With respect to erosion: • a. No evidence of erosion classified as 'moderate' or 'severe' as defined by the erosion classification framework (Appendix) • b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. • c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. • 10o. Corrective actions arising from monitoring program and routine inspections have been undertaken. • 10p. Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so.

	• 10q. Surface water runoff complies with Appendix Table 2 – Surface water quality limits. • 10r. The growth media (topsoil and subsoil) physical, chemical and biological properties does not limit vegetation cover performance or restrict the potential effective depth of rooting. • 10s. Removal of stock/fauna fence (if applicable) when plants are sufficiently established to withstand herbivory. • 10t. Independent AQP certifies achievement of RM 10a - RM10r. •
Quality Assurance	• Verification by a AQP (SQP/CPESC/RPEQ) that works have been undertaken in accordance with the design documentation. • Certification from a AQP that the sediment basins (RA6) is stable and non-polluting.
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Reprofiling or localised repairs to be undertaken if identified as required
Reporting	• Inspection of erosion and sediment control measures implemented across the rehabilitation areas by a Certified Professional in Erosion and Sediment Control (CPESC) • Provision of geotechnical assessment report to verify site suitability for the proposed land use • Completion of as-constructed surveys to verify grading of access tracks and hard stands is compliant with design requirements • Provision of certification that the sediment basin (RA6) is stable and non-polluting

Table 40. Milestone monitoring: RM11 achievement of PMLU to stable conditions (retained infrastructure and water storage)

Item	Description
Rehabilitation Milestone	RM11 – Achievement of PMLU to stable conditions (retained infrastructure and water storage)
Applicable Rehabilitation Areas	RA4, RA5
Schedule and Frequency of Monitoring	Monitoring to be undertaken as per the VMP
Schedule and Frequency of Maintenance	Maintenance to be undertaken as per the VMP
Monitoring Methodologies	• Visual inspection by AQP • Flora survey by AQP (ecologist) • Assessment against the VMP by AQP (ecologist)
Indicators	• • 11a. Safety hazards in the rehabilitation area are not significantly different to surrounding unmined landscapes subject to the same land use. • 11b. Erosion and sediment control measures are in place in accordance with the final design specifications and the erosion and sediment control plan. • 11c. Access tracks are stabilised and graded to facilitate runoff and access for maintenance activities, fire management etc. All access tracks will be retained as per the Landholder Agreement. • 11d. With respect to erosion: • a. No evidence of erosion classified as ‘moderate’ or ‘severe’ as defined by Table 1 – Erosion classification framework. • b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. • c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. • 11e. Groundcover percentage as identified in erosion modelling used to inform the erosion and sediment control plan in criterion RM5a (RA4).

	• 11f. Certification from an AQP that the sediment basins (RA5) are stable and non-polluting. • 11g. Retained stock watering storage water quality is below the trigger values for livestock drinking water defined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) or latest version, for a minimum of 5 years. • 11h. Independent AQP certifies achievement of RM 11a -11g. •
Quality Assurance	Verification made by AQP (ecologist) that revegetation has been completed in accordance with the VMP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Corrective actions to be enacted as per VMP
Reporting	• Assessment report detailing rehabilitation outcome and vegetation assessment in accordance with VMP • GIS files as relevant • Certification that the area has achieved a stable condition

Table 41. Milestone monitoring: RM12 Achievement of PMLU to stable condition (Native ecosystem)

Item	Description
Rehabilitation Milestone	RM12 – Achievement of PMLU to stable condition (Native ecosystem)
Applicable Rehabilitation Areas	RA1, RA6, RA8
Schedule and Frequency of Monitoring	Monitoring to be undertaken as per the VMP
Schedule and Frequency of Maintenance	Maintenance to be undertaken as per the VMP
Monitoring Methodologies	• Visual inspection by AQP • Flora survey by AQP ecologist • Assessment against the VMP by AQP ecologist
Indicators	• 12a • 12a. A BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual'. • 12b. The relevant Biocondition assessment criteria collected under RM12a complies with the criteria described under RM12c - RM12g. • 12c. Canopy cover similar to or greater than median range of the regrowth analogue site (15% canopy cover). • 12d. Shrub layer cover similar to or greater than median range of the regrowth analogue site. • 12e. Groundcover similar to or greater than median range of the regrowth analogue site. • 12f. Tree height > 50 % of tree height at analogue site (Table 3). • 12g. Non-native cover <5% of vegetative ground cover. • 12h. Groundcover percentage as identified in landform erosion modelling in Criterion RM3a. • 12i. 12i. • With respect to erosion: • a. No evidence of erosion classified as 'moderate' or 'severe' as defined by Table 1 – Erosion classification framework • b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. • c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. • 12j. No area of weed outcompeting native species identified. • 12k. Restrictive invasive plants (as defined in the Biosecurity Act 2014) comprise ≤5% of the vegetation cover.

	• 12l. Certification from an AQP that the final landform is geotechnically stable and achieved a factor of safety (FOS) ≥ 1.5. • 12m. Surface water quality results monitored monthly during flow at, but not limited to, downstream locations specified in Table 5 – Surface water monitoring locations, must not exceed the limits in Table 4 - Surface water quality limits, for a minimum of 5 consecutive years. • 12n. If the surface water quality exceeds criteria RM12m, the applicable upstream/reference site must be compared to the downstream site result; and quality result measured at a downstream site must be equal to or less than the quality result measured at the applicable upstream/reference sites. • 12o. Fauna survey observation provides evidence of native fauna utilisation i.e., fauna spotting, scats, and tracks recorded. • 12p. With consideration of the waste material characterisation and the final landform an AQP certifies that the waste rock dump will not cause environmental harm. • 12q. An independent AQP has certified the achievement of RM12a. to RM12p. •
Quality Assurance	Verification made by AQP (ecologist) that revegetation has been completed in accordance with the VMP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Corrective actions to be enacted as per VMP
Reporting	• Assessment report detailing rehabilitation outcome and vegetation assessment utilising remote survey techniques (i.e. LIDAR, aerial imagery from Drone surveys) • assessment • GIS files as relevant • Certification that the area has achieved a stable condition

Table 42. Milestone monitoring: RM13 Achievement of PMLU to stable condition (Native ecosystem - NOVEL)

Item	Description
Rehabilitation Milestone	RM13 – Achievement of PMLU to stable condition (Native ecosystem - NOVEL)
Applicable Rehabilitation Areas	RA2, RA3, RA7
Schedule and Frequency of Monitoring	Monitoring to be undertaken as per the VMP
Schedule and Frequency of Maintenance	Maintenance to be undertaken as per the VMP
Monitoring Methodologies	• Visual inspection by AQP • Flora survey by AQP ecologist • Assessment against the VMP by AQP ecologist
Indicators	• 13a. Canopy cover ≥ 5% excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13b. Non-native cover <5% of vegetative ground cover excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13c. Shrub layer cover 5% excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13d. Groundcover similar or greater than median range of analogue site (Table 3) excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13e. With respect to erosion: • a. No evidence of erosion classified as ‘moderate’ or ‘severe’ as defined by Table 1 – Erosion classification framework

	◦ b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. ◦ c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. • 13f. Restrictive invasive plants (as defined in the Biosecurity Act 2014) comprise ≤5% of the vegetation cover excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13g. Absence of ecosystem altering weeds excluding pit abandonment bunds and areas between bunds and pit walls in RA7. • 13h. Certification from a AQP that the area has achieved a stable condition with a factor of safety ≥ 1.5. • 13i. An independent AQP has certified the achievement of RM13a to RM13i. •
Quality Assurance	Verification made by AQP (ecologist) that revegetation has been completed in accordance with the VMP
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Corrective actions to be enacted as per VMP
Reporting	• Assessment report detailing rehabilitation outcome and vegetation assessment utilising remote survey techniques (i.e. LIDAR, aerial imagery from Drone surveys) • assessment • GIS files as relevant • Certification that the area has achieved a stable condition

Table 43. Milestone monitoring: MM1 Landform development and reshaping / reprofiling of residual void terraced mine benches (NUMA)

Item	Description
Rehabilitation Milestone	MM1 – Landform development and reshaping /re-profiling of residual void terraced mine benches (NUMA)
Applicable Rehabilitation Areas	IA1
Schedule and Frequency of Monitoring	Annual inspection by RPEQ
Schedule and Frequency of Maintenance	NA
Monitoring Methodologies	• Visual inspection • Survey • Assessment against as-constructed design plans/documents
Indicators	• 1a • 1a. Major earthworks completed and landform constructed in accordance with final engineering and design plans: • a. Trend of major axis, 121° • b. Length of major axis at crest, 535 m • c. Average length of minor axis at crest (west/east), 195/385 m • d. Maximum heights of walls (north/south/east/west) 65/79/19/34 m • e. Heights of benches, 10m • f. Maximum number of benches, 10 • g. Widths of berms, 10 m • h. Batter angles in unweathered rocks, 70° • i. Batter angles in weathered rocks, 14° • j. Inter-ramp angles, 43° • k. Maximum overall slope angles (north/south/east/west), 33° /37° /32° /31° • l. Ramp type / Minimum width, linear / 10 m • m. Directional dip of North wall (South dip, 157° to 206 °) • n. Directional dip of South wall (North dip, 024° to 085°) • o. Directional dip of East wall (West dip, 300° to 329°) • p. Directional dip of West wall (East dip, 108°) • 1b. An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥ 1.5) has been achieved. • 1c. Access to the residual void will be restricted by the following: • a. A 2 m abandonment bund installed along the southern/eastern extent of the void, with a footing width of 6 m, slope angle of 35° and constructed from well-graded coarse strong durable limestone of +25mm, consistent with the requirements of the ‘Safety Bund around Abandoned Open Pit Mines Guideline’ (DIR 1997). • b. A chain-link fence installed around the perimeter of the void, set back 10 m, to restrict access to humans and animals, consistent with the requirements of 43 (1) of the Mining and Quarrying Safety and Health Regulation 2017. The fence will be installed with dinobolts, no additional clearing of vegetation will be required. • c. Dense remnant vegetation retained to the north and west of the pit, further restricting access to the void. • 1d. Safety signage designed in accordance with relevant Australian Standards erected at a minimum of 100 m intervals around the void. • 1e. Certification from an AQP verifying design intent has been achieved. •
Quality Assurance	Verification made by AQP (RPEQ)
Review	Review and verification by Proponent.
Corrective Actions / Contingency	Earthworks to be undertaken if identified as required
Reporting	• Assessment report following AQP (RPEQ) assessment • GIS files as relevant

- Survey output

11.3. Annual returns and monitoring

The annual return will include an evaluation of the EA holder's rehabilitation activities against the PRC Plan schedule, including the effectiveness of environmental management carried out under the schedule, for the year to which the annual report relates. This includes reporting on whether rehabilitation and management milestones have been met, and whether conditions imposed on the PRC Plan schedule have been complied with.

In addition to annual reports, new legislation will require mandatory three yearly audits of the PRC Plan schedule to be provided to the Administering Authority within four months of the audit being carried out. As part of the adaptive management of rehabilitation at the Project, audit reports will also be used to assess performance and provide an early warning of necessary corrective actions and will be prepared by a person that meets the requirements under the relevant guideline approved by the chief executive

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Appendix A PRC Plan Schedule

DRAFT FOR COMMENT PRCP schedule

Environmental Protection Act 1994

DRAFT PRCP schedule P-PRCP-100731076

This is the approved form for a PRCP schedule issued by the administering authority under Chapter 5 of the Environmental Protection Act 1994.

PRCP schedule: P-PRCP-100731076

PRCP schedule holder(s)

Name(s)	Registered address
Graymont (NSW) Pty Ltd	Level 9, 118 Mount Street NORTH SYDNEY NSW 2000

Location details

Location(s)
Mining Lease (ML) 50142, ML50220

Take effect

In accordance with section 202B of the *Environmental Protection Act 1994* (EP Act), the PRCP schedule has effect on the day the environmental authority for carrying out relevant activities on land to which the schedule relates takes effect. Pursuant to section 202C of the EP Act, a PRCP schedule continues in force until the environmental authority for the relevant activities to which the PRCP schedule relates is cancelled or surrendered, even if the resource tenure expires or is cancelled and even if the relevant environmental authority is suspended under Chapter 5, part 11 or 11A of the EP Act.

Signature	Date

Department of the Environment, Tourism, Science and Innovation
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Mineral Business Centre
PO Box 7230, Cairns QLD 4870
Phone: (07) 4222 5352
Email: ESCairns@detsi.qld.gov.au

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Obligations under the *Environmental Protection Act 1994*

Pursuant to section 202E of the EP Act, if there is an inconsistency between an environmental authority and a PRCP schedule, the environmental authority prevails to the extent of the inconsistency.

Pursuant to section 285 of the EP Act:

- the holder of a PRCP schedule must commission an audit of the schedule by a rehabilitation auditor for the following periods (each an audit period) —

  (a) the 3-year period starting on the day the schedule takes effect

  (b) each 3-year period starting on the day after the previous audit period ended.

- the holder must, within 4 months after the end of each audit period, give the administering authority -

  (a) the rehabilitation auditor's report (an audit report) about the audit that complies with section 286 of the EP Act, and

  (b) a declaration for the audit report that complies with section 285 of the EP Act.

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

PRCP schedule

The PRCP schedule incorporates the following sections:

- Section A - Conditions of PRCP schedule
- Section B – Definitions
- Section C - Final site design and reference maps
- Section D - Post mining land uses
- Section E - Non-use management areas.

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Section A - Conditions of PRCP schedule

Pursuant to section 206A of the EP Act:

- it is a condition of this PRCP schedule that, in carrying out a relevant activity under the schedule, the holder must comply with a requirement stated in the environmental authority relevant to carrying out the activity.
- it is a condition of this PRCP schedule that the holder must comply with the following matters stated in the schedule -

  (a) each rehabilitation milestone and management milestone

  (b) when each rehabilitation milestone and management milestone is to be achieved

There are no conditions beyond those contained in section 206A of the *Environmental Protection Act 1994* that apply to this PRCP schedule.

General conditions

PRCP1 All mining disturbance authorised under EA EPML00241213 must have an associated rehabilitation outcome provided in this PRCP Schedule.

PRCP2 The holder must for each rehabilitation and improvement area, achieve the corresponding rehabilitation or management milestone criterion (milestone reference):

(a) for the cumulative area available specified in this schedule; and

(b) by the milestone completion date specified in this schedule.

PRCP3 Where land becomes ‘available for rehabilitation’ earlier than the date nominated in this schedule, the holder must:

(a) notify the administering authority in writing within 30 days of the land becoming ‘available for rehabilitation’.; and

(b) unless otherwise agreed to by the administrating authority in writing, within 90 days of the land becoming ‘available for rehabilitation’, apply to the administering authority to amend this schedule in a way that maximises the progressive rehabilitation of the land to a stable condition, including bring forward achievement of relevant milestones and criteria.

Notes:

1. Reference to "earlier than the nominated date in the schedule" means a date that is greater than 1 year prior to the date nominated in the schedule.
2. The written notification must include precise details of the relevant land area and the date when that land became ‘available for rehabilitation’
3. Assessment of land becoming available is undertaken on a nominally annual basis.
4. Rehabilitation of land size must be practicable and economical.
5. The dates by which milestones are to be completed is brought forward, to the extent it is reasonably practicable to do so, by the same amount of time as the commencement was brought forward.

PRCP4 Where an area achieves a rehabilitation or management milestone, the holder must continue to achieve the milestone criteria until a surrender is approved.

PRCP5 The holder must maintain a risk register that identifies the risks to not achieving:

a. a stable condition for post-mining land uses (PMLU), and

b. sufficient improvement for non use management areas (NUMA), and

c. how the risks are being managed or minimised.

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PRCP6 The risk register (PRCP5) must be reviewed annually and include consideration of the outcomes of PRCP monitoring data.

PRCP7 The holder must carry out monitoring in accordance with:

a. the monitoring and maintenance program described in the rehabilitation planning part for the activity version 3; and

b. any requirement under this schedule; and

c. as necessary to demonstrate achievement of each rehabilitation milestone or management milestone criteria.

Note: Where there is any inconsistency between this schedule and the rehabilitation planning part, the schedule criteria prevail to the extent of the inconsistency.

PRCP8 The holder must make and keep up to date records on:

a) Achievement and maintenance of each rehabilitation milestone criteria of this schedule.

b) Rehabilitation activities and the results of those activities (including but not limited to, actions taken, date, location, methods, data collected, QA/QC, photos, waste tracking and disposal records, appropriately qualified person details and assumptions);

c) Maintenance of rehabilitation and the results of maintenance activities;

a) Monitoring of rehabilitation and the results of monitoring;

b) Details and results of rehabilitation trials;

c) Designs, drawings, specifications and any similar documents developed in accordance with good professional practice in relation to rehabilitation milestones or milestone criteria;

d) All documents in relation to the requirements of this schedule, including reports (e.g. site investigation report), statements (e.g. site suitability statement), certifications, assessments, investigations, inspections, audits or any similar documents developed in relation to rehabilitation milestones or milestone criteria;

e) Landholder agreements;

f) Details of community consultation in the community consultation register relating to rehabilitation and closure activities.

PRCP9 Records made under PRCP8 must be kept until the relevant environmental authority has been surrendered.

PRCP10 Records made under PRCP8 must be provided to the administering authority in the specified format within 10 business days of a written request.

PRCP11 All appropriately qualified person (AQP) designs, specifications, certifications, assessments and any similar documents, must:

a. include documented consideration of any relevant guideline or publication material, including material published by the administering authority;

b. detail the boundary conditions (of any model);

c. detail any assumptions made, limitations and areas of uncertainty; and

d. contain sufficient detail to allow for independent peer review and substantiation, where required by the PRCP Schedule.

PRCP12 Where the surface water quality at the downstream site exceeds the upstream site result as per PRCP criteria RM12l., an AQP must complete an assessment of the risk of rehabilitation not achieving a stable condition within the schedule timeframe and:

a) Where there is ~~no~~a low risk to achieving a stable condition, then no further action is to be taken; or

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b) Where there is a risk to achieving a stable condition, then an assessment of potential environment harm and any changes or rectification actions to rehabilitation activities must be determined and implemented.

PRCP13 The assessments under PRCP12 must be completed and provided to the administering authority within 3 months of receiving the relevant sampling results.

PRCP14 All waste rock with the potential for generating acid, neutral or saline mine drainage must be stored and rehabilitated in a surface waste rock dump (WRD).

PRCP15 Only waste rock that is characterised as material that does not cause acid, neutral or saline mine drainage may be used for the construction of temporary or permanent structures within the operation areas.

PRCP16 By 31 December 2026 the holder must provide to the administering authority the locations of a minimum of three vegetation monitoring sites determined through an assessment by an AQP as remnant regional ecosystems (RE) 13.11.4 suitable forn determining rehabilitation outcomes.

END OF CONDITIONS

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Section B - Definitions

Appropriately qualified person (AQP)	means a person who has professional qualifications, training, skills and experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis on performance relative to the subject matter using the relevant protocols, standards, methods or literature.
Activity (EP Regulation)	includes that part, if any, of an activity relating to the following— (a) preparing a place for the activity before carrying out the activity; (b) rehabilitating a place after it has been used for carrying out the activity.
BioCondition	refers to the *BioCondition Assessment Manual* (Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. (2015)) and *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2* (Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane) or later versions thereof.
Ecosystem altering weeds	Ecosystem-altering weeds are invasive plants that significantly change the structure, function, or species composition of an ecosystem.
Flood stress	is the pressure on structures from rapid water rise, erosion, and saturation during extreme floods, risking instability.
Growth media	is defined as all soil and soil-like material that will support the final vegetation cover. This includes the topsoil and subsoil where these materials are applied independently. Where the topsoil is incorporated into the underlying subsoil/spoil, topsoil refers to the depth of incorporation and the remaining depth is regarded as subsoil. The total depth of growth media is nominally considered to be the effective plant root zone.
Gully	A gully is a channel excavated by water, more than 0.3 m deep.
Independent AQP	is an AQP who is a third party, being independent of the PRCP schedule holder, and has not previously provided advice on the matter the subject of the review.
Rehabilitation activity	means any activity that the holder is required to carry out in relation to this PRCP schedule.
Revegetation zone	Means an area in which planting of vegetation has occurred in accordance with the rehabilitation milestones.
Rill	A rill is a channel excavated by water, less than 0.3 m deep.
Stable	in relation to land, means landform dimensions are or will be stable within tolerable limits now and in the foreseeable future. Stability includes consideration of environmental context, geotechnical stability, settlement and consolidation allowances, bearing capacity (trafficability), erosion resistance and geochemical stability with respect to seepage, leachate and related contaminant generation.

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Stabilised	means one or both of the following conditions apply: no evidence of sediment movement; sides and/or floors of erosion form are revegetated (Australian Soil and Land Survey Field Handbook Third Edition).
Stable condition	see section 111A of the *Environmental Protection Act 1994*.
Suitably qualified and experienced person (SQP)	for performing a regulatory function under chapter 7, part 8 (Contaminated Land) of the EP Act or another function prescribed under a regulation, means a person who— (a) has qualifications and experience relevant to performing the function; and (b) if a regulation prescribes an organisation for this paragraph—is a member of the organisation.
Vegetative groundcover	Means plants, plant litter, tree leaf litter, twigs and woody debris capable of protecting the soil surface from erosion.
Weed	Non-native plants that can displace native plants, disrupt ecosystems, and alter landscapes.

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Section C - Final site design and reference maps

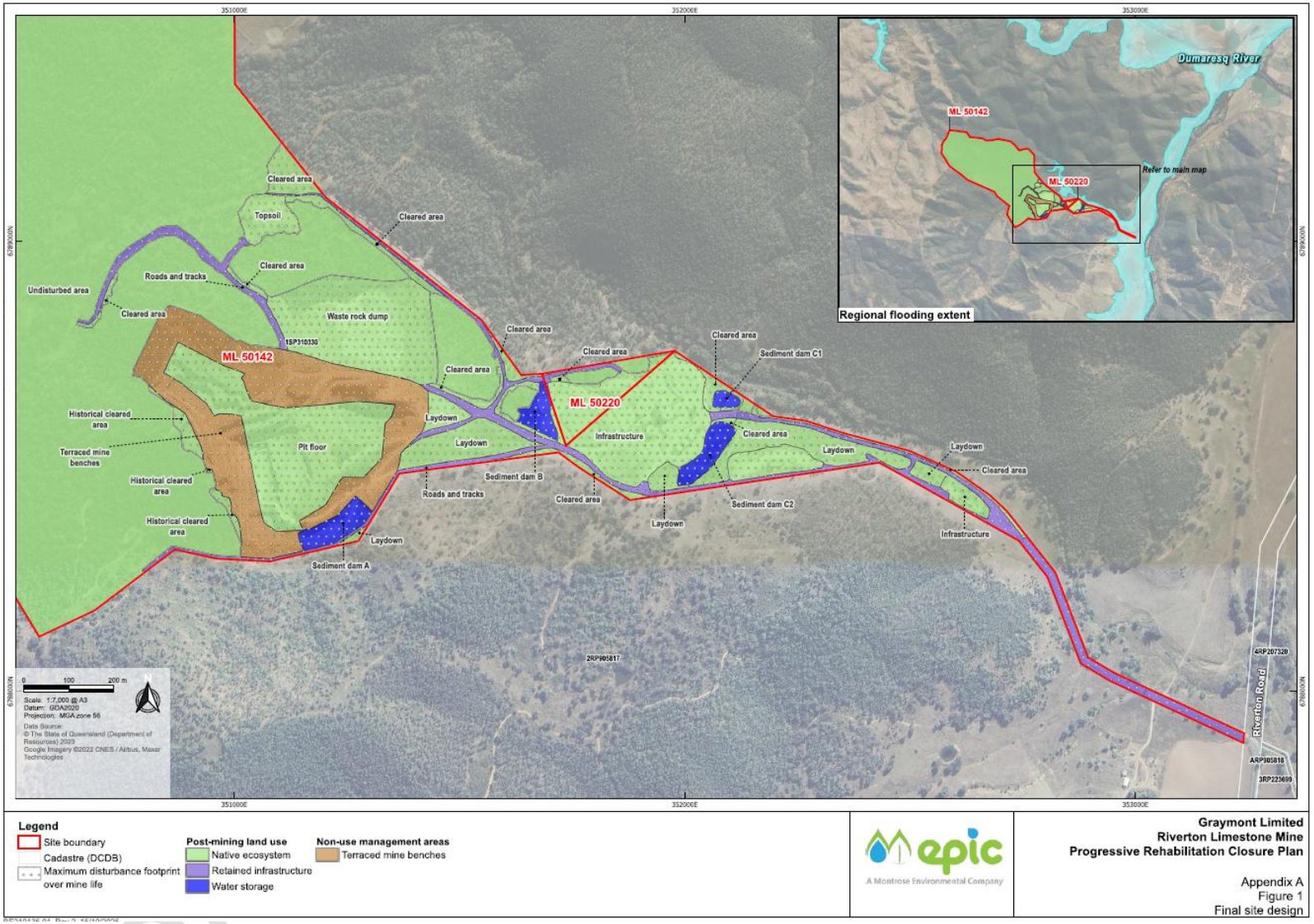

Figure 1 – Final Site Design

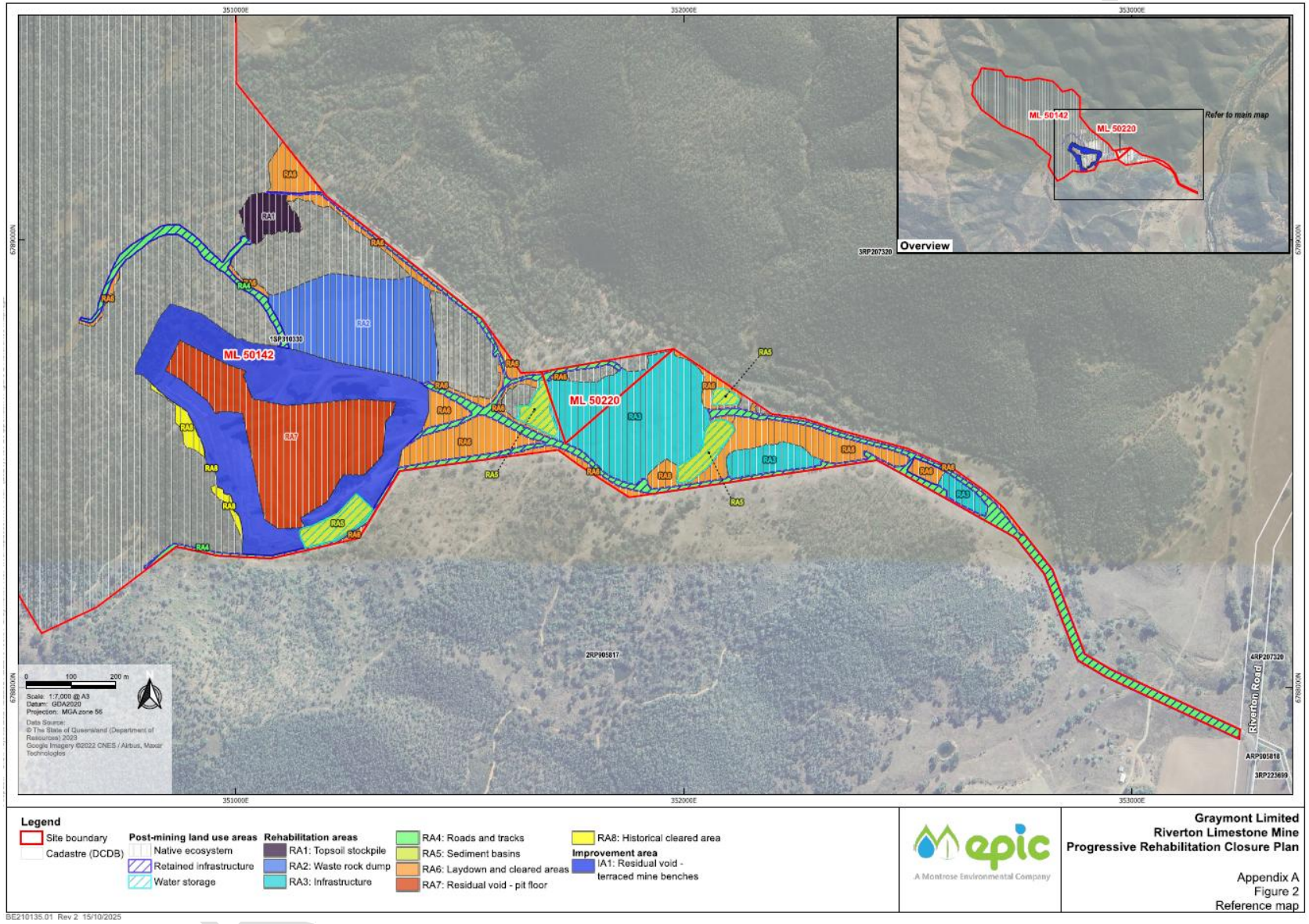

Figure 2 - Rehabilitation Areas

Section D – Post mining land uses

(RA1) Rehabilitation area 1

Rehabilitation area	RA1				
Relevant activities	Topsoil Stockpile				
Total rehabilitation area size (ha)	1.05				
Commencement of first milestone: RM5	10/12/2064				
PMLU	Native Ecosystem				
Date area is available	10/12/2064	10/12/2065	10/12/2066	11/12/2069	12/12/2074
Cumulative area available (ha)	1.05	1.05	1.05	1.05	1.05
Milestone completed by	10/12/2065	10/12/2066	10/12/2069	11/12/2074	12/12/2077
Milestone Reference	**Cumulative area achieved (ha)**				
RM5	1.05	1.05	1.05	1.05	1.05
RM7		1.05	1.05	1.05	1.05
RM8			1.05	1.05	1.05
RM10				1.05	1.05
RM12					1.05

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(RA2) Rehabilitation area 2

Post-mining land uses (PMLU)						
Rehabilitation area	RA2					
Relevant activities	Waste Rock Dump (WRD)					
Total rehabilitation area size (ha)	6.64					
Commencement of first milestone: RM2	10/12/2045					
PMLU	Native Ecosystem (NOVEL)					
Date area is available	10/12/2045	10/12/2046	10/12/2047	10/12/2048	10/12/69	11/12/2074
Cumulative area available (ha)	6.64	6.64	6.64	6.64	6.64	6.64
Milestone completed by	10/12/2046	10/12/2047	10/12/2048	10/12/2051	10/12/74	11/12/2077
Milestone Reference	**Cumulative area achieved (ha)**					
RM2	6.64	6.64	6.64	6.64	6.64	6.64
RM3	6.64	6.64	6.64	6.64	6.64	6.64
RM6	6.64	6.64	6.64	6.64	6.64	6.64
RM7			6.64	6.64	6.64	6.64
RM9				6.64	6.64	6.64
RM10					6.64	6.64
RM13						6.64

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(RA3) Rehabilitation area 3

Post-mining land uses (PMLU)						
Rehabilitation area	RA3					
Relevant activities	Infrastructure					
Total rehabilitation area size (ha)	8.7					
Commencement of first milestone: RM1	10/12/2062					
PMLU	Native Ecosystem (NOVEL)					
Date area is available	10/12/2062	10/12/2063	10/12/2064	10/12/2065	10/12/2066	10/12/71
Cumulative area available (ha)	8.70	8.70	8.70	8.70	8.70	8.70
Milestone completed by	10/12/2063	10/12/2064	10/12/2065	10/12/2066	10/12/2071	10/12/72
Milestone Reference	**Cumulative area achieved (ha)**					
RM1	8.70	8.70	8.70	8.70	8.70	8.70
RM2		8.70	8.70	8.70	8.70	8.70
RM5			8.70	8.70	8.70	8.70
RM7				8.7	8.7	8.7
RM9				8.7	8.7	8.7
RM10					8.70	8.70
RM13						8.70

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(RA4) Rehabilitation area 4

Post-mining land uses (PMLU)	
Rehabilitation area	RA4
Relevant activities	Roads and tracks
Total rehabilitation area size (ha)	6.88
Commencement of first milestone: RM11	10/12/2065
PMLU	Retained infrastructure
Date area is available	10/12/2065
Cumulative area available (ha)	6.88
Milestone completed by	10/12/2067
Milestone Reference	**Cumulative area achieved (ha)**
RM11	6.88

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(RA5) Rehabilitation area 5

Post-mining land uses (PMLU)					
Rehabilitation area	RA5				
Relevant activities	Sediment Basin				
Total rehabilitation area size (ha)	2.32				
Commencement of first milestone: RM5	10/12/2066				
PMLU	Water Storage				
Date area is available	10/12/2066	10/12/2067	10/12/2068	10/12/2071	10/12/2076
Cumulative area available (ha)	2.32	2.32	2.32	2.32	2.32
Milestone completed by	10/12/2067	10/12/2068	10/12/2071	10/12/2076	10/12/2077
Milestone Reference	**Cumulative area achieved (ha)**				
RM5	2.32	2.32	2.32	2.32	2.32
RM7		2.32	2.32	2.32	2.32
RM8			2.32	2.32	2.32
RM10				2.32	2.32
RM11					2.32

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(RA6) Rehabilitation area 6

Post-mining land uses (PMLU)									
Rehabilitation area	RA6								
Relevant activities	Cleared areas and Laydown areas								
Total rehabilitation area size (ha)	8.77								
Commencement of first milestone: RM5	10/12/2025								
PMLU	Native Ecosystem								
Date area is available	10/12/2025	10/12/2026	10/12/2027	10/12/2030	10/12/2031	10/12/2062	10/12/2063	10/12/2066	10/12/2071
Cumulative area available (ha)	1.85	1.85	1.85	1.85	1.85	8.77	8.77	8.77	8.77
Milestone completed by	10/12/2026	10/12/2027	10/12/2030	10/12/2031	10/12/2034	10/12/2063	10/12/2066	10/12/2071	10/12/2074
Milestone Reference	**Cumulative area achieved (ha)**								
RM2	1.85	1.85	1.85	1.85	1.85	8.77	8.77	8.77	8.77
RM5	1.85	1.85	1.85	1.85	1.85	8.77	8.77	8.77	8.77
RM7		1.85	1.85	1.85	1.85	8.77	8.77	8.77	8.77
RM8			1.85	1.85	1.85	1.85	8.77	8.77	8.77
RM10				1.85	1.85	1.85	1.85	8.77	8.77
RM12					1.85	1.85	1.85	1.85	8.77

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(RA7) Rehabilitation area 7

Post-mining land uses (PMLU)					
Rehabilitation area	RA7				
Relevant activities	Residual Void - Pit floor and In-pit WRD				
Total rehabilitation area size (ha)	8.1				
Commencement of first milestone: RM4	10/12/2063				
PMLU	Native Ecosystem (NOVEL)				
Date area is available	10/12/2063	10/12/2064	10/12/2065	10/12/2068	10/12/2073
Cumulative area available (ha)	8.10	8.10	8.10	8.10	8.10
Milestone completed by	10/12/2064	10/12/2065	10/12/2068	10/12/2073	10/12/2074
Milestone Reference	**Cumulative area achieved (ha)**				
RM2	8.10	8.10	8.10	8.10	8.10
RM4	8.10	8.10	8.10	8.10	8.10
RM6	8.10	8.10	8.10	8.10	8.10
RM7		8.10	8.10	8.10	8.10
RM9			8.10	8.10	8.10
RM10				8.10	8.10
RM13					8.10

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(RA8) Rehabilitation area 8

Post-mining land uses (PMLU)			
Rehabilitation area	RA8		
Relevant activities	Historical Disturbance Areas		
Total rehabilitation area size (ha)	0.56		
Commencement of first milestone: RM9	10/12/2025		
PMLU	Native Ecosystem		
Date area is available	10/12/2025	1/06/2028	1/06/2033
Cumulative area available (ha)	0.56	0.56	0.56
Milestone completed by	10/12/2028	1/06/2033	1/06/2034
Milestone Reference	**Cumulative area achieved (ha)**		
RM7	0.56	0.56	0.56
RM8	0.56	0.56	0.56
RM10		0.56	0.56
RM12			0.56

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Rehabilitation area milestones

Milestone reference	Rehabilitation milestone	Milestone criteria
RM1	Infrastructure decommissioning and removal	**Applicable to RA3** 1a. With the exception of any infrastructure to remain as part of the post-mining land use (PMLU), or where infrastructure is agreed to be retained by the landholder as evidenced by a signed landholder agreement, the following criteria are completed. 1b. All services disconnected in coordination with service providers and all associated service infrastructure removed from site. 1c. All buildings and associated infrastructure demolished and removed off-site by appropriately licensed contractors to an appropriately licenced waste facility. 1d. Hazardous building materials have been identified, managed and removed by appropriately licenced contractors from buildings removed as part of mine closure. 1e. Removal of fencing and signage relevant to decommissioned infrastructure. Not including final fencing / site securing. 1f. Machinery and equipment not required for rehabilitation removed off-site. 1g. All hardstand, concrete areas and roads (bitumen, blue metal, aggregate etc.) removed. 1h. All waste not authorised to be disposed of on-site under Environmental Authority EPML00241213 removed. 1i. All drillholes, sediment ponds and sumps decommissioned 1j. An independent AQP has certified the achievement of RM1a to RM1i.
RM2	Investigation and/or remediation of contaminated land	**Applicable to RA2, RA3 and RA7** 2a. An SQP undertakes a Preliminary Site Investigation and prepares a site investigation report that includes a review of previous activities to assess whether contamination has the potential to exist in a mine domain and whether further investigation is needed to be completed by a SQP. 2b. If assessed as required under RM2a a Contaminated Land Investigation Document completed in accordance with the *Environmental Protection Act 1994*, including a site investigation report, and, where required, a Validation Report and/or a draft Site Management Plan. 2c. If required, remediation carried out and validation sampling will be completed. 2d. Removal or onsite treatment of contaminated water (e.g. hydrocarbons, brine, metals etc.). 2e. Removal and appropriate disposal of any contaminated materials in accordance with relevant regulations. 2f. Suitably Qualified person (SQP) certifies that no contamination unsuitable for the PMLU remains or is occurring.

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		2g. If there is residual contamination identified which can remain in situ safely, the site will be placed on a Contaminated Land Register and a Site Management Plan: i. Is prepared and certified by an AQP ii. Includes a statement by the landholder accepting responsibility to implement the Site Management Plan 2h. An independent SQP has certified the achievement of RM2a to RM2g.
RM3	Landform development and reshaping / re-profiling of waste rock dump	**Applicable to RA 2** 3a. Erosion modelling undertaken by an AQP to inform the landform design and determine parameters required to achieve an erosionally stable state with a maximum erosion rate of ≤10 t/ha/yr. 3b. Major earthworks completed in RA2 in accordance with final engineering and design plans provided by an AQP. 3c. All material placed to achieve design levels and compacted in accordance with design specification. 3d. One-metre-high armour rock bund placed 1 m behind upper-level crest to control water flow and access. 3e. Where slope is >10° coir logs placed in rows traversing the slope with 10 m intervals to control erosion and sedimentation. 3f. Landform constructed to meet final design specifications (Maximum final slope of 16° - 18°). 3g. Certification from a AQP that design intent has been achieved. 3h. An "As-Constructed Report" prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance. 3i. Constructed landform achieves geotechnical stability with a Factor of Safety (FOS) ≥ 1.5, which includes consideration of flood stress. 3j. An independent AQP has certified the achievement of RM3a to RM3i.
RM4	Landform development and reshaping / re-profiling of Pit Floor and In-pit WRD	**Applicable to RA7** 4a. Major earthworks completed in accordance with final landform design (0 ° - 5 ° slope for Pit Floor and a 17 ° for In-pit WRD). 4b. Waste rock will be used to backfill area of pit floor identified as a non-free draining basin. 4c. All waste rock used for backfilling pit is assessed and determined to be material that does not cause acid, neutral or saline mine drainage. 4d. Waste rock from the In-pit WRD will be ripped and used to backfill the pit floor to depth of 1 m. 4e. Water drainage lines reinstated to allow natural water flows.

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		4f. Installation of a 2 m abandonment bund constructed from well-graded strong durable limestone of +25 mm, 10 m from the base terraced bench of residual void. These will have a footing width of 6 m and slope angles of 35°. 4g. Certification from an AQP that the landform design intent has been achieved. 4h. An "As-Constructed Report" prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance. 4i. Constructed landform achieves geotechnical stability with a Factor of Safety (FOS) ≥ 1.5, which includes consideration of flood stress. 4j. An independent AQP has certified the achievement of RM4a to RM4i.
RM5	Landform development and reshaping / re-profiling of other areas	**Applicable to RA1, RA3 and RA6** 5a. A landform design report that incorporates the establishment of erosion and sediment control measures is prepared by an AQP. 5b. Effective and functioning Erosion and Sediment Control (ESC) systems in place, with associated design plans. 5c. Major earthworks completed in accordance with final landform design including: i. Maximum final slope of 7° to 9° for RA 1 ii. Maximum final slope of 3° to 4° for RA 3 in ML50142 and <18° in ML50220 iii. Maximum final slope of 0° - 5° for RA 6. 5d. Water drainage lines reinstated to allow natural water flows except where erosion or sediment control is recommended in RM5a. 5e. Registered bore (ID 74426) will be decommissioned in accordance with the Minimum Construction Requirements for Water Bores in Australia (National Uniform Drillers Licensing Committee 2020) or latest version. 5f. Former ROM and infrastructure area (RA3) assessed as stable and non-polluting by an AQP. 5g. An "As-Constructed Report " prepared which details and justifies all variations to the design, including a certification that such variations will not affect the design performance. 5h. An independent AQP has certified the achievement of RM5a to RM5g.
RM6	Installation of cover system	**Applicable to RA2 and RA7** 6a. Cover system design and performance criteria based on level of environmental risk has been prepared by an AQP. 6b. Cover system has been installed as per design. **Applicable to RA2** 6c. Placement of 1,000 mm of a confirmed NAF rock layer across extent of WRDs. 6d. Compaction of NAF rock layer to form stable subgrade for subsequent material layers. 6e. Installation of 300 mm capillary break across top surface of NAF rock layer.

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		Applicable to RA2 and RA7 6f. Placement of 150 mm growth medium / soil layer. 6g. A cover system is installed with appropriate QA/QC measures. 6h. The construction and maintenance design of the cover system / cap has been certified by an AQP that is consistent with the cover design. 6i. An independent AQP has certified the achievement of RM6a to RM6h.
RM7	Surface preparation (general)	**Applicable to RA1, RA2, RA3, RA6, RA7 (**excluding pit abandonment bunds and areas between bunds and pit walls) **and RA8** 7a. Localised erosion areas identified and repaired. 7b. Ripping undertaken and penetrates at least 300 mm into soil profile. 7c. Placement of topsoil 150 mm (minimum) using salvaged topsoil from site, across the disturbed area. 7d. Prior to applying topsoil, any weeds will be removed from the area by hand, ensuring complete removal of root system. 7e. Planting and roto-tilling of an initial green manure treatment, comprising of grain barley and inoculated clover is completed. 7f. Assessment of growth media characteristics and the development of an amelioration and physical treatment plan is completed by an AQP. 7g. Ameliorant and physical treatments such as fertiliser, lime, gypsum and/or organic matter are applied as identified in criteria RM7f. 7h. Soil health and suitability for target vegetation establishment assessed by an AQP prior to seeding to determine outcome of manure treatment and fertiliser application and confirms: i. pH in the range 6 - 8.5 ii. Electrical Conductivity (saturated extract) (dS/m) ≤2 (2,000 µS/cm); iii. Exchangeable sodium percentage (ESP) (%) < 6; iv. Emerson aggregate class: ≥4. **Applicable to RA5 only** 7i. Retained water management structures (sediment basins) have been certified by an appropriately qualified person as conforming to the design standard and specifications consistent with those in the Best Practice Erosion & Sediment Control series (IECA 2008) or latest version. 7j. Annual visual monitoring of the sediment basin batters demonstrates that they have remained stable. Where unacceptable instability is recorded, advice has been sought from an AQP and remediation works have been undertaken as soon as is practicable.

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		7k. Water quality monitoring (biannual) demonstrates that sediment dam water quality meets the water quality limits for livestock drinking water defined in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) or latest version. . 7l. An independent AQP has certified the achievement of RM7a to RM7k.
RM8	Revegetation (Native Ecosystem)	**Applicable to RA1, RA6 and RA8** 8a. Vegetation management plan prepared by an AQP and endorsed via an independent AQP peer review for all disturbance areas that considers species composition and density and rehabilitation outcomes. 8b. Repeat applications of broad-scale non-residual herbicide will be applied in preparation for sowing native grass seeds. 8c. Seeding Native grass seeds will be planted in year two of rehabilitation in the Autumn months (March-May) at a rate)of 25 kg per ha, using the seed mixture described in **Table 2: Species list.** **Applicable to RA1, RA6 and RA8 only** 8d. A combination of tree species as described in **Table 2: Species list** will be planted at densities as specified in vegetation management plan. **Applicable to RA1, RA6 and RA8** 8e. Timing of seeding (sowing) and planting will occur in autumn following significant rain and when the soil moisture levels are optimal. 8f. A watering regime will be followed for a minimum of eight weeks, with a minimum of 10 litres per plant twice weekly in the first week, and once per week for a minimum of eight weeks. 8g. A monitoring and maintenance program established for rehabilitation areas and undertaken annually, on commencement of revegetation. 8h. If monitoring identifies over-browsing as a limitation to rehabilitation success, animal proof fencing will be needed (e.g. hinge-lock wallaby fencing and /or rabbit proof netting). Similarly, if livestock are identified within the revegetation areas, stock fencing may be required. 8i. An annual fauna monitoring program established and undertaken using the following recommended survey methods: • Diurnal bird surveys and reptile searches • Deployment of passive bat echo-location call recording devices (e.g. ANABAT) • Spotlighting surveys for nocturnal mammals, reptiles, and birds. 8j. Existing firebreaks maintained along edge of revegetation zones until rehabilitation complete. 8k. An independent AQP has certified the achievement of RM8a to RM8j.

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RM9	Revegetation (Native Ecosystem - NOVEL)	**Applicable to RA2, RA3 and RA7 (**excluding pit abandonment bunds and areas between bunds and pit walls) 9a. Vegetation management plan prepared by an AQP and endorsed via an independent AQP peer review for all disturbance areas that considers species composition and density and rehabilitation outcomes. 9b. Repeat applications of broad-scale non-residual herbicide will be applied in preparation for sowing native grass seeds. 9c. Native grass seeds seeded using the seed mixture described in **Table 2: Species list** at a minimum rate of 25 kg/ha. 9d. An annual monitoring and maintenance program established on commencement of revegetation. 9e. Existing firebreaks maintained along edge of revegetation zones until rehabilitation complete. 9f. Independent AQP has certified the achievement of RM9a to RM9e.
RM10	Achievement of surface requirement	10a. Species used in revegetation remain present and show evidence of natural recruitment. Evidence of flora recruitment from rehabilitation monitoring data. 10b. Species diversity similar to analogue sites (Table 3) for all RAs except RA2. 10c. Species diversity should be consistent with the vegetation management plan for RA2. 10d. Excluding RA2 and RA7 a BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual'. 10e. The relevant Biocondition assessment criteria collected under RM10d complies with the criteria described under RM10f - RM10m. 10f. Weed presence is less than 5% of total vegetative cover excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10g. Absence of ecosystem altering weeds excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10h. Total vegetative groundcover ≥50% excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10i. Total groundcover (combination of vegetative cover, other organic material (i.e. sticks leaf litter) and inorganic material (i.e. rocks)) ≥70% excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10j. Tree height >50% of tree height described in median cover range at analogue sites (Table 3) excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10k. Non-native cover is 5% of vegetative ground cover excluding pit abandonment bunds and areas between bunds and pit walls.

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		10l. Canopy cover >15% as per median cover range at analogue site (Table 3) excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10m. Shrub layer cover >10% as per median cover range at analogue site (Table 3) excluding RA2 and the area of the pit abandonment bunds and areas between bunds and pit walls in RA7. 10n. With respect to erosion: a. No evidence of erosion classified as 'moderate' or 'severe' as defined by Table 1 – Erosion classification framework b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. 10o. Corrective actions arising from monitoring program and routine inspections have been undertaken. 10p. Surface water runoff has been collected across representative areas of rehabilitation when surface flows occur and it is safe to do so. 10p. Surface water runoff complies with Table 2 – Surface water quality limits. 10q. The growth media (topsoil and subsoil) physical, chemical and biological properties does not limit vegetation cover performance or restrict the potential effective depth of rooting. 10r. Removal of stock/fauna fence (if applicable) when plants are sufficiently established to withstand herbivory. 10s. Independent AQP certifies achievement of RM 10a - RM10r.
RM11	Achievement of post-mining land use to stable condition (retained infrastructure, and water storage)	**Applicable to RA4 and RA5** 11a. Safety hazards in the rehabilitation area are not significantly different to surrounding unmined landscapes subject to the same land use. 11b. Erosion and sediment control measures are in place in accordance with the final design specifications and the erosion and sediment control plan. 11c. Access tracks are stabilised and graded to facilitate runoff and access for maintenance activities, fire management etc. All access tracks will be retained as per the Landholder Agreement. 11d. With respect to erosion: a. No evidence of erosion classified as 'moderate' or 'severe' as defined by Table 1 – Erosion classification framework. b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU.

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		11e. Groundcover percentage as identified in erosion modelling used to inform the erosion and sediment control plan in criterion RM5a (RA4). 11f. Certification from an AQP that the sediment basins (RA5) are stable and non-polluting. 11g. Retained stock watering storage water quality is below the trigger values for livestock drinking water defined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018) or latest version, for a minimum of 5 years. 11h. Independent AQP certifies achievement of RM 11a -11g.
RM12	Achievement of post-mining land use to stable condition (Native ecosystem)	**Applicable to RA1, RA6 and RA8** 12a. A BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual'. 12b. The relevant Biocondition assessment criteria collected under RM12a complies with the criteria described under RM12c - RM12g. 12c. Canopy cover similar to or greater than median range of the regrowth analogue site (15% canopy cover). 12d. Shrub layer cover similar to or greater than median range of the regrowth analogue site. 12e. Groundcover similar to or greater than median range of the regrowth analogue site. 12f. Tree height > 50 % of tree height at analogue site (Table 3). 12g. Non-native cover <5% of vegetative ground cover. 12h. Groundcover percentage as identified in landform erosion modelling in Criterion RM3a. 12i. With respect to erosion: a. No evidence of erosion classified as 'moderate' or 'severe' as defined by Table 1 – Erosion classification framework d. Any erosion present will not compromise the achievement of a PMLU to a stable condition. e. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. 12j. No area of weed outcompeting native species identified. 12k. Restrictive invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of the vegetation cover. 12l. Certification from an AQP that the final landform is geotechnically stable and achieved a factor of safety (FOS) ≥ 1.5. 12m. Surface water quality results monitored monthly during flow at, but not limited to, downstream locations specified in Table 5 – Surface water monitoring locations, must not exceed the limits in Table 4 - Surface water quality limits, for a minimum of 5 consecutive years.

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		12n. If the surface water quality exceeds criteria RM12m., the applicable upstream/reference site must be compared to the downstream site result; and quality result measured at a downstream site must be equal to or less than the quality result measured at the applicable upstream/reference sites. 12o. Fauna survey observation provides evidence of native fauna utilisation i.e., fauna spotting, scats, and tracks recorded. 12p. With consideration of the waste material characterisation and the final landform an AQP certifies that the waste rock dump will not cause environmental harm. 12q. An independent AQP has certified the achievement of RM12a. to RM12p.
RM13	Achievement of post-mining land use to stable condition (Native ecosystem – NOVEL)	**Applicable to RA2, RA3 and RA7** 13a. Non-native cover <5% of vegetative ground cover excluding pit abandonment bunds and areas between bunds and pit walls in RA7. 13b. Groundcover similar or greater than median range of analogue site (Table 3) excluding pit abandonment bunds and areas between bunds and pit walls in RA7. 13c. With respect to erosion: a. No evidence of erosion classified as 'moderate' or 'severe' as defined by Table 1 – Erosion classification framework b. Any erosion present will not compromise the achievement of a PMLU to a stable condition. c. Erosion requiring intervention has been remediated and does not impact achieving the PMLU. 13d. Restrictive invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of the vegetation cover excluding pit abandonment bunds and areas between bunds and pit walls in RA7. 13e. Absence of ecosystem altering weeds excluding pit abandonment bunds and areas between bunds and pit walls in RA7. 13f. Certification from a AQP that the area has achieved a stable condition with a factor of safety ≥ 1.5. 13g. An independent AQP has certified the achievement of RM13a to RM13f.

Table 1: Erosion classification framework

Erosion classification	Minor	Moderate	Severe
Sheet erosion	Shallow soil deposits downslope	Partial exposure of roots; moderate soil deposits downslope.	Loss of surface horizon; subsoil exposure; root exposure; substantial soil deposits downslope.

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Rill	<15 rills/transect*	15-30 rills per transect*	>30 rills per transect*
Gully erosion	Absent	Absent	>0.3m deep
Tunnel erosion[1]	Absent	Absent	Present
Mass movement[2]	Absent	Absent	Present

Source: NCST (2009) *Australian Soil and Land Survey Field Handbook, 3rd edition*. The National Committee on Soil and Terrain. CSIRO Publishing, Collingwood, Australia.

*Transect 100 m across the contour (Source: Tongway, D. J. and Hindley, N. L. 2005. Landscape Function Analysis: Procedures for Monitoring and Assessing Landscapes. CSIRO Publishing, Canberra, Australia.

[1] Tunnel erosion - This is the removal of subsoil by water while the surface soil remains relatively intact

[2] Mass movement - A generic term for any process or sediments (mass movement deposit) resulting from the dislodgment and downslope transport of soil and rock material as a unit under direct gravitational stress. The process includes slow displacements such as creep and solifluction, and rapid movements such as landslides, rock slides and falls, earthflows, debris flows and avalanches

Table 2: Species list

	Scientific Name	Common Name	Mix composition	Rehabilitation area
Native Grasses	*Austrostipa verticillata*	Slender Bamboo Grass	30%	RA1, RA2, RA3, RA6, RA7, RA8
	Digitaria brownii	Cotton Panic Grass	30%	RA1, RA2, RA3, RA6, RA7, RA8
	Aristida calycina	Dark Wire Grass	20%	RA1, RA2, RA3, RA6, RA7, RA8
	Capillipedium spicigerum	Scented-top grass	5%	RA1, RA2, RA3, RA6, RA7, RA8
	Eriachne pallescens	Wanderrie Grass	5%	RA1, RA2, RA3, RA6, RA7, RA8
	Chloris pectinata	Comb Chloris	5%	RA1, RA2, RA3, RA6, RA7, RA8
	Dichanthium sericeum	Queensland Bluegrass	5%	RA1, RA2, RA3, RA6, RA7, RA8

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	Scientific Name	Common Name	Mix composition	Rehabilitation area
Shrubs	*Alphitonia excelsa*	Red Ash		RA1, RA2, RA3, RA6, RA7, RA8
	Notelaea macrocarpa	Native Olive		RA1, RA2, RA3, RA6, RA7, RA8
	Dodonaea Triquetra	Large-leaf Hop-bush		RA1, RA2, RA3, RA6, RA7, RA8
	Geijera parviflora	Wilga		RA1, RA2, RA3, RA6, RA7, RA8
Trees	*Eucalyptus melanophloia*	Silver-leaved Ironbark		RA1, RA6, RA8
	Callitris glaucophylla	White Cypress Pine		RA1, RA6, RA8

Table 3: Vegetation analogue sites (Table 3)

Site	Vegetation	Latitude	Longitude
Q1	Regrowth 13.11.4	-29.021	151.480
Q3	Remnant 13.11.4	-29.022	151.477

Table 4: Surface water quality limits

Quality characteristic (units)	Traprock Limit	Dumaresq Floodplain Limit	Comment on limit
pH	6.9-8.0	7.1-8.1	WQO Low flow Traprock and Dumaresq Floodplain
Electrical Conductivity (µS/cm)	290	220	WQO Low flow Traprock and Dumaresq Floodplain

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Quality characteristic (units)	Traprock Limit	Dumaresq Floodplain Limit	Comment on limit
Sulfate (mg/L)	25	10	WQO Low flow Traprock and Dumaresq Floodplain
Turbidity (NTU)	4	8	WQO Low flow Traprock and Dumaresq Floodplain
Arsenic – Dissolved (µg/L)	13	13	ANZG2018
Cadmium – Dissolved (µg/L)	0.2	0.2	ANZG2018
Chromium – Dissolved (µg/L)	1	1	ANZG2018
Cobalt (µg/L) – Dissolved (µg/L)	1.4	1.4	ANZG2018
Copper – Dissolved (µg/L)	1.4	1.4	ANZG2018
Lead – Dissolved (µg/L)	3.4	3.4	ANZG2018
Mercury (µg/L) – Dissolved (µg/L)	0.06	0.06	ANZG2018
Nickel (µg/L) – Dissolved (µg/L)	11	11	ANZG2018
Selenium (µg/L) – Dissolved (µg/L)	5	5	ANZG2018
Uranium (µg/L) – Dissolved (µg/L)	0.5	0.5	ANZG2018
Zinc – Dissolved (µg/L)	8	8	ANZG2018
Total recoverable hydrocarbons (C6-C9) (µg/L)	20	20	
Total recoverable hydrocarbons (C10-C36) (µg/L)	100	100	
Major ions (mg/L) Calcium, chloride, potassium, magnesium, sodium, bicarbonate, carbonate	For interpretation purposes		
Hardness (mg/L)	For interpretation purposes		

Notes:

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- All metals and metalloids must be measured as 'dissolved' (from analysis of a field filtered sample) and total (unfiltered).
- Limits for metals and metalloids apply to dissolved results.
- ANZG (2018) Aquatic ecosystem protection for moderately disturbed system (95% protection)
- ANZG (2018) To account for the bioaccumulating nature of selenium, it is recommended that the 99% species protection level DGV is used for slightly to moderately disturbed systems.
- WQO - https://environment.desi.qld.gov.au/__data/assets/pdf_file/0016/214225/Border-Rivers-and-Moonie-River-Basins.pdf

Table 5: Surface water monitoring locations

Monitoring Locations	Receiving waters location description	Easting (GDA2020 / MGA zone 56)	Northing (GDA2020 / MGA zone 56)
Upstream monitoring locations			
W1	Unnamed tributary, upstream to north of site	351596	6788934
W4	Sediment Dam C2 upgradient	351993	6788447
Downstream monitoring locations			
W2	Unnamed tributary, downstream to north of site	351508	6788890
W3a	Unnamed tributary, downstream to north of site	351942	6788775
W5	Sediment Dam C1/C2 downstream	352145.5222	6788620.951
W6	Unnamed tributary, downstream to east of site Dumaresq Floodplain	352750	6788476

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Figure 3: Surface water monitoring locations

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Section D – Non-use management areas

(IA1) Improvement area 1

Non-use management area (NUMA)	
Improvement area	IA1
Relevant activities	Residual Void - Mine benches
Total size (ha)	11.55
Commencement of first milestone: MM1	10/12/2062
NUMA	Mine benches
Date area is available	10/12/2062
Cumulative area available (ha)	11.55
Milestone completed by	10/12/2063
Milestone Reference	**Cumulative area achieved (ha)**
MM1	11.55

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Improvement area milestones

Milestone reference	Management milestone	Milestone criteria
MM1	Landform development and reshaping / re-profiling of residual void terraced mine benches (NUMA)	**Applicable to IA1** 1a. Major earthworks completed and landform constructed in accordance with final engineering and design plans: a. Trend of major axis, 121° b. Length of major axis at crest, 535 m c. Average length of minor axis at crest (west/east), 195/385 m d. Maximum heights of walls (north/south/east/west) 65/79/19/34 m e. Heights of benches, 10m f. Maximum number of benches, 10 g. Widths of berms, 10 m h. Batter angles in unweathered rocks, 70° i. Batter angles in weathered rocks, 14° j. Inter-ramp angles, 43° k. Maximum overall slope angles (north/south/east/west), 33° /37° /32° /31° l. Ramp type / Minimum width, linear / 10 m m. Directional dip of North wall (South dip, 157° to 206 °) n. Directional dip of South wall (North dip, 024° to 085°) o. Directional dip of East wall (West dip, 300° to 329°) p. Directional dip of West wall (East dip, 108°) 1b. An AQP has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥ 1.5) has been achieved. 1c. Access to the residual void will be restricted by the following: a. A 2 m abandonment bund installed along the southern/eastern extent of the void, with a footing width of 6 m, slope angle of 35° and constructed from well-graded coarse strong durable limestone of +25mm, consistent with the requirements of the *'Safety Bund around Abandoned Open Pit Mines Guideline*' (DIR 1997). b. A chain-link fence installed around the perimeter of the void, set back 10 m, to restrict access to humans and animals, consistent with the requirements of 43 (1) of the *Mining and Quarrying Safety and Health Regulation 2017*. The fence will be installed with dinobolts, no additional clearing of vegetation will be required.

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		c. Dense remnant vegetation retained to the north and west of the pit, further restricting access to the void. 1d. Safety signage designed in accordance with relevant Australian Standards erected at a minimum of 100 m intervals around the void. 1e. Certification from an AQP verifying design intent has been achieved.

END OF **PRCP** SCHEDULE

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351000E
352000E
353000E
6789000N
6788000N

Cleared area
Topsoil
Cleared area
Cleared area
Roads and tracks
Undisturbed area
Cleared area
Waste rock dump
1SP310330
ML 50142
Cleared area
Cleared area
Cleared area
Sediment dam C1
ML 50220
Historical cleared area
Laydown
Infrastructure
Cleared area
Terraced mine benches
Pit floor
Laydown
Laydown
Laydown
Cleared area
Sediment dam B
Historical cleared area
Roads and tracks
Cleared area
Sediment dam C2
Historical cleared area
Laydown
Infrastructure
Laydown
Sediment dam A
2RP905817
4RP207320
Riverton Road
ARP905818
3RP223699

Dumaresq River
ML 50142
ML 50220
Refer to main map
Regional flooding extent

0 100 200 m
N
Scale: 1:7,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Filepath: ~GIS\Projects\2021\BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Appendix A Figure 1 Final site design.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance footprint over mine life

Post-mining land use

- Native ecosystem
- Retained infrastructure
- Water storage

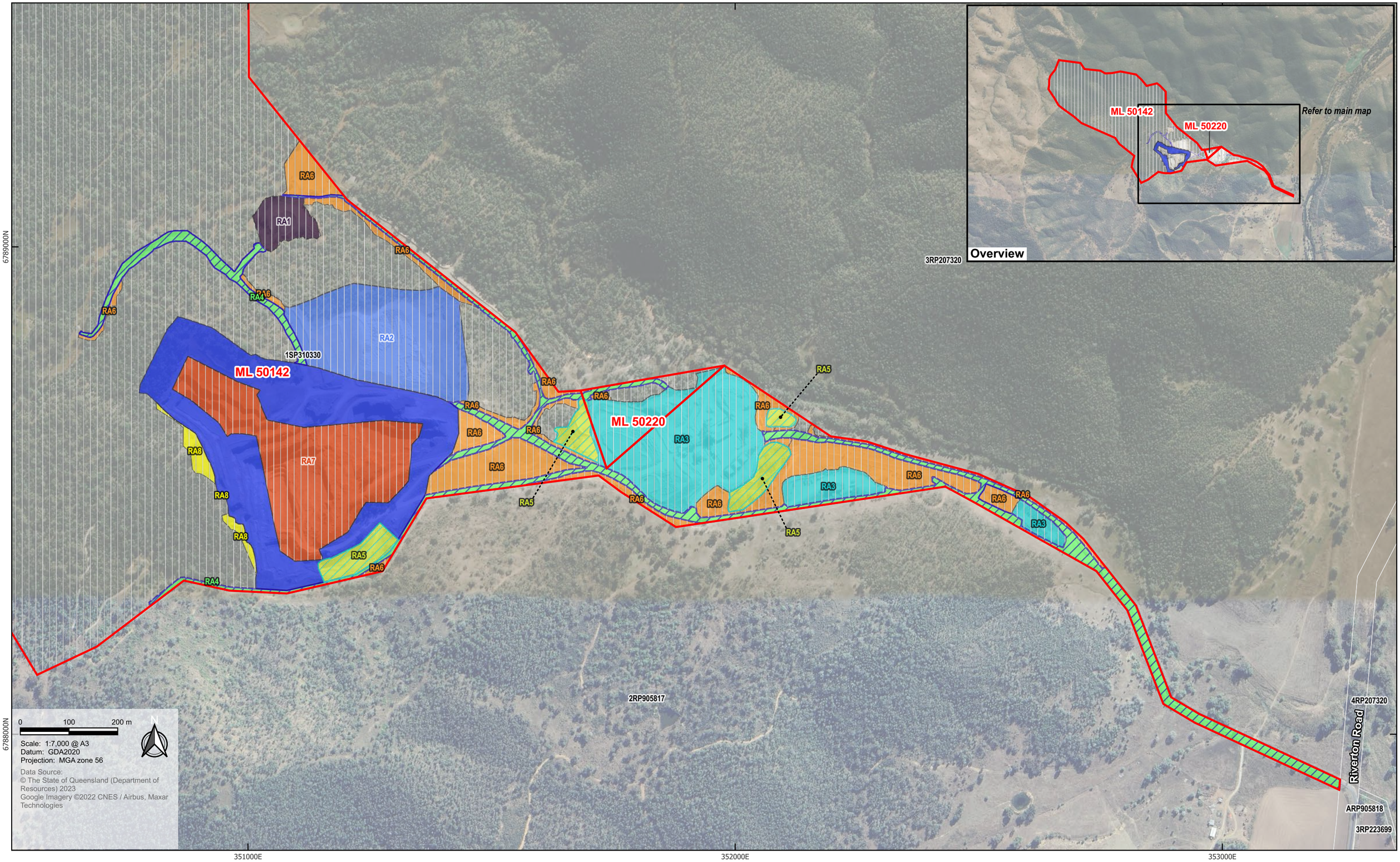
Non-use management areas

- Terraced mine benches

epic
A Montrose Environmental Company

Graymont Limited
Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Appendix A
Figure 1
Final site design



Legend

- Site boundary
- Cadastre (DCDB)

Post-mining land use areas

- Native ecosystem
- Retained infrastructure
- Water storage

Rehabilitation areas

- RA1: Topsoil stockpile
- RA2: Waste rock dump
- RA3: Infrastructure
- RA4: Roads and tracks
- RA5: Sediment basins
- RA6: Laydown and cleared areas
- RA7: Residual void - pit floor
- RA8: Historical cleared area

Improvement area

- IA1: Residual void - terraced mine benches

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Graymont Limited
Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Appendix A
Figure 2
Reference map

Appendix B Final Site Design and Reference Map

351000E
352000E
353000E
6789000N
6788000N

Cleared area
Topsoil
Cleared area
Undisturbed area
Roads and tracks
Cleared area
Cleared area
Waste rock dump
1SP310330
ML 50142
Cleared area
Cleared area
Cleared area
Sediment dam C1
Historical cleared area
Laydown
ML 50220
Infrastructure
Cleared area
Laydown
Laydown
Terraced mine benches
Pit floor
Laydown
Cleared area
Historical cleared area
Sediment dam B
Roads and tracks
Cleared area
Sediment dam C2
Historical cleared area
Laydown
Infrastructure
Sediment dam A
Laydown
2RP905817
4RP207320
Riverton Road
ARP905818
3RP223699

Dumaresq River
ML 50142
ML 50220
Refer to main map
Regional flooding extent

0 100 200 m
N
Scale: 1:7,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Appendix A Figure 1 Final site design.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance footprint over mine life

Non-use management areas
- Terraced mine benches

Post-mining land use
- Native ecosystem
- Flat to sloping areas with hard stand areas
- Bitumen and unsealed roads for access
- Retained sediment basins for water supply and storm water control

epic
A Montrose Environmental Company

Graymont Limited
Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Appendix A
Figure 1
Final site design

351000E
352000E
353000E
6789000N
6788000N

ML 50142
ML 50220
1SP310330
3RP207320
2RP905817
4RP207320
ARP905818
3RP223699
Riverton Road

RA2
RA3
RA4
RA5
RA6
RA7
RA8
RA9

Overview
Refer to main map

0 100 200 m
N
Scale: 1:7,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Filepath: ...\BE2021\BE210135.01 Graymont PRCP\Workspaces\11. PRCP (2024)\Rev 2\Appendix A Figure 2 Reference map.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Rehabilitation areas

- RA2: Topsoil stockpile
- RA3: Waste rock dump
- RA4: Infrastructure
- RA5: Roads and tracks
- RA6: Sediment basins
- RA7: Laydown and cleared areas
- RA8: Residual void - pit floor
- RA9: Historical cleared area

Post-mining land use

- Native ecosystem

- Flat to sloping areas with hard stand areas
- Bitumen and unsealed roads for access
- Retained sediment basins for water supply and storm water control

Improvement area

- IA1: Residual void - terraced mine benches

epic
A Montrose Environmental Company

Graymont Limited
Riverton Limestone Mine
Progressive Rehabilitation Closure Plan

Appendix A
Figure 2
Reference map

Appendix C Environmental Authority

Permit

Environmental Protection Act 1994

Environmental authority EPML00241213

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

Environmental authority number: EPML00241213

Environmental authority takes effect on 27 June 2024.

The anniversary date of this environmental authority is 29 June each year.

Environmental authority holder(s)

Name(s)	Registered address
Graymont (NSW) Pty Ltd	Level 9, 118 Mount Street NORTH SYDNEY NSW 2060

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Schedule 3 21 – A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50142 ML50220

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 land give written notice to the administering authority if they become aware of the following:

- the presence of, or happening of an event involving, a hazardous contaminant on the land that is causing, or is reasonably likely to cause, serious or material environmental harm (notice must be given

Queensland Government

within 24 hours); or

- if the land is contaminated land – a change in the condition of the land that is causing, or is reasonably likely to cause, serious or material environmental harm (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 land (notice must be given within 20 business days).

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.

The anniversary day of this environmental authority is the same day each year as the effective date. The payment of the annual fee will be due each year on this day. An annual return will be due each year on 01 April.

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.

T.Gibbs	27 June 2024
Signature	Date

Teale Gibbs
Department of Environment, Science and Innovation
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Minerals Business Centre
PO Box 7230, Cairns QLD 4870
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)

Other permits required

This permit only provides an approval under the *Environmental Protection Act 1994*. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access State controlled roads), the Department of Resources (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

This **Environmental Authority** 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
- Schedule I - Maps / Plans

Conditions of environmental authority

Schedule A – General

Financial assurance

(A1-1) 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 (A1-1) 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)

(A1-2) 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.

Maintenance of measures, plant and equipment

(A2-1) The holder must:

a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; and

b) maintain such measures, plant and equipment in a proper condition; and

c) operate such measures, plant and equipment in a proper manner.

Monitoring

(A3-1) 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.

(A3-2) Where monitoring is a requirement of this environmental authority, ensure that an appropriately qualified person conducts all monitoring.

Storage and handling of flammable and combustible liquids

(A4-1) 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.

END OF CONDITIONS FOR SCHEDULE A

Schedule B – Air

Dust nuisance

(B1-1) Subject to Conditions (B1-2) and (B1-3) 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.

(B1-2) 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.

(B1-3) If the environmental authority holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of (B1-1):

a) Dust deposition of 120 milligrams per square metre 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 particulates - Deposited matter - Gravimetric method of 1991; and/or

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic metre over a 24 hour averaging time, at a sensitive or commercial place downwind 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 1990; or
- Any alternative method of monitoring PM10 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 (B13) (a) or (b) or both.

(B1-4) If monitoring indicates exceedance of the relevant limits in Condition (B1-3), 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 that emissions of dust from the activity do not result in environmental nuisance.

END OF CONDITIONS FOR SCHEDULE B

Schedule C – Water

Release to waters

(C1-1) Receiving waters affected by the release of storm water contaminated by the mining activities must be monitored at the locations and frequencies defined in Schedule C - Table 1 as defined in Schedule I - Map 1 and for the parameters defined in Schedule C – Table 4 and W6 must comply with the contaminant limit defined in Schedule C - Table 4.

Schedule C - Table 1 (Receiving waters monitoring locations and frequency)

Monitoring point	Northing (AMG)	Easting (AMG)	Monitoring frequency
W1	6788934	351596	6 monthly (during a flow event)
W6	6788476	352750	6 monthly (during a flow event)
W4	6788447	351993	6 monthly (during a flow event)

(C1-2) Stormwater contaminated by mining activities must only be released as seepage from sediment dams at release points defined in Schedule C – Table 2.

(C1-3) Stormwater contaminated by mining activities must be monitored at the locations and frequencies defined in Schedule C - Table 2 and Schedule I - Map 1 and comply with the contaminant limits defined in Schedule C - Table 3.

Schedule C - Table 2 (Release point monitoring locations and frequency)

Monitoring point	Northing (AMG)	Easting (AMG)	Monitoring frequency
W2	6788890	351508	6 monthly (during a flow event)
W3	6788629.83	351720.46	6 monthly (during a flow event)
W5	6788621	352144	6 monthly (during a flow event)
W3a	6788775	351942	6 monthly (during a flow event)

Schedule C - Table 3 (Sediment dam contaminant release limits for monitoring points W2, W3 and W5)

Parameter	Units	Minimum	Maximum
Electrical Conductivity	µs/cm	0	225
pH	range	6.5	8.5
Oil and Grease	mg/L	0	10

Schedule C - Table 4 (W6 monitoring point contamination limit)

Parameter	Units	Maximum
Suspended Solids	mg/L	25

C1-4) The following must be documented when monitoring is conducted in accordance with condition C1-1 Schedule C - Tables 1 and 4 and condition C1-2 and C1-3 and Schedule C - Tables 2 and 3:

a) Flow rate,

b) Time,

c) Date,

d) Weather conditions,

e) Water temperature, and

f) Description of the flow conditions (e.g. turbulence etc).

(C1-5) Monitoring conducted in accordance with condition C1-1 schedule C Tables 1 and 4 and condition C1-2 Schedule C - Tables 2 and 3 must be undertaken at the same time as reasonably practicable.

(C1-6) When monitoring conducted in accordance with condition C1-1 schedule C Table 1 indicates an exceedance of the limit in schedule C Table 4, it is not considered to be an exceedance of the limit in schedule C Table 4 if the environmental authority holder can demonstrate to the satisfaction of the administering authority, through simultaneous monitoring at point W1 and W6, that the peak is a variation in suspended solids levels, not caused by mining activities.

Stream sediment contaminant levels

(C2-1) All reasonable and practicable erosion protection measures and sediment control measures (e.g. diversion banks and progressive re-vegetation of disturbed areas) must be implemented and maintained to minimise erosion and the release of sediment.

(C2-2) Sediment collection dams must be designed and maintained to prevent overtopping during a 1 in 50 year rainfall event (4 month wet season) and to facilitate the settlement of suspended solids in stormwater contaminated by mining activities.

Sewage effluent

(C3-1) Treated sewage effluent from sewage treatment facilities must be reused and/or evaporated and must not be directly or indirectly released from any sewage treatment plant to any water way or drainage line.

Groundwater

(C4-1) All reasonable and practicable measures must be taken to prevent the contamination of groundwater.

(C4-2) There must be no release of contaminants to groundwater as a result of mining activities.

END OF CONDITIONS FOR SCHEDULE C

Schedule D – Noise and Vibration

Noise nuisance

(D1-1) Subject to Conditions (D1-2) and (D1-3) noise from the mining activity must not cause an environmental nuisance, at any sensitive place or commercial place.

(D1-2) 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.

(D1-3) If the environmental authority holder can provide evidence through monitoring that the limits defined in the table in Schedule D - Table 1 and 2 inclusive are not being exceeded then the holder is not in breach of Condition (D1-1). Monitoring must include:

a) LA, max adj, T

b) the level and frequency of occurrence of impulsive or tonal noise;

c) atmospheric conditions including wind speed and direction; and

d) location, date and time of recording.

(D1-4) If monitoring indicates exceedance of the limits in Schedule D - Table 1 and 2 then the environmental authority 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.

(D1-5) The method of measurement and reporting of noise levels must comply with the latest edition of the Environmental Protection Agency's Noise Measurement Manual.

Schedule D – Table 1 (Noise limits)

Noise level dB(A) measured as	Monday to Saturday			Sundays and public holidays		
	6am - 6pm	6pm - 10pm	10pm - 6am	6am - 6pm	6pm - 10pm	10pm - 6am
	Noise measured at a 'Noise sensitive place'					
$L_{Aeq, adj, 1 hr}$	38	33	33	38	33	33
$L_{A1, adj, 10 mins}$	40	35	35	40	35	35
	Noise measured at a 'Commercial place'					
$L_{Aeq, adj, 1 hr}$	43	38	38	43	38	38
$L_{A1, adj, 10 mins}$	45	40	40	45	40	40

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual. ['b/g' means background noise levels]

Schedule D – Table 2 (Airblast overpressure level – 'Sensitive or commercial place')

Noise parameter	Monday to Saturday 7am - 5pm	Sundays and public holidays 9am-1pm
Air blast overpressure level (dB linear peak)	115dB (for nine out of any 10 consecutive blasts)	Blasting permitted with consent of the administering authority. Limits the same as Monday to Saturday
Air blast overpressure level (dB linear peak)	120dB (maximum)	

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual.

Vibration nuisance

(D2-1) Subject to Conditions (D2-2) and (D2-3) vibration from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.

(D2-2) 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 place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

(D2-3) If the environmental authority 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 (D2-1). Monitoring must include:

a) location of the blast/s within the mining 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.

(D2-4) If monitoring indicates exceedance of the relevant limits in Schedule D - Table 3, then the environmental authority 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 – 'Sensitive or commercial place')

Vibration parameter	Monday to Saturday 7am - 5pm	Sundays and public holidays 9am to 1pm
Sensitive or commercial place	5mm/s peak particle velocity for nine out of 10 consecutive blasts and not greater than 10mm/s peak particle velocity at any time	Blasting permitted with consent of the administering authority. Limits the same as Monday to Saturday

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual.

END OF CONDITIONS FOR SCHEDULE D

Schedule E – Waste

Storage of tyres

(E1-1) Tyres stored awaiting disposal or transport for take-back and, recycling, or waste-to-energy options - should be stockpiled in volumes less than 3m in height and 200 sq.m in area and at least 10m from any other tyre storage area.

(E1-2) 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.

Waste Management

(E2-1) The handling and disposal of all waste produced on site is to be conducted using methods to avoid contamination of land and surface and ground water.

(E2-2) 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).

(E2-3) The environmental authority holder must remediate any contaminated land resulting from mining activities within the lease area prior to the surrender of the mining lease.

END OF CONDITIONS FOR SCHEDULE E

Schedule F – Land

(F1-1) The environmental authority holder must not carry out mining activities within any regional ecosystem located on ML50142.

(F1-2) Notwithstanding condition (F1-1), the holder of this environmental authority is authorised to remove the area of regional ecosystem shown in Schedule I - Map 1. In removing this vegetation, the holder of the environmental authority must take all reasonable and practicable measures to minimise disturbance to regional ecosystem 13.11.4, including retention of juvenile species through exclusion of grazing stock including feral goats.

(F1-3) All reasonable and practicable measures must be taken to minimise disturbance of Regional Ecosystem 13.11.4 on ML50220, including retention of juvenile species through exclusion of grazing stock including feral goats.

Rehabilitation landform criteria

(F2-1) All areas significantly disturbed by mining activities must be rehabilitated to a stable landform and unless nominated as a non-use management area must have self-sustaining vegetation cover in accordance with the final land description as defined in Schedule F - Table 1a.

Schedule F - Table 1a (ML50142 and ML50220 Final land use and rehabilitation approval schedule)

Disturbance type	Disturbance area (ha)	Pre-mine land description	Post-mine land description	Pre-mine land classification	Post-mine land classification	Slope Range
Residual Void(s)	8.1 (area of the Pit floor)	Light grazing and fauna habitat	Native ecosystem	vii/viii	viii	TBA[1]
	8.4 (area of the terraced benches)	Light grazing and fauna habitat	Non-use management area	vii/viii	viii	Void wall competent rock max slope 70°; Void wall incompetent rock max slope 37°
Clay waste 'Topsoil'	2.2	Light grazing and fauna habitat	Native ecosystem	vii/viii	viii	7° to 9°
Waste Rock Dump	13	Light grazing and fauna habitat	Native ecosystem	vii/viii	viii	16° to 20°
Infrastructure (processing plant, ROM and office area)	11.8	Light grazing and fauna habitat	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners agreement	vii/viii	viii	3° to 4° (ML50142) <18° (ML50220)
Roads and Tracks	5.3	Access	Bitumen and unsealed roads for site access	Access	Access	N/A
Sediment Pond	2.7	Light grazing and fauna habitat	Water supply in accordance with landowners agreement	vii/viii	Pond	N/A
Total	51.5					

1- To be provided to the administering authority in accordance with condition (F2-6).

(F2-2) Progressive rehabilitation must commence when areas become available within the operational land.

(F2-3) By 31 March 2007, the environmental authority holder must complete an investigation into rehabilitation of disturbed areas and submit a report to the administering authority in

accordance with conditions F2-1 and F2-2 and propose acceptance criteria to meet the outcomes and landform design criteria in Schedule F - Table 1 and 2.

(F2-4) The report submitted to the administering authority in accordance with condition F2-3 must include the following;

a) A detailed description of analogue sites that contain a representative species combination and vegetation cover to achieve the rehabilitation outcomes defined in Schedule F - Table 1 and 2, and

b) A weed management program including a list of all weeds identified and weed control methods.

(F2-5) A map showing the location, disturbance type and disturbance area specified in Schedule F - Table 1a must be submitted to the administering authority through an amendment application in accordance with the *Environmental Protection Act 1994* by 27 September 2024.

(F2-6) The slope of the residual void identified in Schedule F - Table 1a must be nominated through an amendment application in accordance with the *Environmental Protection Act 1994* by 27 September 2024.

Residual void outcome

(F3-1) 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 2.

(F3-2) The environmental authority holder must prior to five years before the end of mining, complete an investigation into residual voids and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in (F3-1) and landform design criteria in Schedule F - Table 2.

Schedule F – Table 2 (Residual void design)

Void identification	Void wall - competent rock slope (degrees)	Void wall - incompetent rock slope (degrees)	Void maximum surface area (ha)
Main Void	70º	37º	16.5

Infrastructure

(F4-1) All infrastructure, constructed by or for the environmental authority holder during the mining activities including water storage structures, must be removed from the site prior to mining lease surrender, except where agreed in writing by the post mining land owner / holder.

Bat Fauna

(F5-1) By 31 August 2006, develop, implement and submit to the administering authority a Bat Monitoring Program that includes the following objectives and methodologies;

a) Monitor the bat population annually before parturition occurs, using the approved video fly-

out count method. The video recording of the exit flights may be conducted by the environmental authority holder but the count and assessment must be conducted by a suitably qualified person.

b) Investigate the feasibility of estimating the population of the Eastern Horseshoe Bat using a bat detector in conjunction with video recordings of exit flights.

c) Monitor by video the bats within the Riverton Bat Cave on at least three occasions during a blast event and at least three occasions in the absence of a blast event, during the bat maternity season (1 November to 31 March) and when there is a significant change in blasting locations, rock strata or explosive intensity.

d) Determine annually a bat population benchmark and limits of acceptable change that, if exceeded would trigger an investigation to determine the cause of the bat population falling to that limit. The environmental authority holder must submit a report on the investigation to the administering authority two months after identifying the population falling below the limit of acceptable change. If the investigation determines that mining activities contributed to the population decline, the environmental authority holder must make recommendations as to what actions can be taken to manage the affects of mining activities on the bat population declines in consultation with the administering authority.

(F5-2) By 31 August 2006, develop and submit a program to monitor the Riverton Bat Cave structural integrity with the objective of minimising the potential for cave collapse. The monitoring program must be submitted to the administering authority and include the following:

a) Expert advice on whether it is possible to secure unstable sections of the cave roof, and

b) Bi-annual geo-technical assessment of the Riverton Bat Cave structure.

(F5-3) For the environmental authority holder to successfully demonstrate compliance with conditions F5-1 and F5-2 the submission to the administering authority must be supported with scientific monitoring, research and is reviewed and supported by experts and stakeholders, to the satisfaction of the administering authority.

(F5-4) No blasting or disturbance (except minor disturbance associated with accessing the cave for purposes of achieving compliance with this environmental authority) of vegetation is to occur within 215 metres of the Riverton Bat Cave entrance.

Note: The environmental authority holder may make a submission to the administering authority for the review of the 215 metre exclusion zone around the Riverton Bat Cave.

(F5-5) Restrict human access to the Riverton Bat Cave except for the purposes of achieving compliance with this environmental authority.

(F5-6) Mining activities must not adversely affect the structural integrity or cause a partial or full collapse of the Riverton Bat Cave.

END OF CONDITIONS FOR SCHEUDLE F

Schedule G – Community

Complaint response

(G1-1) All complaints received must be recorded including details of complainant, reasons for the complaint investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.

(G1-2) By 31 March 2007, a cultural and historical archaeological survey must be conducted to investigate and identify the existence of any cultural and historical archaeological sites or items of significance within the mining lease area.

Notification of Emergencies and Incidents

(G2-1) 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 environmental authority, the holder of this environmental authority must notify the administering authority as soon as possible.

(G2-2) The notification of emergencies or incidents as required by condition G2-1 must include but not be limited to the following:

i) the holder of the environmental authority;

ii) the location of the emergency or incident;

iii) the number of the environmental authority;

iv) the name and telephone number of the designated contact person;

v) the time of the release;

vi) the time the holder of the environmental authority became aware of the release;

vii) the suspected cause of the release;

viii) the environmental harm and or environmental nuisance caused, threatened, or suspected to be caused by the release; and

ix) actions taken to prevent any further release and mitigate any environmental harm and or environmental nuisance caused by the release.

(G2-3) Not more than fourteen (14) days following the initial notification of an emergency or incident, the holder of the environmental authority must provide written advice of the information supplied in accordance with condition G2-2 in addition to:

i) proposed actions to prevent a recurrence of the emergency or incident;

ii) outcomes of actions taken at the time to prevent or minimise environmental harm and or environmental nuisance; and

iii) the results of any environmental monitoring performed.

Any notifications given under section 320 or section 350 of the *Environmental Protection Act 1994* that contains the information set out in conditions G2-2 and G2-3 is also a notification under this condition.

Exception Reporting

(G3-1) The holder of this environmental authority must notify the administering authority in writing of any monitoring result that indicates an exceedence of or non-compliance with any environmental authority limit within twenty-eight (28) days of completion of analysis.

(G3-2) The written notification required by condition number G3-1 above must include:

i) the full analysis results;

ii) details of investigation or corrective actions taken; and

iii) any subsequent analysis.

Any notifications given under section 320 or section 350 of the *Environmental Protection Act* that contains the information set out in condition G3-2 is also a notification under this condition.

END OF CONDITIONS FOR SCHEDULE G

Schedule H - Definitions

Words and phrases used throughout this licence are defined below except where identified in the EP Act or subordinate legislation. Where a word or term is not defined, the ordinary English meaning applies, and regard should be given to the Macquarie Dictionary.

Word definitions

"acceptance criteria" means the measures by which the actions implemented to rehabilitate the land are deemed to be complete (same as completion criteria).

"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 any person who conforms to the EPA operational policy for an 'appropriately qualified person (analyst)' in accordance with Section 490(7) of the Environmental Protection Act 1994.

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

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

- rock, coal and other minerals for later recovery; or

- structural components or other items to facilitate removal from a site or for reuse.

"commercial place" means a place used as an office or for business or commercial purposes, other than a place within the boundaries of the operational land.

“endangered regional ecosystem” means an endangered regional ecosystem identified in the database maintained by the administering authority called ‘Regional ecosystem descriptions database’ containing regional ecosystem numbers and descriptions.

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

"$L_{A\ 10,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

"$L_{A\ 1,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response

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

"$L_{A\ eq,\ adj,\ 1\ hr}$" means the A-weighted sound pressure level adjusted for noise character of a continuous steady sound that within one hour has the same mean-sequence as a sound under consideration whose level varies within time. The equivalent continuous A-weighted sound pressure level is quoted at the nearest whole number of decibels.

"land" in the 'land schedule' of this document means land excluding waters and the atmosphere, "noise sensitive place" or a "commercial place".

"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.

"leachate" means a liquid that has passed through or emerged from, or is likely to have passed through or emerged from, a material stored, processed or disposed of at the operational land which contains soluble, suspended or miscible contaminants likely to have been derived from the said material.

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

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

“parturition” means the process of giving birth.

"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)

"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.

"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.

"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
- an educational institution; or
- a medical centre 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; or
- a place used as a workplace, 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; and
- does not include Riverton Bat Cave.

"stable" means geotechnical stability of the rehabilitated landform where instability related to the excessive settlement and subsidence caused by consolidation / settlement of the wastes deposited, and sliding / slumping instability has ceased.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water natural, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), and any under groundwater, any part-thereof.

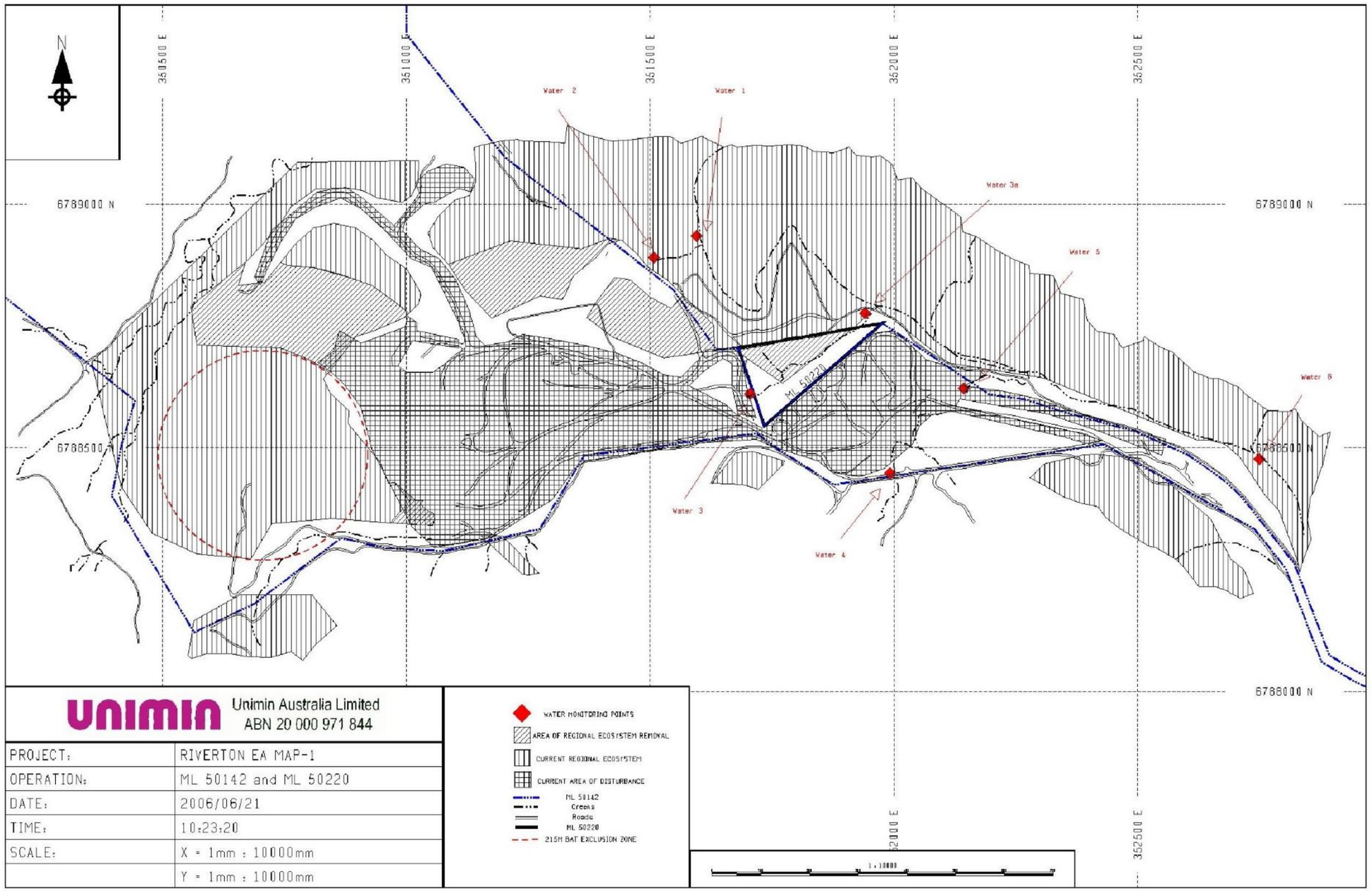
END OF DEFINITIONS IN SCHEDULE H

END OF CONDITIONS

Schedule I – Map

Map 1 – Area of Regional Ecosystem Removal

END OF CONDITIONS FOR SCHEDULE I



MAP 1 – Area of Regional Ecosystem Removal

END OF ENVIRONMENTAL AUTHORITY

Permit

Environmental Protection Act 1994

Environmental authority EPML00241213

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

Environmental authority number: EPML00241213

Environmental authority takes effect on 14 April 2025

The anniversary date of this environmental authority is 29 June each year.

Environmental authority holder(s)

Name(s)	Registered address
Graymont (NSW) Pty Ltd	Level 9, 118 Mount Street NORTH SYDNEY NSW 2060

Environmentally relevant activity and location details

Environmentally relevant activity/activities	Location(s)
Schedule 3 21 – A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20	ML50142 ML50220

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 land give written notice to the administering authority if they become aware of the following:

- the presence of, or happening of an event involving, a hazardous contaminant on the land that is causing, or is reasonably likely to cause, serious or material environmental harm (notice must be given

Queensland Government

within 24 hours); or

- if the land is contaminated land – a change in the condition of the land that is causing, or is reasonably likely to cause, serious or material environmental harm (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 land (notice must be given within 20 business days).

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.

The anniversary day of this environmental authority is the same day each year as the effective date. The payment of the annual fee will be due each year on this day. An annual return will be due each year on 01 April.

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.

T.Gibbs	14 April 2025
Signature	Date

Teale Gibbs
Department of the Environment, Tourism, Science and Innovation
Delegate of the administering authority
Environmental Protection Act 1994

Enquiries:
Minerals Business Centre
PO Box 7230, Cairns QLD 4870
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)

Other permits required

This permit only provides an approval under the *Environmental Protection Act 1994*. In order to lawfully operate you may also require permits / approvals from your local government authority, other business units within the department and other State Government agencies prior to commencing any activity at the site. For example, this may include permits / approvals with your local Council (for planning approval), the Department of Transport and Main Roads (to access State controlled roads), the Department of Resources (to clear vegetation), and the Department of Agriculture and Fisheries (to clear marine plants or to obtain a quarry material allocation).

This **Environmental Authority** 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
- Schedule I - Maps / Plans

Conditions of environmental authority

Schedule A – General

Financial assurance

(A1-1) 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 (A1-1) 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)

(A1-2) 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.

Maintenance of measures, plant and equipment

(A2-1) The holder must:

a) install all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority; and

b) maintain such measures, plant and equipment in a proper condition; and

c) operate such measures, plant and equipment in a proper manner.

Monitoring

(A3-1) 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.

(A3-2) Where monitoring is a requirement of this environmental authority, ensure that an appropriately qualified person conducts all monitoring.

Storage and handling of flammable and combustible liquids

(A4-1) 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.

END OF CONDITIONS FOR SCHEDULE A

Schedule B – Air

Dust nuisance

(B1-1) Subject to Conditions (B1-2) and (B1-3) 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.

(B1-2) 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.

(B1-3) If the environmental authority holder can provide evidence through monitoring that the following limits are not being exceeded then the holder is not in breach of (B1-1):

a) Dust deposition of 120 milligrams per square metre 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 particulates - Deposited matter - Gravimetric method of 1991; and/or

b) A concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 150 micrograms per cubic metre over a 24 hour averaging time, at a sensitive or commercial place downwind 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 1990; or
- Any alternative method of monitoring PM10 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 (B13) (a) or (b) or both.

(B1-4) If monitoring indicates exceedance of the relevant limits in Condition (B1-3), 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 that emissions of dust from the activity do not result in environmental nuisance.

END OF CONDITIONS FOR SCHEDULE B

Schedule C – Water

Release to waters

(C1-1) Receiving waters affected by the release of storm water contaminated by the mining activities must be monitored at the locations and frequencies defined in Schedule C - Table 1 as defined in Schedule I - Map 1 and for the parameters defined in Schedule C – Table 4 and W6 must comply with the contaminant limit defined in Schedule C - Table 4.

Schedule C - Table 1 (Receiving waters monitoring locations and frequency)

Monitoring point	Northing (AMG)	Easting (AMG)	Monitoring frequency
W1	6788934	351596	6 monthly (during a flow event)
W6	6788476	352750	6 monthly (during a flow event)
W4	6788447	351993	6 monthly (during a flow event)

(C1-2) Stormwater contaminated by mining activities must only be released as seepage from sediment dams at release points defined in Schedule C – Table 2.

(C1-3) Stormwater contaminated by mining activities must be monitored at the locations and frequencies defined in Schedule C - Table 2 and Schedule I - Map 1 and comply with the contaminant limits defined in Schedule C - Table 3.

Schedule C - Table 2 (Release point monitoring locations and frequency)

Monitoring point	Northing (AMG)	Easting (AMG)	Monitoring frequency
W2	6788890	351508	6 monthly (during a flow event)
W3	6788629.83	351720.46	6 monthly (during a flow event)
W5	6788621	352144	6 monthly (during a flow event)
W3a	6788775	351942	6 monthly (during a flow event)

Schedule C - Table 3 (Sediment dam contaminant release limits for monitoring points W2, W3 and W5)

Parameter	Units	Minimum	Maximum
Electrical Conductivity	µs/cm	0	225
pH	range	6.5	8.5
Oil and Grease	mg/L	0	10

Schedule C - Table 4 (W6 monitoring point contamination limit)

Parameter	Units	Maximum

Suspended Solids	mg/L	25

C1-4) The following must be documented when monitoring is conducted in accordance with condition C1-1 Schedule C - Tables 1 and 4 and condition C1-2 and C1-3 and Schedule C - Tables 2 and 3:

a) Flow rate,

b) Time,

c) Date,

d) Weather conditions,

e) Water temperature, and

f) Description of the flow conditions (e.g. turbulence etc).

(C1-5) Monitoring conducted in accordance with condition C1-1 schedule C Tables 1 and 4 and condition C1-2 Schedule C - Tables 2 and 3 must be undertaken at the same time as reasonably practicable.

(C1-6) When monitoring conducted in accordance with condition C1-1 schedule C Table 1 indicates an exceedance of the limit in schedule C Table 4, it is not considered to be an exceedance of the limit in schedule C Table 4 if the environmental authority holder can demonstrate to the satisfaction of the administering authority, through simultaneous monitoring at point W1 and W6, that the peak is a variation in suspended solids levels, not caused by mining activities.

Stream sediment contaminant levels

(C2-1) All reasonable and practicable erosion protection measures and sediment control measures (e.g. diversion banks and progressive re-vegetation of disturbed areas) must be implemented and maintained to minimise erosion and the release of sediment.

(C2-2) Sediment collection dams must be designed and maintained to prevent overtopping during a 1 in 50 year rainfall event (4 month wet season) and to facilitate the settlement of suspended solids in stormwater contaminated by mining activities.

Sewage effluent

(C3-1) Treated sewage effluent from sewage treatment facilities must be reused and/or evaporated and must not be directly or indirectly released from any sewage treatment plant to any water way or drainage line.

Groundwater

(C4-1) All reasonable and practicable measures must be taken to prevent the contamination of groundwater.

(C4-2) There must be no release of contaminants to groundwater as a result of mining activities.

END OF CONDITIONS FOR SCHEDULE C

Schedule D – Noise and Vibration

Noise nuisance

(D1-1) Subject to Conditions (D1-2) and (D1-3) noise from the mining activity must not cause an environmental nuisance, at any sensitive place or commercial place.

(D1-2) 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.

(D1-3) If the environmental authority holder can provide evidence through monitoring that the limits defined in the table in Schedule D - Table 1 and 2 inclusive are not being exceeded then the holder is not in breach of Condition (D1-1). Monitoring must include:

a) LA, max adj, T

b) the level and frequency of occurrence of impulsive or tonal noise;

c) atmospheric conditions including wind speed and direction; and

d) location, date and time of recording.

(D1-4) If monitoring indicates exceedance of the limits in Schedule D - Table 1 and 2 then the environmental authority 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.

(D1-5) The method of measurement and reporting of noise levels must comply with the latest edition of the Environmental Protection Agency's Noise Measurement Manual.

Schedule D – Table 1 (Noise limits)

Noise level dB(A) measured as	Monday to Saturday			Sundays and public holidays		
	6am - 6pm	6pm - 10pm	10pm - 6am	6am - 6pm	6pm - 10pm	10pm - 6am
	Noise measured at a 'Noise sensitive place'					
$L_{Aeq, adj, 1 hr}$	38	33	33	38	33	33
$L_{A1, adj, 10 mins}$	40	35	35	40	35	35
	Noise measured at a 'Commercial place'					
$L_{Aeq, adj, 1 hr}$	43	38	38	43	38	38
$L_{A1, adj, 10 mins}$	45	40	40	45	40	40

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual. ['b/g' means background noise levels]

Schedule D – Table 2 (Airblast overpressure level – 'Sensitive or commercial place')

Noise parameter	Monday to Saturday 7am - 5pm	Sundays and public holidays 9am-1pm
Air blast overpressure level (dB linear peak)	115dB (for nine out of any 10 consecutive blasts)	Blasting permitted with consent of the administering authority. Limits the same as Monday to Saturday
Air blast overpressure level (dB linear peak)	120dB (maximum)	

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual.

Vibration nuisance

(D2-1) Subject to Conditions (D2-2) and (D2-3) vibration from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.

(D2-2) 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 place, and the results must be notified within 14 days to the administering authority following completion of monitoring.

(D2-3) If the environmental authority 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 (D2-1). Monitoring must include:

a) location of the blast/s within the mining 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.

(D2-4) If monitoring indicates exceedance of the relevant limits in Schedule D - Table 3, then the environmental authority 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 – 'Sensitive or commercial place')

Vibration parameter	Monday to Saturday 7am - 5pm	Sundays and public holidays 9am to 1pm
Sensitive or commercial place	5mm/s peak particle velocity for nine out of 10 consecutive blasts and not greater than 10mm/s peak particle velocity at any time	Blasting permitted with consent of the administering authority. Limits the same as Monday to Saturday

NOTE: The method of measurement and reporting of noise levels must comply with the latest editions of the Environmental Protection Agency's Noise Manual.

END OF CONDITIONS FOR SCHEDULE D

Schedule E – Waste

Storage of tyres

(E1-1) Tyres stored awaiting disposal or transport for take-back and, recycling, or waste-to-energy options - should be stockpiled in volumes less than 3m in height and 200 sq.m in area and at least 10m from any other tyre storage area.

(E1-2) 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.

Waste Management

(E2-1) The handling and disposal of all waste produced on site is to be conducted using methods to avoid contamination of land and surface and ground water.

(E2-2) 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).

(E2-3) The environmental authority holder must remediate any contaminated land resulting from mining activities within the lease area prior to the surrender of the mining lease.

END OF CONDITIONS FOR SCHEDULE E

Schedule F – Land

(F1-1) The environmental authority holder must not carry out mining activities within any regional ecosystem located on ML50142.

(F1-2) Notwithstanding condition (F1-1), the holder of this environmental authority is authorised to remove the area of regional ecosystem shown in Schedule I - Map 1. In removing this vegetation, the holder of the environmental authority must take all reasonable and practicable measures to minimise disturbance to regional ecosystem 13.11.4, including retention of juvenile species through exclusion of grazing stock including feral goats.

(F1-3) All reasonable and practicable measures must be taken to minimise disturbance of Regional Ecosystem 13.11.4 on ML50220, including retention of juvenile species through exclusion of grazing stock including feral goats.

Rehabilitation landform criteria

(F2-1) All areas significantly disturbed by mining activities must be rehabilitated to a stable landform and unless nominated as a non-use management area must have self-sustaining vegetation cover in accordance with the final land description as defined in Schedule F - Table 1a.

Schedule F - Table 1a (ML50142 and ML50220 Final land use and rehabilitation approval schedule)

Disturbance type	Disturbance area (ha)	Pre-mine land	Post-mine land	Slope Range
Residual Void(s)	8.1 (area of the Pit floor)	Light grazing and fauna habitat	Native ecosystem	0° - 5°
	11.55 (area of the terraced benches)	Light grazing and fauna habitat	Non-use management area	Void wall competent rock max slope 70°; Void wall incompetent rock max slope 37°
Clay waste 'Topsoil'	1.05	Light grazing and fauna habitat	Native ecosystem	7° to 9°
Waste Rock Dump	6.64	Light grazing and fauna habitat	Native ecosystem	16° to 20°
Infrastructure (processing plant, ROM and office area)	8.70	Light grazing and fauna habitat	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners agreement	3° to 4° (ML50142) <18° (ML50220)

Roads and Tracks	6.88	Access	Bitumen and unsealed roads for site access	N/A
Sediment Pond	2.32	Light grazing and fauna habitat	Water supply in accordance with landowners agreement	N/A
Laydown Areas	5.35	Light grazing and fauna habitat	Native ecosystem	0° - 5°
Cleared Areas	3.42	Light grazing and fauna habitat	Native ecosystem	0° - 5°
Historical Cleared Areas	0.56	Light grazing and fauna habitat	Native ecosystem	0° - 5°
Total	54.57			

(F2-2) Progressive rehabilitation must commence when areas become available within the operational land.

(F2-3) By 31 March 2007, the environmental authority holder must complete an investigation into rehabilitation of disturbed areas and submit a report to the administering authority in accordance with conditions F2-1 and F2-2 and propose acceptance criteria to meet the outcomes and landform design criteria in Schedule F - Table 1 and 2.

(F2-4) The report submitted to the administering authority in accordance with condition F2-3 must include the following;

a) A detailed description of analogue sites that contain a representative species combination and vegetation cover to achieve the rehabilitation outcomes defined in Schedule F - Table 1 and 2, and

b) A weed management program including a list of all weeds identified and weed control methods.

Residual void outcome

(F3-1) 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 2.

(F3-2) The environmental authority holder must prior to five years before the end of mining, complete an investigation into residual voids and submit a report to the administering authority proposing acceptance criteria to meet the outcomes in (F3-1) and landform design criteria in Schedule F - Table 2.

Schedule F – Table 2 (Residual void design)

Void identification	Void wall - competent rock slope (degrees)	Void wall - incompetent rock slope (degrees)	Void maximum surface area (ha)
Main Void	70º	37º	16.5

Infrastructure

(F4-1) All infrastructure, constructed by or for the environmental authority holder during the mining activities including water storage structures, must be removed from the site prior to mining lease surrender, except where agreed in writing by the post mining land owner / holder.

Bat Fauna

(F5-1) By 31 August 2006, develop, implement and submit to the administering authority a Bat Monitoring Program that includes the following objectives and methodologies;

a) Monitor the bat population annually before parturition occurs, using the approved video fly-out count method. The video recording of the exit flights may be conducted by the environmental authority holder but the count and assessment must be conducted by a suitably qualified person.

b) Investigate the feasibility of estimating the population of the Eastern Horseshoe Bat using a bat detector in conjunction with video recordings of exit flights.

c) Monitor by video the bats within the Riverton Bat Cave on at least three occasions during a blast event and at least three occasions in the absence of a blast event, during the bat maternity season (1 November to 31 March) and when there is a significant change in blasting locations, rock strata or explosive intensity.

d) Determine annually a bat population benchmark and limits of acceptable change that, if exceeded would trigger an investigation to determine the cause of the bat population falling to that limit. The environmental authority holder must submit a report on the investigation to the administering authority two months after identifying the population falling below the limit of acceptable change. If the investigation determines that mining activities contributed to the population decline, the environmental authority holder must make recommendations as to what actions can be taken to manage the affects of mining activities on the bat population declines in consultation with the administering authority.

(F5-2) By 31 August 2006, develop and submit a program to monitor the Riverton Bat Cave structural integrity with the objective of minimising the potential for cave collapse. The monitoring program must be submitted to the administering authority and include the following:

a) Expert advice on whether it is possible to secure unstable sections of the cave roof, and

b) Bi-annual geo-technical assessment of the Riverton Bat Cave structure.

(F5-3) For the environmental authority holder to successfully demonstrate compliance with conditions F5-1 and F5-2 the submission to the administering authority must be supported with scientific monitoring, research and is reviewed and supported by experts and stakeholders, to the satisfaction of the administering authority.

(F5-4) No blasting or disturbance (except minor disturbance associated with accessing the cave for purposes of achieving compliance with this environmental authority) of vegetation is to occur within 215 metres of the Riverton Bat Cave entrance.

Note: The environmental authority holder may make a submission to the administering authority for the review of the 215-metre exclusion zone around the Riverton Bat Cave.

(F5-5) Restrict human access to the Riverton Bat Cave except for the purposes of achieving compliance with this environmental authority.

(F5-6) Mining activities must not adversely affect the structural integrity or cause a partial or full collapse of the Riverton Bat Cave.

Matters of State Environmental Significance

(F5-7) Significant residual impacts to prescribed environmental matters are not authorised on ML50142 and ML50220 under this environmental authority or the *Environmental Offsets Act* 2014.

(F5-8) Records demonstrating that each impact to a prescribed environmental matter 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.

END OF CONDITIONS FOR SCHEUDLE F

Schedule G – Community

Complaint response

(G1-1) All complaints received must be recorded including details of complainant, reasons for the complaint investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.

(G1-2) By 31 March 2007, a cultural and historical archaeological survey must be conducted to investigate and identify the existence of any cultural and historical archaeological sites or items of significance within the mining lease area.

Notification of Emergencies and Incidents

(G2-1) 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 environmental authority, the holder of this environmental authority must notify the administering authority as soon as possible.

(G2-2) The notification of emergencies or incidents as required by condition G2-1 must include but not be limited to the following:

i) the holder of the environmental authority;

ii) the location of the emergency or incident;

iii) the number of the environmental authority;

iv) the name and telephone number of the designated contact person;

v) the time of the release;

vi) the time the holder of the environmental authority became aware of the release;

vii) the suspected cause of the release;

viii) the environmental harm and or environmental nuisance caused, threatened, or suspected to be caused by the release; and

ix) actions taken to prevent any further release and mitigate any environmental harm and or environmental nuisance caused by the release.

(G2-3) Not more than fourteen (14) days following the initial notification of an emergency or incident, the holder of the environmental authority must provide written advice of the information supplied in accordance with condition G2-2 in addition to:

i) proposed actions to prevent a recurrence of the emergency or incident;

ii) outcomes of actions taken at the time to prevent or minimise environmental harm and or environmental nuisance; and

iii) the results of any environmental monitoring performed.

Any notifications given under section 320 or section 350 of the *Environmental Protection Act 1994* that contains the information set out in conditions G2-2 and G2-3 is also a notification under this condition.

Exception Reporting

(G3-1) The holder of this environmental authority must notify the administering authority in writing of any monitoring result that indicates an exceedence of or non-compliance with any environmental authority limit within twenty-eight (28) days of completion of analysis.

(G3-2) The written notification required by condition number G3-1 above must include:

i) the full analysis results;

ii) details of investigation or corrective actions taken; and

iii) any subsequent analysis.

Any notifications given under section 320 or section 350 of the *Environmental Protection Act* that contains the information set out in condition G3-2 is also a notification under this condition.

END OF CONDITIONS FOR SCHEDULE G

Schedule H - Definitions

Words and phrases used throughout this license are defined below except were identified in the EP Act or subordinate legislation. Where a word or term is not defined, the ordinary English meaning applies, and regard should be given to the Macquarie Dictionary.

Word definitions

"acceptance criteria" means the measures by which the actions implemented to rehabilitate the land are deemed to be complete (same as completion criteria).

"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-

- rock, coal and other minerals for later recovery; or
- structural components or other items to facilitate removal from a site or for reuse.

"commercial place" means a place used as an office or for business or commercial purposes, other than a place within the boundaries of the operational land.

“endangered regional ecosystem” means an endangered regional ecosystem identified in the database maintained by the administering authority called ‘Regional ecosystem descriptions database’ containing regional ecosystem numbers and descriptions.

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

"$L_{A\ 10,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 10% of any 10 minute measurement period, using Fast response.

"$L_{A\ 1,\ adj,\ 10\ mins}$" means the A-weighted sound pressure level, (adjusted for tonal character and impulsiveness of the sound) exceeded for 1% of any 10 minute measurement period, using Fast response

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

"$L_{A\ eq,\ adj,\ 1\ hr}$" means the A-weighted sound pressure level adjusted for noise character of a continuous steady sound that within one hour has the same mean-sequence as a sound under consideration whose level varies within time. The equivalent continuous A-weighted sound pressure level is quoted at the nearest whole number of decibels.

"land" in the 'land schedule' of this document means land excluding waters and the atmosphere, "noise sensitive place" or a "commercial place".

"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.

"leachate" means a liquid that has passed through or emerged from, or is likely to have passed through or emerged from, a material stored, processed or disposed of at the operational land which contains soluble, suspended or miscible contaminants likely to have been derived from the said material.

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

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

“parturition” means the process of giving birth.

"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)

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

"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.

"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.

"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
- an educational institution; or
- a medical centre 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; or
- a place used as a workplace, 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; and
- does not include Riverton Bat Cave.

"significant residual impact" is defined in section 8 of the *Environmental Offsets Act 2014*.

"stable" means geotechnical stability of the rehabilitated landform where instability related to the excessive settlement and subsidence caused by consolidation / settlement of the wastes deposited, and sliding / slumping instability has ceased.

"waters" includes river, stream, lake, lagoon, pond, swamp, wetland, unconfined surface water, unconfined water natural, bed and bank of any waters, dams, non-tidal or tidal waters (including the sea), and any under groundwater, any part-thereof.

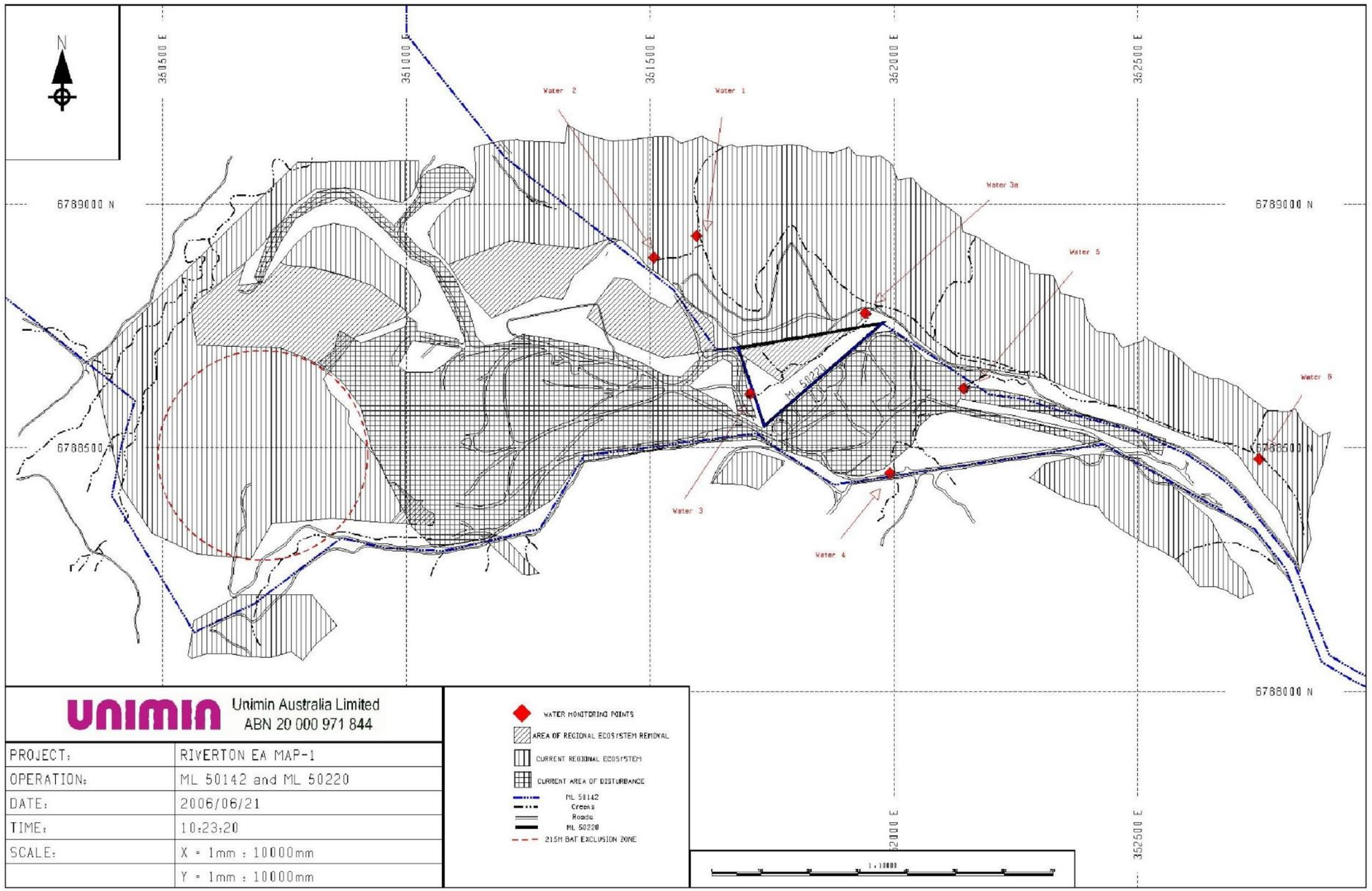
END OF DEFINITIONS IN SCHEDULE H

END OF CONDITIONS

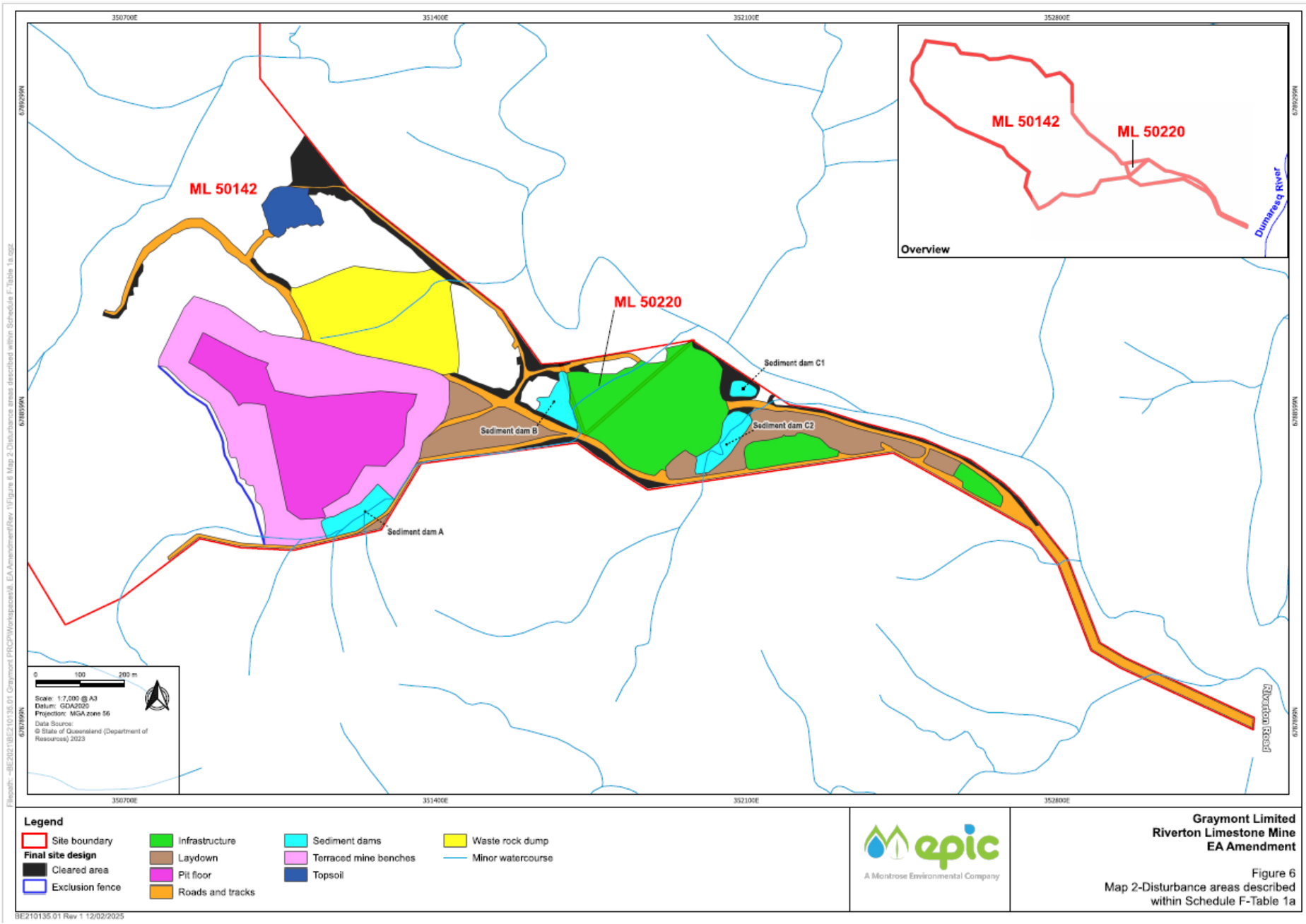
Schedule I – Map

Map 1 – Area of Regional Ecosystem Removal

END OF CONDITIONS FOR SCHEDULE I



MAP 1 – Area of Regional Ecosystem Removal



Map 2 – Location, disturbance type and areas specified in Schedule F-Table 1a as required by condition F2-5.

END OF ENVIRONMENTAL AUTHORITY

Appendix D Landholder Agreement

GRAYMONT

Landholder Statement

Riverton EPML00241213

Graymont (NSW) Pty Ltd is the landowner of Lot 1 SP310330 and Lot 3 RP207320 (the land) which contain the following mining leases (ML) ML50142 and ML50220. The landowner agrees that the following infrastructure, as documented in the 2024 Progressive Rehabilitation and Closure Plan (submitted to Department of Environment, Science and Innovation, June 2024), will be retained at end of mine life after relinquishment of the MLs, and that they will accept all responsibility for the continued maintenance of them:

- Four (4) sediment basins and stormwater diversion infrastructure
- All access tracks and roads
- Decommissioned infrastructure areas, including hardstand areas

Signed by Graymont (NSW) Pty Ltd

Michelle Muir	Corporate Affairs & HSE Manager	MMuir	5 June 2024
Name	**Position**	**Signature**	**Date**

By signing this agreement, the signatory warrants that they are duly authorised to execute this statement on behalf of Graymont (NSW) Pty Ltd.

PO Box 642
North Sydney NSW 2059
Australia

Appendix E Vegetation Management Plan (Epic Environmental 2023)



A Montrose Environmental Company

Riverton Limestone Mine Vegetation Management Plan

Graymont (Australia) Pty Ltd
Riverton Limestone Mine
Riverton, QLD
BE210135.01
9 December 2025

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2	1/08/2025	Draft for Internal Review	O Robertson	-	-	-
3	8/12/2025	Final for Issue	O. Robertson, C. Capewell	H. Tibbetts	O. Robertson	M. Blyth

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Project number:	BE210135.01

1 INTRODUCTION

Epic Environmental Pty Ltd (Epic) was engaged by Graymont (Australia) Pty Ltd (Graymont) to provide a Vegetation Management Plan (VMP) to support the Progressive Rehabilitation Closure Plan (PRCP) for the rehabilitation of the Riverton Limestone Mine. The mine covers two existing mining leases (MLs) held by Graymont comprising ML50142 and ML50220 (the site) and is located west of the Bruxner Highway, at Riverton, Queensland. This VMP was prepared in accordance with **Section 3.6.1** of the PRCP guidelines (DETSI 2025).

1.1 The Site

The site is located approximately 60 kilometres (km) southwest of Stanthorpe and 1.5 km west of the Queensland/New South Wales (NSW) state border (**Figure 1**). The site is surrounded by undulating, forested terrain, with clearing for agriculture located further east in association with the Dumaresq River.

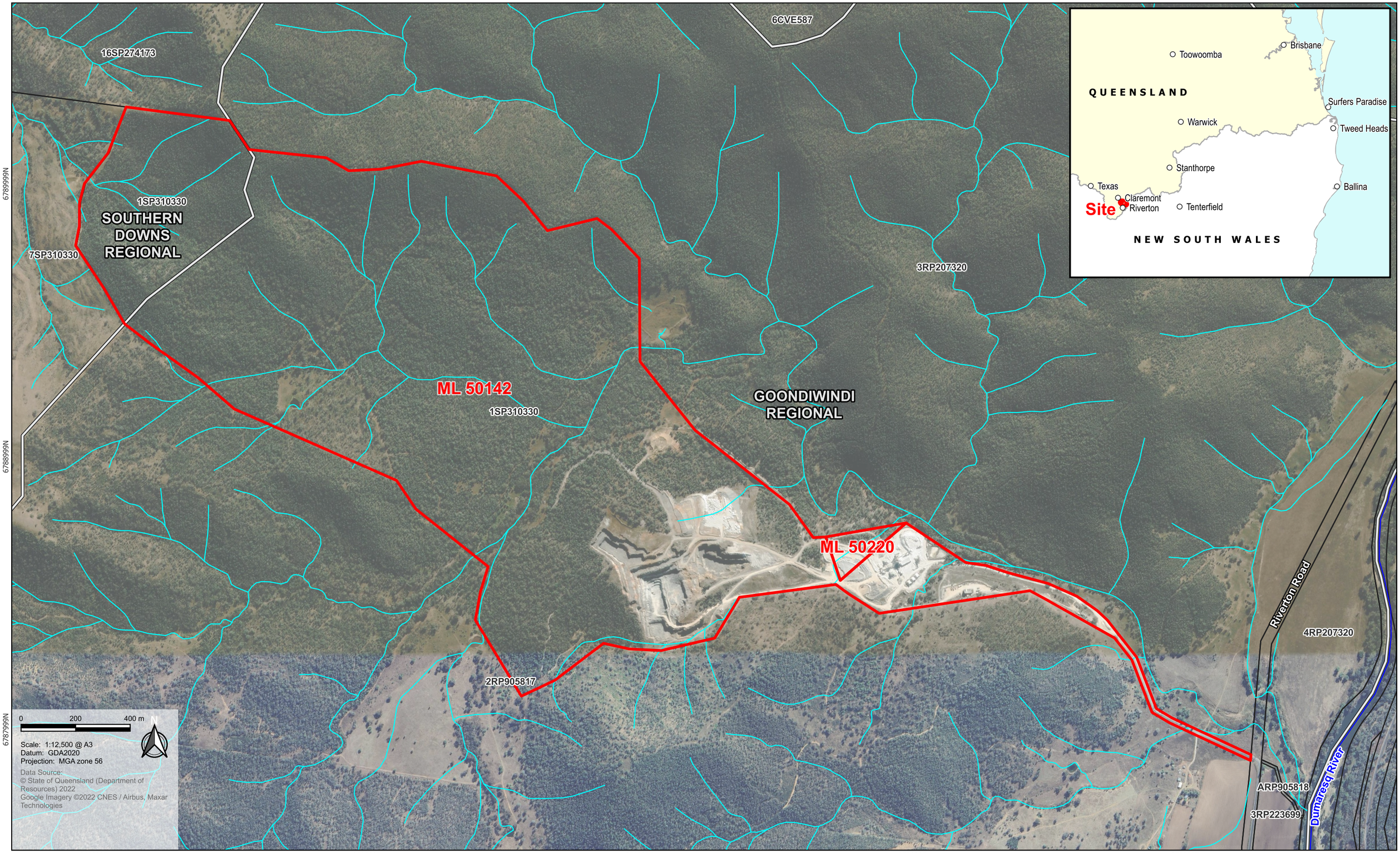
Mining activities are authorised under Environmental Authority (EA) EPML00241213 held by Graymont. The EA authorises the holder to extract between 100,000 and 500,000 tonnes of limestone per year.

1.2 Objective

The objective of this VMP is to inform the PRCP for the site by providing a revegetation plan for disturbed areas proposed for rehabilitation. The object of this VMP is to rehabilitate all areas significantly disturbed by mining activities to a stable landform with self-sustaining vegetation cover in accordance with the final land description as defined in Schedule F – Table 1a and Schedule F – Table 1b of the EA for the site (EPML00241213). The proposed Post Mining Land Use (PMLU) of the rehabilitation areas subject to this report is predominantly 'native ecosystem', with two distinct areas assigned the PMLU of 'native ecosystem - NOVEL' in the 'novel planned' subclass in accordance with the "Implications for leading practice" document, *Native ecosystem rehabilitation in Queensland* (OQMRC 2023). A 'native ecosystem – NOVEL' PMLU was assigned to areas where traditional 'native ecosystem' PMLU could not be achieved due to substrate limitations or safe access restrictions.

1.3 Scope

This VMP only applies to the rehabilitation of disturbance areas identified in Schedule F – Table 1a and Schedule F – Table 1b of the EA for the site within ML50142 and ML50220.



Legend

- Site boundary
- Local Government Areas
- Cadastre (DCDB)

Watercourses

- Major
- Minor

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Graymont Limited
Riverton Limestone Mine
Vegetation Management Plan

Figure 1
Site location

Filepath: -\BE2021\BE210135.01 Graymont PRCP\Workspaces\12. VMP\Rev 1\Figure 1 Site location.qgz

2 EXISTING CONDITIONS

2.1 Current Condition

The majority of the site outside of operational areas is vegetated with remnant woodland. Operational areas include a residual void, topsoil storage area, waste rock dump, sediment basins, hardstand areas, roads and tracks and associated mining infrastructure. The site is bordered by remnant, regrowth and non-remnant vegetation. Vegetation communities across the site are discussed in further detail in **Section 2.3**.

2.2 Topography and Landform

The site occurs on hills and lowland on metamorphic rocks (land zone 11). The site dominates a major ridgeline and has altered the natural landform through the excavation of limestone. Several gullies traverse the site draining towards the north into a 3rd order stream watercourse.

2.3 Vegetation Communities

An inspection of portions of the site was completed over a two-day period on the 26 and 27 of May 2021 by two Epic staff, including a suitably qualified ecologist (Dan Hede). The site inspection involved a census of flora species including weeds and Quaternary Regional Ecosystem (RE) surveys as outlined in Neldner et al (2020). Three vegetation communities were identified within the site, including a single RE type, described as RE 13.11.4 - Eucalyptus melanophloia woodland on metamorphics:

- Remnant *Eucalyptus melanophloia* woodland on metamorphics (refer **Plate 1**)
- Regrowth *Eucalyptus melanophloia* woodland on metamorphics (refer **Plate 2**)
- Disturbed non-remnant vegetation (refer **Plate 3**)



Plate 1. Remnant *Eucalyptus melanophloia* woodland



Plate 2. Regrowth *Eucalyptus melanophloia* woodland



Plate 3. Non-remnant vegetation

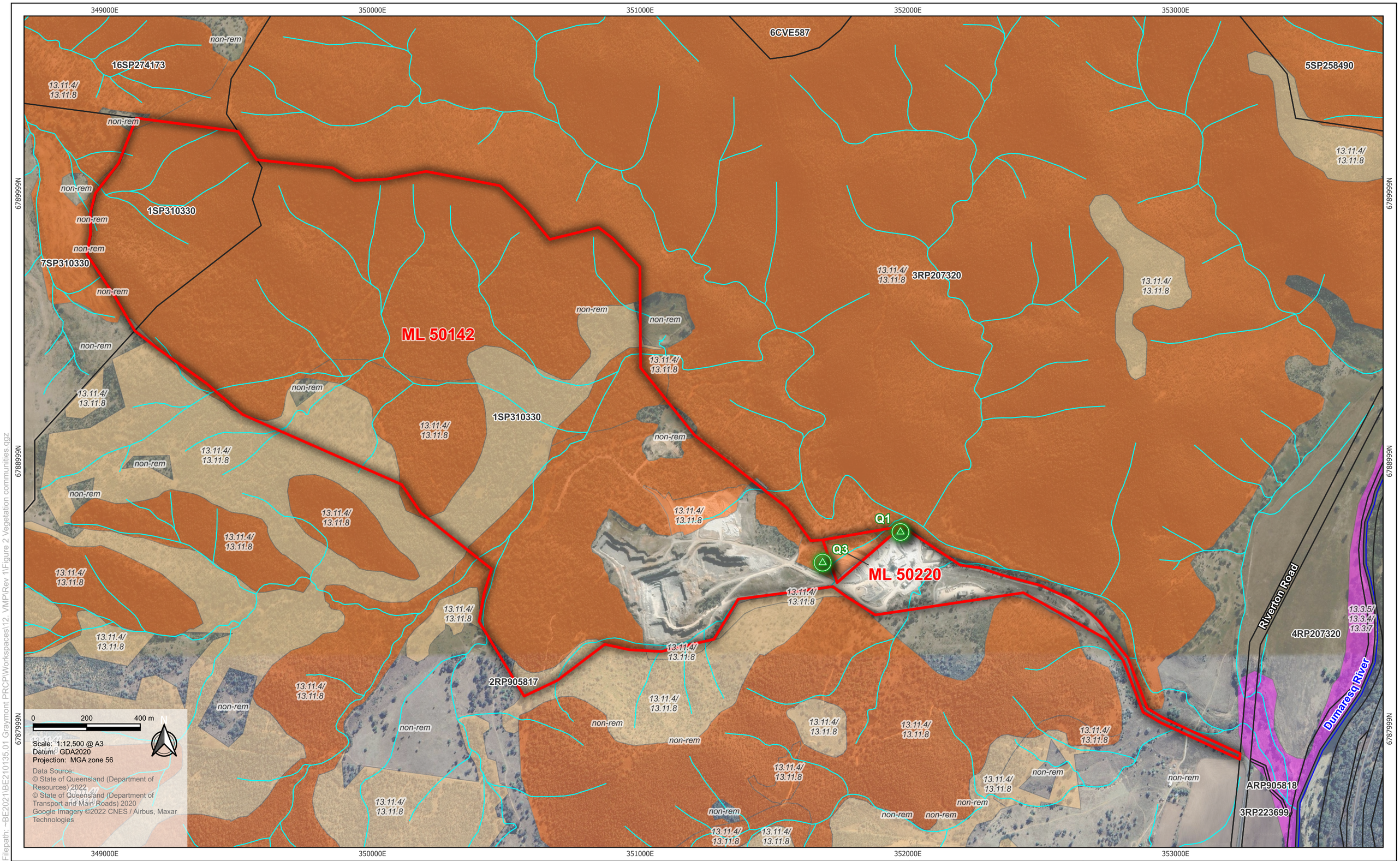
The condition and floristics of remnant and regrowth vegetation communities are described in **Table 1** and current RE mapping displayed in **Figure 2**.

Areas within the site proposed for rehabilitation include regrowth and non-remnant vegetation. The condition of areas proposed for revegetation varies from disturbed/thinned native regrowth vegetation (refer **Plate 2**) to bare areas devoid of woody vegetation (refer **Plate 3**). Two Quaternary RE surveys have been completed in remnant and regrowth vegetation within the site (**Figure 2**). Field data collected during RE surveys is presented in **Table 1**. These RE assessment sites will comprise analogue sites which contain a representative species combination and vegetation cover to achieve the rehabilitation outcomes defined in Schedule F – Table 1 and Table 2 of the EA (EPML00241213). Remnant and regrowth vegetation was considered suitable as analogue sites for the rehabilitation goals of this VMP, primarily to provide a stable landform with self-sustaining vegetation cover.

Table 1. Vegetation Communities

Site	Verified RE code and REDD short description[1]	VM Act status[2]	Field description and condition
Q1 Lat/Long: -29.021, 151.480	Regrowth 13.11.4	Least concern	Median canopy height and coverage: 23 m, 15% Median subcanopy height: 14 m, 20% Median shrub layer 1 height and cover: 7 m, 10% Median shrub layer 2 height and cover: 2 m, 15% Median ground layer height and cover: 0.4, 30% Dominant canopy trees included *Angophora floribunda* and *Eucalyptus melanophloia.* Subcanopy was dominated by *Callitris glaucophylla.* Shrub layer 1 was dominated by *Geijera parviflora,* with non-native *Schinus molle* present as an associate. Shrub layer 2 was dominated by *Notelaea microcarpa.* Native grass *Austrostipa verticillata* was dominant ground layer species.
Q3 Lat/Long: -29.022, 151.477	Remnant 13.11.4 *Eucalyptus melanophloia* woodland on metamorphics	Least concern	Median canopy height and coverage: 16 m, 25% Median subcanopy height and cover: 8 m, 20% Median shrub layer 1 height and cover: 3.5 m, 15% Ground cover height and cover: 0.4 m, 60% Dominant canopy trees included *Eucalyptus albens* and *Eucalyptus melanophloia.* Subcanopy was dominated by *Callitris glaucophylla.* Shrub layer 1 was dominated by *Notelaea microcarpa.* Native grass *Aristida calycina* was dominant ground layer species.

Note:
[1]REDD V12.0 (Queensland Herbarium 2021)
[2]VM Act = *Vegetation Management Act 1999*



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\12. VMP\Rev 1\Figure 2 Vegetation communities.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Regional Ecosystems v13

- Category A or B area containing endangered
- Category A or B area containing of concern
- Category C or R area containing of concern
- Non-remnant

Watercourses

- Major
- Minor
- Analogue RE assessment sites

epic
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Graymont Limited
Riverton Limestone Mine
Vegetation Management Plan

Figure 2
Vegetation communities

BE210135.01 Rev 0 23/10/2024

3 REHABILITATION ACTIVITIES

3.1 Rehabilitation Areas

There are eight rehabilitation areas relevant to the EA (EPML00241213), with four nominated PMLU's, including:

- Native Ecosystem
- Native Ecosystem (NOVEL)
- Water Storage
- Retained Infrastructure

Only those areas proposed for a native ecosystem PMLU will be the subject of this report with works comprising revegetation or assisted regeneration depending on existing vegetation condition and location of the rehabilitation area within the site. The PMLU areas are shown in **Figure 3**.

3.2 Revegetation Method

3.2.1 Objectives

The purpose of the proposed revegetation works is to revegetate rehabilitation areas with a PMLU of native ecosystem (both traditional and NOVEL) to a functional and self-sustaining state.

Mine areas subject to revegetation works will include the following components:

- Topsoil stockpile
- Waste rock dump (out-of-pit)
- Laydown areas
- Cleared areas
- Infrastructure areas
- Residual void pit floor and in-pit waste rock dump
- Historical disturbance areas

Proposed revegetation works will vary between those areas subject to traditional or NOVEL native ecosystem PMLU. This is the result of one or more of the following factors:

- Safe access to work areas to undertake revegetation works
- Ability of substrate to support proposed vegetation
- Long-term landform stability
- Vulnerability of landform to deep rooting vegetation

3.2.2 Surface Preparation

The Steps for surface preparation prior to planting for both traditional and NOVEL ecosystems has been described below.

3.2.2.1 Step 1 - Topsoil Preparation and Initial Planting Seed Mix

The topsoil proposed for use in the revegetation works has been tested by a soil scientist and the following observation made:

- Chemical characterisation of the clay-textured soil sampled indicate the material is alkaline with a pH range of 8.16-8.53
- For rehabilitation purposes, only lime (high pH) tolerant species are suitable
- The soil is grossly deficient in all plant nutrients except calcium and magnesium
- Sulphur is particularly low
- An initial green manure crop is recommended (i.e. grain barley) to build up organic matter
- Initial planting should be combined with an inoculated clover for nitrogen-fixation

The application and preparation of topsoil should occur as follows:

- Compacted soil to be ripped using a suitable machine such as an excavator with ripper attachment or bulldozer
- 150 mm top dress using salvaged topsoil
- Prior to applying topsoil, any weeds will be removed from the area by hand, ensuring complete removal of the root system with the exception of the pit floor
- Where slope is >10° coir logs should be placed in rows running parallel to slope contours and spaced at 10 m intervals to control erosion and sedimentation

3.2.2.2 Step 2 - Initial Treatment

To mitigate deficiencies in the topsoil, a treatment in the form of an initial planting is proposed. The initial planting should be completed in autumn following the spread of topsoil across the revegetation areas. The initial planting seed mix will include grain barley and inoculated clover. Prior to flowering the initial planting crop should be roto-tilled back into the topsoil as a green manure.

3.2.2.3 Step 3 - Fertiliser Application

Following completion of the initial treatment with green manure, a low-dose application of low phosphorus (P) fertiliser (less than 3% P) is recommended at a rate of 200-250 kg/ha. In order to prevent a flush of nitrogen (N) that would promote weeds, a controlled release formulation is recommended, with a release time of 8-9 months. A controlled release formulation would also negate the need for repeat applications. Selected fertiliser should also include trace elements, particularly zinc (Zn) which is highly deficient at the site (Epic 2023). Fertiliser should be applied using standard agricultural machinery, with the exception of the pit abandonment bunds and areas between bunds and pit walls that are restricted due to safety concerns.

3.2.2.4 Step 4 - Initial Weed Control

Repeat applications of herbicide spray should be applied prior to planting

3.2.3 Native Ecosystem (NOVEL)

The planting and maintenance methodology for native ecosystem (NOVEL), is described in the following sections.

3.2.3.1 Step 5 - Planting

Native grass seeds of species identified in **Table 2** will be sown into the topsoil in autumn. Standard agricultural machinery should be used to sow seeds at a rate of 25 kg per ha. The following outlines the standard approach to ensure native grass seeds are sown effectively and support successful germination:

- The soil surface should be prepared to an appropriate condition that facilitates seed–soil contact and promotes establishment
- Native grass seed (refer **Table 2**) should be applied evenly across the designated areas using suitable and consistent sowing methods
- The soil should be lightly settled or stabilised following sowing to enhance germination and reduce seed displacement
- Sowing should be timed to coincide with favourable seasonal conditions, preferably ahead of expected rainfall to support early growth
- Initial germination should be monitored, with supplementary or infill seeding undertaken where establishment is inadequate or patchy

3.2.3.2 Step 6 – Maintenance

Maintenance activities should be undertaken for a minimum period of 12 months and up to 24 months and include:

- Weed management to ensure weeds do not outcompete establishing plants (refer to **Section 3.8.4**)

- Supplementary planting in areas where plants have significant die-off
- Additional watering if hot, dry conditions persist, particularly during the first 8 weeks

3.2.4 Native Ecosystem (Traditional)

The planting and maintenance methodology for native ecosystem (traditional), is described in the following sections.

3.2.4.1 Step 5 – Planting

As far as practicable, planting should be undertaken in autumn following significant rain and when the surface soil moisture levels are optimum. Planting methods specific to native ecosystem (traditional) are t detailed below:

- Planting of trees and shrubs should be planted in rows installed at 5 m intervals and should be configured parallel to the site's contour to allow management access in between rows
- Trees to be selected at the composition as outlined in **Table 2**
- Plants should be spaced 2 m apart
- Planting will involve planting in a slight shallow, twice the size of the tube container, ensuring the root ball is just below the soil surface. A fertilizer tablet is to be placed adjacent to but not touching the root ball. Soil is to be backfilled to the same level as when the plant was in the container. An application of mulch to a depth of 50-100 mm is then required to surround the plant, but not touch the stem
- Ring mulching or blanket mulching is acceptable
- Shrubs and trees will be planted at a density of 12 plants per 100 m^2

3.2.4.2 Step 6 – Maintenance

Maintenance activities should be undertaken for a minimum period of 12 months and up to 24 months, and include:

- Watering:
  - If using a water cart use 10-15 litres water per plant for a minimum of eight weeks
  - Water twice in the first week, then one per week from weeks 2-8
  - Less water required per plant if hand watering
- Maintenance:
  - Weed management to ensure weeds do not outcompete establishing plants (refer to **Section 3.8.4**)
  - Supplementary planting in areas where plants have significant die-off

351000E
352000E
353000E
6789000N
6788000N

ML 50142
1SP310330
ML 50220
3RP207320
Sediment dam A
Sediment dam B
Sediment dam C1
Sediment dam C2
2RP905817
4RP207320
ARP905818
3RP223699
Riverton Road

0 100 200 m
Scale: 1:7,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© State of Queensland (Department of Resources) 2022
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

Legend

- Site boundary
- Cadastre (DCDB)

Non-use management areas

- Terraced mine benches

Post-mining land use areas

- Bitumen and unsealed roads for access
- Flat to sloping areas with hard stand areas
- Native ecosystem
- Retained sediment basins for water supply and storm water control

Watercourses

- Minor

epic
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Graymont Limited
Riverton Limestone Mine
Vegetation Management Plan

Figure 3
Post mining land uses

3.3 Sourcing Seedlings

Seedlings shall be sourced where possible from local provenance stock. Planting stock will be provided in forestry tubes with a minimum plant height of 200 mm and a well-developed root system (tubestock). 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 within forestry tubes. Seedlings are to be watered with a minimum of 5-10 litres (L) of water each at the time of planting and then watered as part of general maintenance requirements.

3.4 Vegetation Composition

To achieve a vegetation community that is considered a native ecosystem that provides ecosystem services and a stable landform with self-sustaining vegetation cover, a combination of the species listed in **Table 2** is proposed to be planted within the revegetation areas.

Table 2. Species Planting Mix

	Scientific Name	Common Name	Mix Composition[1]	PMLU
Native Grasses	*Austrostipa verticillata*	Slender Bamboo Grass	30%	Native Ecosystem (traditional and NOVEL)
	Digitaria brownii	Cotton Panic Grass	30%	
	Aristida calycina	Dark Wire Grass	20%	
	Capillipedium spicigerum	Scented-top grass	5%	
	Eriachne pallescens	Wanderrie Grass	5%	
	Chloris pectinata	Comb Chloris	5%	
	Dichanthium serieceum	Queensland Bluegrass	5%	
Shrubs	*Alphitonia excelsa*	Red Ash	-	Native Ecosystem (Traditional)
	Notelaea macrocarpa	Native Olive	-	
	Dodonaea Triquetra	Large-leaf Hop-bush	-	
	Geijera parviflora	Wilga	-	
Trees	*Eucalyptus melanophloia*	Silver-leaved Ironbark	-	
	Callitris glaucophylla	White Cypress Pine	-	

1 Relevant to grass species needed only

3.5 Revegetation Schedule

The planting and maintenance schedule for the initial planting, sowing native grass seeds and planting shrubs and trees is outlined in **Table 3**.

Table 3. Planting and Maintenance Schedule

Year	Season			
	Summer	Autumn	Winter	Spring
1	• Targeted weed removal • Spread topsoil	• Sow winter crop	• Till green manure	• Broad-scale non-residual herbicide application
2	• Weeds survey • Fertiliser application	• Native grass seeds • Herbicide spot spray		
3	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones	• Shrubs and trees tubestock • Herbicide spot spray	• End irrigation	
4	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones	• Herbicide spot spray		

Year	Season			
	Summer	Autumn	Winter	Spring
5	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones	• Herbicide spot spray • End maintenance (weeding and supplementary planting)		
6	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones			
7	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones			
8	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones			
9	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones			
10	• Ecological monitoring and weeds survey • Monitoring of vegetation within the rehabilitation zones			

3.6 Assisted Regeneration Works

Assisted regeneration will be applied to areas of regrowth vegetation communities with areas of historical disturbance. Assisted regeneration will include weed control and limited tree planting. Weed control will be repeated four times annually. Weed control will include mechanical removal and herbicide spot spraying. Canopy trees will be planted in an opportunistic way in overly sparse locations with the aim of achieving an average canopy cover similar to or greater than median range of the regrowth analogue site (15% canopy cover) and Tree height > 50 % of tree height at analogue site. Trees should be planted following the method described in **Section 3.2**.

3.7 Rehabilitation Limitations

Some limitations to the success of rehabilitation works have been identified and are described in more detail in the preceding sections.

3.7.1 Stock Damage

Livestock accessing the revegetation area from neighbouring properties while grasses and seedlings are vulnerable and not fully established is the greatest potential limitation to the success of site rehabilitation works. The presence of cattle can have the following adverse impacts:

- Introduction and spread of weeds
- Soil compaction
- Seedling loss from herbivory

3.7.2 Erosion

The potential for topsoil erosion is greatest in areas with a slope >10°. Erosion may occur during and/or after rainfall events and may include the following types of erosion:

- Gully erosion
- Sheet erosion
- Tunnelling
- Subsidence

3.7.3 Fire

The proposed revegetation areas and adjacent woodland areas are susceptible to bushfire. Whilst many of the species proposed for planting are adapted to bushfire, the exposure of seedlings to bushfire is likely to result in significant seedling mortality.

3.7.4 Weeds

Invasive plants have the potential to limit the success of the revegetation works. Weeds can outcompete native species and smother young plants. Weeds have been identified at the site and include the following species:

- *Alternanthera pungens*
- *Schinus molle*
- *Gomphocarpus physocarpus*
- *Ambrosia artemisiifolia* (Category 3 – restricted matter under *Queensland Biosecurity Act 2014*)
- *Bidens pilosa*
- *Cirsium vulgare*
- *Conyza bonariensis*
- *Xanthium occidentale*
- *Harrisia martini* (Category 3 – restricted matter under *Queensland Biosecurity Act 2014*)
- *Malvastrum americanum var. americanum*
- *Sida rhombifolia*
- *Oxalis corniculata*
- *Eragrostis tenuifolia*
- *Hyparrhenia hirta*
- *Melinis repens*
- *Verbascum thapsus*
- *Ailanthus altissima*
- *Glandularia aristigera*
- *Verbena rigida*

Due to safety concerns related to personnel accessing pit abandonment bunds and areas between bunds and pit walls, weed maintenance is not recommended in these areas. Because of this there is a likelihood that weeds such as non-native grasses will become established. Spot-spray application of herbicides via drone is not considered feasible at this time.

3.8 Mitigation Measures

3.8.1 Fencing

Due to the proximity of the site to adjacent woodlands, herbivory from native/feral mammals (i.e. wallabies, goats and rabbits) may become a limitation. If monitoring identifies over-browsing as a limitation to rehabilitation success, animal proof fencing will be needed (e.g. hinge-lock wallaby fencing and /or rabbit proof netting). Similarly, if livestock are identified within the revegetation areas, stock fencing may be required.

3.8.2 Erosion and Sedimentation Control

During the early phases of revegetation, the loss of topsoil during rainfall events is a risk that should be mitigated through erosion and sedimentation control measures. These measures should be applied in areas with a slope >10° and include the placement of coir logs in in rows running parallel to slope contours, with rows spaced in 10 m intervals.

3.8.3 Fire Management

The mitigation of bushfire risk to revegetation areas involves fire management in adjacent woodland areas. Fire management guidelines for RE 13.11.4 are as follows (Queensland Herbarium 2021):

- Low intensity burn
- Autumn–winter season
- 5-15 year intervals
- Burn <20% of stands in any year
- Burning patches each year whenever possible

The practicality and scope of fire management within and adjacent to the site is, however, likely to be limited due to safety concerns for the site and adjacent properties and issues regarding land tenure of adjacent properties.

3.8.4 Weed Management

Weed management should be completed annually across the revegetation areas. Weeds listed as a restricted matter in the Queensland Biosecurity Act 2014, have been identified on site (refer **Section 3.7.4**). Weed management actions to be implemented are outlined in **Table 4**. A combination of weed removal techniques may be implemented to effectively manage weeds. Specific weed removal techniques for restricted matters identified on site are outlined **Table 5**.

Table 4. Weed Management Actions

Purpose: Minimise weed dispersal on and off the site	
Performance criteria:	• Remove all restricted plants and control all environmental weeds • Prevent the spread of restricted and environmental weeds on and off the sites • Prevent the introduction of new restricted plants and environmental weeds • Remove all rubbish from site
Responsibility	• Site supervisor and civil contractor
Timing	• Weed control is most effective during December-April • Weed removal/treatment repeated annually
Management actions:	• Remove all restricted weeds from site during site preparation and control non-native plants at <5% • Restricted weeds are to be stockpiled separately and disposed of at an appropriate waste disposal facility • Vehicle/machinery hygiene measures (i.e. valid weed and seed free certificate) to be implemented to prevent the introduction and/or further spread of weeds on and off the site
Monitoring:	• Monitor the germination or regrowth of weed species annually • The Site supervisor is to monitor weed removal and ensure management strategies are adhered to
Corrective actions:	• Undertake weed removal to treat germinated or regrown weeds species
Reporting:	• Any incidents of non-compliance are to be managed in accordance with the contactor's incident management procedure or recorded in an environmental diary

Table 5. Weed Removal Techniques

Weed Species/Type	Technique
Ambrosia artemisiifolia (Annual Ragweed)	Plants can be pulled by hand. Plants may also be slashed/mown prior to seeding. A range of registered herbicides are suitable for the site and may also be applied via the following methods: • 2,4-D as amine 500 g/L, applied at 400 mL/100 L water, spot spray applied to young plants ensuring thorough coverage • Metsulfuron methyl 600g/L. applies at 5 g/100 L water + wetter, handgun spray to thoroughly wet all foliage but not to cause runoff.
Harrisia martini (Harrisia Cactus)	The most effective control method for Harrisia Cactus is mechanical control which involves the following: • Dig out plants completely and burn • Ensure all tubers are removed and destroyed Mechanical control can also be combined with herbicide control including the foliar application of registered herbicides.

3.9 Ecosystem Services Provided by Planned Native Ecosystem

Section 3.6.1 of the PRCP guidelines states that the VMP must identify any species of conservation significance relevant to the mine's approval. The plan should also identify any habitat use requirements, and relevant management and monitoring plans. The EA for the site identifies the Riverton Bat Cave within the site (EPA 2007) (**Plate 4**). The Riverton Bat Cave supports a maternity cave for Eastern Horseshoe Bat (Rhinolophus megaphyllus). Although the species itself is not conservation significant under the NC Act or EPBC Act, the cave site is significant in that there are very few known maternity cave sites for the species.

In addition to the developing a self-sustaining and stable landform, this VMP proposes to provide foraging habitat for Eastern Horseshoe Bat within areas rehabilitated to native ecosystem PMLU. When foraging for insect prey, the species prefers woodland to open areas (Pavey 1998). The native ecosystem areas PMLU areas will aim to provide woodland habitat suitable for foraging by the Eastern Horseshoe Bat.



Plate 4. Riverton Bat Cave

3.9.1 Fauna Monitoring

Annual fauna monitoring is recommended for the native ecosystem PMLU areas. Fauna surveys will include the following:

- Diurnal bird surveys and incidental reptile observations
- Deployment of passive bat echo-location call recording devices (e.g. ANABAT)
- Spotlighting surveys for nocturnal mammals, reptiles, and birds

The results of the fauna monitoring surveys will help gauge the success of rehabilitation works and also help identify any pest fauna species that may be adversely impacting the revegetation works (e.g. goats, rabbits etc.).

4 MONITORING

4.1 Objective

The objective of monitoring the proposed revegetation works across the site is to ensure rehabilitation activities are consistent with the measures outlined in **Section 3** of this VMP.

4.2 Schedule

Monitoring of vegetation within the rehabilitation zones subject to revegetation will continue until the areas are rehabilitated to a stable landform with self-sustaining vegetation cover in accordance with the final land description as defined in Schedule F – Table 1a and Schedule f – Table 1b of the EA. Monitoring of rehabilitation is expected to occur in the summer and has been outlined in **Table 3** of **Section 3.5**.

An annual survey of invasive weeds across the revegetation areas is recommended to document the effectiveness of weed control. Monitoring should occur in summer to inform the following application of weed control techniques during autumn. The weed survey should be completed by a suitably qualified person such as an ecologist.

Monitoring will also include checking that revegetation works are properly maintained including:

- Supplement planting/seed bombs in areas where plants have significant die-off
- Ensure weeds do not outcompete establishing plants
- Coir logs should be placed in rows to control erosion where slope is >10°

4.3 Analogue Sites

Two analogue sites have been surveyed for comparison with revegetation areas to monitor the progress of revegetation works (refer **Table 1** and **Figure 2**). Height and cover ranges have been summarised from the analogue sites and provided in **Table 8**. It is important to note that these data are derived from sites supporting remnant and regrowth vegetation, which is consistent with the intended PMLU of native ecosystem. It is considered unnecessary to attain remnant status for the vegetation to be consistent with the intended PMLU. Shrub layer cover is expected to be less than analogue sites. A period of 10 years is likely to be sufficient to achieve native ecosystem with a canopy cover within the range of the analogue sites (i.e. >15%). It is expected that within 10 years all other strata layers will also reach a degree of cover within the median range of the analogue site data. In rehabilitation areas where vegetation might grow more slowly a benchmark of >5% canopy cover and >75% of the median canopy height from the regrowth analogue site.

Table 6. Averaged Site Data

Strata	Median height range (m)	Median cover range (%)	Dominant species composition
Canopy	16-23	15-30	*Eucalyptus melanophloia,*
Subcanopy	8-15	20-35	*Callitris glaucophylla*
Shrub layer	1.5-7	10-20	*Notelaea microcarpa, Geijera parviflora, Carissa ovata*
Ground	0.3-0.4	30-80	*Austrostipa verticillata, Digitaria brownii, Aristida calycina*

4.4 Rehabilitation Milestones

To track the progress of the revegetation works and identify any limitation to success, expected milestones have been suggested and are provided in **Table 9**. A landform is considered stable when it can sustain the intended PMLU (DETSI 2024).

Table 7. Rehabilitation Milestones (RM) for Revegetation Areas

RM	Description

7	• Localised erosion areas must be identified and repaired
	• Ripping must be undertaken and penetrate at least 300 mm into soil profile
	• Placement of topsoil must be 150 mm (minimum) using salvaged topsoil from site, across the disturbed area
	• Prior to applying topsoil, any weeds must be removed from the area by hand, ensuring complete removal of root system
	• Planting and rototilling of an initial green manure treatment, comprising of grain barley and inoculated clover is completed
	• An assessment of growth media characteristics and development of an amelioration and physical treatment plan must be completed by an AQP
	• Ameliorant and physical treatments such as fertiliser, lime, gypsum and/or organic matter are applied as identified by the abovementioned amelioration and physical treatment plan
	• Soil health and suitability for target vegetation establishment assessed by an AQP prior to seeding to determine outcome of manure treatment and fertiliser application and confirms:
	  ◦ pH in the range 6 - 8.5
	  ◦ Electrical Conductivity (saturated extract) (dS/m) ≤2 (2,000 µS/cm)
	  ◦ Exchangeable sodium percentage (ESP) (%) < 6
	  ◦ Emerson aggregate class: ≥4

8	• Repeat applications of broad-scale non-residual herbicide must be applied in preparation for sowing native grass seeds
	• Seeding Native grass seeds must be planted in year two of rehabilitation in the Autumn months (March-May) at a rate) of 25 kg per ha, using the seed mixture described in **Table 2**
	• A combination of tree species as described in **Table 2** must be planted at densities as specified in vegetation management plan
	• Timing of seeding (sowing) and planting must occur in autumn following significant rain and when the soil moisture levels are optimal
	• A watering regime must be followed for a minimum of eight weeks, with a minimum of 10 L per plant twice weekly in the first week, and once per week for a minimum of eight weeks
	• A monitoring and maintenance program must be established for rehabilitation areas and undertaken annually, on commencement of revegetation
	• If monitoring identifies over-browsing as a limitation to rehabilitation success, animal proof fencing will be needed (e.g. hinge-lock wallaby fencing and /or rabbit proof netting). Similarly, if livestock are identified within the revegetation areas, stock fencing may be required
	• An annual fauna monitoring program must be established and undertaken using the following recommended survey methods:
	  ◦ Diurnal bird surveys and reptile searches
	  ◦ Deployment of passive bat echo-location call recording devices (e.g. ANABAT)
	  ◦ Spotlighting surveys for nocturnal mammals, reptiles, and birds
	• Existing firebreaks must be maintained along edge of revegetation zones until rehabilitation complete
	• Independent AQP must certify the achievement of this milestone

9	• Repeat applications of broad-scale non-residual herbicide must be applied in preparation for sowing native grass seeds • Native grass seeds seeded must use the seed mixture described in **Table 2** at a minimum rate of 25 kg/ha • To achieve a 'novel planned' native ecosystem, a combination of tree species using the species described in **Table 2** must be planted at densities as specified in vegetation management plan • An annual monitoring and maintenance program must be established on commencement of revegetation • Existing firebreaks must be maintained along edge of revegetation zones until rehabilitation complete • Independent AQP must certify the achievement of this milestone

10	• Species used in revegetation remain present and show evidence of natural recruitment. Evidence of flora recruitment from rehabilitation monitoring data
	• Species diversity is similar to analogue sites in the rehabilitation area
	• A BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual'
	• The relevant Bio condition assessment criteria collected complies with the following criteria:
	  ◦ Weed presence is less than 5% of total vegetative cover
	  ◦ Ecosystem altering weeds are absent

RM	Description
	• Total vegetative groundcover ≥50% • Total groundcover (combination of vegetative cover, other organic material (i.e. sticks leaf litter) and inorganic material (i.e. rocks)) ≥70% • Tree height >50% of tree height described in median cover range at analogue sites • Non-native cover is 5% of vegetative ground cover excluding pit abandonment bunds and areas between bunds and pit walls • Canopy cover >15% as per median cover range at analogue site • Shrub layer cover >10% as per median cover range at analogue site • Corrective actions arising from monitoring program and routine inspections have been undertaken • The growth media (topsoil and subsoil) physical, chemical and biological properties do not limit vegetation cover performance or restrict the potential effective depth of rooting • Removal of stock/fauna fence (if applicable) when plants are sufficiently established to withstand herbivory • An independent AQP must certify achievement this milestone
12	• A BioCondition assessment is completed by an AQP using the methodology outlined in the latest version of the Queensland Herbarium's ''BioCondition Assessment Manual' • The relevant Biocondition assessment criteria collected under this milestone complies with the following criteria: • Canopy cover similar to or greater than median range of the regrowth analogue site (15% canopy cover) • Shrub layer cover similar to or greater than median range of the regrowth analogue site • Groundcover similar to or greater than median range of the regrowth analogue site • Tree height > 50 % of tree height at analogue site • Non-native cover <5% of vegetative ground cover • No area of weed outcompeting native species identified • Restrictive invasive plants (as defined in the Biosecurity Act 2014) comprise ≤5% of the vegetation cover • Fauna survey observation provides evidence of native fauna utilisation i.e., fauna spotting, scats, and tracks recorded • An independent AQP must certify achievement this milestone
13	• Canopy cover ≥ 5% • Tree height >75% of tree height at regrowth analogue sites • Non-native cover <5% of vegetative ground cover • Shrub layer cover 5% • Groundcover similar or greater than median range of analogue site • Restrictive invasive plants (as defined in the *Biosecurity Act 2014*) comprise ≤5% of the vegetation cover • Absence of ecosystem altering weeds • An independent AQP must certify achievement this milestone

The rehabilitation milestones listed in **Table 7** align the concept of SMART goals (Specific, Measurable, Achievable, Relevant, Timed). Justification for how the rehabilitation milestones align with the SMART goals principles is provided below:

- **S**pecific
  - The five rehabilitation milestones are clearly defined in **Section 4.4**. Further details of the rehabilitation activities and monitoring are provided in **Section 3.2** and **Section 4** respectively
- **M**easurable
  - The completion of each milestone can be easily measured and documented. Milestones 1-4 will be achieved when completed as per **Section 4.4**. Milestone 10 will be achieved when each rehabilitation area attains an average canopy cover within the median range of the analogue site data (i.e. 15% or 5% for the pit floor)
- **A**chievable
  - All five milestones are considered easily achievable within the specified timeframes. Graymont has the ability and the means to complete the proposed rehabilitation activities
- **R**elevant
  - The proposed rehabilitation activities are conventional and best practice. The rehabilitation milestones have the overall objective of restoring the rehabilitation areas to the relevant

PMLU (i.e. native ecosystem). The final goal of the rehabilitation milestones is to restore each rehabilitation area into a stable landform with self-sustaining vegetation cover in accordance with the final land description as defined in Schedule F – Table 1a and Schedule F – Table 1b of the EA for the site.

- **T**imed
  - The expected timeframe for completion of each rehabilitation milestone is provided in Table 7. Completion of each milestone is quantifiable and will be documented

5 REFERENCES

DETSI 2024, Statutory Guideline Progressive Rehabilitation Closure Plans (PRC Plans). Version 3.01. Department of Environment, Tourism, Science and Innovation.

Epic 2023, Riverton Topsoil Suitability Assessment, Epic Environmental on behalf of Graymont.

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OQMRC 2023, Native ecosystem rehabilitation in Queensland: Implications for leading practice, September 2023, Office of the Queensland Mine Rehabilitation Commissioner, Queensland Government, Brisbane

Pavey, CR. 1998, "Habitat Use by the Eastern Horseshoe Bat, Rhinolophus Megaphyllus, in a Fragmented Woodland Mosaic." Wildlife Research 25 (5): 489–98.

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6 ACRONYMS

EA	Environmental Authority
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
ML	Mining Lease
NC	Nature Conservation
NSW	New South Wales
PRCP	Progressive Rehabilitation and Closure Plan
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
VMP	Vegetation Management Plan

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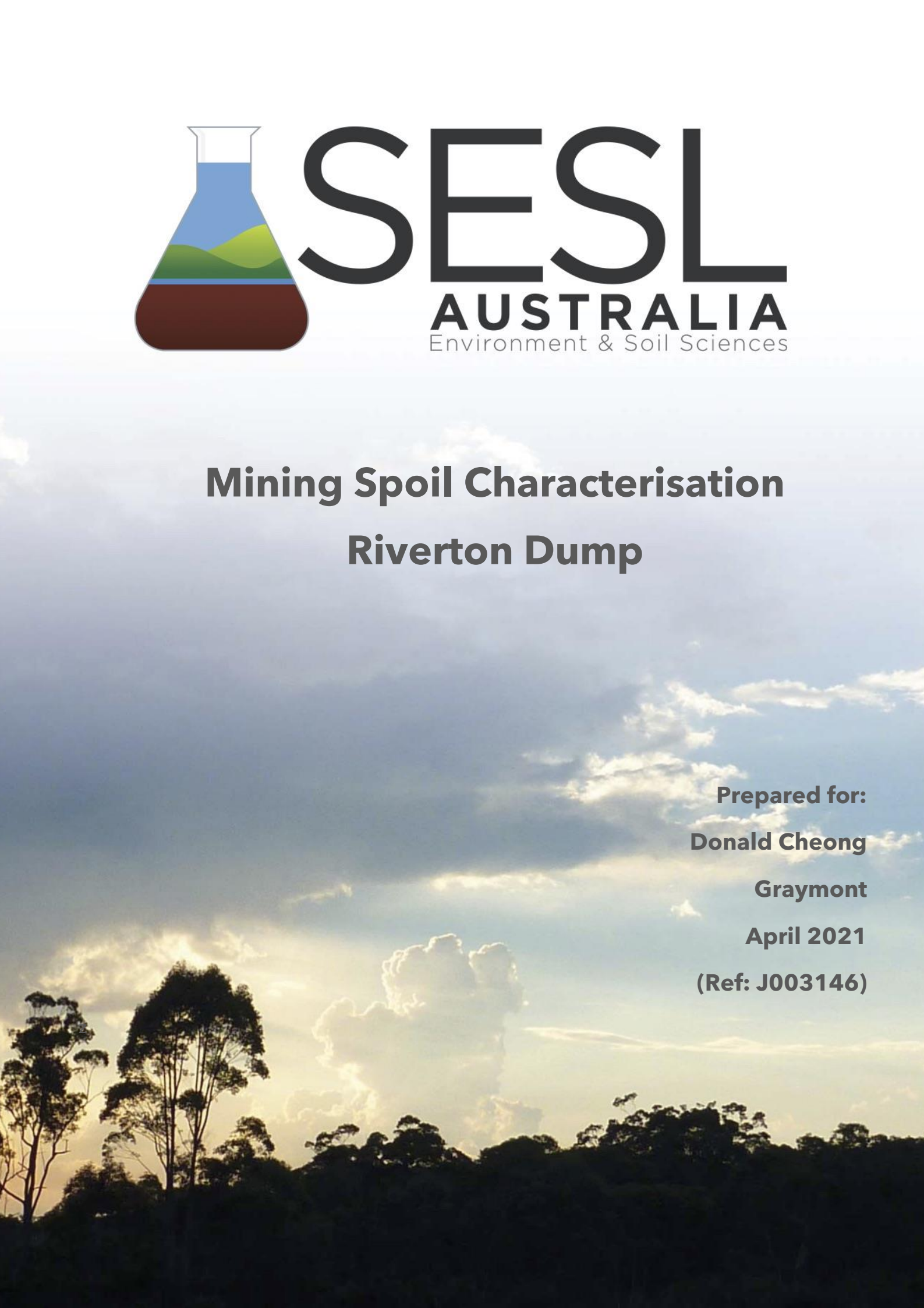
Appendix F Soil and Waste Rock Characterisation Assessment (SESL 2021)



Mining Spoil Characterisation

Riverton Dump

Prepared for:

Donald Cheong

Graymont

April 2021

(Ref: J003146)

09/04/2021

Attention: Mr Donald Cheong
GRAYMONT
Level 16, 111 Pacific Highway
North Sydney NSW 2060

Re: Mining Spoil Characterisation – Riverton dump

1 INTRODUCTION

SESL Australia Pty Ltd (SESL) was engaged by Graymont (the Client) to undertake an assessment of waste rock generated through Graymont mining operations at the Riverton Plant located at 6905 Riverton Rd, Riverton QLD 4385 (the Site). SESL understands that there is approximately 495,000 m^3 of material stockpiled at the main dump, and 56,500 m^3 of material located at the eastern dump on site.

The mining overburden is considered relatively homogenous, comprised of shale clay and crushed limestone. Revegetation of the waste dumps is required as part of the mining consent conditions.

The Queensland Department of Environment and Science (QLD DES) requires the material to be chemically and physically characterised in order to identify potential environmental risks associated with the waste rock dumps. The primary concern for the QLD DES relates to the potential for migration of acidic leachate from the waste rock and the potential for dispersion of the exposed soil materials. The objectives of this assessment are to:

(1) Characterise the mineralogy of the material to identify whether the presence of sulfide bearing ores such as pyrite are present in the waste rock.
(2) Identify whether the waste rock contains heavy metals with the potential to cause harm to environmental receptors
(3) Identify the amelioration requirements of the site-won clay soil for revegetation with (i) pasture and (ii) for native fauna habitat.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

2 SAMPLING AND ANALYSIS

Sampling of the waste rock was undertaken by Graymont's Riverton Operations Site Manager, Wayne Trenning. Graymont collected representative, composite samples from the waste rock dumps, ensuring that subsamples were collected from locations where clear variability in material was observed. Samples of clay soil were also collected to assess its suitability for reuse in revegetation or the waste rock dumps.

Following collection, the samples were transported to SESL's accredited laboratory (NATA #15633) under chain of custody procedures. The following laboratory analysis was undertaken:

- Total element analysis using X-Ray Fluorescence (XRF) methodology
- Identification of minerals present using X-Ray Diffraction (XRD)
- Soil chemistry
    - pH
    - electrical conductivity
    - effective cation exchange capacity
    - major plant nutrients (N, P, K, Ca, S)
    - trace nutrients (Mg, Fe, Cu, Zn, B, Mn)
    - total organic matter
    - total organic carbon
    - texture, structure and estimated permeability

A summary of the samples collected and analysed are outlined in Table 1.

Table 1 – Samples Collected for Analysis

Analysis	Main Dump	East Dump
XRF and XRD	5 composite samples 1 andesite sample	3 composite samples
Full Soil Chemistry	3 clay samples	

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

3 RESULTS

3.1 WASTE ROCK MINERALOGY

XRF and XRD analysis was conducted by Professor Damien Gore at Macquarie University. A summary of the XRD results is outlined in Table 2 and Table 3. None of the identified minerals are acid-generating and do not pose any risks to the environment upon oxidation and/or weathering. Complete results can be seen in Appendix A.

Table 2 – Summary of XRD Results

Sample ID	Dump ID	Minerals	Appendix A Page Reference
SESL_Andesite Sample1	Main	• Extrusive volcanic rock • Intermediate composition, relatively fine grained • The abundance of quartz and plagioclase (albite) helps to define it as an andesite, though the relative absence of mafic minerals such as amphiboles and particularly pyroxenes places it on the felseic end of the spectrum.	2
SESL_WDS1	Main	• Calcite rocks • Fine-grained soil material, contains the white clay mineral kaolinite and orange-red colour is due to iron oxides.	5
SESL_ WDS2	Main	• Calcite rocks	10
SESL_ WDS3	Main		12
SESL_ WDS4	Main	• Calcite rocks • Fine-grained soil material, contains the white clay mineral kaolinite and orange-red colour is due to iron oxides.	14
SESL_ WDS5	Main	• Calcite rocks	17
SESL_OD2_Waste1	Eastern		19
SESL_ OD2_Waste2	Eastern		21
SESL_ OD2_Waste3	Eastern		23

XRF analysis indicates low concentrations of heavy metals. Metals of primary concern (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn)) are negligible. Complete results may be seen in Appendix A.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

3.2 Soil Chemistry

The chemical characteristics of the three (3) clay samples analysed for topsoil suitability are summarised in Table 3. Complete results can be seen in Appendix B.

Table 3 – Summary of Soil Chemistry Results

Analyte		Unit	Sample ID		
			Clay Sample 1	Clay Sample 2	Clay Sample 3
pH	pH	pH unit	8.16	8.46	8.53
EC	Electrical Conductivity	dS/m	0.51	0.3	0.25
Effective Cation Exchange Capacity	Sodium (Na)	cmol(+)/kg	0.75	0.48	0.38
	Potassium (K)	cmol(+)/kg	0.04	0.04	0.04
	Calcium (Ca)	cmol(+)/kg	9.32	12.91	14.75
	Magnesium (Mg)	cmol(+)/kg	0.17	0.13	0.27
	Total eCEC	cmol(+)/kg	10.3	13.6	15.4
Plant Available Nutrients	Nitrate-N (NO_3)	mg N/kg	29	17	12
	Phosphorus (P)	mg P/kg	<5	<5	<5
	Potassium (K)	mg/kg	15.7	16.5	14.5
	Sulfur (S)	mg S/kg	25	16	14
	Calcium (Ca)	mg/kg	1870	2590	2960
	Magnesium (Mg)	mg/kg	21	16	33
	Iron (Fe)	mg/kg	10.1	7.79	11.1
	Manganese (Mn)	mg/kg	3.6	7.4	18
	Zinc (Zn)	mg/kg	<0.65	<0.65	<0.65
	Copper (Cu)	mg/kg	<0.64	<0.64	1.2
	Boron (B)	mg/kg	0.1	0.2	0.2

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4 DISCUSSION

(1) Waste Rock Minerology

XRD analysis identified that the andesite sample was an extrusive volcanic rock, with intermediate composition and relatively fine grained. It is identified as an andesite due to the abundance of quartz and plagioclase (albite) but is placed on the felseic end of the spectrum due to the relative absence of mafic minerals such as amphiboles and particularly pyroxenes. The other composite samples from the main dump were calcite rocks, and the fines consisted of fine-grained soil material, the white clay mineral kaolinite and an orange-red colour due to the concentration of iron oxides in the rock. The samples from the eastern dump were calcite rocks, similar in composition to those from the main dump. None of the identified minerals from either dump are considered to be acid generating upon weathering, and therefore does not pose a risk to environmental receptors.

(2) Heavy Metal Analysis

XRF analysis indicated that heavy metal concentrations, including those of primary concern, were negligible, and presents very minimal risk of environmental contamination.

(3) Soil Chemistry

Chemical characterisation of the clay-textured soil samples indicate the material is alkaline (pH range 8.16 – 8.53). For rehabilitation purposes, only lime tolerant species must be chosen, as this soil chemistry parameter cannot be quickly or easily altered. SESL recommend that a green manure crop be sown first to build up organic matter. Grain barley is tolerant of lime and salinity and is a suitable winter, green manure crop. This should be combined with an inoculated clover for nitrogen-fixation.

The soil is grossly deficient in all plant nutrients except calcium and magnesium. Trace elements are acceptable. Amelioration of the soil should be as follows:

Table 4 - Recommended Fertiliser Application Rates

Fertiliser	Application Rate (kg/ha)
Monoammonium phosphate	200
Muriate of potash	400
Magnesium sulphate	400
Iron sulphate	50
Manganese sulphate	25
Zinc sulphate	15
Copper sulphate	10

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Sodium tetraborate	10

Fertilisers should be worked in to 100mm prior to sowing.

Seek local knowledge for the best clover or medic for your area and make sure it is inoculated with the correct Rhizobium. Also add some ammonium molybdate to the seed/inoculum mix at the equivalent of 50 grams/ha.

Fertilisers should be worked in to 100 mm prior to sowing.

Seek local knowledge for the best clover or medic for the Riverton area and make sure it is inoculated with the correct Rhizobium. Additional ammonium molybdate should be added to the seed/inoculum mix at the equivalent of 50 grams/ha.

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SESL AUSTRALIA PTY LIMITED



Jane Koo
Environmental Scientist

B A



Simon Leake
Principal Soil Scientist

B Sc (Ag) Hons, ASSSI, CPSS

Appendices:

A – XRD and XRF Results
B – Soil Chemistry Summary Certificates
C – Certificates of Analysis

References:

Crouch, R., Reynolds, K. C., Hicks, R. W., & Greentree, D. A. (2007). Soils and their use for earthworks. In Charman, P. E. V. & Murphy, B. W. (Eds), *Soils – their properties and management* (3rd Edition), Oxford University Press: Melbourne.

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Limitations of This Report:

SESL has performed an investigation and consulting services for this project, as outlined in our discussions and in accordance with current professional and industry standards for environmental site assessment. The findings of this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of this site and do not represent the actual state of the site at all points. Should materials or conditions be encountered other than those which have been described, these will require additional assessment.

The SESL assessment is based on the result of limited site investigation. SESL cannot provide unqualified warranties nor assume any liability for site conditions not observed, accessible during the time of the investigations. Despite all reasonable care and diligence, the ground conditions encountered, and the concentrations of contaminants measured, may not be representative of conditions between the locations samples and investigated. In addition, site characteristics may change as a result of soil heterogeneity, chemical reactions and other events. These changes may occur subsequent to SESL investigation and assessment.

This report, associated documentation and the information herein, have been prepared solely for the use of the named Client and any relevant authority. Any reliance assumed by third parties on this report shall be at such parties' own risk. Any ensuring liability resulting from use of the report by a third party cannot be transferred to SESL.

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Environment & Soil Sciences

Appendix A

XRD and XRF Results

Mineralogy of SESL samples, March 2021

SESL_AndesiteSample1 is an extrusive volcanic rock. The composition is intermediate and it is relatively fine grained. The abundance of quartz and plagioclase (albite) helps to define it as an andesite, though the relative absence of mafic minerals such as amphiboles and particularly pyroxenes places it on the felseic end of the spectrum.

SESL_WDS1-WDS5 are calcite rocks. Fine-grained soil material in WDS1 and WDS4, analysed separately, contains the white clay mineral kaolinite and the orange-red colour is due to iron oxides.

SESL_OD2_Waste1-3 are calcite rocks, similar to the WDS samples above.

SESL_N1-N4 are soils with quartz, micaceous minerals and rarer alumino-silicates, clay minerals including kaolinite or montmorillonite, and iron oxides.

SESL_NE1-NE7 are soils similar to **N1-N4**, but they also have calcite.

None of the minerals identified are acid generating upon weathering.

Names, photographs, X-ray diffractograms, mineral lists and diffractogram peak lists follow for each sample. Three appendices follow, detailing quality assurance/quality control for the diffractometer, measurement conditions for all samples, and X-ray fluorescence (XRF) spectrometry (elemental analyses) for all samples. The XRF data have been measured using a silicate calibration, so samples rich in calcite might need an alternative calibration. For silicate samples, measurements of NIST 2710a and 2711a indicate that accuracies are typically within 15%, but for calcite samples values are indicative and potentially less accurate.

Distinction of clay minerals can depend on the hydration state and composition of the field sample, and identification of the specific mineral will involve a series of analytical steps involving repeated treatment and re-measurement. If this is required, please contact me. Sample powders have been returned as analysed.

Professor Damian Gore

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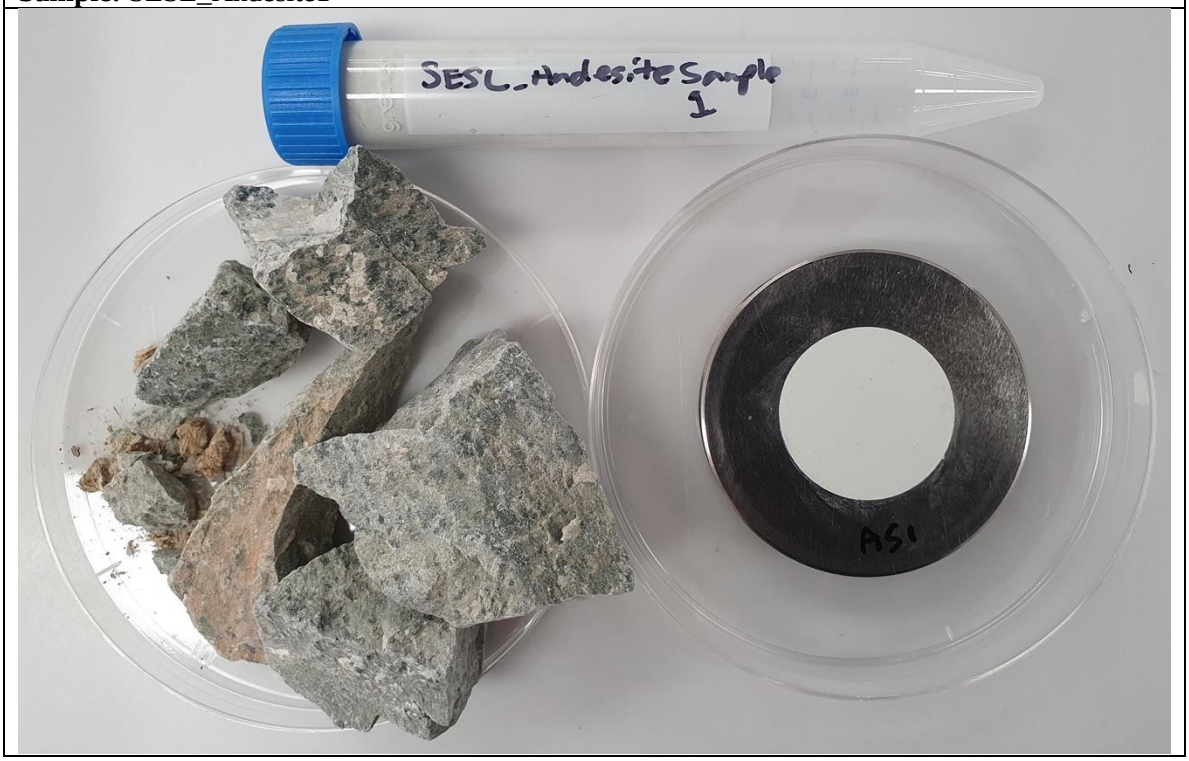
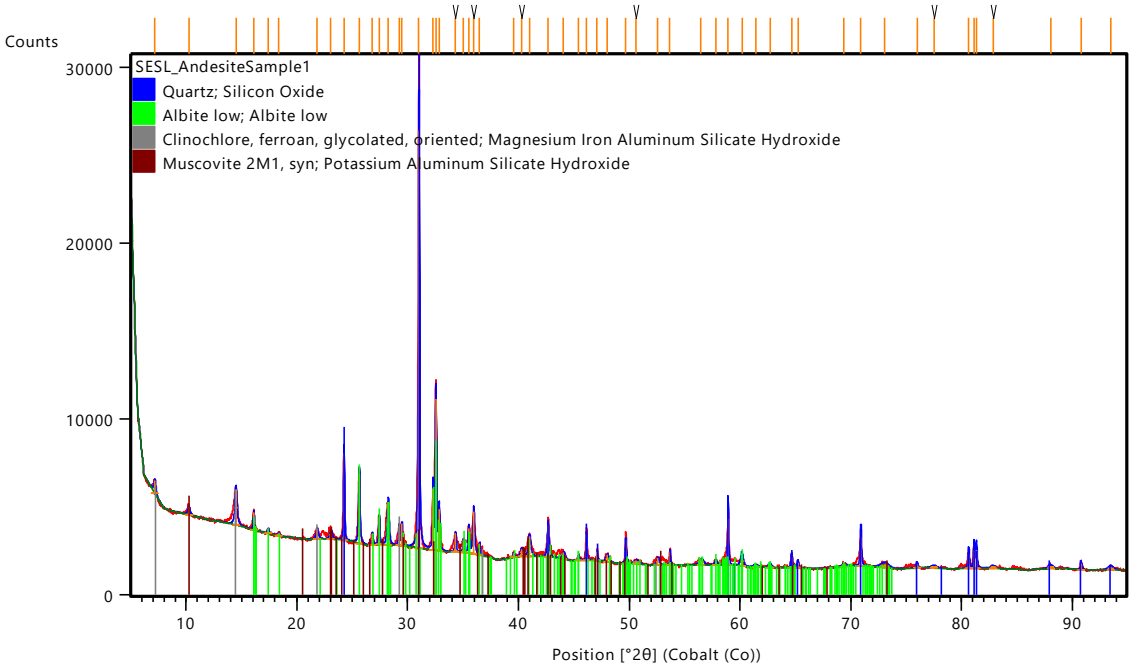
23 March 2021

Sample: SESL_Andesite1



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-070-3755	70	Silicon Oxide	SiO_2
Albite	98-006-1802	54	Albite	$Al\ Na\ O_8\ Si_3$
Clinochlore	00-060-0322	48	Magnesium Iron Aluminum Silicate Hydroxide	$(Mg, Fe, Al)_6\ (Si, Al)_4\ O_{10}\ (OH)_8$
Muscovite	00-007-0032	21	Potassium Aluminum Silicate Hydroxide	$K\ Al_2\ Si_3\ Al\ O_{10}\ (OH)_2$

Peak List

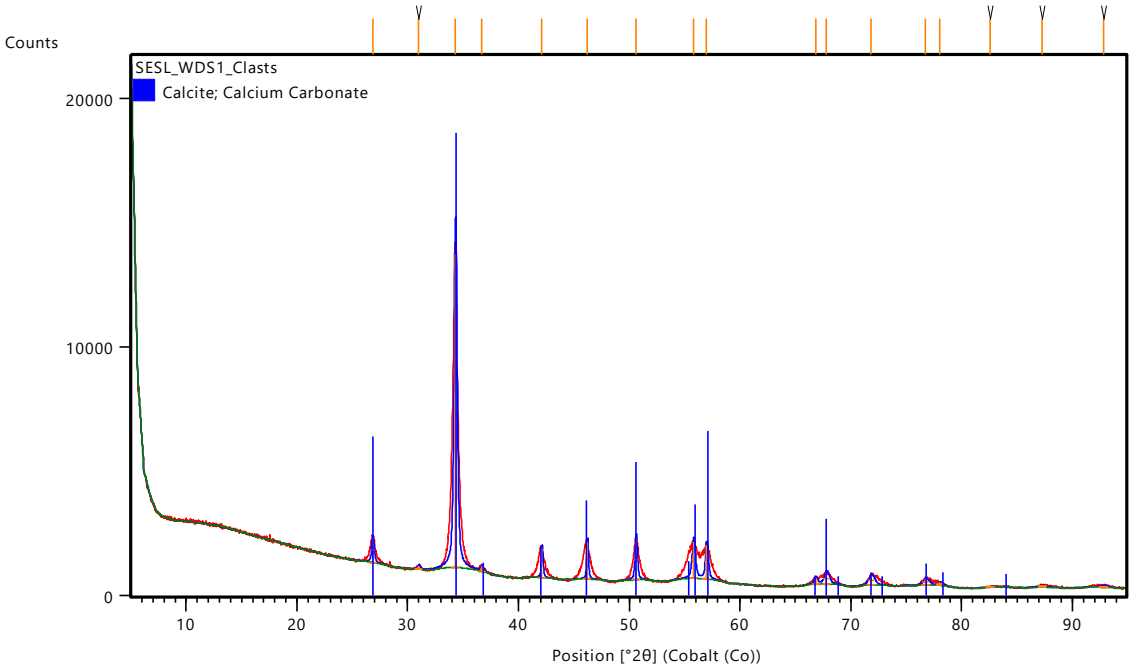
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
7.1817	755.26	0.2165	14.28212	3.18
10.2509	465.93	0.2165	10.01279	1.96
14.4952	2037.50	0.2381	7.09040	8.59
16.0923	974.52	0.1082	6.39068	4.11
17.4025	256.79	0.1732	5.91281	1.08
18.3744	149.54	0.2598	5.60254	0.63
21.8316	548.00	0.2165	4.72368	2.31
23.0668	498.19	0.2598	4.47389	2.10
24.2500	4922.94	0.1082	4.25863	20.75
25.6284	3919.48	0.1515	4.03312	16.52
26.8116	647.00	0.1082	3.85817	2.73
27.4224	1559.27	0.1299	3.77384	6.57
28.2299	2424.26	0.1948	3.66798	10.22
29.2236	1084.35	0.1299	3.54585	4.57
29.4698	1243.41	0.0866	3.51686	5.24
31.0035	23726.72	0.1299	3.34685	100.00
32.2781	3512.86	0.0866	3.21800	14.81
32.5288	8597.33	0.1299	3.19386	36.23
32.8198	2345.17	0.1299	3.16631	9.88
34.2923	1051.07	0.1515	3.03417	4.43
35.0090	689.03	0.1299	2.97394	2.90
35.5101	1417.64	0.1515	2.93330	5.97
35.9450	2401.75	0.1732	2.89896	10.12
36.4775	644.37	0.1299	2.85805	2.72
39.5463	234.13	0.1732	2.64414	0.99
40.2719	437.87	0.2598	2.59843	1.85
40.9763	1135.38	0.2598	2.55563	4.79
42.6538	1820.53	0.1732	2.45954	7.67
44.0610	396.95	0.3031	2.38471	1.67
45.4127	257.17	0.1732	2.31732	1.08
46.1177	1432.60	0.0866	2.28379	6.04
47.0863	527.47	0.0866	2.23940	2.22
47.9994	393.82	0.2598	2.19925	1.66
49.6681	1330.37	0.1299	2.12982	5.61
50.6343	199.07	0.5196	2.09178	0.84
52.5631	402.04	0.2598	2.02019	1.69
53.6607	731.60	0.0866	1.98184	3.08
56.4755	322.48	0.5196	1.89061	1.36
57.7984	258.84	0.2165	1.85094	1.09
58.9314	2629.53	0.1056	1.81846	11.08

60.1810	532.71	0.2640	1.78413	2.25
61.4230	88.80	0.4224	1.75147	0.37
62.7152	172.24	0.3168	1.71895	0.73
64.6642	588.67	0.1320	1.67252	2.48
65.2299	295.26	0.1584	1.65959	1.24
69.4070	97.22	0.4224	1.57115	0.41
70.9172	1627.86	0.1320	1.54195	6.86
73.0699	194.90	0.8448	1.50258	0.82
75.9818	222.33	0.2112	1.45321	0.94
77.4937	93.79	0.6336	1.42919	0.40
80.6481	789.43	0.1320	1.38231	3.33
81.1417	1048.82	0.1056	1.37534	4.42
81.3520	1018.03	0.1320	1.37240	4.29
82.8325	111.05	0.4224	1.35219	0.47
88.0432	147.34	0.5280	1.28719	0.62
90.8030	329.85	0.1584	1.25625	1.39
93.4598	168.10	0.5280	1.22850	0.71

Sample: SESL_WDS1_Clasts



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	00-024-0027	71	Calcium Carbonate	$CaCO_3$

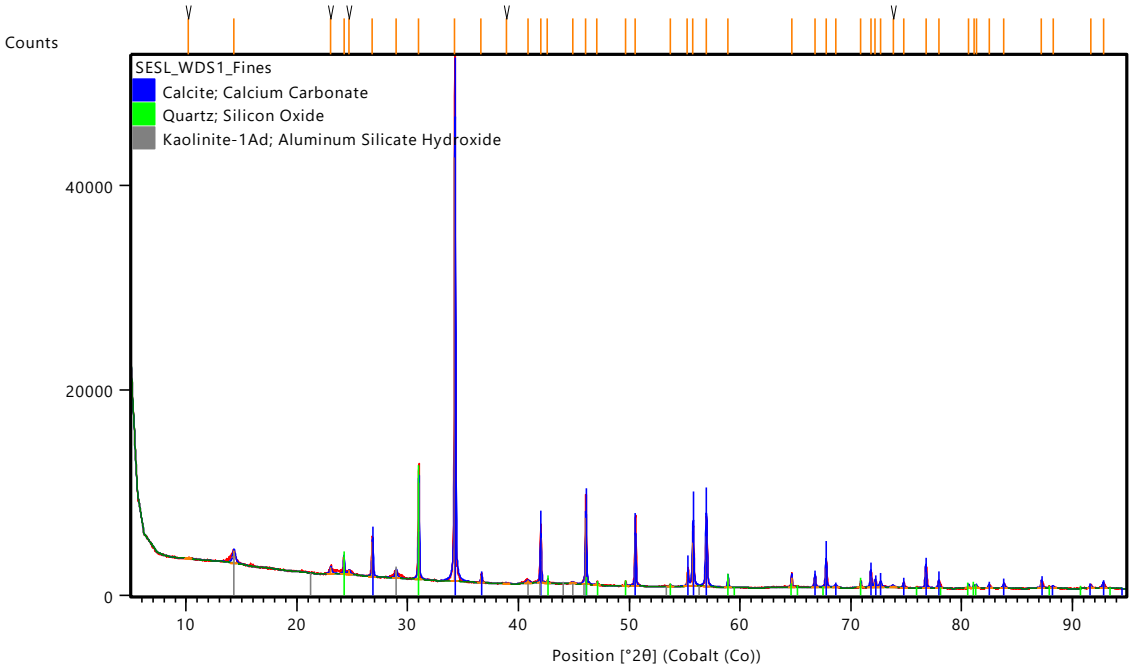
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8530	981.14	0.2598	3.85233	7.78
31.0090	136.37	0.2598	3.34627	1.08
34.3076	12612.95	0.3247	3.03286	100.00
36.7049	205.74	0.2598	2.84095	1.63
42.1229	1186.61	0.1732	2.48910	9.41
46.2168	1490.92	0.1732	2.27916	11.82
50.6042	1659.80	0.2381	2.09294	13.16
55.7943	1455.21	0.3464	1.91180	11.54
56.9795	1362.18	0.3031	1.87527	10.80
66.8203	249.50	0.3464	1.62452	1.98
67.8105	480.37	0.5196	1.60357	3.81
71.8568	379.14	0.6061	1.52445	3.01
76.7634	255.58	0.6061	1.44066	2.03
78.0375	120.71	0.5196	1.42081	0.96
82.5543	19.22	0.8659	1.35592	0.15
87.2375	62.79	0.8659	1.29665	0.50
92.8570	73.84	0.8659	1.23463	0.59

Sample: SESL_WDS1_Fines



Diffractogram



Mineral List

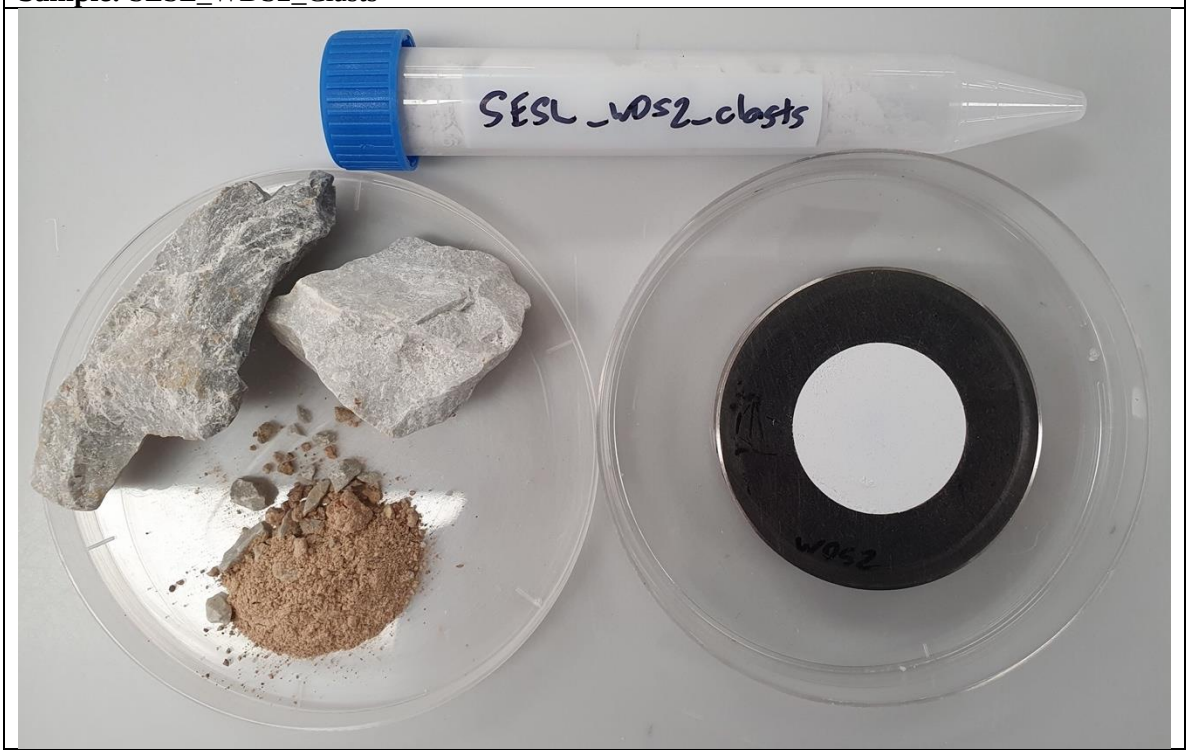
Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-083-1762	78	Calcium Carbonate	$CaCO_3$
Quartz	01-075-8322	52	Silicon Oxide	SiO_2
Kaolinite	00-058-2006	33	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$

Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
10.1550	72.93	0.5196	10.10702	0.18
14.3169	1198.95	0.3031	7.17822	2.90
23.0526	579.22	0.2165	4.47661	1.40
24.2407	1613.73	0.1082	4.26024	3.91
24.7159	394.46	0.2165	4.17957	0.96
26.8151	3429.74	0.1299	3.85768	8.30
28.9532	745.58	0.2165	3.57825	1.81
30.9884	9397.49	0.1082	3.34844	22.75
34.2509	41300.72	0.1299	3.03773	100.00
36.6303	693.06	0.1299	2.84653	1.68
38.8783	73.13	0.5196	2.68777	0.18
40.8309	286.14	0.3031	2.56434	0.69
41.9866	4351.15	0.1082	2.49681	10.54
42.6249	302.62	0.1082	2.46112	0.73
44.8931	151.49	0.2598	2.34273	0.37
46.0593	6519.90	0.1299	2.28653	15.79
47.0717	250.63	0.0649	2.24006	0.61
49.6488	297.34	0.0649	2.13059	0.72
50.5256	4882.29	0.1082	2.09599	11.82
53.6993	115.38	0.2598	1.98052	0.28
55.2581	1319.28	0.1082	1.92887	3.19
55.7656	4206.97	0.1584	1.91271	10.19
56.9681	4847.23	0.1584	1.87561	11.74
58.9190	849.50	0.1056	1.81881	2.06
64.6671	924.51	0.0792	1.67245	2.24
66.7727	847.17	0.1320	1.62554	2.05
67.7801	1878.05	0.1320	1.60420	4.55
68.6432	188.12	0.2640	1.58646	0.46
70.8993	437.34	0.0792	1.54228	1.06
71.8045	1108.16	0.1320	1.52541	2.68
72.2106	503.10	0.1584	1.51799	1.22
72.7016	373.52	0.2112	1.50913	0.90
73.8159	148.32	0.3168	1.48952	0.36
74.7625	360.26	0.1056	1.47337	0.87
76.7821	1542.15	0.1320	1.44037	3.73
77.9449	492.33	0.1584	1.42223	1.19
80.6349	268.31	0.1320	1.38250	0.65
81.1222	206.61	0.1056	1.37561	0.50
81.3499	270.59	0.1056	1.37243	0.66
82.4864	267.89	0.1584	1.35684	0.65
83.8382	316.21	0.2112	1.33892	0.77

87.2301	497.77	0.1320	1.29674	1.21
88.2535	144.26	0.1584	1.28475	0.35
91.6550	230.35	0.1584	1.24714	0.56
92.7925	399.36	0.1848	1.23529	0.97

Sample: SESL_WDS2_Clasts



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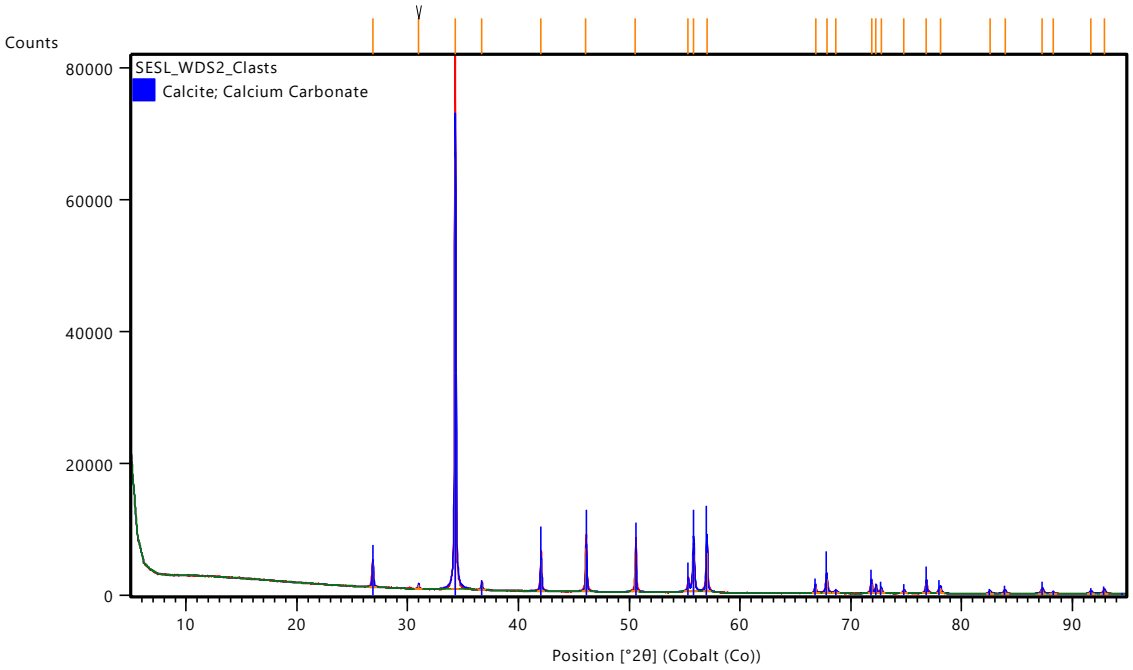


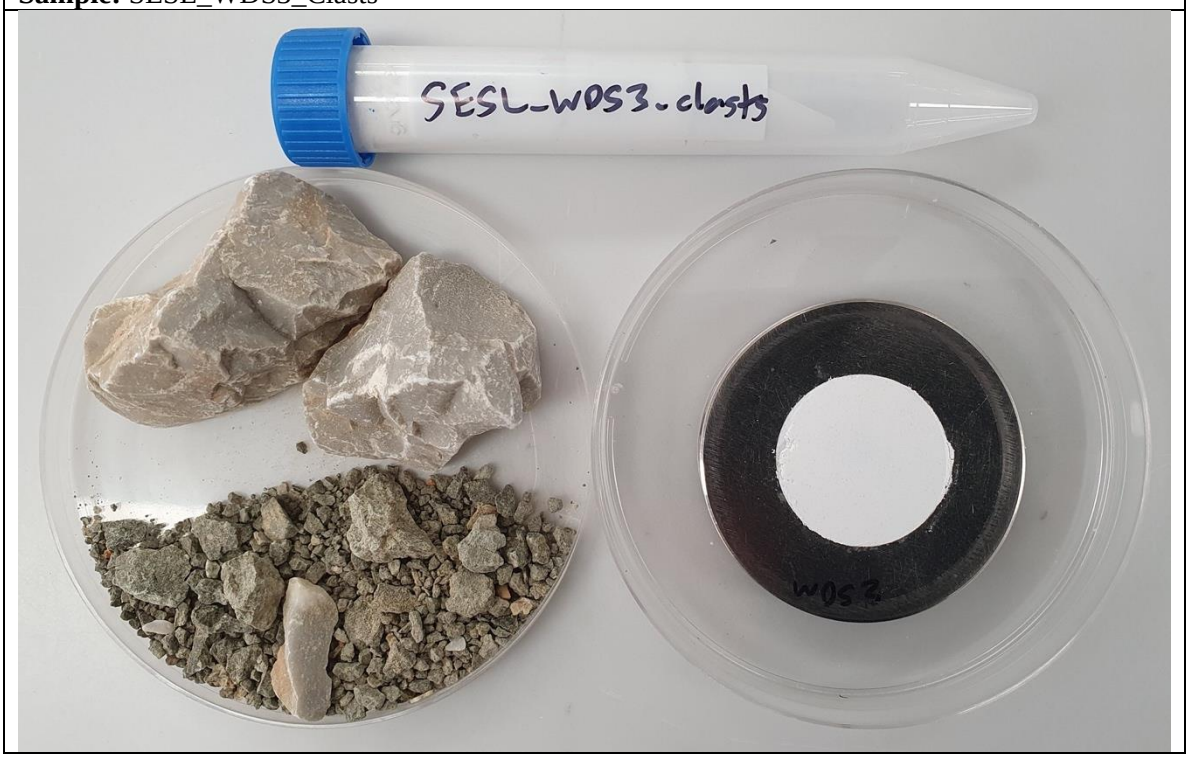
Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-086-2334	70	Calcium Carbonate	$CaCO_3$

Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8406	3722.77	0.1299	3.85408	5.68
30.9728	545.93	0.1082	3.35008	0.83
34.2777	65526.22	0.1515	3.03543	100.00
36.6706	961.10	0.1299	2.84351	1.47
42.0121	4713.02	0.1299	2.49536	7.19
46.0905	6580.09	0.1299	2.28506	10.04
50.5560	5915.40	0.0866	2.09481	9.03
55.3033	1564.26	0.1299	1.92742	2.39
55.8176	5549.25	0.1848	1.91107	8.47
57.0160	5819.69	0.1320	1.87417	8.88
66.8095	850.08	0.1320	1.62475	1.30
67.8265	2030.65	0.1584	1.60324	3.10
68.6760	250.03	0.2640	1.58579	0.38
71.8697	1394.20	0.1320	1.52421	2.13
72.2863	900.91	0.1320	1.51661	1.37
72.7706	584.25	0.1320	1.50790	0.89
74.8106	386.29	0.1584	1.47256	0.59
76.8336	1358.53	0.1320	1.43955	2.07
78.0910	729.83	0.2376	1.41999	1.11
82.5827	273.14	0.2112	1.35554	0.42
83.9361	379.23	0.1848	1.33765	0.58
87.3063	504.22	0.2376	1.29584	0.77
88.3113	135.45	0.2112	1.28408	0.21
91.6999	228.83	0.2640	1.24667	0.35
92.9294	435.85	0.1584	1.23389	0.67

Sample: SESL_WDS3_Clasts



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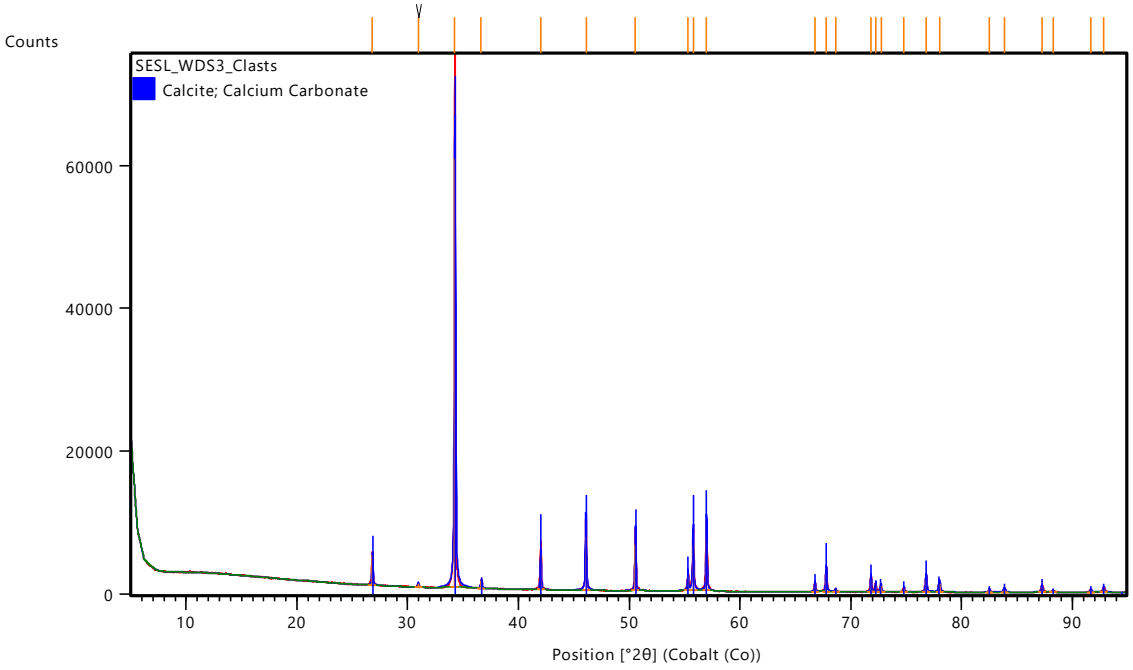


Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-086-2334	83	Calcium Carbonate	$CaCO_3$

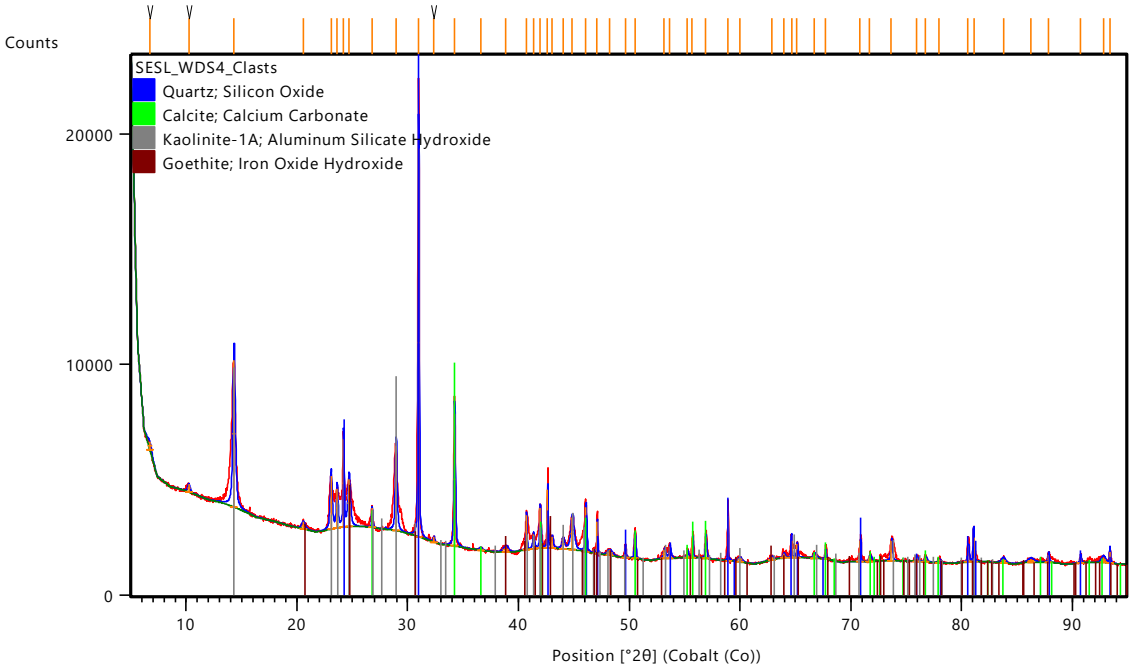
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8107	4173.48	0.1082	3.85831	6.96
30.9466	481.14	0.0866	3.35285	0.80
34.2486	59942.34	0.1515	3.03793	100.00
36.6350	1085.57	0.1515	2.84619	1.81
41.9857	5071.42	0.1082	2.49686	8.46
46.0957	7349.37	0.1320	2.28482	12.26
50.5655	6380.92	0.1056	2.09444	10.65
55.3059	1885.54	0.1056	1.92733	3.15
55.7810	6243.02	0.1320	1.91222	10.42
56.9838	7119.22	0.1056	1.87514	11.88
66.7712	967.43	0.1056	1.62557	1.61
67.7946	2431.54	0.1320	1.60390	4.06
68.6367	308.44	0.1320	1.58659	0.51
71.8312	1655.58	0.1056	1.52492	2.76
72.2496	909.80	0.1056	1.51728	1.52
72.7307	732.53	0.1584	1.50861	1.22
74.8065	506.49	0.1056	1.47263	0.84
76.8124	1703.71	0.1584	1.43989	2.84
78.0130	1146.69	0.1848	1.42118	1.91
82.5287	359.57	0.1056	1.35627	0.60
83.8787	419.89	0.2112	1.33839	0.70
87.2670	668.53	0.1584	1.29630	1.12
88.2719	153.46	0.1584	1.28454	0.26
91.6848	306.76	0.1320	1.24682	0.51
92.8391	559.50	0.1584	1.23481	0.93

Sample: SESL_WDS4_Fines



Diffractogram



Mineral List

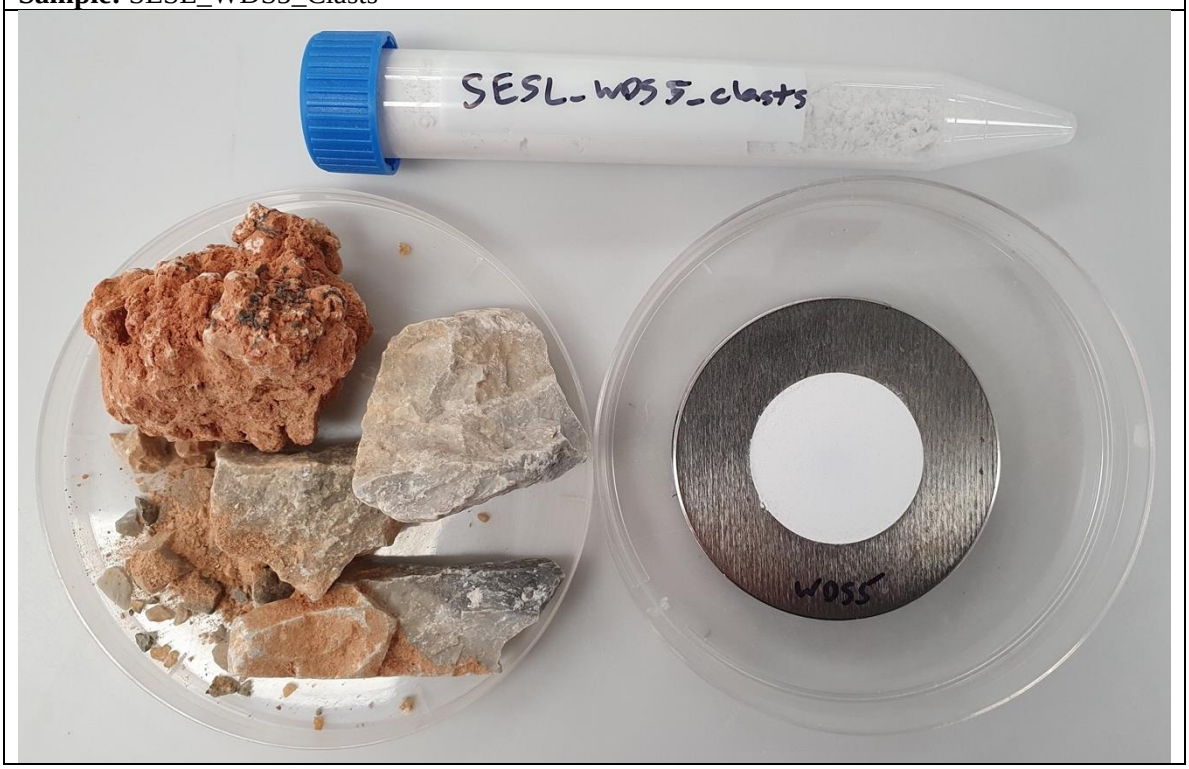
Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-075-8322	65	Silicon Oxide	SiO_2
Calcite	01-072-1937	61	Calcium Carbonate	$CaCO_3$
Kaolinite	00-058-2005	45	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (O\ H)_4$
Goethite	01-075-5065	26	Iron Oxide Hydroxide	FeO(OH)

Peak List

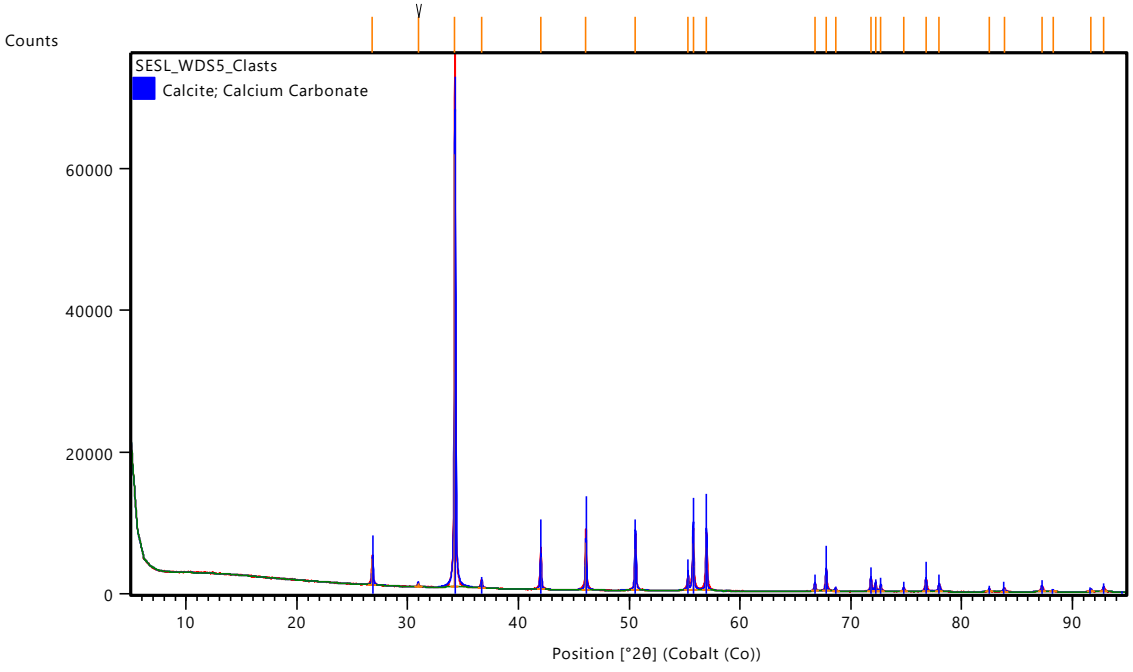
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.7024	335.56	0.4330	15.30209	2.00
10.2395	339.68	0.2598	10.02385	2.02
14.3221	6356.99	0.2598	7.17563	37.81
20.5786	309.65	0.3464	5.00791	1.84
23.0825	2289.92	0.2165	4.47089	13.62
23.6249	1710.03	0.1732	4.36965	10.17
24.2081	3820.25	0.1299	4.26589	22.72
24.7078	2075.78	0.2598	4.18092	12.34
26.7851	849.24	0.1082	3.86193	5.05
28.9460	3681.28	0.1948	3.57911	21.89
30.9750	16814.93	0.1082	3.34986	100.00
32.3546	224.37	0.1732	3.21060	1.33
34.2240	5721.67	0.1515	3.04005	34.03
36.5881	105.34	0.3464	2.84971	0.63
38.8638	252.32	0.5196	2.68874	1.50
40.7098	1494.27	0.0866	2.57164	8.89
41.3446	626.08	0.1732	2.53385	3.72
41.9488	1740.99	0.1299	2.49896	10.35
42.6183	2523.06	0.0866	2.46149	15.00
43.0228	480.58	0.2165	2.43943	2.86
44.0164	420.05	0.2598	2.38701	2.50
44.8537	1387.45	0.3464	2.34468	8.25
46.0782	1936.92	0.1515	2.28564	11.52
47.0854	1365.40	0.0866	2.23944	8.12
48.2411	231.56	0.5196	2.18889	1.38
49.6353	483.56	0.1082	2.13113	2.88
50.5010	1031.41	0.1515	2.09694	6.13
53.1620	383.21	0.2598	1.99906	2.28
53.6614	505.91	0.1948	1.98182	3.01
55.2575	259.64	0.1732	1.92889	1.54
55.6892	871.16	0.1082	1.91512	5.18
56.8933	924.58	0.1515	1.87787	5.50
58.8785	1937.05	0.0649	1.81995	11.52
59.9669	192.90	0.4330	1.78990	1.15
62.8460	130.66	0.2598	1.71574	0.78
63.9451	194.11	0.2598	1.68930	1.15
64.6522	730.46	0.0792	1.67279	4.34
65.1274	580.42	0.1299	1.66192	3.45
66.7288	213.86	0.3464	1.62649	1.27
67.6955	394.80	0.1299	1.60597	2.35
70.8478	896.95	0.0866	1.54326	5.33

71.7123	260.56	0.3031	1.52710	1.55
73.6411	856.69	0.1732	1.49256	5.09
75.9099	202.02	0.2598	1.45438	1.20
76.7438	183.58	0.2598	1.44098	1.09
77.9621	144.70	0.2598	1.42196	0.86
80.5647	706.25	0.1515	1.38349	4.20
81.1056	1025.59	0.1056	1.37585	6.10
83.7952	166.69	0.4224	1.33948	0.99
86.2751	118.11	0.6336	1.30823	0.70
87.8808	312.80	0.1584	1.28908	1.86
90.7684	248.64	0.1584	1.25662	1.48
92.8195	205.96	0.4224	1.23501	1.22
93.4116	480.40	0.1056	1.22898	2.86

Sample: SESL_WDS5_Clasts



Diffractogram



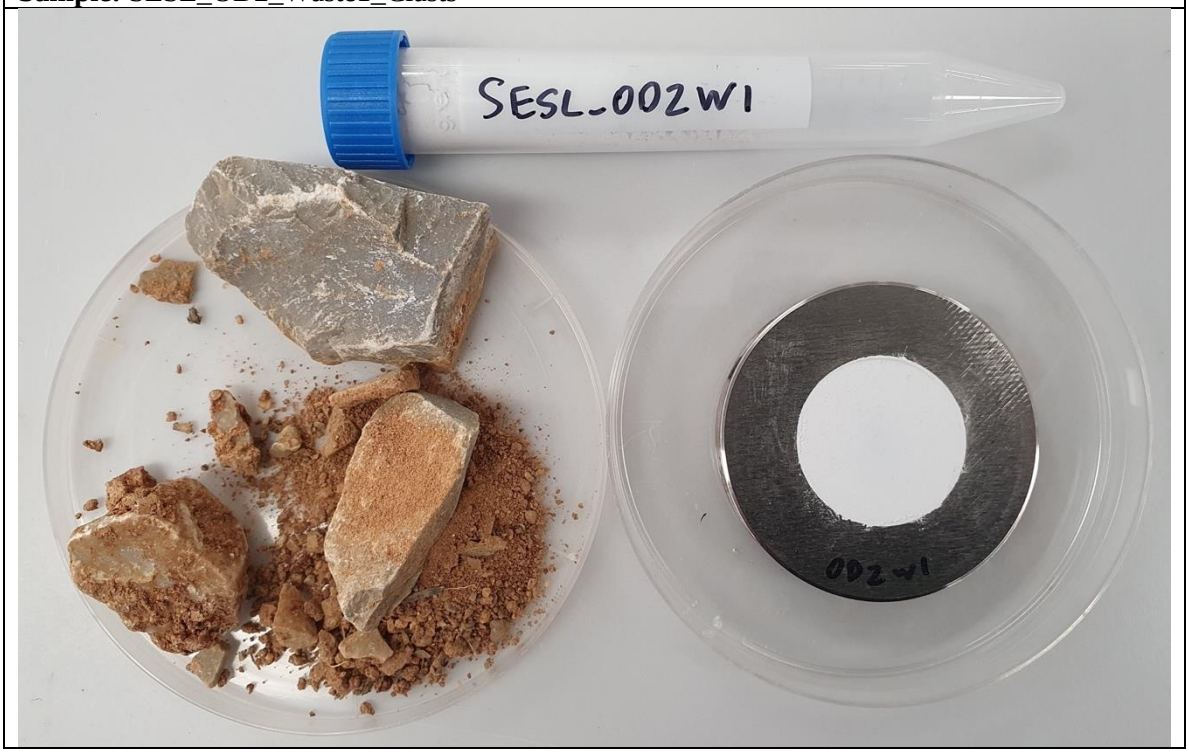
Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-083-1762	78	Calcium Carbonate	$CaCO_3$

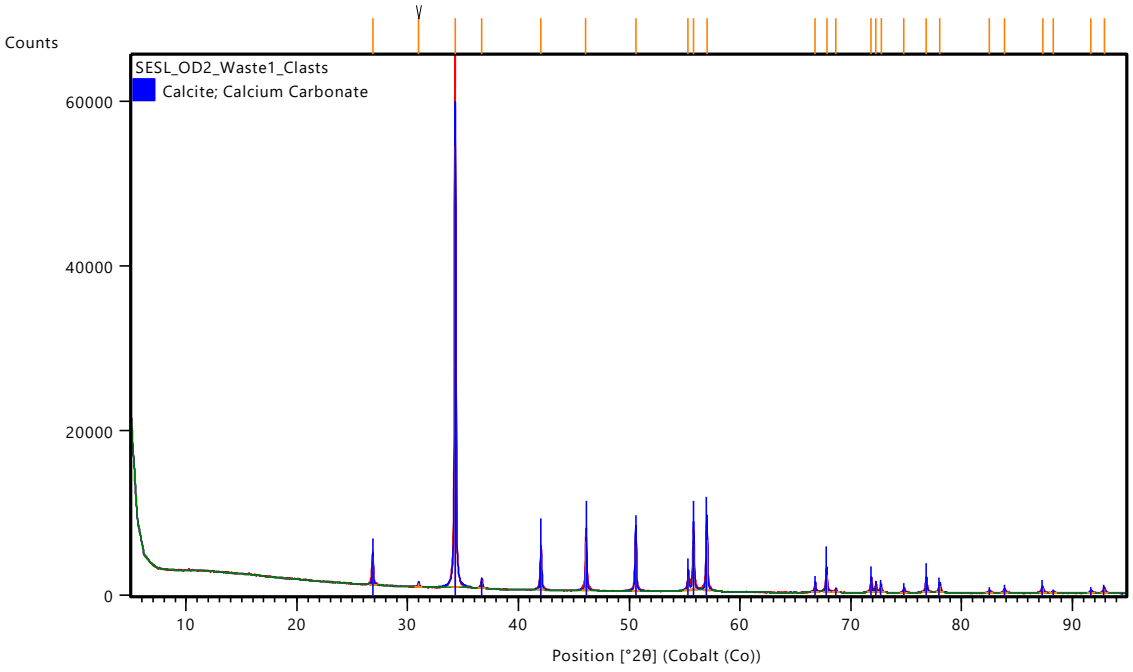
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8177	3722.03	0.1299	3.85732	6.10
30.9397	525.36	0.0866	3.35358	0.86
34.2500	61017.95	0.1515	3.03781	100.00
36.6544	1012.10	0.1515	2.84473	1.66
41.9869	4513.68	0.1299	2.49680	7.40
46.0607	6563.78	0.1299	2.28646	10.76
50.5634	5798.32	0.1320	2.09452	9.50
55.3055	1746.21	0.1056	1.92735	2.86
55.7768	6477.51	0.1320	1.91235	10.62
56.9743	5928.57	0.1056	1.87542	9.72
66.7621	785.37	0.1320	1.62577	1.29
67.7899	2182.66	0.1320	1.60400	3.58
68.6188	295.06	0.1320	1.58696	0.48
71.8225	1380.87	0.1320	1.52508	2.26
72.2367	888.01	0.1320	1.51751	1.46
72.6985	651.10	0.1320	1.50919	1.07
74.7614	408.61	0.1320	1.47339	0.67
76.7941	1267.05	0.1320	1.44018	2.08
77.9883	714.15	0.1848	1.42156	1.17
82.5181	305.80	0.1320	1.35641	0.50
83.8468	380.85	0.1848	1.33881	0.62
87.2541	560.58	0.1584	1.29646	0.92
88.2513	133.83	0.1584	1.28478	0.22
91.6889	243.96	0.1848	1.24678	0.40
92.8160	456.44	0.1320	1.23505	0.75

Sample: SESL_OD2_Waste1_Clasts



Diffractogram



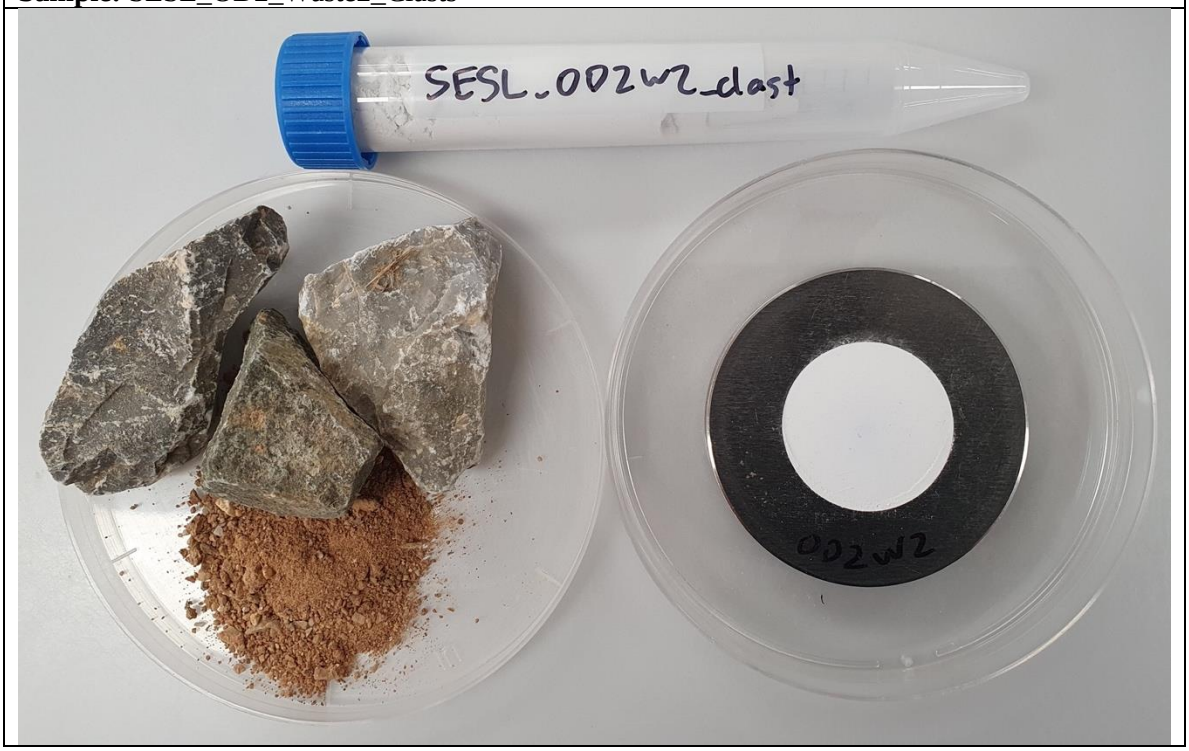
Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-086-2334	78	Calcium Carbonate	$CaCO_3$

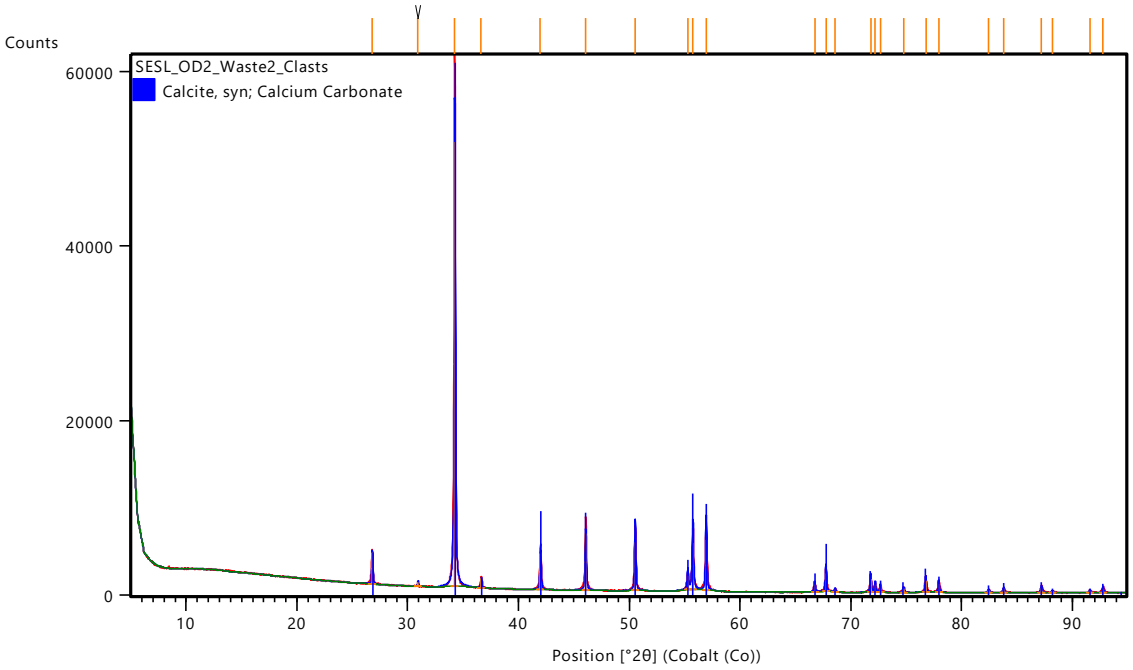
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8333	3424.08	0.1082	3.85511	6.39
30.9739	471.86	0.1082	3.34997	0.88
34.2705	53596.21	0.1515	3.03604	100.00
36.6667	989.25	0.1732	2.84380	1.85
42.0058	4257.37	0.1515	2.49572	7.94
46.0817	5900.68	0.1299	2.28547	11.01
50.5877	5466.19	0.1320	2.09358	10.20
55.3320	1641.26	0.1320	1.92650	3.06
55.8063	5590.90	0.1320	1.91142	10.43
57.0085	6107.68	0.1320	1.87439	11.40
66.7966	799.08	0.1056	1.62503	1.49
67.8208	1966.39	0.1320	1.60335	3.67
68.6824	306.78	0.0792	1.58567	0.57
71.8566	1252.86	0.1056	1.52445	2.34
72.2762	837.28	0.1056	1.51680	1.56
72.7339	633.99	0.1320	1.50856	1.18
74.8024	399.05	0.1320	1.47270	0.74
76.8297	1230.86	0.1584	1.43961	2.30
78.0428	779.76	0.1584	1.42073	1.45
82.5225	216.56	0.1584	1.35635	0.40
83.8813	336.52	0.1584	1.33836	0.63
87.3200	532.59	0.1584	1.29567	0.99
88.3074	155.10	0.2112	1.28413	0.29
91.6931	203.89	0.2112	1.24674	0.38
92.8982	436.88	0.1584	1.23420	0.82

Sample: SESL_OD2_Waste2_Clasts



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-076-2712	85	Calcium Carbonate	$CaCO_3$

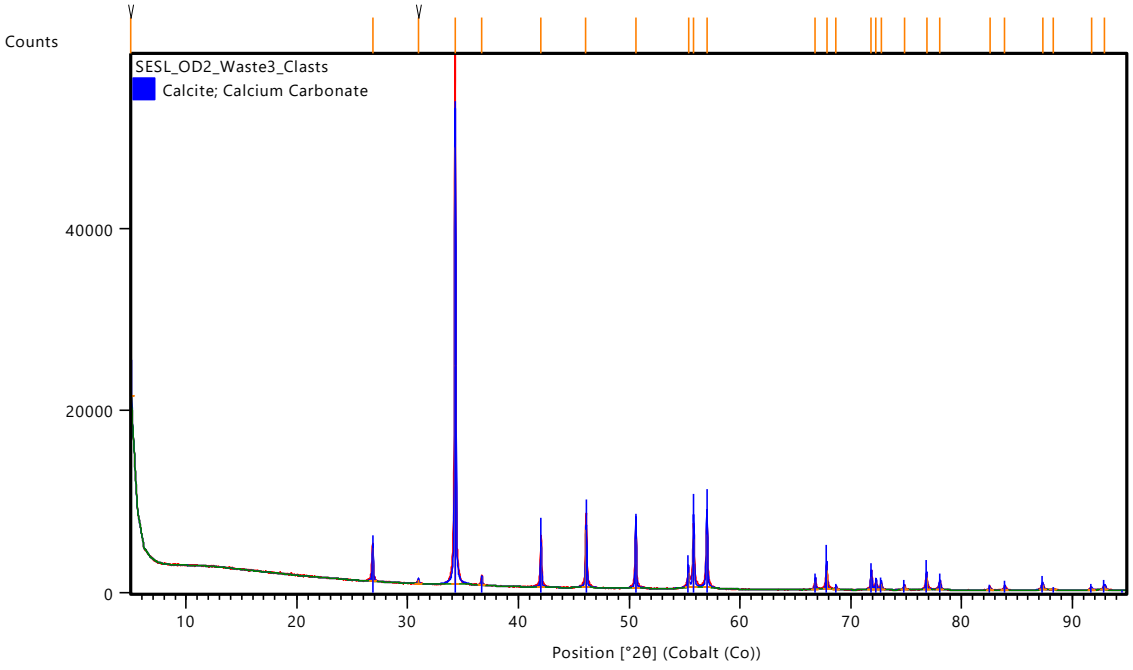
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
26.8013	3557.78	0.1082	3.85964	6.98
30.9298	426.11	0.0866	3.35463	0.84
34.2362	50942.11	0.1515	3.03899	100.00
36.6359	1067.06	0.1299	2.84611	2.09
41.9691	4115.17	0.1299	2.49781	8.08
46.0468	6439.73	0.1299	2.28711	12.64
50.5477	5523.67	0.1320	2.09513	10.84
55.2893	1614.81	0.1584	1.92787	3.17
55.7479	5350.53	0.1584	1.91326	10.50
56.9542	5771.96	0.1320	1.87603	11.33
66.7430	808.74	0.1320	1.62618	1.59
67.7643	2074.91	0.1320	1.60453	4.07
68.5942	256.39	0.1320	1.58745	0.50
71.8016	1453.20	0.1320	1.52546	2.85
72.2048	818.33	0.1320	1.51809	1.61
72.6682	654.67	0.1056	1.50973	1.29
74.7697	429.98	0.1584	1.47325	0.84
76.7736	1242.95	0.1320	1.44050	2.44
77.9454	922.40	0.1320	1.42222	1.81
82.4645	228.74	0.1848	1.35713	0.45
83.8117	403.36	0.1584	1.33926	0.79
87.2163	564.06	0.1584	1.29691	1.11
88.2211	143.69	0.1584	1.28512	0.28
91.5941	209.48	0.1584	1.24778	0.41
92.7707	468.10	0.1320	1.23551	0.92

Sample: SESL_OD2_Waste3_Clasts



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-083-0577	73	Calcium Carbonate	$CaCO_3$

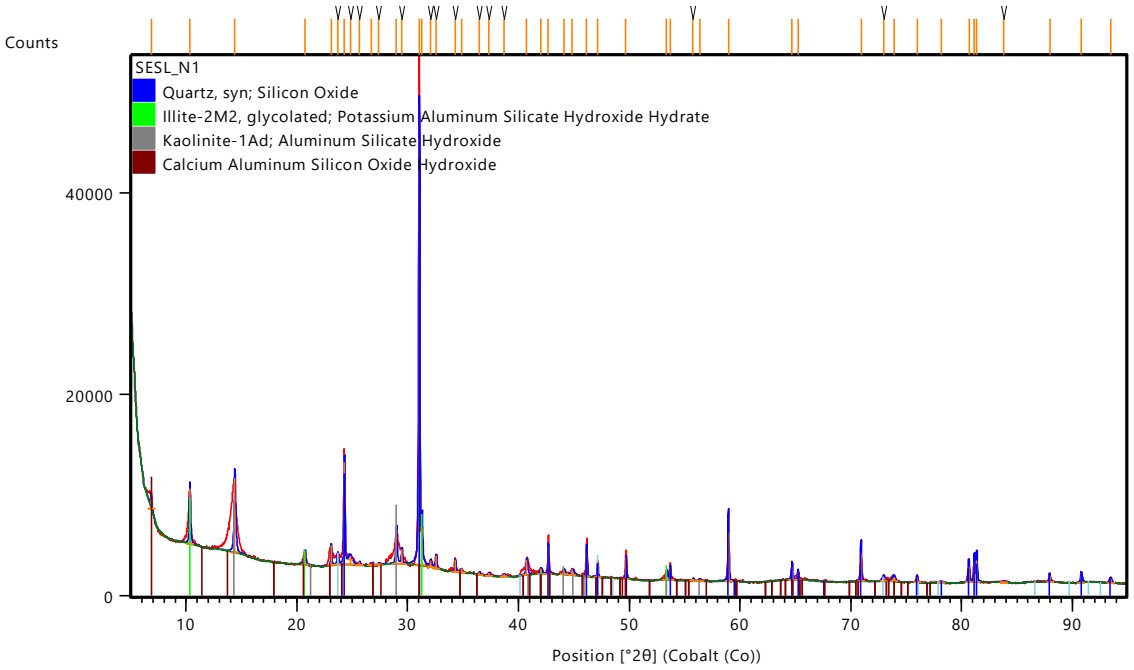
Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
5.0234	3929.85	0.0649	20.41158	8.20
26.8320	3614.02	0.1082	3.85530	7.54
30.9547	382.17	0.0866	3.35200	0.80
34.2691	47903.43	0.1299	3.03616	100.00
36.6714	938.12	0.1082	2.84345	1.96
42.0076	4407.88	0.1082	2.49562	9.20
46.0852	6350.61	0.1299	2.28531	13.26
50.5928	5357.86	0.1056	2.09338	11.18
55.3360	1625.94	0.1320	1.92637	3.39
55.8128	5293.67	0.1320	1.91122	11.05
57.0143	5747.84	0.1320	1.87422	12.00
66.8057	843.68	0.1056	1.62483	1.76
67.8271	2038.12	0.1056	1.60322	4.25
68.6776	259.87	0.1056	1.58576	0.54
71.8600	1414.96	0.1320	1.52439	2.95
72.2898	769.25	0.1320	1.51655	1.61
72.7612	610.07	0.1320	1.50807	1.27
74.8215	354.83	0.1320	1.47238	0.74
76.8461	1259.46	0.1320	1.43935	2.63
78.0524	690.48	0.1584	1.42058	1.44
82.5660	236.17	0.1320	1.35577	0.49
83.9083	340.85	0.1320	1.33801	0.71
87.3156	517.16	0.1848	1.29573	1.08
88.3135	98.59	0.1584	1.28406	0.21
91.7218	232.41	0.1320	1.24643	0.49
92.9255	402.52	0.2112	1.23393	0.84

Sample: SESL_N1



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-076-9281	76	Silicon Oxide	SiO_2
Illite	00-058-2016	44	Potassium Aluminum Silicate Hydroxide Hydrate	$(K,H_{30})Al_2(Si_3Al)O_{10}(OH)_2 \cdot xH_2O$
Kaolinite	00-058-2006	33	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$
Montmorillonite	01-076-8291	21	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5}\ (Al_2\ Si_4\ O_{11}\ (OH))$

Peak List

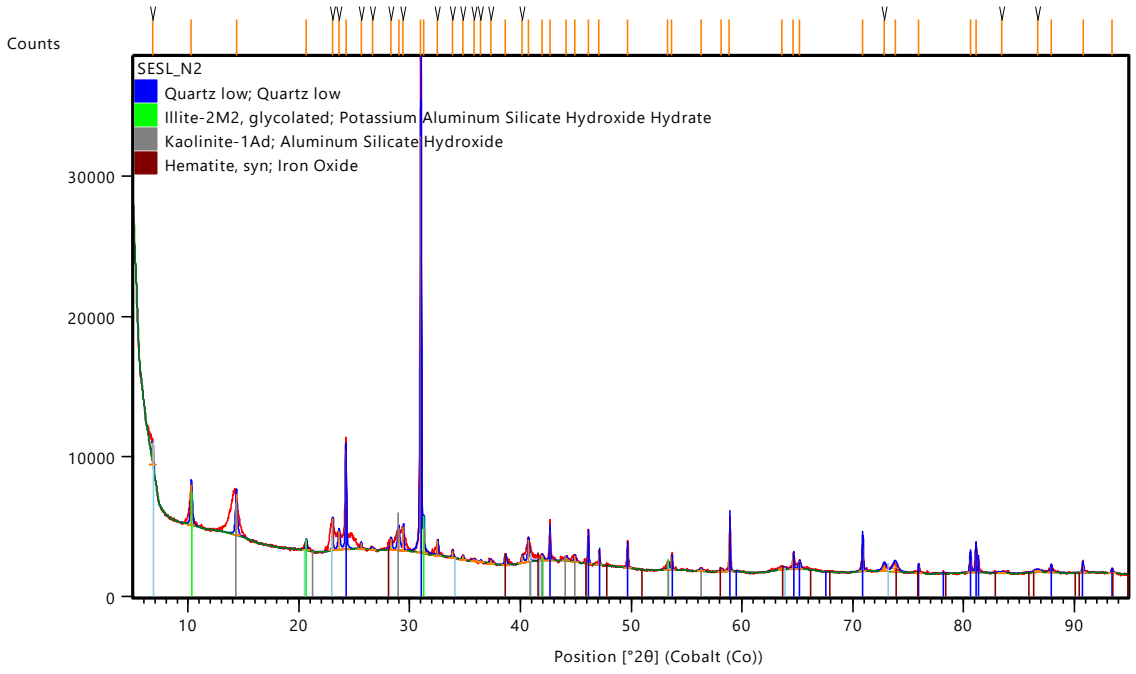
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8502	1403.63	0.1515	14.97243	3.31
10.3362	5492.85	0.1299	9.93032	12.96
14.3940	7405.29	0.1732	7.13997	17.48
20.7297	1341.36	0.1732	4.97180	3.17
23.0911	2006.60	0.1082	4.46924	4.74
23.6828	1110.37	0.1515	4.35912	2.62
24.2812	10166.59	0.1082	4.25324	24.00
24.8122	899.13	0.4330	4.16360	2.12
25.6546	319.47	0.1299	4.02907	0.75
26.7509	214.43	0.2598	3.86678	0.51
27.3733	148.37	0.2165	3.78047	0.35
28.9792	3367.60	0.1515	3.57509	7.95
29.4660	1393.40	0.1299	3.51732	3.29
31.0310	42368.79	0.1299	3.34396	100.00
31.2953	3791.91	0.1082	3.31641	8.95
32.0840	647.30	0.1948	3.23695	1.53
32.5644	1271.59	0.1299	3.19046	3.00
34.2827	1158.28	0.1299	3.03499	2.73
34.8372	351.07	0.1299	2.98815	0.83
36.4587	240.52	0.1732	2.85947	0.57
37.3557	284.09	0.2165	2.79317	0.67
38.6891	225.56	0.3464	2.70041	0.53
40.7360	1488.62	0.1948	2.57006	3.51
42.0292	583.72	0.2165	2.49440	1.38
42.6778	2871.99	0.0866	2.45822	6.78
44.1199	441.85	0.2165	2.38169	1.04
44.8511	547.62	0.3031	2.34481	1.29
46.1412	2853.66	0.0866	2.28269	6.74
47.1195	1257.15	0.1082	2.23791	2.97
49.6865	2128.50	0.0866	2.12908	5.02
53.3758	849.03	0.1515	1.99164	2.00
53.6773	1310.99	0.0866	1.98128	3.09
55.7604	205.54	0.1732	1.91287	0.49
56.3726	155.42	0.2598	1.89377	0.37
58.9555	4805.40	0.1056	1.81778	11.34
64.6986	1238.45	0.1056	1.67172	2.92
65.2516	688.62	0.1056	1.65910	1.63

70.9338	2808.04	0.1056	1.54163	6.63
72.9740	401.72	0.2640	1.50428	0.95
73.8931	459.78	0.3168	1.48819	1.09
75.9953	526.36	0.1320	1.45299	1.24
78.2050	90.21	0.6336	1.41825	0.21
80.6691	1512.26	0.1320	1.38201	3.57
81.1701	1969.88	0.1056	1.37494	4.65
81.3845	2122.23	0.1056	1.37195	5.01
83.8066	92.65	0.7392	1.33933	0.22
87.9762	574.88	0.1056	1.28797	1.36
90.8376	691.48	0.1584	1.25587	1.63
93.4752	378.61	0.2112	1.22834	0.89

Sample: SESL_N2



Diffractogram



Mineral List

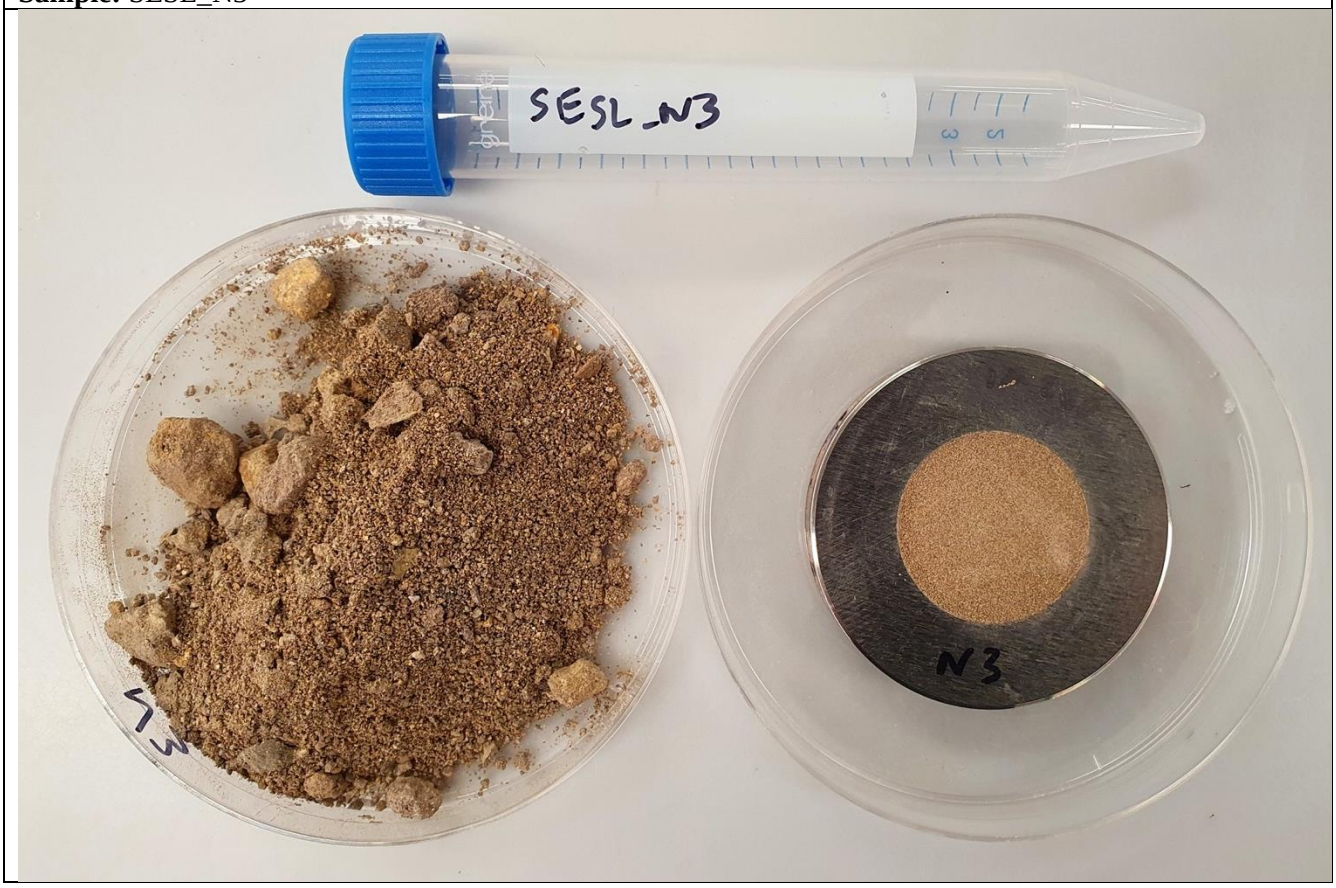
Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	98-005-6888	72	Silicon Oxide	SiO_2
Illite	00-058-2016	51	Potassium Aluminum Silicate Hydroxide Hydrate	$(K,H_{30})Al_2(Si_3Al)O_{10}(OH)_2 \cdot x\ H_2O$
Kaolinite	00-058-2006	35	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$
Hematite	01-089-0597	30	Iron Oxide	$Fe_2\ O_3$

Peak List

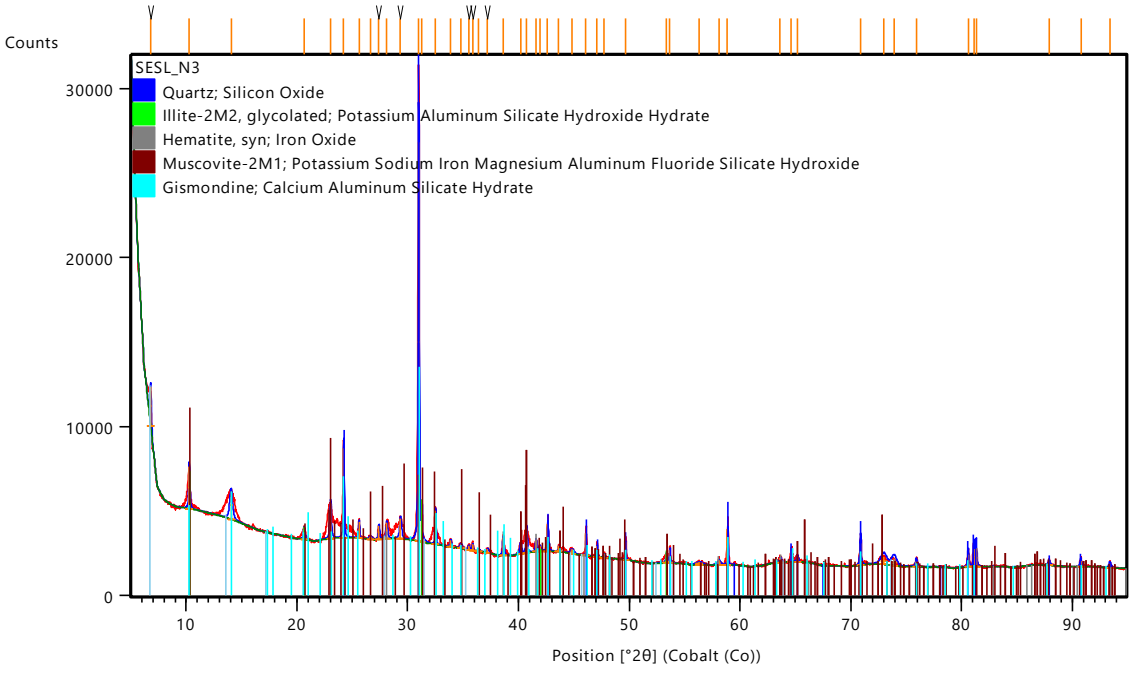
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8106	1560.54	0.1082	15.05934	5.24
10.2891	2891.34	0.1732	9.97569	9.71
14.3504	2949.76	0.1948	7.16156	9.91
20.6561	752.59	0.1515	4.98931	2.53
23.0458	2286.01	0.0866	4.47791	7.68
23.6139	1326.29	0.1948	4.37166	4.46
24.2334	7134.66	0.1082	4.26150	23.97
25.6102	433.64	0.1299	4.03593	1.46
26.6403	176.91	0.3464	3.88253	0.59
28.3095	821.59	0.1732	3.65788	2.76
28.9958	1588.04	0.2381	3.57309	5.33
29.4126	1715.53	0.0866	3.52356	5.76
30.9875	29768.42	0.1299	3.34853	100.00
31.2700	1900.96	0.0649	3.31903	6.39
32.5261	1045.29	0.1082	3.19411	3.51
33.8823	500.96	0.1299	3.06979	1.68
34.7936	268.23	0.1732	2.99178	0.90
35.7856	147.71	0.4330	2.91145	0.50
36.4091	127.16	0.1299	2.86324	0.43
37.3053	276.01	0.2165	2.79681	0.93
38.6394	696.89	0.1948	2.70375	2.34
40.1592	500.95	0.1732	2.60541	1.68
40.7074	1569.47	0.1948	2.57179	5.27
41.9489	409.27	0.2598	2.49895	1.37
42.6380	2159.34	0.0866	2.46040	7.25
44.1325	271.36	0.2598	2.38104	0.91
44.9008	464.12	0.1732	2.34235	1.56
46.1017	1823.77	0.0866	2.28453	6.13
47.0768	798.33	0.0866	2.23982	2.68
49.6456	1382.12	0.0649	2.13072	4.64
53.3052	507.38	0.2165	1.99408	1.70
53.6396	982.40	0.0866	1.98256	3.30
56.2844	177.29	0.3464	1.89650	0.60
58.0826	145.70	0.2598	1.84267	0.49
58.8669	2753.98	0.0866	1.82027	9.25
63.6302	196.01	0.5196	1.69678	0.66
64.6100	899.19	0.0866	1.67377	3.02
65.1572	550.49	0.2598	1.66124	1.85

70.8998	1750.16	0.1320	1.54227	5.88
72.8671	400.55	0.3696	1.50618	1.35
73.8331	502.28	0.5280	1.48923	1.69
75.9496	476.63	0.0792	1.45373	1.60
80.6245	990.86	0.1320	1.38264	3.33
81.1340	1460.79	0.1056	1.37545	4.91
83.4614	63.24	0.8448	1.34385	0.21
86.7067	129.52	0.6336	1.30300	0.44
87.9299	375.85	0.1584	1.28851	1.26
90.7927	490.26	0.1320	1.25636	1.65
93.4257	238.84	0.1584	1.22884	0.80

Sample: SESL_N3



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-075-8322	69	Silicon Oxide	SiO_2
Illite	00-058-2016	54	Potassium Aluminum Silicate Hydroxide Hydrate	$(K, H_{30})\ Al_2\ (Si_3\ Al)\ O_{10}\ (OH)_2 \cdot x\ H_2O$
Hematite	01-089-0597	46	Iron Oxide	Fe_2O_3
Muscovite	01-074-2773	24	Potassium Sodium Iron Magnesium Aluminum Fluoride Silicate Hydroxide	$(K_{0.95\ Na0.05})\ (A_{l0.76}\ Fe_{0.14}\ Mg_{0.10})_2\ (Si_{3.25}\ Al_{0.75})\ O_{10}\ ((OH_{1.96}\ F_{0.04})$
Gismondine	00-020-0452	32	Calcium Aluminum Silicate Hydrate	$Ca\ Al_2\ Si_2\ O_8 \cdot 4\ H_2O$

Peak List

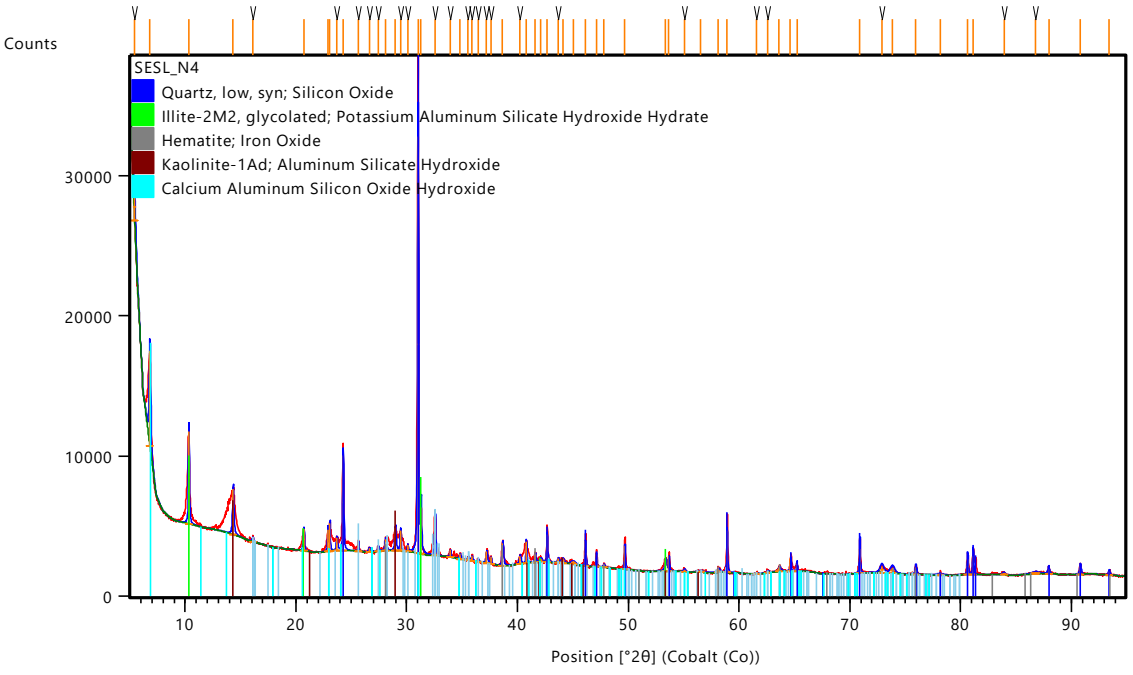
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.7886	2329.38	0.1299	15.10800	9.85
10.2842	2495.83	0.1299	9.98036	10.55
14.0520	1632.86	0.3031	7.31286	6.90
20.6467	699.01	0.1515	4.99158	2.96
23.0219	2081.91	0.1732	4.48250	8.80
24.2234	5275.19	0.1082	4.26324	22.31
25.6056	945.80	0.1082	4.03665	4.00
26.6451	165.67	0.3464	3.88185	0.70
27.3907	771.30	0.1299	3.77812	3.26
28.1021	933.76	0.1515	3.68433	3.95
29.3456	1160.17	0.2165	3.53143	4.91
30.9801	23647.61	0.1082	3.34931	100.00
31.2624	1927.89	0.0866	3.31981	8.15
32.4948	1997.06	0.1082	3.19711	8.45
33.8775	392.46	0.1732	3.07022	1.66
34.7921	259.04	0.2598	2.99190	1.10
35.5114	243.83	0.1299	2.93320	1.03
35.8477	382.68	0.0866	2.90657	1.62
36.4058	106.20	0.1732	2.86349	0.45
37.2138	243.35	0.2165	2.80344	1.03
38.6121	1047.54	0.1515	2.70559	4.43
40.1805	648.39	0.1732	2.60409	2.74
40.7135	1462.02	0.1515	2.57142	6.18
41.5546	672.38	0.1299	2.52160	2.84
41.9216	309.94	0.1732	2.50051	1.31
42.6304	1603.12	0.1515	2.46082	6.78
43.6267	328.09	0.1299	2.40727	1.39
44.8343	256.64	0.3464	2.34565	1.09
46.0834	1311.00	0.0649	2.28539	5.54
47.0787	635.57	0.0866	2.23974	2.69
47.7205	203.45	0.1732	2.21134	0.86
49.6372	1053.01	0.0866	2.13106	4.45
53.3514	544.46	0.1732	1.99248	2.30
53.6370	778.39	0.0866	1.98265	3.29
56.3198	150.68	0.6927	1.89540	0.64
58.0812	256.56	0.2598	1.84271	1.08

58.8595	2103.27	0.0866	1.82048	8.89
63.6212	269.49	0.2165	1.69699	1.14
64.6003	670.61	0.0866	1.67399	2.84
65.1556	357.86	0.1732	1.66128	1.51
70.8864	1275.31	0.1320	1.54253	5.39
72.9900	456.18	0.6336	1.50400	1.93
73.9138	413.08	0.5280	1.48783	1.75
75.9271	333.10	0.1848	1.45410	1.41
80.6134	739.19	0.1320	1.38280	3.13
81.1243	1048.79	0.1056	1.37558	4.44
81.3288	1089.55	0.1320	1.37273	4.61
87.9143	236.65	0.2112	1.28869	1.00
90.7751	327.94	0.1584	1.25655	1.39
93.4014	245.21	0.2112	1.22909	1.04

Sample: SESL_N4



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-083-2465	69	Silicon Oxide	SiO_2
Illite	00-058-2016	45	Potassium Aluminum Silicate Hydroxide Hydrate	$(K, H_{30})\ Al_2\ (Si_3Al)\ O_{10}\ (OH)_2 \cdot x\ H_2O$
Hematite	00-024-0072	43	Iron Oxide	$Fe_2\ O_3$
Kaolinite	00-058-2006	36	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$
Montmorillonite	01-076-8291	23	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5}\ (Al_2\ Si_4\ O_{11}\ (OH))$

Peak List

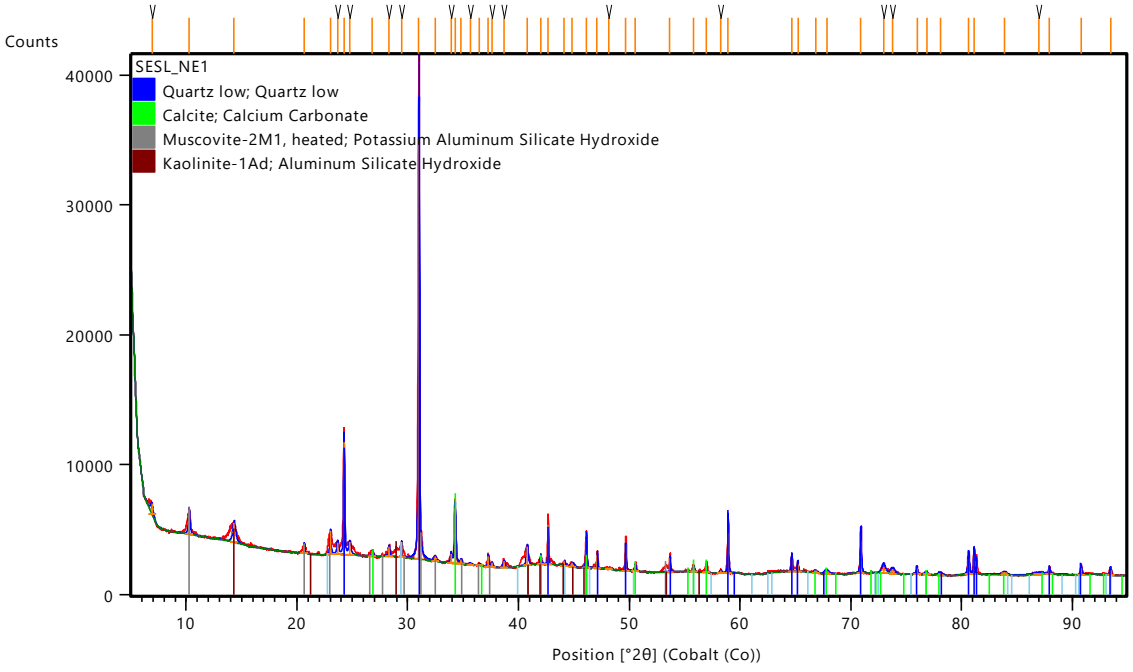
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
5.4442	1838.55	0.3031	18.83486	6.18
6.8194	6825.14	0.1515	15.03988	22.96
10.3328	6601.08	0.1082	9.93355	22.20
14.3382	3263.26	0.1515	7.16762	10.98
16.1044	326.88	0.1299	6.38590	1.10
20.7095	1528.05	0.1299	4.97659	5.14
22.8842	1546.89	0.1082	4.50910	5.20
23.0618	1983.02	0.0866	4.47485	6.67
23.6995	911.55	0.1299	4.35609	3.07
24.2634	6750.54	0.1082	4.25631	22.70
25.6450	656.40	0.0866	4.03055	2.21
26.6206	293.55	0.1732	3.88535	0.99
27.4289	334.06	0.1299	3.77296	1.12
28.0986	793.95	0.1732	3.68478	2.67
28.9762	1611.06	0.1515	3.57546	5.42
29.4350	1470.55	0.1082	3.52093	4.95
30.0939	463.34	0.0866	3.44556	1.56
31.0164	29731.91	0.1082	3.34549	100.00
31.2866	3302.35	0.1082	3.31731	11.11
32.5638	2780.33	0.1299	3.19052	9.35
33.9264	510.19	0.1299	3.06592	1.72
34.8146	368.88	0.1515	2.99003	1.24
35.5345	234.55	0.1299	2.93135	0.79
35.8857	309.87	0.1515	2.90360	1.04
36.4459	138.59	0.1732	2.86045	0.47
37.2166	810.84	0.1515	2.80324	2.73
37.6020	476.49	0.0866	2.77553	1.60
38.6612	1575.75	0.1515	2.70228	5.30
40.2260	566.25	0.1732	2.60127	1.90
40.7774	1515.93	0.0866	2.56756	5.10
41.6005	567.41	0.1299	2.51894	1.91
42.1114	259.15	0.2598	2.48975	0.87
42.6638	1975.31	0.1082	2.45899	6.64
43.6859	285.91	0.1732	2.40417	0.96
44.0896	303.44	0.2598	2.38324	1.02
45.0131	240.41	0.4330	2.33681	0.81
46.1272	1771.57	0.0866	2.28334	5.96

47.1075	887.52	0.0866	2.23845	2.99
47.8067	194.01	0.1732	2.20759	0.65
49.6704	1704.08	0.0866	2.12973	5.73
53.3714	812.13	0.2165	1.99179	2.73
53.6707	1071.38	0.0649	1.98150	3.60
55.0511	180.67	0.2598	1.93555	0.61
56.5260	107.49	0.8659	1.88906	0.36
58.1393	263.07	0.2598	1.84103	0.88
58.8942	3011.89	0.0866	1.81951	10.13
61.5754	67.91	0.2598	1.74756	0.23
62.5779	113.34	0.2598	1.72234	0.38
63.6243	316.74	0.2598	1.69691	1.07
64.6335	883.58	0.0866	1.67322	2.97
65.2427	519.25	0.0792	1.65930	1.75
70.9219	1744.80	0.1056	1.54186	5.87
72.9147	417.72	0.3696	1.50533	1.40
73.8697	351.81	0.4224	1.48859	1.18
75.9740	489.71	0.1584	1.45334	1.65
78.1567	82.78	0.6336	1.41899	0.28
80.6483	1069.51	0.1056	1.38230	3.60
81.1510	1336.41	0.1056	1.37521	4.49
83.9252	119.99	0.3168	1.33779	0.40
86.7811	91.52	0.8448	1.30211	0.31
87.9678	358.95	0.1584	1.28807	1.21
90.8322	534.82	0.1584	1.25593	1.80
93.4394	262.11	0.1584	1.22870	0.88

Sample: SESL_NE1



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	98-005-6888	73	Silicon Oxide	SiO_2
Calcite	01-083-1762	50	Calcium Carbonate	$CaCO_3$
Muscovite	00-058-2037	31	Potassium Aluminum Silicate Hydroxide	$K\ Al_2\ (Si,\ Al)_4\ O_{10}\ (OH)_2$
Kaolinite	00-058-2006	24	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$

Peak List

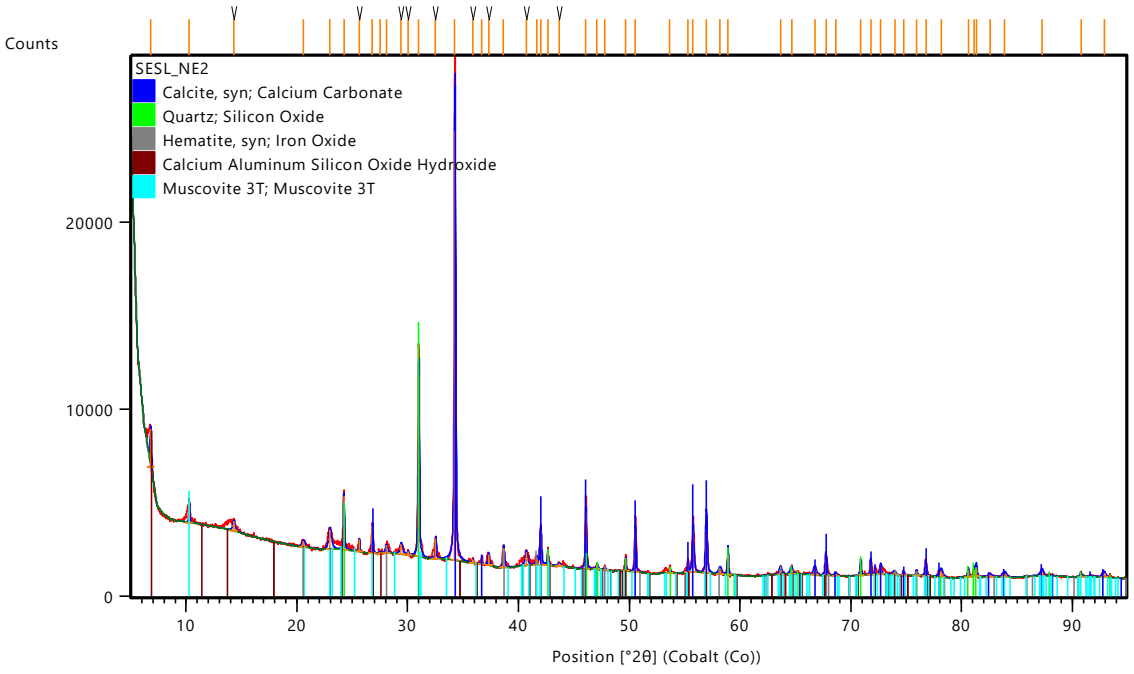
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.9068	775.96	0.2598	14.84976	2.39
10.2702	1866.66	0.1732	9.99393	5.76
14.3312	1476.69	0.3031	7.17111	4.56
20.6714	749.61	0.0649	4.98568	2.31
23.0248	1784.40	0.1299	4.48193	5.50
23.6744	895.65	0.1732	4.36065	2.76
24.2532	8615.74	0.1082	4.25807	26.58
24.7673	957.35	0.2165	4.17103	2.95
26.8175	410.81	0.1299	3.85735	1.27
28.3191	750.79	0.1299	3.65666	2.32
29.4407	1167.13	0.0866	3.52027	3.60
31.0028	32416.53	0.1299	3.34693	100.00
32.4772	380.53	0.2598	3.19880	1.17
33.9162	666.86	0.1299	3.06682	2.06
34.2693	4250.93	0.1515	3.03615	13.11
34.8251	311.40	0.1732	2.98916	0.96
35.6328	109.01	0.3464	2.92353	0.34
36.4676	105.82	0.2598	2.85880	0.33
37.2709	793.78	0.1082	2.79930	2.45
37.6197	292.66	0.1299	2.77428	0.90
38.6814	514.33	0.1732	2.70093	1.59
40.7738	1443.37	0.1948	2.56778	4.45
41.9894	671.65	0.0866	2.49666	2.07
42.6588	2999.46	0.0649	2.45926	9.25
44.1227	326.71	0.1732	2.38154	1.01
44.8529	294.55	0.3031	2.34472	0.91
46.1084	2220.55	0.1082	2.28422	6.85
47.0925	1043.89	0.0866	2.23912	3.22
48.1637	94.55	0.5196	2.19219	0.29
49.6700	1980.67	0.0866	2.12974	6.11
50.5179	459.82	0.1082	2.09628	1.42
53.6546	1071.88	0.0866	1.98205	3.31
55.7828	455.42	0.1732	1.91216	1.40
56.9404	635.50	0.0866	1.87645	1.96
58.2254	209.72	0.1732	1.83854	0.65
58.9312	3071.17	0.1056	1.81847	9.47
64.6726	946.71	0.1056	1.67232	2.92
65.2253	566.57	0.1056	1.65970	1.75
66.8462	140.62	0.3168	1.62396	0.43

67.8258	209.24	0.4224	1.60325	0.65
70.9200	2458.54	0.1320	1.54189	7.58
72.9661	512.06	0.3696	1.50442	1.58
73.7867	313.30	0.4224	1.49003	0.97
75.9831	429.49	0.1056	1.45319	1.32
76.8505	115.09	0.3168	1.43928	0.36
78.0944	157.24	0.4224	1.41994	0.49
80.6461	1187.30	0.1584	1.38234	3.66
81.1460	1439.43	0.1056	1.37528	4.44
83.8974	160.12	0.5280	1.33815	0.49
86.9571	106.67	1.0560	1.30000	0.33
87.9401	368.67	0.1584	1.28839	1.14
90.8095	511.92	0.1320	1.25618	1.58
93.4572	421.37	0.1320	1.22852	1.30

Sample: SESL_ NE2



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Calcite	01-078-4614	68	Calcium Carbonate	$CaCO_3$
Quartz	01-075-8322	60	Silicon Oxide	SiO_2
Hematite	01-080-7077	42	Iron Oxide	$Fe_2 O_3$
Montomorillonite	01-076-8291	22	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5} (Al_2 Si_4 O_{11} (OH))$
Muscovite	98-001-1987	18	Muscovite	$H_2 Al_3 K O_{12} Si_3$

Peak List

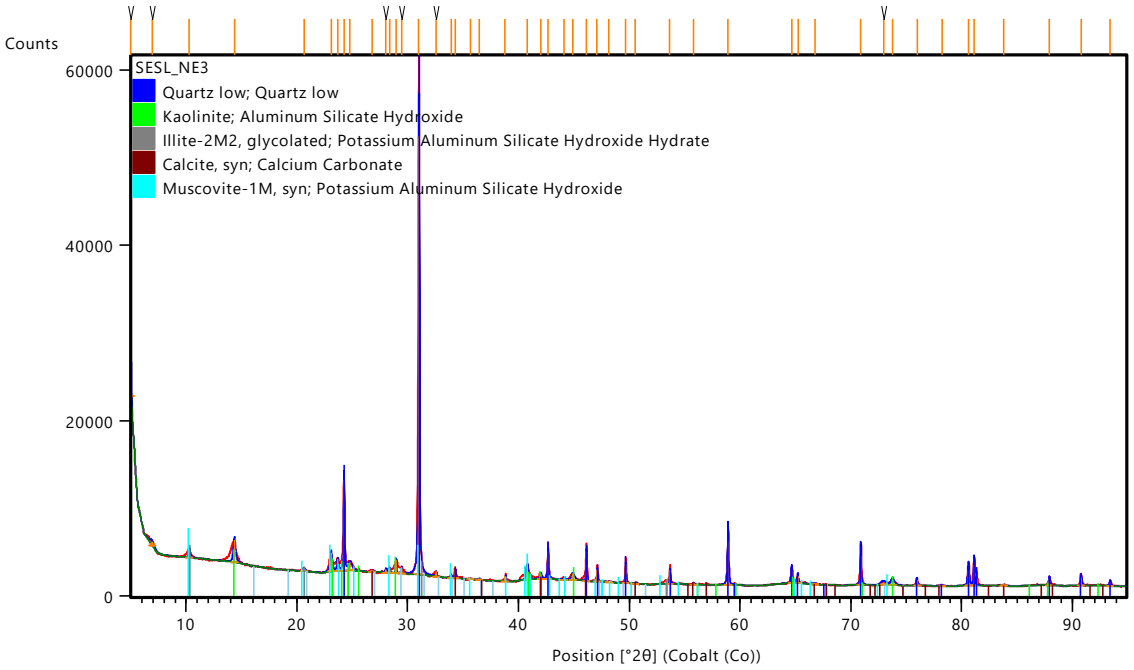
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8103	1983.32	0.1299	15.05989	8.64
10.2820	1135.14	0.0866	9.98249	4.95
14.3097	505.22	0.2598	7.18184	2.20
20.5816	321.59	0.3464	5.00719	1.40
22.9843	1016.05	0.3031	4.48972	4.43
24.2360	2844.28	0.1082	4.26105	12.39
25.6264	638.66	0.1082	4.03343	2.78
26.8140	1460.08	0.1082	3.85784	6.36
27.4945	62.68	0.2598	3.76413	0.27
28.0672	427.03	0.2165	3.68882	1.86
29.4104	544.00	0.2598	3.52382	2.37
30.0341	170.83	0.1299	3.45226	0.74
30.9874	9715.43	0.1299	3.34854	42.33
32.5182	1067.35	0.1299	3.19487	4.65
34.2509	22953.93	0.1515	3.03773	100.00
35.8776	161.89	0.1299	2.90423	0.71
36.6752	383.22	0.0866	2.84317	1.67
37.3052	585.26	0.1732	2.79682	2.55
38.6445	1058.34	0.1732	2.70340	4.61
40.6905	692.10	0.2598	2.57281	3.02
41.6310	390.11	0.1515	2.51718	1.70
41.9826	1806.58	0.1732	2.49704	7.87
42.6356	712.81	0.1082	2.46053	3.11
43.6471	147.59	0.2598	2.40620	0.64
46.0617	3038.86	0.1299	2.28641	13.24
47.0828	244.19	0.1732	2.23956	1.06
47.7725	146.76	0.1299	2.20908	0.64
49.6598	684.95	0.0866	2.13015	2.98
50.5204	2233.37	0.1299	2.09619	9.73
53.6460	300.11	0.1299	1.98235	1.31
55.2645	579.04	0.1082	1.92867	2.52
55.7240	2275.65	0.1732	1.91402	9.91
56.9676	2288.68	0.1584	1.87563	9.97
58.2147	256.75	0.3168	1.83885	1.12
58.9162	1040.04	0.1056	1.81889	4.53
63.6612	283.23	0.2640	1.69603	1.23
64.6484	271.65	0.2640	1.67288	1.18
66.7607	322.58	0.3168	1.62580	1.41

67.7621	839.85	0.1584	1.60458	3.66
68.6711	116.82	0.3168	1.58589	0.51
70.8972	570.71	0.1320	1.54232	2.49
71.8095	592.28	0.1056	1.52531	2.58
72.6993	383.82	0.1584	1.50917	1.67
73.9703	153.19	0.3168	1.48686	0.67
74.7740	135.96	0.1584	1.47317	0.59
75.9439	204.11	0.1584	1.45383	0.89
76.7718	549.92	0.1584	1.44053	2.40
78.1564	312.23	0.3696	1.41899	1.36
80.6174	325.47	0.1320	1.38274	1.42
81.1482	355.86	0.1056	1.37525	1.55
81.3486	491.51	0.1320	1.37245	2.14
82.5657	116.38	0.3168	1.35577	0.51
83.8945	195.28	0.4224	1.33819	0.85
87.2646	254.35	0.3168	1.29633	1.11
90.7781	150.37	0.1584	1.25652	0.66
92.8833	198.90	0.3168	1.23436	0.87

Sample: SESL_ NE3



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	98-005-6888	77	Silicon Oxide	SiO_2
Kaolinite	00-001-0527	40	Aluminum Silicate Hydroxide	$Al_2\ Si_2\ O_5\ (OH)_4$
Illite	00-058-2016	32	Potassium Aluminum Silicate Hydroxide Hydrate	$(K, H_{30})\ Al_2\ (Si_3Al)\ O_{10}\ (OH)_2 \cdot x\ H_2O$
Calcite	01-076-2713	25	Calcium Carbonate	$CaCO_3$
Muscovite	00-007-0025	30	Potassium Aluminum Silicate Hydroxide	$K\ Al_2\ Si_3\ Al\ O_{10}\ (OH)_2$

Peak List

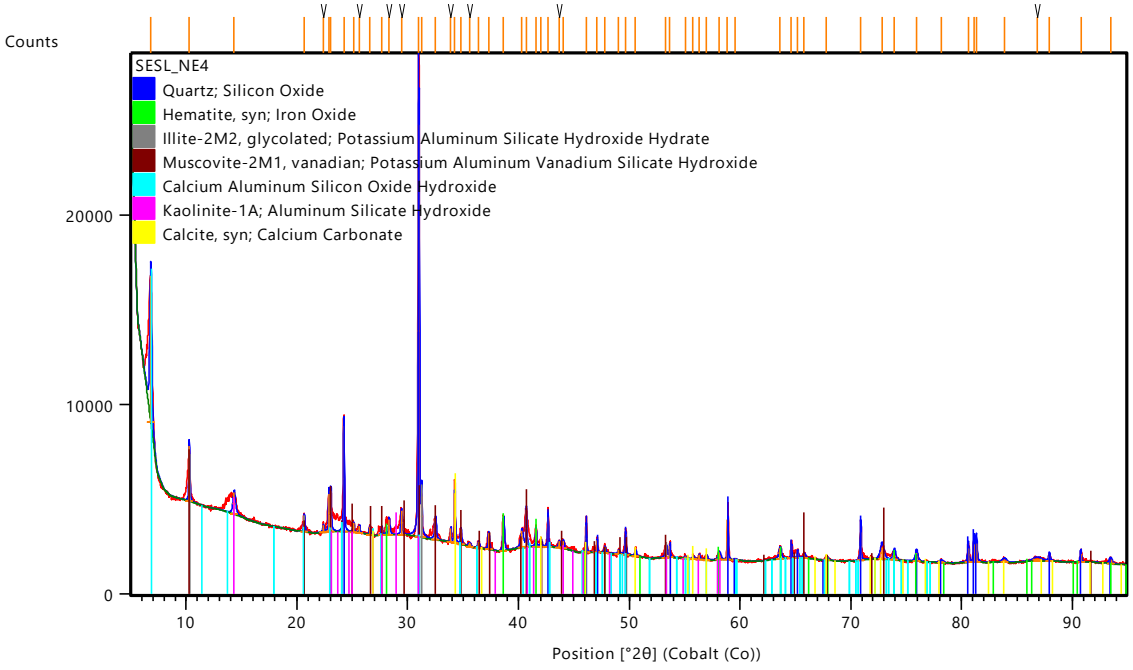
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
5.0253	3780.38	0.0866	20.40394	7.56
6.9392	503.58	0.5196	14.78053	1.01
10.2882	991.80	0.1732	9.97653	1.98
14.3555	2583.50	0.2381	7.15901	5.16
20.6258	339.82	0.2598	4.99657	0.68
23.0820	2116.82	0.2165	4.47098	4.23
23.6786	1324.52	0.1732	4.35988	2.65
24.2507	10335.18	0.1082	4.25852	20.66
24.7919	963.66	0.3464	4.16695	1.93
26.7901	192.64	0.4330	3.86122	0.39
28.0156	354.03	0.1299	3.69547	0.71
28.3502	527.69	0.1299	3.65273	1.05
28.9513	1513.24	0.0866	3.57847	3.02
29.4433	743.07	0.1299	3.51997	1.49
31.0038	50031.18	0.1299	3.34682	100.00
32.5430	559.51	0.0866	3.19250	1.12
33.9156	332.66	0.1299	3.06686	0.66
34.2916	1004.48	0.1299	3.03423	2.01
35.6739	63.21	0.4330	2.92027	0.13
36.4544	108.24	0.2598	2.85980	0.22
38.7975	641.97	0.0649	2.69315	1.28
40.7792	1637.81	0.2165	2.56745	3.27
41.9877	636.44	0.1515	2.49675	1.27
42.6499	3173.75	0.1299	2.45975	6.34
44.1248	254.33	0.1732	2.38143	0.51
44.9001	723.19	0.3031	2.34239	1.45
46.1156	3337.88	0.0866	2.28389	6.67
47.0869	1426.83	0.1082	2.23937	2.85
48.1526	72.92	0.5196	2.19267	0.15
49.6614	2231.77	0.0866	2.13008	4.46
50.5690	108.25	0.1299	2.09430	0.22
53.6509	1607.03	0.1082	1.98218	3.21
55.7780	172.65	0.1732	1.91231	0.35
58.9223	4917.40	0.1320	1.81872	9.83
64.6713	1441.01	0.1320	1.67235	2.88

65.2251	827.43	0.1056	1.65970	1.65
66.7866	82.12	0.7392	1.62524	0.16
70.9086	3337.34	0.1056	1.54211	6.67
72.9518	305.64	0.5280	1.50467	0.61
73.7797	565.57	0.3168	1.49015	1.13
75.9788	606.48	0.1056	1.45326	1.21
78.2155	104.29	0.4224	1.41809	0.21
80.6334	1799.21	0.1584	1.38252	3.60
81.1478	2355.68	0.1056	1.37526	4.71
83.7859	75.51	0.6336	1.33960	0.15
87.9478	692.46	0.1320	1.28830	1.38
90.8054	889.32	0.1320	1.25622	1.78
93.4290	458.74	0.1584	1.22881	0.92

Sample: SESL_ NE4



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-075-8322	67	Silicon Oxide	SiO_2
Hematite	01-089-0597	48	Iron Oxide	$Fe_2 O_3$
Illite	00-058-2016	48	Potassium Aluminum Silicate Hydroxide Hydrate	$(K, H_{30}) Al_2 (Si_3Al) O_{10} (OH)_2 \cdot x H_2O$
Muscovite	00-019-0814	38	Potassium Aluminum Vanadium Silicate Hydroxide	$K (Al, V)_2 (Si, Al)_4 O_{10} (OH)_2$
Montmorillonite	01-076-8291	25	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5} (Al_2 Si_4 O_{11} (OH))$
Kaolinite	00-058-2028	16	Aluminum Silicate Hydroxide	$Al_2 Si_2 O_5 (OH)_4$
Calcite	01-076-2712	27	Calcium Carbonate	$CaCO_3$

Peak List

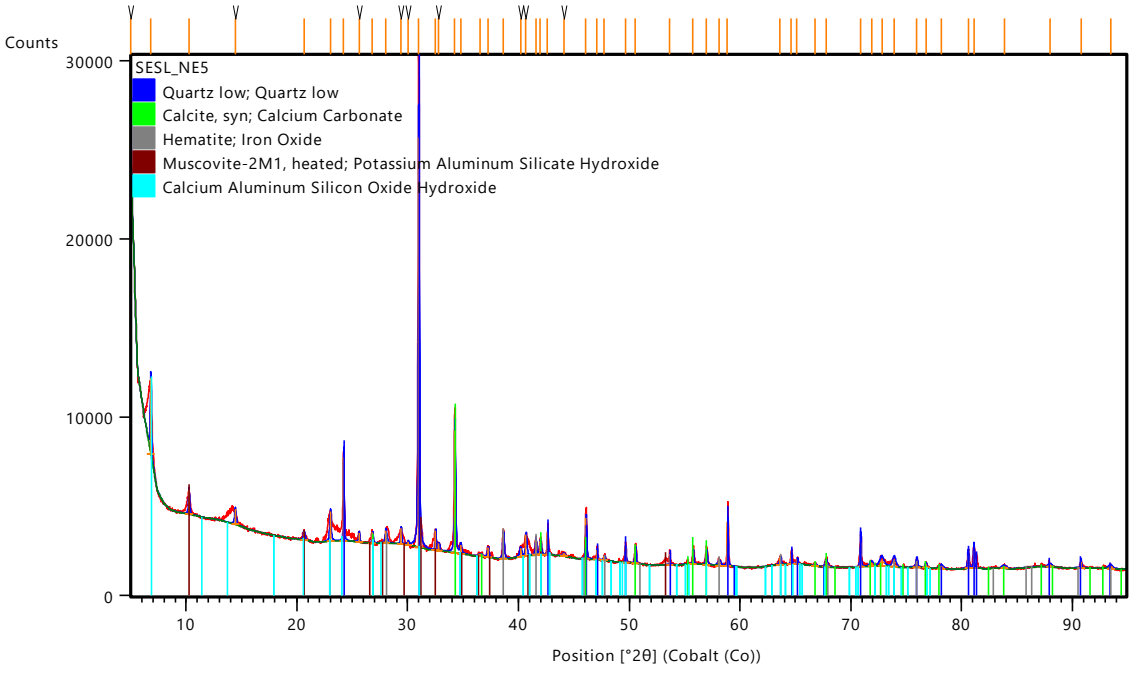
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8064	7717.58	0.1948	15.06869	35.47
10.2865	2939.87	0.1082	9.97821	13.51
14.3379	1155.03	0.2598	7.16779	5.31
20.6632	853.35	0.1082	4.98763	3.92
22.3841	357.94	0.1299	4.60851	1.64
22.8613	1980.11	0.0866	4.51355	9.10
23.0443	2153.63	0.1299	4.47819	9.90
24.2294	5595.75	0.1082	4.26220	25.72
25.1008	482.95	0.1299	4.11648	2.22
25.6493	384.28	0.1082	4.02988	1.77
26.5617	414.42	0.1299	3.89382	1.90
27.6369	403.93	0.1299	3.74511	1.86
28.3152	803.02	0.1515	3.65717	3.69
29.4249	1273.49	0.1299	3.52211	5.85
30.9896	21759.75	0.1299	3.34832	100.00
31.2354	2179.64	0.0649	3.32262	10.02
32.4956	1113.70	0.1948	3.19704	5.12
33.8746	718.84	0.0866	3.07047	3.30
34.2372	2610.57	0.1082	3.03891	12.00
34.7932	794.01	0.1299	2.99182	3.65
35.5712	192.66	0.2598	2.92843	0.89
36.3796	329.40	0.1732	2.86548	1.51
37.2986	862.75	0.1515	2.79730	3.96
38.6479	1626.90	0.1515	2.70317	7.48
40.3011	874.37	0.2598	2.59662	4.02
40.6917	1952.23	0.1082	2.57274	8.97
41.5555	923.53	0.1082	2.52155	4.24
42.0431	337.65	0.1299	2.49361	1.55
42.6453	1580.12	0.1082	2.46000	7.26
43.6576	350.01	0.1732	2.40565	1.61
44.0211	406.43	0.2165	2.38676	1.87
46.0971	1419.50	0.0866	2.28475	6.52

47.0734	645.24	0.0866	2.23998	2.97
47.7812	321.05	0.1732	2.20870	1.48
49.0495	196.79	0.2165	2.15498	0.90
49.6426	1118.35	0.1299	2.13084	5.14
50.5526	303.05	0.1732	2.09494	1.39
53.3075	612.38	0.2165	1.99400	2.81
53.6417	611.09	0.0866	1.98249	2.81
55.0646	105.00	0.2598	1.93512	0.48
55.7563	134.82	0.2165	1.91300	0.62
56.3029	243.16	0.1299	1.89593	1.12
56.9632	230.22	0.1732	1.87576	1.06
58.1124	380.25	0.3031	1.84181	1.75
58.8663	2111.22	0.0866	1.82029	9.70
59.5513	61.45	0.2598	1.80124	0.28
63.5887	565.72	0.2598	1.69776	2.60
64.6078	686.50	0.0866	1.67382	3.15
65.1611	400.37	0.1299	1.66115	1.84
65.7953	214.75	0.2165	1.64691	0.99
67.8188	186.81	0.2598	1.60340	0.86
70.8984	1466.51	0.1056	1.54230	6.74
72.8402	596.19	0.3696	1.50666	2.74
73.9441	395.41	0.2640	1.48731	1.82
75.9461	423.42	0.2640	1.45379	1.95
78.2001	96.50	0.4224	1.41833	0.44
80.6165	737.07	0.1320	1.38276	3.39
81.1312	916.88	0.1056	1.37549	4.21
81.3470	981.28	0.1584	1.37247	4.51
83.8607	152.34	0.4224	1.33863	0.70
86.8381	141.17	0.8448	1.30142	0.65
87.9457	288.79	0.1584	1.28832	1.33
90.7766	446.60	0.1320	1.25653	2.05
93.4701	221.12	0.3168	1.22839	1.02

Sample: SESL_ NE5



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	98-005-6888	65	Silicon Oxide	SiO_2
Calcite	01-076-2712	54	Calcium Carbonate	$CaCO_3$
Hematite	00-024-0072	50	Iron Oxide	$Fe_2 O_3$
Muscovite	00-058-2037	26	Potassium Aluminum Silicate Hydroxide	$K Al_2 (Si, Al)_4 O_{10} (OH)_2$
Montmorillonite	01-076-8291	25	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5} (Al_2 Si_4 O_{11} (OH))$

Peak List

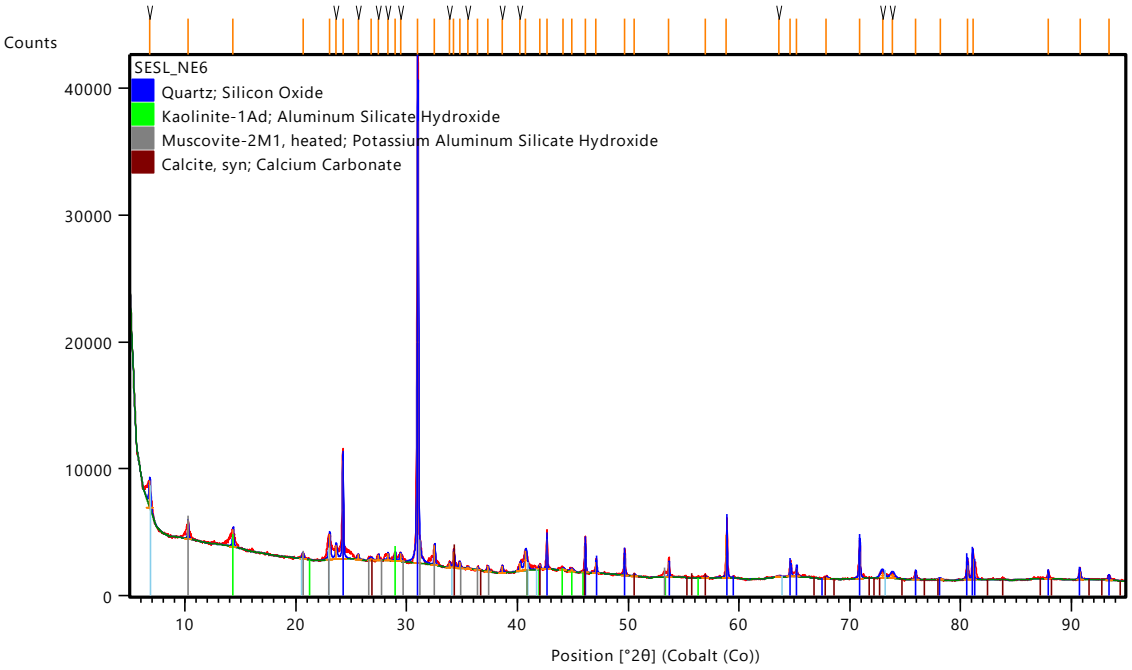
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
5.0271	3753.33	0.0649	20.39673	16.31
6.8075	4274.84	0.1082	15.06611	18.58
10.2606	1367.14	0.1299	10.00327	5.94
14.4334	850.60	0.1732	7.12058	3.70
20.6398	474.44	0.1732	4.99321	2.06
23.0180	1650.43	0.1515	4.48324	7.17
24.2237	4729.95	0.0866	4.26318	20.56
25.6142	521.87	0.1299	4.03531	2.27
26.8207	623.53	0.1082	3.85690	2.71
28.0350	691.51	0.1948	3.69298	3.01
29.3971	883.43	0.1299	3.52538	3.84
30.0459	167.23	0.1299	3.45094	0.73
30.9856	23005.90	0.1299	3.34873	100.00
32.5087	1076.07	0.1082	3.19578	4.68
32.8136	384.17	0.1299	3.16689	1.67
34.2539	6839.10	0.1299	3.03747	29.73
34.7760	487.77	0.1732	2.99325	2.12
36.5459	130.58	0.4330	2.85288	0.57
37.2479	547.90	0.1732	2.80097	2.38
38.6277	1398.29	0.1515	2.70453	6.08
40.1778	491.61	0.2165	2.60426	2.14
40.6725	1199.85	0.1515	2.57390	5.22
41.5498	830.93	0.1299	2.52188	3.61
41.9648	765.77	0.1732	2.49805	3.33
42.6282	1303.26	0.0866	2.46094	5.66
44.0905	191.32	0.2598	2.38319	0.83
46.0900	2285.45	0.1082	2.28509	9.93
47.0742	568.84	0.0866	2.23994	2.47
47.7543	269.87	0.1732	2.20987	1.17
49.6498	878.18	0.1082	2.13055	3.82
50.5410	862.12	0.1299	2.09539	3.75
53.6367	607.27	0.0649	1.98266	2.64
55.7562	766.81	0.1082	1.91300	3.33
56.9479	745.86	0.1515	1.87622	3.24
58.0861	276.88	0.3031	1.84257	1.20
58.8640	2493.38	0.0866	1.82036	10.84
63.6128	415.94	0.1732	1.69719	1.81
64.6051	591.58	0.0866	1.67388	2.57

65.1457	307.53	0.1299	1.66150	1.34
66.7490	121.41	0.2598	1.62605	0.53
67.7502	373.68	0.2598	1.60483	1.62
70.9009	1338.08	0.1056	1.54225	5.82
71.8743	192.15	0.3168	1.52412	0.84
72.8088	370.91	0.4224	1.50722	1.61
73.9342	402.98	0.3168	1.48748	1.75
75.9721	380.61	0.1848	1.45337	1.65
76.8018	183.06	0.1584	1.44006	0.80
78.1890	151.86	0.3696	1.41849	0.66
80.6179	734.90	0.1320	1.38274	3.19
81.1318	983.33	0.1056	1.37548	4.27
83.8429	133.45	0.4224	1.33886	0.58
87.9934	133.83	0.3168	1.28777	0.58
90.7984	350.55	0.1056	1.25630	1.52
93.4522	157.06	0.4224	1.22857	0.68

Sample: SESL_ NE6



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-075-8322	73	Silicon Oxide	SiO_2
Kaolinite	00-058-2006	36	Aluminum Silicate Hydroxide	$Al_2 Si_2 O_5 (OH)_4$
Muscovite	00-058-2037	31	Potassium Aluminum Silicate Hydroxide	$K Al_2 (Si, Al)_4 O_{10} (OH)_2$
Calcite	01-076-2712	30	Calcium Carbonate	$CaCO_3$

Peak List

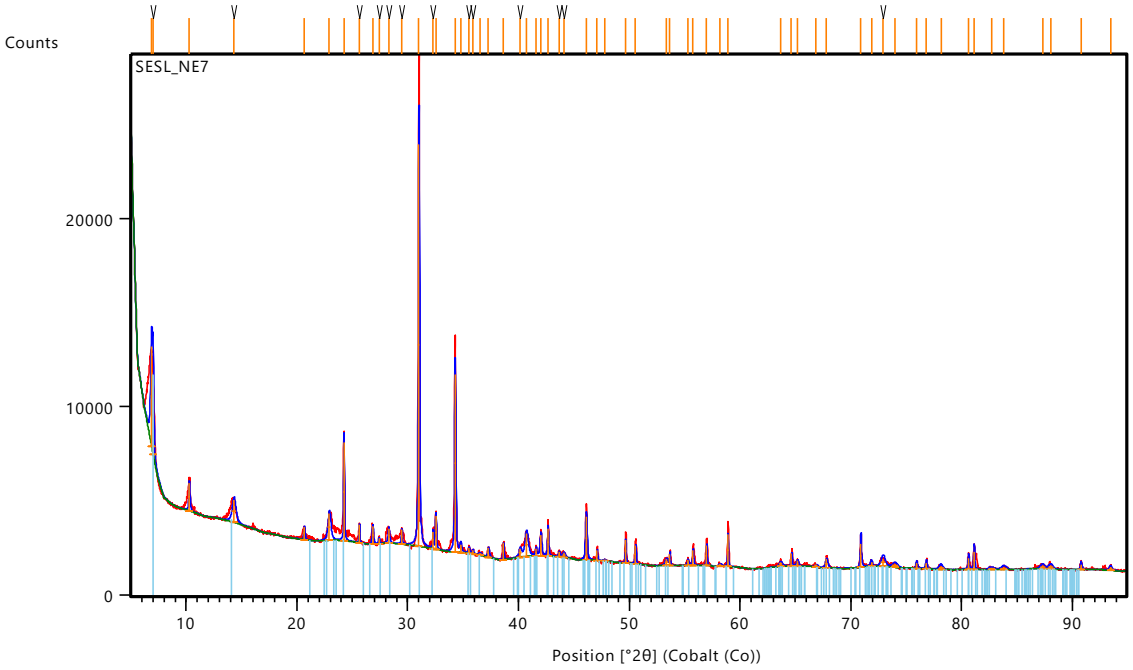
Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8118	2173.29	0.1732	15.05665	6.23
10.2742	1447.44	0.0866	9.99009	4.15
14.3290	1400.72	0.1299	7.17220	4.01
20.6337	444.23	0.1732	4.99467	1.27
23.0363	1978.25	0.1732	4.47974	5.67
23.6367	1067.73	0.1732	4.36750	3.06
24.2335	7770.88	0.1082	4.26148	22.26
25.6052	403.09	0.1732	4.03670	1.15
26.7777	221.51	0.3897	3.86298	0.63
27.4494	447.88	0.1082	3.77019	1.28
28.3081	563.54	0.1299	3.65806	1.61
28.9441	698.53	0.1299	3.57934	2.00
29.4373	648.49	0.1732	3.52066	1.86
30.9921	34902.85	0.1299	3.34805	100.00
32.5122	1555.15	0.1299	3.19544	4.46
33.8940	375.66	0.1299	3.06876	1.08
34.2567	1290.41	0.1299	3.03724	3.70
34.7676	500.10	0.1732	2.99395	1.43
35.5068	145.99	0.2598	2.93357	0.42
36.4156	227.24	0.1299	2.86274	0.65
37.3196	400.68	0.1515	2.79578	1.15
38.6260	523.79	0.1515	2.70465	1.50
40.2416	621.14	0.1732	2.60030	1.78
40.7402	1560.41	0.2598	2.56980	4.47
41.9941	387.00	0.1299	2.49639	1.11
42.6325	2382.79	0.0866	2.46071	6.83
44.1299	165.63	0.2598	2.38117	0.47
44.9113	239.60	0.3464	2.34183	0.69
46.1057	2221.44	0.0866	2.28435	6.36
47.0790	899.63	0.1299	2.23973	2.58
49.6442	1608.53	0.1082	2.13078	4.61
50.5230	165.77	0.1732	2.09609	0.47
53.6429	1171.80	0.0866	1.98245	3.36
56.9458	142.39	0.2165	1.87628	0.41
58.8589	3400.49	0.1082	1.82050	9.74
63.6142	110.97	0.3464	1.69716	0.32
64.6169	915.17	0.1299	1.67361	2.62
65.2202	640.91	0.0792	1.65981	1.84
67.8880	139.56	0.2598	1.60196	0.40
70.8997	2152.96	0.1320	1.54228	6.17

72.9470	453.16	0.4224	1.50476	1.30
73.8653	352.62	0.4224	1.48867	1.01
75.9632	496.29	0.1056	1.45351	1.42
78.1524	108.36	0.4224	1.41905	0.31
80.6222	1134.46	0.1320	1.38268	3.25
81.1243	1642.59	0.1056	1.37559	4.71
87.9372	451.69	0.0792	1.28842	1.29
90.7856	600.35	0.1584	1.25644	1.72
93.4160	304.90	0.1584	1.22894	0.87

Sample: SESL_ NE7



Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Quartz	01-070-3755	68	Silicon Oxide	SiO_2
Calcite	01-083-1762	59	Calcium Carbonate	$CaCO_3$
Hematite	00-024-0072	34	Iron Oxide	$Fe_2 O_3$
Muscovite	00-058-2037	30	Potassium Aluminum Silicate Hydroxide	$K Al_2 (Si, Al)_4 O_{10} (OH)_2$
Montmorillonite	01-076-8291	28	Calcium Aluminum Silicon Oxide Hydroxide	$Ca_{0.5} (Al_2 Si_4 O_{11} (OH))$

Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
6.8780	5266.48	0.1948	14.91188	24.67
7.0208	4221.75	0.1299	14.60897	19.77
10.2957	1459.92	0.1299	9.96928	6.84
14.3273	1203.27	0.3897	7.17302	5.64
20.6770	650.90	0.1082	4.98434	3.05
22.9265	1415.96	0.3031	4.50089	6.63
24.2456	5216.03	0.0866	4.25939	24.43
25.6393	936.72	0.0866	4.03143	4.39
26.8399	937.24	0.1299	3.85419	4.39
27.4071	279.61	0.1299	3.77591	1.31
28.2824	793.61	0.1732	3.66131	3.72
29.4580	755.69	0.1082	3.51825	3.54
31.0044	21349.65	0.1299	3.34676	100.00
32.2788	885.80	0.0649	3.21793	4.15
32.5298	1759.79	0.1299	3.19377	8.24
34.2737	9426.97	0.1299	3.03577	44.16
34.7794	425.90	0.1732	2.99297	1.99
35.5414	304.59	0.1299	2.93080	1.43
35.8899	206.87	0.1299	2.90327	0.97
36.5470	125.20	0.3464	2.85280	0.59
37.2888	493.29	0.1732	2.79801	2.31
38.6347	854.10	0.0866	2.70406	4.00
40.1477	431.37	0.2598	2.60613	2.02
40.7163	1231.29	0.3464	2.57125	5.77
41.5750	380.09	0.1299	2.52042	1.78
42.0037	1099.08	0.1732	2.49584	5.15
42.6519	1448.29	0.1299	2.45964	6.78
43.6670	263.77	0.1732	2.40516	1.24
44.0929	237.45	0.2598	2.38307	1.11
46.1039	2317.08	0.1732	2.28443	10.85
47.0894	544.21	0.0866	2.23926	2.55
47.7613	73.27	0.2598	2.20956	0.34
49.6580	1209.93	0.0866	2.13022	5.67
50.5480	972.67	0.1082	2.09512	4.56
53.3470	354.17	0.3031	1.99263	1.66
53.6554	608.83	0.0866	1.98202	2.85
55.2789	277.73	0.1732	1.92820	1.30

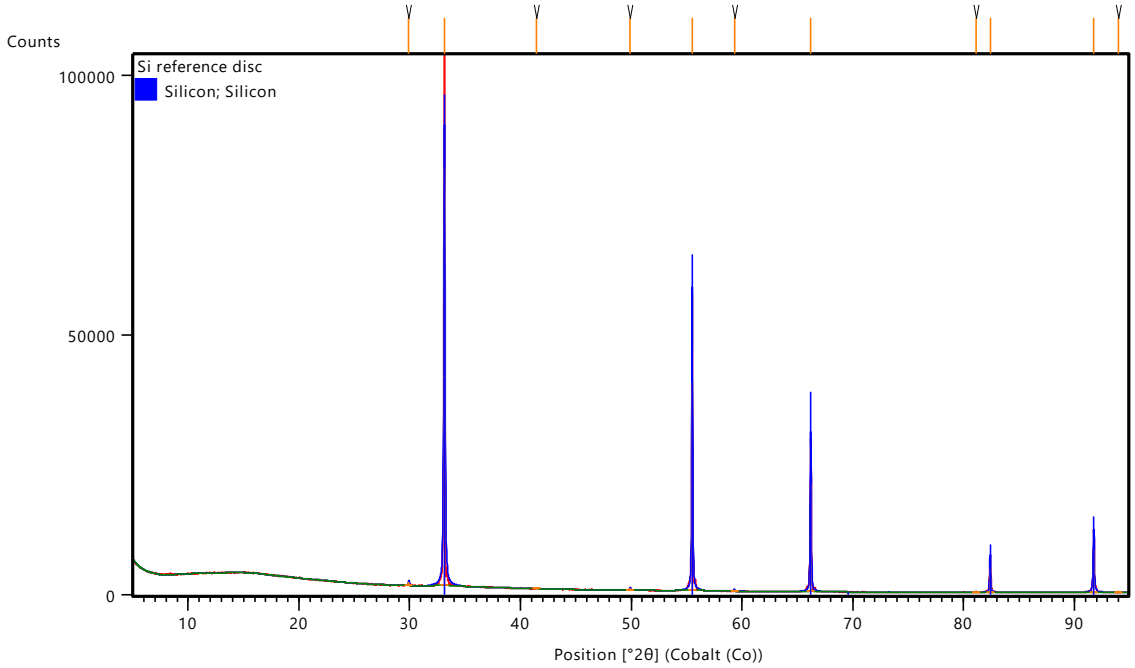
55.7309	795.11	0.1299	1.91380	3.72
56.9540	1061.21	0.0866	1.87604	4.97
58.1891	133.89	0.3031	1.83959	0.63
58.8768	1691.15	0.0866	1.81999	7.92
63.6511	233.35	0.3464	1.69628	1.09
64.6299	663.39	0.0866	1.67331	3.11
65.1598	292.11	0.2165	1.66118	1.37
66.8746	132.13	0.3031	1.62335	0.62
67.7823	468.74	0.2598	1.60416	2.20
70.9218	1228.88	0.1320	1.54186	5.76
71.8683	216.93	0.2112	1.52423	1.02
72.9394	406.57	0.4224	1.50489	1.90
74.0051	171.09	0.5280	1.48626	0.80
75.9585	264.53	0.1584	1.45359	1.24
76.8353	309.09	0.1584	1.43953	1.45
78.1450	180.37	0.3696	1.41917	0.84
80.6392	580.26	0.1056	1.38243	2.72
81.1510	923.53	0.1056	1.37521	4.33
82.6921	100.98	0.5280	1.35407	0.47
83.8264	138.57	0.5280	1.33907	0.65
87.3149	172.85	0.4224	1.29574	0.81
88.0614	169.98	0.4224	1.28698	0.80
90.8051	281.09	0.1584	1.25623	1.32
93.4521	165.25	0.3168	1.22857	0.77

Appendix 1. Quality Assurance/Quality Control

Location and intensity of a silicon reference disc

The diffractometer identified the silicon crystal reference material accurately regarding 2 theta position and with the required intensity, and is performing to specifications.

Diffractogram



Mineral List

Mineral	Code	Score	Compound Name	Chemical Formula
Silicon	98-006-2713	82	Silicon	Si

Peak List

Pos. [°2θ]	Height [cts]	FWHM Left [°2θ]	d-spacing [Å]	Rel. Int. [%]
29.9214	706.72	0.0866	3.46497	0.88
33.1125	80609.48	0.1515	3.13909	100.00
41.4570	40.15	0.5196	2.52728	0.05
49.8776	331.47	0.0866	2.12144	0.41
55.5121	39949.08	0.1056	1.92074	49.56
59.3129	201.22	0.1056	1.80782	0.25
66.2040	20703.35	0.1056	1.63789	25.68
81.1329	73.46	0.1584	1.37546	0.09
82.4066	4813.79	0.1056	1.35792	5.97
91.7541	8188.22	0.1320	1.24609	10.16
93.9642	50.73	0.3168	1.22344	0.06

Appendix 2. XRD Measurement Conditions for all samples

Start Position [°2θ]	5.0149
End Position [°2θ]	94.9729
Step Size [°2θ]	0.0220
Scan Step Time [s]	48.1950
Scan Type	Continuous
PSD Mode	Scanning
PSD Length [°2θ]	2.00
Offset [°2θ]	0.0000
Divergence Slit Type	Fixed
Divergence Slit Size [°]	0.4584
Specimen Length [mm]	10.00
Measurement Temperature [°C]	25.00
Anode Material	Co
K-Alpha1 [Å]	1.78901
Generator Settings	15 mA, 40 kV
Diffractometer Type	209147
Diffractometer Number	0
Goniometer Radius [mm]	145.00
Dist. Focus-Diverg. Slit [mm]	95.00
Incident Beam Monochromator	No
Spinning	Yes

Appendix 3. XRF measurements. Samples measured using a silicate calibration and are generally accurate to 15%. Measurements reported to three significant figures. All values are mg/kg.

	AndS1	WDS1_C	WDS1_F	WDS2_C	WDS3_C	WDS4_F	WDS5_C	OD2_W1_C	OD2_W2_C	OD2_W3_C
P	<1320	<4770	<3390	<4730	<4830	<1410	<4870	<5000	<4830	<4790
S	<327	<908	<660	<930	<920	<374	<897	420	<895	<933
Cl	<387	<693	<544	<706	<727	<424	<698	<734	<713	<706
K	2232	<339	2522	<345	<338	2656	<340	<354	<337	<335
Ca	19040	359600	187200	362800	368800	26640	364000	376800	364400	363600
Ti	2392	12	900	<18	<18	2780	<17	<19	<19	<18
V	31	<4	11	<4	<4	42	<4	<4	<4	<4
Cr	64	<14	14	<14	<13	60	<14	<14	<14	<14
Mn	283	8	140	<15	<16	484	<15	<16	<16	<15
Fe	20200	212	9480	26	28	23920	22	39	53	43
Co	<151	<24	<112	<15	<16	<172	<17	<17	<17	<18
Ni	48	36	29	<18	<18	59	<17	<18	<17	<17
Cu	17	<10	12	<10	<9	18	<9	<9	<9	<9
Zn	22	4	54	4	3	130	4	4	5	8
As	<4	<4	4	<4	<4	5	<4	<4	<4	<4
Se	1	2	<2	<3	<2	<2	<3	<3	1	<3
Rb	6	1	9	<2	<2	13	<2	<2	<2	<2
Sr	161	61	34	62	57	21	44	61	24	66
Y	9	2	15	2	2	50	2	2	1	4
Zr	57	<4	60	<4	<4	193	<3	<4	<3	<4
Mo	<4	<4	<5	<4	<4	<6	<4	<4	<4	<4
Ag	<16	<19	<18	<19	<19	<17	<19	<19	<19	<20
Cd	<22	<27	<25	<27	<28	<23	<27	<27	<27	<28
Sn	<31	<39	<36	<39	<39	<33	<39	<39	<39	<40
Sb	<27	<34	<31	<34	<34	<28	<34	<35	<34	<35
Hg	<4	<5	<3	<3	<3	<3	<3	<3	<3	<3
Pb	4	<5	4	<5	<5	12	<4	<5	<5	<5
Bi	<16	<17	<17	<17	<17	<17	<16	<17	<17	<17
Th	<8	<8	<7	<7	<7	4	<7	<7	<7	<7
U	<8	<7	<6	<6	<6	<6	<6	<7	<6	<7

	SESL_N1	SESL_N2	SESL_N3	SESL_N4	SESL_NE 1	SESL_NE 2	SESL_NE 3	SESL_NE 4	SESL_NE 5	SESL_NE 6	SESL_NE 7
P	<813	<980	<1010	1300	2814	4170	<859	2188	<1850	<1030	2203
S	<249	<300	<318	<297	<368	<559	<241	<393	<396	<301	<434
Cl	<325	<422	521	<413	<436	<533	<320	<476	<513	<359	<504
K	16200	16300	15100	16500	22400	13300	12500	24000	17100	19600	18200
Ca	10100	7060	12600	22800	23240	104400	12200	34600	37960	20800	42000
Ti	4430	9120	9080	7966	8501	6280	3860	10600	8870	5060	8031
V	69	115	107	84	109	70	62	148	132	80	109
Cr	87	149	241	177	79	155	67	141	196	85	149
Mn	1020	1760	2240	1530	5862	1460	873	4660	4850	2090	2460
Fe	38600	68900	66900	54400	61900	42800	39000	71200	65100	44700	56100
Co	<125	<177	<175	<153	<174	<148	<129	<187	<186	<145	<168
Ni	47	105	151	97	163	108	25	122	146	60	128
Cu	29	51	53	45	58	38	31	56	54	34	50
Zn	149	189	118	111	283	122	75	347	192	182	193
As	13	14	6	15	14	<4	18	14	8	17	9
Se	<2	<2	<2	3	<2	<2	<2	3	<2	<2	<2
Rb	78	66	46	55	81	35	63	78	59	96	61
Sr	51	93	136	108	86	154	42	60	102	64	138
Y	36	46	26	29	55	27	29	50	41	36	35
Zr	175	157	127	169	157	100	197	163	133	174	145
Mo	9	5	10	<4	11	6	13	7	<5	11	7
Ag	<15	<16	<16	<15	<17	<18	<15	<17	<17	<16	<17
Cd	<21	<22	<22	<21	<24	<25	<21	<24	<24	<22	<24
Sn	<29	<31	<31	<31	<33	<35	<29	<33	<34	<31	<34
Sb	<25	<27	<26	<27	<29	<30	<25	<29	<29	<27	<29
Hg	<3	<3	<3	<3	<3	<3	3	4	<3	<3	<3
Pb	20	16	16	7	34	12	17	30	34	22	16
Bi	<15	<16	<16	<15	<17	<17	<15	<16	<17	<17	<17
Th	9	8	<7	9	7	<8	<6	14	<7	9	<8
U	<5	<6	<6	<6	<6	<7	<5	<6	<7	<6	<7

Appendix B

Soil Chemistry Summary Certificates

SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 59413A	Sample N°: 7	Date Received: 3/3/21	Report Status: Draft

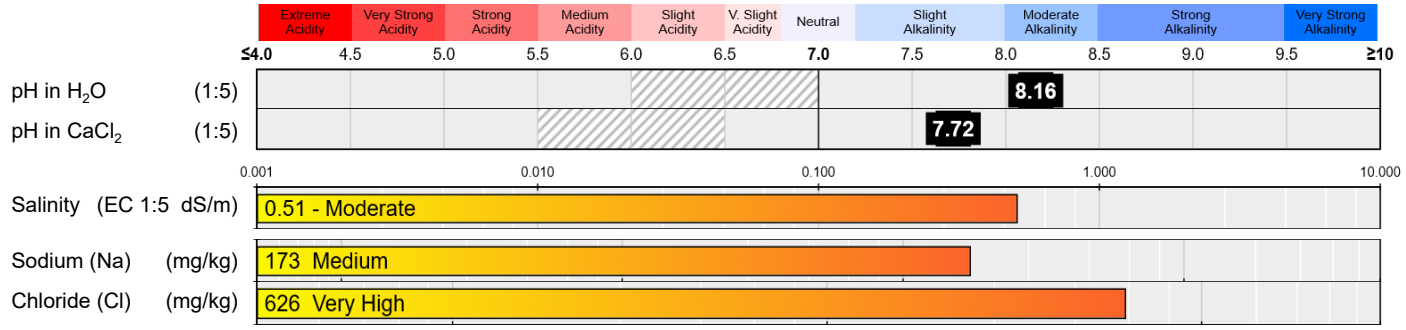
Client Name:	**Graymont**	Project Name:	**Andesite, Waste Dump and Clay Samples**
		SESL Quote N°:	
Client Contact:	**Donald Cheong**	Sample Name:	**Clay Sample 1**
Client Order N°:		Description:	**Soil**
Address:	**Level 16, 111 Pacific Highway North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

Analysed by SESL Australia (NATA # 15633) and ALS Laboratory Group (NATA # 825, Report # ES2107784).

Please refer to report 'J003146 - Mining Spoil Characterisation - Riverton Dump' for further details.

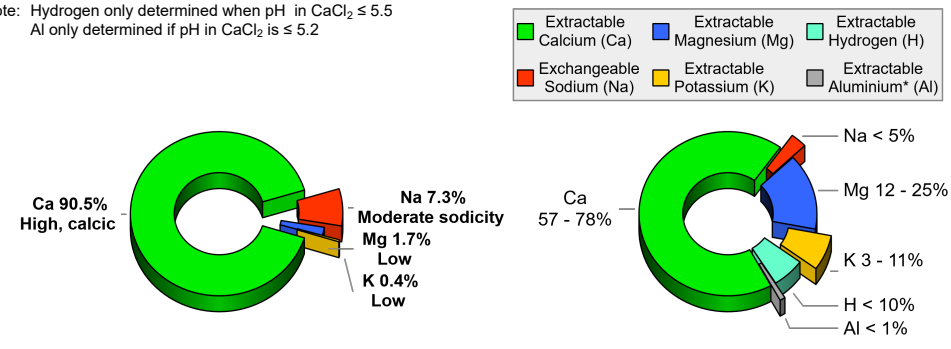
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

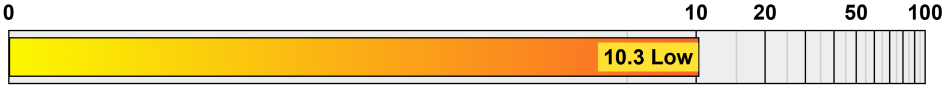
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**54.8**	4.1 – 6.0
Comment: Potential magnesium		
Mg:K	**4.3**	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	**0**	< 0.07
Comment: Acceptable		
K:Na	**0.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.75	0.04	9.32	0.17		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

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This laboratory participates in, and is awarded certification based on results of the scores returned in, ASPAC inter-laboratory proficiency rounds. For detailed current certification status and for more information on the ASPAC inter-laboratory proficiency testing programs, see the ASPAC website: http://www.aspac-australasia.com

Disclaimer
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SESL AUSTRALIA
Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 59413A | **Sample N°: 7** | **Date Received: 3/3/21** | **Report Status: Draft**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 20 **DESIRED FERTILITY CLASS:** ◉ Low ○ Moderate ○ Hig

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	29		3.9	4	0.1
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	15.7		2.1	34.8	32.7
Sulfur (S)	mg S/kg	25		3.3	9	5.7
Calcium (Ca)	mg/kg	1870		248.7	248	Drawdown
Magnesium (Mg)	mg/kg	21		2.8	25.8	23
Iron (Fe)	mg/kg	10.1		1.3	73.4	72.1
Manganese (Mn)	mg/kg	3.6		0.5	5.9	5.4
Zinc (Zn)	mg/kg	<0.65		0.1	0.7	0.6
Copper (Cu)	mg/kg	<0.64		0.1	0.8	0.7
Boron (B)	mg/kg	0.1		0	0.4	0.4

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

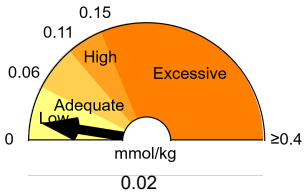
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**10.3**
Eff. Cation Exch. Capacity (eCEC):	**10.3**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0: **0**
– to neutralise Al: **-**

Calculated Gypsum Application Rate (CGAR)

(g/sqm) to achieve 67.5 % exch. Ca: **0**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Sandy Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Very low - 0.2**
Estimated clay content:	**35 - 45%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**0.3**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**29**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**19**
Calculated EC_{SE} (dS/m):	**4.4**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**10**
– Moderate saline. Growth on many plant species is affected.		Est. Permeability Class (mm/hr):	**2.5 - 5**	Est. Plant Available Water (mm/m):	**100**
		Additional comments:			

Date Report Generated 9/04/2021

Consultant: Jane Koo

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

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Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 59413A | **Sample N°: 8** | **Date Received: 3/3/21** | **Report Status: Draft**

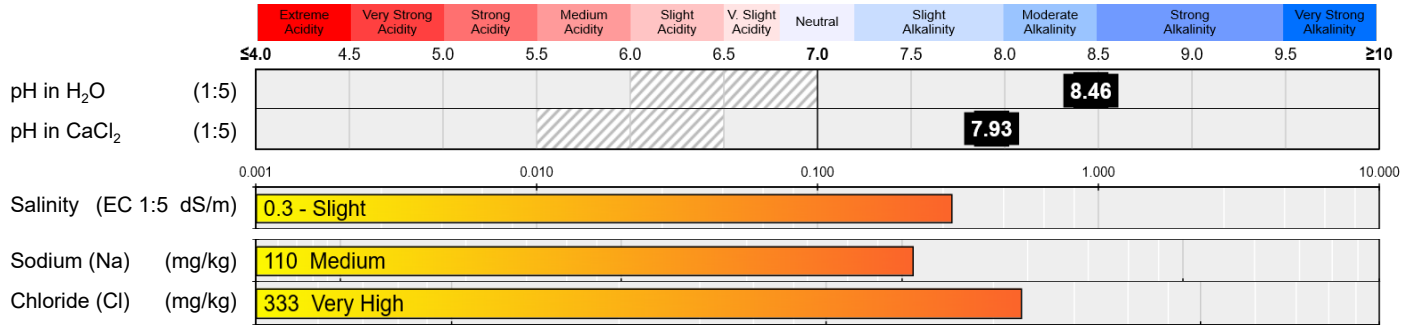
Client Name:	**Graymont**	Project Name:	**Andesite, Waste Dump and Clay Samples**
		SESL Quote N°:	
Client Contact:	**Donald Cheong**	Sample Name:	**Clay Sample 2**
Client Order N°:		Description:	**Soil**
Address:	**Level 16, 111 Pacific Highway North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

Analysed by SESL Australia (NATA # 15633) and ALS Laboratory Group (NATA # 825, Report # ES2107784).

Please refer to report 'J003146 - Mining Spoil Characterisation - Riverton Dump' for further details.

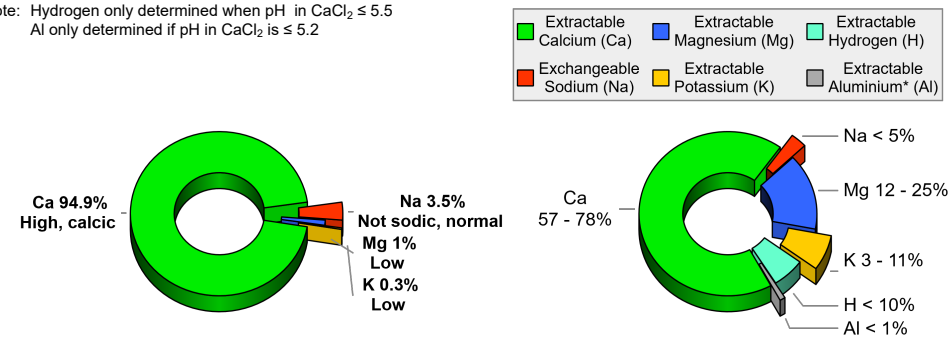
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**99.3**	4.1 – 6.0
Comment: Potential magnesium		
Mg:K	**3.2**	2.6 – 5.0
Comment: Balanced		
K/(Ca+Mg)	**0**	< 0.07
Comment: Acceptable		
K:Na	**0.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.48	0.04	12.91	0.13		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

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Environment & Soil Sciences

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

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Batch N°: 59413A | **Sample N°: 8** | **Date Received: 3/3/21** | **Report Status: Draft**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 20 **DESIRED FERTILITY CLASS:** ◉ Low ○ Moderate ○ Hig

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	17		2.3	4	1.7
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	16.5		2.2	34.8	32.6
Sulfur (S)	mg S/kg	16		2.1	9	6.9
Calcium (Ca)	mg/kg	2590		344.5	248	Drawdown
Magnesium (Mg)	mg/kg	16		2.1	25.8	23.7
Iron (Fe)	mg/kg	7.79		1	73.4	72.4
Manganese (Mn)	mg/kg	7.4		1	5.9	4.9
Zinc (Zn)	mg/kg	<0.65		0.1	0.7	0.6
Copper (Cu)	mg/kg	<0.64		0.1	0.8	0.7
Boron (B)	mg/kg	0.2		0	0.4	0.4

Explanation of graph ranges:

Very Low — Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low — Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

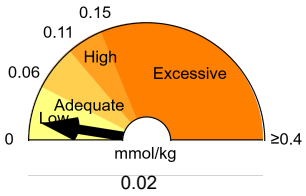
Marginal — Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60 %.

Adequate — Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

High — The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2 %.

NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**13.6**
Eff. Cation Exch. Capacity (eCEC):	**13.6**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0: **0**
– to neutralise Al: **-**

Calculated Gypsum Application Rate (CGAR)

(g/sqm) to achieve 67.5 % exch. Ca: **0**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Sandy Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Very low - 0.2**
Estimated clay content:	**35 - 45%**	Structure Size:	**Medium (11 - 25mm)**	Organic Matter (OM %):	**0.3**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**29**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**19**
Calculated EC_{SE} (dS/m):	**2.6**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**10**
– Slightly saline. Growth on sensitive plant species is affected.		Est. Permeability Class (mm/hr):	**2.5 - 5**	Est. Plant Available Water (mm/m):	**100**
		Additional comments:			

Date Report Generated 9/04/2021

Consultant: Jane Koo

Authorised Signatory: Simon Leake

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

*Structure analysed in the laboratory is conducted on a disturbed sample, therefore is only a representation of the macro-structures that may be present in the field, which provide an indication of the soil physical characteristics and behaviours that may exist.

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Disclaimer
Tests are performed under a quality system complying with ISO 9001: 2008. Results are based on the analysis of the samples collected or received by SESL. Due to the spatial and temporal variability of soils within a given site, and the variability of sampling techniques, environmental conditions and managerial factors, SESL does not accept any liability for a lack of general compliance or performance based on the interpretation and recommendations given (where applicable). This document must not be reproduced except in full.

Soil Chemistry Profile

Mehlich 3 - Multi-nutrient Extractant

Sample Drop Off: 16 Chilvers Road, Thornleigh NSW 2120
Mailing Address: PO Box 357, Pennant Hills NSW 1715
Tel: 1300 30 40 80
Fax: 1300 64 46 89
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 59413A | **Sample N°: 9** | **Date Received: 3/3/21** | **Report Status: Draft**

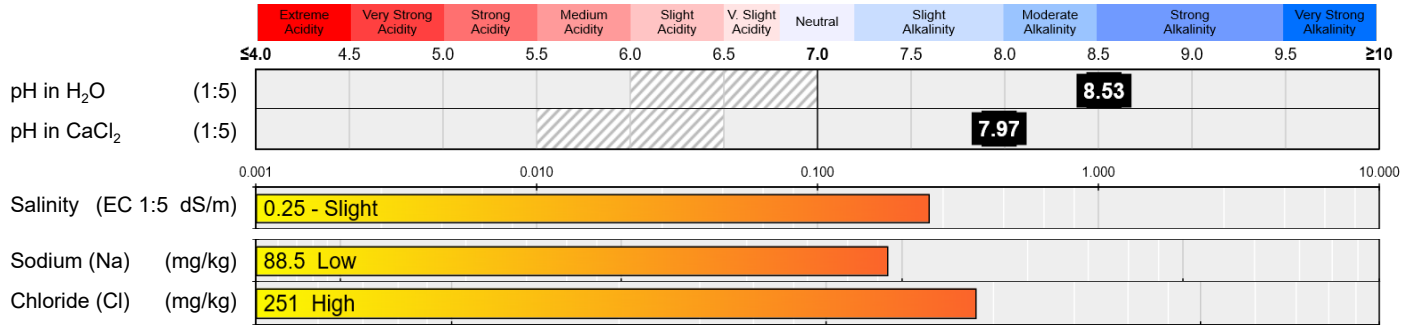
Client Name:	**Graymont**	Project Name:	**Andesite, Waste Dump and Clay Samples**
		SESL Quote N°:	
Client Contact:	**Donald Cheong**	Sample Name:	**Clay Sample 3**
Client Order N°:		Description:	**Soil**
Address:	**Level 16, 111 Pacific Highway North Sydney NSW 2060**	Test Type:	**FSC_Plus**

RECOMMENDATIONS

Analysed by SESL Australia (NATA # 15633) and ALS Laboratory Group (NATA # 825, Report # ES2107784).

Please refer to report 'J003146 - Mining Spoil Characterisation - Riverton Dump' for further details.

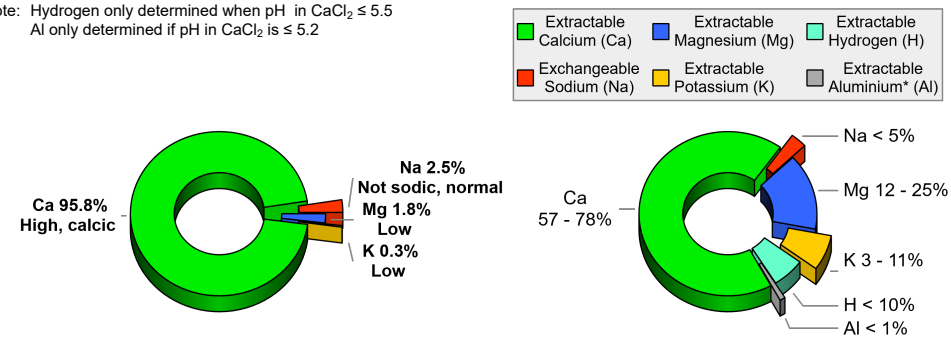
pH and ELECTRICAL CONDUCTIVITY



CATION BALANCE

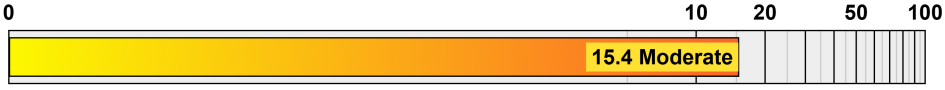
EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $CaCl_2$ ≤ 5.5
Al only determined if pH in $CaCl_2$ is ≤ 5.2



ACTUAL IDEAL

EFFECTIVE CATION EXCHANGE CAPACITY (eCEC) (cmol(+)/kg)



CATION RATIOS

Ratio	Result	Target Range
Ca:Mg	**54.6**	4.1 – 6.0
Comment: Potential magnesium		
Mg:K	**6.8**	2.6 – 5.0
Comment: Potassium low		
K/(Ca+Mg)	**0**	< 0.07
Comment: Acceptable		
K:Na	**0.1**	N/A

EXCHANGEABLE CATIONS (cmol(+)/kg)

Na:	K:	Ca:	Mg:	H:	Al:
0.38	0.04	14.75	0.27		

eCEC does not include correction for soluble salts as standard. Where exchangeable calcium exceeds 80 % of eCEC and/or salinity exceeds 0.75 dS/m, alternative methods are recommended to determine true eCEC.

The units of eCEC *cmol(+)/kg* are the SI unit and are equivalent to *meq/100g*.

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SESL AUSTRALIA
Environment & Soil Sciences

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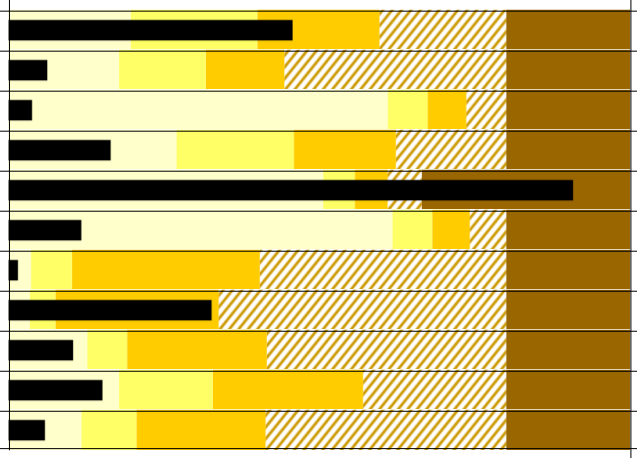
Em: info@sesl.com.au
Web: www.sesl.com.au

Batch N°: 59413A **Sample N°: 9** **Date Received: 3/3/21** **Report Status: Draft**

PLANT AVAILABLE NUTRIENTS

EFFECTIVE AMELIORATION DEPTH (mm): ◉ 100 ○ 150 ○ 20 **DESIRED FERTILITY CLASS:** ◉ Low ○ Moderate ○ Hig

Major Nutrients	Unit	Result	Very Low / Low / Marginal / Adequate / High	Result (g/sqm)	Desirable (g/sqm)	Adjustment (g/sqm)
Nitrate-N (NO_3)	mg N/kg	12		1.6	4	2.4
Phosphorus (P)	mg P/kg	<5		0.7	8.4	7.7
Potassium (K)	mg/kg	14.5		1.9	40.4	38.5
Sulfur (S)	mg S/kg	14		1.9	9	7.1
Calcium (Ca)	mg/kg	2960		393.7	287.8	Drawdown
Magnesium (Mg)	mg/kg	33		4.4	29.9	25.5
Iron (Fe)	mg/kg	11.1		1.5	73.4	71.9
Manganese (Mn)	mg/kg	18		2.4	5.9	3.5
Zinc (Zn)	mg/kg	<0.65		0.1	0.7	0.6
Copper (Cu)	mg/kg	1.2		0.2	0.8	0.6
Boron (B)	mg/kg	0.2		0	0.4	0.4



Explanation of graph ranges:

Very Low Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90 %.

Low Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90 %.

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Adequate Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30 %.

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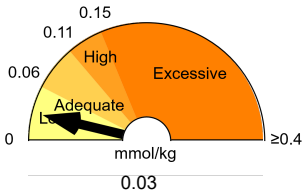
NOTES: Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.
Drawdown: The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.
• g/sqm measurements are based on soil bulk density of 1.33 tonne/m^3 and effective amelioration depth.

Phosphorus Saturation Index



Low. Plant response to applied P is likely.

Exchangeable Acidity

Adams-Evans Buffer pH (BpH):	-
Sum of Base Cations (cmol(+)/kg):	**15.4**
Eff. Cation Exch. Capacity (eCEC):	**15.4**
Base Saturation (%):	**100**
Exchangeable Acidity (cmol(+)/kg):	-
Exchangeable Acidity (%):	-

Lime Application Rate (g/sqm)

– to achieve pH 6.0: **0**
– to neutralise Al: **-**

Calculated Gypsum Application Rate (CGAR)
(g/sqm) to achieve 67.5 % exch. Ca: **0**

The CGAR is corrected for the selected effective amelioration depth (100 mm) and any Lime addition to achieve pH 6.0.

PHYSICAL DESCRIPTION

Texture:	**Sandy Clay**	Munsell Colour:	-	Organic Carbon (OC %):	**Very low - 0.2**
Estimated clay content:	**35 - 45%**	Structure Size:	**Fine (1 - 10mm)**	Organic Matter (OM %):	**0.3**
Tactually gravelly:	**Not gravelly**	Structural Organisation:	**Pedal - Moderate**	Est. Field Capacity (% water):	**29**
Tactually organic:	**Not Organic**	Structural Unit:	**Crumb**	Est. Permanent Wilting Point (% water):	**19**
Calculated EC_{SE} (dS/m):	**2.2**	Potential infiltration rate:	**Slow**	Est. Plant Available Water (% water):	**10**
– Slightly saline. Growth on sensitive plant species is affected.		Est. Permeability Class (mm/hr):	**2.5 - 5**	Est. Plant Available Water (mm/m):	**100**
		Additional comments:			

Date Report Generated 9/04/2021

Consultant: Jane Koo **Authorised Signatory: Simon Leake**

METHOD REFERENCES:
pH (1:5 H_2O) - SESL CM0002; Rayment & Lyons 4A1-2011
pH (1:5 $CaCl_2$) - SESL CM0002; Rayment & Lyons 4B4-2011
EC (1:5) - SESL CM0001; Rayment & Lyons 3A1-2011
Chloride - Rayment & Lyons 5A2a-2011
Nitrate - Rayment & Lyons 7B1a-2011
Aluminium - SESL CM0007; Rayment & Lyons 15A1-2011
P, K, S, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - SESL CM0007; Rayment & Lyons 18F1-2011
Buffer pH and Hydrogen - SSSA Methods of Soil Analysis 2007, Pt 3, Ch 17; Adams-Evans (1962)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure* - "Murphy" (1991), Colour- "Munsell" (2000))

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Environment & Soil Sciences

Appendix C

Certificates of Analysis

SESL Australia Pty Limited
ABN 70 106 810 708
16 Chilvers Rd Thornleigh NSW 2120
Ph: 1300 30 40 80
info@sesl.com.au www.sesl.com.au

Certificate of Analysis

Client: Graymont

Regarding your booking:

Client Ref No.:	59413A	Report Ref No:	192990
Date Received:	4/03/21	Issue Date:	9/04/21
Time Received:	11:39	Date Analysis Completed:	12/03/21
No. of samples:	3	Turn Around Time:	Normal

Report Details:

Accredited for compliance with ISO/IEC 17025 - Testing, NATA accreditation number 15633.
NATA accreditation does not cover the performance of a service if not indicated.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian standards. Results are based on the analysis of the sample received by SESL.

Approved Signatory



Sample Number	Sample Type	Client Sample ID	Sample Name
1	Soil	59413A-7	Clay Sample 1
2	Soil	59413A-8	Clay Sample 2
3	Soil	59413A-9	Clay Sample 3

Sample No. Client Reference Test	Units	Method	Accredited	1 59413A-7	2 59413A-8	3 59413A-9
pH	pH units	Rayment and Lyons 4A1	NATA	8.16	8.46	8.53
pH in $CaCl_2$	pH units	Rayment and Lyons 4B2	NATA	7.72	7.93	7.97
EC	mS/cm	Rayment and Lyons 3A1	NATA	0.51	0.30	0.25
Cl by soluble extract	mg/kg	CM0040		626	332	251
Na in soil by M3	mg/kg	CM0007	NATA	173	110	88
K in soil by M3	mg/kg	CM0007	NATA	16	16	14
Ca in soil by M3	mg/kg	CM0007	NATA	1,870	2,590	2,960
Mg in soil by M3	mg/kg	CM0007	NATA	21	16	33
P in soil by M3	mg P/kg	CM0005	NATA	<10	<10	<10
NO_3 by soluble ext	mg N/kg	CM0042		29	17	12
S in soil by M3	mg S/kg	CM0004	NATA	25	<20	<20
Fe in soil by M3	mg/kg	CM0006	NATA	10	7.8	11
Zn in soil by M3	mg/kg	CM0006	NATA	<1.0	<1.0	<1.0
Cu in soil by M3	mg/kg	CM0006	NATA	<0.25	0.46	1.2
Mn in soil by M3	mg/kg	CM0006	NATA	3.6	7.4	18
B in soil by M3	mg/kg	CM0048		<0.50	<0.50	<0.50
Al in soil by M3	mg/kg	CM0007	NATA	86	90	91
Total Org Carbon in solid	%w/w	CM0009	NATA	0.18	0.19	0.17
Organic Matter - Dumas	%w/w	CM0009		0.31	0.32	0.29
Soil is / isn't gravelly		PM0003		Not gravelly	Not gravelly	Not gravelly
Soil texture by Northcote		PM0003		Sandy Clay	Sandy Clay	Sandy Clay
Soil is / isn't organic		PM0003		Not Organic	Not Organic	Not Organic
Soil aggregate strength		PM0003		Pedal - Moderate	Pedal - Moderate	Pedal - Moderate
Soil structure by Northcote		PM0003		Crumb	Crumb	Crumb
Soil size class by Northcote		PM0003		Medium (11 -25mm)	Medium (11 -25mm)	Fine (1 - 10mm)

Notes from Client:

Notes to Client:

Appendix G Soil Characterisation Assessment (Epic Environmental 2023)



Topsoil Suitability Assessment

Graymont Limited
Riverton Topsoil Suitability Assessment
Riverton Quarry
BCL230007.01
17 May 2023

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DOCUMENT CONTROL

Revision	Revision date	Revision details	Author	Editorial review	Technical review	Approver
RevA	6/04/2023	Internal	AH	MK	LC	LC
Rev0	20/04/2023	Issue for client	AH	MK	LC	LC
Rev1	17/05/2023	Address client comments	AH	MK	LC	LC

DISTRIBUTION

Revision	Revision date	Issued to
Rev0	20/04/2023	Epic Environmental – Michael Blyth
Rev1	17/05/2023	Epic Environmental – Michael Blyth

DOCUMENT INFORMATION

Printed:	17 May 2023
Last saved:	17 May 2023 03:27 PM
File name:	BCL230007.01-RPT-Riverton-Topsoil Suitability Assessment-Rev1
Author:	Andrew Hughes
Project manager:	Michael Kowalczyk
Client:	Graymont Limited
Document title:	Topsoil Suitability Assessment
Project number:	BCL230007.01

EXECUTIVE SUMMARY

Epic Environmental (Epic) was engaged by Graymont Limited (Graymont) to undertake a topsoil characterisation assessment for stockpiled material located at Graymont Riverton Quarry. The stockpiled material is currently stored in two separate stockpiles referred to as stockpile 01 and stockpile 02, which contained approximately ~36,000 m^3 (SP01) and ~45,000 m^3 (SP02) of material. The material is understood to have been sourced from the site during establishment, striping, and/or rejections from processing.

Assessment Criteria

Field and laboratory analytical results were evaluated against the relevant land use suitability criteria sourced from Queensland technical guidelines The adopted land use suitability criteria for this investigation were for cattle grazing land use which is the proposed post mining land use for the site.

As the material was stockpiled at the time of sampling eight evaluation criteria could not be assessed: micro-relief, water availability, rockiness, wetness, topography, water erosion, vegetation regrowth and flooding.

Summary of Findings

The limitation characterisation of stockpiled material identified limitations that are required to be addressed to enable the use of the material as topsoil for the proposed post mining land use:

- Stockpile SP01 is currently suitable for use as cattle grazing with a suitability class of 3
  - soil pH and nutrient deficiency being the limiting factor.
  - soil pH and soil nutrients is suitable, amelioration of the soil pH and nutrients of the soil is recommended
- Stockpile SP02 is currently unsuitable for use for cattle grazing with a suitability class of 4,
  - nutrient deficiency being the limiting factor
  - nutrients of the soil are the limiting factor and are considered to be so severe that the sustainable use of the land in the proposed manner is precluded. However, amelioration of the soil in the stockpile can overcome this limitation
  - soil pH is suitable, amelioration of the soil pH is recommended

Recommendations

Recommendations to ameliorate the stockpile material in both Stockpile SP01 and SP02 are provided in **Section 7**, with a summary provided below:

- Addition of nutrients to be added to both stockpiles
- Stockpile d material pH should be lowered to a range between 6.0 – 8.0, as in this range nutrient availability to plants is optimal
- The separation of gravel, cobbles and boulder fractions from soil fractions (sand, silt and clay) should occur prior to re-using soil onsite

1 INTRODUCTION

Epic Environmental (Epic) was engaged by Graymont Limited (Graymont) to undertake a topsoil characterisation assessment for two stockpiles, located to the north-west of quarry infrastructure within the Riverton Quarry mining leases (MLs) 50142 and 50220 (the site) (see **Figure F1**). The combined area of both mining leases is approximately 301.59 ha, with approximately 57.49 ha occupied by current operations consisting of infrastructure, processing areas, stockpile areas and the mine void.

The Graymont Riverton Quarry is currently operating as a limestone quarry that excavates, processes and exports raw and processed limestone products. Limestone products are processed through primary and secondary crushing, screening and then finished with the fine grinding of the product. Stockpiling, storage and packaging of ground limestone product is completed at an onsite processing plant.

The assessment of soil landscape and suitability is required by the Department of Environment and Science (DES) as part of the Progressive Rehabilitation and Closure Plan (PRCP). As part of the required remediation Graymont requires the replacement of stripped topsoil. Based upon the information provided by Graymont, the proposed post-mining land use (PMLU) will include:

- Infrastructure, overburden dump, process equipment and miscellaneous activity areas: Light grazing and fauna habitat
- Pit area: Terraced mine benches and screen slopes
- Water storage and management areas: water supply

Epic understands that Graymont requires characterisation of stockpiled material prior to re-use onsite. The stockpiled material is currently stored in two separate stockpiles referred to as stockpile 01 and stockpile 02 (**Figure F1**), which currently contain approximately ~36,000 m^3 (SP01) and ~45,000 m^3 (SP02) of material. The material has been sourced from the site during establishment, striping, and/or rejections from processing.

1.1 Objective

The objective of this investigation was to evaluate the suitability of Stockpile 01 (SP01) soil for re-use on site for cattle grazing and provide an preliminary assessment of the suitability of the Stockpile 02 (SP02).

1.2 Scope of Works

To achieve the objective, a stockpile sampling program was undertaken on 28th February 2023. A summary of the stockpile sampling program is as follows:

- Advancement of ten testpits into Stockpile 01, down to a maximum depth of 3.0 meters below surface level (mbsl)
- Advancement of two testpits into Stockpile SP02, down to a maximum depth of 0.3 mbsl
- Submission of stockpile material samples to a National Association of Testing Authority (NATA) accredited laboratory and/or a laboratory certified by the Australasian Soil and Plant Analysis Council (ASPAC) for selected analysis
- Preparation of this topsoil suitability report

1.3 Technical Framework

This report has been with consideration to the following guidelines:

- Department of Science, Information Technology and Innovation (DSITI) and the Department of Natural Resources and Mines (DNRM) (2015). *Guidelines for agricultural land evaluation in Queensland* (2nd edition). Queensland Government (DSITI), Brisbane, Queensland.
- DNRM and Department of Environment and Science (DES) (2013). *Regional Land Suitability Frameworks for Queensland.*
- Queensland Department of Minerals and Energy (DME, 1995) *Guidelines for Environmental Management of Exploration and Mining in Queensland*.

2 SITE DESCRIPTION AND SETTING

2.1 Site Identification

Graymont operates the Riverton Limestone Mine and associated Processing Plant, located at Riverton approximately 2 kilometres (km) west of the border between Queensland and New South Wales, with the site location shown in **Figure F1.** The investigation area comprises of two individual stockpiles, Stockpile 01 (SP01) (**Figure F2**) and stockpile 02 (SP02) (**Figure F3**) and contain approximately 36,000 m^3 and 45,000 m^3 of material respectively.

The site comprises two existing MLs held by Graymont, comprising ML50142 and ML50220. Mining activities are authorised under Environmental Authority (EA) EPML00241213 which authorises the holder to extract between 100,000 and 500,000 tonnes of limestone per year.

A summary of the site details are summarised in **Table 1**.

Table 1. Site Description Summary

Category	Details
Address	Riverton Road, Riverton QLD
Legal Property Description	Portion of Lots 3RP207320, 1SP310330, 2RP905817, with the stockpile located on 1SP310330
Site Owner	Graymont Pty Ltd
Site Access	From Riverton Road
Local Government Area	Goondiwindi Regional Council
Current Use	Mining
Site Features & Infrastructure	Site features include the mine pit, clay waste 'topsoil' stockpile, waste rock dump, infrastructure areas, roads and tracks, sediment basins

2.1.1 Land Use and Activities

It is understood that mining operations at the site are completed using conventional open cut benching currently carried out on ML50142 at a maximum rate of approximately 150,000 tonnes per annum. This results in production of between 100,000 and 115,00 tonnes per annum of limestone based product. The balance of excavated material is considered gangue material comprised of clay, andesite, and clay contaminated limestone. This gangue material (often referred to as scalp material) is stockpiled onsite as reuse of the material onsite and offsite is limited. Graymont export some of the gangue material offsite to construction companies, however most of the material remains onsite in stockpiles.

2.1.2 Geology and Soils

The target limestone deposit is a constituent of the Texas Beds and is the dominant solid geology on the site. On the 1:100,000 geological map of the Surat Basin. Texas beds are described as variably crystallised and sparsely fossiliferous limestone, these beds contain bothlocal limestone and basal breccia. Regionally, this geological unit is comprised of thickly bedded, volcaniclastic arenite, mudstone, siltstone and slate; local phyllite; sporadic lenses of jasper, limestone, chert and volcanics; and mafic conglomerate (DoR, 2022). There are two fossil sites mapped within the site associated with the limestone deposit (Ashford, Field ID TXPD286) containing crinoids and coral fossils.

3 METHODOLOGY

3.1 Sampling Locations and Rational

Prior to the commencement of sampling, a visual inspection was completed of the stockpiled material to determine any potential signs of contamination or variability. The stockpile volumes were provided by Graymont and are understood to be an estimation. A total of 10 sample locations were located across the top of the Stockpile 01 (**Figure F2**). An additional two samples were collected from the Stockpile 02 as requested by Graymont to provide a preliminary assessment of the scalp material (**Figure F3**).

To adequately characterise the material, a sample frequency of one sample per 3,600 m^3 of material was adopted for Stockpile 01 Two soil samples were collected from Stockpile 02 to provide a preliminary assessment of this material's suitability as topsoil.

3.2 Stockpile Sampling

Samples were collected from Stockpile 01 using a client supplied excavator from a depth range of 0.1 to 2.0 mbsl. Samples were collected from Stockpile 02 using a shovel to collected a sample at 0.3 mbsl. Sampling at both stockpiles was completed by a qualified Epic personnel. The samples were collected into laboratory supplied bags and transferred immediately to an Esky containing ice.

Field duplicates (intra-laboratory) and triplicates (inter-laboratory duplicates) were collected in the field by collecting soil samples from the same location as a primary sample. Samples were homogenised during collection.

The stockpile material was textured using the ribboning technique, which estimates soil texture and the amount of clay in a soil. The soil pH, moisture, Munsell colour, consistency, plasticity, and other notable characteristics of the material were also recorded in the field during the test pitting.

3.3 Laboratory Analysis

3.3.1 Laboratory Analytical Schedule

Soil samples were submitted to Environmental Analysis Laboratory (EAL) at Southern Cross University for primary samples and to Department of Environment and Sciences Chemistry Centre for interlaboratory duplicates. Both the DES Chemistry Centre and EAL laboratory hold NATA accreditation and EAL are certified by the Australasian Soil and Plant Analysis Council (ASPAC) for the methods completed.

A summary of the sampling and analytical program for Stockpile 01 and Stockpile 02 assessment are provided in **Table 2**.

Table 2. Analytical Program

Analysis	Primary Samples		QA/QC		Total
	SP02	SP01	Duplicates	Triplicates	
pH, Electrical Conductivity (1:5)	2	11	1	1	15
Total nitrogen, nitrates, Cowell phosphorous	2	11	1	1	15
Organic matter	2	11	1	1	15
Major exchangeable cations, CEC, Ca/Mg ratio, ESP	2	11	1	1	15
11 metals (Al, As, Cd, Cu, Cr, Fe, Mg, Hg, Ni, V, Zn)	2	11	1	1	15
Sulfur	2	11	1	1	15
Chloride	2	11	1	1	15
Particle size distribution	2	11	1	1	15
Emerson aggregate test	2	11	1	0	14
Moisture content	2	11	1	1	15

3.4 Topsoil Evaluation Criteria

Field and laboratory analytical results were evaluated against the relevant land use suitability criteria sourced from technical guidelines as described in **Section 1.3**. The adopted land use suitability criteria for this investigation were for cattle grazing land use which is the proposed post mining land use for the site. Soils were not assessed against the cropping (irrigated or dryland) criteria as this is not proposed as a post mining land use. The land use suitability criteria for cattle grazing are provided in the sections below.

3.4.1 Soil pH (1:5 soil/water)

The pH ratings were used to interpret pH data as described by Bruce and Rayment (1982) which are presented in **Table 3.**

Table 3. pH 1:5 Soil/Water Ratings

Rating	pH
Strongly acidic	<5.5
Acidic	5.6–6.5
Neutral	6.6–7.5
Alkaline	7.6–8.5
Strongly alkaline	>8.5

3.4.2 Electrical Conductivity

The EC 1:5 salinity ratings were used to assess the significance of laboratory measured EC 1:5 data in consideration of the known clay content. A summary of these criteria are presented in **Table 4** (Shaw 1988).

Table 4. Electrical Conductivity Ratings

Rating	EC 1:5 (dS/m)			
	10–20% clay	20–40% clay	40–60% clay	60–80% clay
Very low	<0.05	<0.08	<0.12	<0.18
Low	0.05–0.10	0.08–0.17	0.12–0.25	0.18–0.37
Moderate	0.10–0.25	0.17–0.40	0.25–0.58	0.37–0.85
High	0.25–0.45	0.40–0.67	0.58–1.00	0.85–1.5
Very high	0.45–0.70	0.67–1.05	1.00–1.58	1.5–2.4
Extreme	>0.70	>1.05	>1.58	>2.4

3.4.3 Cation Exchange Capacity (CEC)

CEC was evaluated against the relevant criteria for the surface soils to provide a preliminary indication of the overall fertility status. These criteria as per Landon (1991) are presented in **Table 5.**

Table 5. Cation Exchange Capacity Ratings

Rating	CEC/ECEC (milliequivalent [meq]/100 grams [g] of soil)
Very low	<5
Low	5–15
Moderate	15–25
High	25–40
Very high	>40

3.4.4 Cation Dominance – Exchangeable Sodium Percentage (ESP)

Sodicity was evaluated against the criteria presented by Baker and Eldershaw (1993) using exchangeable sodium percentages (ESP) as presented in **Table 6.**

Table 6. ESP Ratings

Rating	ESP (%)
Non-sodic (low)	<6
Sodic (moderate)	6–15
Strongly sodic (high)	15–20
Extremely sodic (very high)	>20

3.4.5 Calcium/Magnesium Ratio (Ca/Mg)

The ratings used to interpret Ca/Mg ratios (Baker and Eldershaw 1993) are presented in **Table 7.** Soils that disperse readily but have low ESP levels; often have high levels of Mg relative to the other cations. To account for this deviation from ESP, a ratio of Ca to Mg is used to provide a guide to the relative abundance of the two major cations.

Table 7. Ca:Mg Ratio Ratings

Rating	Ca/Mg Ratio	Comments
Very low	<0.10	Mg is >10 times more dominant than Ca
Low	0.10–0.50	Mg is 5–10 times more dominant than Ca
Moderate	0.51–1.0	Ca and Mg becoming co-dominant
High	1.1–2	Ca more dominant than Mg
Very high	>2	Ca >2 times more dominant than Mg

3.4.6 Available Phosphorus (P)

The criteria used to assess bicarbonate extractable phosphorus categories are based upon Ahern et al. (1994) and are presented in **Table 8.**

Table 8. Available Phosphorus

Rating	Bicarb extractable Phosphorus
Very low	<5
Low	6-9
Moderate	10-15
High	16-40
Very high	>40

3.4.7 Dispersion Tests

Dispersion testing was based on the Emerson Aggregate Test (EAT), derived from the Department of Sustainable Natural Resources. The purpose of the EAT is to assess the coherence of the soil aggregates when immersed into water. The coherence of the soil is determined by the slaking and dispersion behaviour of the soil. The EAT can be divided into the following classes:

- **Class 1** - severe dispersion, maybe related to high sodicity which forces the clay particles apart in water. Amelioration with lime or gypsum may improve structural stability by increasing EC. Class 1 soils have a major limitation to wastewater application because of reduced permeability and potential to compact as the pores block.
- **Class 2** – moderate dispersion, maybe related to high sodicity. Amelioration may be effective by increasing EC. Without amelioration, this class has a major limitation to wastewater application as for Class 1.
- **Classes 3-6** –remoulding, and 1:5 soil:water suspension tests are irrelevant to wastewater assessment, but one can report the test results with degree of slaking as:
    - Slake 1 (slight), slake 2 (moderate) or slake 3 (completely slumped) (as shown in Figure 1). Slake 1, 2 or 3 – no limitation to wastewater application, but may benefit from additional organic matter for surface irrigated soils.
    - As a shorthand, this category of slaking soils may be reported as *3/6, slake 1 indicating that the class may be within the group of classes 3 to 6, but the general behaviour of the ped in the

synthetic effluent (SAR 5, EC 1 dS/m) is that that the ped slakes slightly. Replace slaking with grade as 2 or 3 as appropriate.

- **Classes 7 and 8** – these soils are water stable, but may swell (Class 7) or retain original size and shape (Class 8). Neither of these classes is a limitation to wastewater application.

3.4.8 SAR Calculation for Saline and Sodic Soils

The sodium absorption ration (SAR) is commonly used as a measure of the activity of sodium ions relative to calcium and magnesium ions (Pam Hazelton & Brian Murphy 2016). SAR values greater than 3 can cause dispersion in soil of low electrolyte concentration. The SAR and ESP can be used in conjunction which each other to indicate dispersive tendencies of the soil is whether it is prone to soil compaction, crusting and/or hard setting of surfaces.

4 RESULTS

4.1 Field Observations

A total of 10 sample locations were advanced using an excavator to a maximum depth of 3.0 mbsl, with two additional sub-surface (0.3 mbsl) samples collected from a Stockpile 02. Details of the material encountered at each location is summarised in **Table 9.** A photographic log of excavated material for the corresponding test pit is as follows:

- SP01_01 - **Plate P1**
- SP01_02 - **Plate P2**
- SP01_03 - **Plate P3**
- SP01_04 - **Plate P4**
- SP01_05 - **Plate P5**
- SP01_06 - **Plate P6**
- SP01_07 - **Plate P7**
- SP01_08 - **Plate P8**
- SP01_09 - **Plate P9**
- SP01_10 - **Plate P10**
- SP01 - Encountered examples of gravel, cobbles and boulders - **Plate P11** and **Plate P12**

Table 9. Field Logging Summary

Location	Sample Location / ID	Soil pH (field)[1]	Ribbon length (cm)	Moisture	Consistency	Colour	Description
Stockpile 01	SP01_01	8.0	2 – 3	Dry to slightly moist beyond 1.0 mbsl for all sample locations in stockpile01	Soil was compacted in stockpile, once excavated and bolus formed soil was very soft – soft.	5YR – 5/4 Reddish Brown	Coarse grained sandy light CLAY, non-plastic, with coarse subrounded and subangular gravel (8%), trace subrounded and subangular cobbles (60-200mm) (4%) and subangular boulders (200-600mm) (2%).
	SP01_02	8.0 – 8.5	3 – 4			5YR – 4/4 Reddish Brown	Coarse grained sandy light CLAY, non-plastic, with coarse subrounded and subangular gravel (8%), trace subrounded and subangular cobbles (60-200mm) (4%) and subangular boulders (200-600mm) (2%).
	SP01_03	8.5	3 – 4			7.5YR – 4/4 Brown	Coarse grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (11%), trace subrounded and subangular cobbles (60-200mm) (5%) and subangular boulders (200-400mm) (1%).
	SP01_04	8.5	2 – 3			5YR – 5/4 Reddish Brown	Coarse grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (12%), trace subrounded and subangular cobbles (60-200mm) (4%) and subangular boulders (200-400mm) (1%).
	SP01_05_0.5	9.0	N/A		Dense	610Y – 6/1 Greenish Gray	Clayey GRAVEL, coarse grained, subrounded and subangular, with subangular cobbles (60-200mm) (12%), trace of subangular boulders (2%)
	SP01_05_1.5	8.5	4 – 5		Soil was compacted in stockpile, once excavated and bolus formed soil was very soft – soft.	7.5YR – 5/6 Strong Brown	Medium grained sandy light CLAY, non-plastic, trace medium subangular gravel (4%).
	SP01_06	8.0	3 – 4			7.5YR – 5/6 Strong Brown	Medium grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (15%), trace subrounded and subangular cobbles (60-200mm) (4%) and subrounded and subangular boulders (200-400mm) (1%).
	SP01_07	8.5 – 9.0	3 – 4			10R – 4/3 Weak Red	Coarse grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (15%) and subrounded and subangular cobbles (60-200mm) (12%), trace subrounded and subangular boulders (200-600mm) (2%).
	SP01_08	8.0 – 8.5	5 – 6			10YR – 4/3 Brown	Medium grained sandy light CLAY, non-plastic, trace fine to coarse subrounded and subangular gravel (3%)
	SP01_09	8.5	3 – 4			2.5YR – 5/4 Reddish Brown	Medium grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (11%), trace subrounded and subangular cobbles (60-200mm)

							(2%) and subrounded and subangular boulders (200-450mm) (2%).
	SP01_10	8.5	3 – 4			5YR – 5/4 Reddish Brown	Coarse grained sandy light CLAY, non-plastic, with fine to coarse subrounded and subangular gravel (15%), trace subrounded and subangular cobbles (60-200mm) (2%) and subrounded and subangular boulders (200-70mm) (2%).
Stockpile 02	SCALP01_01	8.5 – 9.0	N/A	Dry	Very lose	610Y – 6/1 Greenish Gray	Gravelly SAND, fine to coarse grained, subrounded and subangular, well graded.
	SCALP01_02	8.5 – 9.0	N/A		Very dense		Gravelly SAND, fine to coarse grained, subrounded and subangular, well graded.

4.1.1 Stockpile Matrix Estimations

The estimated stockpile volumes and the corresponding content of gravel, cobbles, boulders and soil content is provided in **Table 10**. The percentage of each component was estimated in the field and therefore calculated volumes should be considered a preliminary estimate only. Based upon these particle sizes, the estimated usable soil volume contained in Stockpile 01 and Stockpile 02 is 28,440 m^3 and 31,500 m^3 respectively. The gravel, cobble and boulder portions could still be utilised on-site by including it in the B-horizon of the soil profile (i.e., sub-surface soil profile).

Table 10. Estimated Stockpile Volume

Stockpile	Total Volume	Gravel		Cobbles		Boulders		Soil	
	m3	%	m3	%	m3	%	m3	%	m3
SP01	36,000	14	5,040	5	1,800	2	720	79	28,440
SP02 (scalp stockpile)	45,000	30	13,500	0	0	0	0	70	31,500

4.2 Laboratory Analytical Results

One soil sample was collected from a depth range of 0.1 to 3.0 mbsl when the material appeared homogenised at each location. A total of two soil samples were collected from SP01_05 test pit as the material in the test pit did not appear homogenised as a clear boundary between material was observed at 1.5 mbsl. The samples were analysed for a range of soil properties (refer to **Section 3.3.1**). Laboratory certificates are provided in **Appendix A** with the analytical results provided in **Table T1**. A summary of the results evaluated against the evaluation criteria (**Section 3.4**) is provided in the sections below.

4.2.1 Stockpile 01

A summary of the laboratory analysis of sample collected from Stockpile 01 included:

- pH (laboratory analysis) ranged from 8.23 (SP01_02) to 8.84 (SP01_05_0.5), which can be classified as an alkaline to strongly alkaline soil.
- Soil EC ranged from 0.096 dS/m (SP01-10) to 0.469 dS/m (SP01_02), which an average of 0.216 dS/m for all Stockpile 01 samples. The soil is classified as a low to moderate saline soil based on EC (Shaw 1988)
- Soil CEC ranged from 19 cmol/kg (SP01_10) to 40 cmol/kg (QC100 (SP01-01)), with an average CEC of 28 cmol/kg. The soil can be classified as having a moderate to high CEC (Landon 1991).
- Ca:Mg ratios ranged from 14 (SP01_05_0.5) to 122 (SP01_09), which an average Ca:Mg ratio of 39. These ratios are very high indicating that Ca is more dominant than Mg (Baker and Eldershaw 1993)
- The level of extractable phosphorus ranged from 6.1 mg/kg (SP01_01) to 20 mg/kg (SP01_03), with an average concentration of 11 mg/kg. The concentration of extractable phosphorus is classified as moderated based upon Ahern et al. (1994)
- Emerson aggregate test ranged from class 2 to 4, with an average class of 3. Dispersion classes indicate that the soil slakes, with minimal dispersion
- Soil ESP ranged from 0.41 % (SP01_05_0.5) to 3.49 % (SP01_03), with an average ESP of 1.46 %. The soil can be classified as a non-sodic soil based on the ESP levels (Baker and Eldershaw 1993)

4.2.2 Stockpile 02

- pH (laboratory analysis) indicates the material to be strongly alkaline material, with a pH range of 8.53 to 9.21
- EC indicates the material to be moderately saline soil based on EC (Shaw 1988), with a range from 0.06 to 0.415 dS/m
- The ECEC indicates the material to have a moderate ECEC (Landon 1991), with a value of 20 cmol/kg

- The ESP of the material can be classified as a non-sodic material based on the ESP levels (Baker and Eldershaw 1993)
- Ca:Mg ratios for the material are very high, indicating that Ca is more dominant than Mg (Baker and Eldershaw 1993)
- The level of extractable phosphorus concentration for the material is classified as very low based upon Ahern et al. (1994) with a range from 3.6 to 4.2 mg/kg
- Emerson aggregate test ranged from class 2 to 4. Dispersion classes indicate that the material is possibly dispersive material

4.3 Quality Assurance and Quality Control

The field and laboratory quality assurance and quality control plan was adopted for the assessment which was designed to achieve pre-determined data quality objectives that were assessed with respect to Data Quality Indicators (DQIs). The data quality indicators of the sampling program were to obtain sufficient data to provide an adequate level of confidence that the assessment objectives are achieved. The following

The specific quality assurance and quality control plan for the field and laboratory components of the investigation was developed and are detailed in the sections below.

4.3.1 Field Quality Assurance and Quality Control

The field quality assurance procedures were adopted, the field quality control samples to be collected during the assessment, and the corresponding acceptable control limits are presented in **Table 11.**

Table 11. Field Quality Assurance and Quality Control

Protocol	Comments and Acceptable Control Limits
Field personnel	Use appropriately trained field personnel and employ procedures detailed in this assessment The investigation used appropriately trained personnel
Field data collection	Site conditions and sample locations to be accurately surveyed and properly described. Information is to be recorded on daily field logs and sampling sheets. Field notes are to be appropriately completed, signed, and included in the final report. Test locations are to be recorded on a handheld GPS unit, accurate to 3 m. The investigation collected field data appropriately
Sample handling (storage and transport)	Soil samples will be collected in bags supplied by the primary analytical laboratory. The sampling containers will be labelled and stored on ice in a chilled, insulated container prior to and immediately after sampling, and during transport to the nominated laboratory Sample numbers, dates, name of sampler, sample type, preservation and analytical requirements will be recorded on a chain of custody (COC) document, which will be included with the samples during transport to the nominated laboratory. The investigation stored, transported and used a COC appropriately
Field intra-laboratory duplicates/inter-laboratory duplicates	Intra-laboratory duplicates will be collected and analysed at a rate of 1 in every 20 primary samples. Inter-laboratory duplicates will be collected and analysed at a rate of 1 in every 20 primary samples. Labelling of duplicate samples on sample bottles and COCs will be done so as to conceal their relationship to the primary sample from the laboratory According to AS 4482.1 – 2005 (Standards Australia, 2005), typical RPDs are expected to range between 30% and 50%; however, this may be higher for concentrations which are close to the laboratory LOR. Considering this, Epic will adopt the following acceptable RPD limits for the DSI, based on standard industry practice: 50% for concentrations greater than ten to times the analyte LOR The RPDs were found to be generally below the data quality indicators (DQI) for relative percent differences (50%), with exceedances and RPD Calculations for soil presented in **Table T2**. The only RPD exceedance was for PSD (hydrometer method) between primary sample SP01_01 and interlaboratory duplicate sample QC200 with a RPD of 78%. This exceedance is attributed to the method in which size fractions are determined and is likely a result of human error and varying techniques between the laboratories. Therefore, field texturing will be used for this investigation to gauge soil type. This RPD exceedance is not considered to impact on data interpretation for this investigation but do demonstrate that difference between laboratory analysis and extraction methods in soil samples.

5 LAND SUITABILITY

The aim of the assessment was to evaluate the suitability of the soil in Stockpile 01 for re-use on site for cattle grazing and provide an preliminary assessment of the suitability of Stockpile 02 material.

The evaluation for topsoil suitability (cattle grazing) has been carried out in accordance with the methodologies described in **Section 2**.

It should be noted that the investigation was carried out on excavated gangue material stockpiled in the investigation area and therefore some methodologies in the guideline documents were not applicable as the material was stockpiled.

The five land suitability classes used for assessing the land are defined in **Table 12**, which describes land as less suitable as the severity of limitations for a land use increase. The land suitability classes are adopted to identity the level of suitability of the soil and landscape for a pre-determined land use scenario or grazing or cropping. When soils are evaluated against the relevant evaluation criteria (**Section 2**), soils may be determined to be unsuitable for the proposed land use. The soil property that is considered unsuitable is considered a limitation, and land is considered more unsuitable as the severity of these limitations increase. An increase in limitation severity increase may reflect:

- Reduced potential for production
- Increased inputs to achieve and acceptable level of production
- Increased inputs to prepare the land for successful production
- Increased inputs required to prevent land degradation

Land determined as Class 1 to 3 is considered suitable for a particular land use, as the long-term benefits obtained from that land use typically outweigh the inputs required to initiate and maintain production.

Class 4 land is considered temporarily unsuitable for the specified land use due to the severity of one or several limitations. However, this land may be improved to a more suitable class with the implementation of considerable soil improvement measures.

Class 5 land is considered entirely unsuitable for the specified land use as the limitation(s) are so severe that the inputs required to initiate and maintain the specified land use are not considered to be practical or sustainable.

A visual representation of data is provided on **Figure F4** and **Figure F5**, showing individual sample results and the geometric mean.

Table 12. Land Suitability Classes

Class	Agricultural Definition	Conservation Definition
1	Suitable land with negligible limitations – land which is well suited to its proposed use.	Areas well suited for conservation uses must possess significant conservation benefits in the pre-mining environment and capable of being returned to that use post-mining.
2	Suitable land with minor limitations – land which is suited to a proposed use but which may require minor changes in management to sustain the use.	These areas are suited to conservation use in that a significant component of the pre-mining conservation values can be restored post-mining. There will however be some loss in conservation where soil terrain or hydrological post-mining conditions may inhibit the full replication of the pre-mining values.
3	Suitable land with moderate limitations – land which is moderately suited to a proposed use but which require significant inputs to ensure sustainable use.	These lands contain significant conservation values pre-mining; however restoration of all of these values may not be feasible. These areas could, however, be restored to a form of conservation use which provides alternative conservation benefits.
4	Marginally suitable land – land which is marginally suited for proposed use and would require major inputs to ensure sustainability. These inputs may not be justified by the benefits to be obtained in using the land for the particular purpose and is hence considered to be presently unsuited.	These lands contain limited conservation value pre-mining and/ or are incapable of being effectively restored post-mining to any alternative conservation use which provides similar benefits. The area could, however, be restored to provide a stable form of use which does not impact on surrounding conservation values.
5	Unsuitable land with extreme limitations – land which is unsuited and cannot be sustainably used for proposed use.	These lands contain no significant conservation values.

5.1 Cattle Grazing

Limitations for the assessment of grazing land suitability on improved pastures as outlined in the Land Suitability Assessment Technique (DME 1995) Guidelines (Table 2.2 and 2.3) are:

- Water availability
- Nutrient deficiency
- Soil physical factors
- Salinity
- Rockiness
- Micro relief
- pH
- ESP
- Wetness
- Topography
- Water erosion
- Flooding
- Vegetation

As the material was stockpiled at the time of sampling some elevation criteria could not be assed, which include: the micro-relief, water availability, rockiness, wetness, topography, water erosion, vegetation regrowth and flooding were unable to be assessed

5.1.1 Summary of Land suitability for Cattle Grazing

The suitability of the stockpiled soil for reuse onsite for cattle grazing land use has been summarised in **Table 13** with the associated investigation area and the location of Stockpile 01 and Stockpile 02 shown on **Figure F4** and **Figure F5** respectively. The limiting factor for SP01 is nutrient deficiency and soil pH, however it is still

suitable for cattle grazing. The limiting factor for SP02 is nutrient deficiency, which is classified as severe and makes the soil unsuitable for cattle grazing in the current state.

A discussion on the derivation of these land suitability classes is discussed further in the sections below

Table 13. Summary of Land Suitability for Cattle Grazing

Limitations	Stockpile 01	Stockpile 02
Water Availability	Not accessed	
Nutrient Deficiency	3	4
Soil Physical Factors	2	2
Salinity	2	3
Rockiness	Not accessed	
Microrelief	Not accessed	
pH	3	3
ESP (0-10cm)	1	1
Wetness	Not accessed	
Flooding	Not accessed	
Vegetation Regrowth	Not accessed	
Topography	Not accessed	
Overall Suitability Rating	3	4

Notes:

1. Red = unsuitable
2. Green = unsuitable

5.1.1 Nutrient Deficiency

The nutrient status of samples analysed were assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995); Cowell P data was considered rather than Bicarbonate. The land suitability classes for the nutrient status are provided on **Figure F4** and **Figure F5,** with a summary provided in **Table 14.**

Table 14. Summary of Land Suitability Classes for Cattle Grazing based on Nutrient Status

Stockpile	Limiting Feature	Land Suitability Class
SP01	Cowell P 5 – 10 mg/kg	3
SP02	Cowell P ≤4 mg/kg	4

5.1.2 Soil Physical Factors

Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995) has been used to assess the physical factors for Stockpile 01 and Stockpile 02. The physical condition of soils plays a direct role with seed germination and emergence. Adverse conditions such as hard setting or crusting of surface soils reduces plant establishment through creating a barrier, reducing seed soil contact. The soil peds determined in the field could be mis-leading as the assessment was undertaken on a stockpile and not an in-situ test pit / borehole. The land suitability classes for soil physical factors are summarised in **Table 15.**

Table 15. Summary of Land Suitability Classes for Cattle Grazing based on Soil Physical Features

Stockpile	Limiting Feature	Land Suitability Class
SP01	Rigid soils with a hard setting surface when dry	2
SP02	Rigid soils with a hard setting surface when dry	2

5.1.3 Salinity

Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995) has been used to determine the land

suitability class against salinity parameters. The land suitability classes for salinity status are provided on **Figure F4** and **Figure F5,** with a summary provided in **Table 16.**

Table 16. Summary of Land Suitability Classes for Cattle Grazing based on Salinity

Stockpile	Limiting Feature	Land Suitability Class
SP01	EC 0.15 – 0.3 mS/cm or CL 300 – 600 ppm	2
SP02	EC 0.3 – 0.9 mS/cm or CL 600 – 900 ppm	3

5.1.4 pH

The land suitability class for pH was assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). Soil pH determines the availability of nutrients for plant uptake, with the following limitations occurring:

- Where the soil is strongly acidic, problems with aluminium and manganese toxicity may occur which limit root growth and plant productivity. Strongly acidic soils may require input of lime or dolomite to increase soil pH.
- Strongly alkaline soils might require the input of sulfur, aluminum sulfate or sulfuric acid to lower the pH level of the soil. Strongly alkaline soils will restrict the availability of some elements (Fe, Cu, Zn) and may be an indicator of sodicity.

Ameliorates may be added to the soil to correct pH and increase nutrient availability. The land suitability classes based on soil pH (water 1:5) are provided on **Figure F4** and **Figure F5,** with a summary provided in **Table 17.**

Table 17. Summary of Land Suitability Classes for Cattle Grazing based on pH

Stockpile	Limiting Feature	Land Suitability Class
SP01	8.0 – 9.0	3
SP02	8.0 – 9.0	3

5.1.5 Exchangeable Sodium Percentage (ESP)

The ESP of each stockpile was assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). ESP is used to determine the erosion potential of soils. The land suitability classes for salinity status are provided on **Figure F4** and **Figure F5** and summarised in **Table 18.**

Table 18. Summary of Land Suitability Classes for Cattle Grazing based on ESP

Stockpile	Limiting Feature	Land Suitability Class
SP01	<5.0 %	1
SP02	<5.0 %	1

5.1.6 Limitation Unable to be Assessed

5.1.6.1 Microrelief

Microrelief refers to local relief (up to several metres) around the plane of the land (NCST 2009). Impacts of microrelief on the suitability of land for cattle grazing are only experienced when soil is severely melon holed. Ponding of water in the depressions can reduce pasture yield, indirectly impacting the land's carrying capacity. This investigation did not undertake a land survey and therefore microrelief criteria are not applied to assess the stockpiles. When the topsoil is re-used onsite, the surface has to contain less than 50% melon holes that are greater than 60cm in depth.

5.1.6.2 Water Availability

Plant available water capacity (PAWC) is estimated with reference to Table 2.3 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). This investigation did not undertake a land survey and therefore PAWC criteria is not applied to assess the stockpiles. The PAWC will have to be greater than 100mm when the topsoil is re-used onsite.

5.1.6.3 Rockiness

The land suitability for rockiness is assessed with reference to Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). The impacts of rockiness are more extreme for cropping than for grazing. Regarding grazing, rock outcrops reduce the area available to grow pasture, indirectly impacting the carrying capacity of the land. This investigation did not undertake a land survey and therefore rockiness criteria is not applied to assess the stockpiles. The rockiness will have to be less than 90% cobbles present on the surface when the topsoil is re-used onsite.

5.1.6.4 Wetness

The land suitability class for wetness is assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). The wetness limitation refers to any excess water both in or on the soil profile. The adverse effects of excess water include reducing plant growth, impeding oxygen supply to plant roots (possibly leading to denitrification) and increased risk of plant disease. This investigation did not undertake a land survey and therefore wetness criteria can not be applied to the stockpile assessment. The wetness of the area where the topsoil is re-used onsite will have to ensure that the area only has shallow seasonal and permeant swamps.

5.1.6.5 Topography

The land suitability class for topography is assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). The topography limitation refers to how a landscape can impact on planting improved pastures and / or heard management. This investigation did undertake a land survey and therefore topography criteria are not applied to assess the stockpiles. The topography of the area where the topsoil is re-used onsite will have to ensure it does not contain deep gullies and / or slopes grater than 15% and / or strongly dissected terrain over 75% of the area.

5.1.6.6 Water Erosion

The land suitability class for water erosion is assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). This investigation did undertake a land survey and therefore water erosion criteria are not applied to assess the stockpiles. The area where the topsoil is re-used onsite will have to ensure it does not contain slopes greater than 3% on sodic rigid soils or slopes greater than 6% on cracking clays or slopes greater than 12% on non-sodic rigid soils.

5.1.6.7 Vegetation Regrowth

The land suitability class for vegetation regrowth is assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). Vegetation communities may contain poisonous species or woody weeds that will limit the productivity of grazing pastures to varying degrees and increase the need for land management. The density of tree species and presence of a woody shrub layer may also limit the carrying capacity of the land. This investigation did undertake a land survey and therefore vegetation regrowth criteria are not applied to assess the stockpiles. The area where the topsoil is re-used onsite cannot be in area where there is Eucalypt

woodlands with wattle story or broad-leaved Teatree woodlands. It is presumed the soil will be re-used in a clear area and therefore vegetation regrowth criteria does not directly apply as the area has been cleared.

5.1.6.8 Flooding

The land suitability class for flooding risk is assessed against Table 2.2 of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland – Land Suitability Assessment Techniques (DME 1995). Flooding may result in plant death or reduced growth. In severe cases where land is inundated for a prolonged period stock loss and loss of grazing production may also occur. This investigation did undertake a land survey and therefore flooding criteria are not applied to assess the stockpiles. The area where the topsoil is re-used onsite is able to flood and no criteria exists beyond class 2.

6 AGRICULTURAL LAND CLASSES

Agricultural land classes (ALC) are based on a simple hierarchical scheme that is applicable across Queensland. ALC allows for the use of land evaluation data to indicate the location and extent of agricultural land and the sustainable land use scenario that maintain land degradation to a minimum. The guidelines used for the evaluation of ALCs are summarise in **Table 19.**

Table 19. Agricultural Land Class Descriptions

Agricultural Land Class	Land Suitability (Grazing)	Description
A		Crop land - Land that is suitable for a wide range of current and potential crops with nil to moderate limitations to production
A1	1-3	Suitable for a wide range of current and potential broadacre and horticultural crops
A2	1-3	Suitable for a wide range of current and potential horticultural crops only.
B	1-3	Limited crop land - Land that is suitable for a narrow range5 of crops. The land is suitable for sown pastures and may be suitable for a wider range of crops
C	-	Pasture land - Land that is suitable only for improved or native pastures due to limitations that preclude continuous cultivation for crop production. Some areas may tolerate a short period of ground disturbance for pasture establishment
C1	1-2	Suitable for grazing sown pastures requiring ground disturbance for establishment; or native pastures on higher fertility soils
C2	3-4	Suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1
C3	4-5	Suitable for light grazing of native pastures in accessible areas and includes steep land more suited to forestry or catchment protection
D	5	Non-agricultural land - Land not suitable for agricultural use, including land alienated from agricultural use
A/C A/D B/C C/D	-	Land that is a complex of class A, B, C or D land where it is not possible to delineate the land class at the map scale. The dominant class is the first code in the sequence and is assumed to be >50% of the area, but <70%

Notes:

- Sourced from DSITI and DNRM, 2015
- Land suitability classes are a guide to assess ALC. Reference to Section 5.1 and Table 11, DSITI and DNRM,2015 have also been referred to as guidance
- A wide range of crops is four or more crop types of local commercial significance
- Horticulture includes intensively grown small crops (e.g. vegetables) as well as tree crops (e.g. grown for nuts, seeds or fruit). Silviculture (plantation forestry) is not included
- A narrow range of crops is three or fewer crop types (broadacre or horticulture) of local commercial significance. Silviculture (plantation forestry) may be included. Crops with similar agronomic requirements e.g. maize and grain sorghum, peaches and nectarines are not generally regarded as different crop types. Different management regimes (including irrigation strategies) for the same crop do not increase the number of crops
- Non-agricultural land includes land that cannot be placed in any of the other land classes and includes land such asurban areas and stream channels
- In cases where two or more land classes are equally dominant and none are greater than 50%, judgement is used to identify the most appropriate agricultural land class/es for the unit.

The overall ALC assessment determined that Stockpile 01 and Stockpile 02 are determined as an ALC of C2 and C3 respectively. The ACL C2 soil may be suitable for native pastures with or without the introduction of pasture species while the ALC of C3 soil is suitable for light grazing.. A summary of the ACL for each stockpile is provided in **Table 20**.

Table 20. Agricultural Land Class Summary – Stockpiles

Stockpile	Agricultural Land Class	Description
SP01	C2	Suitable for grazing native pastures, with or without the introduction of pasture species, and with lower fertility soils than C1
SP02	C3	Suitable for light grazing of native pastures in accessible areas and includes steep land more suited to forestry or catchment protection

7 RECOMMEDATIONS

7.1 Amelioration and Soil Improvement

Based upon the current limitations (discussed in **Section 4**), amelioration for soil within SP02 will be required to enable the use of the material as topsoil for the proposed post mining land use (cattle grazing). There is no requirement to ameliorate soil within SP01, however recommendations to improve the general soil quality of Stockpile 01 are provided, which will improve plant germination and growth rates. In summary:

- Stockpile 01 is suitable for use as cattle grazing with a suitability class of 3. The recommendations to improve the general soil quality of Stockpile 01 are:
  - Soil pH and nutrient deficiency, as they are the limiting factor as detailed below
- Stockpile 02 is currently unsuitable for cattle grazing, with a suitability class of 4. The limitations that are required to be addressed based on the assessment are:
  - Nutrients of the soil are the limiting factor and are considered to be so severe that the sustainable use of the land in the proposed manner is precluded. However, amelioration of the soil in the stockpile can overcome this limitation as detailed below
  - While the soil pH is suitable, amelioration of the soil pH is recommended to improve general soil quality as detailed below

Additional recommendations will be suggested in the following sections to improve general soil quality.

7.1.1 Nutrients

Phosphorus, nitrogen and potassium, also known as NPK are the main nutrients required for plant growth. As such, it is recommended that a phosphorus rich fertiliser be mixed in with the stockpiles when it is being re-used onsite. However, the soil is lacking in several macronutrients (nitrogen, phosphorus, potassium, calcium, sulfur & magnesium) required for adequate plant growth. Consideration of the application of fertilisers containing other macro and micro-nutrients is also recommended based on the nitrogen content and the levels exchangeable potassium (<0.12 to 0.31 cmol/kg) of the soil classified as very low. Further testing would be required to determine which macro and micro-nutrients are required.

Other important nutrients such as exchangeable magnesium and sulphur are also extremely low, while exchangeable calcium is extremely high. High levels of calcium can cause toxic effects to plants and inhibit growth. The ECEC/CEC of the soil is moderate and indicates that the soil would be able to bind and exchange cation nutrients if added. This would mean that nutrients applied using the 4R steward ship[1] would be held in the soil and made available for plant growth with minimal leaching of nutrients through the soil profile

The amelioration of the stockpile soils with nitrogen-based fertiliser is not recommended until topsoil has been landscaped and revegetated as these fertilisers are extremely volatile and are readily leachable during rainfall events, potentially impacting offsite waterways. Therefore, it is recommended that the addition of nitrogen fertiliser is completed when the pasture is planted or incorporate nitrogen fixing pastures species into the seeding mix (often referred to as improved pasture species). The addition of nitrogen fixing pasture species can improve soil structure, water infiltration, soil water holding capacity and supply small quantities of plant available nitrogen to other plant species. Nitrogen fixing plant species in general require phosphorus in adequate amounts as it is essential for nodulation and nitrogen. This reliance on phosphorus can make it difficult to establish nitrogen fixing species and therefore the phosphorus deficiency would need to be addressed prior to planting pasture species.

7.1.2 Soil pH

The soil pH of the stockpiles is suitable for the nominated land class (grazing), however consideration should be given to interactions between soil pH and nutrient availability as a pH range of 6.0 to 8.0 is considered most suitable for plant establishment via the accessibility of nutrients. In alkaline soils the concentrations of

[1] The 4R's stand for right source, right rate, right time, and right place and serve to as a guide to the management practices that help keep nutrients on and in the soil

carbonate and bicarbonate may be present in high concentrations which can inhibit plant root growth. Additionally, alkaline soils can result in the toxicity and deficiency of other nutrients, such as:

- The solubility of iron and manganese increases in alkaline soils which can have toxic effects on plants
- The availability of zinc to plants can be severely lowered due to adsorption of zinc to calcium carbonate. The bicarbonate can also impair the uptake and transport of zinc to new shoots in plants
- The availability of phosphorus is generally lower as phosphorus will tend to adsorb to clay particles

This interaction between soil pH and plant nutrient availability is presented on **Figure 1.**

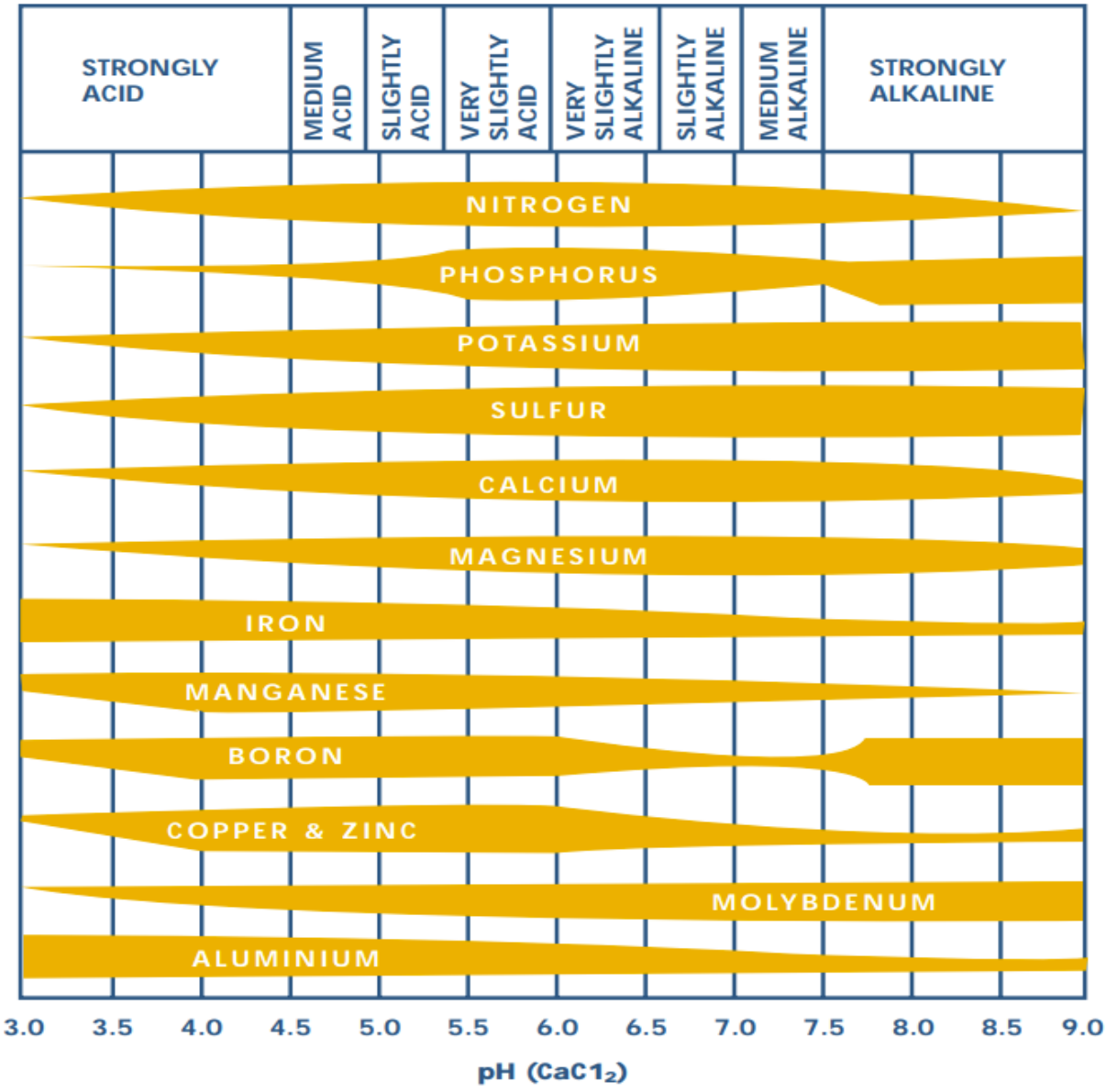

Figure 1. Soil pH and Nutrient Availability Interactions

The thickness of the lines indicates availability of nutrients, with the thicker line indicating surplus of nutrient availability (*Image sourced from DPI, 2000*)

7.1.3 Gravel, Cobbles and Boulders

Based upon field observations and laboratory analysis, Stockpile 01 contained an average of 14% gravel, 5% cobbles and 2% boulders while Stockpile 02 contained an average of 30% gravel (refer to **Section 4.1)**. The boulders and cobbles should be separate out and place beneath the topsoil when re-used on-site. This is because grain sizes including and greater than gravel are considered as a limitation for grazing land use as it will prevent the germination of seedlings. Therefore, the separation of gravel, cobbles and boulder fractions from soil fractions (sand, silt and clay) should occur.

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9 ACRONYMS

- AHD Australian height datum
- ASC Australian soil classification
- ASPAC Australasian Soil and Plant Analysis Council
- CEC Cation Exchange Capacity
- ECEC Effective Cation Exchange Capacity
- CSIRO Commonwealth Scientific and Industrial Research Organisation
- DES Department of Environment and Science
- DME Department of Minerals and Energy
- DNRM Department of Natural Resources and Mines
- DSITI Department of Science, Information Technology and Innovation
- EAL Environmental Analysis Laboratory
- EC Electrical conductivity
- ESP Exchangeable sodium percentage
- mbsl metres below surface level
- mAHD Metres Australian height datum
- NATA National Associate of Testing Authority
- NATA National Association of Testing Authority
- NCST National Committee on Soil and Terrain
- PSD Particle size distribution
- SMU Soil Mapping Unit
- SSA Soil Science Australia

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FIGURES

Figure F1. Site Location and Layout

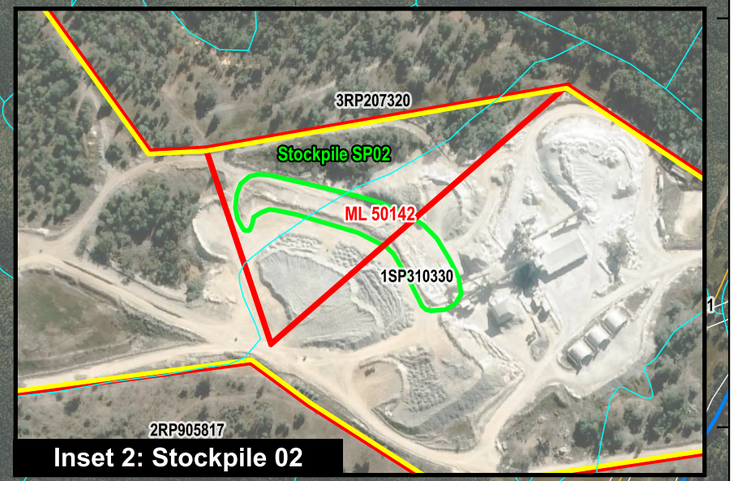
Figure F2. Sample Locations – Stockpile 01

Figure F3. Sample Locations – Stockpile 02





Inset 1: Stockpile 01



Inset 2: Stockpile 02

348000E 349000E 350000E 351000E 352000E 353000E

6791000N 6790000N 6789000N 6788000N

ML 50142

1SP310330

3RP207320

Refer to Inset 1

Stockpile SP01

ML 50220

Stockpile SP02

Refer to Inset 2

2RP905817

Riverton Road

Dumaresq River

4RP207320

ARP905818

3RP223699

0 100 200 m

Scale: 1:15,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© State of Queensland (Department of Resources) 2022
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

N

Filepath: ~GIS\Projects\2023\BCL\BCL230007.01 Graymont Riverton Quarry Topsoil Characterisation\Workspaces\2. Topsoil Suitability Assessment\Rev 0\Figure F1 Site location.qgz

Legend

- Site boundary
- Mining Leases
- Stockpiles
- Cadastre (DCDB)
- Roads and tracks

Watercourses

- Major
- Minor

epic ENVIRONMENTAL

Graymont
Riverton Quarry
Topsoil Suitability Assessment

Figure F1
Site location

351000E 351050E 351100E 351150E 351200E

6789100N

6789050N

6789000N

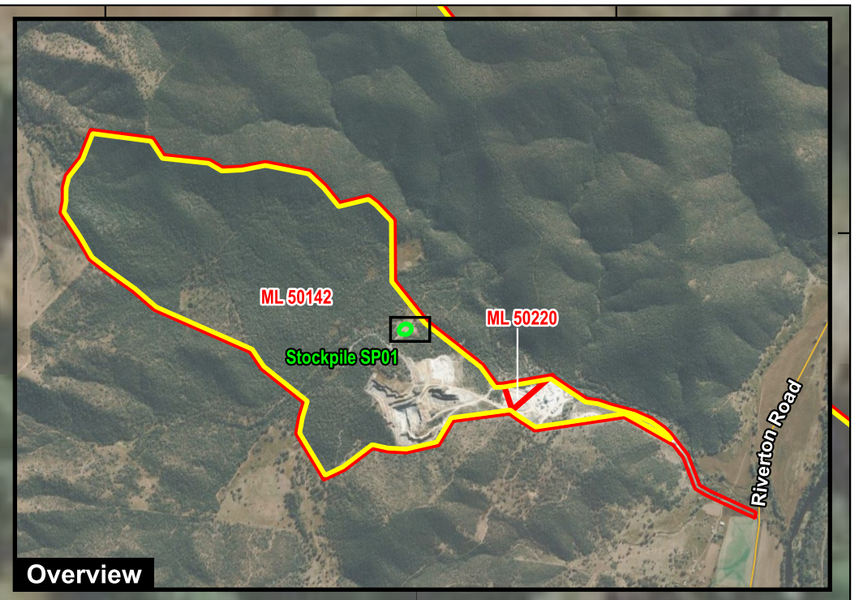
Queensland

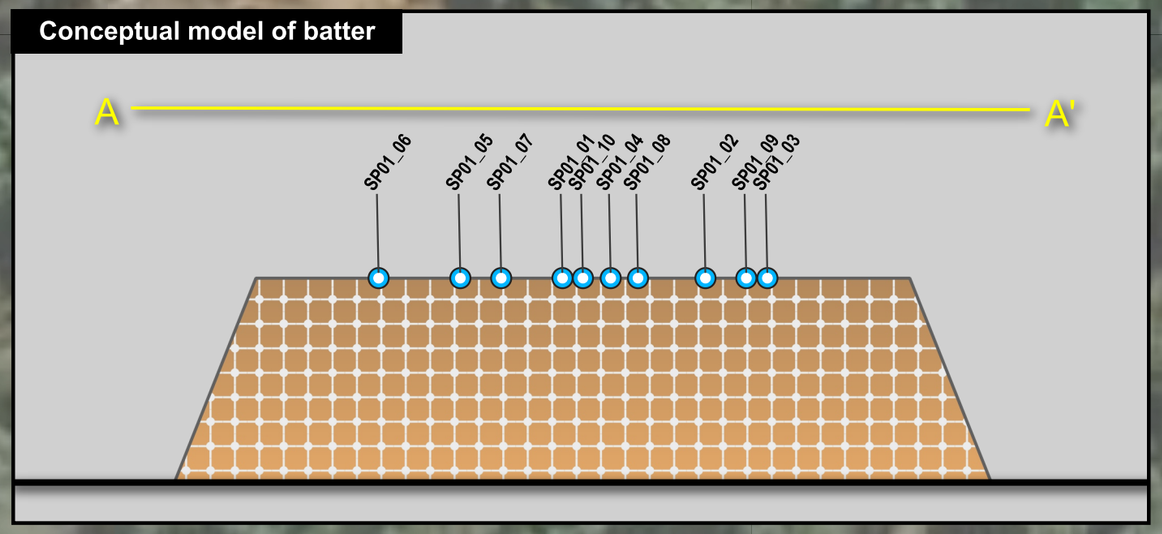
SP01_01 SP01_02 SP01_05 SP01_04 SP01_03 SP01_08 SP01_06 SP01_07 SP01_09 SP01_10

ML 50142

A A'

Stockpile volume = 36000m3





0 10 20 m

N

Scale: 1:600 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© State of Queensland (Department of Resources) 2022
Google Imagery ©2022 CNES / Airbus, Maxar Technologies

351000E 351050E 351100E 351150E 351200E

Filepath: -BCL\BCL230007.01 Graymont Riverton Quarry Topsoil Characterisation\Workspaces\2. Topsoil Suitability Assessment\Rev 0\Figure F2 Sample location - stockpile 01.qgz

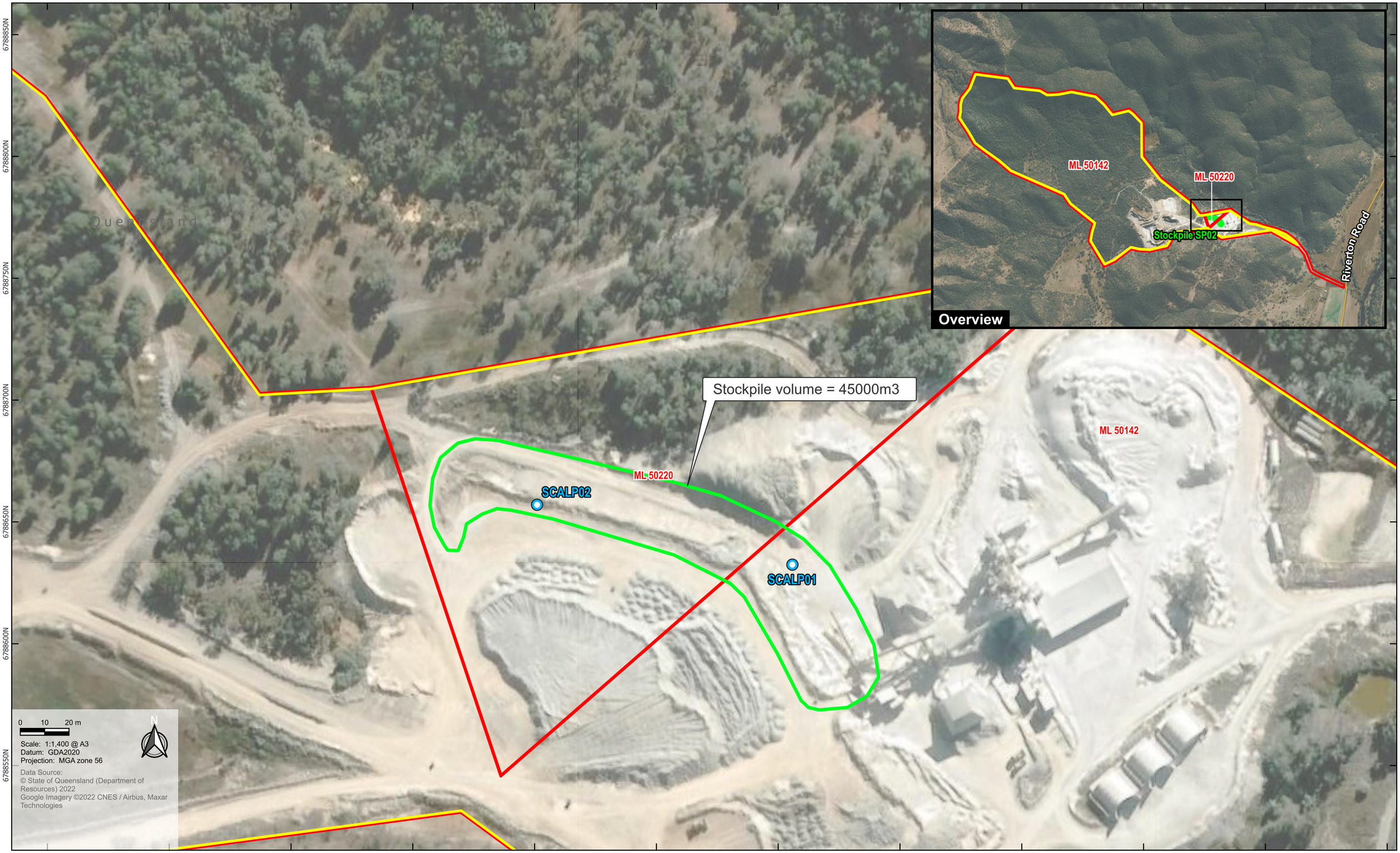
Legend

- Site boundary
- Mining Leases
- Stockpile SP01
- Batter
- Stockpile sample

epic ENVIRONMENTAL

Graymont
Riverton Quarry
Topsoil Suitability Assessment

Figure F2
Sample location - SP01



Filepath: -BCL\BCL230007.01 Graymont_Riverton Quarry Topsoil Characterisation\Workspaces\2. Topsoil Suitability Assessment\Rev 0\Figure F3 Sample location - stockpile 02.qgz

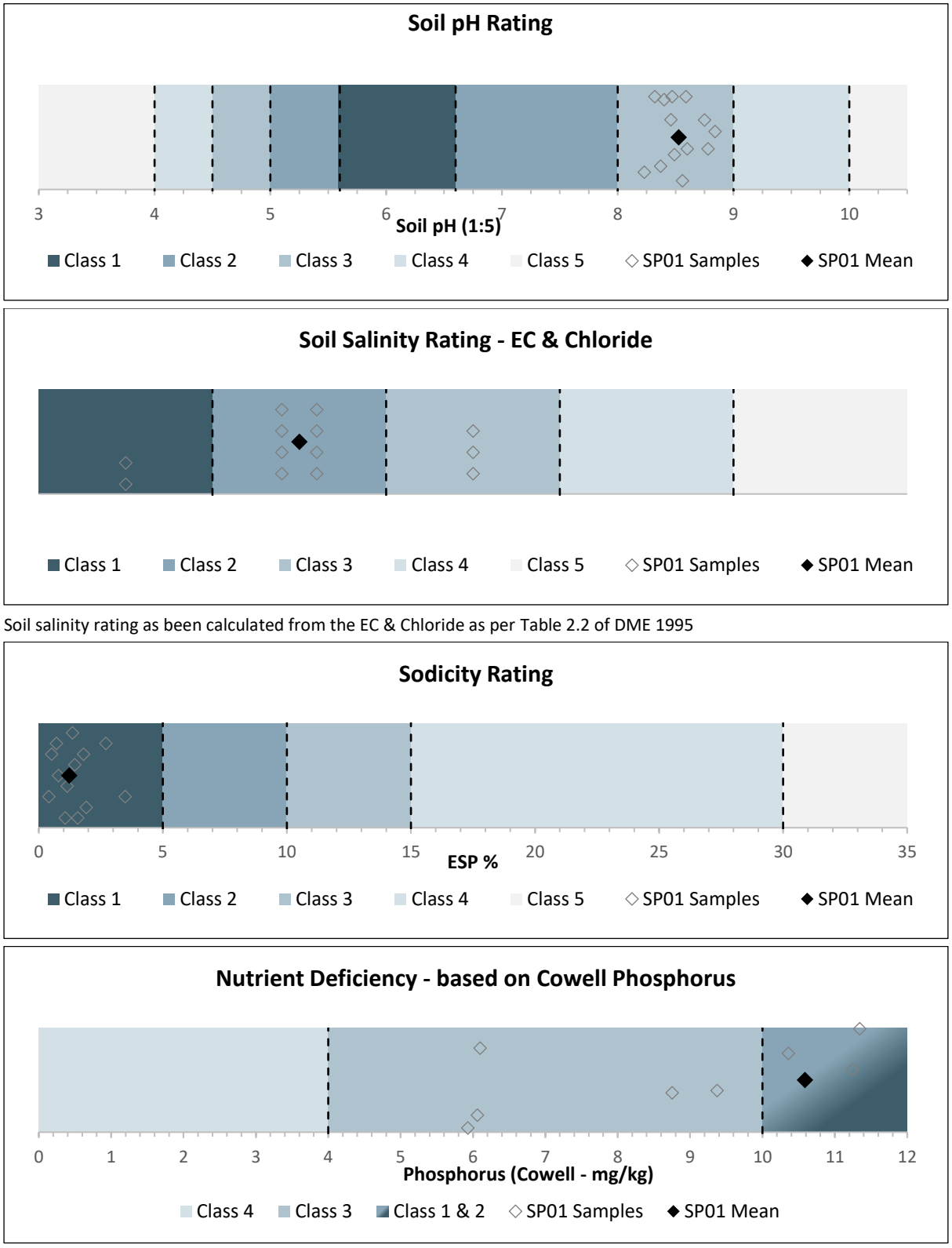
Legend

- Site boundary
- Mining Leases
- Stockpile SP02
- Stockpile sample

epic ENVIRONMENTAL

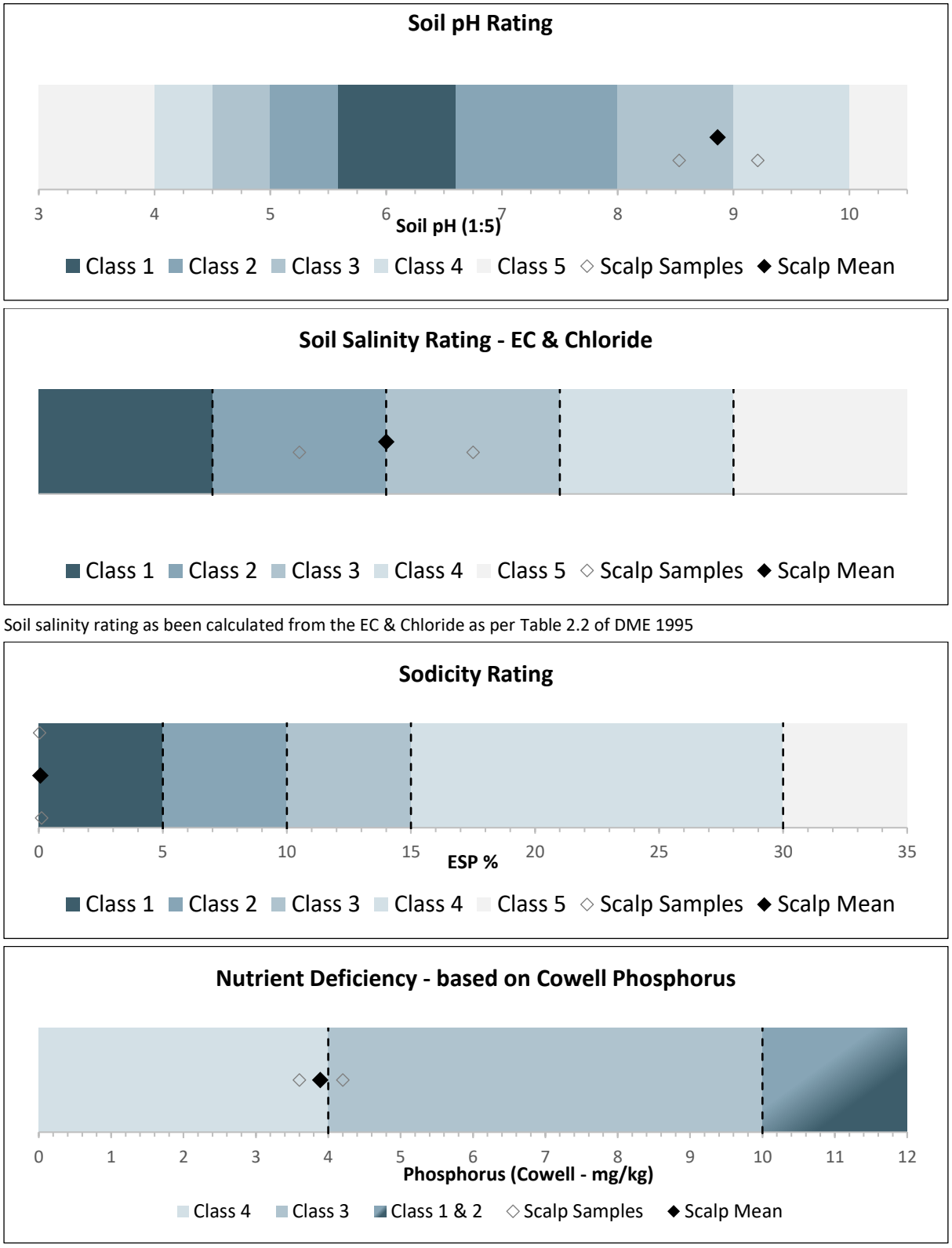
Graymont
Riverton Quarry
Topsoil Suitability Assessment

Figure F3
Sample location – SP02



Soil salinity rating as been calculated from the EC & Chloride as per Table 2.2 of DME 1995

Figure F4. Suitability Classes – Cattle Grazing – Stockpile 01



Soil salinity rating as been calculated from the EC & Chloride as per Table 2.2 of DME 1995

Figure F5. Suitability Classes – Cattle Grazing – Stockpile 02

PLATES



Plate P1. Sample Location SP01_01 – excavated material



Plate P2. Sample Location SP01_02 – excavated material

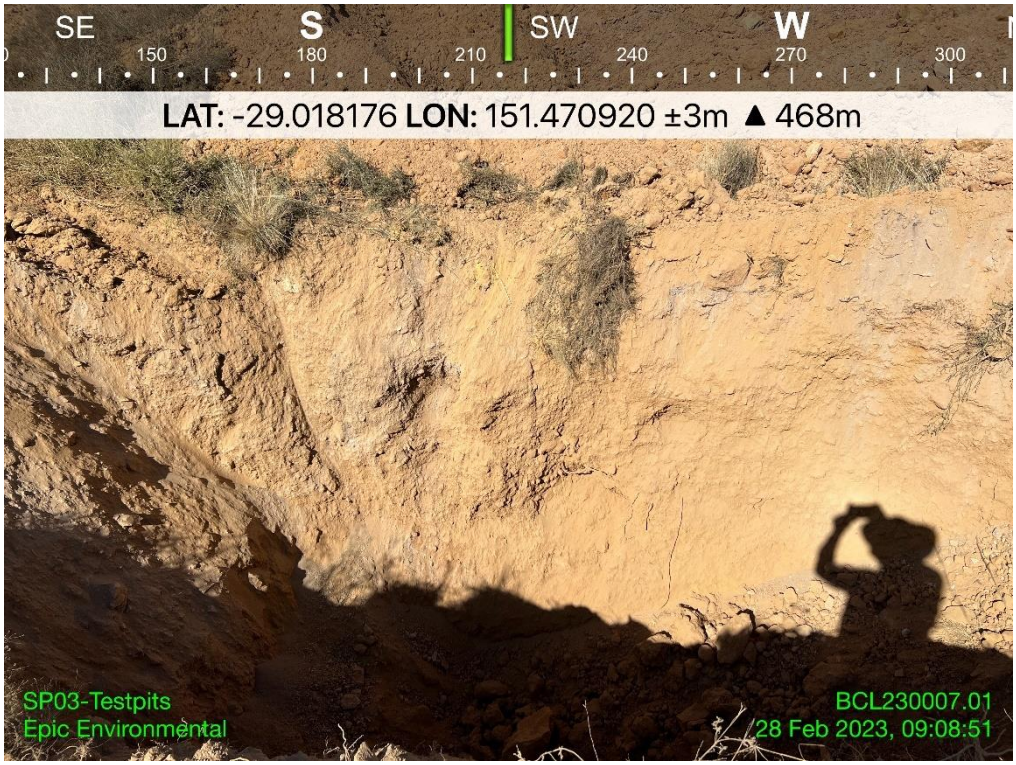


Plate P3. Sample Location SP01_03 – testpit

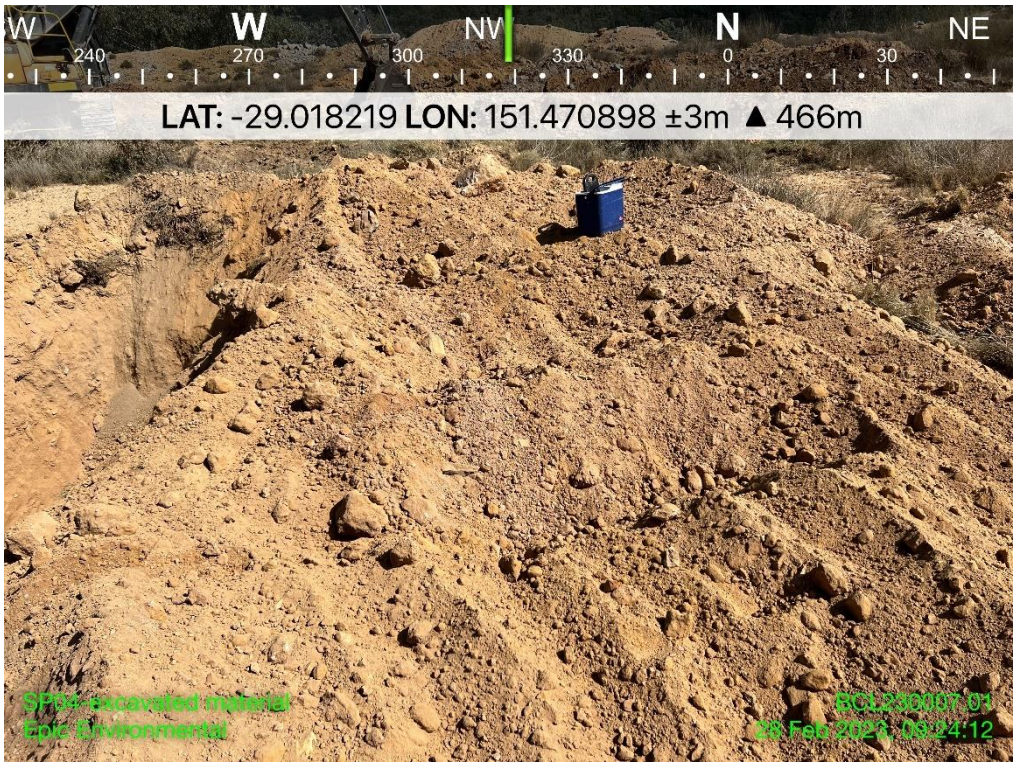


Plate P4. Sample Location SP01_04 – excavated material

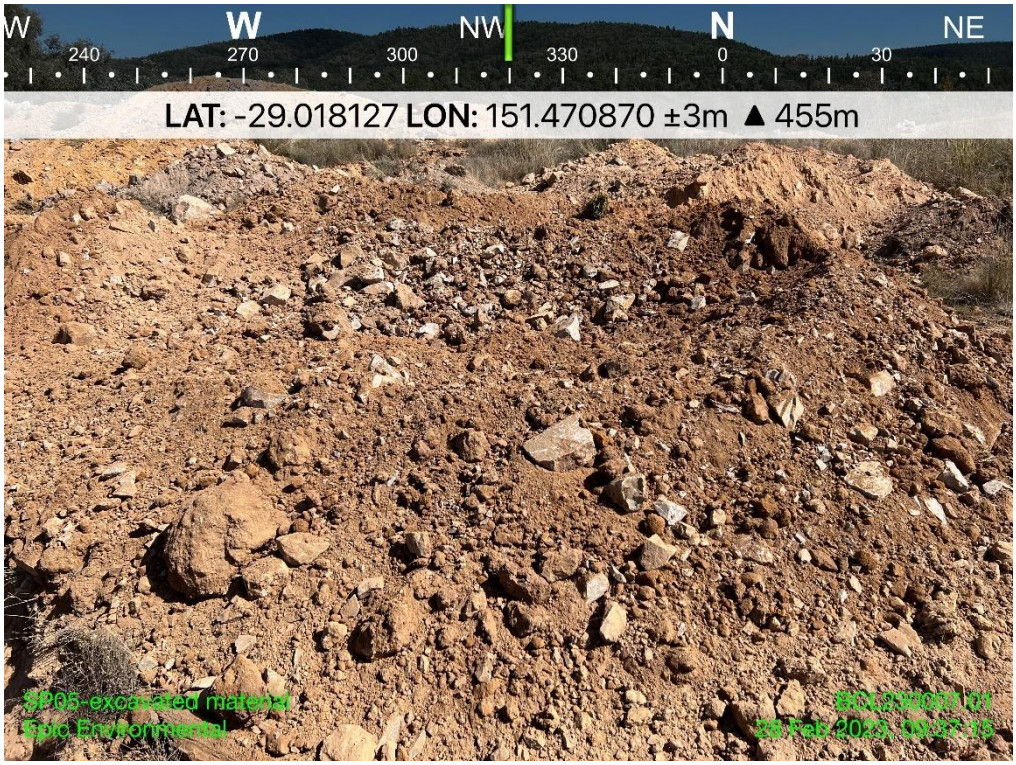


Plate P5. Sample Location SP01_05 – excavated material



Plate P6. Sample Location SP01_06 – excavated material



Plate P7. Sample Location SP01_07 – excavated material



Plate P8. Sample Location SP01_08 – excavated material

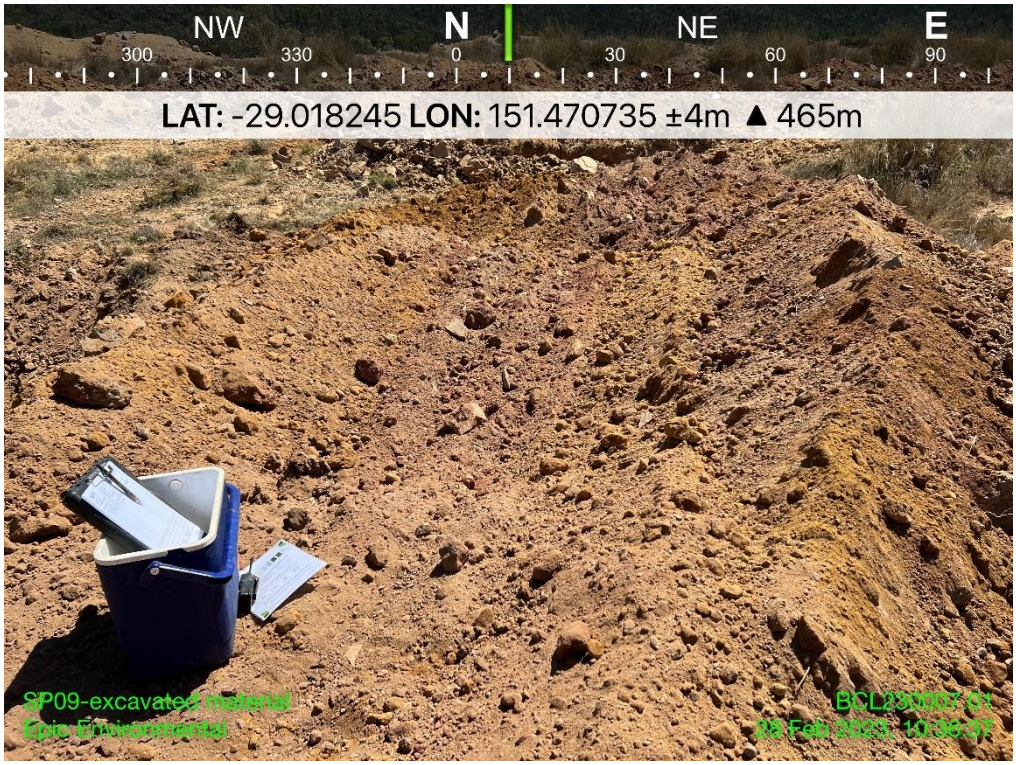


Plate P9. Sample Location SP01_09 – excavated material

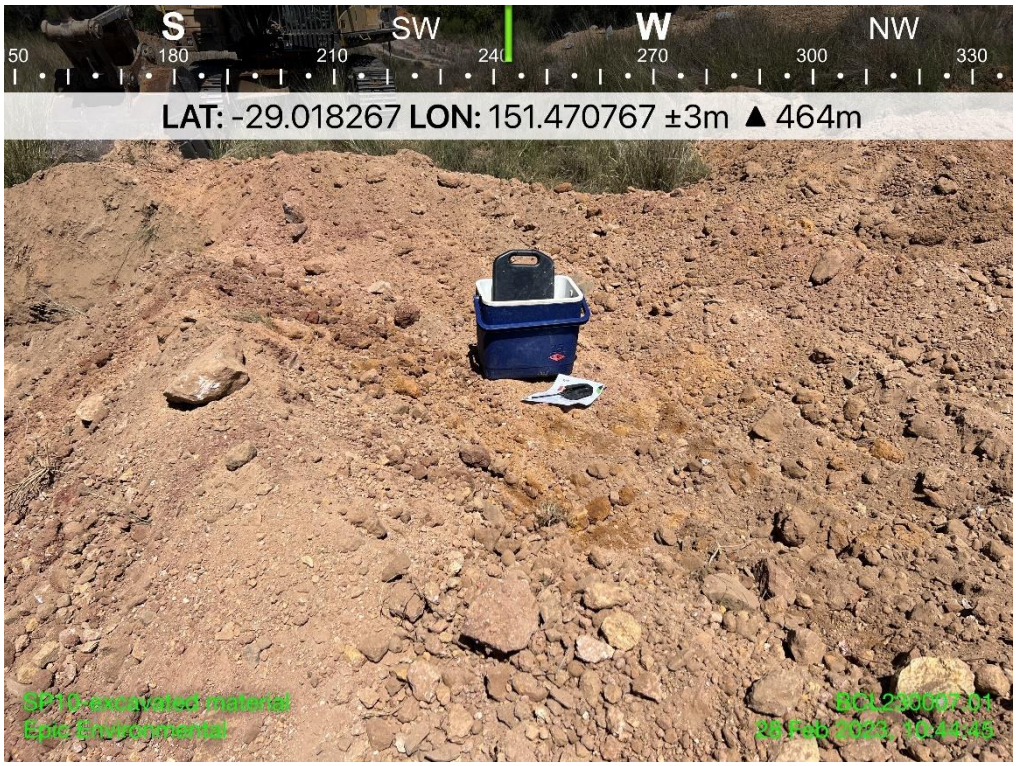


Plate P10. Sample Location SP01_10 – excavated material



Plate P11. Sample Location SP01_01 – comparison of gravel, cobble and boulder



Plate P12. Sample Location SP01_10 – comparison of gravel, cobble and boulder

TABLES

Table T1. Laboratory Analytical Results

Table T2. Relative Percentage Differences

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T1. Soil Laboratory Results

				Physiochemical				Nitrogen Compounds			Carbon Compounds			Ratio	Exchangeable Cations						ECEC	CEC	Base Saturation Calculations									
				Emerson Aggregate Test (EAT)	Electrical Conductivity	pH (1:5 water)	pH (CaCl2)	Total Nitrogen	Ammonium as N	Nitrate as N	Organic Matter	Total Carbon	Organic Carbon	Carbon ; Nitrogen	Calcium	Potassium	Magnesium	Sodium	Aluminium	Hydrogen	Effective Cation Exchange Capacity	Cation Exchange Capacity	Calcium	Magnesium	Potassium	Sodium (ESP)	Aluminium	Hydrogen	Ca:Mg	K:CEC	Mg:Ca	Mg:CEC
			Units		dS/m	-		%	mg/kg	mg/kg	%	%	%		cmol_c/kg	cmol_c/kg	cmol_c/kg	cmol_c/kg	cmol_c/kg	cmol_c/kg	cmol/kg	cmol/kg	%	%	%	%	%	%	-	-	-	-
Date	**Field ID**	**Matrix**	**Sample Type**																													
23/02/2023	SP01-01	Soil	Normal	2.0	0.158	8.56	7.9	0.07	<0.1	1.2	2.4	1.4	-	21	27	<0.12	0.80	0.30	0.15	<0.01	28		95	2.9	0.29	1.1	0.53	0.00	33	0.010	0.030	0.103
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	4.0	0.167	8.59	7.9	<0.02	0.19	3.5	3.0	1.7	-	342	37	0.20	1.7	0.62	<0.01	<0.01	40	-	94	4.4	0.50	1.6	0.01	0.00	21	0.013	0.047	0.111
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup	-	0.15	8.78	-	-	-	4	-	-	0.37	-	12.2	0.082	0.741	0.19	-	-	-	11	92	5.9	0.62	1.8	-	-	16.4	0.008	0.061	0.069
23/02/2023	SP01-02	Soil	Normal	4.0	0.469	8.23	7.8	0.11	0.32	65	3.5	2.0	-	19	26	0.28	1.4	0.55	0.02	<0.01	29	-	92	4.9	0.97	1.9	0.05	0.00	19	0.034	0.053	0.172
23/02/2023	SP01-03	Soil	Normal	2.0	0.420	8.37	7.9	0.07	<0.1	16	2.6	1.5	-	21	24	0.24	1.3	0.91	0.01	<0.01	26	-	90	5.1	0.90	3.5	0.04	0.00	18	0.035	0.056	0.196
23/02/2023	SP01-04	Soil	Normal	2.0	0.167	8.60	8.0	0.06	0.29	6.5	1.0	0.58	-	10	20	<0.12	0.46	0.24	0.01	<0.01	21	-	96	2.2	0.41	1.2	0.07	0.00	44	0.020	0.023	0.104
23/02/2023	SP01-05- 1.5	Soil	Normal	2.0	0.145	8.84	8.0	0.09	0.29	4.5	5.8	3.3	-	38	25	0.31	1.8	0.75	<0.01	<0.01	28	-	90	6.4	1.1	2.7	0.03	0.00	14	0.040	0.071	0.231
23/02/2023	SP01-05-0.5	Soil	Normal	4.0	0.157	8.47	7.7	0.03	0.40	2.7	3.8	2.2	-	83	36	0.30	0.56	0.15	<0.01	<0.01	37	-	97	1.5	0.79	0.41	0.01	0.00	65	0.021	0.015	0.040
23/02/2023	SP01-06	Soil	Normal	2.0	0.231	8.40	7.8	0.02	0.40	12	2.2	1.3	-	52	35	0.18	1.6	0.51	<0.01	<0.01	38	-	94	4.2	0.47	1.4	0.01	0.00	22	0.013	0.045	0.113
23/02/2023	SP01-07	Soil	Normal	2.0	0.198	8.46	7.9	0.03	0.25	24	1.9	1.1	-	42	22	0.16	0.71	0.18	<0.01	<0.01	23	-	95	3.1	0.71	0.79	0.02	0.00	31	0.031	0.032	0.134
23/02/2023	SP01-08	Soil	Normal	2.0	0.322	8.32	7.9	0.03	0.48	64	1.8	1.1	-	42	22	0.16	0.76	0.34	<0.01	<0.01	24	-	95	3.2	0.69	1.4	0.01	0.00	29	0.029	0.034	0.137
23/02/2023	SP01-09	Soil	Normal	4.0	0.122	8.49	7.8	<0.02	0.12	5.7	1.4	0.83	-	413	25	<0.12	0.20	0.13	<0.01	<0.01	25	-	98	0.81	0.20	0.52	0.01	0.00	122	0.008	0.008	0.032
23/02/2023	SP01-10	Soil	Normal	2.0	0.096	8.75	8.0	<0.02	<0.1	0.74	0.75	0.43	-	23	19	<0.12	0.25	0.14	<0.01	<0.01	19	-	98	1.3	0.25	0.71	0.00	0.00	75	0.013	0.013	0.068
23/02/2023	SCALP01-01	Soil	Normal	4.0	0.415	8.53	8.0	<0.02	46	90	12	7.0	-	1,163	20	<0.12	0.28	<0.065	<0.01	<0.01	20	-	98	1.4	0.11	0.11	0.03	0.00	71	0.005	0.014	0.069
23/02/2023	SCALP01-02	Soil	Normal	2.0	0.060	9.21	8.0	<0.02	0.62	1.5	12	6.7	-	6,660	19	<0.12	0.35	<0.065	0.01	<0.01	20	-	98	1.8	0.10	0.04	0.07	0.00	54	0.005	0.018	0.093

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T1. Soil Laboratory Results

						Soil Elements																													
				Mg:K	Na:K	Cloride	Sulfur	Phosphorus (Colwell)	Iron	Boron	Silicoa	Copper	Manganese	Zinc	Arsenic	Barium	Beryllium	Cerium	Cobalt	Chromium	Dysprosium	Erbium	Europium	Gadolinium	Holmium	Lanthanum	Lutetium	Molybdenum	Neodymium	Nickel	Praseodymium	Rubidium
		Units		-		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	**Field ID**	**Matrix**	**Sample Type**																																
23/02/2023	SP01-01	Soil	Normal	9.8	0.1	84	8.8	6.1	2.2	0.14	34	0.15	1.8	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	8.8	0.1	90	7.3	6.1	2.9	0.14	32	0.17	1.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup	9.0	2.3	69	5	-	-	-	-	49	1600	130	25.5	237	1.6	58.3	65.6	337	4.05	2.57	1.11	3.99	0.84	29.5	0.39	<6	31	149	7.98	18.5			
23/02/2023	SP01-02	Soil	Normal	5.1	0.2	212	9.6	19.1	3.7	0.39	31	0.42	4.7	0.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-03	Soil	Normal	5.6	0.2	382	30	20	3.1	0.36	24	0.23	2.4	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-04	Soil	Normal	5.3	0.2	103	12	9	1.9	0.13	28	0.19	1.3	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05- 1.5	Soil	Normal	5.7	0.2	24	11	15	4.3	0.73	42	0.78	3.1	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05-0.5	Soil	Normal	1.9	0.5	23	8.5	9.4	4.9	0.10	25	0.53	1.3	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-06	Soil	Normal	9.0	0.1	157	11	10	4.7	0.26	43	0.20	1.0	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-07	Soil	Normal	4.4	0.2	83	16	14	4.6	0.14	19	0.26	3.7	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-08	Soil	Normal	4.7	0.2	168	22	11	3.3	0.25	26	0.23	3.2	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-09	Soil	Normal	4.0	0.3	21	7.4	11.2	3.1	<0.1	52	0.20	3.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-10	Soil	Normal	5.2	0.2	27	3.4	5.9	2.5	<0.1	41	0.20	1.5	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-01	Soil	Normal	12.9	0.1	4	4.7	4.2	1.2	<0.1	8.0	0.16	2.0	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-02	Soil	Normal	17.5	0.1	3	4.9	3.6	1.1	<0.1	9.0	0.10	1.3	<0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T1. Soil Laboratory Results

														Soil Particle Size Density (mechanically dispersed)										Sediment Particle Size							
				Antimony	Scandium	Samarium	Strontium	Terbium	Thorium	Thulium	Uranium	Vanadium	Yttrium	Ytterbium	<2µm	>2000µm	10µm to 63µm	2µm to 10µm	2µm to 20µm	20µm to 200µm	200µm to 2000µm	63µm to 200µm	d(0.9)	Obscuration	<0.24µm	<62.5µm	0.5µm to 0.24µm	1µm to 0.5µm	1000µm to 500µm	125µm to 62µm	16µm to 8µm	2µm to 1µm
		Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%	µm	%	%	%	%	%	%	%	%	%
Date	**Field ID**	**Matrix**	**Sample Type**																												
23/02/2023	SP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	34.1	15.3	50.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	-	-	-	-	-	-	-	-	-	-	-	32.7	15.7	51.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup	4.2	21	5.24	54.5	0.66	6.27	0.4	1.59	127	28.1	2.44	15	<1.0	32	36	50	32	2.3	15	101.6	15.9	3.2	82.8	3.4	2.2	<1.0	10.9	16.0	5.3
23/02/2023	SP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	33.4	19.2	47.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-03	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	33.1	19.7	47.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-04	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	34.7	14.7	50.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05- 1.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	30.2	21.1	48.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05-0.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	49.8	9.8	40.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-06	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	31.8	26.2	41.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-07	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	36.4	14.3	49.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-08	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	38.4	15.3	46.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-09	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	37.0	12.8	50.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-10	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	29.3	11.6	59.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	7.6	9.6	82.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	4.5	10.0	85.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T1. Soil Laboratory Results

				Density (mechanically dispersed)										Sediment Particle Size Density (pre dispersion)																			
				2000µm to 1000µm	250µm to 125µm	31µm to 16µm	4µm to 2µm	500µm to 250µm	62µm to 31µm	8µm to 4µm	d(0.9)	Obscuration	<0.24µm	<62.5µm	0.5µm to 0.24µm	1µm to 0.5µm	1000µm to 500µm	125µm to 62µm	16µm to 8µm	2µm to 1µm	2000µm to 1000µm	250µm to 125µm	31µm to 16µm	4µm to 2µm	500µm to 250µm	62µm to 31µm	8µm to 4µm	d(0.9)	Obscuration	<0.24µm	<62.5µm	0.5µm to 0.24µm
			Units	%	%	%	%	%	%	%	µm	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	µm	%	%	%	%
Date	**Field ID**	**Matrix**	**Sample Type**																													
23/02/2023	SP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup	<1.0	5.2	12.3	13.5	1.1	9.6	17.3	98.4	15.7	3.2	82.3	3.3	2.2	<1.0	10.7	15.9	5.3	<1.0	5.7	12.3	13.4	1.2	9.4	17.2	102.0	15.7	4.2	82.5	3.5
23/02/2023	SP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-03	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-04	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05- 1.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05-0.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-06	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-07	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-08	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-09	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-10	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T1. Soil Laboratory Results

				Sediment Particle Size Density (ultrasound dispersed)												
				1µm to 0.5µm	1000µm to 500µm	125µm to 62µm	16µm to 8µm	2µm to 1µm	2000µm to 1000µm	250µm to 125µm	31µm to 16µm	4µm to 2µm	500µm to 250µm	62µm to 31µm	8µm to 4µm
			Units	%	%	%	%	%	%	%	%	%	%	%	%
Date	**Field ID**	**Matrix**	**Sample Type**												
23/02/2023	SP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup	2.2	<1.0	10.7	15.7	5.3	<1.0	5.8	12.1	13.3	1.1	9.2	17.0
23/02/2023	SP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-03	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-04	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05- 1.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-05-0.5	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-06	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-07	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-08	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-09	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SP01-10	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-01	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-
23/02/2023	SCALP01-02	Soil	Normal	-	-	-	-	-	-	-	-	-	-	-	-

Project Name: Graymont Riverton
Job Number: BCL230007.01
Client: Graymont
Table: Table T2. Relative Percentage Differences

	Physiochemical				Nitrogen Compounds			Carbon Compounds			Exchangeable Cations						ECEC	CEC	Soil Elements								PSD (mechanically dispersed)		
	Emerson Aggregate Test (EAT)	Electrical Conductivity	pH (1:5 water)	pH (CaCl2)	Total Nitrogen	Ammonium as N	Nitrate as N	Organic Matter	Total Carbon	Organic Carbon	Calcium	Potassium	Magnesium	Sodium	Aluminium	Hydrogen	Effective Cation Exchange Capacity	Cation Exchange Capacity	Cloride	Sulfur	Phosphorus (Colwell)	Iron	Boron	Silicoa	Copper	Manganese	Zinc	<2µm	>2000µm	10µm to 63µm
LOR	1	0.01	0.1	0.1	0.02	0.1	1	0.02	0.02	0.02	0.6	0.05	0.07	0.07	0.01	0.01	2	2	20	1		0.01			30	5	0.5			
5 x LOR	5	0.05	0.5	0.5	0.1	0.5	5	0.1	0.1	0.1	3	0.25	0.35	0.35	0.05	0.05	10	10	100	5	0	0.05	0	0	150	25	2.5	0	0	0
10 x LOR	50	0.5	5	5	1	5	50	1	1	1	30	2.5	3.5	3.5	0.5	0.5	100	100	1000	50	0	0.5	0	0	1500	250	25	0	0	0
23/02/2023	SP01-01	Soil	Normal	2.0	0.158	8.56	7.9	0.07	<0.1	1.2	2.4	1.4	-	27	<0.12	0.80	0.30	0.15	<0.01	28	-	84	8.8	6.1	2.2	0.14	34	0.15	1.8	<0.5	34.1	15.3	50.6
23/02/2023	SP01-01 (QC100)	Soil	Field_Dup	4.0	0.167	8.59	7.9	<0.02	0.19	3.5	3.0	1.7	-	37	0.20	1.7	0.62	<0.01	<0.01	40	-	90	7.3	6.1	2.9	0.14	32	0.17	1.5	<0.5	32.7	15.7	51.6
23/02/2023	SP01-01 (QC200)	Soil	Interlab_Dup		0.15	8.78	-			4			0.37	12.2	0.082	0.741	0.19	-	-		11	69	5	-	-	-	49	1600	130	15	<1.0	32
			Blind Duplicate	67%	6%	0%	0%	N/C	N/C	101%	21%	21%	N/C	33%	N/C	74%	70%	N/C	N/C	35%	N/C	7%	19%	1%	29%	3%	5%	15%	20%	N/C	4%	2%	2%
			Blind Split	200%	5%	3%	N/C	N/C	N/C	110%	N/C	N/C	N/C	74%	N/C	8%	44%	N/C	N/C	N/C	N/C	19%	55%	N/C	N/C	N/C	N/C	199%	200%	N/C	78%	N/C	45%
			Criteria	No Limit	No Limit	<50%	<50%	No Limit	N/C	No Limit	<50%	<50%	<50%	No Limit	N/C	No Limit	No Limit	No Limit	N/C	No Limit	<50%	No Limit	No Limit	<50%	<50%	<50%	<50%	No Limit	No Limit	N/C	<50%	<50%	<50%

Comments

-	Not analysed
N/C	Not Calculated
No Limit	<10 x LOR
<50%	**Criteria**
	RPD >50%
	RPD < 50%
Field_Dup	Field Duplicate
Interlab_D	Interlaboratory Duplicate

APPENDIX A LABORATORY CERTIFICATES

Queensland Government
Department of Environment and Science - Chemistry Centre
Eco Sciences Precinct
Level 3, Block A, 41 Boggo Rd
Dutton Park Qld 4102
Telephone: 07 3170 5696
Facsimile: 07 3170 5801

Analysis Report

Job Number : 23-0156

Epic Environmental Pty Ltd
Epic Environmental Pty Ltd
L17, 95 North Quay,

Brisbane QLD 4000
Attn : Andrew Hughes

Date Sampled:	28-Feb-2023 to 28-Feb-2023
Date Received:	02-Mar-2023 to 02-Mar-2023
Date Tested:	08-Mar-2023 to 08-Mar-2023
Date Reported:	20-Mar-2023

Final Report

Report ID: 23-0156-F-V1

BCL23000701 , Topsoil Assessment
Riverton Quarry
Topsoil Assessment

The Chemistry Centre is always trying to improve our services. Please provide any feedback via chemistry.centre@des.qld.gov.au Thank you.

NOTE: Results pertain to samples as received by this laboratory and relate to the items tested
NOTE: Chemistry Centre is not responsible for sample collection

Additional Notes

Queensland Government
Department of Environment and Science - Chemistry Centre
Eco Sciences Precinct
Level 3, Block A, 41 Boggo Rd
Dutton Park Qld 4102

Sample Receival Advice

Customer Details

Customer:
Epic Environmental Pty Ltd
L17| 95 North Quay|
Brisbane QLD 4000

Contact: Andrew Hughes
Phone: 1800 779 363
Fax: 0409 001 267
email: ahughes@epicenvironmental.com.au

Job Details

Job No: **23-0156**
No Samples: 1
Date Sampled: 28/02/2023 to 28/02/2023
Date Received: 01/03/2023 to 01/03/2023
Consignor:
Contact: Dan Yousaf
Phone: 07 31705697
Fax: 07 31705801
email: dan.yousaf@des.qld.gov.au; renjie.wang@

Sample Details

Comment:

Sample Type	Samples
Soil	1

Water Bottle Details

A	B	C	D	E	Other	Total
0	0	0	0	0	0	0

Tests Requested

Item	Quantity
Soil prep: Dry and grind to <0.5 mm	1
Soil prep: Dry and grind to <2.0 mm	1
Soil: C organic (Walkley & Black)	1
Soil: Cations - Equilibrium or Exchangeable	1
Soil: Cl NO3-N Aqueous (1:5)	1
Soil: Elements, Li metaborate fusion, ICP-OES & MS	1
Soil: Elements, Li metaborate fusion, ICP-OES & MS	1
Soil: Moisture air dry	1
Soil: Particle size distribution (Laser)	1
Soil: R1-R2 Dispersion Ratio	1
Soil: Sulfur extractable 0.01M Ca(H2PO4)2 ICP	1
Soil: pH EC Aqueous (1:5)	1

Sample ID	Customer ID	Upper_Lower Depth for soil	Bottles for water	Condition
23-0156-0001	QC 200	0.0000-3.0000		Good

Laboratory Comments

Customer Comments

01/03/2023

to 01/03/2023

Queensland Government

Department of Environment and Science - Chemistry Centre

Soil Analysis Report

Job No: 23-0156

Report ID: 23-0156-F-V1

Method_SOI	Component	Unit	23-0156-0001
			QC 200
			Interlab_Dup
			B 0.00-3.00
S_ADM_105	ADMC	%	12.8
S_AQ4_AA	Cl	mg/kg	69
	NO3-N	mg/kg	4
S_AQ4_EL	EC	dS/m	0.15
	pH	-	8.78
S_CAT_ALC	Ca	cmol_c/kg	12.2
	K	cmol_c/kg	0.082
	Mg	cmol_c/kg	0.741
	Na	cmol_c/kg	0.190
S_CAT_ALCC	Base sat	%	123
	Ca:CEC		1.14
	Ca:Mg		16.4
	CEC:Clay		-
	ESP	%	1.8
	K:CEC		0.00769
	Mg:Ca		0.0609
	Mg:CEC		0.0694
	Mg:K		9.03
	Na:K		2.31
S_CEC	CEC	cmol/kg	11
	Al	%	6.97
	Ca	%	5.75
	Cr	mg/kg	315
	Cu	mg/kg	46.9

S_FLUX_ICP	Fe	%	5.53
	K	%	0.41
	Mg	%	0.377
	Mn	mg/kg	1490
	Na	%	0.12
	P	%	0.04
	Si	%	20.7
	Ti	%	0.643
	Zn	mg/kg	127
S_FLUX_IMS	As	mg/kg	25.5
	Ba	mg/kg	237
	Be	mg/kg	1.6
	Ce	mg/kg	58.3
	Co	mg/kg	65.6
	Cr	mg/kg	337
	Cu	mg/kg	49
	Dy	mg/kg	4.05
	Er	mg/kg	2.57
	Eu	mg/kg	1.11
	Gd	mg/kg	3.99
	Ho	mg/kg	0.84
	La	mg/kg	29.5
	Lu	mg/kg	0.39
	Mn	mg/kg	1600
	Mo	mg/kg	<6
	Nd	mg/kg	31.0
	Ni	mg/kg	149
	Pr	mg/kg	7.98
	Rb	mg/kg	18.5
	Sb	mg/kg	4.2
	Sc	mg/kg	21
	Sm	mg/kg	5.24
	Sr	mg/kg	54.5
	Tb	mg/kg	0.66

	Th	mg/kg	6.27
	Tm	mg/kg	0.4
	U	mg/kg	1.59
	V	mg/kg	127
	Y	mg/kg	28.1
	Yb	mg/kg	2.44
	Zn	mg/kg	130
S_PSD	<2µm	%	15
	>2000µm	%	<1.0
	10µm to 63µm	%	32
	2µm to 10µm	%	36
	2µm to 20µm	%	50
	20µm to 200µm	%	32
	200µm to 2000µm	%	2.3
	63µm to 200µm	%	15
	d(0.9)	µm	101.6
	Obscuration	%	15.9
S_PSD_MECD	<0.24µm	%	3.2
	<62.5µm	%	82.8
	0.5µm to 0.24µm	%	3.4
	1µm to 0.5µm	%	2.2
	1000µm to 500µm	%	<1.0
	125µm to 62µm	%	10.9
	16µm to 8µm	%	16.0
	2µm to 1µm	%	5.3
	2000µm to 1000µm	%	<1.0
	250µm to 125µm	%	5.2
	31µm to 16µm	%	12.3
	4µm to 2µm	%	13.5
	500µm to 250µm	%	1.1
	62µm to 31µm	%	9.6
	8µm to 4µm	%	17.3
	d(0.9)	µm	98.4
	Obscuration	%	15.7

S_PSD_PRED	<0.24µm	%	3.2
	<62.5µm	%	82.3
	0.5µm to 0.24µm	%	3.3
	1µm to 0.5µm	%	2.2
	1000µm to 500µm	%	<1.0
	125µm to 62µm	%	10.7
	16µm to 8µm	%	15.9
	2µm to 1µm	%	5.3
	2000µm to 1000µm	%	<1.0
	250µm to 125µm	%	5.7
	31µm to 16µm	%	12.3
	4µm to 2µm	%	13.4
	500µm to 250µm	%	1.2
	62µm to 31µm	%	9.4
	8µm to 4µm	%	17.2
	d(0.9)	µm	102.0
	Obscuration	%	15.7
S_PSD_ULTD	<0.24µm	%	4.2
	<62.5µm	%	82.5
	0.5µm to 0.24µm	%	3.5
	1µm to 0.5µm	%	2.2
	1000µm to 500µm	%	<1.0
	125µm to 62µm	%	10.7
	16µm to 8µm	%	15.7
	2µm to 1µm	%	5.3
	2000µm to 1000µm	%	<1.0
	250µm to 125µm	%	5.8
	31µm to 16µm	%	12.1
	4µm to 2µm	%	13.3
	500µm to 250µm	%	1.1
	62µm to 31µm	%	9.2
	8µm to 4µm	%	17.0
	d(0.9)	µm	102.0
	Obscuration	%	15.9

S_R1-R2	R1		0.80
	R2		0.56
S_SCP_ICP	S	mg/kg	5
S_WALKLEY	OC	%	0.37

Name: Dan Yousaf

Title: Soil & Plant team leader

NATA Accredited Laboratory

Number: 5072

This document is issued in accordance with NATA's accreditation requirements.

Accredited for compliance ISO/IEC 17025 - Chemical testing

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Chain of Custody Record

Project No:	BCL230007.01	**Lab:**	DES - Chemistry Centre
Project/Site:	Riverton Quarry	**Lab Quote No:**	QT-000053
Sampled By:	Andrew Hughes	**Lab Batch No:**	23 - 0156
Phone / Email:	ahughes@epicenvironmental.com.au	**Date Results Required:**	2 weeks
Results to:	mkowalczyk@epicenvironmental.com.au ahughes@epicenvironmental.com.au	**Sample Disposal After:**	Standard

				CONTAINER TYPE & PRESERVATIVE										ANALYSIS REQUIRED												
				Soil			Water/ Liquid																			
Number of Eskies				150-250ml	200ml	-	40ml	100-500ml	60ml	60ml	250-500ml	60-500ml	Other													
Sample Type	**Sample ID**	**Date/Time**	**Matrix**	Glass Jar	PFAS Jar	Plastic Bag	Amber Vial	Amber Bottle	Metals	Nutrients	Plastic (Unpreserved)	Plastic (PFAS)		SP_2	SP_05	S_AQ4_WT	S_AQ4_AA	S_AQ4_EL	S_Walkley	S_CAT_AL	S_CAT_CEC	S_FLUX	S_SCP_ICP	S_PSD	S_R1-R2	S_ADM_105
Interlab_Dup	QC200	28/02/2023	Soil			1																				

GRAIN SIZE ANALYSIS (hydrometer techniques)

14 soil samples supplied by Epic Environmental Pty Ltd on 1st March, 2023 - Lab Job No. N8075
Analysis requested by Andrew Hughes. Job Ref: BCL230007.01
Level 17, 95 North Quay BRISBANE QLD 4000

SAMPLE ID	Lab Code	TEXTURE ISSS classification	MOISTURE CONTENT (105 °C) (% Moisture)	GRAVEL > 2 mm (%)	SAND > 20 µm ISSS (< 2 mm fraction)	SILT 2−20 µm ISSS (< 2 mm fraction)	CLAY < 2 µm (< 2 mm fraction)	DISPERSION PERCENT
SP01-01	N8075/1	Clay	13.7%	45.8%	50.6%	15.3%	34.1%	43.2
SP01-02	N8075/2	Clay Loam	10.3%	56.7%	47.4%	19.2%	33.4%	37.0
SP01-03	N8075/3	Clay Loam	8.5%	51.5%	47.2%	19.7%	33.1%	30.2
SP01-04	N8075/4	Clay	11.8%	36.2%	50.6%	14.7%	34.7%	54.5
SP01-05- 1.5	N8075/5	Clay Loam	14.5%	45.9%	48.7%	21.1%	30.2%	37.5
SP01-06	N8075/6	Silty Clay Loam	16.0%	42.5%	41.9%	26.2%	31.8%	37.5
SP01-07	N8075/7	Clay	15.0%	35.7%	49.3%	14.3%	36.4%	40.9
SP01-08	N8075/8	Clay	13.6%	29.8%	46.2%	15.3%	38.4%	41.3
SP01-09	N8075/9	Clay	18.6%	25.7%	50.3%	12.8%	37.0%	32.5
SP01-10	N8075/10	Clay Loam	12.0%	22.6%	59.1%	11.6%	29.3%	56.4
QC100	N8075/11	Clay Loam	11.7%	28.6%	51.6%	15.7%	32.7%	45.5
SPO5-05-0.5	N8075/12	Clay	7.2%	88.6%	40.4%	9.8%	49.8%	25.0
SCALP01-01	N8075/13	Loamy Sand	0.7%	58.0%	82.8%	9.6%	7.6%	20.0
SCALP01-02	N8075/14	Loamy Sand	1.2%	70.0%	85.4%	10.0%	4.5%	57.1

Note:

1. The Hydrometer Analysis method was used to determine the percentage sand, silt and clay,
modified from SOP meth004 (California Dept of Pesticide Regulation), using method of Gee & Bauder (1986)," &
in Methods of Soil Analysis. Part 1 Agron. Monogr. 9 (2nd Ed). Klute, A., American Soc. of Agronomy Inc., Soil Sci. Soc. America Inc., Madison WI: 383-411.
2. The texture classification was based on the hydrometer results and the appropriate texture triangle.
3. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (see EAL website: scu.edu.au/eal).
4. This report is not to be reproduced except in full.
5. This report was issued on 03/04/2023



checked: .....
Graham Lancaster (Nata signatory)
Laboratory Manager

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ABN: 41 995 651 524

AGRICULTURAL SOIL ANALYSIS REPORT

14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075

Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	SP01-01	SP01-02	SP01-03	SP01-04	SP01-05- 1.5
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/1	N8075/2	N8075/3	N8075/4	N8075/5
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	6.1	19	20	8.8	15
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	1.2	65	16	6.5	4.5
	Ammonium Nitrogen (mg/kg N)		<0.1	0.32	<0.1	0.29	0.29
	Sulfur (mg/kg S)		8.8	9.6	30	12	11
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.56	8.23	8.37	8.60	8.84
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.158	0.469	0.420	0.167	0.145
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	2.4	3.5	2.6	1.0	5.8
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	27	26	24	20	25
	Exchangeable Calcium (kg/ha)		11,924	11,791	10,591	9,147	11,185
	Exchangeable Calcium (mg/kg)		5,323	5,264	4,728	4,084	4,993
	Exchangeable Magnesium (cmol+/kg)		0.80	1.4	1.3	0.46	1.8
	Exchangeable Magnesium (kg/ha)		217	381	362	127	484
	Exchangeable Magnesium (mg/kg)		97	170	162	56	216
	Exchangeable Potassium (cmol+/kg)		<0.12	0.28	0.24	<0.12	0.31
	Exchangeable Potassium (kg/ha)		<112	242	206	<112	273
	Exchangeable Potassium (mg/kg)		<50	108	92	<50	122
	Exchangeable Sodium (cmol+/kg)		0.30	0.55	0.91	0.24	0.75
	Exchangeable Sodium (kg/ha)		153	281	468	125	386
	Exchangeable Sodium (mg/kg)		68	125	209	56	172
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.15	0.02	0.01	0.01	<0.01
	Exchangeable Aluminium (kg/ha)		30	3.1	2.1	3.0	1.9
	Exchangeable Aluminium (mg/kg)		13	1.4	<1	1.3	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	28	29	26	21	28
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	95	92	90	96	90
	Magnesium (%)		2.9	4.9	5.1	2.2	6.4
	Potassium (%)		0.29	0.97	0.90	0.41	1.1
	Sodium - ESP (%)		1.1	1.9	3.5	1.2	2.7
	Aluminium (%)		0.53	0.05	0.04	0.07	0.03
	Hydrogen (%)		0.00	0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	33	19	18	44	14

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AGRICULTURAL SOIL ANALYSIS REPORT

14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075

Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	SP01-01	SP01-02	SP01-03	SP01-04	SP01-05- 1.5
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/1	N8075/2	N8075/3	N8075/4	N8075/5
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	0.51	<0.5	<0.5	1.4
	Manganese (mg/kg)		1.8	4.7	2.4	1.3	3.1
	Iron (mg/kg)		2.2	3.7	3.1	1.9	4.3
	Copper (mg/kg)		0.15	0.42	0.23	0.19	0.78
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.14	0.39	0.36	0.13	0.73
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	34	31	24	28	42
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.4	2.0	1.5	0.58	3.3
	Total Nitrogen (%)		0.07	0.11	0.07	0.06	0.09
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	21	19	21	10	38
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	101	300	269	107	93
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	84	212	382	103	24
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	7.9	7.8	7.9	8.0	8.0

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Level 17 BRISBANE QLD 4000

			Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Sample ID:	SP01-06	SP01-07	SP01-08	SP01-09	SP01-10
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/6	N8075/7	N8075/8	N8075/9	N8075/10
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	10	14	11	11	5.9
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	12	24	64	5.7	0.74
	Ammonium Nitrogen (mg/kg N)		0.40	0.25	0.48	0.12	<0.1
	Sulfur (mg/kg S)		11	16	22	7.4	3.4
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.40	8.46	8.32	8.49	8.75
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.231	0.198	0.322	0.122	0.096
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	2.2	1.9	1.8	1.4	0.75
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	35	22	22	25	19
	Exchangeable Calcium (kg/ha)		15,864	9,874	10,024	11,224	8,361
	Exchangeable Calcium (mg/kg)		7,082	4,408	4,475	5,011	3,733
	Exchangeable Magnesium (cmol+/kg)		1.6	0.71	0.76	0.20	0.25
	Exchangeable Magnesium (kg/ha)		435	194	208	56	68
	Exchangeable Magnesium (mg/kg)		194	87	93	25	30
	Exchangeable Potassium (cmol+/kg)		0.18	0.16	0.16	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		156	143	142	<112	<112
	Exchangeable Potassium (mg/kg)		69	64	63	<50	<50
	Exchangeable Sodium (cmol+/kg)		0.51	0.18	0.34	0.13	0.14
	Exchangeable Sodium (kg/ha)		264	94	176	68	70
	Exchangeable Sodium (mg/kg)		118	42	79	30	31
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Aluminium (kg/ha)		<1	1.0	<1	<1	<1
	Exchangeable Aluminium (mg/kg)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	38	23	24	25	19
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	94	95	95	98	98
	Magnesium (%)		4.2	3.1	3.2	0.81	1.3
	Potassium (%)		0.47	0.71	0.69	0.20	0.25
	Sodium - ESP (%)		1.4	0.79	1.4	0.52	0.71
	Aluminium (%)		0.01	0.02	0.01	0.01	0.00
	Hydrogen (%)		0.00	0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	22	31	29	122	75

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Level 17 BRISBANE QLD 4000

			Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Sample ID:	SP01-06	SP01-07	SP01-08	SP01-09	SP01-10
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/6	N8075/7	N8075/8	N8075/9	N8075/10
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	<0.5	<0.5	<0.5	<0.5
	Manganese (mg/kg)		1.0	3.7	3.2	3.5	1.5
	Iron (mg/kg)		4.7	4.6	3.3	3.1	2.5
	Copper (mg/kg)		0.20	0.26	0.23	0.20	0.20
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.26	0.14	0.25	<0.1	<0.1
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	43	19	26	52	41
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.3	1.1	1.1	0.83	0.43
	Total Nitrogen (%)		0.02	0.03	0.03	<0.02	<0.02
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	52	42	42	413	23
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	148	127	206	78	61
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	157	83	168	21	27
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	7.8	7.9	7.9	7.8	8.0

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_+$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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Level 17 BRISBANE QLD 4000

			Sample 11	Sample 12	Sample 13	Sample 14
		Sample ID:	QC100	SPO5-05-0.5	SCALP01-01	SCALP01-02
		Crop:	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/11	N8075/12	N8075/13	N8075/14
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	6.1	9.4	4.2	3.6
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	3.5	2.7	90	1.5
	Ammonium Nitrogen (mg/kg N)		0.19	0.40	46	0.62
	Sulfur (mg/kg S)		7.3	8.5	4.7	4.9
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.59	8.47	8.53	9.21
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.167	0.157	0.415	0.060
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	3.0	3.8	12	12
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	37	36	20	19
	Exchangeable Calcium (kg/ha)		16,630	16,320	8,898	8,578
	Exchangeable Calcium (mg/kg)		7,424	7,286	3,973	3,830
	Exchangeable Magnesium (cmol+/kg)		1.7	0.56	0.28	0.35
	Exchangeable Magnesium (kg/ha)		475	153	76	96
	Exchangeable Magnesium (mg/kg)		212	68	34	43
	Exchangeable Potassium (cmol+/kg)		0.20	0.30	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		173	259	<112	<112
	Exchangeable Potassium (mg/kg)		77	116	<50	<50
	Exchangeable Sodium (cmol+/kg)		0.62	0.15	<0.065	<0.065
	Exchangeable Sodium (kg/ha)		320	79	<33	<33
	Exchangeable Sodium (mg/kg)		143	35	<15	<15
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	<0.01	<0.01	<0.01	0.01
	Exchangeable Aluminium (kg/ha)		1.1	<1	1.3	2.8
	Exchangeable Aluminium (mg/kg)		<1	<1	<1	1.2
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	40	37	20	20
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	94	97	98	98
	Magnesium (%)		4.4	1.5	1.4	1.8
	Potassium (%)		0.50	0.79	0.11	0.10
	Sodium - ESP (%)		1.6	0.41	0.11	0.04
	Aluminium (%)		0.01	0.01	0.03	0.07
	Hydrogen (%)		0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	21	65	71	54

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Level 17 BRISBANE QLD 4000

			Sample 11	Sample 12	Sample 13	Sample 14
		Sample ID:	QC100	SPO5-05-0.5	SCALP01-01	SCALP01-02
		Crop:	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/11	N8075/12	N8075/13	N8075/14
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	<0.5	<0.5	<0.5
	Manganese (mg/kg)		1.5	1.3	2.0	1.3
	Iron (mg/kg)		2.9	4.9	1.2	1.1
	Copper (mg/kg)		0.17	0.53	0.16	0.10
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.14	0.10	<0.1	<0.1
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	32	25	8.0	9.0
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.7	2.2	7.0	6.7
	Total Nitrogen (%)		<0.02	0.03	<0.02	<0.02
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	342	83	1,163	6,660
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	107	100	266	38
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	90	23	4	3
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	7.9	7.7	8.0	8.0

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
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Level 17 BRISBANE QLD 4000

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	80	50	45	35
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	15	13	10	10
	Ammonium Nitrogen (mg/kg N)		20	18	15	12
	Sulfur (mg/kg S)		10.0	8.0	8.0	7.0
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	> 5.5	>4 .5	> 3.5	> 2.5
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	15.6	10.8	5.0	1.9
	Exchangeable Calcium (kg/ha)		7000	4816	2240	840
	Exchangeable Calcium (mg/kg)		3125	2150	1000	375
	Exchangeable Magnesium (cmol+/kg)		2.4	1.7	1.2	0.60
	Exchangeable Magnesium (kg/ha)		650	448	325	168
	Exchangeable Magnesium (mg/kg)		290	200	145	75
	Exchangeable Potassium (cmol+/kg)		0.60	0.50	0.40	0.30
	Exchangeable Potassium (kg/ha)		526	426	336	224
	Exchangeable Potassium (mg/kg)		235	190	150	100
	Exchangeable Sodium (cmol+/kg)		0.3	0.26	0.22	0.11
	Exchangeable Sodium (kg/ha)		155	134	113	57
	Exchangeable Sodium (mg/kg)		69	60	51	25
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.6	0.5	0.4	0.2
	Exchangeable Aluminium (kg/ha)		121	101	73	30
	Exchangeable Aluminium (mg/kg)		54	45	32	14
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.6	0.5	0.4	0.2
	Exchangeable Hydrogen (kg/ha)		13	11	8	3
	Exchangeable Hydrogen (mg/kg)		6	5	4	2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	20.1	14.3	7.8	3.3
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	77.6	75.7	65.6	57.4
	Magnesium (%)		11.9	11.9	15.7	18.1
	Potassium (%)		3.0	3.5	5.2	9.1
	Sodium - ESP (%)		1.5	1.8	2.9	3.3
	Aluminium (%)		6.0	7.1	10.5	12.1
	Hydrogen (%)					
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	6.5	6.4	4.2	3.2

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AGRICULTURAL SOIL ANALYSIS REPORT

14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075

Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	6.0	5.0	4.0	3.0
	Manganese (mg/kg)		25	22	18	15
	Iron (mg/kg)		25	22	18	15
	Copper (mg/kg)		2.4	2.0	1.6	1.2
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	2.0	1.7	1.4	1.0
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	50	45	40	35
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	> 3.1	> 2.6	> 2.0	> 1.4
	Total Nitrogen (%)		> 0.30	> 0.25	> 0.20	> 0.15
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	10–12	10–12	10–12	10–12
	Basic Texture	**Inhouse S65	..	..	..	..
	Basic Colour		..	..	..	..
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	..	..	..	..
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	..			
	pH	**Rayment & Lyons 2011 - 4B4 ($CaCl_2$)	..			

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
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17. This report was issued on 16/03/2023.

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14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075
Analysis requested by Andrew Hughes. Your Job: BCL230007.01
Level 17 BRISBANE QLD 4000

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	SP01-01	SP01-02	SP01-03	SP01-04	SP01-05- 1.5
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/1	N8075/2	N8075/3	N8075/4	N8075/5
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	6.1	19	20	8.8	15
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	1.2	65	16	6.5	4.5
	Ammonium Nitrogen (mg/kg N)		<0.1	0.32	<0.1	0.29	0.29
	Sulfur (mg/kg S)		8.8	9.6	30	12	11
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.56	8.23	8.37	8.60	8.84
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.158	0.469	0.420	0.167	0.145
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	2.4	3.5	2.6	1.0	5.8
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	27	26	24	20	25
	Exchangeable Calcium (kg/ha)		11,924	11,791	10,591	9,147	11,185
	Exchangeable Calcium (mg/kg)		5,323	5,264	4,728	4,084	4,993
	Exchangeable Magnesium (cmol+/kg)		0.80	1.4	1.3	0.46	1.8
	Exchangeable Magnesium (kg/ha)		217	381	362	127	484
	Exchangeable Magnesium (mg/kg)		97	170	162	56	216
	Exchangeable Potassium (cmol+/kg)		<0.12	0.28	0.24	<0.12	0.31
	Exchangeable Potassium (kg/ha)		<112	242	206	<112	273
	Exchangeable Potassium (mg/kg)		<50	108	92	<50	122
	Exchangeable Sodium (cmol+/kg)		0.30	0.55	0.91	0.24	0.75
	Exchangeable Sodium (kg/ha)		153	281	468	125	386
	Exchangeable Sodium (mg/kg)		68	125	209	56	172
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.15	0.02	0.01	0.01	<0.01
	Exchangeable Aluminium (kg/ha)		30	3.1	2.1	3.0	1.9
	Exchangeable Aluminium (mg/kg)		13	1.4	<1	1.3	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	28	29	26	21	28
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	95	92	90	96	90
	Magnesium (%)		2.9	4.9	5.1	2.2	6.4
	Potassium (%)		0.29	0.97	0.90	0.41	1.1
	Sodium - ESP (%)		1.1	1.9	3.5	1.2	2.7
	Aluminium (%)		0.53	0.05	0.04	0.07	0.03
	Hydrogen (%)		0.00	0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	33	19	18	44	14

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AGRICULTURAL SOIL ANALYSIS REPORT

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Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

			Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
		Sample ID:	SP01-01	SP01-02	SP01-03	SP01-04	SP01-05- 1.5
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/1	N8075/2	N8075/3	N8075/4	N8075/5
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	0.51	<0.5	<0.5	1.4
	Manganese (mg/kg)		1.8	4.7	2.4	1.3	3.1
	Iron (mg/kg)		2.2	3.7	3.1	1.9	4.3
	Copper (mg/kg)		0.15	0.42	0.23	0.19	0.78
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.14	0.39	0.36	0.13	0.73
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	34	31	24	28	42
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.4	2.0	1.5	0.58	3.3
	Total Nitrogen (%)		0.07	0.11	0.07	0.06	0.09
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	21	19	21	10	38
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	101	300	269	107	93
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	84	212	382	103	24
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	2	4	2	2	2

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal/t&cs).
17. This final report was issued on 04/04/2023 and replaces the previous report issued on 16/03/2023. EAT data is now included.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

Accreditation No. 14960
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Level 17 BRISBANE QLD 4000

			Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
		Sample ID:	SP01-06	SP01-07	SP01-08	SP01-09	SP01-10
		Crop:	Soil	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/6	N8075/7	N8075/8	N8075/9	N8075/10
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	10	14	11	11	5.9
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	12	24	64	5.7	0.74
	Ammonium Nitrogen (mg/kg N)		0.40	0.25	0.48	0.12	<0.1
	Sulfur (mg/kg S)		11	16	22	7.4	3.4
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.40	8.46	8.32	8.49	8.75
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.231	0.198	0.322	0.122	0.096
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	2.2	1.9	1.8	1.4	0.75
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	35	22	22	25	19
	Exchangeable Calcium (kg/ha)		15,864	9,874	10,024	11,224	8,361
	Exchangeable Calcium (mg/kg)		7,082	4,408	4,475	5,011	3,733
	Exchangeable Magnesium (cmol+/kg)		1.6	0.71	0.76	0.20	0.25
	Exchangeable Magnesium (kg/ha)		435	194	208	56	68
	Exchangeable Magnesium (mg/kg)		194	87	93	25	30
	Exchangeable Potassium (cmol+/kg)		0.18	0.16	0.16	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		156	143	142	<112	<112
	Exchangeable Potassium (mg/kg)		69	64	63	<50	<50
	Exchangeable Sodium (cmol+/kg)		0.51	0.18	0.34	0.13	0.14
	Exchangeable Sodium (kg/ha)		264	94	176	68	70
	Exchangeable Sodium (mg/kg)		118	42	79	30	31
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Aluminium (kg/ha)		<1	1.0	<1	<1	<1
	Exchangeable Aluminium (mg/kg)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	38	23	24	25	19
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	94	95	95	98	98
	Magnesium (%)		4.2	3.1	3.2	0.81	1.3
	Potassium (%)		0.47	0.71	0.69	0.20	0.25
	Sodium - ESP (%)		1.4	0.79	1.4	0.52	0.71
	Aluminium (%)		0.01	0.02	0.01	0.01	0.00
	Hydrogen (%)		0.00	0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	22	31	29	122	75

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Analysis requested by Andrew Hughes. Your Job: BCL230007.01
Level 17 BRISBANE QLD 4000

	Parameter	Method reference	Sample 6 SP01-06 Soil Riverton Quarry N8075/6	Sample 7 SP01-07 Soil Riverton Quarry N8075/7	Sample 8 SP01-08 Soil Riverton Quarry N8075/8	Sample 9 SP01-09 Soil Riverton Quarry N8075/9	Sample 10 SP01-10 Soil Riverton Quarry N8075/10
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	<0.5	<0.5	<0.5	<0.5
	Manganese (mg/kg)		1.0	3.7	3.2	3.5	1.5
	Iron (mg/kg)		4.7	4.6	3.3	3.1	2.5
	Copper (mg/kg)		0.20	0.26	0.23	0.20	0.20
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.26	0.14	0.25	<0.1	<0.1
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	43	19	26	52	41
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.3	1.1	1.1	0.83	0.43
	Total Nitrogen (%)		0.02	0.03	0.03	<0.02	<0.02
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	52	42	42	413	23
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	148	127	206	78	61
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	157	83	168	21	27
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	2	2	2	4	2

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
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7. Total Acid Extractable Nutrients indicate a store of nutrients.
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Level 17 BRISBANE QLD 4000

			Sample 11	Sample 12	Sample 13	Sample 14
		Sample ID:	QC100	SPO5-05-0.5	SCALP01-01	SCALP01-02
		Crop:	Soil	Soil	Soil	Soil
		Client:	Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
	Parameter	Method reference	N8075/11	N8075/12	N8075/13	N8075/14
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	6.1	9.4	4.2	3.6
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	3.5	2.7	90	1.5
	Ammonium Nitrogen (mg/kg N)		0.19	0.40	46	0.62
	Sulfur (mg/kg S)		7.3	8.5	4.7	4.9
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	8.59	8.47	8.53	9.21
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.167	0.157	0.415	0.060
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	3.0	3.8	12	12
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	37	36	20	19
	Exchangeable Calcium (kg/ha)		16,630	16,320	8,898	8,578
	Exchangeable Calcium (mg/kg)		7,424	7,286	3,973	3,830
	Exchangeable Magnesium (cmol+/kg)		1.7	0.56	0.28	0.35
	Exchangeable Magnesium (kg/ha)		475	153	76	96
	Exchangeable Magnesium (mg/kg)		212	68	34	43
	Exchangeable Potassium (cmol+/kg)		0.20	0.30	<0.12	<0.12
	Exchangeable Potassium (kg/ha)		173	259	<112	<112
	Exchangeable Potassium (mg/kg)		77	116	<50	<50
	Exchangeable Sodium (cmol+/kg)		0.62	0.15	<0.065	<0.065
	Exchangeable Sodium (kg/ha)		320	79	<33	<33
	Exchangeable Sodium (mg/kg)		143	35	<15	<15
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	<0.01	<0.01	<0.01	0.01
	Exchangeable Aluminium (kg/ha)		1.1	<1	1.3	2.8
	Exchangeable Aluminium (mg/kg)		<1	<1	<1	1.2
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	<0.01	<0.01
	Exchangeable Hydrogen (kg/ha)		<1	<1	<1	<1
	Exchangeable Hydrogen (mg/kg)		<1	<1	<1	<1
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	40	37	20	20
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	94	97	98	98
	Magnesium (%)		4.4	1.5	1.4	1.8
	Potassium (%)		0.50	0.79	0.11	0.10
	Sodium - ESP (%)		1.6	0.41	0.11	0.04
	Aluminium (%)		0.01	0.01	0.03	0.07
	Hydrogen (%)		0.00	0.00	0.00	0.00
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	21	65	71	54

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Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

	Parameter	Method reference	Sample 11	Sample 12	Sample 13	Sample 14
	Sample ID:		QC100	SPO5-05-0.5	SCALP01-01	SCALP01-02
	Crop:		Soil	Soil	Soil	Soil
	Client:		Riverton Quarry	Riverton Quarry	Riverton Quarry	Riverton Quarry
			N8075/11	N8075/12	N8075/13	N8075/14
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	<0.5	<0.5	<0.5	<0.5
	Manganese (mg/kg)		1.5	1.3	2.0	1.3
	Iron (mg/kg)		2.9	4.9	1.2	1.1
	Copper (mg/kg)		0.17	0.53	0.16	0.10
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.14	0.10	<0.1	<0.1
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	32	25	8.0	9.0
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.7	2.2	7.0	6.7
	Total Nitrogen (%)		<0.02	0.03	<0.02	<0.02
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	342	83	1,163	6,660
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	107	100	266	38
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	90	23	4	3
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	4	4	4	2

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_c/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium,
    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions
17. This final report was issued on 04/04/2023 and replaces the previous report issued on 16/03/2023. I

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Agricultural Co-Ordinator KS

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AGRICULTURAL SOIL ANALYSIS REPORT

14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075
Analysis requested by Andrew Hughes. Your Job: BCL230007.01
Level 17 BRISBANE QLD 4000

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9B2 (Colwell)	80	50	45	35
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	15	13	10	10
	Ammonium Nitrogen (mg/kg N)		20	18	15	12
	Sulfur (mg/kg S)		10.0	8.0	8.0	7.0
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	> 5.5	>4 .5	> 3.5	> 2.5
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	15.6	10.8	5.0	1.9
	Exchangeable Calcium (kg/ha)		7000	4816	2240	840
	Exchangeable Calcium (mg/kg)		3125	2150	1000	375
	Exchangeable Magnesium (cmol+/kg)		2.4	1.7	1.2	0.60
	Exchangeable Magnesium (kg/ha)		650	448	325	168
	Exchangeable Magnesium (mg/kg)		290	200	145	75
	Exchangeable Potassium (cmol+/kg)		0.60	0.50	0.40	0.30
	Exchangeable Potassium (kg/ha)		526	426	336	224
	Exchangeable Potassium (mg/kg)		235	190	150	100
	Exchangeable Sodium (cmol+/kg)		0.3	0.26	0.22	0.11
	Exchangeable Sodium (kg/ha)		155	134	113	57
	Exchangeable Sodium (mg/kg)		69	60	51	25
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.6	0.5	0.4	0.2
	Exchangeable Aluminium (kg/ha)		121	101	73	30
	Exchangeable Aluminium (mg/kg)		54	45	32	14
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.6	0.5	0.4	0.2
	Exchangeable Hydrogen (kg/ha)		13	11	8	3
	Exchangeable Hydrogen (mg/kg)		6	5	4	2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	20.1	14.3	7.8	3.3
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	77.6	75.7	65.6	57.4
	Magnesium (%)		11.9	11.9	15.7	18.1
	Potassium (%)		3.0	3.5	5.2	9.1
	Sodium - ESP (%)		1.5	1.8	2.9	3.3
	Aluminium (%)		6.0	7.1	10.5	12.1
	Hydrogen (%)					
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	6.5	6.4	4.2	3.2

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14 samples supplied by Epic Environmental Pty Ltd on 01/03/2023. Lab Job No.N8075

Analysis requested by Andrew Hughes. Your Job: BCL230007.01

Level 17 BRISBANE QLD 4000

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	**Method reference**	**Indicative guidelines - refer to Notes 6 and 8**			
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	6.0	5.0	4.0	3.0
	Manganese (mg/kg)		25	22	18	15
	Iron (mg/kg)		25	22	18	15
	Copper (mg/kg)		2.4	2.0	1.6	1.2
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	2.0	1.7	1.4	1.0
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	50	45	40	35
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	> 3.1	> 2.6	> 2.0	> 1.4
	Total Nitrogen (%)		> 0.30	> 0.25	> 0.20	> 0.15
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	10–12	10–12	10–12	10–12
	Basic Texture	**Inhouse S65	..	..	..	..
	Basic Colour		..	..	..	..
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	..	..	..	..
	Chloride (mg/kg)	**Rayment & Lyons 2011 - 5A3a	..			
	Emerson Aggregate Test (EAT)	**AS1289.3.8.1-2017	Class 3–8			

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia*. CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013,
   Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
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    122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
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17. This final report was issued on 04/04/2023 and replaces the previous report issued on 16/03/2023. I

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Sample Receipt Notification (SRN)

Project: **EAL/N8075**
Customer: Epic Environmental Pty Ltd
Contact: Andrew Hughes
Client Job ID: BCL230007.01
No. of Samples 14 x Soil
Date Received: 01 MAR 2023
Comments: cc attached

Biller: **Epic Environmental Pty Ltd** - Andrew Hughes

Test Request

Sample Text ID	Client Sample ID	Admin Batch Charge	Agricultural Standard C	Moisture Content 'As Received (%) at 105°C	Emerson Aggregate Test (EAT)	Available Chloride	Particle Size Analysis - Laser Diffraction	Dispersion Percent
		ADMIN	RA-PACK-014	SS-SING-001	SS-SING-025	SS-SING-038	SS-SING-146	SS-SING-215
N8075/001	SP01-01	1	1	1	1	1	1	1
N8075/002	SP01-02	0	1	1	1	1	1	1
N8075/003	SP01-03	0	1	1	1	1	1	1

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Sample Receipt Notification (SRN) for EAL/N8075

		ADMIN	RA-PACK-014	SS-SING-001	SS-SING-025	SS-SING-038	SS-SING-146	SS-SING-215
		Admin Batch Charge	Agricultural Standard C	Moisture Content 'As Received (%) at 105°C	Emerson Aggregate Test (EAT)	Available Chloride	Particle Size Analysis - Laser Diffraction	Dispersion Percent
N8075/004	SP01-04	0	1	1	1	1	1	1
N8075/005	SP01-05	0	1	1	1	1	1	1
N8075/006	SP01-06	0	1	1	1	1	1	1
N8075/007	SP01-07	0	1	1	1	1	1	1
N8075/008	SP01-08	0	1	1	1	1	1	1
N8075/009	SP01-09	0	1	1	1	1	1	1
N8075/010	SP01-10	0	1	1	1	1	1	1
N8075/011	QC100	0	1	1	1	1	1	1
N8075/012	SPOS-0.5	0	1	1	1	1	1	1
N8075/013	SCALP01-01	0	1	1	1	1	1	1

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Sample Receipt Notification (SRN) for EAL/N8075

		Admin Batch Charge	Agricultural Standard C	Moisture Content 'As Received (%) at 105°C	Emerson Aggregate Test (EAT)	Available Chloride	Particle Size Analysis - Laser Diffraction	Dispersion Percent
		ADMIN	RA-PACK-014	SS-SING-001	SS-SING-025	SS-SING-038	SS-SING-146	SS-SING-215
N8075/014	SCALP01-02	0	1	1	1	1	1	1
Total		1	14	14	14	14	14	14

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Sample Receipt Notification (SRN) for EAL/N8075

Test Descriptions

Test List Item	Item Description
ADMIN	**Admin Batch Charge**
RA-PACK-014	**Agricultural Standard C** Basic Colour/Texture Water (pH, EC (1:5)) CaCl (pH) Mod Morgan (NH4, NO3, S) Amm Acet (Na, K, Ca, Mg, Al, H) CEC Colwell P TN TC TC/TN Ratio Organic Matter DTPA (Fe, Cu, Zn, Mn) Hot CaCl2 (Si, B)
SS-SING-001	**Moisture Content 'As Received (%) at 105°C** Oven-dry moisture content as a per cent of the 'as-received' sample (105°C)
SS-SING-025	**Emerson Aggregate Test (EAT)** Provides an Emerson Dispersion Class
SS-SING-038	**Available Chloride** Includes water extract
SS-SING-146	**Particle Size Analysis - Laser Diffraction** Particle size analysis using a Malvern Mastersizer 3000. Span 0.01 to 3000 µm. Size classes dictated by client requirments. Includes organic and acid digestion of organic matter and shell, as required. Price dependent upon application and sample amounts.
SS-SING-215	**Dispersion Percent** Includes Dispersion Percent and Hydrometer particle size analysis

Chain of Custody Record

epic ENVIRONMENTAL

Project No:	BCL230007.01	Lab:	EAL
Project/Site:	Riverton Quarry	Lab Quote No:	
Sampled By:	Andrew Hughes	Lab Batch No:	
Phone / Email:	ahughes@epicenvironmental.com.au	Date Results Required:	Standard TAT
Results to:	mkowalczyk@epicenvironmental.com.au ahughes@epicenvironmental.com.au	Sample Disposal After:	Standard

Number of Eskies				CONTAINER TYPE & PRESERVATIVE										ANALYSIS REQUIRED											
				Soil			Water/ Liquid						Other												
Sample Type	Sample ID	Date/Time	Matrix	150-250ml Glass Jar	200ml PFAS Jar	- Plastic Bag	40ml Amber Vial	100-500ml Amber Bottle	60ml Metals	60ml Nutrients	250-500ml Plastic (Unpreserved)	60-500ml Plastic (PFAS)		RA-PACK-014	SS-SING-038 Chlor.	SS-SING-001 Moist	SS-SING-025 EAT	SS-SING-215 Disperse	SS-SING-146 PS						Hold
Normal	SP01_01	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_02	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_03	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_04	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_05	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_06	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_07	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_08	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_09	28/02/2023	Soil			1								x	x	x	x	x	x						
Normal	SP01_10	28/02/2023	Soil			1								x	x	x	x	x	x						
Field_Dup	QC100	28/02/2023	Soil			1								x	x	x	x	x	x						
	SPOS-05					1																			x
	SCALPOI-01					1																			x
	SCALPOI-02					1																			x
	Totals					11								10	10	10	10					0	0	0	0

2 samples labelled No 7 (I think I was supposed to be #9).

Relinquished By:				Received By:	
Name:	Andrew Hughes	Signature:	28/02/2023	Name:	Signature:
Date:	ah			Date:	

Custody Seals Intact: ☐ Yes ☐ No
Samples Received Chilled: ☐ Yes ☐ No
Method of Shipment:

Notes: PSA Fractions: (Clay <0.002), (Silt 0.002 - <0.02), (Fine Sand, 0.02 - <0.2), (Coarse Sand 0.2 - <2.0), (Fine Gravel 2.0 - <6.0), Medium Gravel 6.0 - <20), (Coarse Gravel 20 - <60), Cobbles (60 - <200)

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N8075

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Appendix H Community Consultation Letter

Graymont Riverton
6905 Riverton Road
Riverton QLD 4385

1 March 2023

Dear Stakeholder

Subject: Graymont Riverton PRC Plan and EA Amendment

1 WHAT DO YOU NEED TO KNOW?

We have prepared this letter to inform you of upcoming approval changes and rehabilitation planning associated with the Graymont Riverton Limestone Quarry (the Site). Graymont has engaged Epic Environmental (Epic) to undertake an amendment to the existing environmental approvals and subsequent planning for the development of a Progressive Rehabilitation and Closure Plan (PRC Plan), which will outline the requirements associated with the rehabilitation of areas of disturbance resulting from mining operations at the Site.

A key component of developing a PRC Plan is ensuring the public is provided an opportunity to provide feedback on the proposed rehabilitation of the site. This letter seeks to provide an overview of the current site operations, existing environmental approvals and the proposed rehabilitation for the Riverton Limestone Quarry.

It is important to note that the intent of this letter is not to inform but to open a dialogue with the public, and to work collaboratively alongside relevant stakeholders to ensure that the rehabilitation outcomes for the Site have been determined together.

2 WHO IS GRAYMONT?

Graymont acquired lime and limestone assets in Australia in August 2019, including the Riverton Limestone Quarry. Graymont is a family-owned company that has been in operation for over 70 years. Headquartered in Canada, Graymont employs over 1600 people globally.

Lime and limestone are essential in addressing today's most pressing environmental issues, while supporting vital industrial processes and agricultural needs. Uses for our products include purification of water for drinking, soil pH adjustment, stock feed, road construction, and the production of materials essential to our modern economy such as steel, cement, paper and metals.

For further information, refer to our website, here: https://www.graymont.com/en

3 ABOUT RIVERTON

The Site comprises an operational limestone quarry, and adjoining processing plant; it has been operating continuously since 1970, with Graymont acquiring the Mining Lease (ML) and managing operations since 2019. The Site is located in Riverton, Queensland approximately 2 kilometres (km) east of the border between Queensland and New South Wales.

Mining operations at the site comprise of conventional open cut benching methods with an annual production rate of between 100,000 and 115,000 tonnes (t). Riverton limestone products are transported offsite for downstream processing with products supplying both domestic and international glass and agriculture markets.

The Site's surrounding land uses include intermittent cattle and sheep grazing, forestry and native vegetation serving as fauna habitat; both the site and the surrounding areas are zoned as rural under the *Goondiwindi Regional Council Planning Scheme 2014* and *Southern Downs Regional Council Planning Scheme 2018* mapping (SDRC 2021; GRC 2014).

Based on current estimates of limestone resources within the MLs and feasible rates of extraction, the site is anticipated to cease extraction operations in 2062.

4 WHAT IS AN ENVIRONMENTAL AUTHORITY?

The Site operates under an approval called an Environmental Authority (EA) (reference number: EPML00241213). The EA covers operations on two MLs, ML50142 and ML50220, as shown in **Figure 1**.

The purpose of an EA is to put conditions on onsite operations to reduce or avoid potential impacts posed by the project and associated operations to the surrounding environment.

The existing EA for Riverton has been provided for your review and is enclosed within this letter, noting there are some amendments likely to be made to this EA.

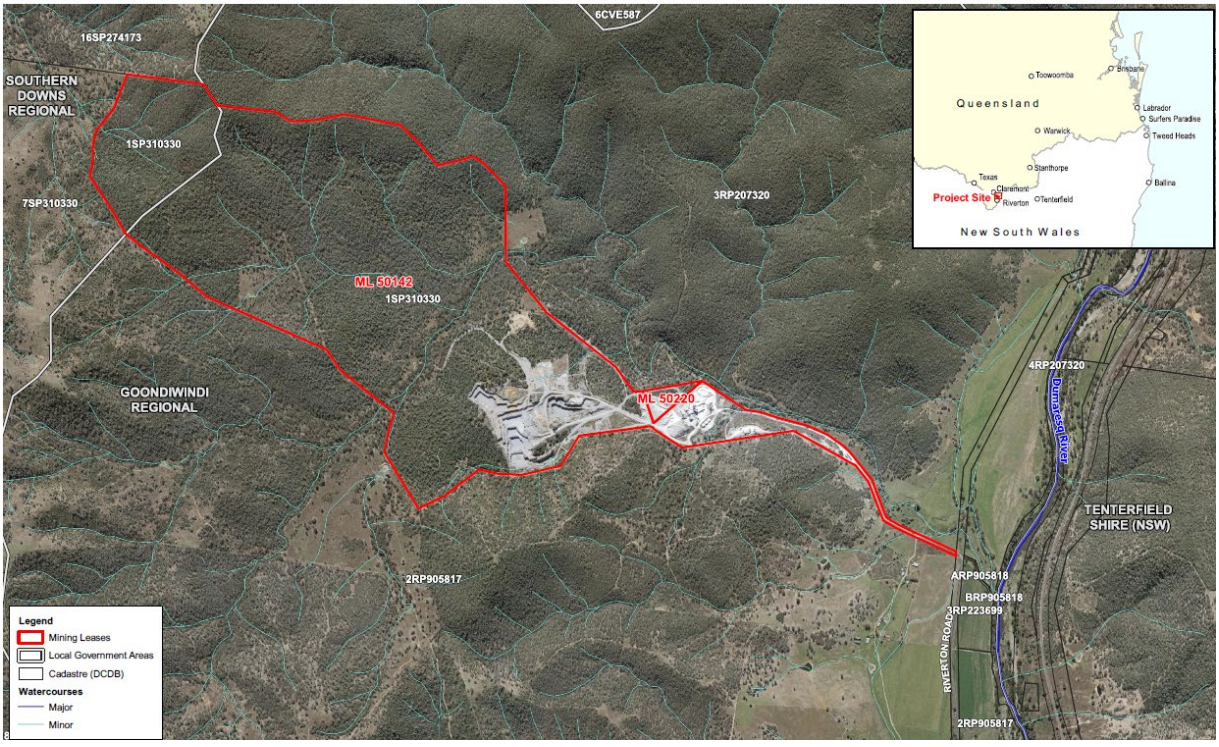


Figure 1. Project Mining Leases

4.1 What is Changing?

Epic Environmental, on behalf of Graymont, is preparing an amendment to the existing EA to better reflect operations as they currently stand and to better describe proposed rehabilitation outcomes; the EA will govern operations until end of mine life in 2062 and inclusion of the PRC Plan.

4.1.1 Contemporising Environmental Authority

As of 2019, EAs are to be accompanied by a PRC Plan. Conditions A1-1 and A1-2 in the EA relating to Financial Assurance have been superseded by conditions within the PRC Plan, therefore, new conditions that relate specifically to PRC Plans will be included in the amended EA.

4.1.2 Amendment of Approved Infrastructure

Throughout the operational life of the Site, there has been a requirement to construct and maintain internal access tracks. Over the years these tracks have been locally widened and modified to suit the various change of plant and equipment used on site. Certain tracks have also been extended to permit access to areas of site as operations progressed. Through this EA amendment, Graymont are seeking to increase the permitted area of access tracks from 5 ha to 6.5 ha.

Stormwater retention basins, or sediment basins, have historically not been included in the post mining land description. To assist in management of stormwater runoff from the site during operations, two basins have been installed in the centre of site. Graymont propose to retain these following mine closure to aid in ongoing water management following rehabilitation. These surface water bodies will also serve as water storage for rural fire services or alternative emergency management as required. Through this amendment Graymont are seeking to have retention of the surface water basins approved. It is noted that the area in which the basins are located is currently dedicated as 'infrastructure', there will be no additional disturbance to accommodate the basins and this amendment reflects a change in terminology only.

4.1.3 Post Mine Land Use – Waste Rock Dump

Approximately 600,000 m^3 of waste rock is contained within the waste rock dumps at the Site. The waste rock primarily contains inert rock material that was overlying the target resource (limestone), this material is known as overburden. The existing EA indicates that following closure of the Site, these areas are to be returned to a land use that will support light grazing, and fauna habitat. Graymont note that achieving a land use that is sufficient to support grazing atop waste rock dumps is often not sustainable due to the amount of continual work required to limit erosional impact of grazing stock on slopes, and that there is currently limited grazing within the surrounding environment. Graymont believe the waste rock dumps should be returned to a land use more in line with the surrounding environment, and through this amendment are seeking approval to return the waste rock dumps to a land use that would support native fauna habitat, and have the area achieve a 'bushland' land use.

4.1.4 Administrative

The following changes will be made to ensure consistency and align the EA to a more contemporary standard:

- Align slope ranges for waste rock dump and the infrastructure areas of ML50220 and ML50142, and

- Amend terminology and conditions throughout the EA to reflect more contemporary terms.

5 WHAT IS A PROGRESSIVE REHABILITATION AND CLOSURE PLAN?

A Progressive Rehabilitation and Closure Plan is a report required under Section 126 of the *Environmental Protection Act 1994* and the *Mineral and Energy Resources (Financial Provisioning) Act 2018*. All areas that are disturbed within a ML must be rehabilitated to an approved post mine land use. Following the cessation of mining operations, Graymont aims to return the site to a state agreed with relevant stakeholders, achieving a balance of locally native ecological communities, light grazing land and stabilised residual voids.

5.1 Proposed Rehabilitation

Pre-mining land use for the site has been described as light grazing and fauna habitat, representative of the wider region as it was in the 1950 and 60s. There is currently limited grazing within the local region, and Graymont instead intend to restore large portions of the site to a level that is representative of the bushland of the surrounding environment. Noting some infrastructure (access tracks, surface water basins, laydown yards), and the residual pit will remain under a landholder agreement[1], and will therefore not be returned to bushland.

The below table (**Table 1)** provides a summary of the post mining land use proposed across both ML50142 and ML50220 for each disturbance type. The EA Amendment will outline the contemporised post mining land uses proposed for Riverton to align with the PRC Plan.

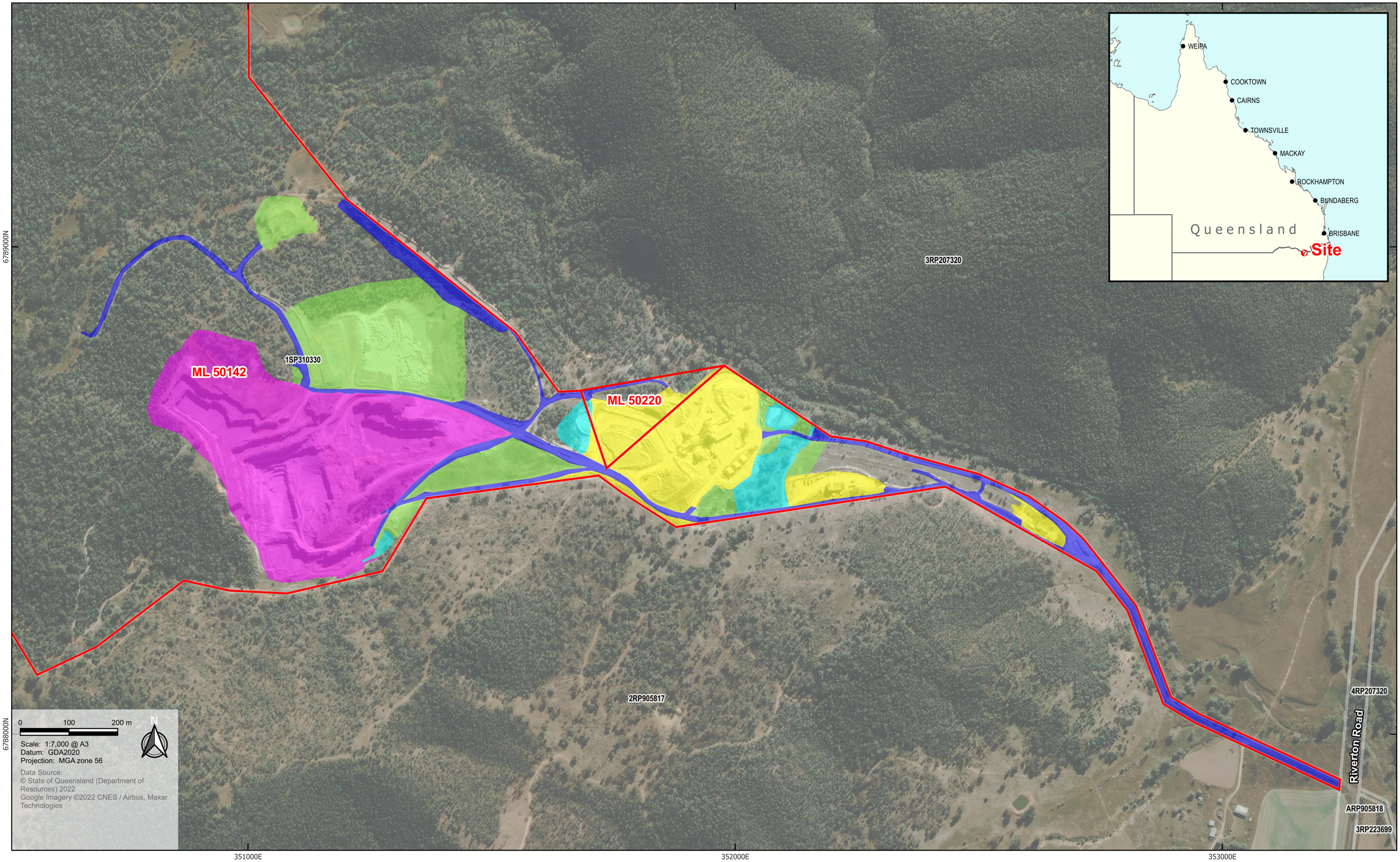
Table 1. Disturbance type and post-mining land use description

Disturbance Type	Post-mining Land Description
ML50142	
Residual voids	Terraced mine benches (Non-use Management Area (NUMA)). There will be no public access to this area, and entry by fauna will be restricted through use of fences and bunds.
Clay waste 'top soil'	The topsoil contained on site will be used to facilitate rehabilitation of the waste rock dump and other select areas. No stockpile will remain at end of mine life. The area currently occupied by the topsoil stockpile will be returned to a condition in line with the surrounding environment for use as 'light grazing and fauna habitat'.
Waste rock dump	The waste rock dumps will be rehabilitated to achieve a land use of bushland, with slopes of up to 18 °. This bushland will be self-sustaining and will provide habitat for native fauna.
Infrastructure (processing plant, ROM and office area)	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners' agreement
Roads and tracks	Bitumen and unsealed roads for site access will remain following end of mine life.
Sediment pond	Surface water storage basins will be maintained through to end of mine life, to ensure long-term stability of the features. They

[1] A landholders agreement is a legally binding document that is prepared by the landholder who will hold the land following closure. A landholders agreement places responsibility on the incoming landholder to maintain the site, and any retained infrastructure following handover from the incumbent landholder. In the case of Riverton, Graymont will retain ownership of the site, and will therefore accept responsibility for any retained infrastructure.

Disturbance Type	Post-mining Land Description
	will remain following end of mine life to serve as part of the ongoing water management plan for the site and to provide a water resource for emergency management.
ML50220	
Clay waste 'top soil'	There are currently no topsoil stockpiles on ML50220.
Infrastructure (processing plant, ROM and office area)	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners' agreement
Sediment pond	Water supply in accordance with landowners' agreement. Noting there is only marginal water storage infrastructure currently on ML50220
Roads and tracks	Bitumen and unsealed roads for site access will remain following end of mine life.

Mapping shown in **Figure 2** outlines the proposed post mining land uses across both MLs.



Legend

- Site boundary
- Cadastre (DCDB)

Post-mining land use

- Bitumen and unsealed roads for access
- Flat to sloping areas with hard stand areas
- Native ecosystem
- Retained sediment basins for water supply and stormwater control
- Terraced mine benches

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Graymont Limited
Riverton Limestone Mine
Community Consultation

Figure 2

Post-mining Land Use

Graymont Riverton
6905 Riverton Road
Riverton QLD 4385

6 CLOSURE

Graymont is committed to preserving the local environmental values, and providing ample opportunity for engagement of the community in determining how the site looks following cessation of operations.

If you have any questions or would like to provide comment on the proposed rehabilitation plans outlined above for the Riverton Limestone Quarry and Processing Plant, please do not hesitate to contact me via phone or the email provided below. I look forward to our ongoing engagement.

Kind regards

Michelle Muir
HSE Specialist Northern
+61 429 985 534
michelle.muir@graymont.com

Enclosed: Riverton Environmental Authority (EPML00241213).

Appendix I Final Landform Flood Assessment

MEMORANDUM

Project:	Riverton Quarry PRCP	Date:	23 August 2024
To:	Epic Environmental	From:	Engeny
ATT:	Michael Blyth	CC:	
Subject:	Riverton Quarry PRCP – Final Landform Flood Assessment		

FINAL LANDFORM FLOOD ASSESSMENT

Engeny were engaged by Epic Environmental (Epic) to undertake a flood assessment of the proposed Riverton Quarry PRCP final landform. Epic supplied Engeny with the final landform surface which is proposed to be constructed by end of life. Engeny have undertaken flood modelling of the key waterways and the final landform surface to assess susceptibility and influence across the Site to inform rehabilitation and final landform planning regarding flood runoff. It is noted that the Site is located upstream of a small tributary of the Dumaresq River. The flood assessment was completed in accordance with Section 3.6.1 of the *Progressive Rehabilitation and Closure Plans Guideline (DESI, March 2021).*

Hydrology

Development of a hydrologic model of the catchment was undertaken to determine runoff hydrographs for a range of storm durations. The Probable Maximum Flood (PMF) was applied to key overland flow paths with consideration of future mine domains and landforms to determine potential flood risks to the ongoing stability of the final landform. PMF rainfall depths were developed in accordance with *The Estimation of Probably Maximum Precipitation in Australia: Generalised Short-Duration Method (BoM, 2003)* and are summarised below in Table 1.

TABLE 1: PMP IFD

Storm Duration	Rainfall Depth (mm)
15 min	200
30 min	280
45 min	360
1 hour	420
1.5 hour	540
2 hour	630
2.5 hour	700
3 hour	780
4 hour	880
5 hour	970
6 hour	1030

Only the burst of the PMF was modelled and therefore it is assumed that sufficient pre-burst rainfall has occurred such that the soil conditions are saturated, therefore an initial/continuing loss regime of 0 mm & 1 mm/h has been adopted in accordance with the recommendations in *Australian Rainfall and Runoff (Ball, et al, 2019)*. The full ensemble of the ten rarest temporal patterns were modelled as well as the BoM Average Variability Method (AVM) temporal pattern to determine the median catchment response.

Hydraulics

Development of a hydraulic model of the mine area and tributary waterway downstream was undertaken to determine the flood risk profile in the final landform scenario. Modelling of the PMF storm included the effects of the tributary waterway to represent any potential alteration of flows upstream and downstream of the Site. Model inflows and domains were applied to appropriately represent key overland flow paths and potential flood levels or ponded areas to determine the extent of flooding in the final landform scenario.

A summary of the key model inputs for hydrology and hydraulics are provided below in Table 1.

The final landform surface as modelled in TUFLOW is shown below in Figure 1 and the catchment breakdown is provided in Figure 2. The Final Site Design is provided in Figure 3.

TABLE 1: FINAL LANDFORM MODEL ASSUMPTIONS

Model Item	Data Used	Source
Catchments	Ashford 2011 5m LiDAR Final Landform Surface (version 20230302)	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Rainfall	*The Estimation of Probably Maximum Precipitation in Australia: Generalised Short-Duration Method*	Bureau of Meteorology
Temporal patterns	10 rarest temporal patterns BoM AVM	Australian Rainfall and Runoff (ARR) 2019 Bureau of Meteorology
Catchment hydrographs	WBNM hydrologic software package	
DEM	Ashford 2011 5m LiDAR Final Landform Surface	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Hydraulic roughness	Final Site Design (Appendix A Figure 1 Rev 0 23/5/23)	Epic Environmental
Tailwater	Ashford 2011 5m LiDAR	Elevation and Depth Foundation Spatial Data (ELVIS)
Flood Extents	TUFLOW hydraulic software package	

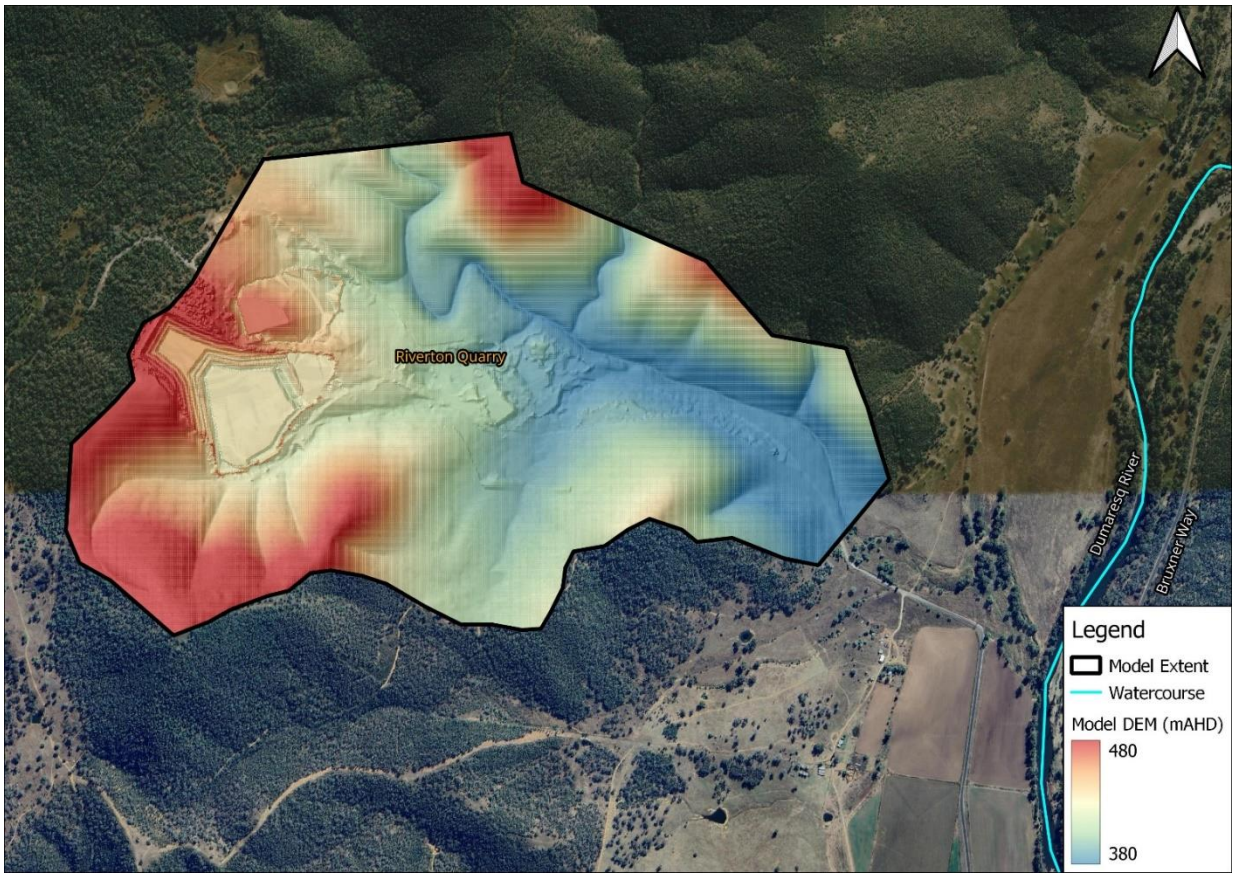

Figure 1: Final Landform DEM

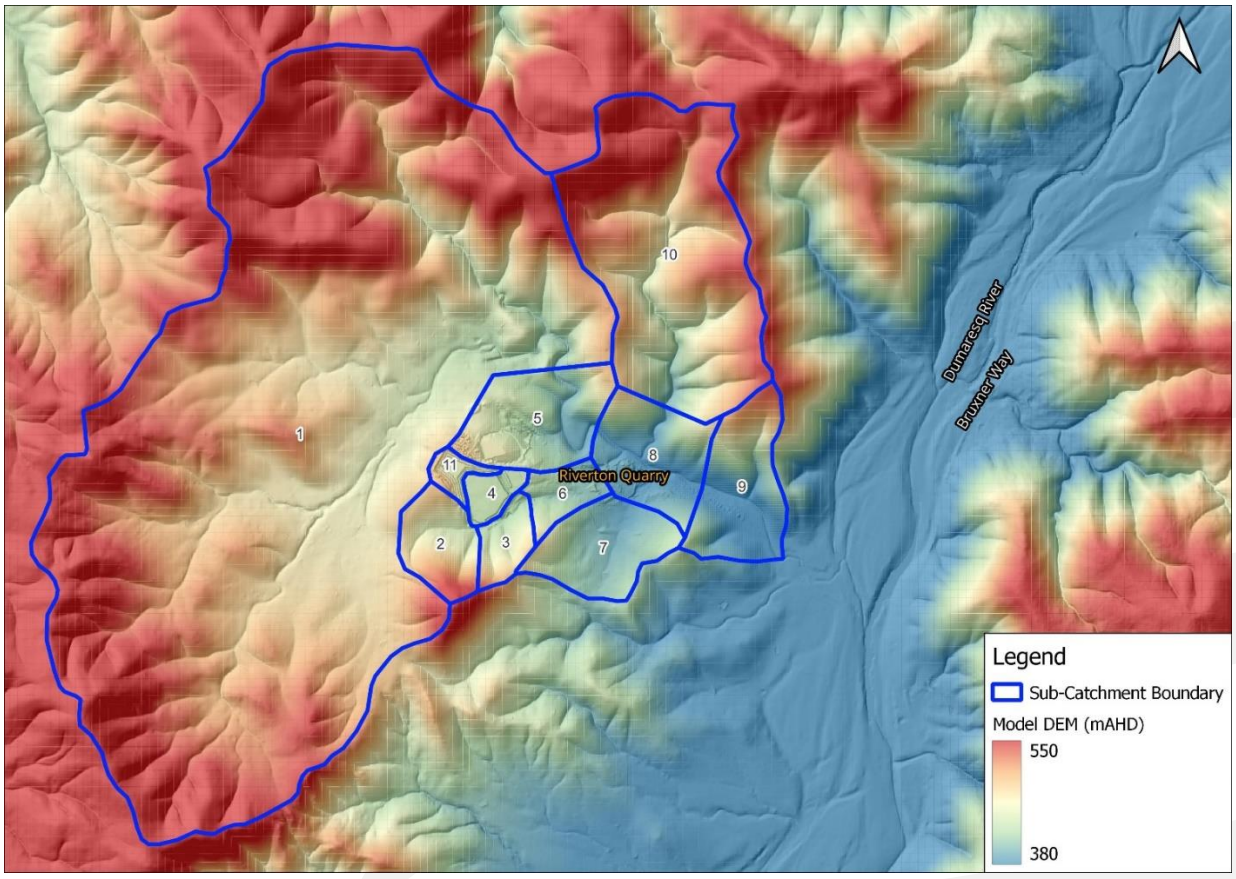

Figure 2: Catchment Breakdown

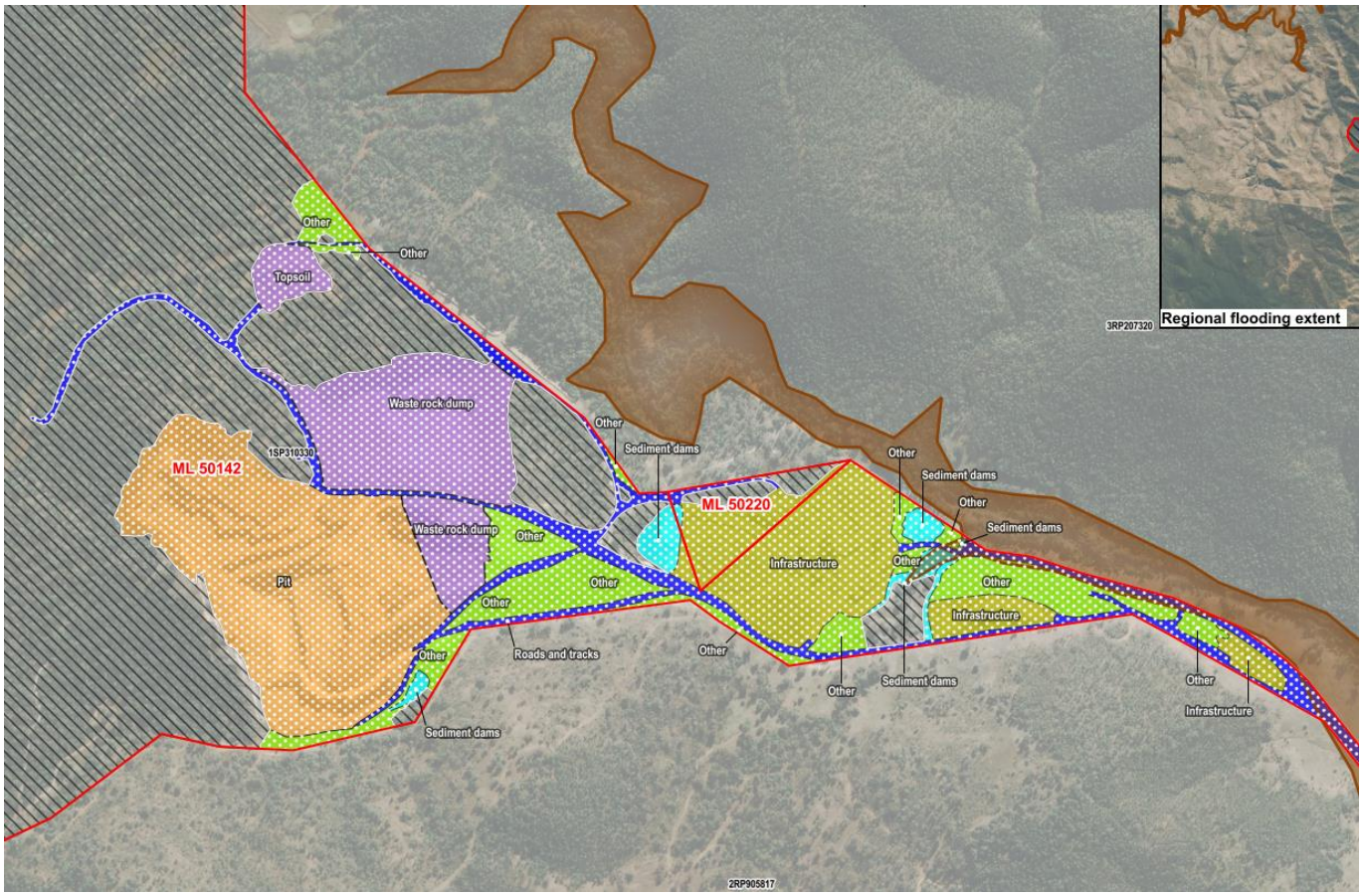

Figure 3: Final Site Design (Epic, May 2023)

Final Landform Flood Risk Profile

The PMF flood depth and velocity mapping of the final landform scenario is shown below in Figure 6 and Figure 7. The Site is anticipated to be located above the flood levels within the creek system tributary adjacent the Site and therefore management of runoff is limited to local catchment runoff only, this is discussed in further detail below.

Based on the current final landform surface, the flood depth maps demonstrate that ponding is anticipated to occur at a non-free-draining basin within the Non-Use Management Area (NUMA) at the pit (shown in Figure 4). The Pit NUMA was designed such that batter slopes and drains divert direct rainfall runoff to this basin, ultimately it is anticipated that any runoff exceeding that capacity of the basin storage (approximately 30,000 m^3) will discharge east to the overland flow path originating from South of the Pit. It is noted that the NUMA is immune to external catchment runoff and the ponding shown on the flood maps is a result of local runoff only. It is understood that an updated design with backfilling of the basin within the NUMA will be completed at a later date. Filling of this basin will result in increased runoff downstream, as it won't be captured by the basin area. Therefore, simulation of the model with the updated landform design is recommended to verify the final flood behaviour, however, it is not anticipated that this will materially impact the modelled behaviour of flooding at the Site following closure or the risk profile discussed below.

Peak velocities within the overland flow paths and creek tributary are anticipated to be as high as 5 m/s. The peak velocities are not caused by the current and future proposed rehabilitation works on the Site and would be present irrespective of the works undertaken. It is noted that the peak velocities of 5 m/s occur adjacent to the Pit NUMA, therefore it is recommended that rehabilitated landform on the southern side of the NUMA is designed to mitigate any failure risk resulting from risk of erosion. These velocities also occur over the Infrastructure area within and east of ML50220, it is recommended that these areas are also designed to mitigate risk of erosion to prevent increased sediment deposition downstream.

Flood runoff from upstream catchments discharges externally from the Site as shown in Figure 5. Minor ponding is shown to occur in Figure 5 where the modelled final landform surface includes some existing sediment basins.

The proposed final landform uses are not anticipated to be influenced by regional flooding. Whilst flooding within Dumaresq River is not directly represented in the flood model, the water surface level at the model outlet is estimated to be at RL 362 mAHD. The sediment basins are located at approximately RL 380 mAHD, and therefore, given the almost 20 m elevation difference between the Site and outlet to Dumaresq River, it is not anticipated that regional flooding will influence the Site.



Figure 4: Pit NUMA Ponding

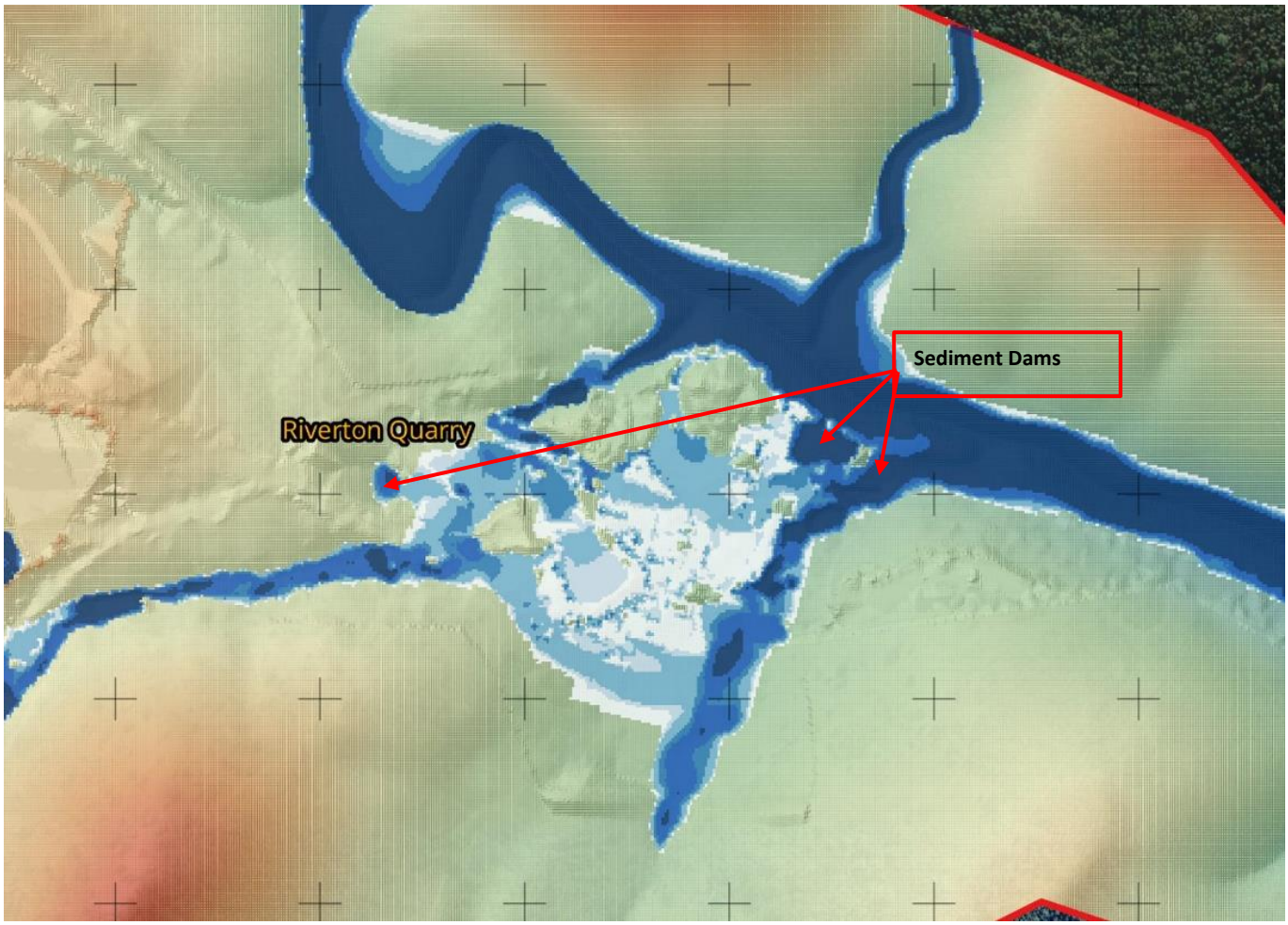

Figure 5: Flood Discharge Location External to Site

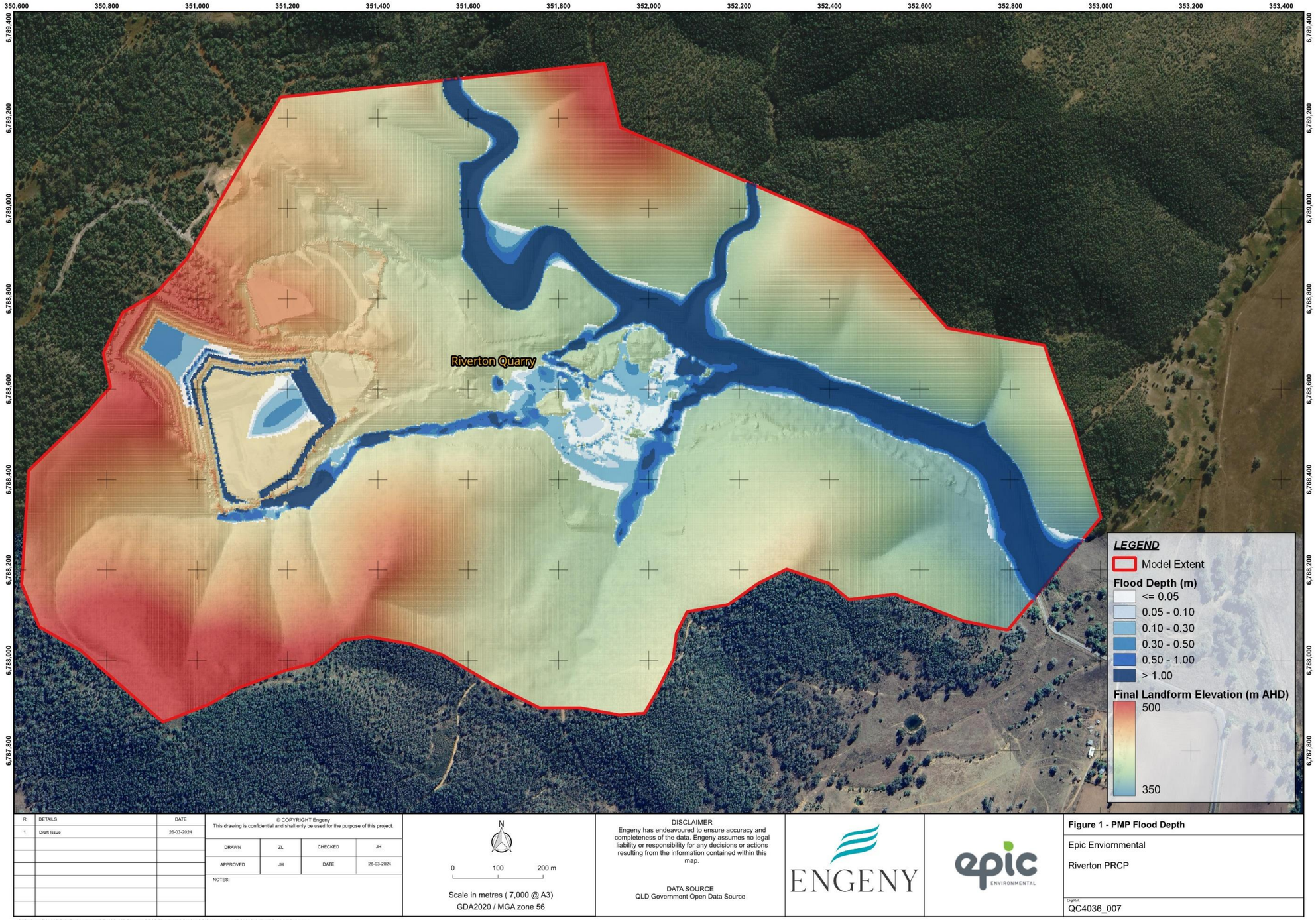

Figure 6: Final Landform PMF Flood Depth

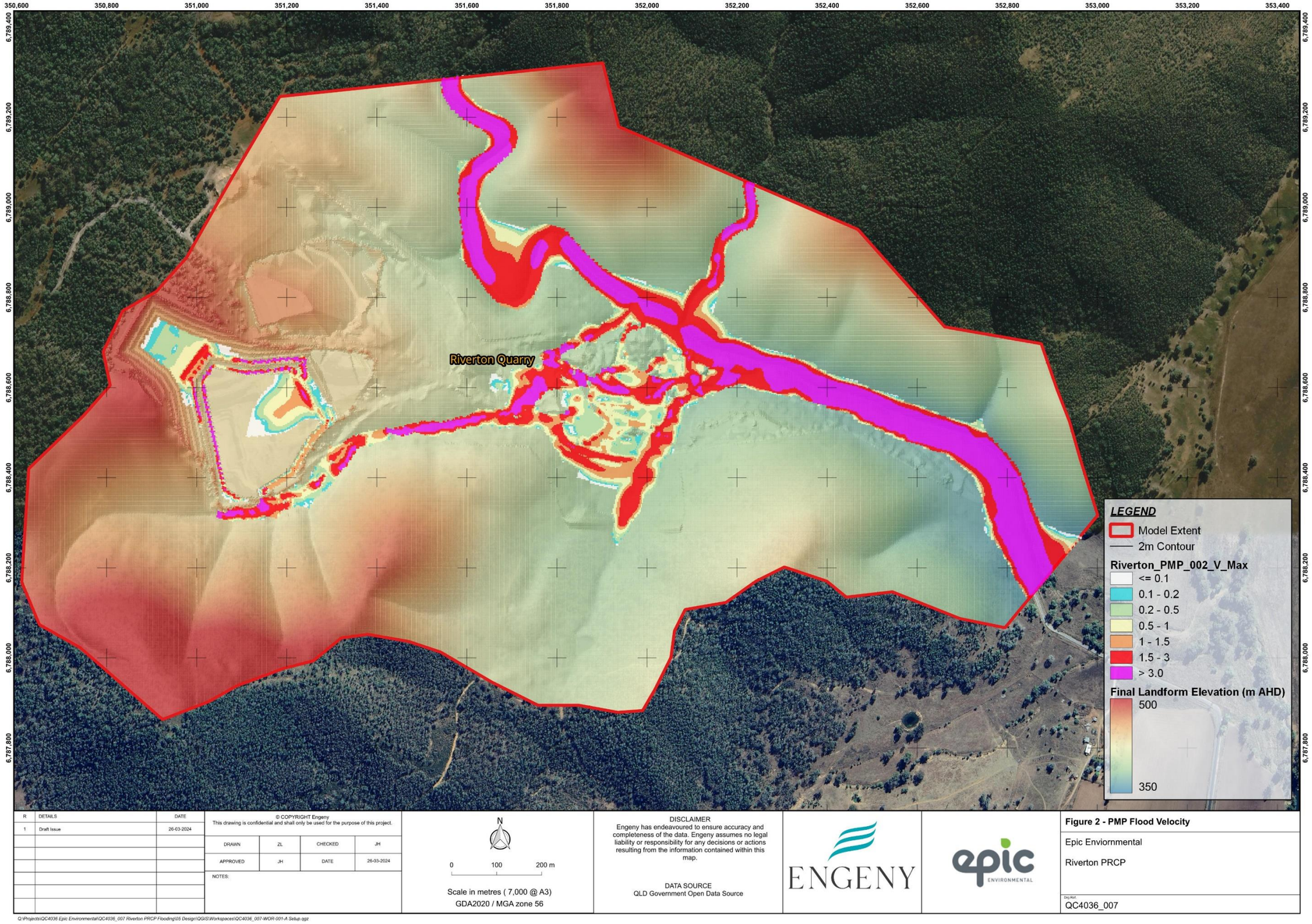

Figure 7: Final Landform PMF Flood Velocity

DISCLAIMER

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Appendix J Ecological Reports (Epic 2020 and 2025)



A Montrose Environmental Company

Ecological Assessment Report

Graymont
Riverton Mine EA Amendment
Riverton
BE210135.01
13 February 2025

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 ECAAS SAFETY MANAGEMENT ISO 45001 CERTIFIED	 ECAAS ENVIRONMENTAL MANAGEMENT ISO 14001 CERTIFIED	 ECAAS QUALITY MANAGEMENT ISO 9001 CERTIFIED

1 INTRODUCTION

Graymont (NSW) Pty Ltd (Graymont) owns and operates Riverton Limestone Quarry and Processing Plant (the project), located at Riverton, approximately two kilometres (km) east of the border between Queensland and New South Wales. The recently approved Environmental Authority (EA) EMPL00241213 (27 June 2024) was developed to support project activities until end of mine life (EOML) and to align with the transitional Progressive Rehabilitation and Closure Plan (PRCP). This has resulted in new conditions being set by the Department of Environment, Tourism, Science, and Innovation (DETSI), which are required to be addressed within a new EA application.

1.1 Project Description

The project is predominantly located within the Goondiwindi Regional Council Local Government Area (LGA), with the north-eastern area of the project located within the Southern Downs Regional Council LGA. Regionally, the project is located approximately 35 km southeast of the township of Texas in Queensland, and 70 km west of the township of Tenterfield in New South Wales. The site is located on top of the Great Dividing Range and is approximately 1 km from the nearest residence, on land described as Lot 1 SP310330 and Lot 3 RP207320 and covers an area of about 302 hectares (ha). The project comprises of resource activities (including limestone mining and processing) undertaken on two mining leases (ML) (namely ML50142 and ML50220) (the project area), which are held by Graymont (**Figure 1**).

As an outcome of the recently approved (27 June 2024) EA EPML00241213, DETSI have set additional conditions which will be required to be addressed in a new EA Amendment prior to the 27 September 2024. Specifically, Condition F2-5 states: -

> "*A map showing the location, disturbance type and disturbance area specified in Schedule F - Table 1a must be submitted to the administering authority through an amendment application in accordance with the Environmental Protection Act 1994 (EP Act) by 27 September 2024*."

Through the process of updating mapping based on the current project disturbance footprint and Schedule F - Table 1a, it has become apparent that historical disturbance occurred in areas not authorised for clearing under Map 1 of the EA (**Appendix A**). The areas were mapped as non-remnant vegetation as well as Category B (Remnant) Vegetation as informed by the regional ecosystem (RE) mapping layer at the time (Version 5). The Category B areas potentially comprised vegetation considered as a Matter of State Environmental Significance (MSES). It is noted this disturbance occurred prior to Graymont acquiring the project in 2019.

In addition to the historical unauthorised disturbance the project proposes 2.37 ha of future vegetation clearing in areas adjacent to the pit and waste rock dump (WRD) at EOML. This will be required to ensure the pit benches and the WRD slopes achieve a geotechnically stable final landform and to allow for the installation of abandonment barriers (exclusion fencing and abandonment bunds) (Rocktest 2024). 1.58 ha is proposed to be cleared for the pit and 0.79 ha is proposed to be cleared for the WRD, hereafter referred to as proposed disturbance areas (**Figure 1**).

An environmental assessment report (EAR) has been developed to assess the potential impact of the historical unauthorised disturbance (hereon referred to as 'previous disturbance area') and the 2.37 ha of proposed disturbance (hereon referred to as 'proposed disturbance area') to underlying ecological values found within the project area.

1.2 Scope and Purpose of Assessment

The scope of this assessment is the terrestrial ecological values and potential impacts of the areas identified as previous disturbance area and proposed disturbance area. The purpose of the assessment is to identify potential for significant residual impacts (SRI) to Matters of National Environmental Significance (MNES) as identified by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) *Environmental Offsets Policy October 2012* (EOP) and MSES as identified as Prescribed Environmental Matters (PEMs) under Schedule 2 of the *Environmental Offsets Regulation 2014* (Offsets Regulation).

2 ASSESSMENT METHOD

2.1 Data sources

The assessment includes a desktop review of publicly available information to ensure all ecological values of conservation significance considered relevant to the project are identified. This includes species and vegetation communities of conservation significance that potentially occur within the project area and surrounds.

Information sources accessed for this assessment included the following:

- Protected Matters Search Tool (PMST) report for MNES listed under the Environment Protection and Biosecurity Conservation Act 1999 (EPBC Act) – search based on a 10 km radius buffer centred on the coordinates: -29.0199, 151.4774 (**0**)
- Vegetation Management Reporting of regulated vegetation mapping for the project area and surrounds (administered by Department of Resources (DoR)) (DoR 2024)
- Reporting and mapping of MSES associated with the Project and surrounds (administered by the Queensland Government) (DESI 2024a)
- Queensland Government WildNet database (records within a 5 km radius around the point -29.0220, 151.4757), (administered by DETSI) (DESI 2024b)
- Flora Survey Trigger Map for Clearing Protected Plants in Queensland – Version 10.0 (DESI 2024c)
- Version 5 (v5) of the Queensland Herbarium RE map (2005-2009)
- Version 10 (v10) of the Queensland Herbarium RE map (2023)

Copies of the environmental reports are provided in **0.**

In addition, the following documents were considered in the preparation of this report:

- Graymont Riverton - Ecological Assessment Report (EAR) (Epic 2021a)
- Environmental Authority (EA) number EMPL00241213 for ML50142 and ML50220
- Riverton Limestone Mine Diversion Levee – Phase A Project (Epic 2020)
- Draft EA Amendment Supporting Report: Riverton – Ecological Assessment Report (Epic 2021b)
- Riverton Mine Progressive Rehabilitation and Closure Plan (PRCP) Pit and WRD Geotechnical Report (Rocktest 2022).

Where practical findings from the 2019 and 2021 field survey (Epic 2020; 2021) will be utilised in this assessment (**Appendix C**). The field surveys were undertaken by Epic ecologists over two-day periods in October 2019 and May 2021. The target survey areas were located in the south east extent of the ML for clearing required for drainage works adjacent to Sediment Dam B and C2 and on Lot 3 RP207320 adjacent to the north edge of ML50142 (**Appendix C**). The study area for the 2021 field survey encompassed areas within 100 m from the proposed disturbance area for the WRD and 700 m from the proposed disturbance area for the Pit. The study area for the 2019 field survey encompassed areas within 600 m of the proposed disturbance area for the WRD and the Pit. As ground truthing has not yet occurred within the proposed disturbance areas and cannot be undertaken for areas historically cleared, the impact will be assessed using the precautionary principle. Historical disturbance will be assessed against the dominant underlying ecological values mapped as occurring at the time the disturbance occurred and proposed disturbance will be assessed against current dominant underlying ecological values.

2.1.1 Database reliability

Database sources have highly variable reliability. The PMST generates a Protected Matters Report (PMR) of MNES, or other matters protected by the EPBC Act considered as potentially occurring in the area of interest. The PMST, while based on some species records, relies on predictive modelling of suitable habitats and does not necessarily reflect an actual record of the species in question for a particular location. In some instances, it generates predictions of species for which there are no records, including historical, based on habitat.

WildNet data recently collected goes through a vetting process and is generally of high quality. However, historical data based on literature and museum specimens have also been entered into the database and some of this data is not reliable. On occasion there are data entry errors that result in erroneous data, most typically through incorrect co-ordinates. Historical records older than the 1980s are excluded from the search. The Atlas of Living

(ALA 2024) incorporates the Online Zoological Collections of Australian Museums providing co-ordinates, often of high precision and sometimes including the collection date and collector. This allows accurate mapping against a Project boundary, providing valuable information for interpreting the likelihood of occurrence of particular species.

Unfortunately, a proportion of ALA records are unreliable, either being misidentifications, 'citizen science' records and other un-vetted records whose accuracy is often questionable or obviously incorrect. In some instances, mostly with historical data, the spatial error associated with a record is so large (up to 54 km and occasionally as much as 108 km) as to render the record useless from the perspective of an environmental assessment except at the landscape scale. These records have been excluded from this report.

2.1.2 Nomenclature and taxonomy

The common names of many flora and fauna species frequently vary between regions, and many species lack them altogether. Taxonomy of flora presented in this report follows that currently endorsed by the Queensland Herbarium in the *Census of Queensland Flora and Fungi 2023* (Bean 2024). The taxonomy of fauna follows the *Australian Faunal Directory* (ABRS 2023). In this report, flora and fauna species are referred to initially by both their common and scientific names and then for ease of reading, only by their common name (where the species has a common name).

2.2 Disturbance areas

2.2.1 Previous disturbance area

A review of historical imagery was undertaken utilising the QImagery, to determine when the unmapped disturbance occurred. The location and extent of unmapped disturbance was calculated utilising Map 1 of the EA (**Appendix A)**, current aerial imagery and the current disturbance footprint for the project.

The historical unmapped disturbance areas were utilised to assess the level of impact which has historically occurred to ecological values in areas mapped as current RE and unmapped areas in Map 1 of the EA. These areas were assessed against v5 of the Queensland Herbarium RE map (2005 -2009), which was the RE mapping active at the time the EA took effect on 22 February 2007. The RE extents mapped in the current RE mapping layer (v13) do not align with the v5 RE mapping layer. The current RE layer identifies REs across the project area which were not mapped at the time the EA took effect and hence do not align with Map 1 of the EA. Therefore, the historical unmapped disturbance to Category B regulated vegetation is being assessed retrospectively using the v5 RE mapping as a proxy for mapped MSES within the project area prior to 2007.

2.2.2 Proposed disturbance area

The additional 2.37 ha of clearing proposed by the project for works required at the EOML will be assessed against the v13 RE mapping. The proposed disturbance areas are provided in **Figure 1**.

2.3 Likelihood of occurrence of conservation significant flora and fauna

A likelihood of occurrence assessment has been carried out on the flora and fauna species identified in the desktop review with regard to the project area (refer **Table 5** and **Table 7**). The assessment is based on the presence of database records in the surrounding area, species ecological requirements and on-site observations of habitat features within the project area, when possible. Species included within the analysis are listed as 'known' or 'likely' to occur within the project area and its 10 km buffer.

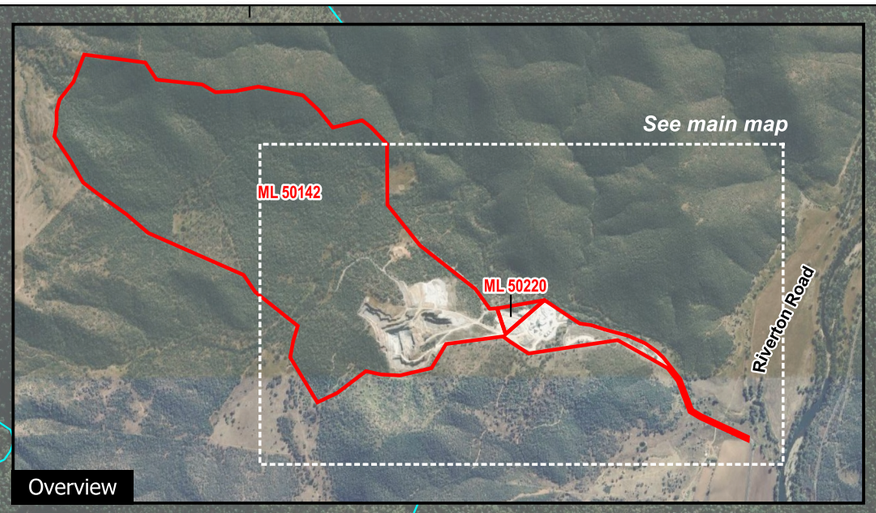
Species of conservation significance include and were sourced from the following desktop reviews:

- Flora and fauna species listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act
- Flora and fauna species listed as Critically Endangered, Endangered, Vulnerable or Near Threatened (CREVNT) under the Nature Conservation Act 1992 (NC Act)

Four categories were used to classify the likelihood of conservation significant flora species being present within the survey area. Categories were defined as:

- **Known to occur**
  - Confirmed during field assessments undertaken within the project area
  - Database records occurring within the project area
- **Likely to occur**
  - Database records occurring close to site (within 5 km)
  - Suitable habitat has the potential to occur within the site
- **Potential to occur**
  - Database records occurring in wider area (>5 km and < 25 km)
  - Suitable habitat has the potential to occur within the site
- **Unlikely to occur**
  - No database records within the wider area (> 25 km)
  - Habitat which has the potential to occur is relatively unsuitable
  - project area generally outside of known distribution for the species.

351000E
352000E
353000E
6789000N
6788000N





ML 50142

ML 50220

Riverton Road

0 100 200 m

N

Scale: 1:8,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
Google Imagery: Data SIO, NOAA, U.S.Navy, NGA, GEBCO Image © 2024 Airbus

Filepath: ...\BE2021\BE210135.01 Graymont PRCP\Workspaces\9. EAR\Rev 1\Figure 1 Proposed disturbance areas.qgz

Legend

- Site boundary
- EOML disturbance footprint
- Proposed disturbance areas
- Vegetation management watercourses and drainage features v7.0

epic
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Graymont Limited
Riverton Limestone Mine
Ecological Assessment Report

Figure 1
Proposed disturbance areas

3 RELEVANT LEGISLATION

3.1 Commonwealth Legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth EPBC Act is the key piece of Commonwealth legislation governing environmental protection in Australia. Administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW), the EPBC Act defines and protects nine MNES including:

- World heritage properties
- National heritage places
- Wetlands of international importance (listed under the Ramsar Convention)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- The Great Barrier Reef Marine Park
- Nuclear actions (including uranium mines)
- A water resource in relation to coal seam gas development and large coal mining development

Under Part 3 of the EPBC Act, a person must not undertake an action (e.g. a project, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things) that will have, or is likely to have, a significant impact on a protected matter, without approval from the Minister. If after all reasonable avoidance and mitigation measures have been taken, and there is still a residual impact on a protected matter, an offset may be required where the impact is, or is likely to be, significant.

3.1.2 EPBC Act Environmental Offsets Policy 2012

The EPBC Act EOP provides upfront guidance on the role of offsets in environmental impact assessments, and how the DCCEEW considers the suitability of a proposed offset. The EOP aims to improve environmental outcomes through the consistent application of best practice offset principles, provide more certainty and transparency, and encourage advanced planning of offsets.

3.2 Queensland State Legislation

3.2.1 Environmental Protection Act 1994

The objective of the EP Act is to protect Queensland's environment and to promote ecologically sustainable development. The EP Act defines a General Environmental Duty under which all persons in Queensland have a responsibility not to carry out an activity that causes or is likely to cause environmental harm, and to take all reasonable and practicable measures to prevent or minimise the harm.

The EP Act provides the key legislative framework for environmental management and protection in Queensland. The objective of the EP Act is to: "*Protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends*" (Section 3 of the EP Act).

Under the EP Act, Graymont must comply with the general environmental duty not to undertake an: "Activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm are taken" (Section 319 of the EP Act).

The project has approval under EA EPML00241213 which authorises the following Environmentally Relevant Activity (ERA) within ML50142 and ML50220s.

- Schedule 3 21 - A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9 to 20.

3.2.2 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) and subordinate documents (the *Nature Conservation (Animals) Regulation 2020* (NC Animals Regulation) and *Nature Conservation (Plants) Regulation 2020* (NC Plants Regulation) are in place to protect Queensland's native flora and fauna from potential environmental impacts of various activities through the nomination of threatened species, and requirements for protected plant clearing permits, species management programs, and other permits.

3.2.3 Vegetation Management Act

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of regulated vegetation in Queensland. The VM Act aims to conserve Queensland's biodiversity through vegetation management. The VM Act provides a framework for identification, description, classification and mapping of remnant and high-value regrowth vegetation communities (listed as REs, essential habitat (for protected flora and fauna) and wetland areas.

Specific area categories mapped under the VM Act (such as essential habitat and wetland areas) are considered as MSES and will be subject to significant residual impact assessment where vegetation clearing is required.

3.2.4 Environmental Offsets Act 2014 and Environmental Offsets Regulation 2014

The *Environmental Offsets Act 2014* (EO Act) is intended to counterbalance significant residual impacts of particular activities on prescribed environmental matters by way of environmental offsets. This is achieved primarily through establishment of a framework for environmental offsets, recognition of protection given to prescribed environmental matters under other legislation, provision for National, State and local matters of environmental significance to be prescribed environmental matters, and coordination of implementation of the framework in conjunction with other legislation.

The purpose of the *Environmental Offset Regulation 2014* (EO Reg) is to compensate for unavoidable impacts on prescribed environmental matters. Prescribed environmental matters are identified as Matters of State Environmental Significance (MSES) and defined in Schedule 2 of the EO Reg.

The *Queensland Environmental Offsets Policy* (QEOP) provides decision support for the assessment of offset proposals to ensure they satisfy offset conditions and meet the requirements of the EO Reg. Offsets may be delivered as either a financial settlement or as a land-based offset. Financial settlement will be paid to the State's offset account, which is managed by the Department of Environment, Tourism and Science and Innovation (DETSI), who will coordinate the on-ground delivery. However, local governments will be encouraged to collaborate with the state to identify suitable offset areas.

4 DESKTOP ASSESSMENT

4.1 Commonwealth

4.1.1 Matters of National Environmental Significance

The DCCEEW PMR identifies MNES protected under the EPBC Act considered as potentially occurring within the site and surrounds. A search of the PMST (**0**) identified the following MNES as either known, likely or potentially occurring within 10 kilometres of the project area:

- Three wetlands of national importance
- Four listed Threatened Ecological Communities (TECs)
- 64 listed threatened species (flora and fauna)
- 12 listed migratory species
- 20 listed marine species

There are no internationally important wetlands within the vicinity of the project area. The closest Internationally Important Wetlands identified are over 1000 km downstream of the Project and are not referred to further in this report.

4.2 MSES

4.2.1 Regulated vegetation

Under v5 and v13 RE mapping, the disturbance areas are mapped as a number of mixed polygons, all of which comprise RE 13.11.4 and 13.11.8. Patches of non-remnant vegetation also occur (**Table 1**).

Current RE mapping (v13) identifies the RE patches present include mapped Regulated Vegetation in both Category B (remnant) and Category C (high-value regrowth) categories. Regional Ecosystem 13.11.4 is currently listed as Least Concern under the VM Act and Of concern under the EP Act, whilst RE 13.11.8 is currently listed as Of Concern under the VM Act and Endangered under the EP Act. In addition, the area is intersected by several watercourses identified on the vegetation management watercourse map.

The previous field surveys undertaken in 2019 and 2021 by Epic confirmed the presence of RE 13.11.4 in the southeast extent of the project area, and in the surrounding land to the east (**Appendix C**). The ground truthed RE is approximately 600 m from the proposed disturbance area for the WRD and 1 km from the proposed disturbance area for the Pit and therefore the presence of RE 13.11.8 within these areas cannot be discounted without a targeted survey.

Table 1. RE mapping as occurring within previous disturbance area (v5 mapping) and proposed disturbance area (v13 mapping)

RE	Percent	Description	Structural Category	Reg veg category	VM Act Status	EP Act Status	Mapped Extent (ha)
RE map layer v5							
13.11.4/ 13.11.8	90/10%	*Eucalyptus melanophloia* woodland on metamorphics/ *E. melliodora* and/or *E. microcarpa*/ *E. moluccana* woodland on metamorphics	Sparse	B	LC / OC	OC / E	2.61
	100%	Non-remnant	-	X	-	-	12.87
RE map layer v13							
13.11.4/ 13.11.8	95%/5%	*Eucalyptus melanophloia* woodland on metamorphics/	Sparse	B	LC / OC	OC / E	4.94

RE	Percent	Description	Structural Category	Reg veg category	VM Act Status	EP Act Status	Mapped Extent (ha)
		E. melliodora and/or *E. microcarpa*/ *E. moluccana* woodland on metamorphics		C			
	100%	Non-remnant vegetation	-	X	-	-	10.53

The MSES relevant to Category B vegetation applicable to the disturbance areas have been summarised in

Table 2.

Table 2. MSES values associated with Category B vegetation within project area

MSES	Search result
Category B (remnant) areas on the regulated vegetation management map, that are 'endangered' and 'of concern' regional ecosystems	• 2.61 ha of the project area is identified as Of concern (90%)/Endangered (10%) under v5 mapping • 4.94 ha as Of Concern (95%)/Endangered (5%) under v13 mapping (refer **Table 1**).
Regulated vegetation located within a defined distance from the defining banks of a relevant watercourse identified on the VM Act watercourse and drainage feature map	The previous disturbance area is intersected by two minor non perennial watercourses encompassing regulated vegetation located within the defined distance (25 m from each bank) of the mapped watercourse.
Regulated vegetation management located within a wetland or within 100 metres from the defining bank of a wetland identified on the VM Act wetlands map	None present
Essential habitat on the essential habitat map for wildlife prescribed as endangered or vulnerable under the NC Act	None present

4.2.2 Protected wildlife habitat

Under state mapping, there is no protected wildlife habitat or essential habitat mapped for critically endangered, endangered or vulnerable wildlife within the disturbance areas. Additionally, there is no habitat mapped for species listed as SLC under the NC Act.

4.2.3 Other MSES

Table 3 summarises the finding that no other MSES are present within the project area, as identified under the *Environmental Offsets Regulation 2014.*

Table 3. Occurrence of other MSES values potentially present within project area

MSES	Search result
Protected areas (including all classes of protected area listed under the NC Act except coordinated conservation areas)	None present
Marine national parks (highly protected zones as listed under the *Marine Parks Act 2004*	None present
Declared Fish Habitat Areas as listed under the Fisheries Regulation 2008	None present
Designated precincts in a Strategic Environmental Area as listed under the Regional Planning Interests Regulation 2014	None present
Wetlands in a wetland protection area or wetlands of high ecological significance as listed under the *Environmental Protection Regulation 2019*	None present

MSES	Search result
Wetlands and watercourses in high ecological value waters identified in the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*	None present
Waterways that provide for fish passage under the *Fisheries Act 1994*	Waterways mapped under the Qld waterways for waterway barrier works mapping intersect the disturbance area. Both of the mapped waterways intersecting the previous disturbance area are mapped as low risk level.

4.3 Threatened Ecological Communities – EPBC Act

The PMST report identifies the following four TECs as possibly present with the project area:

- Natural Grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland – Critically Endangered
- New England Peppermint (*Eucalyptus nova anglica*) grassy woodlands – Critically Endangered
- Weeping Myall woodlands – Endangered
- White Box-Yellow Box-Blakely's Red Gum grassy woodland and derived native grassland (White Box TEC) – Critically Endangered

There are two REs mapped as potentially present throughout the wider area which are considered potentially analogous to the White Box TEC: RE 11.3.4 and 11.3.8. The TEC is considered a primary component of RE 11.3.8 and a smaller component of 11.3.4 (DCCEEW 2023). The current RE mapping indicates that RE 11.3.8 comprises 5% of the vegetated habitat in the local area. The 2021 survey found no occurrences of TEC within the surveyed area (Epic 2021). Nevertheless, White Box (*Eucalyptus albens*) is present and several associated tree species were also recorded including *Eucalyptus crebra, E. melanophloia*, *Callitris glaucophylla* and *Acacia deanei* and important grass species such as *Austrostipa verticillata* and *Dichanthium sericeum.* Further onsite survey works are required to determine whether the White Box TEC occurs elsewhere within the proposed disturbance area.

4.4 Conservation significant fauna

The PMR report predicted 47 fauna species, listed as threatened under the EPBC Act, as occurring within the 10 km buffer area, 12 of which are listed as migratory species (refer **Appendix B**). An additional 20 marine species were identified within the PMR however these species are dependent on marine habitat and considered irrelevant to the assessment due to the absence of this habitat. Therefore, marine species have been excluded from this assessment. Only one conservation significant fauna species listed as Special Least Concern under the NC Act has been previously recorded within the 5 km buffer search area: Osprey (*Pandion haliaetus*) (DESI 2024a).

Of the 47 conservation significant fauna species identified, 25 are 'known' or 'likely' to occur within the 10 km buffer area based on the PMR report (**Table 4**). This assessment has been focused around confirming the likelihood of occurrence of these 25 fauna species in the disturbance areas and surrounds. During the field surveys undertaken in 2019 and 2021 no conservation significant fauna species were identified (Epic 2020; 2021).

Table 4. Conservation significant fauna species identified as known or likely to occur in desktop search

Species and Status[1]	Common Name	Source	NC Act*	EPBC Act*
Mammals				
Dasyurus maculatus maculatus	Spotted-tail Quoll (southeast mainland)	PMR	E	E
Nyctophilus corbeni	Corben's Long-eared Bat	PMR	V	V
Petauroides volans	Greater Glider	PMR	E	E
Petrogale penicillata	Brush-tailed Rock-Wallaby	PMR	V	V
Phascolarctos cinereus	Koala	PMR	E	E
Birds				
Anthochaera phrygia	Regent Honeyeater	PMR	CR	CE
Aphelocephala leucopsis	Southern Whiteface	PMR	V	V
Calyptorhynchus lathami lathami	Glossy Black Cockatoo (southeastern)	PMR	V	V
Climacteris picumnus victoriae	Brown Treecreeper	PMR	V	V

Species and Status[1]	Common Name	Source	NC Act*	EPBC Act*
Falco hypoleucos	Grey Falcon	PMR	V	V
Geophaps scripta scripta	Squatter Pigeon	PMR	V	V
Grantiella picta	Painted Honeyeater	PMR	V	V
Hirundapus caudacutus	White-throated Needletail	PMR	V	V
Lathamus discolor	Swift Parrot	PMR	V	CE
Melanodryas cucullata cucullata	Hooded Robin (southeastern)	PMR	E	E
Rostratula australis	Australian Painted Snipe	PMR	E	E
Stagonopleura guttata	Diamond Firetail	PMR	V	V
Fish				
Bidyanus bidyanus	Silver Perch	PMR	E	E
Maccullochella peelii	Murray Cod	PMR	LC	V
Reptile				
Uvidicolus sphyrurus	Border Thick-tailed Gecko	PMR	V	V
Migratory				
Apus pacificus	Fork-tailed Swift	PMR	SLC	M
Myiagra cyanoleuca	Satin Flycatcher	PMR	SLC	M
Pandion haliaetus	Eastern Osprey	PMR/WildNet	SLC	M
Rhipidura rufifrons	Rufous Fantail	PMR	SLC	M

*Status abbreviations: CE = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, SLC = Special Least Concern, LC = Least Concern

4.4.1 Likelihood of occurrence of conservation significant fauna

A likelihood of occurrence assessment has been carried out on the 25 threatened fauna species considered 'known' and 'likely' to occur based on the Wildlife Online database search and the PMR generated by the Protected Matters Search Tool. This consisted of five mammal species, two fish species, one reptile species and twelve bird species (refer **Appendix B**). The assessment method has been detailed based on the known ecology and distribution of the species and observations of the habitat values present derived from the surveys in 2019 and 2021. The assessment has focused on the habitat areas associated with the previous disturbance area and the proposed disturbance area. The outcome of this assessment is detailed within **Table 5**.

Of the species subject to assessment only one is considered likely to occur: Koala. An additional nine species listed as threatened (EPBC Act and/or NC Act) and three species listed as migratory (EPBC Act) have some potential to occur.

At this stage, based on the desktop assessment, it is recommended that a targeted field survey is required to confirm the presence/absence of habitat suitable for conservation significant fauna within the proposed disturbance area.

Table 5. Likelihood of occurrence of conservation significant fauna predicted to occur within the disturbance areas and surrounds

Species and Status	Likelihood of Occurrence
Mammals	
Dasyurus maculatus maculatus – Spotted-tail Quoll (Southeast Mainland) EPBC Act: E NC Act: E	**Possible**. The closest known record is from 1994, approximately 10 km west of the disturbance areas (ALA 2024). Spotted-tailed Quoll occurs in a variety of habitats including subtropical and temperate rainforests, vine thickets, wet and dry sclerophyll forests, woodland and heathland (Belcher 2003; DELWP 2016). In Queensland they use boulder plies, fallen logs and tree hollows for shelter (Burnett & Meyer-Gleaves 2012). The species is certainly well known from the Stanthorpe region to the north-west. Suitable habitat may be present within the proposed disturbance areas.
Nyctophilus corbeni – Corben's Long-eared Bat EPBC Act: V NC Act: V	**Possible**. The closest known record is from pre-1978, approximately 10 km north of the disturbance areas. The closest recent record is from 2002, approximately 15 km to the north-east. There is a cluster of records from Maroomba State Conservation Area, approximately 25 km west (ALA 2024). In Queensland Corben's Long-eared Bat is mainly

Species and Status	Likelihood of Occurrence
	recorded in the Brigalow Belt (South) bioregion, with records from less than 30 locations (Reardon 2012). The species is most common in box/ironbark/cypress pine woodland on sandy soils (Turbill & Ellis 2006; Churchill 2008; Turbill et al. 2008), though it also occurs in *Allocasuarina luehmannii*, *Acacia harpophylla* and *Casuarina cristata* communities (Turbill et al. 2008), dry sclerophyll forests with *Corymbia citriodora*, and semi-evergreen vine thickets. The species prefers areas with a distinct canopy and a dense understorey (Churchill 2008). *Callitris glaucophylla* has previously been ground-truthed within the project area during the 2021 survey (Epic 2021) and has the potential to occur within areas mapped as RE 13.11.4. Suitable habitat may therefore be present within the proposed disturbance areas.
Petauroides volans – Greater Glider EPBC Act: E NC Act: E	**Unlikely**. The species is poorly documented for the area, with most records being around Girraween National Park or from west south-west of Tenterfield, approximately 46 km to the east (ALA 2024). The closest records are to the southeast in Torrington State Forest approximately 30 km from the disturbance areas (ALA 2024). Greater Glider lives in eucalypt-dominated forest and woodland. By day it shelters in tree hollows, feeding on eucalypts at night (McKay 2008). An individual typically uses 4-7 tree hollows as dens in its home range (Jackson 2015b), and as many as 18 dens (Kehl & Borsboom 1984). The species is absent from regenerating forest lacking old trees with suitable hollows (McKay 2008). Home ranges are about 1-4 ha in size (Kehl & Borsboom 1984). The species occurs patchily in forest with apparently suitable forest often supporting no animals. Defining habitat as suitable needs to be done carefully (Henry 1984). RE 13.11.4 and 13.11.8 are eucalyptus dominant woodlands. However, in a review of tree species associated with Greater Glider (Eyre et al. 2022), the trees present either are not previously identified as habitat (*Eucalyptus albens)* or have a very low record of use (*E. melanophloia*). Therefore the potential for suitable habitat to be present within the disturbance areas is unlikely.
Petrogale penicillata – Brush-tailed Rock-Wallaby EPBC Act: V NC Act: V	**Unlikely**. The closest known record is from 2013, 4.5 km south-east of the disturbance areas (ALA 2024). Brush-tailed Rock-wallaby lives in rocky habitats including cliffs, gorges, rocky outcrops, boulder piles and steep rocky slopes in dry eucalypt forest (Johnson 2003), rainforest and open woodland (Eldridge & Close 2008; Lundie-Jenkins 2012). It also colonises artificial habitats such as dam walls (Johnson 2003). Most sites have a northerly aspect, allowing animals to sun themselves in the morning and evening. Home ranges vary from 2-30 ha (Eldridge & Close 2008). The species forages at night and mainly feeds on grasses and forbs (Eldridge & Close 2008; Lundie-Jenkins 2012). Feeding occurs in grassy areas above or below the rocky habitats (NSW NPWS 2003) and may include pasture (Woinarski et al. 2014). While the species may occur in the wider area there will be no suitable habitat present within or near the disturbance areas.
Phascolarctos cinereus – Koala EPBC Act: E NC Act: E	**Likely**. The closest known record is from 1949, approximately 5 km to the north-east of the disturbance areas. There is a 2016 record 8 km to the east and a 1990 record 10 km to the west (ALA 2024). There is a substantial number of records in the wider surrounds. Koala occurs in forests and woodland and feeds almost entirely on the leaves of eucalypts. Its distribution is linked to the presence and abundance of food species. They are most abundant on coastal plains and in foothills but do extend inland along watercourses with *Eucalyptus camaldulensis* (Martin et al. 2008; Krockenberger et al. 2012). Koalas have been seen feeding on or sitting in 120 species of tree but only about 20 of these can be considered primary food sources (Jackson 2015a). The food preferences of the Koala vary regionally (Martin et al. 2008). *Eucalyptus albens* and *E. melanophloia* are considered locally important food trees in the region (Youngentob et al. 2021). Potential suitable habitat may be present within the disturbance areas.
Birds	
Anthochaera phrygia – Regent Honeyeater EPBC Act: CE NC Act: CR	**Unlikely**. There are a number of records to the north-east and south of the disturbance areas, mostly centred around Sundown National Park and the Severn River. The nearest record is from 1979 and 12 km to the south-east. The closest known record from this century is from 2004, approximately 25 km to the north-east. There is also a cluster of records to the south, around Severn River Nature Reserve (ALA 2024). Regent Honeyeater is restricted to south-eastern Australia where it is widespread but extremely patchy in

Species and Status	Likelihood of Occurrence
	occurrence (Garnett et al. 2011). Reporting frequency and numbers have declined significantly since the 1940s (Garnett & Crowley 2000; Higgins et al. 2001). Breeding occurs regularly west of Warwick, though only by small numbers of birds (Geering 2012). Regent Honeyeater occurs mainly in dry box-ironbark eucalypt woodland and dry sclerophyll forest (Higgins et al. 2001). They are particularly fond of vegetation associations that reliably produce nectar such as mugga ironbark *Eucalyptus sideroxylon*, yellow box *E. melliodora*, white box *E. albens* and yellow gum *E. leucoxylon* (Franklin et al. 1989; Geering & French 1998). Within these vegetation associations they are most regularly recorded from the wettest, most fertile sites with high nectar flows, such as creek flats, river valleys and lower slopes (Garnett & Crowley 2000; Geering 2012). Any possible occurrence is likely to be very sporadic and temporary.
Aphelocephala leucopsis – Southern Whiteface EPBC Act: V NC Act: V	**Possible.** There are scattered records around the disturbance areas, mostly in the north-east. The closest record is from 2008 and approximately 7 km to the south (ALA 2024). Southern Whiteface occurs in a wide range of open woodlands and shrublands usually dominated by acacias or eucalypts occurring on ranges, foothills and lowlands and plains (Higgins & Peter 2002). This species prefers habitats with an understorey of grasses or shrubs that provide cover while foraging for insects and seeds on the ground and in leaf litter (Higgins & Peter 2002; Antos & Bennett 2006; Antos et al. 2008). The species occur across a wide area of mainland Australia which extends from south of the tropics, from the northeastern edge of the Western Australian wheatbelt and east to the Great Dividing Range (Schodde & Mason 1999). RE 13.11.4 and RE 13.11.8 has habitat features analogous with the preferred habitat for this species and therefore the species has the potential to occur within the disturbance areas.
Calyptorhynchus lathami lathami – Glossy Black Cockatoo (southeastern) EPBC Act: V NC Act: V	**Unlikely.** A few scattered records occur around the disturbance areas, with two records (from 1994 and 2000) occurring approximately 15 km away. One record from 2009 occurs approximately 23 km south (ALA 2024). The South-eastern Glossy Black Cockatoo is uncommon although its distribution is widespread (DCCEEW 2022). Within Queensland, their distribution is confined to the south-east and spreads south through eastern New South Wales to eastern Victoria (DCCEEW 2022). The extent of occurrence and area of occupancy for this species is estimated to be 470,000 km^2 and 40,000 $km^{2,}$ respectively (Cameron et al. 2021). The species relies almost entirely on she-oak species (*Allocasuarina* spp. and *Casuarina* spp.) for feeding and show a high preference for individual feed trees (Higgins 1999). The South-eastern Glossy Black Cockatoo relies on tree hollows in living and dead eucalypt trees for nesting (Higgins 1999). Movement and range of this species is poorly understood, studies suggest it may be a seasonal migrant to south-east Queensland, with such movement being driven by breeding requirements and resource availability (Stock & Wild 2005). Food trees for this species are not expected to occur within RE 13.11.4 and 13.11.8 and none were recorded during the 2019 and 2021 surveys.
Climacteris picumnus victoriae – Brown Treecreeper EPBC Act: V NC Act: V	**Possible.** Scattered records occur to the east and south of the disturbance areas. A number of records (recorded in 2003 and 2010) occur approximately 10 km to the northeast and southeast (ALA 2024). The Brown Treecreeper is endemic to south-eastern Australia and in Queensland their distribution is limited to the south-eastern corner of the state from the coast to the inland slopes of the Great Dividing Range (DCCEEW 2023a). Their distribution spans From the Bunya Mountains in Queensland through central New South Wales to the Grampians in western Victoria (Schodde and Mason 1999). The species is found in eucalypt woodlands, in dry open forest and inhabits woodlands which are primarily dominated by stringybark or rough-barked eucalypts with grassy understories lacking a dense shrub layer, as well as mallee. The species requires tree hollows for nesting (Schodde and Mason 1999). RE 13.11.8 and RE 13.11.4 are mapped within the disturbance areas and surrounds. RE 13.11.4 was previously ground-truthed within the previous disturbance areas in the 2019 and 2021 surveys (Epic 2020; 2021). Both RE's are dominated by rough-barked species with grassy understories, although a relatively dense shrub layer was observed as present (which the species does not prefer). Low potential to occur.

Species and Status	Likelihood of Occurrence
Falco hypoleucos – Grey Falcon EPBC Act: V NC Act: V	**Unlikely**. The closest known record is un-dated and from approximately 54 km to the north-east (ALA 2024). This is likely to be a misidentification, though it could be a dispersing young bird. Grey Falcon occurs in semi-arid and arid parts of inland Australia, including Acacia shrublands, grasslands and wooded watercourses, typically in areas of less than 500 mm annual rainfall (Olsen 1995; Debus 1998; Aumann 2001). The species occurs sparsely in the interior and the north of the Australian mainland. Its breeding range has contracted since the 1950s and is now confined to the arid parts of its range (<250 mm annual rainfall) (Marchant & Higgins 1993; Debus 1998). Other raptor species are often misreported as Grey Falcon (Schoenjahn 2010). The disturbance areas do not comprise habitat for the species.
Geophaps scripta scripta – Squatter Pigeon (southern) EPBC Act: V NC Act: V	**Possible**. There are a number of records in the surrounding area. The closest known record is from 1956, approximately 4 km east of the disturbance areas. The closest recent record, from 2017, is from Sundown National Park, approximately 15 km to the north-east (ALA 2024). The southern subspecies of Squatter Pigeon occurs mainly in dry grassy eucalypt woodlands and open forests (Frith 1982; Crome & Shields 1992), also inhabiting Cypress Pine *Callitris* spp. and *Acacia* woodlands (Frith 1982). It mostly occurs on sandy sites near permanent water (Blakers et al. 1984), and particularly favours areas of sandy soil dissected by low gravelly ridges close to water (Frith 1982). Breeding habitat includes stony rises occurring on sandy or gravelly soils, within one km of a suitable, permanent waterbody (Squatter Pigeon Workshop 2011), and alluvial areas, which are also important habitat (Frith 1982). Birds will forage along roads and railway lines (Lord 1956; Longmore 1976) and are often found around homesteads, cattle yards (Pizzey 1980) and occasionally even highly modified areas such as bitumen car parks (Reis 2012). The presence of RE 13.11.4 and RE 13.11.8 within the disturbance areas suggests that there is the potential for suitable habitat to occur for this species. Nevertheless, the species is generally not associated with vegetation communities on land zone 11 and a relatively dense shrub layer was observed as present (which the species does not prefer) during previous surveys. Low potential to occur.
Grantiella picta – Painted Honeyeater EPBC Act: V NC Act: V	**Unlikely**. The closest known record is from 2018, approximately 15 km north-east of the disturbance areas (ALA 2024). There are a number of other records in the wider area surrounding the disturbance areas. Painted Honeyeater occurs mainly in dry open woodlands and forests with a strong association with mistletoe (Higgins et al. 2001). The species prefers woodlands with many mature trees, as these host more mistletoes (Oliver et al. 2003). Woodlands dominated by acacias (e.g. *Acacia harpophylla*, *A. pendula*, *A. aneura*) are particularly favoured, but the species also occurs in *Casuarina cristata*, *Allocasuarina luehmannii*, *Callitris glaucophylla* and riparian woodland of *Eucalyptus camaldulensis* (Barea & Watson 2007; Garnett et al. 2011; Watson 2012). Although *Callitris glaucophylla* has previously been ground-truthed as occurring within the disturbance areas during the 2021 survey (Epic 2021) the preferred Acacia dominated habitat the species prefers is not present.
Hirundapus caudacutus – White-throated Needletail EPBC Act: V NC Act: V	**Possible.** The closest known record is from 1976, approximately 10 km north of the disturbance areas. The closest recent record is from 2018, approximately 13 km to the north-east (ALA 2024). In Australia, White-throated Needletail is almost completely an aerial species, possibly even sleeping on the wing. The species is sometimes found roosting in trees and may on rare occasions rest in trees and on the ground during the day. White-throated Needletails are found over a wide variety of habitat, including open areas, modified land and the ocean but are most often recorded over wooded areas (Higgins 1999).
Lathamus discolor – Swift Parrot EPBC Act: CE NC Act: E	**Unlikely**. The closest known record is from 2002, approximately 14 km to the north-east. It is one of two records for Sundown National Park (ALA 2024). There are other records scattered in the surrounding area. Swift Parrot breeds in Tasmania and spends the winter on the mainland, where it is most common in Victoria and eastern New South Wales, and infrequently recorded in Queensland (Higgins 1999; Garnett et al. 2011). The species is probably annual in Queensland in small numbers (Higgins 1999; Saunders 2012).

Species and Status	Likelihood of Occurrence
	On mainland Australia, the Swift Parrot mainly occurs in dry open eucalypt forest and woodland, usually box-ironbark communities, especially with species such as Mugga Ironbark (*Eucalyptus sideroxylon*), Grey Box (*E. microcarpa*), River Red Gum (*E. camaldulensis*) and Swamp Mahogany (*E. robusta*) (Higgins 1999; Kennedy & Overs 2001). None of these species are characteristic of RE 13.11.4 and RE 13.11.8 and therefore it is unlikely for suitable habitat to occur within the proposed disturbance areas. Any possible occurrence is likely to be very sporadic and temporary.
Melanodryas cucullata cucullata – Hooded Robin (southeastern) EPBC Act: E NC Act: E	**Possible.** Few records exist around the disturbance areas, with some scattered records occurring to the east. The closest record is from 2003 and approximately 10 km northeast (ALA 2024). The southeastern Hooded Robin occurs in the south-east of Australia, from the far southeast of Queensland to Yorke Peninsula, South Australia (Schodde & Mason 1999). Populations of South-eastern Hooded Robin are not particularly fragmented. However, some fragmented populations do occur and are considered to be genetically isolated (Ford et al. 2021). Preferred habitat for this species is dry eucalypt and acacia woodlands and shrublands with an open understorey, grassy areas and a complex ground layer. This species generally avoids habitat with tall trees and dense cover, although has been found in tall, dense heaths with scattered open areas (DCCEEW 2023b). Hooded Robins forage on the ground for small lizards and invertebrates and prefer grassy clearings with rocks and fallen timber (Antos et al. 2008). Breeding season is between July and November. This species shows high site fidelity during breeding season, typically forming monogamous pairs and returning to the same breeding site each season (DCCEEW 2023b). RE 13.11.4 and RE 13.11.8, mapped as occurring within the disturbance areas has the potential to provide suitable habitat for this species.
Rostratula australis – Australian Painted Snipe EPBC Act: E NC Act: E	**Unlikely**. The closest known record is from 2015, approximately 50 km south of the disturbance areas (ALA 2024). There are few other records in the region. Australian Painted Snipe is extremely nomadic, moving in response to local rainfall and flooding (Marchant & Higgins 1993). Breeding only occurs in swamps with temporary water regimes and complex shorelines (Rogers et al. 2005; Geering et al. 2007). During non-breeding periods they may be found in a wider range of habitats including dams, grasslands, roadside drains and even brackish waterways (Marchant & Higgins 1993). There is no suitable waterbody within the project area.
Stagonopleura guttata – Diamond Firetail EPBC Act: V NC Act: V	**Possible.** Scattered records exist around the disturbance areas, with the majority occurring to the east. The closest record is from 2023 and approximately 3 km to the northeast. There are 10 other records within 10 km of the project area (ALA 2024). Diamond firetails occur from southeast Queensland to Eyre Peninsula, South Australia, with their distribution spanning approximately 300 km inland from the sea (Higgins et al. 2007). Their range has contracted from north Queensland inland from Cardwell, to now only occurring in the southeast corner of the state (Hodder et al. 2021). Diamond Firetails occur in woodlands where the dominant species are eucalypt, acacia or casuarina. The species is also found in open forest or lightly timbered habitats such as farmland and grasslands with scattered trees and have a preference for habitat with low tree density and high grass cover (Higgins et al. 2007; Antos et al. 2008). Grass cover is essential for feeding as the species feeds on ripe and partly-ripe grass and herb seeds and green leaves, sometimes also consuming insects - particularly during the breeding season, between January and August (Blakers et al. 1984; Read 1994) The presence of RE 13.11.4 and RE 13.11.8 within the disturbance areas and surrounds suggests that suitable habitat may occur, although a relatively dense shrub layer was observed as present (which the species does not prefer) during previous surveys.
Fish	
Bidyanus bidyanus – Silver Perch EPBC Act: E NC Act: E	**Unlikely.** Records of this species within southeast Queensland are sparse. The closest record is from 2015 and approximately 33 km to the south (ALA 2024). The Silver Perch has been translocated widely for recreational and conservation purposes however its natural range is endemic to the Murray Darling Basin (MDB) (DCCEEW 2024). Historically, this species was one of the most abundant species in the MDB, however its distribution

Species and Status	Likelihood of Occurrence
	within the MDB is now wide, patchy and highly variable (DCCEEW 2024). The species occupies two major geographic regions – Northern and Southern MDB. Northern MDB habitat areas relevant to Queensland include Warrego, Culgoa and Condamine rivers (DCCEEW 2024). There is no suitable habitat on or near the disturbance areas.
Maccullochella peelii – Murray Cod EPBC Act: V NC Act: -	**Unlikely**. Records of this species surrounding the disturbance areas are sparse, with the closest record from 2020 approximately 6.5 km to the north in the Glenlyon Dam. Two other records exist from 2005 approximately 14.5 km to the east in the Mole River (ALA 2024). Murray Cod is widely distributed through the rivers of the Murray-Darling Basin. The species occurs in a wide range of habitat in lower to mid river reaches, though they are also present on some headwaters. They live in river channels but also occur in dams. They prefer slow flowing water with large amount of large, submerged wood (snags) and overhanging vegetation (Koehn 2012; Todd & Koehn 2012). There is no suitable habitat on or near the disturbance areas.
Reptiles	
Uvidicolus sphyrurus – Border Thick-tailed Gecko EPBC Act: V NC Act: V	**Possible.** There are scattered records surrounding the disturbance areas. The closest known record is from 2003, approximately 18 km to the east of the project area. There are three 2020 records from Torrington State Conservation Area, approximately 23 km to the south (ALA 2024). There is a 2011 record 30 km to the northwest from similar habitat as occurs in the project area. Border Thick-tailed Gecko is poorly known. It is found in dry open eucalypt of *Callitris* woodland, appearing to favour rocky hills with boulders, rock slabs, stones, fallen timber and deep leaf litter (Hines 2012; Cogger 2014). It is terrestrial and shelters under rocks and logs (Hines 2012; Wilson 2015). Suitable habitat may be present within the proposed disturbance area.
Migratory	
Apus pacificus Fork-tailed Swift EPBC: M NC Act: SLC	**Possible.** In Australia, Fork-tailed Swift is almost exclusively an aerial species, probably even sleeping on the wing, though individuals are occasionally recorded roosting in trees. The species forages for aerial invertebrates and foraging occurs over a wide variety of habitats including towns and cities, open areas, farmland, coastal areas and sometimes forest (Higgins 1999).
Myiagra cyanoleuca Satin Flycatcher EPBC Act: M NC Act: SLC	**Possible.** The closest record is located approximately 13 km northeast of the disturbance areas recorded in 1999. The most recent record is located approximately 16 km from the project area and recorded in 2008 (ALA 2024). Satin Flycatcher occurs in wet, dense forests, often at high elevations, and also in gullies and near watercourses (Boles 1988; Higgins et al. 2006). The species inhabits east coast forests (Menkhorst et al. 2017), avoiding dry habitats and is virtually confined to the east of the Great Dividing Range (Boles 1988). During passage it may occur in coastal forests, woodlands, mangroves, gardens and trees in open country (Pizzey 1980). Due to the potential presence of RE 13.11.4 and RE 13.11.8 within the project area, suitable habitat may be present.
Rhipidura rufifrons Rufous Fantail EPBC Act: M NC Act: SLC	**Possible.** The closest records to the disturbance areas are located in a cluster approximately 16 km northeast of the project area, the most recent confirmed occurrence was in 2021 (ALA 2024). Rufous Fantail are migratory species found on the eastern coast of Australia. They prefer moist, dense habitats which can comprise mangroves, rainforest, thickets, riparian forests and wet eucalypt forests with a dense understory. The species is known to inhabit dry eucalypt forests and woodlands when on passage (Commonwealth of Australia, 2015). Due to the potential presence of RE 13.11.4 and RE 13.11.8 within the disturbance areas, suitable habitat may be present, this would only be utilised during times of passage in autumn and spring.
Pandion halietus Osprey EPBC Act: M NC Act: SLC	**Unlikely.** Two ALA records for this species are located within 5 km of the disturbance areas. The typical distribution and habitat favoured by eastern osprey is coastal areas and offshore islands, sometimes inhabiting open river systems and areas located beyond tidal plains. Additionally, the eastern osprey infrequently visits inland regions during periods of high rainfall (ALA 2024). The disturbance areas and surrounds do not comprise habitat for the species. Will not occur.

4.5 Conservation significant flora

A total of 29 conservation significant flora species were identified within the PMR, with 13 listed as 'known' or 'likely' to occur based on the Wildlife Online database search and the PMR generated by the Protected Matters Search Tool (**Table 6** and **0**). No conservation significant flora species listed under the NC Act were mapped as occurring within the disturbance areas or within the 5 km buffer area (DESI 2024a). No protected plants are mapped within the disturbance areas or surrounding area, determined based on a review of the Flora Survey Trigger Map for Clearing Protected Plants in Queensland – Version 10.0 (DESI 2024b) (**0**).

This assessment has been focused around confirming the likelihood of occurrence of these flora species in the disturbance areas. No conservation significant flora species were identified in the survey undertaken within the southeast extent of the project area in 2021 (Epic 2021).

Table 6. Conservation significant flora species identified as known or likely to occur in desktop search

Species and Status[1]	Common name	Source	NC Act	EPBC Act
Acacia macnuttiana	McNutt's Wattle	PMR	-	V
Acacia pubifolia	Velvet Wattle	PMR	-	V
Boronia granitica	Granite Boronia	PMR	-	E
Cadellia pentastylis	Ooline	PMR	V	V
Callistemon pungens	-	PMR	-	V
Dichanthium setosum	Bluegrass	PMR	-	V
Eucalyptus caleyi subsp. *ovendenii*	Ovenden's Ironbark	PMR	-	V
Eucalyptus mckieana	McKie's Stringybark	PMR	-	V
Lepidium peregrinum	Wandering Pepper-cress	PMR	-	E
Leucopogon confertus	Torrington Beard-heath	PMR	-	E
Macrozamia cranei	Crane's macrozamia	PMR	E	E
Rutidosis heterogama	Heath Wrinklewort	PMR	-	V
Thesium australe	Austral Toadflax	PMR	V	V

4.5.1 Likelihood of occurrence of conservation significant flora

A likelihood of occurrence assessment has been carried out on the 13 threatened flora species considered 'known' and 'likely' to occur based on the PMR generated by the Protected Matters Search Tool. The assessment method has been detailed based on the known ecology and distribution of the species and observations of the habitat values present derived from the surveys in 2019 and 2021. The assessment has focused on the habitat areas associated with the previous disturbance and the proposed disturbance. The outcome of this assessment is detailed within **Table 7**.

Of the species subject to assessment two species are considered have some potential to occur.

Table 7. Conservation significant flora predicted to occur within 10 km of the project area

Species and Status[1]	Likelihood of Occurrence
Acacia macnuttiana – McNutt's Wattle EPBC Act: V NC Act: -	**Unlikely.** This species has been recorded in areas to the southeast of the disturbance areas, with the closest record recorded in 2021 and approximately 17 km southeast in NSW (ALA 2024). The distribution of McNutt's Wattle is restricted to scattered areas within NSW, with the species occurring from New England Tablelands to just onto the North West Slopes. The species is found most commonly in Boonoo Boonoo Falls area and around Torrington (DECC, 2005). This species occurs in dry sclerophyll forests, woodland and heath, and prefers sandy soil on acid granite substrates, often occurring in riparian areas near streams and gorges and among boulders (Harden 1991; Tame 1992; Sheringham & Westway 1995; Orchard and Wilson 2001). McNutt's Wattle is often found with associated species such as *Allocasuarina littoralis*, *Angophora floribunda*, *Bursaria spinosa, Callistemon flavovirens*, *Eucalyptus biturbinata*, *Leptospermum brachyandra*, *Lophostemon confertus* and *Pomaderris* sp. (Quinn et al. 1995; Sheringham & Westaway 1995). Species is unlikely to occur.

Species and Status[1]	Likelihood of Occurrence
Acacia pubifolia – Velvet Wattle EPBC Act: V NC Act: -	**Unlikely.** Records occur in patches to the northeast and south of the disturbance areas. The closest record was recorded in 2008 and is located approximately 22 km to the southeast (ALA 2024). Velvet Wattle is found exclusively in the Darling Downs, between Glen Aplin and Wallangarra, in south-eastern Qld and to northern NSW, where it is less common (Orchard & Wilson 2001). In Queensland, it is commonly found in locations including the Wyberba district, south of Stanthorpe and drier western sections of the Girraween National Park (McDonald et al. 1995). In Queensland, it occurs mostly in heath, shrubland, forest and woodland communities on rocky granite areas with associated species such as in eucalypt-scrub woodland or Eucalyptus-Callitris forest (McDonald et al. 1995; McDonald 2001, pers. comm.). The disturbance areas occur on metamorphic soils - not the granite soils which the species is associated with.
Boronia granitica – Granite Boronia EPBC Act: E NC Act: -	**Unlikely.** Records of this species occur to the south of the disturbance areas within the Torrington State Conservation Area. The closest record is approximately 14 km to the south (ALA 2024). Granite Boronia is found in Queensland and NSW in the New England Tablelands and Nandewar IBRA bioregions (OEH 2014). In Queensland, the species has an estimated population of 1450 plants and with record from the Stanthorpe area Donatiu, 2006. It is unknown how many subpopulations exists in Queensland, however, the species has been recorded from 10 different sites in the State (NSW NPWS, 2002). This species typically occurs in exposed areas with low precipitation such as rocky outcrops or crevices with shallow granitic soils, or forests and woodlands on granite scree (OEH 2014). In Queensland, the species is found in the following regional ecosystems: 13.12.2 New England blackbutt (*Eucalyptus andrewsii*), Youman's stringybark (*Eucalyptus youmanii*) woodland on igneous rocks; 13.12.3 Wallangarra white gum (*Eucalyptus scoparia*) woodland on igneous rocks; 13.12.4 broad-leaved stringybark (*Eucalyptus caliginosa*) Forest Red Gum (*Eucalyptus tereticornis*) open forest on igneous rocks; 13.12.5 Youman's stringybark on igneous rocks; 13.12.6 Shrubland on igneous rocks (Donatiu, 2006). The disturbance areas occur on metamorphic soils (land zone 11) - not the granite soils which the species is associated with.
Cadellia pentastylis – Ooline EPBC Act: V NC Act: V	**Unlikely.** The closest record is approximately 9.15 km east from 1998 (ALA 2024). It tends to occur as an emergent tree in softwood scrubs alongside Brigalow (*Acacia harpophylla*), Bottle Trees (*Brachychiton rupestris*), Wilga (*Geijera parviflora*) and Belah (*Casuarina cristata*). Prefers the more fertile deep basalt soils as well as residual sandstone ranges and slopes. Suitable habitat is very unlikely to be present.
Callistemon pungens – EPBC Act: V NC Act: -	**Unlikely.** Records of this species occur to the south in Torrington State Conservation Area, and to the northeast towards Stanthorpe. The closest record is from 2021 and is approximately 21 km to the south (ALA 2024). *Callistemon pungens* is endemic to south-east Queensland and in northeast NSW. In southern Queensland, it's found in the Stanthorpe region within Border Rivers and Maranoa–Balonne (Queensland) (DCCEEW 2008). This species grows in rock crevices, specifically granite and trachyte, in forest and heath on sandy or shallow rocky soil (DCCEEW 2008). The disturbance areas occur on metamorphic soils (land zone 11) - not the granite soils which the species is associated with.
Dichanthium setosum – Bluegrass EPBC Act: V NC Act: -	**Unlikely.** The closest record for this species was recorded in 2022, approximately 30 km south west of the project area in NSW (ALA 2024). *Dichanthium setosum* is associated with heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil (and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DEWHA 2008a). No suitable habitat present.

Species and Status[1]	Likelihood of Occurrence
Eucalyptus caleyi subsp. ovendenii - Ovenden's Ironbark EPBC Act: V NC Act: -	**Possible.** There is a cluster of records located approximately 3.4 km east of the project area from 1982 (ALA 2024). Ovenden's Ironbark grows on shallow soils in dry, open grassy woodlands on granite substrates. Associated species include Yellow Box (*E. melliodora*), Tumbledown Red Gum (*E. dealbata*), White Box (*E. albens*), Silver-leaved Ironbark (*E. melanophloia*), and Wilga (*Geijera parviflora*) (DEWHA 2008b). It was not identified during the surveys in 2019 and 2021 and the land zone appears incorrect for the species (metamorphic). Nevertheless, White Box and Silver-leaved Ironbark were recorded and the species has potential to occur within the project area.
Eucalyptus mckieana – McKie's Stringybark EPBC Act: V NC Act: -	**Unlikely**. Records of this species are limited, with a few occurring to the south in Torrington State Conservation area and to the northeast Towards Stanthorpe. The closest record is approximately 24 km to the south and was recorded in 2019 (ALA 2024). *Eucalyptus mckieana* is patchily distributed across a small area of the Northern Tablelands and northwest slopes of NSW with its distribution spanning from Tenterden west to the Gilgai area (Quinn et al. 1995; Peacock 1996). This species grows in flat areas and areas with gentle undulation and is found on a range of soil types. Most commonly it's found on sandy loams derived from granites and quartz porphyrites but can also grow on deep clay loams on metasediments (Quinn et al. 1995; Peacock 1996). Suitable habitat does not occur.
Lepidium peregrinum – Wandering Pepper-cress EPBC Act: E NC Act: -	**Unlikely.** The closest record is located close to the Dumaresq River approximately 5 km north-east from the disturbance areas in 2017 (ALA 2024). Wandering Pepper-cress is a sprawling herb to 50 cm with many thin, wiry branches. The species has been recorded in riparian areas and on the edges of open forest and rainforest at elevated sites (Leiper et al 2008). This species is known to occur within the New England Tableland and Southeast Queensland Bioregions. The species is most associated with riparian habitat and adjacent fringes. Suitable habitat is unlikely to occur.
Leucopogon confertus – Torrington Beard-heath EPBC Act: E NC Act: -	**Unlikely.** The closest records are approximately 20 km to the south, however misidentification of this species with the common species *Leucopogon attenuatus* has been known to occur (ALA 2024). *Leucopogon confertus* has few confirmed records near Torrington in the NSW Northern Tablelands (OEH 2022) Other records are believed to be misidentification of the common species *Leucopogon attenuatus* (Harden 1992; Copeland 2002, pers comm). Further records have not been documented and it is thought the species could be extinct (Copeland 2002 pers comms). The habitat of this species is not well understood, but it is considered to grow in open forest or woodland in rocky granite areas (DECC 2005). Suitable habitat does not occur.
Macrozamia cranei - EPBC Act: E NC Act: E	**Possible.** The closest record is approximately 15.41 km north-east from 2017 (ALA 2024). RE 13.11.4 is listed as potential habitat (QH 2007). *Macrozamia cranei* occurs on hilly terrain between 400-650 m above sea level. It grows on steep ridges in shallow, skeletal soil, among granite and limestone rocks and along seasonal/temporary watercourses. The species has been recorded in open forest communities and in fragmented semi-evergreen vine thicket (DES 2019). Cycads are a distinctive plant taxa that are generally easily observed. No cycads were identified within the 2019 or 2021 surveys. Nevertheless, due to the mapped extent of RE 13.11.4 across the disturbance areas, it has potential to occur.
Rutidosis heterogama – Heath Wrinklewort EPBC Act: V NC Act: -	**Unlikely.** The closest record for the species is located in Torrington State Conservation Area in NSW, approximately 16 km south of the project area, recorded in 2020 (ALA 2024). A large cluster of the species is located further south, within the state forest (ALA 2024).

Species and Status[1]	Likelihood of Occurrence
	Rutidosis heterogama has been recorded in the Central Coast of NSW, from Wyong to Newcastle. North coast populations within NSW have been found between Wooli, Evans Head in Yuraygir and Bundjalung National Parks (OEH 2017). Other notable records occur in the New England Tablelands from Torrington and Ashford south to Wandsworth southwest of Glen Innes (OEH 2017). In the Torrington area it grows in heath, open forest and woodlands on granitic soils (DEWHAc 2008). Suitable habitat is unlikely to occur within the disturbance areas.
Thesium australe - Austral Toadflax EPBC Act: V NC Act: V	**Unlikely.** The closest record (2020) is approximately 30 km west-southwest of the disturbance areas (ALA 2024). The species grows in grassland or woodland, often in damp sites. The species is semi-parasitic on roots of grass species, and particularly Kangaroo Grass (*Themeda triandra*) and occurs in subtropical, temperate and subalpine areas on soils derived from sedimentary, metamorphic and igneous geology. The species can occur on a range of soils such as black clay loams, yellow podzolic and peaty loams (DCCEEW 2024b). Suitable habitat is unlikely to be present..

1. Status: CE: Critically Endangered, E: Endangered, V: Vulnerable

5 POTENTIAL PROJECT IMPACTS AND MITIGATION RECOMMENDATIONS

5.1 Previous disturbance area impacts

Available satellite imagery from 2006 and 2017 confirms that much of the clearing of the previous disturbance areas occurred between 1970 and 2006, prior to the EA taking effect on 22 February 2007, and the remaining area was cleared between 2007 to 2017, prior to Graymont acquiring the Project in 2018. The extent of previous disturbance area has been overlaid on historical aerial imagery from 2006 as identified in **Figure 2.** It is noted clearing in some of these areas had already occurred prior to the EA taking effect in 2007.

A total of 13.82 ha of previous disturbance was identified for the project, a comprehensive breakdown of the extent that these areas have impacted upon REs and non-remnant vegetation (as mapped at the time) has been provided in **Table 8**.

Table 8. Extent of previous disturbance area impacts

RE	Disturbance (ha)
RE 13.11.4/RE13.11.8	1.07
RE within the defined distance from the defining banks of a watercourse.	0.07
Non-remnant	12.75

5.1.1 Threatened species habitat

The previous disturbance area almost entirely impacted areas that were mapped as unmapped areas (non-remnant habitat) which held no value for threatened fauna. While aerial imagery from 2006 indicates some minor areas of trees occurred in the unmapped areas, these were largely located in already disturbed habitats adjacent to existing mining impact. These areas would have had minimal value for threatened fauna. Approximately 2 ha of wooded habitat appears to have occurred within lands mapped as unmapped areas (non-remnant) within ML 50220. These lands may have provided habitat for threatened flora and fauna.

The previous disturbance areas occur within a mosaic of cleared lands and extensive tracts of contiguous woodlands, most of which comprise the identical REs mapped as occurring onsite. An analysis of current RE mapping (v13) identifies there are 14,892 ha of lands comprising RE 13.11.4 and/or 13.11.8 within a 10 km radius of the previous disturbance areas. This does not include identical vegetation communities occurring within a 10 km radius in New South Wales. The 1.07 ha of impacted RE 13.11.4 and/or 13.11.8 which occurred due to the previous disturbance is a very minor proportion of the available habitat in the local area which would have had a negligible impact on threatened flora and fauna, should any have occurred in the local area.

5.2 Proposed disturbance area impacts

A total of 2.37 ha of clearing is proposed by the project in the proposed disturbance areas required for the Pit and WRD at EOML (**Figure 3**). A comprehensive breakdown of the impact these proposed disturbance areas will have upon REs and non-remnant vegetation has been provided in **Table 8**.

The proposed disturbance area will result in the clearing of approximately 2.25 ha of the mixed polygon RE 13.11.4/RE 13.11.8. Most of this disturbance occurs within areas mapped as ‘area of RE removal’ within Schedule I Map 1 of the EA, and therefore only 0.30 ha of disturbance is considered assessable for potential impacts at State level. This does not apply to the EPBC Act, and the whole disturbance of 2.25 ha will require assessment of potential impacts to MNES.

Table 9. Extent of proposed disturbance area impacts

RE	Disturbance (ha)
RE 13.11.4/RE13.11.8	2.25
RE within the defined distance from the defining banks of a watercourse.	0.004
RE within 5m buffer of watercourse	0.001
Non-remnant	0.12
Total	2.37

5.2.1 Threatened species habitat

The proposed disturbance area will result in the clearing of approximately 2.25 ha of RE 13.11.4/RE 13.11.8. This area of remnant eucalypt woodland may provide potential habitat for several conservation significant flora and fauna species.

The proposed disturbance areas occur within a mosaic of cleared lands and extensive tracts of contiguous woodlands, most of which comprise the identical REs mapped as occurring onsite. An analysis of current RE mapping (v13) identifies there are 14,892 ha of lands comprising RE 13.11.4 and/or 13.11.8 within a 10 km radius of the previous disturbance areas. This does not include identical vegetation communities occurring within a 10 km radius in New South Wales.

The remainder of vegetation impacts are limited to areas mapped as non-remnant vegetation that do not provide habitat for threatened flora and fauna species.

5.3 Habitat fragmentation

Historically the site has fragmented remnant vegetation due to authorised clearing for the project. Additionally, the surrounding region has been historically cleared for native grazing purposes, which has also led to habitat fragmentation. The historical disturbance areas largely impacted areas that had already been cleared prior to 2007. As such the impact to local habitat connectivity was negligible and would have not had a significant impact on habitat fragmentation within the project area.

The proposed disturbance of 2.25 ha is minor in extent and limited to areas adjacent to the pit (1.58 ha) and WRD (0.79 ha) and is connected to a contiguous patch of vegetation. In both areas, the clearing will not cause any additional areas to become isolated (i.e. fragmented). The impact to local habitat connectivity will be negligible. Landscape scale fragmentation impacts will not occur.

5.4 Direct mortality

Clearing of vegetation for the project presents a minor risk of direct mortality or injury to fauna. Common birds and mammals are likely to move away from disturbance during the construction phase. However, appropriately qualified fauna spotter/catchers are recommended to be used during the clearing process and procedures must be in place so that any clearing be halted immediately should any conservation significant fauna species be observed.

5.5 Weeds and pest animals

The following activities associated with the proposed disturbance area have the potential to promote the proliferation of weeds and pests within the Study area, or introduce new weeds and pests from surrounding areas:

- The use of construction machinery, plant and materials sourced from outside the region and increased vehicular traffic in general may introduce and spread weed seeds if biosecurity hygiene measures are not in place
- Land clearance favours the establishment of weeds due to increased light and soil disturbance
- Inappropriate disposal and storage of putrescible wastes may attract feral animals

The pests and weeds currently occurring within the proposed disturbance area are not expected to significantly proliferate in response to the proposed clearing activities. The main threat is the introduction of new weeds to the area via contaminated vehicles or soils. Impacts will be managed by implementing biosecurity hygiene and control measures during the works as is already carried out under existing operational environmental management procedures.

5.6 Recommended mitigation measures

It is recommended that the proponent commit to mitigation measures that minimise impacts to ecological values associated with the site. In the first instance, a site survey of the proposed disturbance area and immediate surrounds should be carried out. The survey should at a minimum determine the presence (or not) of TECs and threatened flora within the proposed disturbance area, and the suitability of the habitat to support those threatened species considered to have potential to be present from the desktop review in this assessment.

The detailed design process should aim to reduce the area of impact to habitat areas (i.e. remnant eucalypt woodland) as much as is feasible for the upgrade works. Where avoidance is not possible, a number of mitigation strategies should be implemented as part of the proposed works as outlined in **Table 10**.

Table 10. Recommended mitigation measures

	Management Measure	Timing
Clearing of vegetation		
1	Where possible the overall construction footprint will be refined and minimised further during the final design process	Final design
2	Vegetation clearing extents will be clearly demarcated with flagging or bunting prior to clearing to limit the area safely and reasonably required for the works	Prior to clearing
3	Employees will be made aware of environmental obligations and compliance requirements through the site induction program.	Site induction
4	Nominated site representative will monitor vegetation clearing extents to ensure clearing does not extend beyond demarcated area.	During clearing
Direct mortality		
1	Standard requirements for a pre-clearing inspection (with regard to tree clearing) by a suitably qualified fauna spotter catcher. Fauna spotter catcher to be present during tree clearing.	Prior to and during clearing
Weeds and Pest Animals		
1	All plant and vehicles coming to the project must have a weed hygiene certificate to avoid the introduction of weed and seeds.	Ongoing
2	Disposal and storage of putrescible wastes must be undertaken appropriately to ensure feral animals aren't attracted to the works area.	Ongoing
3	Weeds will be removed or treated prior to clearing.	Ongoing
Water Management		
1	Erosion and sediment controls will be developed and implemented prior to the upgrade works commencing.	Pre-construction
2	The construction contractor will prepare and implement a Construction Erosion and Sediment Control Plan for the duration of the Project.	Prior to and during construction
3	Applicable materials/chemicals will be stored and handled in accordance with relevant legislative requirements and Australian Standards.	Ongoing

Unauthorised current RE disturbance impacts within Historical Regional Ecosystem v5		
RE	Status	Area (ha)
13.11.4/13.11.8	Of concern-subdominant	0.807
Non-remnant	Non-remnant	0.016

ML 50142

ML 50220

Riverton Road

351000E

352000E

353000E

6789000N

6788000N

0 100 200 m

N

Scale: 1:8,000 @ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2023
© Imagery - QGlobe - 1 | Ashford_2006_60cm_9139)

Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\9. EAR\Rev 1\Figure 2 Previous disturbance area impacts on unmapped (non-remnant) and mapped remnant vegetation (v5).qgz

Legend

- Site boundary
- Project area

Historical disturbance

- Intersecting remnant vegetation (of concern-subdominant)
- Intersecting non-remnant vegetation
- Historical unmapped disturbance area
- Vegetation management watercourses and drainage features v7.0

epic
A Montrose Environmental Company

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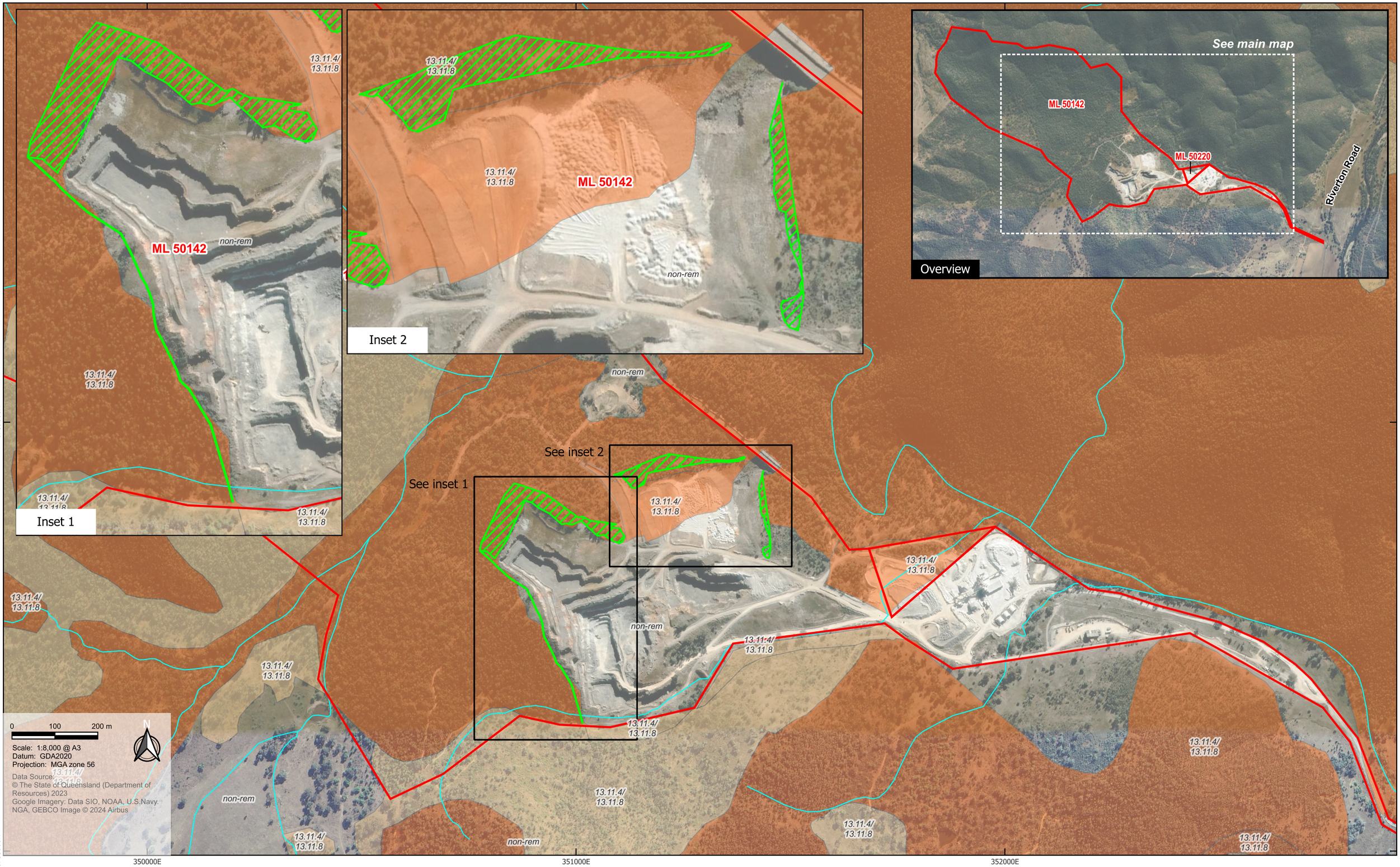
Riverton Limestone Mine
Ecological Assessment Report

Figure 2
Previous disturbance area impacts on unmapped (non-remnant) and mapped remnant vegetation (v5)



Filepath: ~BE2021\BE210135.01 Graymont PRCP\Workspaces\9. EAR\Rev 1\Figure 3 Proposed disturbance area impact on remnant vegetation (v13).qgz

Legend

- Site boundary
- Proposed disturbance areas

Regional Ecosystems v13

- Category A or B area containing of concern
- Category C or R area containing of concern
- Non-remnant
- Vegetation management watercourses and drainage features v7.0

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Figure 3
Proposed disturbance area impact on remnant vegetation (v13)

6 SIGNIFICANT RESIDUAL IMPACT ASSESSMENT

6.1 MSES Significant Residual Impact Assessment

MSES are listed in Schedule 2, Section 1-12 of the Offsets Regulation and are a component of the biodiversity state interest defined under the State Planning Policy (SPP). Under the *Queensland Environmental Offsets Policy significant residual impact guideline* (SRI Guideline) (DEHP 2014), a significant residual impact is described as an adverse impact, whether direct or indirect, of a prescribed activity on all or part of a PEM. Under Queensland offsets legislation, an offset condition may be imposed for significant residual impacts to PEMs. PEMs include:

- MSES
- MNES
- Matters of Local Environmental Significance (MLES): A matter for which an offset is required under a local planning instrument (not applicable to the project area).

Impacts to MSES require assessment against the criteria detailed in the SRI Guideline and are addressed in the following sections.

6.1.1 Category B (remnant) areas on the regulated vegetation management map, that are 'endangered' and 'of concern' regional ecosystems

Regulated Category B vegetation is a legislated MSES and is defined as a prescribed RE that:

- is an Endangered or Of concern RE, as defined under the Queensland *Vegetation Management Act 1999* (VM Act), or
- intersects with an area shown on the vegetation management wetlands map, as defined under the VM Act, or
- is located within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map, as defined under the VM Act.

The previous disturbance area has been assessed as per the SRI Guideline. The guideline applies to activities such as resource activities assessable under the EP Act.

'Clearing' under the SRI Guideline is defined as: "to remove, cut down, ringbark, push over, poison or destroy in any way including by burning, flooding or draining; but does not include destroying standing vegetation by stock, or lopping a tree." Clearing limit thresholds associated with Category B vegetation relevant to the project assessment as identified in the SRI Guideline are presented in **Table 11**. The REs relevant to the project (RE 11.3.4 and 11.3.8) are both identified as comprising a sparse structural category.

Table 11. Clearing limits per RE structure category relevant to the Project (DEHP 2014)

RE structure category	Maximum area (ha)
Dense and mid-dense	0.5
Sparse	2
Grassland	5

6.1.1.1 Previous disturbance area (v5 mapping)

For the purposes of this assessment, it is noted that this assessment is retrospective and the clearing which has occurred is historical and no new disturbance is proposed. Historical impacts to Category B regulated vegetation are being assessed retrospectively against v5 RE mapping as a proxy for mapped MSES within the project area prior to 2007 as per the EA conditions at the time.

Under v5 of the Queensland Herbarium RE map (2005-2009), the project has historically impacted:

- 1.07 ha of RE 13.11.4 / RE 13.11.8 in Current RE areas (refer **Figure 2**)

The two RE were mapped as a mixed polygon with a ratio of 90% RE 13.11.4 and 10% RE 13.11.8. RE 13.11.4 is currently listed as Least concern under the VM Act, whilst RE 13.11.8 is currently listed as Of concern under the VM Act. In accordance with the precautionary principle, impacts to Of concern RE 13.11.8 are assumed in the

absence of RE field-verification. The REs present have a structure category of sparse and therefore a clearing limit of 2 ha applies.

A total of 1.07 ha of clearance of REs occurred under the mapping at the time, which falls under the 2-ha clearing limit threshold.

No SRI predicted to occur

6.1.1.2 Proposed disturbance area (v13 mapping)

Proposed clearing impacts to Category B regulated vegetation are being assessed against v13 RE mapping. Under v13 of the Queensland Herbarium RE Map (2023), the project will impact:

- 2.25 ha of RE 13.11.4 / RE 13.11.8

The two REs are mapped as a mixed polygon with a ratio of 95% RE 13.11.4 and 5% RE 13.11.8. RE 3.11.4 is currently listed as Least concern under the VM Act, whilst RE 13.11.8 is currently listed as Of concern under the VM Act. In accordance with the precautionary principle, impacts to Of concern RE 13.11.8 are assumed in the absence of RE field-verification. The REs present have a structure category of sparse and therefore a clearing limit of 2 ha applies.

A total of 2.25 ha of clearance of REs is proposed at EOML, of which 1.92 ha is mapped as occurring as 'area of RE removal' within Schedule I Map 1 of the EA. Therefore, only 0.33 ha of disturbance is considered assessable for potential impacts, which falls below the 2-ha clearing limit threshold.

No SRI predicted to occur

6.1.2 Regulated vegetation (Category B) located within a defined distance from the defining banks of a relevant watercourse identified on the VM Act watercourse and drainage feature map

A significant impact to MSES for clearing within the defined distance of a watercourse is triggered when more than 2 ha is cleared and clearing occurs within 5 m of the defining bank (DEHP 2014). For stream order 1 watercourses, the defined distance is 25 m (for a non-coastal bioregion).

6.1.2.1 Previous disturbance area (v5 mapping)

Review of the historical clearing against v5 of the Queensland Herbarium RE map (2005-2009) indicates that a total of 0.07 ha of RE within 25 m of the defining bank of a watercourse identified on the vegetation management watercourse map was cleared in unmapped areas. This extent of clearing is not considered a significant impact on MSES. No clearing has occurred within areas mapped as Current RE.

No SRI predicted to occur.

6.1.2.2 Proposed disturbance area (v13 mapping)

Review of the proposed clearing against v13 of the Queensland Herbarium RE map (2023) indicates that there will be 0.004 ha of clearing of RE within 25 m of the defining bank of a watercourse identified on the vegetation management watercourse map is proposed to be cleared. This extent of clearing is not considered a significant impact on MSES.

No SRI predicted to occur.

6.1.3 MSES Fauna and Flora

One species of threatened fauna was identified as likely to occur, and nine threatened fauna and one threatened flora species have some potential to occur in the disturbance areas and surrounds:

- Threatened fauna
  - Likely to occur:
    - Koala - Endangered
  - Potential to occur:
    - Bordered Thick-tailed Gecko – Vulnerable

- Squatter Pigeon (southern) – Vulnerable
- White-throated Needletail - Vulnerable
- Hooded Robin (southeastern) - Endangered
- Brown Treecreeper - Vulnerable
- Southern Whiteface - Vulnerable
- Diamond Firetail – Vulnerable
- Corben's Long-eared Bat - Vulnerable
- Spotted-tail Quoll (southeast mainland) - Endangered

- Threatened Flora
  - *Macrozamia cranei* - Endangered

While these species are considered to have at least some potential to occur, the previous disturbance or proposed disturbance impacts are not considered to be of a scale or nature that warrants an assessment using the MSES guideline significant impact criteria. White-throated Needletail is almost entirely aerial in its habits and will not possibly be impacted by the historical or proposed activities.

Of the remaining species, only Border Thick-tailed Gecko and *Macrozamia cranei* would be considered as sedentary, where individuals (should they actually occur in the area) may be reliant on the areas of habitat historically or proposed to be impacted. A site survey should be carried out on the proposed disturbance areas to determine whether these species actually occur. If either species is found to occur then a revised MSES impact assessment should be carried out.

As already noted in **Section 5**, the disturbance areas occur within a mosaic of cleared lands and extensive tracts of contiguous woodlands, most of which comprise the identical REs mapped as occurring onsite. An analysis of current RE mapping (v13) identifies there are 14,892 ha of lands comprising RE 13.11.4 and/or 13.11.8 within a 10 km radius of the disturbance areas.

No SRI predicted to occur.

6.1.3.1 Previous disturbance areas

The previous disturbance area included impacts to remnant habitats, negligible in overall extent (1.07 ha) and dispersed across several smaller areas (**Figure 2**). The remaining previous disturbance across non-remnant areas largely impacted areas devoid of vegetation or minor areas comprising scattered trees. These areas would have provided little value to any threatened or migratory species at the time. It appears that approximately 2 ha of wooded habitat occurred in areas that may have had potential to support threatened species. The overall possible impact caused by the historical disturbance (1.07 ha) is minor given the extent of identical habitat that would have been present in the surrounding area. Based on current RE mapping the previous disturbance areas encompassed at most 0.016% of available identical habitat located within a 10 km radius.

It is considered highly unlikely this impact would be considered a significant impact to any of the species listed as MSES (or MNES) and this impact is not considered further in this assessment.

No SRI predicted to occur.

6.1.3.2 Proposed clearing

The Project is proposed to impact (through vegetation clearing) up to 2.25 ha of habitat dominated by woodland likely comprising White Box, Silver-leaved Ironbark and *Callitris glaucophylla* (RE 13.11.4). Other tree species may also be present such as *Eucalyptus melliodora* (RE 13.11.8). This habitat is located adjacent to areas associated with existing mining activity already subject to disturbance. This provides potential foraging habitat for some of the identified MSES fauna species including Koala. It is noted this habitat is abundant in the surrounding area. The overall impact from the proposed disturbance to areas not mapped as 'area of RE removal' within Schedule I Map 1 of the EA, is considered minor given the extent of identical habitat mapped as present in the surrounding area.

It is considered unlikely that the proposed disturbance will result in a significant impact to any of the species listed as MSES.

No SRI predicted to occur.

6.1.4 Waterway Barrier Works

Two stream order 1 waterways currently mapped as low risk waterways under the waterway barrier works mapping layer have been intercepted by the previous disturbance assessed in this report. Examination of 2006 aerial imagery indicates these areas were already relatively disturbed and it is uncertain whether water flow would have occurred at that time. Disturbance works removing a portion of the western waterway appear to have occurred by 2009. A small dam blocking the flow of the eastern waterway appears to have been installed at some stage by 2013. These impacts occurred prior to Graymont acquiring the ML. As it was determined that the disturbance to both waterways initially occurred prior to 2014, when the OE Act first came into effect, Water Barrier Works were not considered a MSES at the time the disturbance occurred.

No SRI predicted to occur.

6.2 MNES Significant Impact Assessment

One species of threatened fauna was identified as likely to occur, and one TEC, nine threatened fauna species, two threatened flora species and three migratory species have some potential to occur in the disturbance areas and surrounds:

The following MNES with the potential to occur within or adjacent to the previous or proposed disturbance area:

- Threatened Ecological Communities – possible occurrence
  - White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland
- Threatened fauna
  - Likely to occur:
    - Koala - Endangered
  - Potential to occur:
    - Bordered Thick-tailed Gecko – Vulnerable
    - Squatter Pigeon (southern) – Vulnerable
    - White-throated Needletail - Vulnerable
    - Hooded Robin (southeastern) - Endangered
    - Brown Treecreeper - Vulnerable
    - Southern Whiteface - Vulnerable
    - Diamond Firetail – Vulnerable
    - Corben's Long-eared Bat - Vulnerable
    - Spotted-tail Quoll (southeast mainland) - Endangered
- Threatened Flora
  - Potential to occur
    - Macrozamia cranei - Endangered
    - Ovenden's Ironbark – Vulnerable
- Migratory birds
  - Potential to occur
    - Satin Flycatcher
    - Fork-tailed Swift
    - Rufous Fantail

6.2.1 Threatened Ecological Communities

The *Approved Conservation Advice for the White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (DCCEEW 2023c) identifies RE 13.11.4 and 13.11.8 as potentially analogous to the White Box TEC. RE 13.11.4 has previously been ground-truthed as present within woodlands nearby to the proposed disturbance area during previous surveys undertaken by Epic. No TECs were observed during the 2021 survey although it is noted the survey was limited in extent.

A field survey will need to be conducted prior to any clearing within areas mapped as RE 13.11.4/13.11.8 to confirm the presence of this TEC. If the TEC is found to occur then a revised MNES impact assessment should be carried out and an environmental offset may be required.

Potential for a SRI to occur.

6.2.2 Threatened fauna

The Project is proposed to impact (through vegetation clearing) up to 2.25 ha of habitat dominated by woodland likely comprising White Box, Silver-leaved Ironbark, *Callitris glaucophylla* and *Eucalyptus melliodora.* This habitat is located adjacent to areas associated with existing mining activity already subject to disturbance. This vegetation community provides potential foraging habitat for some of the identified MNES fauna species, including Koala. The disturbance areas occur within a mosaic of cleared lands and extensive tracts of contiguous woodlands, most of which comprise the identical REs mapped as occurring onsite. An analysis of current RE mapping (v13) identifies there are 14,892 ha of lands comprising RE 13.11.4 and/or 13.11.8 within a 10 km radius of the disturbance areas.

A field survey will need to be conducted prior to any clearing within areas mapped as RE 13.11.4/RE13.11.8 to confirm the potential presence of threatened fauna species and species habitat. This will be used to further inform the MNES impact assessment to establish whether an environmental offset may be required.

Potential for a SRI to occur.

6.2.3 Threatened flora

Ovenden's Ironbark has been previously recorded only in New South Wales based on available database records (ALA 2024). The nearest records are 3.4 km east of the disturbance areas. It is uncertain whether the vegetation communities present, or substrate associated with the disturbance areas (metamorphic) would support the species based on known habitat preferences of the species: open grassy woodlands on granite substrates. Regardless, a conservative approach to the likelihood of occurrence was carried out and the species has some potential to occur.

A field survey should be carried out on the proposed disturbance areas to determine whether the subspecies actually occurs. If it is found to occur then a revised MNES impact assessment should be carried out.

Potential for a SRI to occur.

6.2.4 Migratory bird species

Fork-tailed Swift is almost entirely aerial in its foraging and resting habits when in Australia (i.e. they are rarely recorded roosting). They are found over a variety of habitats, including open areas, modified lands and the ocean but are most often observed over wooded areas (Higgins 1999). The airspace above the disturbance areas will only comprise ephemeral foraging habitat. The proposed disturbance requires negligible clearing of woody vegetation and there is abundant woodland habitat in the wider area. The previous disturbance and proposed disturbance will have no impact on the availability of potential foraging habitat for either species.

Rufous Fantail migrates north in early autumn and returns to southern Australia in early spring to breed, wintering on Cape York Peninsula, the Torres Strait and New Guinea (Higgins et al. 2006; Menkhorst et al. 2017). It is common in suitable habitat along the eastern seaboard (Menkhorst et al. 2017) and breeds in rainforest at higher altitudes from the Atherton Tablelands southwards. It is generally absent from the uplands in autumn and winter, having moved to the lowlands. The species is most likely to occur in the area during the winter months.

In Queensland, Satin Flycatcher occurs mostly in coastal areas but occasionally occurs further west, such as west of Lake Dalrymple (Higgins et al. 2006) in north Queensland and west of Oakey in southern Queensland. It is infrequently seen in central and northern Queensland, where it is mostly a passage migrant (Menkhorst et al. 2017). It is generally scarce except in Tasmania. Lindsey (1992) considered it sparse to common and probably secure. Satin Flycatcher may occasionally occur within the proposed action area during the north-south migration periods in September/October and April/May.

The MNES Guideline criteria for Migratory species requires an assessment of the potential for 'important habitat' to be present within or near the disturbance areas or that an 'ecologically significant proportion of the population' may be disrupted. Important habitat is defined as the following:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species

- Habitat that is of critical importance to the species at particular life-cycle stages
- Habitat utilised by a migratory species which is at the limit of the species range and/or
- Habitat within an area where the species is declining

Neither of the two migratory species identified are at the limit of their range in the area or in an area where the species is thought to be declining. There is no evidence that habitat of 'critical importance' occurs for either species within or near the proposed action area.

An ecologically significant proportion of the population of Satin Flycatcher and the northern race of the Rufous Fantail (which likely occurs in the proposed action area) comprise 1,700 birds and 1,500 birds respectively (Commonwealth of Australia 2015).

There is no reason to believe the minor extent of habitat within the proposed action area would support an ecologically significant proportion of the populations of either species. As such, the potential for significant impacts on these species is negligible at worst.

No SRI predicted to occur.

7 CONCLUSION

The Proponent is currently undertaking an EA Amendment for the Riverton Limestone Quarry and Processing Plant. To support the EA Amendment an assessment was undertaken to establish the underlying ecological values within the local area. The assessment also sought to determine the extent of historical unauthorised disturbance and the potential for this disturbance to have caused a SRI on MSES based on historical RE mapping (v5). In addition to the unauthorised disturbance, the project proposes 2.25 ha of future vegetation clearing in areas adjacent to the pit and WRD. The proposed disturbance areas were assessed to determine the potential impact this disturbance may have on MSES and MNES.

It was determined that a total of 13.82 ha of previous disturbance area occurred prior to Graymont acquiring the project in 2018. This comprised 1.07 ha of disturbance in areas mapped as regulated vegetation and 12.75 ha of disturbance in non-remnant vegetation The 2.37 ha of proposed disturbance will impact 2.25 ha of regulated vegetation, of which 0.33 ha is considered assessable, as it falls outside of the 'area of RE removal'.

The vegetation associated with the previous disturbance area and surrounds is mapped as comprising a mix of RE 13.11.4 and 13.11.8. Previous surveys carried out in sites close to the previous disturbance areas in 2019 and 2021 only identified RE 11.3.4 as present. It is noted the vegetation communities present have potential to be analogous to an EPBC Act-listed TEC: White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Database searches found there were no MSES threatened fauna or flora species previously recorded within a 5 km buffer of the disturbance areas. A single species listed as Special Least Concern has been previously recorded: Eastern Osprey. However, there is no suitable habitat present for this species within the disturbance areas or surrounds.

A likelihood of occurrence assessment identified the likely presence of one species listed as threatened under the NC act (Koala). A further nine fauna and one flora species listed as threatened under the NC Act possibly occur. All of these species are also listed as threatened under the EPBC Act. The assessment identified an additional flora species listed as threatened only under the EPBC Act and three species listed as Migratory under the EPBC Act as possibly present.

The desktop assessment found that the following MSES are present, or potentially present, within the disturbance areas and surrounds:

- Category B (remnant) vegetation that are listed as Of concern under the VM Act
- Category B vegetation within a defined distance from the defining banks of a VM Act mapped watercourse
- Potential habitat for threatened flora and fauna species
- Waterways mapped as low risk waterways on the waterway barrier works mapping layer

A retrospective assessment for potential SRIs from the previous disturbance was carried out using the criteria in the SRI Guideline. The previous disturbance comprised 1.07 ha of disturbance to Category B REs (as mapped at the time) with an additional 12.75 ha of disturbance to areas mapped as non-remnant, which comprised 2 ha of wooded habitat which may have provided habitat for threatened species. The assessment identified the following:

- No impacts predicted on MSES associated with Category B (remnant) vegetation
- No impacts to Category B vegetation within a defined distance from the defining banks of a VM Act mapped watercourse
- Unlikely potential for a significant impact on threatened flora or fauna

The proposed disturbance was also assessed to determine the potential for a SRI to occur using the criteria in the SRI Guideline.

- No impacts predicted on MSES associated with Category B (remnant) vegetation
- Unlikely potential for a significant impact on threatened flora or fauna

An assessment was carried out on the potential to impact MNES. It was determined that there is the potential for fauna and flora MNES as well as the TEC, *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland* to occur within the proposed disturbance areas. A survey will need to be undertaken to

determine the presence, or likely presence of MNES. The site information obtained would inform an updated assessment of the likelihood of occurrence of the MNES identified in this report and a detailed significant impact assessment will need to be carried out. There is potential for environmental offsets to be required if a significant impact to a MNES is considered to occur.

This assessment has been largely based on a desktop review of available information. It is recommended the proposed disturbance area be subject to a site ecological survey to determine the potential for MSES and MNES to be present prior to any clearing work being carried out.

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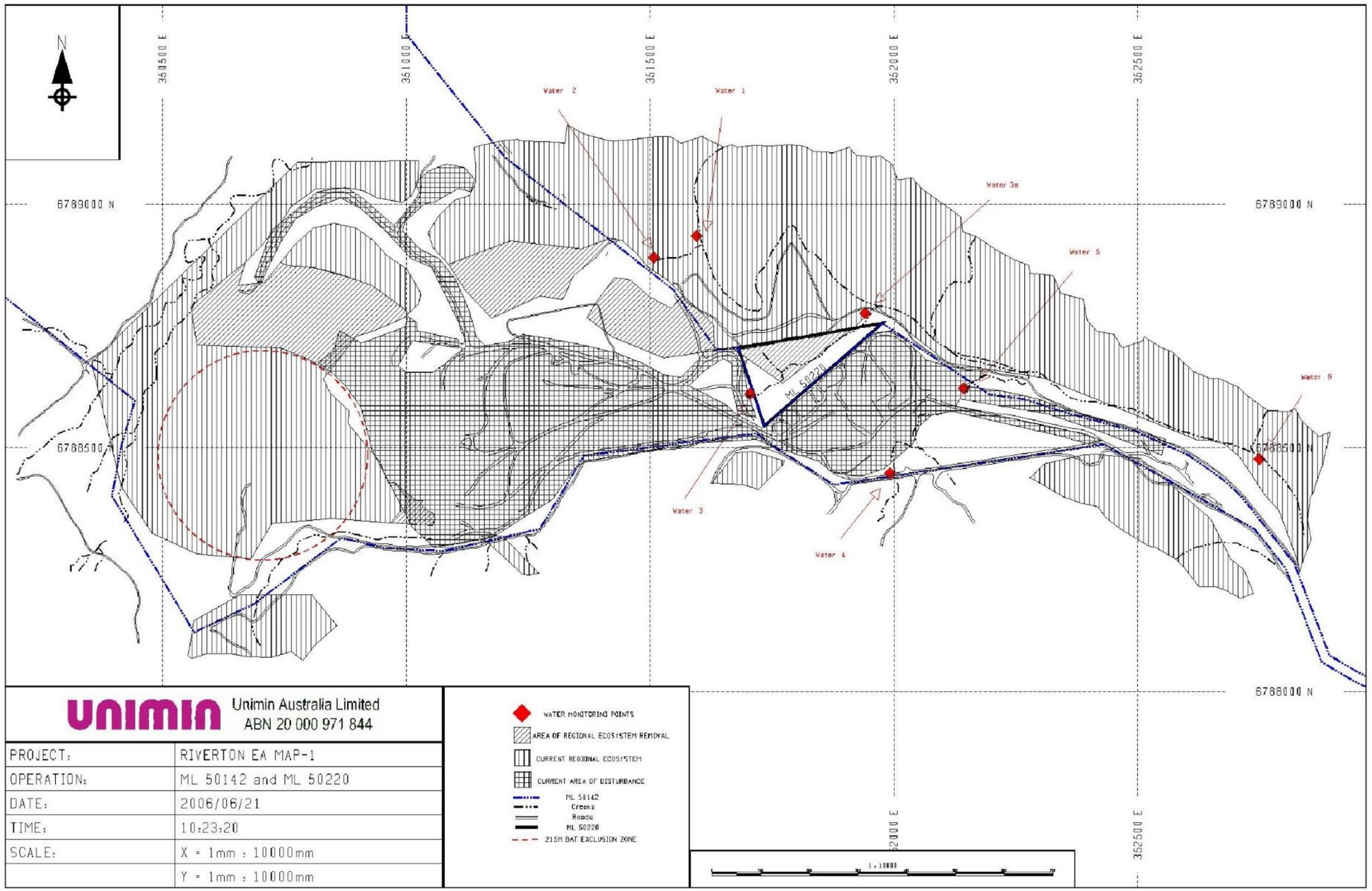
APPENDIX A SCHEDULE I MAP 1 OF EA EPML00241213



MAP 1 – Area of Regional Ecosystem Removal

END OF ENVIRONMENTAL AUTHORITY

APPENDIX B DESKTOP SEARCHES

resources.QLD.GOV.AU



Vegetation management report

For Lot: 1 Plan: SP310330
7/23/2024

Queensland Government

This publication has been compiled by Operations Support, Department of Resources.

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of Environment, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Resources who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of Environment, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of Environment, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 1 Plan: SP310330 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
1	SP310330	Freehold	2,993,000

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 1 Plan: SP310330 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 1 Plan: SP310330, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Southern Downs Regional	Border Rivers	New England Tableland	Nandewar Northern Complex
Goondiwindi Regional			

2. Vegetation management framework (administered by the Department of Resources)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2012, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Resources or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Resources before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Resources prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Resources before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Resources and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Resources

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 1 Plan: SP310330

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category B	217.67
Category C	35.28
Category X	46.23

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Resources to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department of Resources to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

There is no Property Map of Assessable Vegetation (PMAV) present on this property.

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
13.11.4	Least concern	B	197.42	Eucalyptus melanophloia woodland on metamorphics	Sparse
13.11.4	Least concern	C	33.52	Eucalyptus melanophloia woodland on metamorphics	Sparse
13.11.8	Of concern	B	20.25	Eucalyptus melliodora and/or Eucalyptus microcarpa/ E. moluccana woodland on metamorphics	Sparse
13.11.8	Of concern	C	1.76	Eucalyptus melliodora and/or Eucalyptus microcarpa/ E. moluccana woodland on metamorphics	Sparse
non-rem	None	X	46.23	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the

essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C
No records

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?
Class A (with urban areas masked as per SPP): 0.02 ha

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 1 Plan: SP310330.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.resources.qld.gov.au/qld/environment/land/vegetation/vegetation-map-request-form

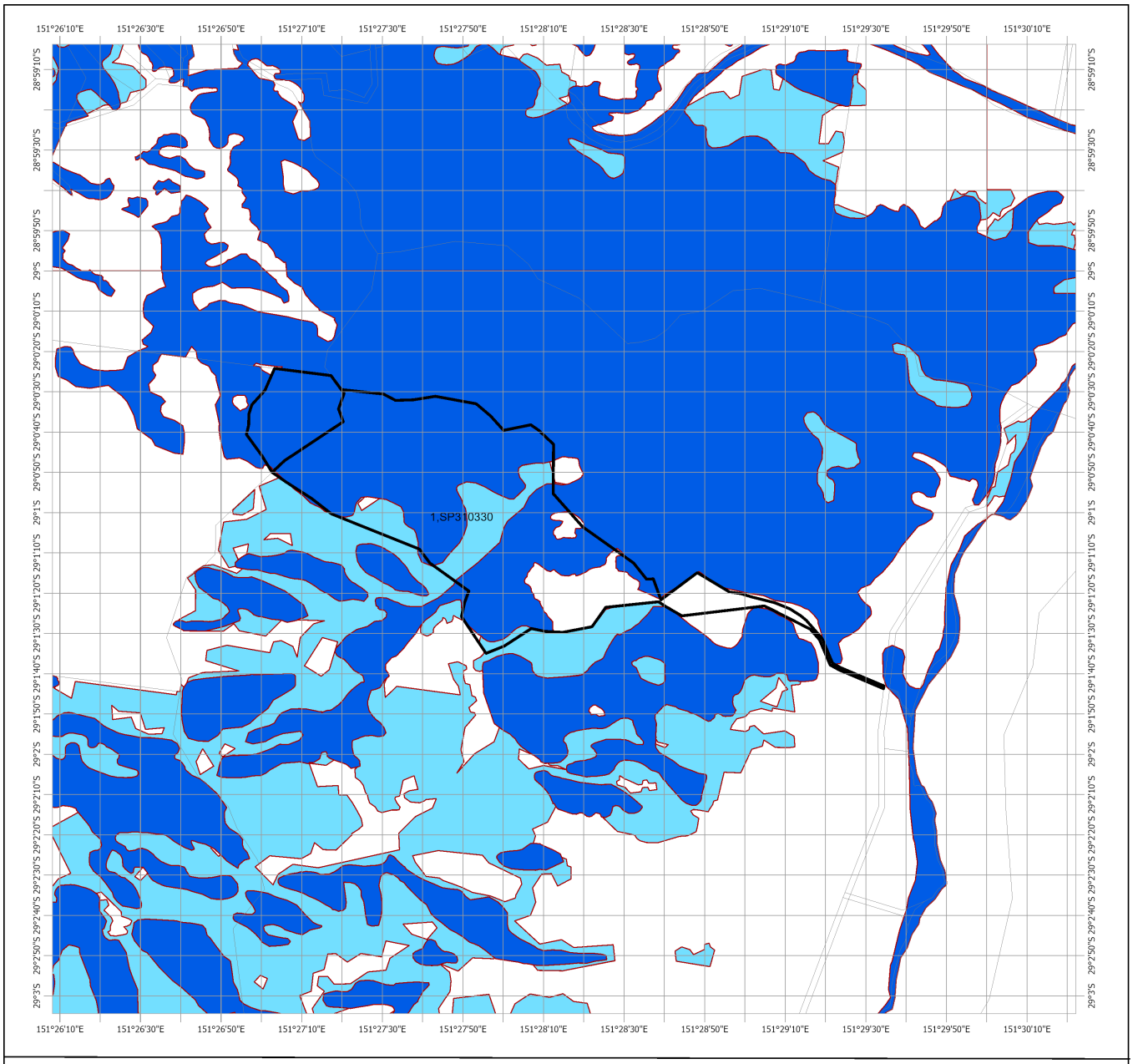
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries
- Selected Lot and Plan

LOCALITY DIAGRAM



N

0 425 850 1,275 1,700 2,125 m

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

Queensland Government

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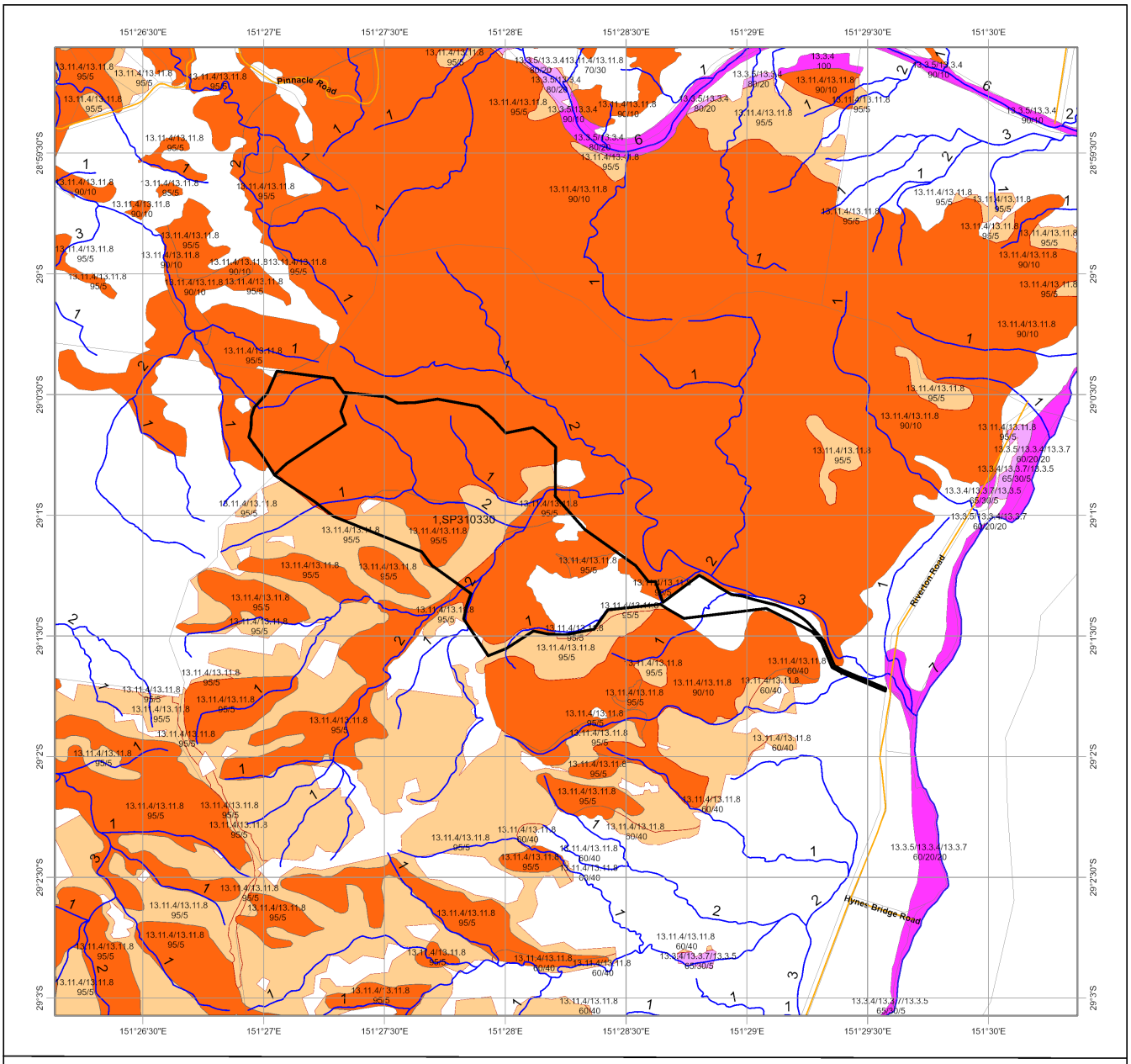
4.2 Vegetation management supporting map

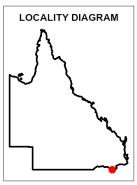


Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

Queensland Government

LOCALITY DIAGRAM



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Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

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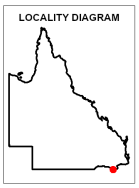
4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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0 275 550 825 1,100 1,375 m

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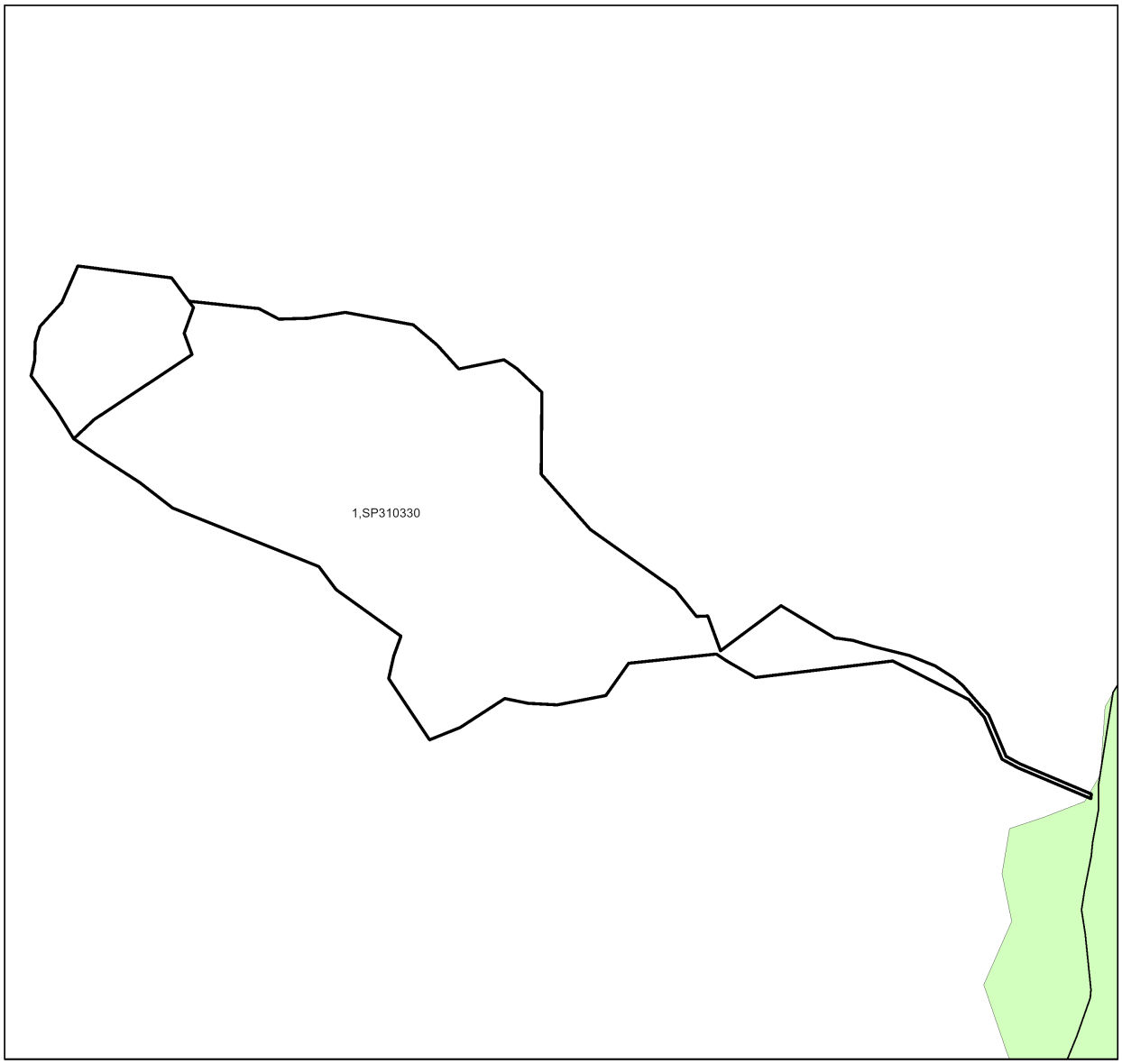
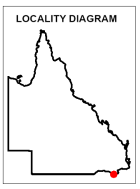
4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

Towns
Rivers and creeks
Freeways / motorways; Highways
Secondary roads; Streets
Agricultural land class A or B
A
B
Not class A or B
Selected Lot and Plan

LOCALITY DIAGRAM



N

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5. Protected plants framework (administered by the Department of Environment, Science and Innovation (DESI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of EVNT plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of Environment, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DESI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

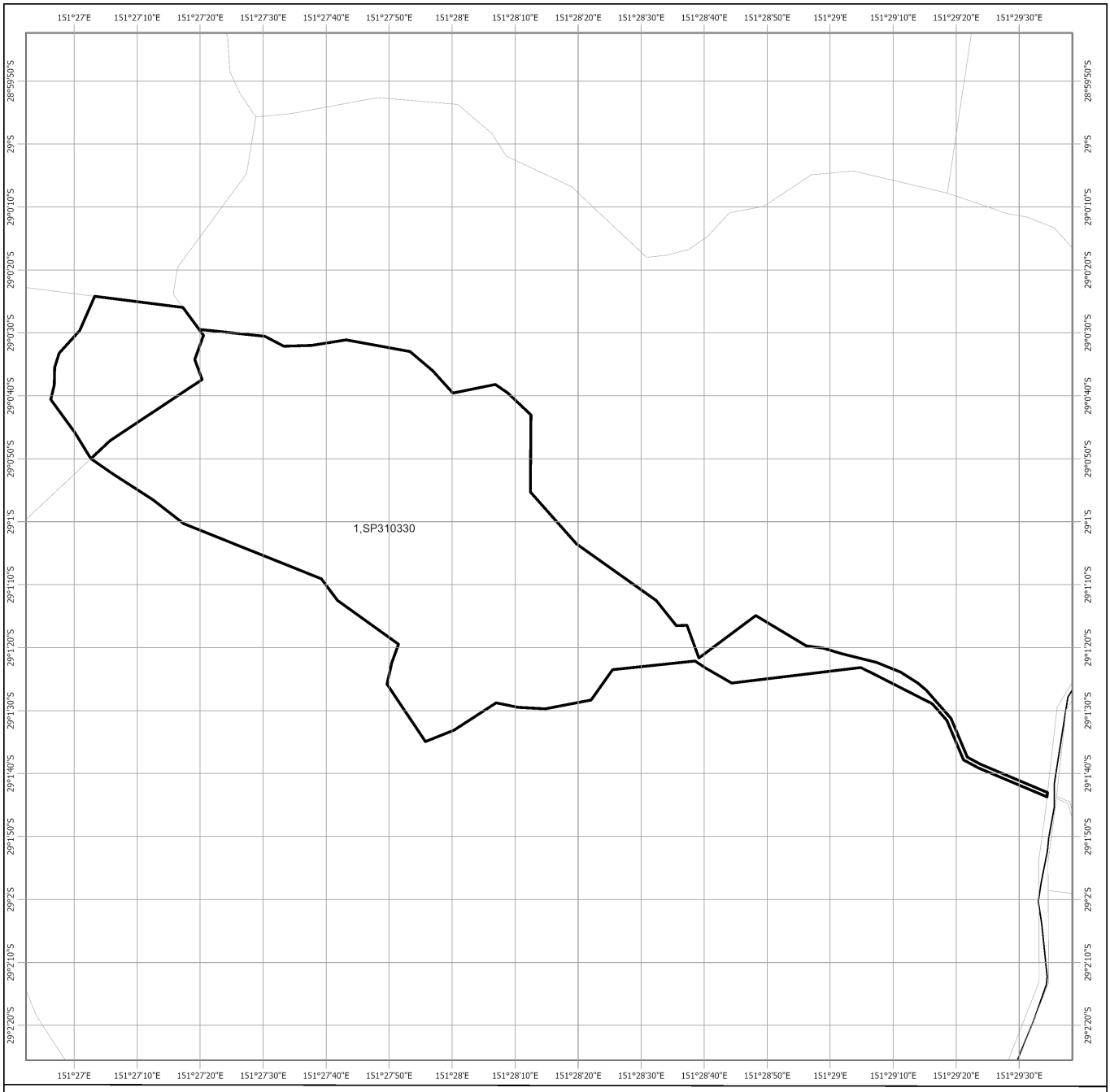
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

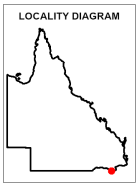
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



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0 190 380 570 760 950 m

This product is displayed in:
GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation at palm@des.qld.gov.au

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6. Koala protection framework (administered by the Department of Environment, Science and Innovation (DESI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DESI

For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@des.qld.gov.au
Visit https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 1 Plan: SP310330

7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



Koala priority area, koala habitat area and identified koala broad-hectare area map

- Koala habitat area (core)
- Koala habitat area (locally refined)
- Koala priority area
- Identified koala broad-hectare area
- Cadastral Boundaries
- Towns
- Major rivers/creeks
- Highway
- Connector
- Street/Local Road
- Queensland
- Selected Lot and Plan

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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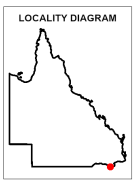

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The koala conservation plan maps will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

In order to ensure that the most recent map for an area of interest can be accessed, prior to the annual update, a register of changes made to koala habitat areas as a result of the map amendment process will be available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/. The register will include lot on plan for the change, the date the decision was made and the map issued to the landholder which shows areas determined to be koala habitat areas.

7.3 Koala habitat regional ecosystems for core koala habitat areas



Koala habitat regional ecosystems for core koala habitat areas

Koala habitat area (core)
Towns
Highway
Connector
Street/Local Road
Major rivers/creeks
Queensland
Selected Lot and Plan

LOCALITY DIAGRAM

N

0 260 520 780 1,040 1,300 m

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Due to varying sources of data, spatial locations may not coincide when overlaid.

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8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
• Interference with overland flow • Earthworks, significant disturbance	*Water Act 2000* *Soil Conservation Act 1986*	Department of Regional Development, Manufacturing and Water (Queensland Government) Department of Resources (Queensland Government)	Ph: 13 QGOV (13 74 68) www.rdmw.qld.gov.au/ www.resources.qld.gov.au
• Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships	Ph: 13 QGOV (13 74 68) www.datsip.qld.gov.au
• Mining and environmentally relevant activities • Infrastructure development (coastal) • Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 13 QGOV (13 74 68) www.des.qld.gov.au
• Protected plants and protected areas	*Nature Conservation Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 1300 130 372 (option 4) palm@des.qld.gov.au www.des.qld.gov.au
• Koala mapping and regulations	*Nature Conservation Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 13 QGOV (13 74 68) Koala.assessment@des.qld.gov.au
• Interference with fish passage in a watercourse, mangroves • Forestry activities on State land tenures	*Fisheries Act 1994* *Forestry Act 1959*	Department of Agriculture and Fisheries (Queensland Government)	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
• Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Agriculture, Water and the Environment (Australian Government)	Ph: 1800 803 772 www.environment.gov.au
• Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) www.dsdmip.qld.gov.au
• Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) Your relevant local government office
• Harvesting timber in the Wet Tropics of Qld World Heritage area	*Wet Tropics World Heritage Protection and Management Act 1993*	Wet Tropics Management Authority	Ph: (07) 4241 0500 https://www.wettropics.gov.au/

resources.QLD.GOV.AU



Vegetation management report

For Lot: 3 Plan: RP207320
7/23/2024

Queensland Government

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Recent changes

Updated mapping

Updated vegetation mapping was released on 22 November 2023 and includes the most recent Queensland Herbarium scientific updates to the Regulated Vegetation Management Map, regional ecosystems, essential habitat, wetland and high-value regrowth mapping.

The Department of Environment, Science and Innovation have also updated their koala protection mapping to align with the Queensland Herbarium scientific updates.

The latest version (v10) of the Protected Plants Flora Survey Trigger Map (trigger map) was released on 6 September 2023.

Overview

Based on the lot on plan details you have supplied, this report provides the following detailed information:
Property details - information about the specified Lot on Plan, lot size, local government area, bioregion(s), subregion(s) and catchment(s);

Vegetation management framework - an explanation of the application of the framework and contact details for the Department of Resources who administer the framework;

Vegetation management framework details for the specified Lot on Plan including:

- the vegetation management categories on the property;
- the vegetation management regional ecosystems on the property;
- vegetation management watercourses or drainage features on the property;
- vegetation management wetlands on the property;
- vegetation management essential habitat on the property;
- whether any area management plans are associated with the property;
- whether the property is coastal or non-coastal; and
- whether the property is mapped as Agricultural Land Class A or B;

Protected plant framework - an explanation of the application of the framework and contact details for the Department of Environment, Science and Innovation who administer the framework, including:

- high risk areas on the protected plant flora survey trigger map for the property;

Koala protection framework - an explanation of the application of the framework and contact details for the Department of Environment, Science and Innovation who administer the framework; and

Koala protection framework details for the specified Lot on Plan including:

- the koala district the property is located in;
- koala priority areas on the property;
- core and locally refined koala habitat areas on the property;
- whether the lot is located in an identified koala broad-hectare area; and
- koala habitat regional ecosystems on the property for core koala habitat areas.

This information will assist you to determine your options for managing vegetation under:
- the vegetation management framework, which may include:

- exempt clearing work;
- accepted development vegetation clearing code;
- an area management plan;
- a development approval;

- the protected plant framework, which may include:

- the need to undertake a flora survey;
- exempt clearing;
- a protected plant clearing permit;

- the koala protection framework, which may include:

- exempted development;
- a development approval;
- the need to undertake clearing sequentially and in the presence of a koala spotter.

Other laws

The clearing of native vegetation is regulated by both Queensland and Australian legislation, and some local governments also regulate native vegetation clearing. You may need to obtain an approval or permit under another Act, such as the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Section 8 of this guide provides contact details of other agencies you should confirm requirements with, before commencing vegetation clearing.

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1. Property details

1.1 Tenure and title area

All of the lot, plan, tenure and title area information associated with property Lot: 3 Plan: RP207320 are listed in Table 1.

Table 1: Lot, plan, tenure and title area information for the property

Lot	Plan	Tenure	Property title area (sq metres)
3	RP207320	Freehold	7,426,430

The tenure of the land may affect whether clearing is considered exempt clearing work or may be carried out under an accepted development vegetation clearing code.

Does the property Lot: 3 Plan: RP207320 have a freehold tenure and is in the Wet Tropics of Queensland World Heritage Area?

No, this property is not located in the Wet Tropics of Queensland World Heritage Area.

1.2 Property location

Table 2 provides a summary of the locations for property Lot: 3 Plan: RP207320, in relation to natural and administrative boundaries.

Table 2: Property location details

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Goondiwindi Regional	Border Rivers	New England Tableland	Nandewar Northern Complex

2. Vegetation management framework (administered by the Department of Resources)

The *Vegetation Management Act 1999* (VMA), the Vegetation Management Regulation 2012, the *Planning Act 2016* and the Planning Regulation 2017, in conjunction with associated policies and codes, form the Vegetation Management Framework.

The VMA does not apply to all land tenures or vegetation types. State forests, national parks, forest reserves and some tenures under the *Forestry Act 1959* and *Nature Conservation Act 1992* are not regulated by the VMA. Managing or clearing vegetation on these tenures may require approvals under these laws.

The following native vegetation is not regulated under the VMA but may require permit(s) under other laws:

- grass or non-woody herbage;
- a plant within a grassland regional ecosystem identified in the Vegetation Management Regional Ecosystem Description Database (VM REDD) as having a grassland structure; and
- a mangrove.

2.1 Exempt clearing work

Exempt clearing work is an activity for which you do not need to notify the Department of Resources or obtain an approval under the vegetation management framework. Exempt clearing work was previously known as exemptions.

In areas that are mapped as Category X (white in colour) on the regulated vegetation management map (see section 4.1), and where the land tenure is freehold, indigenous land and leasehold land for agriculture and grazing purposes, the clearing of vegetation is considered exempt clearing work and does not require notification or development approval under the vegetation management framework. For all other land tenures, contact the Department of Resources before commencing clearing to ensure that the proposed activity is exempt clearing work.

A range of routine property management activities are considered exempt clearing work. A list of exempt clearing work is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/exemptions/.

Exempt clearing work may be affected if the proposed clearing area is subject to development approval conditions, a covenant, an environmental offset, an exchange area, a restoration notice, or an area mapped as Category A. Exempt clearing work may require approval under other Commonwealth, State or Local Government laws, or local government planning schemes. Contact the Department of Resources prior to clearing in any of these areas.

2.2 Accepted development vegetation clearing codes

Some clearing activities can be undertaken under an accepted development vegetation clearing code. The codes can be downloaded at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/codes/

If you intend to clear vegetation under an accepted development vegetation clearing code, you must notify the Department of Resources before commencing. The information in this report will assist you to complete the online notification form.

You can complete the online form at
https://vegetation-apps.dnrm.qld.gov.au

2.3 Area management plans

Area Management Plans (AMP) provide an alternative approval system for vegetation clearing under the vegetation management framework. They list the purposes and clearing conditions that have been approved for the areas covered by the plan. It is not necessary to use an AMP, even when an AMP applies to your property.

On 8 March 2020, AMPs ended for fodder harvesting, managing thickened vegetation and managing encroachment. New notifications cannot be made for these AMPs. You will need to consider options for fodder harvesting, managing thickened vegetation or encroachment under a relevant accepted development vegetation clearing code or apply for a development approval.

New notifications can be made for all other AMPs. These will continue to apply until their nominated end date.

If an Area Management Plan applies to your property for which you can make a new notification, it will be listed in Section 3.6 of this report. Before clearing under one of these AMPs, you must first notify the Department of Resources and then follow the conditions and requirements listed in the AMP.

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/area-management-plans

2.4 Development approvals

If under the vegetation management framework your proposed clearing is not exempt clearing work, or is not permitted under an accepted development vegetation clearing code, or an AMP, you may be able to apply for a development approval. Information on how to apply for a development approval is available at

https://www.qld.gov.au/environment/land/management/vegetation/clearing-approvals/development

2.5. Contact information for the Department of Resources

For further information on the vegetation management framework:

Phone 135VEG (135 834)

Email vegetation@resources.qld.gov.au

Visit https://www.resources.qld.gov.au/?contact=vegetation to submit an online enquiry.

3. Vegetation management framework for Lot: 3 Plan: RP207320

3.1 Vegetation categories

The vegetation categories on your property are shown on the regulated vegetation management map in section 4.1 of this report. A summary of vegetation categories on the subject lot are listed in Table 3. Descriptions for these categories are shown in Table 4.

Table 3: Vegetation categories for subject property

Vegetation category	Area (ha)
Category B	682.34
Category C	19.02
Category X	52.96

Table 4: Description of vegetation categories

Category	Colour on Map	Description	Requirements / options under the vegetation management framework
A	red	Compliance areas, environmental offset areas and voluntary declaration areas	Special conditions apply to Category A areas. Before clearing, contact the Department of Resources to confirm any requirements in a Category A area.
B	dark blue	Remnant vegetation areas	Exempt clearing work, or notification and compliance with accepted development vegetation clearing codes, area management plans or development approval.
C	light blue	High-value regrowth areas	Exempt clearing work, or notification and compliance with managing Category C regrowth vegetation accepted development vegetation clearing code.
R	yellow	Regrowth within 50m of a watercourse or drainage feature in the Great Barrier Reef catchment areas	Exempt clearing work, or notification and compliance with managing Category R regrowth accepted development vegetation clearing code or area management plans.
X	white	Clearing on freehold land, indigenous land and leasehold land for agriculture and grazing purposes is considered exempt clearing work under the vegetation management framework. Contact the Department of Resources to clarify whether a development approval is required for other State land tenures.	No permit or notification required on freehold land, indigenous land and leasehold land for agriculture and grazing. A development approval may be required for some State land tenures.

Property Map of Assessable Vegetation (PMAV)

There is no Property Map of Assessable Vegetation (PMAV) present on this property.

3.2 Regional ecosystems

The endangered, of concern and least concern regional ecosystems on your property are shown on the vegetation management supporting map in section 4.2 and are listed in Table 5.

A description of regional ecosystems can be accessed online at
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/descriptions/

Table 5: Regional ecosystems present on subject property

Regional Ecosystem	VMA Status	Category	Area (Ha)	Short Description	Structure Category
13.11.4	Least concern	B	612.94	Eucalyptus melanophloia woodland on metamorphics	Sparse
13.11.4	Least concern	C	18.07	Eucalyptus melanophloia woodland on metamorphics	Sparse
13.11.8	Of concern	B	67.91	Eucalyptus melliodora and/or Eucalyptus microcarpa/ E. moluccana woodland on metamorphics	Sparse
13.11.8	Of concern	C	0.95	Eucalyptus melliodora and/or Eucalyptus microcarpa/ E. moluccana woodland on metamorphics	Sparse
13.3.4	Endangered	B	0.73	Eucalyptus conica, E. microcarpa, E. melliodora woodland on alluvial plains	Sparse
13.3.5	Of concern	B	0.36	Eucalyptus camaldulensis fringing open forest	Mid-dense
13.3.7	Endangered	B	0.39	Eucalyptus tereticornis, Angophora floribunda open forest on alluvial plains	Mid-dense
non-rem	None	X	52.96	None	None

Please note:
1. All area and area derived figures included in this table have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.
2. If Table 5 contains a Category 'plant', please be aware that this refers to 'plantations' such as forestry, and these areas are considered non-remnant under the VMA.

The VMA status of the regional ecosystem (whether it is endangered, of concern or least concern) also determines if any of the following are applicable:

- exempt clearing work;
- accepted development vegetation clearing codes;
- performance outcomes in State Code 16 of the State Development Assessment Provisions (SDAP).

3.3 Watercourses

Vegetation management watercourses and drainage features for this property are shown on the vegetation management supporting map in section 4.2.

3.4 Wetlands

There are no vegetation management wetlands present on this property.

3.5 Essential habitat

Under the VMA, essential habitat for protected wildlife is native wildlife prescribed under the *Nature Conservation Act 1992* (NCA) as critically endangered, endangered, vulnerable or near-threatened wildlife.

Essential habitat for protected wildlife includes suitable habitat on the lot, or where a species has been known to occur up to 1.1 kilometres from a lot on which there is assessable vegetation. These important habitat areas are protected under the VMA.

Any essential habitat on this property will be shown as blue hatching on the vegetation supporting map in section 4.2.

If essential habitat is identified on the lot, information about the protected wildlife species is provided in Table 6 below. The numeric labels on the vegetation management supporting map can be cross referenced with Table 6 to outline the essential habitat factors for that particular species. There may be essential habitat for more than one species on each lot, and areas of Category A, Category B and Category C can be mapped as Essential Habitat.

Essential habitat is compiled from a combination of species habitat models and buffered species records. Regional ecosystem is a mandatory essential habitat factor, unless otherwise stated. Essential habitat, for protected wildlife, means an area of vegetation shown on the Regulated Vegetation Management Map -

1) that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database. Essential habitat factors are comprised of - regional ecosystem (mandatory for most species), vegetation community, altitude, soils, position in landscape; or
2) in which the protected wildlife, at any stage of its life cycle, is located.

If there is no essential habitat mapping shown on the vegetation management supporting map for this lot, and there is no table in the sections below, it confirms that there is no essential habitat on the lot.

Category A and/or Category B and/or Category C

Table 6: Essential habitat in Category A and/or Category B and/or Category C
No records

3.6 Area Management Plan(s)

Nil

3.7 Coastal or non-coastal

For the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP), this property is regarded as*

Non Coastal

*See also Map 4.3

3.8 Agricultural Land Class A or B

The following can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code:

Does this lot contain land that is mapped as Agricultural Land Class A or B in the State Planning Interactive Mapping System?
Class A (with urban areas masked as per SPP): 0.01 ha

No Class B

Note - This confirms Agricultural Land Classes as per the State Planning Interactive Mapping System only. This response does not include Agricultural Land Classes identified under local government planning schemes. For further information, check the Planning Scheme for your local government area.

See Map 4.4 to identify the location and extent of Class A and/or Class B Agricultural land on Lot: 3 Plan: RP207320.

4. Vegetation management framework maps

Vegetation management maps included in this report may also be requested individually at:
https://www.resources.qld.gov.au/qld/environment/land/vegetation/vegetation-map-request-form

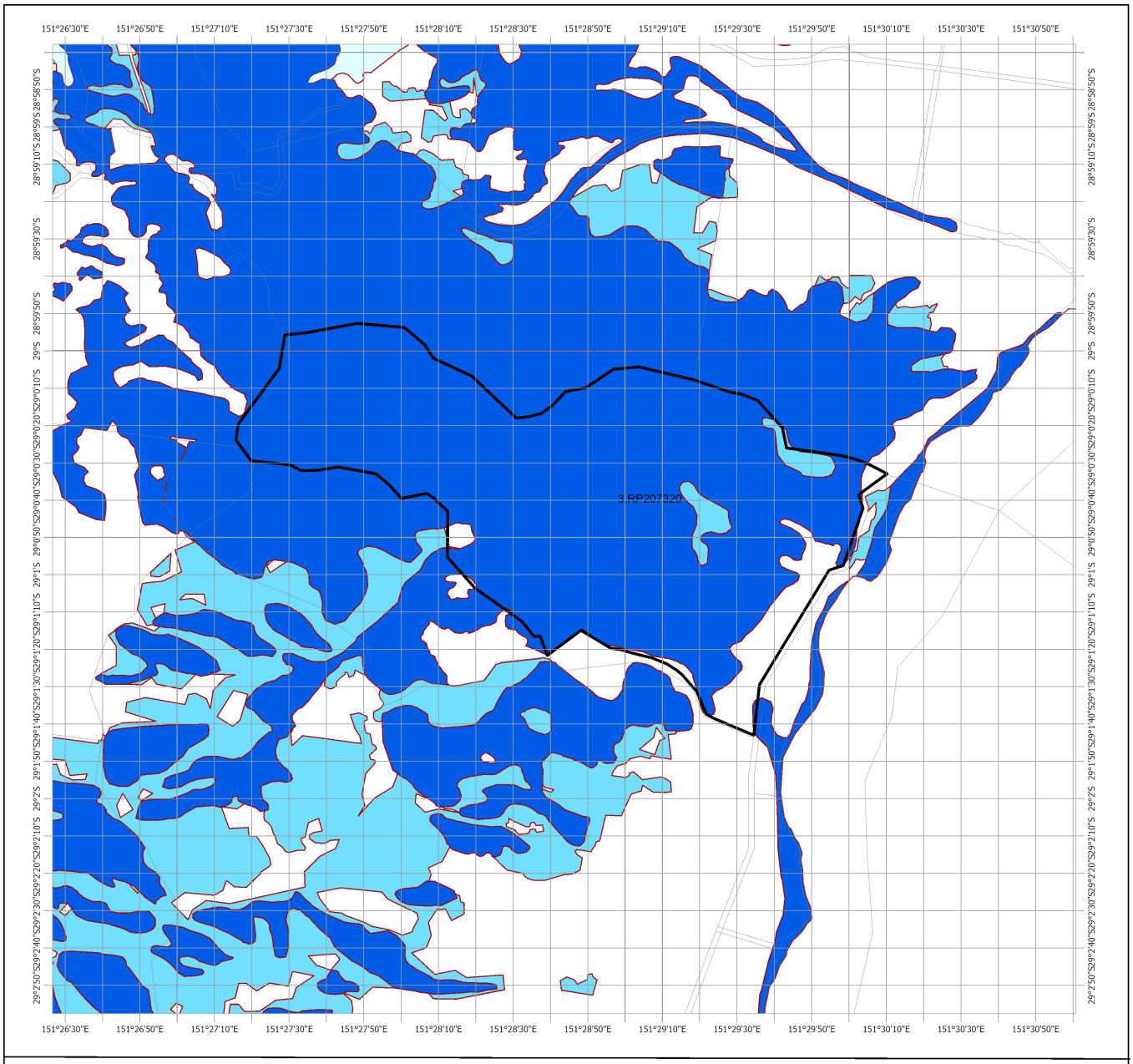
Regulated vegetation management map
The regulated vegetation management map shows vegetation categories needed to determine clearing requirements. These maps are updated monthly to show new property maps of assessable vegetation (PMAV).

Vegetation management supporting map
The vegetation management supporting map provides information on regional ecosystems, wetlands, watercourses and essential habitat.

Coastal/non-coastal map
The coastal/non-coastal map confirms whether the lot, or which parts of the lot, are considered coastal or non-coastal for the purposes of the accepted development vegetation clearing codes and State Code 16 of the State Development Assessment Provisions (SDAP).

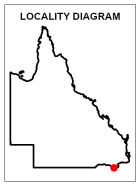
Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture
The Agricultural Land Class map confirms the location and extent of land mapped as Agricultural Land Classes A or B as identified on the State Planning Interactive Mapping System. Please note that this map does not include areas identified as Agricultural Land Class A or B in local government planning schemes. This map can be used to identify Agricultural Land Class A or B areas under the "Managing regulated regrowth vegetation" accepted development vegetation clearing code.

4.1 Regulated vegetation management map



Regulated Vegetation Management Map

- Category A area (Vegetation offsets/compliance notices/VDecs)
- Category B area (Remnant vegetation)
- Category C area (High-value regrowth vegetation)
- Category R area (Reef regrowth watercourse vegetation)
- Category X area (Exempt clearing work on Freehold, Indigenous and Leasehold land)
- Water
- Other land parcel boundaries
- Selected Lot and Plan



N

0 460 920 1,380 1,840 2,300 m

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Additional information required for the assessment of vegetation values is provided in the accompanying "Vegetation Management Supporting map". For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the regulated vegetation management map is available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

Land parcel boundaries are provided as locational aid only.

This map is updated on a monthly basis to ensure new PMAVs are included as they are approved.

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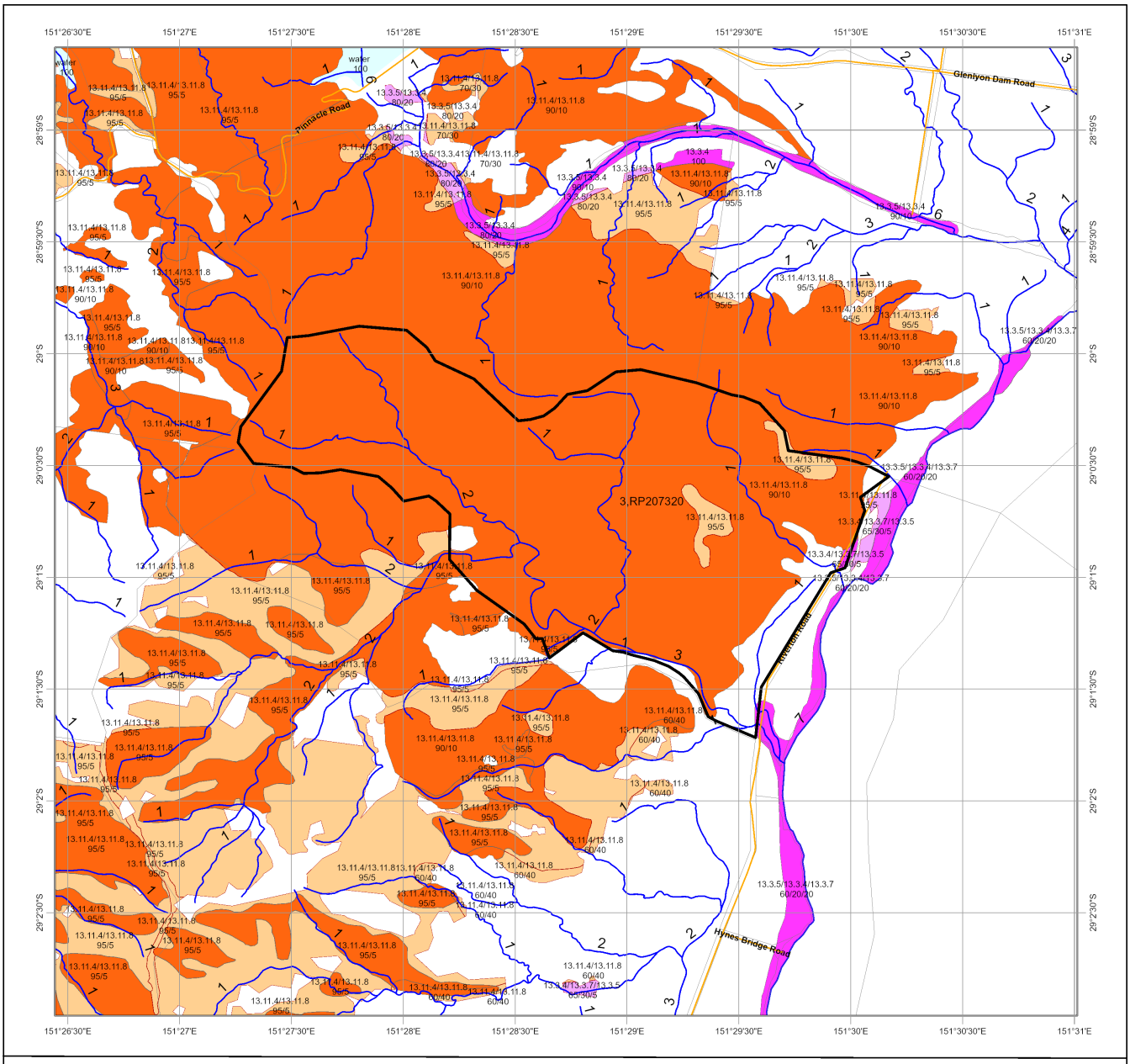
4.2 Vegetation management supporting map



Vegetation Management Supporting Map

- Category A or B area containing endangered regional ecosystems
- Category A or B area containing of concern regional ecosystems
- Category A or B area that is a least concern regional ecosystem
- Category C or R area containing endangered regional ecosystems
- Category C or R area containing of concern regional ecosystems
- Category C or R area that is a least concern regional ecosystem
- Category X area
- Water
- Wetland on the vegetation management wetlands map
- Essential habitat on the essential habitat map
- Essential habitat species record
- Watercourses and drainage features on the vegetation management watercourse and drainage features map (Stream order shown as black number against stream where available)
- Highway
- Connector
- Street/Local Road
- National Parks, State Forest and other reserves
- Other land parcel boundaries
- Selected Lot and Plan

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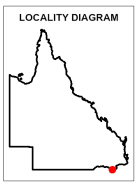
LOCALITY DIAGRAM



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Labels for Essential Habitat are centred on the area of enquiry.

Regional ecosystem linework has been compiled at a scale of 1:100 000, except in designated areas where a compilation scale of 1:50 000 is available. Linework should be used as a guide only. The positional accuracy of RE data mapped at a scale of 1:100 000 is +/- 100 metres.

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Additional information may be required for the purposes of land clearing or assessment of a regional ecosystem map or PMAV applications. For further information go to the web site: www.resources.qld.gov.au or contact the Department of Resources.

Digital data for the vegetation management watercourse and drainage feature map, vegetation management wetlands map, essential habitat map and the vegetation management remnant and regional ecosystem map are available from the Queensland Spatial Portal at http://www.information.qld.gov.au/

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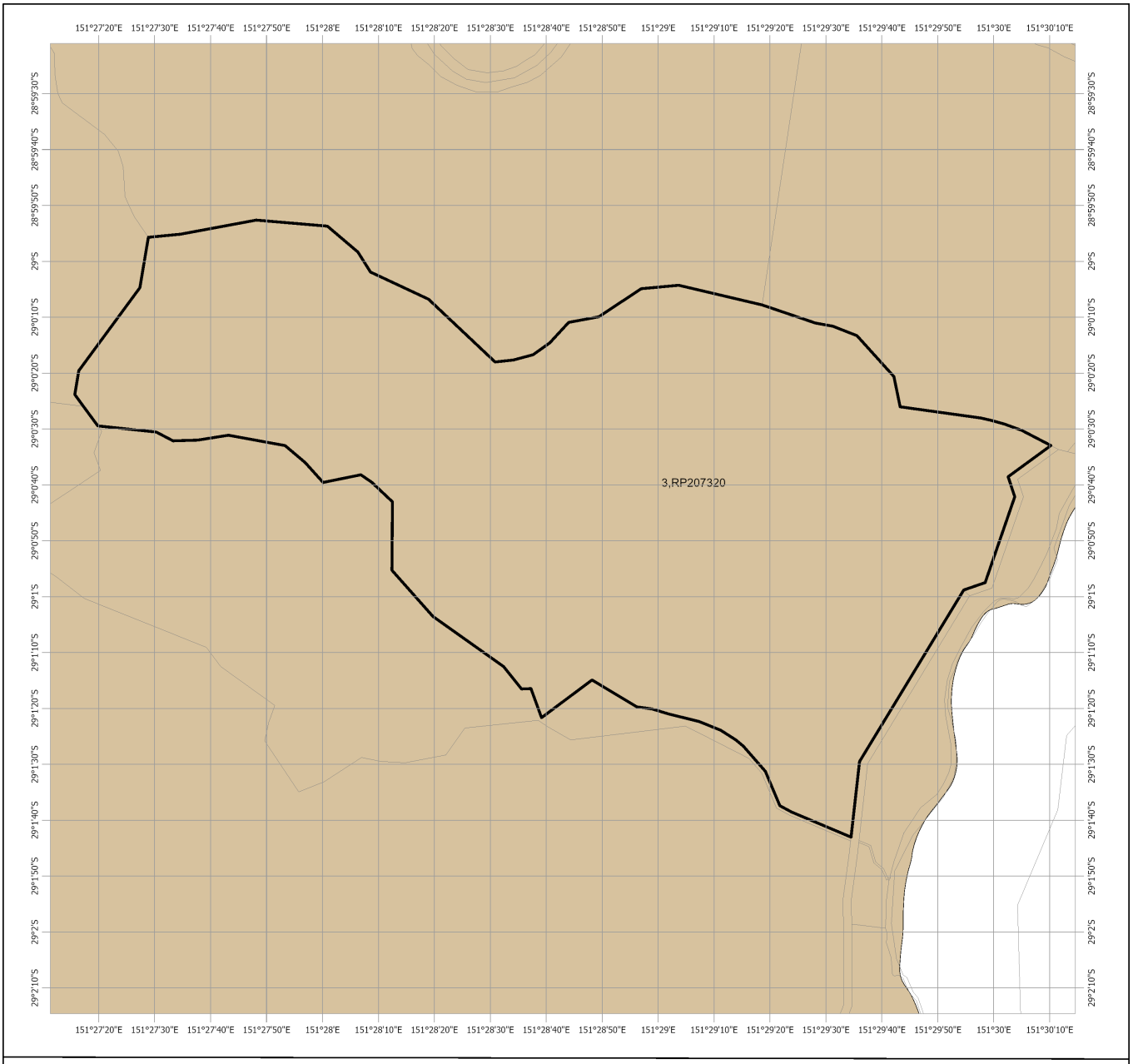
4.3 Coastal/non-coastal map



Coastal/Non Coastal Map

Coastal
Non Coastal
Other land parcel boundaries
Selected Lot and Plan

LOCALITY DIAGRAM



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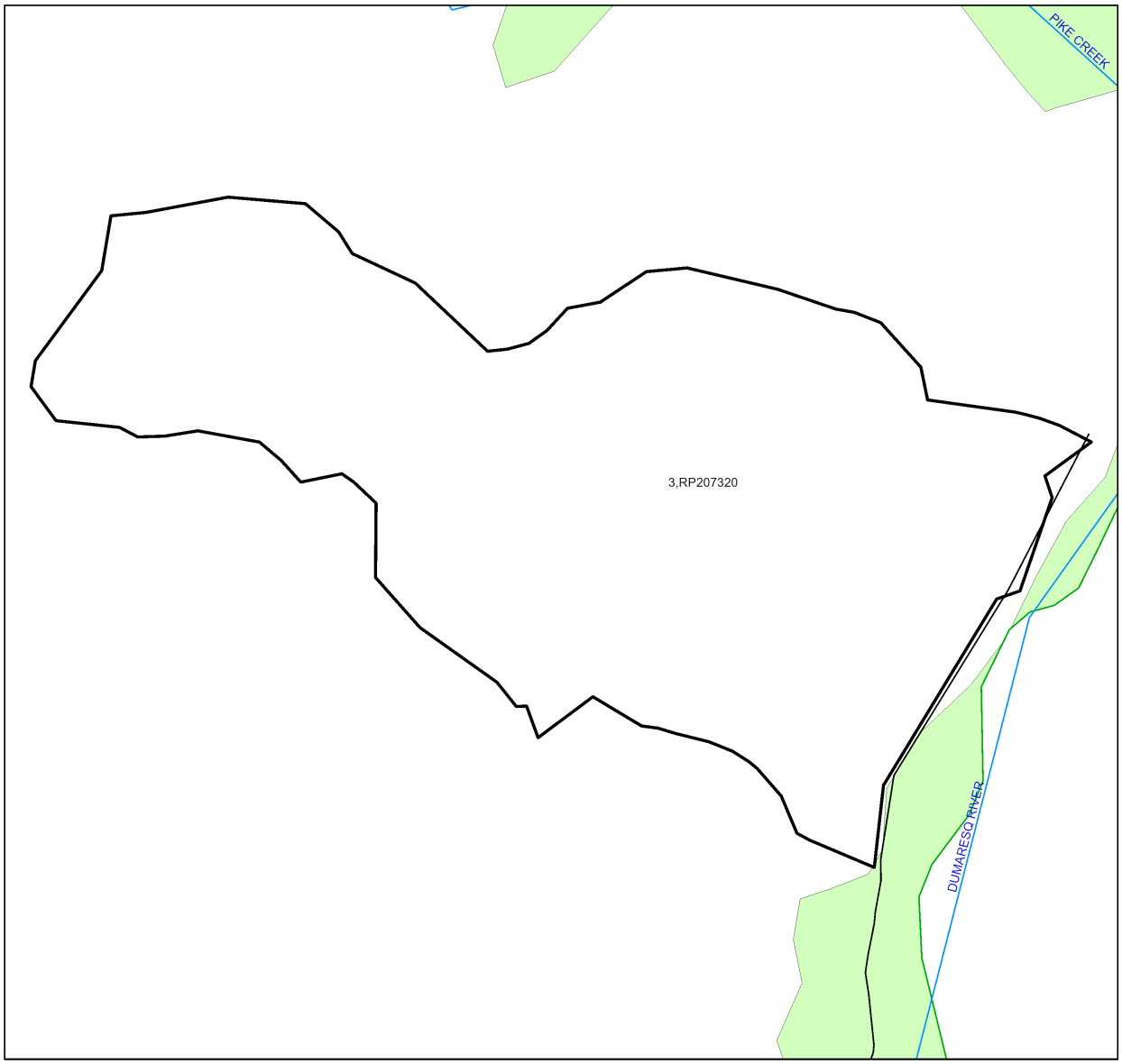
4.4 Agricultural Land Class A or B as per State Planning Policy: State Interest for Agriculture



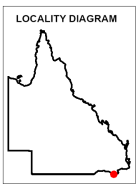
Agricultural Land Class A or B
as per State Planning Policy: State Interest for Agriculture

- Towns
- Rivers and creeks
- Freeways / motorways; Highways
- Secondary roads; Streets

Agricultural land class A or B

- A
- B
- Not class A or B
- Selected Lot and Plan

LOCALITY DIAGRAM



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5. Protected plants framework (administered by the Department of Environment, Science and Innovation (DESI))

In Queensland, all plants that are native to Australia are protected plants under the *Nature Conservation Act 1992* (NCA). The NCA regulates the clearing of protected plants 'in the wild' (see Operational policy: When a protected plant in Queensland is considered to be 'in the wild') that are listed as critically endangered, endangered, vulnerable or near threatened under the Act.

Please note that the protected plant clearing framework applies irrespective of the classification of the vegetation under the *Vegetation Management Act 1999* and any approval or exemptions given under another Act, for example, the *Vegetation Management Act 1999* or *Planning Regulation 2017*.

5.1 Clearing in high risk areas on the flora survey trigger map

The flora survey trigger map identifies high-risk areas for threatened and near threatened plants. These are areas where threatened or near threatened plants are known to exist or are likely to exist based on the habitat present. The flora survey trigger map for this property is provided in section 5.5.

If you are proposing to clear an area shown as high risk on the flora survey trigger map, a flora survey of the clearing impact area must be undertaken by a suitably qualified person in accordance with the Flora survey guidelines. The main objective of a flora survey is to locate any threatened or near threatened plants that may be present in the clearing impact area.

If the flora survey identifies that threatened or near threatened plants are not present within the clearing impact area or clearing within 100m of EVNT plants can be avoided, the clearing activity is exempt from a permit. An exempt clearing notification form must be submitted to the Department of Environment, Science and Innovation, with a copy of the flora survey report, at least one week prior to clearing.

If the flora survey identifies that threatened or near threatened plants are present in, or within 100m of, the area to be cleared, a clearing permit is required before any clearing is undertaken. The flora survey report, as well as an impact management report, must be submitted with the clearing permit application form.

5.2 Clearing outside high risk areas on the flora survey trigger map

In an area other than a high risk area, a clearing permit is only required where a person is, or becomes aware that threatened or near threatened plantsare present in, or within 100m of, the area to be cleared. You must keep a copy of the flora survey trigger map for the area subject to clearing for five years from the day the clearing starts. If you do not clear within the 12 month period that the flora survey trigger map was printed, you need to print and check a new flora survey trigger map.

5.3 Exemptions

Many activities are 'exempt' under the protected plant clearing framework, which means that clearing of native plants that are in the wild can be undertaken for these activities with no need for a flora survey or a protected plant clearing permit. The Information sheet - General exemptions for the take of protected plants provides some of these exemptions.

Some exemptions under the NCA are the same as exempt clearing work (formerly known as exemptions) under the *Vegetation Management Act 1999* (i.e. listed in Schedule 21 of the Planning Regulations 2017) while some are different.

5.4 Contact information for DESI

For further information on the protected plants framework:
Phone 1300 130 372 (and select option four)
Email palm@des.qld.gov.au
Visit https://www.qld.gov.au/environment/plants-animals/plants/protected-plants

5.5 Protected plants flora survey trigger map

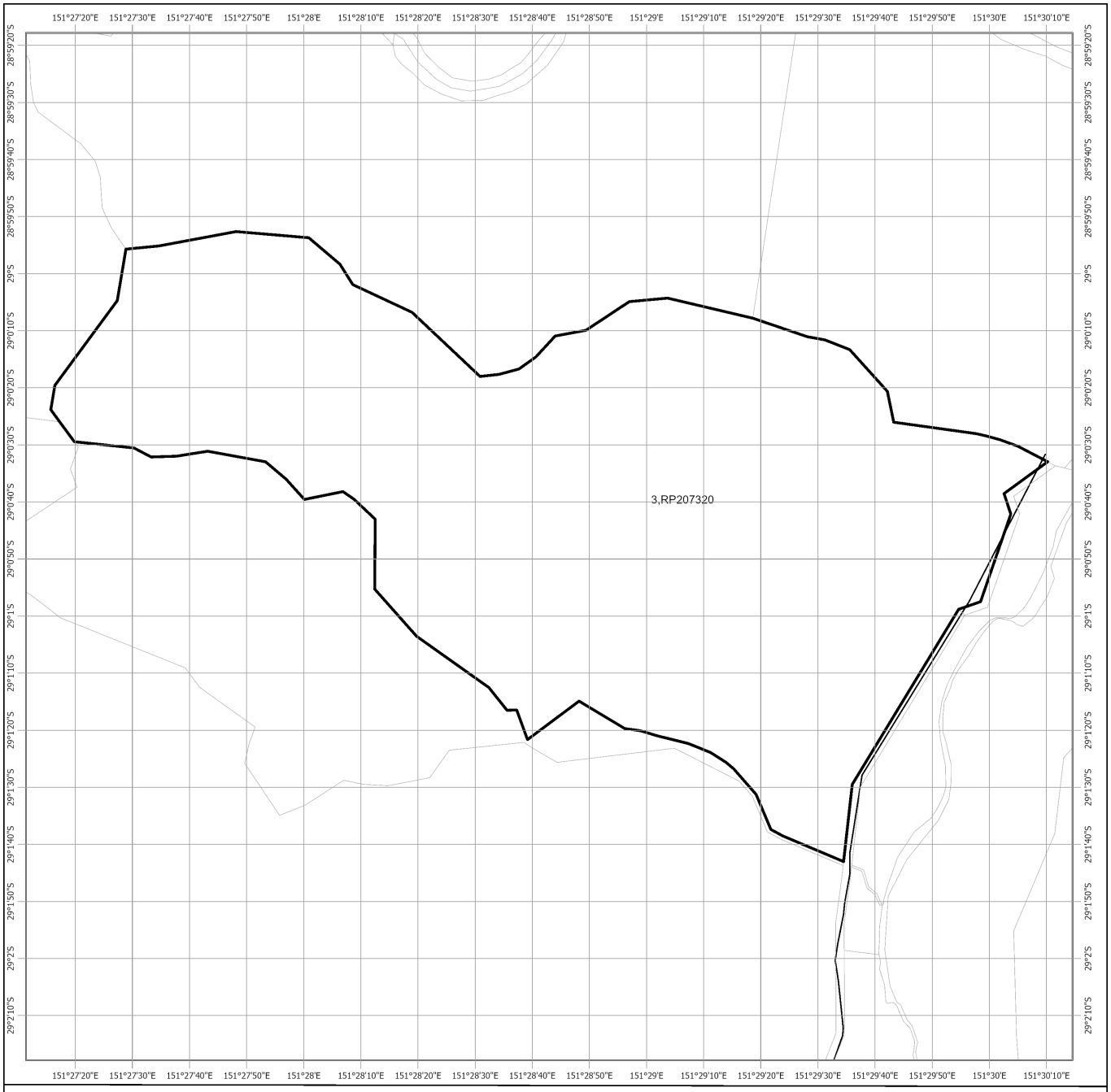
This map included may also be requested individually at: https://apps.des.qld.gov.au/map-request/flora-survey-trigger/.

Updates to the data informing the flora survey trigger map

The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information

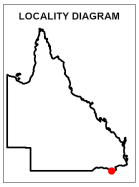
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment, Science and Innovation does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment, Science and Innovation webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



N

0 210 420 630 840 1,050 m

This product is displayed in:
GDA2020

This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation at palm@des.qld.gov.au

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6. Koala protection framework (administered by the Department of Environment, Science and Innovation (DESI))

The koala (*Phascolarctos cinereus*) is listed in Queensland as endangered by the Queensland Government under *Nature Conservation Act 1992* and by the Australian Government under the *Environment Protection and Biodiversity Conservation Act 1999*.

The Queensland Government's koala protection framework is comprised of the *Nature Conservation Act 1992*, the Nature Conservation (Animals) Regulation 2020, the Nature Conservation (Koala) Conservation Plan 2017, the *Planning Act 2016* and the Planning Regulation 2017.

6.1 Koala mapping

6.1.1 Koala districts

The parts of Queensland where koalas are known to occur has been divided into three koala districts - koala district A, koala district B and koala district C. Each koala district is made up of areas with comparable koala populations (e.g. density, extent and significance of threatening processes affecting the population) which require similar management regimes.

Section 7.1 identifies which koala district your property is located in.

6.1.2 Koala habitat areas

Koala habitat areas are areas of vegetation that have been determined to contain koala habitat that is essential for the conservation of a viable koala population in the wild based on the combination of habitat suitability and biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water). In order to protect this important koala habitat, clearing controls have been introduced into the Planning Regulation 2017 for development in koala habitat areas.

Please note that koala habitat areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

There are two different categories of koala habitat area (core koala habitat area and locally refined koala habitat), which have been determined using two different methodologies. These methodologies are described in the document Spatial modelling in South East Queensland.

Section 7.2 shows any koala habitat area that exists on your property.

Under the Nature Conservation (Koala) Conservation Plan 2017, an owner of land (or a person acting on the owner's behalf with written consent) can request to make, amend or revoke a koala habitat area determination if they believe, on reasonable grounds, that the existing determination for all or part of their property is incorrect.

More information on requests to make, amend or revoke a koala habitat area determination can be found in the document Guideline - Requests to make, amend or revoke a koala habitat area determination.

The koala habitat area map will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

Changes to the koala habitat area map which occur between annual updates because of a request to make, amend or revoke a koala habitat area determination can be viewed on the register of approved requests to make, amend or revoke a koala habitat area available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/koalamaps. The register includes the lot on plan for the change, the date the decision was made and the map issued to the landholder that shows areas determined to be koala habitat areas.

6.1.3 Koala priority areas

Koala priority areas are large, connected areas that have been determined to have the highest likelihood of achieving conservation outcomes for koalas based on the combination of habitat suitability, biophysical variables with known relationships to koala habitat (e.g. landcover, soil, terrain, climate and ground water) and a koala conservation cost benefit analysis.

Conservation efforts will be prioritised in these areas to ensure the conservation of viable koala populations in the wild including a focus on management (e.g. habitat protection, habitat restoration and threat mitigation) and monitoring. This includes a prohibition on clearing in koala habitat areas that are in koala priority areas under the Planning Regulation 2017 (subject to some exemptions).

Please note that koala priority areas only exist in koala district A which is the South East Queensland "Shaping SEQ" Regional Plan area. These areas include the local government areas of Brisbane, Gold Coast, Logan, Lockyer Valley, Ipswich, Moreton Bay, Noosa, Redland, Scenic Rim, Somerset, Sunshine Coast and Toowoomba (urban extent).

Section 7.2 identifies if your property is in a koala priority area.

6.1.4 Identified koala broad-hectare areas

There are seven identified koala broad-hectare areas in SEQ. These are areas of koala habitat that are located in areas committed to meet development targets in the SEQ Regional Plan to accommodate SEQ's growing population including bring-forward Greenfield sites under the Queensland Housing Affordability Strategy and declared master planned areas under the repealed *Sustainable Planning Act 2009* and the repealed *Integrated Planning Act 1997*.

Specific assessment benchmarks apply to development applications for development proposed in identified koala broad-hectare areas to ensure koala conservation measures are incorporated into the proposed development.

Section 7.2 identifies if your property is in an identified koala broad-hectare area.

6.2 Koala habitat planning controls

On 7 February 2020, the Queensland Government introduced new planning controls to the Planning Regulation 2017 to strengthen the protection of koala habitat in South East Queensland (i.e. koala district A).

More information on these planning controls can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

As a high-level summary, the koala habitat planning controls make:

- development that involves interfering with koala habitat (defined below) in an area that is both a koala priority area and a koala habitat area, prohibited development (i.e. development for which a development application cannot be made);
- development that involves interfering with koala habitat (defined below) in an area that is a koala habitat area but is not a koala priority area, assessable development (i.e. development for which development approval is required); and
- development that is for extractive industries where the development involves interfering with koala habitat (defined below) in an area that is both a koala habitat area and a key resource area, assessable development (i.e. development for which development approval is required).

Interfering with koala habitat means:

1. Removing, cutting down, ringbarking, pushing over, poisoning or destroying in anyway, including by burning, flooding or draining native vegetation in a koala habitat area; but
2. Does not include destroying standing vegetation stock or lopping a tree.

However, these planning controls do not apply if the development is exempted development as defined in Schedule 24 of the Planning Regulation 2017. More information on exempted development can be found here:
https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/legislation-policy.

There are also assessment benchmarks that apply to development applications for:

- building works, operational works, material change of use or reconfiguration of a lot where:

  - the local government planning scheme makes the development assessable;
  - the premises includes an area that is both a koala priority area and a koala habitat area; and
  - the development does not involve interfering with koala habitat (defined above); and

- development in identified koala broad-hectare areas.

The Guideline - Assessment Benchmarks in relation to Koala Habitat in South East Queensland assessment benchmarks outlines these assessment benchmarks, the intent of these assessment benchmarks and advice on how proposed development may meet these assessment benchmarks.

6.3 Koala Conservation Plan clearing requirements

Section 10 and 11 of the Nature Conservation (Koala) Conservation Plan 2017 prescribes requirements that must be met when clearing koala habitat in koala district A and koala district B.

These clearing requirements are independent to the koala habitat planning controls introduced into the Planning Regulation 2017, which means they must be complied with irrespective of any approvals or exemptions offered under other legislation.

Unlike the clearing controls prescribed in the Planning Regulation 2017 that are to protect koala habitat, the clearing requirements prescribed in the Nature Conservation (Koala) Conservation Plan 2017 are in place to prevent the injury or death of koalas when koala habitat is being cleared.

6.4 Contact information for DESI

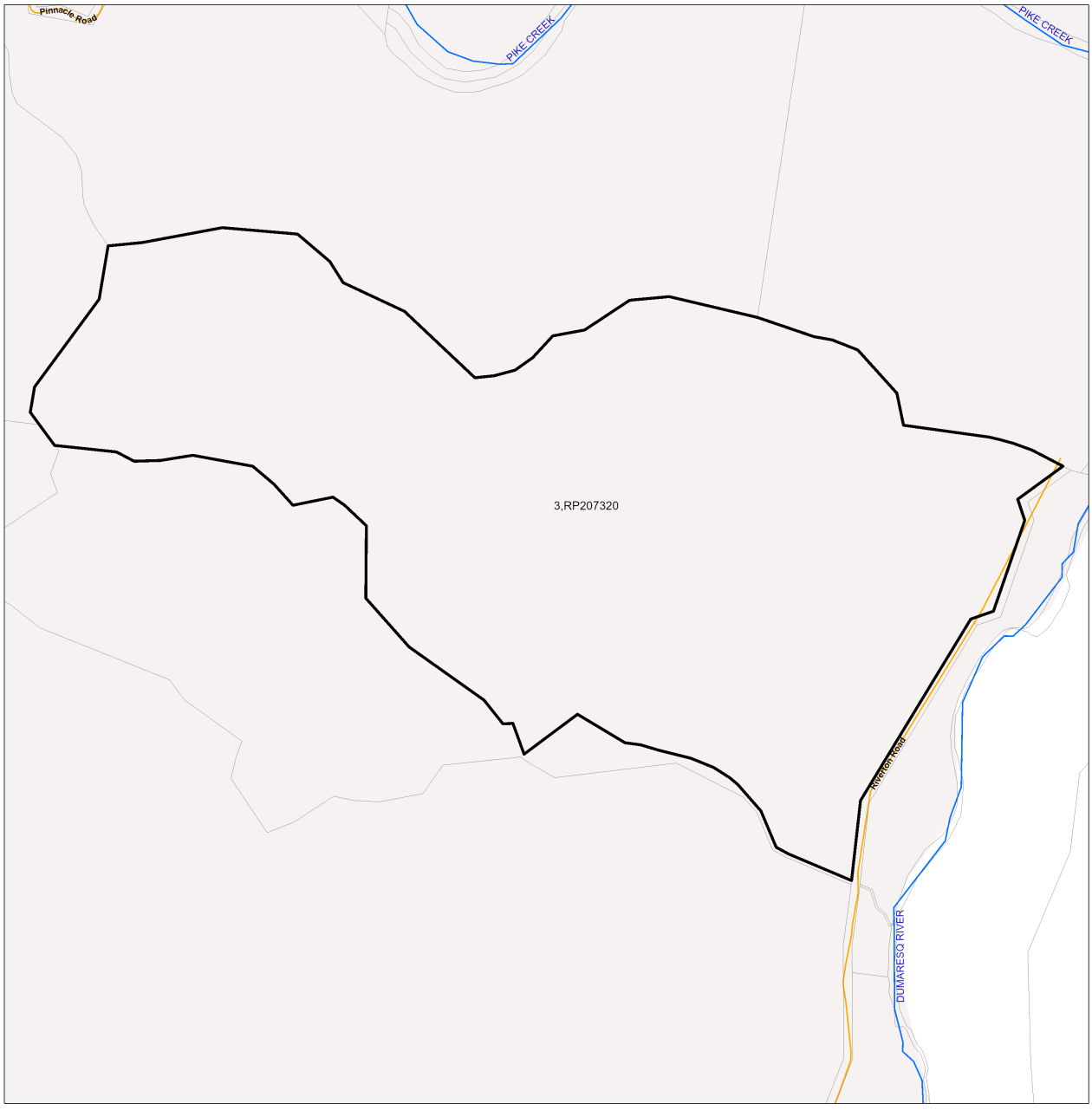
For further information on the koala protection framework:
Phone 13 QGOV (13 74 68)
Email koala.assessment@des.qld.gov.au
Visit https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

7. Koala protection framework details for Lot: 3 Plan: RP207320

7.1 Koala districts

Koala District C

7.2 Koala priority area, koala habitat area and identified koala broad-hectare map



Koala priority area, koala habitat area and identified koala broad-hectare area map

- Koala habitat area (core)
- Koala habitat area (locally refined)
- Koala priority area
- Identified koala broad-hectare area
- Cadastral Boundaries
- Towns
- Major rivers/creeks
- Highway
- Connector
- Street/Local Road
- Queensland
- Selected Lot and Plan

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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LOCALITY DIAGRAM

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The koala conservation plan maps will be updated at least annually to include any koala habitat areas that have been made, amended or revoked.

In order to ensure that the most recent map for an area of interest can be accessed, prior to the annual update, a register of changes made to koala habitat areas as a result of the map amendment process will be available at: https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping/. The register will include lot on plan for the change, the date the decision was made and the map issued to the landholder which shows areas determined to be koala habitat areas.

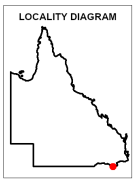
7.3 Koala habitat regional ecosystems for core koala habitat areas



Koala habitat regional ecosystems for core koala habitat areas

Koala habitat area (core)
Towns
Highway
Connector
Street/Local Road
Major rivers/creeks
Queensland
Selected Lot and Plan

LOCALITY DIAGRAM



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8. Other relevant legislation contacts list

Activity	Legislation	Agency	Contact details
• Interference with overland flow • Earthworks, significant disturbance	*Water Act 2000* *Soil Conservation Act 1986*	Department of Regional Development, Manufacturing and Water (Queensland Government) Department of Resources (Queensland Government)	Ph: 13 QGOV (13 74 68) www.rdmw.qld.gov.au/ www.resources.qld.gov.au
• Indigenous Cultural Heritage	*Aboriginal Cultural Heritage Act 2003* *Torres Strait Islander Cultural Heritage Act 2003*	Department of Seniors, Disability Services and Aboriginal and Torres Strait Islander Partnerships	Ph: 13 QGOV (13 74 68) www.datsip.qld.gov.au
• Mining and environmentally relevant activities • Infrastructure development (coastal) • Heritage issues	*Environmental Protection Act 1994* *Coastal Protection and Management Act 1995* *Queensland Heritage Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 13 QGOV (13 74 68) www.des.qld.gov.au
• Protected plants and protected areas	*Nature Conservation Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 1300 130 372 (option 4) palm@des.qld.gov.au www.des.qld.gov.au
• Koala mapping and regulations	*Nature Conservation Act 1992*	Department of Environment, Science and Innovation (Queensland Government)	Ph: 13 QGOV (13 74 68) Koala.assessment@des.qld.gov.au
• Interference with fish passage in a watercourse, mangroves • Forestry activities on State land tenures	*Fisheries Act 1994* *Forestry Act 1959*	Department of Agriculture and Fisheries (Queensland Government)	Ph: 13 QGOV (13 74 68) www.daf.qld.gov.au
• Matters of National Environmental Significance including listed threatened species and ecological communities	*Environment Protection and Biodiversity Conservation Act 1999*	Department of Agriculture, Water and the Environment (Australian Government)	Ph: 1800 803 772 www.environment.gov.au
• Development and planning processes	*Planning Act 2016* *State Development and Public Works Organisation Act 1971*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) www.dsdmip.qld.gov.au
• Local government requirements	*Local Government Act 2009* *Planning Act 2016*	Department of State Development, Infrastructure, Local Government and Planning (Queensland Government)	Ph: 13 QGOV (13 74 68) Your relevant local government office
• Harvesting timber in the Wet Tropics of Qld World Heritage area	*Wet Tropics World Heritage Protection and Management Act 1993*	Wet Tropics Management Authority	Ph: (07) 4241 0500 https://www.wettropics.gov.au/

Queensland Government

Department of Environment, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 50142

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

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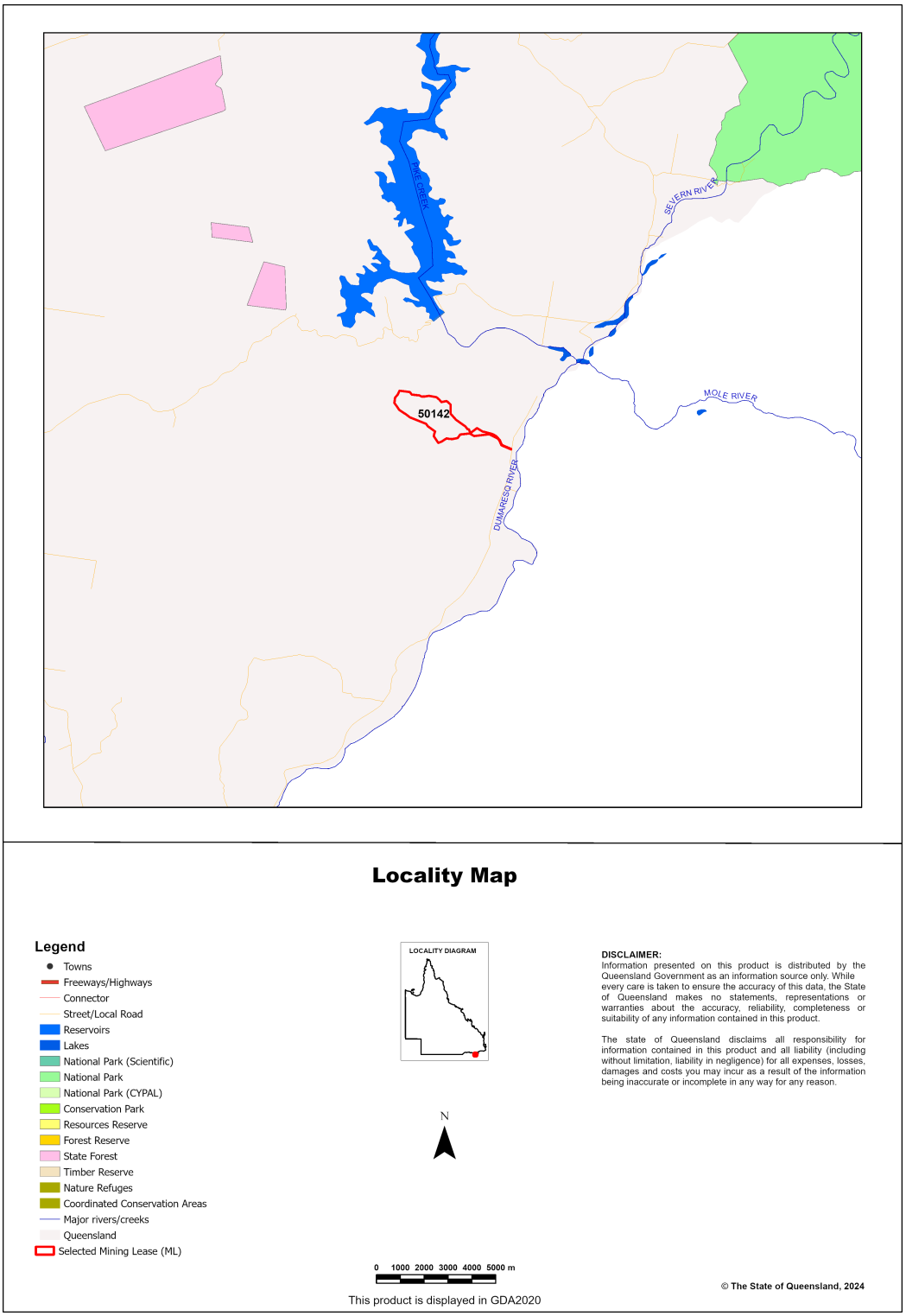
Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 50142, with area 299.41 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Southern Downs Regional	Border Rivers	New England Tableland	Nandewar Northern Complex
Goondiwindi Regional			



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	0.0%
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	0 ha	0.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	218.18 ha	72.9%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	35.07 ha	11.7%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	0 ha	0.0%
8e Regulated Vegetation - intersecting a watercourse	6.6 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Not applicable

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	V	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	None
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
13.11.4/13.11.8	O-subdom	rem_oc

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Regional ecosystem	Vegetation management polygon	Vegetation management status
13.11.4/13.11.8	O-subdom	hvr_oc

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Not applicable

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

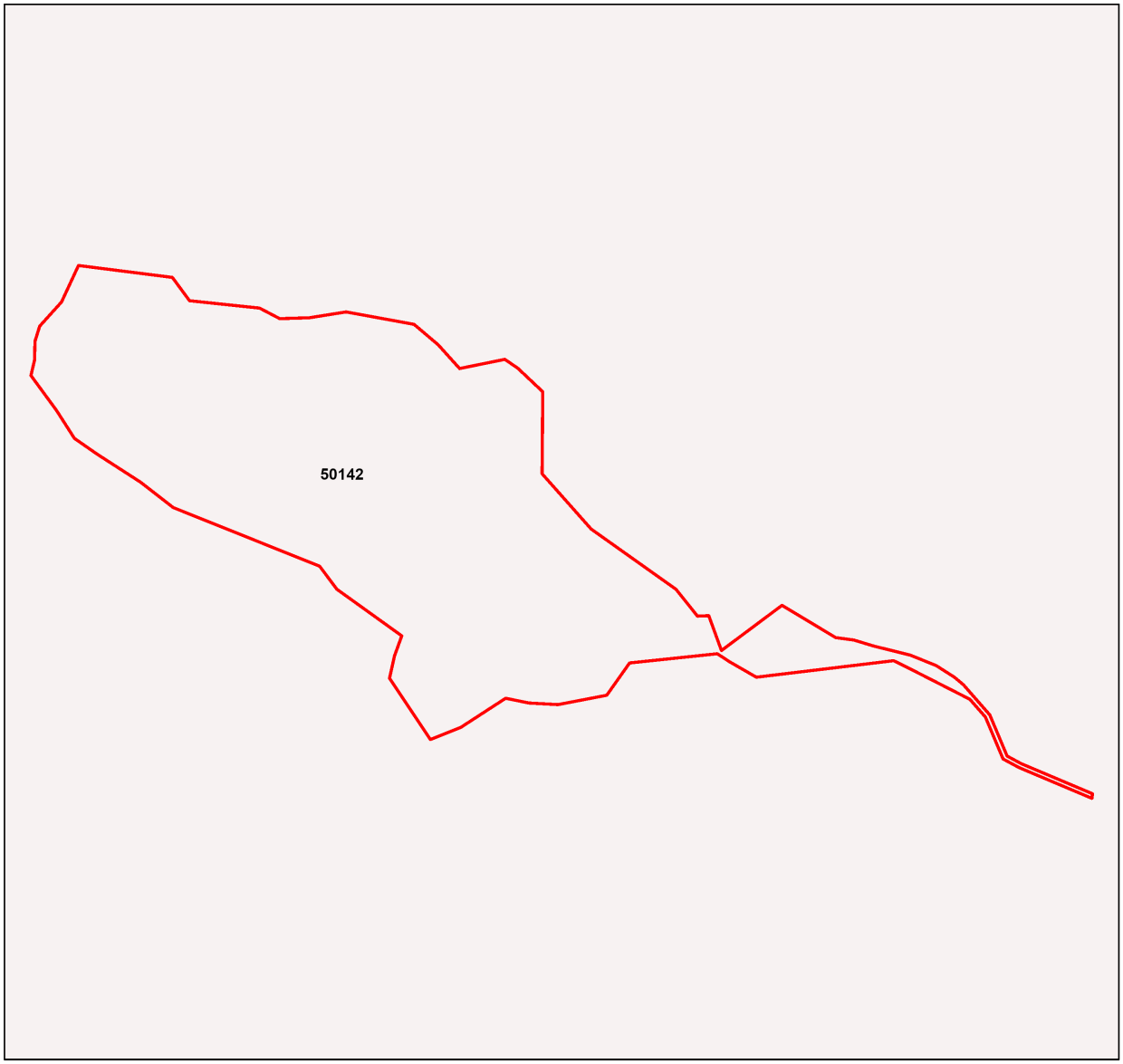
(No results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

(No results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

Map 1 - MSES - State Conservation Areas



MSES - State Conservation Areas

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Protected area (estates, nature refuges, special wildlife reserves)
- Declared fish habitat area (A and B areas)
- Marine park (highly protected)
- Selected Mining Lease (ML)



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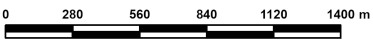

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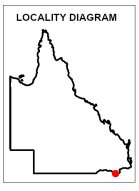
Map 2 - MSES - Wetlands and Waterways



MSES - Wetlands and Waterways

- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Declared high ecological value waters (watercourse)
- Strategic environmental area (designated precinct)
- Declared high ecological value waters (wetland)
- High ecological significance wetlands
- Selected Mining Lease (ML)



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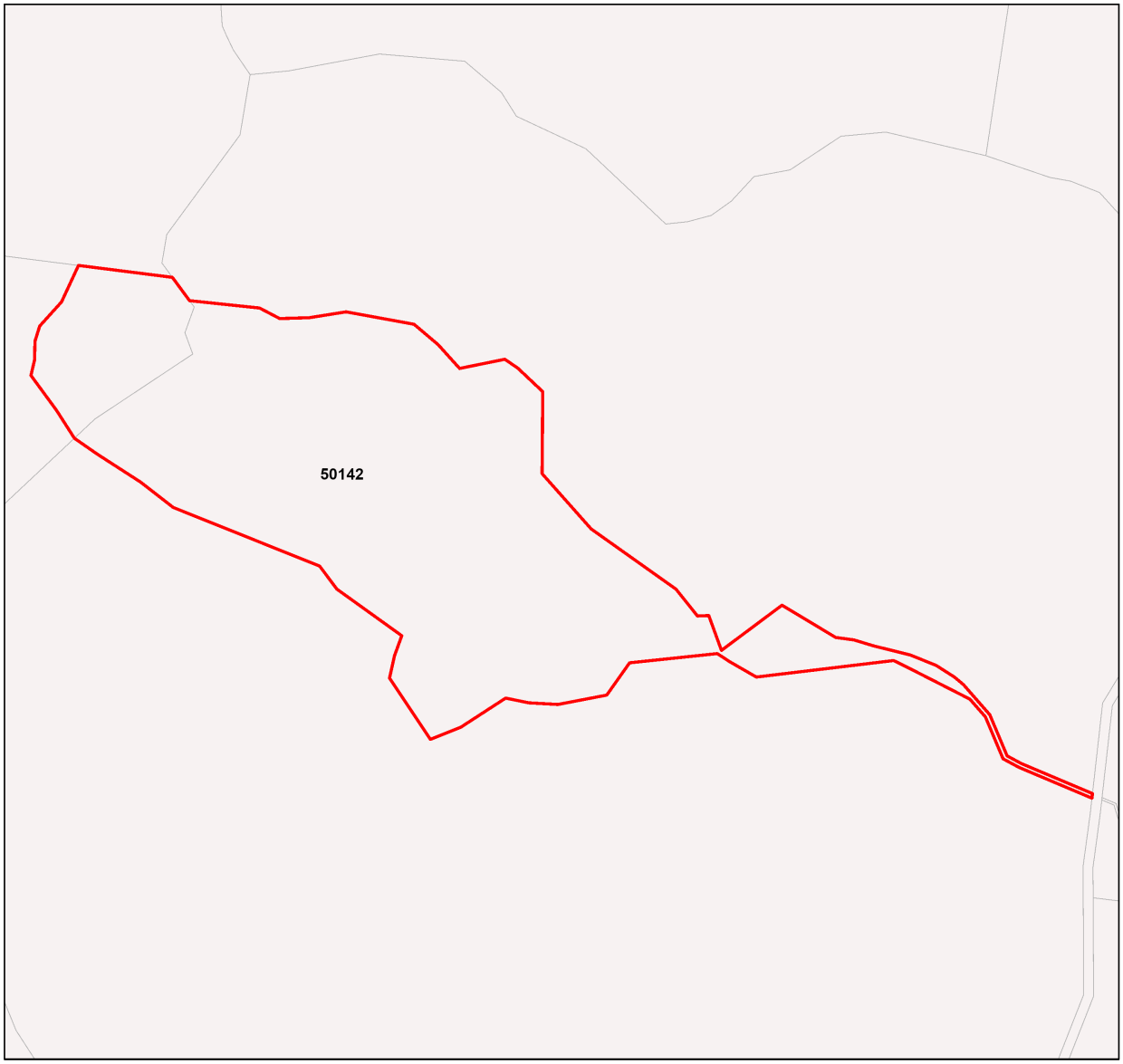
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



MSES - Species
Threatened (endangered or vulnerable) wildlife and special least concern animals

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (special least concern)
- Wildlife habitat (endangered or vulnerable)
- Selected Mining Lease (ML)



N

0 280 560 840 1120 1400 m

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Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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0 260 520 780 1,040 1,300 m

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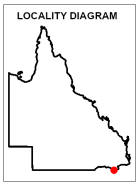
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



MSES - Wildlife habitat (sea turtle nesting areas)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (sea turtle nesting areas)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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MSES mapping of sea turtle nesting areas identifies beaches where the recorded number of turtle nests are over 1% of the turtle species or genetic stock. The linework is also deliberately extended along nearby rocky coastlines and headlands to recognise that significant numbers of nesting adults and hatchlings can become disoriented by light pollution from development on rocky coastlines and headlands while navigating offshore from nesting beaches.

0 260 520 780 1,040 1,300 m

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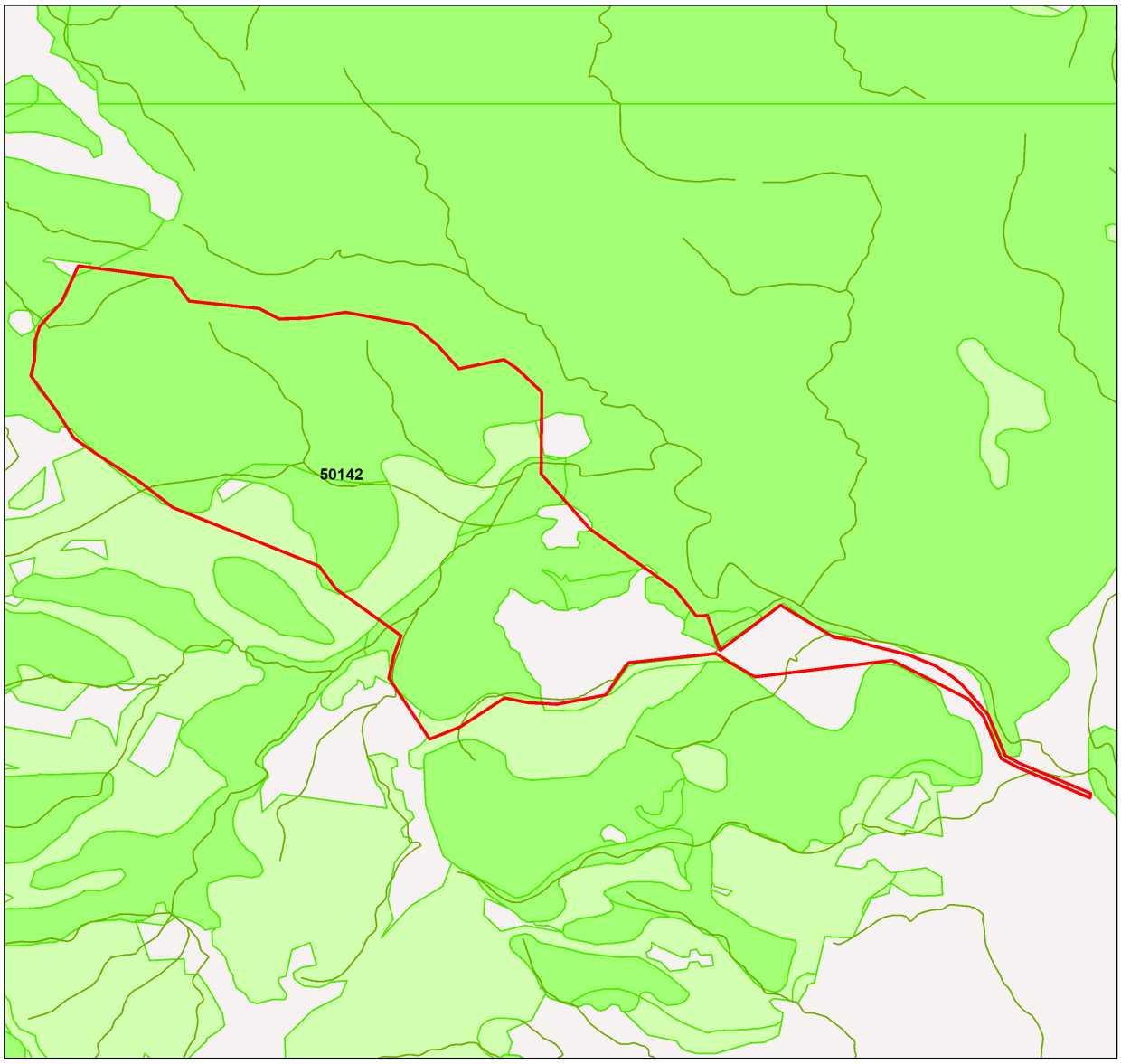
Map 4 - MSES - Regulated Vegetation



MSES - Regulated Vegetation

- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



N

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Map 5 - MSES - Offset Areas



MSES - Offsets

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Legally secured offset area (offset register)
- Legally secured offset area (vegetation offsets)
- Selected Mining Lease (ML)



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Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

MSES mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

MSES mapping does not determine whether state or local development assessment is required. For state assessment triggers refer to the Development Assessment Mapping System (DAMS). For local assessment triggers, refer to the relevant local planning scheme.

The Queensland Government's "Method for mapping - matters of state environmental significance can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DESI	- Department of Environment, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999

Queensland Government

Department of Environment, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

ML: 50220

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and a field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

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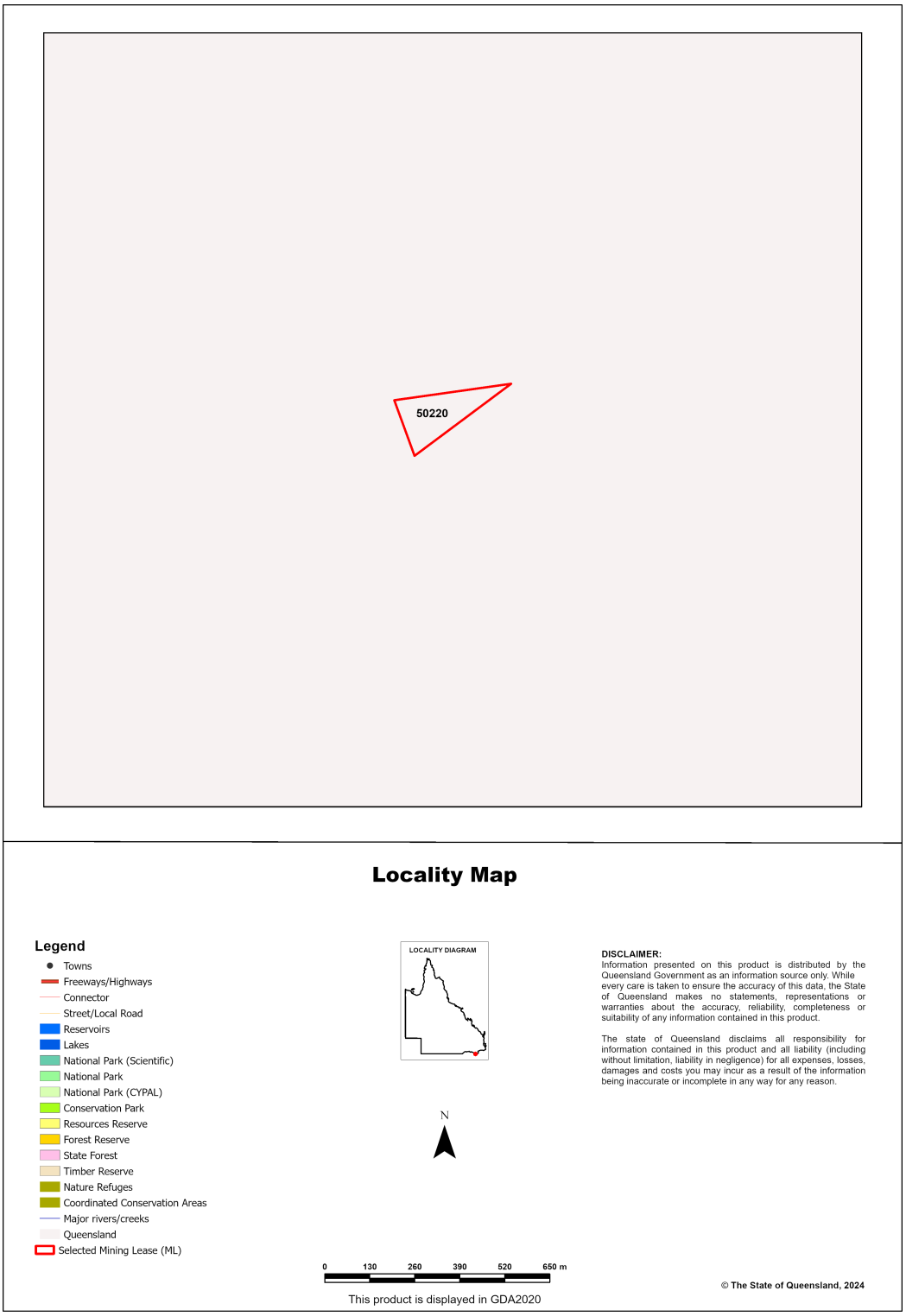
Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: ML: 50220, with area 2.49 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Goondiwindi Regional	Border Rivers	New England Tableland	Nandewar Northern Complex



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992;*

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the Marine Parks Act 2004 ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- *Threatened wildlife under the Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

  - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
  - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
  - Category R areas on the regulated vegetation management map;
  - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
  - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0 ha	0.0%
1b Protected Areas- nature refuges	0 ha	0.0%
1c Protected Areas- special wildlife reserves	0 ha	0.0%
2 State Marine Parks- highly protected zones	0 ha	0.0%
3 Fish habitat areas (A and B areas)	0 ha	0.0%
4 Strategic Environmental Areas (SEA)	0 ha	0.0%
5 High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values	0 ha	0.0%
6a High Ecological Value (HEV) wetlands	0 ha	0.0%
6b High Ecological Value (HEV) waterways	0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	0 ha	0.0%
7b Special least concern animals	0 ha	0.0%
7c i Koala habitat area - core (SEQ)	0 ha	0.0%
7c ii Koala habitat area - locally refined (SEQ)	0 ha	0.0%
7d Sea turtle nesting areas	0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	2.32 ha	93.2%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0 ha	0.0%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0 ha	0.0%
8d Regulated Vegetation - Essential habitat	0 ha	0.0%
8e Regulated Vegetation - intersecting a watercourse	0.3 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0 ha	0.0%
9a Legally secured offset areas- offset register areas	0 ha	0.0%
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0 ha	0.0%

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(No results)

1b. Protected Areas - nature refuges

(No results)

1c. Protected Areas - special wildlife reserves

(No results)

2. State Marine Parks - highly protected zones

(No results)

3. Fish habitat areas (A and B areas)

(No results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(No results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Not applicable

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii	Keys boronia	V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Euastacus bindal	Mount Elliot crayfish	CR	None
Euastacus binzayedi		CR	None
Euastacus eungella		E	None
Euastacus hystricosus		E	None
Euastacus jagara	Jagara hairy crayfish	CR	None
Euastacus maidae		CR	None
Euastacus monteithorum		E	None
Euastacus robertsi		E	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Melaleuca irbyana	swamp tea-tree	E	None
Macadamia ternifolia		V	None
Macadamia tetraphylla	bopple nut	V	None
Petrogale penicillata	brush-tailed rock-wallaby	V	None
Petrogale coenensis	Cape York rock-wallaby	V	None
Petrogale purpureicollis	purple-necked rock-wallaby	V	None
Petrogale sharmani	Sharmans rock-wallaby	V	None
Petrogale xanthopus celeris	yellow-footed rock-wallaby (Qld subspecies)	V	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Phascolarctos cinereus	Koala - outside SEQ*	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Xeromys myoides	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

(No results)

Special least concern animal species records

(No results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Regional ecosystem	Vegetation management polygon	Vegetation management status
13.11.4/13.11.8	O-subdom	rem_oc

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Not applicable

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

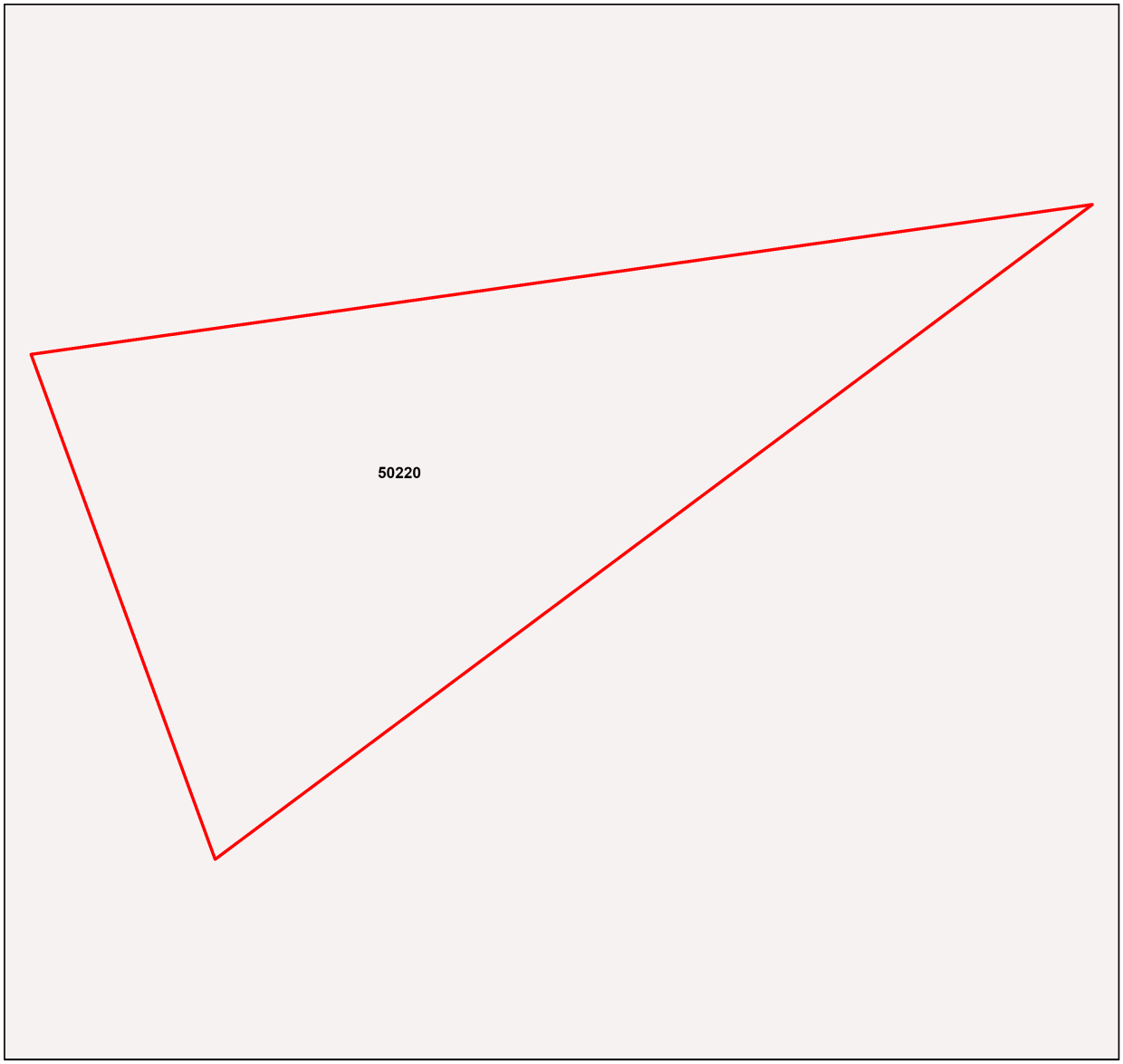
(No results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

(No results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

Map 1 - MSES - State Conservation Areas



MSES - State Conservation Areas

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Protected area (estates, nature refuges, special wildlife reserves)
- Declared fish habitat area (A and B areas)
- Marine park (highly protected)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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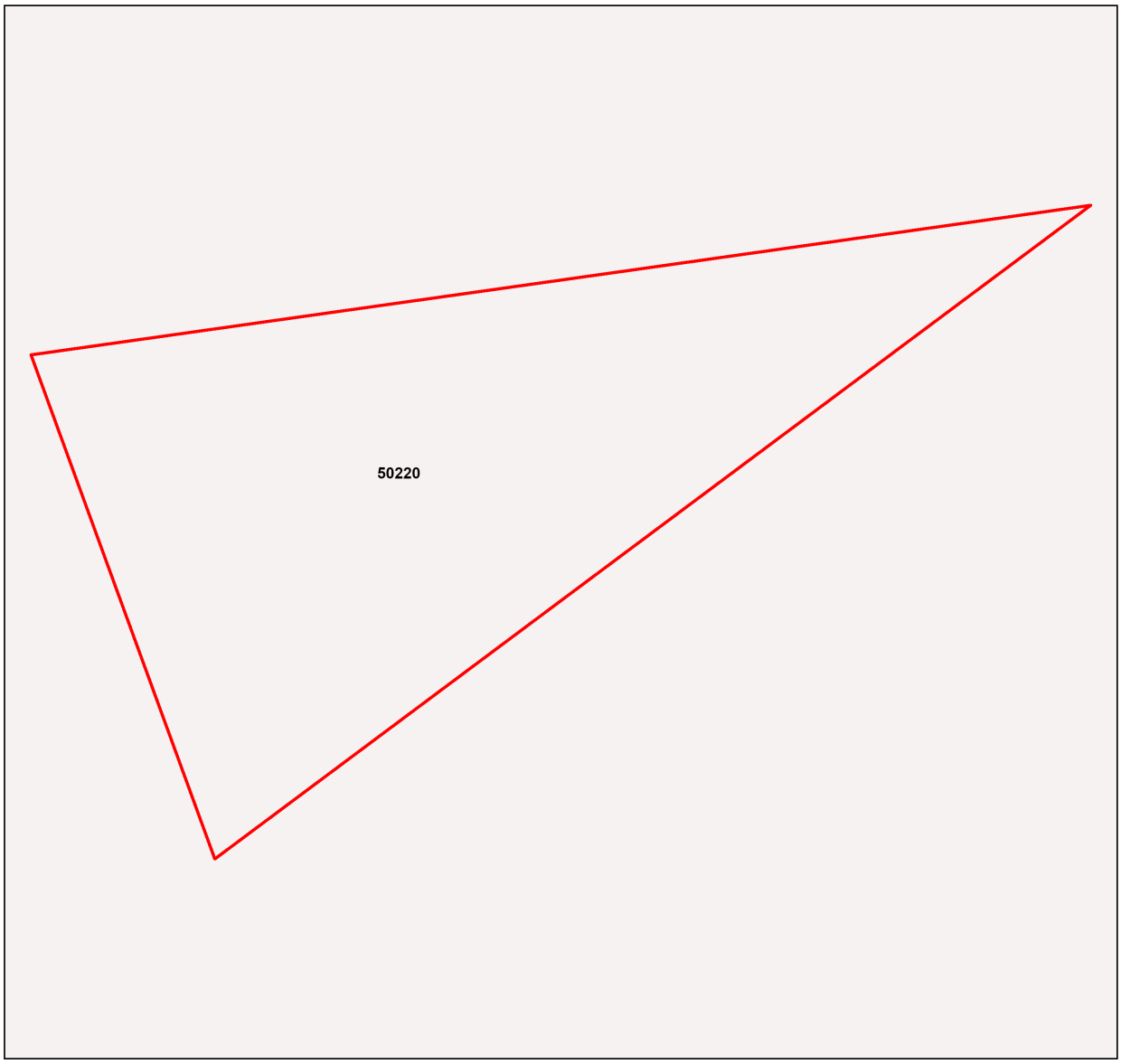
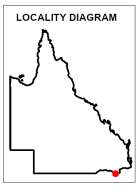
Map 2 - MSES - Wetlands and Waterways



MSES - Wetlands and Waterways

- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Declared high ecological value waters (watercourse)
- Strategic environmental area (designated precinct)
- Declared high ecological value waters (wetland)
- High ecological significance wetlands
- Selected Mining Lease (ML)



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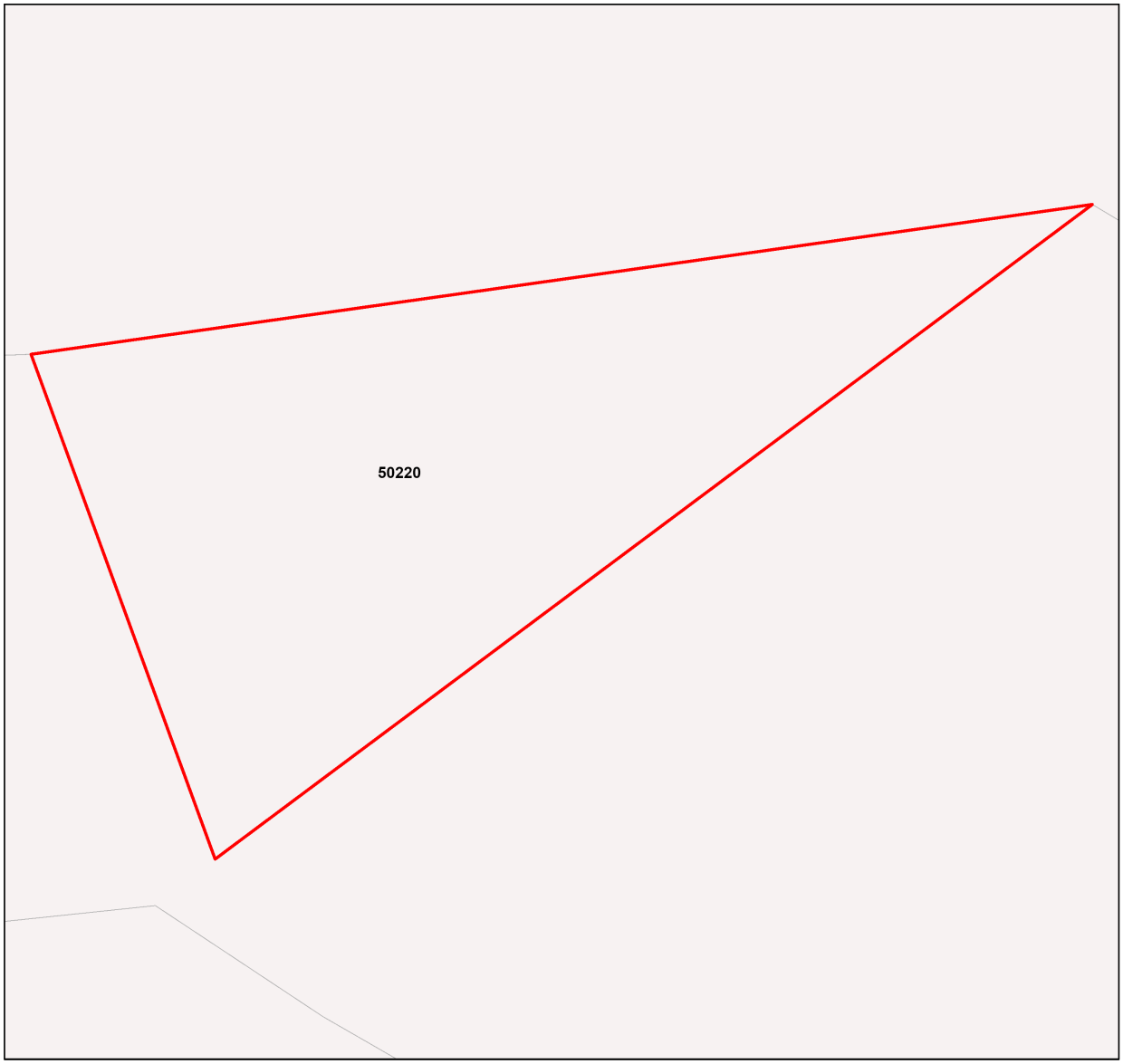
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



MSES - Species
Threatened (endangered or vulnerable) wildlife and special least concern animals

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (special least concern)
- Wildlife habitat (endangered or vulnerable)
- Selected Mining Lease (ML)



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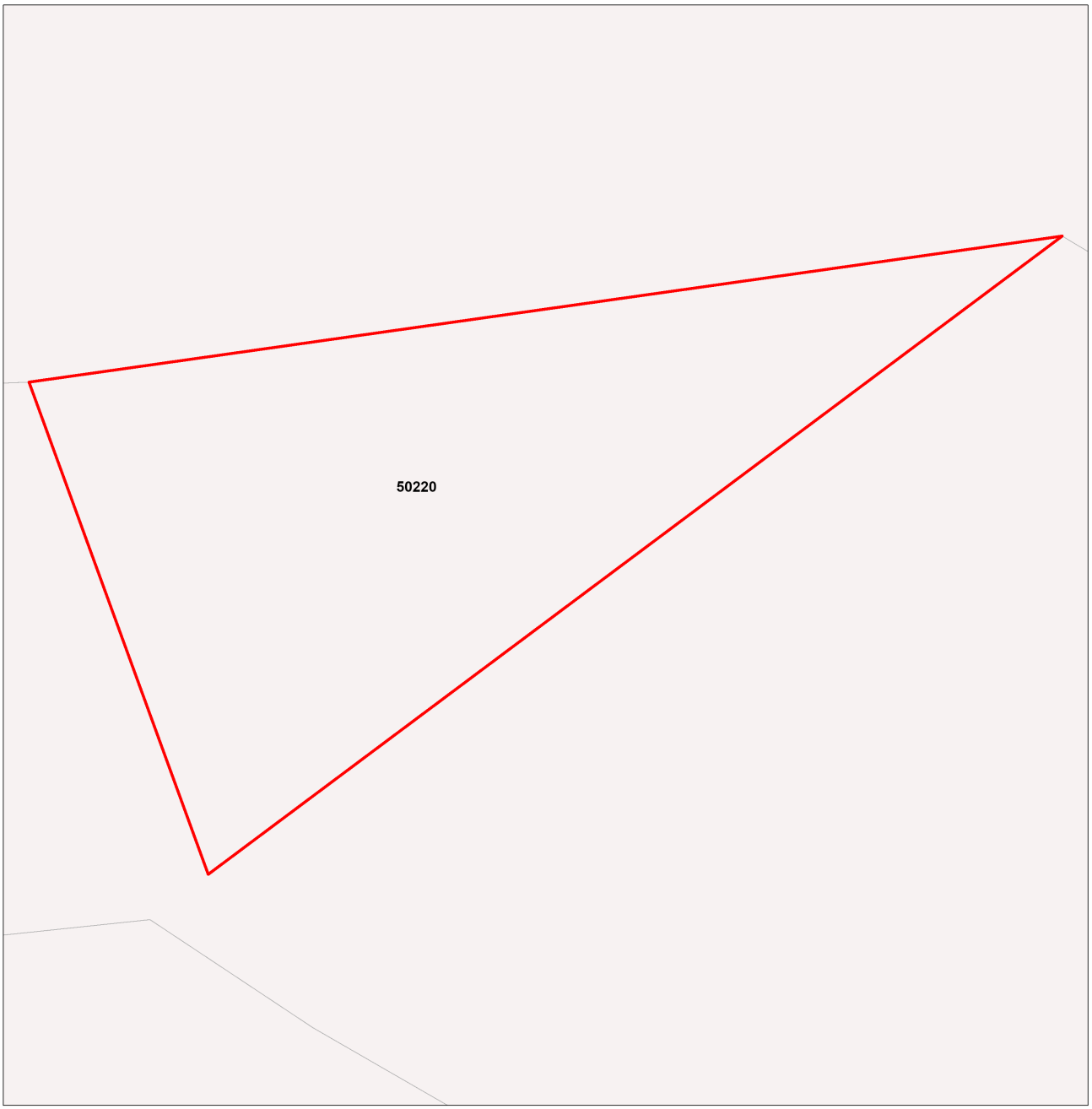
Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species
Koala habitat area (SEQ)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

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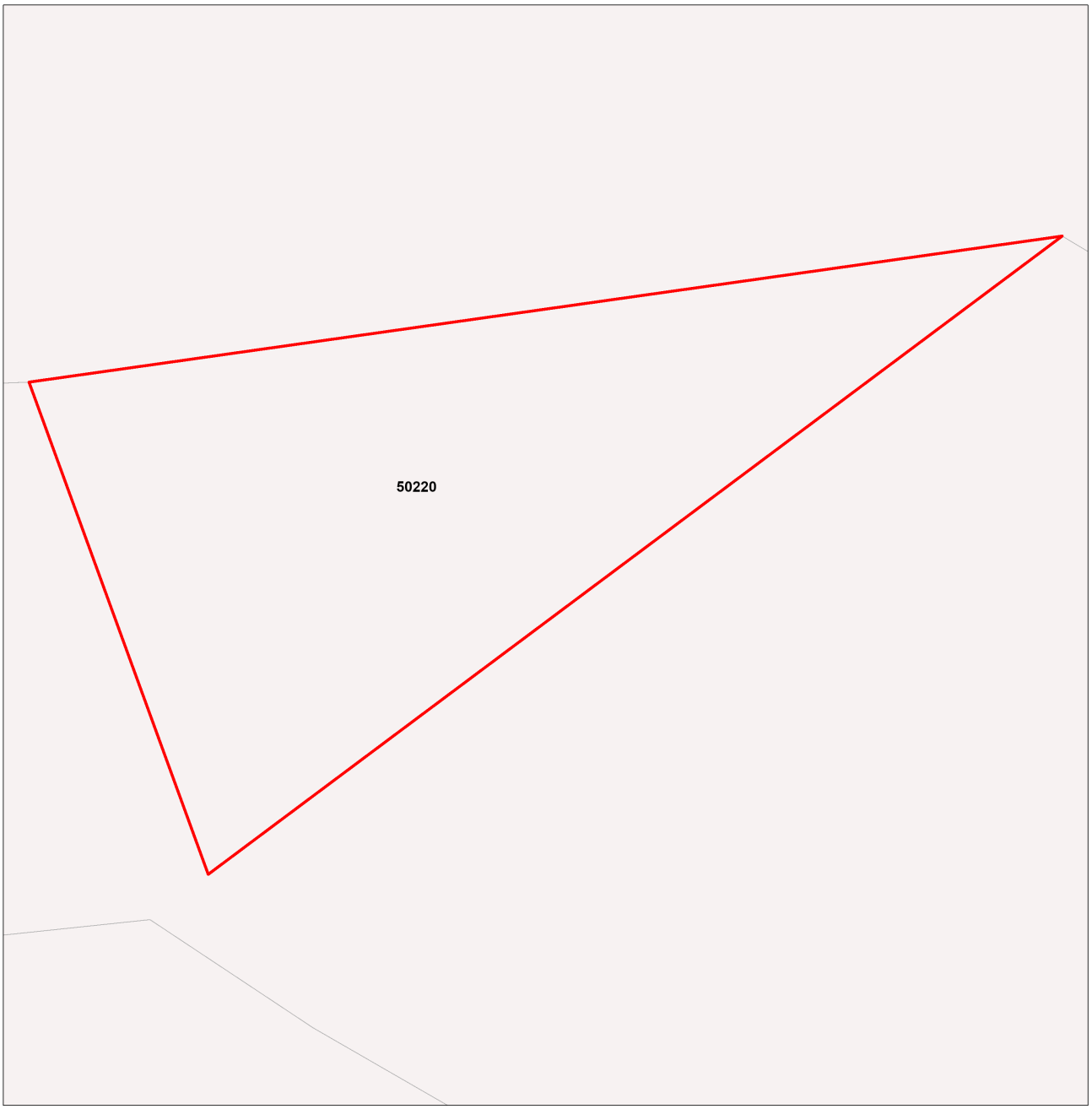
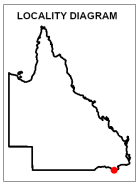
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



MSES - Wildlife habitat (sea turtle nesting areas)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (sea turtle nesting areas)
- Selected Mining Lease (ML)

LOCALITY DIAGRAM



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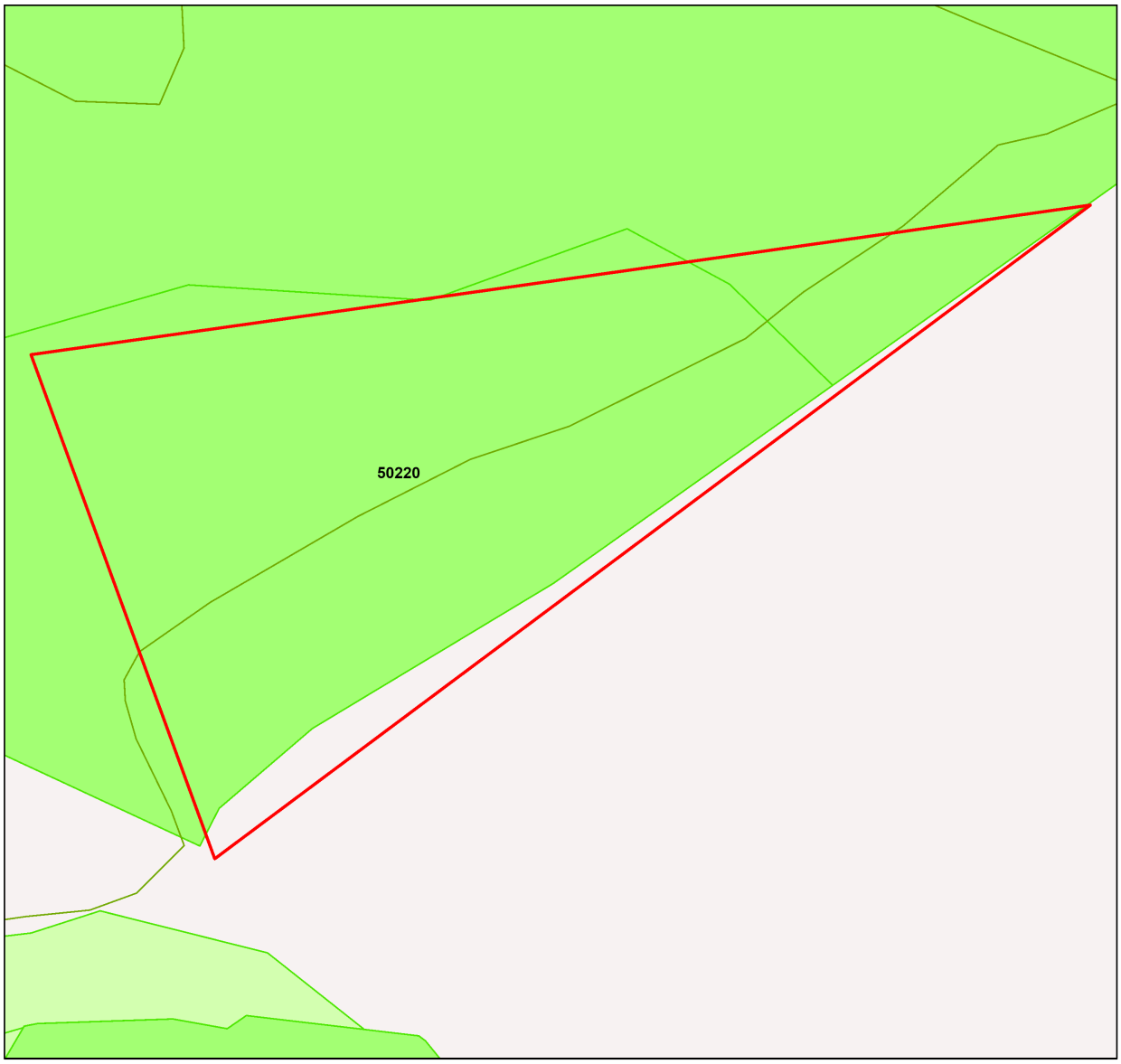
MSES mapping of sea turtle nesting areas identifies beaches where the recorded number of turtle nests are over 1% of the turtle species or genetic stock. The linework is also deliberately extended along nearby rocky coastlines and headlands to recognise that significant numbers of nesting adults and hatchlings can become disoriented by light pollution from development on rocky coastlines and headlands while navigating offshore from nesting beaches.

Map 4 - MSES - Regulated Vegetation



MSES - Regulated Vegetation

- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)
- Selected Mining Lease (ML)



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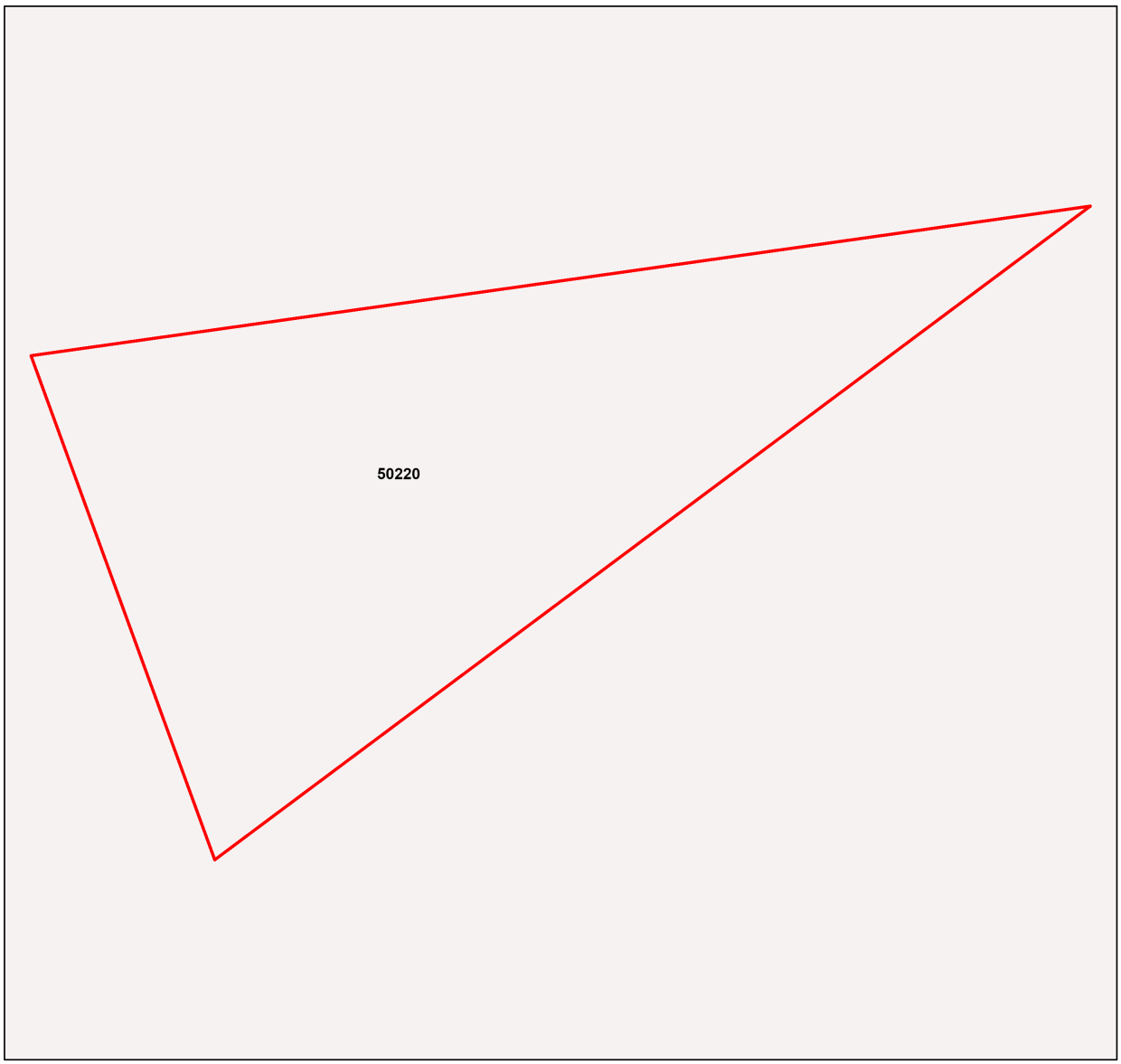
Map 5 - MSES - Offset Areas



MSES - Offsets

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Legally secured offset area (offset register)
- Legally secured offset area (vegetation offsets)
- Selected Mining Lease (ML)



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Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). Its primary purpose is to support implementation of the SPP biodiversity policy.

MSES mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations.

MSES mapping does not determine whether state or local development assessment is required. For state assessment triggers refer to the Development Assessment Mapping System (DAMS). For local assessment triggers, refer to the relevant local planning scheme.

The Queensland Government's "Method for mapping - matters of state environmental significance can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

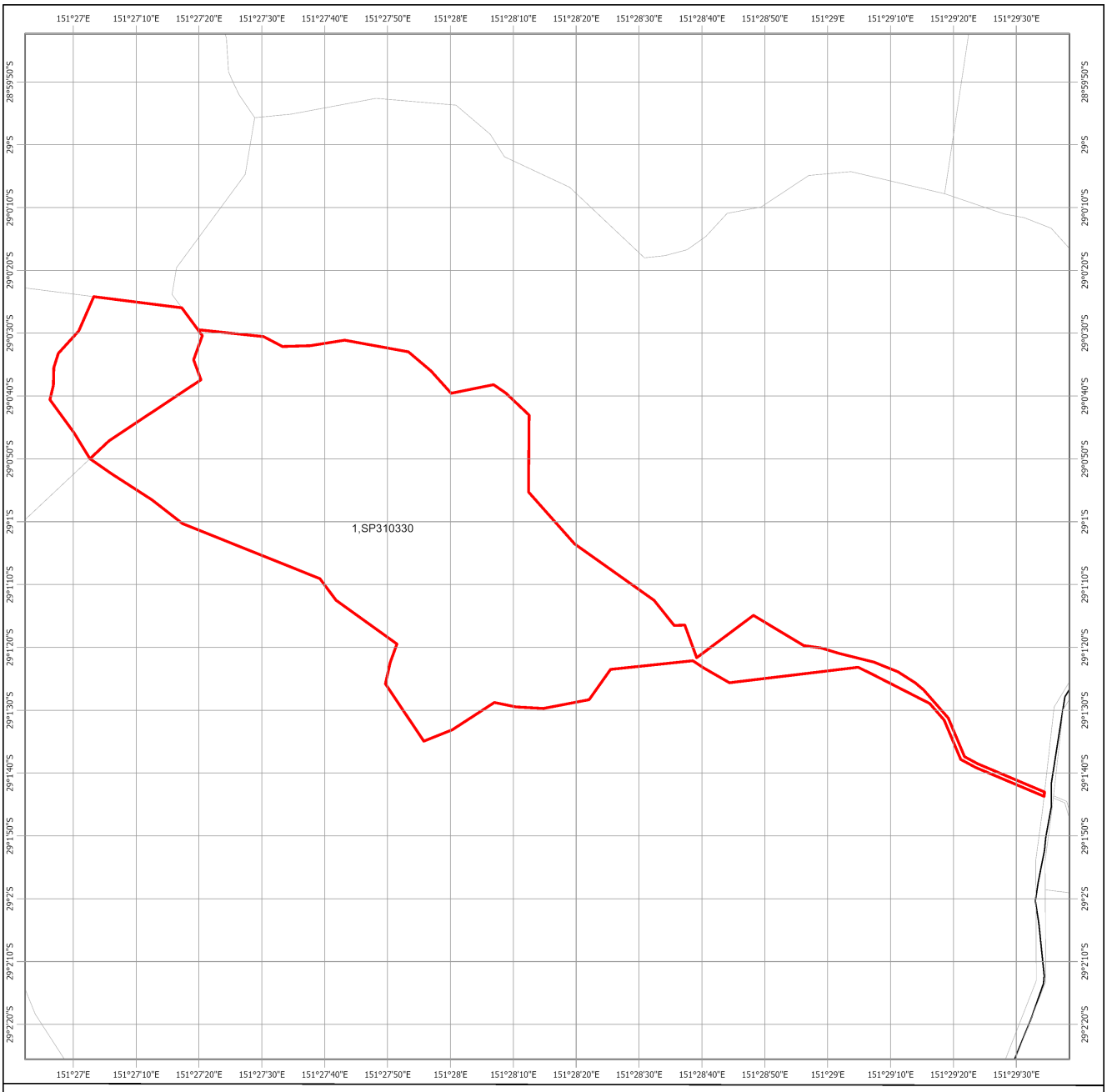
Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

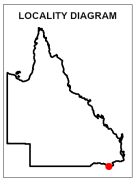
AOI	- Area of Interest
DESI	- Department of Environment, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- Nature Conservation Act 1992
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- Vegetation Management Act 1999



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



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This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

Land parcel boundaries are provided as locational aid only.

This map is produced at a scale relevant to the size of the area selected and should be printed as A4 size in portrait orientation.

For further information or assistance with interpretation of this product, please contact the Department of Environment, Science and Innovation at palm@des.qld.gov.au

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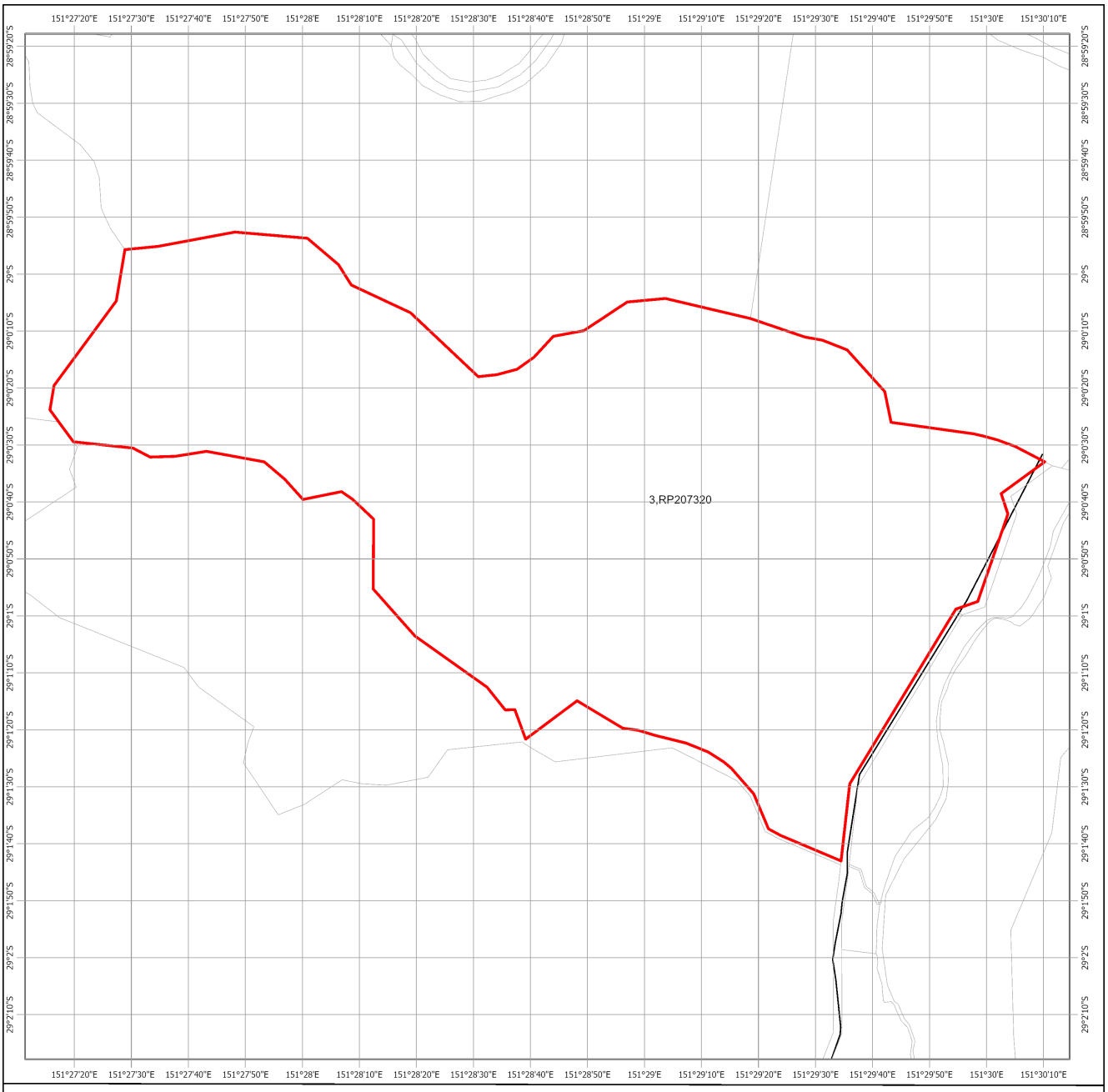
Protected plants flora survey trigger map

The protected plants flora survey trigger map identifies 'high risk areas' where endangered, vulnerable or near threatened plants are known to exist or are likely to exist. Under the *Nature Conservation Act 1992* (the Act) it is an offence to clear protected plants that are 'in the wild' unless you are authorised or the clearing is exempt, for more information see section 89 of the Act.

Please see the Department of Environment and Science webpage on the clearing of protected plants for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map
The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

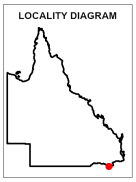
Species information
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the clearing of protected plants for more information.



Protected Plants Flora Survey Trigger Map

High risk area
Other land parcel boundaries
Freeways / motorways / highways
Secondary roads / streets
Selected Lot and Plan

LOCALITY DIAGRAM



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This map shows areas where particular provisions of the Nature Conservation Act 1992 apply to the clearing of protected plants.

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Please see the Department of Environment and Science webpage on the clearing of protected plants for information on what exemptions may apply in your circumstances, whether you may need to undertake a flora survey, and whether you may need a protected plants clearing permit.

Updates to the data informing the flora survey trigger map
The flora survey trigger map will be reviewed, and updated if necessary, at least every 12 months to ensure the map reflects the most up-to-date and accurate data available.

Species information
Please note that flora survey trigger maps do not identify species associated with 'high risk areas'. While some species information may be publicly available, for example via the Queensland Spatial Catalogue, the Department of Environment and Science does not provide species information on request. Regardless of whether species information is available for a particular high risk area, clearing plants in a high risk area may require a flora survey and/or clearing permit. Please see the Department of Environment and Science webpage on the clearing of protected plants for more information.

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 10-Sep-2024

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	64
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	20
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	4
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Banrock station wetland complex	1100 - 1200km upstream from Ramsar site	In feature area
Riverland	1100 - 1200km upstream from Ramsar site	In feature area
The coorong, and lakes alexandrina and albert wetland	1300 - 1400km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community may occur within area	In feature area
New England Peppermint (Eucalyptus nova-anglica) Grassy Woodlands	Critically Endangered	Community may occur within area	In buffer area only
Weeping Myall Woodlands	Endangered	Community may occur within area	In feature area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Aphelocephala leucopsis](#) Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calyptorhynchus lathami lathami](#) South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Climacteris picumnus victoriae](#) Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Erythrotriorchis radiatus](#) Red Goshawk [942]	Endangered	Species or species habitat may occur within area	In feature area
[Falco hypoleucos](#) Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
[Geophaps scripta scripta](#) Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Grantiella picta](#) Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Lathamus discolor](#)			
Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
[Melanodryas cucullata cucullata](#)			
South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area	In feature area
[Neophema chrysostoma](#)			
Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Rostratula australis](#)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
[Stagonopleura guttata](#)			
Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Tringa nebularia](#)			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area	In buffer area only
FISH			
[Bidyanus bidyanus](#)			
Silver Perch, Bidyan [76155]	Endangered	Species or species habitat likely to occur within area	In feature area
[Maccullochella peelii](#)			
Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
MAMMAL			
[Chalinolobus dwyeri](#)			
Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area	In feature area
[Dasyurus maculatus maculatus (SE mainland population)](#)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In feature area
[Nyctophilus corbeni](#)			
Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Petauroides volans](#)			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat likely to occur within area	In feature area
[Petaurus australis australis](#)			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat may occur within area	In feature area
[Petrogale penicillata](#)			
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)](#)			
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area	In feature area
[Pseudomys novaehollandiae](#)			
New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area	In buffer area only
[Pteropus poliocephalus](#)			
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In feature area
PLANT			
[Acacia macnuttiana](#)			
McNutt's Wattle [10711]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
[Acacia pubifolia](#)			
Velvet Wattle [19799]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Acacia ruppii](#)			
Rupp's Wattle [7559]	Endangered	Species or species habitat may occur within area	In buffer area only
[Almaleea cambagei](#)			
Torrington Pea [56308]	Endangered	Species or species habitat may occur within area	In buffer area only
[Arthraxon hispidus](#)			
Hairy-joint Grass [9338]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Boronia granitica Granite Boronia [18598]	Endangered	Species or species habitat likely to occur within area	In feature area
Boronia inflexa subsp. torringtonensis [78597]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Callistemon pungens [55581]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Eucalyptus caleyi subsp. ovendenii Ovenden's Ironbark [56193]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Eucalyptus mckieana McKie's Stringybark [20199]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus nicholii Narrow-leaved Peppermint, Narrow-leaved Black Peppermint [20992]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Grevillea beadleana Beadle's Grevillea [22002]	Endangered	Species or species habitat may occur within area	In buffer area only
Hakea macrorrhyncha [87228]	Endangered	Species or species habitat may occur within area	In buffer area only
Homopholis belsonii Belson's Panic [2406]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Homoranthus lunatus [55189]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium monoplocoides Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area	In feature area
Lepidium peregrinum Wandering Pepper-cress [14035]	Endangered	Species or species habitat known to occur within area	In feature area
Leucopogon confertus Torrington Beard-heath [14417]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Leuzea australis listed as Rhaponticum australe Austral Cornflower, Native Thistle [9363]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Macrozamia cranei [64681]	Endangered	Species or species habitat likely to occur within area	In feature area
Picris evae Hawkweed [10839]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Prostanthera staurophylla a mint-bush [20898]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Rutidosis heterogama Heath Wrinklewort [13132]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thesium australe			
Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Vincetoxicum forsteri listed as Tylophora linearis			
[92384]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			
Anomalopus mackayi			
Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma torquata			
Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area	In feature area
Furina dunmalli			
Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area	In feature area
Hemiaspis damelii			
Grey Snake [1179]	Endangered	Species or species habitat may occur within area	In feature area
Myuchelys belli			
Western Sawshelled Turtle [86075]	Endangered	Species or species habitat may occur within area	In buffer area only
Uvidicolus sphyrurus			
Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Gallinago hardwickii](#) Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area	In buffer area only
[Tringa nebularia](#) Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Hirundapus caudacutus](#) White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
[Lathamus discolor](#) Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
[Merops ornatus](#) Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
[Myiagra cyanoleuca](#) Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
[Neophema chrysostoma](#) Blue-winged Parrot [726]	Vulnerable	Species or species habitat may occur within area overfly marine area	In buffer area only
[Pandion haliaetus](#) Osprey [952]		Species or species habitat known to occur within area	In buffer area only
[Pterodroma cervicalis](#) White-necked Petrel [59642]		Species or species habitat may occur within area	In feature area
[Rhipidura rufifrons](#) Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Rostratula australis as Rostratula benghalensis (sensu lato)](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Torrington	State Conservation Area	NSW	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
North East NSW RFA	New South Wales	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
330 kV Transmission Line, 205km in Length	2010/5326	Controlled Action	Completed	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
Aerial baiting for wild dog control	2006/2713	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Wild Dog Baiting	2006/2768	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: Native
Queensland status: All
Records: All
Date: All
Latitude: -29.0220
Longitude: 151.4757
Distance: 5
Email: htibbetts@epicenvironmental.com.au
Date submitted: Tuesday 23 Jul 2024 14:42:21
Date extracted: Tuesday 23 Jul 2024 14:50:02

The number of records retrieved = 128

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Information about your Species lists request is logged for quality assurance, user support and product enhancement purposes only.
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Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Hylidae	*Litoria latopalmata*	broad palmed rocketfrog		C		1
animals	amphibians	Hylidae	*Litoria peronii*	emerald spotted treefrog		C		2
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		1
animals	amphibians	Hylidae	*Litoria wilcoxii*	eastern stony creek frog		C		2
animals	amphibians	Limnodynastidae	*Limnodynastes fletcheri*	barking frog		C		1
animals	amphibians	Limnodynastidae	*Limnodynastes tasmaniensis*	spotted grassfrog		C		1
animals	amphibians	Limnodynastidae	*Platyplectrum ornatum*	ornate burrowing frog		C		1
animals	amphibians	Myobatrachidae	*Crinia parinsignifera*	beeping froglet		C		1
animals	amphibians	Myobatrachidae	*Uperoleia laevigata*	eastern gungan		C		1
animals	amphibians	Myobatrachidae	*Uperoleia rugosa*	chubby gungan		C		1
animals	birds	Acanthizidae	*Acanthiza chrysorrhoa*	yellow-rumped thornbill		C		1
animals	birds	Acanthizidae	*Acanthiza nana*	yellow thornbill		C		1
animals	birds	Acanthizidae	*Acanthiza reguloides*	buff-rumped thornbill		C		1
animals	birds	Acanthizidae	*Gerygone fusca*	western gerygone		C		1
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		1
animals	birds	Acanthizidae	*Pyrrholaemus sagittatus*	speckled warbler		C		1
animals	birds	Acanthizidae	*Sericornis frontalis*	white-browed scrubwren		C		1
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		3
animals	birds	Accipitridae	*Elanus axillaris*	black-shouldered kite		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		1
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		1
animals	birds	Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler		C		1
animals	birds	Alcedinidae	*Ceyx azureus*	azure kingfisher		C		2
animals	birds	Alcedinidae	*Todiramphus sanctus*	sacred kingfisher		C		2
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		5
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		3
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		1
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		4
animals	birds	Ardeidae	*Nycticorax caledonicus*	nankeen night-heron		C		1
animals	birds	Artamidae	*Artamus cyanopterus*	dusky woodswallow		C		1
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		4
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		2
animals	birds	Artamidae	*Gymnorhina tibicen*	Australian magpie		C		4
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		5
animals	birds	Cacatuidae	*Cacatua sanguinea*	little corella		C		1
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		6
animals	birds	Cacatuidae	*Nymphicus hollandicus*	cockatiel		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		3
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		1
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		2
animals	birds	Climacteridae	*Cormobates leucophaea*	white-throated treecreeper		C		1
animals	birds	Climacteridae	*Cormobates leucophaea metastasis*	white-throated treecreeper (southern)		C		1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Columbidae	*Geopelia placida*	peaceful dove		C		5
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		2
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		3
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		3
animals	birds	Corcoracidae	*Corcorax melanorhamphos*	white-winged chough		C		2
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		4
animals	birds	Corvidae	*Corvus coronoides*	Australian raven		C		2
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		4
animals	birds	Cuculidae	*Scythrops novaehollandiae*	channel-billed cuckoo		C		2
animals	birds	Dicaeidae	*Dicaeum hirundinaceum*	mistletoebird		C		3
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		3
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		3
animals	birds	Hirundinidae	*Hirundo neoxena*	welcome swallow		C		6
animals	birds	Hirundinidae	*Petrochelidon ariel*	fairy martin		C		3
animals	birds	Maluridae	*Malurus cyaneus*	superb fairy-wren		C		4
animals	birds	Meliphagidae	*Acanthagenys rufogularis*	spiny-cheeked honeyeater		C		5
animals	birds	Meliphagidae	*Caligavis chrysops*	yellow-faced honeyeater		C		5
animals	birds	Meliphagidae	*Lichenostomus melanops*	yellow-tufted honeyeater		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		2
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		3
animals	birds	Meliphagidae	*Myzomela sanguinolenta*	scarlet honeyeater		C		1
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		2
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		6
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		3
animals	birds	Meliphagidae	*Ptilotula fusca*	fuscous honeyeater		C		1
animals	birds	Meliphagidae	*Ptilotula penicillata*	white-plumed honeyeater		C		4
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		4
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		7
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		3
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		2
animals	birds	Oriolidae	*Oriolus sagittatus*	olive-backed oriole		C		2
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		4
animals	birds	Pachycephalidae	*Pachycephala pectoralis*	golden whistler		C		1
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		1
animals	birds	Pandionidae	*Pandion haliaetus cristatus*	eastern osprey		SL		1
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		4
animals	birds	Pelecanidae	*Pelecanus conspicillatus*	Australian pelican		C		3
animals	birds	Petroicidae	*Eopsaltria australis*	eastern yellow robin		C		1
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		1
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		4
animals	birds	Phalacrocoracidae	*Phalacrocorax carbo*	great cormorant		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		1
animals	birds	Phalacrocoracidae	*Phalacrocorax varius*	pied cormorant		C		2
animals	birds	Podicipedidae	*Podiceps cristatus*	great crested grebe		C		1
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Psittaculidae	*Alisterus scapularis*	Australian king-parrot		C		2
animals	birds	Psittaculidae	*Aprosmictus erythropterus*	red-winged parrot		C		1
animals	birds	Psittaculidae	*Platycercus adscitus*	pale-headed rosella		C		2
animals	birds	Psittaculidae	*Platycercus eximius*	eastern rosella		C		1
animals	birds	Psittaculidae	*Psephotus haematonotus*	red-rumped parrot		C		5
animals	birds	Psittaculidae	*Trichoglossus moluccanus*	rainbow lorikeet		C		2
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		2
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		7
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		1
animals	birds	Threskiornithidae	*Threskiornis molucca*	Australian white ibis		C		2
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	birds	Zosteropidae	*Zosterops lateralis*	silvereye		C		2
animals	mammals	Miniopteridae	*Miniopterus schreibersii oceanensis*	eastern bent-wing bat		C		2
animals	mammals	Miniopteridae	*Miniopterus sp.*			C		1
animals	mammals	Rhinolophidae	*Rhinolophus megaphyllus*	eastern horseshoe-bat		C		3
animals	reptiles	Agamidae	*Intellagama lesueurii*	eastern water dragon		C		1
fungi	Agaricomycetes	Agaricaceae	*Calvatia*					1/1
plants	land plants	Asteraceae	*Glossocardia bidens*	native cobbler's pegs		C		1/1
plants	land plants	Laxmanniaceae	*Lomandra hystrix*			C		1/1
plants	land plants	Leguminosae	*Desmodium brachypodum*	large ticktrefoil		C		2/2
plants	land plants	Leguminosae	*Desmodium varians*	slender tick trefoil		C		1/1
plants	land plants	Leguminosae	*Jacksonia scoparia*			C		1/1
plants	land plants	Leguminosae	*Zornia dyctiocarpa var. dyctiocarpa*			C		1/1
plants	land plants	Malvaceae	*Hibiscus sturtii var. sturtii*			C		1/1
plants	land plants	Malvaceae	*Malvastrum americanum var. stellatum*			C		1/1
plants	land plants	Malvaceae	*Sida hackettiana subsp. (Gayndah P.Grimshaw+ PG2388)*			C		1/1
plants	land plants	Myrtaceae	*Eucalyptus crebra*	narrow-leaved red ironbark		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus dealbata*	tumble-down red gum		C		1/1
plants	land plants	Plantaginaceae	*Plantago debilis*	shade plantain		C		1/1
plants	land plants	Poaceae	*Anthosachne scabra*			C		1/1
plants	land plants	Poaceae	*Cymbopogon refractus*	barbed-wire grass		C		1/1
plants	land plants	Poaceae	*Microlaena stipoides var. stipoides*			C		1/1
plants	land plants	Polygonaceae	*Persicaria decipiens*	slender knotweed		C		1/1
plants	land plants	Polygonaceae	*Rumex brownii*	swamp dock		C		1/1
plants	land plants	Rubiaceae	*Psydrax odorata forma subnitida*			C		1/1
plants	land plants	Sapindaceae	*Alectryon subdentatus*			C		1/1

CODES

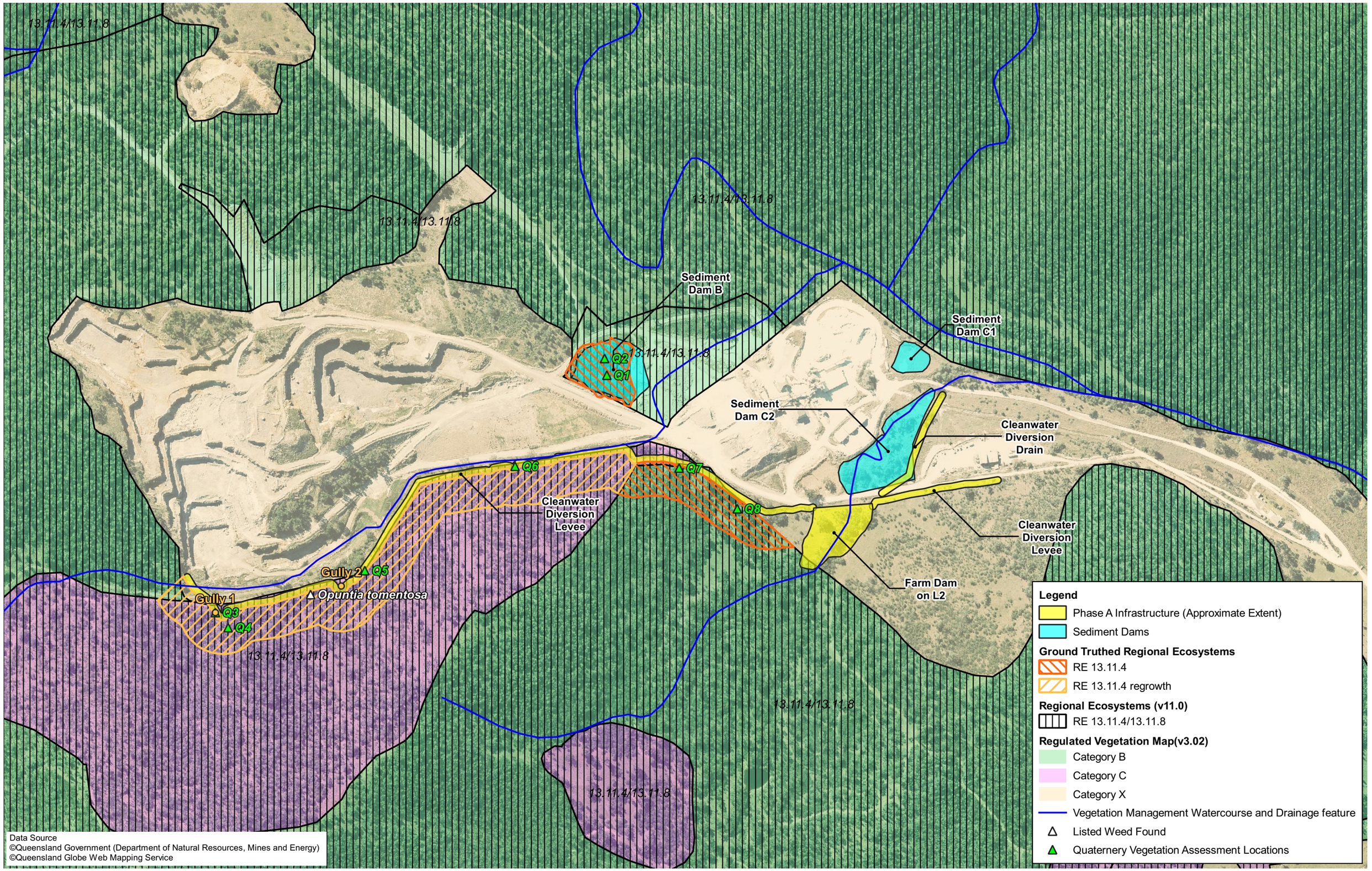
I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

APPENDIX C STUDY AREA AND SURVEY SITES FROM 2021 FIELD SURVEY (EPIC 2019 AND 2021)



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File Path: G:\GIS\Epic Environmental\Projects\BE\BE190098.01 Graymont Riverton Mine\Workspaces\
Figure 2 Regulated Vegetation Site Map, Location of Quaternary Vegetation Assessment & Listed Weed found.qgs

epic ENVIRONMENTAL

0 100 200 300 m

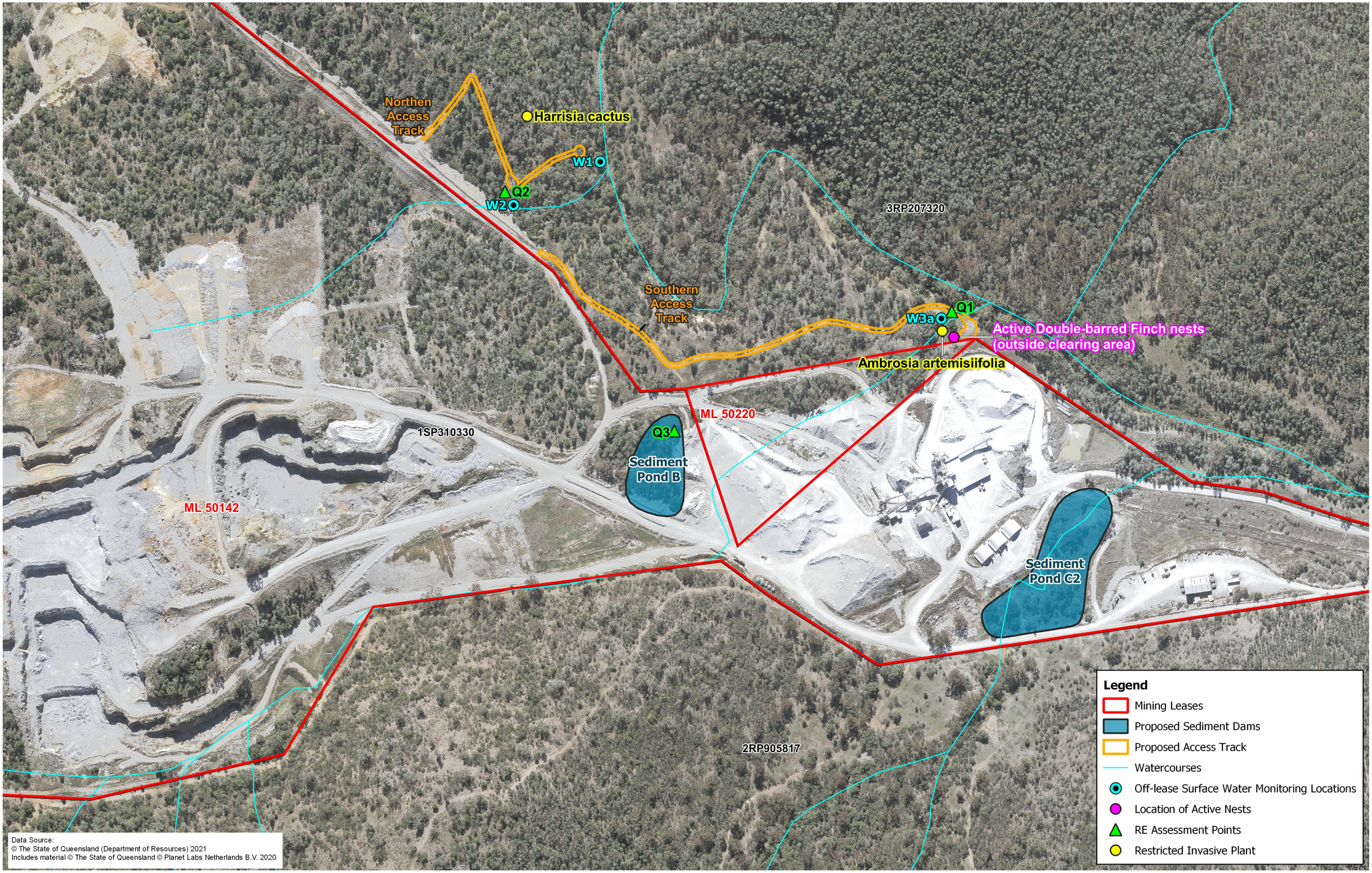
Scale: 1:5,000 @ A3

Datum: GDA94 Projection: MGA56

DRAFT

Graymont
Riverton Mine

Figure 2
Regulated Vegetation Site Map,
Location of Quaternary Vegetation Assessment & Listed Weed found



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File Path: G:\GIS\Epic Environmental\Projects\BE2021\BE210047.01 Graymont Riverton EA Amendment\Workspaces\Figure 4 Ecology Survey Findings.qgs

epic ENVIRONMENTAL

0 50 100 150 200 250 m

Scale: 1:3,500@ A3

Datum: GDA2020 Projection: MGA56

Draft

Graymont (NSW) Pty Ltd
Riverton Limestone Mine
EA Amendment

Figure 4
Ecology Survey Findings

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Appendix K Geotechnical Assessment (Rocktest 2024)

RIVERTON MINE
PRCP PIT AND WRD:
GEOTECHNICAL

for

GRAYMONT

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25 October 2024

HSE Specialist Northern
Graymont Australia Pty Ltd
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Port Adelaide SA 5015

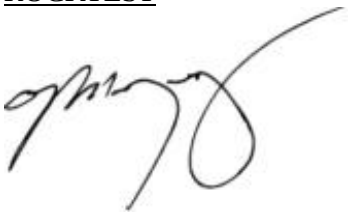
Attention Michelle Muir
via. michelle.muir@graymont.com

Dear Michelle

Riverton Progressive Rehabilitation and Closure Plan (PRCP) - Pit and WRD: Geotechnical

This report addresses geotechnical issues relevant to the PRCP for the Riverton Mine. I trust it 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
BE (Mining) PhD (Rock Mechanics), MAusIMM CP(Mining Geotech), MIEAust CPEng (Civil), NER APEC Engineer IntPE(Aus) RPEQ (Mining, Civil)
Principal Rock Mechanics Engineer

DOCUMENT CONTROL

Project	Riverton Mine PRCP
Client	Graymont Australia Pty Ltd
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Author(s)	Tony Meyers
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Filename	PRCP - Pit and WRD: Geotechnical V1.3

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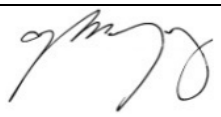
DOCUMENT APPROVAL

Signature	
Approval	Tony Meyers
Position	Principal Rock Mechanics Engineer
Date	25 October 2024

SUMMARY

CONCLUSIONS

- The proposed landform designs satisfy the geotechnical related requirements of the PRCP Guideline.
- The stabilities of the pit walls and the slopes of the northern WRD will be within the ranges typically considered acceptable in the mining industries.
- A permanent water level will not develop in the pit after the EOML,.

RISK MANAGEMENT STRATEGIES

After the EOML, the principal strategies to reduce the risks applicable to the pit walls and the slopes of the WRD will be:

- restricting access to the site by unauthorised persons,
- ripping access routes within and into the pit and to the upper surface and the toe of the northern WRD,
- installing abandonment barriers with signs behind the crests of the pit walls and edge bunds behind the crests of the slopes of the northern WRD,
- visually monitoring and auding the performances of the pit walls and the slopes of the northern WRD,
- routinely inspecting the areas behind the crests of the pit walls and the slopes of the northern WRD for evidence that may be indicative of large scale instabilities developing (e.g., cracking, subsidence etc.),
- adherence to the requirements of the completion criteria (Section 6)
- prior to the EOML, preparedness to modify plans and/or designs and/or site works if any landform deviates from the design and/or its performance does not comply with the criteria.

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ACRONYMS

BGL	Below Ground Level
FoS	Factor of Safety
EOML	End of Mine Life
GCMP	Ground Control Management Plan
GLE	General Limit Equilibrium method of slope stability analysis
IECA	International Erosion Control Association
PGA	Peak Ground Acceleration
PoF and P_f	Probability of Failure
PRCP	Progressive Rehabilitation and Closure Plan
RL	Relative Level
SWL	Standing Water Level
WRD	Waste Rock Dump

1 INTRODUCTION

1.1 BACKGROUND

This report considers geotechnical issues[1] applicable to the Progressive Rehabilitation and Closure Plan (PRCP) for the final landforms at the Riverton Mine. The landforms comprise the open-cut pit and the northern waste rock dump (Figure 1). The requirements of the PRCP, as outlined by the Guideline prepared by the QLD Department of Environment and Science[2], are that it should provide details of how the landforms will achieve post-closure stabilities. This document addresses this requirement. It was prepared by Rocktest at the request[3] of Graymont Australia Pty Ltd (Graymont).

1.2 REQUIREMENTS IN THE PRCP

In regard to geotechnical issues associated with the pit, the PRCP requires the:

- location and specifications i.e., depth, length, width, overall slope angle, bench specifications,
- method of construction with 3D design plan,
- soil/rock characteristics,
- geotechnical conditions (i.e., soil/rock characteristics),
- pit wall geotechnical stabilities, considering the effects of long-term erosion and weathering and the effects of significant hydrological events,
- rehabilitation strategies.

In regard to geotechnical issues associated with the northern waste rock dump (WRD), the PRCP requires the:

- locations and specifications i.e., heights, lengths, widths, overall slope angles, bench specifications,
- method of construction with 3D design plans,
- soil/rock characteristics,
- geotechnical stabilities of the slopes,
- settling and subsidence over time,
- rehabilitation strategies.

1.3 TERMINOLOGY

Time periods referred to in this report are:

- Short-term < 5 years
- Medium-term 5 years to EOML
- Long-term > 100 years

All dimensions in this report are approximate. They are of an accuracy suitable for the purpose of the report.

[1] This report considers geotechnical issues only. Environmental and surface and subsurface hydrology issues are considered only where relevant.

[2] Guideline – Progressive rehabilitation and closure plans (PRC plans) ESR/2019/4964, Version 2.00, Last reviewed: 17 March 2021.

[3] Email to T. Meyers of Rocktest from M. Muir of Graymont, 18 May 2023.

2 LANDFORM CHARACTERISTICS AFTER THE EOML

2.1 PIT CHARACTERISTICS

2.1.1 General Characteristics of Pit

The pit will be excavated until the end-of-mine-life using standard drill/blast/dig/scale method. Clean, ore-grade, limestone will be hauled to the ROM pad. Low-grade limestone, and limestone contaminated with clay or andesite, will be hauled to the WRD. Topsoil will be stockpiled.

Figure 2 shows the elevations of the final pit at the EOML. It will have an approximately triangular circumference with a major axis striking northwest. The final floor will comprise two levels: a lower level at 414 mRL and an upper level at 455 mRL. All walls will have different cross-sections (Figure 3). Their specifications are listed in Table 1 and 2.

Over the long-term, the key geotechnical related considerations will be:

- pit wall stability i.e., failure of multiple benches or an overall slope, potentially resulting in retreat of a crest.,
- minor erosion of a crest, due possibly to ineffective management of surface flows.

These events will be visually monitored and assessed until the EOML and subsequently as required against the indicators and completion criteria outlined in Section 6 to demonstrate the success of the plan. Actions required to achieve these outcomes are:

- Install bunds where necessary to redirect overland flows of water away from localised sections of the crests of the pit walls (Section 2.1.2). However, as the crests are generally at contour highs, flows over most sections of the crests will not occur.
- On the northwest, northeast and southeast pit walls, reduce to $<14^{o}$ batter angles of sections of the upper benches that comprise extremely weathered rocks and/or soil filled karst caverns. Cover soil with broken rocks to prevent erosion (Section 16).
- Maintain the current crest line of the southwest pit wall until the EOML due to restrictions on encroaching on the required offset of the wall from the bat cave. Visually assess the performance of the wall until the EOML. If, during that period, the performance is not acceptable, propose and implement a strategy to ensure the performance will remain acceptable during the long term.

Table 1. Specifications of the pit at the EOML.

Trend of major axis	121°
Length of major axis at crest	535 m
Average length of minor axis at crest (west/east)	195/385 m
Maximum heights of walls (north/south/east/west)	65/79/19/34 m
Heights of benches	10 m
Maximum number of benches	10
Widths of berms	10 m
Batter angles in weathered[4] and unweathered[5] rocks	14° and 70°
Inter-ramp angles	43°
Maximum overall slope angles (north/south/east/west)	33° /37° /32° /31°

[4] The term “weathered” refers to rocks for which weathering has significantly reduced their strengths from what they were when the rocks were fresh. It includes the weathering grades of highly weathered and extremely weathered.
[5] The term “unweathered” refers to rocks that shows little of no change in strength from fresh rocks. In addition to fresh rocks, it includes the weathering grades of moderately weathered and slightly weathered.

Table 2 Dip directions of the pit walls at the EOML.

Northeast (Southwest dip)	*Southwest (Northeast dip)*	*Southeast (Northwest dip)*	*Northwest (Southeast dip)*
172° to 210°	027° to 083°	302° to 328°	118°

2.1.2 Geotechnical Monitoring Prior to EOML

Riverton's Ground Control Management Plan (GCMP) requires the following geotechnical monitoring and management strategies be implemented until the EOML:

- Profiles of the pit walls and the slopes of the WRD are collected at least biannually using drone based photogrammetry. Surfaces are created from the point clouds. The surfaces are compared to previous surfaces to highlight changes. Strategies are implemented if deformations are excessive to ensure the deformation mechanisms are understood and, if necessary, to ensure the risk to persons and the operation remain acceptable.
- Data quantifying the orientations of the discontinuities most recently exposed in the pit is collected annually using discontinuity mapping techniques. The data is compared to data collected elsewhere to highlight whether the characteristics of the discontinuities are consistent with those recorded previously. If different, the data is used as input to kinematic analyses to ascertain whether the wall specifications are appropriate or require modification.
- Visual inspections of the pit walls and the WRD slopes are undertaken weekly. Hazards and strategies for managing any increase in risk are recorded in the daily log.
- An audit of geotechnical risk is undertaken by an independent geotechnical consultant biennially or at lesser intervals.

A programme for visually monitoring and auditing the pit walls, WRD slopes, and the landform after the EOML will be established prior to then.

2.1.3 Abandonment Barriers and Toe Bunds at EOML

2.1.3.1 Abandonment Barrier

The final landform will include an abandonment barrier behind the crest of each pit wall to:

- prevent inadvertent access to the crests of the walls by vehicles and restrict access by motorbikes and persons on foot,
- provide areas between the crests and the barrier that are sufficiently clear and flat to enable evidence of deformation and wall crest retreat to be observed during inspections and to be accessed for remediation.

In lieu of Queensland specific guidelines on abandonment barriers, general recommendations in the Western Australian Guideline (1997)[6] for abandonment bunds will be applied. The recommendations are for a bund to:

- be installed behind the crest of each wall beyond potential failure zones,
- encircle the pit with no gaps other than where locked gates provide restricted access through the barrier,
- be obvious,

[6] 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.

- have sufficient height, typically approximately 2 m, to restrict access,
- have sufficient longevity to remain functional for the long-term.

The Guideline recommends that bunds be offset a minimum of 10 m behind the point at which a construction line from the toe of a wall intersects the natural ground surface behind the wall. The line is to be orientated at 45° in unweathered rocks and 25° in weathered rocks. On this basis, the minimum offsets for barriers will be 10 m as listed in Table 3. These offsets exceed the maximum break-back distances that have occurred to date and those likely to occur during the long term (refer Section 4.3). The offsets are likely to be sufficient to ensure sections of a barrier are not undermined if a wall scale instability occurs.

The approximate specifications of the bunds will be:

- Height 2 m
- Footing width 6 m
- Material Well-graded coarse strong durable limestone of +25 mm
- Slope angles 35° or the angle of repose of the rocks

A bund having these characteristics will be installed behind the northwest, northeast and southeast walls. However, a bund is impractical behind the southwest wall because:

- The footprint of the bund will require clearing an area of well-established natural bushland of up to approximately 2,400 m^2 (i.e., 0.2 Ha). No clearing of this land has occurred to date and is not proposed prior to the EOML.
- No vehicular access is available to the area behind the wall. Providing safe access for trucks and equipment to construct a bund will require clearing additional bushland for roads and will require significant cut and fill earthworks. Although the roads will be ripped after construction, much of the bushland will not regenerate to the current standard during the medium term.
- Sections of the bund and the associated access roads will be within the restricted area between the pit wall and the bat cave. Vibrations from earthworks associated with bund construction will be generated within this area.

For these reasons, a fence rather than a bund is proposed for behind the southwest wall. Doing so is consistent with recommendations in the Guideline, which note “a fence of a suitable construction and appropriate height may be appropriate”. The fence will be offset 10 m from the current crest.

2.1.3.2 Fence Characteristics

A post and wire, farm style, fence typically requires maintenance and/or replacement every 15 years or so if it is to have longevity for the long-term. Ensuring these requirements are undertaken after the EOML typically requires establishing an agreement with a third-party to whom compensation is provided. However, there can be no guarantee that the agreement will be complied with. For this reason, a proprietary rockfall fence is a more appropriate barrier as it can provide a 100 year design life without significant maintenance or the need for replacement. It is suitable for stock control. And it has significantly greater strength than a farm fence, hence, is able to withstand better impact by animals and falling braches.

A suitable rockfall fence would be 1.5 m high and have a 10 kJ capacity (e.g., Figure 4). Post spacings can be 10 m, which minimises the number of posts required compared to a farm fence[7].

[7] Type A fences have rigid posts and star droppers at 7.2 m and 1.8 m spacings respectively. Type B fences have rigid posts and star droppers at 5.4 m and 1.8 m spacings respectively. Type H fences have rigid posts and star droppers at 6 m and 2 m spacings respectively.

2.1.3.3 Toe Bunds

Toe bunds (aka., "rock traps") will be placed out from the toes of the pit walls on both floors to prevent rocks that fall from a wall from running-out onto the adjacent section of floor. The toes of the inside slopes of the bunds will be placed a minimum of 10 m out from the toes of the adjacent wall.

Table 3. Minimum abandonment bund offsets from the crests of the walls based on the Guideline.

Wall		*Height of Wall (m)*	*Overall Slope Angle*	*Depth of weathering[8] (m)*	*Minimum Offset Required (m)*
Northeast	North end	36	29°	4	10
	Central	65	33°	3	10
	South end	42	29°	3	10
Southwest	North end	41	34°	2	10
	Central	79	37°	2	10
	South end	48	27°	2	10
Southeast		19	32°	2	10
Northwest		34	31°	2	10

2.2 NORTHERN WASTE ROCK DUMP (WRD) CHARACTERISTICS

2.2.1 General Characteristics

The WRD is the sidehill fill type. The materials within it comprises low-grade limestone, limestone contaminated with clay, andesite, and crusher fines.

The footing of the dump was constructed on a shallow natural slope dipping at ≈10° towards the east (088°). Prior to the first lift, topsoil comprising silty clay was stripped from the surface to achieve a relatively flat footing comprising bouldery silty clay with a shear strength greater than that of the topsoil.

The dump is constructed using a top down method. Waste materials are end dumped on flat surfaces from trucks. A dozer then spreads, pushes over crests, shapes, and compacts the materials. Fines are spread in thin layers on flat surfaces, not pushed over crests. The front slopes are advanced in the same direction as the topography. No slope extends into a major drainage path.

At the EOML, the surfaces of the dump are to be rehabilitated by:

- pushing down the slopes to 18° beginning from the upper level, which will remove most of the widths from the underlying berms,
- grading the upper surface at 19H:1V (3°) to the west to cause water that impacts the surface to shed to the haul road between the pit and the dump and away from the crests of the slopes,
- compacting[9] the slopes and surfaces to achieve as high a density as practical to reduce transmissivity of water through the body of the dump and to reduce the amount of consolidation of the material over time,
- placing a minimum 1 m high edge bund of durable rocks approximately 2 m behind the crests of the upper surface to control flows of water over the crest and to restrict access to the slopes by vehicles.

[8] The depth of weathering does not include filled karst voids which can extend to the floor. The widths of individual voids are narrow (i.e., <2m) relative to the widths of the walls. Providing additional offsets in where karst occurs is impractical and unnecessary.

[9] Compaction is to be achieved by moisture conditioning the slopes and surfaces then successively tracking across them with preferably a roller or, if not available, a dozer until no additional significant compaction occurs with more passes.

Figure 2 shows the rectangular shape and final elevations of the dump after the EOML. Its specifications are listed in Table 4. Figure 5 is a cross-section through the highest slope. It dips in a direction similar to that of the underlying natural slope.

Over the long-term, the key geotechnical related considerations will be:

- geotechnical stability i.e., slumping or mass failure of a bench or overall slope potentially resulting in loss of material to the surrounding area (Section 5.1),
- erosion, due possibly to failure of vegetation to establish and/or ineffective management of surface flows,
- settlement (Section 2.2.2).

The strategies for achieving the desired outcomes are summarised in Section 5.2. The performances of the surfaces and the slopes are to be visually monitored and assessed against the indicators and completion criteria outlined in Section 6 to demonstrate the success of the strategies.

Table 4 Specifications of the WRD at the EOML.

Length of major axis footing	330 m
Length of minor axis footing	210 m
Maximum height of dump	65 m
Bench heights	30 m
Number of benches	2
Berm width at 440 mRL	10 m
Batter angles	18°
Overall slope angles	17°

2.2.2 Long-Term Settlement

Settlement of the WRD will occur over the long-term as materials spatially rearrange to minimise the inter-granular void spaces. These actions will occur as water infiltrating through the dump causes rocks to degrade and due to the self-weight of the materials. Crushing of grains is unlikely at the low vertical pressures that will apply within the dump due to its low final height above the natural surface (i.e., <25 m).

Settlement will occur slowly as >90% of the materials are high strength and durable; a moderate proportion of which are oversize. Based on a relationship by Kermani (2018)[10], the amount of settlement ΔH will be small (i.e., $51 \leq \Delta H \leq 102$ mm)[11] over the long-term. This amount is insignificant as no infrastructure will be constructed on the dump and drainage flow paths will not be significantly affected. The associated increases in the bulk densities of the materials will reduce the permeability of the materials within the body of the dump and enhance the stabilities of the slopes. Both actions will reduce the rates of subsequent settlement.

[10] Kermani, M., and Konrad, J.M. (2018) In-situ short-term and long-term rockfill compressibility as a function of void ratio and strength of parent rock. In *Jnl. Geotechnical and Geoenvironmental Engineering*, April. Figure 3.
[11] Assumes the dump is a maximum of 65 m high, the rockfill has a density of 1.9 t/m^3. and some compaction occurs during placement. The average vertical stress at the centre of the dump will be 0.37 MPa. This equates to a maximum strain of 1.1%.

2.3 OVERLAND FLOWS

2.3.1 Flood Susceptibility

The Dumaresq River is 2.4 kms east of the pit. The mean level of the water within the river is at 356 mRL. The deck of the bridge over the river is 2.8 m above this height at 359 mRL. The river floods relatively frequently, resulting in water covering the deck; generally, to a depth less than 1 m i.e., 360 mRL. The implication of this level for the flood susceptibility of the landforms are:

- The lowest point on the crest of the pit wall will be at 423 mRL, which is 60 m above the flood height.
- The lowest point at the toe of the WRD will be at 410 mRL, which is 45 m above the flood height.

For these reasons, flooding of the Dumaresq River will not influence the landforms.

2.3.2 Non Flood Conditions: Pit

Water flows along a natural contour low "drain" 40 m southeast of the pit during heavy intensity and/or long duration rainfall events. Some of this water pools in low points in the drain after flows. The surfaces of the pools are a minimum of 3 m below the crest of the southeast wall of the pit (refer Figure 2), hence no water within the drain migrates to the pit. At the EOML, a bund will be placed between the drain and the southeast wall to provide additional assurance that water in the drain will not enter the pit.

Under typical rainfall conditions, inflows to the pit will comprise pit wall runoff, groundwater inflow, and rainfall. The area of the floor of the pit is sufficiently large to ensure that evaporative losses and other outflows will exceed the combined inflows, hence a significant depth of water will not develop on the floor.

The lowest section of the floor will be at 414 mRL, which is 27 m above the standing groundwater level at ≈387 mRL, hence:

- the floor will remain dry after the EOML,
- significant flows of water will not seep from any wall and excess hydrostatic pressures will not develop within a wall.

2.3.3 Non Flood Conditions: WRD

Water flows along a natural contour low ("drain") north and east of the WRD during heavy intensity and/or long duration rainfall events. The drain also collects water that seeps from the toe of the dump. The lowest point of the drain, which is east of the dump, is 10 m below the toe. Flows within the drain will therefore not scour the toe. Water does not pool in the drain after flows.

3 GEOLOGY

The limestone orebody occurs within the regionally extensive Texas beds[12]. Regionally, the beds comprise a thick sequence of regularly interbedded coarse and fine sediments[13]. Locally the beds are not significantly interbedded; limestone being dominant.

The limestone is of late Devonian, to late Carboniferous age (340-380 Ma). The beds are intensely deformed. Folding is tight and extensive. Faults can be regionally persistent; many extend for tens of kms[14]. In the region around the mine, the beds are folded into a large syncline with a northwest/southeast trending hinge[15]. The mine is located on the western limb of the fold. Bedding surfaces dip very steep towards the northeast. The major axis of the pit trends northwest/southeast (121°), parallel to the strike of the beds. These orientation characteristics are consistent with the regional structure.

3.1 SOIL

3.1.1 Characteristics

The limestone is overlain by a thin cover of soil. The soil is generally less than 0.5 m deep on contour highs beyond the crests of the north, east and west walls (Figure 6). Overland flows have transported it to contour lows to the south and east of the pit and the WRD where it can be up to 1.5 m deep. The depths around the pit are controlled by the surfaces of the underlying limestone. These surfaces are highly irregular due to karstification hence so too are the depths of soil. The depths tend to be shallowest in areas where rocks are more durable and/or stronger and/or less calcareous. The depths are greatest where the soil fills karst structures (Section 3.2.3).

The soil is a mixture of soil and cobbles/boulders of weathered limestone. It is classified as SILTY CLAY; medium plasticity; red-brown to orange; dry; firm to stiff; fissured; non-dispersive; medium dense with some gravels. Its shear strength[16] can be defined in terms of a friction angle of 25° and a cohesion of 45kPa.

3.1.2 Soil Management

As the depths of in-situ soil is generally shallow, soil stripping and handling requires:

- retaining the depth of soil where possible,
- minimising the total area from which soil is stripped,
- stockpiling all soil stripped.

The stability of the soil stockpiles and the integrity of nutrients within the soil within the stockpiles is to be maintained by:

- maximising height of stockpiles to below 3 m,

---

[12] The Texas beds, previously referred to as the Texas Beds, are of Visean to Namurian age (346 to 313-Ma). Their thickness is unknown, although it is thought to be great.

[13] The Texas beds comprise lithic sandstone, siltstone and mudstone greywacke, conglomerate, limestone, slate and phyllite with minor chert and basalt. The limestone occurs in large lenses in the form of massive limestone, limestone breccia, and limestone 'conglomerate'. In most areas, the limestone is underlain by andesitic volcanic rocks, fragments of limestone occur in the andesite and andesite occurs in the limestone.

[14] The regionally persistent north/south striking Demon shear fault is located east of Tenterfield. A regionally persistent east/west striking fault occurs 20-km north of the site.

[15] Bedding surfaces dip steep west to southwest 50-km northwest of the mine, south to southwest 40-km west of the mine and north to northwest 60-km northeast of the mine.

[16] The shear strength is based on the results of direct shear tests.

- maintaining the slopes of the stockpiles at less than 3H:1V,
- vegetating the slopes,
- installing sediment fences and/or up contour diversions,
- re-using soil as soon as practical.

3.2 LIMESTONE

3.2.1 Intact Rock Characteristics

The intact limestone has a very-fine sub-crystalline texture, consistent with it having undergone low grade metamorphism. Its colour ranges from pale- grey to mid-grey. It can be slightly vitreous.

At depths exceeding ≈20 mBGL, the limestone is moderately weathered to fresh with high to very high strength (ave. 61 MPa) and an average density of 2.7 t/m^3 (refer Appendix 1). At shallower depths, and adjacent to faults and karst structures, the surfaces of individual rocks tend to be highly weathered. However, the cores of rocks may be only slightly weathered hence their strengths can be similar to those of unweathered[17] rocks. The strengths progressively decrease as the depths of weathering into the cores increase. The rocks eventually become extremely weathered gravels of medium to high strength then become residual sands and silts. The shear strength of the sediments can be defined in terms of a friction angle of 38° and a cohesion of 4 kPa.

The strength of most weathered and all unweathered limestone, and its high durability, results in this rock being suitable for use in erosion control cover. Only the extremely weathered rocks are not suitable for cover; these rocks are non-typical.

3.2.2 Discontinuities

The surfaces of discontinuities[18] within the limestone are slightly rough. At depths exceeding ≈30 mBGL, the surfaces are tight, clean and are unfilled. At shallower depths in the upper benches, the discontinuities can be dilated due to stress relaxation, karst, and weathering. When dilated, they are generally filled with hard clay. The proportion of filled discontinuities is insufficient for them to control the specifications of the batters in the upper benches. Therefore, some instabilities involving these discontinuities occur in these benches as the shear strengths of the discontinuities are less than those of unfilled discontinuities. These instabilities involve only a small proportion (<5%) of the length of the upper benches.

Analysis of data[19] obtained from discontinuity mapping (Figure 7) indicates that most of the discontinuities can be assigned to one of 5 sets (Table 5). Set 1 contains bedding-parallel cleavage, which is the dominant fabric. Sets 2 to 5 contain joints. The pit is aligned along the strike of Set 1. Based on the mean orientations of each set, discontinuities within:

- Set 1 dip steep to very-steep[20], generally towards the northeast but can be towards the southwest,
- Set 2 dip steep to very-steep towards the south,

[17] "Fresh" rocks show no evidence of decomposition or discoloration.

[18] The term "discontinuities" refers to any surface that has lower tensile strength than the intact rock. It includes joints, bedding, cleavage etc.

[19] The orientation characteristics are based on a sample size of 602 discontinuities.

[20] Dip terms: Very shallow 0-20°; Shallow 20-40°; Moderate 40-60°; Steep 60-75°; Very steep 75-90°.

- Set 3 dip moderate to steep towards the northeast,
- Set 4 dip very-shallow to shallow towards the southeast,
- Set 5 dip shallow to moderate towards the west,
- Set 0 are random discontinuities having no preferential orientations.

The average value of Fisher's constant[21] (i.e., F=15) for the sets is low to moderate and the proportion of random discontinuities[22] (9%) is low. These values are indicative of the rockmass having been slightly to moderately deformed; a characteristic consistent with the tectonic history of the rockmass.

The mean and maximum trace lengths[23] of the discontinuities within each set are listed in Table 5. Based on these values, their persistences[24] are likely to be generally "medium" [25] to "high". Bench scale instabilities on all walls have typically involved discontinuities having high persistences (e.g., Figures 8 and 9). A low proportion of discontinuities having very high persistences has likely contributed to the lack of multi-bench scale instabilities.

The shear strength characteristics of the discontinuities can be described in terms of a non-linear relationship defined in terms of a peak friction angle (refer Appendix 1.4). The average angle for unweathered limestone is 37°, reducing to 30° when weathered.

Table 5. Characteristics of the sets of discontinuities in limestone.

Set	*Dip*	*Dip Direction*	*Fisher's constant, F*	*Weighted # logged (% of total)*	*Mean/Max Trace lengths (m)*
1 (cleavage)	89	073	11	228 (26)	0.6/5
2	73	178	21	256 (29)	1.4/7
3	40	020	15	156 (17)	2.2/10
4	28	131	16	68 (8)	0.7/4
5	42	269	11	103 (12)	0.7/7
0		n/a	0	83 (9)	0.9/5

3.2.3 Karst

Karst generally comprises surface depressions, shafts, and caverns, which are exposed extensively in the batters of the upper benches. The features can extend to 40 mBGL although they are most prevalent to 20 mBGL (Figure 10). Their widths generally range from less than 1 m wide to 3 m (Figure 11).

Most features are either filled with the same clayey silt that covers the surface (Figure 6) or with collapse breccia. A small proportion of the features are unfilled (Figure 12). These latter features are stable due to the high strength of the limestone and the relatively small span widths of the voids.

[21] Fisher's constant defines how tightly the orientation data within a group are clustered around the mean orientation of that group. Values near 100 imply parallelism. Values less than 20 imply a highly deviated set of data.

[22] Random discontinuities are those that have no preferential orientation and hence are not assigned to a set. They are sometimes referred to as the isotropic component.

[23] When the 2D surface of a discontinuity intersects a batter, the line of intersection on the batter is referred to as the trace of the discontinuity.

[24] The persistence is the two-dimensional areal extent of a discontinuity.

[25] Persistence classification: 1-m ≤ Low ≤ 3-m ≤ Medium ≤ 10-m ≤ High ≤ 20 m, Very-high >20 m.

At the EOML, the batter angle of sections of the upper benches comprising soil filled karst will be reduced to <14° and the soil will be covered with broken limestone. Lower karst that remains within benches will remain stable during the long term as the limestone is durable hence weathers very slowly.

3.3 ANDESITE

Andesite intrusions within the limestone are ubiquitous in the Texas beds. At this site, they comprise less than 1% of the total rockmass, generally occurring as stringers less than 1 m wide (Figure 13). Less common are dykes, which can be up to 2 m wide (Figure 14). The intrusions generally follow vertical to sub-vertical joints within the limestone from depth until reduced vertical stresses at shallower depths have allowed them to extrude along horizontal joints. They are located randomly anywhere within the pit.

The andesite is grey to dark olive-green, high to very-high strength, fresh to slightly weathered. Shallow dipping joints within the andesite are spaced 10 to 30 cm with very low persistence. Very steep dipping columnar joints are spaced at 5 to 20 cm with very high persistence. Joints are slightly rough, stepped.

Combined with its high strength, and discontinuity characteristics no less favourable to wall stability than those of the limestone, the andesite has insignificant specific influence on the stabilities of the walls. Its influence is not therefore considered further in this report.

3.4 EARTHQUAKES

Geoscience Australia (2013)[26] places Riverton in a zone of Low earthquake hazard. The estimated peak ground acceleration (PGA) having a 10% probability of being exceeded in a 50-year period is 0.015g (0.15m/s^{2}). The probability corresponds to a 1 in 500 annual return period. There is a 10% probability that an acceleration (A_e) of 0.003g (100/500^{ths} of 0.015g) will be exceeded during the 100-year period considered in this study.

Several studies have reported on PGA values of 0.2g generating falls of individual rocks from pit walls[27] in low stress conditions as apply at this site. On this basis, PGA values of 0.003g are unlikely to generate many if any rockfalls. The risk applicable to a person within the pit perimeter when an earthquake of this intensity occurs is unlikely to become unacceptable.

Wall scale instabilities being triggered by earthquakes within any pit are rare. Although they are unlikely to do so at this site, the influence of earthquake loading is considered in the stability analyses in Section 4.

[26] Geoscience Australia (2018) The 2018 National Seismic Hazard Assessment for Australia. (Editor. Allen, T.) Page 10.

[27] Rockfalls have been reported for PGA values of 0.16g in pits where discontinuities contain significant joint pressures.

4 STABILITIES OF THE PIT WALLS

4.1 BENCH SCALE STABILITIES

Bench scale instabilities are unlikely to be significant hazards after the EOML as the 10 m wide berms and toe bunds on the pit floors will retain falling rocks and prevent them from traversing on to lower benches or across a floor.

4.2 INTER-RAMP SCALE STABILITIES

No inter-ramp scale[28] instabilities have occurred in the pit since mining commenced. Nonetheless, a series of analyses were undertaken to ascertain whether instabilities may occur after the EOML and what modes may be most likely to occur.

The stability analyses are discussed in Appendix 2. The results from them are quantified in terms of likelihood of instability (P_f) values[29]. These values are listed in Tables A2.1 and A2.2 and summarised in Table 6. The results indicate that, prior to the EOML, the characteristics of:

- all walls are significantly more conducive to toppling modes of instabilities than sliding modes,
- the southwest wall is more conducive to instabilities than are the other walls,
- the northwest, northeast and southeast walls are similarly conducive to instabilities, albeit less so than is the southwest wall.

The results indicate that after the EOML, during the long term, the characteristics of:

- all walls will be conducive to toppling and sliding modes of instabilities,
- the southwest wall will be slightly more conducive to instabilities than the other walls will be,
- the northwest, northeast and southeast walls will be similarly conducive to instabilities albeit slightly less so than the southwest wall.

After the EOML and during the long term, weathering will increase the likelihoods for instabilities on all walls. Instabilities will be most apparent in the upper benches as they contain the most weathered rocks and clay filled discontinuities. The likelihoods applicable to the lower benches will increase only slightly over the long-term as these benches comprise high strength durable limestone that weather very slowly.

The acceptabilities of the P_f values applicable are considered by comparing them to acceptance criterion typically recommended for pit walls[30]. The applicable criterion depends on the consequence of an event. An instability could be a high consequence event if a person is impacted by falling rocks. However, although conceivable, such an occurrence is highly unlikely due to the remoteness of the site to unauthorised persons and due to the strategies that will be implemented at the EOML to ensure that areas near the pit will be relatively inaccessible. The recommended acceptance criterion requires a maximum P_f value of 20%. A comparison of the results from the analyses with this criteria indicates:

- Most P_f values are less than the criteria hence are compliant.

[28] After the EOML, loss of one or more benches is a significant hazard. Loss of width from an individual berm is not a significant hazard as the displacing rocks are controlled by lower berms.

[29] The likelihood of sliding quantifies the probability that a particular location on a wall will experience a sliding type of instability.

[30] Acceptance criteria are listed in Read, J. and Stacey, P. (2009) Chapter 9: Acceptance Criteria. *Guidelines for Open Pit Slope Design*. CSIRO Publications.

- Values for the southwest wall may exceed slightly the criteria during the long-term. However, as hundreds of years may be required for the shear strengths of the discontinuities within the lower benches to reduce to the very conservative value (i.e., $\phi = 18^o$) assumed in the analyses, the values are considered acceptable for the period being considered in this study.

Table 6. Results of inter-ramp stability analyses.

	Wall (average dip direction)			
	Northeast (182°)	Southwest (054°)	Southeast (314°)	Northwest (108°)
Limestone weathering classification	Total likelihood of instability, P_f (%)			
Unweathered (Medium to long-term)	11	20	14	12
Weathered (Long term)	16	24	16	17

4.3 WALL SCALE STABILITIES

No instabilities at wall scale have occurred in the pit to date. None are expected to occur prior to, or after, the EOML. Nonetheless, a series of analyses were undertaken to inform an understanding of their likelihood over the long-term as the limestone weathers.

The stability analyses are discussed in Appendix 3. The results are quantified in terms of Factor of Safety (FoS)[31] values for each of hundreds of surfaces assessed within each of the northeast and southwest walls; these being the longest walls along the major axis of the pit. The surfaces with the lowest capacities are highlighted in Figures A3.2 and A3.3. Their FoS values are summarised in Table 7. These surfaces are generally non-circular, which indicates that cleavage within the limestone may influence the shape of any surface that developed. The results of the analyses indicate:

- The lowest capacity surfaces on both walls are within weathered limestone in the upper two benches. On both walls these surfaces daylight less than 10 m behind the crests. They are therefore unlikely to undermine the abandonment barriers.
- No wall scale surface has a FoS value of 1.5 or less.
- The surfaces on the northeast and southwest walls that have the lowest capacities have FoS values of 2.8 and 2.5 respectively. This result is consistent with the acceptable performances of the walls to date.

The recommended acceptance criteria require a minimum FoS of 1.5 under static loading conditions and 1.1 under dynamic (earthquake) loading conditions. A comparison of the results of the analyses with these criterion indicates all values are compliant hence the designs for the walls are likely to be acceptable.

Table 7. Results of overall slope scale stability analyses on the major pit walls.

	Factor of Safety (FoS)	
	North wall	South wall
Wall scale	2.8	2.5
Multi-bench scale	2.8	2.5

[31] The Factor of Safety (FoS) is the ratio of the average shear strength of a surface to the average shear stress applied to the surface. A FoS value of less than unity (1.0) indicates a 50% or greater likelihood of an unstable scenario.

4.4 RISK MANAGEMENT STRATEGIES FOR THE PIT

After the EOML, the principal strategies to reduce the risks applicable to the pit walls will be:

- ensuring the benches comply with the specifications in Table 1,
- restricting access to and throughout the site by unauthorised persons,
- ripping access roads to the upper and lower floors of the pit and the access roads into the pit,
- installing the abandonment barriers and safety signs around the perimeter of the pit,
- installing 2 m high bunds on the pit floors, a minimum of 10 m out from the toes of each wall,
- adherence to the requirements of the completion criteria (Section 6).
- visually monitoring the performances of the walls for a specified period after the EOML to ascertain whether they continue to perform acceptably,
- preparedness to modify the design of a wall if its performance does not comply with the completion criteria.

5 STABILITIES OF THE NORTHERN WRD SLOPES

5.1 SLOPE SCALE STABILITIES

No significant instability has occurred on the slopes of the northern WRD to date. None is expected to occur prior to, or after, the EOML. Nonetheless, a series of analyses were undertaken to inform an understanding of their likelihood over the long-term as the materials within the dump weather. The analyses are discussed in Appendix 4.

The results of the analyses are quantified in terms of Factor of Safety (FoS) values for each of hundreds of surfaces assessed within the front slope of the dump. The surfaces with the lowest capacities are highlighted in Figures A4.2 and A4.3 in Appendix 4. These capacities are summarised in Table 8.

The acceptabilities of the FoS values are considered by comparing them to acceptance criterion typically applied to WRD slopes[32]. The criterion depends on the consequence of an event. An instability could be a high consequence event if a person is impacted by displacing materials. However, although conceivable, such an occurrence is highly unlikely due to the remoteness of the site to unauthorised persons and due to the strategies that will be implemented at the EOML to ensure areas near the dump are inaccessible.

A minimum FoS of 1.5 is recommended under static loading conditions and 1.15 under dynamic (earthquake) loading conditions for wall scale instabilities[33]. A comparison of the results of the analyses with these criterion indicates all values are compliant hence the designs for the slopes are likely to be acceptable.

Over the long-term, although no significant slumping is expected, the angles of the slopes will progressively reduce as weathering of the materials within the dump creates additional fines which result in an increase in the densities of the materials. These actions will result in the slope angles reducing progressively. As they do, the slopes will progressively become more stable.

[32] Acceptance criteria are listed in Hawley, M. and Cunning, J. (2017) Chapter 8: Acceptance Criteria. *Guidelines for Mine Waste Dump and Stockpile Design*. CSIRO Publications.

[33] The criteria apply to low confidence in the characteristics of the materials and the footing.

Table 8. Results of slope scale stability analyses on the front slope of the WRD.

	Characteristics of surface		
	Slope scale surface crown behind crest	Slope scale surface crown near crest	Bench scale surface
Shape of surface	Factor of Safety (FoS)		
Circular	1.7	1.6	1.4
Non-circular	1.7	1.6	1.4

5.2 RISK MANAGEMENT STRATEGIES FOR THE WRD

After the EOML, the principal strategies to reduce the risks applicable to the northern WRD will be:

- ensuring the slopes comply with the specifications in Table 4,
- restricting access to the site by unauthorised persons,
- ripping access roads to the crest and the toe of the dump,
- installing a crest edge bund and ensuring it is offset at least 10 m behind the crest,
- installing a 2 m high bund a minimum of 10 m out from the toe of the front slope,
- adherence to the requirements of the completion criteria (Section 6).
- visually monitoring the performance of the dump for a specified period after the EOML to ascertain whether it continues to perform acceptably,
- preparedness to modify the design of the dump if its performance does not comply with the completion criteria.

6 COMPLETION CRITERIA

Table 9 lists the general objectives relevant to geotechnical aspects of the pit and the northern WRD at the EOML and during the long-term. Completion criteria relevant to these aspects are listed in Table 10. The respective landforms will be considered suitable for relinquishment when these objectives and non-geotechnical related criteria have been met.

Table 9. General Objectives Relevant to Geotechnical Aspects of the Landform

Short-term	*Medium to Long-term*
• Reshape sections of the batters of the upper benches to their final landform so they can be progressively rehabilitated. • Stabilise haulroads, batters of the upper benches of the pit and slopes of the WRD as soon as practical. • Visually monitor the performances of the pit walls and the slopes of the northern WRD slopes.	• Provide self-maintaining, geotechnically stable and safe landforms that compliment with the surrounding landforms in terms of slope, geomorphological characteristics, and postmining land use. • Remediate hazards associated with the pit and the northern WRD that may increase the geotechnical related risks. • Construct the upper surface of the WRD to ensure rainfall runoff drains away from the crests of the slopes towards the haul road. • Minimise the catchment area applicable to the pit with an up contour abandonment bund.

Table 10. Completion Criteria Relevant to Geotechnical Aspects of the Final Landform

Domain	*Long-term Goal*	*Objective*	*Performance Indicators*	*Completion criteria*
Pit	Stability	• Walls and areas behind their crests are geotechnically stable. • Landforms having low probabilities of overall wall instability with high safety and environmental consequence. • Void volume and surface area is minimised. • Pit hydrology and hydrogeology are understood.	• Engineering design. • Records of slope instability. • Floodwater isolated from the pit. • Surface water and groundwater parameters.	• Walls are profiled for long-term stabilities as evidenced by surveys of walls. • Visual evidence that the stabilities of the walls have remained constant or have increased as rehabilitation is established. • Evidence that the pit water does not develop.
	Safety	• Structurally sound. • Pit safe for persons and fauna. • Crest locations are clearly defined.	• Fall from height hazards. • Impact hazards.	• Perimeter abandonment bund is in the correct location and structurally sound. • Signs are installed. • Site access is restricted.
WRD	Stability	• Slopes and surfaces of the WRD are geotechnically stable. • Landforms have low probabilities of slope instability with high safety and environmental consequence. • WRD is adequately managed to ensure surface runoff and water seepage are not detrimental to the environment.	• Engineering design. • Records of WRD slope instability.	• Slopes are profiled for long-term stabilities as evidenced by surveys. • Visual evidence that the stabilities of the slopes have remained constant or increased as rehabilitation is established. • No ponding occurring on the surfaces.
	Safety	• Structurally sound.	• Engineering design.	• Site access is restricted to the general public.

7 SUMMARY

7.1 CONCLUSIONS

- The proposed landform designs satisfy the geotechnical related requirements of the PRCP Guideline.
- The stabilities of the pit walls and the slopes of the northern WRD will be within the ranges typically considered acceptable in the mining industries.
- A permanent water level will not develop in the pit after the EOML.

7.2 RISK MANAGEMENT STRATEGIES

After the EOML, the principal strategies to reduce the risks applicable to the pit walls and the slopes of the WRD will be:

- restrict access to the site by unauthorised persons,
- rip access routes within and into the pit and to the upper surface and the toe of the northern WRD,
- install abandonment barriers with signs behind the crests of the pit walls and an edge bund behind the crests of the slopes of the northern WRD,
- visually monitoring and auding the performances of the pit walls and the slopes of the northern WRD,
- routinely inspecting the areas behind the crests of the pit walls and the slopes of the northern WRD for evidence that may be indicative of large scale instabilities developing (e.g., cracking, subsidence etc.),
- adherence to the requirements of the completion criteria (Section 6)
- prior to the EOML, preparedness to modify plans and/or designs and/or site works if any landform deviates from the design and/or its performance does not comply with the criteria.

8 CLOSURE

This report addresses the geotechnical related issues required in a PRCP as listed in Section 1. I trust that it provides the information you require. Please contact the undersigned if you have any queries on any matter discussed within it or wish to discuss any aspect of the report in more detail.

For and on behalf of

ROCKTEST



Tony Meyers
Principal Rock Mechanics Engineer

FIGURES

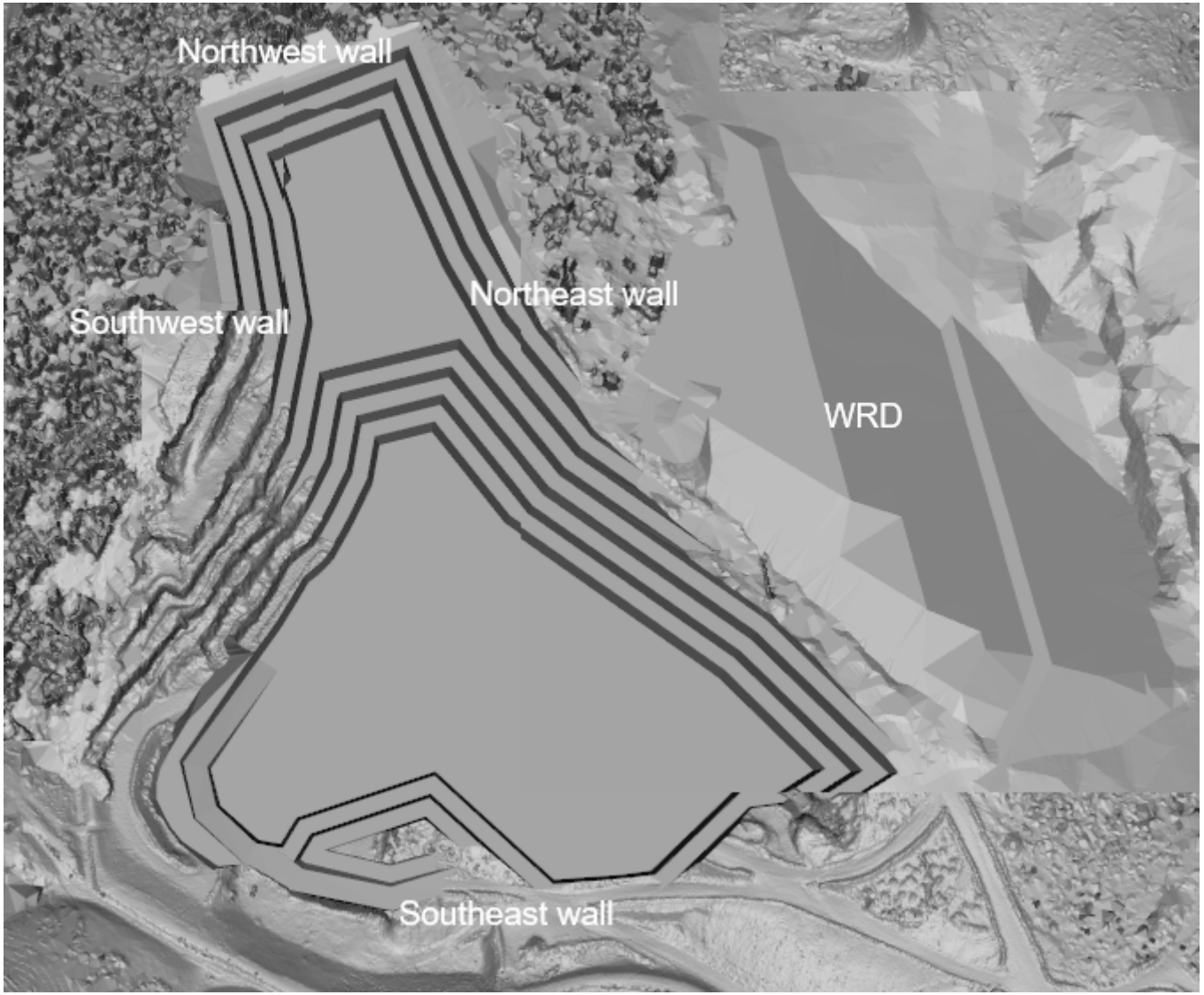


Figure 1. Surface of the pit and the WRD at the end-of-mine-life.

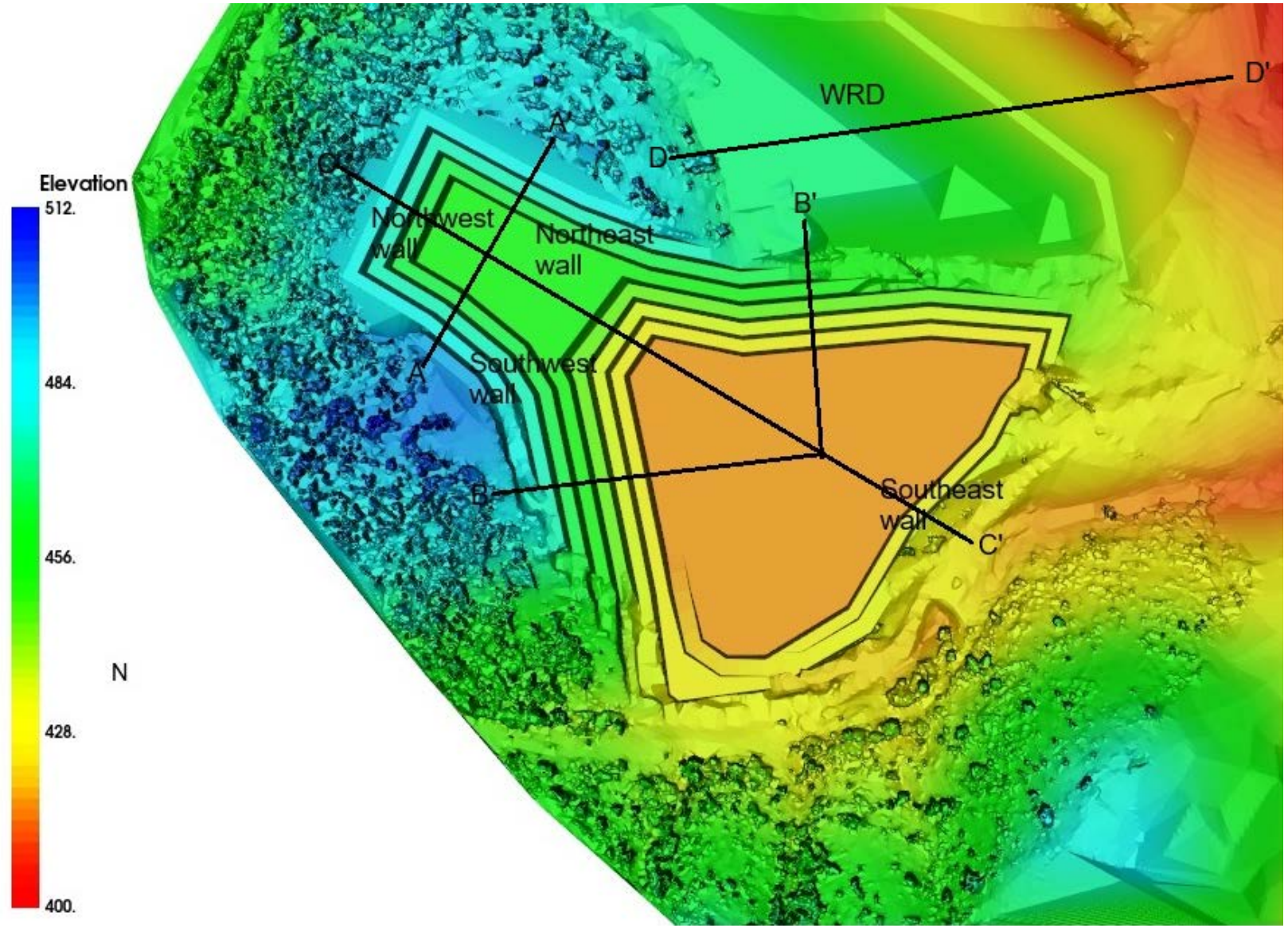


Figure 2. Elevations of the pit and the WRD at the end-of-mine-life and the cross sections considered in the stability analyses.

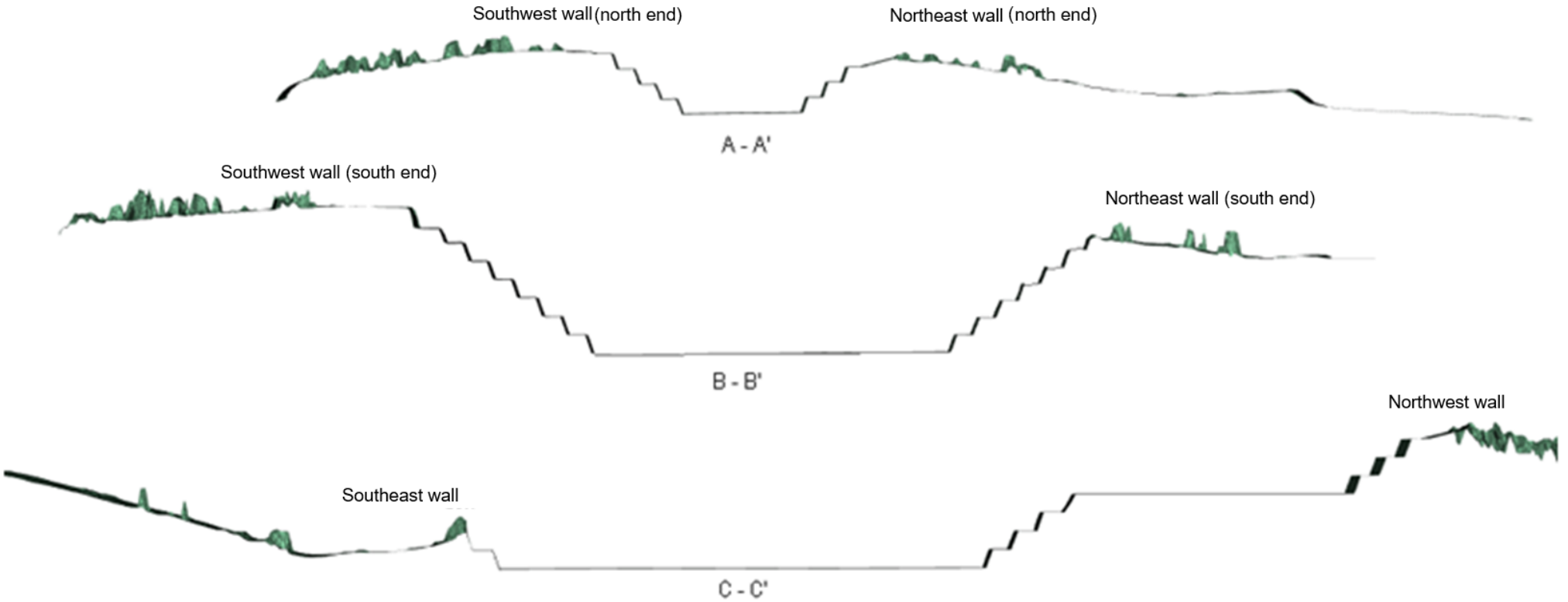


Figure 3. Cross-sections through the pit walls. Refer Figure 2 for locations of cross sections.



Figure 4. Example of a 1.5m high, proprietary rockfall barrier suitable for use as an abandonment barrier behind the southwest wall after the EOML. This style of barrier can have a 100 year design life.

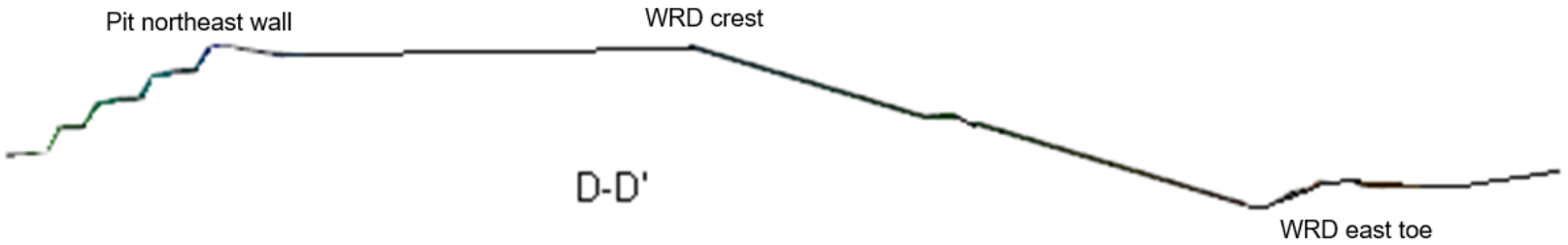
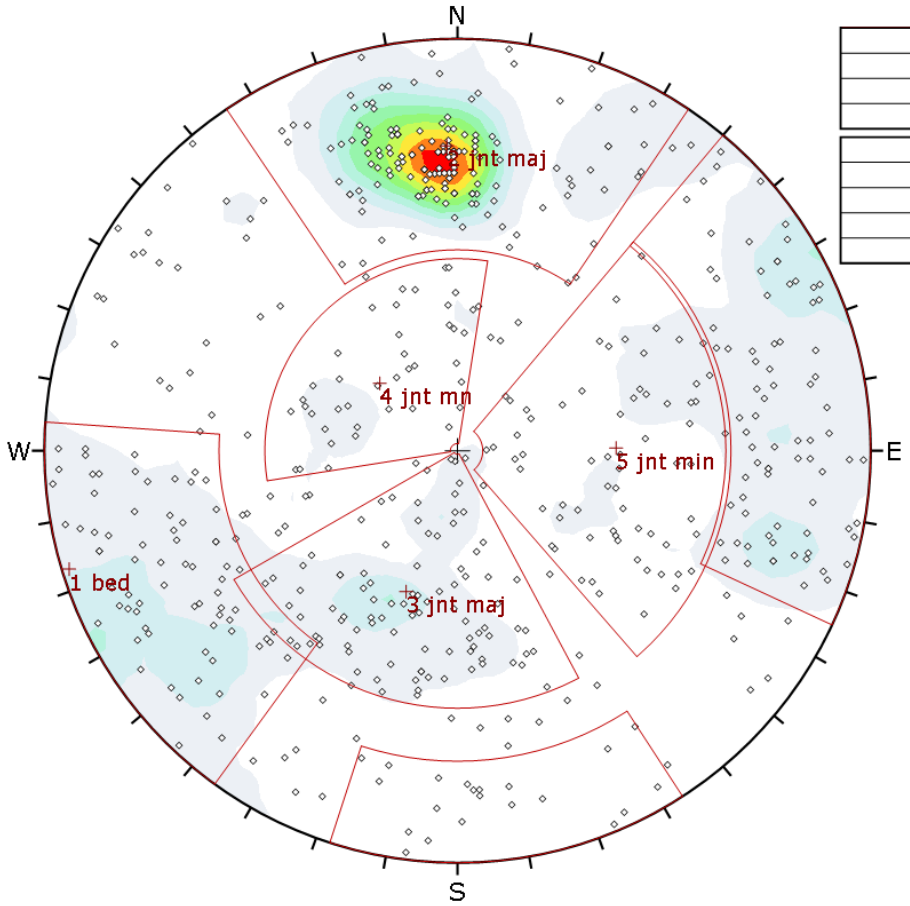


Figure 5. Cross-section through the WRD. Refer Figure 2 for location.



Figure 6. Soil cover is thin on contour highs around most of the crest of the pit. It can be deep where it fills karst caverns. Example is midway along the northeast wall.



Contour Data	Pole Vectors
Maximum Density	9.30%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Plot Mode	Pole Vectors
Vector Count (Weighted)	894 (602 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

Figure 7. Stereonets highlighting the orientations of poles to 894 discontinuities within the limestone, the boundaries of the 5 sets into which the discontinuities have been assigned and the mean orientations of the sets.



Figure 8. Planar sliding involving bench scale masses of rocks sliding along cleavage having high persistence. Example from midway along the southwest wall.



Figure 9. Block toppling involving bench scale masses of rocks bounded to the rear by steep dipping cleavage having high persistences. Example from the east end of the southwest wall.



Figure 10. Highlighted are karst structures extending at least 40 m below the surface.

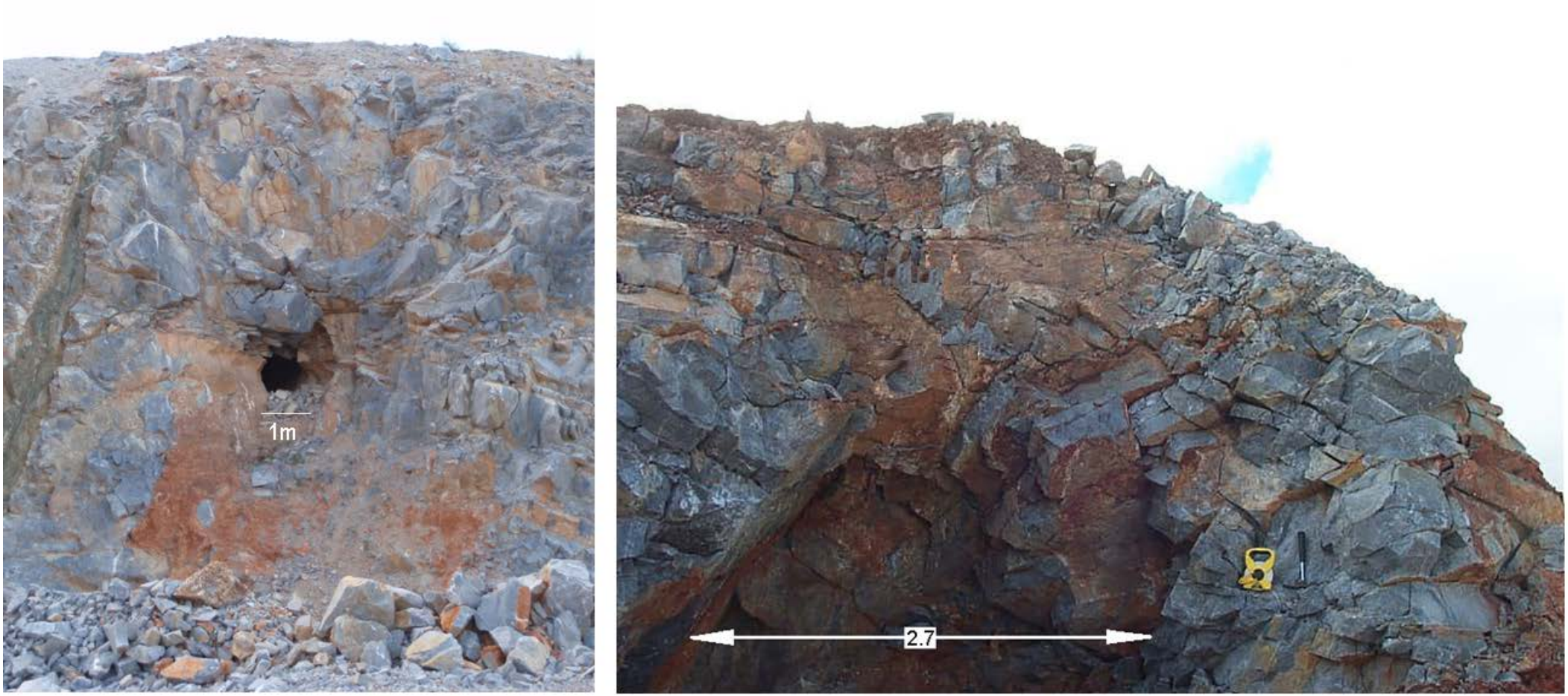


Figure 11. Empty karst caverns in the upper benches generally range from less than 1 m to 3 m wide and high.



Figure 12. Highlighted are unfilled karst caverns midway along the southwest wall.

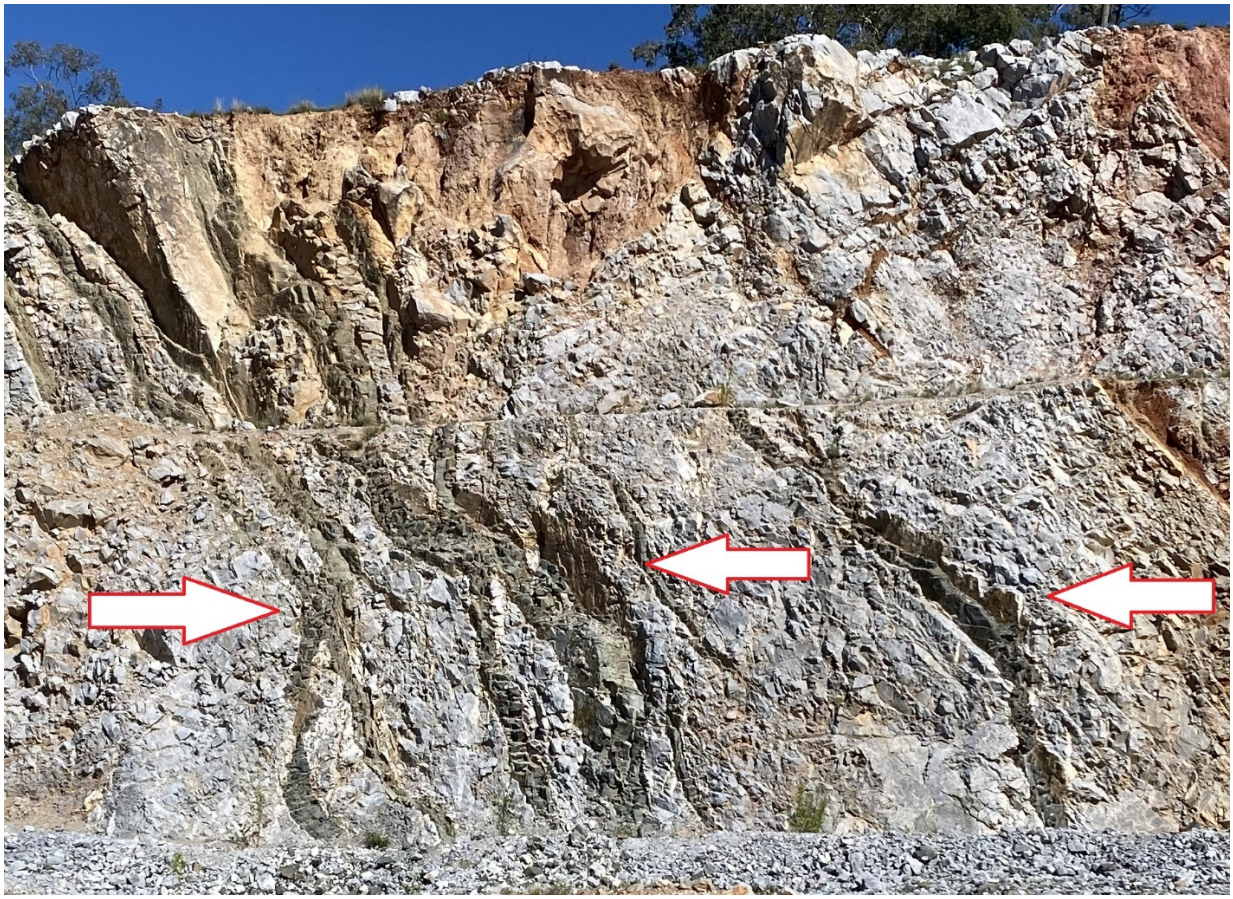


Figure 13. Typical andesite stringers exposed in a wall. Example is midway along the southwest wall.



Figure 14. Wedge sliding involving bench scale masses of limestone and dykes of andesite sliding along moderate to steep dipping cleavage and joints having high persistences.
Example from midway along the northeast wall.

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 long-term geotechnical related risks applicable to the landforms at the Riverton 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 of 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 Graymont 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 accepts 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.

APPENDIX 1 ROCKMASS CHARACTERISTICS

A1.1 COMPRESSIVE STRENGTHS

The strengths of weathered and unweathered limestone were defined in terms of Point-Load Strength Indices, $I_{s(50)}$.

Samples of limestone were collected at random locations within the pit and from areas nearby. No preparation of the rocks was required. They were tested at their moisture content at the time of testing.

The tests were carried out in accordance with ISRM (1985[34]) and AS 4133.4.1 9 (1993[35]).

1. A rock was inserted into an ELE point-load test apparatus. The rock was aligned perpendicular to the dominant fabric.
2. The platens were closed to contact the smallest dimension and away from the edges.
3. The load was steadily and slowly increased until failure. Tests for which the failure plane did not fully intersect the rock were rejected. The pressure at failure was recorded.
4. The distance between the platens at failure and the width of the failure plane were recorded with a Vernier calliper. The width was calculated as (W1+W2)/2[36] if opposite sides of the failure plane were not parallel.

The results are summarised in Table A1.1.

Table A1.1. Summary of point load strength indices $I_{s(50)}$ for limestone.

Weathering	*Number of tests*	*Minimum (MPa)*	*Mean (MPa)*	*Maximum (MPa)*
weathered	4	1.6	1.9	2.4
unweathered	15	2.7	3.8	6.5

A1.2 SPECIFIC GRAVITIES

The densities of weathered and unweathered limestone were estimated as functions of their specific gravities.

1. The mass (M_d) of a dry rock was measured with a Nuweigh KK5000 electronic balance.
2. The rock was suspended in water and its saturated mass (M_s) was measured.
3. The rock was removed from the water and its wet mass (M_w) was measured.
4. The density of the rock was estimated from the following equation.

The results are summarised in Table A1.2.

$$\text{Density} = \frac{1000\, M_d}{M_w - M_s}$$

[34] ISRM (1985) International Society for Rock Mechanics Commission on Testing Methods. Suggested Methods for Determining Point Load Strength, Int. Jnl. Rock Mech., Min. Sci. & Geomech. Abstr. Vol. 22 No. 2 pp.51-60

[35] AS 4133.4.1 (1993) Australian Standard Methods of Testing Rocks for Engineering Purposes. Method 4.1 Rock Strength tests – Determination of Point Load Strength Index.

[36] ISRM (1985) and AS4133.4.1 suggest that the dimension W should be the minimum dimension of the sample perpendicular to the loading direction prior to testing due to the simplicity of obtaining this dimension. However, researchers and the German Standards argue in favour of measuring W as the minimum dimension of the failure surface after testing although obtaining this dimension is more time consuming than the former method. Rocktest adopts the latter method.

Table A1.2. Summary of density values for limestone.

Weathering	*Number of tests*	*Minimum (kg/m^3)*	*Mean (kg/m^3)*	*Maximum (kg/m^3)*
weathered	4	2643	2659	2674
unweathered	14	2686	2753	2833

A1.3 BASIC FRICTION ANGLES

The basic friction angles[37] (ϕ_b) of discontinuities within unweathered and weathered limestone were estimated were estimated using the procedure:

1. A diamond tipped saw blade was used to cut through the sample. The smooth cut surfaces were manually abraded to remove all roughness features. The halves were then reassembled.
2. The lower half of the sample was tilted slowly until the top half begun to slide. The tilting was stopped.
3. The tilt angle was recorded with a digital M&D "SmartTool" level.
4. The halves were realigned and the test repeated a minimum of 12 times.

Table A1.3. summarises the results from the tests:

Table A1.3. Summary of basic friction angles test data.

Weathering	*Minimum*	*Mean*	*Maximum*
weathered	17°	22°	28°
unweathered	14°	19°	23°

A1.4 DISCONTINUITY SHEAR STRENGTHS

Bench scale instabilities within the pit are dominated by gravity driven sliding and toppling of rocks. Displacements occurs when the driving forces applied to individual rocks and masses of rocks exceed the shear strengths of the underlying discontinuities[38]. In this study, these strengths are quantified in terms of minimum and mean peak friction angles[39]. The discontinuities are assumed to have negligible cohesive strengths as:

- the rocks within the benches have been vibrated during blasting,
- most discontinuities have undergone some shear displacements during tectonic deformations and creep which destroyed cementation,
- relatively low stresses are applied to the discontinuities within the benches.

The "shape" of the shear strength/normal stress curve is described by the non-linear Barton-Bandis (BB) shear strength criterion[40]. The criterion is defined in terms of the following parameters. Their assumed values are listed in Table A1.4:

[37] The basic friction angle quantifies the inter-granular friction after all roughness asperities have been abraded from opposing surfaces of a discontinuity.

[38] Assuming rocks are free to move out from a bench.

[39] Any movement along a discontinuity destroys any cohesive bonds leaving a surface that is purely frictional.

[40] 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. (B-B model)

- Joint Wall Compressive Strength (JCS) is assumed to be equivalent to the compressive strengths of the intact rocks. These strengths were quantified as functions of the point load strength indices listed in Table A1.1. A conservative multiplication factor K (i.e., UCS = K x I_{s50}) of 18 was assumed.
- Normal stress (σ_n) acting perpendicular to a discontinuity. This stress is a function of the unit weight of the overlying rocks. This value was quantified using the data obtained from the specific gravity tests listed in Table A1.2.
- Residual friction angle (ϕ_r) of the discontinuities was quantified as a function of the basic friction angles obtained from the tilt tests listed in Table A1.3.
- Joint Roughness Coefficients[41] (JRC) was quantified by comparing the surfaces of the in-situ discontinuities to standard roughness profiles. The corresponding JRC values are listed in Table A1.4.

The estimated peak friction angles are listed in Table A1.5. The range of values is typical for limestone.

Table A1.4. Description of surfaces of discontinuities and corresponding JRC values for 30-cm rocks.

	Surface weathering	
Surface Description	*Weathered*	*Unweathered*
Average surface	slightly rough, planar	smooth to slightly rough, planar
JRC	3 to 10 (ave. = 6)	2 to 8 (ave. 4)

Table A1.5. Summary of peak friction angles for limestone based on B-B model.

Weathering	*Minimum*	*Mean*
weathered	23°	37°
unweathered	18°	30°

A1.5 ROCK MASS STRENGTHS

The shear strength of the limestone rockmass was estimated using the Generalised Hoek-Brown Rock Mass Strength criterion[42]. The criterion is defined in terms of the parameters listed in Table A1.6.

- The Hoek-Brown intact rock constant m_i for limestone.
- The disturbance factor D which depends upon the degree of disturbance to which the rock mass at the depth of a potential surface of instability has been subjected by blast vibration and stress relaxation[43]. A value of 0.5 is applied as controlled blasting has not been used and hence benches will have undergone some disturbance.

[41] The Joint Roughness Coefficient (JRC) quantifies the roughness of the surface of a discontinuity. It is estimated by comparing the surface of a discontinuity with standard roughness profiles. The roughness is scaled from one for a very smooth (slickensided) surface to 20 for a very rough stepped surface.

[42] Hoek, E. Carranza-Torres, C. & Corkum, B. (2002) Hoek-Brown failure criterion, 2002 edn. In *Mining and Tunnelling Innovation and Opportunity. Proc. 5th North American Rock Mech. Symp*. Toronto, vol. 1 pp.267-273 Uni. Toronto Press, Toronto.

[43] D varies from 0 for undisturbed rockmasses to 1 for very disturbed rockmasses.

- The Geological Strength Index (GSI)[44] is a quantitative value that defines the quality of the rockmass in terms of the parameters[45]:
  - Rock volume – the edge length ranges from 10 to 60-cm for unweathered rocks and 2 to 30-cm for weathered rocks.
  - Joint Condition Factor (J_c) is the ratio of the following qualitative parameters from the Q[46] rock mass classification system:
    - Joint Roughness number (J_r) which ranges from 1 to 3 for both weathering grades,
    - Joint Alteration number (J_a) which ranges from 2 to 3 for the weathered limestone and 0.75 to 1.0 for the unweathered limestone.

Figure A1.1 shows the likely ranges in the GSI values based on the data described above. The average values decrease from 66 to 44 as the limestone weathers. Although these values are not definitive, they still provide an indication of the decrease in the quality of the limestone as the degree of weathering increases during the long-term.

Table A1.6. Rock mass shear strength parameters for limestone.

Characteristic		*Grade*	*Min*	*Mean*
Intact rock constant, m_i.		all	9	12
Unit weight, (kN/m^3)		unweathered	27.0	26.3
		weathered	25.9	26.1
Disturbance factor, D.		all	0.5	
Uniaxial compressive strength, UCS (MPa)		unweathered	48.6	68.4
		weathered	28.8	24.2
Rock volume (cm^3)		unweathered	8,000	343,000
		weathered	125	27,000
Joint condition factor, $J_c = J_r/J_a$		unweathered	1	2.5
		weathered	0.3	0.9
Geological Strength Index, GSI.		unweathered	43	66
		weathered	24	44
Rock mass shear strength	friction angle	unweathered	35°	43°
	cohesion (MPa)		0.9	2.7
	friction angle	weathered	29°	38°
	cohesion (MPa)		0.3	0.5

[44] The geological strength index (GSI) produces quantitative values used to calculate the strength properties of a rockmass.

[45] Cai, M., Kaiser, P.K., Uno, H., Tasaka, Y., Minami, M. 2004. Estimation of rock mass deformation modulus and strength of jointed hard rock masses using the GSI system. *Int. J. Rock Mech. & Min. Sci*. 41:3–19

[46] Barton and Choubey (1977) The shear strength of rock joints in theory and practice. *Rock Mechanics* **6** 183-236.

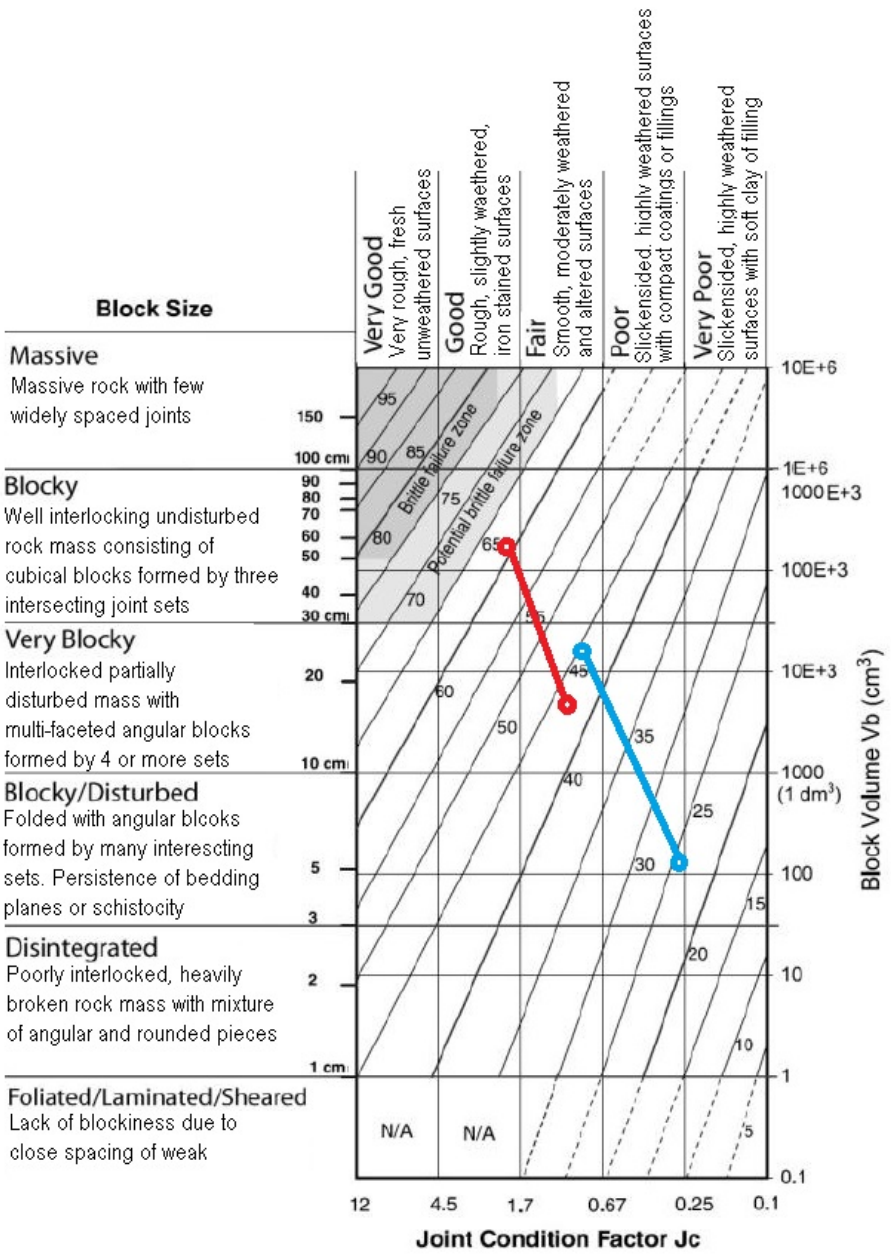


Figure A1.1. Ranges of GSI values for (red) unweathered and (blue) weathered limestone.

A1.6 ROCKFILL SHEAR STRENGTH

Table A1.7 list the range of angles of repose of the materials exposed in the slopes of the WRD. The rocks within the dump are in various stages of decomposition.

The shear strength of the materials can be defined in terms of a friction angle. This angle is typically a few degrees higher than the angle of repose. Based on the values in Table A1.7, the friction angle ranges from 27° to 41°. As the rocks in the WRD are generally free-draining, the values when saturated will differ little from these values when dry.

Table A1.7. Observed angle of repose and estimated friction angles of weathered rocks in the WRD.

Weathering	*minimum*	*average*	*maximum*
Angle of repose	25°	36°	39°
Estimated friction angle	27°	38°	41°

The friction angles of the materials within the dump can also be estimated by applying a non-linear function proposed by Barton (2008)[47]. The function is defined in terms of the parameters listed in Table A1.8. The values listed in the table are lower bound values. The estimated friction angles listed in the table are similar to the values in Table A1.7. On this basis, a lower bound value of 27° is assumed for the long-term friction angle of the materials.

Table A1.8. Estimated parameters for the weathered waste rock.

Parameter	*Source*	*Value*
Basic friction angle, ϕ_b	A1.2	15°
Compressive strength of intact rock, UCS	A1.1	29MPa
Mean size of rocks, D_{50}		100mm
Compacted porosity, n	typical	29%
Density of materials in WRD, d	estimated	$1.9t/m^2$
Size dependent equivalent strength, S = *f*[UCS, D50] (MPa)	chart	6.3
Equivalent roughness, R = *f*[n]	chart	7.3
Friction angle = *f*[S, R, ϕ_b]	calculated	25° to 31°

[47] Shear Strength of Rockfill, Interfaces and Rock Joints, and their Points of Contact in Rock Dump Design. N.R. Barton. Rock Dumps 2008, Perth, Australia 15 pages

APPENDIX 2 PIT INTER-RAMP SCALE STABILITY

Stability analyses were undertaken to quantify the likelihoods[48] for discontinuity controlled modes of instabilities at inter-ramp scales[49]. The analyses used the stereographic method, implemented in the software Dips[50], to assess whether the kinematics[51] applicable to the final benches may be conducive to instabilities. The method calculates the proportions of discontinuities at a location that may underlie masses of rocks that could:

- slide along single discontinuities (i.e., planar sliding) or pairs of discontinuities (i.e., wedge sliding)
- topple from the walls bounded to the rear by single discontinuities or pairs of discontinuities.

Although significant limitations in the analysis method limit the veracities of the results, they are of a standard suitable for highlighting the possible dominant modes of instabilities and the relative likelihood of the modes to occur.

The assessments assumed the following:

- The five sets of discontinuities have the orientation characteristics listed in Tables 3.1 and 3.2.
- An inter-ramp angle of 43° as listed in Table 1.

  The slopes dip towards the medians of the ranges of directions listed in
- Table 2.
- The shear strengths of the discontinuities could transition from friction angles $\phi = 37^o$ to $\phi = 18^o$ over the long-term as listed in Table A1.5.

The percentage of discontinuities having orientations conducive to sliding is defined as,

- for planar sliding and flexural and direct toppling, the percentage (P_{fp}) of the total number of poles[52] to discontinuities that are within "critical zones[53]".
- for wedge sliding and oblique toppling, the percentage (P_{fw}) of the total number of intersections between pairs of discontinuities that are within "critical zones".

The total percentage of discontinuities having orientations conducive to sliding or toppling (P_u) is a function of P_{fp} and P_{fw} based on decision tree theory.

The likelihood of failure (P_f) is defined as P_u x P_l where P_l is the proportion of discontinuities sufficiently persistent to underlie or bound to the rear an inter-ramp scale instability.

Cleavage in the limestone can have high persistence. Its orientation significantly influences the performances of the northeast and the southwest walls and less so the southeast and northwest walls. The northeast and southwest walls are therefore assigned conservative P_l values of 1.0 i.e., 100% of discontinuities involved in instabilities on these walls may have sufficient persistences to influence inter-ramp scale instabilities. The southeast and northwest walls are assigned conservative P_l values of 0.7 i.e., 70% of discontinuities may have sufficient persistences to influence inter-ramp scale instabilities.

---

[48] The likelihood (P_f) is not equivalent to the probability of failure (PoF). A stereonet method cannot provide a definitive assessment of PoF due to fundamental limitations in the analysis method.

[49] After the EOML, loss of one or more benches is a significant hazard. Loss of width from an individual berm is not a significant hazard.

[50] The kinematic analysis software, Dips, is produced by Rocscience Inc, Toronto.

[51] 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.

[52] 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.

[53] "Critical zones" are areas on a stereonet within which a pole is deemed to have the orientation characteristics conducive to sliding.

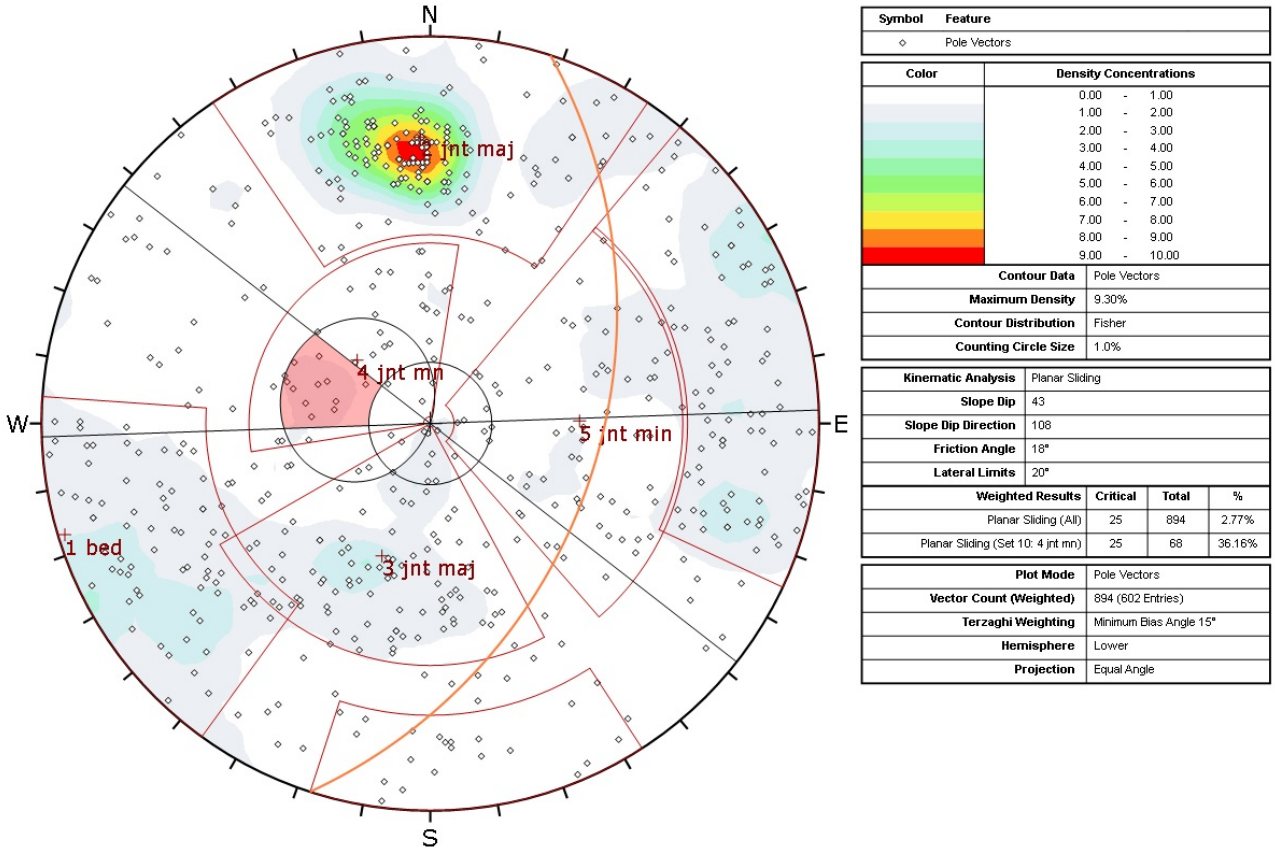
Figures A2.1 to A2.4 shows example of the stereonets applicable to planar and wedge sliding. The results of the analyses are listed in Tables A2.1 and A2.2 and discussed in Section 5.1.

Table A2.1. Results of analyses in unweathered limestone ($\phi = 37^o$).

	Wall (dip direction)			
	Northeast (182°)	*Southwest (054°)*	*Southeast (314°)*	*Northwest (108°)*
Failure Mode	*Percentage of poles in critical area/s (%)*			
Planar sliding, P_{fp}	0.6	0.4	0.4	0.8
Wedge sliding, P_{fw}	0.9	0.8	1.1	2.2
Flexural toppling, P_{ff}	0.4	2.3	0.6	1.0
Direct toppling, P_{fd}	3.7	6.8	6.7	2.0
Oblique toppling, P_{fo}	6.1	11.8	13.1	12.5
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	11.2	20.5	20.6	17.6
Likelihood of failure, $P_f = P_u \times P_i$	11.2	20.5	14.4	12.3

Table A2.2. Results of analyses in weathered limestone ($\phi = 18^o$)

	Wall (dip direction)			
	Northeast (182°)	*Southwest (054°)*	*Southeast (314°)*	*Northwest (108°)*
Failure Mode	*Percentage of poles in critical area/s (%)*			
Planar sliding, P_{fp}	2.0	1.2	1.6	2.8
Wedge sliding, P_{fw}	7.3	9.4	10.7	13.4
Flexural toppling, P_{ff}	2.7	6.0	2.5	6.5
Direct toppling, P_{fd}	3.7	6.8	6.7	2.0
Oblique toppling, P_{fo}	1.8	3.5	3.2	2.4
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	16.4	24.3	22.6	24.6
Likelihood of failure, $P_f = P_u \times P_i$	16.4	24.3	15.8	17.2



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.00
	1.00 - 2.00
	2.00 - 3.00
	3.00 - 4.00
	4.00 - 5.00
	5.00 - 6.00
	6.00 - 7.00
	7.00 - 8.00
	8.00 - 9.00
	9.00 - 10.00

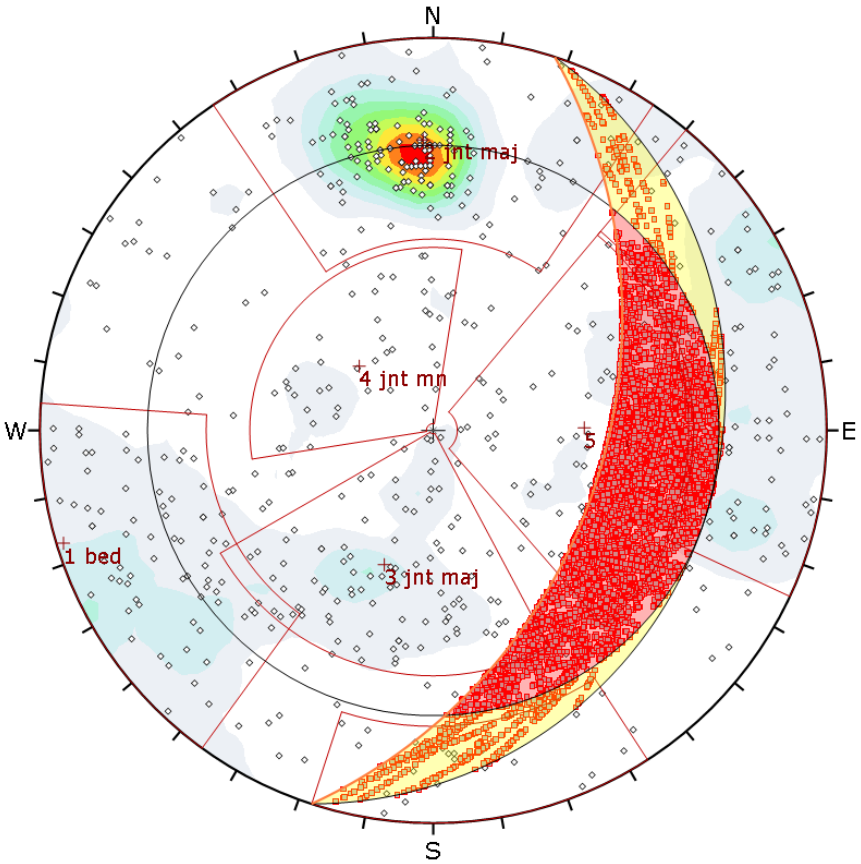
Contour Data	Pole Vectors
Maximum Density	9.30%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	43
Slope Dip Direction	108
Friction Angle	18°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Planar Sliding (All)	25	894	2.77%
Planar Sliding (Set 10: 4 jnt mn)	25	68	36.16%

Plot Mode	Pole Vectors
Vector Count (Weighted)	894 (602 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

Figure A2.1. Stereonet applicable to planar sliding on the northwest wall.



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.00
	1.00 - 2.00
	2.00 - 3.00
	3.00 - 4.00
	4.00 - 5.00
	5.00 - 6.00
	6.00 - 7.00
	7.00 - 8.00
	8.00 - 9.00
	9.00 - 10.00

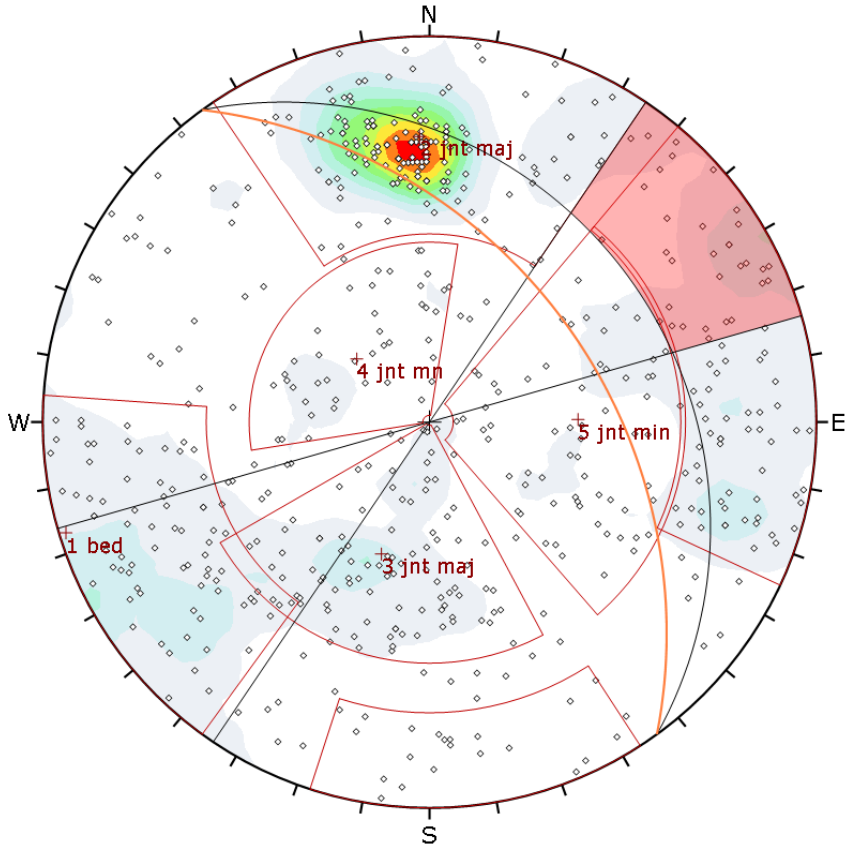
Contour Data	Pole Vectors
Maximum Density	9.30%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	43
Slope Dip Direction	108
Friction Angle	18°

Weighted Results	Critical	Total	%
Wedge Sliding	53162	398282	13.35%

Plot Mode	Pole Vectors
Vector Count (Weighted)	894 (602 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	398282
Hemisphere	Lower
Projection	Equal Angle

Figure A2.2. Stereonet applicable to wedge sliding on the northwest wall.



Symbol	Feature
◇	Pole Vectors

Color	Density Concentrations
	0.00 - 1.00
	1.00 - 2.00
	2.00 - 3.00
	3.00 - 4.00
	4.00 - 5.00
	5.00 - 6.00
	6.00 - 7.00
	7.00 - 8.00
	8.00 - 9.00
	9.00 - 10.00

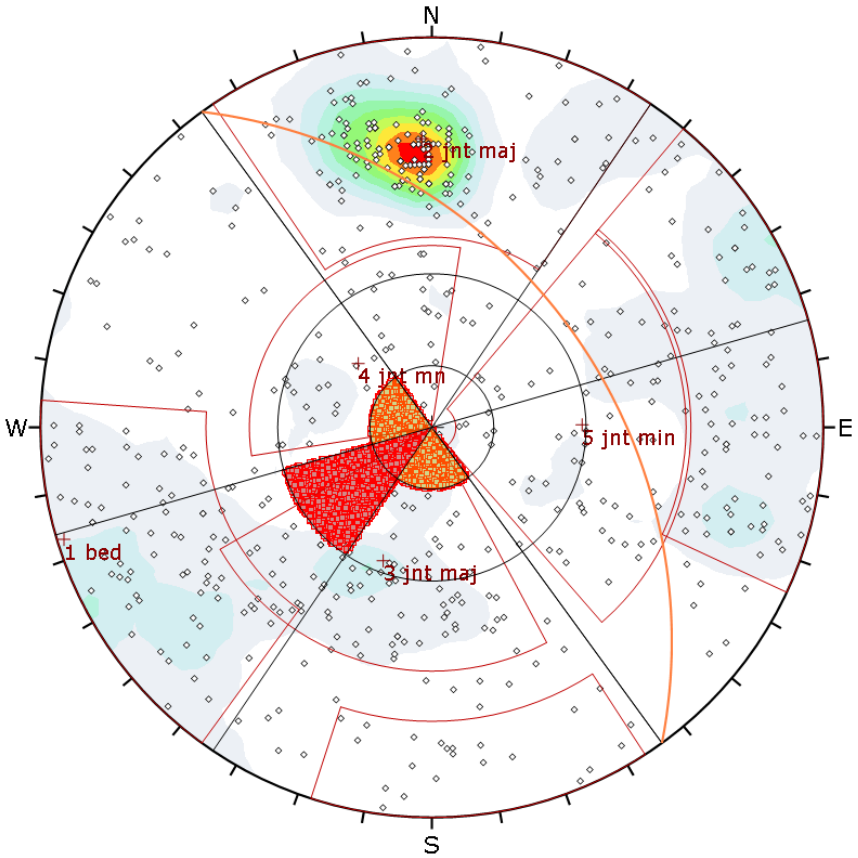
Contour Data	Pole Vectors
Maximum Density	9.30%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Toppling
Slope Dip	43
Slope Dip Direction	54
Friction Angle	18°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Flexural Toppling (All)	54	894	6.04%
Flexural Toppling (Set 5: 1 bed)	47	228	20.66%
Flexural Toppling (Set 11: 5 jnt min)	2	103	1.95%

Plot Mode	Pole Vectors
Vector Count (Weighted)	894 (602 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

Figure A2.3. Stereonet applicable to flexural toppling on the southwest wall.



Symbol	Feature
◇	Pole Vectors
▫	Critical Intersection

Color	Density Concentrations
	0.00 - 1.00
	1.00 - 2.00
	2.00 - 3.00
	3.00 - 4.00
	4.00 - 5.00
	5.00 - 6.00
	6.00 - 7.00
	7.00 - 8.00
	8.00 - 9.00
	9.00 - 10.00

Contour Data	Pole Vectors
Maximum Density	9.30%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Toppling
Slope Dip	43
Slope Dip Direction	54
Friction Angle	18°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Direct Toppling (Intersection)	27086	398282	6.80%
Oblique Toppling (Intersection)	13745	398282	3.45%
Base Plane (All)	33	894	3.64%
Base Plane (Set 8: 3 jnt maj)	24	156	15.37%
Base Plane (Set 10: 4 jnt mn)	4	68	5.65%

Plot Mode	Pole Vectors
Vector Count (Weighted)	894 (602 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	398282
Hemisphere	Lower
Projection	Equal Angle

Figure A2.4. Stereonet applicable to direct and oblique block toppling on the southwest wall.

APPENDIX 3 PIT WALL SCALE STABILITY

The stabilities of wall scale surfaces through the final northeast and southwest walls[54] were assessed using a limit-state equilibrium method implemented in the software *Slide2*[55]. The two-dimensional analysis code is applicable for these walls as they will be wide relative to their heights and they will be relatively straight.

The following characteristics were assumed:

- The walls will have the specifications listed in Table 1. Figure A3.1 show the specifications. The upper two benches will comprise weathered limestone overlying unweathered limestone.
- The shear strength characteristics of the limestone can be described by a Generalised Hoek-Brown shear strength criterion discussed in Appendix A1.5. Lower bound values are assumed as they become progressively more applicable during the long-term.
- An anisotropic model is applied to allow for cleavage in the limestone. The shear strength characteristics of the cleavage are applied to sections of potential sliding surfaces that dip at $90^o \pm 30^o$. This strength is described by the Barton-Bandis (B-B) criterion defined in terms of the parameters listed in Table A1.4. The conservative values applicable to weathered limestone are assumed.
- A peak ground acceleration (A_e) of 0.003g is represented as a pseudo-static horizontal force directed out of the wall (refer Section 3.4). The horizontal component (A_H) of the acceleration is conservatively[56] estimated by $A_H = k_H \times A_e$ where $k_H = 0.45$. On this basis, $A_H = 0.0014g$.
- No groundwater level is applied as discussed in Section 2.1.
- A cuckoo search algorithm was used to find the surfaces through the walls with the lowest capacities. Non-circular surfaces were considered to allow changes in the geology and cleavage to influence the shapes of the surfaces.

The results of the analyses are quantified in terms of Factor of Safety (FoS) values for each of hundreds of surfaces assessed within the walls. The surfaces with the lowest capacities are highlighted in Figures A3.2 and A3.3. Sections of the surfaces are non-circular indicating cleavage may influence the shapes.

The results of the analyses are discussed in Section 4.3.

[54] The east wall is not considered as its height is insignificant. The west wall is not considered as its performance will be an average of the performances of the north and south walls.

[55] *Slide2 Ver 9.02* is developed by RocScience Inc. Toronto, Ontario.

[56] Melo and Sharma (2004) suggest (*Seismic Coefficients for pseudo-static Slope Analysis*, 13th World Conference on Earthquake Engineering Vancouver, B.C., Canada August 1-6, 2004) that k_H values ranging from 40% to 45% of A_e should be used in slope stability design rather than the 50% as proposed by Hynes-Griffin and Franklin (*Rationalizing the seismic coefficient method*. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, 1984, Miscellaneous Paper GL-84-13).

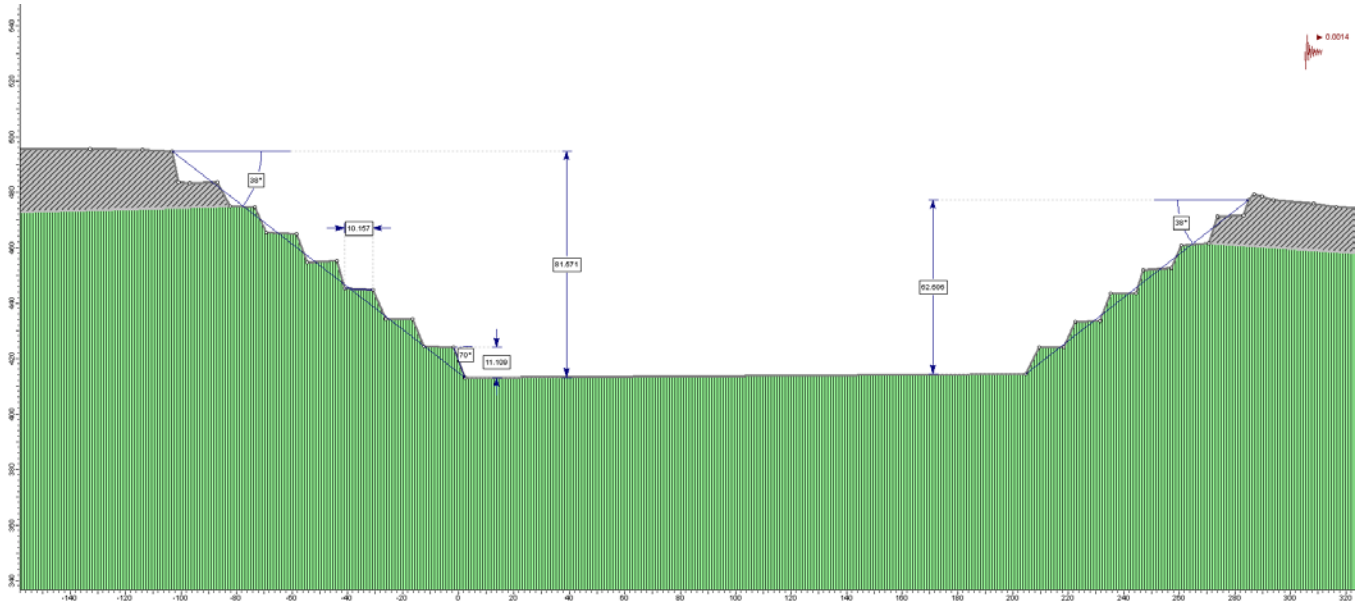


Figure A3.1. Cross-section through the southwest (left) and northeast (right) walls at maximum wall heights.

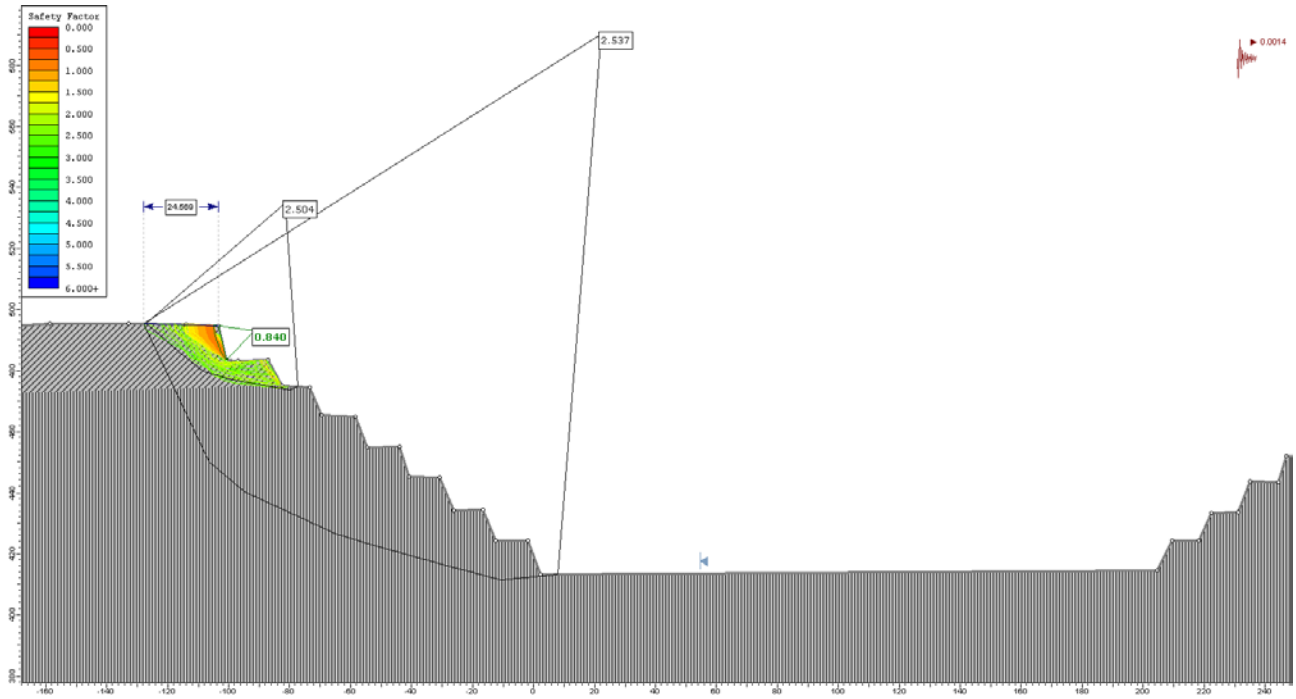


Figure A3.2. Highlighted are surfaces within the southwest wall that have FoS values less than 2.54. Also highlighted is the overall scale surface with the lowest stability that daylights within the upper surface behind the crest.

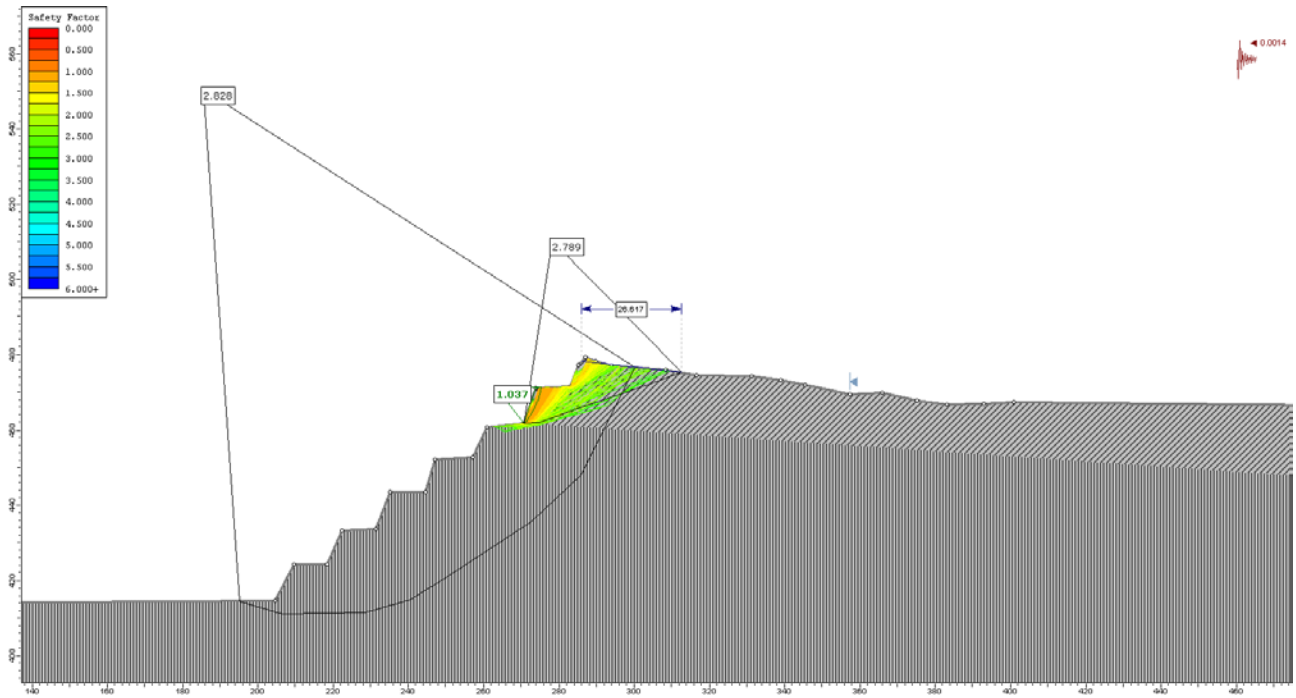


Figure A3.3. Highlighted are surfaces within the northeast wall that have FoS values less than 2.83. Also highlighted is the overall scale surface with the lowest stability that daylights within the upper surface behind the crest.

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APPENDIX 4 WRD SLOPE STABILITY

The stabilities of surfaces through the steepest and highest slope of the WRD were assessed using the limit-state equilibrium method implemented in *Slide2*.

The following characteristics were assumed:

- The slope shown in Figure A4.1 has the dimensions listed in Table 4.
- The footing comprises clayey silt having shear strength characteristic described using a linear Mohr-Coulomb model defined in terms of a friction angle of 25° and a cohesion of 45kPa as discussed in Section 3.1.1.
- The shear strength characteristics of the materials within the dump are described by a linear Mohr-Coulomb model defined in terms of a conservative 25° friction angle as discussed in Section A1.6 in Appendix 1.
- The material is assumed to be permeable. Water that infiltrates its surface migrates through the material to the interface with the weathered limestone then seeps from the down contour toe.
- Earthquake loading applies a horizontal acceleration of 0.0014 as discussed in Appendix 3.

The results of the analyses are quantified in terms of Factor of Safety (FoS) values for each of hundreds of surfaces assessed within the slope. The surfaces with the lowest capacities are highlighted in Figures A4.2. The results of the analyses are discussed in Section 5.1.

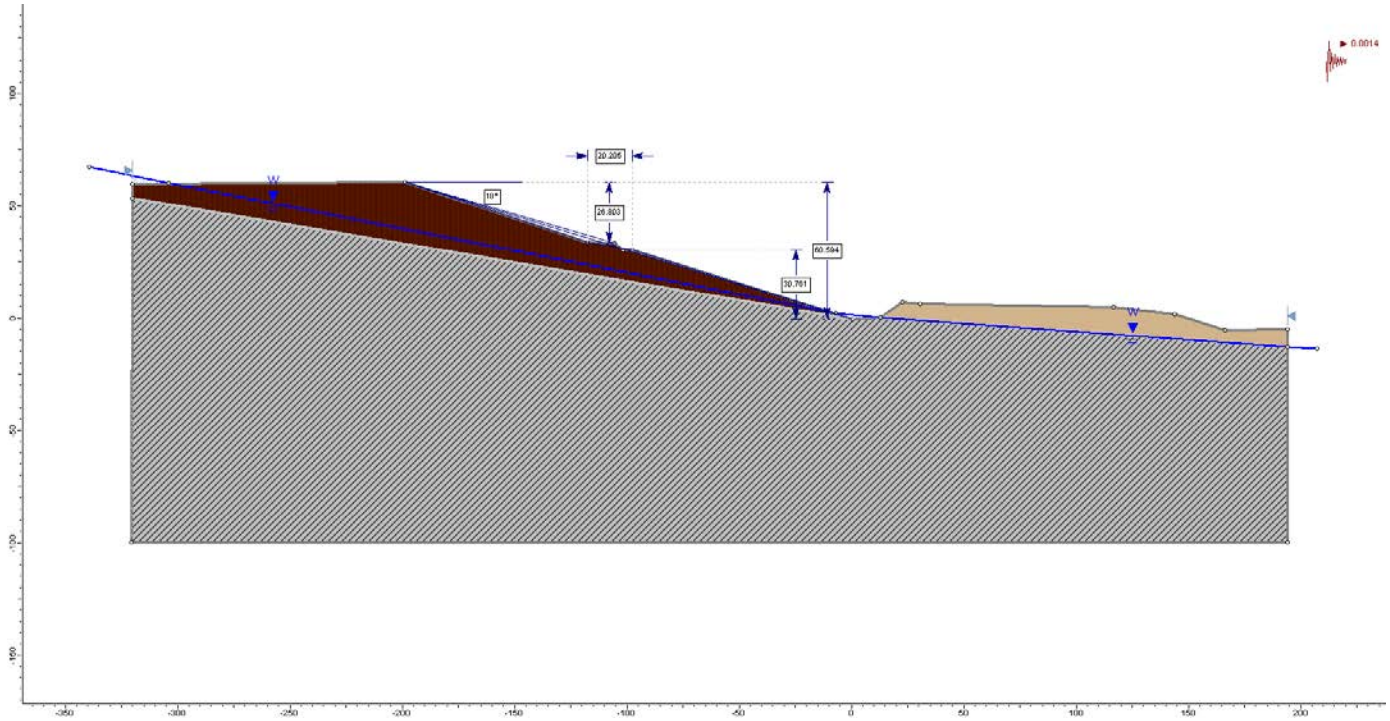

Figure A4.1. Cross-section through the front slope of the northern WRD.

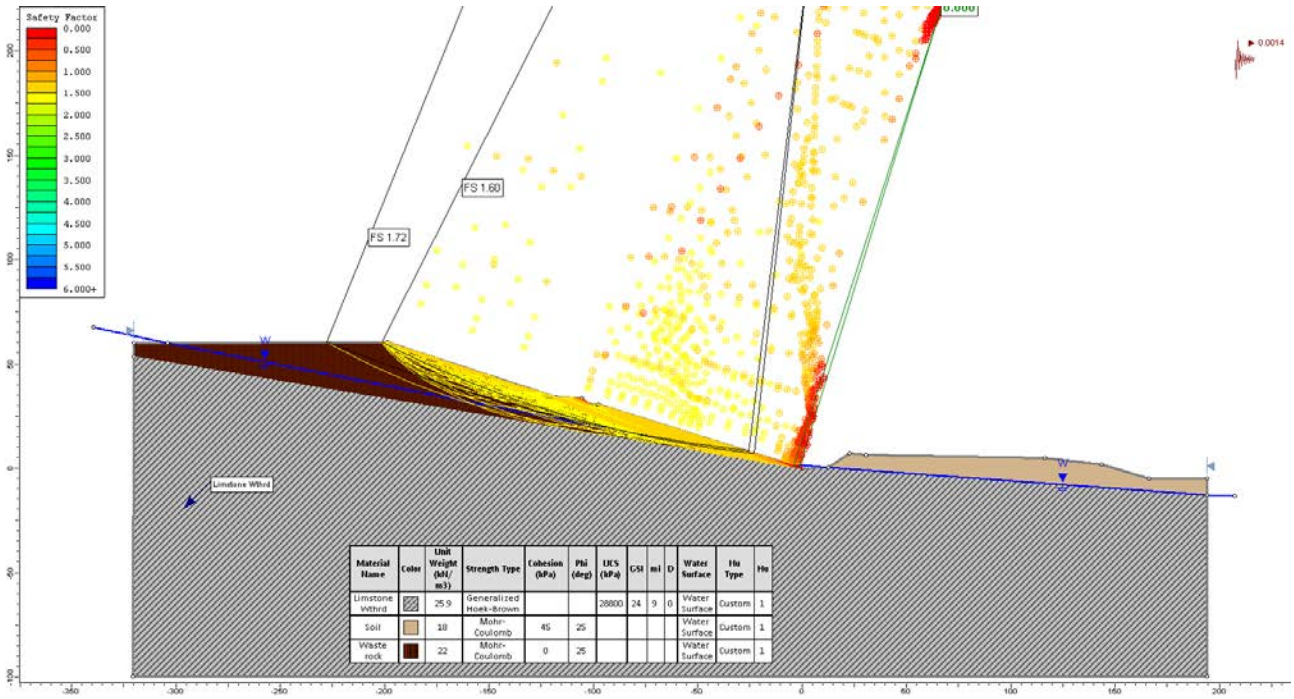

Figure A4.2. Highlighted are circular shaped surfaces having FoS values less than 1.72. This is the lowest FoS of a wall scale surface that daylights behind the crest. The lowest strength wall scale surface has a FoS of 1.60. This surface daylights at the crest. The lowest strength bench scale surface has a FoS of 1.42.

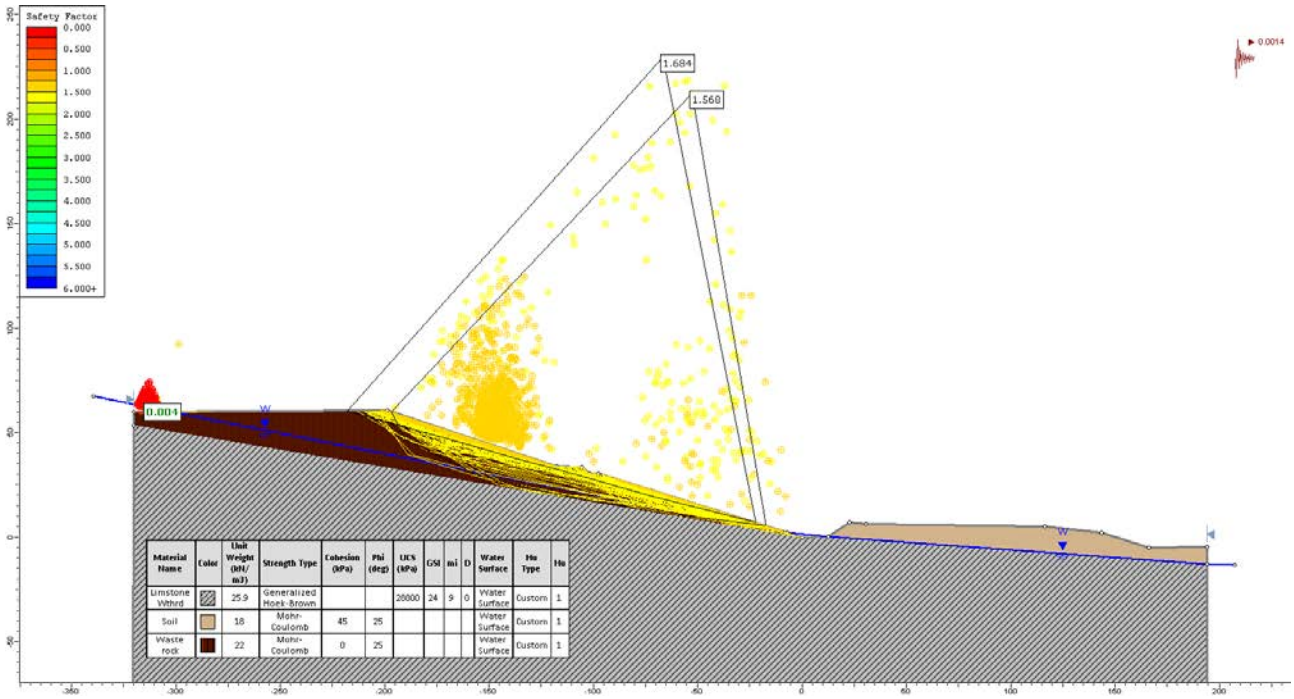

Figure A4.3. Highlighted are non-circular shaped surfaces having FoS values less than 1.68. This is the lowest FoS of a wall scale surface that daylights behind the crest. The lowest strength wall scale surface has a FoS of 1.57. This surface daylights at the crest. The lowest strength bench scale surface has a FoS of 1.44.

Appendix L Final Landform Report (Graymont 2023)

Riverton PRCP Final Landform Report

Author: Jared Parkes

Date: 18th August 24

Approved By:

Date: 18th August 2024

Graymont Mining & Geology
Level 16, 111 Pacific Highway
North Sydney NSW 2060
AUSTRALIA

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1. INTRODUCTION

The Riverton Limestone Quarry is operated by Graymont (NSW) Pty Ltd. The Project involves the operation of an open cut limestone quarry that currently produces over 100,000 tonnes per annum of limestone products annually. The Project commenced operations in the 1970s and, noting potential future changes in reserves and yearly sales quantities, has a planned end of mine life of over 35 years. The Project is located approximately 70 kilometres (km) west of Tenterfield NSW and lies 2km north of the NSW/QLD state border.

This report has been prepared to address the final landform design requirements of the Progressive Rehabilitation and Closure Plans Guideline (ESR/2019/4964) and appends to the Rehabilitation Planning Part prepared by Epic Environmental. This report includes discussion on the 3D design plan and methods for closure, limitations and assumptions, considerations for reducing the risk of the design and minimising footprint size, material balance, material available for landform rehabilitation, and the waste placement strategy.

2. 3D DESIGN AND METHODS FOR CLOSURE

The Riverton Quarry is surrounded by self-sustaining native vegetation, with minor cattle and sheep grazing and forestry located proximate to the site. Due the rural nature and zoning of the quarry, there is not expected to be any visual impact from rehabilitation at these sensitive receptors.

The long-term stability of the landforms has been considered within the design and described further in the Geotechnical Assessment (GA) prepared by Rocktest for the Progressive Rehabilitation and Closure Plan (PRCP) 2023.

2.1 PIT 1

Pit 1 is the only pit being currently mined at Riverton and will make up the largest void at closure. A mine optimisation study was completed to define the size of the economic pit limits. Prior to being able to backfill within the pit the full extent of the pit floor needs to be achieved in so that viable reserves are not sterilised.

Pit 1 is planned to be mined in three stages, with indicative timeframes as follows:

- Stage 1(Establish in pit backfill room) - 2023 - 2045
- Stages 2-3 - 2035 - 2062

Conceptual plans for the 3 stages are shown in section 7 Waste Placement Strategy of this report.

The quarry produces between 20% and 35% waste material during mining and processing operations, it is not deemed feasible to fully backfill the pit. Furthermore, due to the depth of the limestone reserve, a minimum volume of rock is required to be mined before access to in pit backfill room becomes available. Figure 1 shows how the pit is planned to be mined in such a way as to provide in pit backfill room as soon as practicable to minimise the quantity of waste material required to be spoiled outside the void.

Stage 1 is planned to be mined over 22 years focusing on the eastern extent of the Pit. Stage 2 will commence approximately 10 years prior to Stage 1 being finalized and will involve mining the lower section of the western end to the final limit to complete the lower pit level.

Vertical and lateral expansion of Pit 1 is projected to occur using conventional drilling and blasting methods. Blasting occurs approximately once every 2 months within the confines of ML50142 and ML50220. Blasting is restricted during the months of November to March due to bats nesting in a cave to the west of the quarry. Quarrying occurs using excavators and trucks which transport loose material from Pit 1 to the ROM pad for processing. To efficiently mine the Pit, access roads are required to be maintained on the southern and northern boundaries of the pit for the life of mine.

As mining progresses, undisturbed areas will need to be stripped and topsoil stockpiled in zones adjacent to mining. Stockpiling areas will be spread out around the pit limit to allow for efficient rehabilitation of final slopes.

The average final Pit void dimensions will be approximately 575m long by 385m wide by up to 79m deep. Overall slope angles are designed to be between 31 and 37 degrees depending on the orientation within the pit to comply with the GA. This void will remain largely open following closure due to its height in the surrounding landscape.

Backfill in the Pit 1 void will be mostly constructed using waste material from mining and processing. Backfill is not required to provide stability of the final pit slopes, however it will generally be placed in lifts of between 2 and 10m to provide some compaction and consideration will be given to spreading the backfill over a large surface area to provide a wide distribution of toe support of the final pit slopes.

An abandonment bund will be installed as close to the final pit crest as practicable and will consider geotechnical setback recommendations. These bunds are designed to be constructed out of well graded coarse limestone in accordance with GA recommendations and will help to prevent inadvertent access to the void following closure.

As described in the GA some of the strategies employed in the closure plan to reduce risks applicable to pit walls in the final landform are:

- restricting public access to site,
- installing abandonment bunds behind the crests of the pit,
- installing 2m high bunds on the pit floors, a minimum of 10m out from the toes of each wall,
- reducing batter angles of sections of the upper benches comprising extremely weathered rocks and soil,
- ripping access roads to the upper and lower floors of the pit and the access roads into the pit,
- ripping unrequired access roads beyond the perimeters of the pits,
- installing warning signs around the pits and restricting public access to the site,
- preparedness to modify the design of a wall if its performance does not comply with the completion criteria.

2.2 NORTHERN WRD

The Northern WRD will be constructed to ~470m RL which is below the highest level of ~490m RL of the existing landform to the west of the dump. The northern WRD final landform has a maximum height of 65m with two 18 degree slopes and a bench at 440mRL. The upper surface will have a gentle slope to the west of the dump to encourage water to shed towards the haul road between the pit and dump rather than down the slopes. Stability of the final landform will be achieved following recommendations in the GA.

The final Northern WRD footprint in this design is ~7 Ha. An access track at the base of the dump has been maintained in the final landform to provide access to the toe of the WRD and various parts of the site to the west, predominantly for monitoring purposes. The footing of the dump was constructed on a shallow natural slope. Prior to the first lift, topsoil comprising silty clay was stripped from the surface to achieve a relatively flat footing comprising bouldery silty clay with a shear strength greater than that of the topsoil. The dump is constructed using a top down method, whereby trucks end dump materials near the crests and a dozer then spreads, shapes, and compacts the materials.

After the EOML, the principal strategies to reduce the risks applicable to the WRD will be:

- pushing down the slopes to 18 degrees beginning from the upper level, which will remove most of the widths from the underlying berms,
- restricting public access to the site,
- ripping the access roads to and around the dump,
- installing a crest edge bund,
- ensuring all slopes have acceptable stabilities,
- visually monitoring the performance of the dump over the medium to long-terms to ascertain whether the design continues to perform acceptably,
- preparedness to modify plans, designs and/or site works if the dump deviates from the design and/or its performance does not comply with the completion criteria.

Other completion criteria for the Northern WRD are shown in tables 9 and 10 of the GA.

2.3 IN PIT WRD

Stage 1 of the In Pit WRD will be constructed to ~450m RL with 34 degree batters and include 5m wide benches every 10m in elevation. The Pit WRD has a maximum height of 55m and an average grade of 30 degrees.

Stage 2 of the In Pit WRD has an outside overall slope angle of 17 degrees and includes filling the bottom of the pit with ~1m of waste material to allow for final rehabilitation.

The final Pit WRD footprint in this design is 3.5 Ha not including the 1m off fill on the pit floor. Access to the upper surface of the dump will be maintained in the final landform via an access tracks to the north and south east. To reduce the risk of In Pit WRD slope failure the first fill lift will be placed into the rock void left following mining. Subsequent lifts use the top-down method whereby trucks end dump materials near the crests and a dozer then spreads, shapes, and compacts the materials.

After the EOML, the principal strategies to reduce the risks applicable to the WRD will be:

- restricting public access to the site
- ripping the access roads to and around the dump
- ensuring all slopes have acceptable stabilities
- visually monitoring the performance of the dump over the medium to long-terms to ascertain whether the design continues to perform acceptably
- preparedness to modify plans, designs and/or site works if the dump deviates from the design and/or its performance does not comply with the completion criteria.

2.4 VOID CLOSURE PLAN

Geotechnical requirements for void closure are considered in the GA.

3. DOCUMENTED TESTING REGIME

The documented monitoring regime is described in the GA.

The milestone criteria relevant to the landform development of the residual voids to achieve post mining land use are:

- Major earthworks completed in accordance with final engineering and design plans
- Batter slopes meet final design specifications
- Perimeter abandonment bund and safety signage installed around the top of the residual voids IA1
- Certification from a suitably qualified person verifying design intent has been achieved

- Abandonment bunds and residual void slopes have been assessed by a suitably qualified person as sufficient to maintain slope stability and protect from erosion for a minimum of five years after completion of rehabilitation
- Surface water quality complies with the site specific water quality objectives detailed in the environmental authority that relates to the licensed place.

The milestone criteria relevant to the landform development and reshaping of the waste rock dump to achieve a light grazing and fauna habitat post mining land use are:

- Major earthworks completed and landform constructed in accordance with final engineering and design plans
- All material placed to achieve design levels and placed to final design specifications
- One metre high armour rock bund placed 1m behind upper level crest to control water flow and access
- Certification from a suitably qualified person that design intent has been achieved
- All completion criteria have been met on at least three consecutive monitoring events conducted no more frequently than once annually
- Certification from a suitably qualified person that the capping system (on RA3 waste rock dump) is functional and no migration of contaminants to groundwater has or will occur.
- Certification from a suitably qualified person that the area has achieved a stable condition.

4. LIMITATIONS AND ASSUMPTIONS OF THE LANDFORM DESIGN

Quarrying activities in Pit 1will continue for approximately 40 years until EOML in 2062. Therefore, waste percentages and calculations for available reserve volumes including identifying further reserves, will be updated periodically over the LOM. A detailed mine plan is prepared for Riverton for a five to ten year period, and it is likely that future mine plans and unforeseen mine parameters might delay or change proposed schedules.

Assumptions have been made about these mine parameters including the extent of known reserves, future changes in saleable product quantities and other variables that may impact on operational mine scheduling, and consequently, rehabilitation scheduling, for the purposes of providing the required information for the purpose of the PRC Plan for Riverton Limestone Quarry. It is noted that estimates of the LOM, have been prepared based on the material balance and final landform design. However, if refinements from future calculations will impact when Pit 1 can cease quarrying activities, an amendment to this PRC Plan will occur to ensure consistency with mine planning.

5. MATERIAL BALANCE

The material balance for the current LOM design as of the July 24 survey is shown in table 1. For this exercise a waste quantity for the eastern cut of 22% of the total volume was assumed due to waste contamination in this area. An assumed waste factor of 20% in the remainder of the pit has been used in lieu of a waste 3D model, which has been shown historically to be a realistic figure. It is noted that the actual waste generated over time may vary from that predicted in this model based on geological uncertainty and markets for ore and waste products.

The Northern WRD contains ~600,000m3 of historic waste fill up until July 24.

The mass balance in table 1 shows that the remaining Northern WRD capacity of ~218,000 m3 (assuming 18 degree batters) is required to provide time to create in pit backfill room. Following establishment of in pit backfill room all remaining waste material is backfilled in pit.

Riverton LOM Plan Cut vs Fill Material Balance based on 29 July 24 survey										
Pit Cut Volumes Generated						Waste Rock Dump Capacity				
	Waste factor %	Waste bcm	Swell Factor	Waste lcm	Waste Cum lcm	Northern WRD m3	In Pit S1 m3	In Pit S2 m3	In Pit 1m Base m3	Total m3
Remaining Dump Capacity						217,974	322,205	185,552	46,520	772,251
Dump Capacity Cummulative						217,974	540,179	725,731	772,251	
Dump balance						7,984	19,437	15,231	15,231	
Pit Stage 1 East	22%	161,531	1.3	209,990	209,990	209,990				209,990
Pit Stage 2 West	20%	239,040	1.3	310,752	520,742		310,752			310,752
Pit Stage 3 Remaining	20%	181,752	1.3	236,278	757,020			189,758	46,520	236,278
Totals		**582,323**		**757,020**		**209,990**	**310,752**	**189,758**	**46,520**	**757,020**

Table 1: Riverton Material Balance

6. MATERIAL AVAILABLE FOR LANDFORM REHABILITATION

Material available for landform rehabilitation is overburden from the centre of the pit and waste material from processing of the limestone. Total waste is expected to be in the vicinity of 20 - 30% of the total mined quantity. The approximate waste produced from the site to the end of mine life is shown in table 1.

The eastern end of the Riverton Pit will be backfilled using available residual waste from mining and processing operations and other waste rock that may need to be relocated from existing out of pit dumps.

The Northern WRD will be formed to the desired nominal 18° slopes using truck excavator and dozer push. As the overburden rock in this area will be used to form the final landform, no other additional material is required. Topsoil is considered further in the 'Riverton Topsoil Suitability Assessment (Epic 2023)'.

7. WASTE PLACEMENT STRATEGY

The conceptual LOM quarry and dump staging plan is shown in figures 1 to 3 below.

7.1 PIT STAGE 1 AND NORTHERN WASTE ROCK DUMP

Pit Stage 1 concentrates on the eastern end of the pit to provide a void for placement of in pit backfill. During this stage waste fill will be placed in the Northern WRD as shown in figure 1. It is possible that a small quantity of waste material may be able to be placed in pit prior to completing the stage 1 excavation.

Once the Northern WRD is complete rehabilitation of the dump can commence.

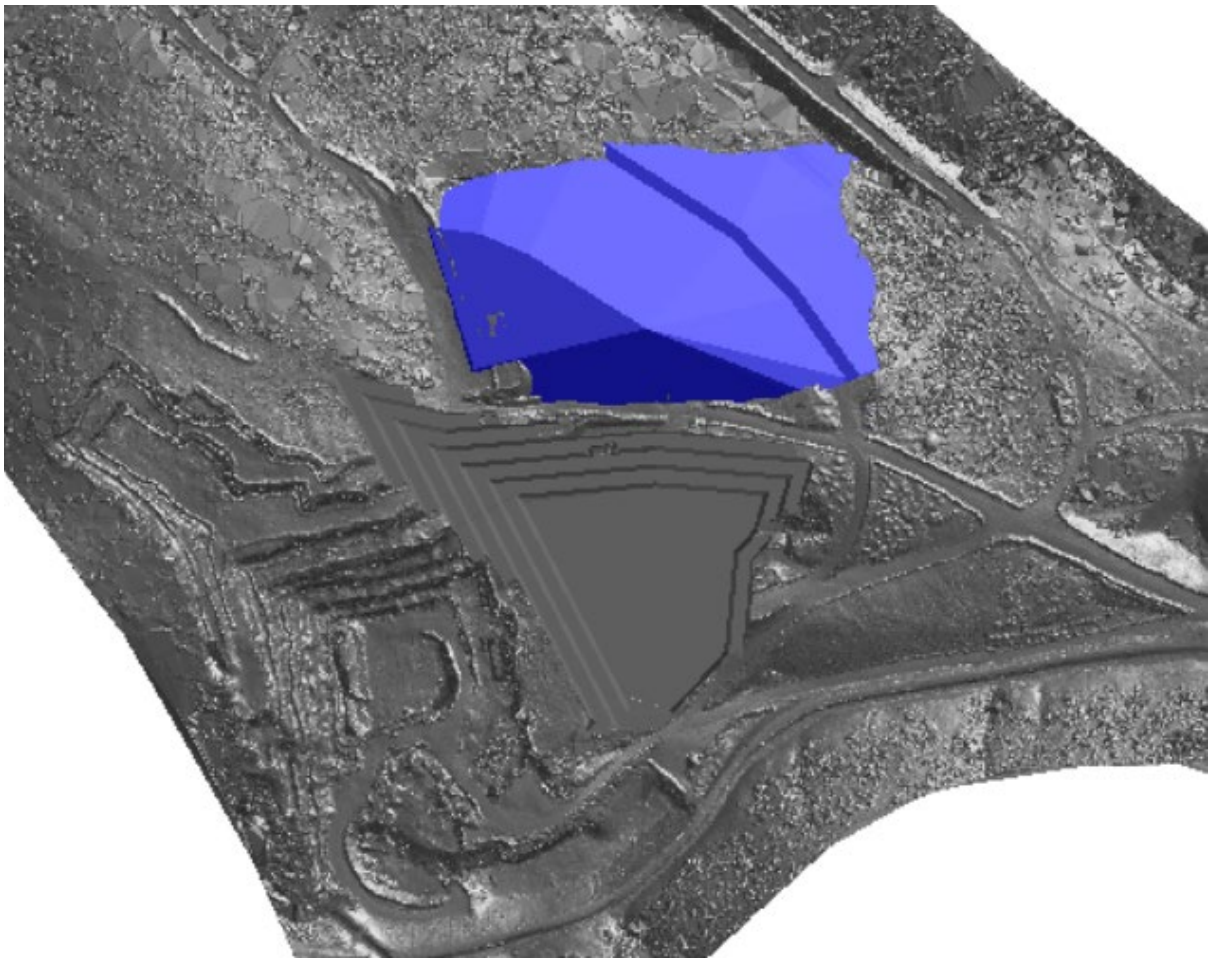

Figure 1. Pit Stage 1 and Northern Waste Rock Dump

7.2 PIT STAGE 2 AND IN PIT BACKFILL STAGE 1

During this stage the remaining material is excavated from the lower levels of the west of the pit below 450mRL. Waste from this stage is placed in the void that was created during Pit Stage 1 as shown in figure 2. Note that depending on final waste quantities it is possible that the quantity of in pit fill will increase resulting in a larger in pit fill dump, however any further dumping will be in accordance with existing geotechnical guidelines.

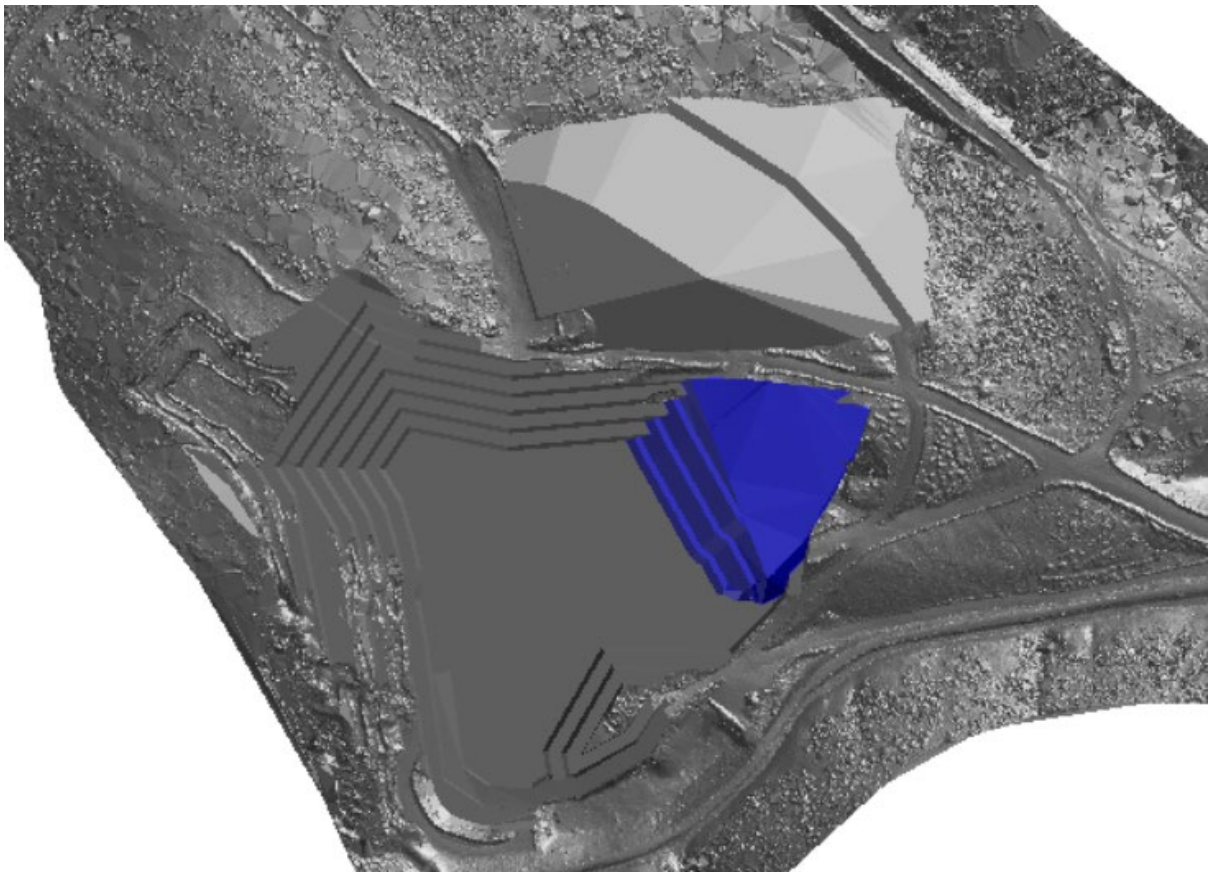

Figure 2. Pit Stage 2 and In Pit Backfill Stage 1

7.3 PIT STAGE 3 AND IN PIT BACKFILL

Pit Stage 3 excavates to the full pit extent removing remaining material from the west of the pit. Waste from this stage is placed in the void that was created during Pit Stages 1 and 2 as shown in figure 3. Note that depending on final waste quantities it is possible that the quantity of in pit fill will increase resulting in a larger in pit fill dump, however any further dumping will be in accordance with existing geotechnical guidelines.

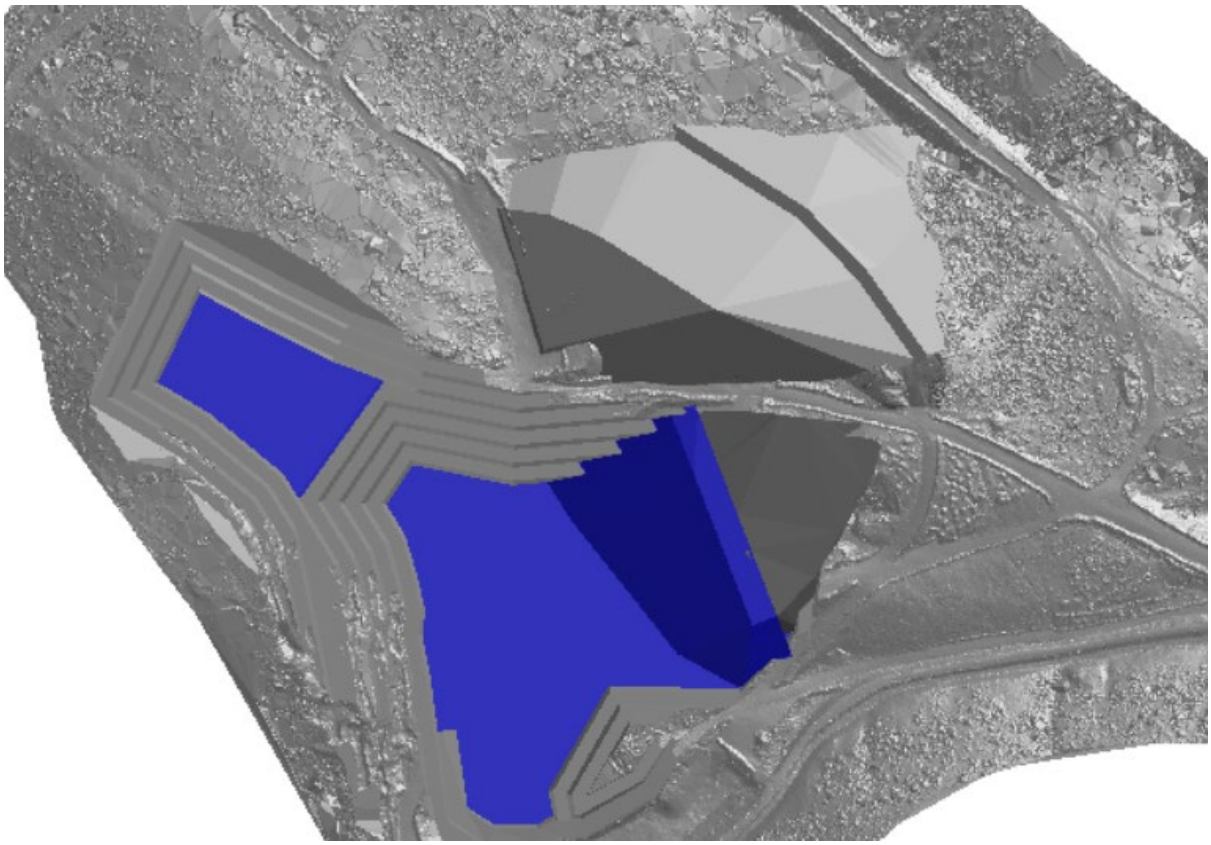

Figure 3. Pit Stage 3 and In Pit Floor Fill

8. FINAL LANDFORM

Figure 4 shows the proposed final landform at closure.

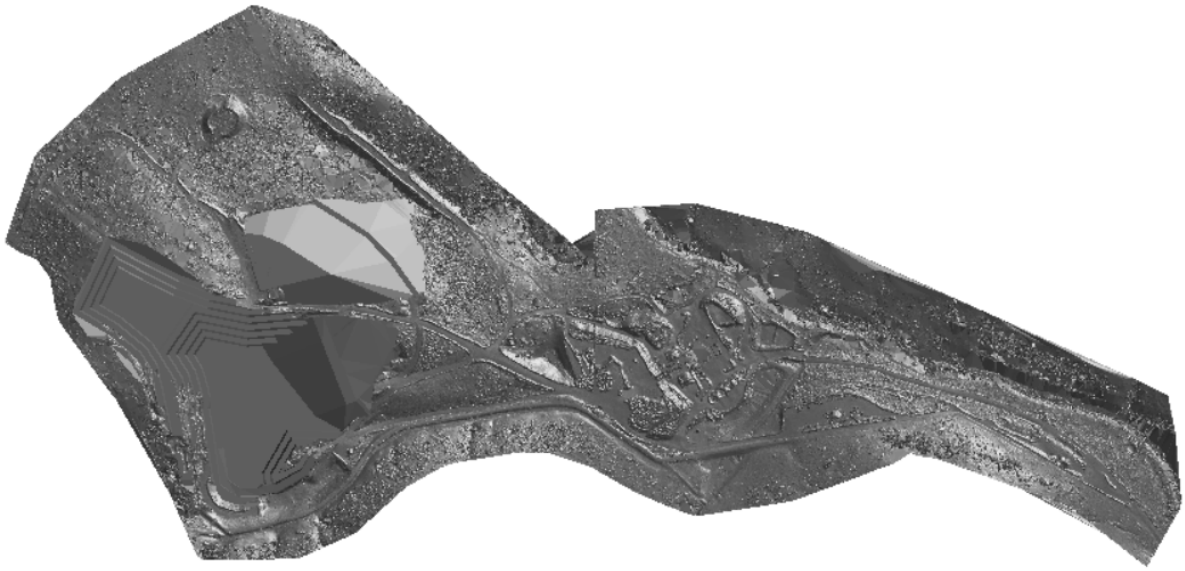

Figure 4. Final Landform

Appendix M Waste Rock Characterisation Assessment and Cover Design (Engeny 2023)

MEMORANDUM

Project:	QC4036_006 / Riverton Quarry Geochemical Assessment and Cover Concept	Date:	1 May 2024
To:	Michael Blyth	From:	Travis Warren (Engeny)
ATT:	QC4046_006-MEM-001-1	CC:	Click or tap here to enter text.
Subject:	Riverton Quarry Geochemical Assessment and Cover Concept		

INTRODUCTION

Engeny Australia Pty Ltd (Engeny) have been engaged by Epic Environmental Pty Ltd (Epic) to undertake an initial assessment of geochemical risk for the waste materials at the Riverton Quarry (the Site) owned and operated by Graymont. The purpose of this assessment is to support the development of a Progressive Rehabilitation and Closure Plan (PRCP) in accordance with the PRCP Guideline (DES 2022).

The site operates under Environmental Authority EPML00241213 (EA) as shown in Figure 1. The site comprises two existing mining leases (MLs) held by Graymont, comprising of ML50142 and ML50220. Mining activities are authorised under Environmental Authority EPML00241213 (the EA held by Graymont (formerly Unimin Lime (NSW) Pty Ltd). The EA authorises the holder to extract between 100,000 and 500,000 tonnes of limestone per year.

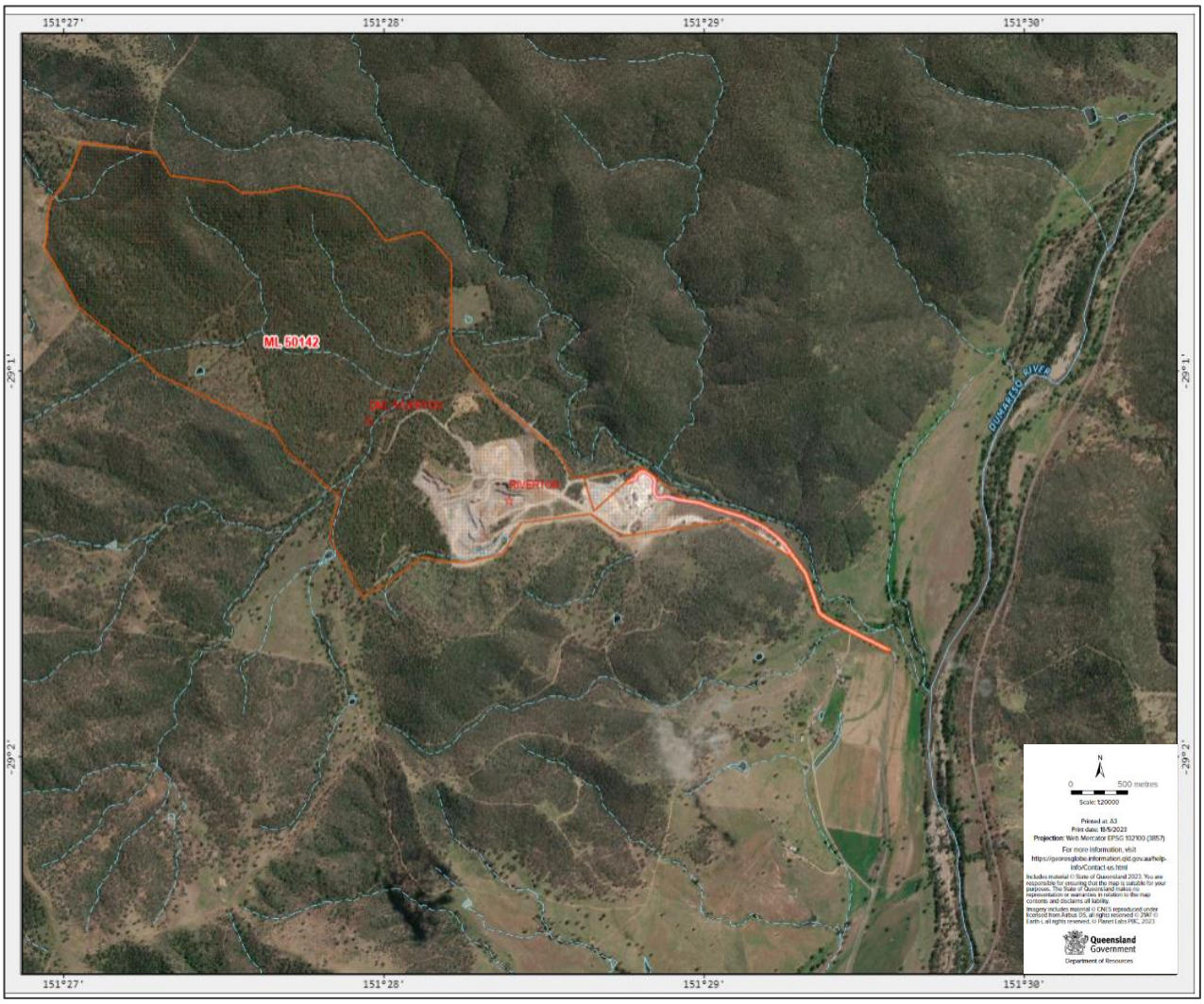

Figure 1: Riverton Quarry General Arrangement Plan

Scope of Work

The scope of works detailed in this document include:

1) Prepare a Technical Memorandum to summarise the available information and provide a preliminary risk assessment of the mine waste, addressing *Section 3.6.1: Waste Characterisation, Cover Design, Guideline Progressive Rehabilitation and Closure Plans, (PRC plans), ESR/2019/4964, Version 3.00, 04 April 2023, QLD Department of Environment and Science, DES*) including:

    a. Assessment of mine waste material:

        i. Summary of geochemical analysis.

        ii. Classify risk profile of mine waste, justification for static/kinetic leach testing.

        iii. Identify potential for acid/metalliferous drainage, neutral mine drainage, saline mine drainage.

    b. Conceptual Cover Design:

        i. Requirement/justification for a cover design for the WRD.

        ii. Nature of capping material required.

        iii. QA/QC requirements for cover design.

A forward works plan, including intrusive works to be undertaken and reporting will be detailed in future amendments of this document. The most critical closure-related selection and cover design considerations relate to:

- Geotechnical and landform surface stability including the design, hydrological and hydrogeological characteristics of the WRDs, final landform and extent of final footprint and post-closure land use.
- Characteristics of the waste rock in terms of acid mine and metalliferous drainage.
- Climate (taking due cognisance of climate change) including rainfall intensities at the site and water balance.
- Materials characterisation (physical and geochemical) and availability (sourcing and inventory) to construct a suitably thick final cover. Other considerations include the attributes of these materials regarding infiltration control, armouring potential and suitability as a revegetation substrate.
- Pollution control through the design and construction of effective and sufficiently thick surface covers and treatments.
- Preliminary trial measures to avoid significant underestimation of the required financial provision, aftercare monitoring and maintenance plan.

Objective

This document details the selection of an appropriate cover design to meet the closure objectives for the Riverton Quarry of Graymont to leave the WRDs, to the extent required by the agreed post-mining land uses (PMLU):

- Safe for future land uses with access to potentially hazardous areas, if any, restricted.
- Stable with regard to failure and erosion with downstream deposition, if any, contained or minimised.
- Non-polluting, with potentially contaminating drainage from the post-mining landform prevented or contained.
- Able to sustain the approved PMLU.

SITE UNDERSTANDING

The site is an open cut limestone/carbonates mine in southeast Queensland, Australia located approximately 230km southwest of Brisbane. The Riverton Mine is at an elevation of approximately 440m above sea level.

Mining operations at Riverton commenced in the 1970s. As such, disturbance at the site pre-dates the requirement to collect baseline information. Consequently, the following sections have been prepared based on a combination of historical (pre-1972) and current available information.

Based on current estimates of limestone resources within the MLs and feasible rates of extraction, the reserves are anticipated to support mining operations for an additional 41 years; extraction operations are expected to cease in 2062. It is noted that the development of the milestones relevant to this PRC Plan are based on the current anticipated mine closure in 2062.

Primary mining features / infrastructure within each MLA include infrastructure areas (including workshops, hardstands supporting prefabricated administration offices, weighbridge), waste rock dumps (WRDs), operational open pit, stormwater management features (including sediment basins, levees) and a topsoil storage area. Further detail on primary mine features present onsite are presented in Table 1.

Mining operations at the Riverton mine comprises conventional open cut benching techniques which are currently carried out on ML 50142 at a rate of approximately 150,000 tonnes per annum (tpa). This results in production of between 100,000 and 115,000 tpa of limestone products used in glass and agriculture markets. The balance of mined material comprises clay, andesite, and clay contaminated limestone, which is removed as waste from the mine, and as scalps which are screened during crushing and screening activities.

Closure Criteria

All mine features are to be rehabilitated to achieve a beneficial use post-closure with the exception of the residual void which has a nominated post-mine land description of terraced mine benches and scree slopes; this description does not lend itself to a beneficial use and is considered a Non-Use Management Area (NUMA). Noting the term NUMA was not in use at the time the approved EA was prepared.

Table 1: Primary Mine Features

Primary Mine Feature	Area (ha)	Rehabilitation Objectives		
		Post-Mine Land Description	**Post-Mine Land Classification**	**Slope Range**
ML50142				
Residual Void	17	Terraced mine benches and scree slopes	viii	Void wall competent rock max slope 70° Void wall incompetent rock max slope 37°
Clay waste 'topsoil' stockpile	2	Fauna habitat	viii	7° to 9°
Waste rock dump	13	Fauna habitat	viii	16° to 20°
Infrastructure areas	12.5	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners agreement	viii	3° to 4°
Roads and tracks	5	Bitumen and unsealed roads for site access	Access	N/A
ML50220				
Clay waste 'topsoil' stockpile	0.2	Fauna habitat	viii	<18°

Infrastructure areas	1.7	Flat to sloping areas with hard stand areas ripped following removal of plant and buildings in accordance with landowners agreement	viii	<18°
Sediment pond	0.3	Water supply in accordance with landowners agreement	Pond	N/A
Roads and tracks	0.3	Bitumen and unsealed roads for site access	Access	N/A

Post Mining Landuse

As part of the assessment of PMLU options, it is acknowledged that land will need to be rehabilitated to a stable condition in accordance with s111A of the EP Act:

Land is in a stable condition if –

- The land is safe and structurally stable, and
- There is no environmental harm being caused by anything on or in the land, and
- The land can sustain a PMLU.

The *Environmental Protection Regulation 2019 (EP Regulation)* further states that each PMLU –

- Is viable, having regard to the use of land in the surrounding region, and
- Satisfies at least one of the following –
  - The use is consistent with how the land was used before a mining activity was carried out on the land.
  - The use is consistent with a development approval relating to the land.
  - The use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016.
  - The use will deliver, or is aimed at delivering, a beneficial environmental outcome.

The proposed PMLU (grazing) for the majority of site including the waste rock dumps (WRD) is considered appropriate as the pre-mining land use is understood to have been grazing. The surrounding land is also dedicated to light grazing and fauna habitat, meaning this proposed PMLU will be consistent with surrounding land uses. The return of the site to light grazing and fauna habitat land will ultimately provide a beneficial environmental outcome.

Climate

The Riverton Quarry (Location: 29.02°S, 151.47°E; Zone 50J, 351,182.75mE, 6,788,570.11mS, Elevation 461mAHD) has a humid subtropical climate with mean minimum and mean maximum temperatures at 11.5°C and 26.9°C respectively. As shown in Table 2 the mean annual rainfall at Texas (Location: 29.06°S, 151.49°E, Elevation 378mAHD) some 36km north-west averages 658.9mm. The highest daily rainfall varies between 51mm and 171mm with the mean annual days with rainfall greater than 25mm at almost 6 days. The mean annual evaporation is 1,752mm at Pindari Dam (29.39°S, 151.24°E 42km south-east of Riverton) i.e. at 2.7 times the annual precipitation.

Table 2: Climate Statistics

Site Name/Number: Pindari Dam 054104 (1971 - 2023)	**Latitude:** 29.39° S		**Longitude:** 151.24° E		**Elevation:** 462 m		42km south-east of Riverton					
Rainfall	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Mean Rainfall (mm)	91.2	76.2	69.3	44.7	42.5	38.7	41.7	37.3	48.1	64.9	85	89.6	730.7
Highest Rainfall (mm)	283.7	248.8	235.2	216.4	169.6	108.6	152.2	100.2	156	175.8	245.6	186.4	1,163
Date	1978	1976	1975	1988	1983	1981	1998	2016	2016	1975	2000	2004	1978
Lowest Rainfall (mm)	10.4	12.4	1.1	0	0.8	0	1.8	0	0	8.4	3	5.8	234.8
Date	2005	1974	2008	1991	2018	1986	2002	1995	2019	2014	1982	1979	2019
Highest Daily Rainfall (mm)	150	160	83	72.4	73.6	81.6	53.4	52.6	92.6	78.4	91	61.6	160
Mean number of days of rain ≥ 25 mm	1.1	0.9	0.8	0.5	0.4	0.4	0.3	0.2	0.4	0.7	0.8	1	7.5
Mean daily evaporation (mm)	7.5	6.8	5.9	4.2	2.7	1.9	2.1	2.9	4.2	5.5	6.5	7.2	4.8
Site Name/Number: Texas PO 041100 (1969 - 2023)	**Latitude:** 28.85° S		**Longitude:** 151.17° E		**Elevation:** 295 m		36km north-west of Riverton					
Mean Maximum Temperature (°C)	33.9	32.7	31.1	27.4	22.9	19.4	18.8	20.9	24.5	28	30.5	32.8	26.9
Mean Minimum Temperature (°C)	18.8	18.3	16.1	11.9	8.1	4.7	3.8	4.6	7.9	11.9	15	17.4	11.5
Mean Rainfall (mm)	88.3	75.2	58.2	34.1	39.4	40.4	41.2	33.7	39.8	61.1	67.2	80.3	658.9
Highest Rainfall (mm)	367.6	299.2	348.7	261.8	151.4	156.1	154.7	130.6	196.6	199	187.5	228.6	1143
Date	1996	1956	1890	1988	1996	1921	1950	1966	1970	1949	1969	1970	2021
Lowest Rainfall (mm)	6.1	0	0	0	0	0	0	0	0	1.8	0	0	163.2
Date	1952	1989	1938	1993	1975	1986	1970	1959	1928	1945	1926	1941	2019
Highest Daily Rainfall (mm)	161.8	171	95.6	61	58.6	83.2	70.1	51	70.4	94.7	70.4	100.6	171
Date	1956	1976	2021	1964	2009	1981	1920	1974	2004	1954	1966	2009	1976
Mean number of days of rain	7.3	6.3	5.6	3.7	4.5	5.7	6	5.3	5	6.7	7.1	7.9	71.1
Mean number of days of rain ≥ 25 mm	0.9	0.7	0.6	0.3	0.4	0.3	0.3	0.2	0.3	0.5	0.6	0.8	5.9

The Cumulative Rainfall Departure (CRD) curve shown in Figure 2 illustrates that average rainfall displays an upward trend since the mid 1950's. The CRD is a concept used to characterise rainfall trends. It is calculated by determining the mean of the rainfall for the period in question, subtracting the mean from each data point to determine the departure from the mean, and accumulating the resulting departures. Therefore, it is shown that the site has been having above average rainfall since the mid 1950's.

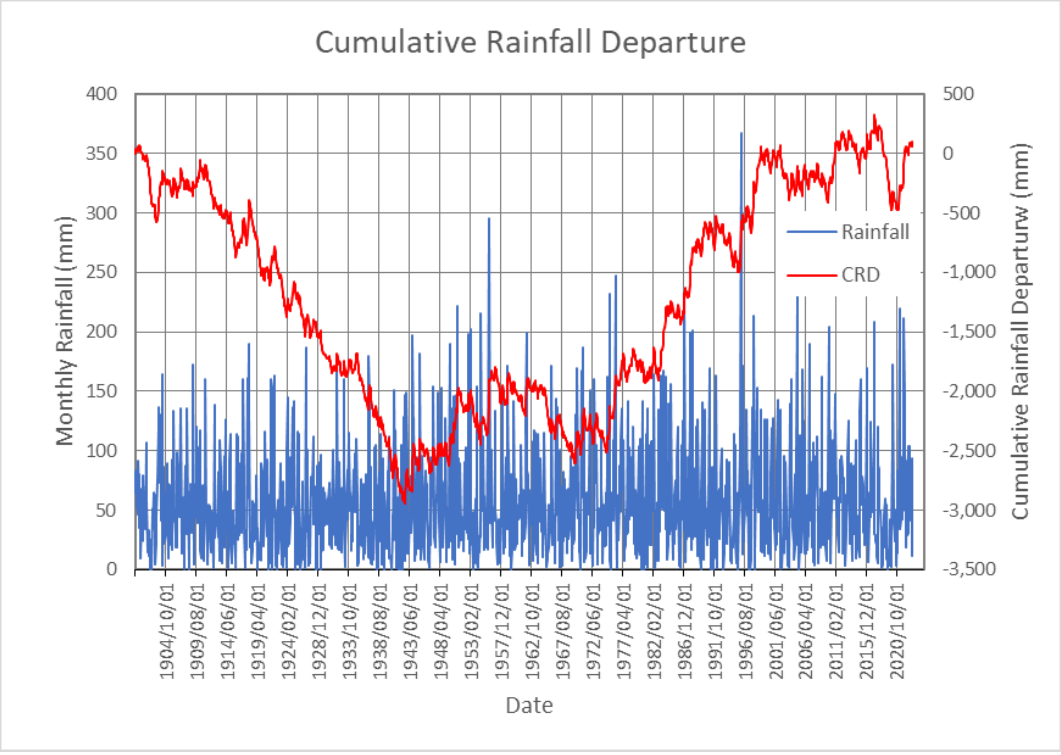

Figure 2: Cumulative Rainfall Departure

Groundwater level data is not available to corelate the CRD to groundwater levels to understand the interaction between surface water and groundwater in the project area.

According to the Bureau of Meteorology (Figure 3), the Riverton Quarry falls in a warm summer cold winter climate zone; it should be noted that the site is close to the hot dry summer and cold winter zone.

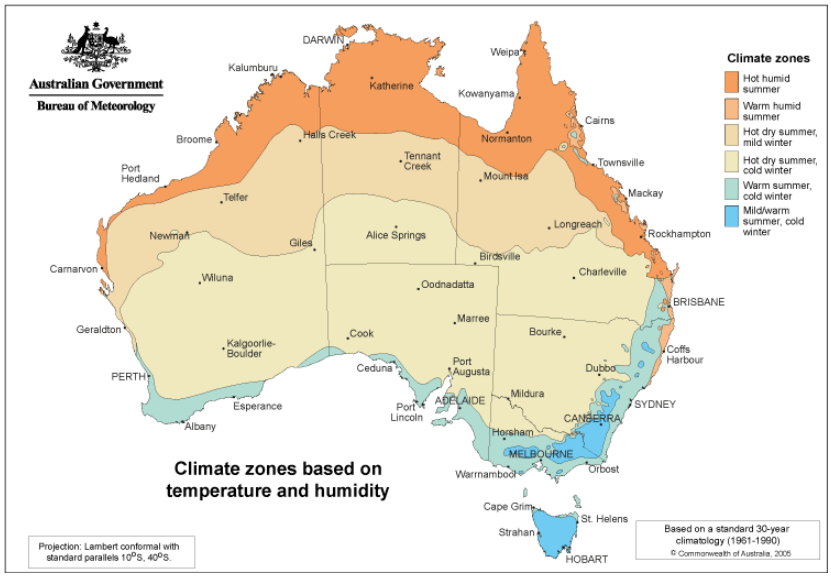

Figure 3: Climate Zones based on Temperature and Humidity (BoM, 2023)

The Köppen climate classification indicates the Riverton Quarry falls within the Cfa humid subtropical climate characterise by temperate climates (Figure 4). Once again, the site is borderline with the Cfb temperate oceanic climate or subtropical highland climate.

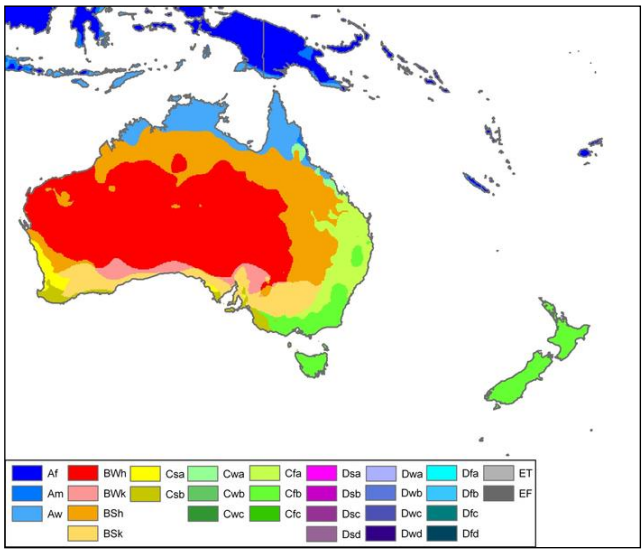

Figure 4: Australia-Oceania Köppen Map

Climate Change

Available information on climate change projections includes (Climate Change in Queensland, Version 1, https://www.qld.gov.au/__data/assets/pdf_file/0023/67631/seq-climate-change-impact-summary.pdf)

- higher temperatures, hotter and more frequent hot days, and consequently higher evaporation,
- harsher fire weather,
- fewer frosts,
- reduced rainfall in the south-east,
- more intense downpours and less frequent but more intense tropical cyclones in the north, and
- rising sea level coupled with more frequent sea-level extremes and warmer and more acidic seas.

The impacts of this projected climate change include:

- The mix and variability of forage species may change, and increased temperatures and carbon dioxide concentrations could reduce digestibility and protein content.

- The likelihood and intensity of wildfire may increase.
- More-intense tropical cyclones may increase the risks of soil erosion and infrastructure damage.
- The threats associated with climate change may impact the implementation, success and long-term sustainability of rehabilitation, particularly with regard to flooding and erosion and selection of cover types to control risks of acid, saline and neutral mine drainage.

Surrounding land-use

Surrounding land-use is dominated by self-sustaining native vegetation, with minor cattle and sheep grazing, with forestry land located proximate to site (QG, 2023). Specifically, the immediately surrounding land comprises of:

- **North** – the north of site is bound by medium to high density native vegetation.
- **South** – the south of site is bound by light to medium density native vegetation, with agricultural land (pasture) located to the south-west of site.
- **East** – the immediate east of site comprises native vegetation, beyond which lies agricultural land (pasture/cropping) and the Riverton Road easement and Dumaresq River. Primary site access is to the east.
- **West** – the west of site is bound by medium to high density native vegetation.

The project and surrounding areas are also zoned as rural under the Goondiwindi Regional Council Planning Scheme 2014 (GRC, 2014) and Southern Downs Regional Council Planning Scheme 2018 mapping (SDRC, 2023).

Landscape and Topography

The topography of the area is steep to undulating, and the site is protected by foothills from the low-lying Dumaresq River and is surrounded by a 600 mAHD ridgeline in the north, south and west.

The site is naturally undulating with steeper grades evident across areas subjected to mining activities; elevation at the site ranges from 360 metres Australian Height Datum (mAHD) to 490 mAHD as shown in Figure 5. It falls gently to the east to the Dumaresq River, running north to south adjacent to the site. Glenlyon Dam is located 5 km north of the site, and confluences with Dumaresq River upstream of the site, via Pike Creek.

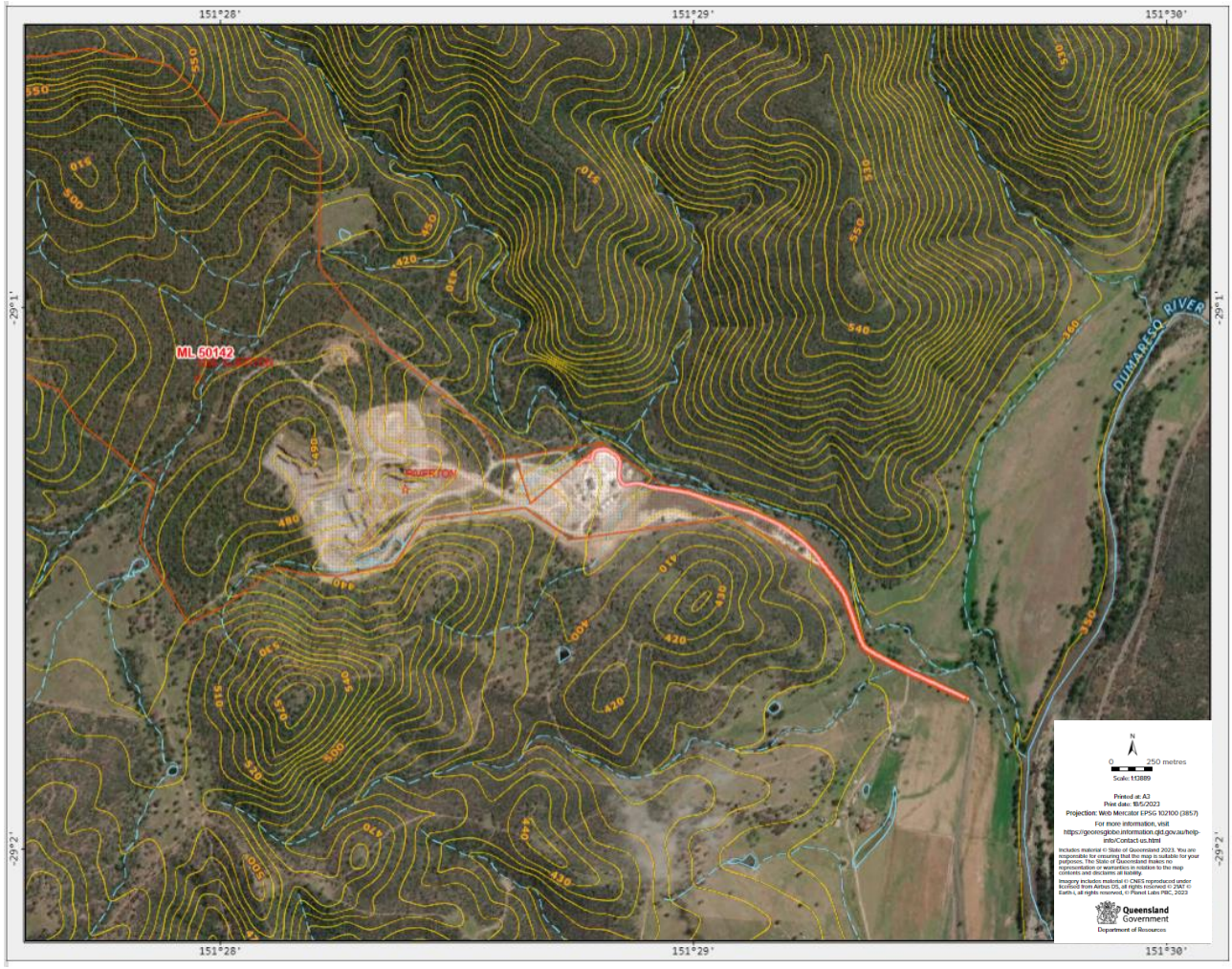

Figure 5: Site Topography

Surface Drainage

Regionally, the site is located within the the Border Rivers catchment, one of the northern-most catchments of the Murray-Darling Basin (Murray Darling Basin Authority (MDBA) 2021). The Border Rivers catchment drains an area of approximately 23,819.8 square kilometres (km^2) across Queensland and New South Wales (BoM 2021d). The catchment's Macintyre, Dumaresq and Barwon rivers rise on the western slopes of the Great Dividing Range and run westward, gradually merging with each other to become the Barwon River on the floodplains upstream from Mungindi (MDBA 2021).

The site is located within the southern extent of the Dumaresq River sub-basin, comprising an area of 4,312.0 km^2 (QG 2021b; QG 2021e). The Dumaresq River receives flows from the Severn River, Pike Creek and Mole River, and forms the border between the states of Queensland and New South Wales at this location (QG 2021d).

Review of the Queensland waterways under the *Water Act 2000* (viewed in Queensland Globe) indicates a first order waterway adjacent the sediment basins onsite and 2nd order waterway north of the site, as shown in Figure 6Error! Reference source not found.. The watercourses drain to the Dumaresq River to the east of the site which is a stream order 7 watercourse.

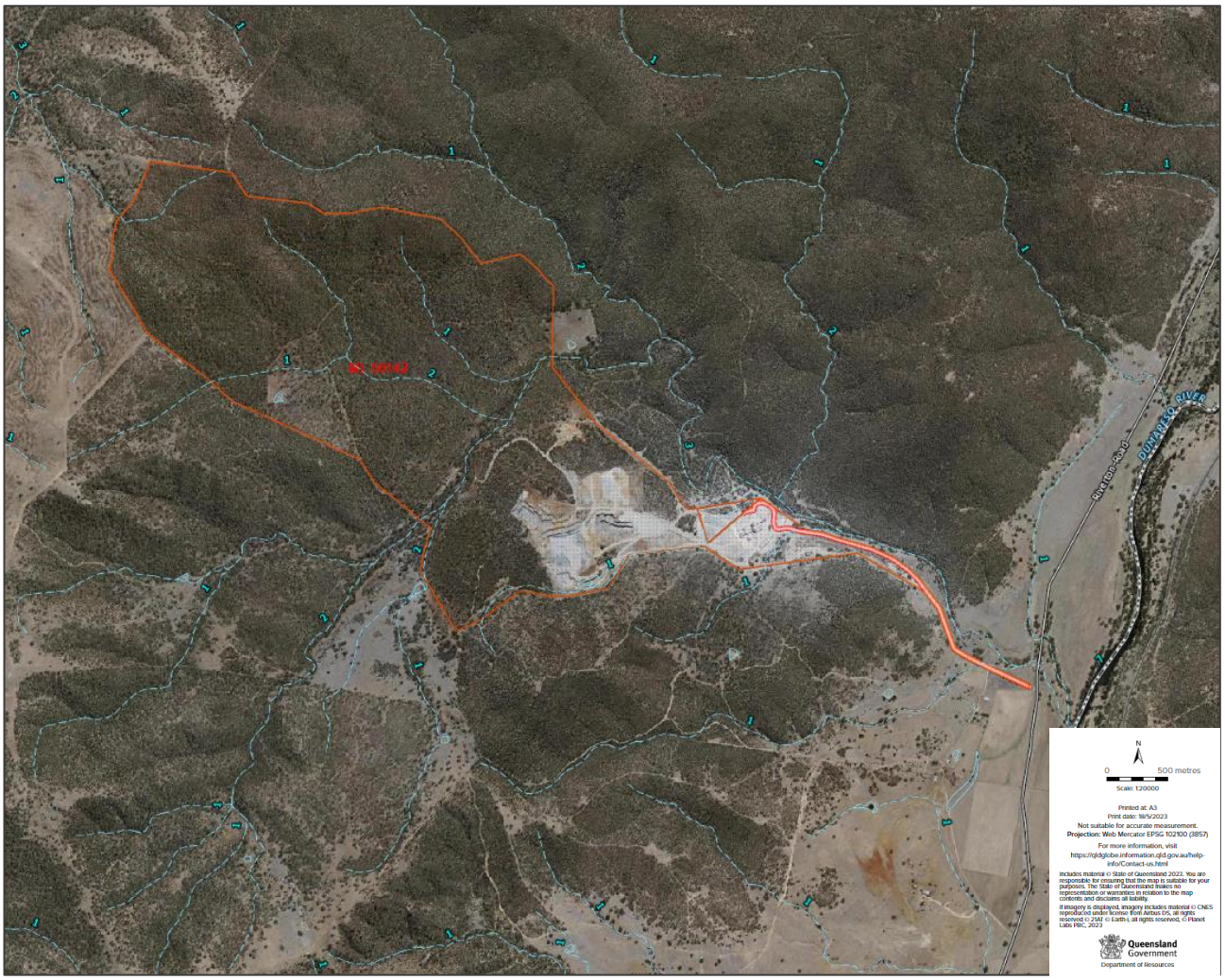

Figure 6: Watercourse and Drainage Features

The intermittent water course that drains in a south-east direction across the site is fed by a series of drainage lines traversing the MLs. Of these drainage lines, it has been identified that a total of 11 local catchments, covering an area of 136 ha, have a direct impact on the extraction and processing activities on the site. Approximately 89 percent (269 ha) of the area drains to the Dumaresq River, located 1.5 km to the east of the processing plant, and the remaining 9 percent (33 ha) drains north to the Glenlyon Dam catchment area.

Flood Risk

The site is not within the flood warning area, and it is not located within a floodplain or flood hazard area under the Goondiwindi Regional Council Planning Scheme or Southern Downs Regional Council mapping (GRC 2014; SDRC 2021). The site is located adjacent to areas that can be affected by major floods. BoM operate a flood warning system for the MacIntyre and Weir Rivers using rainfall and river stage observations (BoM 2021d).

Review of Flood Check Queensland (DoR 2023) indicates the project area has not undergone historical flooding as shown in Figure 7

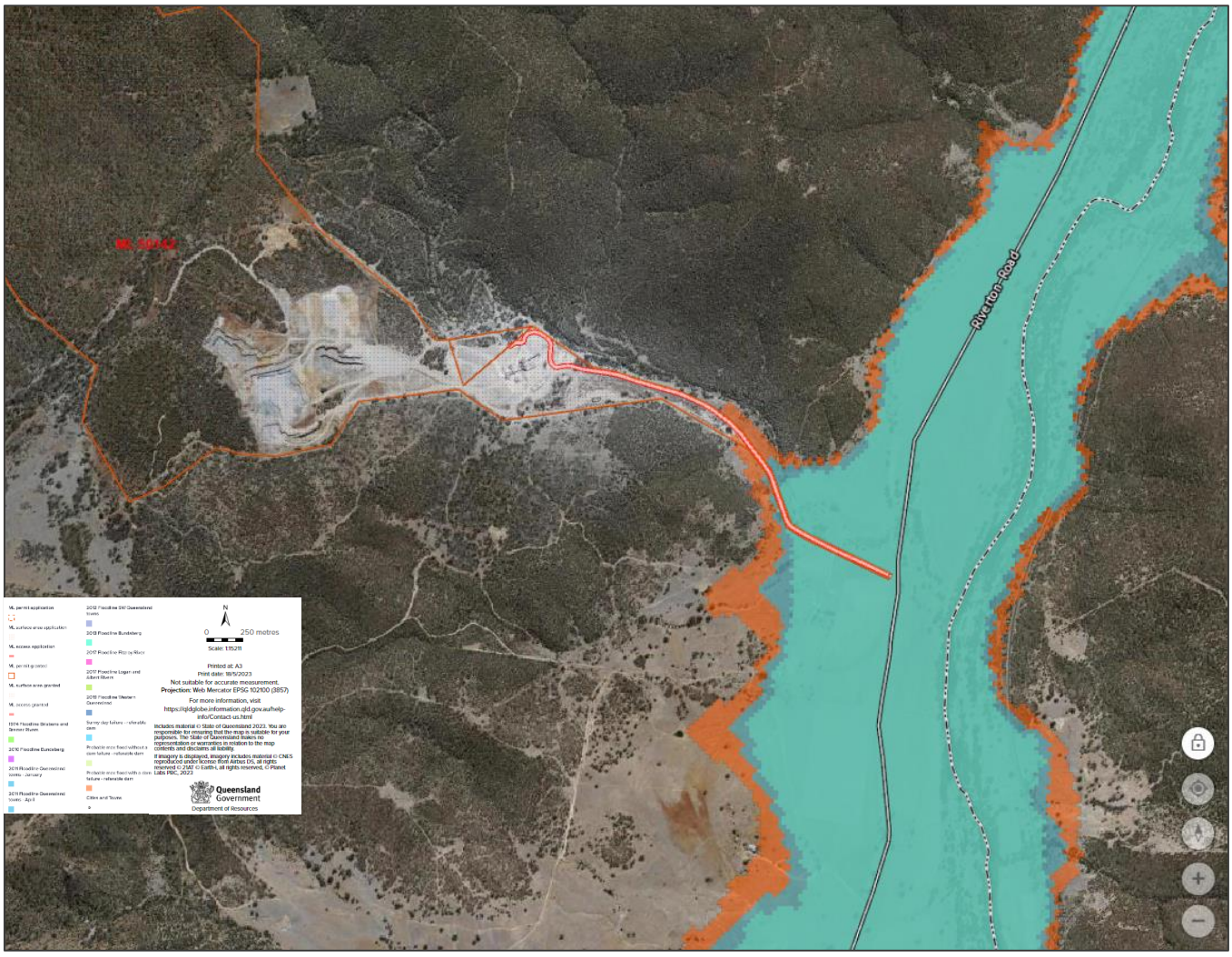

Figure 7: Historical Flood Levels

Hydrogeological Setting

There is a low confidence for terrestrial Groundwater Dependent Ecosystems (GDE) at the site. The occurrence and presence of subterranean GDEs and potential GDE aquifers are illustrated in Figure 8.

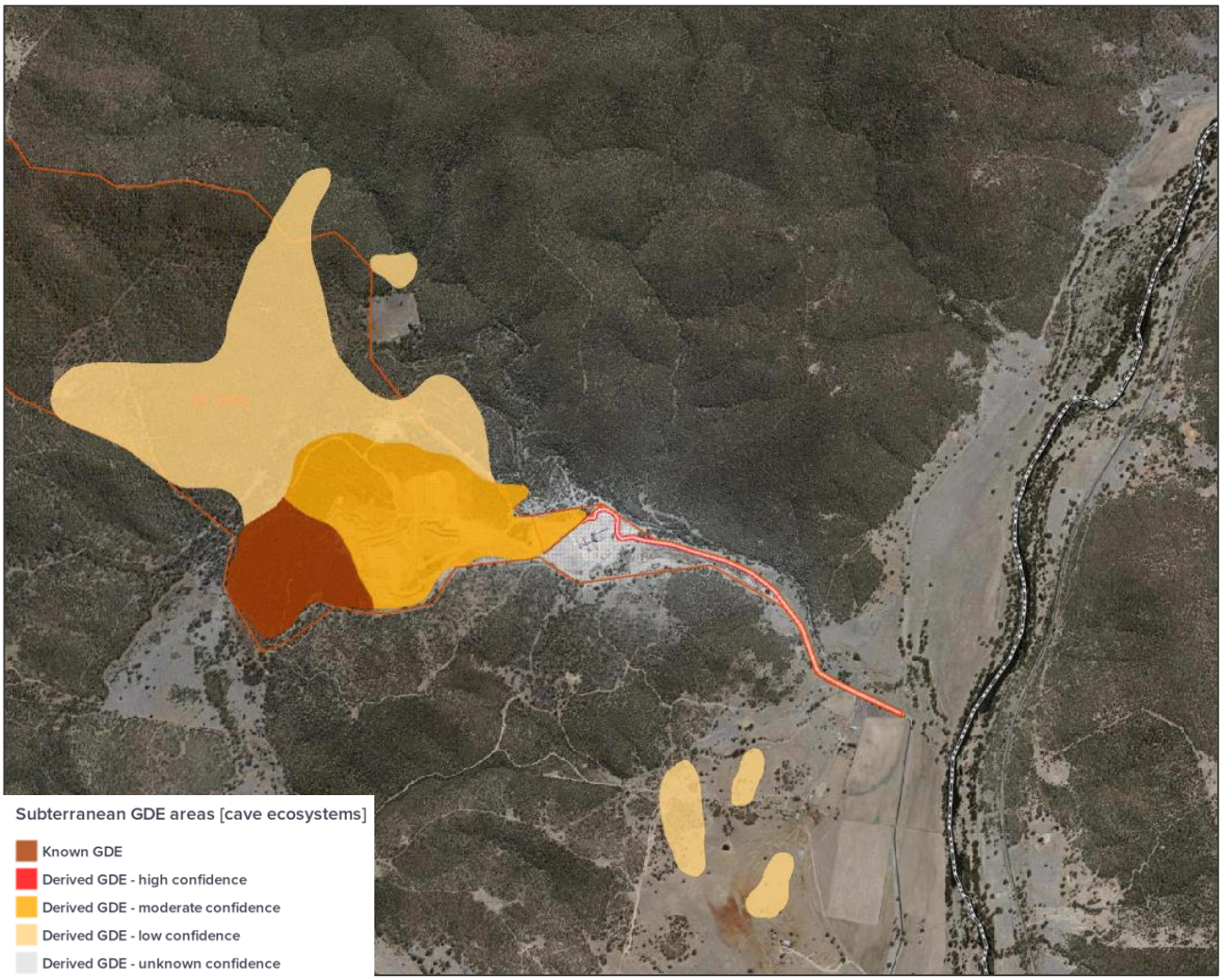

Figure 8: Groundwater Dependent Ecosystems

The Riverton Quarry is underlain by Texas Beds (Ctxl and Ctx) with river alluvium along the course of the Dumaresq River. There is one registered bore at the site (RN77426). The Bore Report shown it is an existing bore drilled in 2004 to 3m with a 125mm plastic casing. Whilst there are several bores in the floodplain of the river, they have no bearing on the occurrence and movement of groundwater at the site.

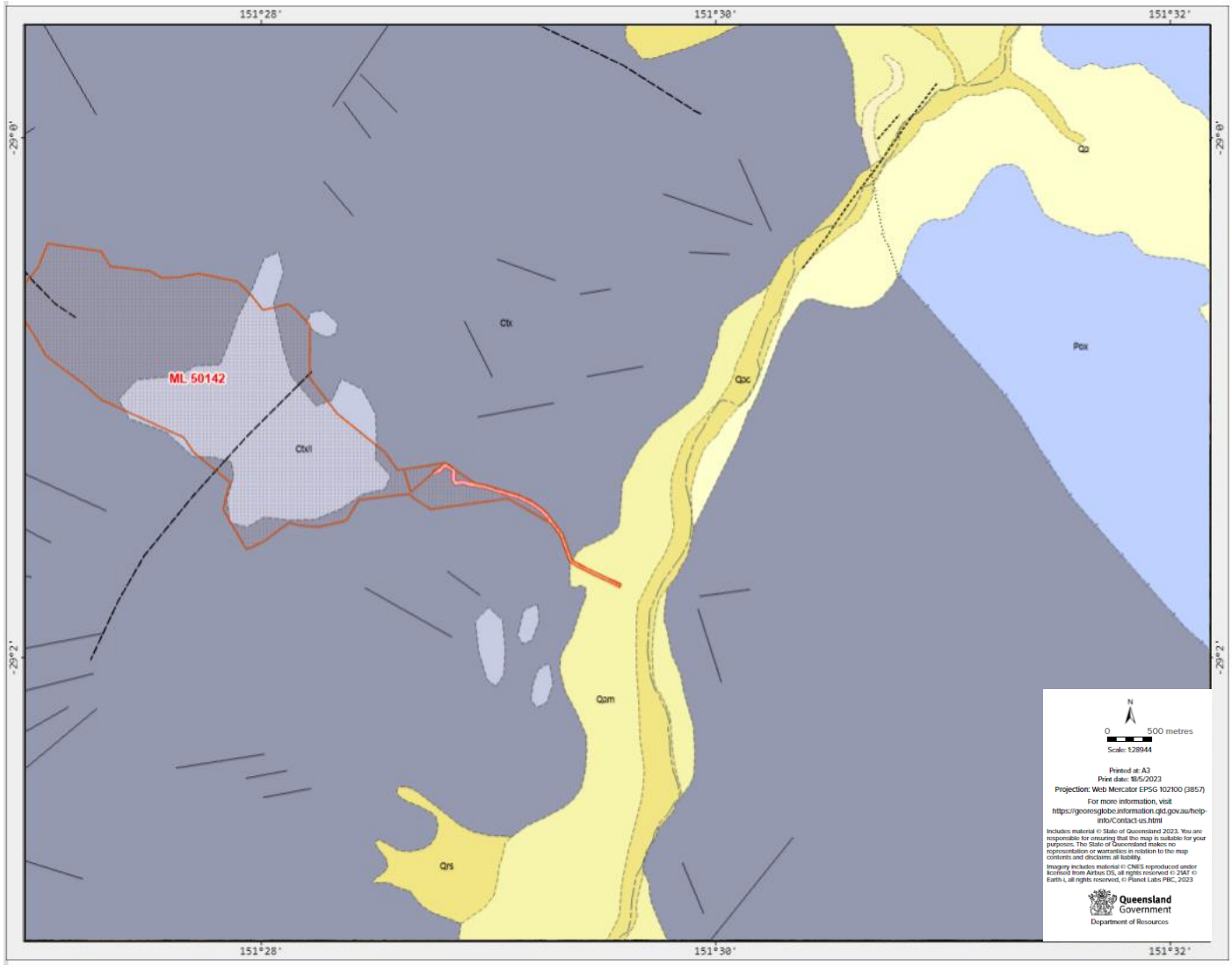

Figure 9: Geological Map

Sedimentary limestone is the dominant rock on the site and forms part of the geological unit referred to as the Texas Beds. The Texas Beds are described as greywacke, conglomerate, siltstone, mudstone, slate, local phyllite, chert, basalt, limestone and rare tuff; low grade regionally metamorphosed, variably deformed (Geoscience Australia). It is most likely that substantial weathering (soil profile) is either absent or thin with bedrock outcrops and that groundwater will occur in fractured rock at depth.

Limestone is a sedimentary rock with the chemical composition of calcium carbonate or $CaCO_3$. The deposits within ML 50142 at Riverton are massive, near vertical and associated with clays and andesitic rocks together with surrounding sandstones and mudstones (Sibelco Lime 2016).

Regional groundwater is reported to be below 387 mAHD (Rocktest 2020). On the basis the lowest elevation of the final waste rock dump and mining pit is 414 mAHD and 425 mAHD respectively. Aquifer yields are likely to be moderate to large given the karstic nature of the hydrogeological regime. Groundwater quality is likely to be dominated by calcium-magnesium-bicarbonate with circum-neutral to alkaline pH and low total dissolved solids concentration.

Therefore, management measures to protect groundwater values are not considered necessary as part of the rehabilitation strategy, and the nature of material underlying the site it is not currently considered that groundwater is at risk of vertical infiltration of surficial contaminants resulting from mining operations.

Soils

The deposit of limestone at the site lies within the Texas Beds geological unit, comprising a sequence of limestone, mudstones, sandstone, and andesitic rocks which are thought to be Upper Devonian to Upper Carboniferous. The soils onsite are described as hard neutral and yellow mottled soils with shallow, gravelly loams and shallow, gravelly texture contrast soils by the Atlas of Australian Soils (SLR Consulting 2019; Isbell 2002). The land Capability Classification for the site is generally rated as Class VI to VII, indicating that the soil has excessive limitations that restrict use to marginal pasture (low stock rates), woodlands or wildlife.

With regards to potential acid sulfate soils, it is noted that acid sulfate soils typically occur in areas of elevation below 20 m AHD, particularly in coastal areas. Queensland Globe mapping shows that acid sulfate soils are not applicable to the Project area, with elevation of the site reported well above the range of acid sulfate soils.

CHARACTERISATION OF W ASTE ROCK AND SOILS

Waste Characterisation

The site is an operating limestone quarry, with approximately 610,000m^3 of waste rock stockpiled in two WRDs (550,000m^3 and 60,000m^3) across 8 ha. An earlier waste characterisation (SESL Australia Environment and Soil Sciences, 2021: Mining Spoil Characterisation Riverton Dump) included 5 representative composite samples (from the main dump) and 3 representative composite samples (from the smaller eastern dump). XRD and XRF analysis, undertaken on the 8 samples, did not identify acid-generating materials.

The mining overburden is considered relatively homogenous, comprised of shale clay and crushed limestone (SESL, 2021). As per the PRCP Guideline requirements the material must be chemically and physically characterised to identify potential environmental risks regarding the potential for migration of acidic metalliferous leachates from the waste rock and the potential for dispersion of the exposed soil materials; hence the objectives of this assessment were to (SESL, 2021):

- Characterise the mineralogy of the material to identify whether the presence of sulfide bearing ores such as pyrite are present in the waste rock.
- Identify whether the waste rock contains heavy metals with the potential to cause harm to environmental receptors.
- Identify the amelioration requirements of the site-won clay soil for revegetation with (i) pasture and (ii) for native fauna habitat.

Following sampling, the following laboratory analyses (Table 3) were undertaken:

- Identification of minerals present using X-Ray Diffraction (XRD; Table 4).
- Total element analysis using X-Ray Fluorescence (XRF) methodology (Table 5).
- Soil chemistry:
  - pH and Electrical Conductivity.
  - Effective Cation Exchange Capacity.
  - Major plant nutrients (N, P, K, Ca, S) and trace nutrients (Mg, Fe, Cu, Zn, B, Mn).
  - Total organic matter and Total Organic Carbon.
  - Texture, structure and estimated permeability.

Table 3: Sample Summary

Analysis	Main Dump	East Dump
XRF and XRD	5 composite samples 1 andesite sample	3 composite samples
Full Soil Chemistry	3 clay samples	-

Table 4: Summary of XRD Results

Sample ID	Dump ID	Minerals
Andesite Sample1	Main	• Extrusive volcanic rock. • Intermediate composition, relatively fine grained. • The abundance of quartz and plagioclase (albite) helps to define it as an andesite, though the relative absence of mafic minerals such as amphiboles and particularly pyroxenes place it on the felsic end of the spectrum.
SESL_WDS1	Main	• Calcite rocks. • Fine-grained soil material, contains the white clay mineral kaolinite; orange-red colour is due to iron oxides.
SESL_ WDS2	Main	• Calcite rocks.
SESL_ WDS3	Main	

SESL_ WDS4	Main	• Calcite rocks. • Fine-grained soil material, contains the white clay mineral kaolinite; orange-red colour is due to iron oxides.
SESL_ WDS5	Main	• Calcite rocks
SESL_OD2_Waste1	Eastern	
SESL_ OD2_Waste2	Eastern	
SESL_ OD2_Waste3	Eastern	

The XRD analyses above did not identify acid generating materials upon weathering and therefore does not pose a risk to environmental receptors (SESL, 2021).

Table 5: Summary of XRF Results

Analyte	Minimum	Maximum	Average	Average Crustal Abundance
Major Ions/Nutrients				
Ca	7,060	376,800	148,602	41,000
Cl	320	734	531	500
K	335	24,000	9,571	21,000
P	813	5,000	2,817	1,000
S	241	933	530	700
Heavy Metals and Metalloids				
Ag	15	20	17	0.07
As	4	5	5	6
Bi	15	17	16	0.05
Cd	21	28	24	0.11
Co	15	187	111	8
Cr	13	241	84	70
Cu	9	58	29	50
Fe	22	71,200	31,601	40,000
Hg	3	5	3	0.06
Mn	8	5,862	1,420	1,000
Mo	4	13	6	2
Ni	17	163	68	50
Pb	4	34	13	35
Rb	1	96	36	120
Sb	25	35	30	5
Se	1	3	2	0.4
Sn	29	40	35	4
Sr	21	161	77	250
Th	4	14	8	12

Analyte	Minimum	Maximum	Average	Average Crustal Abundance
Ti	12	10,600	4,190	6,200
U	5	8	6	2
V	4	148	57	90
Y	1	55	24	30
Zn	3	347	105	90
Zr	3	197	97	250
Note: all concentrations are in mg/kg.				

The XRF analyses indicate that:

- Calcium and phosphate are present in average concentrations well above their average crustal abundance concentrations whilst chloride is present in an average concentration at its average crustal abundance concentration.
- Sulfur is present in an average concentration well below its average crustal abundance concentration and when converted, the average concentrations vary between 0.02% and 0.09% which is well below the trigger value for potential acidity at 0.30%.
- SESL concluded that the *XRF analysis indicates low concentrations of heavy metals. Metals of primary concern (arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn)) are negligible and presents very minimal risk of environmental contamination.*

However, when compared to their average crustal abundance concentrations, several heavy metals and metalloids of concern, including Cd, Co, Cr, Hg, Ni, Se and U are present in average concentrations exceeding their average crustal abundance concentrations.

By using the Geochemical Abundance Index (GAI), a measure of enrichment of elements in whole rock samples and which compares the actual concentration of an element in a sample with the median abundance for that element, to provide an indication of any elemental enrichments that may be of environmental importance, calculated by:

- GAI = log2[C/(1.5*S)] (truncated to integer increments through 0 to 6).
- where C is the concentration of the element in the sample and S is the median content for that element in the reference material.

It is apparent that Cd, Co and Hg have GAI values of 3 or above, which is considered significant and such an enrichment may warrant further examination. In the absence of total metal and leachable metal analyses it is not possible to assess the significance of these apparent enrichment.

Whilst the characterisation of waste rock to date indicates a low risk for acid mine drainage there is uncertainty with regard to the likely physical behaviour and chemical reactivity of the materials under the conditions in which they would be stored. The current waste characterisation does not adequately address the constituent elements present, and their likely future speciation and mobility and particularly lack detailed identification of any contaminants that pose a risk to the environment with regard to potential neutral and saline mine drainage. As such the current report did not achieve the following desirable outcomes (DES, 2023):

- Demonstrate that the sampling regime meets best practice standards, is spatially representative of all waste materials and representative of all lithologies.
- Generally, with a volume of waste at 610,000 m^3, between 8 and 26 samples are required with the lower number if the waste stockpile is completely homogenous with little if any variation in physical appearance and geochemical characteristics. More often a larger number will be required to ensure statistical justification of the analytical results. To date 8 composite samples have been obtained without detailed information and/or descriptions to demonstrate homogeneity to justify the number of samples taken. In addition, the samples must be analysed for the full spectrum of analytes (Table 8) to facilitate a detailed assessment of the physical and geochemical characteristics and metalliferous drainage potential of the wastes.
- Be capable of confidently classifying mine waste streams based on environmental risk and managements requirements.

- Provide recommendations for the management and mitigation of waste streams to manage environmental risk and achieve appropriate rehabilitation methods and objectives.

Soils Assessment

Chemical characterisation of the clay-textured soil samples indicated that the soils are alkaline (pH range between 8.16 and 8.53). SESL indicated that for rehabilitation purposes, only lime tolerant species must be chosen, as this soil chemistry parameter cannot be quickly or easily altered and recommended that a green manure crop be sown first to build up organic matter. SESL indicated that grain barley is tolerant of lime and salinity and is a suitable winter, green manure crop and should be combined with an inoculated clover for nitrogen-fixation.

SESL further indicated that the soil is grossly deficient in all plant nutrients except calcium and magnesium and whilst trace elements are acceptable, amelioration of the soil should be undertaken as shown in Table 6.

Table 6: Recommended Fertiliser Application Rates

Fertiliser	Application Rate (kg/ha)
Monoammonium phosphate	200
Muriate of potash	400
Magnesium sulphate	400
Iron sulphate	50
Manganese sulphate	25
Zinc sulphate	15
Copper sulphate	10
Sodium tetraborate	10
Fertilisers should be worked in to 100mm prior to sowing. **Seek local knowledge for the best clover or medic for the Riverton area and make sure it is inoculated with the correct Rhizobium. Additional ammonium molybdate should be added to the seed/inoculum mix at the equivalent of 50 grams/ha.**	

Assessment Criteria

There is no simple method to define whether mine waste containing small quantities of sulphur will produce sulphuric acid. Sulphide minerals are variable in their behaviour under oxidising conditions and not all forms will produce sulphuric acid (H2SO4). Instead, a combination of approaches is often applied to more accurately classify mine wastes. These approaches are listed below in order of increasing data requirements (and therefore increased reliability):

- The Analysis Concept only requires data for total sulphur content. Its adoption is based on long term experience of wastes from mine sites in arid and semi-arid conditions across Australia. Experience has shown that waste rock containing very low sulphur contents (less than 0.2% to 0.3%) rarely produces significant amounts of acidic seepage.
- The Ratio Concept compares the relative proportions of acid neutralising minerals (measured by the Acid Neutralising Capacity, (ANC)) to acid generating minerals (measured by the Maximum Potential Acidity, MPA)). Experience has shown that, the risk of generating acidic seepage is generally low when this ratio (the Neutralisation Potential Ratio – NPR) is above a value of 2.
- Acid-Base Accounting in which the calculated value for Net Acid Producing Potential (NAPP) is used to classify the acid generating potential of mine waste. The NAPP calculation represents the balance between the maximum potential acidity (MPA) of a sample, which is derived from the sulfide sulfur content, and the acid neutralising capacity (ANC) of the material, which is determined experimentally. By convention, the NAPP result is expressed in units of kg H2SO4/t sample. If the capacity of the solids to neutralise acid (ANC) exceeds their capacity to generate acid (MPA), then the NAPP of the material is negative. Conversely, if the MPA exceeds the ANC, the NAPP of the material is positive. A NAPP assessment involves a series of analytical tests that include:
  - pH and EC measured on 1:5 w/w water extract. This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

- Total sulfur content is determined by the Leco high temperature combustion method. The total sulfur content is then used to calculate the MPA, which is based on the assumption that the entire sulfur content is present as reactive pyrite. Direct determination of the pyritic sulfur content can provide a more accurate estimate of the MPA.
- By addition of acid to a known weight of sample, then titration with NaOH to determine the amount of residual acid. The ANC measures the capacity of a sample to react with and neutralise acid. The ANC can be further evaluated by slow acid titration to a set endpoint in the Acid Buffering Characteristic Curve (ABCC) test through calculation of the amount of acid consumed and evaluation of the resultant titration curve.
- Calculated from the MPA and ANC results. The NAPP represents the balance between a sample's inherent capacities to generate and neutralise acid. If the MPA is greater than the ANC then the NAPP is positive. If the MPA is less than the ANC then the NAPP is negative.

- Procedures recommended by AMIRA (2002), which take into consideration measured values provided by the Net Acid Generation (NAG) test and calculated NAPP values.
- Kinetic leaching column test data, which provides information for the relative rates of acid generation under controlled laboratory conditions, intended to simulate those within a waste rock stockpile or tailings storage facility.

A sound knowledge of geological and geochemical processes must also be employed in the application of the above methods including consideration of non-pyrite (FeS2) sulphides and non-sulphide minerals that may contribute to acid drainage.

Classification of wastes should be undertaken using procedures recommended by AMIRA (2002) based on NAPP and NAGpH results. However, results will also be compared to the Analysis Concept (total sulphur) and Ratio Concept models by determination of the following:

- Analysis for Total Sulphur (%S).
- Analysis for Sulphate-Sulphur (SO_4-S), quoted as sulphur, not sulphate.
- Analysis for ANC (quoted in kg H_2SO_4/t).
- Calculation of MPA = [(%TS - SO_4-S) * 30.6] kg H_2SO_4/t.
- Calculation of NAPP = [MPA – ANC] kg H_2SO_4/t.
- Analysis for NAG (quoted in kg H_2SO_4/t).
- Analysis for NAGpH.
- Calculation of NPR = ANC/MPA.

This AMIRA approach is more conservative than either the Analysis Concept or the Ratio Concept alone but assumes the absence of barium sulphate sulphur. The AMIRA approach of using NAG testing is particularly useful for PAF-LC materials or where there is very low ANC in the host rock. A combined acid generation classification scheme based on NAPP and NAG determinations is presented in Table 7.

Table 7: Waste Classification Criteria

Primary Geochemical Waste Type Class	NAPP Value kg H_2SO_4/t	NAGpH	Sulfide S Content (%)
Potentially Acid Forming (PAF)	≥10	< 4.5	≥ 0.3%
Potentially Acid Forming – Low Capacity (PAF-LC)	0 to 10	< 4.5	0.16 to 0.3%
Uncertain (UC)	0 to 5	> 4.5	Not important
Uncertain (UC)	-10 to 0	< 4.5	Not important
Non-Acid Forming (NAF)	-100 to 0	> 4.5	Not important
Acid Consuming Materials (AC)	< -100	>4.5	Not important

Table 7 is based on the Guidelines on Managing Acidic and Metalliferous Drainage (DITR 2007) and is in turn based on an earlier classification system included within the AMIRA ARD Test Handbook (AMIRA 2002), which is advocated by the Global Acid Rock Drainage Guidelines (GARD) published by the International Network for Acid Prevention (INAP 2009). This classification system, based on static acid

base accounting procedures and used in conjunction with geological, geochemical, and mineralogical analysis can still leave materials classified as *uncertain* where there is conflicting NAGpH and NAPP results. Uncertain materials demonstrating a NAGpH above 4.5 may be tentatively assigned as potentially NAF and those below pH 4.5 as potentially PAF; however, in such cases, further assessment, such as the use of kinetic leaching columns may be required to provide a definitive classification.

Additional Assessment

Static Testing

Further soils (cover materials) and waste characterisation and classification on the propensity of these materials to be potentially acid or non-acid forming, to generate neutral metalliferous or saline drainage, and their susceptibility to weathering should initially include the static testing program defined in Table 8.

Table 8: Recommended Static Geochemical Testing

Assessment Phase	Parameters	Sampling No.
Phase 1: All samples from each alteration within each weathering profile within each lithology	Moisture, Bulk Density, Particle Size Distribution, Emerson Aggregate Test, pH value (1:2), pH_F, pH_{FOX} and NAGpH, Electrical Conductivity @ 25°C (1:2), Total Sulfur (LoR: 0.005wt%), Sulfate-S and SCR, Total Inorganic Carbon and Total Organic Carbon	13 where waste is homogenous. 26 where variable waste is encountered
Phase 2a: If Total Sulfur <0.05wt% then selected waste samples	Total Metals and Leachable Metals	
Phase 2b: If Total Sulfur ≥0.05wt% then all samples from each alteration within each weathering profile within each lithology	Acid Base Accounting: ASLP Leachate Analysis, Net Acid Production Potential (NAPP), pH_{OX}, Net Acid Generation (NAG at pH4.5 and 7.0), Acid Neutralising Capacity (ANC), sulphur speciation, mineralogy and buffering curves, total metals and leachable metals	To be confirmed following Phase 1

The sampling containers required for Phases 1 and 2 are shown in Table 9.

Table 9: Phase 1 and 2 Sample Containers

Phase	Label Colour	Container Type	Parameters
Phase 1	Green	1x Medium Snap Lock Bag	ASS Field Screening Analysis, Chromium Reducible Sulphur, NAPP
Phase 1	Orange	2 x 250mL Soil Glass Jar - Unpreserved	Bulk Density, Electrical Conductivity (1:2 leach), Moisture Content, pH (1:2 leach), Soluble Major Ions
Phase 2a	Orange	1 x 250mL Soil Glass Jar - Unpreserved	Metals, ASLP Leachate
Phase 2b	Orange	1 x 250mL Soil Glass Jar - Unpreserved	Metals, ASLP Leachate
Asbestos	White	1 x 50mL Snap Lock Bag - ACM/Asbestos Grab Bag	Asbestos: presence/absence in grab samples
Radioactivity	Green	1 x Medium Snap Lock Bag	Gross Alpha and Beta

In the absence of elevated concentrations of sulphur, kinetic tests, such as humidity cell leach testing and/or column leach testing should only be considered after completion of the static testing.

In addition to the above geochemical sampling, additional sampling on proposed cover material to be used as growth medium should be undertaken in accordance with the following sampling suits:

- Bulk Density.
- PSDs for aggregates <2mm.
- Coarse fragments.
- Emerson Test.
- Water repellence.
- pH and EC at 1:5.
- Exchangeable Cations.
- Organic Carbon.
- Nutrients: Total N, Available P, K and S.

Kinetic Testing

Kinetic leach column (KLC) tests can be used to provide information on the reaction kinetics of mining waste materials. The objectives of kinetics tests are to:

- Provide time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions).
- Investigate metal release and drainage/seepage quality.
- Assess treatment options such as addition of alkaline materials.

The KLC tests simulate the weathering process that leads to acid and base generation and reaction under laboratory controlled or site conditions. The kinetic tests allow an assessment of the acid forming characteristics and indicate the rate of acid generation, over what period it will occur, and what management controls may be required. In KLC tests, water is added to a sample and the mixture allowed to leach products and by-products of acid producing and consuming reactions. Samples of leachate are then collected and analysed. Intermittent water application is applied to simulate rainfall and heat lamps are used to simulate sunshine. These tests provide real-time information and may have to continue for months or years. Monitoring includes trends in pH, sulfate, acidity or alkalinity, and metals, for example. The pH of the collected leachate simulates the acid drainage process, acidity or alkalinity levels indicate the rate of acid production and acid neutralisation, and sulfate production can be related to the rate of sulfide oxidation. Metal concentration data provides an assessment of metal solubility and leaching behaviour.

Approximately 2 kg of sample is accurately weighed and used in the leach columns and depending on the physical nature of the material and particle size can be used on an as-received basis (i.e., no crushing as with process residues) or crushed to nominal 5-10 mm particle size (as with waste rock). The sample in the column is initially leached with deionised water at a rate of about 400 ml/kg of sample and the initial leachate from the columns collected and analysed. Subsequent column leaching is carried out at a rate of about 400 ml/kg per month and again collected and analysed. The leaching rate can be varied to better simulate expected site conditions or satisfy test program data requirements. The column must be exposed to drying conditions in between watering events. The residual water content and air void content in the column can be determined by comparing the wet and dry column weights. A heat lamp is generally used above the sample during daylight hours to maintain the leach column surface temperature at about 30°C.

The recommended analytical analysis for laboratory kinetic column testing is included below in Table 10.

Table 10: Laboratory Analysis for Laboratory Kinetic Column Testing

Analytical Parameters	Frequency	Comment
Materials used to construct columns	Start of Program	Representative samples of the columns should be included in samples for Phase 1, Phase 2a and 2b static testing
pH, EC, temperature, time, date and volume	every 2 weeks	
Major Cations (Ca, Mg, Na, K)	every 4 weeks	
Major Anions (Chloride, Sulphate, Alkalinity)	every 4 weeks	
15 Metals (NEPM 2013 Suite - incl. Digestion) (As, Ba Be, B, Cd, Cr, Co, Cu, Pb, Mn, Ni, Se, V, Zn, Hg)	Start, then every 2 months and at end	
The following notes are relevant: Measure/weigh column materials, samples and amount of water introduced in the column, etc.) to calculate the degree of saturation of the columns. Water content is a key parameter in arid and semi-arid environments. The above analysis should be measured at the initial and final stages of column leaching tests. Site climatic data indicates that there is substantial variability between average minimum to maximum temperature (~15 to 24 (°C)). This could be replicated by using lamps for a few days (3 to 4 days of a month).		

Following the additional testing a post closure risk assessment should be undertaken to specifically address potential risks such as sufficient quantities of cover materials, their erodibility, dust, establishing vegetation, etc. These risks are to be mitigated by establishing a final cover that is appropriate and designed for the long-term to ensure a closure criterion is achieved, and selection of an appropriate waste management strategy and cover design for closure is undertaken.

CONCEPTUAL COVER DESIGN

Waste Rock Dump Description

The site is an operating limestone quarry, with approximately 610,000m3 of waste rock stockpiled in two WRDs (550,000m3 and 60,000m3) across 6.3 ha (refer Figure 10).

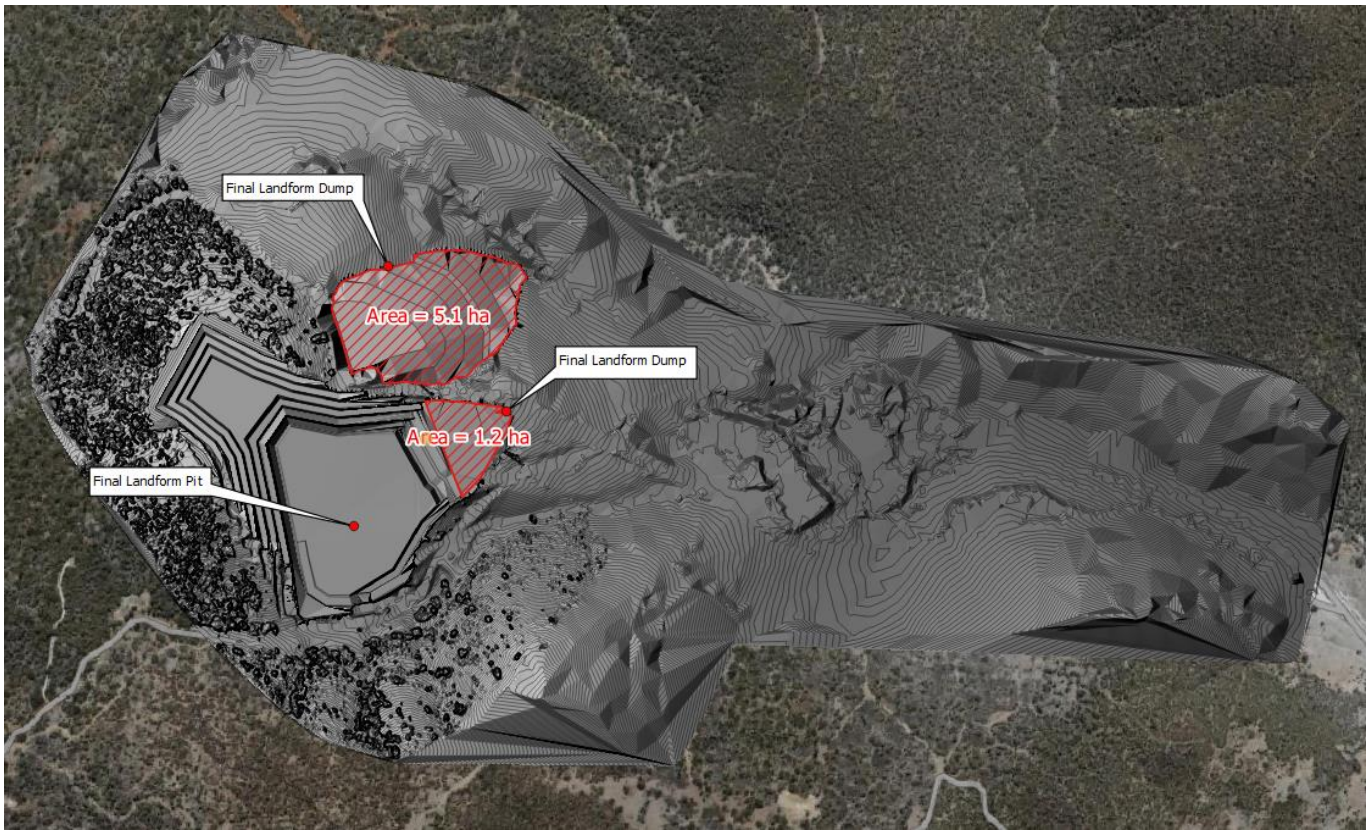

Figure 10: Final Landform Surface (Epic, 2023) with Final Landform Dumps Outlined

The proposed final landform design requirements include:

- Provide long-term geotechnical and erosional stability.
- Blend visually with the surrounding landscape where possible.
- Incorporate adequate surface water flow courses to manage flow velocities associated with the design storm event and direct runoff waters away from the WRD to minimise net percolation into the underlying waste rock.

Since the existing geochemical assessment of waste rock is non-acid forming and will be relatively permeable when rehabilitation occurs albeit that annual evaporation exceeds annual rainfall by about 2.7 times, implying that water will only pond for a short period and that there will not be accumulation of rainfall runoff. It is anticipated that a closure concept utilising the surface to store incidental rainfall and prevent the discharge of stormwater following an extreme rainfall event without spillway will not be considered.

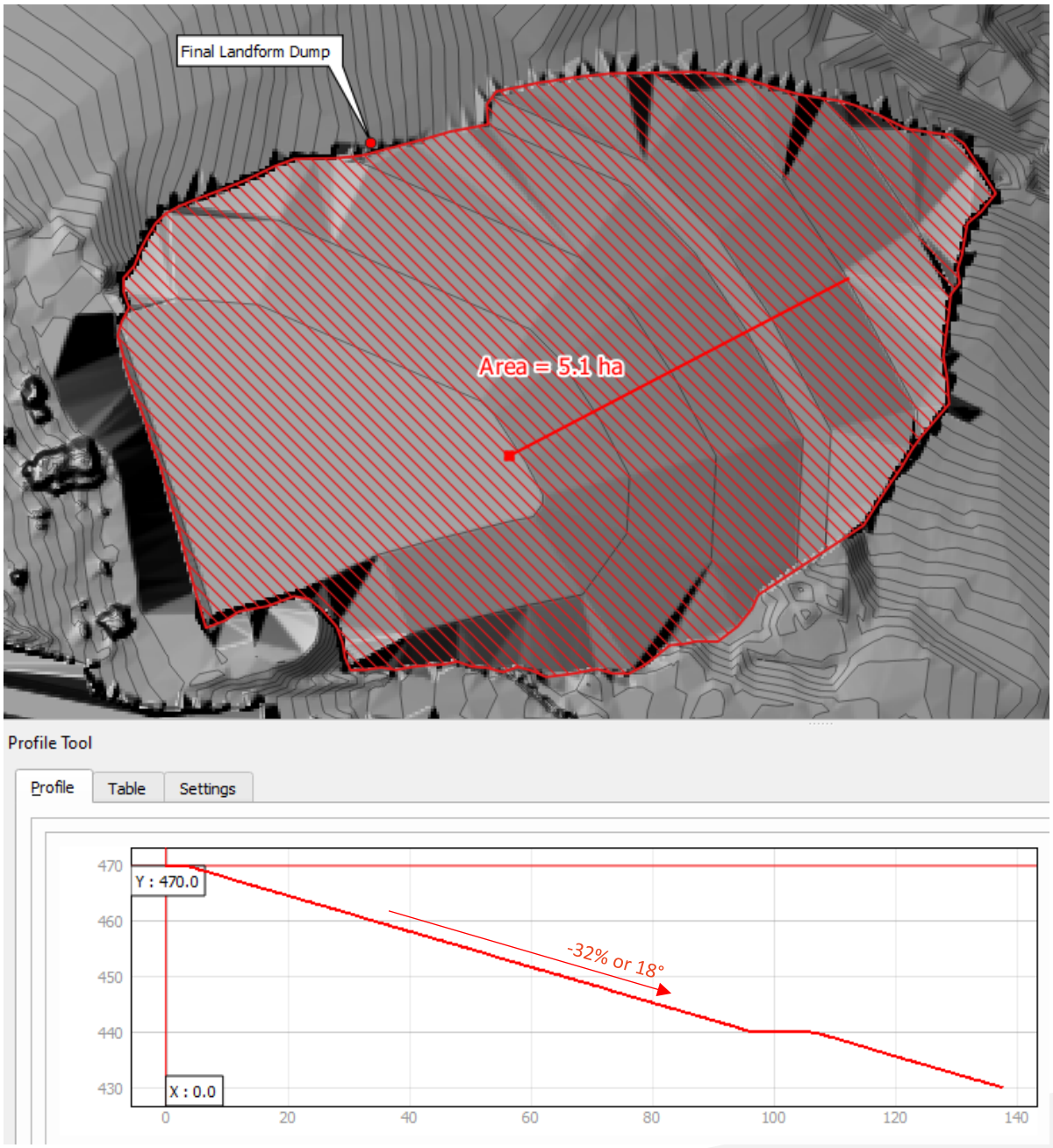

Figure 11: Final Landform Dump Profile

As shown in Figure 11, the slope of the out of the northern out of pit dump is 18°, which is accordance with the EA Schedule F – Table 1a which requires the final land use slope of the WRD to be between 16 to 20°.

Cover Selection

Guidance on the choice of cover type for the tops of potentially contaminating mine waste storages for different climatic settings is provided by the Global Acid Rock Drainage Guide (GARD) (INAP 2009), as reproduced in Figure 12.

The role of covers on potentially contaminating mine wastes is to:

- limit oxygen ingress, and/or
- limit net percolation of rainfall.

Using the average annual rainfall of 660mm (PPT) and the annual potential point evapotranspiration (PET) of 1,800mm yield a ratio for PET/PE = 2.7. As shown in Figure 12 published a store-and-release cover system (to control net percolation or ingress of oxygen) is likely to be most appropriate. Consideration could also be given to an infiltration control/water shedding cover.

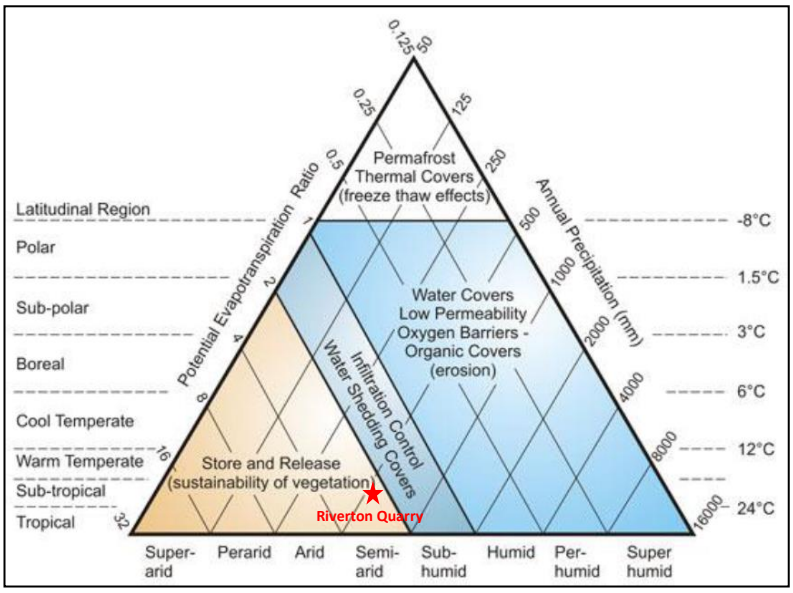

Figure 12: Covers and Climate Types (modified from Holdridge et al, 1971 by Wickland and Wilson, INAP, 2009).

Caution must be used when selecting a particular dry cover design based on "annual" criteria for characterizing the climate at a site. Numerous sites exist where precipitation exceeds potential evaporation on an annual basis; however, the site may experience hot, dry months where evaporation greatly exceeds rainfall. These dry summer conditions can make it difficult to design a cover system that meets all objectives throughout the year. In many instances, where the potential evaporation exceeds precipitation on an annual basis, the site might experience high intensity and short duration rainfall conditions, which may exceed the storage capacity of the cover material. Caution is required when there is potential for consecutive significant rainfall events, which limit the time frame for evapotranspiration to remove moisture from the previous event and therefore increase the net percolation (MEND, 2004a).

However, since the waste rocks are considered non-reactive materials (refer Section 3.2 and pending further waste characterisation), a range of options are available which should consider the availability of cover materials and the PMLU.

The GARD (INAP 2009) provides conceptual cover design options for soil covers as shown in Figure 13 and discussed further in Table 11. The simplest case (i.e. the base method cover system design) is typically evaluated first during the conceptual and/or preliminary cover system design phase, and then complexity added until the desired design objectives are met. In general, increasing complexity in the design of a cover system implies increased cover system performance, but would also typically entail increased costs and a more difficult cover system to construct.

Note, however, that an increase in performance is not necessarily true for all climate conditions. For example, a store and release cover in arid or semi-arid climate conditions can provide the same level of control on net percolation as compared to a cover system with a low hydraulic conductivity barrier layer or a capillary barrier cover system (GARD INAP 2009).

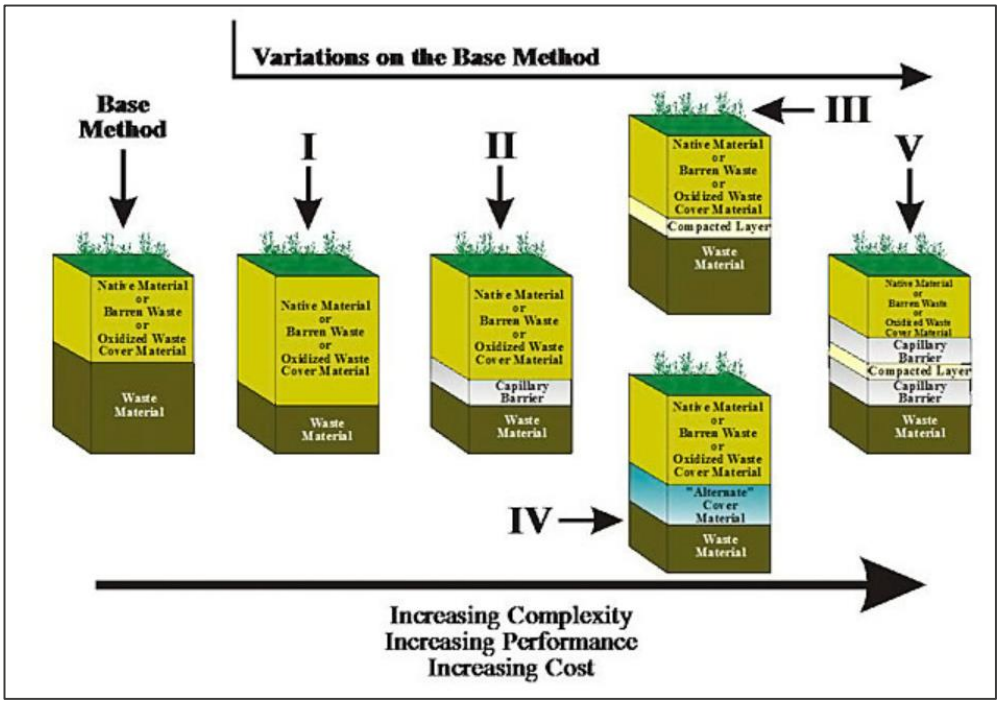

Figure 13: Soil Cover Design Options (GARD INAP 2009)

NO.	DESCRIPTION	COMMENTS
Base	Natural, barren or oxidised growth medium	Basic cover to cap the wastes and serve as a growth medium
I	Base case, but thicker	A thicker growth medium, but too thick a layer may allow deep drainage to below the root zone and into the wastes
II	I, but including a capillary break	Cover II adds a capillary barrier (or break) beneath the growth medium, which may be desirable to limit the uptake of any salts from the underlying waste rock into the growth medium. A capillary barrier relies on a material that limits saturation and flow driven by capillary action and must be carefully selected and sized to ensure that it is effective and will remain so. Suitable capillary barriers may include clean gravel and clean sand. Run-of-mine waste rock would likely not be suitable for use as a capillary barrier, without crushing of coarse-grained particles and screening to remove fines.
III	I, but underlain by a compacted clay layer	The compacted clay layer provides a seal to hold-up rainfall infiltration for access by plants and to limit net percolation into the wastes
IV	I, but underlain by an alternative sealing layer	A geomembrane or GCL could be used in the absence of clay
V	Compacted layer sandwiched between two capillary breaks, without or with a growth medium	Designed specifically to cover sulfidic tailings at the net positive water balance LTA site in Québec, Canada

Table 11: Summary of Soil Cover Design (GARD INAP 2009)

Department of Environment and Science Cover Requirements

Table 4 in *The User Guide for Estimated Rehabilitation Cost Calculator for Mining (DES, 2019) (ERC Guide)* defines the risk categorisation for closure cost estimate for waste rock dumps, heap leach pads and tailings storage facilities. The risk categorisation and description from the ERS Guide for waste rock dumps is shown in Table 12.

Table 12: Risk Categories for Waste Rock Dumps (DES 2019)

Risk Category	Waste Rock Dumps
High Select this category if the waste structure has one or more of the following characteristics:	Potentially acid forming waste rock materials (PAF). Other highly reactive materials including (acid rock drainage (ARD) / acid mine drainage (AMD) / neutral mine drainage (NMD)). Observed contaminated seepage (PAF) capable of causing environmental harm.
Medium with low permeability layer	Waste rock material that could adversely impact on the proposed end land use and/or vegetation function if salinity or materials are exposed, e.g., hypersaline / sodic materials, highly dispersive clay materials. Significant (non-PAF) seepage capable of causing environmental harm. Located in high rainfall area.
Medium	Waste rock material that could adversely impact on the proposed end land use and/or vegetation function if salinity or materials are exposed, e.g., hypersaline / sodic materials, highly dispersive clay materials. Seepage (non-PAF) capable of causing environmental harm.
Low	Waste rock material that may have some impact on the proposed end land use and/or vegetation cover Minor (non-PAF) seepage.
Very low	Benign waste rock materials Minor (non-PAF) seepage.

Further the ERC Guide defines the following in relation to covers or caps for waste rock dumps:

- Working layer:
  - Not required for waste rock dumps or heap leach pads.
  - A “working rock layer” over tailings s specified to provide a “stable surface” for the cap.
- Capillary break:
  - Capillary break layer to mitigate salt uptake into the vegetation surface.
- Low permeability layer:
  - Low permeability layer (typically clay) to prevent infiltration of surface water into the waste.
- Top rock layer:

- Apparently above the cap, presumably before the top layer is placed, and on slopes as armouring, although this is not made clear in DES (2019).

- Top layer:
  - Growth media (typically topsoil) and vegetation.

The requirements of these layers are specified in Table 6-2 in DES (2019), reproduced below in Table 13. The default thickness for growth media is 0.15 m for all cases.

Table 13: Capping Engineering Cost and Default Minimum Thicknesses (DES 2019)

Risk Category	Waste Rock Dumps
High	Engineering $2,000/ha Working layer 0 m Capillary break 0.6 m Low permeability layer 0.5 m Top Rock Layer 1.5 m
Medium	Engineering $2,000/ha Working layer 0 m Capillary break 0.3 m Low permeability layer 0 m Top Rock Layer 1.0 m
Low	Engineering $1,500/ha Working layer 0 m Capillary break 0 m Low permeability layer 0 m Top Rock Layer 0.5 m
Very Low	Supervision / survey $500/ha Working layer 0 m Capillary break 0 m Low permeability layer 0 m Top Rock Layer 0 m

Construction QA/QC Requirements

Key risks associated with the final landform and cover construction include:

- Failure to follow the design, facility not achieving design intent.
- Nonconformance of construction materials to technical specifications.
- Inadequate quality of construction.
- Failure to correctly implement a QA/QC procedure to identify construction inadequacies.

Quality control (QC) must involve the actual testing of materials to confirm the final landform and cover is constructed in accordance with the technical specifications provided by the Design Engineer. Quality assurance (QA) must involve a review of the QC data to ensure testing is representative of the earthwork completed and that the design objectives are met. QA must be managed independently of QC and must involve additional testing to verify certain QC results. QA/QC results need to include statistical analysis of the data, log of non-conformances, and any deviations from the approved design.

The Design Engineer must develop technical specifications that outline construction performance acceptance criteria including material selection and construction requirements. Technical specifications must be comprehensive enough to ensure that construction of the facilities comply with the design and design intent.

The technical specifications must include a QA/QC program that clearly sets out the types and frequency of field and laboratory testing. The program must include a clear reporting and response procedure for nonconforming test results including the requirements for retesting, and reworking. QA/QC and technical specifications must be made available by the Design Engineer before start of construction. Identification of viable borrow areas, including testing, conditioning, and haulage of borrow materials, must be included, where needed, in the construction requirements.

Construction management, technical supervision, and QA/QC of final landforms and covers will be done by a suitably qualified person (SQP), to ensure construction aligns with the design and technical specifications. QAQC testing will be completed, post construction, and including test such as cone penetration testing and permeability testing. An SQP will prepare a QA/QC document to verify landform design is stable and has been constructed in accordance with the design plan.

Reporting

At a minimum, the following QA/QC reporting and analysis will be undertaken:

- Review and approval of manufacturer QC certifications and test results required by the technical specifications.
- Review and approval of QC test results, observations and QC reports.
- Review and approvals of compaction procedures for materials placed and compacted as required by the Technical Specifications.
- Sampling and performing conformance tests on materials as required by the Technical Specifications.
- Initiation of design changes or clarifications required by the contractor.
- Verify that the work is constructed in accordance with industry standards, technical specifications and owners requirements.
- Prepare a construction report to record QAQC activities and outcomes, approved by an SQP.

Conclusions

In consideration of the above information, and existing geochemical characterisation of the waste material, the following is concluded regarding the cover design.

- Geochemical Assessment.
  - The existing geochemical characterisation has not identified waste material that is potentially acid forming.
  - Whilst the characterisation of waste rock to date indicates a low risk for acid mine drainage there is uncertainty with regard to the likely physical behaviour and chemical reactivity of the materials under the conditions in which they would be stored.

- Cd, Co and Hg have GAI values of 3 or above, which is considered significant and such an enrichment warrants further examination. In the absence of total metal and leachable metal analyses it is not possible to assess the significance of these apparent enrichment.
- The potential for saline and neutral mine drainage has not been adequately assessed. Given the metal enrichments, mobilisation of contaminates from the waste rock dump by seepage is possible.

- Cover Design.
  - Given the relatively dry climate at the site, a store-and-release cover system (to control net percolation or ingress of oxygen) is likely to be most appropriate.
  - The waste rock dump is likely to be classified either a medium or low risk structure as per the ERC Guide based on existing information. Adopting a conservative approach given the scarcity of data, a medium risk cover design is recommended for conceptual closure planning.
  - As per Figure 13, selection of cover type II would be appropriate at the specified thickness defined in the ERC Guide (Table 13).

Assessment of Soil and Capping Materials

The PRCP requirements for the assessment of soil and capping materials include (DES, 2023):

- Conservation of soil is a critical component in rehabilitation planning. 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.
- 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 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 which at a minimum, identifies and characterises the following:

- The quality and quantity of available resources (such as topsoil, capillary break material, and competent NAF rock) required to complete the target rehabilitation methodology.
- The location (i.e. with respect to haul distance) and accessibility of cover material.
- An assessment to determine the need for ameliorants and fertilisers for growth media.
- The relationship between soils and vegetation ecosystems for the PMLU and rehabilitation methodology.

In addition to the geochemical sampling defined previously, additional sampling on proposed cover material to be used as growth medium should be undertaken in accordance with the following sampling suits:

- Bulk Density.
- PSDs for aggregates <2mm.
- Coarse fragments.
- Emerson Test.
- Water repellence.
- pH and EC at 1:5.
- Exchangeable Cations.
- Organic Carbon.
- Nutrients: Total N, Available P, K and S.

The cover materials comprise waste rock and soil/growth medium; the quantities are indicated in Table 14.

Table 14: Cover Materials Balance.

Material Type	Thickness (mm)	Volume (m^3)
NAF Waste Rock	1,000mm	63,000 m^3
Soil/Growth Medium	150mm	9,450 m^3
Capillary Break	300mm	18,900 m^3

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Appendix N Stormwater Basin Design (Lyndsay Dynan 2018)

ENGINEERING MEMORANDUM:

SIBELCO - RIVERTON MINE - DRAINAGE WORKS

Project No.00015099

Date: Monday, 3 December 2018

Prepared for:
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1. Introduction

Lindsay Dynan Consulting Engineers (Lindsay Dynan) have been engaged by Sibelco to review the current stormwater strategy at the Riverton Quarry site (the site), located in Riverton, QLD. As part of the review, Lindsay Dynan have prepared suggested drainage measures to comply with the current Environmental Authority (EA) (No. MIN100399006).

This memorandum has been prepared to outline the reliance documents, design calculations and recommendations proposed as a result of this review.

2. Reliance

The following publications have been relied upon:

- IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia);
- Department of Environment and Heritage Protection (EHP) 2017, Guideline: Stormwater and environmentally relevant activities; and
- Environment Protection Agency (EPA) QLD, Notice of Decision – Permit Application Ref 175297, Dated 13 Dec 2005.

3. Methodology

In undertaking this review, the follow methodology was applied:

- Determination of the required design storms, wet season period and average recurrence intervals (ARI) to be managed for each component discussed below including comparison against current guidelines and best practice publications;
- Establishment of contributing upstream clean water catchment sizes grading towards the site, via Lidar contours provided by Sibelco;
- Establishment of internal dirty water catchments to be directed to sediment dams;
- Sizing of clean water conveyance channels to direct upstream flows around the disturbed areas;
- Sizing of sediment dams to comply with current EA requirements; and
- Nomination of internal localised sediment control features to prevent dirty water contamination to clean water channels.

4. Results

4.1 Upstream Diversion Channels

Given the magnitude of the upstream catchment, in order to meet internal dam capacity up to and including in the 50 year event, it was considered critical to maximise diversion of clean water flows around the site. Therefore, the upstream diversion channels were sized for the 1 in 50 year ARI.

Refer to the attached sketches for the location and size of each clean water diversion channel.

At the low point of the upstream catchment, where crossing through the site is required, the intent is:

- Provide an embankment at the site boundary to control the discharge point through the site;
- Provide a low flow pipe for regular conveyance and a high flow weir over the site access road;
- Provide a clean water drain through the centre of the site, upslope of Sediment Dam C1 to avoid contamination;
- Provide at source sediment control within the site upslope of the clean water drain. Upslope measures include:
    - A sediment filter bund to strip out the majority of sediments and impound waters in the day to day runoff; and
    - Maintenance of a grassed buffer strip downslope of the sediment filter bund to aid in retention of sediment on site.

4.2 Sediment Collection Dams

The locations of Sediment Collection Dams were determined based on capture of all disturbed areas within the quarry and processing footprint. The attached sketches show the indicative locations, footprint and cross sections areas.

In designing the sediment dam capacity, the following critical information/assumption is noted:

- The site EA indicates the design is to cater for a 1 in 50 year rainfall event (4 month wet season). Based on Table 4.4.6 of the IECA Best Practice Erosion and Sediment Control Guidelines, the 4 month wet season is assumed to extend from November to February inclusive. Therefore, it is critical that site operations ensure design capacity is restored 1st November to ensure compliance with the current conditions.
- The wording of the EA indicated design is to allow for a 1 in 50 year rainfall event. It is suggested that a duration would need to be applied in addition to an ARI to allow for a design depth to be nominated. For the purpose of these works, a duration of 24 hours was adopted, in line with similar recommendations within EHP Guidelines.
- The subsequent rainfall depth based on the above assumptions is significantly higher than industry best practice and EHP guidelines. The below table identifies the relevant depths for clarity:

Table 1: Indicative Rainfall Depths

Source	Design Duration	Equivalent Depth
IECA Guidelines for discharge to sensitive receiving waters	85%ile 5 day rainfall depth	30 mm
EHP Guidelines for Mining	1 in 10 year, 24 hour	114.2 mm
EHP Guidelines for Quarry	1 in 5 year, 24 hour	102.7 mm
Current Site EA	1 in 50 year (assumed 24 hr)	152.6 mm

The resultant dam capacities and design considerations, adopting the current EA conditions, are summarised below in Table 2. Table 3 and Table 4 are also provided to give a comparison against alternative design storm scenarios. The storage zone is based on 2 months soil loss. It is noted that the upstream catchments grading to these ponds consist of quarried zones with internal storage capacity, therefore, it is considered that the provided pond capacity offer a conservative volume based on additional upstream storage capacity within these current quarry voids.

Table 2: Proposed Sediment Dam Capacity – Adopting 50 yr – 24 hr

Location	Catchment (m^2)	Rainfall depth (mm)	Cv	Storage Zone(m^3)	Settling Zone (m^3)	TOTAL
Sediment Dam A*	97,000	152	0.90#	500	13,250	13,750
Sediment Dam B	146,000	152	0.90#	750	20,000	20,750
Sediment Dam C1/C2	98,000	152	0.90#	500	13,500	14,000

*Sediment Dam A has additional storage capacity to account for overtopping of the upstream diversion drain (SW1B) due to constrained capacity. The additional storage was determined based on the volume of rainfall overtopping the upstream swale during a 50 year event.

#A Volumetric Runoff Coefficient of 0.9 was selected to account for the large runoff volume and steep nature of the site whilst also taking into account the voids in the terrain that are consistent throughout the site.

Table 3: Proposed Sediment Dam Capacity – Adopting 10 yr – 24 hr

Location	Catchment (m^2)	Rainfall depth (mm)	Cv	Storage Zone(m^3)	Settling Zone (m^3)	TOTAL
Sediment Dam A*	97,000	114.2	0.90#	507	9,970	10,477
Sediment Dam B	146,000	114.2	0.90#	763	15,000	15,763
Sediment Dam C1/C2	98,000	114.2	0.90#	512	10,070	10,582

Table 4: Proposed Sediment Dam Capacity – Adopting 5 yr – 24 hr

Location	Catchment (m^2)	Rainfall depth (mm)	Cv	Storage Zone(m^3)	Settling Zone (m^3)	TOTAL
Sediment Dam A*	97,000	102.7	0.90#	507	8,970	9,477
Sediment Dam B	146,000	102.7	0.90#	763	13,500	14,263
Sediment Dam C1/C2	98,000	102.7	0.90#	512	9,050	9,562

5. Recommendations

The primary recommendations following the above analysis are:

- Investigate the appropriateness of the nominated EA Condition (C2-2), specifically, the design storm 1 in 50 year rainfall event. The nomination is adequate for sizing drainage conveyance structures, i.e. determination of the time of concentration and applicable 50 year ARI, but does not give definition to establish a rainfall depth. As discussed in Section 4, a 24 hour rainfall duration was adopted, this is consistent with the EHP Guideline: *Stormwater and environmentally relevant activities,* with respect to storm durations.
- Consider the above referenced Guideline and Best Practice Erosion and Sediment Control Guidelines with regards to nomination of design ARI. The Guideline suggests an appropriate ARI of 10 years for mining activities and 5 years for quarry activities. It is suggested that any future EA updates consider this disparity and amend the condition to align with current best practice/EPH guidelines. With this alignment, the proposed dams will have in excess of the required design capacity. To account for this, it is suggested depth markers be placed in the dams to inform operators of the revised minimum settling storage volumes (i.e. storage of water for dust suppression and quarry activities up to the settling storage depth marker).

Should you require any further advice or clarification of any of the above, please do not hesitate to contact us.

Yours faithfully
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