

A Montrose Environmental Company

EA Amendment
Supporting Report
Graymont (Calliope) Pty Ltd
Calliope Limestone Quarry
Taragoola
BAA250025.01
20 August 2025

CONTENTS

1 INTRODUCTION 1
1.1 Project 1
1.2 Background 1
1.3 Proposed Project 2
1.4 Application Particulars 3
1.4.1 Proponent Details 3
1.5 Purpose and Context 7
1.6 Properly Made Application 8
1.7 Pre-Lodgement 10
2 LEGISLATIVE FRAMEWORK 11
2.1.1 PRC Plan and ERC 17
2.1.2 Assessment Against Criteria for Environmental Impact Statements 17
2.2 Requirements for Activities in the Great Barrier Reef Catchment Area 20
3 PROJECT DESCRIPTION 22
3.1 Location 22
3.2 Overview of Operations 22
3.2.1 Mine Pits 23
3.2.2 Ancillary Activities 29
3.3 Identification of Underlying Landowners and Tenure 38
3.3.1 Underlying Easement and Restricted Areas 40
3.4 Surrounding Land Use 40
3.4.1 Sensitive Receptors 42
3.5 Project Area History 45
3.5.1 Duration of Relevant Activities 45
4 EXISTING ENVIRONMENT 46
4.1 Climate 46
4.1.1 Long Term Projections 47
4.2 Land 49
4.2.1 Topography 49
4.2.2 Geological Setting 49
4.2.3 Land Stability 49
4.2.4 Waste Characterisation 50
4.2.5 Soils 54
4.3 Surface Water and Wetlands 56
4.3.1 Project Hydrology and Fluvial Networks 56
4.3.2 Wetlands 56
4.3.3 Existing Water Use 59
4.3.4 Environmental Values 59

4.3.5 Receiving Environment 61
4.4 Groundwater 63
4.4.1 Hydrogeology 63
4.4.2 Groundwater Dependent Ecosystems (GDEs) 63
4.4.3 Regional Groundwater Quality and Flow 63
4.4.4 Regional Groundwater Levels 64
4.4.5 Hydraulic Conductivity 67
4.4.6 Groundwater Recharge and Discharge 67
4.4.7 Existing Groundwater Use 67
4.4.8 Groundwater Bores and Geochemistry 68
4.4.9 Environmental Values 71
4.4.10 Calliope Water Investigations 73
4.5 Terrestrial Ecology 73
4.5.1 Vegetation Communities 73
4.5.2 Fauna Presence and Populations 75
4.5.3 Pest Flora and Fauna 75
4.5.4 Matters of State Environmental Significance 75
4.5.5 Matters of National Environmental Significance 76
4.6 Air 77
4.6.1 Air Policy 77
4.6.2 Existing Air Quality 77
4.7 Noise and Vibration 78
4.7.1 Noise Policy 78
4.7.2 Current Noise and Vibration Levels 78
4.8 Traffic 79
4.9 Waste 79
4.10 Social and Economic 80
4.11 Cultural Heritage 80
4.11.1 Indigenous Cultural Heritage 80
4.11.2 Non-Indigenous Cultural Heritage 81
5 PROJECT JUSTIFICATION AND ALTERNATIVES 82
5.1 Alternative Post Mining Land Uses 82
6 PROPOSED AMENDMENTS 83
6.1 Proposed Amendments Overview 83
6.2 Amendment 1: Authorised Disturbance and Post Mining Land Uses 83
6.3 Amendment 2: Contemporising EA Conditions 86
6.3.1 Conditions A1 and A2 86
6.3.2 Conditions F6 and F7 87
6.3.3 Condition F14 87

7 POTENTIAL ENVIRONMENTAL IMPACTS 88
7.1 Land 88
7.2 Surface Water and Wetlands 89
7.3 Groundwater 91
7.3.1 Water Balance Modelling of Final Pit Void 91
7.4 Terrestrial Ecology 92
7.4.1 Matters of National Environmental Significance 93
7.4.2 Matters of State Environmental Significance 93
7.5 Air Quality 96
7.6 Greenhouse Gas 97
7.7 Noise 97
7.8 Traffic 98
7.9 Waste 98
7.10 Cultural Heritage 98
7.11 Social and Economic 98
8 RISK ASSESSMENT 100
8.1 Method 100
8.2 Risk Assessment 100
8.3 Management Plans 110
9 REHABILITATION AND CLOSURE 111
9.1 Overview of Rehabilitation Areas 111
9.1.1 Rehabilitation Staging 114
9.2 Assessment of PMLU Options 115
9.3 Community Consultation 117
9.3.1 Calliope Limestone Quarry Open Day 117
9.3.2 Community Consultation Letter 117
10 CONCLUSION 119
11 REFERENCES 120
12 ACRONYMS 124
13 LIMITATIONS AND DISCLAIMER 127

LIST OF FIGURES

Figure 1. Regional location 4
Figure 2. Current disturbance area 5
Figure 3. Maximum disturbance extent 6
Figure 4. Infrastructure being retained 32
Figure 5. Land uses 41
Figure 6. Sensitive receptors 44
Figure 7. Mean monthly rainfall 47
Figure 8. Geochemical AMD classification plot for the three locations based on NAG pH and NAPP 51

Figure 9.Topography and landform 52
Figure 10. Geological setting 53
Figure 11. Soil mapping units 55
Figure 12. Watercourses and wetlands 57
Figure 13. Waterways for waterway barrier works 58
Figure 14. Surface water monitoring locations 62
Figure 15. Groundwater flow before and during mining 64
Figure 16. Groundwater levels for FM5, FM5B and FM6 65
Figure 17. FM5, FM5B and FM6 groundwater levels with Awooga Dam water level 66
Figure 18. Water balance model predicted water level post mining 66
Figure 19. Groundwater monitoring locations 70
Figure 20. Ground-truthed regional ecosystems, survey sites and proposed impacts 74
Figure 21. Rehabilitation areas 113
Figure 22. Rehabilitation staging 114
Figure 23. Post mining land uses 116

LIST OF PLATES

Plate 1. Drone footage of Calliope Limestone Quarry in February 2023 22
Plate 2. View of former Pit 1 from western access point 24
Plate 3. Drone footage of Northern WRD facing east 25
Plate 4. View of Pit 2 facing south 26
Plate 5. Drone Footage of Pit 2 facing south 26
Plate 6. View of Pit 3 from northern ramp 27
Plate 7. View of Pit 4 northern sump facing south 27
Plate 8. Drone footage of southern end of Pit 4 facing south west 28
Plate 9. Drone footage of Pit 3 facing north 29
Plate 10. Southern WRD facing west 30
Plate 11. Western bund (levee) facing north 31
Plate 12. Eastern bund (levee) facing north 31
Plate 13. Site office and weighbridge at site entrance (from Taragoola Road) 34
Plate 14. Drone footage of operational spoil pile area facing west 34
Plate 15. Drone footage of sediment pond adjacent to spoil pile area facing south east 35
Plate 16. Drone footage of silt dump 35
Plate 17. Drone footage of topsoil stockpile adjacent to the eastern bund 36
Plate 18. Cleared area to become helipad for emergency services 37
Plate 19. Cleared area adjacent to Pit 2 37
Plate 20. Snips of Queensland Globe MSES regulated vegetation (defined watercourse) mapping 95
Plate 21. Visitors and personnel at open day at Calliope Limestone Quarry 2023 118
Plate 22. Information about PRC planning and EA amendment on display at Calliope Limestone Quarry 2023 118

LIST OF TABLES

Table 1. Overview of disturbance areas 2
Table 2. EA amendment application particulars 3
Table 3. Proponent details 3
Table 4. Cross-reference of section 4.1.1 minor (EA) amendment (threshold criteria) 7
Table 5. EA amendment requirements from the *Environmental Protection Act 1994* 8
Table 6. Commonwealth, state and local legislation 11
Table 7. EIS criteria cross-reference table 17
Table 8. Criteria for residual impact to GBR catchment area 20

Table 9. Tenure and landholder details 38
Table 10. Sensitive receptors 42
Table 11. Duration of quarry activities 45
Table 12. Long-term mean temperature since 1957 (BoM weather station 39123, Gladstone) 46
Table 13. EVs of Project receiving surface waters 59
Table 14. Boyne River Basin WQOs relevant to the Project (EPP (Water) 2014) 61
Table 15. Water quality data from release point C1 and F1 61
Table 16. Groundwater monitoring locations and frequency 68
Table 17. Groundwater baseline, trigger values and maximum results for 2019-2023 reporting periods 69
Table 18. Summary of water chemistry for monitoring site bores (2019 to 2025) compared to drinking water and stock water guideline values 72
Table 19. Ground-truthed REs within the Project area 73
Table 20. Matters of state environmental significance relevant to the Project area 76
Table 21. Relevant air quality criteria from EPP (Air) 77
Table 22. Relative acoustic quality objectives 78
Table 23. Updated final land use and rehabilitation approval schedule 84
Table 24. Financial assurance EA conditions 86
Table 25. Rehabilitation EA condition 87
Table 26. Infrastructure retention EA condition 87
Table 27. Predicted vegetation clearing resulting from Project proposed impacts 93
Table 28. Significant residual impact test for MSES regulated vegetation (defined watercourse) 95
Table 29. Categories of likelihood 100
Table 30. Categories of consequence 100
Table 31. Likelihood and consequence matrix 100
Table 32. Risk assessment 101
Table 33. Rehabilitation areas 112

LIST OF APPENDICES

APPENDIX A **ENVIRONMENTAL MANAGEMENT PLAN**
APPENDIX B **PLAN OF OPERATIONS**
APPENDIX C **ECOLOGY FIELD REPORT**
APPENDIX D **GEOTECHNICAL REPORT**
APPENDIX E **HYDROGEOLOGICAL ASSESSMENT**
APPENDIX F **WASTE CHARACTERISATION MEMORANDUM**
APPENDIX G **FINAL LANDFORM DESIGN REPORT**
APPENDIX H **FINAL LANDFORM FLOOD ASSESSMENT**
APPENDIX I **EROSION AND SEDIMENT CONTROL PLAN**
APPENDIX J **LANDHOLDER STATEMENT**
APPENDIX K **SURFACE WATER IMPACT ASSESSMENT**
APPENDIX L **RUSLE MEMORANDUM**

DOCUMENT CONTROL

Revision	Revision date	Revision details	Author	Editorial review	Technical review	Approver
A	9/11/2023	Draft for Internal Review	S. Hargreaves H. Tibbetts	S. Hargreaves	M. Longbottom	M. Longbottom
B	01/08/2024	Draft for Client Review	S. Hargreaves H. Tibbetts T. Casson	S. Hargreaves	A. Butler	M. Longbottom
0	28/08/2024	Final for Issue	S. Hargreaves H. Tibbetts T. Casson	S. Hargreaves	M. Longbottom	M. Longbottom
1	20/08/2025	Revised Final for Issue	S. Hargreaves M. Elliott D. Murfitt	K. Cullen	R. Nejad	R. Nejad

DISTRIBUTION

Revision	Revision date	Issued to
A	9/11/2023	Internal
B	01/08/2024	Graymont
0	28/08/2024	Department of Environment, Science and Innovation
1	20/08/2025	Department of Environment, Tourism, Science and Innovation

DOCUMENT INFORMATION

Printed:	19 August 2025
Last saved:	19 August 2025 04:32 PM
File name:	BAA250025.01-REP-Graymont-Calliope-EA Amendment-Rev1
Author:	Shaille Hargreaves
Project manager:	Shaille Hargreaves
Client:	Graymont (Calliope) Pty Ltd
Document title:	EA Amendment Supporting Report
Project number:	BAA250025.01

1 INTRODUCTION

1.1 Project

Graymont (Calliope) Pty Ltd (Graymont, subsidiary of Graymont Pty Ltd) owns and operates the Calliope Limestone Quarry (the Project). This Environmental Authority (EA) Amendment supporting report has been prepared for the Department of Environment, Tourism, Science and Innovation (DETSI) as supporting information for the amendment of the site-specific EA EPML00969013 under Chapter 5, Part 7 of the *Environmental Protection Act 1994* (EP Act) and to assist the administering authority in making an assessment level decision under Chapter 5, Part 7, Division 3 of the EP Act. This EA Amendment pertains exclusively to EPML00969013, and no amendments will be made to the environmentally relevant activities (ERAs) approved under EPPR00881913.

The Project is located in Taragoola, approximately 11 kilometres (km) south of the township of Calliope and 30 km south of Gladstone in Central Queensland within the Gladstone Local Government Area (LGA) (see **Figure 1**). For the purpose of this report the Project refers to the Mining Leases (MLs) approved under the existing EA which comprise: ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, and ML80192 (the MLs). The Project area comprises the current and proposed maximum disturbance areas within the MLs, as displayed in **Figure 2** and **Figure 3**.

1.2 Background

Limestone mining has been ongoing at the Project since 1967, with Graymont acquiring the Project in 2019. Noting potential future changes in reserves and yearly sales quantities, the Project has a current planned end of mine life (EOML) of 2100. Rehabilitation activities are forecast to be completed by 2110, with annual monitoring proposed to be undertaken until 2115.

Situated just west of Lake Awoonga, the Project produces approximately 0.8 Million tonnes per annum (Mtpa) of limestone products and intersects 19 MLs. The Project adjoins land owned and operated by the Gladstone Area Water Board (GAWB), with some shared access tracks in the area used by both Graymont and the GAWB.

In 2023, Graymont developed a Progressive Rehabilitation and Closure (PRC) Plan (PRCP-EPML00969013-V1) to meet the requirements of:

- The transition notice issued to Graymont on 31 March 2021 by the DETSI (formerly DES)
- The *Mining and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act)
- Sections 126B, 126C and 126D of the *Environmental Protection Act 1994* (EP Act)
- Progressive Rehabilitation and Closure Plans Guideline (ESR/2019/4964) (PRC Plan Guideline) (DESI 2024h)
- Schedule 8A of the *Environmental Protection Regulation 2019* (EP Regulation)

The PRC Plan was developed based on the proposed mine plan to allow for mining until EOML (2100). Table 8 of the EA currently authorises 250.65 ha of disturbance. A total disturbance of 207.82 ha is required for the proposed Project, accumulated over the nominal 75-year life of mine (LOM). The proposed mine plan does not propose an increase in scale or intensity of the operation, with no new ERAs proposed.

Since acquisition, it became apparent that ML boundaries historically used (and groundtruthed) at the Project were different to State ML boundaries from the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development (DNRMMRRD, formerly Department of Resources). The discrepancy was about six to 15 metres (m) and was not a projection issue. Therefore, existing disturbance areas developed throughout the LOM, prior to Graymont acquiring the Project, did not align with the DNRMMRRD ML boundaries.

To rectify this issue, a qualified surveyor groundtruthed the mining lease boundaries at the Project in 2023, based on MGA2020 coordinated data, and a shapefile of these boundaries was provided to the DNRMMRRD to update their database. The MLs currently available in public mapping (i.e. in QSpatial) are correct and representative of the groundtruthed MLs.

Epic Environmental Pty Ltd (Epic), on behalf of Graymont, have prepared this application to update the authorised disturbance areas to reflect intended mining activities until the EOML (2100), based on the groundtruthed MLs, and contemporise the EA to align with in-force State legislation. It is noted that the current EA predates the release of the MERFP Act, so administrative changes are proposed to align EA conditions with the PRC Plan, Estimated Rehabilitation Cost (ERC) and PRC Plan Schedule under this legislation.

1.3 Proposed Project

Project operations are proposed to continue until EOML in 2100. Consistent with the PRC Plan (PRCP-EPML00969013-V1), this would require additional disturbance to accommodate a nominal 75 years of mining, as displayed in **Figure 3**. The Project area includes existing disturbance (i.e. operational areas, pits) with proposed disturbance areas which have been presented by activity type in **Table 1**. Some existing disturbance areas (including cleared areas, access tracks, waste rock dump, and spoil pile areas) are proposed to be encroached by future Pit 3-4, therefore, the change in disturbance areas by activity type and the new disturbance areas have been provided in **Table 1** separately for context.

Table 1. Overview of disturbance areas

Mine Activity	Current ground-truthed disturbance in hectares (ha)	Maximum disturbance area (ha)	Change between current and maximum disturbance areas (ha)	New disturbance area (ha)
Cleared areas and laydowns	11.22	6.77	-4.43	-
Infrastructure and plant	7.82	8.55	0.73	0.24
Sediment ponds	1.46	1.46	0.00	-
Access tracks (including levees)	20.31	17.25	-3.03	1.73
Pit	66.85	121.18	+54.33	27.77
Run of mine (ROM) processing area	18.79	18.79	-0.00	-
Silt dump	1.11	1.11	0.00	-
Temporary spoil storage area	19.22	6.03	-13.19	-
Topsoil stockpile	1.29	7.01	+5.72	3.66
Waste rock dumps (WRD)	14.57	19.66	+5.09	11.78
Undisturbed area	266.96	221.91	-45.05	-
Total disturbance area (excluding undisturbed area)	**162.64**	**207.82**	**-**	**45.18**
Authorised total disturbance area (from Table 8 in the EA)	**250.65**			
Percentage of total disturbance against authorised disturbance areas (%)	**65%**	**83%**	**-**	**18% (28% of current disturbance area)**

The proposed new disturbance will be kept within the existing MLs for the Project (specifically ML80192, ML3594, ML3595, ML80190, ML3604, ML3608, ML80189, and ML3609), and will largely be contained within Lot 22 SP15268, with some minimal disturbance also with Lots 4 RP610128, 100 CTM1823, 7 SP215269, and 26 SP228426.

Currently disturbed areas will be preferentially used for alternative activities as mining continues in adjacent areas. This will minimise environmental harm from new disturbance but, will thereby, require disturbed land to be used for operations until the EOML. Disturbed land will largely not be available for rehabilitation until the EOML.

1.4 Application Particulars

Particulars for the EA amendment application (the subject of this report) has been summarised in **Table 2**.

Table 2. EA amendment application particulars

Aspect	Application Details
Applicant	Graymont (Australia) Pty Ltd
Proponent / EA Holder	Graymont (Calliope) Pty Ltd
Project Name	Calliope Limestone Quarry
Applicant Contact	Vicki Robins Organisation: Graymont Phone: +07 4975 4112 Email: vicki.robins@graymont.com
Site Location	Calliope Plant Charters Crossing Road Taragoola QLD 4680
Environmental Authority (EA) application type	Application to amend a site-specific environmental authority (SSEA)
EA Number	EPML00969013
Authorised Environmentally Relevant Activities (ERAs)	Schedule 3, 21: A mining activity that is an ineligible EA, other than a mining activity mentioned in items 9 to 20

1.4.1 Proponent Details

The Project is owned and managed by Graymont. Graymont is a global leader in lime and limestone solutions. Proponent details are outlined in **Table 3**.

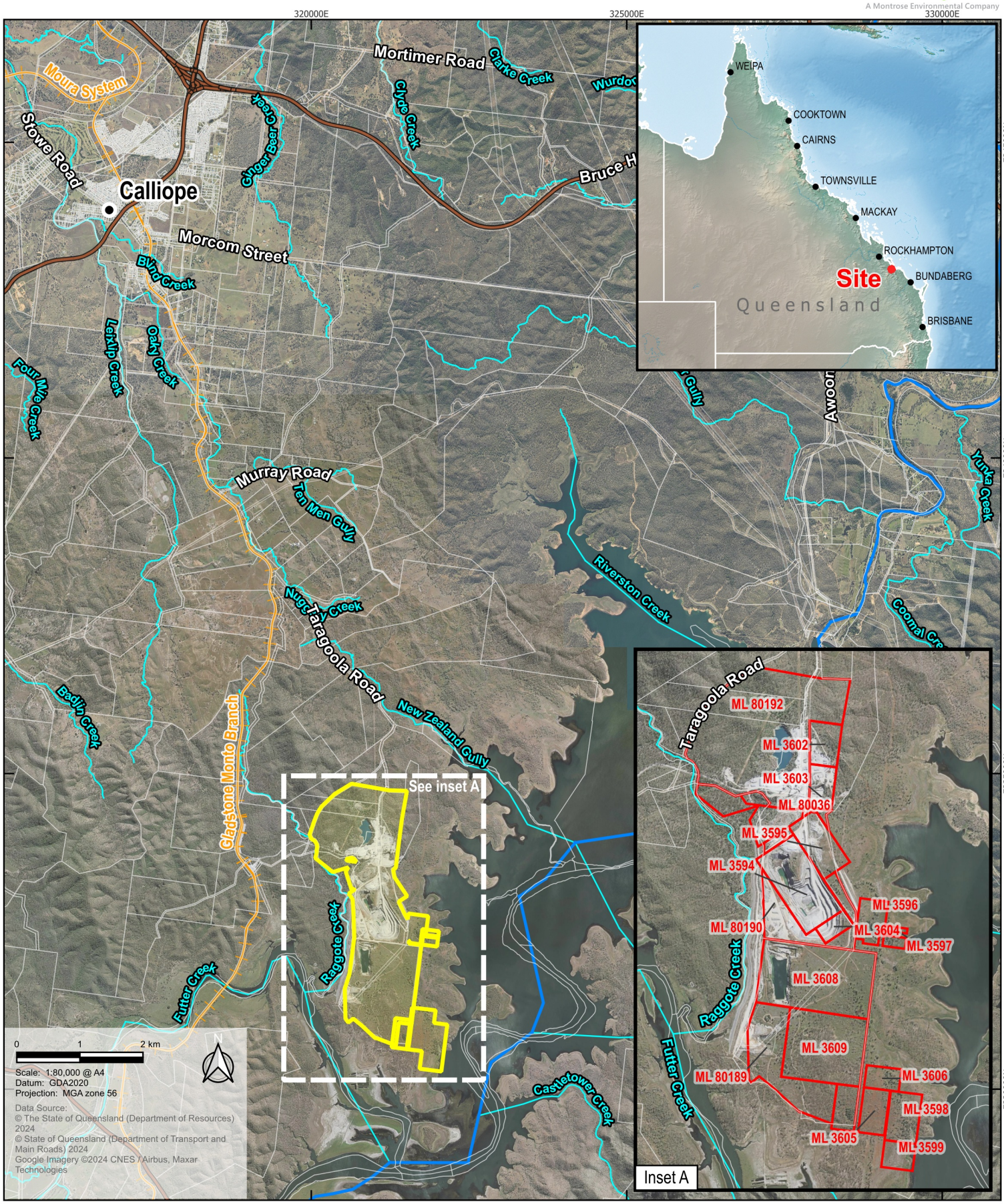
Graymont's products are essential in addressing today's most pressing environmental issues while supporting vital industrial processes and agricultural needs. Uses of Graymont products include the purification of air and water, and the production of items essential to a modern economy such as steel, paper, and metals. Headquartered in Canada, Graymont serves markets throughout North America and Asia-Pacific. Graymont is also the strategic partner of Mexican-based Grupo Calidra, the largest lime producer in Latin America.

Professionally managed and family owned, the company has been in operation for over 70 years. Graymont aims to be the preferred supplier, employer, and partner of choice wherever they operate.

For further information, refer to Graymont's website, here: https://www.graymont.com/en

Table 3. Proponent details

Details	Proponent
Entity	Graymont (Calliope) Pty Ltd
ABN	24 004 406 688
Contact	Vicki Robins
Address	24 Taragoola Road, Calliope QLD 4680
Phone	+07 4975 4112
Email	Vicki.robins@graymont.com



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 1 Regional location.qgz

Legend

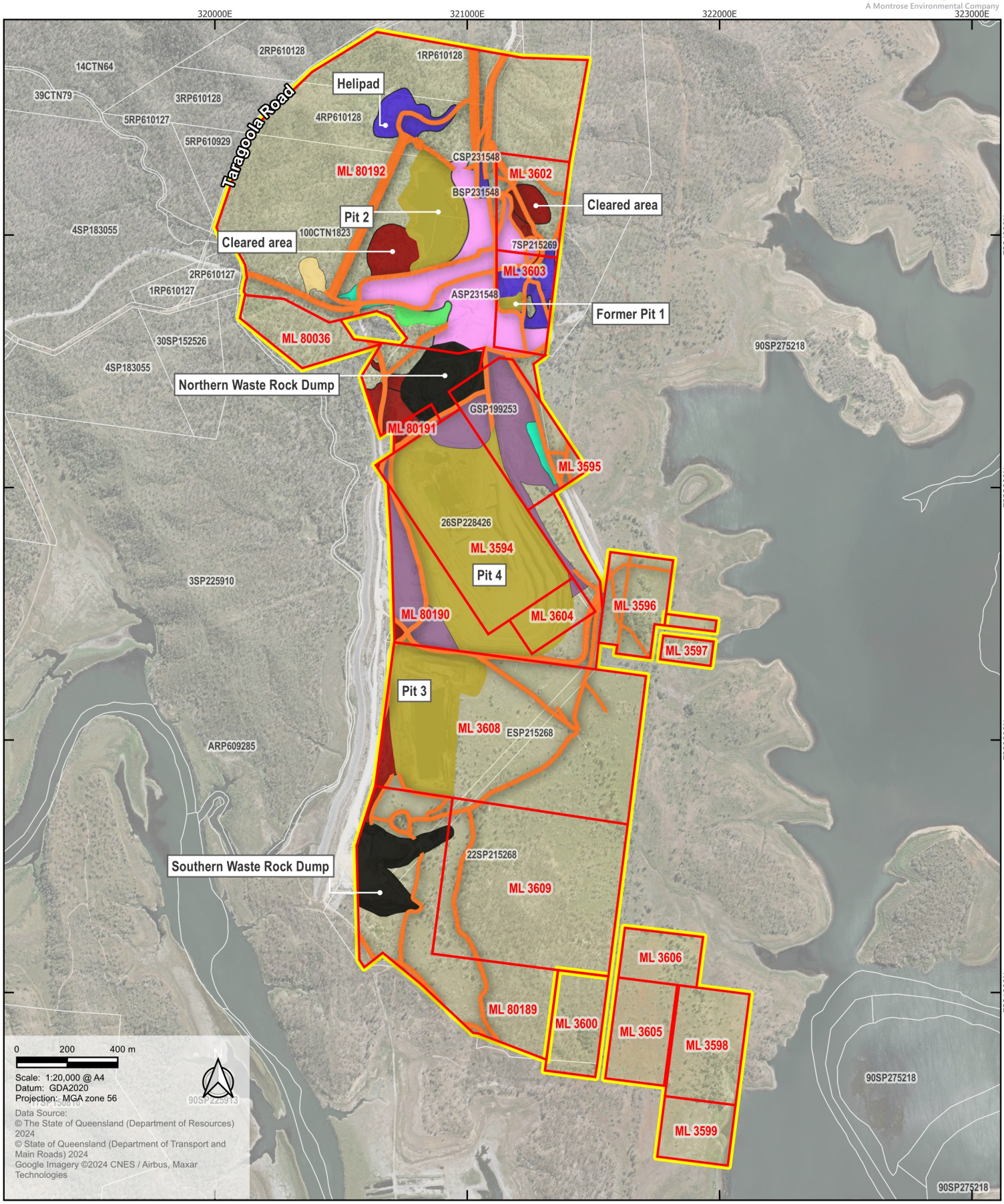
- Site boundary
- Mining leases
- Cadastre (DCDB)
- State controlled roads
- Railways

Watercourses

- Major
- Minor

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 1
Regional location



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 2 Current disturbance area.qgz

Legend

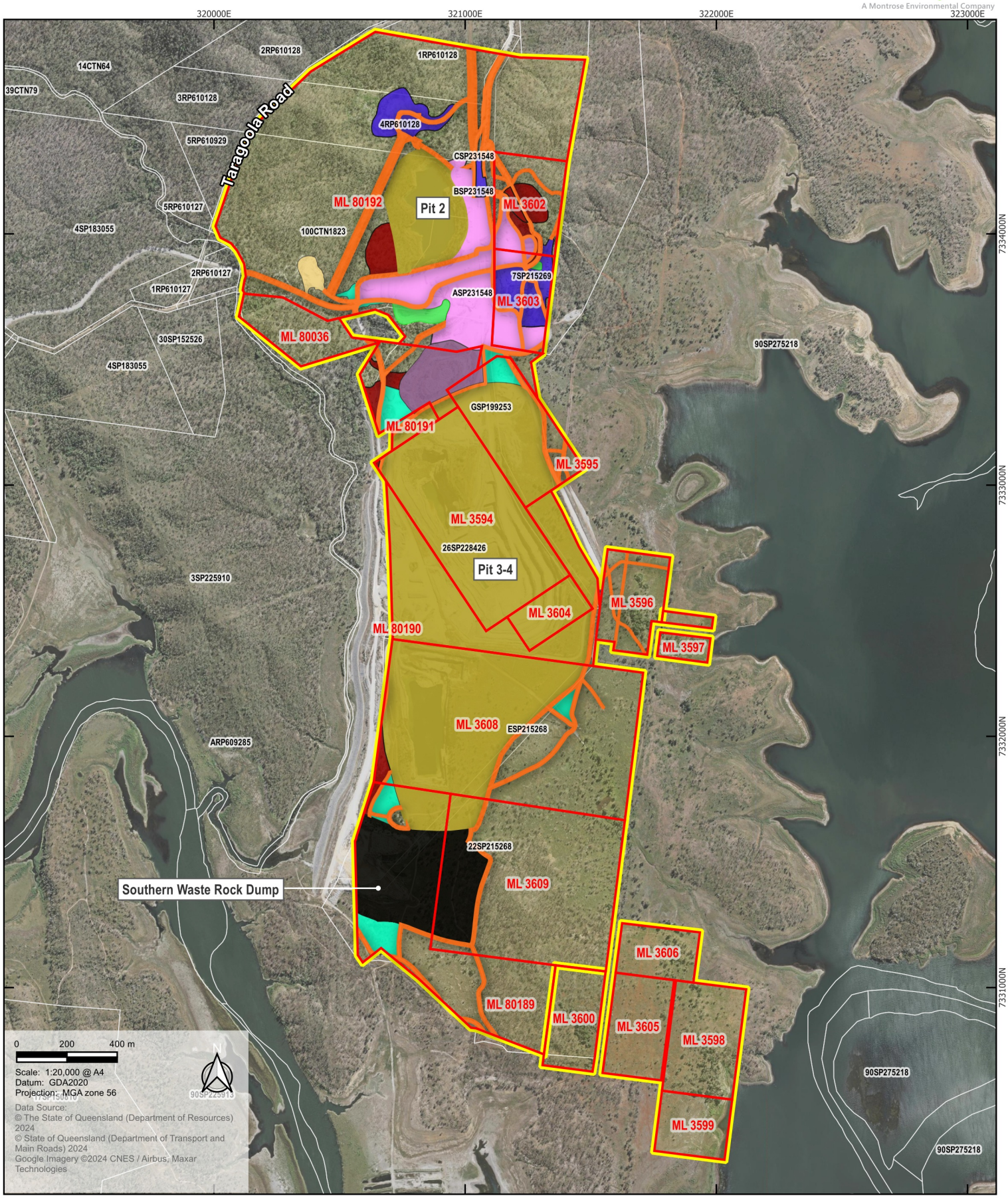
- Site boundary
- Mining Leases
- Cadastre (DCDB)

Current disturbance

- Access tracks
- Cleared areas and laydowns
- Infrastructure and plant
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 2
Current disturbance area



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 3 Maximum disturbance extent.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Mining Leases

Maximum disturbance

- Access tracks
- Cleared areas and laydowns
- Infrastructure and plant
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 3
Maximum disturbance extent

1.5 Purpose and Context

Graymont are seeking to undertake an EA amendment under the EP Act to address proposed changes to disturbance footprints in EA EPML00969013. The minor EA amendment thresholds have been outlined within Section 3.1.1 of the '*Major or minor amendments*' guideline (ESR/2015/1684 Version 10.01) it has been determined that the proposed changes will trigger a Major EA amendment, as identified in **Table 4.** Specifically, the EA amendment will seek to include:

- An update to the authorised maximum disturbance area to account for intended mining operations until the EOML, based on the rectified ML boundaries in DNRMMRRD's database
- Contemporised EA conditions to align with the MERFP Act, through the inclusion of conditions related to the PRC Plan and ERC

The new PRC Plan application (PRCP-EPML00969013-V1) was submitted for the Project on 11 July 2025 and is not yet approved. Therefore, whilst this report proposes an amendment to ensure the EA can be consistent with the PRC Plan, it is not considered a minor amendment based on the PRC Plan threshold or as a result of an amendment to the PRC Plan Schedule. Therefore, these criteria have not been considered in **Table 4**.

Table 4. Cross-reference of section 4.1.1 minor (EA) amendment (threshold criteria)

Section 4.1.1 A minor amendment (threshold) for an EA is an amendment that:	**Application Assessment**
a) is not a change to a condition identified in the authority as a standard condition, other than – (i) a change that is a condition conversion; or (ii) a change that is not a condition conversion but that replaces a standard condition of the EA with a standard condition for the ERA to which the EA relates; or (iii) a change that will not result in a change to the impact of the relevant activity on an environmental value; and	**Threshold not Exceeded** The amendment will include some administrative changes to align with current in-force legislation but will not involve a change to any standard conditions.
b) does not significantly increase the level of environmental harm caused by the relevant activity; and	**Threshold Exceeded** The Project may significantly increase the level of environmental harm caused by the relevant activity.
c) does not change any rehabilitation objectives in the EA in a way likely to result in significantly different impacts on environmental values than the impacts previously permitted under the EA; and	**Threshold not Exceeded** The proposed post-mining land uses (PMLUs) of the PRC Plan (PRCP-EPML00969013-V1) are consistent with the rehabilitation outcomes currently conditioned in the EA.
d) does not significantly increase the scale or intensity of the relevant activity; and	**Threshold not Exceeded** The existing operation is proposed to continue for another nominal 75 years at the same scale and intensity to produce approximately 0.8 Mtpa of limestone products. The EA amendment does not propose any changes to the ROM rate or thresholds, and no new ERAs are proposed to be added. Therefore, the proposed amendment is not considered to cause a significant increase to the scale or intensity of the existing operation.
e) does not relate to a new relevant resource tenure for the EA that is— (i) a new mining lease; or (ii) a new petroleum lease; or (iii) a new geothermal lease under the *Geothermal Energy Act 2010*; or (iv) a new greenhouse gas injection and storage lease under the *Greenhouse Gas Storage Act 2009*; and	**Threshold not Exceeded** Not applicable, all ML tenures currently exist.

Section 4.1.1 A minor amendment (threshold) for an EA is an amendment that:	Application Assessment
f) involves an addition to the surface area for the relevant activity of no more than 10% of the existing area; and	**Threshold Exceeded** The Project includes 45.18 ha of proposed new disturbance, additional to the 162.64 ha of existing disturbance. This represents an increase of 28% of additional disturbance (refer **Table 1**). The proposed maximum disturbance area of 207.82 ha is 83% of the currently authorised total disturbance area of 250.65 ha in the EA. Therefore, the maximum disturbance area is 17% less than the total authorised disturbance in the EA.
g) for an EA for a petroleum activity: (i) involves constructing a new pipeline that does not exceed 150km in length; or (ii) involves extending an existing pipeline by no more than 10% of the existing length of the pipeline; and	**Threshold not Exceeded** Not applicable, the Project is a mining activity only.
h) if the amendment relates to a new relevant resource tenure for the authority that is an exploration permit or greenhouse gas permit—the amendment application seeks an EA that is subject to the standard conditions for the relevant activity, to the extent it relates to the permit.	**Threshold not Exceeded** Not applicable, the Project does not relate to any new resource tenures.

1.6 Properly Made Application

This EA Amendment Report has been prepared for the DETSI as supporting information for the amendment application under Chapter 5, Part 7 of the EP Act and to assist the administering authority in making an assessment level decision under Chapter 5, Part 7, Division 3 of the EP Act.

In order to satisfactorily comply with the requirements for an amendment application, an adequacy checklist for this EA Amendment has been developed in order to guide Assessing Officers to relevant sections throughout the document (**Table 5**).

Table 5. EA amendment requirements from the *Environmental Protection Act 1994*

EA Amendment Requirements	Relevant Section/ Description
Section 226 Requirements for amendment applications generally (1) An amendment application must-	
(a) Be made to the administering authority; and	This report has been prepared for the DETSI as the administering authority, as outlined in **Section 1.5**
(b) Be made in the approved form; and	This report is in the approved form.
(c) Be accompanied by the fee prescribed by regulation; and	This report is accompanied by the fee prescribed under the EP Regulation.
(d) Describe the proposed amendment; and	Refer **Section 6**
(e) Describe the land that will be affected by the proposed amendment; and	Refer to project description in **Section 3**
(f) Include any other document relating to the application prescribed by regulation.	The Environmental Management Plan (EMP) is provided in **Appendix A** and the Plan of Operations is provided in **Appendix B**
Section 226AA- Requirement for amendment application by holder of environmental authority and PRCP schedule (1) This section applies if-	
(a) the holder of an environmental authority and a PRCP schedule for the environmental authority (each a relevant environmental requirement) makes an amendment application; and	Not applicable, whilst the purpose of the EA amendment is to ensure consistency with the PRC Plan (PRCP-EPML00969013-V1) and to capture the maximum disturbance areas until EOML, the PRC Plan is not yet approved.
(b) the application is to amend only 1 of the relevant environmental requirements; and	

EA Amendment Requirements	Relevant Section/ Description
(c) the approval of the amendment application would result in the relevant environmental requirement to which the application relates being inconsistent with the other relevant environmental requirement.	
(2) The holder must make an amendment application to amend both relevant environmental requirements in a way that, if the amendment application were approved, would not result in 1 of the relevant environmental requirements being inconsistent with the other relevant environmental requirement.	
Section 226A Requirement for amendment applications for environmental authorities (1) If the amendment application is for the amendment of an environmental authority, the application must also-	
(a) describe any development permits in effect under the Planning Act for carrying out the relevant activity for the authority; and	No Development Permits apply.
(b) state whether each relevant activity will, if the amendment is made, comply with the eligibility criteria for the activity; and	There would be more than 10 hectares (ha) of land to be significantly disturbed at one time, however, the proposed disturbance area is less than the authorised disturbance area currently in the EA. The proposed disturbance areas are not mapped as Category A or B environmentally sensitive areas (ESAs). Progressive rehabilitation will occur where possible in accordance with the PRC Plan (PRCP-EPML00969013-V1).
(c) if the application states that each relevant activity will, if the amendment is made, comply with the eligibility criteria for the activity—include a declaration that the statement is correct; and	Not applicable
(d) state whether the application seeks to change a condition identified in the authority as a standard condition; and	This application does not propose to change any standard conditions.
(e) if the application relates to a new relevant resource tenure for the authority that is an exploration permit or GHG permit—state whether the applicant seeks an amended environmental authority that is subject to the standard conditions for the relevant activity or authority, to the extent it relates to the permit; and	This application does not relate to new relevant resource tenure for an exploration or GHG permit.
(f) include an assessment of the likely impact of the proposed amendment on the environmental values, including – (i) a description of the environmental values likely to be affected by the proposed amendment; and (ii) details of emissions or releases likely to be generated by the proposed amendment; and (iii) a description of the risk and likely magnitude of impacts on the environmental values; and (iv) details of the management practices proposed to be implemented to prevent or minimise adverse impacts; and (v) if a PRCP schedule does not apply for each relevant activity—details of how the land the subject of the application will be rehabilitated after each relevant activity ends; and	Refer **Section 4** for relevant environmental values (EVs). Refer **Section 7** for potential impacts. Refer **Section 8** for the risk assessment and mitigation measures A PRC Plan (PRCP-EPML00969013-V1) does apply for this Project, further described in **Section 2.1.1** and **Section 8.3.**.
(g) include a description of the proposed measures for minimising and managing waste generated by amendments to the relevant activity; and	Refer **Section 4.9** and **Section 7** for consideration of waste.
(h) include details of any site management plan or environmental protection order that relates to the land the subject of the application.	This Project has an EMP provided in **Appendix A** and the Plan of Operations is provided in **Appendix B**

1.7 Pre-Lodgement

A pre-lodgement meeting was initially held with the DETSI (formerly DES) on 29 April 2022, with attendees from Graymont, Epic Environmental, and the Department. The meeting included discussions of the background, location, current operations, PRC Planning progress and key matters and actions to inform the PRC Plan (PRCP-EPML00969013-V1) and EA Amendment being prepared for the Project.

Additional pre-lodgement meetings were held with the Department on 3 May 2023 and 5 March 2025, with attendees from Graymont, Epic Environmental, and the Department. The meetings included discussions of the status of the Project in relation to the EA Amendment and PRC Plan approval applications and next steps. Questions relating to the Not Properly Made Notice, and timing implications of resolving the ML discrepancy with the former Department of Resources (now DNRMMRRD) was also discussed.

2 LEGISLATIVE FRAMEWORK

Applicable Commonwealth, State, and local legislation is presented in **Table 6**.

Table 6. Commonwealth, state and local legislation

Legislation	Framework	Application to Project
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act provides a legal framework to protect and manage nationally and internationally important aspects of the Australian environment including its biodiversity and heritage places.	A significant impact assessment of matters of national environmental significance (MNES), including a likelihood of occurrence assessment was undertaken for the Project by Epic. It was found that the potential for a significant impact on MNES was unlikely.
Native Title Act 1993 (NT Act)	The objectives of the NT Act include providing for the recognition and protection of native title. The NT Act also provides a mechanism for ensuring that future acts such as the grant of mining leases, or the rights to construct and operate under such authorities, are undertaken in accordance with procedural rights given to relevant native title parties.	There are no Native Title determinations or claims over the Project area, however Raggote Creek which borders the western boundary of the Project, is mapped as Registered Native Title , refer to **Section 4.11.1** for applicability to the Project.
Great Barrier Reef Marine Park Act 1975 (GBRMP Act)	The purpose of the *Great Barrier Reef Marine Parks Act 1975* (GBRMP Act) is to provide long term protection and conservation of the Great Barrier Reef (GBR) region. The Act allows for ecologically sustainable use consistent with the Reef's protection and conservation. This is the governing legislation for the Reef Plan 2050, which is the overarching policy framework for managing the GBR to 2050. The regulation of activities in the GBR catchment area is set out under the EP Regulation.	The site is located in the Boyne River Basin (Basin no. 133) of the GBR catchment area. The Proposed activity does not propose to release water or waste to GBR catchment waters or other coastal waters. Refer to **Section 2.2** for an assessment of the Proposed activity against the requirements for activities in the GBR catchment area.
State		
EP Act	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 operates under an EA in accordance with the EP Act. Activities which cause or are likely to cause environmental harm constitute offences unless authorised through the EA.
EP Regulation	A resource activity is considered to be an ERA and is defined as a mining activity, being an 'authorised activity for a mining tenement' under the MR Act (Schedule 2). Such authorised activities include the act of mining, processing, and ancillary activities in support of a mining operation. Schedule 2 of the EP Regulation lists the resource ERAs.	EA EPML00969013 approves the relevant ERA for the resource activity occurring onsite, Schedule 3 21: A mining activity that is an ineligible ERA other than a mining activity mentioned in Items 9 to 20.

Legislation	Framework	Application to Project
		Extractive activities are authorised and conducted under ERA 16(2)(d) and EA EPPR00881913 (original permit # SPCE04023712 issued under the Sustainable Planning Act 2009). The Project also has approval under EA EPPR00881913 for the following ancillary prescribed ERAs: • ERA 8 (3a) - Chemical storage >10m3 but 1,000,000 tonnes (t) of material • ERA 16 (3c) – Screening in a year >1,000,000 t of material • ERA 50 (2) - Bulk material handling >100 t day The Project will comprise backfilling of clean waste rock only into the Pit, therefore ERA 60 waste disposal will not be triggered. Environmental objectives per Schedule 8 of the EP Regulation are also considered within the LOM plan to minimise impact and performance outcomes adopted where required to manage and mitigate potential impacts.
Fisheries Act 1994 (Fisheries Act)	The Fisheries Act provides for the management, use, development and protection of fish habitats and resources. This includes waterways potentially used for 'fish passage' (considered as a MSES) as mapped within waterways for waterway barrier works mapping administered by the Department of Agriculture and Fisheries (DAF). Environmental offsets may be required where significant residual impact to waterways for fish passage are identified (including permanent, partial and temporary barriers).	Six low-risk waterways for waterway barrier works are mapped within the Project area.
Native Title (Queensland) Act 1993 (NT Qld Act)	The NT Qld Act recognises the land rights and interests of Indigenous peoples where they have historically resided and regulates the conduct of 'future acts', including development. The legislation provides for the determination of native title claims, the treatment of 'future acts' that may impact on native title rights and requires consultation and/or notification to relevant claimants. The provisions of the NT Ald Act are administered by the National Native Title Tribunal. The Tribunal is established to work with people to understand Native Title and reach outcomes that recognise everyone's rights and interests in land and waters.	There are no Native Title determinations or claims over the Project area, however Raggote Creek which borders the western boundary of the Project is mapped as Registered Native Title, refer **Section 4.11** for applicability to Project.

Legislation	Framework	Application to Project
Aboriginal Cultural Heritage Act 2003 (ACH Act)	The ACH Act binds all persons to provide recognition, protection, and conservation of Aboriginal cultural heritage. The Cultural Heritage Duty of Care (section 23 of the ACH Act) states: '*a person who carries out an activity must take all reasonable and practical measures to ensure the activity does not harm Aboriginal cultural heritage*'.	As part of the community consultation for the PRC Plan (PRCP-EPML00969013-V1) prepared for the Project, the First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC were notified of proposed operations and rehabilitation activities and invited to provide comment.
Queensland Heritage Act 1992 (Heritage Act)	The Heritage Act provides a framework for the conservation of Queensland's Cultural Heritage, with the objective of benefiting the community and future generations.	A search of the Queensland Heritage Register on 09 April 2025 did not identify any Registered Places within the Project area.
Mineral Resources Act 1989 (MR Act)	The MR Act, administered by the DNRMMRRD, provides for the assessment, development, and utilisation of mineral resources. The MR Act establishes a framework to facilitate mining-related activities, through the leasing of prospecting, exploration, mineral development, and mining tenure. The MR Act also sets royalty payments, rents, landholder compensation and notification requirements which CFS must comply with. Section 4A of the MR Act precludes the application of the *Planning Act 2016* to activities undertaken for purposes of the mining tenure, with the exception of provisions in relation to the Heritage Act. The MR Act also makes building work controlled under the *Building Act 1975* self-assessable development within the lease.	This EA amendment will address legacy issues regarding ML boundaries and disturbance areas to the alignment of future disturbances and ML boundaries in the DNRMMRRD's database. ML boundaries historically used at the Project (and now by Graymont) were different to State Mining Lease boundaries from the DNRMMRRD. To rectify this, a qualified surveyor has ground-truthed the ML boundaries and provided spatial data to DNRMMRRD who have now updated their database. The MLs currently available on public mapping websites now display the groundtruthed locations of the MLs. This EA Amendment seeks to update the authorised disturbance areas to reflect the intended future mining activities until the end of mine life.
Mining and Energy Resources (Financial Provisioning) Act 2018 (MERFP Act)	The MERFP Act came into force on 1 April 2019. The MERFP Act replaces the financial assurance arrangements for resource activities under the EP Act with the Financial Provisioning Scheme. The MERFP Act also amended the EP Act to require mining companies to develop PRC Plans. The main objectives of the MERFP Act are to: • Provide for holders of mining and resource authorities to pay a contribution to the scheme fund, or give a surety for rehabilitation costs • Manage the risk to the State of incurring costs and expenses of holders failing to complete rehabilitation • Provide a source of funds to the State for costs for residual mining impacts and legacy impacts DETSI will require an ERC and PRC Plan to be in place to ensure land disturbed by mining activities is rehabilitated to a safe, stable, and non-polluting landform that does not cause environmental harm and is able to sustain an approved post-mining land use. Once the EA has been granted for the Project, an application for an ERC decision can be lodged with the DETSI	A new PRC Plan (PRCP-EPML00969013-V1) was submitted to the DETSI on 11 July 2025. A valid ERC (EPML00969013) is also active for the Project until 30 June 2026.

Legislation	Framework	Application to Project
Nature Conservation Act 1992 (NC Act), *Nature Conservation (Animals) Regulation 2020* and *Nature Conservation (Plants Regulation) 2020*	In broad terms, the objective of the NC Act is the conservation of nature (plants and animals) within Queensland. Specifically, the NC Act seeks to gather relevant information, identify critical habitat areas, manage protected areas, protect wildlife and promote ecologically sustainable development. The NC Act has 10 subordinate regulatory instruments in the form of regulations, conservation plans and notices. Of relevance to the Project is the *Nature Conservation (Animals) Regulation 2020* and *Nature Conservation (Plants Regulation) 2020* which lists the protected flora and fauna species (extinct in the wild, endangered, vulnerable, near threatened) and also international wildlife and prohibited wildlife. Under the NC Act, permits for the movement of protected animals and the clearing of protected plants are required and a Species Management Program must be approved when interfering with protected native fauna habitat and breeding places. The Act also provides legislative guidance in offsets in respect to the conservation and protection of flora and fauna deemed to be of State significance.	Impacts to Matters of State Environmental Significance (MSES) are considered in the Ecology Field Report provided in **Appendix C** and summarised in **Section 7.4.**
Environmental Offsets Act 2014 (Offsets Act), *Environmental Offsets Regulation 2014* (Offsets Regulation) and the *Queensland Government Environmental Offsets Policy* (Offsets Policy)	The Offsets legilsation provide a streamlined framework for environmental offset requirements. Environmental offsets (offsets) provide the flexibility to approve development in one place on the basis of a requirement to make an equivalent environmental gain in another place where there is not the same value to industry. An environmental offset may be required as a condition of approval where the activity is likely to result in a significant residual impact on prescribed environmental matters as identified through the following guidelines: • The State guideline that provides guidance on what constitutes a significant residual impact for a Matter of State Environmental Significance (MSES) • The Commonwealth Significant Impact Guidelines for what constitutes a significant residual impact on a Matter of National Environmental Significance (MNES) • Any relevant local government significant impact guideline for Matters of Local Environmental Significance (MLES) Offsets may be delivered through a variety of manners, including financial settlement offsets, proponent driven offsets and a combination of these approaches. To avoid duplication of offset conditions between jurisdictions, State and local governments can only impose an offset condition in relation to a prescribed activity, if the same, or substantially the same impact and the same, or substantially the same matter has not been subject to assessment under the EPBC Act.	Impacts to MSES are considered in the Ecology Field Report provided in **Appendix C** and summarised in **Section 7.4.**
Water Act 2000 (Water Act)	The Water Act provides a structured system for the planning, protection, allocation and use of Queensland's surface waters and groundwater. Under the Water Act, a person must not take, supply, or interfere with water unless authorised for the taking of water from overland flow, groundwater, a watercourse, lake, or spring. Resource tenure holders can access underground water taken in the course of, or as a result of, exercising underground water rights. Thus, no authority is required for the use of water from mine dewatering undertaken to the extent necessary to achieve safe operating conditions.	The Project has onsite water storage within Pit 2 which supports all Project activities. As such, the Project does not access surface water or groundwater requiring authorisation under the Water Act and there are no existing water licences for the Project.
Mining and Quarrying Safety	The MQSH Act applies to all mines, other than coal mines. It imposes safety and health obligations on persons who operate mines or who may affect the safety or health of others at mines, including:	Graymont as the operator of the Project is required to manage the risk in a way that shows that the mining

Legislation	Framework	Application to Project
and Health Act 1999 (MQSH Act)	• Implementing a safety management system • Site representatives on the Project • Worker with adequate competencies • Supervision • Incident reporting • Emergency preparedness. The MQSH Act requires risk to a person from operations to be at an acceptable level, which means within acceptable limits and as low as reasonably achievable (Section 26). The Project will incorporate a hierarchy of controls from elimination, substitution, isolation, engineering, administration, and personal protective equipment. There are a number of guidelines specified by the Minister under Section 63(1) which provide ways of achieving an acceptable standard of risk for people working in mineral mines and quarries.	method used is at least equivalent to the method in the guideline.
Waste Reduction and Recycling Act 2011	The legislation establishes a framework for waste management and resource recovery practices in Queensland. It promotes waste avoidance and reduction and encourages resource recovery and efficiency.	Waste transport and disposal is managed by an appropriately qualified waste constructor, therefore any ERAs related to waste do not apply.
Regional Planning Interests Act 2014 (RPI Act)	The RPI Act identifies and protects areas that are of regional interest throughout Queensland. The RPI Act is supported by the RPI Regulation and aims to: • Manage the impact of resource and regulated activities on areas of regional interest • Support these activities with other activities, such as highly productive agricultural activities • Assist in resolving land use conflict between activities which contribute to the State's economy	There are no declared interest areas within the Project footprint or immediate surroundings which require further approvals or management.
Planning Act 2016	The Planning Act establishes Queensland's planning framework and is supported by other Acts and regulations. The Planning Act also establishes the framework of planning instruments that support the operation of the three main systems: plan-making, development assessment and dispute resolution. Further, the Planning Act provides the Planning Minister with powers that can be enacted in response to matters that relate to state interests. Section 4A of the MR Act precludes the application of the Planning Act to activities undertaken for purposes of mining tenure, with the exception of provisions in relation to the *Queensland Heritage Act 1992*. The MR Act also makes building work controlled under the *Building Act 1975* self-assessable development within the lease.	All mining activities occur within the Project's MLs, therefore, the *Planning Act 2016* does not apply.
Vegetation Management Act 1999 (VM Act)	The VM Act regulates the clearing of vegetation in Queensland in a way that conserves remnant vegetation, ensures clearing does not cause land degradation, prevents loss of biodiversity, maintains ecological processes, reduces greenhouse gas emissions and allows for sustainable land use.	The clearing of native vegetation for the Project will be exempt from the provisions of the VM Act under Schedule 21 (Part 1, section 1, item 6) of the *Planning Regulation 2017* where clearing occurs within the Project ML for a mining activity.

Legislation	Framework	Application to Project
Land Act 1994	The *Land Act 1994* administers and manages non-freehold land and deeds of grant in trust, and the creation of freehold land.	As the Project is located on freehold land owned by Graymont and GAWB, and Project infrastructure does not and will not occupy any state land including lease land, unallocated state land, road reserves or stock routes, the *Land Act 1994* does not apply.
Biosecurity Act 2014 (Biosecurity Act)	The Biosecurity Act provides a consistent, modern, risk-based, and less prescriptive approach to biosecurity in Queensland. The Biosecurity Act provides comprehensive biosecurity measures in relation to pests (e.g. wild dogs and weeds), diseases (e.g. foot-and-mouth disease) and contaminants (e.g. lead on grazing land). Decisions made under the Biosecurity Act will depend on the likelihood and consequences of risk, allowing for more appropriate management of risks.	Graymont have a 'general biosecurity obligation' under the Biosecurity Act (s23) to manage biosecurity risks and threats under their control. Refer **Section 4.5.3** for identified biosecurity matters.
Transport Infrastructure Act 1994	Before any road works (including road access works) can be undertaken within a State-controlled road, written approval is required from the Department of Transport and Main Roads. It is an offence under section 33 of the *Transport Infrastructure Act 1994* (TI Act) to carry out road works on a State-controlled road without written approval.	The Project utilises state-controlled roads to deliver limestone products to customers offsite for further downstream processing. Historically, limestone was loaded onto trains via Rail Siding Road (to the east of the Project) to be transported to Gladstone, however it is now transported via Taragoola Road to the north of the Project. As the rail infrastructure still exists, there may be potential in the future for limestone export to commence again via rail.
Local		
Gladstone Regional Council Planning Scheme 2017 (Planning Scheme)	The Planning Scheme regulates the use and development of land and describes plans for managing change and growth in the Gadstone Regional Council LGA, in consultation with the local community.	The Project is zoned as rural under the Planning Scheme and is not within the flood hazard investigation area.
State Planning Policy 2017 (SPP)	The SPP provides a framework for planning and development across Queensland. It sets out the government's objectives, principles, and strategies for land use planning, development, and environmental management. It aims to balance economic development with environmental and social considerations. The SPP covers a wide range of topics including urban growth, housing, transport, infrastructure, natural resource management, and environmental protection. The SPP outlines guidelines and objectives for resource extraction and Key Resource Areas (KRAs). KRAs are regions with significant mineral or energy resources. These areas are prioritized for resource extraction activities while ensuring sustainable land use and environmental protection.	The Project is zoned as a KRA No: 19 (resource and processing area) under the SPP.

2.1.1 PRC Plan and ERC

An ERC (ERC100436752) was prepared for the Project and took effect from 4 December 2023. The ERC period is three years, valid until 30 June 2026. A proposed PRC Plan (PRCP-EPML00969013-V1) has been prepared for the Project in accordance with the MERFP Act and EP Act. The PRC Plan was first submitted on 16 March 2023 and was resubmitted as a new application on 11 July 2025. The PRC Plan includes a description of the rehabilitation areas and milestone criteria proposed for EOML in 2100. All areas that are disturbed within the Project's MLs will be rehabilitated, with exception to the access tracks and levees which will be retained for ongoing access by GAWB.

The proposed PMLU will be predominantly grazing for livestock, consistent with surrounding land uses. Mine pits within the Project area (with exception to Pit 1) will have a PMLU of water storage. Access tracks will be retained for land management and access. Further information about rehabilitation and closure is provided in **Section 8.3.**

2.1.2 Assessment Against Criteria for Environmental Impact Statements

The Project was assessed against the *'Criteria for environmental impact statements (EIS) for resource projects under the Environmental Protection Act 1994'*(Criteria) (ESR/2016/2167), in accordance with requirements for assessment of resource projects in Section 143 and 228 of the *Environmental Protection Act 1994* (EP Act). From this assessment, it was **determined that an EIS is not required for this Project** as it does not trigger any of the Appendix B EIS triggers and all items in Section 3 of the Criteria and Appendix A Standard Criteria have been appropriately considered (see **Table 7**).

Table 7. EIS criteria cross-reference table

In making the decision if an EIS is required, the department will take into account:	Application Response
The relative magnitude (scale and risk) of impacts (e.g., impacts on matters of state environmental significance, water quality and resources, environmentally sensitive areas (Category A, B and/or C), air, noise)	This EA Amendment supporting information report has considered the relative magnitude (scale and risk) of impacts and determined the magnitude of impacts to be not significant. Impacts for EVs can be found in **Section 7**, the risk assessment and management measures are provided in **Section 8.**
The public interest	Community consultation has occurred for the Project, with no key issues raised. Further information is provided in **Section 9.3**. Calliope Limestone Quarry produces lime products which have various uses including water purification and cement production. In this sense, the Project is in the public interest.
Uncertainty about possible impacts	Baseline studies have been undertaken for the Project. Findings of the studies have been described in **Section 4** and **Section 7** and provided as appendices. Impacts from the Project are understood for the life of the mine.
Any significant issues with another Queensland Government/ Australian Government authority (e.g., matters of national environmental significance under the *Environment Protection and Biodiversity Conservation Act 1999*, agriculture, fisheries, transport)	There are no significant issues with other Queensland or Australian authorities. A significant impact assessment of MNES has been undertaken and found that a significant impact from the Project would be unlikely. A new PRC Plan (PRCP-EPML00969013-V1) application was submitted to the DETSI on 11 July 2025 and is not yet approved.
Social and economic impacts	Social and economic impacts have been considered in **Section 4.10** and **Section 7.7.** The Project will not result in any significant impacts to the local community or economy.
Cumulative impacts, including consideration of: • state and regional planning • strategic assessments (e.g., *Environment Protection and Biodiversity Conservation Act 1999*) • bioregional assessments	The Project commenced operations in 1967 and is not in proximity to any conflicting Projects. Regional planning has been considered in **Section 3.1** and **Section 3.5**. Bioregional assessments including MNES have been described in **Section 4.4.10.** Social and economic impacts have been considered in

In making the decision if an EIS is required, the department will take into account:	Application Response
• regional air/water/noise plans, monitoring and modelling • social and economic impacts • matters of national and state environmental significance or other environmental values.	**Section 4.10** and **Section 7.7.** Water modelling has been undertaken in the hydrogeological assessment provided in **Appendix E.**
Appendix A- Standard criteria	
a) the following principles of environmental policy as set out in the Intergovernmental Agreement on the Environment— i. the precautionary principle; ii. intergenerational equity; iii. conservation of biological diversity and ecological integrity; and	• There is a low level of uncertainty associated with the potential impacts and cumulative impacts • Best practice environmental management practices have been applied as much as possible. • In accordance with the Department of Environment and Energy's Intergovernmental Agreement of the Environment: - The precautionary principle has been applied to the Project where possible, by keeping extended disturbance activities within the existing footprint as much as possible. This included construction of a helipad within a previously disturbed area and amalgamating Pit 3-4 to the north where current spoil pile areas are located. Further studies were undertaken to understand the impacts of the Project at EOML, as provided in the appendices, and to support the assessment of risk-weighted consequences assessed in **Section 8.2**. - Intergenerational equity was considered through the development of the Progressive Rehabilitation and Closure Plan to ensure the health, productivity and diversity of the environment is maintained and enhanced for the benefit of future generations. Intentions of the operation and rehabilitation of the site have been communicated to relevant stakeholders, who showed interest in the Project (refer **Section 9.3)**. - Conservation of biological diversity and ecological integrity has been considered. Application of the mitigation hierarchy allowed for avoidance of identified EVs as much as possible (refer **Section 4**). Controls to minimise and mitigate residual impacts to EVs are outlined in **Section 7**.
b) any Commonwealth or State government plans, standards, agreements or requirements about environmental protection or ecologically sustainable development; and	Relevant Commonwealth or State government plans, standards, agreements, or requirements are discussed in **Section 2.**.
d) any relevant environmental impact study, assessment or report; and	Technical studies undertaken to support this report are included as appendices.
e) the character, resilience and values of the receiving environment; and	The character, resilience, and values of the receiving environment has been considered in **Section 4** and **Section 7.** The risk assessment has been presented in **Section 8.**
f) all submissions made by the applicant and submitters; and	This EA amendment reflects the mine plan proposed in the PRC Plan (PRCP-EPML00969013-V1) and ERC (ERC100436752). It is the first EA amendment by Graymont since they acquired the Project in 2019.
g) the best practice environmental management for activities under any relevant instrument, or proposed instrument, as follows— i. an environmental authority ii. a transitional environmental program	EA conditions and management has been discussed throughout this report. Items ii, iii, iv and v do not apply to this Project.

In making the decision if an EIS is required, the department will take into account:		Application Response
	iii. an environmental protection order iv. a disposal permit v. a development approval; and	
h)	the financial implications of the requirements under an instrument, or proposed instrument, mentioned in paragraph (g) as they would relate to the type of activity or industry carried out, or proposed to be carried out, under the instrument; and	The financial implications of the requirements under the SSEA have been adequately incorporated into the mining planning and ERC (ERC100436752) for the Project, valid until 30 June 2026.
i)	the public interest; and	Key stakeholders have bene identified and consulted about the Project, with no key issues raised. Further information is provided in **Section 9.3**. Calliope Limestone Quarry produces lime products which have various uses including water purification and cement production. In this sense, the Project is in the public interest.
j)	any relevant site management plan; and	The Project does not have a site management plan as the underlying Lot and Plans are not listed on the Environmental Management Register. Notifiable activities are conditioned under the Project's EA. Therefore, the requirement for a site management plan as part of the PRC Plan under Section 125(1)(L)(iii) of the EP Act does not apply to this Project. The Project had an active Plan of Operations in place from 2018 to 2023, provided in **Appendix B**, and an EMP provided in **Appendix A.** These documents provide further information about daily operations and procedures including the Project's monitoring program that compliments the EA conditions.
k)	any relevant integrated environmental management system or proposed integrated environmental management system; and	Graymont is committed to achieving industry leadership in sustainability. Graymont's focus in the context of health, safety and environmental management systems is on air emissions, energy efficiency and waste reduction, with an aim to be able to reduce impacts to the environment primarily in these areas. Further information about Graymont's systems can be found on their website: https://www.graymont.com/en/sustainability/environmental-care
l)	any other matter prescribed under a regulation	The Project is an existing operation with an approved ERC (ERC100436752) in place, and the PRC Plan (PRCP-EPML00969013-V1).
Appendix B- EIS triggers		
For greenfield (new) mine proposals		
1.	Would the application involve the removal of two million tonnes per year or more of run-of-mine (ROM)1 ore or coal?	Not applicable, the Project is an existing (brownfield) operation
2.	Would the application involve the removal of one million tonnes per year or more of ROM ore or coal on or under a floodplain or in a coastal hazard area?	
3.	Would the application involve the introduction of a novel or unproven resource extraction process, technology or activity?	
For proposals to amendment/alter an existing mine		
4.	For mines already removing 2–10 million tonnes per year ROM ore or coal, would the application increase the current annual removal rate by more than 100% or 5 million tonnes per year (whichever is the lesser)?	No, the Project will not be removing 2-10 million tonnes per year of ore.

In making the decision if an EIS is required, the department will take into account:	Application Response
5. For mines already removing over 10 million tonnes per year ROM ore or coal, would the application increase the current annual removal rate by more than 50% or 10 million tonnes per year (whichever is the lesser)?	No, the Project will be removing under 10 million tonnes of ore per year.
6. For mines already removing more than 20 million tonnes per year ROM ore or coal, would the application increase the current annual removal rate by more than 25%?	No, the Project will not remove more than 20 million tonnes of ore per year.
7. Would the application involve an extension into and significant impact on a Category A or B environmentally sensitive area, which is not already authorised by the State?	No, the Project will not have a significant impact on a Category A or B ESA.
8. Would the application involve a substantial change in mining operations—such as from underground to open cut, or (for underground mining) a change in operations from one causing little subsidence to one likely to cause substantial subsidence?	No, the mining method is consistent with what has previously been used within the Project area. The Project is a brownfield Project, with extensive disturbance from previous mining. The Project will use existing pits.
9. Would the application introduce a novel or unproven resource removal process, technology or activity?	No, the Project does not introduce any novel or unproven removal process, technology or activity.

2.2 Requirements for Activities in the Great Barrier Reef Catchment Area

Activities proposed within the GBR catchment waters are required to address the provisions under the EP Regulation to determine if reef discharge standards apply. Reef discharge standards aim to achieve no net decline to water quality of the GBR catchment area in line with the commitments under the *Reef Plan 2050*. The Proposed activity is located within the GBR catchment area, specifically within the Boyne River Basin (Basin no. 133), therefore assessment against the provisions under the EP Regulation apply.

The EP Act Guideline *Reef Discharge Standards for Industrial Activities* (DESI 2024j) sets out the criteria for determining if a residual impact[1] to the GBR catchment is likely to occur as a result of a relevant activity and whether further consideration under s41AA[2] of the EP Regulation by the administering authority applies. Each of the criteria need to be fulfilled in order to trigger consideration of s41AA of the EP Regulation. An assessment of this criteria against the Proposed activity is provided in **Table 8.** Based on the assessment, there will be no residual impact as the Proposed activity does not fulfill all the criteria and therefore does not trigger further consideration of section 41AA of the EP Regulation.

Table 8. Criteria for residual impact to GBR catchment area

Criteria	Triggered by	Relevance to Proposed activity
Application type	• A site-specific EA application under Chapter 5 of the EP Act • A major amendment application under Chapter 5 of the EP Act • A standard application is made for a mining activity for a mining lease, and a properly made submission has been received	**Applicable.** This is an application for a major amendment

[1] Under Section 41AA (4), a residual impact of a relevant activity is the presence of fine sediment, or dissolved inorganic nitrogen, in GBR catchment waters, or waters mentioned in section 41AA (1)(b) of the EP Regulation, that—
(a) was released to the water because of the relevant activity; and
(b) remains, or is likely to remain, in the water despite mitigation measures for the relevant activity.

[2] Under Section 41AA of the EP Regulation, the administering authority must refuse to grant an application if the authority considers that:
(a) the relevant activity will, or may, have a residual impact; and
(b) having regard to the matters mentioned in the water quality offset policy, the residual impact will not be adequately counterbalanced by offset measures for the relevant activity.

Criteria	Triggered by	Relevance to Proposed activity
	• A variation application is made, and the variation relates to releases to waters • A decision on a transitional environmental program (TEP) under section 338(1)(a) of the EP Act. See the Transitional Environmental Program guideline (ESR/2016/2277)6 for further information.	
Activity type	Resource and prescribed ERAs except for the following ERAs as described in Schedule 2 of the EP Regulation: • ERA 16 - Extractive and screening activities to the extent the activity is dredging in the coastal waters of the State (as defined in section 41AA) this includes any ancillary activity associated with ERA 16 that is dredging in coastal water of the State such as ERA 50; and • ERA 13A - Commercial cropping and horticulture in the Great Barrier Reef catchment.	**Applicable**. This application relates to a prescribed ERA for a resource activity. EA EPML00969013 approves the relevant ERA for the resource activity occurring onsite, Schedule 3 21: A mining activity that is an ineligible ERA other than a mining activity mentioned in Items 9 to 20. Extractive activities are authorised and conducted under ERA 16(2)(d) and EA EPPR00881913, which includes the following ancillary prescribed ERAs: • ERA 8 (3a) - Chemical storage >10m3 but 1,000,000 tonnes (t) of material • ERA 16 (3c) – Screening in a year >1,000,000 t of material • ERA 50 (2) - Bulk material handling >100 t day
Release location	The release is to the GBR catchment waters[3].	**Not applicable.** This application does not propose any release to GBR catchment waters. The disposal of reside material to the residual void will be contained within the catchment of the void.
Release type	An application proposing a point source release to GBR catchment waters and the: • Release is from a point source as the end of pipe and, • Release source is waste water from the relevant activity (excluding stormwater containing sediment only), and • Release event is planned/controlled.	**Not applicable.** This application does not propose a point source release to GBR catchment waters.
Contaminant type	An application proposing to discharge waste water from a point source release that contains DIN/fine sediment.	**Not applicable.** This application does not propose to discharge waste water from a point source. The release points in Table 1 of EA EPML00969013 are upstream and downstream monitoring points for compliance.

[3] GBR catchment waters is defined under Section 112 of the EP Act and means water in a river in the GBR catchment or a tributary of a river in the GBR catchment.

3 PROJECT DESCRIPTION

3.1 Location

The Project is wholly located within the Gladstone LGA, in Taragoola, near the Central Queensland coast (see **Figure 1**). Gladstone LGA has existed since 2008 and is an amalgamation of Gladstone City, Calliope and Miriam Vale Shires, which covers 10,484 square kilometres (km^2). The Project area and surrounds are zoned as rural under the *Gladstone Regional Council Planning Scheme 2017*.

The south, east and west of the Project adjoins Lake Awoonga which is owned and operated by the GAWB. The primary access route to the Project is via Taragoola Road to Charters Crossing Road to the north of the Project area. Taragoola Road intersects Nuggety Road and Rail Siding Road which provides an alternative access route to the west of the Project. An unnamed road managed by GAWB borders the west, south-west boundary and the closest residential area is mapped as approximately 4 km north of the Project's northern boundary. Surrounding land is primarily freehold land owned by the GAWB and classified as grazing native vegetation.

Regionally, the Project is 11 km south south-east of the township of Calliope, approximately 27.5 km south south-west of Gladstone and approximately 142 km north north-west of Bundaberg. Neighbouring townships include:

- Benaraby, approximately 13 km north north-east of the Project area
- Bororen, approximately 31 km southeast of the Project area
- Nagooren, approximately 30 km south of the Project area

3.2 Overview of Operations

Limestone mining has been ongoing at the Project since 1967, with Graymont managing operations since 2019. Situated just west of Lake Awoonga, the quarry produces approximately 0.8 Mtpa of limestone products, with an estimated 142,000 tonnes (t) of overburden and waste rock extracted annually (Sibelco 2012; Sibelco 2018b). The quarry intersects 19 MLs and adjoins land owned and operated by the GAWB, with some shared access tracks in the area used by both Graymont and the GAWB (Sibelco 2018b). Drone footage of the Project is captured in **Plate 1**. The current disturbance area of the Project is shown in **Figure 2** and maximum disturbance extents are shown in **Figure 3.**



Plate 1. Drone footage of Calliope Limestone Quarry in February 2023

Source: Epic Environmental 2022

Mining operations have remained consistent throughout the LOM to date and consists of conventional open cut benching methods. Mining begins with topsoil stripping and removal of clay rich overburden and waste rock which is hauled to designated spoil dumps. Limestone ore is then extracted by drilling and blasting, then crushed, screened, and washed onsite at the ROM pad (Sibelco 2018a). Blasting is undertaken about once a month and is confined to ML3594, ML3604, ML3608 and ML80190 only (Sibelco 2018b). The Project is equipped to continue the processing of limestone with purpose-built infrastructure including the crushing and screening plant and wash plant, that have a rate of production of up to 20,000 t a week. Limestone is loaded by a 120 t excavator onto 85 t and 100 t off road dump trucks to be transported to customers outside of the Project area for further downstream processing into quicklime and hydrate production. There is a second 75 t excavator within the Project area which is utilised as a backup for the open cut operations (Sibelco 2018b).

Uses for the Project's 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. Limestone, overburden and waste rock of different grades and suitable physical properties are also used as process feed for road base production.

Overburden rock materials have been used for the construction of barriers to prevent surface water inundation of the quarry workings due to the recent and possible future raising of the Awoonga Dam wall. These material placements were conducted under the direction of the GAWB. The Pits and most access tracks within the Project area have material placed along the perimeters to safely prevent access and control surface water flows. Future material placement to prevent Lake Awoonga inundation will continue to be conducted in collaboration with the GAWB. There are no geochemically reactive or acid forming wastes, tailings dams, or heap leach pads onsite, and the environmental risks from the inert waste rock is considered low/negligible. A maximum of 10 to 20 scrap tyres will be temporarily stored onsite in the infrastructure area and will be regularly collected and transported to an appropriately licensed waste facility.

The current Project schedule includes limestone ore to be mined exclusively from the existing open cut mining pit, Pit 4, which is located centrally within the Project area. Blasting in Pit 4 occurs approximately once a month. Lateral and vertical expansion of Pit 4 is projected over the next 70 years to occur in four stages from north to south, with amalgamation of Pit 3 expected to occur during the southern expansion (**Figure 3**). A south to north mining approach has also been considered in the final landform design report (**Appendix G**).

EOML is currently scheduled for 2100, but this may change depending on reserves and yearly sales quantities. A PRC Plan amendment will be undertaken if there are any material changes to operations that will impact the rehabilitation staging of the Project. Some of the disturbance areas including former Pit 1, the Northern WRD and some cleared areas and laydowns north of Pit 4, will change over the LOM as mining progresses. All future disturbance until EOML will be authorised by, and undertaken in accordance with, the amended EA.

3.2.1 Mine Pits

3.2.1.1 Pit 1 and Northern Waste Rock Dump

Pit 1 is a former mined pit that was located within ML3603 adjacent to the current infrastructure area (refer **Figure 2** and **Plate 2**). This was an open cut mine pit which has not been operational since the 1970's. Historically (pre Graymont ownership) it is understood scrap tyres have been buried in former Pit 1. Since Graymont commenced operations in 2019, no scrap tyres were buried in former Pit 1. Where possible, any new scrap tyres acquired in future operations will be transported to an appropriately licensed facility.



Plate 2. View of former Pit 1 from western access point

Source: Epic Environmental 2023

The base of former Pit 1 sat above the water table and did not have any water collecting within it. Overburden rock from the Northern WRD, located in ML80036, ML3595, and ML3594, was transported by dozer to backfill Pit 1 prior to and throughout 2024.To achieve the requirements of low intensity grazing, Pit 1 was backfilled to achieve a relative grade consistent with the surrounding area so that it could be used for aglime production and stockpile area. Remaining material from the Northern WRD (if any) is proposed to be placed in the pit floor of Pit 4 (if the northern pit floor is established), or on the Southern WRD depending on the staging of future Pits 3 and 4. At EOML this area will be available for rehabilitation to a low intensity grazing PMLU.

The Northern WRD has not been used since 2008 when the southern WRD was commissioned, therefore it is not required to support current or future operations. However, the disturbed land where the Northern WRD is currently, as shown in **Plate 3**, will be required for spoil pile storage during future operations. Therefore, this area will not be available for rehabilitation until EOML in 2100 and is proposed to be rehabilitated to a low intensity grazing PMLU.



Plate 3. Drone footage of Northern WRD facing east

Source: Epic Environmental 2023

3.2.1.2 Existing Pit 2

Existing Pit 2 is an open bench cut mine located in ML112092 in the northern extent of the Project area (refer **Figure 2** and **Plate 4**). This pit has been non-operational since the 1970's and is currently utilised for water storage. A 50,000 L water truck collects water from the Pit and completes all dust suppression for the Project, including spoil piles and the washdown area at the workshop that leads into the interceptor for washdown of vehicles.

Pit 2 will be required for operations as a water storage until EOML, with progressive rehabilitation occurring over a three year period, commencing in 2100. The western side of Pit 2 currently does not meet the final design specifications for EOML stability, described further in the Geotechnical Assessment in **Appendix D**. Prior to closure, the western batter slopes of Pit 2 will be established, and it is intended that adjoining undisturbed land will not need to be disturbed (Rocktest 2024).

Final landform design for Pit 2 will be suitable for a PMLU of water storage. A hard rock perimeter abandonment bund will be constructed with a minimum offset distance from the top of the slopes to prevent access. This is consistent with the requirements of the '*Safety Bund around Abandoned Open Pit Mines Guideline*' (DIR 1997).



Plate 4. View of Pit 2 facing south

Source: Epic Environmental 2023

The northeast, north, west and southeast sides of Pit 2 are steep and have been largely undisturbed and/or subject to natural regrowth as shown in **Plate 5**. The remaining area on the southern and eastern sides abut access tracks and spoil pile areas proposed for rehabilitation to a grazing PMLU. Therefore, as there will be minimal disturbed areas in the exclusions zone between the top of the crest to the abandonment bund and these areas will be unsafe to access, no revegetation activities will occur. Criteria provided in the PRC Plan will ensure achievement of the intended PMLU of water storage.



Plate 5. Drone Footage of Pit 2 facing south

Source: Epic Environmental 2023

3.2.1.3 Existing Pit 3 and Pit 4

Existing Pit 3 is a residual non-operational mine pit in ML3608 that has not been mined for many years (refer **Figure 2** and **Plate 6**). Pit 3 is currently used for water storage, and whilst it is not currently operational, it will be dewatered and amalgamated with Pit 4 in future operations.



Plate 6. View of Pit 3 from northern ramp

Source: Epic Environmental 2023

Existing Pit 4 is located centrally within the Project area within ML3594 and ML3604 and is the only operational pit (Refer **Plate 7** and **Plate 8**). Vertical and lateral expansion of the pit is projected to occur in the form of a range of cutbacks (using conventional drilling and blasting methods) on the current pit. Blasting occurs approximately once a month within the confines of ML3594, ML3604, ML3608 and ML80190, and dozers transporting loose material from Pit 4 to the ROM pad for processing. Mining of Pit 4 is proposed to occur in four stages from north to south, over a period of approximately 75 years. Mining will involve widening Pit 4 to the north and south, with Pit 3 being amalgamated with Pit 4 to form the final pit design, Pit 3-4.



Plate 7. View of Pit 4 northern sump facing south

Source: Epic Environmental 2023



Plate 8. Drone footage of southern end of Pit 4 facing south west

Source: Epic Environmental 2023

Pit 3-4 is planned to be mined in four stages, with indicative timeframes as follows:

- Stage 1- 2027 - 2060
- Stage 2- 2050 – 2070
- Stage 3- 2060 - 2090
- Stage 4- 2080 – 2100 (Graymont 2024a).

Stage 1 and 2 will occur over 35 years focusing on the northern extent of the Pit. The maximum disturbance extent will be established, with final bench design and pit floor depth being achieved. Stage 3 will commence approximately 10 years prior to Stage 1 and 2 being finalised. During Stage 3, Pit 3-4 will become amalgamated, with the eastern and western walls of the central Pit being pushed out to the maximum disturbance extent. Similarly, Stage 4 will commence approximately 10 years prior to Stage 3 being finalised and will involve final mining operations in the southern extent of the Pit. It is intended that backfilling of the Northern and Southern WRDs could occur in the northern extent of Pit 3-4 once the entire pit floor has been established and quarrying activities have shifted to the southern extent of the pit (Graymont 2024a).

Quarrying activities in future Pit 3-4 will continue for approximately 75 years until EOML in 2100. Therefore, waste percentages and calculations for available reserve volumes will be updated periodically over the LOM. A detailed mine plan is prepared for the Project for a five to ten year period, and it is likely that future mine plans and unforeseen mine parameters might delay or change intended schedules for future Pit 3-4. These mine parameters include 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. It is noted that conservative estimates of the LOM, with an EOML of 2100, have been prepared based on the material balance and final landform design for the purpose of the PRC Plan. However, if refinements from future calculations will impact when Pit 3-4 can cease quarrying activities, an amendment to the PRC Plan will occur to ensure consistency with mine planning.

As the Pit 3-4 maximum disturbance extent encroaches into adjacent land, spoil pile areas will be required to store overburden and accommodate a safety clearance area around the top of the pit. Where possible, future spoil pile areas have been allocated around the Pit, with topsoil areas to be placed adjacent to the spoil pile areas, but farthest from the top of Pit 3-4. Additionally, a currently undisturbed area adjacent to the eastern side of future Pit 3-4 will be required to store topsoil stripped from the undisturbed land within the maximum disturbance extent of Pit 3-4 (Graymont 2024a).

At EOML, future Pit 3-4 will be rehabilitated to support a PMLU of water storage. Consistent with the closure requirements for Pit 2, a hard rock perimeter bund will be constructed with a minimum offset disturbance

from the top crest of Pit 3-4 also, as per the requirements of the '*Safety Bund around Abandoned Open Pit Mines Guideline*' (DIR 1997).

The western, southern, northern and north eastern extents of the future Pit 3-4 adjoin existing disturbed areas proposed to be retained access track or rehabilitated to a grazing PMLU. The area to the south east is undisturbed, as shown in **Plate 9**. The exclusion zone between the top of the crest to the abandonment bund will be partially undisturbed, or unsafe to access, therefore no revegetation activities will occur. Criteria provided in the PRC Plan will ensure achievement of the intended PMLU of water storage.



Plate 9. Drone footage of Pit 3 facing north

Source: Epic Environmental 2023

3.2.2 Ancillary Activities

3.2.2.1 Southern Waste Rock Dump

Overburden rock has been placed on the Southern WRD, in ML80189 and ML3609, since it was commissioned in 2008 and will continue to be used for this purpose until EOML. The maximum disturbance extent of the Southern WRD has been determined based on the material balance prepared for the Project, including the quantity of overburden to be taken out of Pit 3-4 and the material currently on the Northern WRD (Graymont 2023a, Graymont 2024a). The southern WRD will be formed with nominal 23 % slopes, which is intended to be pushed to form 12 % slopes at the EOML. It is intended that some of the overburden material from Pit 3-4 will be returned to Pit 3-4 once the pit floor is established.

Graymont have considered final landform design of the Southern WRD based on the alternative south to north quarrying staged plan for Pit 3-4. If Pit 3-4 was to be quarried from south to north, ongoing backfilling of material from the southern and northern WRDs would be delayed until the pit floor is established in the south. Therefore, the overburden from the Northern WRD would need to be shifted for this area to be available for spoil piling. To account for this, a WRD buffer has been included into the final landform design. The final Southern WRD with buffer area is the maximum disturbance area that would be required if all remaining overburden from the Northern WRD and Pit 3-4 was required to be placed on the Southern WRD. An exclusionary buffer and access track is included within this footprint. The area adjacent to the Southern WRD is currently undisturbed. Therefore, a topsoil area will be required adjacent to the Southern WRD to store topsoil and subsoil that is stripped from the WRD maximum disturbance area so it can be used for future rehabilitation.

Access tracks around the base of the dump have been included to provide access to various parts of the site predominantly for monitoring purposes. To reduce the risk of Southern WRD slope failure, clay loam topsoil will be stripped from the surface prior to placement of the first fill lift. Subsequent lifts use at the top-down method whereby trucks end dump materials near the crests and a dozer then spreads, shapes, and compacts the materials. The slopes are advanced in the same directions as the topography. No major drainage paths are

blocked by the toes of the dump. As the Southern WRD is designed for grazing the slopes have very high factors of safety as calculated indicated in the geotechnical assessment provided in **Appendix D**.

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 and the toe of the northern slope is a sufficient distance from the crest of the south wall of Pit 4
- 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.

The Southern WRD is intended to have a PMLU of low intensity grazing that will support grasses, consistent with the existing natural regrowth that this landform can support (refer **Plate 10)**.



Plate 10. Southern WRD facing west

Source: Epic Environmental 2023

3.2.2.2 Tailings Storage Facility

There is no tailings storage facility at the Project.

3.2.2.3 Access Tracks and Levees

Most of the access tracks at the Project have existed for many decades since initial construction of the quarry. Graymont's use of the access tracks for mine haulage, general and land maintenance access is shared with the GAWB who require access to Lake Awoonga and the eastern and western levees for monitoring and maintenance activities. The access tracks to the north are also utilised by cattle grazers who work in the undisturbed areas.

The location of future realigned access tracks required due to the amalgamation of Pit 3-4 and the proposed final footprint of the southern WRD are displayed in **Figure 3**. Access tracks will be used throughout the LOM and to facilitate access for rehabilitation activities. As Graymont are the underlying landholders for most of mining tenures, the access tracks and eastern and western levees are proposed to be retained at EOML to facilitate access for future GAWB maintenance requirements and surrounding land uses (**Table 23**).

There are existing levees running along the eastern and western boundaries of the Project that are also used as access tracks (**Plate 11** and **Plate 12**). The levees control surface water flows across the Project and will also

be retained for GAWB's management requirements. **Figure 4** depicts the access tracks and levees to be retained in accordance with the landholder statement, provided in **Appendix J**.



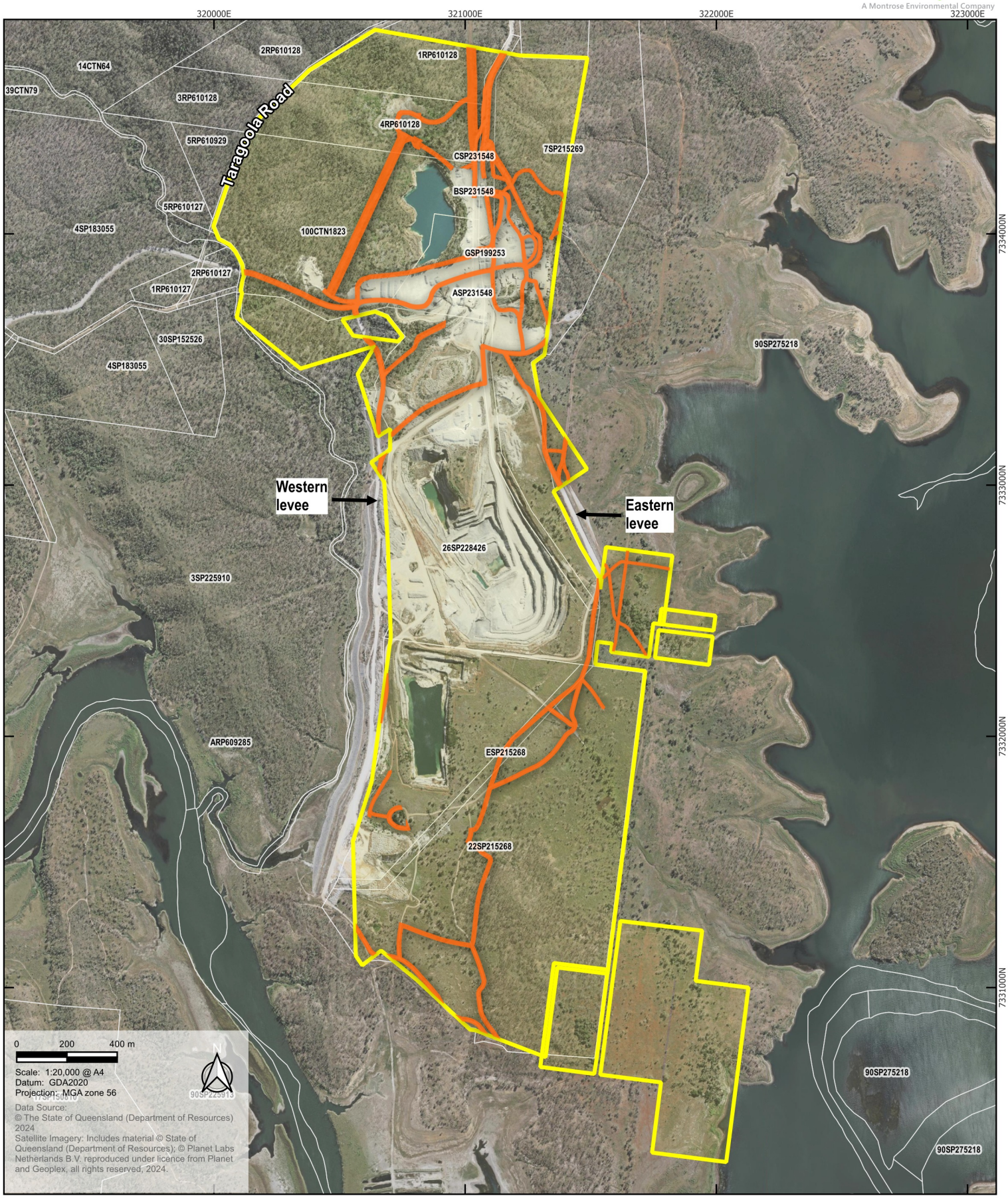
Plate 11. Western bund (levee) facing north

Source: Epic Environmental 2023



Plate 12. Eastern bund (levee) facing north

Source: Epic Environmental 2023



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 4 Infrastructure being retained.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Retained infrastructure

- Access tracks

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 4
Infrastructure being retained

3.2.2.4 Mine Infrastructure Area

Infrastructure for the Project is located within ML3602, ML3603, and ML80192 (refer **Figure 2**) and accommodates processing and logistics infrastructure and plant, which includes the following:

- Administration office and weighbridge (refer **Plate 13**)
- Workshop office, shed and container
- Duty Operations office
- Storage infrastructure
- Crushing and screening plant
- One 140 Finlay impact crusher
- Three LG250 Volvo loaders
- One 984 Finlay screen
- Wash plant
- Processing area
- Powerlines
- Communication towers
- Access tracks
- 88,000 L double self-bunded fuel storage tank
- Flammable and combustible liquid storage area
- Four water tanks
- Hardstand areas
- Laydown yards
- Humeceptor
- Amenities block
- Crib room
- Old Duty Operations shed
- Boilermaker shed
- Oil shed
- Proposed Helipad (to be constructed for emergency services)
- 415-voltage transmission line supplying 1000 kVA to the Project
- Transformer compound
- Mobile lighting tower
- Two 988 Caterpillar loaders
- One C1550 Finlay cone
- One WA600 loader
- Two WR80 mobile conveyors
- One PC1250 Komatsu Excavator
- One TR80 track conveyor
- One 375 Caterpillar excavator
- One TR65 track conveyor
- Two 785 Komatsu Dump Trucks
- Two miscellaneous mobile conveyors
- Two EH1700 Euclid Dump Trucks
- One fuel truck
- One 773 B water Truck
- Pug Mill
- One 966 Caterpillar tyre handler
- Eight light vehicles (service truck, Utes)
- Existing and proposed groundwater monitoring bores (including FM5, FM5b and FM6)



Plate 13. Site office and weighbridge at site entrance (from Taragoola Road)

Source: Epic Environmental 2023

The infrastructure area will be decommissioned prior to closure. Contaminated land investigations will be undertaken at the appropriate time to identify if there is any contaminant leaching from the fuel tanks stored in the infrastructure area onsite. After this has occurred, the infrastructure areas will be rehabilitated to low intensity grazing land.

3.2.2.5 Spoil Piles

All spoil pile areas associated with Project activities are used for current operations to store limestone products for sale (refer **Plate 14**). The spoil pile area hosts the crushing and screening plant and wash plant that have a rate of production of 10-20,000 t a week (Sibelco 2018b). Lime aggregate is stockpiled based on size and intended product use (e.g. to Cement Australia) so it is ready to be transported offsite. Based on the current scale of yearly sales and trucking movements, spoil pile areas required for future operations will be relatively consistent. Therefore, the spoil pile area and (former) Northern WRD area that will be encroached by Pit 3-4 have been shifted to the perimeter of the Pit extent.

There are various overburden rock safety bunds adjacent to access tracks and around the perimeter edge of the Pits. These will be temporarily stored in the stockpile areas adjacent to future Pit 3-4 until they can be backfilled onto the established Pit 3-4 floor. All spoil pile areas will be required for operations until EOML, at which time all stockpiled unprocessed raw limestone or graded limestone products remaining at end of mine life will be returned to the base of Pit 3-4. The proposed PMLU is low intensity grazing.



Plate 14. Drone footage of operational spoil pile area facing west

Source: Epic Environmental 2023

3.2.2.6 Sediment Ponds

There are two sediment ponds located adjacent to the operational areas in ML80192 and ML3603. A humeceptor is in place adjacent to the sediment pond to capture sediment and hydrocarbons that may be spilt within these areas (refer **Plate 15**). Both sediment ponds capture water runoff from operations as well as surface water flow over the Project area from rain events. The sediment ponds are not proposed to be retained and will be rehabilitated to a low intensity grazing PMLU at EOML.



Plate 15. Drone footage of sediment pond adjacent to spoil pile area facing south east

Source: Epic Environmental 2023

3.2.2.7 Silt Dumps

Lime silt is a waste product from operations onsite that is hauled to the designated silt dump, located on Rail Siding Road in the north western extent of the site (**Plate 16**). This area will be required to store silt until EOML. Graymont are looking into opportunities to sell this lime silt so it can be processed into lime products (quick lime etc.). Alternatively, this lime silt may be reintroduced to topsoil during rehabilitation if required.



Plate 16. Drone footage of silt dump

Source: Epic Environmental 2023

3.2.2.8 Topsoil Storage

There are current topsoil stockpile areas onsite that store topsoil and subsoil stripped from operational areas (refer **Plate 17**). As these storages are temporary, it is expected that topsoil stockpiles may shift as required, based on operations throughout the LOM. Prior to drill and blast activities, vegetation consisting predominantly of pasture grasses, along with approximately 0.25 m topsoil, is cleared from above the limestone ore body and placed in stockpiles and stored for future use in site rehabilitation. Topsoil is also stripped ahead of mining and is generally used to create safety bunds on the pit edge with overburden rock. Stockpiles are built less than two metres in height and have been seeded if they are to be stored for a long period. Many of the topsoil spoil piles contain a high proportion of clay and soil. It is anticipated that these dumps can be processed to recover enough material to cover the required areas during rehabilitation. The recovered material is considered to be a good growing medium for establishing regrowth.

Based on the material balance, topsoil areas required at EOML are mostly consistent with ongoing operations (Sibelco 2018b). The future Pit 3-4 and Southern WRD maximum disturbance extents will require stripping and topsoil and subsoil stockpiling in close proximity to these landforms so the soil can be used for rehabilitation of these areas. Therefore, topsoil and subsoil to be stripped for the final Pit 3-4 will be placed onto new topsoil areas outside of the disturbance footprint, on currently undisturbed land. Due to the extent of future Pit 3-4 encroaching into some areas that are currently used for topsoil storage, additional disturbed areas that have other uses will also be required for this purpose. All topsoil areas will be rehabilitated to a low intensity grazing PMLU at EOML, after the majority of the topsoil and subsoil has been hauled to and evenly spread across adjoining disturbed areas where required. There is potential that, based on the size and history of the site, additional topsoil will be required to be imported to site for rehabilitation purposes.



Plate 17. Drone footage of topsoil stockpile adjacent to the eastern bund

Source: Epic Environmental 2023

3.2.2.9 Cleared Areas and Laydown Areas

All cleared areas and laydown areas onsite will be rehabilitated to a PMLU of low intensity grazing land, consistent with surrounding land uses. The northern most cleared area at the site is currently not used for operations, however, emergency services requested Graymont to develop this area into a helipad (refer **Plate 18**). For this reason, it is not available for rehabilitation and will remain as infrastructure until EOML, at which time it will be rehabilitated to low intensity grazing land.

The cleared area adjacent to the south western edge of Pit 2 was historically used for operations and is currently partially revegetated. This area is proposed to commence rehabilitation to a low intensity grazing PMLU in 2025 when it is not required for operations (refer **Plate 19**). As rehabilitation activities at the Project

will first be undertaken in this area, it is proposed that this area will be used as a rehabilitation trial to refine approaches before future rehabilitation commences.

The laydown area adjacent to the infrastructure areas on the eastern side of the site supports operations as it is used for storage. The laydown area located in ML80036 and ML80191, referred to as the 'Graveyard,' is located within GAWB land, and is used by both GAWB and Graymont. The Graveyard stores Graymont's old plant and some of GAWB's monitoring equipment. Both areas will be available for rehabilitation at EOML in 2100.



Plate 18. Cleared area to become helipad for emergency services

Source: Epic Environmental 2022



Plate 19. Cleared area adjacent to Pit 2

Source: Epic Environmental 2022

3.2.2.10 Groundwater Bores

There are three groundwater bores located on site (FM5, FM5B and FM6), further described in **Section 4.4**. Two monitoring bores, FM5 (State water database RN151689) and FM6 (State water database RN151688), are the current registered groundwater monitoring bores for the site as required under the current EA

(EPML00969013). FM6 is next to an inactive pit to the north in a non-working area. FM5 is next to an active working pit and benchmarks groundwater entering Pit 4 from the east. Groundwater levels and groundwater quality data are obtained 6-monthly to analyse and report trends.

An additional deeper monitoring bore (RN187863, also known as FM5B) located close to the original FM5 was drilled in January 2021 due to low groundwater levels recorded in FM5 during mid-2019 to late-2020. Monitoring of FM5B has occurred since January 2021 and indicates that bores FM5 and FMB5 have similar water levels and appear to be in hydraulically connection. Bore FM5B is currently used by Graymont as a monitoring bore but not for compliance monitoring purposes under the current EA (Graymont 2025).

At EOML, the on-site bores North and South (FM6 and FM5) will be surrendered, and the bore decommissioned in consultation with the DNRMMRRD 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 and decommissioned by fully grouting from the bottom of the bore to the surface.

Additional groundwater monitoring bores are planned to be installed at the site and their final locations will be determined based on ongoing groundwater investigations throughout 2025. The addition of these new groundwater bore locations to the EA will be the subject of a separate EA amendment application.

3.3 Identification of Underlying Landowners and Tenure

The Project is located across 19 MLs owned by Graymont and does not overlap with any other mineral tenements. The Lot and Plans surrounding the Project's MLs are mapped as freehold land owned by Graymont and the GAWB. There are seven Lot and Plans within the Project area. Graymont is the landholder for six of these, with one (Lot 90 on SP275218) owned by GAWB which contains the western levee.

The underlying landholders for the Project area are identified in **Table 9**.

Table 9. Tenure and landholder details

Permit	Underlying Property Description	Holder	Granted	Expiry	Area (ha)	Current Usage
ML3594	7SP215269 26SP228426 90SP275218	Graymont	1 March 1964	28 February 2041	32.3749	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3595	7SP215269 26SP228426 90SP275218	Graymont	22 January 1986	28 February 2041	15.7903	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3596	7SP215269 90SP275218	Graymont	1 June 1972	28 February 2041	9.1029	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3597	90SP275218	Graymont	1 March 1964	31 December 2041	2.8328	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3598	90SP275218	Graymont	22 January 1986	31 December 2041	12.4694	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3599	90SP275218	Graymont	19 February 1976	31 December 2041	6.7987	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land

Permit	Underlying Property Description	Holder	Granted	Expiry	Area (ha)	Current Usage
ML3600	90SP275218 22SP215268	Graymont	28 September 1972	28 February 2041	8.0937	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3602	7SP215269	Graymont	7 March 1988	31 March 2027	10.2284	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3603	7SP215269 26SP228426 90SP275218	Graymont	7 March 1988	31 March 2027	8.3416	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3604	7SP215269 26SP228426	Graymont	1 March 1965	29 February 2028	4.8562	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3605	90SP275218	Graymont	10 March 1988	31 July 2028	9.4444	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3606	90SP275218	Graymont	7 March 1988	31 July 2028	5.61	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3608	26SP228426 22SP215268	Graymont	26 October 1972	31 October 2030	60.0705	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML3609	90SP275218 22SP215268	Graymont	18 April 1988	31 October 2030	43.3519	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML80036	7SP215269 26SP228426 90SP275218 100CTN1823	Graymont	15 June 2001	30 June 2043	18.73	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML80189	7SP215269 90SP275218 22SP215268	Graymont	13 May 2013	31 May 2043	36.05	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML80190	26SP228426 90SP275218	Graymont	13 May 2013	31 May 2043	22.5	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML80191	26SP228426	Graymont	13 May 2013	31 May 2043	1.6	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
ML80192	7SP215269 26SP228426 90SP275218 100CTN1823 1RP610128 4RP610128	Graymont	14 May 2013	31 May 2043	121.5	Mining, Access/roads, Infrastructure, Spoil areas, Top soil areas, Native bush/grazing land
					429.7457 ha	

3.3.1 Underlying Easement and Restricted Areas

The eastern levee adjacent to the current Pit 4 is a mapped easement for Charters Crossing Road identified in the Gladstone Regional Council (GRC) Public Road Register. An agreement for this asset between the previous proponents, namely Calliope- Comalco Aluminium Limited and Frost Enterprises Pty Ltd (now Graymont) with Calliope Shire Council (now GRC) took effect from 2006, which notes that both parties can use the easement for the specified purpose of 'access.' GRC have a direct responsibility to maintain this asset as it is part of their road network. According to the GRC Maintenance Guidelines (GRC 2023), the level of service required by GRC is a level '5 Rural'- local road (for access) which is unsealed, requiring minimal service standard (GRC n.d.).

The proposed future Pit 3-4 will encroach into this easement; therefore, conversations are occurring between Graymont and GRC to update this agreement. GRC have a need to maintain access to this area, so alternative options for the easement will be discussed so the agreement conditions can be upheld.

The Project also overlaps two mapped restricted areas as follows:

- Restricted area 44 which relates to the Awoonga Dam ponded area
- Restricted area 196 which relates to the Awoonga Dam catchment area

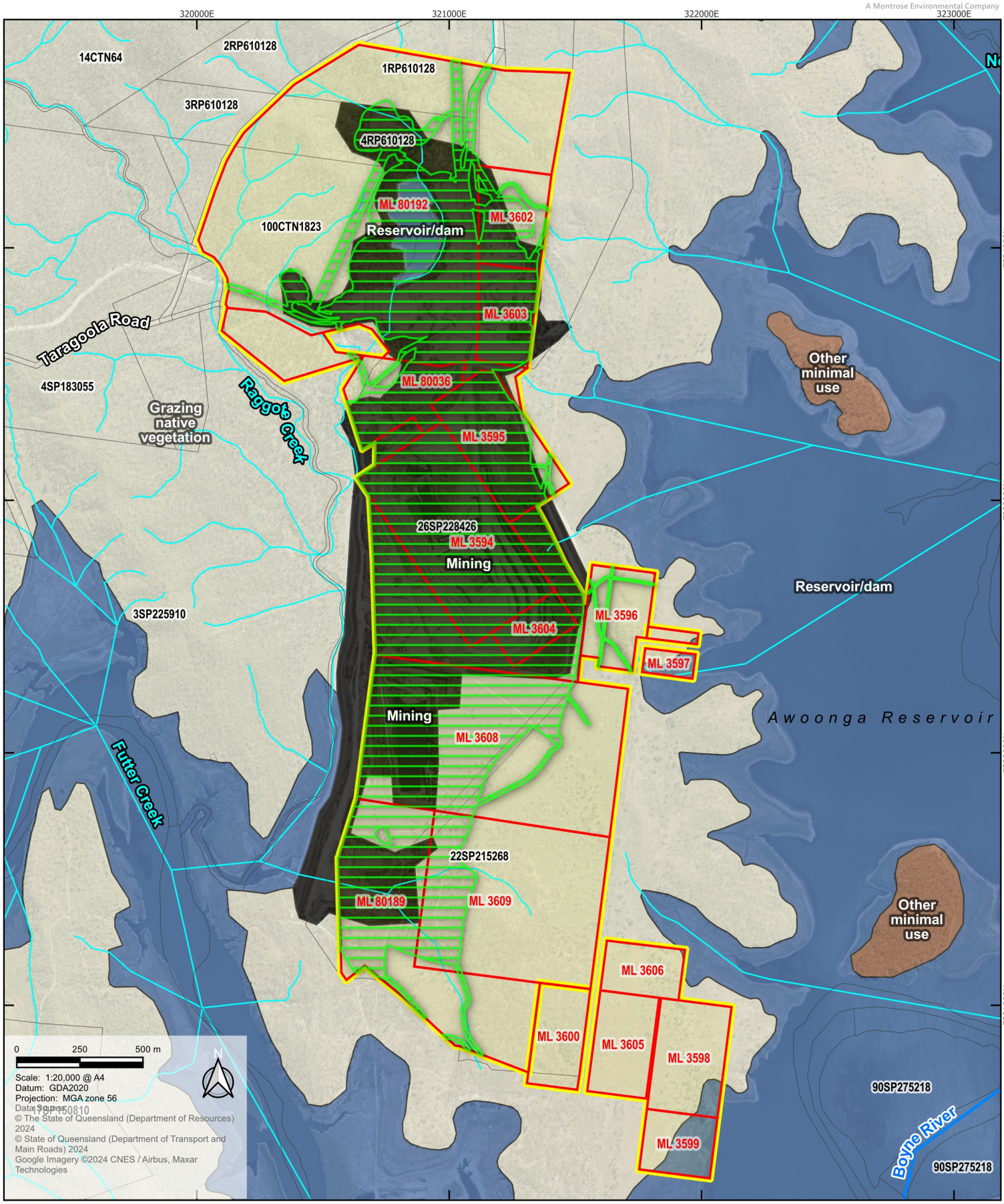
GAWB is the nominated referral entity for an application for a mining tenement within these restricted areas. All MLs for the Project are existing, however GAWB is a key stakeholder and adjoining landholder. Therefore, Graymont's proposed mining activities have and will continue to be discussed with GAWB.

3.4 Surrounding Land Use

The State of Queensland maps the predominant land use within the Project area as mining and the surrounds are almost entirely mapped as grazing native vegetation and dam/reservoir (**Figure 5**). The dam/reservoir area is mapped over Lake Awoonga which is the main water supply to the Gladstone and Calliope region. The lake and associated land are also utilised for recreational activities and facilities (caravan park, barbecues and picnic area, boat ramp) approximately 6.6 km east of the Project. Recreational activities permitted include:

- Swimming
- Camping
- Fishing
- Watercraft activities

Other identified land uses include Production Forestry occurring approximately 3.5 km to the west of the Project area and the closest residential area is approximately 4 km north of Pit 4. Calliope township is 11 km north of the northern boundary of the Project. Additional land use mapped near the Project are small land masses within Lake Awoonga classified as other minimal use. Graymont also has an agreement with local farmers in the area for grazing animals to use undisturbed areas within the MLs.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 5 Land uses.qgz

Legend

- Site boundary
- Mining leases
- Cadastre (DCDB)
- Maximum disturbance extent

Watercourses

- Major
- Minor

QLD Land use mapping (secondary)

- Other minimal use
- Grazing native vegetation
- Mining
- Reservoir/dam

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 5
Land uses

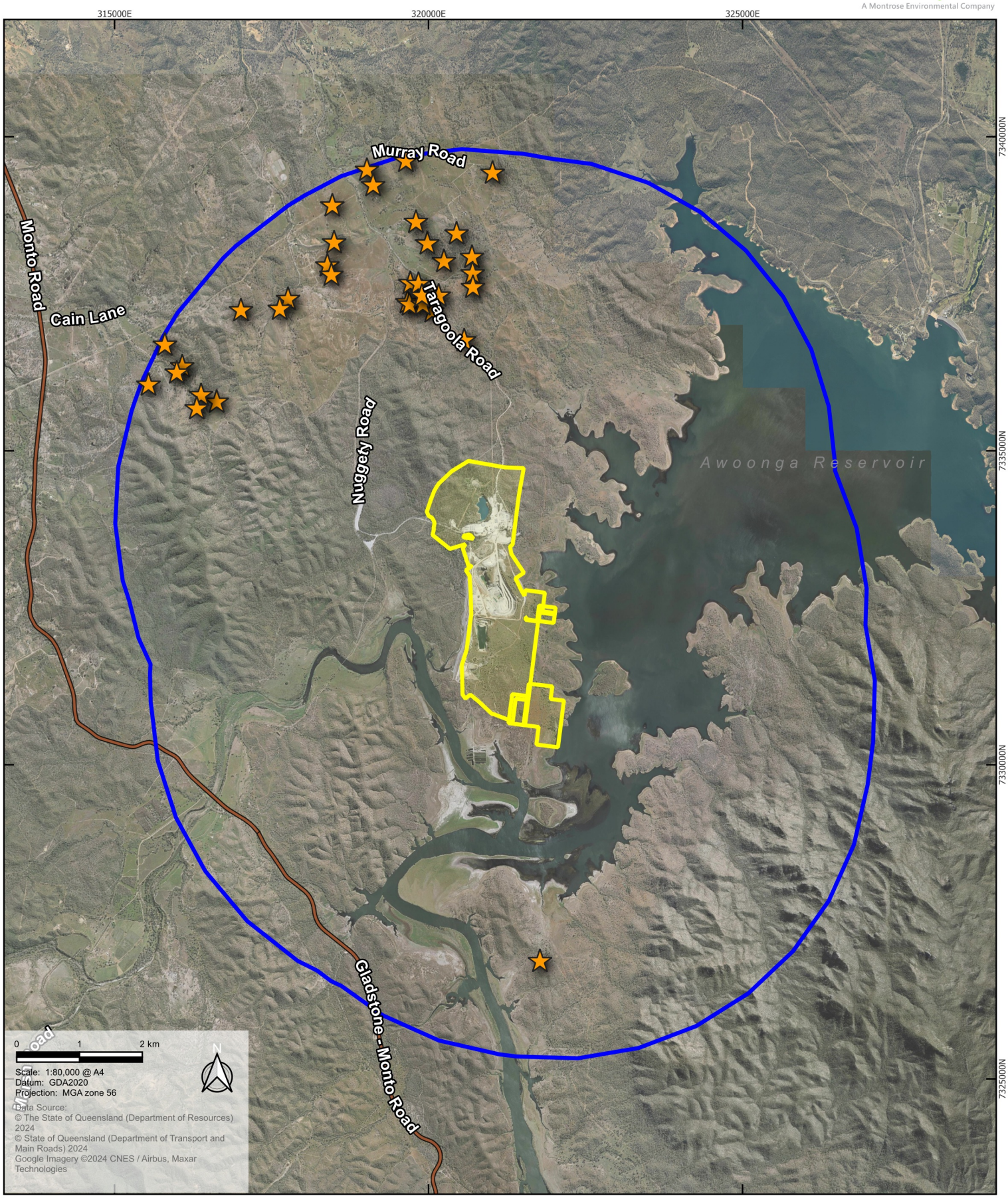
3.4.1 Sensitive Receptors

Table 10 provides details on the sensitive receptors found within a 5 km radius of the Project area, also shown in **Figure 6**.

Table 10. Sensitive receptors

ID	Houses	Lat	Long	LOTPLAN	Address	wkt_geom
1	House	-24.07968541	151.1961918	94CTN408	155 Laurenkar Road Calliope QLD	Point (151.1961918477539939 -24.07968541231785053)
2	House	-24.07869295	151.1937594	94CTN408	155 Laurenkar Road Calliope QLD	Point (151.19375942037834193 -24.07869295236952567)
3	House	-24.0771038	151.1855409	5RP886635	106 Laurenkar Road Calliope QLD	Point (151.1855408750214167 -24.07710380048684939)
4	House	-24.07452838	151.1908635	3RP892601	95 Laurenkar Road Calliope QLD	Point (151.19086349224093624 -24.07452838354649316)
5	House	-24.07138969	151.1881861	2RP892601	85 Laurenkar Road Calliope QLD	Point (151.18818608341697995 -24.07138969132162387)
6	House	-24.06656967	151.2001732	1RP892600	668 Racecourse Road Calliope QLD	Point (151.2001731597626133 -24.06656966712923662)
7	House	-24.0657267	151.2262594	98CTN287	5 Nuggety Road Calliope QLD	Point (151.22625936060438789 -24.0657267048802197)
8	House	-24.06606739	151.2265769	98CTN287	5 Nuggety Road Calliope QLD	Point (151.22657694327128297 -24.06606739412394447)
9	House	-24.06709475	151.2301167	1RP612432	796 Taragoola Road Calliope QLD	Point (151.23011674891381517 -24.06709475467907211)
10	House	-24.06605036	151.228654	1MPH30541	754 Taragoola Road Calliope QLD	Point (151.22865401767836602 -24.06605036170250145)
86	House	-24.05167749	151.214687	1RP889919	477 Racecourse Road Calliope QLD	Point (151.21468699837453187 -24.05167748711573239)
90	House	-24.04662051	151.220172	4MPH22983	30 Murray Road Calliope QLD	Point (151.22017200647289314 -24.04662051351532526)
91	House	-24.04884259	151.221117	9MPH22983	649 Taragoola Road Calliope QLD	Point (151.2211169909315629 -24.04884259486497911)
93	House	-24.04542417	151.226291	1MPH2865	120 Murray Road Calliope QLD	Point (151.226291029947987 -24.04542416836173402)
97	House	-24.04726977	151.2398437	104CTN2035	258 Murray Road Calliope QLD	Point (151.23984374680782139 -24.0472697706003764)
98	House	-24.0559328	151.2340863	1MPH23026	232 Murray Road Calliope QLD	Point (151.23408632025660836 -24.05593279825897213)
99	House	-24.05989589	151.2320538	101SP112314	29 Traylee Road Calliope QLD	Point (151.23205379693180817 -24.05989588772888865)
100	House	-24.05933012	151.2364478	102SP112314	85 Traylee Road Calliope QLD	Point (151.23644776173088644 -24.05933011886863682)
101	House	-24.06169826	151.2365228	103SP112314	90 Traylee Road Calliope QLD	Point (151.23652280695486638 -24.06169826342015483)
102	House	-24.0636651	151.2365459	103SP112314	90 Traylee Road Calliope QLD	Point (151.23654589801637371 -24.06366509728306369)
103	House	-24.06483038	151.2311589	100SP112314	735 Taragoola Road Calliope QLD	Point (151.23115886622738913 -24.06483038030656019)
467	House	-24.06298354	151.2267525	2MPH31430	720 Taragoola Road Calliope QLD	Point (151.2267525479428798 -24.06298353645359001)
468	House	-24.06309681	151.2280162	3MPH31430	724 Taragoola Road Calliope QLD	Point (151.22801616304832351 -24.06309681415476831)
469	House	-24.06482355	151.2285415	1MPH30541	754 Taragoola Road Calliope QLD	Point (151.22854148515503425 -24.06482355383060323)
470	House	-24.05731634	151.2294979	2MPH23020	485 Taragoola Road Calliope QLD	Point (151.22949793016886133 -24.05731634149884712)
471	House	-24.0542055	151.2277504	7MPH22983	669 Taragoola Road Calliope QLD	Point (151.22775039928708907 -24.05420550386283551)

ID	Houses	Lat	Long	LOTPLAN	Address	wkt_geom
472	House	-24.05699323	151.2148939	2RP889919	523 Racecourse Road Taragoola QLD	Point (151.21489392332182433 -24.05699322753575586)
473	House	-24.06029563	151.213792	3RP889919	551 Racecourse Road Taragoola QLD	Point (151.21379195722687427 -24.06029562828712187)
474	House	-24.06165082	151.2144058	4RP889919	581 Racecourse Road Taragoola QLD	Point (151.21440576835627212 -24.0616508164909213)
475	House	-24.06504501	151.2075674	5RP889919	623 Racecourse Road Taragoola QLD	Point (151.20756736849770618 -24.06504501480205604)
476	House	-24.06644331	151.2062469	5RP892602	647 Racecourse Road Calliope QLD	Point (151.20624693157574825 -24.06644331269094295)
477	Yard	-24.07131033	151.2350651	3SP275218	795 Taragoola Road Taragoola QLD	Point (151.23506512355578479 -24.07131033149327948)
478	Shed	-24.16068004	151.2457178	90SP275218	865 Awoonga Dam Road Taragoola QLD	Point (151.2457178247349816 -24.16068004181781248)
479	House	-24.07542077	151.1899922	3RP892601	95 Laurenkar Road Calliope QLD	Point (151.18999220403992467 -24.07542077049482998)
480	Yard	-24.08059424	151.193056	94CTN408	155 Laurenkar Road Calliope QLD	Point (151.19305601507574011 -24.08059423654879083)



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 6 Sensitive Receptors.qgz

Legend

- Site boundary
- 5km buffer
- State controlled roads
- Sensitive receptors

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 6
Sensitive receptors

3.5 Project Area History

Prior to mining activities, the Project area was used for low intensity grazing of native improved pasture. This is consistent with the grazing land surrounding current operations (refer **Figure 5**). The original mixed Eucalypt woodland which occurred in the Project area has been significantly altered by clearing, grazing and mine/quarry activities since 1967.

The Project was first commissioned by Commonwealth Aluminium Corporation in 1964, with ownership transferred between the following companies:

- 10/08/1981 – 03/05/2006: Comalco Aluminium Limited
- 03/05/2006: Frost Enterprises Pty Ltd (operated by Sibelco Australia Limited)
- 30/09/2019: Graymont (Calliope) Pty Ltd

Other regional changes have been brought about by agriculture and the extensive land inundation caused by Lake Awoonga which was originally constructed in the 1950s and has gone through two iterations of dam raising, in the 1980s and more recently in 2002 to its current full supply level of 40 metres Australian Height Datum (mAHD). The Project area and surrounds are zoned as rural under the GRC Planning Scheme (GRC 2017).

3.5.1 Duration of Relevant Activities

The Project has been operational since 1967. The duration of each relevant activity is outlined in **Table 11**. Whilst the exact year that each activity commenced cannot be confirmed, the final year of operations for current activities is known and is the basis for the PRC Plan.

Table 11. Duration of quarry activities

Rehabilitation Area Description	Duration of Activity	Duration of Rehabilitation
Historical Pit 1[1]	1967- ~1970 as a pit	2103 – 2115
Cleared Areas	1967- 2023 (for this purpose) Note: northern cleared area will be used for infrastructure (helipad)	2025 – 2036
Pit 2	1967 - ~1970 for quarrying ~1970 - 2100 for water supply	2100 – 2110
Infrastructure, ROM processing areas and laydown areas	1967 - 2100	2100 – 2113
Southern waste rock dump (WRD)	1967 - 2100	2101 – 2112
Northern WRD	Pre 2000s – 2008[2]	2096 - 2107
Future Pit 3-4	1967 - 2100	2102 – 2113
Spoil pile areas	1967 - 2100	2103 – 2115
Sediment ponds	1967 - 2100	2104 – 2116
Topsoil stockpile areas and silt dump	1967 - 2100	2105 – 2117
Access tracks and levees	1967 - 2100	2100 – 2110

1. Former Pit 1 area will be used as a spoil pile area until EOML
2. Northern WRD will become a future cleared area until EOML

4 EXISTING ENVIRONMENT

The following section has been limited to describing the existing EVs and the surrounding environment of the Project.

4.1 Climate

The Project is located within Queensland's sub-tropical climatic zone which is characterised by high summer temperatures, warm dry winters, and distinct wet and dry seasons. It lies within the southeast trade wind belt but is too far south to experience monsoonal influence from the northwest and too far north to benefit from higher altitude cold fronts (Bureau of Meteorology (BoM) 2025a).

Climate data for the region has been captured by the Gladstone Radar Weather station (station no. 39123) from 1957 to present (BoM 2025b). Based on the climate data collected from this weather station, the region experiences an annual mean maximum temperature of 27.8 degrees Celsius (°C), an annual mean minimum temperature of 18.6°C and a mean total annual rainfall of 870.4 millimetres (mm). The long-term mean temperature and the mean monthly rainfall is presented in **Table 12**.

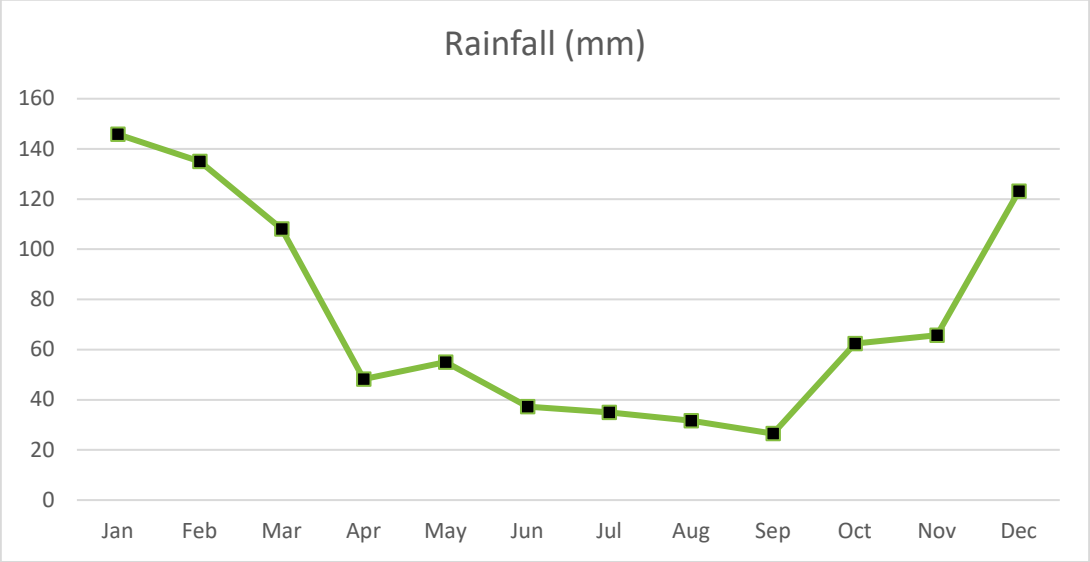
Table 12. Long-term mean temperature since 1957 (BoM weather station 39123, Gladstone)

Temp (mean °C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min	22.6	22.5	21.7	19.7	17.0	14.4	13.5	14.4	16.6	18.8	20.6	22.0
Max	31.4	31.1	30.3	28.4	25.7	23.4	23.0	24.4	26.7	28.5	30.1	31.2

Data accessed in May 2024 from BOM. The data range spans from 1957 to May 2024. The weather station remains active as of May 2024.

Rainfall data displays distinct wet and dry seasons, with high rainfall from December to March and low rainfall from June to September **(Figure 7)**. Winds are primarily south-easterly; however, during the warmer months there is often a north-easterly sea breeze. The region is subject to the effects of tropical cyclones and tropical lows during the summer months which can produce wind and rainfall events that are typically short-lived and intense. The resulting run-off can cause localised flooding in the region (BoM 2025a).

Evaporation rates influence soil moisture, rehabilitation success and mine water balance and is therefore relevant in the Project assessment. Mean solar exposure based on climatic data recorded at the nearest meteorological stations (Gladstone (site no. 39123), located approximately 25 km from the Project area indicate a seasonal trend with monthly values ranging from an average of 13.8 megajoules per square metre (MJ/m^2) during the winter (June) to 25.6 MJ/m^2 in summer (December) (BoM 2024b). The mean annual evaporation is 1800 mm, with an approximate range of 80 mm during the winter (June) to 250 mm during the Summer (January) (BoM 2016).



Data accessed in April 2025 for BoM weather station 39123, Gladstone (BoM 2025b). The data range spans from 1957 to April 2025. The weather station remains active as of April 2025

Figure 7. Mean monthly rainfall

4.1.1 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 frequently occur during summer months (October to April) and periods of heatwave (Queensland Fire and Emergency Services (QFES) 2023). Severe storms can result in damaging or destructive wind gusts, flash flooding and large hailstones (greater than five centimetres (cm) in diameter) (QFES 2013).

Cyclones

Tropical cyclones are low pressure systems that form over warm tropical waters (Commonwealth Scientific and Industrial Research Organisation (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 2024). There have been three cyclones documented as occurring within 50 km of the Project since 1969, and a further four within 100 km of the Project area. The majority of these cyclones occurred during the period from 1970 – 1992, with one cyclone occurring in recent decades (2015 Severe Tropical Cyclone Marcia, approximately 40 km southwest of the Project area).

Impacts from tropical cyclones depend on the category, wind speed, rainfall intensity and duration, and riverine flooding as a result of prolonged deluges (QFES 2023; BoM 2025c). 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 (former Department of Agriculture and Fisheries (DAF) 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 2025c).

Floods

The Project is located within the Boyne River Basin, which covers approximately 2,590 km^2. The area is bound by Many Peaks Range to the east, Dawes Range to the south, Calliope Range to the south-west and Boyne Range to the west. The terrain is relatively steep with heights ranging from 600 to 850 m above sea level. Several other towns are also located within the catchment including Nagoorin, Ubobo, and Builyan. The Boyne River Basin Plan area comprises a single catchment with one major river system (the Boyne River) and a number of tributaries (including Ridler, Degalgil, Marble and Diglum Creeks) that drain to Gladstone Harbour and the Great Barrier Reef. Flooding can occur along these river systems causing isolation of towns. As a result, BoM operate a flood warning system using rainfall and river stage observations (BoM 2025d).

The Project area is located within a Rapid Hazard Assessment area, and Basin level Flood Modelling for the Booyne River Basin maps the Project are as having the potential for being partially inundated in 1% AEP events (State of Queensland 2025a). A concept final landform flooding assessment is provided in **Appendix H**.

A flooding assessment (**Appendix H**) and a surface water impact assessment (SWIA) (**Appendix K**) were undertaken to determine overland flow paths and risk of contamination until the EOML.

Bushfires

Bushfire risk is influenced by a combination of increased temperatures, higher winds, lower rainfall, and woody vegetation. The GRC Planning Scheme (GRC 2017) and the State-wide mapping of the Bushfire Hazard Area (developed by Department of State Development, Infrastructure and Planning (DSDIP)) indicates that the Project is located partially within Very High, High and Medium Potential Bushfire Intensity areas with some potential impact buffer.

The Project area is within the Brigalow Belt bioregion and is characterised by brigalow forests and woodlands, although they are not predominant through the entire region. Other ecosystems include eucalypt forest and woodlands, grasslands, dry rainforest, cypress pine forest and woodland and riparian communities.

As winters are typically dry with little rain received, wildfires can occur in the spring and early summer. The likelihood of a fire weather day or sequence of days gradually increases from the start of the dry season, peaking around September and decreasing into the wet season (QG 2012). The edges of the Project are mapped as medium to very high potential bushfire intensity area and potential impact buffer area.

Earthquakes

Queensland is considered seismically active, with the highest hazard region lying along the eastern coast and near offshore regions (University of Queensland (UQ) 2025). Between 1977 and 2000, an average of 110 earthquakes per year have been recorded by the Queensland seismic network (Earth Systems Science Computational Centre (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 Project area is low (UQ 2025).

Droughts

Queensland is particularly vulnerable to natural rainfall variability. Droughts are common in Queensland and generally associated with El Niño conditions. In March 2022, there were a total of 34 councils and three part council areas drought-declared in Queensland (QG 2022). These declarations represented 64.7 percent of the land area of the state (QG 2022). The most recent records of drought in Queensland are from April 2024, where Diamantina and Bulloo Shires were recorded as fully drought-declared shires (accounting for 9.7 percent of Queensland's land area) (QG 2025a). As of 1 April 2025, there are no drought declared LGAs in Queensland (QG 2025a). However, the most recent drought in the Calliope area occurred between January 2017 and December 2019, with below average rainfall annually and the lowest rainfall on record between the cool season (April to September). The Calliope area also experienced the Millennium drought between 1997 and 2009, with very much below average rainfalls. Historical droughts occurred in 1982 to 1983, and in 1965 to 1966 just prior to operations commencing in 1967. Cycles of drought are expected in the future across greater Queensland and Australia which have a high likelihood of also impacting the Project area (QFES 2023).

4.2 Land

A description of the site and relevant EVs has been provided in **Section 4.2.1** to **Section 4.10** in accordance with the *Application requirements for activities with impacts to land guideline* (DESI 2024e). The proposed disturbance areas are not mapped as Category A or B ESAs. There is a mapped area of regional interest approximately 2.5 km west of the Project. This area is mapped as strategic cropping land adjacent to Futter Creek, upstream of the Project.

No ESAs are mapped within the Project area. The nearest ESA is Category C ESA Boyne Range State Forest, located 3 km to the west of the Project area.

4.2.1 Topography

The topography in the vicinity of the Project area is hilly with elevations ranging from 40 to 100 mAHD, as shown in **Figure 9**. Topography falls to the east, south, and west to Lake Awoonga. The land surrounding the Project is classified as low intensity grazing land for cattle.

The Project is offered some protection from inundation from floods by the Eastern and Western bunds constructed at the Project. A 1,900 m long earth and rock wall has been constructed adjacent to Raggote Creek, with a smaller wall constructed along the eastern perimeter of the Project area. Both bunds are also used as access tracks. The crest of these walls is approximately 52 mAHD. The walls are protected by a clay liner and outer rock layer to an elevation of 47 m (the estimated 1 in 100-year flood level). These works were completed as part of a cooperative agreement between the previous owners of the Project and the GAWB.

4.2.2 Geological Setting

The Project's limestone deposits occur within the Early Devonian age (419-million years ago (Mya)) Calliope Beds. The Beds occupy a north-northwest striking belt about 40 km long and 3-4 km wide. They comprise predominantly volcanic rocks with relatively minor inter-bedded sedimentary rocks, including limestone. The rocks have been subjected to folding and faulting. Overburden consists of a shallow cover of soil. Boulders and cobbles of limestone and volcanics occur in much of the layer (Sibelco 2018a). The edges of the Project are mapped as medium to very high potential bushfire intensity area and potential impact buffer area. The geological setting is illustrated in **Figure 9**.

Underlying the overburden is predominantly limestone. Discontinuities within the limestone are clay filled and karst features are prevalent to a depth up to approximately 15 meters below ground level (mBGL). Below this depth, karst and infill becomes less prevalent and apertures become tight. Bedding surfaces within the limestone generally dip very steeply towards the west. The major axes of the pits are parallel to the strikes of the beds. This characteristic is consistent with the regional structure.

The volcanics exposed in the walls of the pits include predominantly basic basalt and intermediate olive green andesite. The basalt occurs as lava flows. It is exposed primarily in the upper benches of the east and south walls of Pit 4. It is dark grey, has high to very high strength and is slightly weathered. The andesite generally occurs as steep dipping dykes following vertical to sub-vertical bedding and joints within the limestone. Two dominant systems strike north-north-west and east. Their widths range from stringers to a few meters. Reduced vertical stresses at shallower depths have allowed the andesite to extrude along shallow dipping joints. It has high to very high strength and is moderately to slightly weathered (Rocktest 2025).

4.2.3 Land Stability

The pre-mining land uses at the MLs were low intensity grazing. No information is available on pre-mining lease land stability, however, reference to available topographical information and aerial imagery indicates the MLs were predominantly vegetated with undulating surface levels prior to mining commencing. Mapped geological landforms are shown in **Figure 10**.

As described in the Geotechnical Assessment provided in **Appendix D**, the intact limestone at the Project is fine grained and recrystallised due to regional metamorphism. At depths exceeding approximately 15 mBGL, the limestone is moderately weathered to fresh with high to very high strength (average, 65 Megapascals (MPa)) and an average density of 25.8 tonnes per cubic metre (t/m3). At shallower depths, and adjacent to

faults and karst, the surfaces of intact rocks tend to be highly weathered. However, their cores are typically only slightly weathered, hence their strengths are similar to those of unweathered (fresh) rocks that show no evidence of decomposition or discolouration. The strengths progressively decrease as the depths of weathering towards the cores of the rocks increase. The rocks eventually become extremely weathered gravels of medium to high strength which then become residual sands and silts. The shear strength of the sediments can be defined in terms of a friction angle of 34°, based on the angle of repose of fines and gravels in the Southern WRD (refer **Appendix D**).

Most weathered and all unweathered limestone has sufficient strength and durability necessary for it to be used as erosion control cover. Only the extremely weathered rocks are unsuitable for cover and these rocks are a-typical on the Project area.

Volcanics randomly intrude the limestone, predominantly along discontinuities, and comprise basalt and andesite. The basalt occurs primarily as lava flows and is dark grey, has high to very high strength and is slightly weathered. The andesite has high to very high strength and is moderately to slightly weathered. It primarily occurs as steep dipping dykes up to a few metres wide. The dykes follow steep bedding and joints within limestone. Two dominant systems strike north-north-west and east. Reduced vertical stresses at shallower depths have allowed it to extrude along shallow dipping joints.

The volcanics comprise less than 5% of the total volume of the rock mass. Combined with their high strengths, and discontinuity characteristics no less favourable to wall stabilities than those within the limestone, the volcanics have insignificant specific influence on the stabilities of the walls compared to the limestone.

No significant soil stability issues are expected to limit rehabilitation efforts at the Project.

4.2.4 Waste Characterisation

Waste rock across the Northern and Southern WRDs includes overburden, poor quality limestone (low specification, high clay fines material such as that visible on the Southern WRD), andesite, greywacke (fault rock), and conglomerate. Of the sampled materials, andesite is considered to be the only rock exposed in the void wall to have any potential for acid generation and mixed andesite or andesite dominated waste was targeted during sampling.

Production bench blast drill chips are also collected from mining benches to characterise the main ‘ore’ exposed in the void walls. Similarly, samples of product stockpiled at the site were also analysed for mineralogy.

Sampling was completed by Epic for both the Northern and Southern WRDs and production bench blast drill chips a detailed methods and results are available within (**Appendix F**) a summary of the results found are as follows:

- Very low levels of total sulfur (<0.1%) across all three locations, which, from the SCr test, appeared to be in the form of sulfides
- Strongly negative NAPP values (markedly less than 20 kg H_2SO_4/t) across all three locations (indicating the material is acid consuming)
- NAG pH values above 7 across all three locations
- NPRs markedly greater than 3 across all samples (INAP 2009)

Due to the very low total sulfur concentrations, there is no need to further account for the different forms of sulfur present (such as oxidised forms of sulfur; sulfates) to improve the assessment of AMD risk (Epic 2024).

Net acid generation (NAG) pH and NAPP have been plotted on **Figure 8**. All of the data confirms that the waste rock and production (drill chip) material is classified as non-acid forming (NAF) (AMIRA 2002).

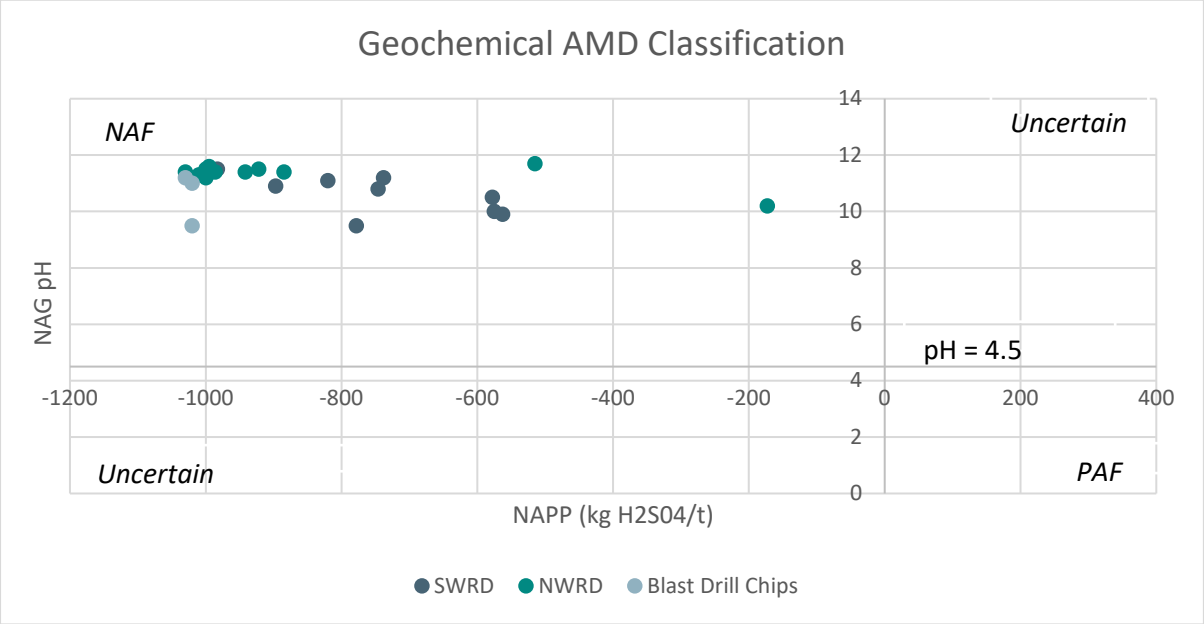
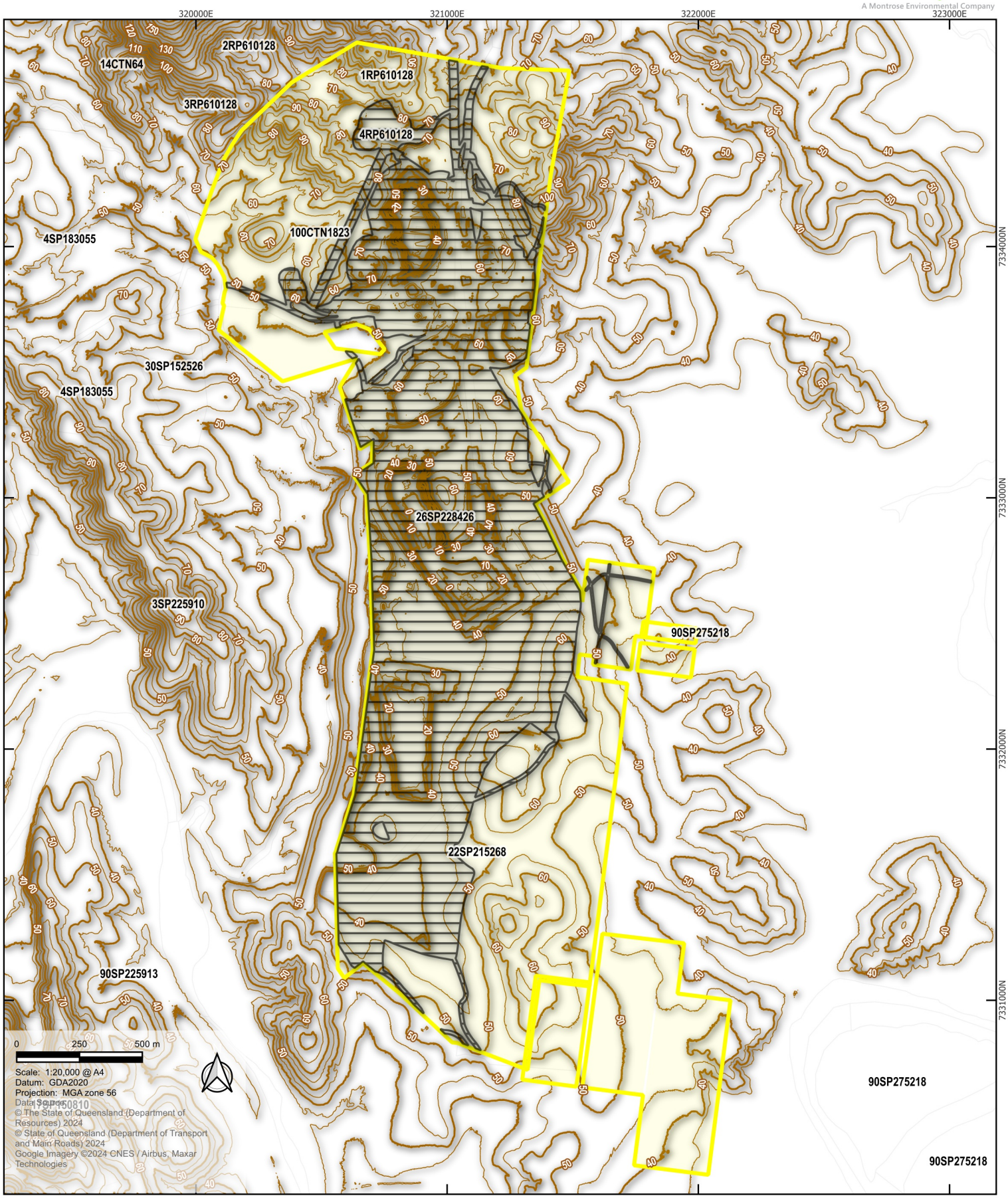


Figure 8. Geochemical AMD classification plot for the three locations based on NAG pH and NAPP

Source: AMIRA 2002



Legend

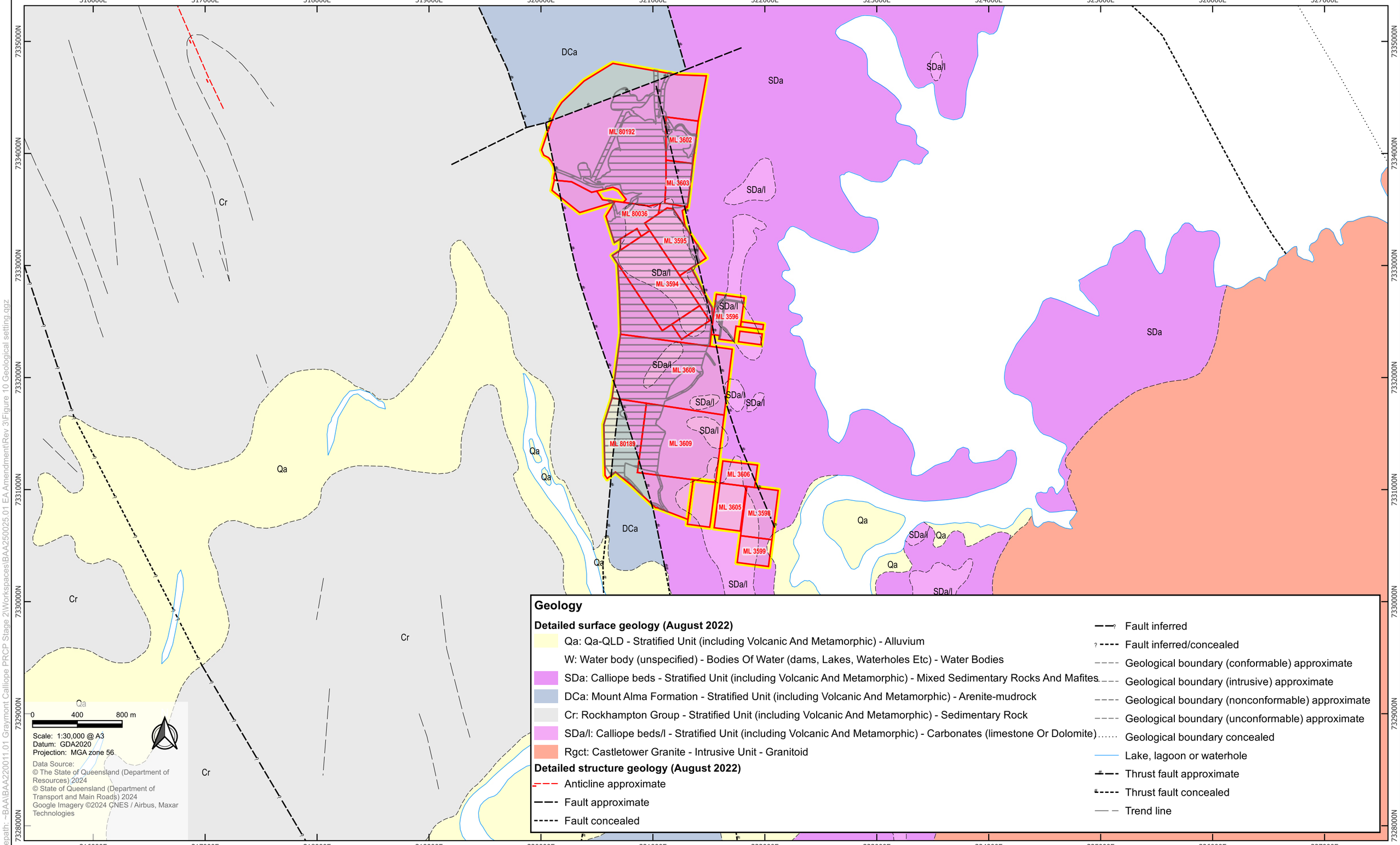
- Site boundary
- Maximum disturbance extent

Elevation contours

- 5m intervals
- 10m intervals

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 9
Topography and landform



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 10 Geological setting.qgz

Legend

- Site boundary
- Mining leases
- Maximum disturbance extent

epic
A Montrose Environmental Company

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 10
Geological setting

4.2.5 Soils

The limestone deposit comprises a large orebody of steeply dipping, north-south, striking limestone. The limestone is fine-grained to crystalline, light grey with cream inclusions, very-high strength, fresh to slightly-weathered, moderately-jointed to massive. Discontinuities are sharp and generally clean. Soil mapping units are illustrated in **Figure 11.**

Dissolution of the upper surface has created some minor karst features; predominantly a slightly irregular surface, dilated joint apertures, small caverns, and shafts. These features are most obvious to a depth of approximately 20 m below surface. These features are likely to have negligible detrimental influences on the performance of the walls. The limestone is overlain by red-brown clayey sand (Sibelco 2018b).

As described in the Hydrogeological Assessment, the average thickness of the soil is 1-4 m and comprises of the following (refer to **Appendix E**):

- The upper horizon is approximately 0.2 m thick. It comprises red to red-brown, Terra-Rosa, clay loam, medium plasticity, moist, soft, medium dense, and weakly cemented. Some to many smooth to angular gravels to boulders of weathered limestone and volcanics, 10 to 100 mm in diameter
- The lower horizon comprises light to medium, yellowish-brown, silty clay, low plasticity, dry, firm to stiff, medium dense, weakly to moderately cemented. Many angular gravels to boulders of weathered limestone and volcanics 10 to 300 mm in diameter.

The Project is located in an area of undulating terrain which has largely been cleared for grazing. The pre-mine land capability is classified as:

- 50% Class V- Land primarily used for pastoral uses but can be cropped if limitations are removed
- 50% Class VI – Land not suitable for cultivation but well suited to pasture improvements.

4.2.5.1 Contaminated Land

Contaminated land investigations will be undertaken at the appropriate time to identify if there is any contaminant leaching from the fuel tanks stored in the Infrastructure area onsite. In 2022, Graymont submitted an application to the DETSI (formerly DES) to list the Project on the Environmental Management Register (EMR) / Contaminated Land Register (CLR) for 11 tyres buried within former Pit 1. The application was not processed by DETSI, and the Project remains unlisted on the EMR / CLR.

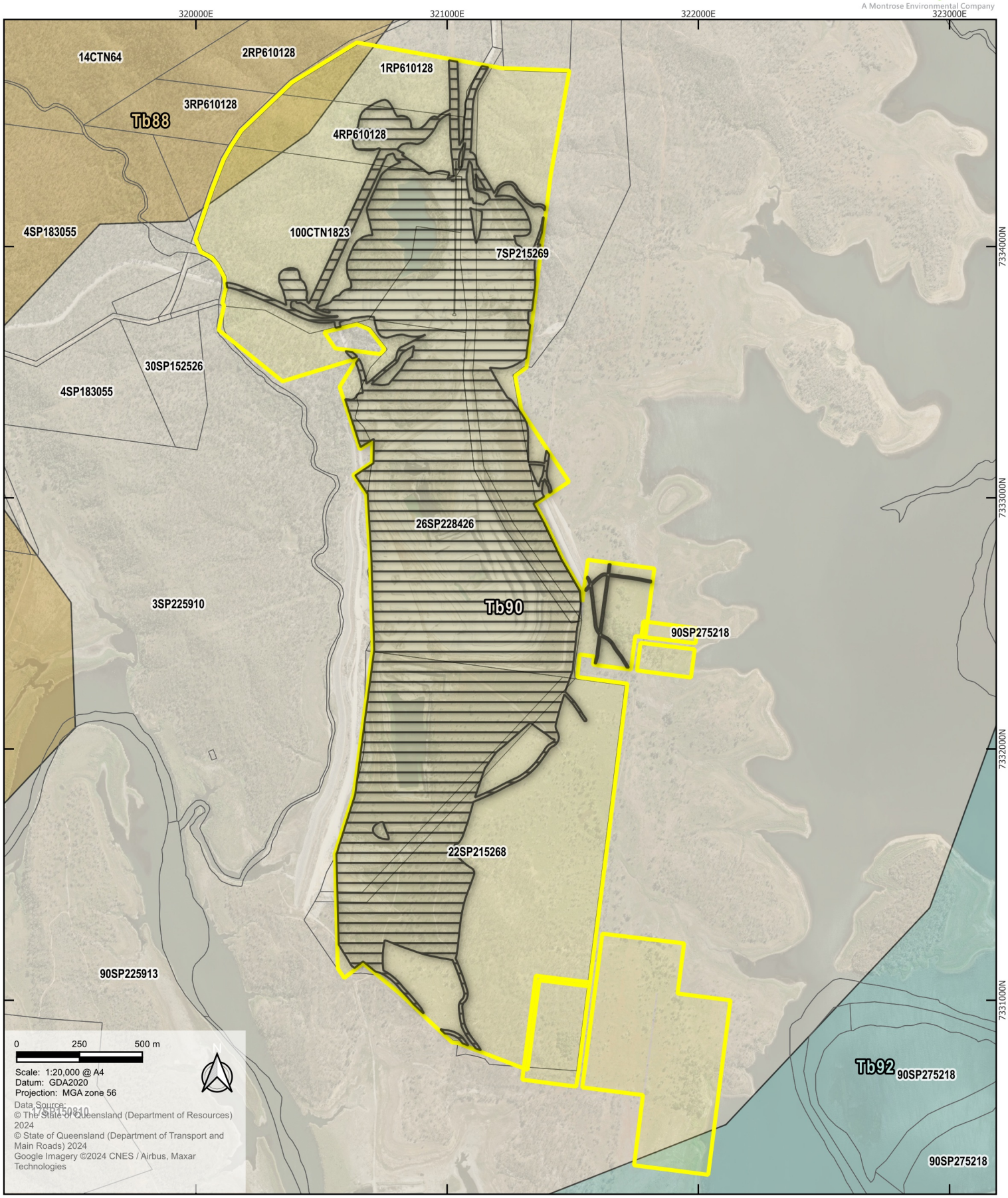
Historically (pre Graymont ownership) it is understood scrap tyres had been buried in former Pit 1. Since Graymont commenced operations in 2019, no scrap tyres have been buried in former Pit 1 and no further burial is proposed for future operations. Where possible, any new scrap tyres acquired in future operations will be transported offsite to an appropriately licensed facility. To ensure compliance with conditions E1, E2, E3 and E4 of the EA (EPML00969013), any scrap tyres requiring temporary storage within the Project area will be placed in a trench on the Southern WRD, noting the following:

- They will be stored in stable stacks and at least 10 m from any scrap tyre storage area, or combustible or flammable material, including vegetation
- All reasonable and practicable fire prevention measures will be implemented, including removal of grass and other materials within a 10 m radius of the scrap tyre storage area, and
- Scrap tyres temporarily stored on the Southern WRD will not impede saturated aquifers or compromise the stability of the consolidated landform.

A maximum of 10 to 20 scrap tyres will be temporarily stored onsite in the infrastructure area and will be regularly collected and transported to an appropriately licensed waste facility. This is consistent with the best practice environmental management measures outlined in the *Disposal and storage of scrap tyres at mine sites operational policy* (DESI 2024d).

4.2.5.2 Acid Sulfate Soils

Gladstone Regional Plan mapping has mapped sections of ML3594, ML3608 and ML80192 as Acid Sulfate Soils 5-20 mAHD and Acid Sulfate Soils 0-5 mAHD (Gladstone Regional Council, 2022). Further investigation utilising Queensland Globe (QGlobe 2025) revealed no mapped Acid Sulfate Soils within the Project area.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 11 Soil mapping units.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance extent

Soils (Atlas of Australian Soils)

- Tb88
- Tb90
- Tb92

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 11
Soil mapping units

4.3 Surface Water and Wetlands

4.3.1 Project Hydrology and Fluvial Networks

4.3.1.1 Catchment Overview

The Project is located within the Fitzroy catchment region within the Boyne River Basin, which covers approximately 2,590 km^2. The area is bound by Many Peaks Range to the east, Dawes Range to the south, Calliope Range to the south-west and Boyne Range to the west. The terrain of the bounding ranges is relatively steep with heights ranging from 600 to 850 m above sea level. Several other towns are also located within the catchment including Nagoorin, Ubobo, and Builyan. The Boyne River Basin Plan area comprises a single catchment with one major river system (the Boyne River) and a number of tributaries (including Ridler, Degalgil, Marble and Diglum Creeks) that drain to Gladstone Harbour and the GBR.

4.3.1.2 Watercourses and Waterways

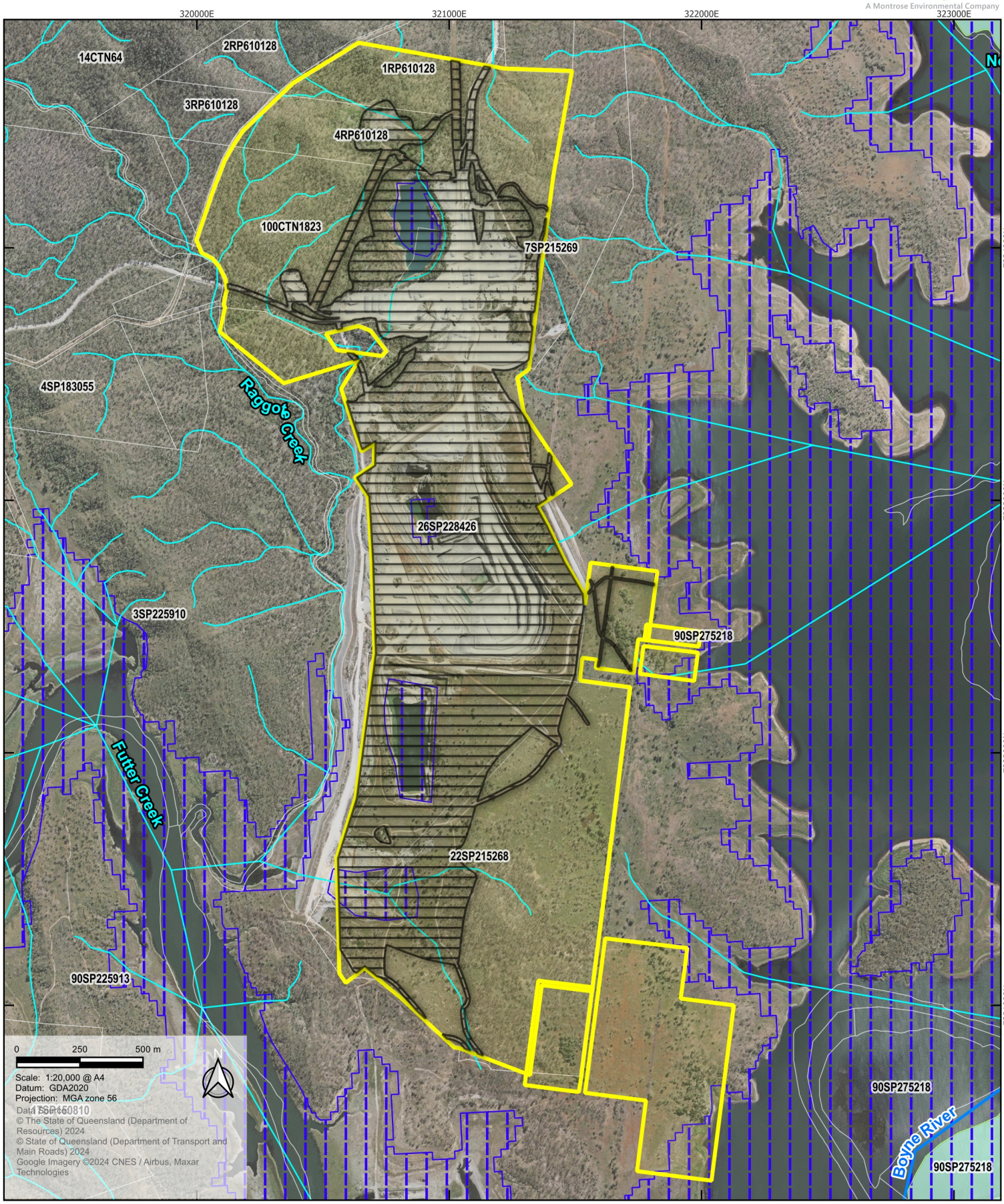
The Project is bound by Lake Awoonga to the east, south and west. Lake Awoonga forms the drinking water supply dam from the surrounding catchment area for the GAWB.

To the west of the Project is a significant bund wall adjacent to Pit 3 and Pit 4. The water body adjacent to the bund wall is known as Raggote Creek, which is a tributary that flows into Lake Awoonga (see **Figure 12**). The eastern side of Pit 4 has another bund wall to prevent inundation of the Project area. GAWB has plans to increase the height of this bund wall in anticipation of raising the water level within Lake Awoonga. The lake is fed by a series of minor watercourses traversing the MLs. Several of which have a direct impact on the extraction and processing activities on the Project area.

Review of the Queensland waterways for waterway barrier works under the Fisheries Act (viewed in QGlobe 2025) indicates several low (green) first order waterways intercepting the Project area, a high (red) waterway bordering the Project to the west (corresponding to Raggote Creek), and the Major (purple) waterways of Futter Creek and Boyne River to the Southwest, South, and East, as shown in **Figure 13**. DETSI Biomaps interactive mapping online also revealed '*buffered streams of conservation significance: Queensland Murray Darling Basin*' bordering the Project area that correspond to the high (red) waterway and Futter Creek.

4.3.2 Wetlands

Lake Awoonga is mapped as a lacustrine wetland, as shown in **Figure 12**. The existing farm dam adjacent to the Southern WRD is mapped as a hydrologically modified or artificial lacustrine wetland. There are no internationally important wetlands within the vicinity of the Project area; the closest Internationally Important Wetland is located greater than 1,000 km away. There are no MSES - High ecological significance wetlands mapped within the Project area. The closest of which is approximately 4 km east of the Project area.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 12 Watercourses and wetlands.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance extent
- MSES - Regulated vegetation (100m from wetland)

Wetland areas (Qld Wetland Mapping v5.0)

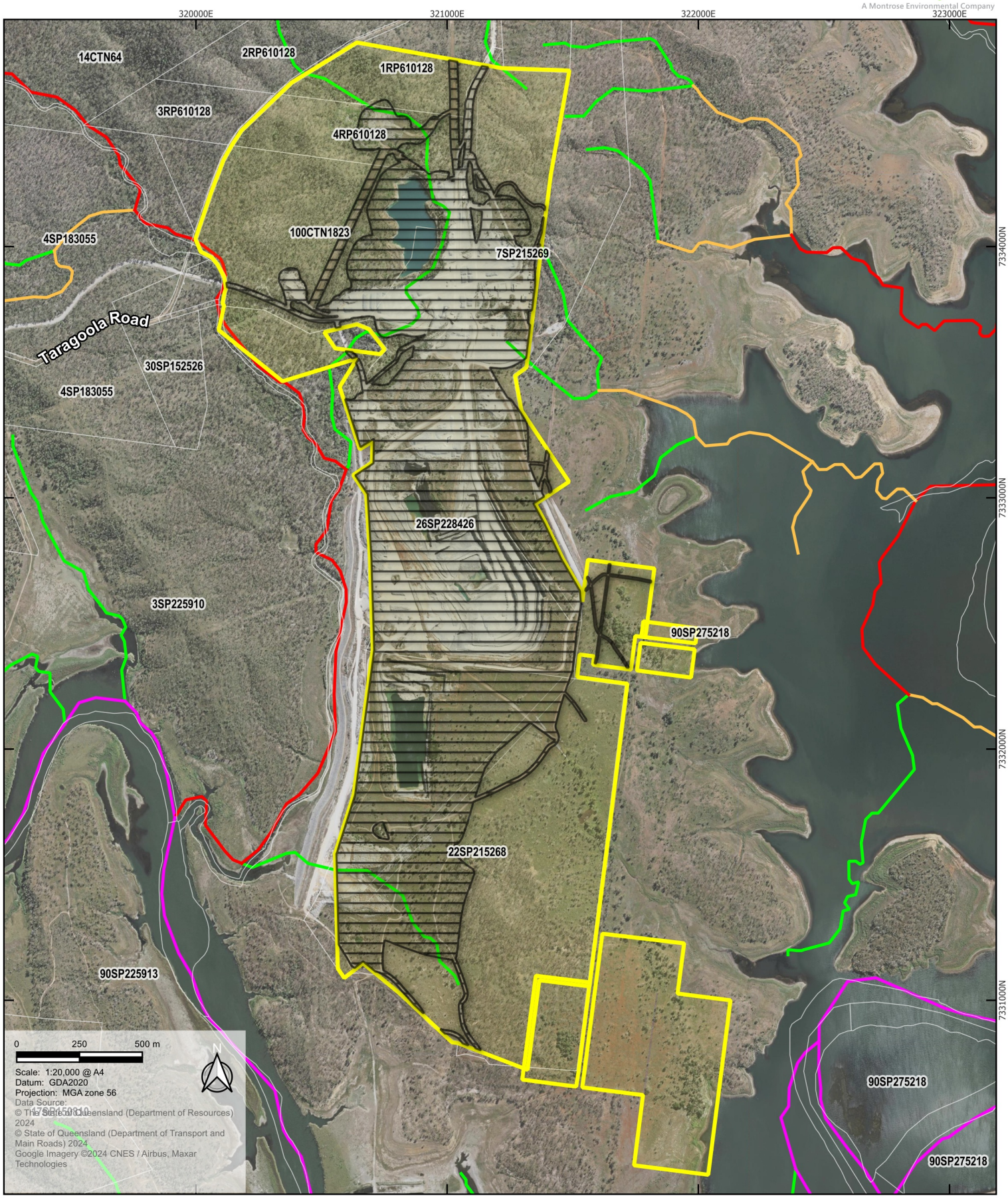
- Lacustrine

Watercourses

- Major
- Minor

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 12
Watercourses and wetlands



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 13 Waterways for waterway barrier works.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance extent

QLD waterways for waterway barrier works

- Low
- Moderate
- High
- Major

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 13
Waterways for waterway barrier works

4.3.3 Existing Water Use

The Project currently operates three pits (however only Pit 4 is currently used for extraction) and two sediment ponds. The three pits each have a small local catchment which directs most disturbed areas within the Project area back into the pits. There is a small catchment in proximity to the stockpile areas which is directed to the sediment pond for treatment prior to discharge into Raggote Creek, and a farm dam directly east of the Southern WRD. Water for process use is sourced from onsite water tanks (stormwater) and Pit 2.

The three main Project water storage areas are summarised as follows (see **Figure 3**):

- Pit 2 - a water storage used for the supply of water to the wash plant
- Pit 3 - a water storage and stormwater surge capacity during periods of high rainfall.
- Four onsite water tanks- located within the operational stockpile areas and supply the wash plant

Pit 2 and onsite water tanks provide water for current operations. A 50,000 L water truck collects water from the pit and completes all dust suppression onsite, including spoil piles and the washdown area at the workshop that leads into the interceptor for washdown of vehicles.

At a regional level, Lake Awoonga is the main drinking water supply source for the greater Gladstone region. As such, maintaining suitable water quality within this Lake is important for water supply as well as the other EVs of the Lake (Sibelco 2018a). The construction of the Awoonga Dam has led to permanent water being now present in what were previously ephemeral drainage lines. Groundwater and surface water interaction is now dependent upon water levels in Lake Awoonga and mingling of the water and its uses is now common. Therefore, it is expected that future groundwater uses for this closed system would include drinking water and recreation, as it is currently used.

The catchment area contributing to Lake Awoonga is 2,240 km^2 and is surrounded by the Boyne, Dawes, and Many Peaks Ranges. The lake is located approximately 20 km upstream of the mouth the Boyne River. Downstream of the lake, limited amounts of freshwater is allowed to flow downstream of the lake. The main use of the Boyne River is for recreational fishing. However, the Lake is the main source of drinking water for the greater Gladstone area. The catchment area of the mine is approximately 700 ha, which represents less than 0.4 percent of the overall catchment (SKM 2012a).

4.3.4 Environmental Values

Identification of EVs has been undertaken in accordance with the *Application requirements for activities with impacts to water guideline* (DESI 2024c). The EVs for the Project's receiving surface water environment has been defined as WQ1331— Boyne River in Schedule 1 of the *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (EPP (Water and Wetland Biodiversity). The specific EVs applicable to the Project are detailed in the supporting EPP (Water and Wetland Biodiversity) document, *Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives* (EPP 2014) and have been summarised in **Table 13**. The EPP water type for this area is listed as "Lowland Fresh Waters" and environmental values zone includes "Northern Boyne tributaries and Lake Awoonga".

Table 13. EVs of Project receiving surface waters

Value	Icon	Description	Pathway/ Receptor Linkage
Aquatic Ecosystems		The Project is adjacent to Lake Awoonga, a tributary to Boyne River. Areas downstream may support aquatic ecosystems.	Possible
Irrigation		The Project is in proximity to a few groundwater bores that may be used for irrigation. Water from the Boyne River is used for industrial purposes that may include irrigation in the region through the Awoonga Callide Water Supply Scheme (Sunwater 2023).	Possible
Farm Supply Use		The Project has a farm dam which does not support any farming activities, and therefore is not considered to impact on water used for farming.	Low

Value	Icon	Description	Pathway/ Receptor Linkage
Stock Water		The Project is not considered to impact on the water used for livestock on Lake Awoonga or Boyne River. Neither Lake Awoonga or Boyne River are used for stock water supply.	Low
Aquaculture		The Project is not located in proximity to any aquaculture facilities.	Unlikely
Human Consumer		Areas downstream from the Project may be utilised for the consumption of aquatic foods, including fish.	Possible
Primary Recreation		Areas adjacent to the Project support recreational activities including swimming and diving. Water discharges from the Project to Raggote Creek, a tributary to Lake Awoonga, are controlled in accordance with the EA.	Possible
Secondary Recreation		Lake Awoonga supports recreational fishing and boating activities. There are no uncontrolled releases to Lake Awoonga from the Project.	Possible
Visual Recreation		The Project is located approximately 7km south west of the Lake Awoonga lookout, boat ramp, and camping area, and is not clearly visible from this location. Potential releases from the Project is unlikely to be contribute to deterioration of the aesthetics of Lake Awoonga.	Low
Drinking Water		Raw water from Lake Awoonga is processed at water treatment plants for drinking.	Possible
Cultural and Spiritual Values		Releases from the Project will be minor in nature and will not impact on the cultural and spiritual values of Lake Awoonga.	Low
Groundwaters (aquatic ecosystems, irrigation, farm supply/use, stock water, drinking water)		Mining activities occur above the groundwater table so any discharges to groundwater are unlikely.	Unlikely

The site is within the Boyne River Basin which is within the GBR catchment for which the GBR Water Quality Protection Plan (the Reef Plan) applies. The Reef Plan sets targets for improved water quality and land management practices which are implemented through each WQIP.

4.3.4.1 Water Quality Objectives

Water Quality Objectives (WQOs) for the Boyne River Basin have been defined within the *Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives* (EPP (Water) 2014). The Project area 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. The WQOs for the water areas relevant to the Project have been summarised in **Table 14** below. Lowland fresh waters is considered relevant as Raggotte Creek and Futter Creek, which are tributaries of Lake Awoonga, have elevations less than 150 m.

Table 14. Boyne River Basin WQOs relevant to the Project (EPP (Water) 2014)

Water area/ type	Management Intent / level of protection	Amm (N) (µg/L)	Oxid N (µg/L)	Total N (µg/L)	FRP (µg/L)	Total P (µg/L)	Chl-a (µg/L)	DO (% sat)	Turb (NTU)	SS (mg/L)	pH
Lake Awoonga	Moderately Disturbed (MD)	-	-	<700	-	<40	-	85-105	<4.7	-	7.75 -8.4
Lowland fresh <150m (other waters)	MD	<20	<60	<500	<20	<50	<5	85-110	<50	<10	6.5-8.0

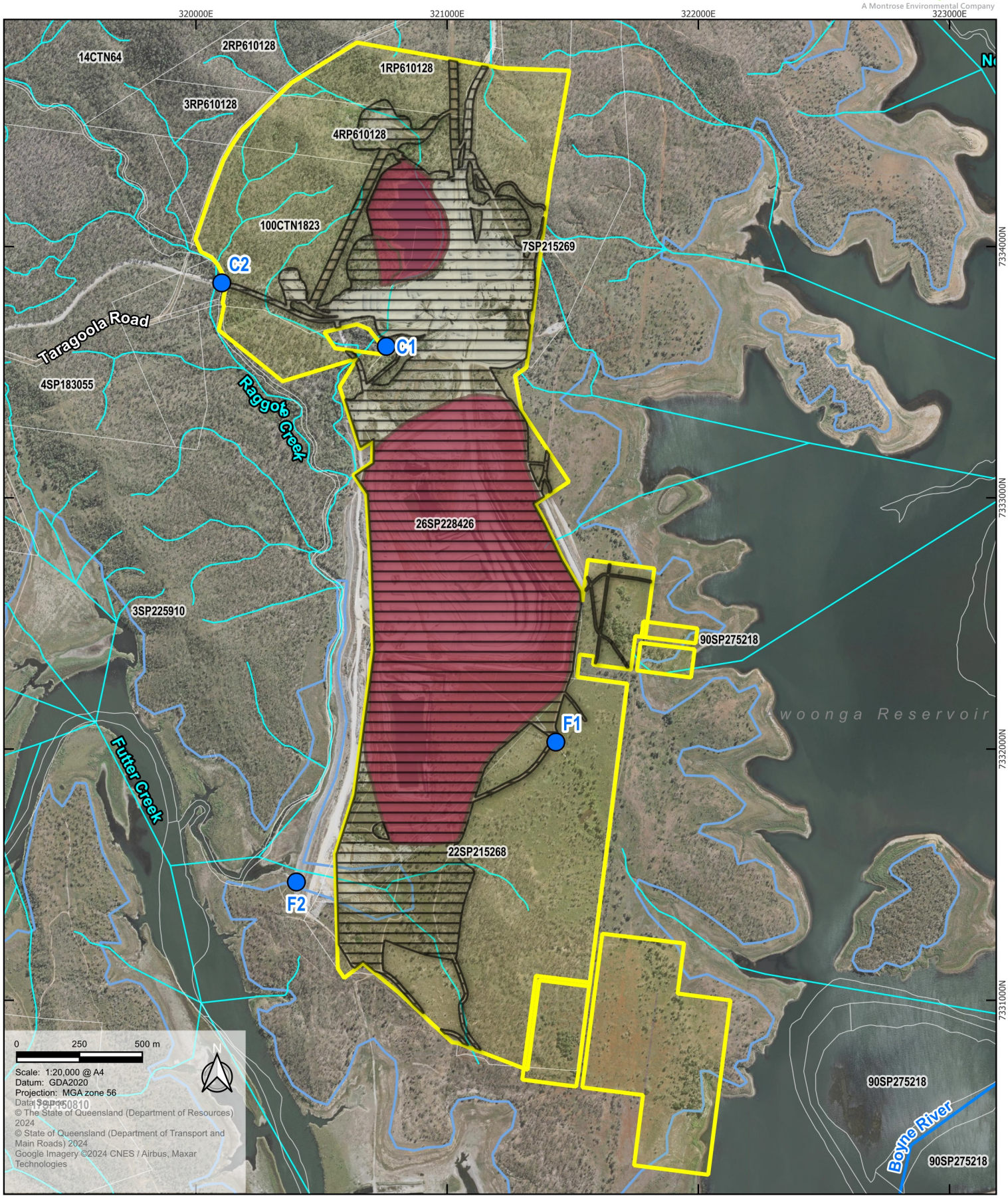
4.3.5 Receiving Environment

The release of mine impacted waters must only occur from the release points specified in Conditions C1-C6 of the EA. Water quality monitoring has been undertaken at the Project at the release points in the EA (release points F1, F2, C1 and C2, shown in **Figure 14**). Both release points C1 and F1 have water quality data available since January 2023. Release point C2 has had pooling water, and at some times, not enough water for adequate sampling. Release point F2 cannot be accessed. The summary of water quality data collected at Release Point C1 and F1 for all sampling events during 2023 to 2025 is provided in **Table 15**.

Table 15. Water quality data from release point C1 and F1

Release Point	Measurement	pH	Electric Conductivity (EC)	Total Suspended Solids (TSS)
C1	20th percentile	7.88	520	5
	Median	8.09	564	6.5
	80th percentile	8.18	591.8	10.6
F1	20th percentile	7.838	727	5
	Median	8.085	741	6
	80th percentile	8.168	760	7

As described by Graymont (2024), the water quality of the Pit 3 water samples is likely a combination of bedrock derived groundwater seepage but shows a closer affinity to the andesitic volcanics type bedrock groundwater chemistry. Pit 3 and seepage samples also shows some degree of evaporation effect demonstrated by the higher proportion of chloride and sodium (refer **Appendix E**).



Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance extent
- Contamination sources
- Awoonga Reservoir

Watercourses

- Major
- Minor

- Surface water monitoring point

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 14
Surface water monitoring locations

4.4 Groundwater

4.4.1 Hydrogeology

The Calliope limestone mining operations lies within the Calliope beds rock unit. The rock units within the Project area would not strictly be considered aquifers in a hydrogeological sense, however for the purposes of this application, the groundwater flow system locally is considered as a fractured bedrock aquifer. The groundwater system is considered to be largely unconfined across the site. The limestone and surrounding suite of rocks within this group are connected to some degree through fracturing.

Groundwater levels are influenced primarily by topography and the associated combination of recharge waters from direct rainfall through fractures, run-off, and accumulation to low points (i.e. pit floor and other depressions) and subsequent infiltration.

Historical drilling information from the area and observations by mining geologists during various mining operation phases indicate the rocks in the area have relatively low bulk hydraulic conductivity. This is supported by recent hydraulic conductivity testing completed at the site (**Appendix E**). Groundwater flow within the bedrock is most likely via fractures such as jointing or small faults, providing some preferential flow paths (refer **Figure 15** and **Figure 19**). In the upper zones close to the weathered profile, clay filled karstic voids are typical of weathered limestone deposits. However, no significant karstic features or voids have been recorded in the Project area (Graymont 2025).

A hydrogeological assessment of seepage from bedrock to the open pit workings was undertaken by mining company hydrogeologists between 2018 and 2019 (Graymont 2020), and has recently been updated (Graymont 2025, refer **Appendix E**). The investigation focused on the potential risk of leakage or seepage from Lake Awoonga into Pits 3 and 4 following several heavy rainfall events, which led to high water levels in Lake Awoonga and rising water levels in Pit 3.The updated conclusion drawn was that the most significant cause for rising Pit 3 water levels was due to surface run-off, seepage and flow of water from the Farm Dam following rainfall events, and not from Awoonga Dam leakage. Analysis of salinity and major ion chemistry shows notable differences between Awoonga Dam water, Pit 3 water, surface water in the Farm Dam and seepage from the Farm Dam (**Appendix E**).

4.4.2 Groundwater Dependent Ecosystems (GDEs)

No Groundwater Dependent Ecosystems (GDE's), in the categories of surface expression, terrestrial, and subterranean potential GDE's, are shown as occurring in the Ragotte Creek and adjacent catchment in publicly available mapping (QGlobe 2025).

4.4.3 Regional Groundwater Quality and Flow

Groundwater flow and surface drainage around Pits 3 and 4 at Calliope functions as a closed system. An implication of a closed system is that it becomes difficult to measure the impact of mining on groundwater as the measurement of impacts can only be undertaken within the area of mining (as opposed to an open system where impacts can be measured as water moves off-lease). Groundwater can be benchmarked outside the pit but there are a number of complications with attempting to measure the impact of mining from groundwater samples collected on the pit floor, including:

- Groundwater flow direction on the pit floor is not only horizontal but also potentially upward (discharge) and so groundwater at depth below the pit floor may not be related to sub-horizontal groundwater seeping into the pit (refer **Figure 15** and **Figure 19**)
- Mining potential creates a shallow water table on the pit floor from blasting induced fracturing which may mix with local groundwater flow
- Mixing of surface water and groundwater changes the chemistry of measured groundwater
- Dilution (rainfall) and evaporation (concentration) effects.

Groundwater above Pit 4 can be benchmarked (bore FM5 was installed to provide this data, and the new boreholes shall provide additional data) whereas groundwater in Pit 4 is integrated with surface water as pit water. Groundwater quality can be approximated by the collection of pit water from the sump in the pit floor.

In an extended dry period, pit water may become exclusively groundwater but the concentration by evaporation may elevate water quality parameters. In high rainfall events groundwater is diluted with surface water.

The main mining void (combined Pit 3 and Pit 4) will be dewatered progressively as required to access the limestone resource and will remain a water storage post-mining. Pit 2 void is planned to remain a water storage facility for the current life of mine and post-mine. The Pit 2 water level is assumed to continue at current water levels 40 mAHD.

A local groundwater gradient toward the main mining void is set to continue as mining and dewatering progresses with mining. Groundwater seepage from surrounding bedrock in addition to surface water run-off accumulates in the mine void (refer **Figure 15**). Following cessation of mining, the mine voids will recharge with water as pressure differentials equalize with the surrounding bedrock and a new equilibrium is established.

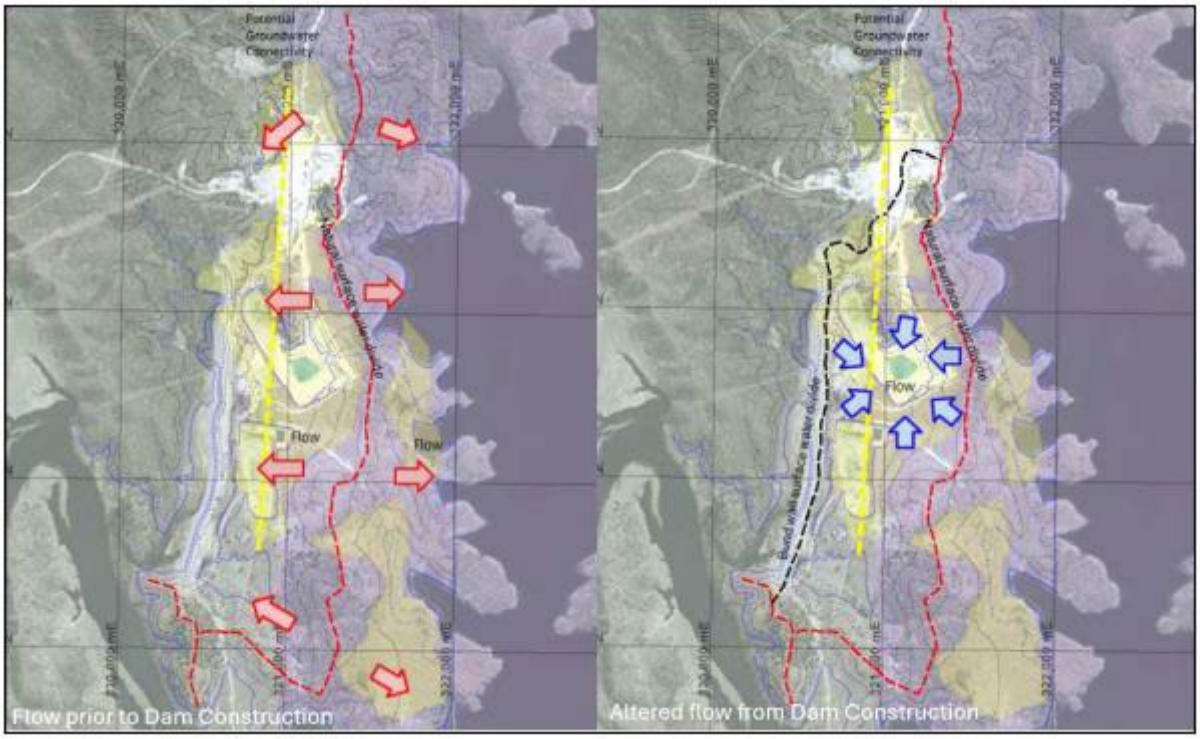


Figure 15. Groundwater flow before and during mining

Source: Graymont 2025, as in Sibelco (2012)

The water balance modelling indicates the pit water is predicted not to fill beyond approximately 30mAHD if the model assumptions are correct (the model is sensitive to groundwater inflow), and the pit will remain a sink.

The regional groundwater flow from the topographic high region of the Boyne Range State Forest that lies to the west of the mining leases is to the east and south-east. In the vicinity of the Graymont limestone mining leases, groundwater flow is predominantly from north to the south from Pit 2 to the southeast of Pit 4. Preliminary data from recently drilled boreholes indicates that groundwater is primarily hosted in volcanic rock and not limestone, which is low yielding, and groundwater occurs at or near volcanic-limestone contacts, as detailed in the **Appendix E** (Graymont 2025).

4.4.4 Regional Groundwater Levels

Prior to the construction of Awoonga Dam (within Lake Awoonga) and the mining activity, the groundwater levels would have been a subdued reflection of the topography with a groundwater gradient from topographic highs toward valley floors. A regional groundwater gradient is from west in the Boyne Range State Forest hills

area to the east and southeast discharging to the Boyne River (now Awoonga Dam) and Futter Creek, a tributary of the Boyne River catchment. Following construction of the Awoonga Dam and the development of the mine void, groundwater gradients flow toward the mining voids (Graymont 2025).

Locally, a topographic high on the east side of the Project area within volcanic rock is a local recharge area for infiltration to groundwater, and provides a subtle natural groundwater divide with groundwater flow to the west on the west side the topographic high, and flow to the east, east of the topographic high. Data from recently drilled boreholes indicates that this groundwater divide is still in effect, with overall groundwater flow to the south (Graymont 2025).

Water levels for the bores are shown in **Figure 16**. As discussed in **Section 3.2.2.10**, the deeper FM5B was drilled in 2021 close to the original FM5 location, and is used generally for groundwater monitoring but not for compliance purposes.

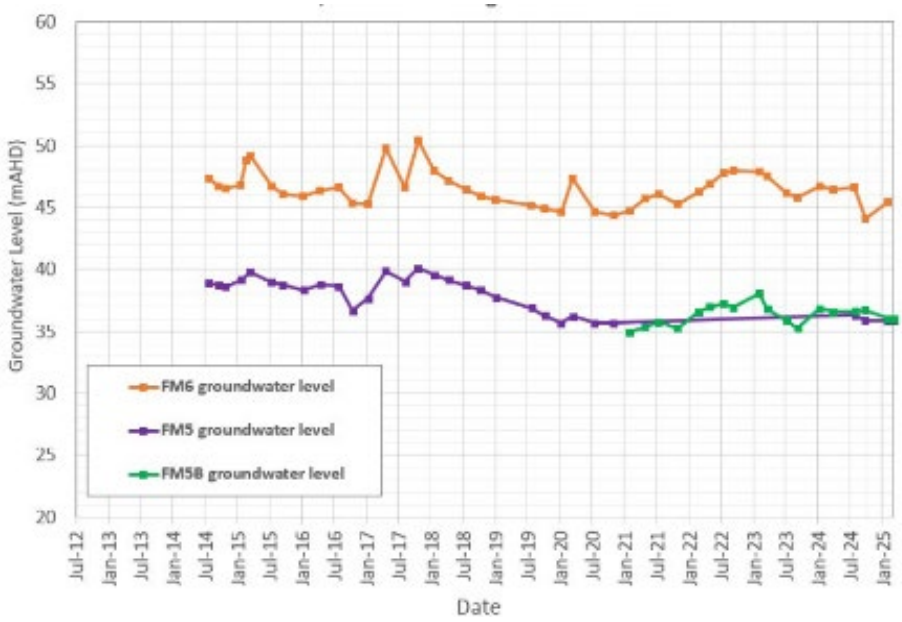


Figure 16. Groundwater levels for FM5, FM5B and FM6

Source: Graymont 2025

Both bores exhibit a natural seasonal fluctuation of groundwater levels of greater than 2 metres per year (m/year), and show similar water level responses to precipitation events during periods when FM5 isn't dry.

Groundwater levels declined from 2018-19 during a drier climate. A hydrograph of bores FM5, FM5B and FM6 is presented with Awoonga Dam water levels in **Figure 17**.

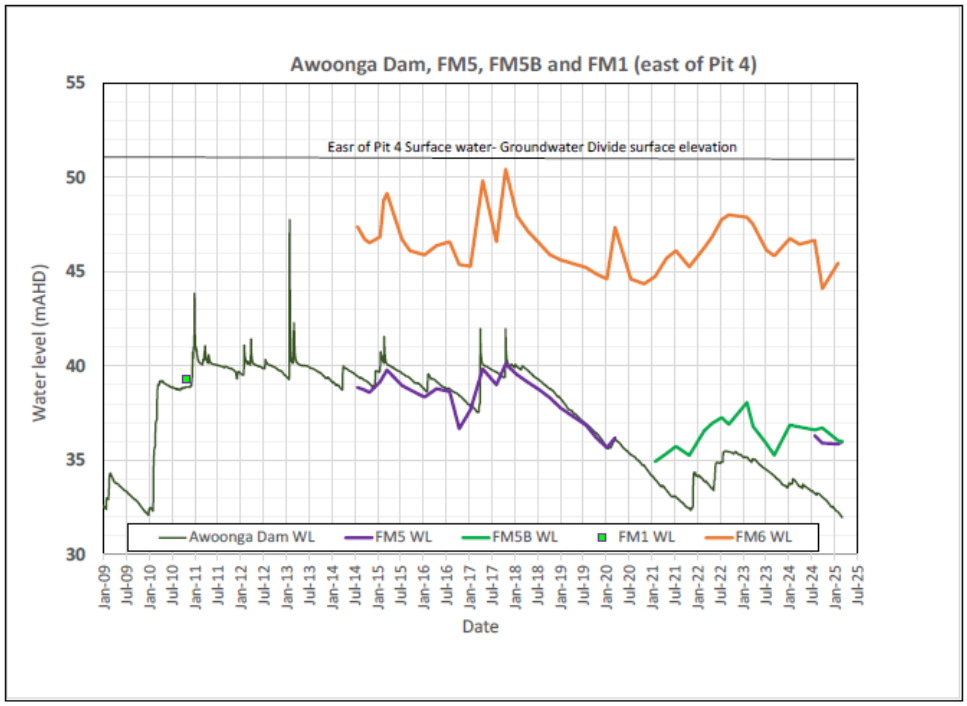


Figure 17. FM5, FM5B and FM6 groundwater levels with Awooga Dam water level

Source: Graymont 2025

Analytical water balance modelling has been undertaken and provided in **Appendix E.** A Water Balance Model was developed by Graymont (2025) which was run for 100 years using various groundwater inflow rates. **Figure 18** shows the water level rebound in the final main void reaching stabilised water level around 26 mAHD over a period of approximately 70 years post mine closure. The result will likely be a groundwater gradient toward the void (Graymont 2025).

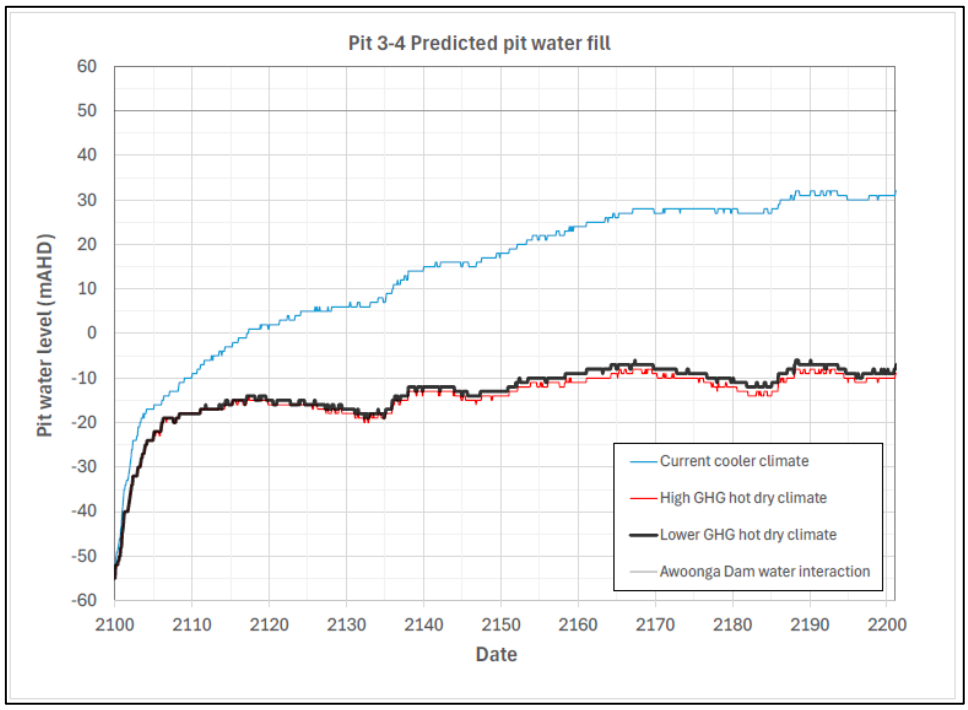


Figure 18. Water balance model predicted water level post mining

Source: Graymont 2025

4.4.5 Hydraulic Conductivity

Drill records from 4 bores drilled in 2002 on the east side of Pit 4 including bores FM1, FM2, FM3 and FM4 (refer to **Figure 19**), reported some fracturing and minor seepage zones. FM1 struck a fracture zone at 43.5 m – 44.0 m below ground with an air lift test estimating 0.4 L/s yield. Air lift pump testing by drilling operators tend to be approximate instantaneous yield rather than an estimate of long-term yield potential. Therefore, this information should not be viewed as accurate yield estimates. Recovery test estimates reported hydraulic conductivity values in the order of 0.003 metres per day (m/d) from the bore. Given that fracture spacing is irregular often in bedrock, the chances of hitting a water bearing fracture in drill holes is low (Graymont 2023a). This is supported by recent borehole drilling, with numerous boreholes initially dry, details are provided in **Appendix E**.

Drilling logs also report minor seepage in cavities in FM2 during drilling which are not unusual in limestone environments and can occur as part of the drilling process through weather broken bedrock. No evidence of solution channels was reported.

Recent slug testing of the bore FM6 and analysis of the response provided estimates of hydraulic conductivity of 0.036 to 0.056 m/day. A groundwater investigation initiated by Graymont in January 2025 is currently on-going, with planned further work to include hydraulic conductivity testing of additional monitoring bores

4.4.6 Groundwater Recharge and Discharge

Groundwater recharge from rainfall tend to occur on areas of bare rock areas or shallow soil and infiltrates via rock fractures. Usually that occurs on topographically higher areas. Areas of thick clay soil will slow the infiltration and lead to run-off.

Discharge of groundwater occurs in the topographically low areas such as the mine voids and natural drainage lines toward Raggote Creek, Futter Creek and the Awoonga dm storage (Graymont 2025).

Locally, the impact of mining and the management of Lake Awoonga water levels are both factors that could potentially affect groundwater recharge and discharge, although investigations indicate that there is little evidence of seepage from or interaction between the dam and the quarry. The development of the mining void will further develop the immediate areas around the mining void as a groundwater discharge zone. The infilling of the void with water over time in the years post mining will see a rebound in groundwater levels.

As outlined by Graymont (2025), groundwater quality is driven by the nature of rainfall and properties of the unsaturated zone. Rainfall entering the soil zone undergoes significant changes in chemical composition and pH by processes such as root respiration and decomposition of organic matter via chemical reactions such as sorption and redox. The chemical constituency of infiltrating water in turn modifies groundwater chemistry by processes such as leaching, dilution/concentration as well as dissolution/precipitation. Water quality is dependent upon the nature of rainfall (i.e. timing, intensity, duration) which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals (Graymont 2025).

4.4.7 Existing Groundwater Use

The primary groundwater affecting activities in the Project area are mining and Lake Awoonga water levels. However, as there is no direct groundwater discharge from the Project area, there are no receiving environments potentially exposed to groundwater level drawdown or potential contamination.

Groundwater use in the region, apart from re-use of mine pit water, is primarily for stock and domestic use. Project operations re-use water collected in the operating pit void for processing plant operation and dust suppression on access tracks. Currently, the mine operation uses approximately 33,000 litres per month for the wash plant (5% of all pit re-use water) and 727,000 litres average per month for dust suppression (95% of all re-used pit water). The water is a combination of rainfall run-off and groundwater seepage (Graymont 2025).

Excess pit water from Pit 3 and 4 is also periodically pumped out to the main discharge points primarily at F1 and a secondary location F2, displayed in **Figure 14**. Water release is authorised if the water quality parameters are below EA specified limits including:

- 900 µS/cm salinity (EC)
- 6.5 <pH< 8.5
- 100 mg/L total suspended solids (TSS)

The groundwater that discharges internally in the Project area (to the pits) is mixed with surface water and this is monitored regularly to ensure quality specifications are met before being released to Lake Awoonga. While the groundwater affecting activities do not impact downstream environments, the groundwater level drawdown at the mine pits may potentially induce leakage from Lake Awoonga. Studies undertaken thus far indicate that significant leakage rates from Lake Awoonga are unlikely (SKM 2012b, **Appendix E**).

4.4.8 Groundwater Bores and Geochemistry

There are three groundwater bores located on site (FM5, FM5B and FM6), as shown in **Figure 19**. Two monitoring bores, FM5 (State water database RN151689) and FM6 (State water database RN151688), are the current registered groundwater monitoring bores for the Project and are monitored for compliance under the EA (EPML00969013). FM6 is next to an inactive pit to the north in a non-working area. FM5 is next to an active working pit and benchmarks groundwater entering Pit 4 from the east.

Groundwater monitoring bores FM5 and FM6 were installed in 2012 and water monitoring data collected in the period 2012-13 was used to construct action trigger levels for these bores. The bores were installed to benchmark the natural condition of groundwater flow into quarry voids. Monitoring bore FM5 benchmarks radial inward groundwater flow to Pit 4 and FM6 benchmarks radial inward groundwater flow into Pit 2. The trigger levels for bores FM5 and FM6 are specified in EA (Graymont 2024b).

Groundwater levels and groundwater quality data are obtained 6-monthly to analyse and report trends from July 2012. An additional monitoring bore (RN187863, also known as FM5B) is located next to the original FM5. It was drilled in January 2021 due to low groundwater levels in FM5 during mid-2019 to late-2020. Monitoring of FM5B has occurred since January 2021 and indicates that bores FM5 and FM5B are in hydraulic connection.

Bore FM5B is currently used by Graymont as a monitoring bore but not for compliance monitoring purposes under the current EA (Graymont 2025).

The Project's groundwater monitoring bores provide the most consistent time series data available for the area. The remaining data from the Queensland State database is limited with no time series data available. However, the data has been compiled along with lithological type to assess water quality trends between the two main rock types of the area being limestone and volcanics (andesite and basalt). Water quality data includes field measurements of water levels, salinity, pH, turbidity in addition to laboratory analyses for major ions and hydrocarbons. The current compliance monitoring program outlined in the EA is shown in **Table 16**.

Table 16. Groundwater monitoring locations and frequency

Monitoring Point	Easting (GDA94)	Northing (GDA94)	Monitoring Frequency			
			Groundwater level	EC, TSS, pH and Major Anions	Metal Screen	Hydrocarbon
FM5	321430	7332650	Quarterly	Six monthly	Annual	Annual
FM6	321080	7334350				

In July 2012 the previous operator (now Graymont) developed and implemented a Background Groundwater Monitoring Program in accordance with MINB100942509 groundwater conditions C17-25 for the Project (formerly called Taragoola Limestone Site). Groundwater monitoring results from FM5 and FM6 taken until October 2013 were used to create groundwater trigger values in the EA (Graymont 2021). The results of background monitoring, trigger values and maximum results for FM5 and FM6 during the reporting periods 2019-2023 are shown in **Table 17.**

The major ion chemistry between FM5 and FM6 is generally similar, with the relatively recent exception of sulphate. Sulphate in FM5 and FM6 was similar until the installation of Bore FM5B. The cause of sulphate rise in FM5B is attributed to dissolution of gypsum (CaSO4) and leaching of sulphate ions into groundwater.

Table 17. Groundwater baseline, trigger values and maximum results for 2019-2023 reporting periods

Water Quality Indicator	Tigger Value	FM5			FM6		
		Count	Mean	Max	Count	Mean	Max
Electrical Conductivity µS/cm	1500	20	1163	1337	23	1180	1320
pH	6.5 – 8.5	21	6.9	7.53	23	6.89	7.63
Total Suspended Solids mg/L	1500	21	177	7400	20	30.85	386
Carbonate ($C0_3$) mg/L	500	22	<1	<1	22	<1	<1
Calcium mg/L	250	21	169	205	23	155	191
Magnesium mg/L	35	21	14.5	17	23	23.8	31
Sodium mg/L	100	21	60.5	78	23	65.1	76
Potassium mg/L	5	4	1	1	20	1.55	3
Chloride mg/L	200	21	91.7	148	23	111.1	179
Sulfate (SO_4) mg/L	20	21	16.3	72	23	10.8	17
Bicarbonate ($HC0_3$) mg/L	500	21	442.8	491	23	452.2	503
Petroleum hydrocarbons mg/L	1	16	0.051	0.07	16	0.051	0.06
Arsenic mg/L	-	3	0.001	0.001	4	0.003	0.006
Cadmium mg/L	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium mg/L	-	3	0.002	0.003	4	0.002	0.003
Copper mg/L	-	3	0.16	0.108	4	0.022	<0.001
Nickel mg/L	-	3	0.003	0.005	4	0.005	0.006
Lead mg/L	-	3	0.014	<0.001	4	0.003	<0.001
Zinc mg/L	-	3	0.075	0.155	4	0.085	0.128

At EOML, the on-site bores North and South (FM6, FM5B and FM5) will be surrendered and the bore decommissioned in consultation with the DNRMMRRD 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 and decommissioned by fully grouting from the bottom of the bore to the surface.

4.4.8.1 Non-Compliances

Groundwater monitoring of bores FM5B and FM6 was most recently undertaken in 2023 to 2025. There have been non-compliances during the reporting period for sulphate in FM5B when applying the FM5 sulphate trigger values to this bore. New trigger levels are required for FM5B via an amendment to the EA (Graymont 2025). Changes to conditions in the EA relating to groundwater, including the addition of bore FM5B and a change to the water quality trigger level parameters is not included in this EA Amendment, but will be the subject of a future EA Amendment application specific to groundwater.

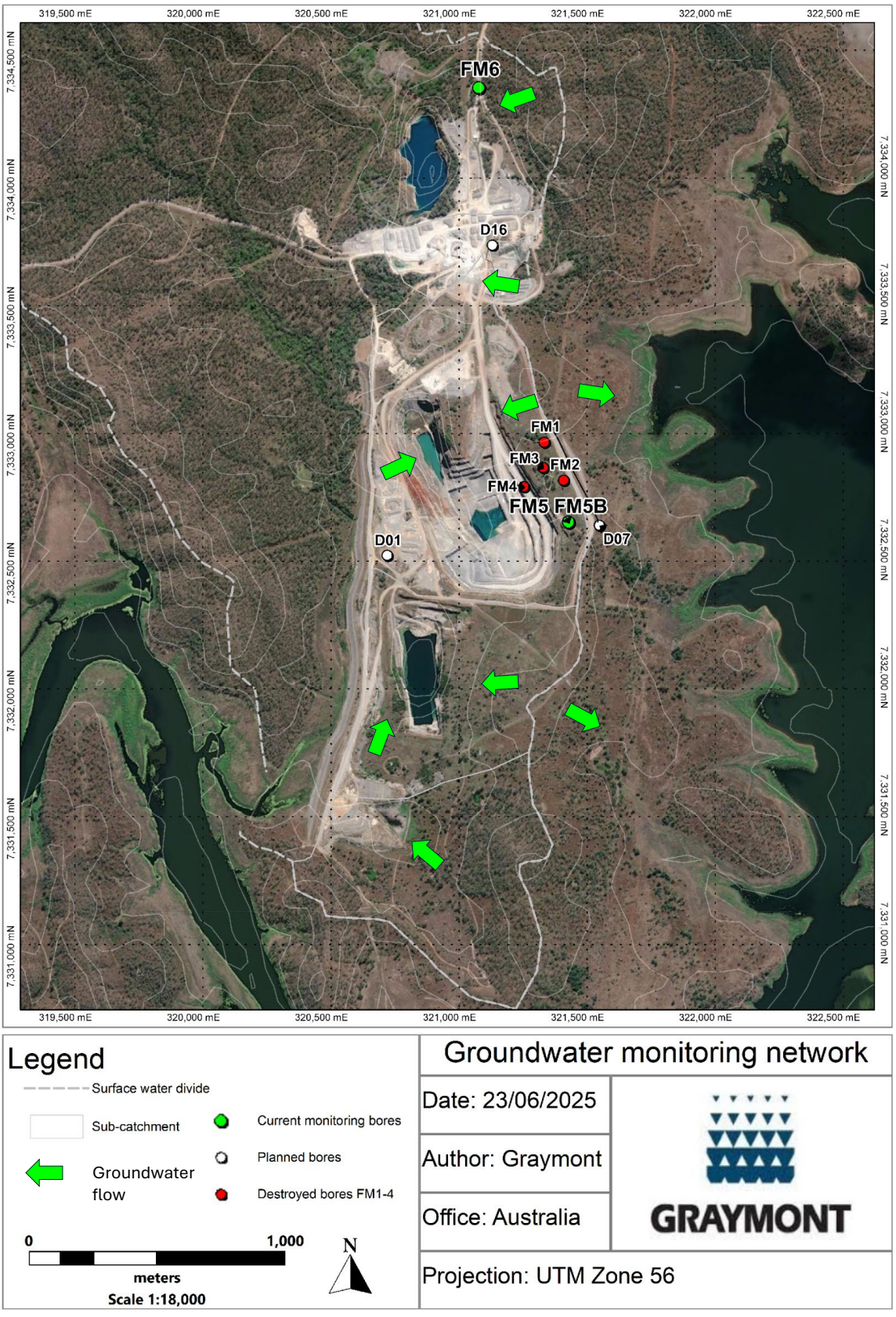


Figure 19. Groundwater monitoring locations

Source: Graymont 2025

4.4.9 Environmental Values

The Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. The livestock drinking water guidelines (Australian and New Zealand Guidelines (ANZG) 2023) provides recommended values for biological, chemical and radiological substances that may occur in livestock drinking water. Both guidelines have been considered against available data for the Project in **Table 18**.

The guidelines for groundwater quality protection in Australia supports the objective of the National Water Quality Management Strategy (NWQMS) to enhance and protect groundwater quality to support the nominated EVs and preventing groundwater contamination.

The guidelines for groundwater quality protection are primarily used by government agencies, however there is no specific groundwater protection plan for the Project area and no Groundwater Resource Management Plan in the areas within or surrounding the Project MLs (Graymont 2025).

The surface and groundwater monitoring and reporting process as part of the EA requirements for the limestone mine provides a management tool for water management at the site. Historic groundwater and surface water monitoring have met the required limits set out in the EA (Graymont 2025).

The Awoonga Dam water supply is the main environmental value in the local area and due to the downstream connection with the Boyne River valley, may indirectly impact on downstream EVs. Groundwater resources are also considered due to the impact of mine void likely causing some local groundwater depressurization during the mining phase and a period of returning groundwater levels post mine closure.

Recent mean water quality data presented in **Table 18** indicates that physical and chemical characteristics in groundwater (including water in or pumped from the void) within the ML currently meets the drinking water and stock water quality guidelines, except for the aesthetic drinking water salinity (EC) guideline value, but would be expected to meet the guidelines post-mining (Graymont 2025).

Table 18. Summary of water chemistry for monitoring site bores (2019 to 2025) compared to drinking water and stock water guideline values

Parameter	Aust Drinking Water Guidelines		Stock Water Guidelines	EA Compliance Limits[1]	FM5 Groundwater Bore				FM6 Groundwater Bore			
	Health	Aesthetic		Max	Min	Max	Mean	Count	Min	Max	Mean	Count
Calcium (mg/L)	-	-	-	250	165	193	181	9	143	191	164	17
Chloride (mg/L)	NA	250	NA	200	47	116	70	9	12	132	66	17
CO_3 (mg/L)	-	-	-	500	<1	<1	<1	9	<1	<1	<1	17
Electrical conductivity (µS/cm)	NA	-	-	1,500	165	1400	1210	8	754	1257	1067	17
HCO_3 (mg/L)	-	-	-	500	326	483	410	9	409	507	472	17
Magnesium (mg/L)	-	-	-	35	13	16	14.2	9	9	55	18	17
Petroleum Hydrocarbons (Total) (mg/L)	-	-	-	1.0	<0.05	0.1#	<0.06	14	<0.05	0.16#	<0.07	15
pH	NA	6.5 – 8.5	NA	8.5	6.6	7.53	7.0	8	6.5	8.00	7.2	17
Potassium (mg/L)	-	-	-	5.0	0	2	0.2	9	0	2	1	17
Sulfate (mg/L)	NA	250	1,000	20	18	168	108	9	6	64	13	17
Sodium (mg/L)	-	-	-	100	60	74	66	9	27	75	52	17
Total Suspended Solids (mg/L)	-	-	-	1,500	5	407	113	9	6	310	35	17

#Note: Result marginally above laboratory reporting limit, subsequent results below limit.

1. Per Table 4 of the EA EPML00969013

4.4.10 Calliope Water Investigations

A hydrogeological assessment of seepage from bedrock to the open pit workings was undertaken by mining company hydrogeologists 2018-2019 (Graymont 2020), and has recently been updated (Graymont 2025, refer **Appendix E**). The investigation focused on the potential risk of leakage or seepage from Lake Awoonga into Pits 3 and 4 following several heavy rainfall events, which led to high water levels in Lake Awoonga and rising water levels in Pit 3.The updated conclusion drawn was that the most significant cause for rising Pit 3 water levels was due to surface run-off, seepage and flow of water from the Farm Dam following rainfall events, and not from Awoonga Dam leakage. Analysis of salinity and major ion chemistry shows notable differences between Awoonga Dam water, Pit 3 water, surface water in the Farm Dam and seepage from the Farm Dam (**Appendix E**).

4.5 Terrestrial Ecology

4.5.1 Vegetation Communities

The Project area is located within the Mount Morgan subregion, within the Brigalow Belt South bioregion. Current Regulated Vegetation mapping for the Project included Category X (non-remnant), Category B (remnant), Category C (high-value regrowth), and Category R (riverine regrowth). Current government regional ecosystem (RE) mapping for the Project includes the following RE types (**Figure 20**):

- RE 11.11.15 - *Eucalyptus crebra* woodland to open woodland on deformed and metamorphosed sediments and interbedded volcanics
- RE 11.11.4 - *Eucalyptus crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding
- RE 11.114a - *Eucalyptus tereticornis* dominated woodland. Other tree species listed above may occur as sub or co-dominant species

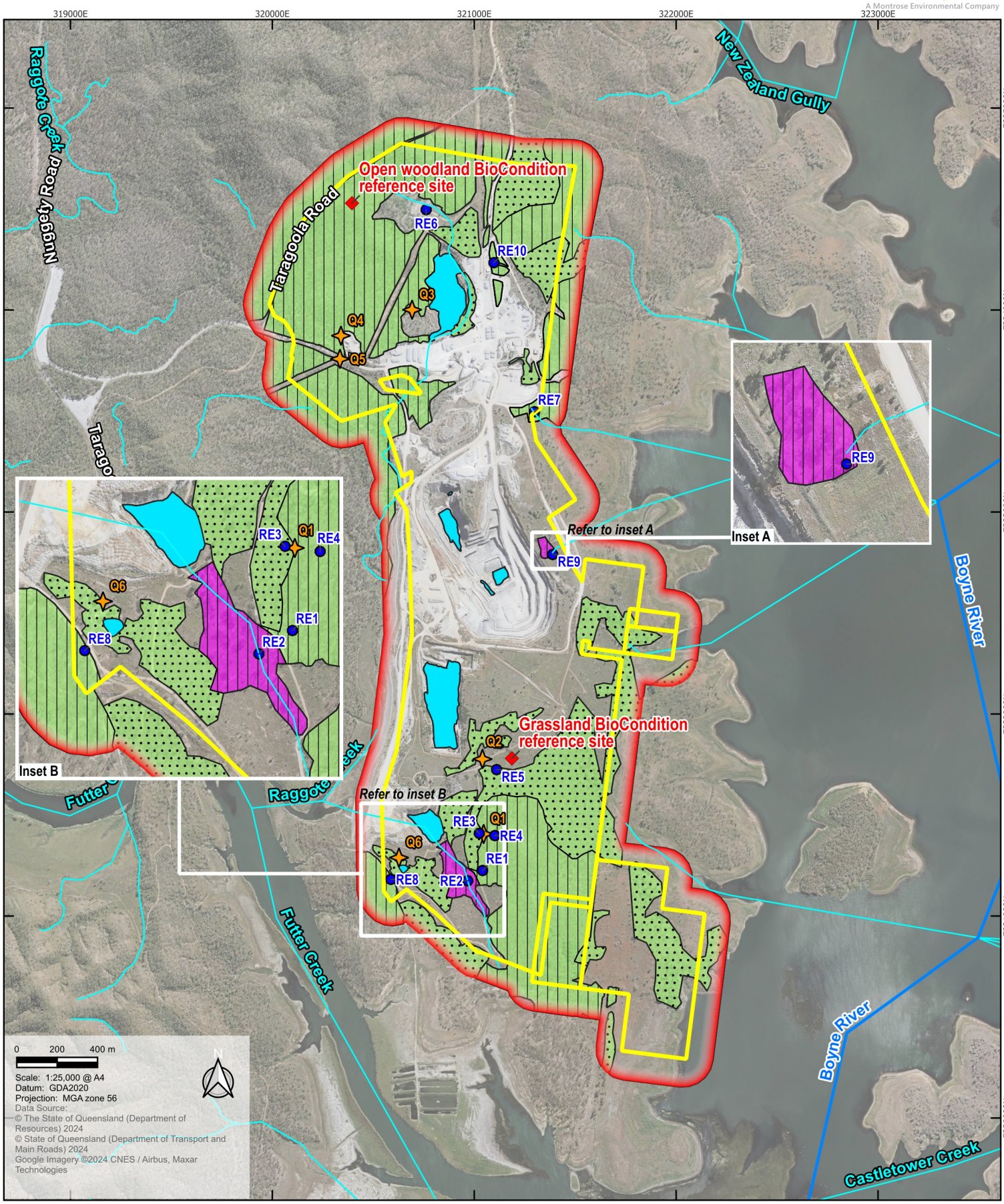
All three RE types are listed as 'Least concern' under the VM Act and 'No concern at present' under the EP Act.

4.5.1.1 Ground-truthed Regional Ecosystems

Ground-truthing of current RE mapping confirmed the presence of four vegetation communities analogous to two RE types (Epic 2024a). Large portions of the Project currently mapped as a mixed polygon of multiple RE types was confirmed as remnant RE 11.11.15 *Eucalyptus crebra* woodland to open woodland. Some areas currently mapped as non-remnant or regrowth vegetation on the regulated vegetation map meet the definition of remnant vegetation analogous to RE 11.11.15. Water bodies and non-remnant areas impacted by vegetation clearing were also mapped. The description, status, and area of each RE is provided in **Table 19,** and the extent illustrated in **Figure 20**. Further detail regarding vegetation community floristics, structure and representative photos is provided in the Terrestrial Ecology Report provided in **Appendix C**.

Table 19. Ground-truthed REs within the Project area

Vegetation community	RE	Regulated vegetation category	EP Act (biodiversity status)	Extent within Project area (ha)
1. Remnant *Eucalyptus crebra* woodland	11.11.15	B	No concern at present	115.21
2. Regrowth *Eucalyptus crebra* woodland	11.11.15	C	No concern at present	65.84
3. Remnant *Eucalyptus tereticornis* fringing woodland	11.3.25	B	Of concern	4.12
4. Disturbed non-remnant vegetation	N/A	X	N/A	230.10



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 20 Ground-truthed regional ecosystems mapping, survey sites and proposed impacts.qgz

Legend

- Site boundary
- Survey area

Ground-truthed Regional Ecosystems

- 11.11.15
- 11.3.25
- Non-remnant
- Water

Biodiversity status

- Regrowth
- Remnant
- Water
- Non-remnant

Vegetation management watercourses v7.0

- Major
- Minor

Survey sites

- Quaternary RE
- Secondary RE
- BioCondition

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 20
Ground-truthed regional ecosystems, survey sites and proposed impacts

4.5.1.2 Conservation Significant Flora

The likelihood of occurrence assessment for conservation significant flora species identified in database searches determined that no conservation significant flora species are considered likely to occur within the Project area. Two flora species area considered a possible occurrence within the Project area:

- *Cassinia collina*
- *Cycas megacarpa.*

The remaining flora species area considered unlikely to occur within the Project area (Epic 2024a).

4.5.2 Fauna Presence and Populations

A desktop ecological assessment identified 27 fauna species listed as conservation significant under the NC Act as potentially occurring within proximity to the Project area (source WildNet [Wildlife Online] database search and the Protected Matters Report (PMR) generated by the Protected Matters Search Tool). This included the Squatter Pigeon (southern) (*Geophaps scripta scripta*) which is listed as vulnerable under the *Nature Conservation Act 1992* (NC Act) and EPBC Act, and the Koala (*Phascolarctos cinereus*) which is listed as endangered under the NC Act and EPBC Act (Epic 2024a).

A total of 23 fauna species (or evidence of) have been observed within the Project area, including three non-native species. The faunal assemblage was dominated by common diurnal birds, particularly those species that are tolerant of disturbance and able to utilise cleared open areas. A range of microhabitats suitable for various fauna occurred on site. Rock piles were common and likely provide suitable habitat for reptiles and small mammals. Several small farm dams also occur within the southern portion of the Project area and likely provide drinking water for a range of mammals and birds. It may also support native and exotic aquatic fauna species. A full list of fauna species recorded during the field survey and the presence of fauna habitats has been provided in **Appendix C.**

4.5.2.1 Fauna abundance and diversity generally declined from remnant to regrowth vegetation, and was poorest in cleared areas, with the exception of Agile Wallabies, which were in high abundance in disturbed areas such as cleared areas, easements and access tracks (Epic 2024a). Conservation Significant Fauna

The likelihood of occurrence assessment for conservation significant fauna species identified in database searches determined that three threatened fauna species, Koala, Squatter Pigeon (southern), and White-throated Needletail (*Hirundapus caudacutus*) (Vulnerable - NC Act, Vulnerable and Migratory - EPBC Act), are considered likely to occur within the Project area. The Powerful Owl (*Ninox strenua*) (Vulnerable - NC Act) is the only other threatened fauna species that is considered possible to occur.

Marine species such as marine mammals and turtles were excluded from the assessment due to the absence of marine environments from the Project area or adjacent areas. The remaining conservation significant fauna species area considered unlikely to occur within the Project area and are not considered further in the report (Epic 2024a).

4.5.3 Pest Flora and Fauna

A total of 26 non-native flora species are located within the Project area, including invasive grasses, shrubs, vines, herbs and cactus (Refer **Appendix C**). Of these species, a total of six are classified as category 3 Biosecurity matters and four are classified as Weeds of National Significance (WoNS). There are three non-native fauna species known to occur within the Project area, these are Feral Pig (*Sus scrofa*), European Rabbit (*Oryctolagus cuniculus*) and Wild dog/dingo (*canis spp.*).

4.5.4 Matters of State Environmental Significance

The ecology field report provided in **Appendix C** has considered MSES within the Project area. As described in **Section 2**, the Offsets Act is supported by the Offsets Regulation which provides detail on prescribed activities and environmental matters (i.e. MSES) to which the Offset Act applies. MSES relevant to the Project include EVs that are protected under Queensland legislation, have been considered in **Table 20**.

Table 20. Matters of state environmental significance relevant to the Project area

Matters of State Environmental Significance	Relevance to Project
Protected wildlife habitat under the NC Act:	
Threatened flora and fauna	A total of 4 fauna species and 2 flora species listed as threatened or near threatened under the NC Act were identified as possible or likely to occur within the Project area
Regulated vegetation under the VM Act:	
Endangered/Of concern in Category B	**Not relevant**. Remnant RE 11.3.4/11.3.25 is mapped outside of the Project area to the south-west along the banks of Futter Creek.
Endangered/Of concern in Category C	**Not relevant**. Regrowth RE 11.3.4/11.3.25 is mapped outside of the Project area to the west along the banks of Futter Creek.
Category R (GBR riverine regrowth)	Small patches of riverine regrowth vegetation are mapped within the Project area in association with tributaries of Raggote Creek close to Pit 2 and along the eastern boundary of the Project area in association with gullies draining into Awoonga Lake.
Intersecting a watercourse	Regulated vegetation intersecting a watercourse identified on the VM Act watercourse map occur in the far northern and southern portions of the Project area.
Within 100 m of a Vegetation Management Wetland	**Not relevant**. Regulated vegetation within 100 m of a Vegetation Management Wetland is mapped outside of the Project area adjacent to the western boundary and to the south and east of the Project area.
Connectivity areas:	
Remnant vegetation	Remnant vegetation providing connectivity is mapped within the Project areas
Wetlands and watercourses under the EP Act:	
Waterway providing fish passage	Waterways mapped as low risk Queensland waterways for waterway barrier works occur within the Project area

4.5.5 Matters of National Environmental Significance

A Significant Impact Assessment (SIA) Report was prepared by Epic Environmental to summarise the potential impacts to MNES based on the proposed Project clearing footprint for operations until EOML. The assessment noted that the following features are not within the Project area:

- World heritage properties
- National heritage properties
- Wetlands of international importance
- Great Barrier Reef Marine Park
- Commonwealth Marine Area

Six threatened ecological communities (TECs) were identified in desktop searches but none of the REs field-verified within the Project area are considered to be analogous to a TEC. The likelihood of occurrence assessment determined that the following MNES listed species are considered likely to occur within the Project area:

- Koala - Endangered
- Squatter Pigeon (southern) - Vulnerable
- White-throated Needletail - Vulnerable and Migratory
- Fork-tailed Swift (*Apus pacificus*) - Migratory

Furthermore, the following MNES species are considered a possible occurrence within the Project area:

- Grey-headed Flying-fox (*Pteropus poliocephalus*) - Vulnerable
- Sharp-tailed Sandpiper (*Calidris acuminata*) - Vulnerable
- Common Greenshank (*Tringa nebularia*) – Endangered and Migratory
- Latham's Snipe (*Gallinago hardwickii*) - Vulnerable
- *Cycas megacarpa* - Endangered
- Caspian Tern (*Hydroprogne caspia*) - Migratory

4.6 Air

The Project is situated in a rural setting where sources of existing air pollution include current mining operations, unsealed roads, general agricultural activities, and soot and fallout from bush fires and land clearing (Sibelco 2018b). The Project is located within Queensland's sub-tropical climatic zone which is characterised by high summer temperatures, warm dry winters, and distinct wet and dry seasons. The prevailing 9 am wind direction is southeast and tends to the east by 3 pm.

4.6.1 Air Policy

Queensland *Environmental Protection (Air) Policy 2019* (EPP (Air)) identifies EVs to be enhanced or protected and specifies air quality objectives for indicators to protect these values. These objectives are derived from national and international standards.

Under the EPP (Air), the following EVs are to be enhanced or protected:

- The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems
- The qualities of the air environment that are conducive to human health and wellbeing
- The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property
- The qualities of the air environment that are conducive to protecting agricultural use of the environment

The EPP (Air) incorporates most of the goals nominated within the *National Environmental Protection (Ambient Air Quality) Measures* and also specifies air quality objectives for pollutant compounds relevant to the Project. Air quality objectives from the EPP (Air) are summarised in **Table 21**.

Table 21. Relevant air quality criteria from EPP (Air)

Indicator	Averaging period	Objectives (µg/m^3)
$PM_{2.5}$	24 hours	25
	1 year	8
PM_{10}	24 hours	50
	1 year	25
TSP	1 year	90

The principal source of air pollution from the Project is the emission of dust due to the following activities:

- Land clearing
- Topsoil and overburden stripping and stockpiling
- Shot rock loading
- Raw materials hauling and tipping
- Crushing and screening
- Conveying
- Stockpiling
- Rail loading
- Wind acting on stockpiles and exposed areas

Furthermore, the *Application requirements for activities with impacts to air guideline* (DESI 2024a) notes that a dust deposition limit of 120 mg/m^2/day (3.6 g/m^2/month), averaged over one month, is often used in Queensland. For extractive industries such as mining, the insoluble component of the captured dust is analysed (DESI 2024a).

4.6.2 Existing Air Quality

Potential sources of air pollution which may take place within the Project include the generation and propagation of dust particles from mining and extraction activities and the emissions from the diesel engines of mobile equipment. Fumes may also be associated with blasting activities in Pit 4 that occur once a month.

Dust deposition monitoring was conducted at monthly intervals throughout 2021 at four ongoing monitoring sites (North Boundary, South East, South West, and South Corner). Dust Deposition KPI's, as outlined in the Plan of Operations, are set at a target (50%) limit of 1.8 g/m^2/day and a maximum limit of 3.6g/m^2/day. Monitoring data indicates that dust deposition exceeded target emissions on eleven occasions and exceed the maximum limit on two occasions, with the highest record occurring in June reaching 5.7 g/m^2/day. Southwest monitoring site exceeded target emissions to a greater extent than the other sites, this disparity relates to mine site activities, with the monitoring site located close to Pit 4 where mining and extractive activities are currently under operation. Average annual dust deposition for the Project is 1.138 g/m^2/day (Graymont 2022). No confirmed complaints have been received in relation to air emissions or air quality throughout the lifetime of the Project.

Activities conducted within the Project area are well separated from sensitive places, with the nearest sensitive receptor (residential area) located approximately 4 km from Pit 4. Therefore, the current impact on air quality due to mining and quarrying activities is considered negligible.

4.7 Noise and Vibration

4.7.1 Noise Policy

The *Environmental Protection (Noise) Policy 2019* (EPP (Noise)) identifies EVs to be enhanced or protected, states acoustic quality objectives, and provides a framework for making decisions about the acoustic environment. Based upon criteria outlined by Schedule 8, Part 3, Division 1 of the EP Regulation and Schedule 1 and 6 of the EPP (Noise), the following acoustic quality objectives are required for sensitive receptors (refer **Table 22**).

Table 22. Relative acoustic quality objectives

Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at the receptor) *dB(A)*			Environmental Value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Dwelling (for outdoors)	Daytime and evening	50	55	65	Health and Wellbeing
Dwelling (for indoors)	Daytime and evening	35	40	45	Health and Wellbeing
	Night-time	30	35	40	Health and Wellbeing and in relation to the ability to sleep

Potential noise impacts on nearby sensitive places have been considered in accordance with the *Application requirements for activities with noise impacts guideline* (DESI 2024b).

4.7.2 Current Noise and Vibration Levels

Activities that may generate noise and vibration impacts are related to the level of sound produced by mining operation activities. Graymont has identified the following mine and operational activities as having the potential to generate noise and vibration:

Principle noise sources

- Drilling and blasting- occurs approximately once a month
- Rock breaking i.e., percussion hammering
- Operation of mining equipment
- Loading, unloading and haulage of raw materials i.e., rocks falling into metal truck bodies and bins
- Crushing and screening activities

Other contributors

- Vegetation clearing
- Topsoil and overburden removal

- Conveying
- Pumping
- Material transfer
- Stockpiling
- Product reclaiming
- Rail loading (when being utilised)
- Maintenance works
- Heavy vehicle movements within the Project area and on haul roads
- Infilling and final landform/rehabilitation works

Activities conducted within the Project area are well separated from sensitive places and the potential impact on acoustic quality is negligible. To date, there have been no formal complaints in relation to mining noise and vibration because of mining operation activities at the Project.

Drilling and blasting are the mining activities which have been identified as the principal vibration sources of the Project. Historical monthly records of blast events showed a total of 82 blast events have occurred between 2015 and 2021.The blast monitoring site is located inside the mining area approximately 350 m from the start of Pit 4, this is approximately 500 m from the front gate and 1 km from the Project boundary. Vibration monitoring data was recorded for 2021 blast events. Maximum Air Blast Pressure was 118.2 dBL in February and the maximum Ground Vibration was recorded as 1.650 mm/s in March. The targets for the Project (50% of limit) are 57.5 dBL which was exceeded nine times during this time, and 2.5mm/s, which was not exceeded. The limit for dBL, 115 dBL was exceed once during this monitoring period.

4.8 Traffic

The Project area is currently accessible via two roads from Taragoola Road, Charters Crossing Road which is the primary access to the north of the Project area, and Nuggety Road and Rail Siding Road to the west of the project. There are 24 personnel when fully staffed and all staff travel locally from Calliope, Gladstone and other regional towns. The Project is rarely fully staffed and as such it is expected that a maximum total of 24 light vehicles related to Project operations are expected to be travelling on the roads per day.

Approximately 23,500 trucks (including single body, truck and quad dogs and B doubles) transport 0.8 Mtpa of limestone products from the Project via Taragoola Road (graded, partially unsealed road) to the town of Calliope where they connect to Gladstone via Dawson Highway (Sibelco 2018b). Historically, limestone was loaded onto trains via Rail Siding Road (to the west of the Project) to be transported to Gladstone, however it is now transported via truck along Taragoola Road to the north of the Project area. As the rail infrastructure still exists, there may be potential in the future for limestone export to commence again via rail.

Transport only occurs between 5am to 6pm on Monday to Friday and 7am to 1pm on Saturdays, with no transport undertaken on Sundays or public holidays. The operation uses tipper truck combinations including single body, quad dogs and B doubles (Sibelco 2018b). Vehicle operations within the Project area follow 4GN-P6.115.2-Traffic Management Plan and utilised vehicles are restricted to designated areas as per 4GN-P6.115.2 – Traffic Management Plan.

4.9 Waste

Waste has been considered in accordance with the *Application requirements for activities with waste impacts guideline* (DESI 2024f). There is minimal general waste generated by the Project which is disposed of at an appropriately licenced facility. Similarly, a maximum of 10 to 20 scrap tyres will be temporarily stored onsite in the infrastructure area and will be regularly collected and transported to an appropriately licensed waste facility. This is consistent with the best practice environmental management measures outlined in the *Disposal and storage of scrap tyres at mine sites operational policy* (DESI 2024d).

The greatest portion of waste is in the form of overburden rock which is placed on the Southern WRD in ML80189 and ML3609. The Southern WRD has been used for waste rock storage since it was commissioned in 2008 and will continue to be used for this purpose until EOML. Overburden rock from the Northern WRD,

located in ML80036, ML3595, and ML3594, was transported by dozer to backfill Pit 1 prior to and throughout 2024.

Lime silt is another waste product from Project operations that is hauled to the designated silt dump, located on Rail Siding Road in the northwestern extent of the Project area. This area will be required to store silt until EOML. Graymont are looking into opportunities to sell this lime silt so it can be processed into lime products (quick lime etc.). Alternatively, this lime silt may be reintroduced to topsoil during rehabilitation if required.

There are no geochemically reactive or acid forming wastes, tailings dams, or heap leach pads within the Project area, and the environmental risks from the inert waste rock is considered low/negligible (refer **Appendix F**).

4.10 Social and Economic

There are no nearby or surrounding mining projects in proximity to the Project and the nearest sensitive receptor (residential receptor) is located approximately 4 kms from the Project. The closest community to the Project is Calliope town, comprising a population of 4396 people (as documented in the 2021 Census, Australian Bureau of Statistics (ABS 2025)). With respect to Indigenous community stakeholders, there are no native title determinations or claims over the Project area, however there is an Aboriginal cultural heritage party registered for the area (Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People).

The main employment categories for Calliope includes technicians and trade operators (23%), machinery operators and drivers (15.7%) and labourers (12.6%), with a higher proportion of these employment categories being represented in Calliope in comparison to the broader Gladstone LGA. Calliope town also provides a range of community services, infrastructure and social and sporting groups opportunities for community members (GRC 2021).

Other characteristics of the local community include:

- A higher median weekly household income ($1840) compared to the Gladstone Region ($1,639) and Queensland ($1,675)
- A younger median age (30) compared to the Gladstone Region and Queensland median of 38
- A higher percentage of couple families with children (49.2%) compared to the region (41.7%) and Queensland (41.2%)

The Project currently directly employs 24 persons, most of whom reside locally, with staff travelling from Calliope, Gladstone and other regional towns. Other direct employment results from the engagement of various contract services including transport, maintenance, fabrication, electrical and plumbing contracts with local and regional businesses, which also provide direct and indirect social and economic benefits to local communities within the Gladstone LGA.

Graymont has historically been and continues to be an active participant in the local Calliope community and regularly engages with stakeholders. Graymont hosted a Quarry Open Day on Saturday 4 March 2023, which saw 140 people attend the Project to meet with Graymont personnel, participate in a tour of the Project area, and discuss current and future operations and rehabilitation plans. Information about the EA Amendment and PRC Plan for the Project was also provided, as further discussed in **Section 9.3.1.**

Following the success of the first Open Day, Graymont is currently planning to host another Open Day in the third quarter of 2025.

4.11 Cultural Heritage

4.11.1 Indigenous Cultural Heritage

There is an existing Indigenous Land Use Agreement (ILUA) over the Project area; the Port Curtis Coral People and Local Government ILUA (Tribunal No: QI2016/045). This ILUA is an area agreement with the Bundaberg Regional Council, North Burnett Regional Council, and GRC.

There are no Native Title determinations or claims specific to the Project which is on freehold land. However, Raggote Creek, which borders the western boundary of the Project, is mapped under the Registered Native Title Bodies Corporate (RNTBC) area for First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation (Tribunal No: QCD2017/010, Federal Court No: QUD6026/2001). Raggote Creek is noted in the EA as receiving waters downstream of release points F2 and C2.

4.11.2 Non-Indigenous Cultural Heritage

Non-indigenous cultural heritage values are protected under the *Queensland Heritage Act 1992* in Queensland and are generally associated with human activities since the beginning of non-Aboriginal settlement of an area, as well as natural places which have meaning for people of the current day.

There are no Non-Indigenous Cultural Heritage areas located within the Project area. The nearest state heritage listed value is the Glengarry Homestead (600386) which is located approximately 7.5 km south of the Project along Gladstone-Monto Road, Gladstone, as determined through a review of the Queensland Government Heritage Register and GRC Local Heritage Register (LHR) (QG 2025b).

The Project also sits outside of the Great Barrier Reef World Heritage Area.

5 PROJECT JUSTIFICATION AND ALTERNATIVES

The Project has been operational for over fifty years and is important for the local community due to its provision of employment opportunities. The Project area is located in a rural setting and removed from sensitive receptors which minimises the impact of mining activities. Alternative locations for operations will likely not have the same low level impact and have not been considered further by Graymont. Additionally, as the Project is already established, the continuation of the existing Project is the most feasible and financially sensible for Graymont. Additional disturbance for operations has been considered until EOML, with rehabilitation planned to occur in accordance with the PRC Plan. Impacts to EVs are considered to be consistent with existing disturbance, and within the same MLs as current operations. This is further discussed in **Section 7.**

5.1 Alternative Post Mining Land Uses

The PMLU for Pit 1 in the EA is currently water storage, however, it was determined that low intensity grazing would be a more appropriate PMLU due to backfilling activities that have been undertaken at the site. Pit 1 sat above the water table and did not hold any water, therefore overburden material from the Northern WRD was placed into Pit 1 so that this area could become available for use as spoil storage and aglime production when Pit 3-4 is extended to its northern-most extent during Stages 1 and 2. The backfilling activity is further described in the geotechnical assessment provided in **Appendix D.**

Table 8 of the EA lists PMLUs by ML, which include:

- ML3595 (grazing)
- ML3604 (grasses and access tracks)
- ML80190 (roadways)

At the time the EA was approved, the life of mine duration and consequent staging and disturbance areas for ongoing operations were not known. Through developing this PRC Plan, maximum disturbance areas in each ML and activity type have been determined which include amended PMLUs corresponding to these areas, largely associated with the amalgamating Pit 3-4 as follows:

- ML3595 (water storage, access tracks and low intensity grazing)
- ML3604 (water storage)
- ML80190 (water storage)

These PMLUs are included in this EA amendment application for the Project.

6 PROPOSED AMENDMENTS

6.1 Proposed Amendments Overview

The EA amendments required to facilitate the continuation of mining at the Calliope Limestone Quarry include:

- **Amendment 1:** Amendment of **Table 8- Final land use and rehabilitation approval schedule** to include additional disturbance area and updated Post Mining Land Uses
- **Amendment 2:** Contemporising ES Conditions, including:
  - Replacing **Condition A1** and **Condition A2** with contemporary ERC conditions
  - Replacing **Condition F6** and **Condition F7** for rehabilitation with a contemporary PRC Plan Schedule condition
  - Removal of **Condition F14** as it contradicts **Table 8** and the PRC Plan

6.2 Amendment 1: Authorised Disturbance and Post Mining Land Uses

Under Table 8- Final land use and rehabilitation approval schedule in the EA, Graymont are requesting amendment of the authorised disturbance areas to facilitate ongoing mining activities until the EOML in 2100. As the Project's PRC Plan (PRCP-EPML00969013-V1) has proposed largely consistent PMLUs to the currently authorised post-mine land descriptions in Table 8 of the EA, an administrative update to the terminology of 'Post mining land use' is also proposed to align with the PRC Plan. These changes are displayed in **Table 23**. It is noted that the MLs reflected in this table have been realigned based on the ground-truthed MLs in the DNRMMRRD's database.

The maximum disturbance area is not reflective of the disturbance that will exist at EOML as some areas will have commenced rehabilitation prior to this. Some areas that are currently spoil pile, topsoil areas, access track and waste rock dump are proposed to become the future Pit 3-4, therefore, the maximum 'Pit' disturbance type takes precedence. The PMLU for Pit 1 in the EA is currently water storage, however, as described in **Section 5.1** and **Appendix D,** it has been backfilled to be preferentially used for aglime production and stockpile area to avoid additional disturbance of undisturbed land. Therefore, low intensity grazing would be a more appropriate PMLU.

Table 23. Updated final land use and rehabilitation approval schedule

Disturbance Type	Relevant Tenures	Authorised Disturbance in Current EA		Proposed Amendment to EA			
		Projective Disturbance Area (ha)	Post-Mine Land Description	Existing Disturbance (2025) (ha)	Maximum Disturbance at any point during life of mine (ha)	Area Available for Rehabilitation at End of Mine Life (ha)[1]	Post Mining Land Use
Access Tracks and Levees	ML3602, ML3603, ML3594, ML3608, ML3609, ML80036, ML3595, ML3596, ML80189, ML80190, ML80191, ML80192	6.5 (In/roads, Roadways)	Roads maintained for land management and access	20.31	20.31	17.25	Retained Access Tracks, per Landholder Agreement
Infrastructure	ML3602, ML3603, ML80192	27.4	Plants/ stockpile area rehabilitate with natural vegetation	7.82	8.55	8.55	Low Intensity Grazing
ROM processing area	ML80036, ML3602, ML3603, ML80192	Included in Mining footprint	Livestock, grazing	18.79	18.79	18.79	Low Intensity Grazing
Open pit (Voids)	ML3595, ML3594, ML3603, ML3604, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192	195.5 (Mining, mine faces below water level, mine faces above water level)	Grasses (Mine faces above water level) Water reserve (Mine faces below water level)	66.85[2]	121.18	121.18[3]	Water Storage
Cleared Areas and Laydowns	ML3595, ML3602, ML3603, ML3608, ML80036, ML80189, ML80192	Included in Infrastructure footprint	Livestock, grazing	11.22	11.22	6.77	Low Intensity Grazing
Spoil Piles	ML3595, ML80036, ML80191, ML80192	20.9 (Spoil areas and Product stockpile areas)	Plants/stockpile area rehabilitate with natural vegetation	19.22	19.22	6.03	Low Intensity Grazing

Disturbance Type	Relevant Tenures	Authorised Disturbance in Current EA		Proposed Amendment to EA			
		Projective Disturbance Area (ha)	Post-Mine Land Description	Existing Disturbance (2025) (ha)	Maximum Disturbance at any point during life of mine (ha)	Area Available for Rehabilitation at End of Mine Life (ha)[1]	Post Mining Land Use
Topsoil Areas	ML3595, ML3608, ML80036, ML80191, ML80192, ML80189	0.35	Stockpile area rehabilitate with natural vegetation	1.29	7.01	7.01	Low Intensity Grazing
Sediment Ponds	ML3603, ML80192	Included in Infrastructure footprint	Livestock, grazing	1.46	1.46	1.46	Low Intensity Grazing
Waste Rock Dump	ML3609, ML80189	Included in Mining footprint	Livestock, grazing	14.57	19.66	19.66	Low Intensity Grazing
Silt Dump	ML80192	Included in Mining footprint	Livestock, grazing	1.11	1.11	1.11	Low Intensity Grazing
Total Disturbance		**250.65**	-	**162.64**		**207.82**	

[1] As a result of disturbance areas transition between types of disturbance during life of mine, in some instances, the area available for rehabilitation at EOML will be less than the maximum disturbance during life of mine

[2] Includes Pit 1, Pit 2, Pit 3 and Pit 4

[3] Include Pit 2 and amalgamated Pit 3-4

6.3 Amendment 2: Contemporising EA Conditions

The EA for the Project predates in-force legislation that applies to mining operations in Queensland, in particular, the release of the MERFP Act. Amendments to the EA are proposed to ensure EA conditions align with the proposed PRC Plan (PRCP-EPML00969013-V1) and existing ERC (ERC100436752) for the Project.

6.3.1 Conditions A1 and A2

ERC requirements supersede the financial assurance process, currently conditioned in the EA (A1 and A2 respectively), shown in **Table 24.**

Table 24. Financial assurance EA conditions

Condition number	Condition
A1	**Financial assurance** Provide financial assurance in the amount and form required by the administering authority prior to the commencement of activities proposed under this environmental authority. The calculation of financial assurance for condition A1 must be in accordance with the administering authority's Guideline – Financial Assurance for Mining Activities 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).
A2	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.

It is proposed that the following conditions that relate to ERC are included in the EA as a direct replacement of the superseded financial assurance conditions. These conditions were taken from approved EAs on the public register for Ironbark No. 1 Coal Mine (ref. EA001299, effective from 1 September 2022), and Cameby Downs Mine (ref. EPML00900113, effective from 19 April 2024):

Estimated Rehabilitation Cost (Proposed Conditions)

A1 The environment authority holder must not carry out, or allow the carrying out of, a resource activity under this environment authority unless –

a. An ERC decision is in effect for the resource activity being carried out; and
b. The environmental authority holder has paid a contribution to the scheme fund or given a surety for the environmental authority under the *Mineral and Energy Resources (Financial Provisioning) Act 2018*; and
c. The environmental authority holder has complied with the requirements under the *Mineral and Energy Resources (Financial Provisioning) Act 2018* for paying a contribution to the scheme fund, or giving a surety for the authority, as required from time to time.

A2-1 When an ERC decision is in force for this environment authority, the environmental authority holder must apply, under section 298 of the *Environmental Protection Act 1994*, for a new ERC decision, at least three (3) months before the ERC period to which the decision relates ends.

A2-2 When an ERC decision is in force for this environmental authority, the environmental authority holder must re-apply within **ten (10) business days** under section 298 of the *Environmental Protection Act 1994* for an ERC decision when:

a. there is an increase in the likely maximum amount of disturbance to the environment as a result of the environment authority holder carrying out the resource activity; or

b. there is a change relating to the carrying out of the resource activity that may result in an increase in the ERC for the resource activity

6.3.2 Conditions F6 and F7

It is proposed that a condition related to PRC Planning is also included in the Project's EA to increase the longevity of the approval for ongoing operations until EOML, specifically to replace Condition F6 and/or F7 shown in **Table 25**.

Table 25. Rehabilitation EA condition

Condition number	Condition
F6	Progressive rehabilitation must commence when areas become available within the operational land.
F7	Areas which are to be rehabilitated to native ecosystem must achieve a self-sustaining native ecosystem with species composition and distribution similar to an analogue site or another suitable alternative approved by the administering authority.

Other approved EAs on the public register for Ensham Coal Mine (ref. EPML00732813, effective from 5 September 2022), Cameby Downs Mine (ref. EPML00900113, effective from 19 April 2024) and Commodore Coal Mine (ref: EPML00841513, effective from 11 October 2023) include conditions related to PRC Planning. Therefore, it is proposed that the wording of Condition F6 and F7 is updated to reflect this rehabilitation condition from these approved EAs, as follows:

Rehabilitation (Proposed Condition)

F6 Land disturbed by mining must be rehabilitated in accordance with the approved PRC Plan Schedule for this environmental authority

6.3.3 Condition F14

In preparing this EA Amendment application adjacent to the PRC Plan for the Project, it was identified that Condition F14 contradicts Table 8 in the EA. The condition relates to the retention of infrastructure as in agreement with a landholder statement (Appendix J). As it is determined that this condition will be appropriately satisfied with the proposed amendments to Table 8 and the PRC Plan (once approved) for the Project, it is proposed this condition is removed.

Table 26. Infrastructure retention EA condition

Condition number	Condition
F14	All infrastructure constructed by or for the environmental authority holder during the licensed activities including water storage structures, must be removed from the site prior to surrender, except where agreed in writing by the post mining land owner/holder. Note: this is not applicable where the landowner/holder is also the environmental authority holder.

Rehabilitation (Proposed Condition)

None – condition should be removed

7 POTENTIAL ENVIRONMENTAL IMPACTS

7.1 Land

The environmental objective for land, as per Schedule 8, Part 3, Division 1 of the EP Regulation, is "*the activity will be operated in a way that protects the environmental values of land including soils, subsoils, landforms and associated flora and fauna*." Potential impacts to land have been considered in accordance with the *Application requirements for activities with impacts to land guideline* (DESI 2024e).

To facilitate continuation of the existing Project, 45.18 ha of currently undisturbed land will be cleared. Current mining/ quarrying and associated activities have previously been identified as having an impact to land, as these activities disturb the land surface, drainage patterns, and create a different landform. The following processes have the potential to impact land as a result of the Project:

- Disturbance and loss of agricultural grazing native vegetation land due to additional land clearing, earthworks and vehicle movement
- Disturbance from open cut mining and quarrying activities to the land surface and potential resultant impacts to surface drainage patterns
- Modification of the existing landform which has the potential to impact ecological processes
- Contamination of land from potential chemical/fuel spills, leaching from WRDs and unplanned releases of tailings from in-pit tailings storage
- Increased erosion and runoff to the receiving environment including Lake Awoonga and Raggote Creek
- Potential compaction or loss of biomass from poor topsoil management practices
- Unstable Pit and WRD landforms exist at EOML

A detailed land suitability and waste characterisation assessment was undertaken for the Project to ensure that the land underlying the proposed Pit 3-4 amalgamation posed no additional risk from the proposed disturbance (RGS 2023b). The waste characterisation assessment undertaken by RGS (2023a) identified that the risk from AMD from the additional disturbance proposed was highly unlikely as there is no historical evidence or reports of AMD occurrences for the Project. Additional assessment by Epic Environmental (2024c), provided in **Appendix F**, noted that the waste rock and production (drill chip) material is classified as NAF. Additionally, any soil that will need to be stripped will be stockpiled for use in rehabilitation activities at the EOML.

The change in PMLU for Pit 1 from water storage to low intensity grazing land is considered to have a beneficial outcome for the Project, as the Pit previously sat above the groundwater table and did not hold any surface water, therefore it was unable to achieve this PMLU in its current form. This change also facilitates a beneficial grazing outcome that was not previously compatible due to the residual slopes of the mined void. A grazing PMLU requires a vegetated asset which can be appropriately managed and achieved in accordance with the performance outcomes and milestone criteria outlined in the PRC Plan for the Project.

Through the backfilling activity further described in **Appendix D,** LOM disturbance can be constrained to the existing footprint as much as possible. This land could be beneficially reused for alternative activities thereby reducing the need to disturb adjoining undisturbed area within the ML for future operations.

The backfilling activity improves the stability of the former Pit 1 area and reduces safety risks associated with the unused residual void onsite. Further, the waste placement strategy of backfilling material from the WRDs into the voids ensures that erosion risks can be suitably managed largely through the final landform design within the PRC Plan. Through preparation of the PRC Plan, a geotechnical assessment (**Appendix D**) was undertaken to ensure the residual voids and the Southern WRD will achieve design specifications. Erosion modelling of the Southern WRD was also undertaken by Epic (2025b) to demonstrate that acceptable rates of erosion can be achieved through modifying the preliminary SWRD design (**Appendix L**). The improved design also provides a landform that is suited to the development of the nominated grazing PMLU.

All disturbed areas will be rehabilitated in accordance with the PRC Plan, thereby reducing residual impacts from the mining activity. Potential impacts to land from the proposed EA amendment are therefore considered to be not significant and will be continually managed throughout the LOM.

The Project will achieve the following performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation:

- As it relates to the location of activities on site:
  - The activity, and components of the activity, are carried out on the site in a way that prevents or minimises adverse effects on the use of surrounding land and allows for effective management of the environmental impacts of the activity
  - Areas used for storing environmentally hazardous materials in bulk are located taking into consideration the likelihood of flooding
- As it relates to the protection of and values:
  - activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the environmental values of land
  - areas disturbed will be rehabilitated or restored to achieve sites, that are safe and stable, where no environmental harm is being caused by anything on or in the land and that are able to sustain an appropriate land use after rehabilitation or restoration.
  - the activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants
  - the application of water or waste to land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils

7.2 Surface Water and Wetlands

The environmental objectives relevant for surface water and wetlands, as per Schedule 8, Part 3, Division 1 of the EP Regulation, are:

- The activity will be operated in a way that protects environmental values of waters
- The activity will be operated in a way that protects environmental values of wetlands

Potential impacts to surface water have been considered in accordance with the *Application requirements for activities with impacts to water guideline* (DESI 2024c).

The existing surface water environment including waterways, water bodies, wetlands, and surface water users has been described in **Section 4.3**. Compliance monitoring has been undertaken in accordance with the Project's EA at the surface water monitoring locations displayed in **Figure 14**. All surface water monitoring locations will be suitable until EOML, however, ongoing monitoring will occur to determine if any changes to release points are required prior to EOML.

The increased disturbance area relating to the final amalgamation of Pit 3-4 will result in the removal of an existing farm dam. The dam water is not currently utilised within the Project's water management strategy and does not supply water to any external users. The farm dam overflows into Pit 3 and an assessment undertaken by GAWB engineers determined that there is likely a dam wall failure, causing inflow into Pit 3 and subsequent erosion which has left an incised channel along the base of the pit wall separating the Project from Awoonga Dam (Graymont 2018). Therefore, the removal of the farm dam may decrease the risk of localised overflow. This was further supported by updated flood modelling provided in **Appendix H** which found that under the maximum disturbance scenario, the existing farm dam catchment will flow into Pit 3-4. As a result the catchment area for Pit 3-4 in the maximum disturbance will encompass the current catchments for Pit 3, Pit 4, and the Farm Dam (Engeny 2025). There are also no changes anticipated to the catchment areas for Pit 2 and the Sediment Basin in the maximum disturbance landform, which are limited to only disturbance required to ensure stability and design specifications can be met post-closure. Additionally, the existing natural and constructed surface water divides to the east and the west of the Project remain unchanged, maintaining a closed surface water system in which all runoff is contained within the Project area (Engeny 2025, refer **Appendix H)**.

The potential risk of discharge of sediment laden water from the mining operation into the receiving environment was considered in the context of potential impact upon the EVs of Raggote Creek and Lake Awoonga (as a lacustrine wetland).

To consider the potential for contaminant release from the proposed Project, a SWIA was undertaken be Epic (2025, **Appendix K)** to assess this risk of overland flows impacting receiving waters as a result of the proposed Project. This assessment found that the risk of potential impact to downstream surface water and the receiving environment under the maximum disturbance landform is considered relatively low based on the following factors:

- The site functions as a closed surface water system, with all disturbed areas draining internally into site water storages
- Changes to the current catchments are minimal in the maximum disturbance, with the primary change being the amalgamation of the Pit 3, Pit 4, and Farm Dam catchments
- The stormwater flow assessment undertaken demonstrates that the predicted changes in peak discharge between current and maximum disturbance scenarios are minor
- Water balance (Graymont 2025) indicates that overtopping of site water storages is unlikely, even during extreme rainfall events
- An assessment of the sediment pond indicates that the existing dam has sufficient capacity to manage runoff under both current and maximum disturbance conditions, thereby minimising the potential for uncontrolled releases into the receiving environment

Potential sources of contaminants may include runoff from chemical and fuel/oil storage areas and general wastewater from vehicle/machinery washdown areas. However, existing spill response procedures and management plans that describe the methods to be employed in an event of a spill appropriately manages this risk to a suitable level and is considered to be suitable to manage surface water risks from the proposed Project. There is also no potential impact to surface water quality anticipated from AMD from waste rock generated by the Project, as no AMD materials were identified during waste characterisation undertaken by RGS (2023a, 2023b) and Epic (2024c) (Refer **Appendix F**).

The final landform flood assessment was undertaken by Engeny (2025), which included development of hydrologic and hydraulic models to determine runoff hydrographs for a range of storm durations. The 1% annual exceedance probability (AEP), 0.1% AEP, 0.01% AEP and Probable Maximum Flood (PMF) design storms were 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 (refer **Appendix H**). The flood depth maps demonstrate that ponding is anticipated to occur across the Project area following all simulated flood events, with standing water expected both within and external to the voids.

There are four locations at Pit 3-4, and one location at Pit 2 where inflow to the voids is observed by overtopping of the pit protection structures which was predicted to occur in all simulated design events. However, these void inflows are caused by local catchment runoff only and it is not anticipated that the flooding within the tributary of the Boyne River on the western side would generate any inflows to the voids based on the flood results and ground levels (Engeny 2025).

Velocities at the pit inflow locations are in excess of 1.5 m/s based on the velocity mapping. These locations will be suitably protected (with rock, or some alternative form of armouring) to minimise scour potential and ensure the longevity of the final landform. Velocities across the remainder of the landform are generally less than 1.5 m/s and can be protected from erosion through application of revegetation outcomes. There is a location adjacent Pit 2 (east) and a single location south of the waste rock dump where velocities exceed 1.5 m/s, these areas will be considered for additional rock armouring controls for long term landform stability (Engeny 2025, refer **Appendix H**).

The proposed change in activity type and PMLU of the former Pit 1 area is considered to be suitable for the Project, as Pit 1 did not hold any surface water and any overland flow over this area is directed into the sediment pond. Impacts to surface water from the proposed change in activity type and PMLU is considered to be negligible as the sediment pond can suitably manage any overland flow until EOML (refer **Appendix K**). The area was not compatible with a water storage PMLU, and can now support a vegetated asset with a beneficial grazing PMLU outcome.

The Project has an ESCP (provided in **Appendix I**) for operations that will be updated throughout the LOM as required to reflect recommended design standards in the Best Practice Erosion and Sediment Control (BPESC) guideline so it can be implemented at the EOML (e.g. IECA 2008).

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.3 Groundwater

As per Schedule 8, Part 3, Division 1 of the EP Regulation, the environmental objective relevant to potential impacts on groundwater is *"the activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems."* Potential impacts to groundwater have been considered in accordance with the *Application requirements for activities with impacts to water guideline* (DESI 2024c).

The hydrogeological assessment has been updated to include cross sections, consideration of adjacent geological formations, recharge and hydraulic connectivity, and updated conceptual modelling using available data. The existing groundwater environment has been discussed in **Section 4.4**.

Mining is the primary groundwater affecting activity related to the Project. Impacts to groundwater and the EVs of Lake Awoonga as a result of the proposed disturbance are considered to be negligible because, as noted in **Section 4.4.3**, groundwater gradients flow toward the mining voids which is attributable to construction of the Awoonga Dam and the development of the mine void (refer **Appendix E**) (Graymont 2025). It is proposed that the main mining void (combined Pit 3 and Pit 4) will be dewatered progressively as required to access the limestone resource throughout operations with the void to remain to support a PMLU of water storage.

The change in PMLU of the former Pit 1 area is considered to be suitable as the former Pit sat above the groundwater table and can now suitably support a grazing outcome. Groundwater was intersected in the recently drilled hole 16, near former Pit 1, which is planned to be constructed as a bore and added to the Groundwater Monitoring Network so that is can be monitored during the LOM (refer **Figure 19**).

Potential sources of contaminants include primary sources from the weathering rocks and secondary sources introduced by mining. The primary water quality parameters of potential concern are hydrocarbons and metals. Hydrocarbons and metals are not routinely monitored in Pit 2 but FM6 provides groundwater quality data for flow into Pit2 from six monthly annually monitoring. Bore FM5 provides groundwater quality data for flow into Pit 4. Metal concentrations in both the bores are low and are at or near detection limits (Graymont 2025).

Since the initial submission of this EA amendment application in September 2024, a total of 34 holes were drilled in 2025 around the perimeter of Pit 4, Pit 1 and east of Pit 3 to further define geology and groundwater behaviour. Slug testing was also undertaken to provide an estimate of near bore hydraulic conductivity (Graymont 2025). Updated data has informed the assessment outcomes presented in **Appendix E.**

Drilling confirms that the limestone resource extends to -105.1mAHD which is below the natural surface but limestone is weathered with some voids that are generally clayed at shallow depths beneath the natural surface. Seepage of pit water through the bedrock to Awoonga Dam is extremely low to negligible because the long-term void water levels will be lower than the Awoonga Dam water levels, hence the groundwater gradient will be towards the mining void. This is further described in **Appendix E.**

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.3.1 Water Balance Modelling of Final Pit Void

Updated details of water balance modelling developed to predict water levels of the final void at the EOML are provided in **Appendix E.** The following sub-sections summarise the components and assumptions used for the main pit void water balance and the water balance model.

Water Balance Model

An analytical spreadsheet based model was used to formulate the Water Balance Model. A monthly timescale was adopted for the model for a period of 100 years past end of mine date. The analytical final void Pit 3-4 Water Balance model was created based on the formula:

Pit water inflow = direct rainfall capture +surface water run-off + groundwater inflow – pit evaporation

Model Assumptions were:

- No dam leakage
- Groundwater inflow of 1 L/second (L/sec), based on calibration to logged pit discharge volumes
- Farm Dam flow has a base flow of 1.7ML/day but there is no flow during Hot Dry climatic conditions

Details are provided in **Appendix E**.

Water Inputs:

- Rainfall (m/month) x area (m^2) of bunded Pit 3-4 void = volume (m^3/month), converted to ML/month
- Pit 3-4 Void Boundary Catchment (for surface water run-off entering Pit 3 and Pit 4 voids excluding surface water run-off from the Farm Dam catchment)
- Farm Dam Catchment (for surface water currently entering Pit 3 void)

Water Outputs:

- The evaporation volume = evaporation rate x surface area of the void water, converted to ML/month

Water Balance:

- End of month Void Water Volume (and resultant water level) = previous month Void water volume + water volume IN – water volume OUT (ML/month)

Pit Void Water Balance and Final Water Level Equilibrium

The Water Balance Model was run for a period of 100 years. The pit water is predicted to fill to approximately 30 mAHD under current climate conditions, and lower levels resulting from increased evaporation under different climate scenarios. Based on the model assumptions the pit will remain a sink, with a groundwater gradient toward the void. Sensitivity testing indicates that climate change is the variable with the greatest influence on water inputs. However, the model is relatively insensitive to monthly total water inflow changes of 10-20 ML. The modelled outcome is sensitive to groundwater inflow volumes, which is a determining factor on whether pit water equilibria is achieved within the pit void and water is contained or escapes the pit void to interact with Awoonga Dam. Simulations show that with an increase of groundwater inflows to 25 L/sec, the pit will remain a sink and final water levels would remain below the 50 mAHD groundwater interaction threshold with Awoonga Dam (Graymont 2025, refer **Appendix E)**.

7.4 Terrestrial Ecology

The environmental objective for ecology, as per Schedule 8, Part 3, Division 1 of the EP Regulation, is "*the activity will be operated in a way that protects the environmental values of land including….associated flora and fauna*."

The existing ecology for the Project has been summarised in **Section 4.4.10** and further assessed in **Appendix C**. **Figure 20** displays the field-verified vegetation mapping in relation to the proposed Project footprint. For conservation significant species considered as potentially occurring, impacts were assessed for loss of habitat (Epic 2024a). The change of PMLU of the former Pit 1 area to grazing is considered to have a beneficial outcome as it will allow for beneficial reuse of already disturbed land, reduce clearing of adjoining undisturbed land, and provide an opportunity to rehabilitate the land to a grazing PMLU, mitigating the residual impact of Project operations of ecological values.

The clearing of vegetation is the most significant and direct impact of the Project on ecological values of the Project area. The predicted extent of overall impact to vegetation communities and habitat for conservation significant species is provided in **Table 27**. The extent of impact is based on the results of the ground-truthed vegetation mapping, analysis of aerial imagery, and Project area habitat assessments. The primary potential

impact to threatened fauna species is on remnant woodland vegetation suitable for Koala, which is considered likely to occur within the Project area, considered in **Section 7.4.2.1**.

Table 27. Predicted vegetation clearing resulting from Project proposed impacts

GTRE	Biodiversity (EP Act) status	Potential habitat	Proposed impact area (ha)
11.11.15 remnant	No concern at present	Koala, Powerful Owl, Squatter Pigeon, *Cycas megacarpa*, *Cassinia collina.*	3.27
11.11.15 regrowth	No concern at present	Koala, Squatter Pigeon	9.86
11.3.25 remnant	Of concern	Koala, Powerful Owl, Squatter Pigeon, *Cassinia collina*.	2.30
		Total clearing area	**15.43**

As described in **Appendix C,** additional impacts may include:

- Habitat fragmentation and connectivity
- Fauna mortality
- Airbourne dust
- Noise and lighting
- Weeds and pests
- Fire risk

The landscape associated with the Project has been heavily impacted by tree clearing for pastoralism and open cut mining. Remnant and regrowth vegetation communities within the Project area are largely consolidated, although in the southern portion of the Project area vegetation is isolated by water and mining activities. Vegetation communities in the northern portion of the Project area are connected to a large expanse of remnant vegetation to the north of the Project area. The proposed impacts of the Project will not further fragment remnant and regrowth vegetation communities within the Project area, with negligible impacts to connectivity (Epic 2024a).

As the limestone quarry is already operational, impacts from airborne dust resulting from the proposed amendment are considered negligible. The Project area is already subject to artificial lighting and noise from the existing limestone quarry and further increases are also considered negligible. Mobile plant and vehicular movements for future Project activities have a very high potential to further the spread of American Ratstail Grass (*Sporobolus jacquemontii*) within the Project area, with adverse impacts on proposed post-mining pastoralism. However, mitigation measures can be put in place to manage weed spread.

The farm dam within the southern portion of the Project area likely provides drinking water for a range of mammals and birds (refer **Appendix C**). It may also support native and exotic aquatic fauna species. The removal of the farm dam is not considered to be a significant impact to terrestrial and aquatic ecology due to the proximity of the farm dam to Lake Awoonga which provides similar, yet more extensive habitat suitable for these species.

Therefore, potential impacts to terrestrial ecology and EVs from the proposed EA amendment are considered to be not significant and will be continuously mitigated and managed throughout the LOM.

7.4.1 Matters of National Environmental Significance

As noted in **Section 4.5.5**, a likelihood of occurrence and assessment of significance of impacts was undertaken by Epic (2024b). Assessment of the significance of impacts in accordance with the *Matters of National Environmental Significance significant impact guidelines 1.1* (DE 2013) determined that significant residual impacts to MNES are considered unlikely to occur (Epic 2024b).

7.4.2 Matters of State Environmental Significance

Significant residual impacts on MSES have been considered further in **Appendix C** in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (SRI Guideline) (DEHP 2014) to determine if offsets are required under the Offsets Act.

7.4.2.1 Conservation Significant Species

An assessment of the potential for significant residual impacts resulting from the proposed Project was carried out only on those MSES listed species considered as likely or possible to occur. The assessment has been carried out in accordance with the SRI guideline (DEHP 2014). The assessment for Koala, Squatter Pigeon (southern), White-throated Needletail, Powerful Owl, *Cassinia* collina, and *Cycas megacarpa* noted that the Project is considered unlikely to:

- Lead to a long-term decrease in the size of a local population
- Reduce the extent of occurrence of the species.
- Fragment an existing population
- Result in genetically distinct populations forming as a result of habitat isolation
- Result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat
- Introduce disease that may cause the population to decline
- Interfere with any of the recovery actions identified in recovery plans
- Cause disruptions to ecologically significant locations of a species.

Therefore, significant residual impacts to conservation significant species resulting from the proposed impacts are considered unlikely to occur in accordance with the SRI Guideline. Offsets for impacts to conservation species' habitat under the Offsets Policy are not required (Epic 2024a).

7.4.2.2 Waterway Providing for Fish Passage

The Project is expected to impact three low risk waterways for waterway barrier works. All low risk waterways impacted by the Project are subject to artificial impoundment and are no longer connected to the wider catchment. Therefore, based on the assessment provided in **Appendix C**, significant residual impacts to waterways providing fish passage resulting from the Project are considered unlikely to occur.

7.4.2.3 Prescribed RE within the Defined Distance of a Watercourse

The Project will require clearing of two areas of mapped regulated vegetation within the defined distance from the defining bank of a relevant watercourse for both linear (access track) and non-linear infrastructure (Southern WRD and future Pit 3-4). The mapping of the MSES regulated vegetation (defined watercourse) is considered to be inconsistent with ground conditions as it partially overlaps existing Project disturbance areas authorised under the Project's EA, as shown in **Plate 20**.



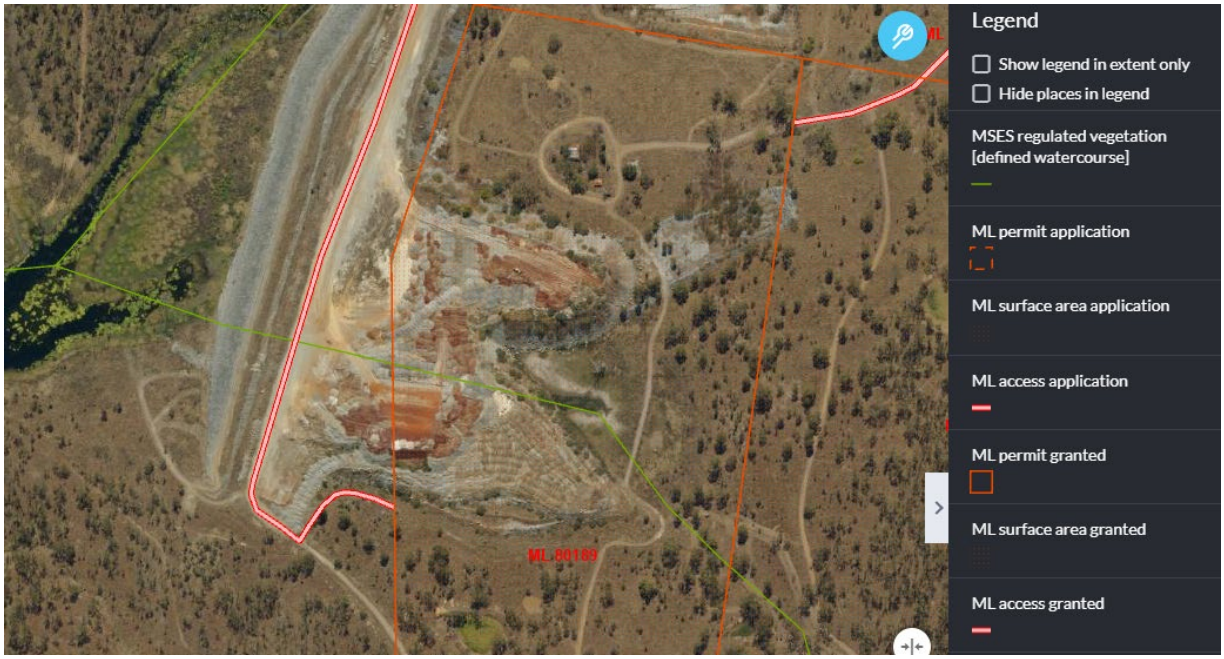


Plate 20. Snips of Queensland Globe MSES regulated vegetation (defined watercourse) mapping

The alignment does not reflect the topography of the area, as in both instances the MSES regulated vegetation (defined watercourses) mapping crosses the eastern and western levees at a perpendicular angle, despite being a nominal 15 m taller than the adjacent land. Photos of where the mapped MSES regulated vegetation (defined watercourses) crosses the western and eastern levees are shown in **Plate 11** and **Plate 12** respectively. Overland flows and seepage locations until the EOML have been further considered in **Appendix D, Appendix E, Appendix H,** and the SWIA in **Appendix K**.

The MSES defined watercourse mapping shown in **Plate 20** follows the same alignment as 'unmapped' watercourse mapping under the *Water Act 2000* and are labelled as stream order 1. Both areas are also mapped low risk (green) waterways for waterway barrier works, considered in **Section 7.4.2.2**. Based on the satellite imagery and field surveys undertaken by Epic in March 2023 (refer **Appendix C**), these waterways are ephemeral, short-in length, and do not provide fish habitat as they are either totally (artificially) impounded and isolated from downstream waterways, or significantly modified by earthworks and/or mining operations. In this context the waterways do not function as mapped and would be heavily altered by historic mining activities. Irrespective of this, an assessment of potential significant residual impact to prescribed REs within the defined distance of a watercourse has been considered in **Table 28,** in relation to Section 2.1 of the SRI Guideline (DEHP 2014).

Under Schedule 2 Section 2 of the Offsets Act, a prescribed RE is a matter of state environmental significance to the extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature. In Schedule 2, Section 2 (6) of the Offsets Regulation, the 'defined distance' for RE is defined as a distance identified in the Offsets Policy (Appendix 3, V1.15) as the relevant distance from the defining banks of a relevant watercourse or relevant drainage feature. For stream order 1 watercourses in a non-coastal bioregion, the defined distance is 25 metres. Excluding the existing disturbance, the RE within the proposed disturbance areas is RE 11.3.25 which has a woodland structure code. Therefore, criteria for the 'sparse' structural category applies.

Table 28. Significant residual impact test for MSES regulated vegetation (defined watercourse)

Ref.	Vegetation Clearing Type	Trigger specified in Section 2.1 of guideline	Proposed Project disturbance
1	Clearing for linear infrastructure in a sparse RE	Greater than 20 m wide	Nil- all tracks are no more than 10 m wide
	Clearing in a sparse RE, other than for linear infrastructure	Area greater than 2 ha	1.86 ha

Ref.	Vegetation Clearing Type	Trigger specified in Section 2.1 of guideline	Proposed Project disturbance
2	Clearing within 50 m of the defining bank	N/A	N/A
3	Clearing within 5 m of the [25 m] defining bank	Any clearing	0.42 ha

For a prescribed activity to have a significant residual impact on a RE that is within the defined distance of watercourses, criteria 1 and 3 must be exceeded. Significant impacts are unlikely based on the SRI Guideline (DEHP 2014), however the watercourse does not exist as mapped and therefore there is no potential impact. No offsets under the Offsets Act are required.

7.4.2.4 Category R Regulated Vegetation

The Project is mapped as a key resource area (KRA) (State of Queensland 2025a). KRAs are a planning tool designed to protect resources from being rendered inaccessible by urban expansion. Further, they are designed to maintain adequate separation distances between sensitive uses and any future extractive industry (State of Queensland 2025b).

Category A, B, and C regulated vegetation has been completely avoided in developing the proposed future mine plan for the Project. However, the proposed final footprint of the Southern WRD to the east will impact 2.95 ha of mapped MSES category R (GBR riverine) least concern vegetation. This area is specifically within the separation area of KRA19 (Taragoola- hard rock operation). The *Accepted Development Clearing Code- Clearing for an Extractive Industry* (DoR 2020) and *List of exempt clearing work* (State of Queensland 2019) notes that clearing in a category C area or category R area within a KRA is exempt clearing work. Therefore, an approval or notification prior to clearing this area is not required.

Under the Offsets Regulation, offsets may be required for any significant residual impact on prescribed environmental matters defined in Schedule 2, Section 1. A prescribed RE is defined as a RE, other than a RE mentioned in the VM Act, section 8(b), located in a category B area on the regulated vegetation management map, to the extent the ecosystem contains remnant vegetation. Therefore, the Category R area is not considered a prescribed environmental matter for offsets under the Offsets Regulation as it is regrowth vegetation.

Based on the above there are no significant residual impacts to Category R regulated vegetation considered applicable for the Project.

7.5 Air Quality

The environmental objective relevant to potential impacts to air, as per Schedule 8, Part 3, Division 1 of the EP Regulation, is "*the activity will be operated in a way that protects the environmental values of air*." Potential impacts from the proposed Project has been undertaken with consideration of the *Application requirements for activities with impacts to air* guideline (ESR/2015/1840) (DESI 2024a) and EPP Air (summarised in **Section 4.6.2**) to ensure the activity will be operated in a way that protects the environmental values of air**.**

Air monitoring undertaken by Graymont as part of the current air quality management protocol outlined in the EA indicates that Project activities and the management measures utilised to control dust emissions are maintaining air quality within the ambient criteria for the region (Refer **Section 4.6.2**). Air emissions generated by the current Project have no observed impact on ambient air quality.

Air emission impacts are expected to remain within the range recorded in existing monitoring results (**Section 4.6**) and no additional potential impacts are expected from the proposed amendments as there is no change in intensity of mining and quarrying activities proposed by the Project.

The additional disturbance proposed by the Project is not expected to increase the risk of impacting sensitive receptors as the Project is 3 km south of the closest homestead, which is away from the prevailing wind direction (Refer **Section 4.1**).

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.6 Greenhouse Gas

Greenhouse gas (GHG) emissions are a consequence of Project's operation activities. These are generated by:

- Combustion of fuel in heavy and light vehicles
- Blasting activities
- Combustion of fuel for electricity production via portable generators

Due to the location of the Project, there are no feasible alternatives to the use of fuel combustion for electricity production. Therefore, Graymont has a limited capacity to reduce GHG emissions however, options and opportunities for reducing emissions will be an ongoing consideration throughout the life of the Project.

An assessment of the Project's GHG gas emissions was undertaken against the *Greenhouse gas (GHG) emissions guideline,* released by the DETSI in May 2024 (DESI 2024g). Based on the thresholds provided in Appendix C of the GHG guideline, the Project is considered to be within the **Low emitter** category as expected GHG emissions (for Scope 1 and Scope 2) will be less than 25,000 t carbon dioxide equivalent (CO_2-e) per year. Therefore, a GHG abatement plan is not required, but ongoing assessments and reporting will continue throughout the LOM to ensure compliance.

GHG emissions data at the Project have been recorded as part of the National Greenhouse and Energy Reporting (NGER) scheme requirements. Consistent with Table 3 of the GHG guideline, this data includes Scope 1 and 2 GHG emissions and electricity from the grid. The Project is proposed to continue at the same scale and intensity as current operations to produce 0.8 Mtpa of limestone and will not change as a result of the proposed EA Amendment. Therefore, the annual GHG emissions and impacts are considered proportional with existing operations and will exist until the EOML.

The expected life of the Project is approximately 75 years, from 2025 to 2100 inclusive. Therefore, potential greenhouse gas impacts from the proposed EA amendment are not considered to be not significant and will be continuously mitigated and managed throughout the LOM where possible. The proposed amendment will not result in a change in GHG emissions as the scale and intensity of the Project will remain the same.

7.7 Noise

The environmental objective relevant to noise, as per Schedule 8, Part 3, Division 1 of the EP Regulation, is *"the activity will be operated in a way that protects the environmental values of the acoustic environment."* The proposed Project was considered against the *Application requirements for activities with noise impacts guideline* (DESI 2024b) to ensure the activity will be operated in a way that protects the environmental values of the acoustic environment.

No additional impacts from noise and vibration are anticipated as a result of the proposed changes to disturbance area. Noise and vibration impacts of the current Project have been described in **Section 4.7** and are related to the degree of attenuation from the source to the receiver as well as the level of sound from the sound source. Therefore, the distance of the Project to sensitive receptors is a key factor which is considered when assessing the potential impact of noise and vibration from Project activities.

As the nearest sensitive receptor not owned by Graymont is located approximately 4 km from the Project, the potential impacts due to noise and vibration from the Project have been identified as negligible. Additionally, monitoring previously undertaken by Graymont indicates that there have been minimal exceedances of ambient noise and vibration criteria, which have only occurred during blasting activities (Sibelco 2018).

No additional impact to noise and vibration is anticipated as a result of the proposed amendments to the former Pit 1 PMLU or increase in disturbance areas, and impacts are expected to remain within the range recorded in existing monitoring results. There will be no change to the scope or location of blast events, which are projected to remain within the bounds of future Pit 3-4 until EOML in 2100.

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.8 Traffic

No additional impacts from traffic are anticipated as a result of the proposed changes to disturbance area or PMLUs as the scale and intensity of the Project will not change as a result of this amendment and access will be retained throughout the LOM.

7.9 Waste

The environmental objective relevant to waste, pr Schedule 8, Part 3, Division 1 of the EP Regulation, is "*any waste generated, transported, or received as part of carrying out the activity will be managed in a way that protects all environmental values*." The proposed Project was considered against the *Application requirements for activities with waste impacts guideline* (DESI 2024f).

No additional impacts from waste are anticipated as a result of the proposed changes to disturbance area or PMLUs as the scale and intensity of the Project will not change as a result of this amendment.

The clean overburden rock from mining and processing on the Northern WRD has been partially used to backfill Pit 1, with future amalgamated Pit 3-4 to also be backfilled with clean waste rock in accordance with the PRC Plan. This waste placement strategy facilitates a beneficial reuse of the former Pit 1 area for ag lime production, reduces the footprint of 'waste' material onsite, reduces the need for additional disturbed land to store waste rock from future operations, and improves the ability of the site to support a grazing PMLU with suitable slopes of 12% or less that minimise erosion (refer **Appendix L**).

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.10 Cultural Heritage

Potential impacts to cultural heritage values has been considered in the context of the environmental objective and relevant application requirements for land. No additional impacts to cultural heritage have been identified, as the Project is not within any indigenous or non-indigenous cultural heritage areas. A former homestead exists in the southern portion of the Project area; however, searches on both Gladstone Regional Council's Local Heritage Register and the Queensland Heritage Register (via Queensland Globe layers), shows that this is not a heritage listed site.

It is noted that there are no Native Title determinations or claims over the Project area, however Raggote Creek which borders the western boundary of the Project is mapped under the First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC (Tribunal No: QCD2017/010, Federal Court No: QUD6026/2001). Raggote Creek is identified within the EA as receiving waters downstream of the Project area. No changes are proposed to release points or monitoring programs.

The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation.

7.11 Social and Economic

Further development of the region may occur and therefore the distance between the Project and sensitive areas may change. A review of Development Assessment Mapping indicates that there are no areas of regional interest mapped within close proximity of the Project. Priority Living Areas (PLAs) are the closest mapped areas of regional interest, with the Gladstone/Calliope PLAs southern boundary located approximately 6.3 km from the northern most extent of the Project. PLAs are areas that include the existing settled area of a city, town or other community and other areas necessary or desirable:

- for the future growth of the existing settled area
- as a buffer between the existing or a future settled area and resource activities

Currently, the Project supports local employment for up to 24 employees. While there may be fluctuations in the number of people employed for the Project, it is unlikely that this is to increase to a level that would impact the local available labour force, given that there is no proposed change in the scale or intensity of

activities. As a result, it is not anticipated that there will be increased impacts to the local housing market or community infrastructure. Local accommodation providers and the local tourism industry should not experience any impacts as employees primarily live locally to the Project.

Graymont will continue to support and provide benefits for local goods and service providers and seek opportunities to support local Indigenous businesses. Given that there is no change in Project activities, it is not anticipated that there will be increased demand or pressure on local suppliers and businesses to support the Project.

There are no further impacts expected on local health and emergencies services. Graymont maintains regular communication with emergency services and regularly looks for opportunities to support these functions. This includes consultation that occurred throughout the development of the PRC Plan, with Graymont allocating a previously cleared area in the north of the Project to develop a helipad for use by emergency services until EOML.

Health and safety impacts and traffic impacts are not expected to increase from the risks that are currently associated with traffic and works associated with the Project.

As outlined in **Section 7,** impacts to air quality and noise and vibration are considered to be negligible. These impacts give consideration to the closest sensitive receptor not owned by Graymont. Should further regional development result in additional sensitive receptors in proximity to the Project area, then monitoring of these EVs in accordance with the EA will ensure these do not exceed trigger levels and inadvertently impact sensitive receptors.

Public consultation is ongoing for the Project, as further described in **Section 9.3**. Consultation specific to the proposed PMLU change for Pit 1 and disturbance areas until EOML will occur at the next planned Open Day in August 2025. Stakeholder consultation has had an added benefit to local stakeholders in the region as they have been provided the opportunity to be engaged in the decision-making process for the proposed PMLUs of the Project, to ensure that the final land-use is appropriate, and add to the current and future socio-economic objectives of the region.

8 RISK ASSESSMENT

The purpose of this EA application is to identify potential environmental impacts associated with the proposed activity, describe environmental risks, and assess the likely magnitude of impacts on EVs identified in **Section 4.** This has been achieved through a environmental risk assessment with a methodology aligned with the AS/NZS ISO 31000:2009 Risk Management Principles and Guidelines.

8.1 Method

A risk assessment was undertaken to determine the potential for the proposed activity to impact on the environment using a quantitative assessment of the scale and magnitude of risks associated with the activity. A risk matrix was used to determine the likelihood and consequence of potential impacts.

'Likelihood' is defined as the chance that something might happen, refer **Table 29.** 'Consequence' is defined as the outcome of an event which may have the potential to change the existing EVs, refer **Table 30**. A likelihood and consequence score are generated for each hazard, which combine to determine the category of risk (high, medium, or low), refer **Table 31.** The residual risk score should be as low as reasonably practicable (**Table 32**).

Table 29. Categories of likelihood

Value	Category	Description
5	Almost Certain	May occur several times per year or is expected to occur
4	Likely	May occur about once per year or more likely to occur than not occur.
3	Possible	Could occur more than once during a lifetime or more likely to occur as not to occur.
2	Unlikely	Could occur about once during a lifetime or more likely not to occur than to occur.
1	Rare	Unlikely to occur during a lifetime or very unlikely to occur.

Table 30. Categories of consequence

Value	Category	Description
5	Catastrophic	Permanent environmental damage: remediation will take more than 5 years to remediate or remediation costs exceed $500,000.
4	Major	Long term environmental impact. Remediation between 1-5 years or costs between $50,000 and $500,000.
3	Moderate	Medium-term environmental damage. Remediation will be between 2 months and 1 year or cost between $10,000 and $50,000.
2	Minor	Short-term environmental impact. Remediation will take less than 2 months or cost less between $5,000 and $10,000. No lasting environmental damage.
1	Negligible	No environmental impact. Remediation costs less than $5,000 or requires minor or no remediation.

Table 31. Likelihood and consequence matrix

		Consequence				
		1	2	3	4	5
Likelihood	5	High	High	Critical	Critical	Critical
	4	Moderate	High	High	Critical	Critical
	3	Low	Moderate	High	High	Critical
	2	Low	Low	Moderate	High	High
	1	Low	Low	Low	Moderate	Moderate

8.2 Risk Assessment

The risk assessment has been provided in **Table 32** based on the potential impacts to EVs identified in **Section 7**. This risk assessment evaluate the environmental risk associated with the proposed Project. For this risk assessment, the local community is identified as residential properties adjacent to operation including sensitive receptors, or local communities including Calliope, dependent on scope of impact to the EV.

Table 32. Risk assessment

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
Land	1	Disturbance and loss of agricultural grazing land from additional land clearing, earthworks and vehicle movement	2	3	Mod	• Progressive rehabilitation will be undertaken throughout the mine life to minimise the require area for operations • The Project will utilise existing disturbance areas to minimise the overall impact to land • Additional Project disturbance is limited to 47.27 ha, which represents approximately 11% of the total ML area • The Project's final landform has been designed to ensure the Project area has a suitable PMLU	1	2	Low
	1	Disturbance to land surface and modification of exisiting landform having impacts on surface drainage patterns and ecological processes	4	2	High	• Soil disturbance to be kept to a minimum, with groundcover maintained until works are imminent • Hydrogeological assessments have been undertaken to ensure minimal impact from ongoing operations. • Control measures from the Project's ESCP, provided in **Appendix I**, are in place and will be revised as needed throughout the mine life • Western and eastern levees will remain in place • Runoff from new disturbance areas will be directed towards sediment ponds or Pit • The Project's final landform has been designed to ensure the Project area has a suitable PMLU	3	1	Low
	1	Land contamination from the unplanned release of potentially contaminated liquid/water	3	2	Mod	• All potentially contaminated waters are directed to the ponds onsite, with control measures implemented in accordance with the Project's Water Management Plan • The waste characterisation assessment undertaken by RGS (2023a) identified that the risk from AMD from the additional disturbance proposed was highly unlikely as there is no historical evidence or reports of AMD occurrences for the Project.	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• Additional assessment by Epic (2024c), provided in **Appendix F**, noted that the waste rock and production (drill chip) material is classified as NAF • Regular monitoring and inspections of all containments will be ongoing • Rehabilitation of all disturbance areas will occur in accordance with the PRC Plan, and all contamination sources (fuel storages etc) will be removed offsite • All storage of chemicals associated with Project works are stored a minimum of 200 m from the nearest watercourse • Spill response equipment is available at refuelling areas and other locations (where relevant). Staff are trained in the appropriate use of spill response equipment • Fuel, oil and chemicals are stored, transported and handled in accordance appropriate standards including: - AS3780:2008 – The storage and handling of corrosive substances - AS1940:2004 – The storage and handling of flammable and combustible liquids - AS3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers			
	1	Unstable Pit and WRD landforms exist at EOML	3	3	High	• A stable final landform has been designed as part of the Project's PRC Plan • Drone-based photogrammetry will be utilised to gather profiles of the walls of the pits and the slopes of the WRD annually. Surfaces will be created from the point clouds, and these surfaces will be compared to previous surfaces to identify any changes. If excessive deformations occur, appropriate strategies will be implemented to understand the deformation mechanisms and, if necessary, ensure the risk to persons will remain acceptable for the long term (Rocktest 2024)	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• Annual data collection on the orientations of the discontinuities exposed at Pit 3-4 will be undertaken during operation. This data will be compared to previous records to assess whether the characteristics of the discontinuities align with those exposed previously and upon which the final pit shell was based. If variations are identified, the data will be used for kinematic analyses to determine whether modifications are required • Weekly visual inspections of pit walls and WRD slopes will be conducted during operation, with strategies in place to manage any potential increase in risk over the long term • An audit of geotechnical risk issues will be undertaken by an independent geotechnical consultant every 18 months • Monitoring of erosion and drainage controls will be ongoing and replaced as needed • A programme for visually monitoring and auditing the walls, slopes, and the landforms after the EOML will be established and will have a similar methodology as current annual geotechnical monitoring for the Project • Site access will be restricted at closure via construction of the abandonment bund • Exclusions fencing and signage will be maintained • Certification from a suitably qualified person verifying design intent has been achieved			
Surface Water	1	Release of contaminated water to the receiving environment causing a reduction in off-site water quality and reduction in the health of the aquatic	3	3	High	• No Project activities are located in close proximity to the receiving watercourse Raggote Creek or Awoonga Dam • Progressive rehabilitation will be undertaken to reinstate drainage lines and minimise the required disturbance area of the Project in accordance with the PRC Plan	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
		ecosystem or impact to Great Barrier Reef				• The Project's ESCP is in place and follows *Best Practice Erosion and Sediment Control* guidelines to design, prevent and / or manage sediment laden runoff resulting from any land disturbance from water entering the receiving environment • Surface water is additionally managed through the existing Stormwater Management Plan (Sibelco 2018b) • Monitoring of erosion and drainage controls will be ongoing and replaced as needed • All storage of chemicals associated with Project works are stored a minimum of 200 m from the nearest watercourse • Washdown areas for Project vehicles/machinery are clearly demarcated to prevent contaminated run-off from entering waterways • Spill response equipment is available at refuelling areas and other locations (where relevant). Staff are trained in the appropriate use of spill response equipment • Fuel, oil and chemicals are stored, transported and handled in accordance appropriate standards including: - AS3780:2008 – The storage and handling of corrosive substances - AS1940:2004 – The storage and handling of flammable and combustible liquids - AS3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers			
	1	Removal of Farm Dam resulting in a change to overland flow paths and increased erosion onsite	3	2	Mod	• The Farm Dam is not currently utilised within the existing water management strategy and is not used by external users • The Farm Dam causes uncontrolled release of sediment laden water and erosion towards Pit 3, therefore removal of the farm dam will assist in management of erosion and sediment runoff impacts	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• SWIA (**Appendix K**) undertaken to understand flow paths and suitability of sediment ponds until EOML, with recommendations included into progressive rehabilitation planning within the PRC Plan			
	1	Proposed final landform results in flooding impacts	2	3	Mod	• Overland flows (up to a PMF event) are directed to sediment ponds or into the Pits • Management of overland flows after closure via the abandonment bunds • Flood design storms have been modelled to understand risk of overtopping of the pit protection structures (refer **Appendix H**), with recommendations identified including protection at inflow locations to minimise scour potential and improve longevity of the landform, and rock armouring controls at identified areas where velocities exceed 1.5 m/s (Engeny 2025)	1	3	Low
Groundwater	1	Groundwater drawdown results in the loss of available groundwater for downstream users (i.e. bores, GDEs, springs etc.)	3	2	Mod	• Ongoing groundwater monitoring will be carried out in accordance with the EA to monitor groundwater levels • Hydrogeological assessments will be undertaken throughout the life of mine to ensure risks are appropriately managed • There are currently no existing groundwater supply bores within the expected zone groundwater drawdown zone of 2 km • Following cessation of mining, the mine voids will recharge with water as pressure differentials equalize with the surrounding bedrock and a new equilibrium is established (Graymont 2025) • Groundwater is not used to support operations	2	2	Low
	1	Degradation of groundwater quality from contaminated water seepage into the receiving environment	2	4	High	• Ongoing groundwater monitoring will be carried out in accordance with the EA • Groundwater is currently managed under the Water Management Plan (Appendix G of the EMP), Background Groundwater Monitoring Program (Appendix H(a) of the EMP) and Groundwater Monitoring Program (Appendix H(b) of the EMP, provided in **Appendix A)**	1	4	Mod

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• There is no potential impact to groundwater quality anticipated from Acid, Saline or Metalliferous Drainage (AMD) from waste rock generated by the Project, as no AMD materials were identified during waste characterisation assessments undertaken by RGS (2023a, 2023b) and Epic (2024c) • Previous groundwater and void water quality samples have been taken which demonstrate that the results achieve the required standards to support a water storage PMLU • The hydraulic gradient toward the final void means there is not likely to be seepage through the bedrock toward the Awoonga Dam and that the void will be a groundwater sink (Graymont 2025)			
Terrestrial Ecology	1	Habitat fragmentation and loss of connectivity from vegetation clearing activities	3	2	Mod	• Proposed disturbance is limited to 47.27 ha • A Revegetation Plan has been developed in line with Section 3.6.1 of the PRC Plan guidelines (DESI 2024g) to establish self-sustaining vegetation communities, post construction and at EOML • Environmental Management Plan includes measures to minimise impacts to undisturbed areas including management procedures for threatened species considered to be potentially or likely to be present • Vegetation clearing extents will be clearly demarcated with flagging or bunting prior to clearing to limit the area safely and reasonably required for permanent and temporary works • Fallen timber created by vegetation clearing should be scattered in adjacent habitats to provide offsite shelter habitat for fauna	2	2	Low
	1	Accidental death of resident fauna during vegetation clearing.	3	2	Mod	• Fauna spotter-catchers (licensed) will inspect sites prior to vegetation clearing. Fauna habitat shelter features (large hollows) will be clearly marked where they are unable to be accessed/inspected prior to tree felling	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• Procedures will be in place where injured fauna are encountered during clearing works. Local wildlife carer and/or veterinarian will be identified prior to works being carried out and be notified in the event that fauna is injured • Project speed limits are maintained across the Project area to limit the potential for road collisions			
	1	Proliferation of weed and pest species as a result of additional land clearing and increased vehicular movement, in particular American Ratstail Grass (*Sporobolus jacquemontii*)	3	2	Mod	• Weed and Pest Management Plan is currently in place to mitigate impacts of operations. The plan details all required management measures and monitoring procedures. Weed control strategies will be developed in line with the Gladstone Regional Council biosecurity plan 2021-2025 (GRC 2020) • Mapping of the extent of weed/pest occurrence within the Project footprint will be recorded during pre-clearance surveys • Progressive rehabilitation of available disturbance areas will be undertaken as Project progresses, thus reducing impacts to connectivity • Disposal and storage of putrescible wastes will be undertaken appropriately to ensure feral animals are not attracted to the Project area • Storage of construction/operation materials carried out in a manner so as to not encourage the establishment of resident pest fauna • Regular monitoring of weed and pest occurrence in association with Project works areas and in response to complaints from adjacent landowners	2	2	Low
	1	Increased risk of fire from Project operations	3	3	High	• Graymont will maintain communications with the QFES regarding Project activities and bushfire hazard conditions • QFES conduct regular controlled burning of undisturbed areas within the MLs as they are adjacent to Lake Awoonga	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						• Monitoring of weather conditions will be carried out to inform Project activities and planning during high fire-risk weather conditions • Appropriate fire breaks are maintained around above ground Project infrastructure • Fire-fighting equipment will be regularly maintained, and staff training will be ongoing throughout the life of mine			
	1	Operational noise, lighting and airborne dust causing an environmental nuisance	3	2	Mod	• Monitoring of air/dust emissions will be carried out in accordance with the EA • A 50,000 L water truck collects water from the Pit and completes all dust suppression for the Project, including spoil piles and the washdown area at the workshop • All Project-associated construction/operational machinery will be maintained as per manufacturer design specifications to ensure project noise is minimised • Speed limits will be established throughout Project area to limit noise levels as a result of vehicle movements • Low spill lighting components and directional lighting (away from adjacent fauna habitat) are used where possible where night lighting is considered necessary	2	2	Low
Greenhouse Gas	1	Ongoing GHG emissions from the Project contribute to climate change impacts.	3	2	High	• Opportunities to minimise emissions will be considered throughout the life of the Project • GHG emissions reporting and calculations will be ongoing to assess progress • 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	2	2	Low

Environmental Value	Corresponding Amendment (Section 6)	Risk Event	Inherent Risk			Proposed Mitigation / Controls	Residual Risk		
			Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
						ecologists and soil scientists. This will maximise the probability of progressive and final rehabilitation success			
Social and Economic	1, 2	Stakeholders are not consulted about the Project and do not have the opportunity to comment on the proposed mine plan and rehabilitation	3	2	Mod	• A Stakeholder Engagement Plan has been developed as part of the PRC Plan and will ensure consultations occur throughout the life of mine • The consultation register will be updated regularly to capture all key communications with relevant stakeholders • A mine open day occurred to provide the community an opportunity to comment on the EA amendment and PRC Plan for the Project (refer **Section 9.3.1)** • Graymont will provide updates of Project milestones to local community members and the First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation (RNTBC). All proposed disturbance will be kept within the existing MLs for the Project	1	2	Low

8.3 Management Plans

Graymont has an existing EMP in place which outlines actions to mitigate and manage potential impacts, which has been updated to ensure that additional potential impacts posed by the proposed amendments are accounted for.

The EMP (refer **Appendix A**) is accompanied by the following management plans for operations:

- Stormwater Management Plan
- Water Management Plan
- Background Groundwater Monitoring Program
- Groundwater Monitoring Program
- Erosion and Sediment Control Plan
- Land and Rehabilitation Management Plan
- Ground Control Management Plan
- Pest and Weed Management Plan

As summarised in **Table 32**, existing mitigation measures and controls which include management plans, monitoring programs in accordance with the EA, and communication strategies are considered to be appropriate to continually manage risk of impacts from Project activities. The PRC Plan developed for the Project also outlines further monitoring commitments and progressive rehabilitation methodologies appliable at the EOML, further described in **Section 9**.

9 REHABILITATION AND CLOSURE

A Progressive Rehabilitation and Closure Plan was prepared for the Project to address the requirements of:

- The transition notice issued to Graymont on 31 March 2021 by the Queensland DETSI (formerly DESI)
- The MERFP Act
- Sections 126B, 126C and 126D of the EP Act
- PRC Plan Guideline (ESR/2019/4964) (PRC Plan Guideline) (DESI 2024h)
- Schedule 8A of the EP Regulation
- *Spatial information submission guideline* (ESR/2018/4337) (DESI 2024i)

Following the initial submission of the PRC Plan for the Project on 16 March 2023, a Not Properly Made Notice was issued by DETSI, dated 29 March 2023. These comments from the Notice were addressed in the PRC Plan which was resubmitted on 27 June 2023. An Information Request (IR) Notice for the PRC Plan was issued to Graymont on 7 August 2023, in which it is noted in Item 3 that the PRC Plan must reflect disturbance areas approved in the EA. An updated PRC Plan was submitted to the DETSI on 17 March 2025 and was resubmitted as a new application on 11 July 2025.

Key information from the proposed PRC Plan related to closure and rehabilitation at the EOML has been summarised in this EA Amendment supporting report.

No rehabilitation has occurred in the Project area prior to the Proponent acquiring operations in 2019, and there has been no certified rehabilitation undertaken since 2019. The northernmost cleared area of the Project was identified as not being required for operations and has been previously grass seeded in 2020/2021. This area was not applied for progressive certification under the EP Act as it has since been identified by emergency services as an area required for helipad construction. This area will be cleared and flattened to support this infrastructure and will be retained until the EOML.

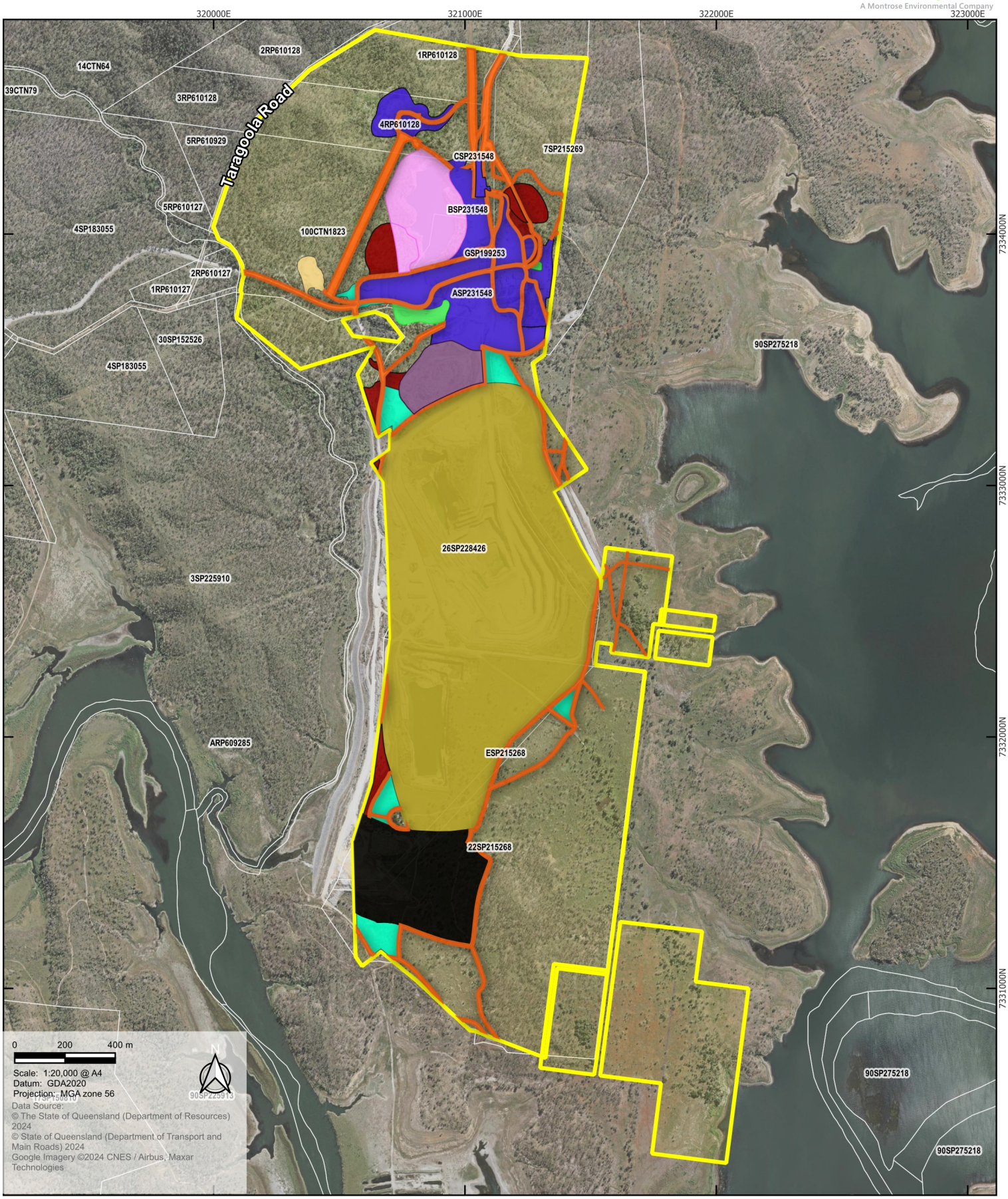
9.1 Overview of Rehabilitation Areas

The proposed rehabilitation areas (RAs) will encompass the entirety of the disturbed areas contained within the MLs. Areas within the disturbance footprint will be rehabilitated to achieve the approved post-mining land use description. Ten RAs have been nominated for the Project, summarised in **Table 33** and displayed in **Figure 21.**

.

Table 33. Rehabilitation areas

Rehabilitation area ID	Rehabilitation Area Description	Rehabilitation Period		Applicable milestone criteria	Post mining land use (PMLU)	Area (ha)
		Start	End			
RA 1	**Cleared areas and laydowns**- this includes laydown areas, the cleared area in the northern extent of the site (within ML80192) that was previously required for operations, and inactive Pit 1 which has been backfilled with material from the Northern WRD.	2025 2096	2036 2107	RM5, RM6, RM8, RM9, RM11,	Low intensity grazing	6.77
RA2	**Silt dump-** this incorporates the maximum extent of the silt dump.	2096	2108	RM2, RM5, RM6, RM8, RM9, RM11,	Low intensity grazing	1.11
RA 3	**Pit 2-** inactive Pit currently used to supply water for operations (including for dust suppression, processing, etc). Footprint includes surrounding disturbed and undisturbed area within the extent of the perimeter abandonment bund.	2100	2110	RM3, RM7, RM9 RM10	Water storage	11.46
RA 4	**Infrastructure and ROM pad-** this incorporates the run-of-mine infrastructure, administration, workshop, and storage infrastructure, crushing and screening plant, wash plant, and processing area; inclusive of all buildings, powerlines, conveyors, concrete pads, communications towers, groundwater bores, fuel storage, hardstand areas, and equipment. This incorporates former Pit 1, which has been backfilled and is intended to be used for aglime production and stockpile area.	2100	2113	RM1, RM2, RM5, RM6, RM8, RM9, RM11	Low intensity grazing	27.34
RA 5	**Southern WRD-** this includes the current, future, and buffer areas of the southern WRD. The footprint includes an exclusionary area comprising a perimeter access track and rock armour bund around the base of the WRD.	2101	2112	RM4, RM6, RM8, RM9, RM11	Low intensity grazing	19.66
RA 6	**Pit 3-4** – this incorporates the extent of the existing and proposed quarry disturbance area of the future amalgamated Pit 3-4. Footprint also includes surrounding disturbed area within the extent of the perimeter abandonment bund.	2102	2113	RM3, RM7, RM9, RM10,	Water storage	109.71
RA 7	**Spoil pile areas**- this includes all areas required for spoil pile storage until end of mine life, outside of the Pit 2 and Pit 3-4 abandonment bunds. This will also incorporate the (former) Northern WRD area at end of mine life.	2103	2115	RM1, RM5, RM6, RM8, RM9, RM11	Low intensity grazing	6.03
RA 8	**Sediment ponds**- this incorporates the extent of the two sediment ponds onsite.	2104	2116	RM2, RM5, RM6, RM8, RM9, RM11	Low intensity grazing	1.46
RA 9	**Topsoil stockpile areas**- this includes all areas required for topsoil and subsoil storage until the end of mine life, outside of the Pit 2 and Pit 3-4 abandonment bunds.	2105	2117	RM5, RM6, RM8, RM9, RM11	Low intensity grazing	7.01
RA 10	**Access tracks**- this includes the eastern and western levees and all existing and proposed access tracks required for operations until end of mine life.	2100	2110	RM5, RM7, RM9, RM12	Access tracks	17.25
					Total (ha)	**207.82**



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 21 Rehabilitation areas.qgz

Legend

- Site boundary
- Cadastre (DCDB)

Rehabilitation areas

- RA01 - Cleared areas and laydowns
- RA02 - Silt dump
- RA03 - Pit 2
- RA04 - Infrastructure and ROM pad
- RA05 - Southern waste rock dump
- RA06 - Pit 3-4
- RA07 - Spoil piles
- RA08 - Sediment ponds
- RA09 - Topsoil areas
- RA10 - Access tracks

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 21
Rehabilitation areas

9.1.1 Rehabilitation Staging

Figure 22 shows the proposed rehabilitation staging of each RA.

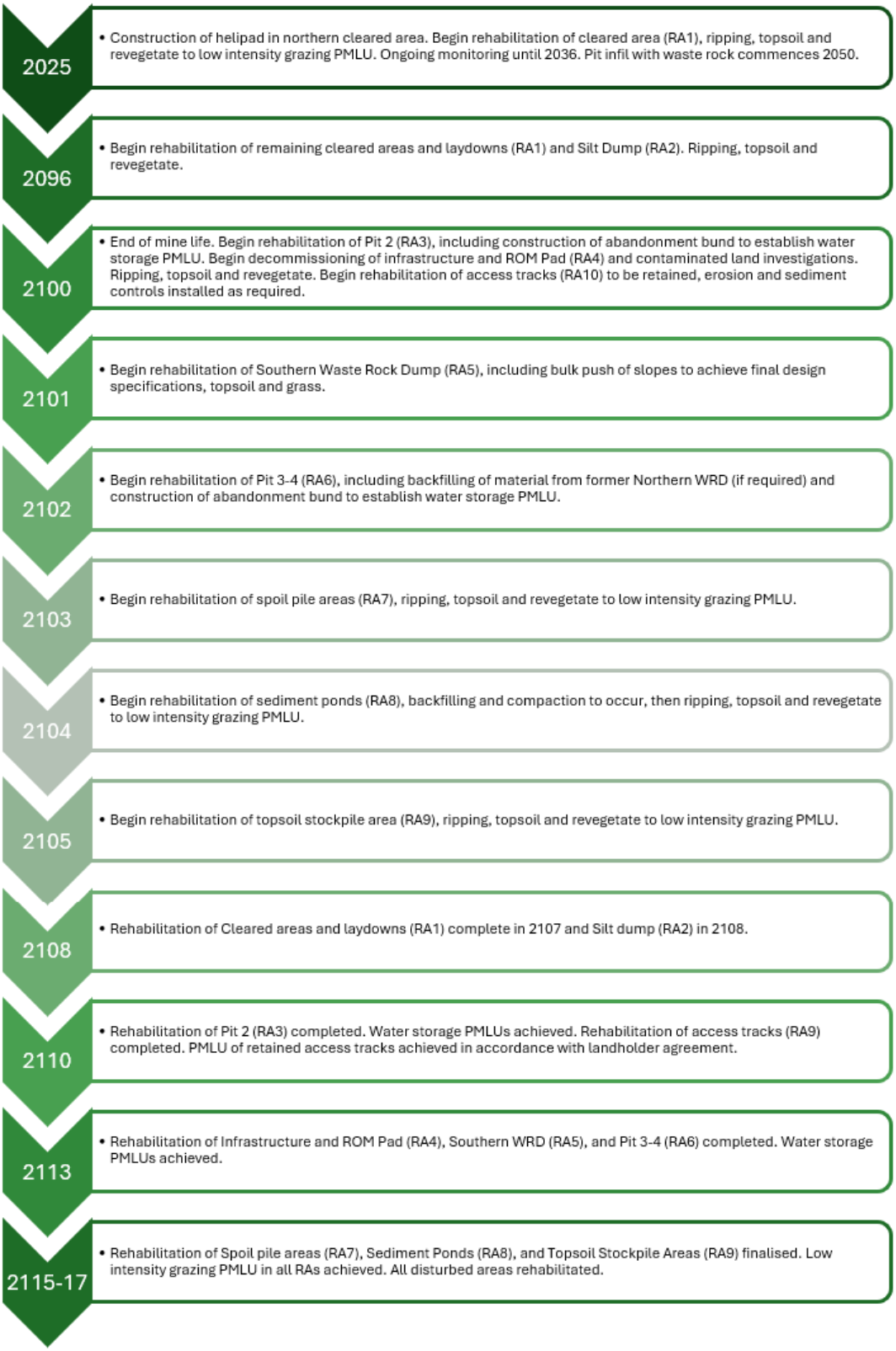


Figure 22. Rehabilitation staging

9.2 Assessment of PMLU Options

As part of the assessment of PMLU options, it is acknowledged that land will need to be rehabilitated according to the relevant legislation.

The proposed PMLUs for the Project (refer **Figure 23**) are considered appropriate as they are consistent with pre-mining land use and surrounding land uses. The return of the Project to predominantly low intensity grazing land will ultimately provide a beneficial environmental outcome.

It is noted that PMLUs included within the EA Amendment will be consistent with the current EA, but contemporized to suit the terminology and expectations of the PRC Plan guideline (DETSI 2024g), noting that:

- Residual voids (Pit 2 and future Pit 3-4) will be retained as water storage, including installation of an exclusion zone and perimeter abandonment bunds, for intended use for water management purposes including drought mitigation and fire fighting
- All access tracks and the eastern and western levees will be retained to facilitate future Project access to Lake Awoonga for GAWB's maintenance activities (per landholder statement in **Appendix J** and **Figure 4**)
- All remaining areas (infrastructure, spoil piles, cleared areas and laydowns, topsoil, sediment ponds, Southern WRD, former Pit 1 area and existing and proposed groundwater bores) will be rehabilitated to low intensity grazing land, with the Southern WRD to be grassed.

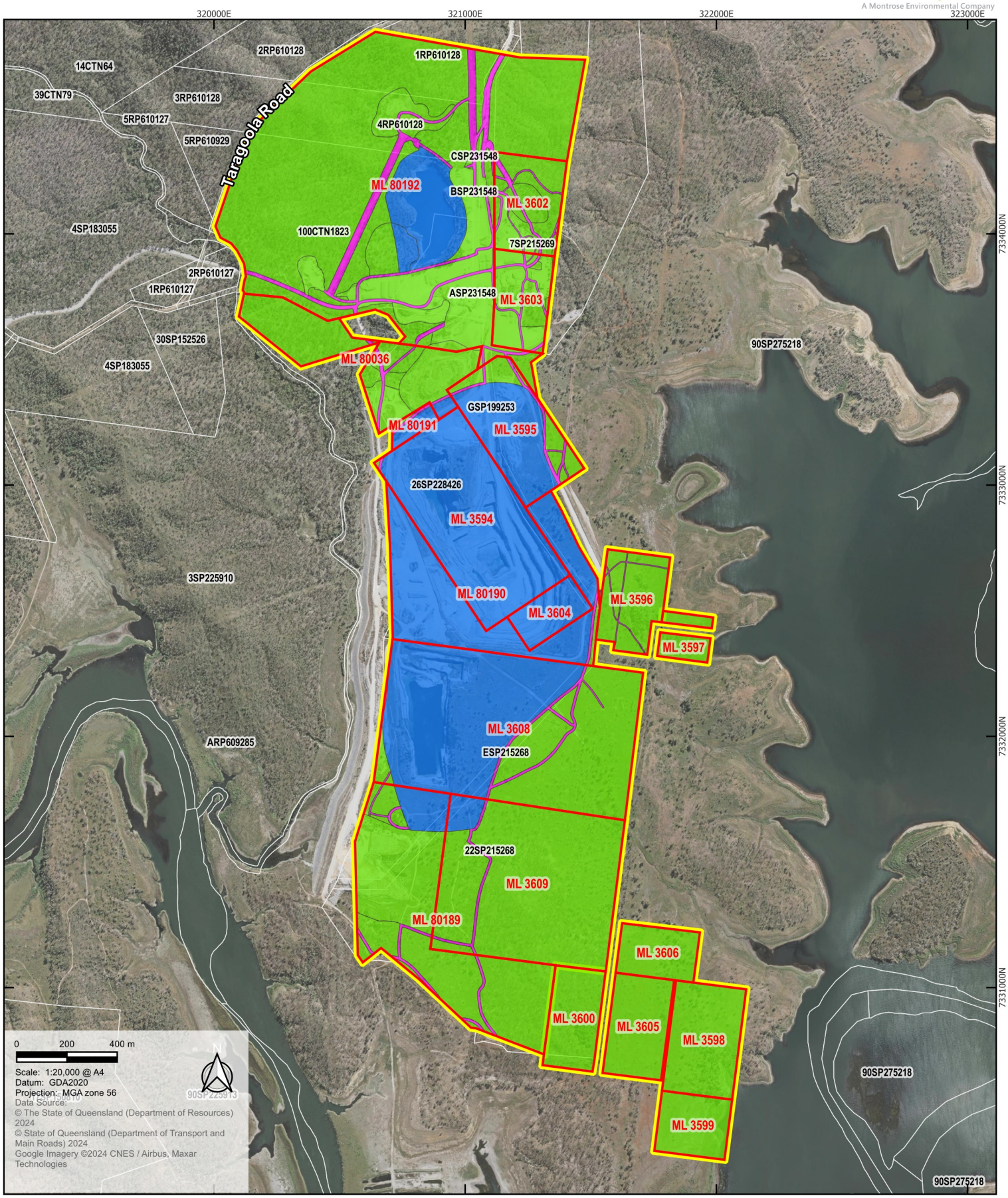
No other legislation (at a State or Commonwealth level) has been identified as relevant to the land use of the surrounding area. There are also no development approvals relevant to the land.

The methodology employed for determining PMLU options was undertaken as an evidence-based comparison, and subsequent justification of possible PMLU options. The methodology involved the incorporation of community feedback and consultation (see Section 9.3 for more information), assessment of potential PMLU options specified in the PRC Plan Guideline and identification of regulatory constraints (Local, State and Commonwealth). A ranking scale was also developed to enable comparison and decision making on the appropriateness of each potential PMLU against the PRC Plan Guideline criteria for the Project.

The options analysis includes consideration of each PMLU against the following:

- Complies with regulatory considerations / constraints (Commonwealth, State and Local), including the GRC Planning Scheme zoning
- Able to appropriately manage physical constraints and chemical characteristics
- Meets or exceeds available rehabilitation methods
- Cost effective
- Able to provide potential economic, environmental, and social benefits
- Compatibility with surrounding landscape and pre-mined landscape
- Optionality for retaining / transitioning infrastructure and/or utilities

The access tracks and levees to be retained in accordance with the landholder statement in **Appendix J** is displayed in **Figure 4**.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 EA Amendment\Rev 3\Figure 23 Post mining land uses.qgz

Legend

- Site boundary
- Mining leases
- Cadastre (DCDB)

Post mining land uses

- Grazing
- Other
- Water storage

Graymont
Calliope Limestone Quarry
Major Environmental Authority Amendment

Figure 23
Post mining land uses

9.3 Community Consultation

Graymont has maintained a Community Engagement Register throughout ownership of the Project and updated as needed. PMLUs have been previously approved through an existing land outcome document (the EA) and under transitional arrangements have been included in the PRC Plan. There has been no material change to the proposed PMLU for any of the disturbance types. A consultation register was developed to document details of past and future engagement undertaken with stakeholders regarding rehabilitation and closure and changes to EA conditions. Key consultations included the Calliope Limestone Quarry Open Day and community consultation letter, described in **Section 9.3.1** and **Section 9.3.2.**

9.3.1 Calliope Limestone Quarry Open Day

On Saturday 4 March 2023, Graymont held an Open Day at the Calliope Limestone Quarry. Open Day invitations were sent out to all residents of Calliope town, the First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC, the Mayor and Councillors from Gladstone Regional Council, GAWB, PCCC Land Trust, and the Rural Fire Service on 22 February 2023. The Open Day invitation was on display at the grocery stores, butchery, and hardware stores in the town in the week prior. 140 people visited the Project to meet with Graymont personnel, participate in a tour of the Project area, and discuss current and future operations and rehabilitation plans (refer **Plate 21**).

Information about the EA Amendment and PRC Planning was on display for the attendees, and they were provided an opportunity to comment on proposed plans (refer **Plate 22**). Overall, the engagement with community members was positive. One community member asked about the status of the rail line for transporting limestone, as was previously done for the Project. Graymont representatives explained the use of trucks for moving saleable product, as the rail line has not been used for some time and is non-operational infrastructure managed by Queensland Rail. No other queries were noted.

Graymont is currently planning to hold another Open Day for the end of the third quarter of 2025.

9.3.2 Community Consultation Letter

In December 2022, a letter was prepared for identified stakeholders, including direct and adjoining landholders, local emergency services, Indigenous stakeholders (First Nations Bailai, Gurang, Gooreng Gooreng, Taribelang Bunda People Aboriginal Corporation RNTBC), and the PCCC Land Trust, to describe the Project and provide an opportunity for stakeholders to comment. The letter included a description of the EA and PRC Plan, the proposed EA Amendments, PMLUs, rehabilitation areas and staging as part of the PRC Plan, Graymont's contact details, and enclosed the existing EA. As Graymont acquired operations in 2019, the letter included a description of Graymont's business and operations across Australia and internationally, and a description of the Project's current and future planed operations. No responses were received from the letter.



Plate 21. Visitors and personnel at open day at Calliope Limestone Quarry 2023

Source: Graymont 2023



Plate 22. Information about PRC planning and EA amendment on display at Calliope Limestone Quarry 2023

Source: Graymont 2023

10 CONCLUSION

This report has been prepared by Epic, on behalf of Graymont, to accompany an application for an EA Amendment under Chapter 5, Part 7, Division 2, Section 226(1) and 226A of the EP Act. This EA amendment application seeks to update the authorised disturbance areas to reflect intended mining activities until the EOML in 2100, based on the groundtruthed MLs, and to contemporise the EA to align with in-force State legislation. It is noted that the current EA pre-dates the release of the MERFP Act and updates to the EP Act in relation to rehabilitation, so administrative changes are proposed to align EA conditions with the PRC Plan (PRCP-EPML00969013-V1) and valid ERC (ERC100436752) approvals applicable to the Project.

To authorise the additional disturbance proposed by the Project on the MLs, Graymont commissioned Epic to:

- Assess existing environment and existing EVs, including specific technical studies
- Evaluate the potential environmental impacts on identified EVs
- Prepare an environmental risk assessment to quantify the risk

It was determined that an EIS is not required for this Project as the proposed EA amendment does not trigger any of the Appendix B EIS triggers and all items in Section 3 of the Criteria and Appendix A Standard Criteria have been appropriately considered. The proposed EA amendment will not result in any significant impacts on the EVs related to land, surface water and wetlands, groundwater, terrestrial ecology, greenhouse gas, and social and economic. Proposed disturbance will be staged and progressively rehabilitation over the life of the mine, consistent with the proposed PRC Plan for the Project, and appropriate mitigation measures are proposed. The Project will achieve the performance outcomes identified in Schedule 8, Part 3, Division 1 of the EP Regulation, and Condition F1 of the EA.

This report concluded that with implementation of adequate environmental controls, this Project will have an acceptable level of impact on EVs. Overall, the mining operation is proposed to continue at the same scale and intensity of 0.8 Mtpa of limestone for a nominal 75 years until EOML. The EA amendment does not propose any changes to the ROM rate or thresholds, and no new ERAs are proposed to be added. Therefore, the proportional disturbance and impacts are consistent with existing operations. Existing disturbance areas have been planned to support future mining activities as much as possible to minimise new disturbance areas required. It is therefore recommended that this application be approved by DETSI, subject to the relevant and reasonable Project-specific conditions.

11 REFERENCES

ANZG 2023, *Livestock drinking water guidelines*, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra.

AMIRA, 2002. *Prediction & Kinetic Control of Acid Mine Drainage,* Melbourne: Environmental Geochemistry International.

Australian Bureau of Statistics (ABS) 2025, QuickStats- Calliope 2021 Census All Persons, viewed 10 April 2025, https://www.abs.gov.au/census/find-census-data/quickstats/2021/UCL315012

BoM 2025a, *Australian Climate Influences*, Bureau of Meteorology, viewed 10 April 2025, http://www.bom.gov.au/climate/about/

BoM 2025b, Climate statistics for Australian locations, Bureau of Meteorology, viewed 10 April 2025. http://www.bom.gov.au/climate/averages/tables/cw_039123_All.shtml

BoM 2025c, *What is a tropical cyclone?*, viewed 10 April 2025, http://www.bom.gov.au/cyclone/about/intensity.shtml

BoM 2025d, *Flood Warning Services*, viewed 10 April 2025, http://www.bom.gov.au/water/floods/floodWarningServices.shtml

BoM 2016, *Evaporation: Average Monthly & Annual Evaporation*, Bureau of Meteorology, viewed 10 April 2025, http://www.bom.gov.au/watl/evaporation/

Buchanan B. W. 1993, Effects of enhanced lighting on the behaviour of nocturnal frogs. *Animal Behaviour*, Vol 45, pp. 893–899

CSIRO 2024, *Frequently asked questions about tropical cyclones, their causes, occurrences and impacts*, CSIRO, viewed 10 April 2025, https://www.csiro.au/en/research/disasters/faqs-on-tropical-cyclones CSIRO and Bureau of Meteorology 2015, *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*, CSIRO and Bureau of Meteorology, Australia

DAF 2018, *Accepted development requirements for operational work that is constructing or raising waterway barrier works*. Department of Agriculture and Fisheries, Brisbane

DAFF 2014, *Cyclone – wind gust events greater than 75 km per hour (ID: 74),* Department of Agriculture, Fisheries and Forestry, Department of Science, Queensland Government.

DE 2013, Matters of National Environmental Significance significant impact guidelines 1.1. Department of the Environment, Canberra.

DEHP 2014, *Queensland Environmental Offsets Policy - significant residual impact guideline*, Department of Environment and Heritage Protection, Queensland Government, Brisbane.

Department of Environment, Science and Innovation (DESI) 2024a, *Application requirements for activities with impacts to air,* ESR/2015/1840, viewed 12 July 2024, Application requirements for activities with impacts to air (des.qld.gov.au)

DESI 2024b, *Application requirements for activities with noise impacts,* ESR/2015/1838, viewed 12 July 2024, ESR/2015/1838, Application requirements for activities with noise impacts, EM962 (des.qld.gov.au)

DESI 2024c, *Application requirements for activities with impacts to water,* ESR/2015/1837, viewed 12 July 2024, ESR/2015/1837 Application requirements for activities with impacts to water (des.qld.gov.au)

DESI 2024d, *Disposal and storage of scrap tyres at mine sites,* ESR/2016/2380*,* viewed 12 July 2024, https://www.des.qld.gov.au/policies?a=272936:policy_registry/rs-op-scrap-tyres-mine-sites.pdf

DESI 2024e, *Application requirements for activities with impacts to land,* ESR/2015/1839, viewed 12 July 2024, https://www.des.qld.gov.au/policies?a=272936:policy_registry/era-gl-land-impacts.pdf

DESI 2024f, *Application requirements for activities with waste impacts,* ESR/2015/1836, viewed 12 July 2024, https://www.des.qld.gov.au/policies?a=272936:policy_registry/era-gl-waste-impacts.pdf

DESI 2024g, *Greenhouse gas emissions guideline,* ESR/2024/6819, viewed 12 August 2024, https://www.desi.qld.gov.au/policies?a=272936:policy_registry/era-gl-greenhouse-gas-emissions.pdf

DESI 2024h, *Progressive rehabilitation and closure plans,* ESR/2019/4964, viewed 27 March 2025, https://www.des.qld.gov.au/policies?a=272936:policy_registry/rs-gl-prc-plan.pdf

DESI 2024i, *Spatial information submission guideline,* ESR/2018/4337, viewed 21 March 2025, https://www.des.qld.gov.au/policies?a=272936:policy_registry/rs-gl-spatial-information.pdf

DESI 2024j, ESR/2021/5627, *Guideline Reef Discharge Standards for Industrial Activities (Version 1.04),* dated 23 FEB 2024, viewed 23 April 2025, https://environment.desi.qld.gov.au/management/activities/mining/guidelines

Department of Environment and Science 2019, *Great Barrier Reef River Basins End-Of-Basin Load Water Quality Objectives,* viewed 24 April 2025, https://environment.desi.qld.gov.au/management/water/policy/gbr-water-quality-objectives

Department of Environment and Science (DES) 2022, *Environmental Management Register (EMR) and Contaminated Land Register (CLR),* Department of Environment and Science, viewed 05 April 2022

DIR 1997, *Safety Bund around Abandoned Open Pit Mines Guideline*, Government of Western Australia Department of Industry and Resources, MOSHAB Approved. Document No. ZMA048HA, Western Australia Government.

DoR 2020, *Guide to using the extractive code, Accepted Development Vegetation Clearing Clode- Clearing for an Extractive Industry,* State of Queensland.

Engeny 2025, *Calliope Limestone Quarry PRCP- Final Landform Flood Assessment,* Memorandum prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2025a, *Surface Water Impact Assessment,* report prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2025b, RUSLE Memorandum, report prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2024a, *Calliope Limestone Quarry Ecological Field Report,* report prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2024b, *Calliope Limestone Quarry Expansion Significant Impact Assessment (MNES) Report,* report prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2024c, *Calliope Waste Rock Characterisation Letter*, Report prepared for Graymont (Calliope) Pty Ltd.

Epic Environmental 2023, *Photos of Calliope Limestone Quarry*, March 2023.

ESSCC 2021, *Earthquake Information for Queensland, Australia*, Earth Systems Science Computational Centre, The University of Queensland, Australia, viewed 7 March 2022, http://www.quakes.uq.edu.au/quakeinfo.html.

Graymont 2025, *Calliope Hydrogeological Assessment for Operations Progressive Rehabilitation and Closure Plan and Environmental Authority Amendment*, Report prepared by Graymont

Graymont 2024a, *Calliope PRCP Final Landform Design Report*, Report prepared by Graymont

Graymont 2024b, *EPML00969013 Calliope Annual Groundwater Report 2023/24,* Graymont.

Graymont 2023b, *Calliope Environmental Management Plan,* Report prepared by Graymont.

Graymont 2022, *Calliope/Taragoola Limestone Project – Initial Development Plan (Prescribed Mineral Mining Lease),* Graymont (Calliope) Pty Ltd GRC 2021, *Calliope*, Gladstone Regional Council, viewed 01 February 2024, https://www.gladstone.qld.gov.au/calliope/calliope-1

Graymont 2021, *EPML00969013 Calliope Annual Groundwater Report 2020/21*, Graymont (Calliope) Pty Ltd, Braeside Victoria

Graymont 2018, *Calliope Hydrogeological Investigation of Excess Water in Pit 3 2018-20,* Graymont (Calliope) Pty Ltd.

GRC 2023, *Gladstone Regional Council Roads Maintenance Guidelin*e, Gladstone Regional Council, viewed 5 July 2024, https://www.gladstone.qld.gov.au/downloads/file/5928/maintenance-guideline-replaces-part-3-of-3-

GRC 2020, *Biosecurity Plan 2021-25 for invasive plants and animals,* Gladstone Regional Council, viewed 9 July 2024, https://www.gladstone.qld.gov.au/downloads/file/2462/biosecurity-plan-2021-2025

GRC 2017, *Gladstone Regional Council Planning Scheme- Our Place Our Plan*, Gladstone Regional Council, viewed 10 April 2025, https://www.grcplanningscheme.com.au/

GRC n.d., *Road Services – Levels of Service*, Gladstone Regional Council, viewed 5 July 2024, https://www.gladstone.qld.gov.au/downloads/file/1273/road-services-part-1-of-3-levels-of-service-rating

INAP, 2019. *The GARD Guide,* Skelleftea: INAP.

National Health and Medical Research Council (NHMRC) 2011, *Australian Drinking Water Guidelines 6*, Version 3.8, Australian Government.

Kalf 2023, *Hydrogeological model assessment of sub-surface inflow due to increase in Awoonga storage level – Taragoola Mining Lease area* (for Frost Enterprises Pty Ltd David Mitchell Ltd), 19th February 2003

Meyers, T. 2023, *Personal communications with S.Hargreaves regarding geotechnical site inspection*, February 2023.

National Uniform Drillers Licensing Committee 2020, *Minimum Construction Requirements for Water Bores in Australia,* Fourth Edition, viewed 9 July 2024, https://adia.com.au/wp-content/uploads/2020/09/Minimum-Construction-Requirements-Edition-4.pdf

Perry, G, Buchanan, BW, Fisher, RN, Salmon, M & Wise, SE 2008, 'Effects of artificial night lighting on amphibians and reptiles in urban environments.' In: JC Mitchell, RE Jung Brown & B Bartholomew (eds.), *Herpetological Conservation*, Society for the Study of Amphibians and Reptiles

Pitt & Sherry 2022, *Amendment to water monitoring points memorandum,* prepared 9 September 2022 for Graymont.

Queensland Fire and Emergency Services (QFES), 2023. *Queensland 2023 State Disaster Risk Report*. Queensland Fire and Emergency Services, Brisbane. https://www.disaster.qld.gov.au/qermf/Pages/Assessment-and-plans.aspx

QFES 2017, *Queensland State Natural Hazard Risk Assessment 2017*, Queensland Fire and Emergency Services, The State of Queensland, viewed 10 April 2025, https://www.disaster.qld.gov.au/__data/assets/pdf_file/0024/339315/QLD-State-Natural-Risk-Assessment-2017.pdf

Queensland Government (QG) 2025a, *Drought Situation,* State of Queensland, viewed 10 April 2025, https://www.longpaddock.qld.gov.au/drought/sequence/

QG 2025b, *Queensland Heritage Register*, Queensland Government, viewed 9 April 2025, https://apps.des.qld.gov.au/heritage-register/

QG 2022, *Community Drought Support Program- Grant Application Guidelines,* Queensland Government, viewed 10 April 2025, https://www.chde.qld.gov.au/__data/assets/pdf_file/0012/20253/cdsp-grant-application-guidelines.pdf

QG 2012, *Planned Burn Guidelines,* viewed 10 April 2025, https://parks.des.qld.gov.au/__data/assets/pdf_file/0024/155193/pbg-brigalow-belt-1.pdf

QGlobe 2025, *Queensland Globe*, Queensland Government, viewed 10 April 2025, https://qldglobe.information.qld.gov.au/

Radle, AL 2007, *Effects of noise on wildlife: a literature review*, available from: http://wfae.proscenia.net/library/articles

RGS 2023a, *Mine Waste Characterisation Report- Calliope Limestone Mine,* Report prepared for Graymont (Calliope) Pty Ltd.

RGS 2023b, *Land Stability Assessment- Calliope Limestone Mine,* Report prepared for Graymont (Calliope) Pty Ltd.

Rich, C & Longcore, (eds.) T 2006, *Ecological consequences of artificial night lighting*, Island Press, Washington

Rocktest 2025, *Calliope Mine PRCP Pits and WRD: Geotechnical*, report prepared by Rocktest for Graymont (Calliope) Pty Ltd.

Sibelco 2012, *Land and Rehabilitation Management Plan,* Sibelco Australia Limited

Sibelco 2018a, *Environmental Management Plan,* Frost Enterprises Taragoola Limestone Project (Calliope), Sibelco Australia Limited

Sibelco 2018b, *Plan of Operations EPML00969013 July 2018 to June 2023,* Sibelco Australia Limited

SKM 2012a, *Calliope Limestone Quarry Erosion and Sediment Control Plan,* Sinclair Knight Merz Pty Ltd

SKM 2012b, *Calliope Limestone Quarry Groundwater management and monitoring plan*, Sinclair Knight Merz Pty Ltd

State of Queensland 2025a, *State Planning Policy Interactive Mapping System,* Department of Resources and Geoscience Australia, viewed 10 April 2025, https://spp.dsdip.esriaustraliaonline.com.au/geoviewer/map/planmaking

State of Queensland 2025b, *Identification of Key Resource Areas,* Business Queensland, viewed 10 April 2025, https://www.business.qld.gov.au/industries/mining-energy-water/resources/quarries/key-resource-areas/identification

State of Queensland 2019, *List of exempt clearing work,* Department of Natural Resources, Mines and Energy, viewed 26 July 2024, https://www.resources.qld.gov.au/__data/assets/pdf_file/0009/847800/vegetation-clearing-exemptions.pdf

Sunwater 2023, *Awooga Callide Scheme,* Sunwater, viewed 5 August 2025, https://www.sunwater.com.au/schemes/awoonga-callide/

Threlfall, CG, Law, B, & Banks, PB 2013, 'The urban matrix and artificial light restricts the nightly ranging behaviour of Gould's long-eared bat (Nyctophilus gouldi).' *Austral Ecology*, vol. 38, pp. 921–930

UQ 2025, *Earthquake information for Queensland, Australia*, The University of Queensland, viewed 10 April 2025, http://www.quakes.uq.edu.au/quakeinfo.html

12 ACRONYMS

Acronym	Description
%	Percent
°C	Degrees Celsius
µg/L	Micrograms per litre
µS/cm	Micro Siemens per centimetre
µg/m3	Micrograms per cubic metre
ACH Act	*Aboriginal Cultural Heritage Act 2003*
ADWG	Australian Drinking Water Guidelines
AMD	Acid Mine Drainage
Amm N	Ammonia Nitrate
ANC	Acid Neutralisation Capacity
ANZG	Australian and New Zealand Guidelines
ASRIS	Australian Soil Resource Information System
bcm	Billion cubic metres
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
Chl-a	Chlorophyll a
CO_2-e	Carbon dioxide equivalent
$C0_3$	Carbonate
cm	Centimetres
CLR	Contaminated Land Register
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Department of Agriculture and Fisheries(Formerly DAF)
dB(A)	A weighted decibel
dBL	Linear decibel
DETSI	Department of Environment, Tourism, Science and Innovation (formerly DESI)
Do	Dissolved oxygen
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development (formerly DoR)
DSDIP	Department of State Development, Infrastructure and Planning
EA	Environmental Authority
EC	Electrical conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EMR	Environmental Management Register
ENSO	El Niño Southern Oscillation
EOML	End of Mine Life
EP Act	*Environmental Protection Act 1994*
EPP (Air)	*Environmental Protection (Air) Policy 2019*
EPP (Noise)	*Environmental Protection (Noise) Policy 2019*
EP Regulation	*Environmental Protection Regulation 2019*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPR	*Environmental Protection Regulation 2019*
ERAs	Environmentally Relevant Activities
ERC	Estimated Rehabilitation Cost
ESA	Environmentally Sensitive Area
ESCP	Erosion and Sediment Control Plan
FRP	Free Radical Polymerization
FSL	Full Supply Level
ESSCC	Earth Systems Science Computational Centre
GAWB	Gladstone Area Water Board
GBR	Great Barrier Reef
GDE	Groundwater Dependent Ecosystems
GHG	Greenhouse Gas
GIS	Geographical Information Systems
GRC	Gladstone Regional Council

Acronym	Description
GRC Planning Scheme	The Gladstone Regional Council Planning Scheme
ha	Hectares
$HC0_3$	Bicarbonate
ID	Identification
ILUA	Indigenous Land Use Agreement
IR	Information Request
K	Hydraulic conductivity value
Kg/L	Kilograms per litre
kL	Kilolitre
Km	Kilometres
Km/h	Kilometres per hour
km^2	Square kilometres
KPI	Key Performance Indicator
KRA	Key Resource Area
kVA	Kilovolt-ampere
kW	Kilowatt
KWh	Kilowatt-hour
$L_{A1,adj,1hr}$	A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 1% of a 1 hour period when measured using a fast standardised response time
$L_{A10,adj,1hr}$	A-weighted sound pressure level, adjusted for tonal character or impulsiveness, that is exceeded for 10% of a 1 hour period when measured using a fast standardised response time
$L_{Aeq,adj,1hr}$	A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within a 1 hour period has the same mean square sound pressure of a sound that varies with time
L	Litres
L/s	Litres per Second
LGA	Local Government Area
LHR	Local Heritage Register
LOM	Life of Mine
m	Metres
MD	Moderately Disturbed
m/d	Metres per Day
M^3	Cubic Metres
M^3/d	Cubic Metres per Day
mAHD	Australian Height Datum
mBGL	Below Ground Level
MCA	Minerals Council Australia
MERFP Act	*Mining and Energy Resources (Financial Provisioning) Act 2018*
mg/L	Milligrams per litre
MJ/ m^2	Megajoules per square metre
ML	Mining Leases
MLES	Matters of Local Environmental Significance
mm	Millimetres
mm/s	Milimetres per second
MNES	Matters of National Environmental Significance
MP	Member of parliament
MPa	Megapascals
MQSH Act	*Mining and Quarrying Safety and Health Act 1999*
MR Act	*Mineral Resources Act 1989*
MSES	Matters of State Environmental Significance
Mtpa	Million tonnes per annum
Mya	Million years ago
NAG	Net acid generation
NAPP	Net acid producing potential
NC Act	*Nature Conservation Act 1992*
NGER	National Greenhouse Gas and Energy Reporting

Acronym	Description
NHMRC	National Health and Medical Research Council
NLAA	National Lime Association Australia
NT Act	*Native Title Act 1993*
NT Qld Act	*Native Title (Queensland) Act 1993*
NTU	Nephelometric Turbidity Unit
NUMA	Non-use management areas
NWQMS	National Water Quality Management Strategy
OEMP	Operation Environmental Management Plan
Oxid N	Oxidation number
P	Phosphorus
PCB	Polychlorinated biphenyls
pH	pH Unit
PIE	Public interest evaluation
PLA	Priority Living Areas
PM	Parts per million
PMF	Probable Maximum Flood
PMLU	Post mine land use
PMR	Protected Matters Report
PRC Plan	Progressive Rehabilitation and Closure Plan
PRCP Schedule	Progressive Rehabilitation and Closure Plan Schedule
QA/QC	Quality Control and Quality Assurance
QFES	Queensland Fire and Emergency Services
QG	Queensland Government
QGlobe	Queensland Globe
QRC	Queensland Resource Council
RA	Rehabilitation Areas
RAP	Remediation Action Plan
RE	Regional Ecosystem
RL	Relative Level
RNTBC	Registered Native Title Bodies Corporate
ROM	Run of Mine
RPI Act	*Regional Planning Interests Act 2014*
RPP	Rehabilitation Planning Part
RUSLE	Revised Universal Soil Loss Equation
SAQP	Soil Analysis and Quality Plans
SDAP	State Development Assessment Provisions
SPP	State Planning Policy
Spp	Species
SRI	Significant residual impact
SS	Suspended Solids
SSEA	Site-specific Environmental Authority
SWIA	Surface water impact assessment
t	Tonnes
t/m^3	Tonnes per Cubic Metres
TEC	Threatened ecological community
TI Act	*Transport Infrastructure Act*
TSF	Tailings Storage Facility
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UQ	University of Queensland
VM Act	*Vegetation Management Act 1999*
WoNS	Weed of National Significance
WQO	Water Quality Objectives
WRD	Waste Rock Dump

13 LIMITATIONS AND DISCLAIMER

Epic Environmental Pty Ltd (Epic) has prepared the following report for the exclusive benefit of Graymont (Calliope) Pty Ltd (Client) and for the singular purpose of [Purpose] at Taragoola. All interpretations, finding or recommendations outlined in this report should be read and relied upon only in the context of the report as a whole.

The following report cannot be relied upon for any other purpose, at any other location or for the benefit of any other person, without the prior written consent of Epic. Except with Epic's prior written consent, this report may not be:

a. released to any other person, whether in whole or in part
b. used or relied upon by any other party
c. filed with any Governmental agency or other person or quoted or referred to in any public document

This report has been prepared based on information provided by the Client and other parties. In preparing this report Epic:

a. presumed the accuracy of the information provided by the Client (including its representatives)
d. has not undertaken any verification to the accuracy or reliability included in this information (with the exception where such verification formed part of the scope of works)
e. has not undertaken any independent investigations or enquiries outside the scope of works with respect to information provided for this report
f. provides no warranty or guarantee, expressed or implied, as to the accuracy or reliability of the information provided in this report

In recognition of the limited use of this report, the Client agrees that, to the maximum extent permitted by law, Epic (including its representatives and related entities) is not liable for any losses, claims, costs, expenses, damages (whether pursuant to statute, in contract or tort, for negligence or otherwise) suffered or incurred by the Client or any third party as a result of the information, findings, opinions, estimates, recommendations and conclusions provided in this report.

Without limiting the above, Epic (including its representatives and related entities) is not liable, in any way whatsoever:

a. for the use or reliance of this report for any purpose other than that for which it has been prepared
g. for any use or reliance upon this report by any person other than the Client
h. where another person has a different interpretation of the same information contained in the report
i. for any consequential or indirect losses, or for loss of profit or goodwill or any loss or corruption of any data, database or software

If a section of this disclaimer is determined by any court or other competent authority to be unlawful and/or unenforceable, the other sections of this disclaimer continue in effect. Where further information becomes available, or additional assumptions need to be made, Epic reserves its right to amend this report, but is not

APPENDIX A ENVIRONMENTAL MANAGEMENT PLAN



CALLIOPE ENVIRONMENTAL MANAGEMENT PLAN

Rev	Date	Prepared By	Comments
1	21/02/11	W. Speirs (SKM)	First draft
2	10/03/11	W. Speirs (SKM)	Second draft
3	22/08/11	N. Ryan (Sibelco)	Third draft
4	15/08/12	N. Ryan (Sibelco)	Updated for new EA
5	29/10/14	E. Leech (Sibelco)	Review
6	08/10/15	E. Leech (Sibelco)	Review
7	13/06/18	C.Bax/C.Mann (Sibelco)	Review
8	18/11/22	A. Butler (pitt&sherry)	Review
9	03/11/23	A. Bishop (pitt&sherry)	Review

TABLE OF CONTENTS

1. Introduction 4
1.1. Purpose 4
1.2. Authority / Legislative Details 5
1.3. Related Documents 6
1.4. Relevant Stakeholders 6
2. Site Description 7
1.5. Location 7
1.6. Climate 11
1.7. Topography, Geology, and Soils 11
1.8. Hydrology and Water Storage 12
1.9. Flora and Fauna 12
3. Description of Operations 13
1.10. Operation Overview 13
1.11. Extraction 13
1.12. Material Handling 13
1.13. Transport 13
1.14. Management Roles and Responsibilities 13
4. Environmental Risks and Controls 14
1.15. Risk and Consequence Ratings 15
5. Air Quality 16
1.16. Objectives 16
1.17. Environmental Values 16
1.18. Potential Impacts 16
1.19. Air Emissions Inventory 17
1.20. Control Measures 17
1.21. Monitoring 18
1.22. Reporting 18
6. Noise and Vibration Management 20
1.23. Objectives 20
1.24. Environmental Values 20
1.25. Potential Impacts 20
1.26. Noise and Vibration Inventory 20
1.27. Control Measures 21
1.28. Monitoring 21
1.29. Reporting 21
7. Water Management 22
1.30. Objectives 22
1.31. Environmental Values 22
1.32. Potential Impacts 22
1.33. Water Inventory 23

1.34. Control Measures 23
1.35. Monitoring 24
1.36. Reporting 25
8. Waste Management 25
1.37. Objectives 25
1.38. Environmental Values 25
1.39. Waste Inventory 25
1.40. Control Measures 26
1.41. Monitoring 26
9. Land Use Management 27
1.42. Objectives 27
1.43. Potential Impacts 27
1.44. Rehabilitation 28
1.45. Weed and Pest Management 28
1.46. Erosion and Sediment Control 28
1.47. Land Inventory 29
10. Monitoring and Maintenance 30
1.48. Maintenance 31
11. Reporting 32
1.49. Environmental Incident 33
1.50. Emergency Contacts 33
12. Environmental Training 33
13. Community Engagement 34
1.51. Control Measures 34
1.52. Community Complaints 34
14. Audit and Review 35
1.53. Environmental Auditing 35
1.54. Environmental Management Plan Review 35
15. Associated (referenced) Documents 35

1. Introduction

Graymont (Calliope) Pty Ltd owns and operates the limestone quarry and associated processing plant, herein referred to as the Graymont Calliope Plant (GCP).

The GCP is located approximately 30km south of Gladstone, and 10km southeast of the township of Calliope in Central Queensland. It operates under two Environmental Authorities held by Graymont (Calliope) Pty Ltd:

- EPPR00881913
- EPML00969013

1.0. Purpose

This Environmental Management Plan (EMP) provides a governance framework for environmental management and is supported by several sub-plans and related documents where relevant.

Environmental Authority number: EPPR00881913, condition A8 specifies:

Environmental Management Plan An environmental management plan (EMP) must be implemented. The EMP must address the following matters: a) Describe the project and surrounding environment b) Identify relevant environmental values likely to be affected by the activities c) State the potential adverse and beneficial impacts on environmental values d) Provide details on how the proposal will protect and enhance the environmental values.

The environmental management strategies provided in the EMP have been developed to meet the requirements and obligations of EPPR00881913 and EPML00969013.

This EMP aims to:

- Ensure that the operation meets contractual, legal, and other environmental requirements including industry codes of practice.
- Comply with the requirements of EPPR00881913 by providing auditable commitments to practical and achievable strategies for the management of the GCP.
- Serve as an integrated plan for comprehensive monitoring and management of environmental risk through a set of environmental sub-plans that are issue specific.
- Provide all Graymont (Calliope) personnel with systems, procedure, and documentation necessary to undertake the activities of the operation in a sustainable manner, while meeting legislative and production requirements, and minimising potential impacts on the local and broader environment and community.

Figure 1 outlines the relationship between the operation specific environmental requirements, the EMP and associated plans, and support documentation for the operation.

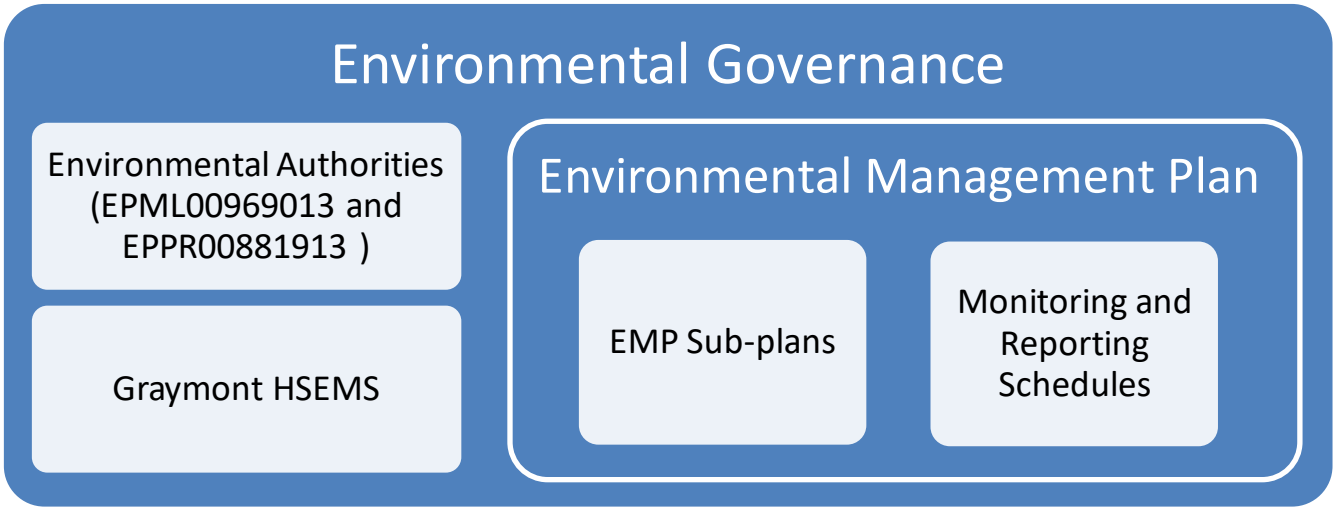


Figure 1 Environmental Governance

1.1. Authority / Legislative Details

Graymont is required to ensure that all mining operations are conducted in accordance with all legislative requirements, including the *Mineral Resources Act 1989*, the *Environmental Protection Act 1994* (EP Act), and associated environmental Authorities EPML00969013 and EPPR00881913.

Environmentally Relevant Activities (ERAs) are activities that will or have the potential to release contaminants into the environment that may cause environmental harm. It is a requirement of EP Act and the *Environmental Protection Regulation 2019* (EP Regulation) that anyone who conducts an ERA must possess an environmental authority.

The operation is approved as a resource activity under Chapter 5, Section 195 of the EP Act. Under Section 608 of the EP Act, an Environmental Management Plan may be required for an environmental authority (mining lease).

Two Environmental Authorities are effective for this site:

- EA EPML00969013 for all mining leases, and
- EA EPPR00881913 (original permit # SPCE04023712 issued under the Sustainable Planning Act 2009) which covers all of the land held by Graymont including Mining leases and Freehold land.

EPML00969013 permits the operation to carry out activities defined in Schedule 3, Item 21, of the EP Regulation, namely “A mining activity that is an ineligible ERA, other than a mining activity mentioned in items 9-20”. This activity is permitted to be carried out across all active mining leases for the operation, which are detailed below in Table 1. These leases are depicted in red in Figure 2.

Table 1: Mining Leases

Mining Leases
ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192.

Environmental Authority EPPR00881913 was originally issued as permit number SPCE04023712 under *The Planning Act 2016* (previously the *Sustainable Planning Act 2009* at time of issue).
The operation has approval under Environmental Authority EPPR00881913 for the following ERAs:

- ERA 50(2) – Bulk material handling >100t day
- ERA 16(2) – Extracting in a year >1,000,000t of material
- ERA 16(3) – Screening in a year >1,000,000t of material

The Queensland Government changed the provisions of the EP Act and the EP Regulation on 31st of March 2013. Therefore, a number of ERAs that were previously regulated have been removed and will no longer require registration certificates to operate and will be exempt from licensing requirements (Gladstone Regional Council website lists deleted ERAs). This includes the following ERA which is listed in previous versions of this document:

- ERA 8 (3a) - Chemical storage >10m3 but <500m3 class C1 or C2 combustible liquids.

The EA EPPR00881913 approval covers the associated lots detailed below in Table 2.Table 2: ERA conditions corresponding to Lot numbers.

Environmentally relevant activity/activities	Location(s)
Prescribed ERA, ERA 50(2) - Bulk Material Handling: Loading or unloading 100t or more of bulk materials in a day or stockpiling bulk materials	Lot 22/SP215268, Lot 7/SP215269, Lot 1/RP610708, Lot 2/RP610127, Lot 26/SP228426, Lot 1/RP610127, Lot 2/RP610128, Lot 20/SP162111, Lot 2/RP209261, Lot 4/RP610128, Lot 44/CPCTN115, Lot 14/CPCTN64, Lot 100/CTN1823, Lot 30/SP152526, Lot 3/RP610127, Lot 1/RP610128, Lot 39/CPCTN79, Lot 2/RP610708, Lot 96/CPCTN408, Lot 5/RP610127, Lot 5/RP610929, Lot 4/SP183055, Lot 3/RP610128, Lot 39/CTN79, Lot 44/CTN115, Lot 96/CTN408, Lot 2/RP609261, Lot 14/CTN64
Prescribed ERA, ERA 16(2) - Extraction and Screening: Extracting, other than by dredging, in a year, the following quantity of material, more than 1,000,000t	Lot 30/SP152526, Lot 3/RP610127, Lot 1/RP610128, Lot 4/SP183055, Lot 5/RP610929, Lot 5/RP610127, Lot 96/CPCTN408, Lot 2/RP610708, Lot 39/CPCTN79, Lot 2/RP209261, Lot 4/RP610128, Lot 44/CPCTN115, Lot 14/CPCTN64, Lot 100/CTN1823, Lot 20/SP162111, Lot 3/RP610128, Lot 2/RP610128, Lot 39/CTN79, Lot 44/CTN115, Lot 96/CTN408, Lot 2/RP609261, Lot 14/CTN64, Lot 2/RP610127, Lot 7/SP215269, Lot 22/SP215268, Lot 26/SP228426
Prescribed ERA, ERA 16(3) - Extraction and Screening: Screening, in a year, the following quantity of material, more than 1,000,000t	Lot 2/RP209261, Lot 4/RP610128, Lot 44/CPCTN115, Lot 14/CPCTN64, Lot 100/CTN1823, Lot 20/SP162111

1.2. Related Documents

- Water Management Plan
- Progressive Rehabilitation and Closure Plan
- Ground Control Management Plan
- Waste Management Plan
- Erosion and Sediment Control Management Plan
- Pest and Weed Management Plan
- Community and Stakeholder Engagement Plan

1.3. Relevant Stakeholders

Relevant stakeholders are kept informed of activities at the operation as per the Community and Stakeholder Engagement Plan. These stakeholders are listed below:

- Gladstone Area Water Board (GAWB);
- Queensland Department of Resources;
- Queensland Department of Environment and Science (DES);
- Resources Safety & Health Queensland (RSHQ);
- Gladstone Regional Council;
- Nearby residences; and
- The local community.

2. Site Description

2.3. Location

The GCP is located in Central Queensland, approximately 30km south of Gladstone, and 10km southeast of the township of Calliope as shown in Figure 2. The GCP is situated to the west of Lake Awoonga and allotments held by the Gladstone Area Water Board (GAWB) within the Gladstone Regional Council Local Government Area (LGA). The surrounding area is predominantly forested with some grazing activities. The lots covered by the operation are outlined in Table 3, with active mining leases outlined in Table 4. Lots and mining leases associated with the operation are illustrated in Figure 3. All mining leases are held by Graymont (Calliope) Pty Ltd.

Table 3: Lots and mining leases covered by the GCP

Deposited Plan Number	Tenure Type
Lot 1 RP 610127	Freehold
Lot 1 RP 610128	Freehold
Lot 1 RP 610708	Freehold
Lot 100 CP CTN 1823	Freehold
Lot 14 CP CTN 64	Freehold
Lot 2 RP 609261	Freehold
Lot 2 RP 610127	Freehold
Lot 2 RP 610128	Freehold
Lot 2 RP 610708	Freehold
Lot 20 SP 162111	Freehold
Lot 22 SP 215268	Freehold
Lot 26 SP 228426	Freehold
Lot 3 RP 610128	Freehold
Lot 30 SP 152526	Freehold
Lot 39 CP CTN 79	Freehold
Lot 4 RP 610128	Freehold
Lot 4 SP 183055	Freehold
Lot 44 CP CTN 115	Freehold
Lot 5 RP 610127 (Previously Lot 5 SP 610127)	Freehold
Lot 5 RP 610929	Freehold
Lot 7 SP 215269	Freehold
Lot 96 CP CTN 408	Freehold

Table 4: Active mining lease area and currency for the operation

Mining Lease	ML Area (ha)	ML Expiry Date
ML 3594	32.37	28/02/2041
ML 3595	13.49	28/02/2041
ML 3596	9.10	28/02/2041
ML 3597	2.83	31/12/2041
ML 3598	12.448	31/12/2041
ML 3599	6.798	31/12/2041
ML 3600	8.093	28/02/2041
ML 3602	10.23	31/03/2027
ML 3603	8.34	31/03/2027
ML 3604	4.85	29/02/2028
ML 3605	9.45	31/07/2028
ML 3606	5.61	31/07/2028
ML 3608	57.14	31/10/2030
ML 3609	42.99	31/10/2030
ML 80036	18.73	30/06/2022
ML 80189	36.05	31/05/2043
ML 80190	22.5	31/05/2043

Mining Lease	ML Area (ha)	ML Expiry Date
ML 80191	1.6	31/05/2043
ML 80192	121.5	31/05/2043



Figure 2: Site Location



Figure 3: Lots and mining lease layout



Figure 4: Quarry Layout

2.4. Climate

The operation area is classified as being in a subtropical climate zone characterised by a hot, humid summer and low winter rainfall. Median annual rainfall is in the range 650mm to 1,200mm. The area does not tend to experience regular northwest monsoonal activity, nor does it experience higher latitude cold fronts.

The nearest Bureau of Meteorology station is located in Gladstone. Average annual rainfall experienced for Gladstone is around 850mm. There are two distinct seasons - wet and dry. The wet season is predominant from December to March and the dry season from June to September. The average summer temperatures for Gladstone average around 22 to 31˚C, whilst winter temperatures vary from around 7 to 24˚C (Bureau of Meteorology 2022).

It is possible for extreme climatic events, influenced by season or time of year, to occur in the area. These include severe thunderstorms and tropical cyclones. Although the considerable majority of cyclone impacts are located in north Queensland, occasionally a cyclone affects areas further south down the east coast including heavy rain, hail, and lightning.

The local government area relevant to the site is Gladstone Regional Council. The following document discusses possible extreme climatic events that may occur in the area:

Gladstone - local-disaster-management-plan (gladstone.qld.gov.au)

The operation is offered some protection from inundation due to floods by two barriers constructed at the site. A 1900m long earth and rock wall has been constructed adjacent to Raggote Creek, with a smaller wall to the east of the site, the crests of these walls are approximately 52m AHD. The walls are protected by a clay liner and outer rock layer to an elevation of 47m (the estimated 1 in 100-year flood level). These works were completed as part of a cooperative agreement between the operation's previous owners and the GAWB.

2.5. Topography, Geology, and Soils

The topography of the land is slightly undulating land that rises approximately 30m above the surface water level of Lake Awoonga Dam.

The site covers approximately 700ha, with approximately 685ha owned by Graymont Pty Ltd. The remainder is owned by the Gladstone Area Water Board (GAWB), who also own contiguous landholdings outside the operations area. With the exception of mining and quarrying activities, the land is put to no active use or is used for rural grazing activities.

The Taragoola limestone deposit comprises a large orebody of steeply dipping, north-south, striking limestone. The limestone is fine grained to crystalline, light grey with cream inclusions, very-high strength, fresh to slightly weathered, moderately jointed to massive. Discontinuities are sharp and generally clean.

Dissolution of the upper surface has created some minor karst features; predominantly a slightly irregular surface, dilated joint apertures, small caverns, and shafts. These features are most obvious to a depth of ≈20m below surface. These features are likely to have negligible detrimental influences on the performances of the walls.

The limestone is overlain by red-brown clayey sand. The cover ranges in thickness from 0.5m to 5m. Where thickest, it contains boulders of limestone up to 1m diameter. Stripping of the upper bench involves stockpiling clean soil east of the pit for future use in rehabilitation and sending bouldery soil to the waste rock dump.

Basaltic to andesitic mafic volcanics have intruded around the site. The most obviously regions are centred north of the pit at 321000E 7333000N and south of the pit at 321500E 7333000N. There have not been many significant intrusions into the section of the ore body being mined; most notable is those on the north and south walls.

2.6. Hydrology and Water Storage

The GCP is bound by Lake Awoonga to the east, south and west. Lake Awoonga forms the drinking water supply dam from the surrounding catchment area for the GAWB. To the west of the site is a significant bund wall adjacent to Pit 3 and Pit 4. The water body adjacent to the bund wall is known as Raggote Creek, which is a tributary that flows into Lake Awoonga.

The eastern side of Pit 4 has another bund wall to prevent inundation of the quarry site.

Groundwater at the site is hosted by limestone as a variably connected, in places karstic aquifer.
The operation site has three main water storage areas:

- Pit 1 – a non-operational mining pit final void that is backfilled;
- Pit 2 - a water storage used for the supply of water to the wash plant, Crushing Circuit and Production; and
- Pit 3 - a final void pit used for water storage and stormwater capacity during periods of high rainfall.

Water storage and sediment dams are described in more detail in the Water Management Plan in Appendix B.

2.7. Flora and Fauna

Prior to mining activities, the site area was used for low to moderate intensity grazing of native improved pasture. The original mixed Eucalypt woodland which occurred in the area has been significantly altered by clearing, grazing and quarry activities. Other regional changes have been brought about by agriculture and the extensive land inundation caused by Lake Awoonga.

The active mining leases and allotments associated with the operation are subject to the following categorised vegetation communities; category B remnant vegetation (least concern and of concern), category C regulated regrowth vegetation (least concern and endangered), category R reef regrowth watercourse vegetation, and category X non remnant vegetation.

The vegetation communities, as categorised under the *Vegetation Management Act 1999*, present within the site are:

- 11.11.15 least concern, sparse Eucalyptus crebra woodland to open woodland on deformed and metamorphosed sediments and interbedded volcanics.
- 11.11.4 Least concern, Eucalyptus crebra woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges
- 11.3.4 of concern, sparse Eucalyptus tereticornis and/or Eucalyptus spp. woodland on alluvial plains.
- 11.3.25 least concern, sparse Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines.

3. Description of Operations

3.1. Operation Overview

The GCP conducts limestone mining and extraction to produce a range of agricultural and industrial limestone products for sale. Waste rock is also removed and either stockpiled on site or crushed for use as aggregate in a variety of applications such as road base construction.

Mining activities include topsoil stripping and removal of clay rich overburden and waste rock followed by extraction of limestone ore of appropriate grade and chemical properties suitable for quicklime, hydrate production and other end uses. Suitable limestone ore is then crushed, screened, and washed on site before being transported to customers off site for further downstream processing. Extractive activities are also conducted on site where limestone of different grades and suitable physical properties follow a similar process to mining for the production of road base and aggregates etc.

3.2. Extraction

Open cut mining and quarrying are similar operations employing straight forward open cut mining/quarrying methods utilising a dedicated truck and excavator fleet. Vegetation, comprising mostly pasture grass, is removed together with an upper soil layer, and stockpiled or used as a final surface layer on spoil embankments to facilitate revegetation. Underlying the surface soil/ clay layer is a clayey limestone strata. This layer is excavated by earthmoving equipment, usually following drill and blast. This material is either spoiled or, if appropriate, stockpiled for later separation of clay and limestone by a heavy-duty rock screener.

Underlying the clayey limestone layer is dominantly homogeneous limestone which is drilled, blasted, and loaded out by an excavator serviced by a number of ridged dump trucks. A second excavator is on site as a backup for the open cut operations. Drilling and blasting is conducted at a rate of approximately one blast per month.

3.3. Material Handling

Material is hauled either to the Run-Of-Mine (ROM) pad for crushing, or to the stockpiles for screening or to the designated spoil dumps. Both a wet and dry plant are utilised.

The ‘dry’ plant sees material first screened by mobile rock screeners to separate oversized material and soils and scalping from the product. The material is then sent through the various crushers and stockpiled according to size.

A portion of the crushed material is then passed through the wash plant. This material is washed with reclaimed water from Pit 2 and screened into various sizes. The washed, sized material is then stockpiled before being exported by truck to customers. Water discharged from this process is collected in a settling pond system before being recirculated back to Pit 2 dam.

3.4. Transport

Approximately 1 million tonnes per annum of limestone products are currently transported from site by road. Limestone products are loaded by wheeled loader into B-double road trucks. The trucks travel north on graded and paved roads to the town of Calliope where they connect to the Dawson Highway.

The operation previously transported material via rail, however this activity is not currently occurring.

3.5. Management Roles and Responsibilities

The following people are the key Graymont personnel responsible for the implementation and review of this Management Plan. An organisational chart for the site can be found in Appendix H.

Table 5: Environmental management responsibilities

Personnel	Summary of Responsibility
Regional HSE Manager	• Facilitate and provide technical support for the development of this plan • Provide ongoing technical support for control and monitoring measures described in this plan. • Participate in the annual review of this plan
Director Operations Northern	• Ensure performance targets specified in this plan are being met
Plant Manager	• Ensure the implementation of all control, monitoring and reporting measures as specified in this plan • Ensure compliance with site specific requirements • Participate in the annual review of this plan
HSEQ Specialist	• Put onsite systems in place to implement all control, monitoring, and reporting requirements in this plan • Participate in the annual review of this plan

4. Environmental Risks and Controls

The Calliope Environmental Risk Register categorises risks and hazards and provides mitigation measures alongside original and residual risk ratings.

A summary of risks identified is presented in Table 6 below:

Table 6: Summary of risks identified

Activity	Summary of Risk
Air Quality	• Extractive activities • Vehicle movements
Water Management	• Discharge events from site • Inappropriate sampling methodology resulting in cross contamination • Cleaning chemicals • General water uses on site
Waste Management	• Inappropriate sampling methodology resulting in cross contamination • Recycling and landfill • Batteries and IT equipment
Noise and Vibrations	• Extractive activities • Vehicle movements
Energy use	• Office and operational power needs • Diesel consumption; vehicle use • Lighting causing community or environmental disruption
Chemical and Hazardous Materials	• Storage, handling and transport of hazardous goods • Pest control risks • Hydrocarbon spills
Vegetation removal	• For projects and site development
Climate Change	• Consideration for existing impacts and future impacts of upcoming projects and expansion • Travel
Cultural heritage	• As it relates to community and reputation risk as cultural heritage is generally intertwined with Environmental concerns under new projects

3.6. Risk and Consequence Ratings

Risk Assessment Matrix

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)

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

Level	Descriptor	Definition
		• 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

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

5. Air Quality

3.7. Objectives

- To eliminate or minimise pollutant air emissions from GCP and their potential impacts on the environment, community, and ambient air quality; and
- To ensure compliance with the regulatory requirements for the air emissions relevant to this site.

3.8. Environmental Values

The mining and quarrying operations are situated in a rural setting where sources of air pollution include unsealed roads, general agricultural activities, and soot and fallout from bush fires and land clearing.
The principal environmental values for air quality are the social amenity and wellbeing of people.

3.9. Potential Impacts

Potential sources of air pollution include the generation and propagation of dust particles from mining and extraction activities and the emissions from the diesel engines of mobile equipment. Fumes may also be associated with the detonation of explosives.

Activities conducted within the Site area are well separated from sensitive places and the potential impact on air quality due to mining and quarrying activities is negligible. The nearest residential dwelling external to land owned or controlled by Graymont (Calliope) is a minimum of three kilometres distance in a northerly direction from mining and extraction activity areas.

The principal source of air pollution is the emission of dust due to the following activities:

- Land clearing
- Topsoil and overburden stripping and stockpiling
- Shot rock loading
- Raw material hauling and tipping
- Crushing and Screening
- Conveying
- Stockpiling
- Rail loading (when being utilised)
- Wind acting on stockpiles and exposed areas

3.10. Air Emissions Inventory

Table 7 details the activities on site that are likely to cause air emissions and/or impact air quality.

Table 7: Air emission inventory

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Blasting	On site	Generation of dust impacting local residences and surrounding land uses. Dust deposition affecting water quality	Complaints from local residences and surrounding landowners. Negative impacts on water quality. Graymont required to conduct complaint-based monitoring.	Unlikely	Moderate	6 Moderate
Movement and handling	On site			Unlikely	Moderate	6 Moderate
Crushing and screening	On site			Unlikely	Moderate	6 Moderate
Transportation of product	On site, Taragoola Road, near rail loading facility	Windblown dust generation impacting local residences and surrounding land uses. Dust deposition affecting water quality		Unlikely	Moderate	6 Moderate
Stockpiling	On site			Unlikely	Moderate	6 Moderate

3.11. Control Measures

Table 8: Air emission control measure

Controls	Timing/ Frequency	Evidence of Implementation
Management of Air-Borne Dust on site	Ongoing	Review and audit of airborne dust emissions on site.
Vehicle operations on site follow Traffic Management Plan (speed, routes)	Ongoing	Review and audit of airborne dust emissions on site.
Deploy water carts to all unsealed roads to reduce the generation of dust from these areas	When required during dry days	Vehicle log detailing number of tank refills
Dust suppression devices installed on operating plant/crushers	When in use	Equipment equipped with dust suppression systems / sprays. Site supervisor daily inspection.
All trucks containing product must not leave the site without trailer covers	Ongoing	Weighbridge operator to report all instances of loads not securely covers to site supervisor.
Stockpiles to be located as far as practicable from residential areas	Ongoing	Site supervisor has predetermined and defined stockpile areas with updated weekly mud maps of locations
Activities which have the potential to cause significant dust emissions should be modified or cease operation under adverse (high wind) weather conditions where sensitive receptors may be impacted.	When required	Weather forecast maps are printed by the Administration staff weekly and communicated through the DOR. They are distributed to front office and DOR room for review. Should weather conditions change significantly, the forecast is consulted more regularly.
Continuous visual surveillance of dust emissions to ensure effectiveness of control measures	Ongoing	Report any issue of excessive dust emissions into JD Edwards incident and event reporting program
Mobile plant will be maintained to manufacturer's specifications to comply with dust and pollution emission control	Ongoing	Inspections to be recorded on vehicle pre-start inspection sheet

A continuous improvement program is actively undertaken on site to ensure that best work practices are implemented to avoid/or minimise generation of dust.	Ongoing	Regular internal audits of work practices, processes, and environmental objectives. Any corrective actions addressed in the audit are to be entered into JD Edwards.
Installation of screens and windbreaks around areas of potential dust emissions	When required	Job start checks and JRAs are undertaken before commencing work to identify the need for screens or wind breaks to avoid excessive dust in work area.

3.12. Monitoring

This section outlines the various modes of monitoring in order to quantitatively track and observe air emissions emanating from site. All monitoring requirements are detailed in Table 9 below. The EHS Inspection, Testing, and Monitoring Procedure should be used to provide further guidance in site monitoring requirements.

All monitoring and sampling is to be conducted by a competent person in accordance with the latest version of the administering authority's Air Quality Sampling Manual.

Table 9: Air emission monitoring measures

Description of monitoring	Timing/ Frequency	Parameters	Monitoring method
Ambient air quality monitoring for TSP at monitoring sites N, SE, SW, and S.	Monthly	TSP (g/m2/month)	Dust deposition gauges using AS/NZS 3580
Visual inspection of dust suppression devices on equipment as part of prestart checklist	During activities	Device is correctly fitted	Inspections noted in vehicle prestart check logbook. Any defects are tagged out and/or reported to supervisor.
Visual inspection of dust emissions from the primary crushing and screening plant	Daily	Visible dust	Any defects are tagged out and/or reported to supervisor.
Visual inspection of dust emissions from drilling and blasting activities	During activities	Visible dust	Non-compliance with dust emissions will be entered into the incident and corrective action reporting: JD Edwards
Visual inspection of dust control measures to ensure correct operation	During activities	Visible dust	Non-compliance with dust emissions will be entered into the incident and corrective action reporting, JD Edwards
Site compliance audit of operations by third party co-ordinated by Graymont HSE team.	3 yearly	Audit checklist	Environmental audit procedure. Audit forms to be filed and any actions arising from audit will be entered into JD Edwards

3.13. Reporting

Table 10 below details the reporting requirements for air emissions and air quality under this Plan.

Table 10: Air Emission Reporting Requirements

Description of reporting	Frequency of reporting	Reporting tool	Reporting to:
Dust deposition gauge results	Monthly	Monitoring data form	Graymont Calliope Environmental Monitoring Spreadsheet
Air emission complaints	As they occur	JD Edwards	Regional HSE team
Air emission related environmental incidents	As they occur	JD Edwards	Regional HSE team
Complaint Based Dust Monitoring Report	Within 14 days of complaint	Written advice	Administering Authority

Complaint Based Odour Monitoring Report	Within 14 days of complaint	Written advice	Administering Authority

6. Noise and Vibration Management

3.14. Objectives

- To eliminate or minimise material and non-trivial noise and vibration from the GCP and their potential impacts on the environment and the community; and
- To ensure compliance with the regulatory requirements for environmental noise and vibration for this site.

3.15. Environmental Values

The mining and quarrying operations are located in a rural setting and hence the acoustic environment is dominated by noise from local vehicle movements, operation of farm equipment, rustling of leaves, insects, birds, and animals.
The principal environmental values for noise and vibration are the wellbeing of the community within the region.

3.16. Potential Impacts

Noise and vibration impacts are related to the level of sound from the sound source and degree of attenuation from the source to receiver. Mining/quarrying activities conducted in the GCP area are well separated from sensitive places and the potential impacts due to noise and vibration are negligible. The nearest residential dwelling external to land owned or controlled by Graymont is a minimum of three kilometres North from mining and extraction activity areas.

Activities at the quarry which may generate noise include:

- Vegetation clearing
- Topsoil and overburden removal
- Drilling and blasting
- Rock breaking
- Loading, unloading and haulage of raw materials
- Pumping
- Crushing
- Conveying
- Material transfer
- Stockpiling
- Product reclaiming
- Rail loading (when being utilised)
- Maintenance works
- Heavy vehicle movements within the operation area and on haul roads.

Engine noise from the operation of mining equipment, rocks falling into metal truck bodies and bins, percussion hammering of the rock drill , crushing and screening activities are the principal noise sources. Table 12 presents those controls that assist on site in mitigating risk associated with noise impacts on personnel, community, and the environment.

3.17. Noise and Vibration Inventory

Table 11 below details the reporting requirements for noise and vibration inventory under this Plan.

Table 11: Noise and vibration inventory

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Onsite vehicle movement	On site	Noise disturbances to local residences	Complaints from local residences and surrounding	Unlikely	Moderate	6 Moderate

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Crushers and Screeners	On site		landowners. Graymont required to conduct complaint-based monitoring.	Unlikely	Moderate	6 Moderate
Road truck movements	On site and Taragoola Road			Possible	Moderate	9 Moderate
Blasting	On site	Noise and/or vibration disturbances to local residences		Unlikely	Moderate	6 Moderate

3.18. Control Measures

Table 12: Noise control measures

Controls
Fit and maintain effective exhaust mufflers to plant and equipment
Maintain all plant and equipment in good working order
Mobile plant to be regularly serviced to manufacturers standards
Implement complaints handling protocols which includes recording, investigating, and settling complaints
Ensure contractor trucks do not exceed noise limits and are maintained in good order.
Ensure that blasting is only undertaken during the hours listed in the EA conditions.
Ensure that hours of operation are consistent with EA conditions and local council bylaws
Ensure that mobile plant and machinery are operated in a manner to reduce excessive noise emissions

3.19. Monitoring

This section outlines the various modes of monitoring in order to quantitatively track and observe noise and vibration emanating from site. Noise monitoring at the operation is complaint driven, with no regular monitoring taking place.
All monitoring and sampling is to be conducted by a competent person.

Table 13: Air emission monitoring measures

Description of monitoring	Timing/ Frequency	Parameters	Monitoring method
Noise and vibration monitoring will be undertaken in response to noise related complaints	Within 14 days of complaint	EA Conditions	Latest edition of the administering authority's *Noise Measurement Manual*
Vibration and over-blast pressure monitoring is conducted during blasting	During blasting	EA Conditions	As per Environmental Authority requirements
Site compliance audit of operations by third party co-ordinated by Graymont HSE team.	3 yearly	Audit checklist	Environmental audit procedure. Audit forms to be filed and any actions arising from audit will be entered into JD Edwards

3.20. Reporting

Table 14 below details the reporting requirements for air emissions and air quality under this Plan.

Table 14: Air emission reporting requirements

Description of reporting	Frequency of reporting	Reporting tool	Reporting to:
Noise and vibration complaints	As they occur	JD Edwards	Regional HSE team
Noise and vibration related environmental incidents	As they occur	JD Edwards	Regional HSE team
Complaint Based Noise Monitoring Report	Within 14 days of complaint	Written notification	Administering Authority
Complaint Based Vibration Monitoring Report	Within 14 days of complaint	Written notification	Administering Authority

7. Water Management

A detailed Water Management Plan that describes catchment areas, stormwater flow, clean and dirty stormwater separation, groundwater monitoring, sediment dams, sediment control devices, and receiving waters is attached in Appendix B.

3.21. Objectives

- To ensure access to secure and sufficient water resources to service operations;
- To ensure the efficient and sustainable use of water recognising that water is a valuable resource;
- To provide protection of water resources and ecosystems by eliminating or minimising the impacts of water discharges from operations on the surrounding environment and meet community expectations regarding water quality. This can be done by:
    - Identifying, separating, and controlling clean, dirty, and contaminated water areas onsite;
    - Promoting the maintenance and/or improvement of water quality upstream and downstream of the site; and
    - Ensuring the appropriate treatment of discharge waters.

3.22. Environmental Values

Mining and extractive activities of the GCP are conducted within the catchment area for Lake Awoonga.

To date, mining and quarrying activities have co-existed with GAWB interests with the principal environmental value being the maintenance of water quality within Lake Awoonga.

3.23. Potential Impacts

The potential impacts to surface waters due to mining and quarrying include:

Surface Runoff
Mining and quarrying have the potential to alter surface water flows by capture in voids and re-direction by diversion/catch drains. Peak flows can be reduced by capture or concentrated by diversions. Construction of sediment containment structures also alters flow patterns.

Surface Water Quality
The quality of surface runoff can be affected by erosion from disturbed areas such as roads, spoil dumps, stockpiles, hardstands, benches/faces and so on. If released to the natural drainage system, turbid or otherwise contaminated water may impact on downstream surface water quality.

Void Water Quality
The final voids will fill with water either from surface flows or groundwater seepage or a combination of both. Final water quality may depend upon the final design, catchment characteristics and climatic factors.

Quarry Affected Water

Water is used for dust suppression on haul roads, working benches, hardstands, and stockpile areas. Water is applied at a controlled rate to prevent runoff. Water is also used for dust suppression at plant locations and for certain product washing, vehicle washdown, product moisture content control and product transportation. Excess water from product washing activities is directed to settling ponds essentially operating in a closed-circuit configuration.

3.24. Water Inventory

Table 15 details the below reporting requirements for water inventory under this Plan.

Table 15: Water inventory

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Stockpiles and ROM areas	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Pollution of waterways by sediment and/or hydrocarbons	Unlikely	Moderate	6 Moderate
Crushers and Screening area	On site			Unlikely	Moderate	6 Moderate
Haul roads	On site and Taragoola Road	Sediment runoff; Erosion	Sediment run-off into stormwater drains	Possible	Minor	6 Moderate
Blasting	On site	Sediment from blasting; Increase nitrogen levels	Increase nitrogen levels may be pumped to sediment dams	Rare	Moderate	3 Low
Rail siding area	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Pollution of waterways by sediment and/or hydrocarbons	Unlikely	Moderate	6 Moderate
Workshop area	On site			Unlikely	Moderate	6 Moderate
Administration, weighbridge, and gatehouse area	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Pollution of waterways by sediment and/or hydrocarbons	Rare	Moderate	3 Low
Active quarry pit	On site	Spillage of hydrocarbons or chemicals into pit water	Pollution of groundwater or water storage bodies if discharged from pit	Unlikely	Moderate	6 Moderate
Water storage dams	On site			Unlikely	Moderate	6 Moderate

3.25. Control Measures

Table 16 presents those controls that assist on site in mitigating risk associated with water impacts on personnel, community, and the environment.

Table 16: Water control measures

Controls
Land disturbance will be restricted to that which is essential for mining purposes
Disturbed land will be rehabilitated/revegetated as soon as is practicable to minimise erosion and sediment transport

Controls
The extent of disturbed / exposed areas is to be kept to the minimum area necessary for works
Vehicle wash-down to be carried out in a designated area so that washings (including concrete washings) will not enter waterways or stormwater drains
A steel sump has been installed at the C1 discharge point to assist in sediment control before continuing downstream.
Earth bunds and diversion drains are maintained around the perimeter of the site, particularly on the upslope, of excavations to prevent surface water entering these areas
Stabilised diversion drains are maintained to direct dirty water to sediment traps (e.g. straw bale filter, sandbag filter, sediment dams)
Spill control equipment is stocked at specific locations around the site for spill response.
The following procedure dictates Refuelling procedures on site: 620-P8.200.213 Main Hardstand Refuelling. Site has introduced an annual cleanout of humeceptor by competent and qualified contractors.
Vehicles to be well maintained to avoid fuel and oil leakages
Re-fuelling of trucks on site to take place away from drainage lines and in isolated/bunded areas to minimise the risk of environmental contamination and contain spills.
Fuels, oils, and chemicals required for construction and operation to be appropriately stored. Storage in open areas will be bunded to ensure any spills are contained
Any spillages to be immediately contained and absorbed with a suitable material and disposed in an approved manner.
Staff to be appropriately trained in procedures for the management of fuel and chemical spills and the location and use of spill kits
To the extent practicable, all water pumped from mining/quarrying operational areas (except for water used for dust suppression) will be directed to the recycle water storage near the plant area
The administering authority will be consulted prior to the release by pumping of void water to the natural drainage system other than what is allowed under the EA licence conditions (i.e. licenced discharge points F1 and C1).
Releases of pumped void water to natural drainage system will be in accordance with water quality standards, monitoring locations and frequencies as nominated by EA conditions.

3.26. Monitoring

The following section describes the site's water monitoring program. The program is designed to qualify and quantify the extent to which the key objectives of the subplan- Water Management Plan are being achieved. All monitoring is conducted by a suitably qualified/trained person. Surface water sampling and preservation of samples must be conducted in accordance with the administering authority's *Monitoring & Sampling Manual 2009*. Groundwater monitoring is to be regularly undertaken from piezometer FM5, FM5B, piezometer FM6

All water quality samples are sent to a laboratory for analysis that is NATA accredited for the parameters listed in the following tables.

Table 17 and Table 18 present the surface water and groundwater monitoring commitments for the quarry.

Table 17: Surface water monitoring program

Monitoring ID	Location description	Purpose	Frequency	Parameters	Sampling Method
F1 Discharge & Monitoring	321432E, 7332026N	EA Conditions	Weekly during discharge	pH, Electrical conductivity (µS/cm) and Total Suspended Solids (mg/L)	Latest version of the administering authority's Monitoring and Sampling Manual
F2 Monitoring	320399E, 7331469N				
C1 Discharge & Monitoring	320757E, 7333601N				
C2 Monitoring	320102E, 7333854N				

Table 18: Groundwater monitoring program

Monitoring Point	Easting (GDA 94)	Northing (GDA 94)		Monitoring Frequency			
			Groundwater Level	EC, TSS, pH	Metals: As, Cd, Cr, Cu, Ni, Pb, Zn, Hg	Major Cations, Major Anions, CO3	Hydrocarbon
FM5	321430	7332650	Quarterly (Jan, Mar, Jul, Sep)	Quarterly (Jul, Sep, Jan, Mar)	Annual (Jul)	Six Monthly (Jan, Jul)	Annual (Jul)
FM6 FM5B	321080	7334350					

3.27. Reporting

Table 19 details the reporting requirements for water management at the operation.

Table 19: Water reporting requirements

Description of reporting	Frequency of reporting	Reporting tool:	Reporting to:
Water monitoring as described in EA licence conditions	As per EA conditions	Notification to administering authority	Administering Authority

8. Waste Management

3.28. Objectives

- To avoid generation of waste material as far as practicable
- To ensure environmentally safe and effective management of wastes generated by operations
- Where waste is generated, controls should be put in place to reduce, reuse, or recycle waste generated; and
- Ensure appropriate classification and disposal of waste where required.

3.29. Environmental Values

Unmanaged wastes detract from amenity and have the potential to contaminate land, restrict post extraction land uses, attract vermin, pose a fire hazard, affect downstream water quality and impact on post extraction land use. The Environmental Protection Policy (Waste Management) nominated a waste management hierarchy in a preferred order of adoption. The hierarchy is as follows:

- Waste avoidance;
- Waste re-use;
- Waste recycling;
- Energy recovery from waste; and
- Waste disposal.

The principal environmental value for waste management is to conserve resources for the wellbeing of people and maintenance of ecological processes.

3.30. Waste Inventory

Table 20 presents those the onsite waste streams.

Table 20: Waste streams

Activity	Location
General Waste	On site

Activity	Location
General Recycle Waste (paper, cardboards, glass, etc)	On site
Hydrocarbon Waste	Workshops and Maintenance
Steel	Scrap yard
Batteries	Workshop

3.31. Control Measures

The proposed controls measures in Table 21 are in place to:

1. Avoid or reduce the waste generated onsite;
2. Manage the storage of waste onsite to ensure that waste does not enter the environment, and
3. Ensure appropriate treatment and/or disposal of waste.

Table 21: Waste control measures

Controls	Timing/ Frequency	Evidence of implementation
Generation		
Green waste to be mulched and used on site for landscaping and rehabilitation (where feasible)	When required	View via inspection
Absorbent pads and sawdust used to absorb hydrocarbon-based spills in workshop areas.	When required	Absorbent materials fully stocked in workshop areas
Waste recycling bins are provided at specific locations around administration buildings to divert waste from landfill	Ongoing	Waste contractor invoices
Wash down areas to maintain oil/water separating devices for wastewater reuse.	Ongoing	Oily water separator maintenance log
Clean water surface water/runoff to be diverted around quarry facilities	Ongoing	Inspection checklist
Storage		
Maintaining a dedicated safe storage area for waste oil	Ongoing	Visual Inspection
Waste oil storage containers are stored in a bunded area	Ongoing	Visual Inspection
All domestic waste is stored within onsite waste bins	Ongoing	Visual Inspection
Waste chemicals (including) solvents are to be segregated and stored appropriately awaiting collection by licensed waste contractor for suitable offsite recycling/disposal	Ongoing	Waste contractor invoices
Treatment/Disposal		
Correct classification and disposal of hazardous waste by an approved controlled waste contractor	Ongoing	Waste contractor invoices
General wastes from operations (food etc) to be disposed of at an appropriately licensed waste management facility	Ongoing	Waste contractor invoices
Waste metal materials to be separated onsite and collected by scrap steel recycling contractor or transported to appropriate waste management facility for recycling	Ongoing	Visual inspection and waste contractor invoices
Waste oils and greases to be segregated and stored appropriately until collection by a licensed waste contractor for appropriate offsite recycling/disposal	Ongoing	Visual inspection and waste contractor invoices

3.32. Monitoring

The volumes of waste generated and stored onsite are required to be monitored and reported. Volumes of waste that are reused onsite or recycled are also required to be monitored and reported. A site waste tracking form is

used to maintain these records. Furthermore, inspections of waste storage areas and audits of waste control measures is conducted.

Table 22 details the monitoring and reporting requirements for onsite waste management.

Table 22: Waste monitoring and reporting measures

Description of monitoring	Timing/ Frequency	Reporting requirement	Relevant forms/procedures
Environmental site inspection and audit of operations by HSEQ Specialist	Annually	Corrective actions to be reported in JD Edwards	Environmental Inspection
Inspections of all waste storage areas onsite to ensure waste is fully contained	Monthly	Corrective actions to be reported in JD Edwards. Regional	Environmental Inspection
Inspection of clean water diversion bunds and drainage	Monthly	Corrective actions to be reported in JD Edwards.	Environmental Inspection
Volume of general and recyclable waste removed by waste contractor offsite	Fortnightly	Waste tracking receipts shall be provided to site and recorded in the Environmental Monitoring Spreadsheet	Waste contractor invoices; Environmental Monitoring Data Spreadsheet
Volume of waste oil generated onsite and disposed of offsite	Monthly	Waste tracking receipts shall be provided to site and recorded in the Environmental Monitoring Spreadsheet	Waste contractor invoices; Environmental Monitoring Data Spreadsheet

9. Land Use Management

3.33. Objectives

- To undertake a strategic and integrated approach to land management that recognises the current and potential use of land to maximise environmental outcomes, economic return and maintain access to future resource;
- To protect heritage items/aspects, flora and fauna and preserve biodiversity;
- To ensure rehabilitation is considered and incorporated throughout the design, development, operation, and closure of sites to optimise post closure social, environmental, and economic outcomes; and
- Where site contamination has occurred, properly identify, and manage the contamination to protect the health and safety of personnel and the community and to minimise or eliminate environmental impact.

3.34. Potential Impacts

Open cut mining / quarrying disturbs the land surface, drainage patterns and creates a different landform and affects ecological processes. Disturbance of the land surface can lead to increased erosion resulting in increased turbidity of surface waters and increased sedimentation of watercourses and lagoons.

Topsoil stripping has taken place prior to mining activities in certain areas. The value of the soil for rehabilitation can be reduced if not managed properly to prevent compaction and loss of biomass.

Limited potential exists for any significant land contamination as wastes will not be stored or disposed of on the leases or adjacent lands. Possible land contamination could occur due to accidental hydrocarbon and/or other chemical spillage.

Potential impacts to native ecosystems could include:

- Land clearing required for extraction of raw materials;
- Vehicle movements outside designated operational areas damaging vegetation and habitats;
- Mobile stationary equipment noise 'scaring off' native animals;
- Dust affecting vegetation;
- Indiscriminate waste disposal encouraging feral animals;
- Land disturbance resulting in an increase in weed infestation; and
- Fires resulting in the accidental burning of bushland.

3.35. Rehabilitation

Refer to the Progressive Rehabilitation and Closure Plan for all details on all rehabilitation objectives, methodologies, monitoring and reporting requirements.

3.36. Weed and Pest Management

A Weed and Pest Management Plan has been developed for site, which can be seen in Appendix G. Currently the site supervisor is responsible for inspecting noxious weeds and feral pests on site, and either managing these internally or engaging an external licenced contractor to control weed and pest infestations as required.

Table 23: Weed and pest control measures

Management Issue	Control/action measure	Timing/ Frequency	Evidence of Implementation
Land disturbance	Engage pest controllers at regular intervals to address feral animals.	As required	Pests minimised
	Land disturbance will be restricted to that which is essential for mining purposes	As per Weed and Pest Management Plan	Land disturbance mapped and within ML and extractive boundaries.
	Topsoil will be stripped and used directly for rehabilitation to the maximum practicable extent	Refer to LRMP	Topsoil plan implemented.
	Topsoil will be stripped during favourable weather conditions and will not be stripped when it is too wet or too dry	Refer to LRMP	Topsoil plan implemented.
	Stockpiled topsoil will be configured to minimise erosion and maximise future viability	Refer to LRMP	No significant erosion of topsoil stockpiles.
	Appropriate erosion control measures to protect undisturbed land and downstream water quality will be implemented	Refer to LRMP, SWMP and ESC Plan	Erosion control measures in place
	The operation area will be inspected regularly for declared plants and weed control programs implemented as necessary	Refer to Monitoring Table 11-4	Records kept.
	The lighting of fires will be restricted to when permits have been issued by the local fire warden	Ongoing	Permits kept on file.
	Site vehicles will be restricted to designated areas	Ongoing	Traffic Management Plan

3.37. Erosion and Sediment Control

Erosion and sediment control are covered in Appendix F: Erosion and Sediment Control Plan.
The site supervisor is responsible for maintaining erosion control due to mining operation, stockpiling, maintenance of roads, drains, sediment pits, and as a result of natural stormwater run-off or unseasonal high rainfall events.
Sediment control devices such as silt fencing, bunding, berms, diversions and silt pits should be used to collect sediment from flowing outside of the mining lease area.

Stormwater drains, channels and diversions should be used to separate clean stormwater due to rainfall away from disturbed land areas. Disturbed or plant water should not be allowed to contaminate or mix with clean stormwater flow or storage.

Table 24: Erosion and sediment control monitoring

Description of monitoring	Timing/ Frequency	Monitoring Method
Visual inspection of sedimentation pond to ensure basin is free of weeds	Monthly	Inspection by site supervisor
Regular cleaning and removal of sediment from sediment collection devices, pits, and dams	When required	Following inspection report
Visual inspection of sediment control fencing to ensure its effectiveness	Monthly	Inspection by site supervisor
Rehabilitated areas shall be monitored periodically to check for the possible onset of soil erosion	Monthly	Inspection by site supervisor

3.38. Land Inventory

Table 25: Land Inventory

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Land Clearing	On site	Removal of natural vegetation	Clearing excessive vegetation	Rare	Moderate	3 Low
Driving on undisturbed vegetation	On site	Damaging existing or rehab vegetation	Increasing disturbed areas; Possible increase in erosion of soil	Unlikely	Minor	4 Low
Topsoil Storage	On site	Reduced quality of topsoil	Poor rehab coverage and species diversity	Possible	Minor	6 Moderate
Weed and Pest Management	Onsite	Increased weeds and pests on site	Degradation of land and vegetation quality	Likely	Minor	8 Moderate
Stockpiles and ROM areas	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Pollution of waterways by sediment and/or hydrocarbons	Unlikely	Moderate	6 Moderate
Crushers and Screening area	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Contamination of land. Increased possibility of erosion	Unlikely	Moderate	6 Moderate
Haul roads	On site and Taragoola Road	Sediment runoff; Erosion	Instability of land and loss of soil	Possible	Minor	6 Moderate
Rail siding area	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Contamination of land. Increased possibility of erosion	Unlikely	Moderate	6 Moderate
Workshop area	On site			Unlikely	Moderate	6 Moderate

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Administration, weighbridge, and gatehouse area	On site	Sediment Runoff; Hydraulic hose discharge on mobile plant	Contamination of land. Increased possibility of erosion	Unlikely	Moderate	6 Moderate
Active quarry pit	On site	Spillage of hydrocarbons or chemicals into pit water	Contamination of land. Increased possibility of erosion discharged from pit	Unlikely	Moderate	6 Moderate

10. Monitoring and Maintenance

Graymont must ensure that a competent person conducts all monitoring where monitoring is a requirement of the relevant operation permits.

Table 25 summarises the routine monitoring conducted on site to meet environmental requirements.

Table 25: Monitoring requirements

Management Issue	Timing /Frequency	Description of Monitoring	Monitoring Method
Air Quality	Monthly	Ambient air quality monitoring for TSP at monitoring sites N, SE, SW, and S.	Dust deposition gauges using AS/NZS 3580
Air Quality	Continuous	Monitoring of onsite weather conditions	BOM
Air Quality	Daily	Visual inspection of wind speed and direction	Observations
Air Quality	During activities	Visual inspection of dust suppression devices on equipment as part of prestart checklist in accordance with Dust Management Plan - Calliope	Inspections noted in vehicle prestart check logbook. Any defects are tagged out and/or reported to supervisor.
Air Quality	Daily	Visual inspection of dust emissions from the primary crushing and screening plant	Any defects are tagged out and/or reported to supervisor.
Air Quality	During activities	Visual inspection of dust emissions from drilling and blasting activities	Non-compliance with dust emissions will be entered into the incident and corrective action reporting.
Air Quality	During activities	Visual inspection of dust control measures to ensure correct operation	Non-compliance with dust emissions will be entered into JD Edwards.
Noise and vibration	During blasting	Vibration and over-blast pressure monitoring is conducted during blasting	Each Blast
Surface water	Weekly during discharge	F1- Discharge point for water pumped from Pit 3. F2- Intention of this monitoring point is as a downstream reference point for receiving water quality.	Latest version of the administering authority's Monitoring and Sampling Manual

Management Issue	Timing /Frequency	Description of Monitoring	Monitoring Method
		C1- Discharge point for stormwater pumped from mining and production. Water is circulated where possible within water storage facilities. C2- Intention of this monitoring point is as an upstream reference point	
Erosion and Sediment	Monthly	Visual inspection of sedimentation pond to ensure basin is free of weeds	Inspection by site supervisor
Erosion and Sediment	When required	Regular cleaning and removal of sediment from sediment collection devices, pits, and dams	Following inspection report
Erosion and Sediment	Quarterly	Visual inspection of sediment control fencing to ensure its effectiveness	Inspection by site supervisor
Erosion and Sediment	Monthly	Rehabilitated areas shall be monitored periodically to check for the possible onset of soil erosion	Inspection by site supervisor
Waste	Annually	Environmental site inspection by HSEQ Specialist.	Environmental Inspection
Waste	Monthly	Inspections of all waste storage areas onsite to ensure waste is fully contained	Environmental Inspection
Waste	Monthly	Inspection of clean water diversion bunds and drainage	Environmental Inspection
Waste	Fortnightly	Volume of general and recyclable waste removed by waste contractor offsite	Waste contractor invoices; Environmental Monitoring Data Spreadsheet
Waste	Monthly	Volume of waste oil generated onsite and disposed of offsite	Waste contractor invoices; Environmental Monitoring Data Spreadsheet
Land - Contaminated Land	As required	Conduct soil and groundwater monitoring in accordance with any incidents of suspected contamination.	
Land – Weed and pest	Annually	Monitor the spread of declared weed species across the site. Monitor via visual inspection and photographic record. Incorporate weed species spread, type and condition monitoring into site wide vegetation survey as mentioned above.	
Site compliance audit of operations by third party co-ordinated by Graymont HSE team.	3 yearly	Audit checklist	Environmental audit procedure. Audit forms to be filed and any actions arising from audit will be entered into JD Edwards

3.39. Maintenance

Graymont is required to:

- Install all measures, plant, and equipment necessary to ensure compliance with the conditions of the relevant environmental authority;

- Maintain such measures, plant, and equipment in a proper condition; and
- Operate such measures, plant, and equipment in a proper manner.

11. Reporting

Graymont is required to:

Record, compile and keep for a minimum of five years all monitoring results required by the relevant environmental authority and make available for inspection all or any of these records upon request. Graymont use ORACLE by JD Edwards as a reporting system to record and manage incidents on site.

Table 26 presents the routine monitoring conducted on site to meet reporting requirements.

Table 26: Environmental management responsibilities

Management Issue	Frequency of Reporting	Description	Responsible Authority
Air Quality	Monthly	Dust deposition gauge results	Environmental Monitoring Spreadsheet
Air Quality	Quarterly	Air emission related environmental incidents	JD Edwards
Noise and vibration	Quarterly	Noise and vibration related environmental incidents	JD Edwards
Water	As per EA conditions	Water monitoring as described in EA licence conditions	Administering Authority
Waste	Annually	Waste monitoring results	HSEQ Specialist
Land	5-yearly	Vegetation mapping and condition survey	HSEQ Specialist
Land	Annually if required	Progress of remediation of contaminated site	HSEQ Specialist
Land	5-yearly	Progress on rehabilitation including: New areas of revegetation (ha) in the reporting year Total area revegetation (ha) Volume of topsoil stockpiled Evaluation of rehabilitation success against targets	HSEQ Specialist

An environmental management plan will usually require reporting arrangements for two purposes. Reporting arrangements assist with effective implementation and with external reporting. External reports may include reports on environmental incidences to the regulator, reports to stakeholders, reports to inform reviews of the plan and reports to meet the reporting requirements of the conditions of approval.

The description of reporting requirements should include:

- A list of required reports including where appropriate monitoring, environmental incidents, non-compliance, corrective action, and auditing
- A description of the standard report content
- The schedule or triggers for preparing a report
- Who the report is provided to
- Document control procedures
- Reporting commitments should also be consistent with any reporting to the Department required by the conditions of approval.

3.40. Environmental Incident

As per Condition 20 of EA – EPPR00881913 a written notice detailing the following information must be provided to the administering authority within 14 days of any advice provided to the administering authority within 14 days of any advice provided:

- The name of the operator, including their approval/registration number;
- The name and telephone number of a designated contact person;
- The quantity and nature of substance released;
- Vehicle and registration details;
- The names of person/s involved in the release and/or clean up;
- The location and time of release;
- The suspected cause of the release;
- A description of the effects of the release;
- Details of the area of impact;
- The results of any sampling performed in relation to the release;
- Actions taken to mitigate any environmental harm caused by the release and details of the success of these actions; and
- Proposed actions to prevent a recurrence of the release.

3.41. Emergency Contacts

Refer to Incident Reporting Policy and Acknowledgement Calliope Plant - for a full list of contact personnel in the event of an Environmental Incident.

12. Environmental Training

As a minimum all on site staff and contractors shall be made aware of the requirements of health and safety, and environmental requirements through site specific inductions. Key elements of this EMP will be covered in all site induction materials. All site personnel responsible for implementing the components of this plan shall ensure they have the appropriate training and competencies to ensure this Plan is implemented correctly and fully.
Where monitoring or sampling collection is required on site, this shall only be undertaken by a competent person who has been appropriately trained in monitoring and sampling techniques.

All people involved with the operation should receive relevant environmental training to ensure they understand their responsibilities when implementing the environmental management plan. People to be trained include those at the site/s of all operation activities and operations, including contractors, subcontractors, and visitors. The training should be tailored to the role of the individual in the operation.

The environmental management plan should describe the training to be implemented and could include:

- Site inductions
- Identification of key points of environmental value and any relevant matters of national environmental significance
- Understanding the requirements of the environmental management plan and the individual's role
- Environmental incident emergency response procedures
- Site environmental controls
- An outline of the potential consequences of not meeting their environmental responsibilities.

Records of all training conducted should be maintained and include:

- The person receiving the training
- The date the training was received
- The name of the person conducting the training
- A summary of the training.

13. Community Engagement

The environmental values for local community are to maintain the natural environment surrounding the quarry, including maintaining or enhancing the biodiversity and conservation values that the area provides. The nearest sensitive residential dwelling is over 3km distance from the quarry.

The mining operation proactively ensures that the local residents and community enjoy an environment that is conducive to human health and well-being by ensuring a continuation of:

- Undisturbed sleep;
- Being involved in recreation, including relaxation and conversation;
- The qualities of the natural environmental that are conducive to protecting the amenity of the community.

Potential Impacts
The operation directly employs approximately 25 persons, all of whom reside locally. Other direct employment results from the engagement of various contract services including transport, maintenance, fabrication, electrical and plumbing.
The location of the operation is relatively remote from residential communities which limit potential impacts from dust, noise, vibration, and odour. The principal potential impact relates to water quality with Lake Awoonga, which is the raw water supply for the Gladstone region.
Potential impacts on community stakeholders include noise, dust and vibration issues at nearby residences and roads, and contamination of Lake Awoonga.

3.42. Control Measures

Focused and timely communication of relevant activities conducted on site leads to effective community engagement. The following communication methods detailed in Table 27 provide the proactive and reactive approaches to community and stakeholder engagement conducted by the GCP. This is to ensure planning, construction projects, and ongoing site operations continue efficiently, and key stakeholders are adequately informed and consulted to ensure community concerns are considered and addressed throughout site operations.

Table 27: Communication methods for community and stakeholder engagement

Proactive	
Communication Methods	Timing
Advise key stakeholders via letter or other approved means prior to a change in standard operations that may cause disruption to the local community	As required
Maintain a single complaint contact and advise key stakeholders of his/her details.	Continuous
Consultation with relevant government agencies shall be conducted for all new developments proposed onsite. Consultation will be sought at the concept phase to determine approval processes and key stakeholder issues associated with the proposal.	As required
Reactive	
Communication Methods	Timing
Complaints received shall be managed in accordance with the **Environmental Authorities.**	When received
Media enquiries received by the site shall be managed by the Plant Manager.	When received
Government agency enquiries shall be responded to by the Environmental Manager.	When received

3.43. Community Complaints

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.

Dust, noise, and odours are not expected to adversely impact on neighbouring stakeholders as long as operational activities are carried out with the relevant safeguards identified in this EMP. The environmental complaints register, and the investigations of any complaints received will be maintained.

All complaints shall be recorded.

The complaints register should report the following information:

- Date and time of complaint
- Date and time of incident
- Location
- Weather data to determine wind speed and direction to assist in identifying source of nuisance, if appropriate
- Type of complaint – noise, dust, odour, truck movements, community, etc.
- Description of complaint
- Contact details of complainant
- Who recorded complaint
- Who was responsible for investigating complaint
- Immediate actions that were undertaken, and
- Results and outcome for investigation and follow up.

14. Audit and Review

3.44. Environmental Auditing

The GCP must ensure that a third-party audit of the site's compliance with the conditions of Environmental Authority (EPPR00881912) is completed every 2 years as per condition A10 of the Environmental Authority).

A Site compliance audit of operations is co-ordinated by the Graymont HSE team and takes place on a 3 yearly cycle by a third-party auditor. These audits are used to monitor environmental performance of operations against the risks identified and commitments made within this EMP.

3.45. Environmental Management Plan Review

This Plan will be reviewed every two years. The review shall be conducted with the HSEQ Specialist, Environmental Manager and the Plant Manager.

The process will involve the review of all monitoring data, complaints and incidents and comparing this data and information to mandatory limits and internal KPIs.

Procedural changes or a review of targets and/or KPIs should be employed if targets are not met.

15. Associated (referenced) Documents

- Calliope Environmental Risk Register
- Water Management Plan
- Progressive Rehabilitation and Closure Plan (PRCP)
- Ground Control Management Plan
- Waste Management Plan
- Erosion and Sediment Control Plan
- Pest and Weed Management Plan

APPENDIX B PLAN OF OPERATIONS

Plan of Operations

1 July 2018 to 30 June 2023

Taragoola Limestone Project



Mining Leases: ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192

Environmental Authority – EPML00969013

Frost Enterprises Pty Ltd

ABN 90 000 111 884

Operated by Sibelco Australia Limited

ABN 20 000 971 844

PO Box 74, Rosewater East, SA 5013

Telephone 08) 8240 8200 Facsimile 08) 8341 1010

PROJECT SUMMARY

Project Name:	Taragoola Limestone Project
Location Description:	12kms South of Calliope Township, Queensland
GPS Location:	321189E, 7333803N
Project Controller:	Mr Simon Havis
Site Contact Details:	Sibelco Calliope MS 24 Taragoola Road Calliope QLD 4680 Ph: 07 4975 4100
Mining Lease and Expiry Dates:	Refer to Table 1 below
EA Number:	EPML00969013
Tenure Holder Details:	Frost Enterprises Pty Ltd PO Box 74 Rosewater East SA 5013 Ph: (08) 8240 8200 Fax: (08) 8341 0305
Notifiable Activities:	(29) Petroleum product or oil storage – storing petroleum products or oil (b) in above ground tanks with (iii) for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS 1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia – more than 25,000L capacity.
Mining Activities:	Limestone mining and extraction to produce a range of agricultural and industrial limestone products for sale. Waste rock removal and mine site rehabilitation.

TERM OF PLAN OF OPERATIONS:	**5 Years**
COMMENCEMENT DATE:	**1 July 2018**
EXPIRY DATE:	**30 June 2023**
DETAILS:	This Plan of Operations covers Environmental Authority number EPML00969013 held by Frost Enterprises Pty Ltd, operated by Sibelco Australia Limited. The Taragoola operation has an expected life of mine of approximately 60 years.

TABLE OF CONTENTS

PROJECT SUMMARY 2
1 INTRODUCTION 5
1.1 BACKGROUND 5
1.2 LOCATION AND TENURE 5
1.3 PLAN OF OPERATIONS REGULATORY REQUIREMENTS 8
1.4 REPORT STRUCTURE 8
2 TERM AND COVERAGE OF THIS PLAN OF OPERATIONS 9
2.1 PERIOD OF THIS PLAN 9
2.2 COVERAGE OF THIS PLAN 9
2.3 NOTIFIABLE ACTIVITIES 10
3 PROJECT DESCRIPTION 10
3.1 OVERVIEW OF MINING METHODS 10
3.2 ACTIVITIES COVERED BY THIS PLAN OF OPERATIONS 11
3.3 FIVE YEAR MINE PLAN 13
4 ACTION PROGRAM 15
Department Interest – General 15
Department Interest – Air 19
Department Interest – Water 21
Department Interest – Noise and Vibration 28
Department Interest – Land 31
Department Interest – Waste 34
Department Interest – Dams 36
Department Interest – Community 38
5 REHABILITATION PROGRAM 40
5.1 SCHEDULE OF REHABILITATION WORKS 40
5.2 TOPSOIL 40
5.3 AREAS AND TYPES OF DISTURBED LAND 40
5.4 THIRD PARTY QUOTE FOR REHABILITATION OF WORKSHOP & LAYDOWN 45
5.5 FINANCIAL ASSURANCE REQUIRED 46
6 ENVIRONMENTAL COMPLIANCE STATEMENT 51
6.1 INTRODUCTION 51
6.2 COMPLIANCE STATEMENT – PART A 51
6.3 COMPLIANCE STATEMENT – PART B 52
APPENDICES 55
APPENDIX 1 – FROST ENTERPRISES MINING TENURE LAYOUT 55
APPENDIX 1B – PLAN OF LEASE AND CADASTRAL BOUNDARIES 56
APPENDIX 2A – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2018 ... 57
APPENDIX 2B – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2019 ... 58
APPENDIX 2C – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2020 ... 59
APPENDIX 2D – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2021 ... 60
APPENDIX 2E – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2022 ... 61
APPENDIX 2F – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2023 ... 62
APPENDIX 3 - DEVELOPMENT AND MINING PLAN FY2018-19 63
APPENDIX 4 – DEVELOPMENT AND MINING PLAN FY2019-20 64
APPENDIX 5 – DEVELOPMENT AND MINING PLAN FY2020-21 65
APPENDIX 6 – DEVELOPMENT AND MINING PLAN FY2021-22 66

APPENDIX 7 – DEVELOPMENT AND MINING PLAN FY2022-23 67
APPENDIX 8 – TABLES FROM ENVIRONMENTAL AUTHORITY EPML00969013..... 68

1 INTRODUCTION

Frost Enterprises Pty Ltd owns the Taragoola Limestone Project, which is located south of the township of Calliope in Central Queensland. Frost Enterprises Pty Ltd is wholly owned by Sibelco Australia Limited (SAL) who operates the Project today.

The Project has approval under Environmental Authority (EA) EPML00969013 which covers the following Mining Leases (ML): ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192.

The Project also has approval under EA EPPR00881913 for the following Environmentally Relevant Activities:

- ERA 8 (3a) - Chemical storage >10m3 but <500m3 class C1 or C2 combustible liquids
- ERA 16 (2d) – Extracting in a year >1,000,000t of material
- ERA 16 (3c) – Screening in a year >1,000,000t of material
- ERA 50 (2) - Bulk material handling >100t day

This replacement Plan of Operations describes the activities to be undertaken in accordance with EPML00969013 requirements, for the five-year planning period 1 July 2018 to 30 June 2023.

1.1 BACKGROUND

Significant exploration of the Taragoola limestone deposits was conducted in the early 1960's followed by application for and grant of a number of mining leases to both Frost Enterprises and Comalco. In 1967, Frost commenced mining operations on Comalco held ML3594, as well as mining and quarrying operations on its own lease ML3603.

In September 2004 Unimin Australia Limited (Unimin) purchased Frost Enterprises Pty Limited who owned and operated Taragoola Limestone Project. Unimin later purchased the adjacent Comalco mining leases on the 30th of December 2005. Unimin Australia Limited and Frost Enterprises Pty Ltd are wholly owned subsidiaries of Sibelco Australia Limited who operates the project today.

1.2 LOCATION AND TENURE

The Taragoola Limestone Project is located approximately 11 kilometres (km) south of the township of Calliope and 28km south of Gladstone in Central Queensland (Figure 1).

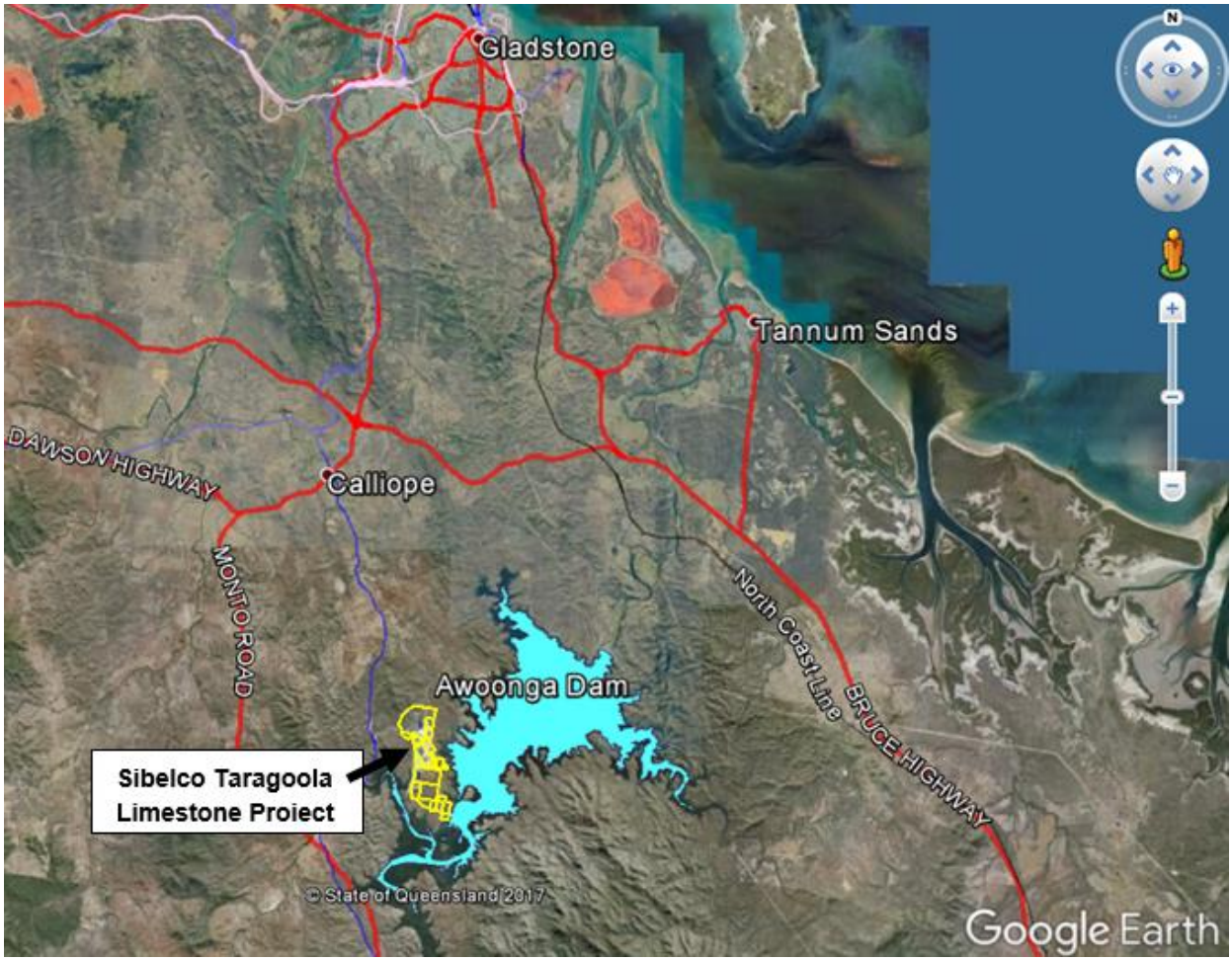


Figure 1: Locality Map of Sibelco Taragoola Limestone Project

Table 1 details the Mining Tenements and Lot and Plan summaries for the Taragoola Limestone Project which can also be visualised in the maps provided in Appendix 1A and 1B. The Project covers a mining lease area of approximately 425 hectares within the catchments of the Awoonga Dam that is owned and operated by the Gladstone Area Water Board. The majority of the project area is comprised of freehold land currently owned by Unimin and the Gladstone Area Water Board.

Table 1: Mining Tenement and Lot on Plan Summaries for EA EPML00969013

Mining Lease	Land Description	ML Area (ha)	ML Holder	ML Expiry Date	Authorised Holder Name
ML 3594	Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218 LotG_PlanSP199253	32.37	Frost Enterprises Pty Ltd	28/02/2041	Frost Enterprises Pty Ltd
ML 3595	Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218 LotG_PlanSP199253	13.49		28/02/2041	
ML 3596	Lot7_PlanSP215269 Lot90_PlanSP275218 LotG_PlanSP199253	9.1		28/02/2041	
ML 3597	Lot90_PlanSP275218	2.83		31/12/2041	
ML 3598	Lot90_PlanSP275218	12.448		31/12/2041	
ML 3599	Lot90_PlanSP275218	6.798		31/12/2041	
ML 3600	Lot22_PlanSP215268 Lot90_PlanSP275218	8.093		28/02/2041	
ML 3602	Lot7_PlanSP215269	10.23		31/03/2027	
ML 3603	Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218	8.34		31/03/2027	
ML 3604	Lot7_PlanSP215269 Lot26_PlanSP228426 LotG_PlanSP199253	4.85		29/02/2028	
ML 3605	Lot90_PlanSP275218	9.45		31/07/2028	
ML 3606	Lot90_PlanSP275218	5.61		31/07/2028	
ML 3608	Lot22_PlanSP215268 Lot26_PlanSP228426 Lot90_PlanSP275218 LotE_PlanSP215268	57.14		31/10/2030	
ML 3609	Lot22_PlanSP215268 Lot90_PlanSP275218 LotE_PlanSP215268	42.99		31/10/2030	
ML 80036	Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218 Lot100_PlanCTN1823 LotG_PlanSP199253	18.73		30/06/2022	
ML 80189	Lot22_PlanSP215268 Lot90_PlanSP275218 LotE_PlanSP215268	36.05		31/05/2043	
ML 80190	Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218 LotG_PlanSP199253	22.5		31/05/2043	
ML 80191	Lot26_PlanSP228426	1.6		31/05/2043	
ML 80192	Lot1_PlanRP610128 Lot3_PlanRP610128 Lot4_PlanRP610128 Lot7_PlanSP215269 Lot26_PlanSP228426 Lot90_PlanSP275218 Lot100_PlanCTN1823 LotA_PlanSP231548 LotB_PlanSP231548 LotC_PlanSP231548 LotD_PlanSP231548 LotG_PlanSP199253	121.5		31/05/2043	

1.3 PLAN OF OPERATIONS REGULATORY REQUIREMENTS

In accordance with Section 288 of the *Environmental Protection Act 1994* (EP Act) (current as at 1 January 2018), this replacement Plan of Operations (the Plan) describes how SAL will comply with the conditions of EA EPML00969013 (covering the Mining Leases described in Table 1 above).

The content and form of this replacement Plan is as prescribed by Section 288 of the EP Act and includes:

- The period to which the replacement Plan applies (Section 2);
- Project description including each relevant ML for the EA and associated activities and their locations (Sections 2 and 3);
- Action program for complying with the conditions of the EA (Section 4);
- Rehabilitation program for land disturbed or proposed to be disturbed (Section 5); and
- Financial Assurance (Section 5).

In accordance with Section 288(3) of the EP Act, an environmental compliance statement for the replacement Plan is also included (Section 6) which addresses:

- the extent to which the plan complies with the conditions of the EA; and
- whether the amount of the Financial Assurance for the EA has been calculated in accordance with the guideline under Section 295(3)(b).

1.4 REPORT STRUCTURE

This replacement Plan is structured as follows:

Section 1 Provides a summary of ownership, locality, tenure and regulatory requirements for this replacement Plan of Operations.

Section 2 Describes the term and coverage of this Plan including; each relevant mining lease for the EA and the MLs to which this Plan applies.

Section 3 Provides an overview of the typical mining methods used at the Taragoola Limestone Project and detailed descriptions of the areas where mining activities are scheduled to occur over the period covered by this Plan.

Section 4 Explains how the conditions of the EA will be complied with and how the control strategies will be implemented. The structure of the action program follows the sequence of the schedules and conditions in the EA.

Section 5 Discusses the schedule of rehabilitation including all types and areas of land to be disturbed and rehabilitated during the period covered by this Plan, and an estimate to decommission all infrastructure and rehabilitate all lands scheduled to be disturbed during the period covered by this Plan. The estimate has been calculated using the Financial Assurance calculator developed by the Administering Authority. The performance category for the operation is also discussed.

Section 6 Presents the environmental compliance statement for this Plan.

2 TERM AND COVERAGE OF THIS PLAN OF OPERATIONS

2.1 PERIOD OF THIS PLAN

This replacement Plan of Operations covers a five-year planning period from 1 July 2018 to 30 June 2023.

2.2 COVERAGE OF THIS PLAN

This replacement Plan relates to all activities to be conducted by SAL on the leases described in Table 1 above and as relevant to EA EPML00969013. The Plan specifically addresses the scheduled mine-related activities on the following mining leases:

ML3594 There will be mining of limestone from ML3594 during the period of this Plan. Part of this lease contains roads and a stockpile area.

ML3595 ML3595 is used for stockpiling, truck park-up area and it also includes the ramp in to Pit 4 which is the main mining area. A portion of this lease will be rehabilitated during the Plan of Operations period.

ML3596 No mining activity or new disturbance is planned for ML3596, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3597 No mining activity or new disturbance is planned for ML3597, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3598 No mining activity or new disturbance is planned for ML3598, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3599 No mining activity or new disturbance is planned for ML3599, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3600 No mining activity or new disturbance is planned for ML3599, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3602 ML3602 is used for a truck park-up area for trucks entering site and for stockpiling final product.

ML3603 ML3603 contains the workshop, office areas and stockpiling for final product.

ML3604 There will be mining of limestone from ML3604 during the period of this Plan of Operations.

ML3605 No mining activity or new disturbance is planned for ML3605, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3606 No mining activity or new disturbance is planned for ML3606, during this Plan of Operations period. There is currently no disturbance on this lease.

ML3608 ML3608 contains Pit 3 that had been mined previously. There are also tracks used for inspecting the land. An area of approximately 0.41ha will be cleared in 2022-2023 to extend Pit 4 to the south where limestone mining will also occur. As the wall will be a final batter it will be blasted to the final batter angle.

ML3609 No mining activity or new disturbance is planned for ML3609, during this Plan of Operations period. There is currently no disturbance on this lease apart from tracks that are used for inspecting the land.

ML80036 This lease is used as a waste dump, low-grade stockpile and redundant equipment area.

ML80189 ML80189 contains the stockpiles where the overburden removed during the period of this Plan of Operations will be placed.

ML80190 Overburden will be removed from ML80190 and limestone will be mined from this lease during the period of this Plan of Operation. An area of approximately 0.26ha will be cleared in 2022-2023 to extend Pit 4 to the south. As the wall will be a final batter it will be blasted to the final batter angle.

ML80191 ML80191 contains part of a main haul road and a spoil pile. There will be no mining from this lease during the period of this Plan of Operation.

ML80192 ML80192 contains the main office, weighbridge, ROM stockpile, access roads, crushing and screening plant, wash plant and main stockpile area for final product. It also contains a redundant limestone pit which is used as a water storage and for operational water use in the wash plant as required. The lease also contains a silt pond and spoil areas.

2.3 NOTIFIABLE ACTIVITIES

Activities as prescribed by Schedule 3 of the Environment Protection Act 1994 as notifiable activities are as follows:

- (29) Petroleum product or oil storage – storing petroleum products or oil (b) in above ground tanks with (iii) for petroleum products that are combustible liquids in class C1 or C2 in Australian Standard AS 1940, 'The storage and handling of flammable and combustible liquids' published by Standards Australia – more than 25,000L capacity.

The above activities are located on ML3603.

3 PROJECT DESCRIPTION

3.1 OVERVIEW OF MINING METHODS

Approximately 0.8 million tonnes of limestone products are planned to be transported by road and rail annually from the Taragoola Limestone Project during the five (5) year term of this Plan. Limestone mining will occur from Pit 4 and in the direction of Pit 3 as detailed in Section 3.3 below. Mining will consist of conventional open cut benching methods currently being performed by SAL.

Mining activities include topsoil stripping and removal of clay rich overburden and waste rock followed by extraction of limestone ore of appropriate grade and chemical properties suitable for quicklime, hydrate production and other end uses. Suitable limestone ore is then crushed, screened and washed on site before being transported to customers off site for further downstream processing. Extractive activities are also conducted on site where limestone of different grades and suitable physical properties follow a similar process to mining for the production of road base and aggregates etc. Extractive activities are authorised and conducted under ERA 16(2)(d) and EA EPPR00881913 (original permit # SPCE04023712 issued under the *Sustainable Planning Act 2009*).

During the term of this Plan, an estimated 142,000 tonnes of overburden and waste rock will be shifted annually. A large proportion of this material will be used as process feed for road base production. Material unsuitable for road base will be placed in a stockpile to the south of Pit 3.

After drilling and blasting, the limestone, overburden and or waste material is loaded by a 120-tonne excavator serviced by two 100-tonne and one 85-tonne off road dump trucks. Material is hauled either to the ROM pad for crushing, or to the stockpiles for screening or placement in the designated spoil dumps. There is a second 75 tonne excavator on site which is utilised as a backup for the open cut operations.

3.2 ACTIVITIES COVERED BY THIS PLAN OF OPERATIONS

This section describes the mining operations and supporting activities projected to occur during this Plan of Operations period.

Upon any significant change to activities described in this Plan, an amendment or replacement plan will be submitted at least 20 business days prior to the intended commencement of those activities. A significant change is deemed as:

- Any new activity or waste stream associated with a high or medium inherent environmental risk; or
- Any change or cumulative changes that results in an increase in financial assurance of 10% above the amount described for this Plan of Operations.

The activities to be conducted during the period of this Plan are described below in Table 2:

Table 2: Activities covered by this Plan of Operations

Vegetation clearing:	Prior to drill and blast the vegetation consisting predominantly of pasture grasses, along with approximately 0.25m topsoil is cleared from above the Limestone ore body and placed in stockpiles and stored for future use in site rehabilitation. Vegetation clearing is anticipated to take place on ML3608 and ML80190 (south-end of Pit 4) during this Plan of Operations period.
Topsoil stripping, use and stockpiling	Topsoil is stripped ahead of mining and is generally used to create safety bunds on the pit edge. Topsoil is also stored in stockpiles shown in Appendix 2. Stockpiles are built less than 2 metres in height and are seeded if they are to be stored for a long period. Topsoil stripping is anticipated to take place on ML3608 and ML80190 (south-end of Pit 4) during this Plan of Operations period.

	Areas requiring topsoil at the end of the operation's life include the stockpile areas, infrastructure areas and spoil dumps. The total estimate tonnage required is around 50,000bcm. It should be noted there are a number of spoil dumps on site which contain a high proportion of clay and soil. It is anticipated that these dumps can be processed to recover enough material to cover the required areas. The recovered material is considered to be a good growing medium with regrowth already established on a number of areas.
Blasting	Blasting activities will be confined to ML3594, ML3604, ML3608 and ML80190 only.
Active pit / Mining:	Limestone will be mined from ML3594, ML3604, ML3608 and ML80190 during the period of this Plan of Operations.
Water supply:	Water will continue to be sourced from the on-site sediment and storage dams.
Overburden Placement:	The current waste dump on ML80189 will continue to be used for waste placement. Some areas outside the mining leases on ML3608, ML80189 and ML80190 have been disturbed by placement of mining spoil (overburden and waste rock). These materials have been used for the construction of barriers to prevent surface water inundation of the mine workings due to the recent and possible future raising of the Awoonga Dam wall. These material placements were conducted under the direction of the Gladstone Area Water Board (GAWB). Future material placement to prevent inundation by the Awoonga Dam will continue to be conducted in collaboration with the GAWB.
Road construction / maintenance:	Roads and tracks will be required for mine haulage, general access and land maintenance access. Mine development on ML3594, ML3604 and ML80190 will involve lateral expansion (principally to the west) and deepening of the open cut. During the five-year term of the plan, the principal emphasis will be maintenance of safe stable batters on cut and fill embankments (including spoil heaps) and ensuring that any parts of the void wall which approach terminal configuration will meet design slope criteria for rehabilitation in accordance with EA requirements.
Rehabilitation:	Due to the current disturbance footprint and continued expansion of the working mine pits, there is limited availability to complete significant areas of rehabilitation during the term of this Plan. However, 1.45ha has been scheduled for completion on ML3595 and ML80190 during Years 1 and 2 of this Plan of Operations period. Should further areas of disturbed land become available and deemed suitable, additional rehabilitation will occur.

Workshop and storage:	The current workshop and storage area on ML3603 will continue to service the project over the duration of the Plan.
Fuel storage:	The operation has an 88,000L self-bunded diesel transtank and a flammable and combustible liquid storage area on ML3603 which will continue to service the operation. A humeceptor is in place to capture potential contaminants that may be spilled within these areas.
Power supply:	The current 1000 kVA is transformed down to a 415-voltage line and will continue to service the project. There is also a mobile lighting tower that is used on an as required basis to light the operation.
Administration:	The current administration building will continue to service the project on ML80192.
Product storage:	The current product storage areas will continue to service the project on ML3602, ML3603 and ML80192.
Hardstand areas:	The current hardstand areas will continue to service the project.

3.3 FIVE YEAR MINE PLAN

The anticipated extent of the open cut mining, pit development and rehabilitation over the next five years are shown in the annual plans detailed in Appendix 3 to 7. Appendix 2A provides an overview of disturbance and rehabilitation as at the end of current Plan of Operations period June 2018 (Year 0).

Below is an annual summary of development and mining during the five-year term of this Plan.

Year 1 (2018/19) Appendix 2B and Appendix 3

- Mining will be mainly from the south-west corner of Pit 4 from the 1040-1028, 1028-1016, 1016-1004 benches. Some limestone from 1004-992 benches at the base of ramp 4 will also be mined.
- Overburden will be stripped from an area on the western side of Pit 4.
- Waste from pit development will go to the waste stockpile to the south of Pit 3.
- An area of 1.45ha on the eastern side of Pit 4 will be topsoiled in Year 1. This area is on ML3595 and ML80190.

Year 2 (2019/20) Appendix 2C and Appendix 4

- Overburden removal continues on the western side of Pit 4.
- Overburden will be placed in the waste stockpile to the south of Pit 3.
- Limestone will be mined from the southern end of Pit 4 from the 1040-1028, 1028-1016, 1016-1004 and 1004-992 benches.
- An area of 1.45ha on the eastern side of Pit 4 will be seeded during Year 2. This area is on ML3595 and ML80190.

Year 3 (2020/21) Appendix 2D and Appendix 5

- Overburden removal continues on the western side of Pit 4.
- Overburden is placed in the waste stockpile to the south of Pit 3.

- Limestone is mined from the southern end of Pit 4 from the 1040-1028, 1028-1016, 1016-1004 and 1004-992 benches.
- The rehabilitation on the eastern side of Pit 4 will be monitored.

Year 4 (2021/22) Appendix 2E and Appendix 6

- Overburden removal is from the western side of Pit 4.
- Overburden is placed in the waste stockpile to the south of Pit 3.
- Limestone is mined from the western side of Pit 4 from the 1040-1028, 1028-1016, and 1016-1004 benches.
- The rehabilitation on the eastern side of Pit 4 will continue to be monitored.

Year 5 (2022/23) Appendix 2F and Appendix 7

- Vegetation will be cleared from the southern end of Pit 4 with the topsoil stripped and stockpiled and overburden removed for limestone mining. The batter on the overburden bench will be blasted and dug to leave a rehabilitated batter.
- Overburden is placed in the waste stockpile to the south of Pit 3.
- Limestone is mined from the western side of Pit 4 from the 1040-1028, 1028-1016, and 1004-992 benches.
- The rehabilitation on the eastern side of Pit 4 will continue to be monitored.

4 ACTION PROGRAM

This section describes the action program for complying with the conditions of EA EPML00969013. For each EA Schedule, the conditions, control strategies and action program details are listed sequentially, as recommended by the Department's Guidelines: *Version 1: Preparing a Plan of Operations and Audit Statement for Level 1 mining projects* and the Guideline for *Financial Assurance under the Environmental Protection Act 1994, Version 3.* All Environmental Authority (EA) EPML00969013 Tables are presented in **Appendix 8**.

Table 3: Environment Authority EPML00969013 Action Program

Condition #	Environmental Authority Condition	Control Strategy	Action Program
Department Interest – General			
(A1)	**Financial assurance** Provide financial assurance in the amount and form required by the administering authority prior to the commencement of activities proposed under this environmental authority. *The calculation of financial assurance for condition A1 must be in accordance with the administering authority's Guideline – Financial Assurance for Mining Activities, 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).*	Financial assurance has been provided in the form of a Bank Guarantee as defined by previous Plan of Operations.	Financial assurance will remain in place until the administering authority is satisfied that no claim is required.
(A2)	The financial assurance is to remain in force until the administering authority is satisfied that no claim on the assurance is likely.	Financial assurance will remain in place until the administering authority is satisfied that no claim is likely.	The financial assurance will remain in place throughout the term of this Plan and will not be cancelled unless authority to do so is provided in writing from the administering authority.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	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.*	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.	
(A3)	In carrying out the environmentally relevant activities, the holder of this environmental authority must take all reasonable and practicable measures to prevent and/or minimise the likelihood of environmental harm being caused. Any environmentally relevant activity, that if carried out incompetently, or negligently, may cause environmental harm, in a manner that could have been prevented, shall be carried out in a proper manner in accordance with this authority. *Note: This authority authorises the environmentally relevant activity, it does not authorise environmental harm unless a condition contained within this authority explicitly authorises that harm. Where there is no condition or the authority is silent on a matter, the lack of a condition or silence shall not be construed as authorising harm.*	Operations to be conducted in accordance with the EA, Plan of Operations and other relevant legislation.	Definitions of environmental harm and other matters in the Environment Protection Act 1994 will be considered in the operation of the mining activities.
(A4)	**Maintenance of measures, plant and equipment** The environmental authority holder must ensure: a) that all measures, plant and equipment necessary to ensure compliance with the conditions of this environmental authority are installed; b) that such measures, plant and equipment are maintained in a proper condition; and	Measures, plant and equipment will be installed and maintained as required to ensure compliance with the conditions of the EA.	Plant and equipment will be maintained and operated in accordance with the manufacturers' specifications during the term of this Plan of Operations.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	c) that such measures, plant and equipment are operated in a proper manner.		In addition, the maintenance and operation of plant and equipment will comply with SAL's corporate and site-specific policies. Records of plant and equipment maintenance will be documented along with other equipment related to site activities.
(A5)	**Monitoring and records** 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.	Records of all relevant monitoring results will be kept for a minimum period of 5 years.	All monitoring results will be catalogued and will be maintained. Records will be kept for a minimum period of 5 years and made available to the administering authority upon request.
(A6)	Where monitoring is a requirement of this environmental authority, ensure that a competent person(s) conducts all monitoring.	Monitoring will be conducted by competent persons.	All persons conducting environmental monitoring shall be trained in appropriate environmental sampling and monitoring techniques and will understand the monitoring standards and requirements.
(A7)	**Storage and handling of flammable and combustible liquids** Spillage of all flammable and combustible liquids must be contained within an on-site containment system and controlled in a manner that prevents environmental harm (other than trivial harm) and maintained in accordance with the current version of AS 1940 - Storage and Handling of Flammable and Combustible Liquids.	Spillage prevention and handling of flammable and combustible liquids will be accordance with AS 1940.	The operation has an 88,000L self-bunded diesel transtank and a flammable and combustible liquid storage area on ML3603. A humeceptor is in place to capture potential contaminants that may be spilled within these areas. Stocked spill kits shall be provided and operational site personnel will be trained in their use.
(A8)	Spillage of all chemicals must be contained within an on-site containment system and controlled in a manner that prevents environmental harm.	Chemicals must be contained in a containment area on site.	Site to ensure that all chemicals are contained within a contained area as prescribed by AS 1940.
(A9)	**Notification of emergencies, incidents and exceptions** All reasonable actions to be taken to minimise environmental harm, or potential environmental	Operations to be conducted in accordance with the EA, Plan of Operations and other relevant legislation.	SAL has implemented company-wide procedures which include incident notification and response

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	harm, resulting from any emergency, incident, or circumstances not in accordance with the conditions of this environmental authority.		actions under *CWP 10.202 EHS Incident Notification & Investigation.* The site maintains a compliance register which includes the requirement to notify the administering authority within 24 hours of a relevant incident.
(A10)	As soon as practicable after becoming aware of any emergency, incident or information about circumstances which results or may result in environmental harm not in accordance with the conditions of this environmental authority, the administering authority must be notified by telephone or email.	Notify administering authority of any release of contaminants not in accordance with the conditions of this EA.	Persons on site are trained to identify and advise the appropriate supervisors and or environmental department of any release of contaminant not in accordance with the conditions of this EA. Supervisors and environmental advisor to advise administering authority if release is not in accordance with conditions of EA.
(A11)	Not more than fourteen days following the initial notification of an emergency or incident, written advice must be provided of the information supplied in accordance with condition A8 in relation to: a) proposed actions to prevent a recurrence of the emergency or incident; b) outcomes of actions taken at the time to prevent or minimise environmental harm; c) proposed actions to respond to the information about circumstances which result or may result in environmental harm.	Relevant personnel to be aware of responsibility to notify the administering authority within 14 days.	Relevant personnel to notify the administering authority within 14 days of an emergency or incident.
(A12)	As soon as practicable, but not more than six weeks following the initial notification of an emergency, incident or information about circumstances which results or may result in environmental harm, environmental monitoring must be performed and written advice must be provided of the results of any such monitoring performed to the administering authority.	Relevant personnel to be aware of responsibility to notify the administering authority within the appropriate timeframe of the results of any monitoring undertaken as a result of an emergency or incident.	Relevant person to notify the administering authority within the appropriate timeframe of the results of any monitoring undertaken as a result of an emergency or incident.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
(A13)	**Definitions** Words and phrases used throughout this environmental authority are defined in the Definitions section of this authority. Where a definition for a term used in this environmental authority is sought and the term is not defined within this environmental authority, the definitions in the *Environmental Protection Act 1994,* its regulations and policies must be used.	Definitions section of the EA to be consulted where required.	Definitions section of the EA to be consulted where required.
Department Interest – Air			
(B1)	**Dust nuisance** Subject to conditions B2 and B3 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.	To minimise the release of dust and particulate matter from mining activities the following abatement measures will be implemented: • Unsealed roadways will be watered on an as required basis via the use of water truck/s, fixed water spray systems and or irrigation sprinklers • Removal of topsoil shall only be undertaken as required to clear the immediate mine path. This will also minimise the area exposed at any one time • Topsoil stockpiles will be seeded to maintain soil quality and minimise dust • Avoidance of activities which produce dust during windy conditions.	A dust management program will be maintained during the term of the Plan of Operations to ensure that the mining activities do not cause environmental nuisance. Dust sampling when undertaken will be conducted in accordance with AS 3580 – method for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method of 1991.
(B2)	When requested by the administering authority, dust and particulate monitoring must be undertaken within	When requested by the administering authority, dust and particulate monitoring is to be undertaken within a	Monitor the point located closest to the location of the complaint. Current dust sampling is to be conducted in accordance with AS 3580 – method

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	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.	reasonable and practicable timeframe as nominated by the administering authority to investigate any complaint. The results are to be provided to the administering authority within 14 days.	for sampling and analysis of ambient air – Determination of particulates – Deposited matter – Gravimetric method of. The dust management program will be maintained and regularly reviewed during the term of the Plan of Operations to ensure that the mining activities do not cause an environmental nuisance.
(B3)	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: 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*; or b) a concentration of particulate matter with an aerodynamic diameter of less than 10 micrometre (µm) (PM10) suspended in the atmosphere of 50 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; i. 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*; and	In relation to any complaint that is neither frivolous nor vexatious, as requested by the administering authority the site will seek to provide evidence that the limits in B3 (a) and (b) have not been exceeded. When requested by the administering authority the site will monitor dust and particulate matter within a reasonable and practicable timeframe to investigate any complaint that is neither frivolous nor vexatious.	Should Condition B2 be triggered the site will seek to provide evidence that the limits in B3 (a) and (b) have not been exceeded. After monitoring the results will be provided to the administering authority within 14 days.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	ii. any alternative method of sampling PM10, which may be permitted by the *Air Quality Sampling Manual* as published from time to time by the administering authority.		
(B4)	If monitoring indicates exceedence of the relevant limits in condition B3, then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement dust abatement measures so that emissions of dust from the activity do not result in further environmental nuisance.	Should any monitoring indicate exceedance of the limits defined in Condition B3, the operation will address the complaint utilising appropriate dispute resolution techniques where required. Dust abatement measures are to be employed to prevent further environmental nuisance and reduce or limit the emissions of dust from the activity.	Dust abatement measures have been implemented on site as detailed in the control strategies outlined in Condition B1 above. Any complaints arising from dust will be handled promptly and in accord with the Sibelco Incident Cause Analysis Method (ICAM). Additional dust abatement measures and control strategies will be implemented as required to prevent further environmental nuisance.
Department Interest – Water			
(C1)	**Contaminant release** Contaminants that will, or have the potential to cause environmental harm must not be released directly or indirectly to any waters except as permitted under the conditions of this environmental authority.	• Control mobilisation of contaminants by diversion channels, sediment dams and water quality monitoring. • Land disturbance to be restricted to that which is essential for mining purposes. • Rehabilitate/revegetate disturbed land wherever available to minimise erosion and sediment transport • Construct and maintain undisturbed catchment diversion drains as necessary ahead of advancing mining operations. • Implement appropriate erosion prevention/controls to minimise	• Regular inspection and implementation of control measures as necessary including erosion and drainage maintenance. • Desilt settling pond and implement improvements as necessary. • Monitor sediment accumulation in settling ponds/sediment traps and implement regular cleanout and sediment disposal actions. • Flammable and combustible liquids contained in bunded areas.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
		sediment transportation by surface runoff. • Implement and maintain an effective settling pond system, operating in closed circuit to the extent practicable, to accept water from processing plant operations • Appropriate bunding of fuel storage and hydrocarbon areas.	
(C2)	The release of contaminants to waters must only occur from the release points specified in Table 1 and depicted in Figure 1 attached to this environmental authority.	Release of contaminants only to occur from release points in Table 1 (Figure 1 of the EA).	Ensure person collecting samples is trained and competent to do so and is familiar with the release points in Table 1.
(C3)	The release of contaminants to waters must not exceed the release limits stated in Table 2 when measured at the monitoring points specified in Table 1 for each quality characteristic.	Release of contaminants not to exceed the release limits stated in Table 2. Monitoring must occur during discharge of water from release point.	• Ensure person collecting samples is trained and competent to do so and is familiar with the release limits in Table 2. • Keep a record of all monitoring results on site for 5 years. • Ensure that all equipment is calibrated within manufacturer's specifications.
(C4)	**Water general** All determinations of water quality must be: a) performed by a person or body possessing appropriate experience and qualifications to perform the required measurements; b) made in accordance with methods prescribed in the latest edition of the administering authority's *Monitoring and Sampling Manual;* c) collected from the monitoring locations identified within this environmental authority, within 10 hours of each other where possible; d) carried out on representative samples; and	All determinations of water quality to be performed by a person or body possessing appropriate experience and qualifications and made in accordance with methods prescribed in the latest edition of the administering authority's *Monitoring and Sampling Manual.* Water quality samples must be collected from the monitoring locations identified within this environmental authority, within 10 hours of each other where possible; be representative	• Conduct water monitoring in accordance with EA conditions. • Conduct regular visual surveillance of the quality of water (suspended solids/turbidity) pumped or otherwise released to the natural drainage system. • Provide necessary training to site personnel in use and maintenance of field monitoring equipment and water sampling techniques.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	e) laboratory testing must be undertaken using a laboratory accredited (e.g. NATA) for the method of analysis being used. *Note: The Monitoring and Sampling Manual to be followed and where it is not followed because of exceptional circumstances this should be explained and reported with the results.*	samples; and sent to an accredited laboratory (e.g. NATA).	
(C5)	The release of contaminants directly or indirectly to waters: a) must not produce any visible discolouration of receiving waters; and b) must not produce any slick or other visible or odorous evidence of oil, grease or petrochemicals nor contain visible floating oil, grease, scum, litter or other objectionable matter.	Visual inspection of the release waters will be undertaken on a regular basis during discharge to identify visible discolouration and presence of contaminants e.g. oil, grease, hydrocarbon, litter.	Visual inspection of release waters to occur during water releases.
(C6)	**Annual water monitoring reporting** The following information must be recorded in relation to all water monitoring required under the conditions of this environmental authority and submitted to the administering authority in the specified format with each annual return: a) The date on which the sample was taken; b) The time at which the sample was taken; c) The monitoring point at which the sample was taken; d) The measured or estimated daily quantity of the contaminants released from all release points; e) The release flow rate at the time of sampling for each release point; f) The results of all monitoring and details of any exceedence with the conditions of this environmental authority; and	Water monitoring to be conducted in accordance with EA Condition C6 and an annual report submitted to the administering authority with the annual return.	Submit water monitoring report to the administering authority that meets the content requirements of EA Condition C6.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	g) Water quality monitoring data must be provided to the administering authority in the specified electronic format upon request.		
(C7)	**Temporary interference with waterways** Temporarily destroying native vegetation, excavating, or placing fill in a watercourse, lake or spring necessary for and associated with mining operations must be undertaken in accordance with Department of Natural Resources and Mines *Guideline - Activities in a Watercourse, Lake or Spring associated with Mining Activities.*	No native vegetation, excavating or placing fill in a watercourse, lake or spring will occur on site without informing the environmental advisor. If this condition is triggered, the environmental advisor will assess the request and refer to the relevant Guideline.	No such requirement to interfere with waterways is expected to occur during the term of the plan of operations, however should it occur, the activities will be undertaken in accordance with the relevant Guideline.
(C8)	**Water Management Plan** A Water Management Plan must be developed and implemented that provides for the proper and effective management of the actual and potential environmental impacts resulting from the mining activity and to ensure compliance with the conditions of this environmental authority.	Complete	Implement water management activities in consultation with the Water Management Plan, EA and relevant site operating procedures.
(C9)	The Water Management Plan must be developed in accordance with the department's *Guideline for Preparing a Water Management Plan* and must include at least the following components: a) contaminant source study; b) site water balance and model; c) water management system; d) saline drainage prevention and management measures; e) acid rock drainage prevention and management measures (if applicable); f) emergency and contingency planning; and g) monitoring and review.	Complete	Review Water Management Plan per EA Condition C10 requirements.
(C10)	Each year the holder of the environmental authority must undertake a review of the water management plan prior to the wet season (i.e. by 1 November) and	Review Water Management Plan before wet season (by 1 November) and following wet season (by 1 May)	Review Water Management Plan before wet season (by 1 November) and following wet season

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	a further review following the wet season (i.e. by 1 May the following year) to ensure that proper and effective measures, practices or procedures are in place so that the mine is operated in accordance with the conditions of this environmental authority and that environmental harm is prevented or minimised.		(by 1 May). If required consult with Environment and Mining Services Department as required.
(C11)	A copy of the water management plan and/or a review of the water management plan must be provided to the administering authority on request.	Make available a copy of the Water Management Plan for inspection/review by the administering authority as required.	Ensure that a copy of the Water Management Plan is available should the administering authority request it.
(C12)	**Saline drainage** The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of saline drainage.	Surface and groundwater monitoring in accordance with this EA will alert site should the presence of saline drainage exist.	If the presence of saline drainage occurs, notify Environment and Mining Services Department so measures can be taken to avoid or otherwise minimise generation.
(C13)	**Acid rock drainage** The holder of this environmental authority must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid rock drainage.	Given the nature of the limestone formation and the geography of the site it is highly unlikely that acid rock drainage will be present.	If the presence of acid rock drainage occurs (e.g. low pH), notify Environment and Mining Services Department so measures can be taken to avoid or otherwise minimise generation.
(C14)	**Stormwater and water sediment controls** An erosion and sediment control plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.	Complete	Implement erosion and sediment control measures in association with the erosion and sediment control plan, EA and relevant site operating procedures.
(C15)	The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any receiving waters.	Vehicles, plant and equipment to be cleaned in designated areas to prevent the release of contaminants to receiving waters. In the case of potential hydrocarbon spills, cleaning must be carried out in an area that is contained	Train personnel to clean vehicles, plant and equipment in designated areas to prevent the release of contaminants to receiving waters. In the case of potential hydrocarbon spills, cleaning must be carried out in an area that is contained and drains to an oil water separator e.g. humeceptor located near the workshop.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
		and drains to an oil water separator e.g. humeceptor located near the workshop.	Regular EHS inspection of site for spills, contaminants or other waste materials.
(C16)	Any spillage of wastes, contaminants or other materials must be cleaned up as quickly as practicable to minimise the release of wastes, contaminants or materials to any stormwater drainage system or receiving waters.	Spill kits to be located strategically around site to enable fast spill response.	Staff to be trained in spill response through inductions and toolbox meetings. Signage to be placed on spill kits and instructions on how to appropriately clean up spills. Regular EHS inspection of site for spills, contaminants or other waste materials.
(C17)	**Groundwater** The holder of this environmental authority must develop and implement a groundwater monitoring and management program. The program must: a) be able to detect a significant change to groundwater quality values due to activities that are part of this mining project; b) include measures to minimise the impact of the mining activities on groundwater resources; c) include contingency procedures for emergencies; and d) include a program for monitoring and review of the effectiveness of the groundwater monitoring and management program.	A groundwater monitoring and management program has been developed per EA requirements.	Suitable person/s to implement groundwater monitoring and management program. Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA.
(C18)	When requested by the administering authority, report the results and analysis of groundwater monitoring.	Ground water monitoring results will be maintained in a safe and secure location and be available to the administering authority when requested.	Site to keep accurate ground water monitoring records and be readily available for inspection. Ground water data to be compiled into annual reports that indicate trends and status of compliance.
(C19)	Subject to condition C20, groundwater levels must be monitored and groundwater draw down fluctuations in excess of two metres per year of previously observed maximum seasonal fluctuation, not resulting from the pumping of licensed bores, must be notified as per conditions A9 – A12.	Ground water levels will be monitored as per condition C19.	Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
(C20)	Groundwater must be monitored at the locations and frequencies defined in Table 3 Groundwater monitoring locations and frequency and as shown in Figure 1 Surface and Groundwater monitoring locations.	Groundwater will be monitored as per condition C20.	Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA.
(C21)	If the groundwater contaminant trigger levels defined in Table 4 Groundwater contaminant trigger values are exceeded, an investigation must be completed into the potential for environmental harm and notify the administering authority within 28 days of receiving the analysis results.	An investigation will be completed for values that are exceeded for contaminants in groundwater and notify the administering authority within 28 days.	Site to undertake investigation by appropriately qualified persons for trigger exceedance. Site will notify the administering authority within 28 days of receiving the results.
(C22)	**Background groundwater monitoring program** A background groundwater monitoring program must be developed to include bore(s) that are located an appropriate distance from potential sources of impact from mining activities to provide the following: a) representative groundwater samples from the aquifers potentially affected by mining activities; b) at least eight sampling events (quarterly sampling) to determine background groundwater quality as practicable; c) background groundwater quality in hydraulically isolated background bores(s) that have not been affected by any mining activities; and d) the final groundwater contaminant parameters and trigger levels required for each bore type must be provided according to condition C24.	A groundwater monitoring program has been developed per condition C22.	Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA.
(C23)	The groundwater monitoring data must be reviewed on an annual basis. The review must include the assessment of groundwater levels and water quality data, and the suitability of the monitoring network. The assessment must be submitted to the administering authority within 28 days of receiving the report.	Groundwater monitoring program will be reviewed on an annual basis.	Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA. An annual groundwater monitoring report is to be submitted to the administering authority on an annual basis.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
(C24)	The following information must be recorded in relation to all groundwater water sampling: a) the date on which the sample was taken; b) the time at which the sample was taken; c) the monitoring point at which the sample was taken; and d) the results of all monitoring.	Ensure procedures are in place for recording information in relation to groundwater sampling as listed in condition C25.	Site currently utilises a 3rd party specialist to undertake monitoring and reporting as required by the EA.
Department Interest – Noise and Vibration			
(D1)	**Noise nuisance** Subject to conditions D2 and D3 noise from the mining activity must not cause an environmental nuisance, at any sensitive or commercial place.	The following control strategies will be implemented to minimise noise-related impacts: • all plant and equipment will be regularly maintained which will contribute to minimisation of noise emissions at the source; • a complaint-based investigation and response system will be implemented which will include direct consultation with the complainant for the purpose of resolution, investigative monitoring (where a resolution cannot be achieved) and implementation of relevant mitigation where investigations warrant the need.	Take all reasonable action to ensure that noise from site activities does not cause an environmental nuisance, subject to condition (D2 and D3), at any sensitive place or commercial place.
(D2)	When requested by the administering authority, noise monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or	Carry out noise monitoring within a reasonable and practical timeframe nominated by the administering authority to investigate any noise complaint at any sensitive or commercial place.	When requested by the administering authority the site will monitor for noise within a reasonable and practicable timeframe to investigate any complaint that is neither frivolous nor vexatious. Results will be sent to the administering authority within 14 days.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.		Any complaints arising from noise will be handled internally and in accord with the Sibelco Incident Cause Analysis Method (ICAM).
(D3)	If the environmental authority holder can provide evidence through monitoring that the limits defined in Table 5 and Table 6, are not being exceeded then the holder is not in breach of condition D1. Monitoring must include: a) LA, max adj; T b) relevant background sound level; c) the level and frequency of occurrence of impulsive or tonal noise; d) atmospheric conditions including wind speed and direction; and e) location, date and time of recording.	Carry out noise monitoring to demonstrate that the limits in Tables 5 and 6 are not exceeded.	When requested by the administering authority noise monitoring will be undertaken to demonstrate that the limits defined in Tables 5 and 6 are not exceeded. The noise monitoring program will be conducted in accordance with guidelines published by the administering authority.
(D4)	If monitoring indicates exceedence of the limits in Table 5 and Table 6, then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and b) immediately implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.	Investigate any noise complaint and implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.	Any complaints arising from noise will be handled internally and in accord with the Sibelco Incident Cause Analysis Method (ICAM). Noise abatement measures will be implemented where required so that the emissions from noise will not result in further environmental nuisance.
(D5)	The method of measurement and reporting of noise levels must comply with the latest edition of the administering authority's *Noise Measurement Manual*.	Carry out measurement and reporting of noise levels in compliance with the administering authority's Noise Measurement Manual.	Perform measurements and reporting to comply with the latest version of the administering authority's Noise Measurement Manual.
(D6)	**Vibration nuisance** Subject to Conditions D7 and D8 vibration from the mining activity must not cause an environmental nuisance, at any sensitive place.	The Project is situated in a remote location, with the nearest sensitive or commercial place located approximately 4km from the main quarry so it is anticipated the potential for vibration nuisance is extremely low. However, vibration monitoring will be	If requested by the administering authority conduct vibration monitoring to demonstrate that the limits defined in Schedule D – Table 3 are not exceeded.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
		conducted at a sensitive place if requested by administering authority.	
(D7)	When requested by the administering authority, vibration monitoring must be undertaken within a reasonable and practicable timeframe nominated by the administering authority to investigate any complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer) of environmental nuisance at any sensitive or commercial place, and the results must be notified within 14 days to the administering authority following completion of monitoring.	Carry out vibration monitoring within a reasonable and practical timeframe nominated by the administering authority to investigate any complaint at any sensitive or commercial place.	If requested by the administering authority conduct vibration monitoring within a reasonable and practicable timeframe to investigate any complaint that is neither frivolous nor vexatious. Results are to be sent to the administering authority within 14 days. Any complaints arising from vibration will be handled internally and in accord with the Sibelco Incident Cause Analysis Method (ICAM).
(D8)	If the environmental authority holder can provide evidence through monitoring that the limits defined in Table 7, are not being exceeded then the holder is not in breach of condition D6. Monitoring must include: a) peak particle velocity (mm/s); b) air blast overpressure level (dB linear peak); c) location of the blast/s within the mining area (including which bench level); d) atmospheric conditions including temperature, relative humidity and wind speed and direction; and e) location, date and time of recording.	If requested by the administering authority conduct vibration monitoring at sensitive place to confirm compliance.	If requested by the administering authority conduct vibration monitoring at sensitive place to confirm compliance.
(D9)	For the purposes of condition D6 the mining activities will not cause environmental nuisance where noise from the mining activities does not exceed the criteria specified in Table 7.	If requested by the administering authority conduct vibration monitoring at sensitive place to confirm compliance.	If requested by the administering authority conduct vibration monitoring at sensitive place to confirm compliance.
(D10)	If monitoring indicates exceedance of the limits in Table 7, then the environmental authority holder must: a) address the complaint including the use of appropriate dispute resolution if required; and	Investigate any vibration complaints and implement abatement measures so that the activity does not result in further environmental nuisance.	Any complaints arising from vibration will be handled internally and in accord with the Sibelco Incident Cause Analysis Method (ICAM). Vibration abatement measures will be implemented

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	b) immediately implement noise abatement measures so that emissions of noise from the activity do not result in further environmental nuisance.		where required so that the activity will not result in further environmental nuisance.
(D11)	Every explosive blast for the mining activity shall be designed by a competent person to achieve the criteria specified in Table 6 and Table 7.	Ensure that every explosive blast for mining activity shall be designed by a competent person to achieve the criteria listed in Table 6 and 7.	Utilise licenced explosives contractor to design and conduct explosive blasting on site.
(D12)	All relevant information pertaining to the design of every explosive blast for the mining activity in relation to the criteria specified in Table 6 and Table 7 shall be kept in written and diagrammatic form.	All records shall be securely stored on site and maintain to comply with condition D12.	The site supervisor shall ensure that all relevant information pertaining to the design of every explosive blast for the mining activity is kept in a way that meets condition D12.
Department Interest – Land			
(F1)	**Preventing contaminant release to land** Contaminants must not be released to land in manner which constitutes nuisance, material or serious environmental harm.	• Control mobilisation of contaminants by diversion channels, sediment dams and water quality monitoring. • Land disturbance to be restricted to that which is essential for mining purposes. • Rehabilitate/revegetate disturbed land wherever available to minimise erosion and sediment transport. • Construct and maintain undisturbed catchment diversion drains as necessary ahead of advancing mining operations. • Implement appropriate erosion prevention/controls to minimise sediment transportation by surface runoff. • Implement and maintain an effective settling pond system, operating in closed circuit to the	• Regular inspection and implementation of control measures as necessary including erosion and drainage maintenance. • Desilt settling pond and implement improvements as necessary. • Monitor sediment accumulation in settling ponds/sediment traps and implement regular cleanout and sediment disposal actions. • Flammable and combustible liquids contained in bunded areas.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
		extent practicable, to accept water from processing plant operations. • Appropriate bunding of fuel storage and hydrocarbon areas.	
(F2)	**Fire prevention** All reasonable and practicable fire prevention measures must be implemented.	Fire prevention managed through Emergency Response Plan and general site-specific inductions.	• Appropriate fire safety equipment should be installed and maintained regularly. • Signage erected and free from obstruction.
(F3)	**Topsoil** Topsoil must be strategically stripped ahead of mining in accordance with a topsoil management plan.	Manage topsoil per EA and Plan of Operations requirements.	Ensure that earthworks and rehabilitation workers are familiar with the management of topsoil, including stripping, handling and storing of topsoil.
(F4)	A topsoil inventory which identifies the topsoil requirements for the Frost Enterprises Calliope Limestone Mine and availability of suitable topsoil on site must be detailed in the Plan of Operations.	Mining Services manages the topsoil inventory per EA and Plan of Operations requirements.	Manage topsoil inventory per EA and Plan of Operations requirements.
(F5)	**Rehabilitation landform criteria** All areas significantly disturbed by mining activities must be rehabilitated to a stable landform with a self-sustaining vegetation cover in accordance with Table 8 and Table 9.	Mining Services manages mining disturbance and rehabilitation per EA and Plan of Operations requirements.	Monitoring of significantly disturbed land by mining activities to be undertaken by competent person (e.g. Mining Services).
(F6)	Progressive rehabilitation must commence when areas become available within the operational land.	Progressive rehab opportunities have been identified within this Plan of Operations.	Site to ensure that progressive rehab is undertaken on a regular basis as defined in the Plan of Operations. Progressive rehab is to occur in a timely manner. Should further areas of disturbed land become available and deemed suitable, additional rehabilitation will occur.
(F7)	Areas which are to be rehabilitated to native ecosystem must achieve a self-sustaining native ecosystem with species composition and distribution similar to an analogue site or another suitable alternative approved by the administering authority.	Rehabilitate land to to achieve a self-sustaining native ecosystem with species composition and distribution similar to an analogue site.	Rehabilitate land to to achieve a self-sustaining native ecosystem with species composition and distribution similar to an analogue site.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
(F8)	Areas to be rehabilitated must be rehabilitated to the landform design criteria defined in Table 9 and the landforms must be stable.	Mining Services manages rehabilitation and landform design criteria per EA and Plan of Operations requirements.	Mining Services manages rehabilitation and landform design criteria per EA and Plan of Operations requirements.
(F9)	Where reasonable and practicable, areas of the site where grazing is nominated as the post-mine land use must include native grass species endemic to the area.	Where reasonable and practicable, include native grass species endemic to the area for nominated post mine land use.	Rehabilitate areas of the site where grazing is nominated as the post-mine land use with native grass species endemic to the area, once the area becomes available for rehabilitation.
(F10)	**Residual void outcome** Residual voids must comply with the following outcomes: a) Residual voids must not cause any serious environmental harm to land, surface waters or any recognised groundwater aquifer, other than the environmental harm constituted by the existence of the residual void itself and subject to any other condition within this environmental authority; and b) Residual voids must comply with Table 10.	Mining Services manages mining disturbance and rehabilitation per EA and Plan of Operations requirements, including design of residual voids. Ensure that residual voids comply with the outcomes in F12 and are managed through the Plan of Operations.	No final residual void will be created during the term of this Plan.
(F11)	**General** The environmental management plan and plan of operations must be consistent with the geotechnical and erosivity assessment within three months of the completion of the assessment outlined in condition F10.	Complete	Mining Services manages mining disturbance and rehabilitation per EA and Plan of Operations requirements, including geotechnical and erosivity assessments.
(F12)	Cleared vegetation from the site must be managed in accordance with the following hierarchy: a) reuse, e.g. use of logs and tree stumps as shelter for fauna in rehabilitated areas; b) recycle, e.g. mulching of vegetation and use in rehabilitation on the site; and c) other alternative management options implemented in a way that causes the least amount of environmental harm.	Manage clearance activities in accordance with EA Condition F12 requirements.	Train operators in the management of clearance activities in accordance with EA Condition F12 requirements.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
(F13)	A weed management plan must be developed and implemented. The weed management plan must describe how the weeds are to be managed in accordance with the *Land Protection (Pest and Stock Route Management) Act 2002* and/or local government requirements for weeds not declared under state legislation.	Perform weed management activities in association with the weed management plan.	Implement weed management plan.
(F14)	**Infrastructure** All infrastructure constructed by or for the environmental authority holder during the licensed activities including water storage structures, must be removed from the site prior to surrender, except where agreed in writing by the post mining land owner / holder. Note: *This is not applicable where the landowner / holder is also the environmental authority holder.*	The Project is not anticipated to close during the term of this Plan of Operations. However, if this occurs the removal of infrastructure will occur in conjunction with EA Condition F14. The environmental authority holder is the landowner where current infrastructure is located. Any future mine closure plan will address site infrastructure decommissioning and removal issues.	The environmental authority holder is the landowner where current infrastructure is located. Any future mine closure plan will address site infrastructure decommissioning and removal issues.
(F15)	**Exploration** Disturbance due to exploration activities in areas not authorised to be mined must be rehabilitated in accordance with provisions detailed in the Code of Environmental Compliance for Exploration and Mineral Development Projects.	Disturbance to be rehabilitated in accordance with the code as per EA Condition F18.	Disturbance to be rehabilitated in accordance with the code as per EA Condition F18.
Department Interest – Waste			
(E1)	**Storage of tyres** Scrap tyres stored awaiting disposal or transport for take-back and recycling, or waste-to-energy options must be stored in stable stacks and at least 10 metres from any other scrap tyre storage area, or	Implement tyre storage measures as required by EA conditions.	Regular inspection and implementation of control measures as necessary. Establish dedicated tyre stores areas. Storage to align with EA Condition requirements

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	combustible or flammable material, including vegetation.		
(E2)	All reasonable and practicable fire prevention measures must be implemented, including removal of grass and other materials within a 10-metre radius of the scrap tyre storage area.	Implement fire prevention measures as required by EA condition.	Regular inspection and implementation of control measures as necessary to ensure a minimum of 10m between tyres and other materials.
(E3)	Where no feasible recycling or waste-to-energy options are available, disposing of scrap tyres resulting from the mining activities in spoil emplacements is acceptable, provided tyres are placed as deep in the spoil as reasonably practicable.	Manage tyre disposal to avoid using control strategy condition E3 where possible.	If necessary dispose of tyres in accordance with condition E3.
(E4)	Scrap tyres resulting from the mining activities disposed within the operational land must not impede saturated aquifers or compromise the stability of the consolidated landform.	Consult with appropriately qualified persons to ensure that scrap tyres that are disposed of within the operational land do not impede saturated aquifers or compromise the stability of the consolidated landform.	Site to ensure that condition E4 is complied with in respect to saturated aquifers and stability of the consolidated landform.
(E5)	Where possible and practical, vegetation waste from clearing shall be spread on rehabilitated areas. Vegetation waste only may be burnt as a last resort and only if there is minimal risk of causing nuisance to the neighbouring sensitive receptors. General waste must not be burnt or allowed to burn on the licensed site unless permitted by the administering authority.	Where possible and practical spread vegetation waste on rehabilitated areas. If burning vegetation waste consider this as a last resort and manage activities to minimise risk of causing nuisance to the neighbouring sensitive receptors.	Where possible and practical spread vegetation waste on rehabilitated areas. If burning vegetation waste consider this as a last resort and manage activities to minimise risk of causing nuisance to the neighbouring sensitive receptors.
(E6)	All regulated waste removed from the site must be removed by a person who holds a current approval to transport such waste under the provisions of the *Environmental Protection Act 1994*.	Engage licenced waste contractor to remove regulated waste.	Licenced waste contractor manages the removal of regulated waste.
(E7)	Regulated waste must only be removed to a facility licensed under the *Environmental Protection Act 1994* to receive such waste.	Engage licenced waste contractor to remove regulated waste.	Licenced waste contractor manages the removal of regulated waste.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
Department Interest – Dams			
(G1)	**All dams** The holder of this environmental authority must ensure that dams are designed, constructed, operated and maintained in accordance with accepted engineering standards.	Dam design, construction and maintenance is managed in consultation with Mining Services. Silt ponds are inspected regularly e.g. monthly and drain internally to prevent runoff from site.	Silt ponds inspected regularly e.g. monthly and desilted as required.
(G2)	Except for dams affected by condition G3, the hazard category of dams must be assessed by a suitably qualified and experienced person prior to their construction, and then not less frequently than on an annual basis.	SKM was commissioned in November 2013 to undertake an assessment of the hazard and consequence category of all existing structures at the Project. The assessment was undertaken by Registered Professional Engineers Queensland (RPEQ) from SKM (SKM 2013). All existing structures on the mine site were assessed as low consequence category.	All future structures to be designed using the same principals as those used for existing structures and as assessed by SKM.
(G3)	The hazard category of dams constructed prior to grant of this environmental authority, must be assessed by a suitably qualified and experienced person within six months of this environmental authority taking effect, and not less frequently than on an annual basis.	Completed by SKM in 2013.	Completed by SKM in 2013.
(G4)	Where the hazard category of a dam is assessed as significant or high, the holder of the environmental authority must act immediately to ensure: a) the administering authority is advised of the current location and details of that dam, and	SKM assessed in 2013 that there are no significant or high hazard category dams on site.	There are no significant or high hazard category dams on site.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	b) that dam meets the hydraulic performance required of the assessed hazard category within six months of that assessment.		
(G5)	The condition of dams must be monitored for early signs of loss of structural or hydraulic integrity, based on the advice of a suitably qualified and experienced person. The methods of monitoring and frequency of monitoring shall be as assessed by that suitably qualified and experienced person, based on the hazard category and particular circumstances of each dam.	Mining Services and site monitors dams for early signs of loss of structural or hydraulic integrity. In 2013 SKM assessed that there are no significant or high hazard category dams on site.	Mining Services and site to monitor dams for early signs of loss of structural or hydraulic integrity.
(G6)	In the event of early signs of loss of structural or hydraulic integrity, the holder of this environmental authority must immediately take action to prevent or minimise any actual or potential environmental harm and report in writing any findings and actions taken to the administering authority within 28 days.	Should early signs of loss of structural or hydraulic integrity be identified immediate action is to be taken to prevent or minimise actual or potential harm with the findings and actions reported to the administering authority within 28 days.	Should early signs of loss of structural or hydraulic integrity be identified immediate action is to be taken to prevent or minimise actual or potential harm with the findings and actions reported to the administering authority within 28 days.
(G7)	The holder of this environmental authority must decommission each dam to a situation where ongoing environmental harm is prevented.	The Project is not anticipated to close during the term of this Plan of Operations. However, if this occurs the decommissioning of dams are to occur to ensure environmental harm is prevented.	If dams are decommissioned consult Environment and Mining Services departments to ensure environmental harm is prevented.
(G8)	As a minimum, dams must be decommissioned such that they: a) no longer contain flowable substances b) become stable landforms; and c) comply with the rehabilitation requirements of this environmental authority.	The Project is not anticipated to close during the term of this Plan of Operations. However, if this occurs the decommissioning of dams are to occur to ensure compliance with EA Condition G8 and environmental harm is prevented.	If dams are decommissioned consult Environment and Mining Services departments to ensure compliance with EA Condition G8 occurs and environmental harm is prevented.
(G9)	The holder of this environmental authority must ensure that, where a current operational plan covers	The Project is not anticipated to close during the term of this Plan of Operations.	The Project is not anticipated to close during the term of this Plan of Operations.

Condition #	Environmental Authority Condition	Control Strategy	Action Program
	decommissioning and rehabilitation, those operations are consistent with the objectives in any design plan for the dam.		
(G10)	The annual inspection may be conducted as early as 1 September each year, but not later than 1 November each year, except that the assessment of adequacy of available storage in a dam must be based on dam levels observed within the month of October in the year that the inspection is conducted.	Advice on the requirement of this condition was sought from the administering authority in 2014, due to the issue of new guideline EM634. Feedback from the administering authority indicated the current structures guideline and model conditions (em634) only requires annual reporting for 'regulated structures'; i.e. those with a consequence category of significant or high and that the model conditions only require existing dams be re-assessed should there be a change in purpose or the nature of stored contents. In 2013 SKM assessed that there are no significant or high hazard category dams on site. There has been no change in purpose of the stored contents.	Should there be a change in purpose or the nature of stored contents of dams reassessment by a 3rd party needs to occur. All future structures to be designed using the same principals as those used for existing structures and as assessed by SKM.
Department Interest – Community			
(H1)	**Complaint response** All complaints received must be recorded including investigations undertaken, conclusions formed and actions taken. This information must be made available for inspection by the administering authority on request.	The Sibelco Incident Cause Analysis Method (ICAM) is in place and will be utilised to record all complaints received, investigations undertaken, conclusions formed and action taken.	The Sibelco Incident Cause Analysis Method (ICAM) is in place and will be utilised to record all complaints received including details of complainant, reasons for the complaint, investigations undertaken, conclusions formed and actions taken. This information will be made

Condition #	Environmental Authority Condition	Control Strategy	Action Program
			available to the administering authority upon request.
(H2)	The holder of this environmental authority must record the following details for all complaints received and provide this information to the administering authority on request: a) time, date, name and contact details of the complainant; b) reason for the complaint; c) conclusions formed; and d) any actions taken.	If a complaint is received the information required by EA Condition H2 is to be provided to the administering authority upon request.	If a complaint is received record the information required by EA Condition H2 and provide to the administering authority upon request.

5 REHABILITATION PROGRAM

5.1 SCHEDULE OF REHABILITATION WORKS

This section provides a general outline to the method and schedule of annual rehabilitation works and the financial assurance required by the administering authority for this Plan of Operations.

Due to the current disturbance footprint and continued expansion of the working mine pits, there is limited availability to complete significant areas of rehabilitation during the term of this Plan. However, 1.45ha has been scheduled to have topsoil spread and be seeded on ML3595 and ML80190 during Years 1 and 2 of this Plan of Operations period.

Should further areas of disturbed land become available and deemed suitable, additional rehabilitation will occur.

5.2 TOPSOIL

Topsoil is stripped ahead of mining and is generally used to create safety bunds on the pit edge. Topsoil is also stored in stockpiles shown in Appendix 2. Stockpiles are built less than 2 metres in height and are seeded if they are to be stored for a long period.

Areas requiring topsoil at the end of the operation's life include the stockpile areas, infrastructure areas and spoil dumps. The total estimate tonnage required is around 50,000bcm. It should be noted there are a number of spoil dumps on site which contain a high proportion of clay and soil. It is anticipated that these dumps can be processed to recover enough material to cover the required areas. The recovered material is considered to be a good growing medium with regrowth already established on a number of areas.

5.3 AREAS AND TYPES OF DISTURBED LAND

The current disturbance types and areas of disturbance for each of the project leases are summarised in Table 4, as well as the projected disturbance types and areas to be disturbed for the project through the period covered by this Plan of Operations. The maximum year of disturbance has been calculated to be Year 5 (2022-2023).

Table 4: Summary of Projected Disturbance Types and Rehabilitation

Area Category	Year 0: as at June 2018	Year 1: 1/07/18 - 30/06/19	Year 2: 1/07/19 - 30/06/20	Year 3: 1/07/20 - 30/06/21	Year 4: 1/07/21 - 30/06/22	Year 5: 1/07/22 - 30/06/23
Combined Mining Leases	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**	**Area (ha)**
A. Total Lease Area (A = B + C + D)						
ML3594	32.37	32.37	32.37	32.37	32.37	32.37
ML3595	13.49	13.49	13.49	13.49	13.49	13.49
ML3596	9.1	9.1	9.1	9.1	9.1	9.1
ML3597	2.83	2.83	2.83	2.83	2.83	2.83
ML3598	12.448	12.448	12.448	12.448	12.448	12.448
ML3599	6.798	6.798	6.798	6.798	6.798	6.798
ML3600	8.093	8.093	8.093	8.093	8.093	8.093
ML3604	4.85	4.85	4.85	4.85	4.85	4.85
ML80036	18.73	18.73	18.73	18.73	18.73	18.73
ML 3602	10.23	10.23	10.23	10.23	10.23	10.23
ML 3603	8.34	8.34	8.34	8.34	8.34	8.34
ML 3605	9.45	9.45	9.45	9.45	9.45	9.45
ML 3606	5.61	5.61	5.61	5.61	5.61	5.61
ML 3608	57.14	57.14	57.14	57.14	57.14	57.14
ML 3609	43	43	43	43	43	43
ML 80189	36.05	36.05	36.05	36.05	36.05	36.05
ML 80190	22.5	22.5	22.5	22.5	22.5	22.5
ML 80191	1.6	1.6	1.6	1.6	1.6	1.6
ML 80192	121.5	121.5	121.5	121.5	121.5	121.5
Total	**424.129**	**424.129**	**424.129**	**424.129**	**424.129**	**424.129**
B. Undisturbed Area						
ML3594	2.67	2.67	2.67	2.67	2.67	2.67
ML3595	2.16	2.16	2.16	2.16	2.16	2.16
ML3596	8.85	8.85	8.85	8.85	8.85	8.85
ML3597	2.83	2.83	2.83	2.83	2.83	2.83
ML3598	12.448	12.448	12.448	12.448	12.448	12.448
ML3599	6.798	6.798	6.798	6.798	6.798	6.798
ML3600	8.093	8.093	8.093	8.093	8.093	8.093
ML3604	0.76	0.76	0.76	0.76	0.76	0.76
ML80036	10.41	10.41	10.41	10.41	10.41	10.41
ML 3602	7.47	7.47	7.47	7.47	7.47	7.47
ML 3603	2	2	2	2	2	2
ML 3605	9.45	9.45	9.45	9.45	9.45	9.45
ML 3606	5.61	5.61	5.61	5.61	5.61	5.61
ML 3608	39.41	39.41	39.41	39.41	39.41	39
ML 3609	42.36	42.36	42.36	42.36	42.36	42.36
ML 80189	27.88	27.88	27.88	27.88	27.88	27.88
ML 80190	5.66	5.65	5.66	5.63	5.65	5.39

Area Category	Year 0: as at June 2018	Year 1: 1/07/18 - 30/06/19	Year 2: 1/07/19 - 30/06/20	Year 3: 1/07/20 - 30/06/21	Year 4: 1/07/21 - 30/06/22	Year 5: 1/07/22 - 30/06/23
ML 80191	0.23	0.23	0.23	0.23	0.23	0.23
ML 80192	98.4	98.4	98.4	98.4	98.4	98.4
Total	**293.489**	**293.479**	**293.489**	**293.459**	**293.479**	**292.809**
C. Cleared Area						
ML3594	0	0	0	0	0	0
ML3595	0	0	0	0	0	0
ML3596	0	0	0	0	0	0
ML3597	0	0	0	0	0	0
ML3598	0	0	0	0	0	0
ML3599	0	0	0	0	0	0
ML3600	0	0	0	0	0	0
ML3604	0	0	0	0	0	0
ML80036	0	0	0	0	0	0
ML 3602	0	0	0	0	0	0
ML 3603	0	0	0	0	0	0
ML 3605	0	0	0	0	0	0
ML 3606	0	0	0	0	0	0
ML 3608	0	0	0	0	0	0
ML 3609	0	0	0	0	0	0
ML 80189	0	0	0	0	0	0
ML 80190	0	0	0	0	0	0
ML 80191	0	0	0	0	0	0
ML 80192	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
D. Total Area of Significant Disturbance						
(D = D1 + D2 + D3)	**130.64**	**130.65**	**130.64**	**130.67**	**130.65**	**131.32**
ML3594	29.7	29.7	29.7	29.7	29.7	29.7
ML3595	11.33	11.33	11.33	11.33	11.33	11.33
ML3596	0.25	0.25	0.25	0.25	0.25	0.25
ML3597	0	0	0	0	0	0
ML3598	0	0	0	0	0	0
ML3599	0	0	0	0	0	0
ML3600	0	0	0	0	0	0
ML3602	2.76	2.76	2.76	2.76	2.76	2.76
ML3603	6.34	6.34	6.34	6.34	6.34	6.34
ML3604	4.09	4.09	4.09	4.09	4.09	4.09
ML3605	0	0	0	0	0	0
ML3606	0	0	0	0	0	0
ML3608	17.73	17.73	17.73	17.73	17.73	18.14
ML3609	0.64	0.64	0.64	0.64	0.64	0.64
ML80036	8.32	8.32	8.32	8.32	8.32	8.32
ML80189	8.17	8.17	8.17	8.17	8.17	8.17

Area Category	Year 0: as at June 2018	Year 1: 1/07/18 - 30/06/19	Year 2: 1/07/19 - 30/06/20	Year 3: 1/07/20 - 30/06/21	Year 4: 1/07/21 - 30/06/22	Year 5: 1/07/22 - 30/06/23
ML80190	16.84	16.85	16.84	16.87	16.85	17.11
ML80191	1.37	1.37	1.37	1.37	1.37	1.37
ML80192	23.1	23.1	23.1	23.1	23.1	23.1
Total	**130.64**	**130.65**	**130.64**	**130.67**	**130.65**	**131.32**
D1 Disturbance Category						
Active Pit - Above water	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**	**6.01**
ML3603	0.58	0.58	0.58	0.58	0.58	0.58
ML3604	0.23	0.23	0.23	0.23	0.23	0.23
ML3608	0.55	0.55	0.55	0.55	0.55	0.55
ML80192	4.65	4.65	4.65	4.65	4.65	4.65
Active Pit - Below water	**51.9**	**53.21**	**53.21**	**54.27**	**54.99**	**55.82**
ML3594	26.9	26.9	26.9	26.9	26.9	26.9
ML3604	3.79	3.79	3.79	3.79	3.79	3.79
ML3608	12.25	12.25	12.25	12.25	12.25	12.72
ML80190	5.43	6.74	6.74	7.8	8.52	8.88
ML80192	3.53	3.53	3.53	3.53	3.53	3.53
Infrastructure	**4.88**	**4.88**	**4.88**	**4.88**	**4.88**	**4.88**
ML3603	4.31	4.31	4.31	4.31	4.31	4.31
ML 80192	0.57	0.57	0.57	0.57	0.57	0.57
Roads	**20.82**	**20.53**	**20.53**	**20.34**	**19.94**	**19.86**
ML3594	0.74	0.74	0.74	0.74	0.74	0.74
ML3595	2.6	2.6	2.6	2.6	2.6	2.6
ML3596	0.25	0.25	0.25	0.25	0.25	0.25
ML3602	1.46	1.46	1.46	1.46	1.46	1.46
ML3603	0.84	0.84	0.84	0.84	0.84	0.84
ML3608	3.9	3.9	3.9	3.9	3.9	3.84
ML3609	0.56	0.56	0.56	0.56	0.56	0.56
ML80036	0.82	0.82	0.82	0.82	0.82	0.82
ML80189	0.79	0.79	0.79	0.79	0.79	0.79
ML80190	2.86	2.57	2.57	2.38	1.98	1.96
ML80191	0.47	0.47	0.47	0.47	0.47	0.47
ML80192	5.53	5.53	5.53	5.53	5.53	5.53
Spoil Piles	**25.7**	**25.68**	**25.67**	**25.07**	**24.73**	**24.72**
ML3595	6.25	6.25	6.25	6.25	6.25	6.25
ML3608	1.03	1.03	1.03	1.03	1.03	1.03
ML3609	0.08	0.08	0.08	0.08	0.08	0.08
ML80036	7.5	7.5	7.5	7.5	7.5	7.5
ML80189	7.38	7.38	7.38	7.38	7.38	7.38
ML80190	1.71	1.69	1.68	1.08	0.74	0.73
ML80191	0.9	0.9	0.9	0.9	0.9	0.9
ML80192	0.85	0.85	0.85	0.85	0.85	0.85

Area Category	Year 0: as at June 2018	Year 1: 1/07/18 - 30/06/19	Year 2: 1/07/19 - 30/06/20	Year 3: 1/07/20 - 30/06/21	Year 4: 1/07/21 - 30/06/22	Year 5: 1/07/22 - 30/06/23
Stockpile Areas	**13.7**	**11.26**	**11.26**	**11.02**	**11.02**	**10.95**
ML3594	2.06	2.06	2.06	2.06	2.06	2.06
ML3595	2.07	1.09	1.09	1.09	1.09	1.09
ML3602	1.3	1.3	1.3	1.3	1.3	1.3
ML3603	0.61	0.61	0.61	0.61	0.61	0.61
ML80190	6.32	4.86	4.86	4.62	4.62	4.55
ML80192	1.34	1.34	1.34	1.34	1.34	1.34
Tailings Dam	**0.73**	**0.73**	**0.73**	**0.73**	**0.73**	**0.73**
ML80192	0.73	0.73	0.73	0.73	0.73	0.73
Top Soil Stockpiles	**1**	**1**	**1**	**1**	**1**	**1**
ML3604	0.07	0.07	0.07	0.07	0.07	0.07
ML3595	0.41	0.41	0.41	0.41	0.41	0.41
ML80190	0.52	0.52	0.52	0.52	0.52	0.52
Contaminated Land Remediation	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
ML80192	0.3	0.3	0.3	0.3	0.3	0.3
D2 Rehabilitation Category						
Recontoured	**0**	**0**	**0**	**0**	**0**	**0**
Topsoiled	**0**	**1.45**	**0**	**0**	**0**	**0**
ML3595		0.98				
ML80190		0.47				
Seeded	**0**	**0**	**1.45**	**0**	**0**	**0**
ML3595			0.98			
ML80190			0.47			
Established - Year 1	**0**	**0**	**0**	**1.45**	**0**	**0**
ML3595				0.98		
ML80190				0.47		
Year 2	**0**	**0**	**0**	**0**	**1.45**	**0**
ML3595					0.98	
ML80190					0.47	
Year 3	**6.17**	**6.17**	**6.17**	**6.17**	**6.17**	**7.62**
ML3595						0.98
ML80190						0.47
D3 Successfully Rehabilitated	**0**	**0**	**0**	**0**	**0**	**0**

5.4 THIRD PARTY QUOTE FOR REHABILITATION OF WORKSHOP & LAYDOWN AREAS

A third-party quote has been received to determine the financial assurance cost liability to clean up the workshop and laydown areas at site. This amount has been allocated within the financial assurance calculations provided with this Plan of Operations submission.



ZEBRA METALS
Environmental Services

Quote

13nd April 2018

To Whom It May Concern,

Zebra Metals & Environmental Services will clean up the10,100 sq m. Sibelco graveyard site and workshop area. The project would be estimated to be completed within two week after the site inductions are completed as long as there are not outside factors prohibiting work to be completed. During the duration of the clean-up Zebra Metals & Environmental Services will have one excavator, two trucks, equalling two employees on site. All scrap metal will be removed from site and recycled under Zebra Metals & Environmental Services(EPA # 0540000017). The Total cost of this job is $19,500+gst. This cost covers labour, equipment, trucking, fuel, accommodation and any other incidentals.
The quote is valid from Jan 1st 2018 till Dec 31st 2019. If there are any questions please do not hesitate to ask.

Labour Cost $6,000 + gst
Equipment Hire and Fuel $8,000 + gst
Trucking and Fuel $5,500 + gst

Kind Regards

William P Ross
Trading and Marketing Manager

Masters Of Metal Management
PO Box 70, Gracemere, QLD 4702 | 227 Somerset Road, Gracemere, QLD 4702
Telephone: (07) 4933 3333 | Fax: (07) 4933 1544 | Email: info@zebrametals.com.au
www.zebrametals.com.au
ABN: 89 108 897 445

Figure 2: Quote from 3rd Party to Rehabilitate Workshop and Laydown Areas

5.5 FINANCIAL ASSURANCE REQUIRED

The estimated total gross financial assurance liability for the period covered by this Plan of Operations is summarised in Table 5 using the administering authority's FA calculator for an open cut mine. The full calculations can be found in spreadsheet included with this submission.

In accordance with the DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994,* ESR/2015/1758 – Version 3.00, the gross financial assurance liability is determined from the cost of rehabilitation of all outstanding significantly disturbed areas after decommissioning of infrastructure not otherwise approved to remain. All current disturbance types have been included for the purpose of this financial assurance calculation as types of infrastructure to remain on site (if any) is yet to be determined. Prior to surrender of disturbed areas, SAL is required to decommission and remove all infrastructure associated with its operations (EA condition F14) except where agreed in writing by the post mining land owner/holder.

The total rehabilitation liability has:

- Been calculated on a project basis;
- Been calculated for all land that has been or is proposed to be significantly disturbed;
- Been based on the rehabilitation costs for the year in which the maximum liability is incurred within the nominated disturbance period;
- Costs from the administering authority's FA calculator have been used; and
- Includes the following activities;
    - Terminate, decommission and remove all infrastructure and services;
    - Constituent tasks or activities required for rehabilitation;
    - Project management costs of 10%;
    - Maintenance and monitoring costs of 5%; and
    - The cost of a site investigation report.

Table 5: Cost to Rehabilitate all Mining Leases during the period of the Plan of Operations.

Summary Report of Financial Assurance Estimator

Environmental Authority Num	EPML00969013
Tenure Numbers:	ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3604, ML80036, ML3602,
Site Name (if applicable):	Frost Enterprises Pty Ltd
EA Holder:	Frost Enterprises Pty Ltd
Current Financial Assurance Amount:	$2,488,700.00
Date of Last Financial Assurance Revie	7 August 2013
Site Contact:	Mr Simon Havis
Position:	Operations Superintendent
Address:	MS 24 Taragoola Road Calliope QLD 4680
Phone:	07 4975 7144
Email:	Simon.Havis@sibelco.com.au

Domain	Rehabilitation Liability
Domain 1: Infrastructure	$2,286,121
Domain 2: Waste	$255,169
Domain 3: Other Management Issues	$0
Subtotal	**$2,541,290**

Contingencies		Rehabilitation Liability
Project Management	10%	$254,129
Environmental Maintenance and Monitoring	5%	$127,064
Subtotal		**$381,193**

Total Rehabilitation Liability for the Operation (excl. GST)	**$2,922,483**

This is an accurate assessment of the rehabilitation liability for the site.

Mathew Stewart Ross	Senior Mine Planner	30/05/2018
Assessment Completed By	**Title**	**Date:**
Simon Havis	Operations Superintendent	30/05/2018
Site Manager	**Title**	**Date:**

A discount on the financial assurance is available under particular circumstances. The environmental performance criteria for mining lease projects are found in the DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994,* ESR/2015/1758 – Version 3.00. SAL is applying for a discounted Financial Assurance during the term of this plan. The following is submitted to address the requirements in Tables 1-4 of Appendix B of the guideline to determine the appropriate level of discount.

FA Guideline – Table 1 Mandatory pre-requisite - Responses

Mandatory Pre-requisites	Response
General	• FA has been calculated using the EHP financial assurance calculator in accordance with Appendix A of the Guideline – *Financial Assurance under the Environmental Protection Act 1994,* ESR/2015/1758 – Version 3.00. • The conditions in Environmental Authority EPML00969013 - Department Interest General are worded in such a way to trigger review of the FA as a result of an event or change in circumstances.
Financial Standing	• The latest annual fees for EA EPML00969013 were paid in April 2018 and are up to date. • The EA holder is solvent. ASIC company search results for the EA holder Frost Enterprises Pty Ltd is supplied to accompany this Plan of Operations. ASIC search results for the parent company of the EA holders, Sibelco Australia Limited is also supplied. • The Sibelco Australia Limited (owner of the EA holders) Financial Reports for the years ending 31 December 2015 and 31 December 2016 demonstrating the financial standing of the group is supplied.
Environmental Performance	• In the past two years there have been no relevant compliance actions as defined in the guideline.

FA Guideline – Table 2 Financial Discount Responses

Discount Description	Response	Discount eligibility confirmed and discount claimed
1. Financial		
A 10% discount for demonstrating sound financial health and adequate budgeting for the scheduled rehabilitation in the forthcoming FA period.	• Previous two years financial statements for the year ended 31 December 2015 and 31 December 2016, which have been audited by *a suitably qualified financial auditor* are supplied. • A Statutory Declaration (EM1266) signed by the company Chief Financial Officer is supplied stating that: 1. The information provided is accurate, complete and not misleading;	YES 10%

	2. The costs of scheduled rehabilitation (in the upcoming FA period) have been budgeted for; and 3. The entity can pay its debts if and when they fall due.	
2. Progressive rehabilitation & certification		
(AVOID) A 10% discount for avoiding any impacts to remnant vegetation.	• No impacts to remnant vegetation are proposed during the term of the Plan of Operations, therefore no impacts to remnant vegetation will occur. • The EA does not have a condition relating to impacts to remnant vegetation	NO
(STABILISE) A 10% discount for undertaking proactive rehabilitation work to reduce the total area of disturbance (irrespective of final land use).	• All areas disturbed for mining production that have not been designated to service current or future operational requirements have been re-vegetated. Remaining disturbed areas can only be rehabilitated as they are released from ongoing operational requirements and deemed to be available for re-vegetation.	NO
(RESTORE) A 10% discount for undertaking proactive revegetation of a woody regional ecosystem.	• There has been no proactive revegetation of woody regional ecosystem.	NO
(CERTIFY) A 10% discount for progressive certification.	• Progressive certification has not been sought to date.	NO
3. Waste Management		
(LOW RISK) A 10% discount for only undertaking activities that are considered to have a low environmental risk.	• Not Applicable	NO
(HIGH RISK) A 10% discount for undertaking activities that reduce the amount of waste stored	• Not Applicable	NO

onsite (10% discount for each waste management measure).		

The responses above to the requirements of Appendix B of the guideline have been used to determine the total level of discount that is applied for the financial assurance that will be lodged based on the calculation in this Plan of Operations. A 10% discount is being claimed for the term of the Plan of Operations.

Consequently, the financial assurance required is calculated in accordance with the following formula (from DEHP Guideline – *Financial Assurance under the Environmental Protection Act 1994,* ESR/2015/1758 – Version 3.00*:*

Financial Assurance (FA) Required = Gross FA Liability x (100-Discount Rate) / 100
= $2,922,483 x (100-10)/100
= $2,630,234.7

6 ENVIRONMENTAL COMPLIANCE STATEMENT

6.1 INTRODUCTION

This compliance statement has been prepared in accordance with Section 288 (3) of the EP Act to state the extent to which this replacement Plan of Operations complies with the conditions of Environmental Authority EPML00969013 and to confirm that the calculation method for the financial assurance is in accordance with section 295 (3) of the EP Act. This compliance statement has been prepared in two parts.

Part A deals with the extent that the 2018 - 2023 replacement Plan of Operations complies with the conditions of Environmental Authority EPML00969013 (excluding Schedule A – Financial Assurance Conditions A1 to A2). Part A was completed by Chris Mann.

Part B confirms that the calculation method for the financial assurance is in accordance with the DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994*, ESR/2015/1758 – Version 3.00. Part B was completed by Chris Mann.

6.2 COMPLIANCE STATEMENT – PART A

I, the auditor (Part A), confirm the documentation and evidence considered in this Audit demonstrate that this Plan of Operations generally conforms with the Environmental Authority Conditions for EPML00969013 to the extent that the conditions are relevant to the activities to be undertaken during the term of this Plan of Operations.

Auditor's Name:	**Chris Mann**
Auditor's Credentials:	Bachelor of Engineering (Environment) and Bachelor of Science, Degree qualified with over 8-years environmental management experience in Australia.
Relationship to EA Holder:	**Sibelco Australia Limited - Senior Environmental Advisor**
Date of Audit:	30 May 2018
Method of Audit:	Review of supporting documentation (Environmental Authority Monitoring Data and other records)
Mining Project Name:	Frost Enterprises Pty Ltd Taragoola Limestone Project, managed by Sibelco Australia Limited
EA Number/s:	EPML00969013
Mining Lease Numbers:	ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192

AUDIT PROCESS – PART A

Action Program

The documentation and evidence considered in this Audit demonstrate that the Action Program within this Plan of Operations conforms with the Environmental Authority Conditions to the extent

that the conditions are relevant to the activities to be undertaken during the term of this Plan of Operations.

Rehabilitation Program

The type and areas of disturbance listed in this Plan of Operations are consistent with the Environmental Authority. The estimates in this Plan of Operations of the areas to be disturbed appear to be correct. Sibelco Australia Limited have calculated the areas that have been disturbed and will be rehabilitated.

The EA conditions for EPML00969013 are included sequentially and have individually addressed the corresponding action or actions related to the particular EA conditions.

Financial Assurance Discount System

The DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994*, ESR/2015/1758 – Version 3.00 has been consulted to determine a discount in financial assurance. SAL is applying for a discounted Financial Assurance during the term of this plan and has supplied the relevant evidence to support this discount.

CONCLUDING REMARKS AND CERTIFICATION

I Chris Mann, being aware that it is an offence under Section 480 of the *Environmental Protection Act 1994* to provide false or misleading information, state that:

- I am authorised to sign on behalf of the person (meaning a corporation or individual) holding the Environmental Authority;
- All information provided is true and complete; and
- I understand that information given with this Plan of Operations and Audit Statement could become available to the public in accordance with the *Environmental Protection Act 1994* and *Freedom of Information Act 1992*.

Signed:  Date: 30 May 2018

6.3 COMPLIANCE STATEMENT – PART B

I, the auditor (Part B), confirm the documentation and evidence considered in this Audit demonstrate that the calculation method used for the financial assurance is in accordance with the DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994*, ESR/2015/1758 – Version 3.00.

Auditor's Name:	**Chris Mann**
Auditor's Credentials:	Bachelor of Engineering (Environment) and Bachelor of Science, Degree qualified with over 8-years environmental management experience in Australia.
Relationship to EA Holder:	**Sibelco Australia Limited - Senior Environmental Advisor**
Date of Audit:	30 May 2018

Method of Audit:	Review of supporting documentation (Environmental Authority Monitoring Data and other records)
Mining Project Name:	Frost Enterprises Pty Ltd Taragoola Limestone Project, managed by Sibelco Australia Limited
EA Number/s:	EPML00969013
Mining Lease Numbers:	ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192

AUDIT PROCESS – PART B

Rehabilitation Program

In accordance with the DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994*, ESR/2015/1758 – Version 3.00, the gross financial assurance liability is determined from the cost of rehabilitation of all outstanding significantly disturbed areas after decommissioning of infrastructure not otherwise approved to remain. Prior to rehabilitation of disturbed areas, Sibelco Australia Limited is required to decommission and remove all equipment and infrastructure associated with its operations unless written agreement is held with the landholder.

The total cost to complete final rehabilitation is the highest total rehabilitation cost during the period covered by this Plan of Operations.

Net Financial Assurance

Calculation of net financial assurance for the Environmental Authority has been conducted in accordance with the requirement of DEHP Guideline - *Financial Assurance under the Environmental Protection Act 1994*, ESR/2015/1758 – Version 3.00. The total rehabilitation liability has:

- Been calculated on a project basis;
- Been calculated for all land that has been or is proposed to be significantly disturbed;
- Been based on the rehabilitation costs for the year in which the maximum liability is incurred within the nominated disturbance period;
- Costs from the administering authority's FA calculator have been used and includes the following activities:
    - Terminate, decommission and remove all infrastructure and services;
    - Constituent tasks or activities required for rehabilitation;
    - Project management costs of 10%;
    - Maintenance and monitoring costs of 5%;
    - The cost of a site investigation report; and

Maximum Rehabilitation Cost

I have checked the calculation and confirm the maximum cost estimate for rehabilitation (including decommissioning of infrastructure) of **$2,922,483** for the period covered by this Plan of Operations is correct.

Financial Assurance Discount System

Frost Enterprises is applying for a 10% performance discount for financial performance on Financial Assurance during the term of this plan. I have checked the evidence supplied to demonstrate eligibility with both the mandatory pre-requisites and discount criteria and was satisfied that the criteria for a 10% discount for financial performance has been met.

Net Financial Assurance
The net financial assurance calculated is as follows:
Net Financial Assurance = **$2,630,234.7**

CONCLUDING REMARKS AND CERTIFICATION

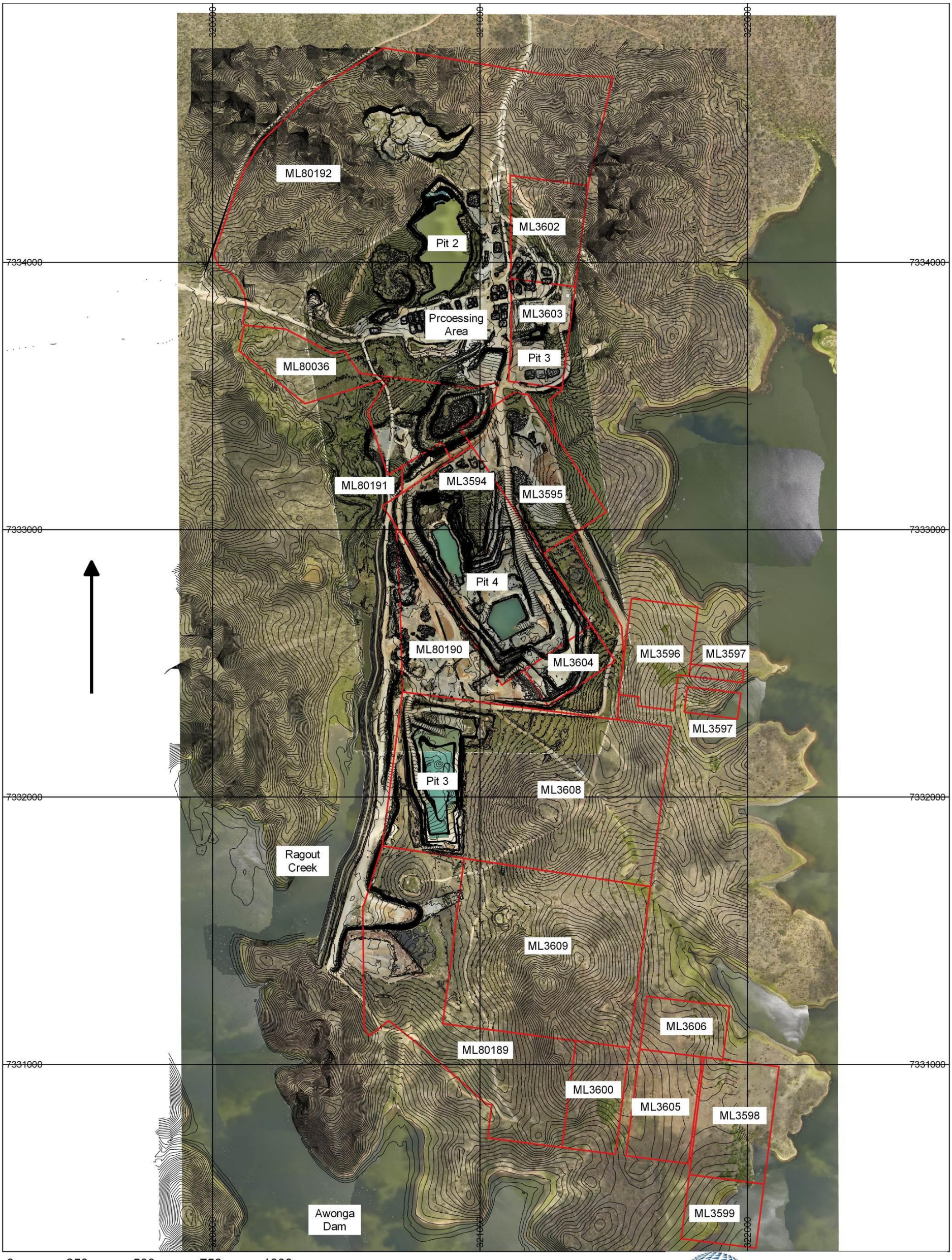
I Chris Mann, being aware that it is an offence under Section 480 of the *Environmental Protection Act 1994* to provide false or misleading information, state that:

- I am authorised to sign on behalf of the person (meaning a corporation or individual) holding the Environmental Authority;
- All information provided is true and complete; and
- I understand that information given with this Plan of Operations and Audit Statement could become available to the public in accordance with the *Environmental Protection Act 1994* and *Freedom of Information Act 1992*.

Signed:  Date: 30 May 2018

APPENDICES

APPENDIX 1 – FROST ENTERPRISES MINING TENURE LAYOUT



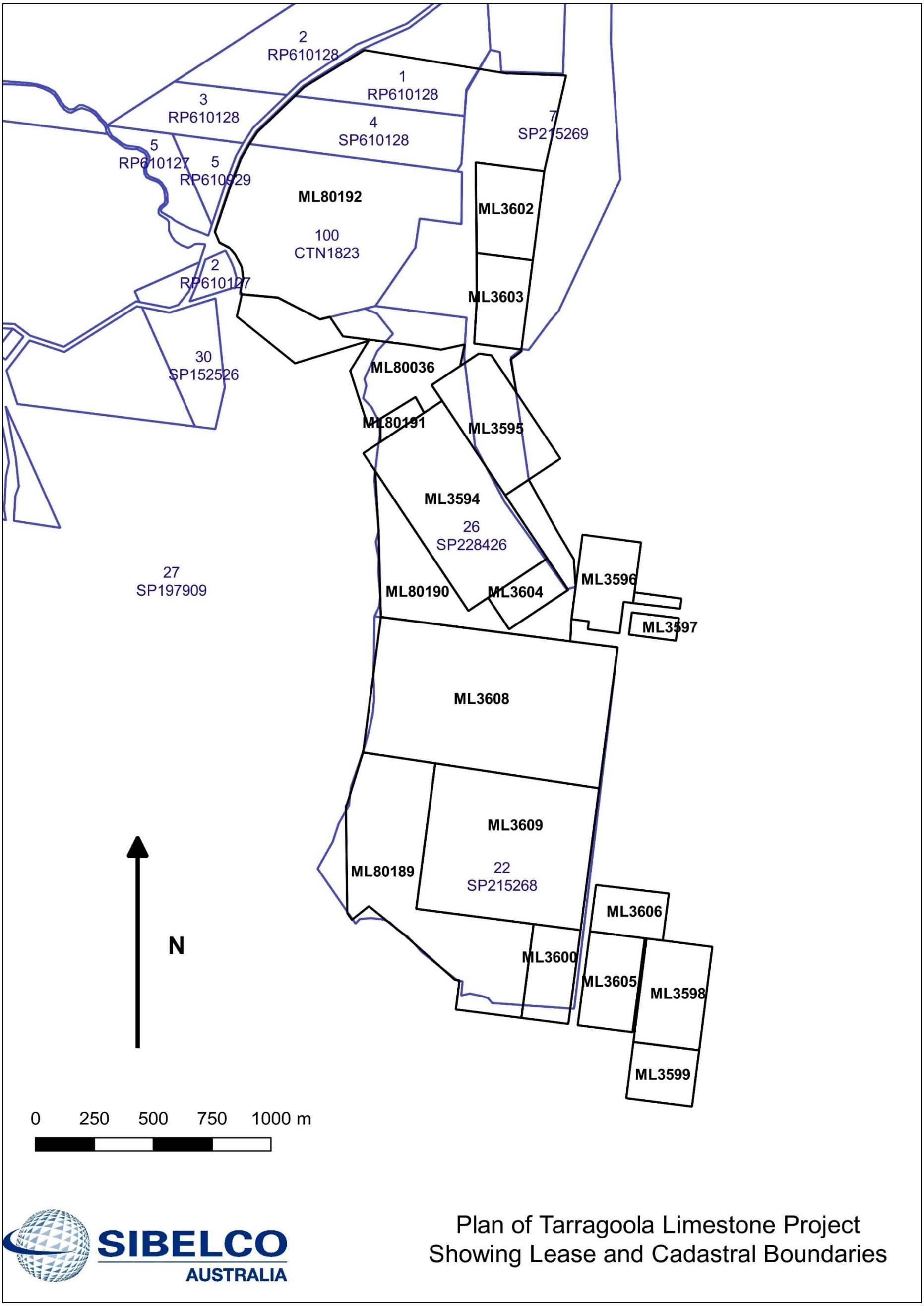
Taragoola Limestone Project

Plan of Operations
Lease Boundaries

SIBELCO AUSTRALIA

Figure 2

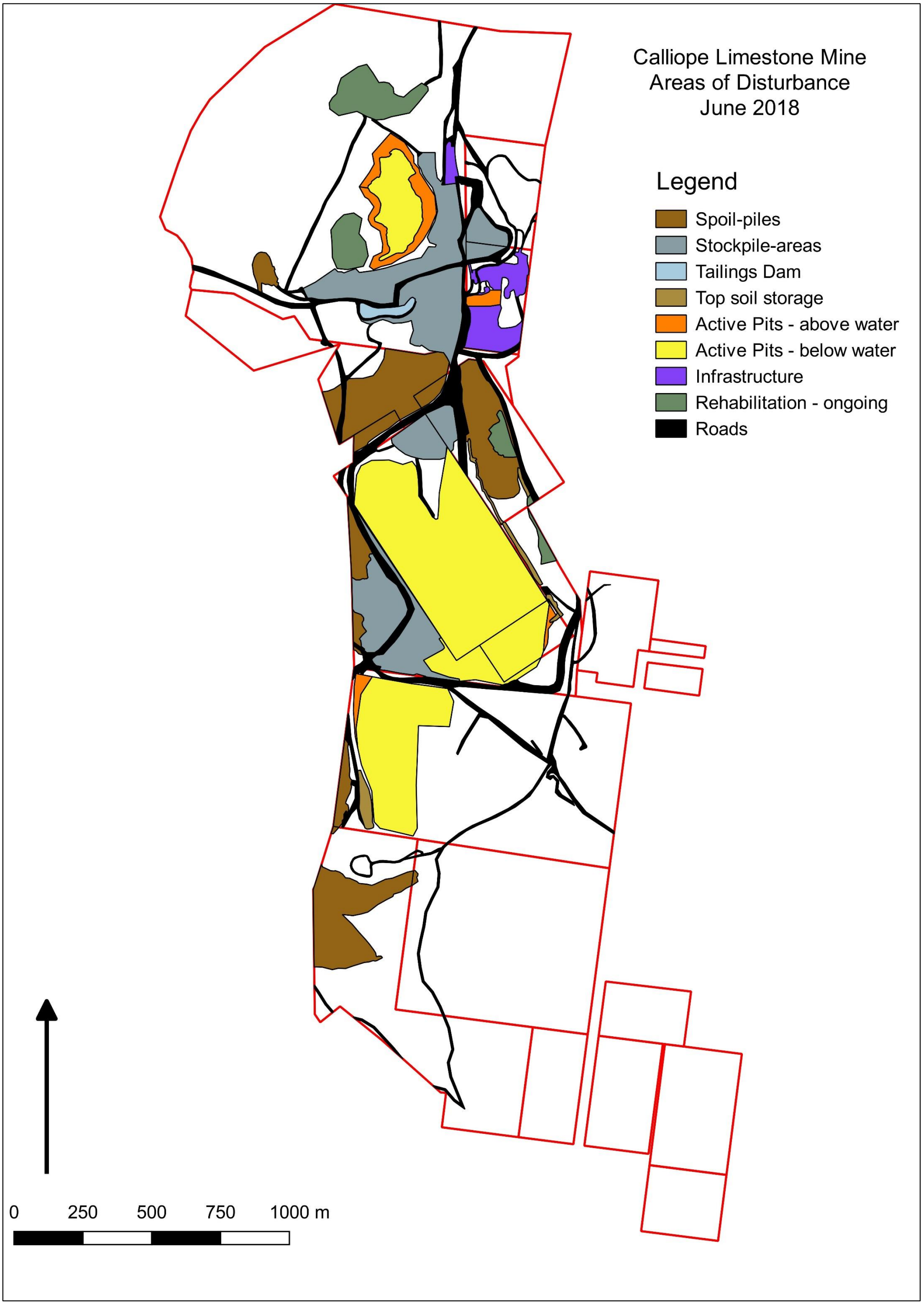
APPENDIX 1B – PLAN OF LEASE AND CADASTRAL BOUNDARIES



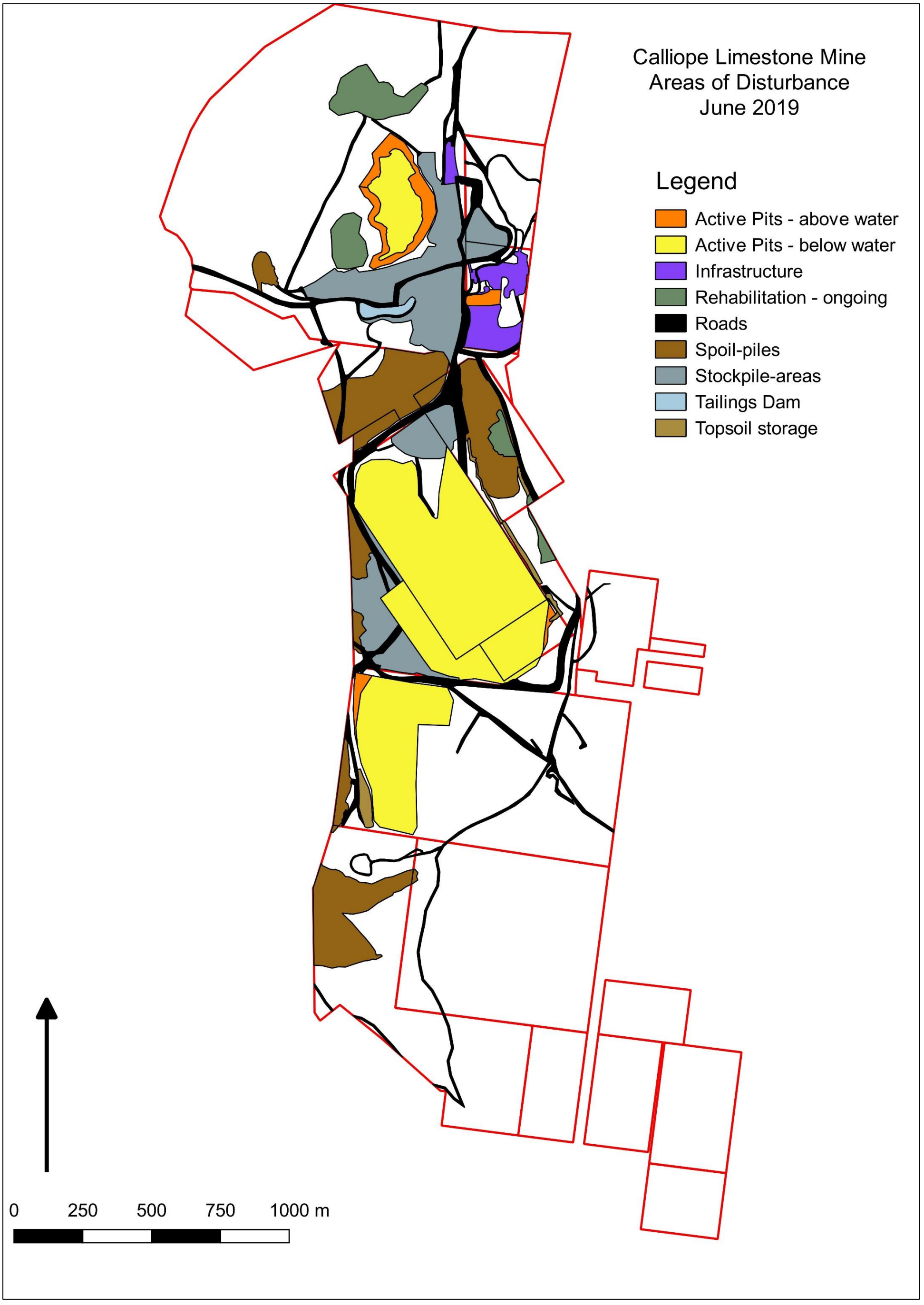
SIBELCO AUSTRALIA

Plan of Tarragoola Limestone Project
Showing Lease and Cadastral Boundaries

APPENDIX 2A – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2018



APPENDIX 2B – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2019



APPENDIX 2C – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2020



APPENDIX 2D – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2021



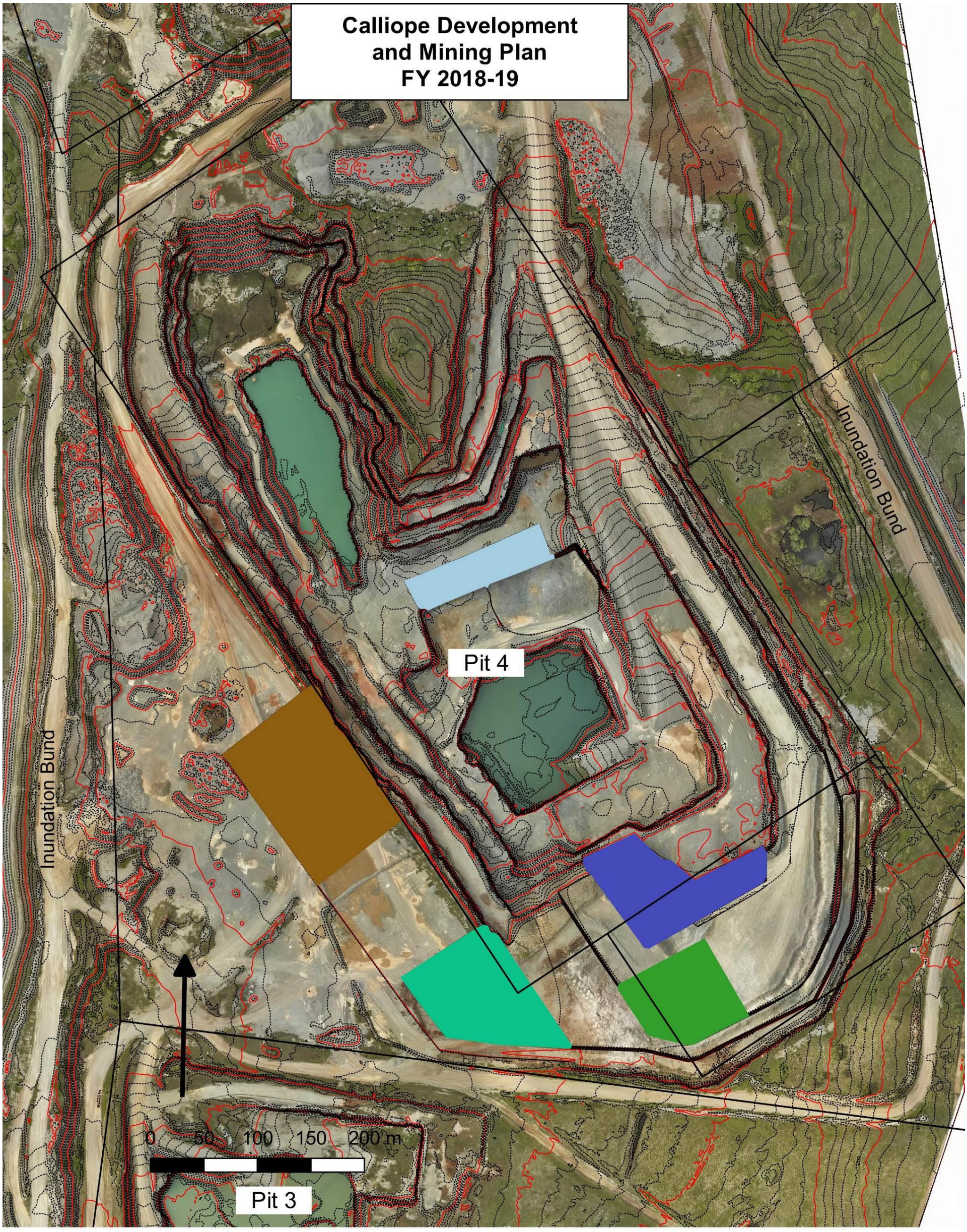
APPENDIX 2E – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2022



APPENDIX 2F – SUMMARY OF DISTURBANCE AND REHABILITATION AT JUNE 2023

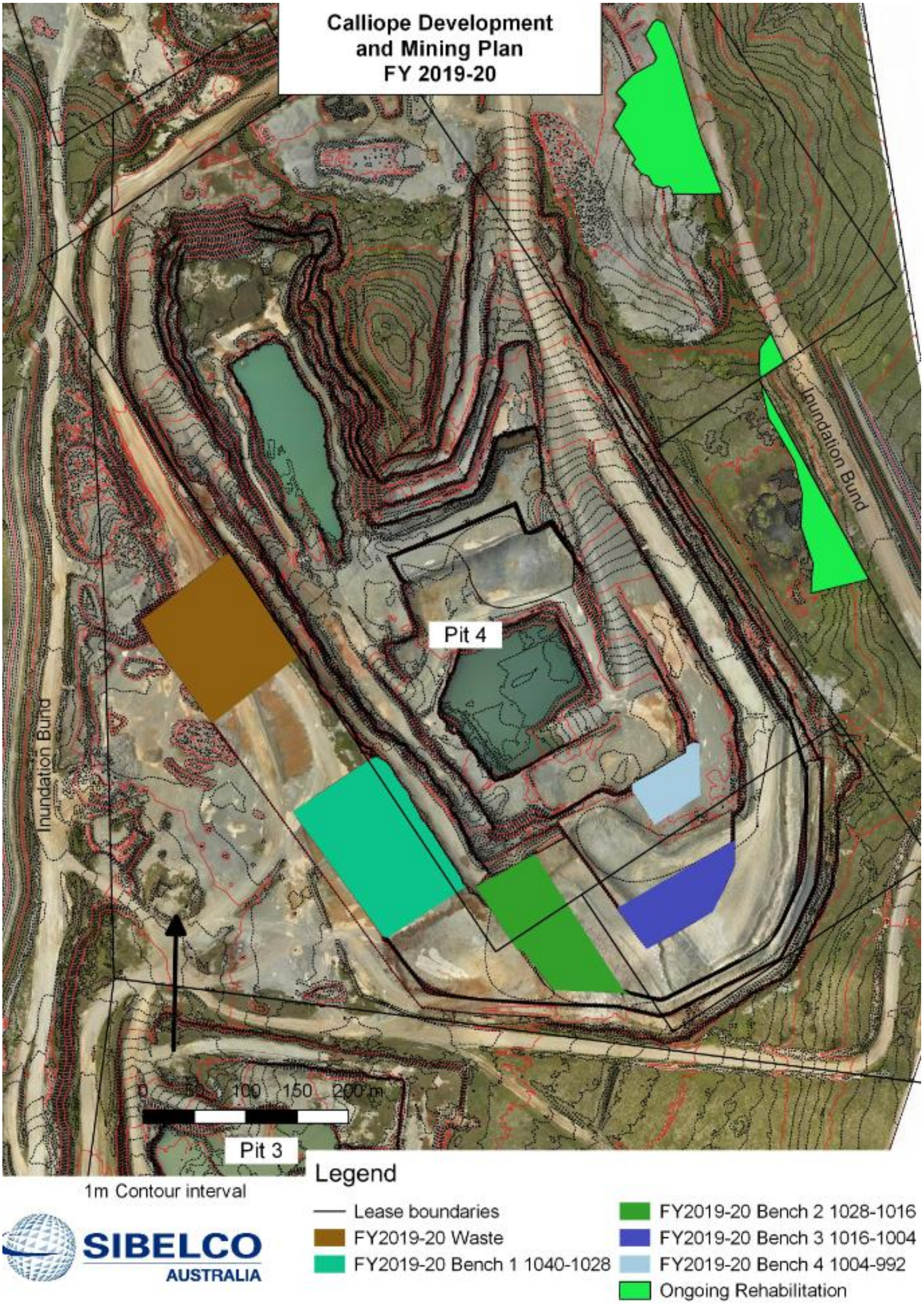


APPENDIX 3 - DEVELOPMENT AND MINING PLAN FY2018-19

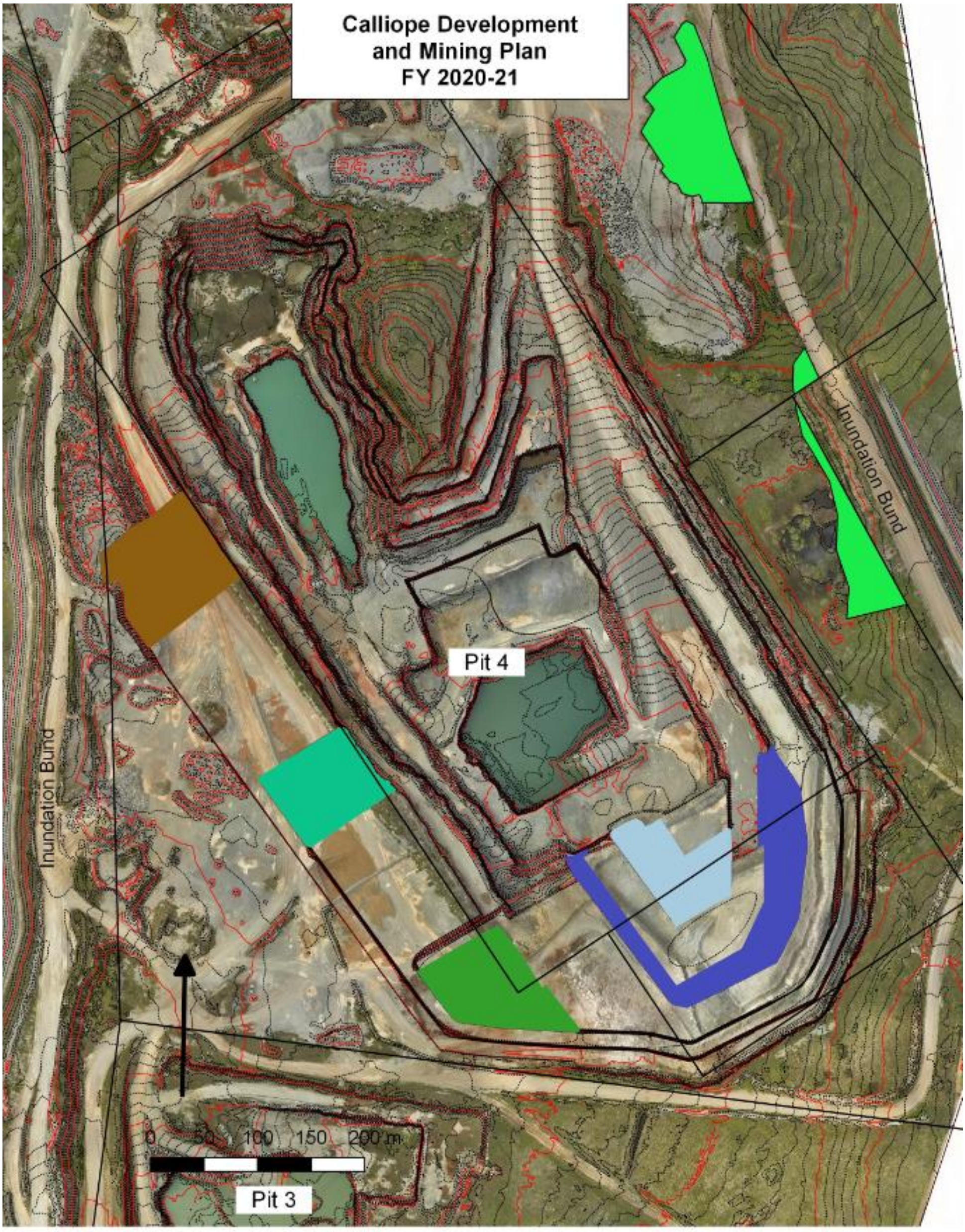


SIBELCO AUSTRALIA

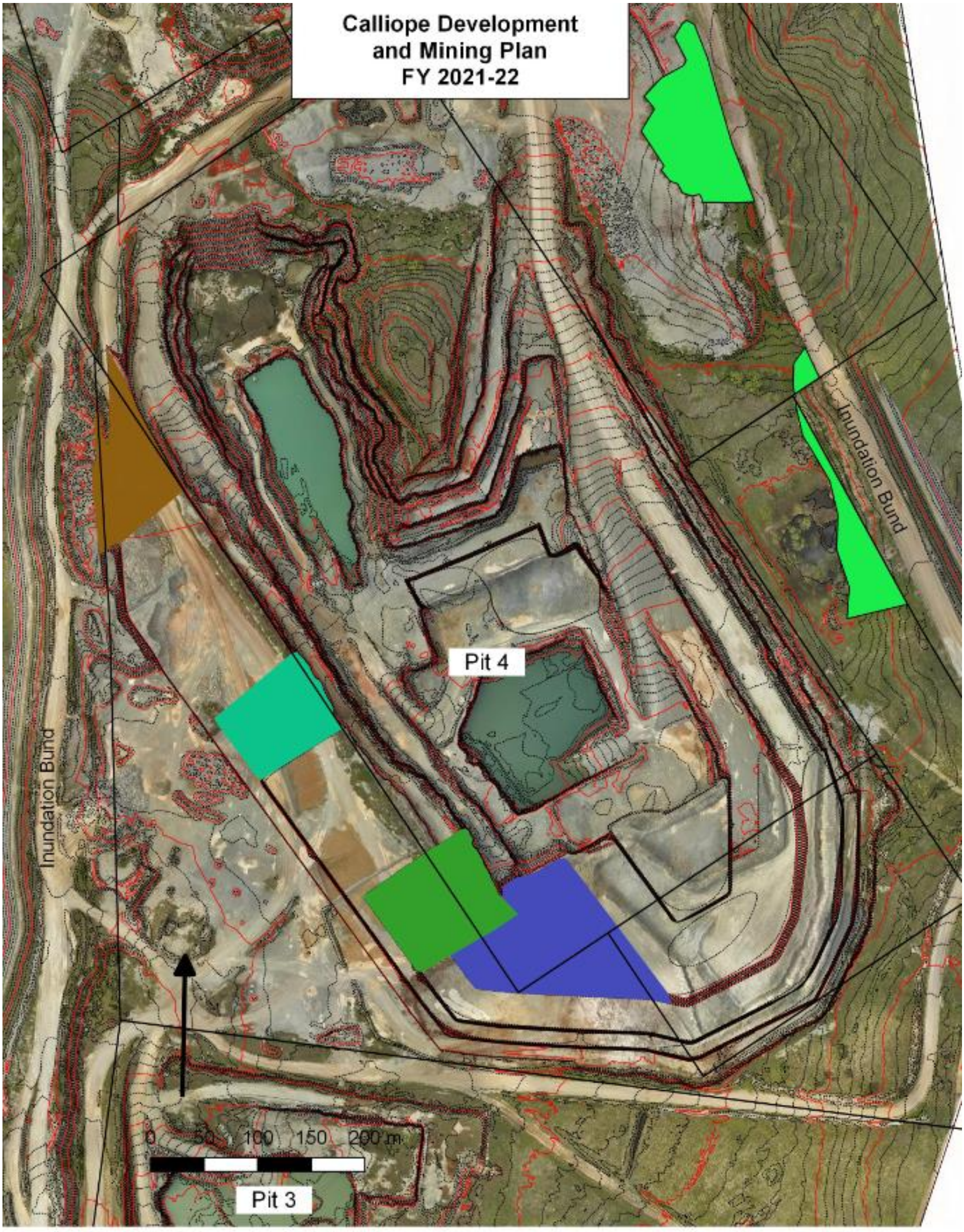
APPENDIX 4 – DEVELOPMENT AND MINING PLAN FY2019-20



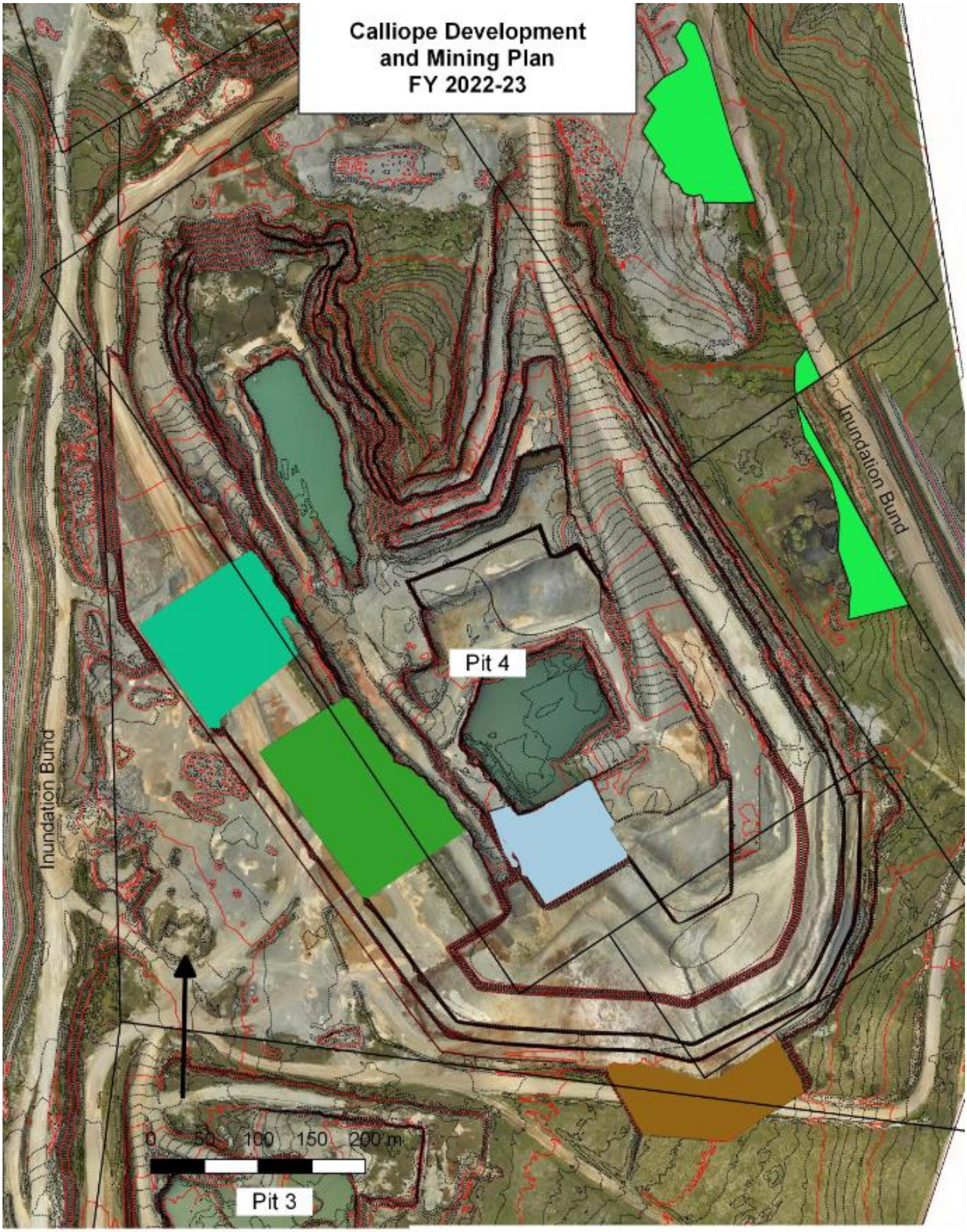
APPENDIX 5 – DEVELOPMENT AND MINING PLAN FY2020-21



APPENDIX 6 – DEVELOPMENT AND MINING PLAN FY2021-22



APPENDIX 7 – DEVELOPMENT AND MINING PLAN FY2022-23



APPENDIX 8 – TABLES FROM ENVIRONMENTAL AUTHORITY EPML00969013

Table 1 - Contaminant release points, sources and receiving waters

Release point (RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
F1	321 432	733 2026	Pit 3 and Pit 4	End of pipe F1 (Discharge Monitoring Point)	Lake Awoonga Dam
F2	320 399	733 1469	Undisturbed natural flow and/or Pit 3	Raggote Ck at F2 (Downstream Monitoring Point)	Farmers Dam
C1	320 757	733 3601	Pit 1, Pit 2 and Pit 4	C1 dam spillway (Discharge Monitoring Point)	Pit 2 and/or Recycled Water Storage Dam
C2	320 102	733 3854	Undisturbed natural stormwater flow	C2 creek adjacent to rail siding road (Upstream Monitoring Point)	Raggote Creek

Table 2 - Contaminant release limits

Quality characteristic	Release limits	Monitoring frequency
Electrical conductivity (uS/cm)	900	Weekly during discharge
pH (pH Unit)	6.5 (minimum) 8.5 (maximum)	Weekly during discharge
Total Suspended solids (mg/L)	100 (maximum) Or when measured at C1, F2 or F1 not more than 110% of value at monitoring point C2	Weekly during discharge

Table 3 - Groundwater monitoring locations and frequency

Monitoring point	Easting (GDA 94)	Northing (GDA 94)	Monitoring frequency			
			Groundwater level	EC, TSS, pH and Major Anions	Metal Screen	Hydrocarbon
FM5	321430	7332650	Quarterly (Jan, Mar, Jul, Sep)	Six monthly (Jan, Jul)	Annual (Jul)	Annual (Jul)
FM6	321080	7334350				

Table 4 – Groundwater contaminant trigger values

Water Quality Indicator	Unit	Trigger Value
Calcium	µg/L	250
Chloride	µg/L	200
CO_3	µg/L	500
Electrical Conductivity	µS/cm	1500
HCO_3	µg/L	500
Magnesium	µg/L	35
Petroleum Hydrocarbons (Total)	µg/L	1.0
pH	pH units	6.5 – 8.5
Potassium	µg/L	5.0
SO_4	µg/L	20
Sodium	µg/L	100
Total Suspended Solids	µg/L	1500

Table 5 - Noise limits

Noise level dB(A)	Monday to Sunday (including public holidays)		
	7am - 6pm	6pm - 10pm	10pm - 7am
	Noise measured at a 'sensitive or commercial place'		
$L_{A10, adj, 10 mins}$	Background + 5	Background + 5	Background + 3
$L_{A1, adj, 10 mins}$	Background + 10	Background + 10	Background + 5

Note: Where "Background" means background sound pressure level measured in accordance with the latest edition of the administering authority's Noise Measurement Manual. Table 5 does not purport to set operating hours for the mining activities.

Table 6 – Airblast overpressure level

Parameter	Airblast overpressure measured at a sensitive or commercial place	
	Monday to Sunday 9am - 7pm	Other times and public holidays
Air blast overpressure level (dB [Lin] Peak)	Maximum 115 dB for 4 out of 5 consecutive blasts	No blasting to occur
Air blast overpressure level (dB [Lin] Peak)	120 dB maximum	No blasting to occur

*Note: * Table 6 does not purport to set limits applicable to any particular explosive blast, rather sets design criteria for every explosive blast.*

Table 7 - Vibration limits

Vibration parameter	Vibration measured at a sensitive place	
	Monday to Sunday 9am - 7pm	Other times and public holidays
Peak particle velocity (mm/s)	Maximum 5 mm/s for 4 out of 5 consecutive blasts	No blasting to occur
Peak particle velocity (mm/s)	10 mm/s maximum	No blasting to occur

Table 8 - Final land use and rehabilitation approval schedule

Tenure ID	Disturbance Type	Projective Surface Area (ha)	Post-Mine Land Description	Post-Mine Land Capability/Sustainability Classification
ML3602	Roadways	0.7	Roads maintained for land management and access	VIII
	Infrastructure	1.5	Plants/stockpile area rehabilitate with natural vegetation	
ML3603	Infrastructure	4.5	Plants/stockpile area rehabilitate with natural vegetation	VII - VIII
	Mine faces above water level	1.9	Grasses	
	Mine faces below water level	1.6	Water reserve	VIII
ML3605	Mining	17.5	Livestock, grazing	III
ML3606	Mining	3.3	Livestock, grazing	III
ML3609	Mining	43	Livestock, grazing	III
ML3608	Infrastructure	2.4	Plant/stockpile area rehabilitate with natural vegetation	VIII
	Mine faces above water level	4.4	Grasses	VIII
	Mine faces below water level	8.8	Water reserve	VIII
	Mining	42	Livestock, grazing	III
	Topsoil areas	0.35	Stockpile area rehabilitate with natural vegetation	III

Tenure ID	Disturbance Type	Projective Surface Area (ha)	Post-Mine Land Description	Post-Mine Land Capability/Sustainability Classification
ML800036	Infrastructure	1.1	Plants/stockpile area rehabilitate with natural vegetation	VIII
	Spoil areas	18.7	Grasses	VIII
ML3595	In/roads	2.1	Roads retained for access	III
	Mining	12.7	Livestock, grazing	III
ML3594	Infrastructure	0.3	Plant/stockpile area rehabilitate with natural vegetation	VIII
	Mine faces above water level	7.4	Grasses	VIII
	Mine faces below water level	18.1	Water reserve	
	Mining	4.4	Livestock, grazing	III
	Product stockpile areas	1.1	Plant/stockpile area rehabilitate with natural vegetation	VIII
ML3604	Mine faces above water level	1.6	Grasses	VIII
	Mining	3	Livestock, grazing	III
ML3596	Mining	6.3	Livestock, grazing	III
ML3597	Mining	0.8	Livestock, grazing	III
ML3600	Native bush			
ML3598	Mining	1.8	Livestock, grazing	VIII
ML3599	Mining	5.3	Livestock, grazing	VIII
ML80189	Spoil areas	1.1	Grasses	VIII

Tenure ID	Disturbance Type	Projective Surface Area (ha)	Post-Mine Land Description	Post-Mine Land Capability/Sustainability Classification
ML80190	Roadways	2.9	Roads maintained for land management and access	VIII
ML80191	Roadways	0.4	Roads maintained for land management and access	VIII
ML80192	Roadways	0.4	Roads maintained for land management and access	VIII
	Infrastructure	17.6	Plant/stockpile area rehabilitate with natural vegetation	VIII
	Mine faces above water level	5.8	Grasses	VIII
	Mine faces below water level	5.8	Water reserve	

Table 9 - Landform design criteria

Disturbance type	Maximum slope range %	Projective surface area (ha)
Residual void(s)	< = 128% (52°)	30 ha Approximate values +/- 20%
Rejects	25%	

Table 10 - Residual void design

Void identification	Void wall – competent rock slope (%)	Void low wall – incompetent rock slope (%)	Void maximum surface area (ha)
ML3602	< = 128% (52°)	< = 70% (35°)	
ML3603	< = 128% (52°)	< = 70% (35°)	3.6
ML3608	< = 128% (52°)	< = 70% (35°)	12.3
ML3594	< = 128% (52°)	< = 70% (35°)	35
ML3604	< = 128% (52°)	< = 70% (35°)	3
ML80192	< = 128% (52°)	< = 70% (35°)	11.6

APPENDIX C ECOLOGY FIELD REPORT



Ecology Field Report

Graymont
Calliope Limestone Quarry
Calliope
BAA220009.01
9 June 2025

CONTENTS

1 INTRODUCTION 1
1.1 Project Location 1
1.2 Scope and Purpose of Assessment 1
2 PROJECT DESCRIPTION AND ACTIVITIES 5
3 LEGISLATIVE CONTEXT 6
3.1 Queensland State Legislation 6
3.1.1 Environmental Protection Act 1994 6
3.1.2 Nature Conservation Act 1992 6
3.1.3 Environmental Offsets Act 2014 6
3.1.4 Fisheries Act 1994 6
3.1.5 Biosecurity Act 2014 7
4 ASSESSMENT METHODS 8
4.1 Desktop Assessment 8
4.1.1 Data Sources 8
4.1.2 Previous Studies 8
4.2 Field Assessment Methods 8
4.2.1 Survey Timing and Conditions 8
4.2.2 Flora 9
4.2.3 Fauna 9
4.2.4 Fauna Habitat 9
4.2.5 Suitably Qualified Personnel 10
4.2.6 Permits and Ethics Approval 10
4.2.7 Limitations 10
4.3 Likelihood of Occurrence Assessment 10
4.4 Nomenclature and Taxonomy 11
5 DESKTOP ASSESSMENT RESULTS 12
5.1 Existing Environment 12
5.1.1 Topography, Geology and Soils 12
5.1.2 Wetland and Watercourse Mapping 12
5.2 Matters of State Environmental Significance 14
5.3 Environmentally Sensitive Areas 14
5.4 Flora 14
5.4.1 Vegetation Communities 14
5.4.2 Conservation Significant Flora 15
5.5 Fauna 16
5.5.1 Conservation Significant Fauna 16
5.5.2 Habitat Mapping 17
6 FIELD ASSESSMENT RESULTS 20

6.1 Flora Survey Results 20
6.1.1 Flora Diversity 20
6.1.2 Ground-truthed Regional Ecosystems 20
6.1.3 Conservation Significant Flora 25
6.1.4 Weed Species 42
6.1.5 BioCondition 44
6.2 Fauna Survey Results 44
6.2.1 Fauna Diversity 44
6.2.2 Fauna Habitats 45
6.2.3 Conservation Significant Fauna 46
6.2.4 Pest Species 46
7 POTENTIAL PROJECT IMPACT AND MITIGATION MEASURES 53
7.1 Potential Project Impacts 53
7.1.1 Clearing Vegetation 53
7.1.2 Habitat Fragmentation and Connectivity 53
7.1.3 Fauna Mortality 54
7.1.4 Airborne Dust 54
7.1.5 Noise and Lighting 54
7.1.6 Weeds and Pest Animals 55
7.1.7 Fire 55
7.1.8 Surface Water 55
7.2 Proposed Mitigation Measures 56
8 MSES SIGNIFICANT RESIDUAL IMPACT ASSESSMENT 59
8.1 Conservation Significant Species 59
8.2 Category R (GBR Riverine regrowth) Regulated Vegetation 69
8.3 Clearing in a RE that is within the Defined Distance of a Watercourse 69
8.4 Waterways Providing for Fish Passage 70
8.5 Significant Residual Impacts – Environmental Offsets 71
9 SUMMARY AND CONCLUSION 72
10 REFERENCES 73
11 ACRONYMS 78

LIST OF FIGURES

Figure 1. Site location 2
Figure 2. Current disturbance area 3
Figure 3. Proposed disturbance area 4
Figure 4. Watercourses and waterways 13
Figure 5. Current government RE mapping 18
Figure 6. Conservation significant flora and fauna species records within 25 km of the Project area 19
Figure 7. Ground-truthed regional ecosystems, survey sites and proposed impacts 21

LIST OF PLATES

Plate 1. Remnant *Eucalyptus crebra* woodland 22
Plate 2. Regrowth *Eucalyptus crebra* woodland 23
Plate 3. Remnant *Eucalyptus tereticornis* fringing woodland 24
Plate 4. Disturbed non-remnant vegetation 25
Plate 5. Rubber Vine infestation 43
Plate 6. White Cedar infestation 44

LIST OF TABLES

Table 1. Project area surface geology (QGlobe 2023) 12
Table 2. Matters of State Environmental Significance relevant to the Project area 14
Table 3. Regulated vegetation mapped within the Project area 15
Table 4. Regional Ecosystems currently mapped within Project area 15
Table 5. Ground-truthed REs within the Project area 20
Table 6. Likelihood of occurrence assessment of conservation significant flora species 26
Table 7. Non-native flora species identified within the Project area 42
Table 8. Fauna species observed within the Project area 44
Table 9. Pest species identified within the Project area 46
Table 10. Likelihood of occurrence assessment of conservation significant fauna species 47
Table 11. Predicted vegetation clearing resulting from Project proposed impacts 53
Table 12. Recommended mitigation measures proposed for general impacts resulting from proposed impacts 56
Table 13. Significant residual impact criteria assessment: Koala 60
Table 14. Significant residual impact criteria assessment: *Cycas megacarpa* 62
Table 15. Significant residual impact criteria assessment: Squatter Pigeon 65
Table 16. Significant residual impact criteria assessment: Powerful Owl 66
Table 17. Significant residual impact criteria assessment: *Cassinia collina* 68
Table 18. Significant residual impact test for MSES regulated vegetation (defined watercourse) 70
Table 19. Significant residual impact criteria assessment: waterway providing for fish passage 70

LIST OF APPENDICES

APPENDIX A DESKTOP SEARCH RESULTS

APPENDIX B SURVEY DATA

DOCUMENT CONTROL

Revision	Revision date	Revision details	Author	Editorial review	Technical review	Approver
A	9/03/2023	Draft for Internal Review	O Robertson	B Taylor	B Taylor	M. Longbottom
B	7/05/2024	Draft for Internal Review	O Robertson	B Taylor	B Taylor	M. Longbottom
C	22/05/2024	Draft for Client Review	O Robertson	B Taylor	B Taylor	M. Longbottom
0	28/08/2024	Final for Issue	O Robertson	S. Hargreaves	M. Longbottom	M. Longbottom
2	24/04/2025	Final for Issue	O Robertson	H Tibbetts	M Mahon	M Longbottom

DISTRIBUTION

Revision	Revision date	Issued to
1	24/04/2024	Department of Environment, Tourism, Science, and Innovation
2	9/06/2025	Department of Environment, Tourism, Science, and Innovation

DOCUMENT INFORMATION

Printed:	9 June 2025
Last saved:	9 June 2025 01:44 PM
File name:	BAA220009.01-REP-Calliope Ecology Field Report-Rev 2
Author:	O Robertson
Project manager:	Shaille Hargreaves
Client:	Graymont
Document title:	Ecology Field Report
Project number:	BAA220009.01

1 INTRODUCTION

This Ecology Field Report has been prepared on behalf of Graymont (Australia) Pty Ltd (Graymont) to support the legislated environmental approvals process for the Calliope Limestone Quarry (the Project), located in Central Queensland. The Project involves the operation of an open cut limestone quarry that produces approximately 0.8 million tonnes per annum (Mtpa) of limestone products annually. The Project commenced operations in 1967 and, noting potential future changes in reserves and yearly sales quantities, has a planned end of mine life (EOML) in 2100.

1.1 Project Location

The Project is located approximately 11 kilometres (km) south of the township of Calliope and 30 km south of Gladstone within the Gladstone Local Government Area (LGA) (refer **Figure 1**). The current and proposed disturbance areas are displayed in **Figure 2** and **Figure 3**.

The Project has approval under Environmental Authority (EA) EPML00969013 which covers the following Mining Leases (ML): ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, ML80192 (the Project area). The Project also has approval under EPPR00881913 for the following Environmentally Relevant Activities (ERAs):

- ERA 8 (3a) - Chemical storage >10m^3 but 1,000,000 tonnes (t) of material
- ERA 16(2)(d) – Extracting, in a year >1,000,000 t of material
- ERA 16 (3c) – Screening in a year >1,000,000 t of material
- ERA 50 (2) - Bulk material handling >100 t day

1.2 Scope and Purpose of Assessment

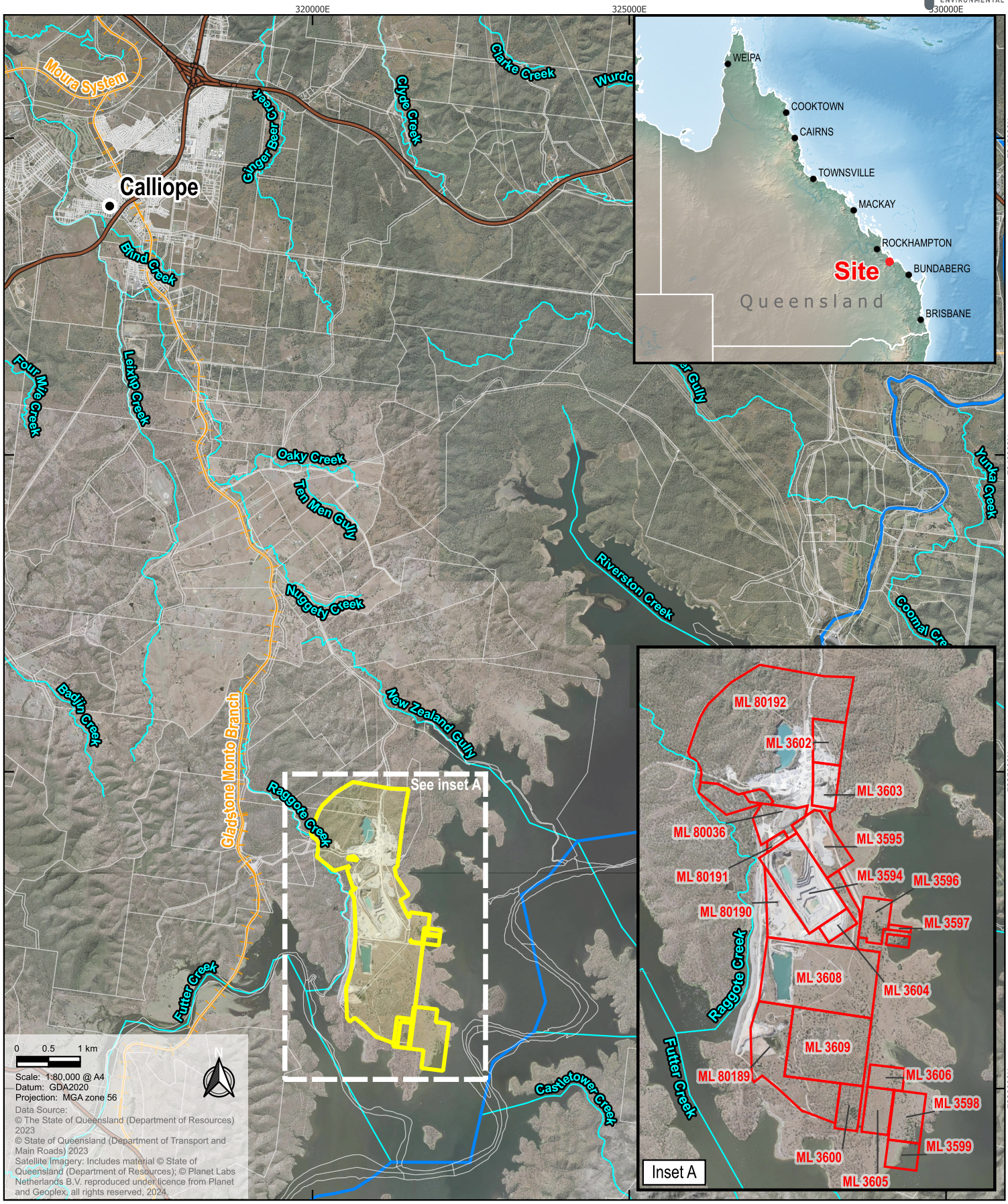
The purpose of this report is to document the baseline terrestrial ecological values of the Project area and provide avoidance, mitigation and management measures to adequately address impacts associated with the Project. The scope is defined as including the MLs listed in **Section 1.1**.

The description of baseline ecological values has been documented to support an application for an amendment to an existing Environmental Authority. Graymont are seeking to amend EA EPML00969013 for the Project via a major EA Amendment under the *Environmental Protection Act 1994* (EP Act), to address the discrepancies in disturbance areas and activity types for the mine until end of mine life (EOML).

Epic was engaged by Graymont to undertake terrestrial ecological surveys for the Project. The scope of this report includes a description of the terrestrial fauna and flora species and habitats within the Project area. The assessment includes an analysis under relevant State guidelines of the potential for significant residual impacts to the following:

- Matters of State Environmental Significance (MSES) as identified as Prescribed Environmental Matters (PEMs) under Schedule 2 of the *Environmental Offsets Regulation 2014* including conservation significant species and identified species habitat areas, listed vegetation communities, waterways and wetlands

The potential requirements for environmental offsets will be identified where significant residual impacts are identified as likely occurring to identified environmental matters as a result of the Project's activities.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 1 Site Location.qgz

Legend

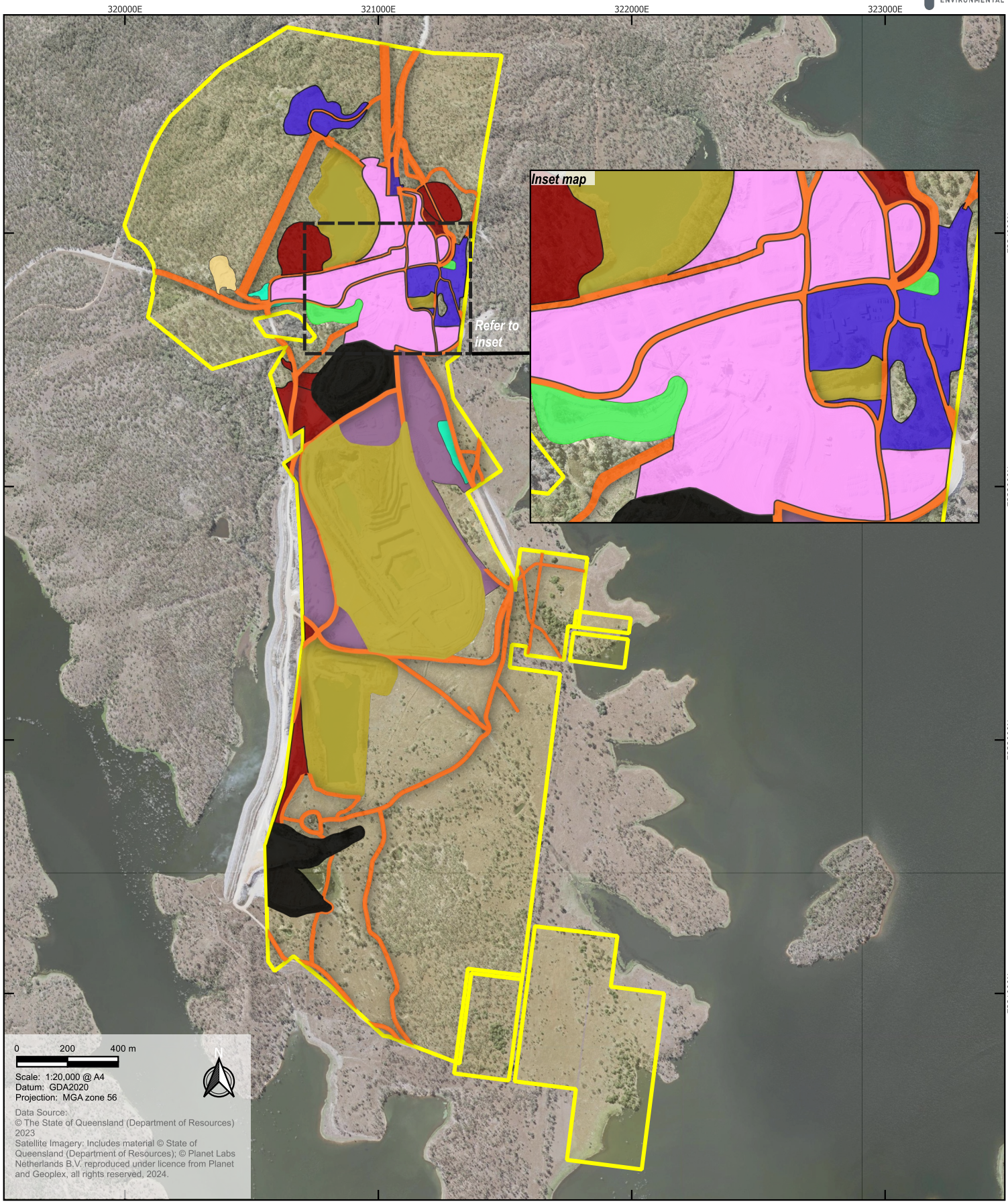
- Site boundary
- Mining leases
- Cadastre (DCDB)
- State controlled roads
- Railways

Watercourses

- Major
- Minor

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 1
Site location



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 2 Current disturbance area.qgz

Legend

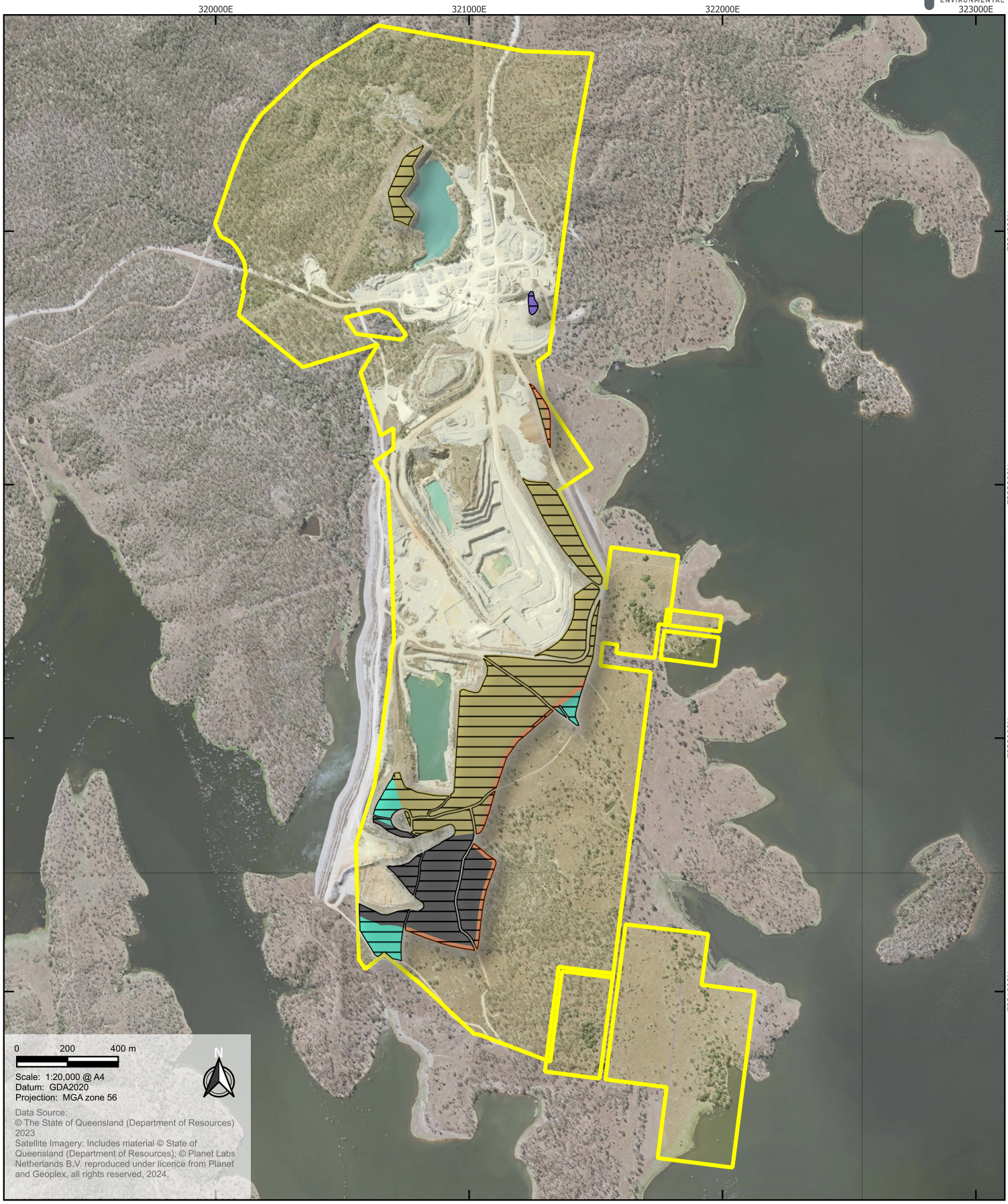
- Site boundary

Current disturbance area

- Access tracks
- Cleared areas and laydowns
- Infrastructure and plant
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 2
Current disturbance area



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 3 Proposed disturbance area.qgz

Legend

- Site boundary
- Proposed disturbance expansion

Proposed disturbance expansion (by activity type)

- Access tracks
- Infrastructure and plant
- Pit
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 3
Proposed disturbance area

2 PROJECT DESCRIPTION AND ACTIVITIES

Limestone mining has been ongoing at Calliope since 1967, with Graymont managing operations since 2019. Situated just west of Lake Awoonga, the Project produces approximately 0.8 million tonnes per annum of limestone products and intersects 19 MLs. The Project area covers 429.6 hectares (ha) and includes four open cut pits (**Figure 2**). The Project area includes 152.9 ha of existing disturbance (i.e. operational areas, pits etc) and 211.9 ha of proposed disturbance areas. Two non-operational pits (former Pit 1 and Pit 2) are located in the northern end of the ML. Pit 1 was completely back filled with waste rock in 2024 and is now utilised for ag-lime production, and Pit 2 is utilised for onsite water storage. Water from Pit 2 is primarily utilised for the wash plant. Pit 3 and Pit 4 are located to the southern extent of the ML. The Project adjoins land owned and operated by the Gladstone Area Water Board (GAWB), with some shared access tracks in the area used by both Graymont and the GAWB.

Other infrastructure located onsite includes the main office, weighbridge, run of mine (ROM) stockpile, access roads, crushing and screening plant, wash plant, main stockpile area of final product, silt ponds and spoil areas located in the northern portion of the Project (**Figure 2**).

Mining operations have remained consistent throughout the life of mine (LOM) and consists of conventional open cut benching methods and begins with topsoil stripping and removal of clay rich overburden and waste rock. Based on the Plan of Operations for the Project for July 2018 – June 2023, an estimated 142,000 t of overburden and waste rock will be shifted annually (Sibelco 2018).

Limestone ore is extracted by drilling and blasting, then crushed, screened and washed onsite before being loaded by a 120 tonne (t) excavator serviced by two 100 t and one 85 t off road dump trucks. Material is hauled either to the ROM pad for crushing, or to the stockpiles for screening or placement in the designated spoil dumps. There is a second 75 t excavator onsite which is utilised as a backup for the open cut operations.

Extractive activities are also conducted onsite where limestone of different grades and suitable physical properties follow a similar process to mining for the production of road base and aggregates. Extractive activities are authorised and conducted under ERA 16(2)(d) and EA EPPR00881913 (original permit # SPCE04023712 issued under the *Sustainable Planning Act 2009*).

The current Project schedule includes limestone ore to be mined exclusively from the existing open cut mining pit (Pit 4), which is located centrally within the Project area. Lateral and vertical expansion of Pit 4 is projected over the next 70 years, with amalgamation of Pit 3 expected to occur during southern expansion (**Figure 3**). All future disturbance until EOML will be authorised by, and undertaken in accordance with, the amended EA. Mine closure is scheduled for 2100. Limestone ore will continue to be processed onsite utilising pre-existing purpose-built infrastructure in the crushing and screening plant and wash plant, with a rate of production of 10-20,000 t a week.

3 LEGISLATIVE CONTEXT

3.1 Queensland State Legislation

3.1.1 Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* (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 Environmental Authority EPML00969013 which authorises activities within the MLs. The Project also has approval under EA EPPR00881913 for the following Environmentally Relevant Activities (ERAs):

1. ERA 8 (3a) - Chemical storage >10m^3 but 1,000,000 t of material
2. ERA 16 (3c) – Screening in a year >1,000,000 t of material
3. ERA 50 (2) - Bulk material handling >100 t day

Extractive activities are authorised and conducted under ERA 16(2)(d) and EA EPPR00881913 (original permit # SPCE04023712 issued under the *Sustainable Planning Act 2009*).

3.1.2 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) regulates environmental impacts of development through the requirement for vegetation clearing permits, species management programs and other permits.

A clearing permit is required to clear protected plants unless an exemption applies. In general, clearing of Critically Endangered, Endangered, Vulnerable or Near Threatened protected plants will require a clearing permit. Clearing permit applications are assessed on a case-by-case basis and approvals will be subject to conditions.

Where activities involve tampering with 'animal breeding places', the tampering may be authorised by application to the Department of Environment, Tourism, Science and Innovation (DETSI) through an approved species management program.

3.1.3 Environmental Offsets Act 2014

Under the *Environmental Offsets Act 2014* (Offsets Act) an environmental offset is defined as 'an activity undertaken to counterbalance a significant residual impact of a prescribed activity on a PEM.' PEMs are described as MSES and defined under Schedule 2 of the *Environmental Offsets Regulation 2014*. Where a significant residual impact is assessed as occurring on a PEM there may be a requirement for environmental offsets to compensate for the impact. The Queensland Environmental Offsets Policy Significant Residual Impact Guideline (QEOIP Guidelines) (DEHP 2014) provides the framework for assessing the potential for significant residual impacts to MSES from a Project's activities.

3.1.4 Fisheries Act 1994

The *Fisheries Act 1994* (Fisheries Act) provides for the management, use, development and protection of fish habitats and resources. This includes waterways potentially used for 'fish passage' (considered as a MSES) as mapped within waterways for waterway barrier works mapping administered by the Department of

Agriculture and Fisheries (DAF). Environmental offsets may be required where significant residual impact to waterways for fish passage are identified (including permanent, partial and temporary barriers).

3.1.5 Biosecurity Act 2014

The *Biosecurity Act 2014* (Biosecurity Act) ensures a consistent, modern, risk-based and less prescriptive approach to biosecurity in Queensland. The Biosecurity Act provides comprehensive biosecurity measures to safeguard the economy, agricultural and tourism industries, environment and way of life from pests, diseases and contaminants. Decisions made under the Biosecurity Act will depend on the likelihood and consequences of risk, allowing for more appropriate management of risks.

Graymont have a statutory duty of care ("general biosecurity obligation (GBO)") under the Act (s23). Under the GBO, Graymont must:

- Take all reasonable and practical steps to prevent or minimise each biosecurity risk
- Minimise the likelihood of causing a 'biosecurity event', and limit the consequences if such an event is caused
- Prevent or minimise the harmful effects a risk could have, and not do anything that might make any harmful effects worse

Under the Biosecurity Act there are seven categories of 'restricted matter' with associated restrictions (under the Biosecurity Act). Several categories may apply to a single 'restricted matter' and include the following (as relevant to the Project):

- Category 3: You must not distribute this restricted matter. This means it must not be given as a gift, sold, traded or released into the environment unless the distribution or disposal is authorised in a regulation or under a permit
- Category 4: You must not move this restricted matter to ensure that it does not spread into other areas of the State
- Category 5: You must not keep in your possession this category of restricted matter
- Category 6: You must not feed this category of restricted matter. Feeding for the purpose of preparing for or undertaking a control program is exempted

4 ASSESSMENT METHODS

The ecological assessment for the Project consisted of a desktop review of publicly available ecological data sources and information. The desktop review was followed by a field survey carried out within the Project area to describe the ecological values present and to aid the evaluation of the potential impacts of the Project to values considered important to MSES. A summary of the assessment methods is provided in the following sections.

4.1 Desktop Assessment

Prior to commencing the field survey, desktop assessments were carried out to identify species and ecological communities of conservation significance (MSES) that potentially occur within the assessment Project area. Flora and fauna values of conservation significance in this report refer to:

- Flora and fauna species listed as Critically Endangered, Endangered or Vulnerable under the NC Act
- Regional Ecosystems (RE) listed as Endangered or Of Concern under the EP Act

The desktop assessment also aimed to identify other environmental values relevant to the Project area including Environmentally Sensitive Areas (ESAs) and MSES.

4.1.1 Data Sources

Flora and fauna records listed in publicly available databases and other resources were investigated to identify ecological matters relevant to the Project area. These resources included the following:

- Queensland Government Wildlife Online (WildNet) database (records within a 25 km radius around the point -24.1043, 151.2392) (**Appendix A**)
- Species Profile and Threats Database maintained by the Department of Climate Change, Energy, Environment and Water (DCCEEW) (DCCEEW 2023)
- Atlas of Living Australia (ALA), a web-based search tool that is a partnership between CSIRO, Australian museums, herbaria and other biological collections, and the Australian Government (ALA 2025)
- DETSI Matters of State Environmental Significance (MSES) mapping
- DETSI Map of ESAs
- Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development (DNRMMRRD)Regulated Vegetation Management Map and Vegetation Management Supporting Map, including REs, essential habitat, watercourse and wetland mapping
- DETSI certified RE mapping (Version 13).

4.1.2 Previous Studies

During an ecological assessment (flora and fauna) undertaken by Ansar Environmental in 1997, no rare, vulnerable, or endangered species or ecological communities were found in the Project area (Ansar Environmental 1997).

4.2 Field Assessment Methods

4.2.1 Survey Timing and Conditions

A field survey of the Project area was completed during 27 February to 1 March 2023. The survey included a baseline flora and fauna assessment, ground-truthing of REs, and assessment of habitat suitability for conservation significant species.

The nearest weather station providing continuous temperature and rainfall data is Gladstone Airport (39326), located approximately 25 km north of the Project area. During the field survey temperatures ranged between 19.4 and 30.5°C (BoM 2023). No rainfall occurred during the field survey. The region recorded slightly below average rainfall during the three months prior to the field survey, with a total of 300.6 millimetres (mm) during December to February (BoM 2023).

4.2.2 Flora

Native vegetation within the Project area was assessed and mapped into analogous REs. The survey and mapping of REs was in accordance with the *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland V6.0* (Neldner et al. 2022). A combination of tertiary and quaternary RE sites were used to verify the on-ground vegetation communities present. Quaternary assessments were carried out where simple confirmation of the RE present was considered based on the results of the more detailed quaternary assessments carried out elsewhere at the Project area.

Tertiary sites were used to identify REs with the quantification of vegetation community condition and floristic species composition. At a minimum the following data were recorded at each quaternary survey site:

- RE type
- Vegetation condition
- Dominant, co-dominant, sub-dominant and associated flora species, median height and cover for each strata level
- Ecologically dominant layer (EDL)
- Structural classification (Specht and Specht 2000) (i.e. grassland, open-woodland, woodland etc)
- Structure category (i.e. dense, mid-dense, sparse, very sparse)
- Landform
- Soil type
- Weed species and density
- Disturbance.

Quaternary were used to ground-truth the extent, classification and condition of vegetation communities within the Project area. At each quaternary site the following data were recorded:

- RE type
- Condition (i.e. remnant, regrowth, non-remnant)
- Dominant flora species at each strata level
- EDL strata
- EDL cover and median height
- Structural classification (Specht & Specht 2000) (i.e. grassland, open-woodland, woodland etc).

In addition to RE mapping, incidental observations of all native and non-native flora species observed within the Project area were recorded.

BioCondition assessments were also completed in accordance with *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland* (Eyre et al 2015) to provide a reference for future planned rehabilitation works.

4.2.3 Fauna

Fauna surveys comprised non-invasive methods and included the following:

- Diurnal bird surveys
- Habitat searches for herpetofauna
- Opportunistic observations throughout the survey.

4.2.4 Fauna Habitat

Fauna habitat assessments were conducted at sites across the Project area to ascertain the quality and availability of habitat, particularly for the potential presence of Koala (*Phascolarctos cinereus*), Squatter Pigeon (southern) (*Geophaps scripta scripta*) and Greater Glider (southern and central) (*Petauroides volans*). Habitat assessment sites were selected during the fauna surveys and assessed for the following features:

- Ground cover
  - Grass cover
  - Bare ground

  - Non-native cover
- Presence of tree hollows
- Rocky habitat
- Nearby water source
- Woody debris
- Recent fire
- Level of cattle disturbance (lack of grass cover and surface soil trampling)

4.2.5 Suitably Qualified Personnel

The field surveys were led by Senior Environmental Scientist Oliver Robertson.

Oliver Robertson

With almost 9 years in the industry, Oliver has extensive experience in undertaking surveys for listed weeds and conservation significant fauna and flora species as part of environmental monitoring and compliance programs for projects throughout Queensland for a broad range of industries and government sectors including road and rail transport, energy, communications, and defence. He is familiar with environmental legislative requirements in Queensland and NSW. Oliver is suitably qualified to complete Protected Plant Flora Surveys under the Queensland Department of Environment and Science Protected Plants Flora Survey Guidelines (DES 2020) Oliver holds a PhD in Ecology from University of Queensland as well as a Bachelor of Environmental Science and a Bachelor of Science (Zoology) from Deakin University and University of Melbourne respectively.

4.2.6 Permits and Ethics Approval

The field surveys were conducted in accordance with the following Queensland government permits and approvals:

- Scientific Use Registration Certificate (DAF) – Registration No. SUR001535)
- Animal Ethics Approval (DAF) – (Reference No. CA 2020/06/1377)
- Research Permit (DETSI) – Permit No. WA0027840

4.2.7 Limitations

In accordance with the *Terrestrial vertebrate fauna survey guidelines for Queensland* (Eyre et al. 2022) surveys in the Brigalow Belt Bioregion should be carried out in spring to early summer (September to mid-November) and autumn (March-mid-May). The field survey was completed during late summer.

4.3 Likelihood of Occurrence Assessment

Following the field survey, a likelihood of occurrence assessment was completed to categorise the potential for conservation significant flora and fauna to occur based on the habitat observed within the Project area and surrounds (refer **Section 6.1.3** and **Section 6.2.3**). The assessment provides the following criteria:

- Known to occur
  - Observed onsite during surveys
- Likely to occur
  - Observed close to the Project area during surveys and suitable habitat occurs within the Project area
  - Database records occurring close to the Project area (within 5 km) and suitable habitat occurs within the Project area
- Potential to occur
  - Database records occurring in wider area (>5 km and <25 km) and suitable habitat occurs within the Project area

  - Database records occurring close to the Project area (within 5 km) and marginally suitable habitat occurs although remain relatively isolated (due to vegetation clearing)
- Unlikely to occur
  - No database records in wider area and/or
  - Habitat present in generally unsuitable and/or
  - Project area generally outside of known distribution of species

4.4 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).

5 DESKTOP ASSESSMENT RESULTS

5.1 Existing Environment

The Project is located within the Brigalow Belt South Bioregion (BBSB). Within the BBSB the Project area lies within the Mount Morgan subregion. Large areas of the Brigalow Belt have been cleared of remnant native vegetation for grazing, agriculture and mining. Remaining vegetation is often confined to rockier hilly areas, linear strips of roadside vegetation, riparian vegetation and relatively small, isolated pockets of remnant vegetation.

5.1.1 Topography, Geology and Soils

The topography in the vicinity of the Project area is hilly with considerable height variance between 100 and 40 metres Australian Height Datum (mAHD)**.** It falls to the east, south, and west to Lake Awoonga.

The Taragoola limestone deposits occur within the Early Devonian age (419-Ma) Calliope Beds. The Beds occupy a north-northwest striking belt about 40 km long and 3-4 km wide. They comprise predominantly volcanic rocks with relatively minor inter-bedded sedimentary rocks, including limestone. The rocks have been subjected to folding and faulting. Overburden consists of a shallow cover of soil. Boulders and cobbles of limestone and volcanics occur in much of the layer.

Underlying the overburden is predominantly limestone. Discontinuities within the limestone are clay filled and karst features are prevalent to a depth up to approximately 15 mBGL. Below this depth, karst and infill becomes less prevalent and apertures become tight. Bedding surfaces within the limestone generally dip very steeply towards the west. The major axes of the pits are parallel to the strikes of the beds. This characteristic is consistent with the regional structure.

The volcanics exposed in the walls of the pits include predominantly basic basalt and intermediate olive green andesite. The basalt occurs as lava flows. It is exposed primarily in the upper benches of the east and south walls of Pit 4. It is dark grey, has high to very high strength and is slightly weathered. The andesite generally occurs as steep dipping dykes following vertical to sub-vertical bedding and joints within the limestone. Two dominant systems strike north-north-west and east. Their widths range from stringers to a few meters. Reduced vertical stresses at shallower depths have allowed the andesite to extrude along shallow dipping joints. It has high to very high strength and is moderately to slightly weathered. A summary of the dominant surface geology of the Project area is provided below in **Table 1**.

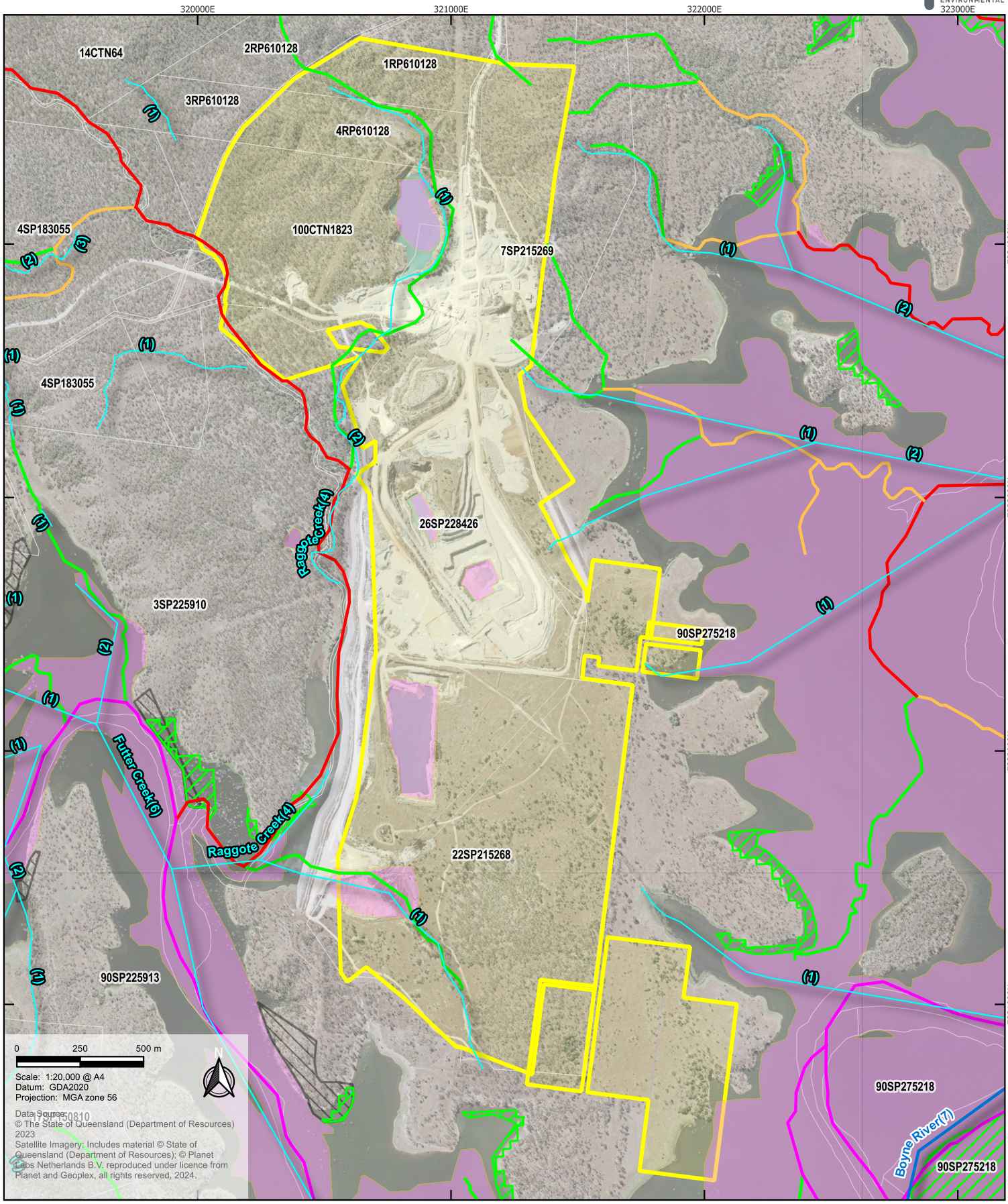
Table 1. Project area surface geology (QGlobe 2023)

Rock unit name	Lithological summary	Dominant rock	Age
SDa	Basaltic to andesitic (rarely dacitic and rhyolitic) volcaniclastic sandstone and conglomerate, limestone, siltstone, andesite	Stratified unit (including volcanic and metamorphic)	Silurian - early Devonian
DSa/l	Fossiliferous limestone, marble	Carbonates (limestone or dolomite)	Silurian - early Devonian

5.1.2 Wetland and Watercourse Mapping

The Project area is within the Boyne River drainage sub-basin. The Project area is intersected by nine stream order 1 watercourses and one stream order 2 watercourse (**Figure 4**). No wetlands of high ecological significance (HES) are mapped within the Project area. East of the Project area, the Boyne River, a stream order 7 watercourse flows into Awoonga Lake. Awoonga Lake is an artificial reservoir maintained by the Awoonga Dam wall. The farm dam is a mapped hydrologically modified or artificial wetland.

A total of six low-risk waterways for waterway barrier works are mapped within the Project area (**Figure 4**).



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 4 Watercourse and waterways.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Vegetation management wetlands map v8.01

Wetland areas (Qld Wetland Mapping v6.0)

- Lacustrine Wetlands (hydrologically modified or artificial)
- Contains Wetlands (1 - 50%)

QLD waterways for waterway barrier works

- Low
- Moderate
- High
- Major

Vegetation management watercourses and drainage features v7 (stream order)

- Major
- Minor

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 4
Wetlands, waterways and watercourses

5.2 Matters of State Environmental Significance

The Offsets Act is supported by the *Environmental Offsets Regulation 2014* (Offsets Regulation) which provides detail on prescribed activities and environmental matters (i.e. MSES) to which the Act applies. MSES include environmental values that are protected under Queensland legislation. The Queensland Government Environmental Reports Online portal identified five MSES as present within the Project area (as summarised in **Table 2**).

Table 2. Matters of State Environmental Significance relevant to the Project area

Matters of State Environmental Significance	Relevance to Project
Protected wildlife habitat under the NC Act:	
Conservation significant flora and fauna	A total of 26 fauna species and 18 flora species listed as threatened or near threatened under the NC Act were identified as potentially occurring within the Project area
Regulated vegetation under the *Vegetation Management Act 1999* (VM Act):	
Endangered/Of concern in Category B	**Not relevant**. Remnant RE 11.3.4/11.3.25 is mapped outside of the Project area to the south-west along the banks of Futter Creek.
Endangered/Of concern in Category C	**Not relevant**. Regrowth RE 11.3.4/11.3.25 is mapped outside of the Project area to the west along the banks of Futter Creek.
Category R (Great Barrier Reef (GBR) riverine regrowth)	Small patches of riverine regrowth vegetation are mapped within the Project area in association with tributaries of Raggote Creek close to Pit 2 and along the eastern boundary of the Project area in association with gullies draining into Awoonga Lake.
Intersecting a watercourse	Regulated vegetation intersecting a watercourse identified on the VM Act watercourse map occur in the far northern and southern portions of the Project area.
Within 100 m of a Vegetation Management Wetland	**Not relevant**. Regulated vegetation within 100 m of a Vegetation Management Wetland is mapped outside of the Project area adjacent to the western boundary and to the south and east of the Project area.
Connectivity areas:	
Remnant vegetation	Remnant vegetation providing connectivity is mapped within the Project areas
Wetlands and watercourses under the EP Act:	
Waterway providing fish passage	Waterways mapped as low risk Queensland waterways for waterway barrier works occur within the Project area

5.3 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESAs) are mapped within the Project area. The nearest ESA is Category C ESA Boyne Range State Forest, located 3 km to the west of the Project area.

5.4 Flora

5.4.1 Vegetation Communities

Current Queensland regulated vegetation mapping indicates the majority of the Project area is Category X non-remnant vegetation. Areas of Category B, C and R vegetation are mapped in the far northern and southern portions of the Project area (**Appendix A**). The extent of this mapping within the Project area is detailed in **Table 3**. Current DNRMMRRD vegetation community mapping identified three REs within the Project area mapped as a mix of homogenous and heterogenous polygons. The REs are described in **Table 4** and depicted in **Figure 5**.

Table 3. Regulated vegetation mapped within the Project area

Regulated vegetation category	Extent (ha)
Category X (non-remnant)	278.50
Category B (remnant)	103.50
Category C (high-value regrowth)	28.60
Category R (riverine regrowth)	18.90

Table 4. Regional Ecosystems currently mapped within Project area

RE	Short description (Queensland Herbarium 2021)	VM Act status	EP Act status
11.11.15	*Eucalyptus crebra* woodland to open woodland on deformed and metamorphosed sediments and interbedded volcanics	Least concern	No concern at present
11.11.4	*Eucalyptus crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	Least concern	No concern at present
11.11.4a	*Eucalyptus tereticornis* dominated woodland. Other tree species listed above may occur as sub or co-dominant species. Not a wetland	Least concern	No concern at present

5.4.2 Conservation Significant Flora

The desktop assessment revealed there are no areas mapped as 'high risk' on the Queensland Flora Survey Trigger Map within the Project area (refer DNRMMRRD Vegetation Management Report in **Appendix A**).

The Wildlife Online database search results identified 18 flora species listed as threatened or near threatened under the NC Act, including five Near Threatened, four Critically Endangered, three Endangered and six Vulnerable species.

Historical database records from ALA (2025) identified 15 threatened or near threatened flora species within 25 km of the assessment area including the following (refer **Figure 6**):

- *Scleromitrion gibsonii* (Critically Endangered – NC Act) - 14 records 18 km south south-west of the Project area within Wietalaba National Park
- *Rhodamnia glabrescens* (Critically Endangered – NC Act) - 11 occurrence records 20 km southeast of the Project area
- Narrow-leaved Malletwood (*Rhodamnia angustifolia*) (Critically Endangered – NC Act) - 21 records 18 km south-southwest of the Project area
- Discolorous-leaved Ironbark (*Eucalyptus decolor*) (Near Threatened – NC Act) - 11 records 6-15 km southeast of the Project area
- *Acacia* sp. (Castletower N.Gibson TOI345) (Vulnerable – NC Act) - one record 9 km southeast of the Project area
- Cudgerie (*Hernandia bivalvis*) (Near Threatened – NC Act) - one record 21 km southeast of the Project area
- Scarlet Fuchsia (*Graptophyllum excelsum*) (Near Threatened – NC Act) - one record 16 km north of the Project area and one record 18 km south southwest of the Project area
- *Parsonsia kroombitensis* (Vulnerable – NC Act) - two records 3-5 km west of the Project area
- *Cassinia collina* (Vulnerable – NC Act) - one record 14 km southeast of the Project area
- Many Peaks Apatophyllum (*Apatophyllum olsenii*) (Endangered - NC Act) – four records 6.5-9 km southeast of the Project area
- *Macropteranthes leiocaulis* (Near Threatened NC Act) - one record 19 km north-northeast of the Project area and two records 22 km southeast of the Project area
- *Cycas megacarpa* (Endangered NC Act) - one record 24 km southwest of the Project area and one record 20 km northeast of the Project area
- *Bergera crenulata* (Critically Endangered – NC Act) - one record 15 km south-southeast of the Project area

- Grevillea (*Grevillea venusta*) (Vulnerable – NC Act) -20 occurrence records within 25 km of the Project area with the nearest record located 6 km southeast of the Project area
- Scrub Ironbark (*Rhodamnia spongiosa*) (Critically Endangered – NC Act) – one record 20 km northeast of the Project area and one record 25 km northwest of the Project area

5.5 Fauna

5.5.1 Conservation Significant Fauna

The desktop review identified 27 fauna species listed as conservation significant under the NC Act as potentially occurring within the wider area surrounding the Project area (refer **Appendix A** for database search results).

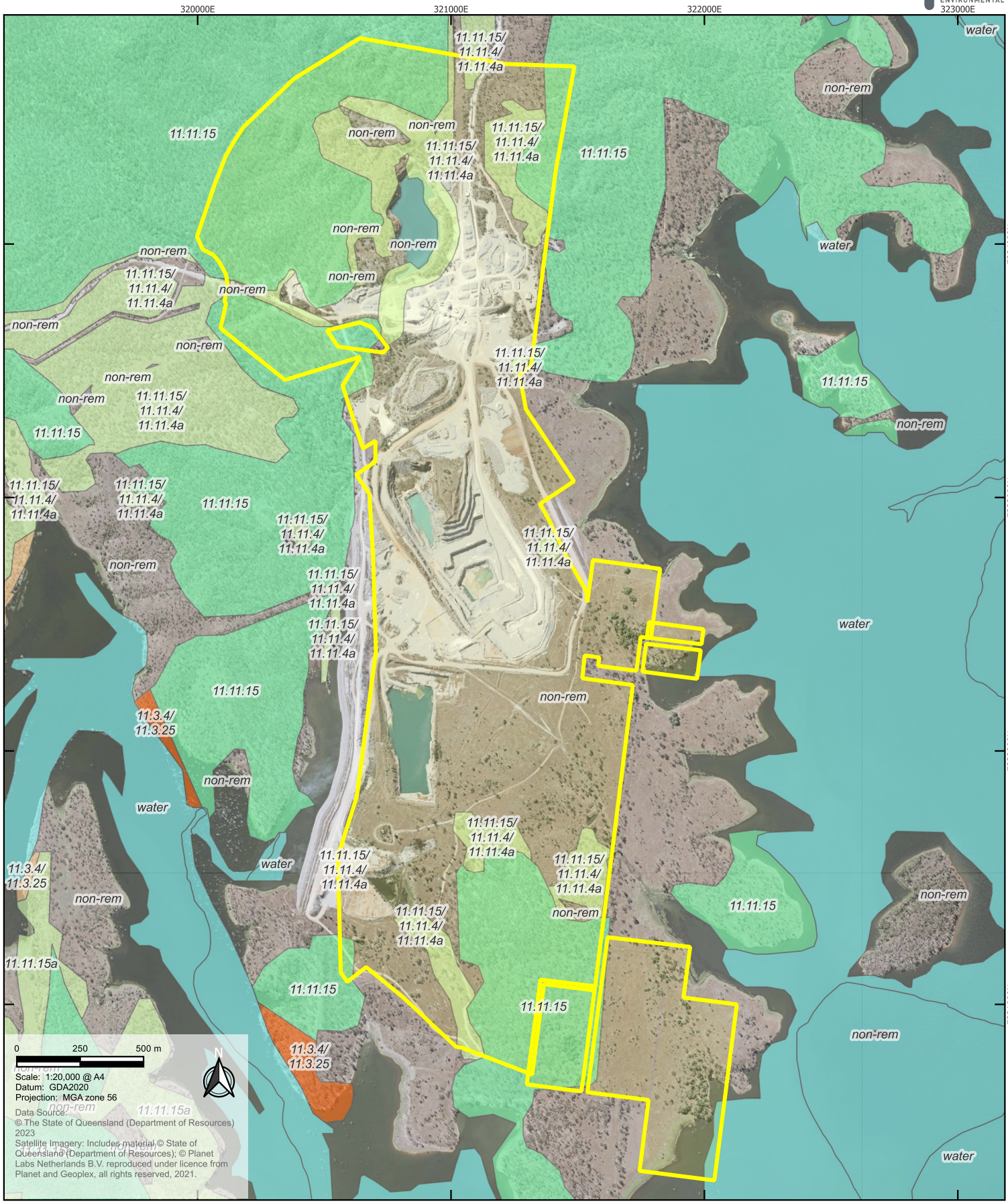
Conservation significant fauna species identified as occurring within 25 km of the Project area from the ALA (2025) database include the following (refer **Figure 6** for locations):

- White-throated Needletail (*Hirundapus caudacutus*) (Vulnerable - NC Act) – 19 occurrence records within 25 km with the nearest record 1.5 km northeast of the Project area
- Curlew Sandpiper (*Calidris ferruginea*) (Critically Endangered - NC Act) – 23 occurrence records within 25 km with the nearest record 1.5 km northeast of the Project area
- Greater Sand Plover (*Charadrius leschenaultii*) (Vulnerable - NC Act) – six occurrence records with 25 km of the Project area with the nearest record located 16 km east of the Project area
- Red Goshawk (*Erythrotriorchis radiatus*) (Endangered - NC Act) – one record from Boyne Island 20 km north-northeast of the Project area
- Squatter Pigeon (*Geophaps scripta scripta*) (Vulnerable - NC Act) – 24 occurrence records with 25 km of the Project area with the nearest record located 3.5 km west of the Project area
- Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri*) (Endangered - NC Act) – three occurrence records within 25 km of the Project area at Boyne Island with the nearest record located 20 km to the north-northeast of the Project area
- Eastern Curlew (*Numenius madagascariensis*) (Critically Endangered - NC Act) – 88 occurrence records within 25 km of the Project area
- Yellow-bellied Glider (*Petaurus australis australis*) (Vulnerable - NC Act) – f occurrence records within 25 km of the Project area with the nearest record located 11 km south southeast of the Project area
- Koala (*Phascolarctos cinereus*) (Endangered - NC Act) – 17 occurrence records within 25 km of the Project with the nearest record located 3.5 km west-southwest of the Project area
- Beach Stone-curlew (*Esacus magnirostris*) (Vulnerable - NC Act) – 20 occurrence records within 25 km of the Project area with the nearest record located 17 km east of the Project area
- Lesser Sand Plover (*Charadrius mongolus*) (Endangered - NC Act) – 19 occurrence records within 25 km of the Project area with the nearest record located 17 km east of the Project area
- Great Knot (*Calidris tenuirostris*) (Critically Endangered - NC Act) – two occurrence records within 25 km of the Project area with the nearest record located 20 km north-north-east of the Project area
- Powerful Owl (*Ninox strenua*) (Vulnerable - NC Act) – seven occurrence records within 25 km of the Project area with the nearest record located 11 km south-southeast of the Project area
- Black-breasted Button-quail (*Turnix melanogaster*) (Vulnerable - NC Act) – eight occurrence records within 25 km of the Project area with the nearest record located 20 km northeast of the Project area on Boyne Island
- Australian Humpback Dolphin (*Sousa sahulensis*) (Vulnerable - NC Act) – one record within 25 km of the Project area located 20 km northeast of the Project area
- Greater Glider (southern and central) (*Petauroides volans*) (Endangered – NC Act) – six occurrence records within 25 km of the Project area with the nearest record located 11 km south-southeast of the Project area
- Red Knot (*Calidris canutus*) (Endangered - NC Act) - Three occurrence records within 25 km of the Project area with the nearest record located 1.5 northeast of the Project area

- Flatback Turtle (*Natator depressus*) (Vulnerable – NC Act) – one record 18 km northeast of the Project area, numerous additional records within Wild Cattle Island National Park
- Glossy Black-cockatoo (northern) (*Calyptorhynchus lathami erebus*) (Vulnerable – NC Act) – numerous records within 25 km of the Project area, the closest record located 19 km northeast of the Project area
- Grey Plover (*Pluvialis squatarola*) (Vulnerable – NC Act) – Two records within 25 km of the Project area, with the closest record 21 km to the north northeast of the Project area
- Ruddy Turnstone (*Arenaria interpres*) (Vulnerable – NC Act) – Two records 22 km northeast of the Project area
- Sharp-tailed Sandpiper (*Calidris acuminata*) (Vulnerable – NC Act) – 10 records within 25 km of the Project area, the closest of which is located 6.5 km northeast of the Project area
- Latham's Snipe (*Gallinago hardwickii*) (Vulnerable – NC Act) – seven records within 25 km of the Project area, the closest of which is located 1.9 km north-northeast of the Project area
- Common Greenshank (*Tringa nebularia*) (Vulnerable – NC Act) – three records within 25 km of the Project area, the closest record, located 1.9 km northeast of the Project area
- Terek Sandpiper (*Xenus cinereus*) (Vulnerable – NC Act) – four records within 25 km of the Project area, the closest record, 17 km east of the Project area

5.5.2 Habitat Mapping

Assessment of DETSI threatened wildlife habitat suitability models determined that habitat for conservation significant fauna species is absent from the Project area (**Appendix A**).



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 5 Queensland Herbarium RE mapping.qgz

Legend

- Site boundary

Regional Ecosystems v13.00

- Category A or B area containing of concern
- Category A or B area that is least concern
- Category C or R area containing of concern
- Category C or R area that is of least concern
- water
- Non-remnant

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 5
Queensland herbarium RE mapping

Legend

- Site boundary
- 25 km buffer of site boundary

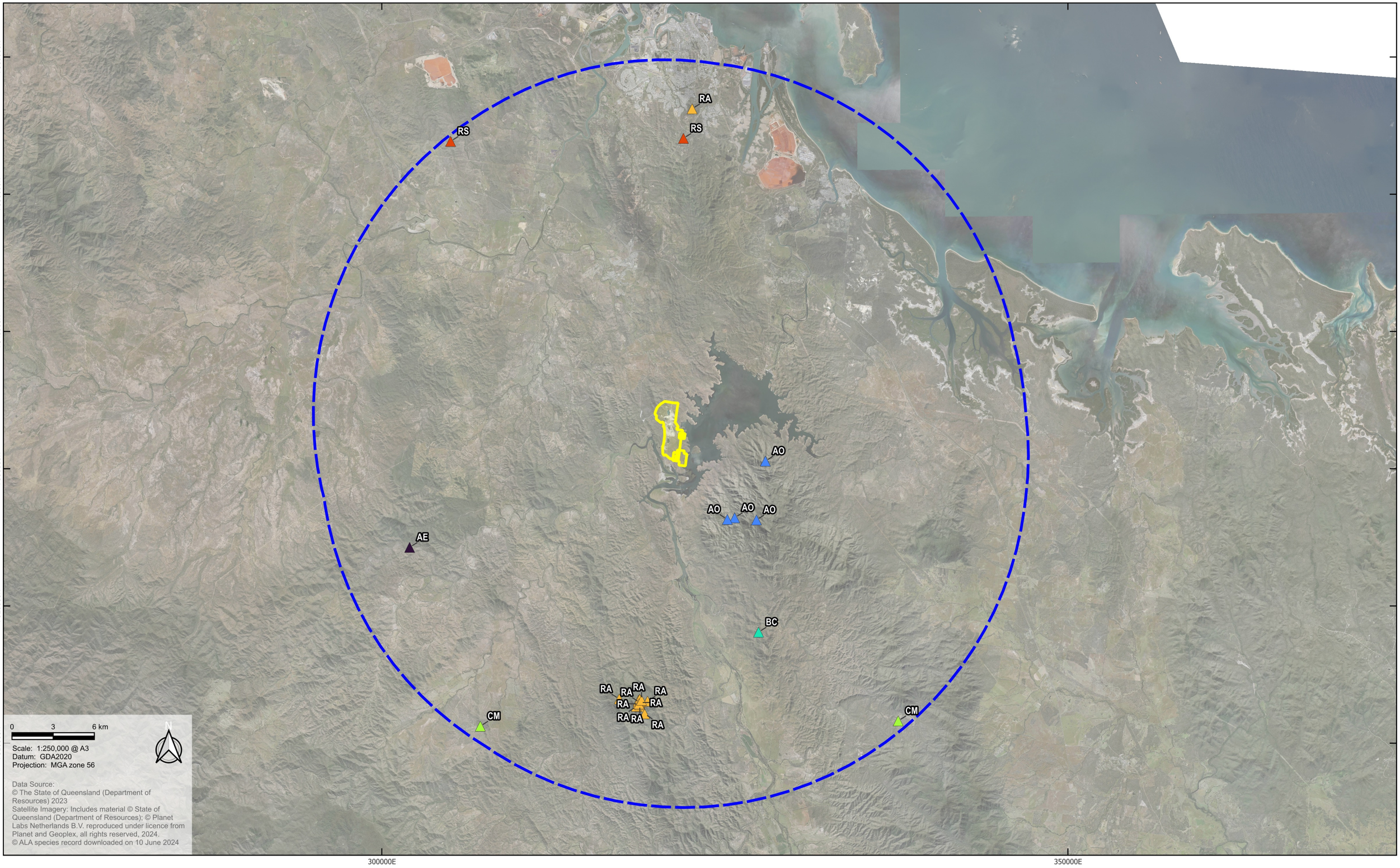
Threatened fauna

- Australian Hump-backed Dolphin (AHBD)
- Common Greenshank (CG)
- Curlew Sandpiper (CS)
- Dunmall's Snake (DS)
- Eastern Curlew (EC)
- Flatback Turtle (FT)
- Great Knot (GK)
- Grey Plover (GP)
- Koala (K)
- Latham's Snipe (LS)
- Pacific Ridley (PR)
- Red Goshawk (RG)
- Red Knot (RK)
- Ruddy Turnstone (RT)
- Sharp-tailed Sandpiper (STS)
- Southern Squatter Pigeon (SSP)
- Terek Sandpiper (TS)
- Western Alaskan Bar-tailed Godwit (WABTG)
- White-throated Needletail (WTN)
- White-throated Snapping Turtle (WTST)
- Yellow-bellied Glider (YBG)

epic
A Montrose Environmental Company

Graymont
Calliope Limestone Quarry
Significant Impact Assessment (MNES) Report

Figure 6a
Conservation significant flora and fauna species records within 25 km of the project area - Threatened fauna species



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 6 ALA record of threatened species and Migratory within 25 km.qgz

Legend

- Site boundary
- 25 km buffer of site boundary

Threatened flora

- Acacia eremophiloides (AE)
- Apatophyllum olsenii (AO)
- Bergera crenulata (BC)
- Cycas megacarpa (CM)
- Rhodamnia angustifolia (RA)
- Rhodamnia spongiosa (RS)

epic
A Montrose Environmental Company

Graymont
Calliope Limestone Quarry
Significant Impact Assessment (MNES) Report

Figure 6b
Conservation significant flora and fauna species records within 25 km of the project area - Threatened flora species

6 FIELD ASSESSMENT RESULTS

6.1 Flora Survey Results

6.1.1 Flora Diversity

A total of 85 flora species were identified within the Project area, including 26 non-native flora species. The floral assemblage is dominated by eucalypts with an understorey of native woody shrubs, herbs and tussock grasses. Narrow-leaved Ironbark (*Eucalyptus crebra*) was the dominant eucalypt within the Project area. A full list of recorded flora species is provided in **Appendix B**.

6.1.2 Ground-truthed Regional Ecosystems

A total of 10 tertiary RE assessments and six quaternary RE assessments were completed across the Project area (refer **Figure 7**). Ground-truthing of current RE mapping confirmed the presence of four vegetation communities analogous to two RE types. Large portions of the Project area currently mapped as a mixed polygon of multiple RE types was confirmed as remnant RE 11.11.15 *Eucalyptus crebra* woodland. Some areas currently mapped as non-remnant or regrowth vegetation on the regulated vegetation map meet the definition of remnant vegetation analogous to RE 11.11.15. Water bodies and non-remnant areas impacted by vegetation clearing were also mapped. The description, status and area of each RE is provided in **Table 5**, and the extent illustrated in **Figure 7**. Further detail regarding vegetation community floristics, structure and representative photos is provided in the following sections. Tertiary and quaternary RE assessment data is provided in **Appendix B**.

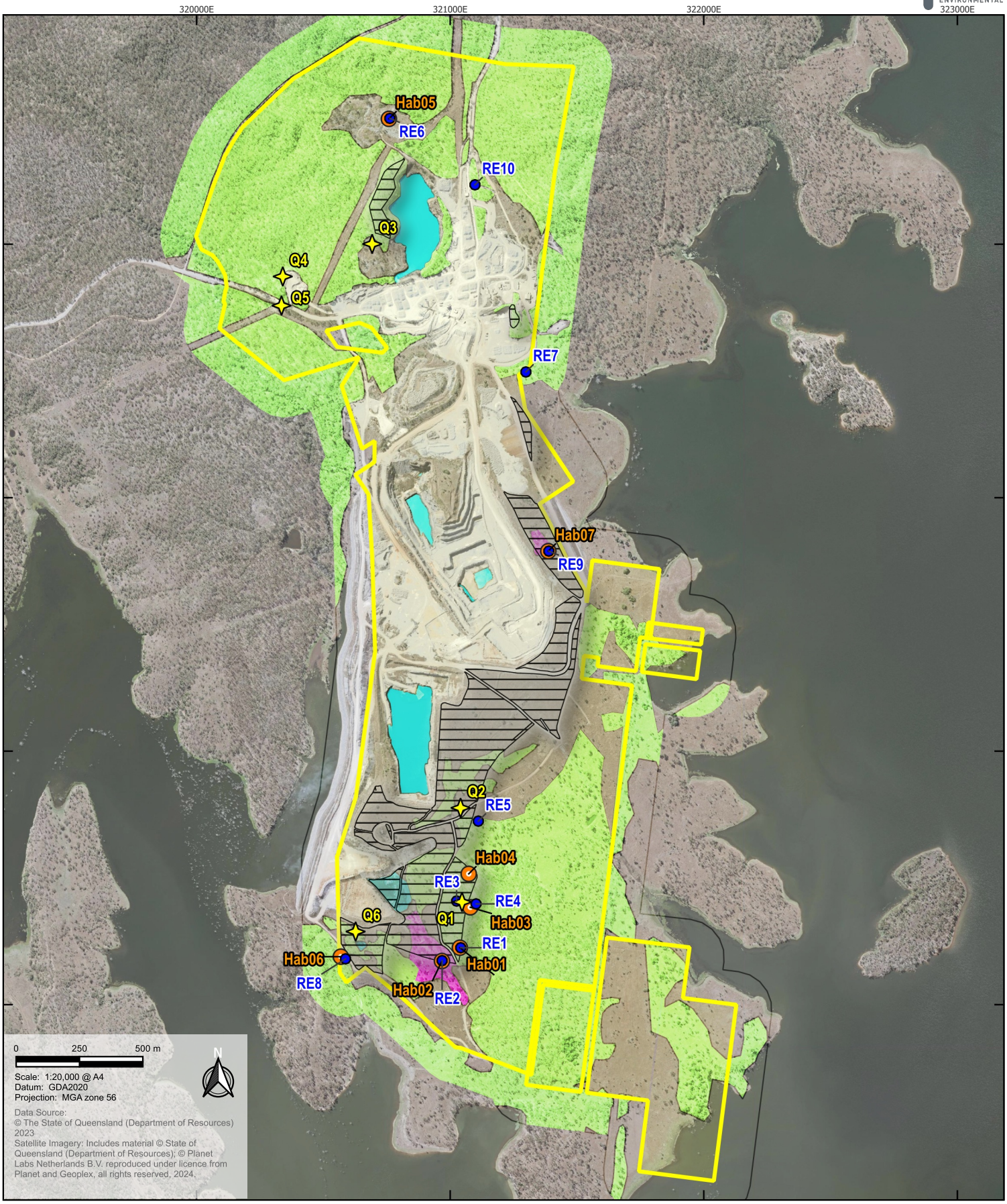
Table 5. Ground-truthed REs within the Project area

Vegetation community	RE	Regulated vegetation category	EP Act (biodiversity)	Extent within Project area (ha)
1. Remnant *Eucalyptus crebra* woodland	11.11.15	B	No concern at present	115.2
2. Regrowth *Eucalyptus crebra* woodland	11.11.15	C	No concern at present	65.8
3. Remnant *Eucalyptus tereticornis* fringing woodland	11.3.25	B	Of concern	4.1
4. Disturbed non-remnant vegetation	N/A	X	N/A	230.1

6.1.2.1 Remnant *Eucalyptus crebra* Woodland

This vegetation community occurs on deformed and metamorphosed sediments with interbedded volcanics. The structure of the vegetation community varies from woodland to open-forest (**Plate 1**). The vegetation community is dominated by Narrow-leaved Ironbark with associated Variable-barked Bloodwood (*Corymbia erythrophloia*) and sub-dominant Moreton Bay Ash (*Corymbia tessellaris*). With a median canopy height range of 14-17 m and a canopy cover range of 18-36 %. A sparse sub-canopy always occurred and included Narrow-leaved Ironbark, Variable-barked Bloodwood, Moreton Bay Ash, and Queensland Bluegum (*Eucalyptus tereticornis*) with a median height range of 7-8.5 m and a median cover range of 3-6%.

A very-sparse to mid-dense shrub layer typically occurred and included Dogs Balls (*Grewia retusifolia*), Spiked Sida (*Sida subspicata*), Glycine Pea (*Glycine tabacina*), Narrow-leaved Ironbark, Pretty Wattle (*Acacia decora*), Catkin Wattle (*Acacia julifera*), Cockatoo Wattle (*Planchonia careya*), Dysentery Plant (*Grewia latifolia*), (*Capparis canescens*), Queensland Bluegum, and Green Wattle (*Acacia deanei*) with a median height range of 0.9-2.5 m and a median canopy cover range of 5-30%.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220009.01 EA Amendment\2. Ecology Field Report\Rev 0\Figure 7 Field-verified regional ecosystems, survey sites and proposed impacts.qgz

Legend

- Site boundary
- Proposed disturbance expansion

Ground-truthed regional ecosystems

- 11.11.15
- 11.3.25
- Non-remnant
- Water

- Quaternary RE
- Secondary RE
- Habitat assessment sites

Graymont
Calliope Limestone Quarry
Ecology Field Report

Figure 7
Field-verified regional ecosystems, survey sites and proposed impacts

Groundcover was dense and dominated by native tussock grasses and herbs including Dark Wiregrass (*Aristida calycina*), Cotton Panic (*Digitaria brownii*), Queensland Bluegrass (*Dichanthium sericeum*), Pitted Bluegrass (*Bothriochloa decipiens*), Black Speargrass (*Heteropogon contortus*), Slender Bamboo Grass (*Austrostipa verticillata*), Kangaroo Grass (*Themeda triandra*), Fuzzweed (*Peripleura hispidula*), Barbed-wire Grass (*Cymbopogon refractus*), White Speargrass (*Aristida leptopoda*), Slender Sedge (*Cyperus gracilis*), High Sida (*Sida trichopoda*),Rusty Glycine (*Glycine tomentella*), Hairy Panic (*Panicum effusum*), Birdsville Indigo (*Indigofera linnaei*), Australian Millet (*Panicum decompositum*), Wiregrass (*Aristida queenslandica*), Nine-awn Grass (*Enneapogon lindleyanus*), Fairy Grass(*Sporobolus caroli*), Desert Bluegrass (*Bothriochloa ewartiana*), Chaff Flower (*Achyranthes aspera*), Spurge (*Phyllanthus maderaspatensis*), and Asthma Plant (*Euphorbia hirta*) with a median height range of 0.2-1.5 m and a median cover range of 80-90%.

Non-native plant cover ranged from 10% to 45% and included African Lovegrass (*Eragrostis curvula*), Cobbler's Pegs (*Bidens pilosa*), Flannel Weed (*Sida cordifolia*), Shrubby Stylo (*Stylosanthes scabra*), Creeping Lantana (*Lantana montevidensis*), Cayenne Snake Weed (*Stachytarpheta cayennensis*), Dwarf Poinsettia (*Euphorbia cyathophora*), Corky Passion Flower (*Passiflora suberosa*), Rubber Vine (*Cryptostegia grandiflora*), Siratro (*Macroptilium atropurpureum*), Canadian Fleabane (*Conyza bonariensis*), American Rat's Tail Grass (*Sporobolus jacquemontii*), Woolly Rattlepod (*Crotalaria incana*), and Lantana (*Lantana camara*). This vegetation community was subject to low cattle disturbance and edge effects from adjacent access tracks.



Plate 1. Remnant *Eucalyptus crebra* woodland

6.1.2.2 Regrowth Eucalyptus crebra Woodland

This vegetation community occurs on deformed and metamorphosed sediments with interbedded volcanics and occurs as woodland (**Plate 2**). The vegetation community is dominated by Narrow-leaved Ironbark with sub-dominant Moreton Bay Ash and Queensland Bluegum with a median canopy height range of 17-17.5 m and a canopy cover range of 11-12%. A very-sparse sub-canopy always occurred and included Narrow-leaved

Ironbark, Moreton Bay Ash, and Queensland Bluegum with a median height range of 6-7 m and a median cover range of 4-5%.

A very-sparse to sparse shrub layer always occurred and included Spiked Sida and Catkin Wattle with a median height range of 1.2-2.4 m and a median canopy cover range of 2-20%.

A dense ground layer was dominated by native tussock grasses with sub-dominant native forbs and was comprised of Pitted Bluegrass, Hairy Panic, Barbed-wire Grass, Wiregrass, Black Spear Grass, Slender Bamboo Grass, Kangaroo Grass, Fuzzweed, Rusty Glycine, and Ryncho (*Rhynchosia minima*) with a median height range of 0.7-1.1 m and a median cover range of 90-95%.

Non-native plant cover occurred at 5% and included Shrubby Stylo, Cobbler's Pegs, Canadian Fleabane, Balloon Cotton Bush (*Gomphocarpus physocarpus*). The vegetation community was subject to disturbance resulting from historical land clearing.



Plate 2. Regrowth *Eucalyptus crebra* woodland

6.1.2.3 Remnant *Eucalyptus tereticornis* Fringing Woodland

This vegetation community occurs along alluvial drainage line and varies from woodland to open-forest (**Plate 3**). The vegetation community is dominated by Queensland Bluegum with sub-dominant Moreton Bay Ash and Narrow-leaved Ironbark with a mean height range of 20-21 m and a median canopy cover range of 24-40%. A very-sparse sub-canopy always occurred and included Queensland Bluegum and Moreton Bay Ash with a median height range of 5-9 m and a median cover range of 1-10%.

A very-sparse shrub layer always occurred and was comprised of Tuckeroo (*Cupaniopsis anacardioides*), Currantbush (*Carissa ovata*) and Dysentery Plant with a median height range of 1.2-1.8 m and a median cover of 1%. A secondary low-shrub layer sometimes occurred and was comprised of Dysentery Plant.

A mid-dense to dense ground layer was dominated by native tussock grasses and herbs including Slender Bamboo Grass, Pitted Bluegrass, Black Speargrass, Reedgrass (*Arundinella nepalensis*), Fuzzweed, High Sida, Common Rush (*Juncus usitatus*), Slender Sedge and Woolly Rattlepod with a median height range of 0.5-1.5m and a median cover range of 60-80%.

Non-native plant cover was sparse and comprised of Shrubby Stylo, Lantana, Canadian Fleabane, Corky Passion Flower, Siratro, Cayenne Snake Weed, Noogoora Burr (*Xanthium occidentale*), Argentine Peppercress (*Lepidium bonariense*), and Castor Oil Bush (*Ricinus communis*) with a median cover of 10%. This vegetation community was subject to disturbance from wash-out erosion and Feral Pig (*Sus scrofa*) rooting and wallowing.



Plate 3. Remnant *Eucalyptus tereticornis* fringing woodland

6.1.2.4 Disturbed Non-remnant Vegetation

This vegetation community occurs as a grassland dominated by native tussock grasses although it is not considered analogous to any RE type (**Plate 4**). A sparse, low, emergent shrub layer is comprised of Australian Indigo (*Indigofera australis*) with a median height of 0.6 m and a median cover of 2%. A sparse ground layer was dominated by native tussock grasses including Pitted Blue Grass, Black Speargrass, Queensland Wiregrass, Hairy Panic, and Narrow-leaved Indigo (*Indigofera linifolia*) with a median height of 0.3 m and a median cover of 20%.

Non-native plant cover was sparse and comprised of Cayenne Snake Weed, Shrubby Stylo, and Blue Billygoat Weed (*Ageratum houstonianum*) with a median cover of 25%.

This vegetation community was subject to very high level of current and historical disturbance including cattle grazing, land clearing, and mining operations (i.e. stock piles and laydowns).



Plate 4. Disturbed non-remnant vegetation

6.1.3 Conservation Significant Flora

The likelihood of occurrence assessment for conservation significant flora species identified in database searches determined that no conservation significant flora species are considered likely to occur within the Project area (**Table 6**). Two flora species area considered a possible occurrence within the Project area:

- *Cassinia collina*
- *Cycas megacarpa*

The remaining flora species area considered unlikely to occur within the Project area and are not considered further in the report.

Table 6. Likelihood of occurrence assessment of conservation significant flora species

Species	Distribution and habitat	Likelihood of occurrence
Acacia sp. (Castletower N. Gibson TO1345) NC Act: V	The species is endemic to Queensland and in restricted to a single known population in the Mt Castletower area along a stream order 3 waterway (Queensland Herbarium 2011a). The single known population occurs in riverine vegetation at 45 m ASL (Halford 2011).	**Unlikely**. Suitable riverine habitat does not occur within the Project area. The nearest historical record of the species is located 9 km southeast of the Project area (ALA 2025).
Acacia eremophiloides NC Act: V	This species is a resinous shrub which grows in shallow well-drained sandy soils on exposed granite ridges at altitudes between 460-550 m. The species occurs in a small isolated population restricted to a distribution range of less than 10 km, in the Burnett Pastoral District of south-eastern Queensland, located 46 km south southwest of Gayndah (DCCEWW 2025).	**Unlikely.** The species has a highly restricted range located over 200 km southwest of the Project area (ALA 2025). The nearest unverified record is located 20 km southwest of the Project area which does not align with its known distribution and is likely incorrectly recorded (ALA 2025).
Bergera crenulata (Turcz.) F.J.Mou NC Act – CR	The species is in the *Rutaceae* family and is a small shrub or tree. The species distribution in Australia is restricted to isolated and scattered records recorded as far north as Goodedulla National Park northwest of Rockhampton and as far south as Gatton in southeast Queensland.	**Unlikely.** The species only occurs in scattered and isolated locations, the closest record is located 15 km south-southeast of the Project area (ALA 2025).
Cassinia collina NC Act: V	The species occurs three locations including Mount Walsh NP, Wongi SF and Mt Stanley (Queensland Herbarium 2011b). Suitable habitat for the species includes open forest on stony soils or sandy loams, along rocky creek banks in fine-grained granite, tall woodland with *Eucalyptus dura, Corymbia trachyphloia* and *Acacia blakei*, and woodland dominated by *Corymbia citriodora, E, acmenoides, C. trachyphloia* and *E. crebra* on shallow sandy soils (Queensland Herbarium 2011b).	**Possible**. Suitable habitat occurs within the Project area in the form of remnant woodland on stony granite soils, however the nearest historical record occurs 14 km southeast of the Project area (ALA 2025).
Cudgerie (*Hernandia bivalvis*) NC Act: NT	This species is restricted to the central coastal and south-east Queensland, between Dryander Creek south to Mt Tamborine. It has also been recorded from Mt Colosseum National Park (DESI 2024). This species grows in vine thicket, microphyll vine forest, or rainforests on rock pavements and outcrops with shallow soils. It occurs up to 620 m altitude (DESI 2024).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record of the species is located 21 km southeast of the Project area (ALA 2025).
Cycas megacarpa NC Act: E	This species is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north (Queensland Herbarium 2007). This species is found in woodland, open woodland and open forests, often in conjunction with a grassy understory, as well as on the edge of rainforest habitat. Associated species included *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Queensland Herbarium 2007).	**Possible**. Suitable habitat for the species occurs within the Project area in the form of remnant woodland and open-forest with a grassy understorey. The nearest historical record of the species is located 24 km southwest of the Project area (ALA 2025).
Dansiea elliptica NC Act: NT	The species is known to occur across two disjunct regions including the Wet Tropic of NE Qld and central Queensland (Queensland Herbarium 2012a). Suitable habitat for the species includes lowland dry rainforest and vine thicket communities (Queensland Herbarium 2012a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. No historical records of the species occur within 25 km of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Discolorous-leaved Ironbark (*Eucalyptus decolor*) NC Act: NT	This species is restricted to Queensland. It is distributed as far north as Castle Tower National Park (north west of Miriam Vale) to south to the ranges south of Biggenden (Mount Walsh National Park). The species occurs within Castle Tower National Park; Many Peaks Range; Eurimbula National Park; Gongiberoo Range; and Mt Walsh National Park, near Biggenden (DESI 2024). This species grows in open forest or open tall woodland on ridges, crest or steep slopes on grey loams or shallow soils derived from granite or sandstone from 160 to 550 metres above sea-level. Associated species include: C*orymbia citriodora, C. trachyphloia subsp. trachyphloia, Eucalyptus major, E. moluccana, E. acmenoides, E. montivaga, E. exserta, Allocasuarina littoralis, Lophostemon confertus, Leptospermum neglectum, Pomaderris argyrophylla, Arundinella nepalensis* and *Eremochloa bimaculata*, and *E. montivaga.*	**Unlikely**. The Project area is beyond the known distribution of the species and suitable habitat in the form of open forest or open tall woodland on ridges, crest or steep slopes does not occur within the Project area. The nearest historical record of the species is located 6 km southeast of the Project area (ALA 2025).
Graptophyllum excelsum	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012b). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012b).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the species is located 16 km north of the Project area (ALA 2025).
Grevillea (*Grevillea venusta*)	The species is restricted to central eastern Queensland, where it occurs in coastal areas from Many Peaks Range to Shoalwater Bay (Makinson, 2000). Suitable habitat for the species includes rocky areas at the foot of mountains, along drainage lines in sandy soil, and forests and woodlands on granite. Suitable vegetation communities include *Eucalyptus acmenoides*, *Corymbia trachyphloia*, *Eucalyptus exserta* open forest on shallow rocky soil with granite, and open forest with *Corymbia intermedia*, *Syncarpia glomulifera* and *Eucalyptus acmenoides*.	**Unlikely**. Habitat with suitable vegetation communities does not occur within the Project area. Historical records include 17 occurrence records within 25 km of the Project area with the nearest record located 6 km southeast of the Project area (ALA 2025).
Macropteranthes leiocaulis NC Act: NT	*Macropteranthes leiocaulis* grows in vine thickets and dry rainforest from approximately Gayndah to Townsville (Harden et al 2018).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record occurs 19 km north north-east of the Project area (ALAL 2025).
Many Peaks Apatophyllum (*Apatophyllum olsenii*) NC Act: E	This species is known from three localities in the Many Peak Range, south of Gladstone, Queensland. Two populations occur in the vicinity of Castle Tower National Park (NP). One population occurs in the NP on the east slopes of Many Peaks Range and contains six plants. The other population occurs just out of the Park, west of Castletower Mountain, and is described as small. The third population occurs about 40 km to the south of Castle Tower NP (DEWHA, 2008). This species inhabits granite ridges and granite boulder outcrops in open forest or tall shrubland with *Eucalyptus exserta, Lophostemon confertus, and Xanthorrhoea johnsonii* (DEWHA, 2008a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include four records 6.5-9 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Narrow-leaved Mallettwood (*Rhodamnia angustifolia*) NC Act: CR	The species is known from a single location at the head of Cedar Creek along a single ridgetop and subtending slopes in the Wietalaba National Park, 45 km south of Gladstone (Queensland Herbarium 2012c). Suitable habitat for the species includes microphyll vineforest with *Backhousia subargentea, Barklya syringifolia, Archidendropsis thozetiana, Backhousia kingii, Sterculia quadrifida, Mallotus philippensis, Croton stigmatosus* and *Araucaria cunninghamii* as the dominant tree species. The substrate is reddish or brown loam from mudstones of Muncon volcanics. The elevation range is from 200 to 560 metres (Snow and Guymer, 1999).	**Unlikely**. Suitable habitat for the species in the form of microphyll vine forest does not occur within the Project area. The nearest historical record is located 18 km south-southwest of the Project area (ALA 2025).
Parsonsia kroombitensis NC Act: V	The species occurs in central east Queensland at Kroombit Tops NP, Boyne Range SF and Cania Gorge NP north-west of Monto (Wang 1998, William 1996). Suitable habitat for the species includes low shrubby woodland and open shrubland along the escarpments of deep valleys, outcrops of acidic volcanic rocks and on skeletal soils derived from sandstone (Queensland Herbarium 2011c).	**Unlikely**. Suitable habitat for the species in the form of low shrubby woodland or open shrubland does not occur within the Project area. The nearest historical record is located 3 km west of the Project area (ALA 2025).
Rib-fruited Malletwood (*Rhodamnia dumicola*) NC Act: E	Occurs in sub-coastal dry rainforest communities from Beenleigh north to the Gladstone area (Leiper et al. 2014, ALA 2022).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest record of the species is 20 km northeast of the Project area (ALA 2025)
Scarlet Fuchsia (*Graptophyllum excelsum*) NC Act: NT	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012c). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012c).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the specie is located 16 km north of the Project area (ALA 2025).
Scleromitrion gibsonii NC Act: E	The species is restricted to an area west of Miriam Vale in central Queensland where it is known to occur in Araucarian microphyll vineforest and dry rainforest (DES 2023).	**Unlikely**. Suitable habitat for the species in the form of *Araucarian* microphyll vine forest and dry rainforest do not occur within the Project area. The nearest historical record of the species is located 18 km south-southwest of the Project area (ALA 2025).
Scrub Ironbark (*Rhodamnia spongiosa*) NC Act: CR	The species is a rainforest tree or shrub which occurs in North and Central east Queensland as well as the Cape York Peninsula. Scrub Ironbark occurs as an understory tree in a variety of established drier rainforest environments and is commonly associated with Kauri Pine (*Agathis robusta)* (Zich et al 2020).	**Unlikely**. Suitable habitat for the species in the form of dry rainforest and Kauri Pine do not occur within the Project area. The nearest record of the species is located 20 km northeast of the Project area (ALA 2025).
Smooth Malletwood (*Rhodamnia glabrescens*) NC Act: NT	The species is known to occur around the districted of Miriam Vale, Mt Boogooramunya and Proserpine (Harden et al 2018). Suitable habitat for the species includes dry rainforest and subtropical rainforest (Harden et al 2018).	**Unlikely**. Suitable habitat for the species in the form of rainforest does not occur within the Project area. The nearest historical record of the species is located 20 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Southern Penda (*Xanthostemon oppositifolius*)	The species is distributed from Miriam Vale in the north to Noosa Heads in the south (ALA 2024). Suitable habitat for the species includes notophyll and microphyll vineforest and wet sclerophyll forest (DESI 2024).	**Unlikely**. Suitable vineforest habitat does not occur within the Project area. There are no historical records within 25 km with the nearest record located 57 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Acacia sp. (Castletower N. Gibson TO1345) NC Act: V	The species is endemic to Queensland and in restricted to a single known population in the Mt Castletower area along a stream order 3 waterway (Queensland Herbarium 2011a). The single known population occurs in riverine vegetation at 45 m ASL (Halford 2011).	**Unlikely**. Suitable riverine habitat does not occur within the Project area. The nearest historical record of the species is located 9 km southeast of the Project area (ALA 2025).
Acacia eremophiloides NC Act: V	This species is a resinous shrub which grows in shallow well-drained sandy soils on exposed granite ridges at altitudes between 460-550 m. The species occurs in a small isolated population restricted to a distribution range of less than 10 km, in the Burnett Pastoral District of south-eastern Queensland, located 46 km south southwest of Gayndah (DCCEWW 2025).	**Unlikely.** The species has a highly restricted range located over 200 km southwest of the Project area (ALA 2025). The nearest unverified record is located 20 km southwest of the Project area which does not align with its known distribution and is likely incorrectly recorded (ALA 2025).
Bergera crenulata (Turcz.) F.J.Mou NC Act – CR	The species is in the *Rutaceae* family and is a small shrub or tree. The species distribution in Australia is restricted to isolated and scattered records recorded as far north as Goodedulla National Park northwest of Rockhampton and as far south as Gatton in southeast Queensland.	**Unlikely.** The species only occurs in scattered and isolated locations, the closest record is located 15 km south-southeast of the Project area (ALA 2025).
Cassinia collina NC Act: V	The species occurs three locations including Mount Walsh NP, Wongi SF and Mt Stanley (Queensland Herbarium 2011b). Suitable habitat for the species includes open forest on stony soils or sandy loams, along rocky creek banks in fine-grained granite, tall woodland with *Eucalyptus dura, Corymbia trachyphloia* and *Acacia blakei*, and woodland dominated by *Corymbia citriodora, E, acmenoides, C. trachyphloia* and *E. crebra* on shallow sandy soils (Queensland Herbarium 2011b).	**Possible**. Suitable habitat occurs within the Project area in the form of remnant woodland on stony granite soils, however the nearest historical record occurs 14 km southeast of the Project area (ALA 2025).
Cudgerie (*Hernandia bivalvis*) NC Act: NT	This species is restricted to the central coastal and south-east Queensland, between Dryander Creek south to Mt Tamborine. It has also been recorded from Mt Colosseum National Park (DESI 2024). This species grows in vine thicket, microphyll vine forest, or rainforests on rock pavements and outcrops with shallow soils. It occurs up to 620 m altitude (DESI 2024).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record of the species is located 21 km southeast of the Project area (ALA 2025).
Cycas megacarpa NC Act: E	This species is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north (Queensland Herbarium 2007). This species is found in woodland, open woodland and open forests, often in conjunction with a grassy understory, as well as on the edge of rainforest habitat. Associated species included *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Queensland Herbarium 2007).	**Possible**. Suitable habitat for the species occurs within the Project area in the form of remnant woodland and open-forest with a grassy understorey. The nearest historical record of the species is located 24 km southwest of the Project area (ALA 2025).
Dansiea elliptica NC Act: NT	The species is known to occur across two disjunct regions including the Wet Tropic of NE Qld and central Queensland (Queensland Herbarium 2012a). Suitable habitat for the species includes lowland dry rainforest and vine thicket communities (Queensland Herbarium 2012a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. No historical records of the species occur within 25 km of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Discolorous-leaved Ironbark (*Eucalyptus decolor*) NC Act: NT	This species is restricted to Queensland. It is distributed as far north as Castle Tower National Park (north west of Miriam Vale) to south to the ranges south of Biggenden (Mount Walsh National Park). The species occurs within Castle Tower National Park; Many Peaks Range; Eurimbula National Park; Gongiberoo Range; and Mt Walsh National Park, near Biggenden (DESI 2024). This species grows in open forest or open tall woodland on ridges, crest or steep slopes on grey loams or shallow soils derived from granite or sandstone from 160 to 550 metres above sea-level. Associated species include: C*orymbia citriodora, C. trachyphloia subsp. trachyphloia, Eucalyptus major, E. moluccana, E. acmenoides, E. montivaga, E. exserta, Allocasuarina littoralis, Lophostemon confertus, Leptospermum neglectum, Pomaderris argyrophylla, Arundinella nepalensis* and *Eremochloa bimaculata*, and *E. montivaga.*	**Unlikely**. The Project area is beyond the known distribution of the species and suitable habitat in the form of open forest or open tall woodland on ridges, crest or steep slopes does not occur within the Project area. The nearest historical record of the species is located 6 km southeast of the Project area (ALA 2025).
Graptophyllum excelsum	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012b). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012b).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the species is located 16 km north of the Project area (ALA 2025).
Grevillea (*Grevillea venusta*)	The species is restricted to central eastern Queensland, where it occurs in coastal areas from Many Peaks Range to Shoalwater Bay (Makinson, 2000). Suitable habitat for the species includes rocky areas at the foot of mountains, along drainage lines in sandy soil, and forests and woodlands on granite. Suitable vegetation communities include *Eucalyptus acmenoides*, *Corymbia trachyphloia*, *Eucalyptus exserta* open forest on shallow rocky soil with granite, and open forest with *Corymbia intermedia*, *Syncarpia glomulifera* and *Eucalyptus acmenoides*.	**Unlikely**. Habitat with suitable vegetation communities does not occur within the Project area. Historical records include 17 occurrence records within 25 km of the Project area with the nearest record located 6 km southeast of the Project area (ALA 2025).
Macropteranthes leiocaulis NC Act: NT	*Macropteranthes leiocaulis* grows in vine thickets and dry rainforest from approximately Gayndah to Townsville (Harden et al 2018).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record occurs 19 km north north-east of the Project area (ALAL 2025).
Many Peaks Apatophyllum (*Apatophyllum olsenii*) NC Act: E	This species is known from three localities in the Many Peak Range, south of Gladstone, Queensland. Two populations occur in the vicinity of Castle Tower National Park (NP). One population occurs in the NP on the east slopes of Many Peaks Range and contains six plants. The other population occurs just out of the Park, west of Castletower Mountain, and is described as small. The third population occurs about 40 km to the south of Castle Tower NP (DEWHA, 2008). This species inhabits granite ridges and granite boulder outcrops in open forest or tall shrubland with *Eucalyptus exserta, Lophostemon confertus, and Xanthorrhoea johnsonii* (DEWHA, 2008a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include four records 6.5-9 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Narrow-leaved Mallettwood (*Rhodamnia angustifolia*) NC Act: CR	The species is known from a single location at the head of Cedar Creek along a single ridgetop and subtending slopes in the Wietalaba National Park, 45 km south of Gladstone (Queensland Herbarium 2012c). Suitable habitat for the species includes microphyll vineforest with *Backhousia subargentea, Barklya syringifolia, Archidendropsis thozetiana, Backhousia kingii, Sterculia quadrifida, Mallotus philippensis, Croton stigmatosus* and *Araucaria cunninghamii* as the dominant tree species. The substrate is reddish or brown loam from mudstones of Muncon volcanics. The elevation range is from 200 to 560 metres (Snow and Guymer, 1999).	**Unlikely**. Suitable habitat for the species in the form of microphyll vine forest does not occur within the Project area. The nearest historical record is located 18 km south-southwest of the Project area (ALA 2025).
Parsonsia kroombitensis NC Act: V	The species occurs in central east Queensland at Kroombit Tops NP, Boyne Range SF and Cania Gorge NP north-west of Monto (Wang 1998, William 1996). Suitable habitat for the species includes low shrubby woodland and open shrubland along the escarpments of deep valleys, outcrops of acidic volcanic rocks and on skeletal soils derived from sandstone (Queensland Herbarium 2011c).	**Unlikely**. Suitable habitat for the species in the form of low shrubby woodland or open shrubland does not occur within the Project area. The nearest historical record is located 3 km west of the Project area (ALA 2025).
Rib-fruited Malletwood (*Rhodamnia dumicola*) NC Act: E	Occurs in sub-coastal dry rainforest communities from Beenleigh north to the Gladstone area (Leiper et al. 2014, ALA 2022).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest record of the species is 20 km northeast of the Project area (ALA 2025)
Scarlet Fuchsia (*Graptophyllum excelsum*) NC Act: NT	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012c). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012c).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the specie is located 16 km north of the Project area (ALA 2025).
Scleromitrion gibsonii NC Act: E	The species is restricted to an area west of Miriam Vale in central Queensland where it is known to occur in Araucarian microphyll vineforest and dry rainforest (DES 2023).	**Unlikely**. Suitable habitat for the species in the form of *Araucarian* microphyll vine forest and dry rainforest do not occur within the Project area. The nearest historical record of the species is located 18 km south-southwest of the Project area (ALA 2025).
Scrub Ironbark (*Rhodamnia spongiosa*) NC Act: CR	The species is a rainforest tree or shrub which occurs in North and Central east Queensland as well as the Cape York Peninsula. Scrub Ironbark occurs as an understory tree in a variety of established drier rainforest environments and is commonly associated with Kauri Pine (*Agathis robusta)* (Zich et al 2020).	**Unlikely**. Suitable habitat for the species in the form of dry rainforest and Kauri Pine do not occur within the Project area. The nearest record of the species is located 20 km northeast of the Project area (ALA 2025).
Smooth Malletwood (*Rhodamnia glabrescens*) NC Act: NT	The species is known to occur around the districted of Miriam Vale, Mt Boogooramunya and Proserpine (Harden et al 2018). Suitable habitat for the species includes dry rainforest and subtropical rainforest (Harden et al 2018).	**Unlikely**. Suitable habitat for the species in the form of rainforest does not occur within the Project area. The nearest historical record of the species is located 20 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Southern Penda (*Xanthostemon oppositifolius*)	The species is distributed from Miriam Vale in the north to Noosa Heads in the south (ALA 2024). Suitable habitat for the species includes notophyll and microphyll vineforest and wet sclerophyll forest (DESI 2024).	**Unlikely**. Suitable vineforest habitat does not occur within the Project area. There are no historical records within 25 km with the nearest record located 57 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Acacia sp. (Castletower N. Gibson TO1345) NC Act: V	The species is endemic to Queensland and in restricted to a single known population in the Mt Castletower area along a stream order 3 waterway (Queensland Herbarium 2011a). The single known population occurs in riverine vegetation at 45 m ASL (Halford 2011).	**Unlikely**. Suitable riverine habitat does not occur within the Project area. The nearest historical record of the species is located 9 km southeast of the Project area (ALA 2025).
Acacia eremophiloides NC Act: V	This species is a resinous shrub which grows in shallow well-drained sandy soils on exposed granite ridges at altitudes between 460-550 m. The species occurs in a small isolated population restricted to a distribution range of less than 10 km, in the Burnett Pastoral District of south-eastern Queensland, located 46 km south southwest of Gayndah (DCCEWW 2025).	**Unlikely.** The species has a highly restricted range located over 200 km southwest of the Project area (ALA 2025). The nearest unverified record is located 20 km southwest of the Project area which does not align with its known distribution and is likely incorrectly recorded (ALA 2025).
Bergera crenulata (Turcz.) F.J.Mou NC Act – CR	The species is in the *Rutaceae* family and is a small shrub or tree. The species distribution in Australia is restricted to isolated and scattered records recorded as far north as Goodedulla National Park northwest of Rockhampton and as far south as Gatton in southeast Queensland.	**Unlikely.** The species only occurs in scattered and isolated locations, the closest record is located 15 km south-southeast of the Project area (ALA 2025).
Cassinia collina NC Act: V	The species occurs three locations including Mount Walsh NP, Wongi SF and Mt Stanley (Queensland Herbarium 2011b). Suitable habitat for the species includes open forest on stony soils or sandy loams, along rocky creek banks in fine-grained granite, tall woodland with *Eucalyptus dura, Corymbia trachyphloia* and *Acacia blakei*, and woodland dominated by *Corymbia citriodora, E, acmenoides, C. trachyphloia* and *E. crebra* on shallow sandy soils (Queensland Herbarium 2011b).	**Possible**. Suitable habitat occurs within the Project area in the form of remnant woodland on stony granite soils, however the nearest historical record occurs 14 km southeast of the Project area (ALA 2025).
Cudgerie (*Hernandia bivalvis*) NC Act: NT	This species is restricted to the central coastal and south-east Queensland, between Dryander Creek south to Mt Tamborine. It has also been recorded from Mt Colosseum National Park (DESI 2024). This species grows in vine thicket, microphyll vine forest, or rainforests on rock pavements and outcrops with shallow soils. It occurs up to 620 m altitude (DESI 2024).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record of the species is located 21 km southeast of the Project area (ALA 2025).
Cycas megacarpa NC Act: E	This species is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north (Queensland Herbarium 2007). This species is found in woodland, open woodland and open forests, often in conjunction with a grassy understory, as well as on the edge of rainforest habitat. Associated species included *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Queensland Herbarium 2007).	**Possible**. Suitable habitat for the species occurs within the Project area in the form of remnant woodland and open-forest with a grassy understorey. The nearest historical record of the species is located 24 km southwest of the Project area (ALA 2025).
Dansiea elliptica NC Act: NT	The species is known to occur across two disjunct regions including the Wet Tropic of NE Qld and central Queensland (Queensland Herbarium 2012a). Suitable habitat for the species includes lowland dry rainforest and vine thicket communities (Queensland Herbarium 2012a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. No historical records of the species occur within 25 km of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Discolorous-leaved Ironbark (*Eucalyptus decolor*) NC Act: NT	This species is restricted to Queensland. It is distributed as far north as Castle Tower National Park (north west of Miriam Vale) to south to the ranges south of Biggenden (Mount Walsh National Park). The species occurs within Castle Tower National Park; Many Peaks Range; Eurimbula National Park; Gongiberoo Range; and Mt Walsh National Park, near Biggenden (DESI 2024). This species grows in open forest or open tall woodland on ridges, crest or steep slopes on grey loams or shallow soils derived from granite or sandstone from 160 to 550 metres above sea-level. Associated species include: C*orymbia citriodora, C. trachyphloia subsp. trachyphloia, Eucalyptus major, E. moluccana, E. acmenoides, E. montivaga, E. exserta, Allocasuarina littoralis, Lophostemon confertus, Leptospermum neglectum, Pomaderris argyrophylla, Arundinella nepalensis* and *Eremochloa bimaculata*, and *E. montivaga.*	**Unlikely**. The Project area is beyond the known distribution of the species and suitable habitat in the form of open forest or open tall woodland on ridges, crest or steep slopes does not occur within the Project area. The nearest historical record of the species is located 6 km southeast of the Project area (ALA 2025).
Graptophyllum excelsum	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012b). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012b).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the species is located 16 km north of the Project area (ALA 2025).
Grevillea (*Grevillea venusta*)	The species is restricted to central eastern Queensland, where it occurs in coastal areas from Many Peaks Range to Shoalwater Bay (Makinson, 2000). Suitable habitat for the species includes rocky areas at the foot of mountains, along drainage lines in sandy soil, and forests and woodlands on granite. Suitable vegetation communities include *Eucalyptus acmenoides*, *Corymbia trachyphloia*, *Eucalyptus exserta* open forest on shallow rocky soil with granite, and open forest with *Corymbia intermedia*, *Syncarpia glomulifera* and *Eucalyptus acmenoides*.	**Unlikely**. Habitat with suitable vegetation communities does not occur within the Project area. Historical records include 17 occurrence records within 25 km of the Project area with the nearest record located 6 km southeast of the Project area (ALA 2025).
Macropteranthes leiocaulis NC Act: NT	*Macropteranthes leiocaulis* grows in vine thickets and dry rainforest from approximately Gayndah to Townsville (Harden et al 2018).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record occurs 19 km north north-east of the Project area (ALAL 2025).
Many Peaks Apatophyllum (*Apatophyllum olsenii*) NC Act: E	This species is known from three localities in the Many Peak Range, south of Gladstone, Queensland. Two populations occur in the vicinity of Castle Tower National Park (NP). One population occurs in the NP on the east slopes of Many Peaks Range and contains six plants. The other population occurs just out of the Park, west of Castletower Mountain, and is described as small. The third population occurs about 40 km to the south of Castle Tower NP (DEWHA, 2008). This species inhabits granite ridges and granite boulder outcrops in open forest or tall shrubland with *Eucalyptus exserta, Lophostemon confertus, and Xanthorrhoea johnsonii* (DEWHA, 2008a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include four records 6.5-9 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Narrow-leaved Mallettwood (*Rhodamnia angustifolia*) NC Act: CR	The species is known from a single location at the head of Cedar Creek along a single ridgetop and subtending slopes in the Wietalaba National Park, 45 km south of Gladstone (Queensland Herbarium 2012c). Suitable habitat for the species includes microphyll vineforest with *Backhousia subargentea, Barklya syringifolia, Archidendropsis thozetiana, Backhousia kingii, Sterculia quadrifida, Mallotus philippensis, Croton stigmatosus* and *Araucaria cunninghamii* as the dominant tree species. The substrate is reddish or brown loam from mudstones of Muncon volcanics. The elevation range is from 200 to 560 metres (Snow and Guymer, 1999).	**Unlikely**. Suitable habitat for the species in the form of microphyll vine forest does not occur within the Project area. The nearest historical record is located 18 km south-southwest of the Project area (ALA 2025).
Parsonsia kroombitensis NC Act: V	The species occurs in central east Queensland at Kroombit Tops NP, Boyne Range SF and Cania Gorge NP north-west of Monto (Wang 1998, William 1996). Suitable habitat for the species includes low shrubby woodland and open shrubland along the escarpments of deep valleys, outcrops of acidic volcanic rocks and on skeletal soils derived from sandstone (Queensland Herbarium 2011c).	**Unlikely**. Suitable habitat for the species in the form of low shrubby woodland or open shrubland does not occur within the Project area. The nearest historical record is located 3 km west of the Project area (ALA 2025).
Rib-fruited Malletwood (*Rhodamnia dumicola*) NC Act: E	Occurs in sub-coastal dry rainforest communities from Beenleigh north to the Gladstone area (Leiper et al. 2014, ALA 2022).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest record of the species is 20 km northeast of the Project area (ALA 2025)
Scarlet Fuchsia (*Graptophyllum excelsum*) NC Act: NT	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012c). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012c).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the specie is located 16 km north of the Project area (ALA 2025).
Scleromitrion gibsonii NC Act: E	The species is restricted to an area west of Miriam Vale in central Queensland where it is known to occur in Araucarian microphyll vineforest and dry rainforest (DES 2023).	**Unlikely**. Suitable habitat for the species in the form of *Araucarian* microphyll vine forest and dry rainforest do not occur within the Project area. The nearest historical record of the species is located 18 km south-southwest of the Project area (ALA 2025).
Scrub Ironbark (*Rhodamnia spongiosa*) NC Act: CR	The species is a rainforest tree or shrub which occurs in North and Central east Queensland as well as the Cape York Peninsula. Scrub Ironbark occurs as an understory tree in a variety of established drier rainforest environments and is commonly associated with Kauri Pine (*Agathis robusta)* (Zich et al 2020).	**Unlikely**. Suitable habitat for the species in the form of dry rainforest and Kauri Pine do not occur within the Project area. The nearest record of the species is located 20 km northeast of the Project area (ALA 2025).
Smooth Malletwood (*Rhodamnia glabrescens*) NC Act: NT	The species is known to occur around the districted of Miriam Vale, Mt Boogooramunya and Proserpine (Harden et al 2018). Suitable habitat for the species includes dry rainforest and subtropical rainforest (Harden et al 2018).	**Unlikely**. Suitable habitat for the species in the form of rainforest does not occur within the Project area. The nearest historical record of the species is located 20 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Southern Penda (*Xanthostemon oppositifolius*)	The species is distributed from Miriam Vale in the north to Noosa Heads in the south (ALA 2024). Suitable habitat for the species includes notophyll and microphyll vineforest and wet sclerophyll forest (DESI 2024).	**Unlikely**. Suitable vineforest habitat does not occur within the Project area. There are no historical records within 25 km with the nearest record located 57 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Acacia sp. (Castletower N. Gibson TO1345) NC Act: V	The species is endemic to Queensland and in restricted to a single known population in the Mt Castletower area along a stream order 3 waterway (Queensland Herbarium 2011a). The single known population occurs in riverine vegetation at 45 m ASL (Halford 2011).	**Unlikely**. Suitable riverine habitat does not occur within the Project area. The nearest historical record of the species is located 9 km southeast of the Project area (ALA 2025).
Acacia eremophiloides NC Act: V	This species is a resinous shrub which grows in shallow well-drained sandy soils on exposed granite ridges at altitudes between 460-550 m. The species occurs in a small isolated population restricted to a distribution range of less than 10 km, in the Burnett Pastoral District of south-eastern Queensland, located 46 km south southwest of Gayndah (DCCEWW 2025).	**Unlikely.** The species has a highly restricted range located over 200 km southwest of the Project area (ALA 2025). The nearest unverified record is located 20 km southwest of the Project area which does not align with its known distribution and is likely incorrectly recorded (ALA 2025).
Bergera crenulata (Turcz.) F.J.Mou NC Act – CR	The species is in the *Rutaceae* family and is a small shrub or tree. The species distribution in Australia is restricted to isolated and scattered records recorded as far north as Goodedulla National Park northwest of Rockhampton and as far south as Gatton in southeast Queensland.	**Unlikely.** The species only occurs in scattered and isolated locations, the closest record is located 15 km south-southeast of the Project area (ALA 2025).
Cassinia collina NC Act: V	The species occurs three locations including Mount Walsh NP, Wongi SF and Mt Stanley (Queensland Herbarium 2011b). Suitable habitat for the species includes open forest on stony soils or sandy loams, along rocky creek banks in fine-grained granite, tall woodland with *Eucalyptus dura, Corymbia trachyphloia* and *Acacia blakei*, and woodland dominated by *Corymbia citriodora, E, acmenoides, C. trachyphloia* and *E. crebra* on shallow sandy soils (Queensland Herbarium 2011b).	**Possible**. Suitable habitat occurs within the Project area in the form of remnant woodland on stony granite soils, however the nearest historical record occurs 14 km southeast of the Project area (ALA 2025).
Cudgerie (*Hernandia bivalvis*) NC Act: NT	This species is restricted to the central coastal and south-east Queensland, between Dryander Creek south to Mt Tamborine. It has also been recorded from Mt Colosseum National Park (DESI 2024). This species grows in vine thicket, microphyll vine forest, or rainforests on rock pavements and outcrops with shallow soils. It occurs up to 620 m altitude (DESI 2024).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record of the species is located 21 km southeast of the Project area (ALA 2025).
Cycas megacarpa NC Act: E	This species is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north (Queensland Herbarium 2007). This species is found in woodland, open woodland and open forests, often in conjunction with a grassy understory, as well as on the edge of rainforest habitat. Associated species included *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Queensland Herbarium 2007).	**Possible**. Suitable habitat for the species occurs within the Project area in the form of remnant woodland and open-forest with a grassy understorey. The nearest historical record of the species is located 24 km southwest of the Project area (ALA 2025).
Dansiea elliptica NC Act: NT	The species is known to occur across two disjunct regions including the Wet Tropic of NE Qld and central Queensland (Queensland Herbarium 2012a). Suitable habitat for the species includes lowland dry rainforest and vine thicket communities (Queensland Herbarium 2012a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. No historical records of the species occur within 25 km of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Discolorous-leaved Ironbark (*Eucalyptus decolor*) NC Act: NT	This species is restricted to Queensland. It is distributed as far north as Castle Tower National Park (north west of Miriam Vale) to south to the ranges south of Biggenden (Mount Walsh National Park). The species occurs within Castle Tower National Park; Many Peaks Range; Eurimbula National Park; Gongiberoo Range; and Mt Walsh National Park, near Biggenden (DESI 2024). This species grows in open forest or open tall woodland on ridges, crest or steep slopes on grey loams or shallow soils derived from granite or sandstone from 160 to 550 metres above sea-level. Associated species include: C*orymbia citriodora, C. trachyphloia subsp. trachyphloia, Eucalyptus major, E. moluccana, E. acmenoides, E. montivaga, E. exserta, Allocasuarina littoralis, Lophostemon confertus, Leptospermum neglectum, Pomaderris argyrophylla, Arundinella nepalensis* and *Eremochloa bimaculata*, and *E. montivaga.*	**Unlikely**. The Project area is beyond the known distribution of the species and suitable habitat in the form of open forest or open tall woodland on ridges, crest or steep slopes does not occur within the Project area. The nearest historical record of the species is located 6 km southeast of the Project area (ALA 2025).
Graptophyllum excelsum	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012b). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012b).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the species is located 16 km north of the Project area (ALA 2025).
Grevillea (*Grevillea venusta*)	The species is restricted to central eastern Queensland, where it occurs in coastal areas from Many Peaks Range to Shoalwater Bay (Makinson, 2000). Suitable habitat for the species includes rocky areas at the foot of mountains, along drainage lines in sandy soil, and forests and woodlands on granite. Suitable vegetation communities include *Eucalyptus acmenoides*, *Corymbia trachyphloia*, *Eucalyptus exserta* open forest on shallow rocky soil with granite, and open forest with *Corymbia intermedia*, *Syncarpia glomulifera* and *Eucalyptus acmenoides*.	**Unlikely**. Habitat with suitable vegetation communities does not occur within the Project area. Historical records include 17 occurrence records within 25 km of the Project area with the nearest record located 6 km southeast of the Project area (ALA 2025).
Macropteranthes leiocaulis NC Act: NT	*Macropteranthes leiocaulis* grows in vine thickets and dry rainforest from approximately Gayndah to Townsville (Harden et al 2018).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest historical record occurs 19 km north north-east of the Project area (ALAL 2025).
Many Peaks Apatophyllum (*Apatophyllum olsenii*) NC Act: E	This species is known from three localities in the Many Peak Range, south of Gladstone, Queensland. Two populations occur in the vicinity of Castle Tower National Park (NP). One population occurs in the NP on the east slopes of Many Peaks Range and contains six plants. The other population occurs just out of the Park, west of Castletower Mountain, and is described as small. The third population occurs about 40 km to the south of Castle Tower NP (DEWHA, 2008). This species inhabits granite ridges and granite boulder outcrops in open forest or tall shrubland with *Eucalyptus exserta, Lophostemon confertus, and Xanthorrhoea johnsonii* (DEWHA, 2008a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include four records 6.5-9 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Narrow-leaved Mallettwood (*Rhodamnia angustifolia*) NC Act: CR	The species is known from a single location at the head of Cedar Creek along a single ridgetop and subtending slopes in the Wietalaba National Park, 45 km south of Gladstone (Queensland Herbarium 2012c). Suitable habitat for the species includes microphyll vineforest with *Backhousia subargentea, Barklya syringifolia, Archidendropsis thozetiana, Backhousia kingii, Sterculia quadrifida, Mallotus philippensis, Croton stigmatosus* and *Araucaria cunninghamii* as the dominant tree species. The substrate is reddish or brown loam from mudstones of Muncon volcanics. The elevation range is from 200 to 560 metres (Snow and Guymer, 1999).	**Unlikely**. Suitable habitat for the species in the form of microphyll vine forest does not occur within the Project area. The nearest historical record is located 18 km south-southwest of the Project area (ALA 2025).
Parsonsia kroombitensis NC Act: V	The species occurs in central east Queensland at Kroombit Tops NP, Boyne Range SF and Cania Gorge NP north-west of Monto (Wang 1998, William 1996). Suitable habitat for the species includes low shrubby woodland and open shrubland along the escarpments of deep valleys, outcrops of acidic volcanic rocks and on skeletal soils derived from sandstone (Queensland Herbarium 2011c).	**Unlikely**. Suitable habitat for the species in the form of low shrubby woodland or open shrubland does not occur within the Project area. The nearest historical record is located 3 km west of the Project area (ALA 2025).
Rib-fruited Malletwood (*Rhodamnia dumicola*) NC Act: E	Occurs in sub-coastal dry rainforest communities from Beenleigh north to the Gladstone area (Leiper et al. 2014, ALA 2022).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The nearest record of the species is 20 km northeast of the Project area (ALA 2025)
Scarlet Fuchsia (*Graptophyllum excelsum*) NC Act: NT	The species occurs across the coastal regions of northern and southern Queensland (Queensland Herbarium 2012c). Suitable habitat for the species includes semi-evergreen vine thickets and grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* (Queensland Herbarium 2012c).	**Unlikely**. Suitable habitat for the species in the form of semi-evergreen vine thickets or grassy woodland dominated by *Eucalyptus cullenii* and *Corymbia erythrophloia* do not occur within the Project area. The nearest historical record of the specie is located 16 km north of the Project area (ALA 2025).
Scleromitrion gibsonii NC Act: E	The species is restricted to an area west of Miriam Vale in central Queensland where it is known to occur in Araucarian microphyll vineforest and dry rainforest (DES 2023).	**Unlikely**. Suitable habitat for the species in the form of *Araucarian* microphyll vine forest and dry rainforest do not occur within the Project area. The nearest historical record of the species is located 18 km south-southwest of the Project area (ALA 2025).
Scrub Ironbark (*Rhodamnia spongiosa*) NC Act: CR	The species is a rainforest tree or shrub which occurs in North and Central east Queensland as well as the Cape York Peninsula. Scrub Ironbark occurs as an understory tree in a variety of established drier rainforest environments and is commonly associated with Kauri Pine (*Agathis robusta)* (Zich et al 2020).	**Unlikely**. Suitable habitat for the species in the form of dry rainforest and Kauri Pine do not occur within the Project area. The nearest record of the species is located 20 km northeast of the Project area (ALA 2025).
Smooth Malletwood (*Rhodamnia glabrescens*) NC Act: NT	The species is known to occur around the districted of Miriam Vale, Mt Boogooramunya and Proserpine (Harden et al 2018). Suitable habitat for the species includes dry rainforest and subtropical rainforest (Harden et al 2018).	**Unlikely**. Suitable habitat for the species in the form of rainforest does not occur within the Project area. The nearest historical record of the species is located 20 km southeast of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Southern Penda (*Xanthostemon oppositifolius*)	The species is distributed from Miriam Vale in the north to Noosa Heads in the south (ALA 2024). Suitable habitat for the species includes notophyll and microphyll vineforest and wet sclerophyll forest (DESI 2024).	**Unlikely**. Suitable vineforest habitat does not occur within the Project area. There are no historical records within 25 km with the nearest record located 57 km southeast of the Project area (ALA 2025).

6.1.4 Weed Species

A total of 26 non-native flora species were identified within the Project area and included invasive grasses, shrubs, vines, herbs and cactus (**Table 7**). A total of six category 3 Biosecurity matters and four WoNS were identified within the Project area with Lantana and Creeping Lantana the most common. Rubber Vine was also relative common in disturbed areas (i.e. rock dumps, residual voids, and adjacent to access tracks) (**Plate 5**). Non-native plant cover ranged from 5% to 45%.

Large infestation of White Cedar (*Melia azedarach*) occurred in rock dump areas (**Plate 6**). The species is technically native to the state of Queensland, however it is not considered a natural component of local vegetation communities and appears to be responding to anthropological disturbance resulting in a novel vegetation community.

Table 7. Non-native flora species identified within the Project area

Common name (Species name)	Species name	Biosecurity status	WoNS
African Lovegrass	*Eragrostis curvula*	-	-
American Ratstail Grass	*Sporobolus jacquemontii*	3	Yes
Argentine Peppercress	*Lepidium bonariense*	-	-
Balloon Cottonbush	*Gomphocarpus physocarpus*	-	-
Blue Billygoat Weed	*Ageratum houstonianum*	-	-
Canadian Fleabane	*Conyza bonariensis*	-	-
Castor Oil Bush	*Ricinus communis*	-	-
Cobbler's Pegs	*Bidens pilosa*	-	-
Corky Passion Flower	*Passiflora suberosa*	-	-
Creeping Lantana	*Lantana montevidensis*	3	-
Dwarf Poinsettia	*Euphorbia cyathophora*	-	-
Flannel Weed	*Sida cordifolia*	-	-
Lantana	*Lantana camara*	3	Yes
Lippia	*Phyla canescens*	-	-
Maynes pest	*Glandularia aristigera*	-	-
Mimosa Bush	*Vachellia farnesiana*	3	-
Noogoora Burr	*Xanthium occidentale*	-	-
Prickly Pear	*Opuntia stricta*	3	Yes
Red Natal Grass	*Melinis repens*	-	-
Rubber vine	*Cryptostegia grandiflora*	3	Yes
Shrubby Stylo	*Stylosanthes scabra*	-	-
Siratro	*Macroptilium atropurpureum*	-	-
Snake Weed	*Stachytarpheta cayennensis*	-	-
Urena Weed	*Urena lobata*	-	-
Verbena	*Verbena littoralis*	-	-
Woolly Rattlepod	*Crotalaria incana*	-	-



Plate 5. Rubber Vine infestation



Plate 6. White Cedar infestation

6.1.5 BioCondition

Two BioCondition assessments were completed, one in remnant RE 11.11.15 in the far north of the Project area, and a second within a derived native grassland in the south of the Project area (**Figure 7**).

BioCondition assessment data is provided in **Appendix B**.

6.2 Fauna Survey Results

6.2.1 Fauna Diversity

A total of 23 fauna species (or evidence of) were observed within the Project area during the field survey, including three non-native species. The faunal assemblage was dominated by common diurnal birds, particularly those species that are tolerant of disturbance and able to utilise cleared open areas. A full list of fauna species recorded during the field survey is provided in **Table 8**.

Table 8. Fauna species observed within the Project area

Common name	Species name	Non-native	Biosecurity status
Agile Wallaby	*Notamacropus agilis*	-	-
Bearded Dragon	*Pogona barbata*	-	-
Black Cormorant	*Phalacrocorax sulcirostris*	-	-

Common name	Species name	Non-native	Biosecurity status
Brown Goshawk	*Accipiter fasciatus*	-	-
Brown Quail	*Coturnix ypsilophora*	-	-
Dragon species	*Diporiphora sp.*	-	-
Eastern Grey Kangaroo	*Macropus giganteus*	-	-
Eastern Sedge Frog	*Litoria fallax*	-	-
Feral Pig	*Sus scrofa*	*	3,4,6
Grey Butcherbird	*Cracticus torquatus*	-	-
Kestrel	*Falco cenchroides*	-	-
Magpie	*Gymnorhina tibicen*	-	-
Noisy Friarbird	*Philemon corniculatus*	-	-
Noisy Miner	*Manorina melanocephala*	-	-
Pacific Black Duck	*Anas superciliosa*	-	-
Pied Butcherbird	*Cracticus nigrogularis*	-	-
European Rabbit (scat)	*Oryctolagus cuniculus*	*	3,4,5,6
Red-backed Fairy-wren	*Malurus melanocephalus*	-	-
Striated Pardalote	*Pardalotus striatus*	-	-
Wedge-tailed Eagle	*Audax aquila*	-	-
White-Faced Heron	*Egretta novaehollandiae*	-	-
White-throated Honeyeater	*Melithreptus albogularis*	-	-
Wild Dog/dingo (scat)	*Canis sp.*	*	3,4,6

6.2.2 Fauna Habitats

A total of seven habitat assessments were completed within the Project area (**Figure 7**). Fauna habitat within the Project is limited relative to the broader landscape. Remnant open-forests and woodland provide suitable habitat for birds, reptiles and mammals. Mature trees (i.e. Narrow-leaved Ironbark) within the Project area provided very few hollows and no large tree hollows were observed within the Project area. The Project area is unlikely to provide habitat for hollow-dependent arboreal mammals.

Fauna abundance and diversity generally declined from remnant to regrowth vegetation, and was poorest in cleared areas, with the exception of Agile Wallabies, which were in high abundance in disturbed areas such as cleared areas, easements and access tracks.

A range of microhabitats suitable for a various fauna occurred onsite. Rock piles were common and likely provide suitable habitat for reptiles and small mammals. Several small farm dams also occur within the southern portion of the Project area, and likely provide drinking water for a range of mammals and birds. Fauna habitat assessment data is provided in **Appendix B**.

6.2.3 Conservation Significant Fauna

The likelihood of occurrence assessment for conservation significant fauna species identified in database searches determined that three conservation significant fauna species, Koala, Squatter Pigeon and White-throated Needletail, are considered likely to occur within the Project area (**Table 10**). An additional conservation significant fauna species is considered a possible occurrence and listed below:

- Powerful Owl

Marine species such as marine mammals and turtles were excluded from the assessment due to the absence of marine environments from the Project area or adjacent areas and not considered in this report.

The remaining conservation significant fauna species area considered unlikely to occur within the Project area and are not considered further in the report.

6.2.4 Pest Species

Three non-native fauna species were observed during the field survey within the Project area, either directly or indirectly through evidence of occurrence (i.e. scats) (**Table 9**).

Table 9. Pest species identified within the Project area

Common name	Species name	Biosecurity Act categories
Feral Pig	*Sus scrofa*	3,4,6
European Rabbit (scat)	*Oryctolagus cuniculus*	3,4,5,6
Wild Dog/dingo (scat)	*Canis sp.*	3,4,6

Table 10. Likelihood of occurrence assessment of conservation significant fauna species

Species	Distribution and habitat	Likelihood of occurrence
Beach-stone Curlew (*Esacus magnirostris*) NC Act: V	The species is distributed along the coast of northern and eastern Australia (ALA 2024). Suitable habitat for the species includes beaches, foredunes, mangroves, tidal flats and offshore islands (Menkhorst et al 2017).	**Unlikely**. Suitable coastal habitat for the species does not occur within the Project area. Historical records include 20 occurrence records within 25 km of the Project area with the nearest record located 17 km east of the Project area (ALA 2025).
Black-breasted Button-quail (*Turnix melanogaster*) NC Act: V	Has been recorded from the Byfield region in the north to at least the Border Ranges rainforests, generally east of the Great Dividing Range, although some observations have been made on its western slopes, up to 300 km inland at locations such as Palm Grove National Park and Barakula State Forest in Queensland (Marchant & Higgins 1993; Smyth & Pavey 2001; Garnett et al. 2011). Habitat considered critical to the survival of the black-breasted button-quail includes: Vine thickets and rainforest vegetation types, particularly semi-evergreen vine thicket, low microphyll vine forest, *Araucarian* microphyll vine forest, *Araucarian* notophyll vine forest and *Brachychiton* scrubs; Low thickets or woodlands with a dense understorey but little ground cover, typically dominated by Acacia spp.; and in littoral situations, dry vine scrubs, acacia thickets and areas densely covered in shrubs, particularly *Austromyrtus dulcis* and Lantana (DEECCW 2022).	**Unlikely**. Suitable rainforest/thicket vegetation does not occur within the Project area. The species was not observed within the Project area during field surveys. The nearest record of the species is located 20 km northeast of the Project area on Boyne Island (ALA 2025).
Common Greenshank (*Tringa nebularia*) NC Act: E	Recorded in most coastal regions. Inland, there have been a few records south of a line from near Dalby to Mt Guide, and sparsely scattered records elsewhere. Sites of international importance in Queensland include the south-east Gulf of Carpentaria and the Great Sandy Strait (DotE 2015a). The species occurs in all types of wetlands. This species inhabits a wide variety of inland wetlands and sheltered coastal habitats of varying salinity, including sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass, both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats (DotE 2015a).	**Unlikely** - Suitable coastal and wetland habitats are not present within the Project area. The closest occurrence record for the species was recorded 1.9 km northeast of the Project area (ALA 2025)**.**
Curlew Sandpiper (*Calidris ferruginea*) NC Act: CR	The species migrates to coastal regions of Australia with scattered location inland (DE 2015a). This species usually forages and roosts in intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms (DE 2015a).	**Unlikely**. Suitable wetland habitat for the species does not occur within the Project area. Historical records of the species include 23 occurrence records within 25 km with the nearest record 1.5 km northeast of the Project area (ALA 2025).
Eastern Curlew (*Numenius madagascariensis*) NC Act: E	Coastal distribution in all states. Rarely recorded inland. Continuous distribution along the Qld coast. Internationally important sites occur in Great Sandy Strait, Moreton Bay, Shoalwater Bay and Broad Sound, Notch Point (Ilbilbie), SE Gulf of Carpentaria and Mackay Town Beach (DCCEEW 2023). Typically inhabit sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets.	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include 88 occurrence records within 25 km of the Project area (ALA 2025).

Species	Distribution and habitat	Likelihood of occurrence
Glossy Black-cockatoo (northern) (*Calyptorhynchus lathami erebus*) NC Act: V	This species is widespread across the north and central east coast of Queensland and is found north of the Dawes and Many Peaks ranges to north of the Connors-Clarke Ranges and as far west as the Denham Ranges. The Glossy Black-cockatoo (northern) has a similar preferred habitat to the Glossy Black-cockatoo (south-eastern) preferring woodlands dominated by casuarina and Allocasuarina species (Horigan 2012). The species is visually similar to the Glossy Black-cockatoo (south-eastern) and can be distinguished by the smaller size of its bill (DCCEEW 2022).	**Unlikely.** Suitable habitat for the species was not recorded within the Project area, and no Casuarina or Allocasuarina species were identified. The closest occurrence record for the species is located approximately 19 km northeast of the Project area (ALA 2025)**.**
Great Knot (*Calidris tenuirostris*) NC Act: CR	The species is known to occur along the entire Australian coastline (DCCEEW 2023). Suitable habitat for the species includes sheltered coastal habitats, with large intertidal mudflats or sandflats, inlets, bays, harbours, estuaries and lagoons, exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, saltlakes and non-tidal lagoons (DCCEEW 2023).	**Unlikely**. Suitable wetland or coastal habitats do not occur within the Project. Historical records of the species include two occurrence records within 25 km of the Project area with the neatest record located 20 km north-northeast of the Project area (ALA 2025).
Greater Sand Plover (*Charadrius leschenaultii*) NC Act: V	Greater Sand Plovers occur along most of the coastline but are more widespread in northern Australia (DCCEEW 2022). There are 5 sites in Australia of international importance including the south-eastern corner of Gulf of Carpentaria, Queensland (Bamford et al. 2008). The species forages on intertidal mudflats and sandflats, usually in sheltered bays and estuaries but also on ocean beaches, coral reefs and rock platforms. It roosts on beaches, sandbars and estuarine lagoons and occasionally rocky islets and reefs (Marchant & Higgins 1993).	**Unlikely**. Suitable wetland or coastal habitats do not occur within the Project. Historical records of the species include six occurrence records with 25 km of the Project area with the nearest record located 16 km east of the Project area (ALA 2025).
Grey plover (*Pluvialis squatarola*) NC Act: V	The Grey Plover is a migratory shorebird which breeds in Alaska, northern Siberia and northern Canada, migrating during the non-breeding season (austral summer). The Australian distribution of the species is located primarily along the west and south coasts; however, they can be found in all States. The species distribution in Queensland is most recorded around the south-eastern Gulf of Carpentaria. The Grey Plover feeds within the whole tidal range, feeding diurnally on polychaete worms, marine molluscs and crustaceans, and to a lesser extent, insects. The species roosts in sandy areas such as unvegetated sandbanks and sheltered habitats such as estuaries, lagoons or sheltered beaches (DCCEEW 2024a).	**Unlikely –** Suitable coastal habitat for the species does not occur within the Project area. The closes record for the species is approximately 22 km northeast of the Project area along the coast (ALA 2025).
Koala (*Phascolarctos cinereus*) NC Act: LC	In Queensland, the species contains scattered populations throughout moist forests along the coastline, subhumid woodlands in central and southern regions and within eucalypt woodlands along watercourses within semi-arid areas further west. Koalas occur in a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by *Eucalyptus* species (preference varying regionally). Diet is thought to be a major determinant of habitat selection, with the use small remnants of original vegetation where suitable habitat is present. Koalas are also known to occur in modified or regenerating native vegetation communities, as well as urban and rural landscapes where food trees or shelter trees may be highly scattered (DE 2014).	**Likely**. Suitable habitat for the species occurs within the Project area in the form of eucalypt woodland. Historical records of the species include 17 occurrence records within 25 km of the Project with the nearest record located 3.5 km west-southwest of the Project area (ALA 2024).

Species	Distribution and habitat	Likelihood of occurrence
Latham's Snipe (*Gallinago hardwickii*) NC Act: V	Widespread although scattered occurrence in both coastal and inland areas. Extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales (Barrett et al. 2003; Blakers et al. 1984; Frith et al. 1977). Occasionally recorded in south-western Queensland. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. Various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (DotE 2015b).	**Unlikely** - Suitable wetland habitat is not present within the Project area. The closest occurrence record for the species was recorded 1.9 km northeast of the Project area (ALA 2025)**.**
Lesser Sand Plover (*Charadrius mongolus*) NC Act: E	The species is known to occur along the Australian coastline. Suitable habitat for the species includes coastal littoral and estuarine environments (DCCEEW 2023).	**Unlikely**. Suitable coastal or estuarine habitat for the species does not occur within the Project area. Historical records of the species include 19 occurrence records within 25 km of the Project area with the nearest record located 17 km east of the Project area (ALA 2024).
Powerful Owl (*Ninox strenua*) NC Act: V	In Queensland, Powerful Owl occurs as far north as the Eungella area and west to Carnarvon Gorge (Debus 2012). This species lives in open forests and woodlands, sometimes with dense forest nearby. It is often found in tall open wet sclerophyll forest, mainly in sheltered gullies containing old-growth forest with dense understorey and often near permanent streams (Higgins 1999). Roost and nest sites are usually in gullies (Debus 2012). It nests in hollows in large old trees (Higgins 1999; Kavanagh 2002), usually a living eucalypt, often in trees near creeks. Roost sites are mostly in closed forest but occasionally in open forest and woodland (Higgins 1999). The species also occurs in large areas of urban bushland and large botanic gardens in cities (Debus 2012)	**Possible**. Marginal habitat for the species exists within the Project area in the form of eucalypt woodland and open forest, although no suitably large hollows were observed. Historical records of the species include seven occurrence records within 25 km of the Project area with the nearest record located 11 km south-southeast of the Project area (ALA 2024).
Red Goshawk (*Erythrotriorchis radiatus*) NC Act: E	Sparsely dispersed across 15% of coastal and sub-coastal Australia, from the Kimberley in Western Australia to north-eastern New South Wales (DCCEEEW 2023). Also recorded along major rivers in central Australia, most likely to be transient birds (DCCEEEW 2023). Recent records in Queensland suggest that both southern and northern Queensland birds are in existing national parks or state forests with a strongholds in north-east Queensland and eastern Cape York Peninsula (DERM 2012). The species prefers landscapes containing a mosaic of habitats including coastal and sub-coastal tall open forest, woodland and rainforest edges. Forests of intermediate density are particularly favoured, as are ecotones between variably dense habitats. Habitat utilisation is influenced by the location of large populations of birds (primary prey). It is rarely encountered over agricultural land as it avoids open habitats. Nesting occurs in tall trees within 1 km of permanent water, generally in open, biologically rich forest or woodland (TSSC 2015a).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Historical records of the species include one record from 2016 taken from Boyne Island 20 km northeast of the Project area. It should be noted that this record is highly dubious due to the lack of suitable habitat in this area and that the population of this species has largely disappeared from southeast Queensland (DCCEEW 2023b).

Species	Distribution and habitat	Likelihood of occurrence
Ruddy Turnstone (*Arenaria interpres*) NC Act: V	The Ruddy Turnstone is a shorebird which migrates to Australia from Europe, Asia and North America during the non-breeding season (austral summer). The species is found across Australia in coastal regions, with occasional inland records. In Queensland, the species distribution extends the entire east coast and the north coast. A carnivorous species, the Ruddy Turnstone feeds diurnally and nocturnally on insects, crustaceans, molluscs arachnids and worms in the tidal range, with a preference for upper tidal flats. The species prefers to roost on platforms, rock shelves or shingle coral and gravel beaches, adjacent to shallow pools and are occasionally observed in estuaries, coastal lagoons, harbours, bays, sewage ponds and mudflats (DCCEEW 2024c).	**Unlikely** - Suitable coastal habitat is not present within the Project area. The closest occurrence record for the species was recorded 22 km northeast of the Project area (ALA 2025).
Southern Greater Glider (*Petauroides volans volans*) NC Act: E	This species occurs in Eastern Australia with a broad distribution from around Proserpine in Qld, south through NSW and the ACT, to Wombat State Forest in central Vic. The species is generally restricted to eucalypt forests and woodlands, particularly favouring forest with a diversity of eucalypt species. During the day the species shelters in tree hollows, with a particular selection for large hollows in large, old trees (DCCEEW 2023). Modelling suggests they require native forest patches of at least 160 km^2 to maintain viable populations (Eyre 2002).	**Unlikely**. Eucalypt woodland does occur within the although field surveys determined that suitably large hollows where absent for the Project area. The species was not observed during field surveys within the Project area. Historical records of the species include six occurrence records within 25 km of the Project area with the nearest record located 11 km south-southeast of the Project area (ALA 2025).
Sharptailed Sandpiper (*Calidris acuminata*) NC Act: V	This species is recorded in most regions of Queensland and their distribution is widespread along much of the coast and very sparsely scattered inland, particularly in central and south-western regions (Higgins & Davies 1996). The Sharptailed Sandpiper typically inhabits muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. The species may use flooded paddocks, sedgelands and other ephemeral wetlands, but vacate these habitats during dry conditions. Marine habitats for the species include intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. Sometimes occur on rocky shores and rarely on exposed reefs (DotE 2015b).	**Unlikely –** Suitable wetland habitat is not present within the Project area. The closest occurrence record for the species was recorded 1.9 km northeast of the Project area (ALA 2025)
Squatter Pigeon (southern) (*Geophaps scripta scripta*) NC Act: V	Squatter Pigeon is now largely restricted to Queensland, where the southern subspecies occurs north to the Burdekin River (Frith 1982). The species extends west to Longreach and Charleville. There is a subpopulation from Warwick to Texas. A small population may persist in the upper Brisbane valley, where the last Bird data record is from 2014 (Ward et al. 2021). Squatter Pigeon does not appear to undertake any large-scale seasonal movement and is probably locally nomadic, or perhaps sedentary (Frith 1982; Blakers et al. 1984). The southern subspecies of the Squatter Pigeon occurs mainly in dry grassy woodlands and open forests (Frith 1982; Crome & Shields 1992).	**Likely**. Suitable habitat for the species occurs within the Project area in the form of grassy woodlands. Historical records of the species include 24 occurrence records with 25 km of the Project area with the nearest record located 3.5 km west of the Project area (ALA 2025), although the occurrence record is generalised to 10km and

Species	Distribution and habitat	Likelihood of occurrence
		undated. Numerous records to the west are dated 2003-2018 (ALA 2025).
Terek Sandpiper (*Xenus cinereus*) NC Act: V	This migratory shorebird migrates from Russia during non-breeding periods to coastal, western and central Africa, South Africa, throughout Asia including but not limited to the Persian Gulf, the Indian subcontinent and southeast Asia and as far south as New Guinea, Australia and New Zealand. The species distribution within Australia is primarily restricted to coastal distributions in all Australian States and Territories (with the exception of the ACT) and will occasionally be recorded inland. In Queensland, the species is commonly recorded along the coast from the southeast of the Gulf of Carpentaria and extends as far north as the Torres Strait. This species is carnivorous, and its primary diet comprises crustaceans and insects and feed within the supralittoral or upper littoral zone of mudflats in estuaries. The species prefers to roost in mudflats and mangrove swamps (DCCEEW 2024b)	**Unlikely** – Suitable coastal and estuarine mudflats are not present within the Project area. The closest record for the species is located 17 km east of the Project area (ALA 2025).
Western Alaskan Bar-tailed Godwit (*Limosa lapponica baurei*) NC Act: V	The species is known to occur along the coast of northern, southern, and eastern Australia (with the exception of the WA) (DCCEEW 2023). Suitable habitat for the species includes intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays (DCCEEW 2023).	**Unlikely**. Suitable habitat for the species does not occur within the Project area. The species was not detected during recent field surveys within the Project area. Historical records of the species include three occurrence records within 25 km of the Project area at Boyne Island with the nearest record located 20 km to the north-northwest of the Project area (ALA 2025).
White-throated Needletail (*Hirundapus caudacutus*) NC Act: V	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 (Higgins 1999). White-throated Needletail is found over a wide variety of habitat, including open areas, modified land and the ocean but is most often recorded over wooded areas (Higgins 1999). They sometimes forage over recently disturbed areas, such as forest that has been cleared or burnt (Blakers et al. 1984).	**Likely**. Suitable habitat for the species occurs within the Project area. Historical records of the species include 19 occurrence records within 25 km with the nearest record 1.5 km northeast of the Project area (ALA 2025).
White-throated Snapping Turtle (*Elseya albagula*) NC Act – CE	Found only in Queensland in the Fitzroy, Mary and Burnett Rivers and associated smaller drainages in southeastern Queensland. The Fitzroy catchment population has been separated from the Mary and Burnett catchments for an extended period. It has been suggested that the two lineages can be considered to be Evolutionarily Significant Units (Todd et al. 2013). Prefers clear, flowing, well-oxygenated waters. The species does occur in non-flowing waters, but typically at much reduced densities (DE 2014a).	**Unlikely** – Suitable habitat for the species is not located within the Project area. The closest verified occurrence record for the species is located approximately 49 km northeast of the Project area (ALA 2025).
Yellow-bellied Glider (*Petaurus australis australis*) NC Act: V	The species has a widespread but patchy distribution from south-eastern Queensland (Qld) to far south-eastern SA, near the SA-Vic border in found at altitudes ranging from sea level to 1400 m above sea level (DAWE 2022). The species occurs in tall mature eucalypt forest in areas with high	**Unlikely**. Suitable habitat for the species does not occur within the Project area. Soils within the Project area low in fertility and woodlands are low

Species	Distribution and habitat	Likelihood of occurrence
	rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forest in the north; moist coastal gullies and creek flats to tall mountain forests in the south (OEH 2017).	without suitable hollows. Historical records of the species include five occurrence records within 25 km of the Project area with the nearest record located 11 km south-southeast of the Project area (ALA 2025).

7 POTENTIAL PROJECT IMPACT AND MITIGATION MEASURES

The majority of impacts within the Project area are pre-existing. The proposed extensions to the extent of current mining impact areas area, includes increases in the size of open pits and stockpiles, in addition to new access tracks and other operational areas (hereby referred to as proposed impacts). Proposed impacts areas are shown in **Figure 7** overlaid on the field-verified vegetation mapping. For conservation significant species considered as potentially occurring, impacts were assessed for loss of habitat by the construction of proposed impacts.

7.1 Potential Project Impacts

The proposed impacts have the potential to directly and indirectly impact a range of ecological values, including vegetation communities and habitat for conservation significant flora and fauna. The proposed impacts will occur incrementally, as open pits and stockpiles increase in size over time. Proposed impacts include the following:

- Access tracks – 1.73 ha
- Infrastructure and plant – 0.24 ha
- Pit – 27.77 ha
- Topsoil stockpile – 3.66 ha
- Waste rock dump – 11.78 ha

7.1.1 Clearing Vegetation

The clearing of vegetation is the most significant and direct impact of the Project on ecological values of the Project area. The removal of habitat reduces the size of local populations of flora and fauna dependent on that habitat. These impacts are immediate and significant in the short-term. Impacts may persist in the long-term if habitat created during rehabilitation does not closely resemble pre-disturbance ecosystems. In addition, if sufficient habitat refuges are not maintained locally, prior to the maturation of rehabilitated land, local extinction of certain species may occur.

The predicted extent of overall impact to vegetation communities and habitat for conservation significant species is provided in **Table 11**. The extent of impact is based on the results of the ground-truthed vegetation mapping, analysis of aerial imagery, and onsite habitat assessments. The proposed impacts of the Project area are predicted to impact 5.57 ha of remnant vegetation and 9.86 ha of regrowth habitat under the current layout. The primary potential impact to conservation significant fauna species is on remnant woodland vegetation suitable Koala, which is considered likely to occur within the Project area.

Table 11. Predicted vegetation clearing resulting from Project proposed impacts

GTRE	Biodiversity (EP Act) status	Potential habitat	Proposed impact area (ha)
11.11.15 remnant	No concern at present	Koala, Powerful Owl, Squatter Pigeon, *Cycas megacarpa, Cassinia collina*.	3.27
11.11.15 regrowth	No concern at present	Koala, Squatter Pigeon.	9.86
11.3.25 remnant	Of concern	Koala, Powerful Owl, Squatter Pigeon, *Cassinia collina*.	2.30
		Overall area	15.43

7.1.2 Habitat Fragmentation and Connectivity

Highly fragmented habitats support fewer species than connected blocks of habitat of the same size. This is because fragmentation restricts dispersal of fauna and plant seeds between available habitat. The impacts of habitat fragmentation depend on the degree to which dispersal is inhibited by habitat gaps., the size of the remaining habitat fragments, and ecological attributes of the species.

The landscape associated with the Project has been heavily impacted by tree clearing for pastoralism and open cut mining. Remnant and regrowth vegetation communities within the Project area are largely consolidated, although in the southern portion of the Project area vegetation is isolated by the dam impoundment and mining activities. Vegetation communities in the northern portion of the Project area are connected to a large expanse of remnant vegetation to the north of the Project area, although the proposed impacts of the expansion are largely concentrated in the south of the Project area. The proposed impacts of the Project will not further fragment remnant and regrowth vegetation communities within the Project area, with negligible impacts to connectivity.

The farm dam within the southern portion of the Project area likely provides drinking water for a range of mammals and birds. It may also support native and exotic aquatic fauna species. The removal of the farm dam is not considered to be a significant impact to terrestrial and aquatic ecology due to the proximity of the farm dam to Lake Awoonga which provides similar, yet more extensive habitat suitable for these species.

7.1.3 Fauna Mortality

Clearing of vegetation for the Project presents a risk of direct mortality or injury to fauna. Fauna of low mobility are at risk to injury or death from heavy machinery and vehicular movements during the construction and operational phases of the Project.

Clearing will only occur within designated areas and only during designated time periods. The presence of qualified Wildlife Spotter-Catcher/s to assist with vegetation clearing will decrease incidences of fauna mortality. Educating employees and contractors with regard to fauna and flora will further reduce direct mortality as part of the Project.

7.1.4 Airborne Dust

Earthworks, vehicular traffic, mobile plant movements and mining activities associated with construction and operation can generate substantial amounts of dust during dry weather (Field et al. 2010). Dust can have both a physical and chemical impact on plants, either through the smothering of leaves, whereupon the rate of deposition is important, or through chemical changes to the soil or directly to the plant surface. Changes in soil properties, such as pH, can ultimately impact plant species assemblages. Dust can form a hard crust on plant photosynthesis, respiration transpiration and productivity (Farmer 1993; Chaston & Dooley 2006). Evidence of potential impacts on entire vegetation communities is scarce. Many studies focus on specific impacts to single species and findings may not be conclusive. Because a limestone quarry is already operating within the Project area, additional impacts to airborne dust resulting from the proposed expansion area considered negligible.

7.1.5 Noise and Lighting

Understanding of the impacts of noise on fauna is limited. There are no current government policies or guidelines that recommend noise thresholds or limits for development activities to mitigate potential harm to fauna. Noise may affect wildlife through a variety of impacts such as: interfering with communication calls; interfering with foraging/defence through cloaking the sound of predators and prey; causing general stress or avoidance reactions; or changes in reproductive or nesting behaviours. Excessive noise may lead some species to avoid noisy areas, which could result in the localised fragmentation of habitat at the specie or individual territory level. Radle (2007) states the consensus that terrestrial fauna will avoid any industrial plant or construction area where noise or vibration presents an annoyance to them. Nevertheless, many animals may interpret a new noise as a potential danger at first, but rapidly understand the noise is not associated with any threats (Radle 2007).

Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups. Some taxa such as rodents may avoid brightly lit areas at night. Alternatively, nocturnal fauna such as many microbat species, frogs and some reptiles may congregate at artificial lights to feed on insects attracted to light (Perry et al. 2008; Rich and Longcore 2006). Although, other microbat species may avoid well-lit areas (Threlfall et al. 2013). Artificial light can alter foraging and calling by frogs and probably impairs their vision (Buchanan 1993) and may lead to individuals being killed by vehicles when attracted to lights for feeding on invertebrates. The Project area is already subject to artificial lighting and noise from the existing limestone quarry and further increases from the proposed expansion area are considered negligible.

7.1.6 Weeds and Pest Animals

Introduced weeds have the potential to impact on terrestrial and aquatic ecological values as native flora can become displaced through competition with weed species, and adversely affected by browsing and soil trampling caused by feral herbivores. Native fauna populations, particularly small to medium sized species, may be impacted by predation from introduced carnivores such as feral cats (*Felis catus*) and Red Fox (*Vulpes vulpes*). These are indirect impacts which may not manifest themselves in the short-term and are likely to be exacerbated by proposed cattle grazing activities within the Project area. Introduced weed species are already present throughout the Project area including six Category 3 Biosecurity matters and four WoNS with Lantana and Creeping Lantana the most common. Rubber Vine was common in heavily disturbed areas such as rock-dumps, roadsides and topsoil stockpiles.

The following activities associated with the Project have the potential to promote the proliferation of weeds and pests within the Project 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

Mobile plant and vehicular movements have association with future Project activities have a very high potential to further the spread of American Ratstail Grass (*Sporobolus jacquemontii*) within the Project area, with adverse impacts on proposed post-mining pastoralism.

7.1.7 Fire

The Project area is comprised of operational mining areas, cleared areas, and woodland/open-forest vegetation to the north and south. Woodland/open-forest areas have potential to be severely impacted by accidental high-intensity fires caused by Project activities. Fire hazard mapping indicates the majority of woodland and open-forests within the Project area as having a medium potential bushfire intensity with a small patch of high and very-high potential bushfire intensity bordering the northern pit.

7.1.8 Surface Water

7.1.8.1 Construction Impacts

The Project has potential to impact surface water and associated aquatic ecology values through a variety of processes:

- During construction disturbance, uncontrolled sedimentation of watercourses (particularly during and following heavy rainfall events) can impact aquatic ecology by smothering stream beds with fine material, and decreasing bed roughness and reducing habitat diversity
- Similarly, uncontrolled sedimentation movements associated with construction disturbance may lead to localised increased turbidity and suspended solids which may negatively impact fish and macroinvertebrates (through reduced respiratory and feeding efficiency), and adversely affect submerged aquatic plants as light penetration (required for photosynthesis) is reduced
- Poorly designed and constructed waterway crossings may create waterway barriers that prevent or impede movements of aquatic fauna
- Waterway crossings may cause bank instability if remediation works are not adequately designed and implemented. This may lead to bank erosion (causing impacts to instream sedimentation and turbidity) and adverse impacts to riparian vegetation

The Project area is intersected by six stream order 1 watercourses (**Figure 4**). A total of six low-risk waterways for waterway barrier works are mapped within the Project area and three of these waterways will be impacted by the proposed impact area. Waterways within the Project area are ephemeral and were dry at the time of the field survey. Furthermore, the environmental values of the potentially impacted waterways are very low as all are artificially impounded. The potentially impacted stream in the north flows directly into Pit 2, and a

potentially impacted stream in the east is impounded by a steep embankment. The potentially impacted stream in the south is impounded by the existing waste rock stockpile and mine longwall.

7.1.8.2 Waterway Barrier Works

The Project is expected to impact 3 low risk waterways with barrier works. Barrier works (i.e. maintenance or upgrade of existing culvert crossings) should be completed in accordance with *Accepted development requirements for operational work that is constructing or raising waterway barrier works* (DAF 2018). All low risk waterways impacted by the Project are subject to artificial impoundment and no longer connected to the wider catchment.

7.1.8.3 Aquatic Pollutant Release

The accidental release of pollutants from Project activities has the potential to degrade the surrounding environment and local waterways within and downstream of the Project area. Potential sources of contaminants may include runoff from chemical and fuel/oil storage areas and general wastewater from vehicle/machinery washdown areas. In the event of a significant fuel spill (>200 litres) (L) to waterways there is potential to have a local impact on both flora and fauna. The extent of impact will of course be dependent on the size of the spill and the volume of water in the waterway (including whether there is flow), thereby influencing the length of stream potentially impacted.

Waterways in the Project area are ephemeral (no flows occurring the majority of the time) and are predominantly likely to be considered to be of low value.

7.2 Proposed Mitigation Measures

The proponent will commit to a range of measures to minimise impacts to MSES and general ecological values associated with Project area. Avoidance is largely not possible as the majority of Project impacts have already occurred. A range of mitigation strategies will be implemented under an overarching Environmental Management Plan (EMP). The current EMP for the existing EA for the Project will be amended to reflect the proposed amendments to the EA. The EMP is informed by a number of updated management plans relevant to ecological impacts including (but not limited to):

- Water Management Plan
- PRC Plan
- Erosion and Sediment Control Plan (ESCP)
- Pest and Weed Management Plan

The EMP and various sub-plans comprise a range of measures that will mitigate the potential impact to ecological values as detailed in **Table 12**.

Table 12. Recommended mitigation measures proposed for general impacts resulting from proposed impacts

Impact	Management measure
Vegetation clearing	The Project has an EMP in place. Vegetation clearing protocols are established within the EMP and will be updated to include the following mitigation measures below at a minimum.
	A PRCP including rehabilitation measures following mine closure
	Project employees and contractors should be made aware of environmental obligations and compliance requirements through the induction program.
	Vegetation clearing extents will be clearly demarcated with flagging or bunting prior to clearing to limited the area safely and reasonably required for permanent and temporary works
	Targeted pre-clearance surveys will be carried out prior to vegetation clearing and will incorporate searches for conservation significant plants that potentially occur, including: • *Cassinia collina* • *Cycas megacarpa.* Pre-clearance surveys will be carried out by suitable qualified ecologists prior to vegetation clearing.

Impact	Management measure
	Topsoil should be stockpiled in designated areas and used for rehabilitation.
	Disturbed areas that are no longer required will be immediately reinstated to a non-polluting and stable landform.
Conservation significant flora and fauna	Fauna and Flora Management Plan will be in place prior to construction works being carried out. Plan will establish species-specific management procedures for conservation significant species considered to be potentially or likely to be present in this report.
	Searches for conservation significant flora and fauna species will be carried out by a suitably qualified ecologist as part of pre-clearance surveys.
	Procedures will be in place where injured fauna are encountered during clearing works. Local wildlife carer and/or veterinarian will be identified prior to works being carried out and be notified that clearing works are being carried out (prior to clearing).
	Project inductions will outline species of significance that may occur on the project area.
	Project employees will be required to notify fauna spotter/catchers when a species of significance is observed in the Project area. All encounters with a conservation significant species will recorded in the project fauna register maintained by the designated Environmental Officer.
	Fauna spotter-catchers (licensed) will inspect sites prior to vegetation clearing. Fauna habitat shelter features (large hollows) will be clearly marked where they are unable to be accessed/inspected prior to tree felling.
	EMP will incorporate procedures for tree felling that will minimise potential impacts on resident fauna where habitat shelter features are identified.
	Procedures will be in place where injured fauna are encountered during clearing works. Local wildlife carer and/or veterinarian will be identified prior to works being carried out and be notified that clearing works are being carried out (prior to clearing).
	Onsite speed limits will be established throughout Project area to limit the potential for road collisions.
Noise and lighting	The final Project design process will incorporate the use of low light spill lighting components and directional lighting (away from adjacent fauna habitat) where night lighting is considered necessary.
	All Project-associated construction/operational machinery will be maintained as per manufacturer design specifications to ensure project noise is minimised.
	Onsite speed limits will be established throughout Project area to limit noise levels as a result of vehicle movements.
Airborne dust	Monitoring of weather conditions will be carried out to inform Project activities and planning during high-wind weather conditions.
	Ensure employees made aware of potential dust generating activities and mitigation and management measures to prevent nuisance
	Monitoring of air/dust emissions will be carried out in accordance with regulatory requirements.
	Dust from areas likely to be a source of airborne dust (such as tracks and topsoil stockpiles) will be suppressed during construction using water trucks/wetting to keep dust related impacts to a minimum. Water used for dust suppression will be obtained from Pit 2 and onsite water tanks.
	Onsite speed limits will be established to minimise dust caused by vehicle movements
	Areas subject to vegetation clearing and no longer required for construction will be subject to vegetation reinstatement as soon as is practicable as per the assigned post-mining land-use.
Weeds and pest	Pest and Weed Management Plan is in place prior to construction works being carried out. Plan will detail all required management measures and monitoring procedures.
	Mapping of the extent of weed/pest occurrence within the Project footprint will be recorded during pre-clearance surveys.
	Vehicle wash-downs will be required for all new vehicles (including earthmoving and other construction machinery) entering the Project area.
	Disposal and storage of putrescible wastes must be undertaken appropriately to ensure feral animals aren't attracted to the Project area.
	Storage of construction/operation materials carried out in a manner so as to not encourage the establishment of resident pest fauna.
	Regular monitoring of weed and pest occurrence in association with Project works areas and in response to complaints from adjacent landowners.

Impact	Management measure
Fire	Monitoring of weather conditions will be carried out to inform Project activities and planning during high fire-risk weather conditions.
	The Project will maintain communications with local representatives for the Queensland Fire and Emergency Services (QFES) regarding Project activities and bushfire hazard conditions.
	Appropriate fire breaks will be maintained around above ground Project infrastructure.
	Site will include designated smoking areas.
	Onsite fire-fighting equipment will be regularly maintained and staff training will be developed and implemented.
Surface water	An ESCP will be developed and implemented prior to construction commencing. The ESCP will be developed by a Certified Professional in Erosion and Sediment Control.
	Access track crossings of watercourses will be designed and constructed in accordance with the accepted development requirements for waterway barrier works (DAF 2018) to minimise impacts to fish passage.
	Earth bunds and diversion drains are maintained around the perimeter of the site, particularly on the upslope, of excavations to prevent surface water entering these areas.
	Stabilised diversion drains are maintained to direct dirty water to sediment traps (e.g. straw bale filter, sandbag filter, sediment dams).
	Applicable Project materials/chemicals will be stored and handled in accordance with relevant legislative requirements and Australian Standards (AS) including: • AS 3780:2008 – The storage and handling of corrosive substances • AS 1940:2004 – The storage and handling of flammable and combustible liquids • AS 3833:2007 – Storage and handling of mixed classes of dangerous goods in packaged and intermediate bulk containers
	All storage of chemicals associated with Project works will be stored away from watercourse and in bunded areas
	Refuelling will be in designated bunded areas away from watercourses. Or in accordance with the existing refuelling procedures – 620-P8.200.213 Main Hardstand Refuelling.
	Spill response equipment (e.g. booms and absorbent materials) will be available at refuelling areas and other sites (where relevant). Staff will be trained in the appropriate use of spill response equipment.
	Onsite washdown areas for Project vehicles/machinery will be located and clearly demarcated to prevent contaminated run-off from entering waterways.

8 MSES SIGNIFICANT RESIDUAL IMPACT ASSESSMENT

An assessment of the potential for significant impacts resulting from the proposed Project has been carried out only on those MSES considered as potentially subject to substantial impacts. The assessments have been carried out in accordance with the *Queensland Environmental Offsets Policy Significant Residual Impact Guideline* (MSES Guideline) (DEHP 2014) to determine if offsets under the Offsets Act are not required for the proposed Project. The assessment is focused on MSES identified in **Section 5.2** as potentially occurring within the Project area, including:

- Listed conservation significant species
- Category R (GBR) Riverine Regulated Vegetation
- MSES regulated vegetation (defined watercourse)
- Waterways providing fish passage

8.1 Conservation Significant Species

The likelihood of occurrence assessment in **Section 4.3** has determined the following listed conservation significant species to be relevant for the significant residual impact assessment:

- Likely to occur:
  - Koala (*Phascolarctos cinereus*) – Endangered
  - Squatter Pigeon (Southern) (*Geophaps scripta scripta*) – Vulnerable
- Possibly occurs:
  - *Cycas megacarpa* – Endangered
  - Powerful Owl - Vulnerable
  - *Cassinia collina* - Vulnerable

White-throated Needletail is an aerial species that may occur over any habitat including inland, coastal and marine areas and disturbed habitat such as urban areas. The species is only occasionally recorded as landing in Australia. The species is highly mobile and may forage anywhere up to 100s of metres above ground (Higgins 1999; DCCEEW 2023). Given the species' aerial habits it is inconceivable the Project area would support an important population or represent important habitat (as defined in DE 2013a) for the species and the proposed impacts would be highly unlikely to impact the species in any way. Therefore, it has not been considered in the significant residual impact assessment.

8.1.1.1 Koala – Endangered

Ecology

Koalas have a distinct association with eucalypt woodland and forest habitats comprising suitable food trees, mainly of the following genus: Eucalyptus, Corymbia, Angophora and Melaleuca (Moore and Foley, 2000; and Martin et al. 2008). They are not necessarily restricted to bushland areas and are known to occur and breed where suitable tree species occur within farmland and the urban environment (Dique et al. 2004). Similarly, movement is not confined to vegetated corridors, as they also move across cleared rural land and through suburbs (Martin et al. 2008). They may use a variety of trees, including many non-eucalypts, for feeding, shelter and breeding purposes (Dique et al. 2004; Martin et al. 2008).

They are known to have localised and variable preferences throughout their range, favouring some tree species over others (Pahl and Hume 1990). At the local level they are known to prefer individual trees. It has been suggested this could be a response to a number of factors such as high leaf moisture and/or nitrogen content, and low levels of toxic chemical compounds which are expressed by eucalypts as a result of herbivory (Pahl and Hume 1990; Hume and Esson 1993; Moore and Foley 2000).

Breeding occurs in spring / summer when males become territorial. Young permanently leave the pouch after seven months but may continue to ride on the mothers back until approximately 12 months. After this time adolescent females may remain in the natal habitat. Males generally disperse to new territories from one to three years of age (Dique et al. 2003; Martin et al. 2008).

Association with the Project area

The species was not observed during field surveys within the Project area. Numerous records of the species occur in the wider landscape include 17 occurrence records within 25 km of the Project with the nearest record from 1987 located 3.5 km west-southwest of the Project area (ALA 2025). The majority of Koala records in the wider landscape are from 1987 or earlier. More recent records from 1992 and 1997 occur further west at Dan Dan National Park located 15 km southwest of the Project area (ALA 2025).

Suitable habitat for Koala within the Project area is provided by remnant and regrowth RE 11.11.15 and remnant RE 11.3.25 with a total area of 168.7 ha of which, 15.43 ha is proposed to be disturbance by the Project.

Government approved species documents

The *National recovery plan for the Koala* Phascolarctos cinereus *combined populations of Queensland, New South Wales and the Australian Capital Territory* (the Koala recovery plan) (DAWE 2022b) was approved on 8 April 2022. The Koala Recovery plan notes the following threats to the species:

- Habitat loss, fragmentation and modification including the impact of native forestry activities
- Drought, extreme heat events including associated with climate change
- Altered fire regimes
- Mortality from dog attack and vehicle collisions
- Diseases including Chlamydia and Koala retrovirus
- Plant pathogens impacting Koala habitat such as Myrtle Rust

The *Conservation Advice for* Phascolarctos cinereus *(Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory* (DAWE 2022c) notes (with relevance to Queensland) the priority management actions associated with the south-east Queensland population and that sub-populations on the western edge of the species range may be 'climate-sensitive' and comprise genes adapted to environmental extremes which may prove critical to populations elsewhere in the future through translocation programs.

The Koala recovery plan does not specifically identify any areas comprising 'valued populations' of Koala but does note an imperative to conserve populations:

- That may act as source populations to adjacent areas
- Occur in areas of climatic refugia (specifically from droughts and heat waves)
- Genetically diverse
- Contain adaptive genes to potential environmental stressors or
- Are geographical or environmental outliers

The Koala recovery plan identified the following objectives:

- The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased
- The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased
- Metapopulation processes are maintained or improved
- Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management.

Table 13 provides as assessment of the potential for significant residual impacts on Koala from the Project using the assessment criteria for Endangered and Vulnerable wildlife habitat outlined in the Guideline. It is important to note that Koala is also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and will also need to be assessed as a Matter of National Environmental Significance (MNES) as per the EPBC Act.

Table 13. Significant residual impact criteria assessment: Koala

Criteria	Endangered species assessment
Lead to long-term decrease in the size	The species was not observed during the recent field survey within the Project area although the species is considered likely to occur. Historical records of the species include 17 occurrence records within 25 km of the Project area with the nearest record from 1987 located 3.5 km west-

Criteria	Endangered species assessment
of a local population	southwest of the Project area (ALA 2025). Pre-clearance surveys will be completed prior to clearing and a licenced Wildlife spotter-catcher will be present during clearing. The Project will result in the clearing of 15.43 ha of suitable habitat for Koala. Suitable habitat for Koala within the Project area is adjacent to areas of existing disturbance. The majority of suitable Koala habitat proposed for clearing is in a highly isolated location between the existing mine and Awoonga Reservoir. Significant areas of continuous and undisturbed Koala habitat occurs to the north and west of the Project area. Whilst the species is likely to occur, there is no evidence to suggest that a local population occurs within the Project area. The Project is considered unlikely to lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	The extent of occurrence (EOO) of the species is estimated at 1,665,850 km^2 (DAWE 2022). The Project will result in the clearing of 15.43 ha of suitable habitat for Koala. The Project area is not near the limit of the species distribution. The Project is considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	The species was not observed during recent field surveys within the Project area although the species is considered likely to occur. Whilst the species is likely to occur, there is no evidence to suggest that a local population occurs within the Project area. Although operational mining areas will be unsuitable for Koala movements, Koalas will be able to move freely to the north along the eastern boundary of the Project area. In addition, the extent of the proposed impacts relatively minor in relation to the extent of existing operation mining areas within the Project area.
Result in genetically distinct populations forming as a result of habitat isolation	The species was not observed during recent field surveys within the Project area although the species is considered likely to occur. Whilst the species is likely to occur, there is no evidence to suggest that a local population occurs within the Project area. Although operational mining areas will be unsuitable for Koala movements, Koalas will be able to move freely to the north via the eastern boundary of the Project area. Remnant vegetation to the north and south of the operational areas will remain consolidated. The Project is considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that area harmful to an endangered to vulnerable species becoming established in the endangered or vulnerable species habitat	The species is vulnerable to predation from Wild Dogs. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The Project is considered unlikely to result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat.
Introduce disease that may cause the population to decline	Koala retrovirus (KoRV) and Chlamydia (*Chlamydia percorum*) are known threats to the species. It is inconceivable the Project activities will result in the introduction of these diseases into the Project area. The Project is considered unlikely to introduce disease that may cause the population to decline.
Interfere with the recovery of the species	The Koala recovery plan identified the following objectives: • The area of occupancy and estimated size of populations that are declining, suspected to be declining, or predicted to decline are instead stabilised then increased • The area of occupancy and estimated size of populations that are suspected and predicted to be stable are maintained or increased • Metapopulation processes are maintained or improved • Partners, communities and individuals have a greater role and capability in listed Koala monitoring, conservation and management. There is no evidence to suggest a Koala population occurs within the Project area and is therefore not a known area of occupancy. The Project is not expected to significantly increase he isolation of habitat suitable for Koala. The Project is unlikely to interfere with any of the recovery actions identified in the Koala recovery plan.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration	The species was not observed during recent field surveys within the Project area although the species is considered likely to occur. Whilst the species is likely to occur, there is no evidence to suggest that a local population occurs within the Project area. The Project area is not considered an ecologically significant location for Koala. The proposed impacts are considered unlikely to cause disruptions to ecologically significant locations of a species.

Criteria	Endangered species assessment
or resting sites) of a species	
Assessment result	Significant residual impacts to Koala resulting from the proposed impacts are considered unlikely to occur in accordance with the Guideline. Offsets for impacts to Koala habitat under the *Queensland Environmental Offsets Policy* are not required.

8.1.1.2 *Cycas megacarpa* – Endangered

Ecology

The species is a small to medium sized cycad reaching a maximum height of 8 m with green new growth and eggs shaped seeds (DESI 2024). Suitable habitat for the species is described as Spotted Gum and Narrow-leaved Ironbark woodland or open-forest on hill tops and steep slopes with stony sandy loams or stony shallow clay loams. The species typically occurs at 40-600 m above sea level (ASL). Fruiting occurs during May to February and ripen from March. Seeds remain infertile for a minimum of nine months (DES1 2024).

Relationship with the Project area

The species was not observed during recent field surveys within the Project area. No Cycad species were identified within the Project area during the field survey. Cycad species are highly distinctive and easily located in the field. The nearest historical record of the species is located 24 km south-west of the Project area from 2003. Numerous records of the species occur further south and west. Suitable habitat for the species within the Project area is provided by remnant RE 11.11.15 with an area of 115.2 ha of which 3.27 ha is proposed to be impacted by the Project.

Government documents species documents

There is no approved conservation advice or listing advice for the species. The *National Multi-species Recovery Plan for the cycads*, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi *and* Macrozamia platyrhachis (Queensland Herbarium 2007) identifies the following threats relevant to the species:

- Land clearing
- Illegal harvesting
- Loss of genetic variation and insect pollinators
- Timber harvesting
- Fire.

The recovery plan also identifies the following recovery objectives relevant to the species:

- Protect existing populations
- Prevent loss of individuals and populations from legal harvesting and salvage
- Prevent loss of individuals, plant parts and seeds to illegal harvesting and destruction
- Determine habitat, ecological and reproductive needs
- Populations managed according to the best available knowledge
- Recovery of populations

Table 14 provides as assessment of the potential for significant residual impacts on *Cycas megacarpa* from the proposed impacts using the assessment criteria for Endangered and Vulnerable wildlife habitat outlined in the Guideline.

Table 14. Significant residual impact criteria assessment: *Cycas megacarpa*

Criteria	Endangered species assessment
Lead to long-term decrease in the size of a local population	The species was not observed during field surveys within the Project area although its occurrence is considered possible. The nearest historical record of the species is located 24 km south-west of the Project area from 2003 (ALA 2025). The proposed impacts will result in the clearing of 3.27 ha of suitable habitat for the species, although there is no evidence to suggest a

Criteria	Endangered species assessment
	population of Cycas megacarpa occurs within the Project area. The proposed impacts area considered unlikely to lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	The EOO of the species is estimated at 18,726 km^2 (DCCEEW 2023). The species was not observed during field surveys within the Project area and there is no evidence to suggest a population occurs within the Project area. The proposed impacts are considered unlikely to reduce the EOO of the species.
Fragment an existing population	The species was not observed during field surveys within the Project area and there is no evidence to suggest a population occurs within the Project area. The proposed clearing areas are adjacent to areas of existing disturbance. The proposed impacts are considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	The species was not observed during field surveys within the Project area and there is no evidence to suggest a population occurs within the Project area. The proposed impacts areas area consolidated with the existing Project area and will not increase the current degree of habitat isolation within the Project area (i.e. suitable habitat in the southern portion of the Project area). The proposed impacts are unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that area harmful to an endangered to vulnerable species becoming established in the endangered or vulnerable species habitat	There are no invasive species known to be harmful to the species, although dense weed infestation may adversely impact recruitment. A large number of non-native plant species are already established within the Project area. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The proposed impacts area considered unlikely to result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat.
Introduce disease that may cause the population to decline	The species was not observed during field surveys within the Project area and there is no evidence to suggest a population occurs within the Project area. The species is not known to be vulnerable to any diseases. The Project is considered unlikely to introduce disease that may cause the population to decline.
Interfere with the recovery of the species	The species was not observed during field surveys within the Project area and there is no evidence to suggest a population occurs within the Project area. The proposed impacts will not interfere with any of the recovery objectives identified in the recovery plan for the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The following important populations of the species have been identified in the recovery plan for the species: • Population 8 (Biloela) • Population 19 (Kroombit) • Population 30 (Woonbah) • Population 2 (Bouldercombe) • Population 3 (Mt Morgan) • Population 5 (Dee Range) • Population 14 (Biloela). The proposed impacts will not impact any of the locations listed above. The proposed impacts are unlikely to cause disruptions to ecological significant locations of the species.
Assessment result	Significant residual impact to *Cycas megacarpa* resulting from the proposed impacts are considered unlikely to occur.

8.1.1.3 Squatter Pigeon – Vulnerable

Ecology

Largely terrestrial pigeon species, foraging and breeding on the ground. Mainly occurs in dry grassy eucalypt woodlands and open forests (Frith 1982; Crome and Shields 1992). May also inhabit *Callitris*/*Acacia* dominated woodlands. Reported from open plains in its historical southern range (Frith 1982). Most birds live in sandy sites within 3 km of a permanent water source (Blakers et al. 1984). They remain common in heavily grazed country in tropical Queensland (Reis 2012) but they are typically more common in ungrazed lands (Woinarski and Ash 2002; Reis 2012). This species mainly feeds on grass seed although insects are seasonally important in the diet (Reis 2012).

The species may breed throughout the year but this appears to be greatly influenced by rainfall and abundance of foraging resources. Peak breeding is likely to occur during the dry season (April to October) (Squatter Pigeon Workshop 2011; DCCEEW 2023). The nest is a shallow depression on the ground usually sheltered by a bush or log (Reis 2012). The total population size is estimated at 40,000 breeding birds and is thought to occur as a single continuous interbreeding population (DCCEEW 2023).

The subspecies was historically found from the Dubbo region in New South Wales north to the Burdekin River area in in Queensland. There have been no official records in New South Wales since the 1970s. Although the species has declined greatly in southern Queensland in the past it appears this decline has slowed, and the species now persists over a wide area and can be locally abundant in central Queensland (Garnett et al. 2011) where groups of up to 30 individuals can still be seen (Reis 2012). South of the Carnarvon Range the species appears to occur only in scattered areas.

Association with Project area

The species was not detected during field surveys within the Project area. Historical records of the species include 24 occurrence records with 25 km of the Project area with the nearest record located 3.5 km west of the Project area. Suitable habitat for the species includes remnant and regrowth RE 11.11.15 and remnant RE 11.3.25 with a total area of 168.7 ha of which 15.43 ha is proposed to be impacted by the Project. The entire Project area is within 3 km of permanent water provided by Awoonga Reservoir.

Government approved species documents

There is no approved recovery plan for the species. The Approved Conservation Advice for the species (TSSC 2015b) notes the following threats to the species:

- Habitat loss through land clearing, particularly for livestock grazing which decreases foraging resources
- Overgrazing by livestock and feral herbivores
- Unsuitable fire regimes
- Changes to habitats caused by invasive weeds and/or thickening of understorey vegetation (Higgins & Davies 1996; Garnett et al 2011)

Relevant threat abatement plans considered applicable to the species include:

- *Threat abatement plan for competition and land degradation by rabbits* (DEE 2016)
- *Threat abatement plan for predation by feral cats* (DE 2015b)
- *Threat abatement plan for predation by the European red fox* (DEWHA 2008c)

The Approved Conservation Advice for the species also identifies the following primary conservation actions:

- Identify sub-populations of high conservation priority, especially in the southern part of the Squatter Pigeon's (southern) range.
- Protect and rehabilitate areas of vegetation that support important sub-populations
- Protect sub-populations of the listed subspecies through the development of covenants, conservation agreements or inclusion in reserve tenure
- Develop and implement a stock management plan for key sites
- Develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the squatter pigeon (southern)
- Raise awareness of the squatter pigeon (southern) within the local community, particularly among land managers.

All of the small, isolated and sparsely distributed populations south of the Carnarvon Range area are considered as important subpopulations of Squatter Pigeon (southern) including:

- Populations occurring in the Condamine River catchment and Darling Downs
- Populations known to occur in the Warwick-Inglewood-Texas area
- Populations potentially occurring in northern NSW (Squatter Pigeon Workshop 2011; DCCEEW 2023).

An important sub-population of the species is not known to occur within the Project area. There is no definition of habitat critical to the survival of the species is the available literature. This is likely due to the relatively broad habitat requirements of the species and the abundance of similar habitat across the wider landscape.

Table 15 provides an assessment of the potential for significant impacts to Squatter Pigeon from the proposed impacts using the assessment criteria for Vulnerable species outlined in the Guideline.

Table 15. Significant residual impact criteria assessment: Squatter Pigeon

Criteria	Vulnerable species assessments
Lead to long-term decrease in the size of a local population	The species was not detected during the recent field survey within the Project area, although the species is considered a likely occurrence. There is no evidence to suggest that a local population occurs within the Project area. The proposed impacts will result in the clearing of 15.43 ha of suitable habitat for the species. The habitat proposed for clearing is adjacent to areas of existing disturbance and is partially isolated by the existing mine and Awoonga Reservoir. Ther species has limited dispersal abilities and required woodland or forest habitat to move between areas of suitable breeding or foraging habitat (Squatter Pigeon Workshop 2011). Extensive areas of suitable habitat for the species occurs to the north and west of the Project area. Pre-clearance surveys will be completed prior to clearing to survey for any breeding places for the species, however individual birds are likely to fly away from any disturbance during the construction phase. The proposed impacts are considered unlikely to lead to a long-term decrease in the size of local population of the species.
Reduce the extent of occurrence of the species	The species was not detected during field surveys within the Project area, although the species is considered a likely occurrence. There is no evidence to suggest that a population occurs within the Project area. The current EOO of the species is estimated at 440,000km^2 (DCCEEW 2023). The Project area is not at the limit of the species distribution. The proposed impacts will result in the clearing of 15.43 ha of suitable foraging habitat for the species. The proposed impacts are considered unlikely to reduce the EOO of the species.
Fragment an existing population	The species was not detected during field surveys within the Project area, although the species is considered a likely occurrence. There is no evidence to suggest that a population occurs within the Project area. The species is highly mobile and able to fly, the Project will not form a barrier to the species. The proposed impacts are considered unlikely to fragment an existing population into two or more populations.
Result in genetically distinct populations forming as a result of habitat isolation	The species was not detected during field surveys within the Project area, although the species is considered a likely occurrence. There is no evidence to suggest that a population occurs within the Project area. The species is highly mobile and able to fly, the Project will not form a barrier to the species. The proposed impacts will not increase the existing degree of habitat isolation within the Project area. The proposed impacts area considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that area harmful to an endangered to vulnerable species becoming established in the endangered or vulnerable species habitat	Predation by feral Cats (*Felis catus*) and Foxes (*Vulpes vulpes*) is a known threatening process for the species, as is habitat degradation resulting from Buffel Grass (*Cenchrus ciliaris*) invasion. Cats and foxes area expected to be common within the Project and wider landscape. Buffel Grass was not observed within the Project area. The Project is unlikely to introduce Buffel Grass into the Project area. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The proposed impacts are considered unlikely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.
Introduce disease that may cause the population to decline	The species may be susceptible to avian bird flu. The Project is unlikely to introduce avian bird flu into the Project area. Machinery imported from outside the region for Project earthworks, transportation and other construction activities will be required to be certified free of weed seeds and soil matter prior to entry onsite. It is inconceivable the proposed impacts will result in the introduction of a disease causing the species to decline.
Interfere with the recovery of the species	The Project will not interfere with any recovery strategies identified in the Approved Conservation Advice for the species.
Cause disruption to ecologically significant locations (breeding,	The species was not observed during recent field surveys within the Project area although the species is considered likely to occur. Historical records of the species include 24 occurrence records with 25 km of the Project area with the nearest record located 3.5 km

feeding, nesting, migration or resting sites) of a species	west of the Project area from 2003 (ALA 2024). There is no evidence to suggest that a local population occurs within the Project area. The Project area is not considered an ecologically significant location for the species. The proposed impacts are considered unlikely to cause disruptions to ecologically significant locations of a species.
Assessment result	Significant impacts to Squatter Pigeon are considered unlikely to occur.

8.1.1.4 Powerful Owl – Vulnerable

Ecology

The Powerful Owl is a large hawk-owl with no facial disc and yellow eyes. Suitable habitat for the species includes open forests and woodlands, and sheltered gullies in wet forests with abundant tree hollows to provide habitat for their preferred prey (Birdlife Australia 2023). The species prey primarily on arboreal mammals such as Common Ring-tail Possum (*Pseudocheirus peregrinus*) and Greater Glider. Nesting occurs in large vertical tree hollows provided by old-growth eucalypt vegetation communities. Breeding pairs of Powerful Owls defend home ranges of 400-4,000 ha, depending on habitat quality (NSW Scientific Committee 2008). The species is distributed from Mackay in the north to western Victoria in the south across a band along the coast and up to 200 km inland, with the exception of the Carnarvon Ranges and the Pilliga (ALA 2024).

Association with the Project area

The species was not observed during the field surveys within the Project area. Historical records of the species include seven occurrence records within 25 km of the Project area with the nearest record located 11 km SSE of the Project area. Marginal habitat for the species within the Project area is provided by remnant RE 11.11.15 and remnant RE 11.3.25 with a total area of 5.57 ha. The habitat is considered marginal due to the absence of suitably large hollows required for nesting and scarcity of smaller hollows to support prey species (I.e. arboreal mammals). Powerful owls may intermittently use the habitat as part of a wider home range.

Government documents

There are no Commonwealth or Queensland Government documents relevant to the species. The NSW Government Saving Our Species Program identifies the following critical actions for the species:

- Consolidate all available information, knowledge and assessment protocols to create a consensus of best practice guidelines, providing a single point source to advise land managers about powerful owl conservation
- Negotiate with relevant landholders to enter into agreements, particularly in-perpetuity covenants or stewardship agreements, that promote the retention of large old trees, riparian habitat, owl roost sites and other high value habitat
- In regions where high priority powerful owl populations can be increased and stabilised, improve habitat quality and reconstruct connectivity
- At sites where tree hollows are few or declining within high priority powerful owl populations, trial the installation of nest boxes to increase mammalian prey densities
- Encourage development of citizen science programs in urban areas where an increase in community engagement is likely to create broader conservation awareness of powerful owls
- Document and protect known nests.

Table 16 provides an assessment of the potential for significant impacts to Powerful Owl from the Proposed impacts using the assessment criteria for Vulnerable species outlined in the Guideline.

Table 16. Significant residual impact criteria assessment: Powerful Owl

Criteria	Vulnerable species assessments
Lead to long-term decrease in the size of a local population	The species was not observed during recent field surveys within the Project area. Historical records of the species include seven occurrence records within 25 km of the Project area with the nearest record located 11 km south southeast of the Project area from 2003 (ALA 2025). There is no evidence to suggest that a local population occurs within the Project area. The proposed impacts will result in the clearance of 18.0 ha of

Criteria	Vulnerable species assessments
	marginal habitat for the species. The habitat proposed for clearing is adjacent to areas of existing disturbance and is partially isolated by the existing mine and Awoonga Reservoir. The proposed impacts are considered unlikely to lead to a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	The EOO of the species is estimated at 1,290,000 km^2 (Garnet & Baker 2020). The Project area is not at the limit of the species distribution. The proposed impacts will result in the clearance of 18.0 ha of marginal habitat for the species. The proposed impacts are considered unlikely to reduce the EOO of the species.
Fragment an existing population	The species was not observed during recent field surveys within the Project area. There is no evidence to suggest that a population exists within the Project area. The proposed impact area of 18.0 ha of marginal habitat for the species is relatively minor compared to the existing operational areas within the Project area. The majority of marginal habitat for the species proposed to be impacted is currently isolated to the south of the existing mine. The proposed impacts will not further the current degree of habitat fragmentation within the Project area. The proposed impacts are considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	The species was not observed during recent field surveys within the Project area. There is no evidence to suggest that a population exists within the Project area. The proposed impact area of 18.0 ha of marginal habitat for the species is relatively minor compared to the existing operational areas within the Project area. The proposed impacts will increase the degree of habitat fragmentation within the Project area. The proposed impacts are considered unlikely to fragment an existing population.
Result in invasive species that area harmful to an endangered to vulnerable species becoming established in the endangered or vulnerable species habitat	There are no invasive species that area a known threat to the species. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The proposed impacts are considered unlikely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.
Introduce disease that may cause the population to decline	The species may be susceptible to avian bird flu. The Project is unlikely to introduce avian bird flu into the Project area. Machinery imported from outside the region for Project earthworks, transportation and other construction activities will be required to be certified free of weed seeds and soil matter prior to entry onsite. It is inconceivable the proposed impacts will result in the introduction of a disease causing the species to decline.
Interfere with the recovery of the species	The Project will not interfere with any critical actions identified for the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The species was not observed during recent field surveys within the Project area although the species is considered likely to occur. There is no evidence to suggest that a local population occurs within the Project area. The Project area is not considered an ecologically significant location for the species. The proposed impacts are considered unlikely to cause disruptions to ecologically significant locations of a species.
Assessment result	Significant impacts to Powerful Owl are considered unlikely to occur.

8.1.1.5 Cassinia collina – Vulnerable

Ecology

Cassinia collina is a shrub reaching 2 m in height, with brown branches and leaves 3 to 7 cm in length. Inflorescences are up to 16 cm long (DESI 2024). Flowering has been observed during April-June and also September-October (Wang 1999; Queensland Herbarium 2011b). Suitable habitat for the species includes tall woodland and open forest on stony soils and sandy loams, including fine-grained granite soils (DESI 2024). The species is restricted to eight populations, including six within Mount Walsh National Park, one within Wongi State Forest and one near Mount Stanley in the Many Peaks Range.

Association with the Project area

The species was not observed within the Project area during the recent field survey. A single record of the species occurs within 25 km of the Project area, located 14 km to the southeast (ALA 2025). Suitable habitat for the species within the Project area is provided by remnant RE 11.11.15 and 11.3.25 with a total area of 5.57 ha.

Government approved documents

There are no government documents relevant to the species. The DETSI species profile for the species identifies the following threat as relevant to the species:

- Habitat clearing on private land

The following management recommendations are also identified:

- Establishment of protective buffers that exclude clearing in areas where the species occurs
- Adaptive management techniques to be implemented during timber harvesting.

Table 17 provides an assessment of the potential for significant impacts to *Cassinia collina* from the proposed impacts using the assessment criteria for Vulnerable species outlined in the Guideline.

Table 17. Significant residual impact criteria assessment: *Cassinia collina*

Criteria	Vulnerable species assessments
Lead to long-term decrease in the size of a local population	The species was not recorded during the recent ecology field survey within the Project area, although a formal protected plant survey was not completed. Known populations occur at Mount Walsh National Park, Wongi State Forest and near Mount Stanley. A single record of the species occurs within 25 km of the Project area, located 14 km to the southeast (ALA 2025). There is no evidence to suggest a local population of the species occurs within the Project area. The proposed impacts will result in the clearance of 18 ha of suitable habitat for the species. The habitat proposed for clearing is adjacent to areas of existing disturbance and is partially isolated by the existing mine and Awoonga Reservoir. A pre-clearance survey targeting the species will be completed within areas of suitable habitat prior to clearing. In the event that a population is discovered within the proposed disturbance areas, further mitigation measures including avoidance will be required to prevent a significant impact. The proposed impacts are considered unlikely to result in a long-term decrease in the size of a local population.
Reduce the extent of occurrence of the species	The species was not recorded during recent surveys within the Project area. The Project area is likely to be outside of the known EOO of the species. A pre-clearance survey targeting the species will be completed within areas of suitable habitat prior to clearing. In the event that a population is discovered within the proposed disturbance areas, further mitigation measures including avoidance will be required to prevent a significant impact. The proposed impacts area considered unlikely to reduce the extent of occurrence of the species.
Fragment an existing population	The species was not recorded during recent surveys within the Project area. There is no evidence to suggest a local population of the species occurs within the Project area. The proposed impacts will not increase the degree of fragmentation of suitable habitat for the species within the Project area. A pre-clearance survey targeting the species will be completed within areas of suitable habitat prior to clearing. In the event that a population is discovered within the proposed disturbance areas, further mitigation measures including avoidance will be required to prevent a significant impact. The proposed impacts are considered unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	The species was not recorded during recent surveys within the Project area. There is no evidence to suggest a local population of the species occurs within the Project area. The proposed impacts will not increase the isolation of suitable habitat for the species within the Project area. The proposed impacts are considered unlikely to result in genetically distinct populations forming as a result of habitat isolation.
Result in invasive species that area harmful to an endangered to	There are no invasive species that are known threats to the species, although the species may be vulnerable to herbivory from non-native fauna and habitat degradation from invasive plants. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The proposed impacts are considered unlikely to result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat.

Criteria	Vulnerable species assessments
vulnerable species becoming established in the endangered or vulnerable species habitat	
Introduce disease that may cause the population to decline	There are no diseases that are known to adversely impact the species. A Pest and Weed Management Plan will be in place prior to construction works being carried out. The proposed impacts are considered unlikely to introduce disease that may cause the population to decline.
Interfere with the recovery of the species	The proposed impacts are considered unlikely to interfere with the management recommendation for the species. Flora surveys associated with the Project may increase understanding of the species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	The species was not recorded during recent surveys within the Project area. There is no evidence to suggest a local population of the species occurs within the Project area. The only known location of the species near Mt Castletower is considered an ecologically significant location for the species. A pre-clearance survey targeting the species will be completed within areas of suitable habitat prior to clearing. In the event that a population is discovered within the proposed disturbance areas, it may be considered an ecologically significant location for the species and further mitigation measures including avoidance will be required to prevent a significant impact. The proposed impacts are considered unlikely to cause disruption to ecological significant locations of a species.
Assessment result	Significant impacts to *Cassinia collina* are considered unlikely to occur.

8.2 Category R (GBR Riverine regrowth) Regulated Vegetation

The Project is mapped as a key resource area (KRA) (State of Queensland 2024a). KRAs are a planning tool designed to protect resources from being rendered inaccessible by urban expansion. Further, they are designed to maintain adequate separation distances between sensitive uses and any future extractive industry (State of Queensland 2024b).

Category A, B, and C regulated vegetation has been completely avoided in developing the proposed future mine plan for the Project. However, the proposed expansion of the Southern WRD to the east will impact 2.95 ha of mapped MSES category R (GBR riverine) least concern vegetation. This area is specifically within the separation area of KRA19 (Taragoola- hard rock operation). The *Accepted Development Clearing Code- Clearing for an Extractive Industry* (DoR 2020) and *List of exempt clearing work* (State of Queensland 2019) notes that clearing in a category C area or category R area within a KRA is exempt clearing work. Therefore, an approval or notification prior to clearing this area is not required.

Under the Offsets Regulation, offsets may be required for any significant residual impact on prescribed environmental matters defined in Schedule 2, Section 1. A prescribed RE is defined as a RE, other than a RE mentioned in the VM Act, section 8(b), located in a category B area on the regulated vegetation management map, to the extent the ecosystem contains remnant vegetation. Therefore, the Category R area is not considered a prescribed environmental matter for offsets under the Offsets Regulation as it is regrowth vegetation. Therefore, there are no significant residual impacts to Category R regulated vegetation considered applicable for the Project.

8.3 Clearing in a RE that is within the Defined Distance of a Watercourse

The Project will require clearing of two areas of mapped regulated vegetation within the defined distance from the defining bank of a relevant watercourse for both linear (access track) and non-linear infrastructure (Southern WRD and future Pit 3-4). The mapping of the MSES regulated vegetation (defined watercourse) is considered to be inconsistent with ground conditions as it partially overlaps existing Project disturbance areas authorised under the Project's EA. The alignment does not reflect the topography of the area, as in both instances the MSES regulated vegetation (defined watercourses) mapping crosses the eastern and western levees at a perpendicular angle, despite being a nominal 15 m taller than the adjacent land.

The MSES defined watercourse mapping follows the same alignment as 'unmapped' watercourse mapping under the *Water Act 2000* and are labelled as stream order 1. Both areas are also mapped low risk (green) waterways for waterway barrier works. Based on the satellite imagery and field surveys undertaken by Epic in March 2023, these waterways are ephemeral, short-in length, and do not provide fish habitat as they are either totally (artificially) impounded and isolated from downstream waterways, or significantly modified by earthworks and/or mining operations. In this context the waterways do not function as mapped and would be heavily altered by historic mining activities. Irrespective of this, an assessment of potential significant residual impact to prescribed REs within the defined distance of a watercourse has been considered in **Table 18,** in relation to Section 2.1 of the SRI Guideline (DEHP 2014).

Under Schedule 2 Section 2 of the Offsets Act, a prescribed RE is a matter of state environmental significance to the extent the ecosystem is located within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature. In Schedule 2, Section 2 (6) of the Offsets Regulation, the 'defined distance' for RE is defined as a distance identified in the *Queensland Environmental Offsets Policy 2023* (Appendix 3, V1.15) as the relevant distance from the defining banks of a relevant watercourse or relevant drainage feature. For stream order 1 watercourses in a non-coastal bioregion, the defined distance is 25 metres. Excluding the existing disturbance, the RE within the proposed disturbance areas is RE 11.3.25 which has a woodland structure code. Therefore, criteria for the 'sparse' structural category applies.

Table 18. Significant residual impact test for MSES regulated vegetation (defined watercourse)

Ref.	Vegetation Clearing Type	Trigger specified in Section 2.1 of guideline	Proposed Project disturbance
1	Clearing for linear infrastructure in a sparse RE	Greater than 20 m wide	Nil- all tracks are no more than 10 m wide
	Clearing other than for linear infrastructure in a sparse RE	Area greater than 2 ha	1.86 ha
2	Clearing within 50 m of the defining bank	N/A	N/A
3	Clearing within 5 m of the [25 m] defining bank	Any clearing	0.42 ha

For a prescribed activity to have a significant residual impact on a RE that is within the defined distance of watercourses, criteria 1 and 3 must be exceeded. Significant impacts are unlikely based on the SRI Guideline (DEHP 2014), however the watercourse does not exist as mapped and therefore there is no potential impact. No offsets under Queensland's *Environmental Offsets Act 2014* are required.

8.4 Waterways Providing for Fish Passage

The Project is expected to impact 3 low risk waterways with barrier works. An environmental offset may be required for any part of a waterway that provides for passage of fish if the construction, installation or modification of waterway barrier works caried out under an authority will limit the passage of fish along the waterway. An assessment of the potential for significant residual impacts to a waterway providing fish passage against the criteria provided in the Guideline is provided below in **Table 19**.

Table 19. Significant residual impact criteria assessment: waterway providing for fish passage

Criteria	Waterway providing fish passage assessment
A permanent modification to the volume, depth, timing, duration or flow frequency on the waterway	Two of the low risk waterways will be impacted by the proposed expansion of Pit 2 and Pit 3-4. A third low risk waterway will be impacted by the proposed waste rock dump. All three waterways and ephemeral, short in length and already subject to artificial impoundment. The expected flow volume and duration is expected to be zero except during very high rainfall event triggering surface flow across the wider area. Expansion of the pits and waste rock dump is not expected to reduce flow the flow of the waterways. The proposed Project is considered unlikely to result in a permanent modification to the volume, depth, timing, duration or flow frequency on the waterway.

Criteria	Waterway providing fish passage assessment
Permanent modification or fragmentation of fish habitat including but not limited to in stream vegetation, snags or woody debris, substrate, bank or riffle formation necessary for breeding and/or survival of native fish	The expected impact areas of all three waterways do not provide fish habitat as they are either totally impounded and isolated from downstream waterways or significantly modified by earthworks and/or mining operations. The proposed Project in considered unlikely to result in permanent modification or fragmentation of fish habitat including but not limited to in stream vegetation, snags or woody debris, substrate, bank or riffle formation necessary for breeding and/or survival of native fish.
The mortality or injury of fish species	Native fish are considered highly unlikely to occur within any of the proposed impact areas. The proposed Project is considered unlikely to result in the mortality or injury of fish.
Works that permanently reduce the level of fish passage provided in a tidal waterway or a waterway identified as a major high risk waterway for waterway barrier works, to a level that would increase stress on fish populations	The waterways or not tidal or major risk. The proposed Project is considered unlikely to result in works that permanently reduce the level of fish passage provided in a tidal waterway or a waterway identified as a major high risk waterway for waterway barrier works, to a level that would increase stress on fish populations.
Assessment result	Significant residual impacts to waterways providing fish passage resulting from the Project are considered unlikely to occur.

8.5 Significant Residual Impacts – Environmental Offsets

Under the Offsets Act, environmental offsets may be required for significant residual impacts to MSES from the proposed Project. As described in **Section 0** and in accordance with the MSES Guideline, significant residual impacts to the following MSES are not expected to be likely:

- Listed conservation significant species
- Regulated vegetation (prescribed RE within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map)
- Category R (GBR riverine regrowth) regulated vegetation
- Waterways providing for fish passage

Therefore, no offsets under the Offsets Act are required.

9 SUMMARY AND CONCLUSION

A field survey of the Project area was completed during 27 February to 1 March 2023. The survey included a baseline flora and fauna assessment, verification of REs and regulated vegetation, and assessment of habitat suitability for conservation significant species.

A total of two different RE types were verified within the Project area, including remnant and regrowth vegetation analogous to Category B and Category C regulated vegetation.

The likelihood of occurrence assessment for conservation significant flora species determined that no conservation significant flora species are likely to occur within the Project area (**Table 6**), although two flora species area considered a possible occurrence within the Project area:

- *Cassinia collina*
- *Cycas megacarpa*

The likelihood of occurrence assessment for conservation significant fauna species determined that three conservation significant fauna species, Koala, Squatter Pigeon (southern) and White-throated Needletail, are considered likely to occur within the Project area (**Table 10**), whilst Powerful Owl is considered a possible occurrence within the Project area.

Significant residual impacts from the proposed Project were considered for these listed species considered likely to occur, as well as for regulated vegetation (prescribed RE within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map), Category R (GBR riverine) regulated vegetation, and waterways providing for fish passage. It was determined that no significant impact is expected from the proposed Project and therefore, no offsets under the Queensland *Environmental Offsets Act 2014* are required.

10 REFERENCES

ABRS 2023, *Australian Faunal Directory*. Australian Biological Resources Study, Canberra, available from: https://biodiversity.org.au/afd/home.

ALA 2025, *Atlas of Living Australia spatial portal*, available from: https://spatial.ala.org.au/.

Ansar Environmental 1997, *Ecological assessment (flora and Fauna) report (on behalf of Graymont)*. Ansar Environmental.

Bamford M, Watkins, D, Bancroft, W, Tischler, G & Wahl, J 2008, *Migratory shorebirds of the East Asian - Australasian Flyway: population estimates and internationally important sites*, Canberra, ACT, Department of the Environment, Water, Heritage and the Arts, Wetlands International Oceania, available from: http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html.

Bean, A.R. 2024. Introduction to the Census of the Queensland Flora and Fungi 2023. Queensland Department of Environment, Science and Innovation, Queensland Government

Birdlife Australia 2023, *Red Goshawk*, available from: https://birdlife.org.au/bird-profiles/red-goshawk/. Accessed 26/04/2023.

Blakers, M, Davies, SJJF & Reilly, PN 1984, *The atlas of Australian birds*, Melbourne University Press, Melbourne.

BoM 2023, *Climate data online*. Bureau of Meteorology, Bureau of Meteorology, Commonwealth of Australia. Canberra, available from: http://www.bom.gov.au/climate/averages/tables/cw_035129.shtml.

Buchanan B. W. 1993, Effects of enhanced lighting on the behaviour of nocturnal frogs. *Animal Behaviour*, Vol 45, pp. 893–899.

Chaston, K & Doley, D 2006, 'Mineral Particulates and Vegetation: Effects of Coal Dust, Overburden and Flyash on Light Interception and Leaf Temperature, *Clean Air and Environmental Quality*, vol. 40, pp. 40-44.

CHRC 2019, *Central Highlands Regional Council Biosecurity Plan 2020-2025*, Central Highlands Regional Council, Queensland, Australia

Crome, F & Shields, J 1992, *The parrots and pigeons of Australia: The National Photographic Index of Australian wildlife*, Angus and Robertson, Pymble.

DAF 2018, *Accepted development requirements for operational work that is constructing or raising waterway barrier works*. Department of Agriculture and Fisheries, Brisbane.

DAWE 2022. *Conservation Advice for* Petaurus australis australis *(yellow-bellied glider (south-eastern)).* Canberra: Department of Agriculture, Water and the Environment, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/87600-conservation-advice-02032022.pdf.

DAWE 2022b, *National Recovery Plan for the Koala* Phascolarctos cinereus *(combined populations of Queensland, New South Wales and the Australian Capital Territory).* Department of Agriculture, Water and the Environment, Australian Government, Canberra, available from: http://www.awe.gov.au/environment/biodiversity/threatened/publications/recovery/koala-2022.

DAWE 2022c, *Conservation Advice for* Phascolarctos cinereus *(Koala) combined populations of Queensland, New South Wales and the Australian Capital Territory*. Canberra: Department of Agriculture, Water and the Environment, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/85104-conservation-advice-12022022.pdf. In effect under the EPBC Act from 12-Feb-2022.

DCCEEW 2023, *Species Profile and Threats Database*. Department of Climate Change, Energy, Environment and Water, Australian Government, Canberra, available from: https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=17906.

DCCEEW 2024a, Conservation Advice for Pluvialis squatarola (grey plover), Canberra. This publication is available at the SPRAT profile for Pluvialis squatarola (grey plover).

DCCEEW 2024b, *Conservation Advice for* Xenus cinereus *(terek sandpiper)*. Canberra: Department of Climate Change, Energy, the Environment and Water. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/59300-conservation-advice-05012024.pdf.

DCCEEW 2024c, *Conservation Advice for* Arenaria interpres *(ruddy turnstone).* Canberra: Department of Climate Change, Energy, the Environment and Water. Available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/872-conservation-advice-05012024.pdf.DE 2014. *EPBC Act referral guidelines for the vulnerable koala*. Department of the Environment. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-`idelines-vulnerable-koala.

DE 2015a, *Wildlife conservation plan for migratory shorebirds*, Department of the Environment, Canberra.

DE 2015b, *Threat abatement plan for predation by feral cats*, Canberra, ACT, Department of the Environment, Commonwealth of Australia, Canberra, available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=678.

DE 2014, *Conservation Advice* Elseya albagula *White-throated snapping turtle*, Department of the Environment, Canberra.Debus, SJS 2012, 'Powerful Owl Ninox strenua (Gould, 1838)', in LK Curtis, AJ Dennis, KR McDonald, PM Kyne & SJS Debus (eds), *Queensland's threatened animals*, CSIRO Publishing, Collingwood, pp. 302-303.

DEE 2016. *Threat abatement plan for competition and land degradation by rabbits*. Department of Environment and Energy, Canberra, ACT: Commonwealth of Australia, available from: http://www.environment.gov.au/biodiversity/threatened/publications/tap/competition-and-land-degradation-rabbits-2016. In effect under the EPBC Act from 07-Jan-2017.

DEHP 2014, *Queensland Environmental Offsets Policy - significant residual impact guideline*, Department of Environment and Heritage Protection, Queensland Government, Brisbane.

DERM 2012. *National recovery plan for the red goshawk* Erythrotriorchis radiatus. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Queensland Department of Environment and Resource Management, Brisbane, available from: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-red-goshawk-erythrotriorchis-radiatus.

DES 2020, *Flora Survey Guidelines – Protected Plants*. Department of Environment and Science, Queensland Government, Brisbane.

DESI 2024, *Species Profile Search*. Department of Science, Queensland Government, Brisbane, available from: https://apps.des.qld.gov.au/species-search/.

DEWHA 2008a. *Approved Conservation Advice for Apatophyllum olsenii*. Canberra: Department of the Environment, Water, Heritage and the Arts, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/7718-conservation-advice.pdf.

DEWHA 2008b, *Threat abatement plan for predation by the European red fox*, Department of the Environment, Water, Heritage and Arts, Canberra.

Dique, DS, Preece, HJ, Thompson, J & de Villiers, DL 2004, 'Determining the distribution and abundance of a regional koala population in south-east Queensland for conservation management', *Wildlife Research*, vol. 31, pp. 109-117.

DotE 2015a, *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act*. Department of the Environment, Canberra. Available at: https://www.awe.gov.au/sites/default/files/documents/migratory-birds-draft-referral-guideline.pdf.

DotE 2015b, *Wildlife Conservation Plan for Migratory Shorebirds*. Canberra, ACT: Department of the Environment. This Wildlife Conservation Plan was made for this species prior to it being listed as threatened. The plan is no longer in effect for this species under 285(2) of the EPBC Act. Available from: http://www.environment.gov.au/biodiversity/publications/wildlife-conservation-plan-migratory-shorebirds-2016

Eyre TJ 2002, *Habitat preferences and management of large gliding possums in southern Queensland*. Ph.D. thesis, Southern Cross University, Lismore.Eyre, T, Ferguson D, Smith G, Mathieson M, Venz, M, Hogan, L, Hourigan C, Kelly, A & Rowland, J 2022, *Terrestrial Vertebrate Fauna Survey Assessment Guidelines for Queensland*, Version 4.0. Department of Environment and Science, Queensland Government, Brisbane, available from: https://www.qld.gov.au/__data/assets/pdf_file/0022/68224/fauna-survey-guidelines.pdf.

Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. 2015, BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Farmer, AM, 1993, The effects of dust on vegetation – a review, *Environmental Pollution*, vo. 79, pp. 63-75.

Field, JP, Belnap, J, Breshears, DD, Neff, JC, Okin, GS, Whicker, JJ, Painter, TH, Ravi, S, Reheis, MC & Reynolds, RL 2010, 'The ecology of dust', *Frontiers in Ecology and the Environment*, vol. 8, pp. 423-430.

Frith, HJ 1982, *Pigeons and doves of Australia*, Rigby, Adelaide

Garnet, ST & Baker, GB 2020, *The action plan for Australian birds 2020*, CSIRO Publishing, Collingwood.

Garnett, ST, Szabo, JK & Dutson, G 2011, *The action plan for Australian birds 2010*, CSIRO Publishing, Collingwood.

Halford, D. 2011. *Species nomination form and guidelines for adding or changing the category of a native species listing under the Queensland Nature Conservation Act 1992 (NCA*). Rare and Threatened Species Technical Committee March 2011.

Harden, G., McDonald, B. & Williams, J. 20018, *Rainforest Trees and Shrubs. A field guide to their identification*. Gwen Harden Publishing, N.S.W, Australia.

Higgins, PJ & Davies, SJJF (eds) 1996, *Handbook of Australian, New Zealand and Antarctic birds, Vol. 3: snipe to pigeons,* Oxford University Press, Melbourne.

Higgins, PJ (ed) 1999, *Handbook of Australian, New Zealand and Antarctic birds, Vol. 4: parrots to dollarbird*, Oxford University Press, Melbourne.

Hourigan, C. 2012, Glossy black-cockatoo, Calyptorhynchus lathami. Targeted species survey guidelines. Queensland Herbarium, Department of Environment and Science, Brisbane.

Hume, ID & Esson, C 1993, 'Nutrients, antinutrients and leaf selection by captive koalas (*Phascolarctos cinereus*).' *Australian Journal of Zoology*, vol. 41, pp. 379–392.

Kavanagh, RP 2002, 'Conservation and management of large forest owls in south eastern Australia', in I Newton, R Kavanagh, J Olsen & I Taylor (eds), *Ecology and conservation of owls*, CSIRO Publishing, Collingwood, pp. 201-219.

Leiper G., Galzebrook J., Cox D. and Rathie K, 2014 *Mangroves to Mountains: A field Guide to the Native Plants of South-east Queensland* (2014 Revised Edition).

Makinson, R 2000, *Flora of Australia Volume 17A, Proteaceae 2*. ABRS/CSIRO, 1–460, Melbourne.

Marchant, S & Higgins, PJ (eds) 1993, Handb*ook of Australian, New Zealand and Antarctic birds. Vol. 2: raptors to lapwings*, Oxford University Press, Melbourne.

Martin, RW, Handasyde, KA & Krockenberger, A 2008, 'Koala *Phascolarctos cinereus*', in S Van Dyck & R Strahan (eds), *The mammals of Australia, Third edition*, Reed New Holland, Sydney, pp. 198-201.

Menkhorst, P, Rogers, D & Clarke, R 2017, *The Australian bird guide*, CSIRO Publishing, Clayton South.

Moore, BD & Foley, WJ 2000, 'A review of feeding and diet selection in koalas (*Phascolarctos cinereus*)', *Australian Journal of Zoology*, vol. 48, pp. 317-333.

Neldner, VJ, Wilson, BA, Thompson, EJ, Dillewaard, HA, Ryan TS, Butler DW, McDonald WJF, Richter D, Addicott EP & Appelman CN 2023. *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland, Version 7.0*. Queensland Herbarium, Queensland Environmental Protection Agency, Brisbane.

NSW Scientific Committee 2008, Powerful Owl Ninox strenua. Review of current information in NSW. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. NSW Scientific Committee, Hurstville.

OEH 2017. *Yellow-bellied Glider – profile*, Office of the Environment and Heritage, accessed 26/04/2023, available from: https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10601.

Pahl, LI & Hume, ID 1990, 'Preferences for Eucalyptus species of the New England Tablelands and initial development of an artificial diet for Koalas.' In: AK Lee, KA Handasyde and GD Sanson (eds.), *Biology of the Koala*. Surrey Beatty and Sons, Sydney. pp. 123–128

Perry, G, Buchanan, BW, Fisher, RN, Salmon, M & Wise, SE 2008, 'Effects of artificial night lighting on amphibians and reptiles in urban environments.' In: JC Mitchell, RE Jung Brown & B Bartholomew (eds.), *Herpetological Conservation*, Society for the Study of Amphibians and Reptiles.

Queensland Herbarium 2007. *National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis*. Report to Department of the Environment and Water Resources, Canberra. Environmental Protection Agency, Brisbane, available from: http://www.environment.gov.au/biodiversity/threatened/publications/pubs/cycads .

Queensland Herbarium 2011a, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2011b, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2011c, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2012a, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2012b, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2012c, *Specimen label information*, Queensland Herbarium, accessed 26/04/2023.

Queensland Herbarium 2021a, *Introduction to the Census of the Queensland flora 2021*. Queensland Herbarium, Department of Environment and Science.

Radle, AL 2007, *Effects of noise on wildlife: a literature review*, available from: http://wfae.proscenia.net/library/articles

Reis, T 2012, 'Squatter Pigeon (southern subspecies) Geophaps scripta scripta (Temminck, 1821)', in LK Curtis, AJ Dennis, KR McDonald, PM Kyne & SJS Debus (eds), *Queensland's threatened animals*, CSIRO Publishing, Collingwood, pp. 254-255.

Rich, C & Longcore, (eds.) T 2006, *Ecological consequences of artificial night lighting*, Island Press, Washington.

Sibelco 2018b, *Plan of Operations EPML00969013 July 2018 to June 2023*, Sibelco Australia Limited.

Smyth, AK & Pavey, CR 2001, 'Foraging by the endangered black-breasted button-quail (*Turnix melanogaster*) within fragmented rainforest of an agricultural landscape', *Biological Conservation*, vol. 98, pp. 149-157.

Snow, N. and Guymer, G 1999. *Austrobaileya* 5 (3): 421-426.

Specht & Specht 2000, *Australian Plant Communities*, Oxford University Press, USA.

Squatter Pigeon Workshop 2011, *Proceedings from the workshop for the Squatter Pigeon (southern)*, 14-15 December 2011, Queensland Parks and Wildlife Service, Toowoomba.

Threatened Species Scientific Committee 2015a. *Conservation Advice Erythrotriorchis radiatus red goshawk*. Canberra: Department of the Environment, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/942-conservation-advice-31102015.pdf. In effect under the EPBC Act from 27-Oct-2015. Ceased to be in effect under the EPBC Act from 30-Mar-2023.

Threatened Species Scientific Committee 2015b. *Conservation Advice Geophaps scripta scripta squatter pigeon (southern)*. Canberra: Department of the Environment, available from: http://www.environment.gov.au/biodiversity/threatened/species/pubs/64440-conservation-advice-31102015.pdf. In effect under the EPBC Act from 27-Oct-2015.

Threlfall, CG, Law, B, & Banks, PB 2013, 'The urban matrix and artificial light restricts the nightly ranging behaviour of Gould's long-eared bat (Nyctophilus gouldi).' *Austral Ecology*, vol. 38, pp. 921–930.

Todd, EV, Blair, D, Farley, S, Farrington, L, Fitzsimmons, NN, Georges, A, Limpus, CJ & Jerry, DR 2013, Contemporary genetic structure reflects historical drainage isolation in an Australian snapping turtle, Elseya albagula, *Zoological Journal of the Linnean Society*, vol. 169, pp. 200-214.

Wang, J 1998. *Parsonsia kroombitensis Species Management Profile*. Department of Natural Resources, Brisbane.

Wang, J 1999. Cassinia collina Species Management Profile. Department of Natural Resources, Brisbane.

Ward, MS, Reside, AE & Garnett, ST 2021, 'Southern squatter pigeon *Geophaps scripta scripta*', in ST Garnett & GB Baker (eds), *The action plan for Australian birds 2020*, CSIRO Publishing, Melbourne, pp. 44-47.

Williams, J.B. in Orchard, A.E. (Ed) (1996). *Flora of Australia* 28: 189, 319.

Woinarski, JCZ, Burbidge, AA & Harrison, PL 2014, *The action plan for Australian mammals 2012*, CSIRO Publishing, Collingwood.

Zich F.A., Hyland B.P.M., Whiffin T., Kerrigan R.A. 2020 Rhodamnia spongiosa *Australian Tropical Rainforest Plants*, Edition 8. https://apps.lucidcentral.org/rainforest/. Viewed 14 April 2025.

11 ACRONYMS

Acronym	Description
ALA	Atlas of Living Australia
AS	Australian Standards
ASL	Above sea level
BBSB	Brigalow Belt South Bioregion
Biosecurity Act	*Biosecurity Act 2014*
BoM	Bureau of Meteorology
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAF	Department of Agriculture and Fisheries
DAWE	Department of Agriculture, Water, and the Environment
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEHP	Department of Environment and Heritage Protection
DNRMMRRD	Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development
DESI	Department of Environment, Science and Innovation (formerly DES)
DETSI	Department of Environment, Tourism, Science and Innovation (formerly DESI)
DoR	Department of Resources
EA	Environmental Authority
EDL	Ecologically dominant layer
EMP	Environmental Management Plan
EOML	End of mine life
EOO	Extent of occurrence
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EP Regulation	*Environmental Protection Regulation 2019*
ERAs	Environmentally Relevant Activities
ESAs	Environmentally Sensitive Areas
ESCP	Erosion and Sediment Control Plan
Fisheries Act	*Fisheries Act 1994*
GAWB	Gladstone Area Water Board
GBO	General biosecurity obligation
GBR	Great Barrier Reef
ha	hectares
HES	High ecological significance
km	kilometres
KRA	Key resource area
L	Litres
LGA	Local Government Area
LOM	Life of mine
ML	Mining Leases
m	metre
mAHD	Metres Australian Height Datum
mBGL	Metres below ground level
mm	millimetre
MNES	Matter of national environmental significance
MSES	Matter of state environmental significance
Mtpa	Million tonnes per annum
NC Act	*Nature Conservation Act 1992*
NSW	New South Wales
Offsets Act	*Environmental Offsets Act 2014*
Offsets Regulation	*Environmental Offsets Regulation 2014*
PEM	Prescribed environmental matter
PMLU	Post mining land use
PRC Plan	Progressive Rehabilitation and Closure Plan
QFES	Queensland Fire and Emergency Services
RE	Regional ecosystem

Acronym	Description
ROM	Run of mine
t	tonne
VM Act	*Vegetation Management Act 1999*
WildNet	Wildlife Online
°C	Degrees Celsius
%	Percent

APPENDIX A DESKTOP SEARCH RESULTS

Queensland Government

Department of the Environment, Tourism, Science and Innovation

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest

Longitude: 151.2392 Latitude: -24.1043 with 2 kilometre radius

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 2020). 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

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



Table of Contents

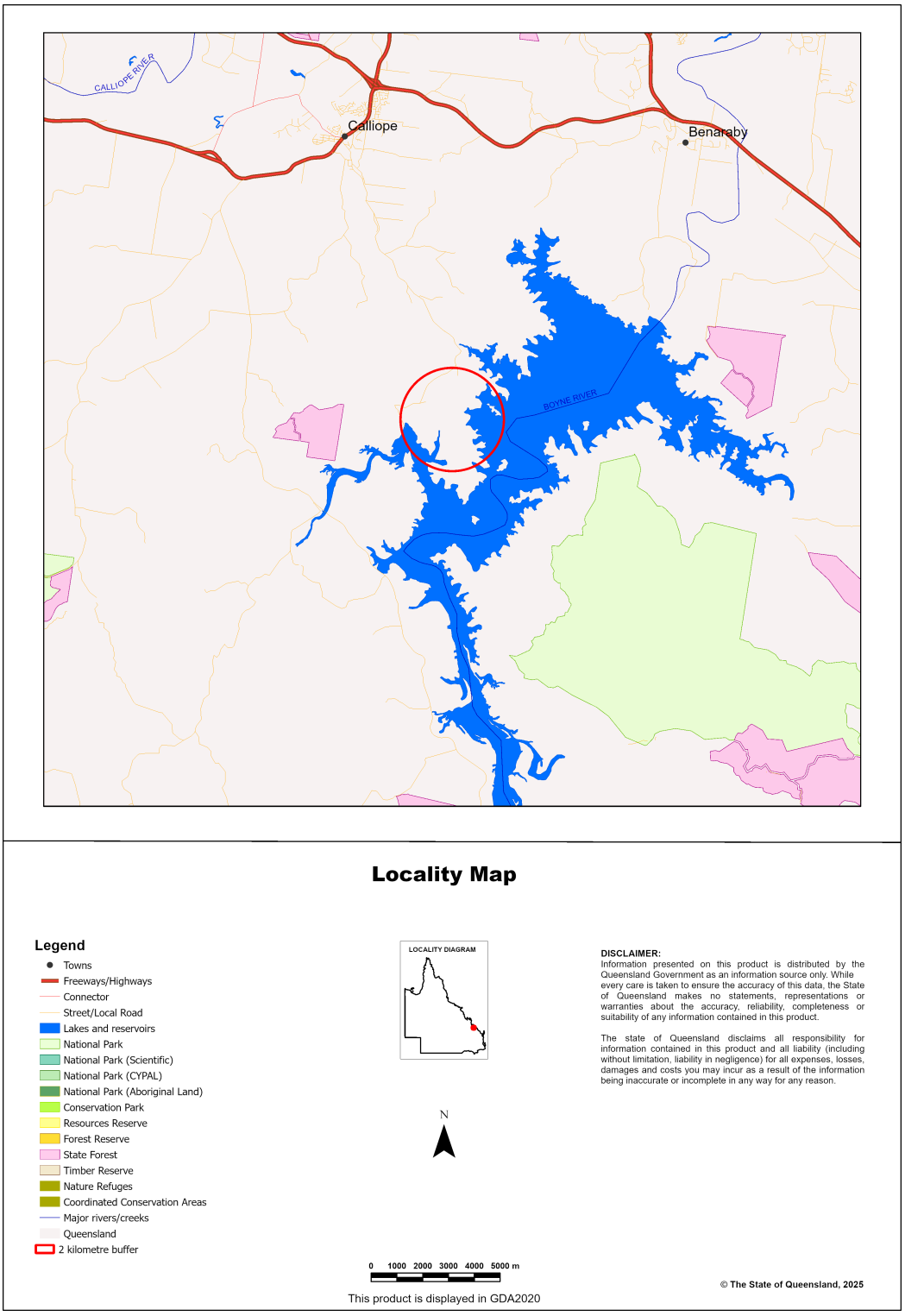
Assessment Area Details 4
Matters of State Environmental Significance (MSES) 5
MSES Categories 5
MSES Values Present 6
Additional Information with Respect to MSES Values Present 6
MSES - State Conservation Areas 6
MSES - Wetlands and Waterways 7
MSES - Species 7
MSES - Regulated Vegetation 10
MSES - Offsets 11
Maps 12
Map 1 - MSES - State Conservation Areas 12
Map 2 - MSES - Wetlands and Waterways 13
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals 14
Map 3b - MSES - Species - Koala habitat area (SEQ) 15
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas) 16
Map 4 - MSES - Regulated Vegetation 17
Map 5 - MSES - Offset Areas 18
Appendices 19
Appendix 1 - Matters of State Environmental Significance (MSES) methodology 19
Appendix 2 - Source Data 20
Appendix 3 - Acronyms and Abbreviations 21

Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI: Longitude: 151.2392 Latitude: -24.1043 with 2 kilometre radius, with area 1256.64 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Gladstone Regional	Boyne	Brigalow Belt	Mount Morgan Ranges



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)	2.07 ha	0.2%
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	1.79 ha	0.1%
8c Regulated Vegetation - Category R (GBR riverine regrowth)	28.33 ha	2.3%
8d Regulated Vegetation - Essential habitat	0 ha	0.0%
8e Regulated Vegetation - intersecting a watercourse	26.5 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	E	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
11.3.4/11.3.25	O-dom	rem_oc

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Regional ecosystem	Vegetation management polygon	Vegetation management status
11.3.4/11.3.25	O-dom	hvr_oc

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Regulated vegetation map category	Map number
R	9149

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

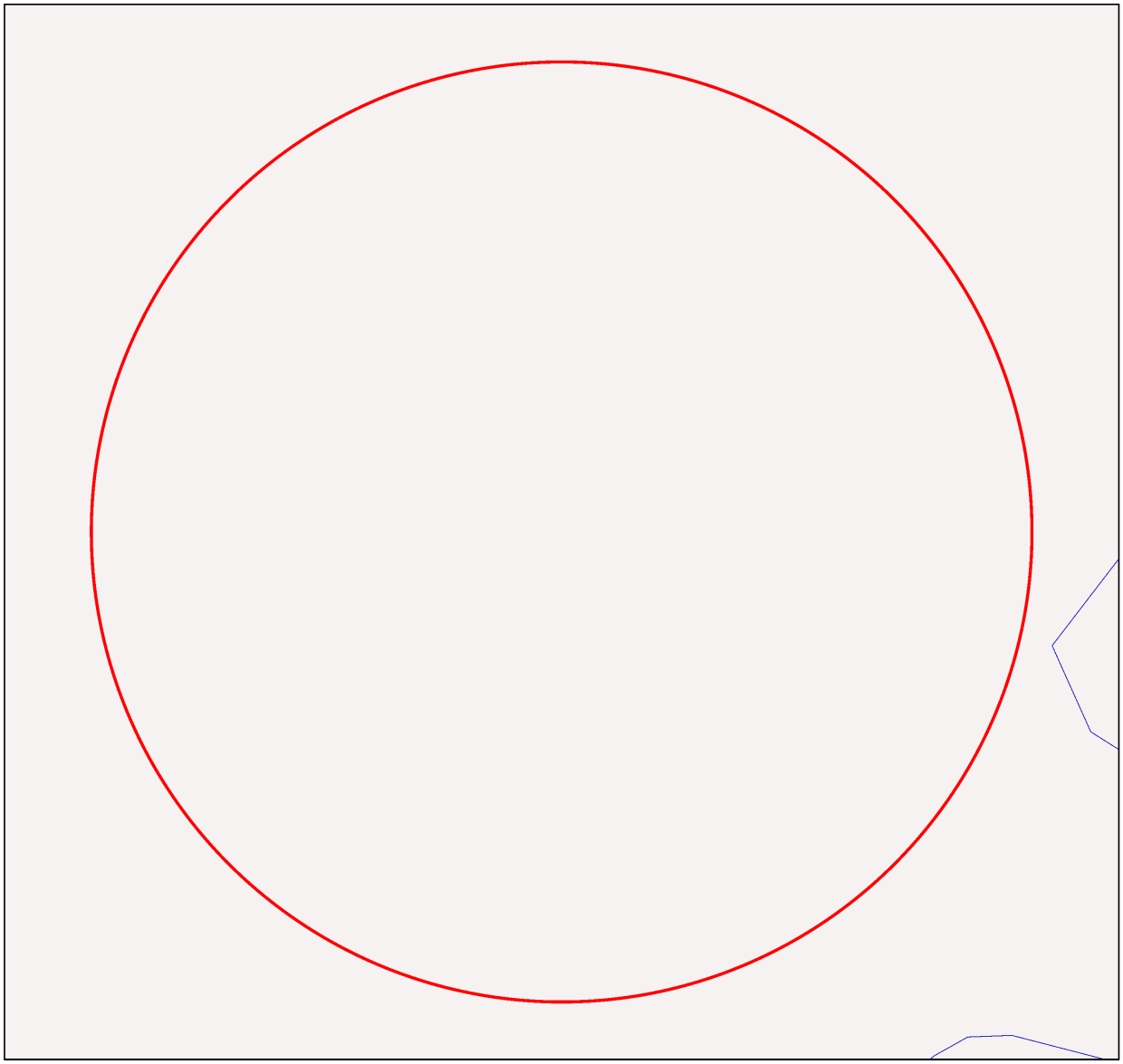
(No results)

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

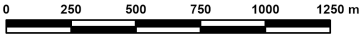
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Protected area (estates, nature refuges, special wildlife reserves)
- Declared fish habitat area (A and B areas)
- Marine park (highly protected)
- 2 kilometre buffer



Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

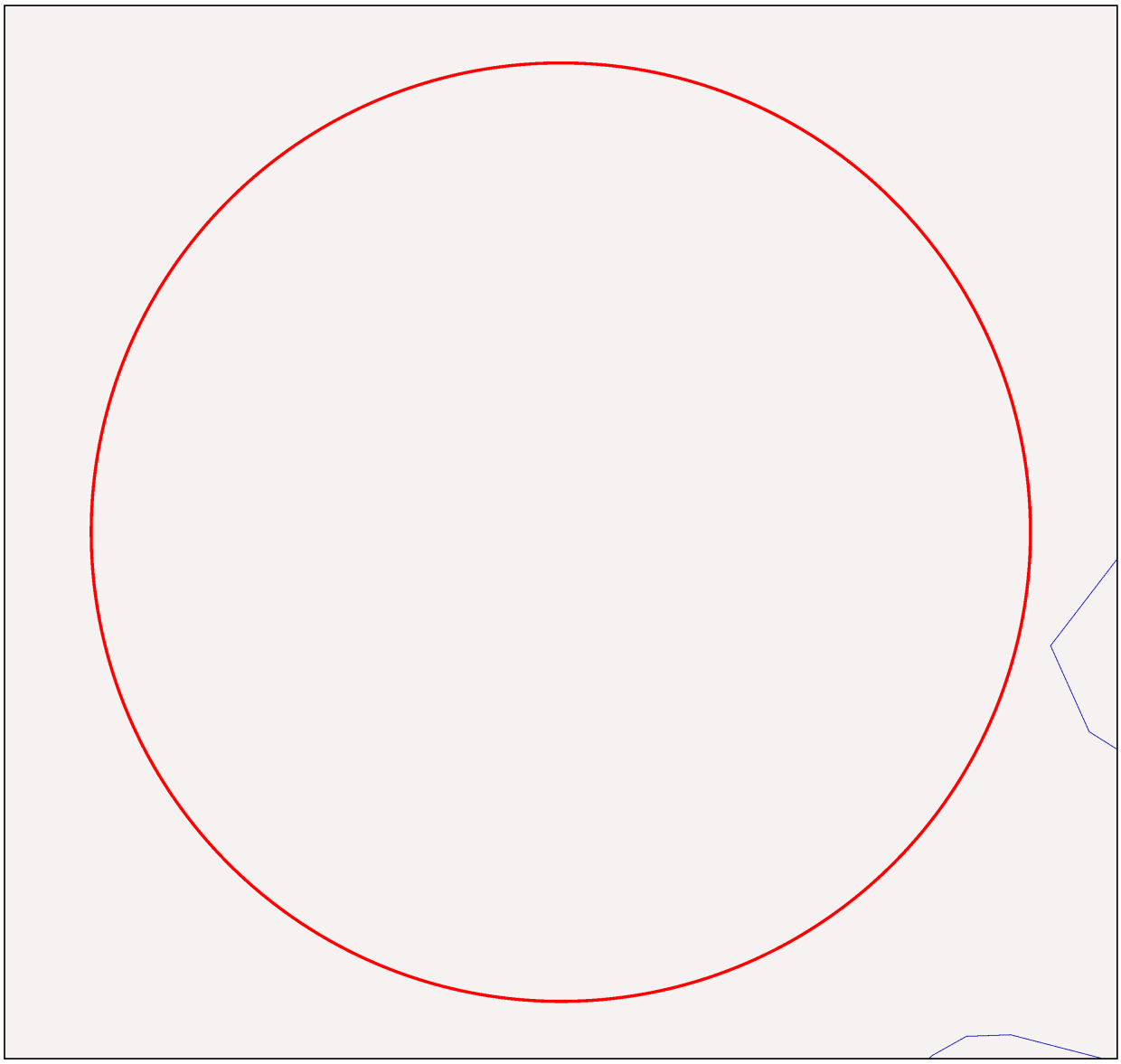




This product is displayed in GDA2020

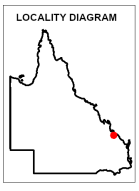
© The State of Queensland, 2025

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
- 2 kilometre buffer



Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the state of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

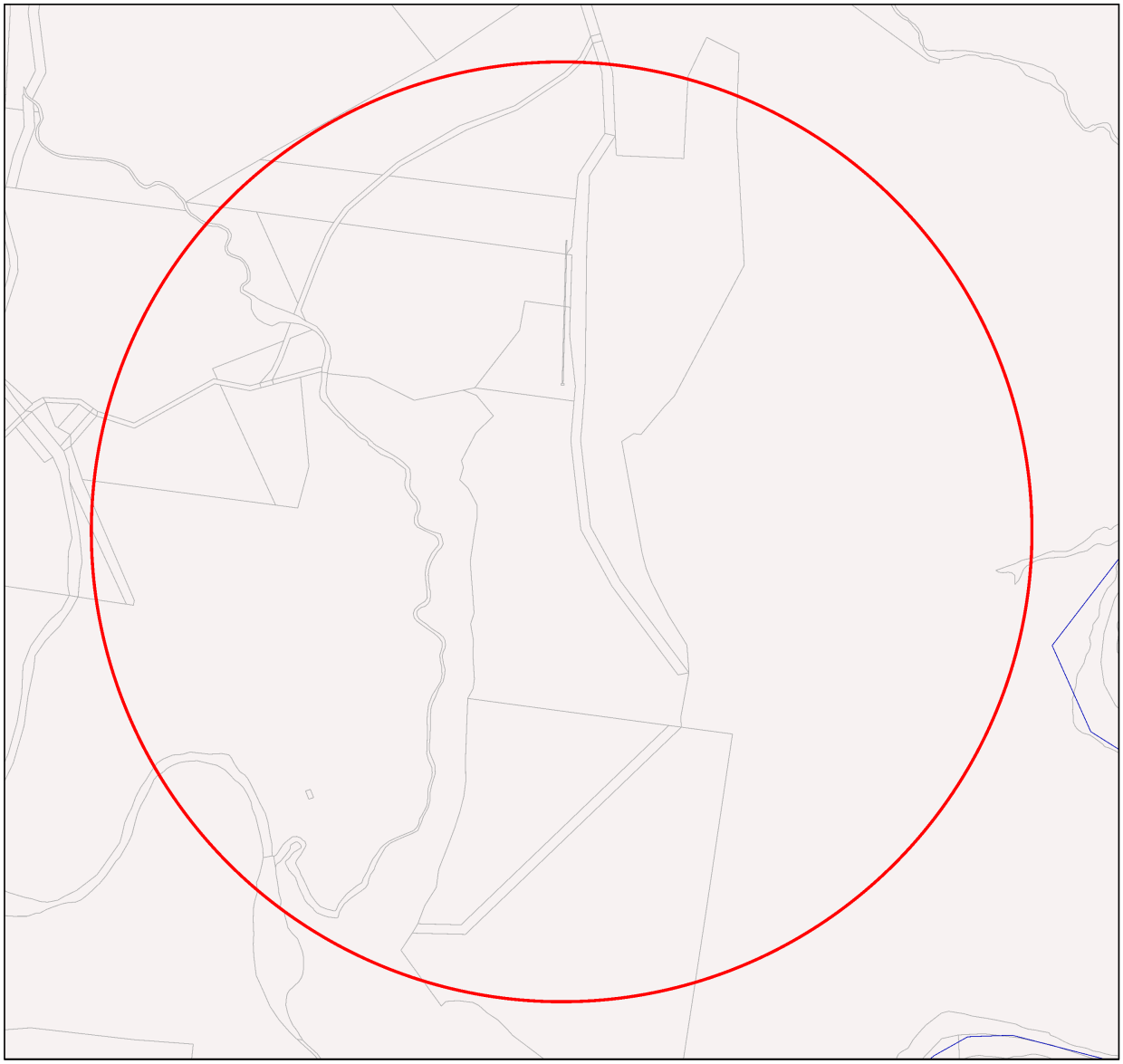
N

0 250 500 750 1000 1250 m

This product is displayed in GDA2020

© The State of Queensland, 2025

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)
- 2 kilometre buffer



N

0 250 500 750 1000 1250 m

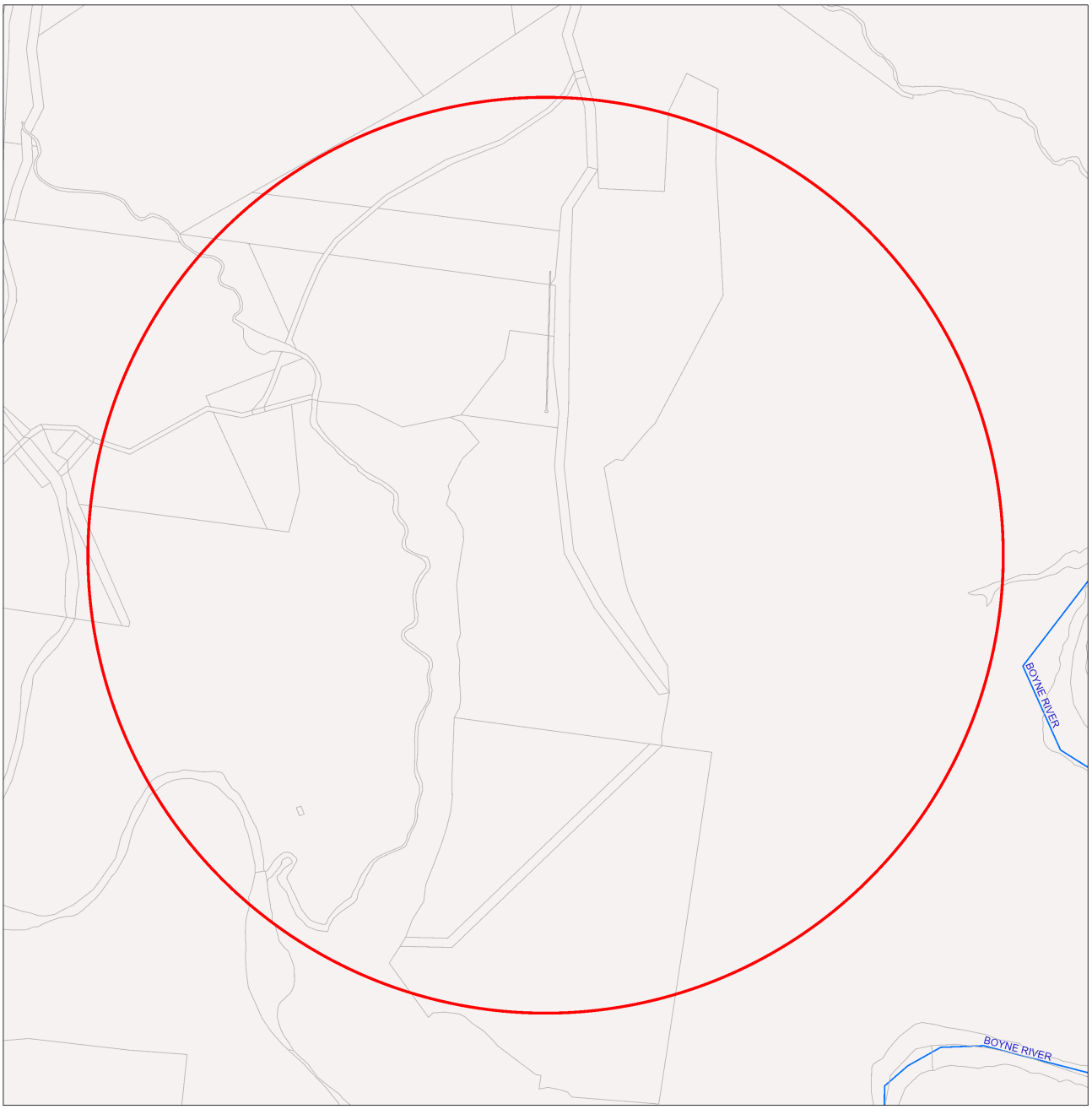
This product is displayed in GDA2020

Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the state of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

© The State of Queensland, 2025

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)
- 2 kilometre buffer

LOCALITY DIAGRAM



While every care is taken to ensure the accuracy of this product, the Department of the Environment, Tourism, Science and Innovation acting on behalf of the State of Queensland makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the data being inaccurate or incomplete in any way and for any reason. Due to varying sources of data, spatial locations may not coincide when overlaid.

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

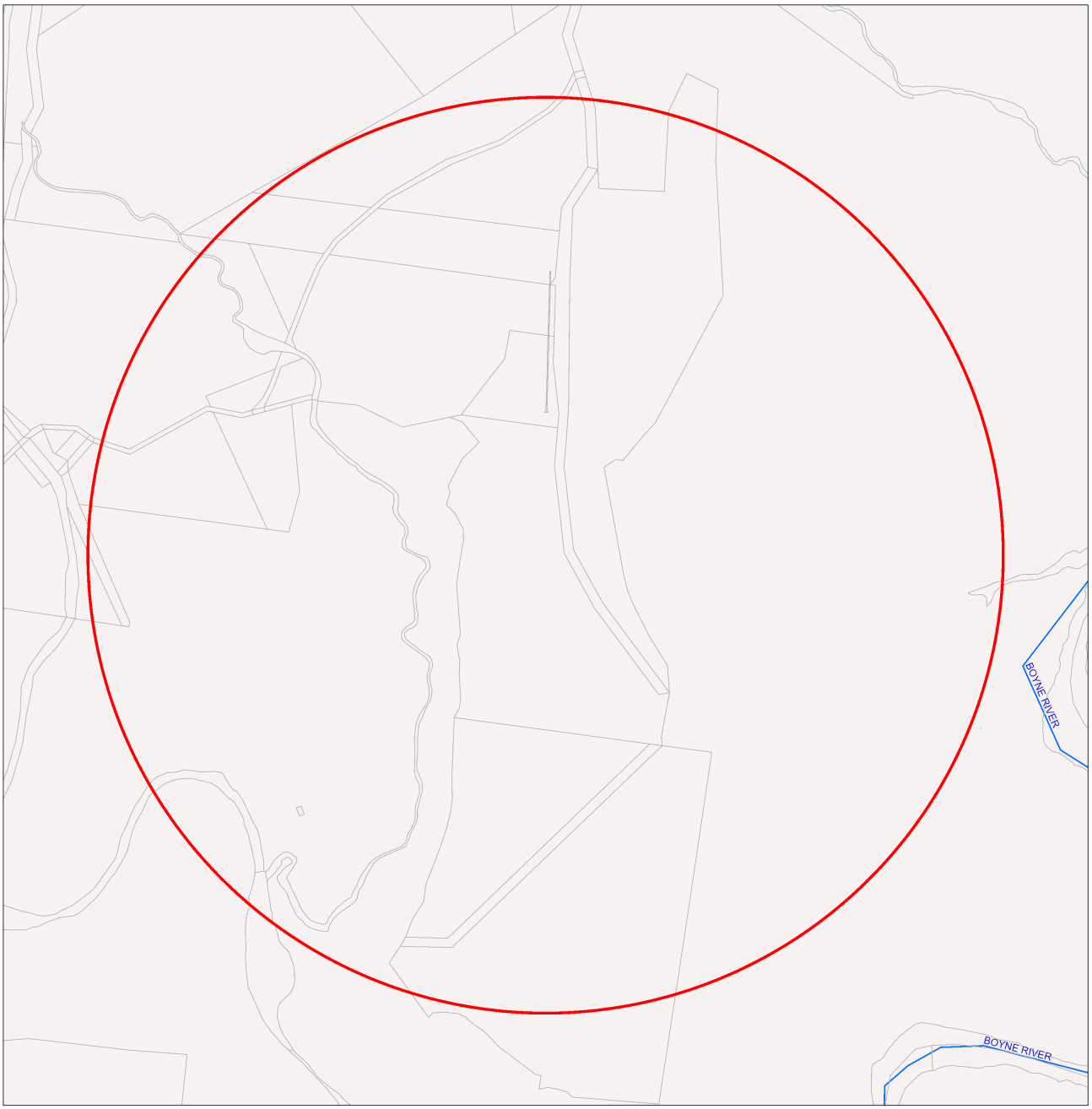
The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

© The State of Queensland, 2025

0 240 480 720 960 1,200 m

This product is displayed in GDA2020

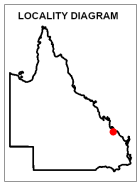
Map 3c - MSES - Species - Wildlife habitat (sea turtle nesting areas)



MSES - Wildlife habitat (sea turtle nesting areas)

- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (sea turtle nesting areas)
- 2 kilometre buffer

LOCALITY DIAGRAM



While every care is taken to ensure the accuracy of this product, the Department of the Environment, Tourism, Science and Innovation acting on behalf of the State of Queensland makes no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which you might incur as a result of the data being inaccurate or incomplete in any way and for any reason. Due to varying sources of data, spatial locations may not coincide when overlaid.

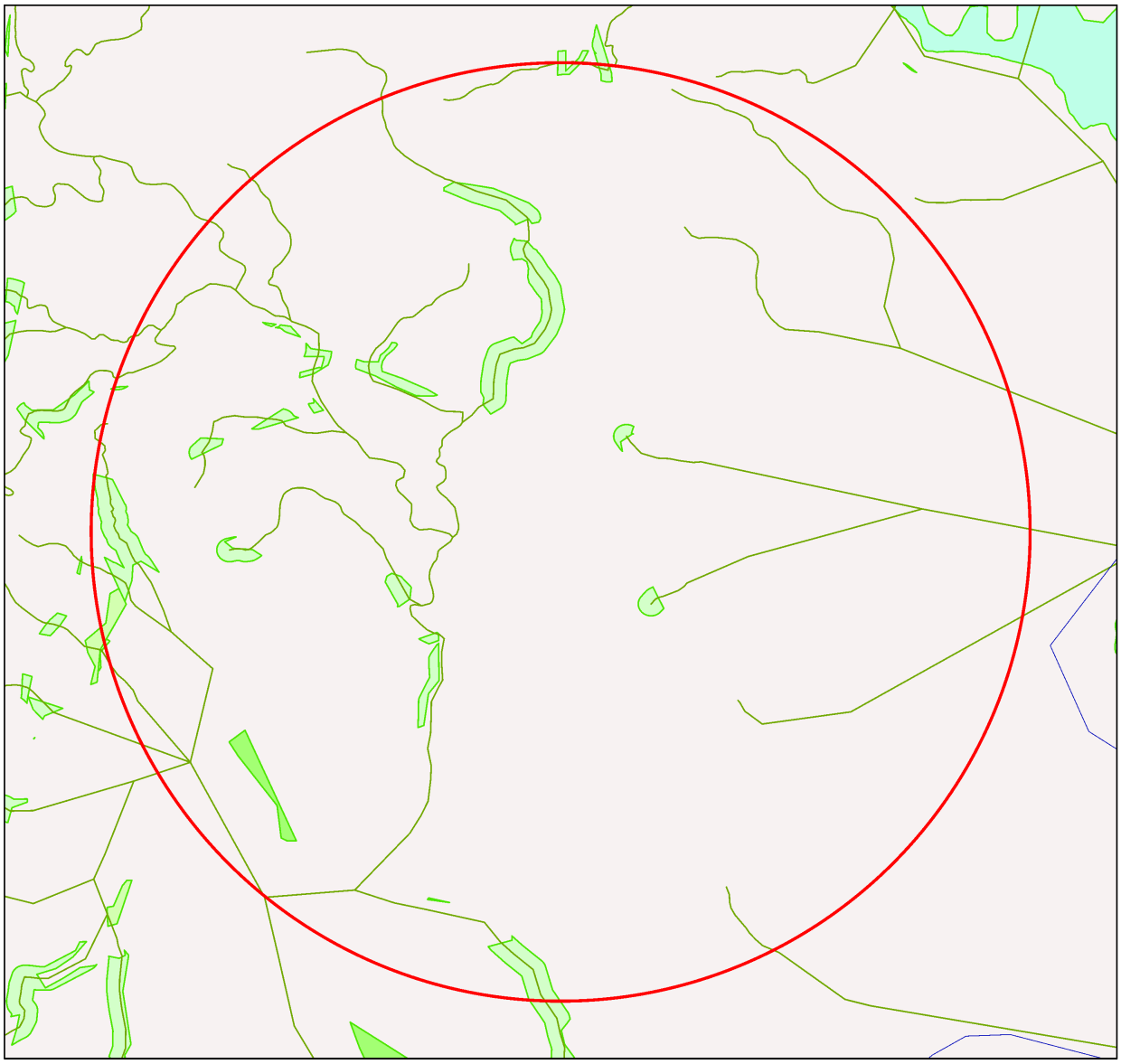
MSES mapping of sea turtle nesting areas identifies beaches where the recorded number of turtle nests are over 1% of the turtle species or genetic stock. The linework is also deliberately extended along nearby rocky coastlines and headlands to recognise that significant numbers of nesting adults and hatchlings can become disoriented by light pollution from development on rocky coastlines and headlands while navigating offshore from nesting beaches.

0 240 480 720 960 1,200 m

© The State of Queensland, 2025

This product is displayed in GDA2020

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)
- 2 kilometre buffer



N

Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the state of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

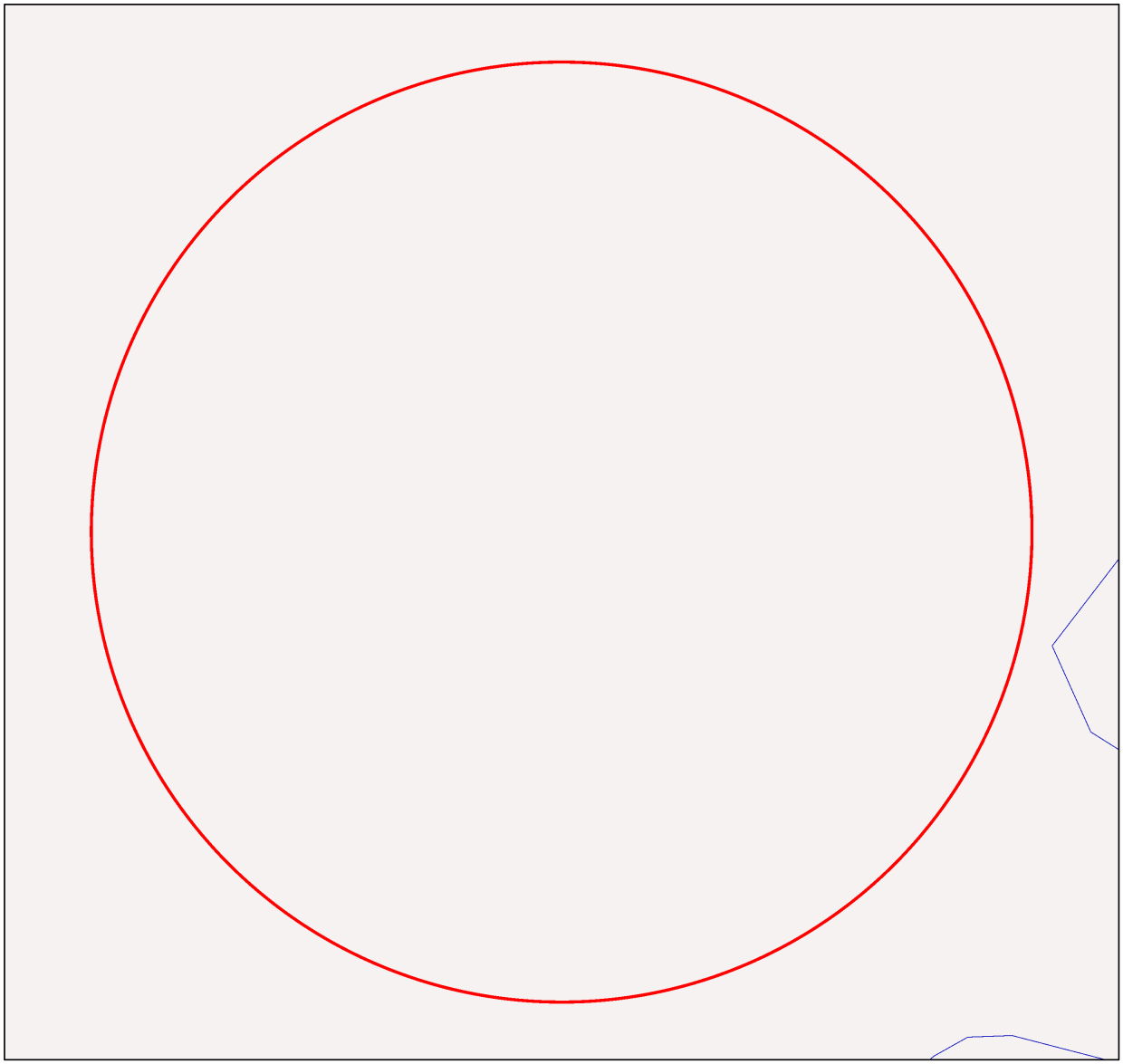
The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

0 250 500 750 1000 1250 m

This product is displayed in GDA2020

© The State of Queensland, 2025

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)
- 2 kilometre buffer



N

Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

0 250 500 750 1000 1250 m

This product is displayed in GDA2020

© The State of Queensland, 2025

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 DETSI
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DETSI	- Department of the Environment, Tourism, Science and Innovation
EP Act	- Environmental Protection Act 1994
EPP	- Environmental Protection Policy
GDA2020	- Geocentric Datum of Australia 2020
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 the Environment, Tourism, Science and Innovation

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Longitude: 151.2392 Latitude: -24.1043 with 2 kilometre buffer

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 input coordinates.

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 2020). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium & Biodiversity Science's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium & Biodiversity Science's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



Table of Contents

Summary Information 4
Regional Ecosystems 5
1. Introduction 5
2. Remnant Regional Ecosystems 6
3. Remnant Regional Ecosystems by Broad Vegetation Group 7
4. Technical and BioCondition Benchmark Descriptions 8
Maps 10
Map 1 - Location 10
Map 2 - Remnant 2021 regional ecosystems 11
Map 3 - Pre-clearing regional ecosystems 12
Map 4 - Remnant 2021 regional ecosystems by BVG (5M) 13
Map 5 - Pre-clearing regional ecosystems by BVG (5M) 14
Map 6 - Wetlands and waterways 15
Links and Other Information Sources 16
References 16
Appendices 17
Appendix 1 - Source Data 17
Appendix 2 - Acronyms and Abbreviations 18

Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Details for area of interest:
Longitude: 151.2392 Latitude: -24.1043 with 2 kilometre buffer, with area 1256.64 ha

Local Government(s)	Catchment(s)	Bioregion(s)	Subregion(s)
Gladstone Regional	Boyne	Brigalow Belt	Mount Morgan Ranges

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.00	0.00
Of concern	2.07	0.16
No concern at present	393.81	31.34
Total remnant vegetation	395.87	31.50

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and may be distinguished by differences in structure or sub-dominant species in the ecologically dominant layer. Vegetation communities with different dominant species in the ecologically dominant layer may be amalgamated in to a regional ecosystem if they are not mappable and predictable in the landscape at 1:100 000 scale. Vegetation communities may be mappable at a scale larger than 1:100 000. Vegetation communities within a regional ecosystem are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2023) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium & Biodiversity Science's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Natural Resources and Mines, Manufacturing, and Regional and Rural Development website https://www.nrmmrrd.qld.gov.au/.

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 percent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 percent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (<1000 ha); or patch size (<100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
11.11.15	Eucalyptus crebra woodland to open woodland on deformed and metamorphosed sediments and interbedded volcanics	No concern at present	393.81	31.34
11.3.25	Eucalyptus tereticornis or E. camaldulensis woodland fringing drainage lines	Of concern	0.31	0.02
11.3.4	Eucalyptus tereticornis and/or Eucalyptus spp. woodland on alluvial plains	Of concern	1.76	0.14
non-remnant	None	None	645.45	51.36
water	None	None	214.49	17.07

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
11.11.15	Pre-clearing 892000 ha; Remnant 2021 519000 ha	13c	Not a Wetland	Low
11.3.25	Pre-clearing 813000 ha; Remnant 2021 531000 ha	16a	Riverine	Low
11.3.4	Pre-clearing 684000 ha; Remnant 2021 178000 ha	16c	Not a Wetland	Low

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
non-remnant	None	None	None	None
water	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
11.11.15	11.11.15: Potential habitat for NCA listed species: Capparis humistrata, Corymbia clandestina, Corymbia xanthope, Cycas megacarpa, Cycas ophiolitica.
11.3.25	11.3.25: Shown to be associated with a high fauna species richness in the Taroom area (Venz et al. 2002). Within parts of the Fitzroy catchment, this RE is known habitat for the threatened freshwater turtle Rheodytes leukops. Known to be important habitat for other riparian freshwater turtle species. This ecosystem is also known to provide suitable habitat for koalas (Phascolarctos cinereus).
11.3.4	11.3.4: Potential habitat for NCA listed species: Acacia pedleyi, Callicarpa thozetii, Cycas megacarpa, Cycas ophiolitica, Digitaria porrecta, Eriocaulon carsonii subsp. orientale, Livistona nitida, Rhaponticum australe, Samadera bidwillii, Sannantha brachypoda. This ecosystem is also known to provide suitable habitat for koalas (Phascolarctos cinereus).
non-remnant	None
water	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at: https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	859.94	68.43

BVG (1 Million)	Description	Area (Ha)	% of AOI
13c	Woodlands of Eucalyptus crebra (sens. lat.) (narrow-leaved red ironbark), E. drepanophylla (grey ironbark), E. fibrosa (dusky-leaved ironbark), E. shirleyi (shirley's silver-leaved ironbark) on granitic and metamorphic ranges.	393.81	31.34
16a	Open forest and woodlands dominated by Eucalyptus camaldulensis (river red gum) (or E. tereticornis (blue gum)) and/or E. coolabah (coolabah) (or E. microtheca (coolabah)) fringing drainage lines. Associated species may include Melaleuca spp., Corymbia tessellaris (carbeen), Angophora spp., Casuarina cunninghamiana (riveroak). Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	0.31	0.02
16c	Woodlands and open woodlands dominated by Eucalyptus coolabah (coolabah) or E. microtheca (coolabah) or E. largiflorens (black box) or E. tereticornis (blue gum) or E. chlorophylla on floodplains. Does not include alluvial areas dominated by herb and grasslands or alluvial plains that are not flooded.	1.76	0.14

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium & Biodiversity Science's QBEIS database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2023 (PDF)* section 3.3 of: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community. http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

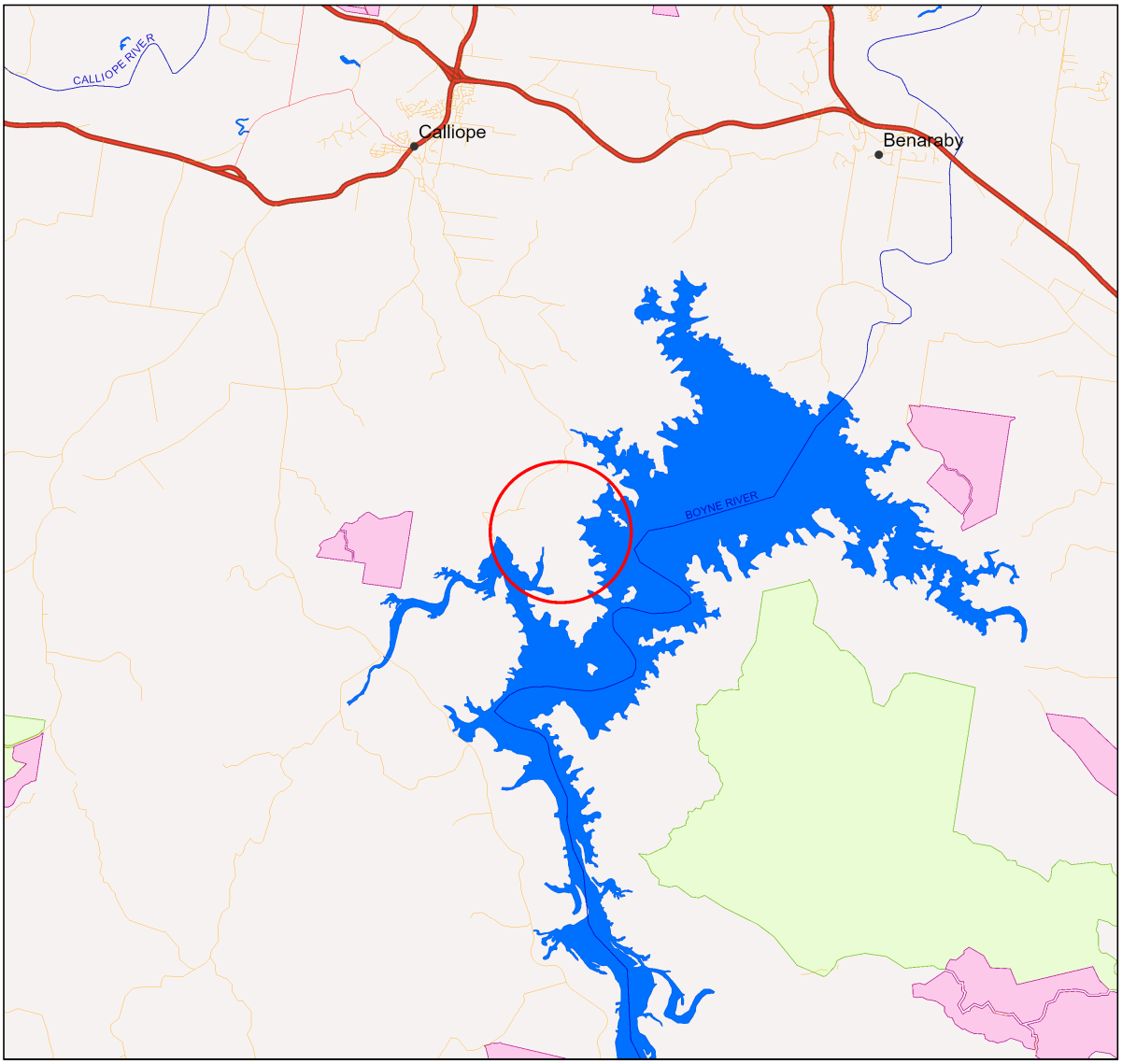
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
11.11.15	Available	Available
11.3.25	Available	Available
11.3.4	Available	Available
non-remnant	Not currently available	Not currently available
water	Not currently available	Not currently available

Maps

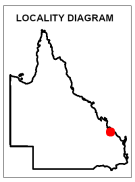
Map 1 - Location



Locality Map

Legend

- Towns
- Freeways/Highways
- Connector
- Street/Local Road
- Lakes and reservoirs
- National Park
- National Park (Scientific)
- National Park (CYPAL)
- National Park (Aboriginal Land)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Coordinated Conservation Areas
- Major rivers/creeks
- Queensland
- 2 kilometre buffer



N

0 1000 2000 3000 4000 5000 m

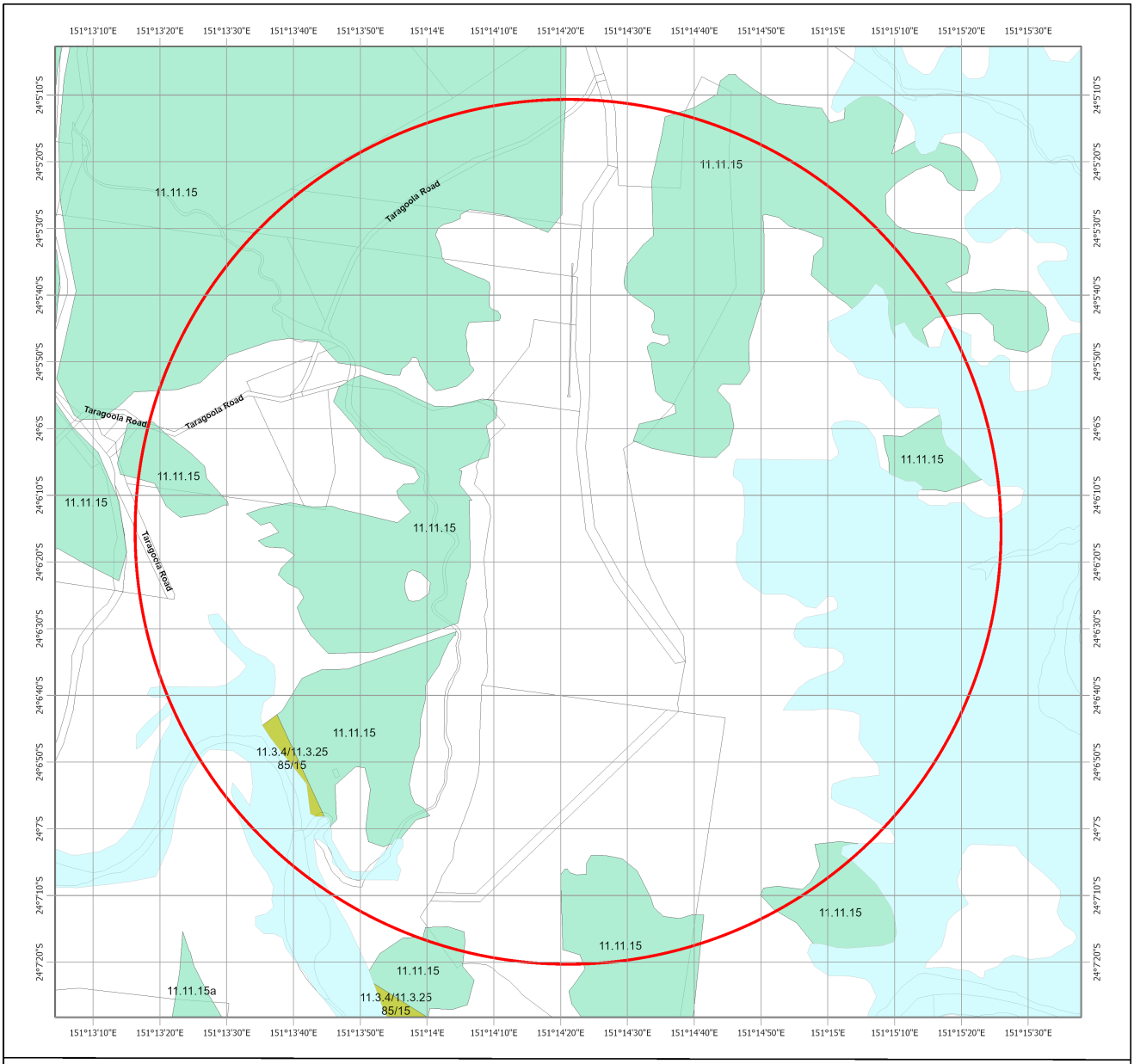
This product is displayed in GDA2020

DISCLAIMER:
Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

© The State of Queensland, 2025

Map 2 - Remnant 2021 regional ecosystems

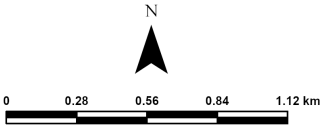


Remnant 2021 Regional Ecosystems

Biodiversity Status

- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries
- 2 kilometre buffer



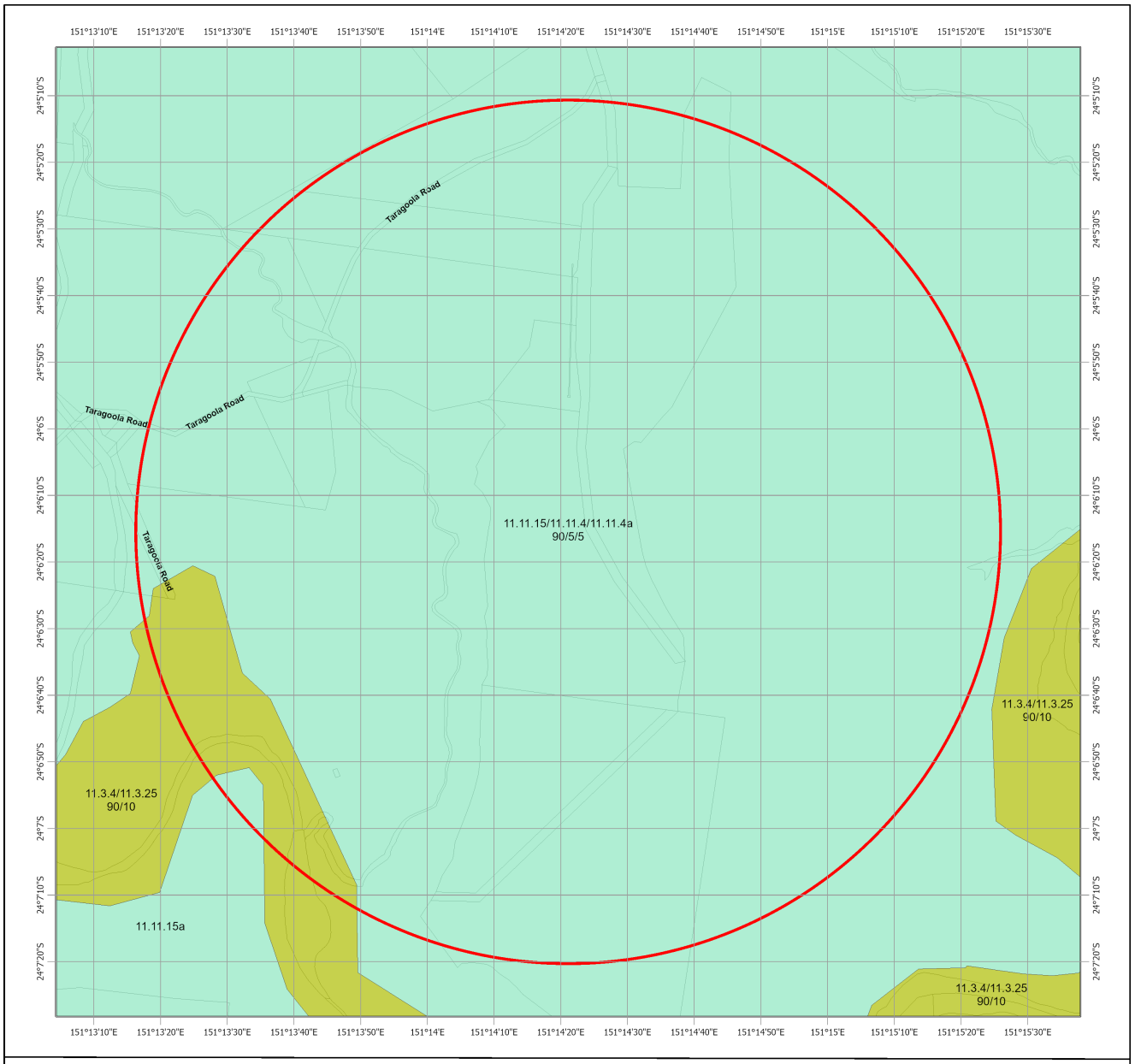


This product is projected into GDA2020

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

© The State of Queensland, 2025

Map 3 - Pre-clearing regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries
- 2 kilometre buffer



N

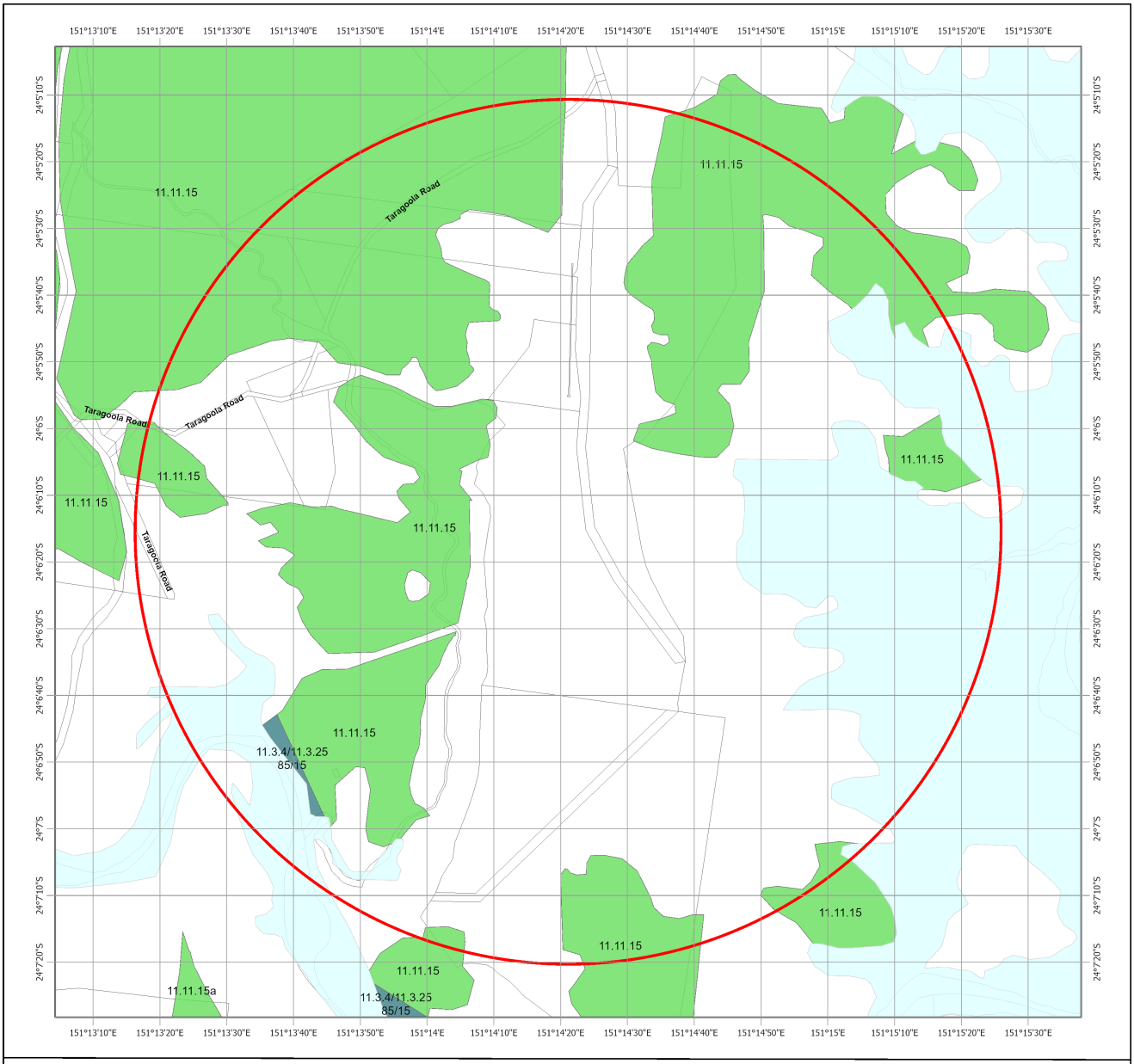
0 0.28 0.57 0.85 1.14 km

This product is displayed in GDA2020

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

© The State of Queensland, 2025

Map 4 - Remnant 2021 regional ecosystems by BVG (5M)



Remnant 2021 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries
- 2 kilometre buffer



N

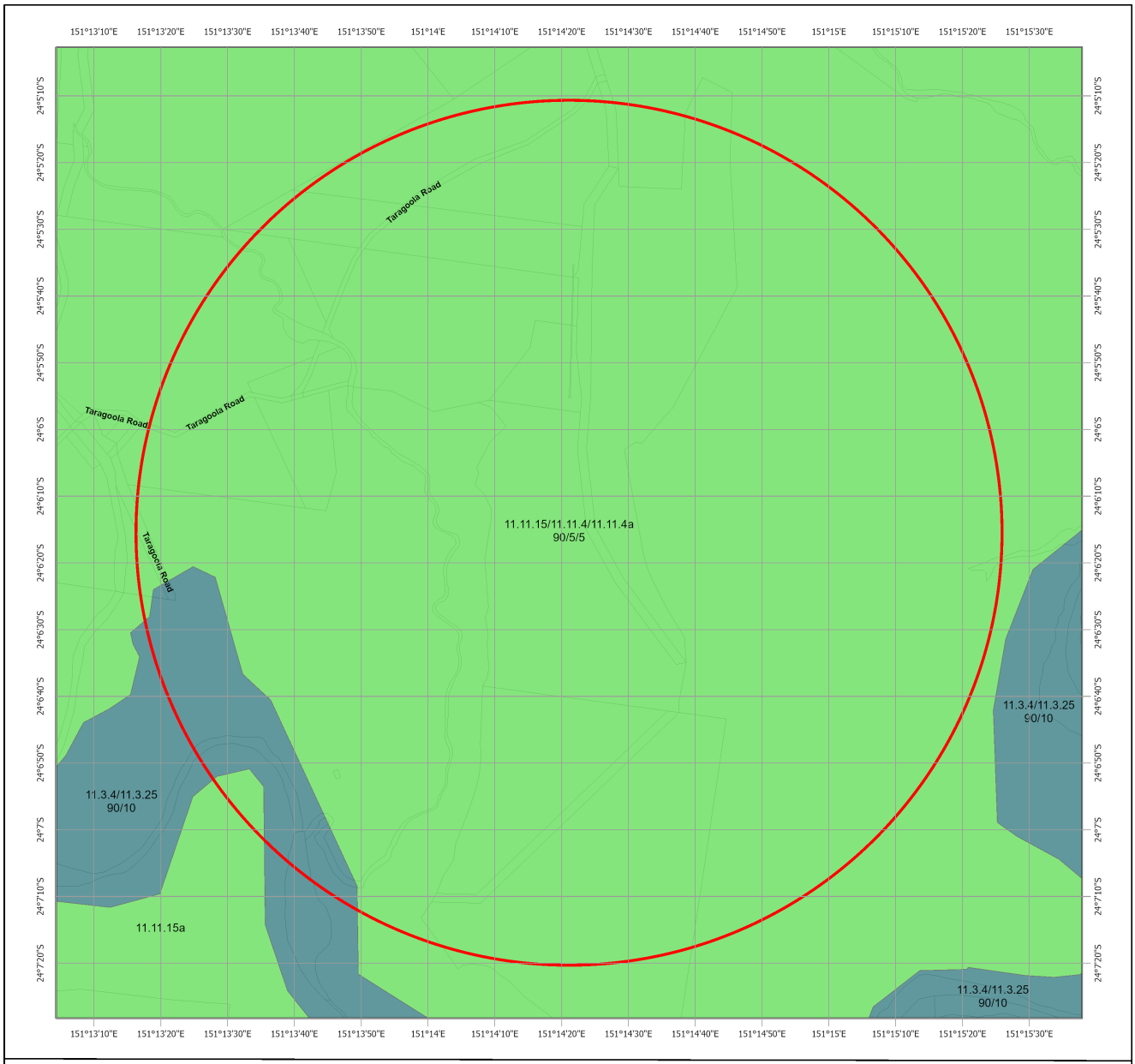
0 0.28 0.56 0.84 1.12 km

This product is displayed in GDA2020

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled. Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

© The State of Queensland, 2025

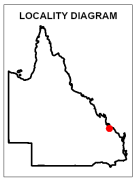
Map 5 - Pre-clearing regional ecosystems by BVG (5M)

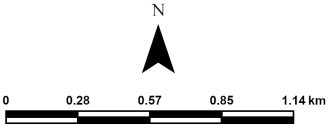


Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries
- 2 kilometre buffer



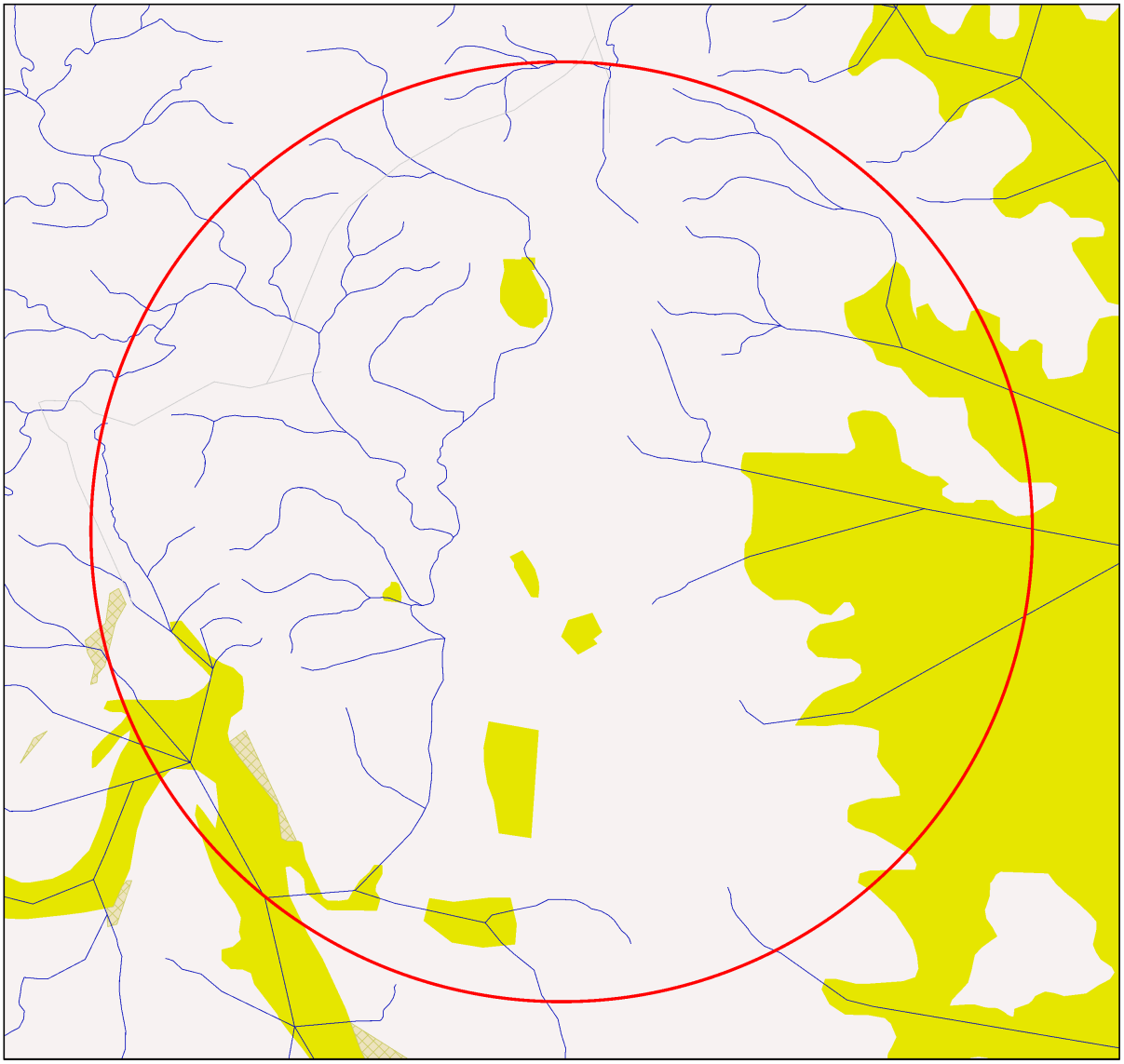


This product is displayed in GDA2020

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

© The State of Queensland, 2025

Map 6 - Wetlands and waterways



Wetlands and Waterways

- Towns
- Roads
- Springs
- Rivers/Creeks
- Directory of Important Wetlands
- Ramsar Sites - QLD

Wetland Type

Hydrologically natural Wetlands
- Lacustrine Wetlands (hydrologically natural)
- Palustrine Wetlands (hydrologically natural)
- Riverine Wetlands (hydrologically natural)
- Intertidal Wetlands (hydrologically natural)
- Subtidal Wetlands (hydrologically natural)
- Intertidal/Subtidal Wetlands (hydrologically natural)

Hydrologically Modified and Artificial Wetlands
- Lacustrine Wetlands (hydrologically modified or artificial)
- Palustrine Wetlands (hydrologically modified or artificial)
- Riverine Wetlands (hydrologically modified or artificial)
- Intertidal Wetlands (hydrologically modified or artificial)
- Subtidal Wetlands (hydrologically modified or artificial)
- Intertidal/Subtidal Wetlands (hydrologically modified or artificial)

Subdominant Wetlands
- Subdominant Wetlands (51 - 80%)

Contains Wetlands
- Contains Wetlands (1 - 50%)
- Queensland
- 2 kilometre buffer

LOCALITY DIAGRAM



N

0 250 500 750 1000 1250 m

This product is displayed in GDA2020

DISCLAIMER:
Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.

The state of Queensland disclaims all responsibility for information contained in this product and all liability (including without limitation, liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.

© The State of Queensland, 2025

Links and Other Information Sources

The Department of the Environment, Tourism, Science and Innovation's Website - http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/ provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from: https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/broad-vegetation

The methodology for mapping regional ecosystems can be downloaded from: https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf

Technical descriptions for regional ecosystems can be obtained from: http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from: http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Spatial Catalogue, Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link: https://qldglobe.information.qld.gov.au/

References

Neldner, V.J., Niehus, R.E., Wilson, B.A., McDonald, W.J.F., Ford, A.J. and Accad, A. (2023). The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 6.0. Queensland Herbarium, Department of Environment and Science. (https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086)

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S., Butler, D.W., McDonald, W.J.F, Richter,D., Addicott, E.P. and Appelman, C.N. (2023) Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland. Version 7.0. Updated December 2023. Queensland Herbarium, Queensland Department of Environment, Science and Innovation, Brisbane. (https://www.qld.gov.au/__data/assets/pdf_file/0033/459186/methodology-mapping-surveying-v7.pdf).

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems.* Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:
http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:
Queensland Spatial Catalogue : Queensland Government (information.qld.gov.au)

- Biodiversity status of pre-clearing and 2021 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas
- Pre-clearing broad vegetation groups of Queensland
- Remnant 2021 broad vegetation groups of Queensland

Appendix 2 - Acronyms and Abbreviations

AOI - Area of Interest
GIS - Geographic Information System
RE - Regional Ecosystem
REDD - Regional Ecosystem Description Database
VMA - *Vegetation Management Act 1999*

Queensland Government

WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Queensland status: Rare and threatened species
Records: All
Date: All
Latitude: -24.1043
Longitude: 151.2392
Distance: 25
Email: dcox@epicenvironmental.com.au
Date submitted: Friday 11 Apr 2025 14:22:06
Date extracted: Friday 11 Apr 2025 14:30:04

The number of records retrieved = 45

Disclaimer
Information presented on this product is distributed by the Queensland Government as an information source only. While every care is taken to ensure the accuracy of this data, the State of Queensland makes no statements, representations or warranties about the accuracy, reliability, completeness or suitability of any information contained in this product.
The State of Queensland disclaims all responsibility for information contained in this product and all liability (including liability in negligence) for all expenses, losses, damages and costs you may incur as a result of the information being inaccurate or incomplete in any way for any reason.
Information about your Species lists request is logged for quality assurance, user support and product enhancement purposes only.
The information provided should be appropriately acknowledged as being derived from WildNet database when it is used. As the WildNet Program is still in a process of collating and vetting data, it is possible the information given is not complete. Go to the WildNet database webpage (https://www.qld.gov.au/environment/plants-animals/species-information/wildnet) to find out more about WildNet and where to access other WildNet information products approved for publication. Feedback about WildNet species lists should be emailed to wildlife.online@des.qld.gov.au.

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Accipitridae	*Erythrotriorchis radiatus*	red goshawk		E	E	1
animals	birds	Apodidae	*Hirundapus caudacutus*	white-throated needletail		V	V	10
animals	birds	Burhinidae	*Esacus magnirostris*	beach stone-curlew		V		19
animals	birds	Cacatuidae	*Calyptorhynchus lathami*	glossy black-cockatoo		V		1
animals	birds	Cacatuidae	*Calyptorhynchus lathami erebus*	glossy black-cockatoo (northern)		V		3
animals	birds	Charadriidae	*Charadrius leschenaultii*	greater sand plover		V	V	2
animals	birds	Charadriidae	*Charadrius mongolus*	lesser sand plover		E	E	23
animals	birds	Charadriidae	*Pluvialis squatarola*	grey plover		V	V	1
animals	birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)		V	V	35
animals	birds	Scolopacidae	*Arenaria interpres*	ruddy turnstone		V	V	5
animals	birds	Scolopacidae	*Calidris acuminata*	sharp-tailed sandpiper		V	V	11
animals	birds	Scolopacidae	*Calidris ferruginea*	curlew sandpiper		CR	CE	5
animals	birds	Scolopacidae	*Calidris tenuirostris*	great knot		V	V	1
animals	birds	Scolopacidae	*Gallinago hardwickii*	Latham's snipe		V	V	1
animals	birds	Scolopacidae	*Limosa lapponica baueri*	Western Alaskan bar-tailed godwit		E	E	36
animals	birds	Scolopacidae	*Numenius madagascariensis*	eastern curlew		CR	CE	110
animals	birds	Scolopacidae	*Tringa nebularia*	common greenshank		E	E	9
animals	birds	Scolopacidae	*Xenus cinereus*	terek sandpiper		V	V	13
animals	birds	Strigidae	*Ninox strenua*	powerful owl		V		10
animals	birds	Turnicidae	*Turnix melanogaster*	black-breasted button-quail		V	V	15
animals	insects	Lycaenidae	*Jalmenus eubulus*	pale imperial hairstreak		V		1
animals	mammals	Delphinidae	*Sousa sahulensis*	Australian humpback dolphin		V	V	2
animals	mammals	Petauridae	*Petaurus australis australis*	yellow-bellied glider (southern subspecies)		V	V	5
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		E	E	16
animals	mammals	Pseudocheiridae	*Petauroides volans volans*	southern greater glider		E	E	6
animals	reptiles	Chelidae	*Elseya albagula*	white-throated snapping turtle		CR	CE	1
animals	reptiles	Cheloniidae	*Natator depressus*	flatback turtle		V	V	1
plants	land plants	Acanthaceae	*Graptophyllum excelsum*			NT		3/1
plants	land plants	Apocynaceae	*Parsonsia kroombitensis*			V		1/1
plants	land plants	Asteraceae	*Cassinia collina*			V		2/2
plants	land plants	Celastraceae	*Apatophyllum olsenii*			E	V	4/4
plants	land plants	Combretaceae	*Dansiea elliptica*			NT		6/4
plants	land plants	Combretaceae	*Macropteranthes leiocaulis*			NT		3/3
plants	land plants	Cycadaceae	*Cycas megacarpa*			E	E	4/3
plants	land plants	Hernandiaceae	*Hernandia bivalvis*	cudgerie		NT		2/1
plants	land plants	Leguminosae	*Acacia eremophiloides*			V	V	1
plants	land plants	Leguminosae	*Acacia sp. (Castletower N.Gibson TOI345)*			V		1/1
plants	land plants	Myrtaceae	*Eucalyptus decolor*			NT		6/5
plants	land plants	Myrtaceae	*Rhodamnia angustifolia*	narrow-leaved malletwood		CR	CE	16/16
plants	land plants	Myrtaceae	*Rhodamnia dumicola*	rib-fruited malletwood		E		2
plants	land plants	Myrtaceae	*Rhodamnia glabrescens*			CR		5/4
plants	land plants	Myrtaceae	*Rhodamnia spongiosa*			CR		2/1
plants	land plants	Myrtaceae	*Xanthostemon oppositifolius*	southern penda		V	V	1/1
plants	land plants	Proteaceae	*Grevillea venusta*	grevillea		V		7/2
plants	land plants	Rubiaceae	*Scleromitrion gibsonii*			CR		11/11

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 B SURVEY DATA

Flora Species List

Common name	Species name	Non-native	Biosecurity	WoNS
Green Wattle	*Acacia deanei*			
Pretty Wattle	*Acacia decora*			
Catkin Wattle	*Acacia julifera*			
Chaff Flower	*Achyranthes aspera*			
Blue Billygoat Weed	*Ageratum houstonianum*	*		
Chain Fruit	*Alyxia ruscifolia*			
Dark Wiregrass	*Aristida calycina*			
White Speargrass	*Aristida leptopoda*			
Queensland Wiregrass	*Aristida queenslandica*			
Reedgrass	*Arundinella nepalensis*			
Slender Bamboo Grass	*Austrostipa verticillata*			
Cobbler's Pegs	*Bidens pilosa*	*		
Forest Bluegrass	*Bothriochloa bladhii*			
Pitted Bluegrass	*Bothriochloa decipiens*			
Desert Bluegrass	*Bothriochloa ewartiana*			
Coffee Bush	*Breynia oblongata*			
Wild Orange	*Capparis canescens*			
Currant Bush	*Carrisa ovata*			
Canadian Fleabane	*Conyza bonariensis*	*		
Red Bloodwood	*Corymbia erythrophloia*			
Moreton Bay Ash	*Corymbia tessellaris*			
Woolly Rattlepod	*Crotalaria incana*	*		
Rubber vine	*Cryptostegia grandiflora*	*	3	*
Tuckeroo	*Cupaniopsis anacardioides*			
Tiger Orchid	*Cymbidium canaliculatum*			
Barbed-wire Grass	*Cymbopogon refractus*			
Slender Sedge	*Cyperus gracilis*			
Queensland Bluegrass	*Dichanthium sericeum*			
Cotton Panic	*Digitaria brownii*			
Nine-awn Grass	*Enneapogon lindleyanus*			
Brown's Lovegrass	*Eragrostis brownii*			
African Lovegrass	*Eragrostis curvula*	*		
Mountain Wanderrie Grass	*Eriachne mucronata*			
Narrow-leaved Ironbark	*Eucalyptus crebra*			
Gum-topped Box	*Eucalyptus moluccana*			
Queensland Bluegum	*Eucalyptus tereticornis*			
Dwarf Poinsettia	*Euphorbia cyathophora*	*		
Asthma Plant	*Euphorbia hirta*			
Creek Sandpaper Fig	*Ficus coronata*			
Moreton Bay Fig	*Ficus macrophylla*			
Maynes pest	*Glandularia aristigera*	*		
Glycine Pea	*Glycine tabacina*			
Woolly Glycine	*Glycine tomentella*			
Balloon Cottonbush	*Gomphocarpus physocarpus*	*		
Dogs Balls	*Grewia retusifolia*			
Dysentery Plant	*Grewia latifolia*			
Black Speargrass	*Heteropogon contortus*			
Australian Indigo	*Indigofera australis*			
Native Indigo	*Indigofera linifolia*			
Common Rush	*Juncus usitatus*			
Lantana	*Lantana camara*	*	3	*
Creeping Lantana	*Lantana montevidensis*	*	3	
Argentine Peppercress	*Lepidium bonariense*	*		
Siratro	*Macroptilium atropurpureum*	*		
White Cedar	*Melia azedarach*			
Red Natal Grass	*Melinis repens*	*		
Common name	**Species name**	**Non-native**	**Biosecurity**	**WoNS**

Murdannia	*Murdannia graminea*			
Prickly Pear	*Opuntia stricta*	*	3	*
Native Millet	*Panicum decompositum*			
Hairy Panic	*Panicum effusum*			
Paspalidium	*Paspalidium sp*			
Water Couch	*Paspalum distichum*			
Corky Passion Flower	*Passiflora suberosa*	*		
Fuzzweed	*Peripleura hispidula*			
Princes Feathers	*Persicaria orientalis*			
Lippia	*Phyla canescens*	*		
Spurge	*Phyllanthus maderaspatensis*			
Cockatoo Apple	*Planchonia careya*			
Applebush	*Pterocaulon sphacelatum*			
Rhynchosia	*Rhynchosia minima*			
Castor Oil Bush	*Ricinus communis*	*		
Senna	*Senna sophora*			
Flannel Weed	*Sida cordifolia*	*		
Spiked Sida	*Sida subspicata*			
High Sida	*Sida trichopoda*			
Fairy Grass	*Sporobolus caroli*			
American Ratstail Grass	*Sporobolus jacquemontii*	*	3	*
Snake Weed	*Stachytarpheta cayennensis*	*		
Shrubby Stylo	*Stylosanthes scabra*	*		
Kangaroo Grass	*Themeda triandra*			
Small Burr Grass	*Tragus australianus*			
Urena Weed	*Urena lobata*	*		
Mimosa Bush	*Vachellia farnesiana*	*	3	
Verbena	*Verbena littoralis*	*		
Noogoora Burr	*Xanthium occidentale*	*		

Tertiary RE Assessments

siteID	RE7	RE8
RE	11.11.15 Cat R	11.11.15
GTRE	11.11.15	11.11.15
Geology	Dark brown reddish clay loam sediment	Grey-brown clay loam
Landform	Gully	Undulating hills
Status	B	B
TEC	No	No
EDL	T1	T1
EDL height range	11-15.5	16.5-17.5
EDL_med_height m	14	17
EDL_cover %	32	20
struc_clas	Open-forest	Woodland
T1_hei	14	17
T1_cover	32	20
T1_sp	*Eucalyptus crebra, Corymbia tessellaris, Corymbia erythrophloia,*	*Eucalyptus crebra, Corymbia tessellaris,*
T2_hei	7.5	8
T2_cover	3	5
T2_sp	*Corymbia erythrophloia, Eucalyptus crebra*	*Eucalyptus crebra*
S1_hei	1.1	1.8
S1_cover	10	20
S1_sp	*Crotalaria incana, Sida subspicata, Grewia latifolia,*	*Sida subspicata, Capparis canescens, Eucalyptus tereticornis, Glycine tabacina, Acacia deanei,*
S2_hei		0.3
S2_cover		2
S2_sp		Glycine tomentella, Grewia latifolia,
G_hei	1.5	1.5
G_cover	80	80
G_sp1	*Austrostipa verticillata, Peripleura hispidula, Glycine tomentella, Heteropogon contortus,*	*Peripleura hispidula, Sida trichopoda, Panicum effusum, Heteropogon contortus, Themeda triandra, Panicum decompositum, Glycine tomentella, Eriachne mucronata*
G_sp2	*Indigofera linifolia, Bothriochloa decipiens, Phyllanthus maderaspatensis, Sida trichopoda , Aristida calycina,*	*Euphorbia hirta*
W_cover	29	45
W_sp	*Euphorbia cyathophora, Passiflora suberosa, Cryptostegia grandiflorum, Macroptilium atropurpureum, Lantana camara, Ageratum houstonianum, Conyza bonariensis, Stylosanthes scabra, Bidens pilosa,*	*Sida cordifolia, Stylosanthes scabra, Sporobolus jacquemontii, Lantana montevidensis,*
Disturbanc		Adjacent road
x	151.2418585	151.2345759
y	-24.10077866	-24.12159939

siteID	RE10	RE3
RE	X	11.11.15
GTRE	11.11.15	11.11.15
Geology	Light brown gravelly clay loam	Ligh brown sediment
Landform	Hillside	Undulating hills
Status	B	C
TEC	No	No
EDL	T1	T1
EDL height range	15-18	Dec-19
EDL_med_height m	16	17
EDL_cover %	24	11
struc_clas	Woodland	Woodland
T1_hei	16	17
T1_cover	24	11
T1_sp	*Eucalyptus crebra, Corymbia tessellaris, Eucalyptus tereticornis*	*Eucalyptus crebra, Eucalyptus tereticornis*
T2_hei	7.5	7
T2_cover	5	5
T2_sp	*Eucalyptus crebra, Eucalyptus tereticornis, Corymbia tessellaris*	*Eucalyptus crebra, Corymbia erythrophloia*
S1_hei		1.2
S1_cover		2
S1_sp		*Acacia julifera, Sida subspicata*
S2_hei		
S2_cover		
S2_sp		
G_hei	0.2	1.1
G_cover	80	95
G_sp1	*Bothriochloa decipiens, Indigofera linnaei, Heteropogon contortus, Sida trichopoda, Euphoria hirta, Glycine tomentella, Peripleura hispidula,*	*Heteropogon contortus, Peripleura hispidula, Austrostipa verticillata, Glycine tomentella, Themeda triandra, Eragrostis sp., Rhynchosia minima*
G_sp2	*Phyllanthus maderaspatensis,*	*Heteropogon contortus, Bothriochloa decipiens, Panicum effusum, Cymbopogon refractus, Aristida queenslandica*
W_cover	30	5
W_sp	*Lantana montevidensis, Stachytarpheta cayennensis*	*Stylosanthes scabra, Conyza bonariensis, Bidens pilosa, Sida cordifolia*
Disturbanc	Regularly slashed	Historical land clearing
x	151.2399746	151.2389132
y	-24.09409076	-24.11959077

siteID	RE5	RE2
RE	11.11.15	11.11.15
GTRE	11.11.15	11.3.25
Geology	Ligh brown sediment	Ligh brown sediment
Landform	Undulating hills	Drainage line
Status	C	B
TEC	No	No
EDL	T1	T1
EDL height range	13.5-18	18-23
EDL_med_height m	17.5	21
EDL_cover %	12	24
struc_clas	Woodland	Woodland
T1_hei	17.5	21
T1_cover	12	24
T1_sp	*Eucalyptus crebra, Eucalyptus tereticornis, Corymbia tessellaris*	*Eucalyptus tereticornis*
T2_hei	6	5
T2_cover	4	1
T2_sp	*Eucalyptus crebra, Eucalyptus tereticornis*	*Eucalyptus tereticornis*
S1_hei	2.4	1.8
S1_cover	20	1
S1_sp	*Sida subspicata,*	*Cupaniopsis anacardioides , Carrisa ovata,*
S2_hei		0.5
S2_cover		1
S2_sp		Breynia oblongata , Crotalaria incana
G_hei	0.7	1.5
G_cover	90	80
G_sp1	*Heteropogon contortus, Peripleura hispidula, Austrostipa verticillata, Glycine tomentella, Themeda triandra, Eragrostis sp., Rhynchosia minima*	*Austrostipa verticillata, Peripleura hispidula, Bothriochloa decipiens, Sida trichopoda*
G_sp2	*Austrostipa verticillata, Crotalaria incana*	*Juncus usitatus, Eragrostis sp, Heteropogon contortus, Sida subspicata, Crotalaria incana*
W_cover	5	10
W_sp	*Gomphocarpus physocarpus, Stylosanthes scabra*	*Stylosanthes scabra, Lantana camara, Conyza bonariensis, Passiflora suberosa, Macroptilium atropurpureum, Bidens pilosa, Stachytarpheta cayennensis,*
Disturbanc	Historical land clearing	Pigs
x	151.2397935	151.238321
y	-24.11675423	-24.12170596

siteID	RE9	RE6
RE	11.11.15 Cat R	11.11.15 Cat R
GTRE	11.3.25	X
Geology	Light brown clay loam	Modified
Landform	Drainage line	Hill crest
Status	B	X
TEC	Yes	No
EDL	T1	G
EDL height range	18-28	0-0.5
EDL_med_height m	20	0.3
EDL_cover %	40	20
struc_clas	Open-forest	Grassland
T1_hei	20	
T1_cover	40	
T1_sp	*Eucalyptus tereticornis, Corymbia tessellaris, Eucalyptus crebra*	
T2_hei	9	
T2_cover	10	
T2_sp	*Eucalyptus tereticornis, Corymbia tessellaris*	
S1_hei	1.2	0.6
S1_cover	1	2
S1_sp	*Breynia oblongata*	*Indigofera australis*
S2_hei		
S2_cover		
S2_sp		
G_hei	0.5	0.3
G_cover	60	20
G_sp1	*Peripleura hispidula, Sida trichopoda, Heteropogon contortus, Verbena littoralis, Bothriochloa decipiens, Arundinella nepalensis, Paspalidium sp.,*	*Bothriochloa decipiens, Heteropogon contortus, Indigofera linifolia, Aristida calycina,*
G_sp2	*Cyperus gracilis*	*Panicum effusum*
W_cover	10	25
W_sp	*Stachytarpheta cayennensis, Macroptilium atropurpureum, Xanthium occidentale, Ricinus communis, Lepidium bonariense*	*Stachytarpheta cayennensis, Stylosanthes scabra , Ageratum houstonianum,*
Disturbanc	Washout	Handstand, modified landform
x	151.2426603	151.2367055
y	-24.10716855	-24.0916857

Quaternary RE Assessments

siteID	Q1	Q2	Q3	Q4	Q5	Q6
RE	12.11.15	X	X	X	X	X
condition	Remnant	non-remnant	non-remnant	non-remnant	non-remnant	non-remnant
EDL	T1	G	S1	G	G	G
EDL_cover	25	100	20	1	1	85
EDL_med_he	17	0.4	2	0.2	0.1	1.5
struc_clas	Woodland	Grassland	Low shrubland	Grassland		Grassland
Landform	Undulating hills	Undulating hills	Waste rock dump	Stockpile	Road	Hill slope
TEC	No	No	No	No	No	No
T1	*Eucalyptus crebra*					
S1			*Melia azedarach*	*Melia azedarach*		
G3		*Austrostipa verticillata*		*Paspalum distichum*	*Paspalum distichum*	*Heteropogon contortus , Austrostipa verticillata*
Weed			*Cryptostegia grandiflora*			
x	151.2391222	151.2391116	151.2359585	151.2324764	151.2324122	151.2349816
y	-24.1196263	-24.1162737	-24.0961502	-24.0972694	-24.0983061	-24.1206321

BioCondition Data

Site	Open woodland	Grassland
# Eucs > 30cm	13	-
Large tree benchmark	34	N/A
# large trees	10	-
Large Euc diameter	39, 38, 37, 31, 31, 45, 30, 36, 39, 41, 35, 41, 36	
Canopy species	Eucalyptus crebra, Corymbia erythrophloia	-
Tree sp rich #	2	N/A
Canopy height range (m)	14-15.5	-
Canopy height (m)	14.5	-
Recruitment%	100	-
Canopy cover%	31	-
Sub-canopy height (m)	7	-
Sub-canopy cover (%)	5	-
Shrub cover%	7.3	-
Shrub species	*Acacia decora, Acacia excelsa, Grewia latifolia, Acacia disparrima, Capparis canescens, Planchonia careya, Alyxia ruscifolia, Melia azedarach*	-
Shrub sp rich	8	-
Grass species	*Aristida queensladicum, Bothriochloa decipiens, Heteropogon contortus, Aristida calycina, Panicum decompositum, Themeda triandra, Eragrostis brownii, Enneapogon mucronata*	*Austrostipa verticillata, Heteropogon contortus, Bothriochloa decipiens, Aristida calycina, Panicum effusum*
Grass speceies rich	8	5
Forbs_other	*Sida subspicata, Cyperus gracilis, Rhynchosia minima, Cyanthillium cinereum, Glycine tomentella, Phyllanthus virgatus, Indigofera pratensis, Euphorbia drummondii, Alternanthera nana*	*Indigofera australis, Indigofera linifolia*
Forbs_other species rich	9	2
Total species rich	27	7
CWD	50	N/A
Weed cover %	5	1

Weeds	*Melinis repens, Opuntia stricta, Ageratum houstonianum, Stachytarpheta cayennensis, Lantana montevidensis, Lantana camara*	
Q1 perrenial grass %	2	
Q1 litter %	20	
Q2 perrenial grass %	75	
Q2 litter %	20	
Q3 perrenial grass %	20	
Q3 litter %	40	
Q4 perrenial grass %	15	
Q4 litter %	5	
Q5 perrenial grass %	90	
Q5 litter %	10	
Mean perrenial grass %	40.4	75
Mean litter %	19	10

Fauna Habitat Assessments

SiteID	Hab01	Hab02	Hab03	Hab04	Hab05	Hab06	Hab07
ng_cover	Dense >40%	Dense >40%	Dense >40%	Sparse <10%	Sparse <10%	Dense >40%	Dense >40%
tree_cover	Moderate	Riparian	Moderate	Not	Not	Moderate	Riparian
hollow_pre	Sparse	Common	Sparse				
hollow_not		Small <200mm	None				
woody_debr	Common	Sparse	Common	Not	Not	Sparse	Common
Mis_presen	yes	no	no	no	no	yes	yes
Mis_cover	Sparse and immature					Abundant	Sparse and immature
rocky_hab	no	no	no	no	yes	no	no
rocky_pres							
rocky_note					Waste rock dump		
water_pres	no	yes	yes	yes	no	yes	yes
water_note		Waterhole	Waterhole	Farm dam with dense aquatic vegetation		Waterhole	Waterhole
fire_evide	no		no		no	no	no
cattle_dis			None		None	None	None
site_note	Macropod	Pigs, macropods	Grey kangaroos		High density agile wallaby		
x	151.2390169	151.2383154	151.2394408	151.2393969	151.2366682	151.2343961	151.2426392
y	-24.1212533	-24.1217193	-24.1198191	-24.1186276	-24.0917038	-24.1215204	-24.1071716

CONTACT US

www.epicenvironmental.com.au

1800 779 363

enquiries@epicenvironmental.com.au

http://www.epicenvironmental.com.au/

APPENDIX D GEOTECHNICAL REPORT

Rocktest
Rock Engineering Consultants
ABN 51 760 370 906
46 Hastings Street
Glenelg South SA 5045
P +61 (0)412 903 222
E tony@rocktest.com.au

17 June 2025

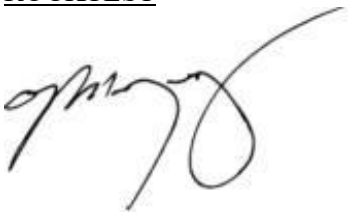
Maxime Descôteaux
HSE & Corporate Affairs Manager
Graymont Australia Pty Ltd
Level 9, 118 Mount Street
North Sydney, NSW, Australia 2060

Dear Maxime,

Calliope Progressive Rehabilitation and Closure Plan (PRCP) - Pits and WRD: Geotechnical

The attached report addresses geotechnical issues relevant to the PRCP for the Calliope 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), RPEQ (Mining, Civil) RPEV (Civil)
Principal Rock Mechanics Engineer

CALLIOPE MINE PRCP PITS AND WRD: GEOTECHNICAL V1.5

for

DOCUMENT CONTROL

Project	Calliope Mine PRCP
Client	Graymont Australia Pty Ltd
Version	1.5
Distribution	1. Graymont Australia Pty Ltd 2. Rocktest Consulting – Project File
Filename	PRCP - Geotechnical V1.5

DOCUMENT HISTORY

Version	Date	Status	Issued to	Comments
1	02/04/2022	Draft	E. Ashong of Graymont	
1.1	06/04/2022	Final	E. Ashong of Graymont	Issued after addressing comments from Graymont.
1.2	20/03/2024	Revised	J. Parkes of Graymont	Address Regulators requirements
1.3	08/08/2024	Revised	J. Parkes of Graymont	Specification modifications
1.4	18/02/2025	Revised	M. Muir of Graymont	Address Regulators requirements
1.5	17/06/2025	Revised	M Descôteaux of Graymont	

DOCUMENT APPROVAL

Signature 

Approval	Tony Meyers
Position	Principal Rock Mechanics Engineer
Date	17 June 2025

CONTENTS

1 INTRODUCTION 6
1.1 Background 6
1.2 Requirements in the PRCP 6
1.3 Terminology 6
2 LOCATION AND GENERAL LANDFORM CHARACTERISTICS 7
3 GEOLOGY 7
3.1 General Characteristics 7
3.2 Soil 8
3.2.1 Characteristics 8
3.2.2 Soil Management 8
3.3 Limestone 8
3.3.1 Intact Rock Characteristics 8
3.3.2 Discontinuities 9
3.3.3 Karst 10
3.4 Earthquakes 11
4 PIT CHARACTERISTICS AND RISK MANAGEMENT 11
4.1 Background 11
4.1.1 Pit 1 11
4.1.2 Pit 2 11
4.1.3 Pits 3 and 4 11
4.2 Specifications 12
4.2.1 Pit 2 12
4.2.2 Pit 3-4 12
4.3 Risk Management Strategies for the Pits at EOML 13
4.4 Pit Water Management During Typical Conditions 14
4.5 Overland Flows Around Pits 14
4.6 Management of Flood Events 14
4.7 Abandonment Bund 15
4.7.1 General Requirements 15
4.7.2 Offsets from the Crests 16
4.7.3 Construction 16
5 WASTE ROCK DUMP (WRD) CHARACTERISTICS AND RISK MANAGEMENT 17
5.1 Background 17

5.2 Specifications 17
5.3 Managing and Assessing the WRD Slopes at the EOML 17
5.4 Settlement of the WRD 18
5.5 Water Management 19
6 STABILITIES OF THE WALLS OF THE PITS 19
6.1 Rockfalls and Bench Scale Stabilities 19
6.2 Inter-ramp Scale Stabilities 20
6.3 Wall Scale Stabilities 20
7 STABILITIES OF THE SLOPES OF THE WRD 21
7.1 Slope Scale Stabilities 21
8 COMPLETION CRITERIA 22
9 GEOTECHNICAL MONITORING 24
10 SUMMARY 24
10.1 Conclusions 24
10.2 Risk Management Strategies 24
10.3 Limitations in the Stability Analyses 25
11 CLOSURE 25
FIGURES 26
ADDITIONAL INFORMATION 46
APPENDIX 1 ROCKMASS CHARACTERISTICS 47
A1.1 Compressive Strengths 48
A1.2 Specific Gravities 48
A1.3 Basic Friction Angles 49
A1.4 Discontinuity Shear Strengths 49
A1.5 Rock Mass Strengths 51
A1.6 Rockfill Shear Strength 53
APPENDIX 2 PIT INTER-RAMP SCALE STABILITY 54
APPENDIX 3 PIT WALL SCALE STABILITY 58
APPENDIX 4 WRD SLOPE STABILITY 63
APPENDIX 5 BENCH SCALE ROCKFALL ANALYSES 65

ACRONYMS

AQP	Appropriately Qualified Person (e.g., qualified geotechnical consultant)
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
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 Calliope Mine. The landforms considered are two open-cut pits and a waste rock dump (WRD). The requirements of the PRCP, as outlined by the Guideline prepared by the QLD Department of Environment and Science[2], are that this report provides details of how the landforms will achieve post-closure stabilities.

The project was undertaken by Rocktest at the request[3] of Graymont Australia Pty Ltd (Graymont).

1.2 Requirements in the PRCP

Consistent with the requirements of the PRCP in regard to the pits, this document discusses the:

- locations and specifications i.e., depths, lengths, widths, overall slope angles, bench specifications,
- methods of construction, with 3D design plans,
- soil/rock characteristics,
- geotechnical conditions (i.e., soil/rock characteristics),
- geotechnical stabilities of the walls, considering the effects of long-term erosion and weathering and the effects of significant hydrological events,
- rehabilitation strategies.

Consistent with the requirements of the PRCP in regard to the WRD, this document discusses the:

- location and specification i.e., height, length, width, 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 strategy.

1.3 Terminology

Time periods referred to in this report are:

- Short-term < Five years
- Medium-term Five years to EOML
- Long-term > 100 years

[1] This report considers geotechnical issues only. Surface and subsurface hydrology issues and environmental 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] Phone call to T. Meyers of Rocktest from E. Ashong of Graymont, 28 February 2022.

2 LOCATION AND GENERAL LANDFORM CHARACTERISTICS

The landforms at the Calliope mine at the EOML will comprise two pits and a waste rock dump[4] (WRD). Figure 1 shows their final footprints. Pit 2 is the small northernmost pit, which will not be mined between the current date and the EOML. The large pit, Pit 3-4, will be mined prior till then. This pit comprises existing Pits 3 and 4.

The landforms are on a low north-south trending ridge separating Awoonga Dam on the Boyne River to the east from its tributary, Futter Creek, to the southwest, and its tributary Ragotte Creek to the west (Figures 2 and 3). Ragotte Creek is ephemeral. Futter Creek has permanent water. Its maximum depth, and that of the water in the lake, is controlled primarily[5] by the height (i.e., 40 mRL) of the spillway on the dam wall.

Pit 2 is within a natural contour high that prevents it from being inundated during floods.

The likelihood for Pit 3-4 to flood is reduced by two levees, the Western and Eastern levees (Figures 4 and 5), and natural contour highs to the north and east of the pit. The lowest point on the upper surfaces of the levees is at 52 mRL, which is significantly higher than the spillway.

3 GEOLOGY

3.1 General Characteristics

The Taragoola limestone deposit occur within the Early Devonian age (419-Ma) Calliope Beds. The Beds occupy a north-northwest striking belt about 40 km long and 3 to 4 km wide. They comprise predominantly volcanic rocks with relatively minor inter-bedded sedimentary rocks, including limestone. The rocks have been subjected to folding and faulting.

Overburden consists of a shallow cover of soil. Boulders and cobbles of limestone and volcanics occur in much of the layer.

Underlying the overburden is predominantly limestone. Discontinuities within the limestone are clay filled to a depth up to approximately 15 mBGL. Karst features are prevalent to approximately this depth. Below this depth, karst and infill becomes less prevalent and the apertures of the discontinuities become tight.

Bedding surfaces within the limestone generally dip very steep towards the west. This characteristic is consistent with the regional structure. The major axes of the pits are parallel to the strikes of the beds.

The volcanics exposed in the walls of the pits include predominantly basic basalt and intermediate olive green andesite (Figure 6).

- The basalt occurs as lava flows. It is exposed primarily in the upper benches of the east and south walls of Pit 4. It is dark grey, has high to very high strength and is slightly weathered.
- The andesite generally occurs as steep dipping dykes that follow vertical to sub-vertical bedding and joints within the limestone. The two dominant systems of the dykes strike north-north-west and east. The widths of the dykes range from stringers to a few metres. Reduced vertical stresses at shallower depths

[4] Two WRDs are on site at the current date, a northern and a southern dump. The northern dump will be removed during the medium to long term, prior to the EOML. Hence, at the EOML, only the southern dump will be a component of the final landform. As this report considers the landforms at the EOML, the terms WRD and dump refer to the southern dump only.

[5] The width of the spillway is also relevant under flood conditions.

have allowed the andesite to extrude along shallow dipping joints. The andesite has high to very high strength and is moderately to slightly weathered.

The volcanics comprise less than 5% of the total rockmass below the second bench (i.e., <27 mRL). Combined with their high strengths, and discontinuity characteristics no less favourable to wall stabilities than those within the limestone, the volcanics have insignificant influence on the stabilities of the walls. Their influence is not therefore considered specifically in this report.

3.2 Soil

3.2.1 Characteristics

The thickness of the soil generally ranges between 1 m and 4 m (Figure 7).

- The upper horizon is ≈0.2 m thick. It comprises red to red-brown, Terra-Rosa, clay loam, medium plasticity, moist, soft, medium dense, weakly cemented. It contains some to many smooth to angular gravels to boulder sized rocks. The rocks comprise weathered limestone and volcanics from 10 mm to 100 mm.
- The lower horizon comprises light to medium, yellowish brown, silty clay, low plasticity, dry, firm to stiff, medium dense, weakly to moderately cemented. It contains many angular gravels to boulder sized rocks. The rocks comprise weathered limestone and volcanics from 10 mm to 300 mm.

The average shear strength of the two horizons is defined[6] in the stability analyses in terms of a conservative friction angle of 25^{o} and a cohesion of 50 kPa.

3.2.2 Soil Management

As the depths of in-situ soil is generally shallow, soil stripping and handling prior to the EOML 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 stockpiled soil will be maintained by:

- maximising the height of the stockpile to below 3 m,
- maintaining the slopes of the stockpile at less than 3H:1V,
- vegetating the slopes,
- installing sediment fences and/or up contour diversion bunds,
- re-using the soil as soon as practical.

3.3 Limestone

3.3.1 Intact Rock Characteristics

The intact limestone is fine grained and recrystallised due to regional metamorphism. It is light to dark grey but can be various colours (e.g., pink, red, pale brown). It can be vitreous or mottled. It is even textured. It can have occasional ferruginous bands. It can be iron stained on discontinuities.

[6] The shear strength of the soil is estimated, based on the characteristics of the materials.

At depths exceeding ≈15 mBGL, the limestone is moderately-weathered to fresh with high to very high strength (ave. 65 MPa) and an average density of 25.8 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, their cores may be only slightly weathered, hence their strengths can be similar to those of the unweathered[7] 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 is defined in the stability analyses in terms of a conservative friction angle of 34^{o}[8].

Most of the weathered[9], and all of the unweathered, limestone has sufficient strength and durability for it to be suitable for use as erosion control cover. Only the extremely weathered rocks are not suitable for use as cover, although these rocks are non-typical.

3.3.2 Discontinuities

The surfaces of the discontinuities (i.e., joints, bedding) are generally smooth. At depths exceeding ≈20 mBGL, they are tight, clean, and unfilled. At shallower depths in the upper benches, they can be dilated due to stress relaxation, karst, and weathering. When dilated, they are generally filled with either lava or hard clay. The clay can influence the stabilities of the upper benches. Maintaining stability over the long-term will require reducing the batter angles of the applicable sections of the benches.

Analysis of data obtained from discontinuity mapping (Figure 8) indicates that most discontinuities can be assigned to one of 6 sets[10] (Table 1). Set 1 contains bedding-parallel cleavage, which is the dominant fabric. Sets 2 to 6 contain joints. Based on the mean orientations of each set, discontinuities within:

- Set 1 dip very steep[11] generally towards the west but can be overturned and dip east,
- Set 2 dip very steep generally towards the southeast but can be overturned and dip northwest,
- Set 3 dip very steep generally towards the south but can be overturned and dip north,
- Set 4 dip moderate towards the southwest,
- Set 5 dip shallow to moderate towards the northeast and east,
- Set 6 dip very steep generally towards the southwest but can be overturned and dip northeast,
- Set 0 are random discontinuities having no preferential orientations.

The average of the six Fisher's constant[12] values (i.e., F_{ave} = 35) applicable to Sets 1 to 6 is moderate. This characteristic is generally indicative of a rockmass not having been significantly deformed. However, the high proportion of random discontinuities[13] (i.e., R_p = 28%) is typically indicative of a rockmass having been

[7] "Unweathered" rocks that shows little of no change in strength from fresh rocks. The term includes fresh rocks and rocks that are moderately weathered and slightly weathered.

[8] The friction angle of the sediments is based on the angle of repose of fines and gravels in the WRD.

[9] "Weathered" rocks have strengths that are significantly reduced from what they were when the rocks were unweathered. The term includes the weathering grades of highly weathered and extremely weathered.

[10] Characteristics based on the orientations of 726 discontinuities within fresh limestone.

[11] Dip terms: Very shallow 0-20^{o}; Shallow 20-40^{o}; Moderate 40-60^{o}; Steep 60-75^{o}; Very steep 75-90^{o}.

[12] Fisher's constant defines how tightly the orientation data within a group are clustered around the mean orientation of that group. Values near o imply parallelism. Values less than 20 imply a highly deviated set of data.

[13] 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.

significantly deformed, which is consistent with the tectonic history of the rockmass. Understanding the tectonic history that resulted in this inconsistency[14] is beyond the scope or requirement of this PRCP.

The mean and maximum trace lengths[15] of the discontinuities within each set are listed in Table 1. Based on these values, the persistences[16] of the discontinuities are generally medium[17] although a small proportion have high persistences. The general characteristic has contributed to the instabilities on all walls in Pit 4 having been of bench scale or smaller (e.g., Figures 9, 10 and 11).

The shear strength characteristics of the discontinuities is described in terms of an average peak friction angle of 32^{o} for unweathered limestone, reducing to 18^{o} over the long-term (Appendix 1.4).

3.3.3 Karst

Karst does not generally occur below 20 mBGL. Karst has not therefore influenced the strengths of the lower benches in any of the pits. However, karst is exposed extensively in the batters of the upper benches of all walls of the pits. Although it can extend to 20 mBGL, it is most prevalent to 10 mBGL. The most obvious karst features are clay filled solution widened discontinuities and caverns (e.g., Figure 12). The widths of these features are generally less than 2 m. Unfilled features are rare.

Prior to the EOML, the batter angles of sections of the upper benches that contain karst will be reduced to <18^{o}. Soil exposed within karst will be covered with broken limestone to reduce the rate the soil erodes.

Table 1. Characteristics of the sets of discontinuities in the limestone.

Set	*Dip*	*Dip Direction*	*Fisher's constant, F*	*Weighted # logged (% of total)*	*Min/Mean/Max spacing (m)*	*Mean/Max trace lengths (m)*
1 (cleavage)	89	269	25	438 (25)	0.01/0.31/10.3	1.8/10
2	82	146	51	243 (14)	0.01/0.43/3.0	1.6/8
3	85	175	48	151 (9)	0.01/0.58/2.1	1.4/10
4	44	247	42	128 (7)	0.01/0.25/1.1	0.8/3
5	14	031	19	107 (6)	0.03/0.90/5.4	4.5/10
6	85	222	28	178 (10)	0.01/0.69/4.3	1.5/10
0		n/a	0	486 (28)	0.01/0.35/3.9	1.2/10
			Total	1731 (100)		

[14] The inconsistency between F_{ave} and R_p may be due to insufficient data having been sampled. The data set is however sufficiently large to characterize the orientation and spacing characteristics of the discontinuities.

[15] 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.

[16] The persistence is the two-dimensional areal extent of a discontinuity.

[17] Persistence classification: 1-m ≤ Low ≤ 3-m ≤ Medium ≤ 10-m ≤ High ≤ 20 m, Very high >20 m.

3.4 Earthquakes

Geoscience Australia (2018)[18] places Calliope 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 0.005g (0.05 m/s^2). The probability corresponds to a 1 in 500 annual return period. There is therefore a 10% probability that an acceleration (A_e) of 0.001g (100/500^{ths} of 0.005g) will be exceeded during a 100-year period.

Several studies have reported on PGA values of 0.2g being required to generate falls of individual rocks from pit walls[19] in low stress conditions as apply at this site. On this basis, PGA values of 0.001g are unlikely to generate many rockfalls. On this basis, a 100-year event is unlikely to significantly increase the risk to persons within or upon the crest of a wall when an earthquake of this intensity occurs.

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 on the stabilities of the walls is considered in the stability analyses (Section 6.3 and 7.1).

4 PIT CHARACTERISTICS AND RISK MANAGEMENT

4.1 Background

4.1.1 Pit 1

Pit 1 (Figure 13) was mined prior to 1960. The final floor of the pit was at 46 mRL, 6 m above the spillway of the dam. Hence, the floor does not saturate with groundwater.

The pit was fully backfilled to surface in 2024. The backfill material comprises well-graded[20] blasted material. It was placed in thin layers (i.e., <30 cm), moisture conditioned then well-compacted with a roller prior to placing the next layer. Due to this procedure, the maximum displacment of the final upper surface would unlikely have exceeded 0.1 m[21] at the EOML. However, to accelerate consolidation prior to then, the surface will be used as a laydown crushing area. If any consolidation occurs, the surface will be filled back to the level of the natural surface. The rate of consolidation during the PMLU will be insignificantly low and the area will be safe and stable.

Prior to the EOML, the surface will be ripped to encourage natural revegetation.

4.1.2 Pit 2

Pit 2 (Figure 14) was mined from the mid-1960s until the mid-1970s. It is currently used for water storage and will continue to be used for that purpose prior, and subsequent, to the EOML.

4.1.3 Pits 3 and 4

Pit 3 was mined from the mid-1960s until the mid-1970s. Pit 4 begun in 1976 and has been mined since then. The two pits will be combined into a single pit, Pit 3-4, prior to 2030. This pit will be mined until the EOML using a standard drill/blast/dig/scale method. As currently occurs, ore-grade limestone is hauled to the ROM

[18] Geoscience Australia (2018) The 2018 National Seismic Hazard Assessment for Australia. (Editor. Allen, T.) Page 10.

[19] Rockfalls have been reported for PGA values of 0.16g in pits where discontinuities contain significant joint pressures.

[20] The sizing of the backfill material ranges from sand to boulder sized rocks up to 30cm.

[21] Consolidation is estimated using the method of 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*. Jnl. Geotechnical and Geoenvironmental Engineering, April.

pad north of the pit from where it is transported off site. Low-grade limestone and limestone contaminated with clay or volcanics are hauled to the WRD south of Pit 3.

4.2 Specifications

4.2.1 Pit 2

Figure 15 shows cross sections through the highest section of each wall of Pit 2. Their specifications are listed in Tables 2 and 3. The pit is shallow, the walls being less than 17 m high. Their stabilities are considered in Section 6.3.

4.2.2 Pit 3-4

Figures 2 and 3 show the elevations of Pit 3-4 at the EOML. It will have an approximately rectangular circumference with the major axis trending north-south. Figure 16 shows cross-sections through the highest section of each wall. Their specifications are listed in Tables 2 and 3.

Water seeps from the western and eastern walls of Pits 3 and 4 respectively. These locations, highlighted in Figures 17 and 18, are listed in Table 4. It will do so from the same locations in Pit 3-4. A hydrogeological study[22] concluded that the water originates in Awoonga Dam and its tributaries. The flows likely occur within permeable sediments between the sources and the walls and within karst voids. They may also occur along east-west striking joints with solution widened apertures. The rates of seepage are functions of the heights of water in the sources (Table 5). No evidence has been observed to indicate the flows have contributed to hydrostatic pressures sufficiently large to reduce the stabilities of the respective sections of either walls. Nonetheless, the influence of groundwater on the stabilities of the walls is considered in stability analyses in Section 6.3.

Table 2. Specifications of the pits at the EOML.

Dimension	*Pit 2*	*Pit 3-4*
Trend of major axis	168°	178°
Length of major axis at crest	418 m	1550 m
Average length of minor axis at crest	200 m	584 m
Maximum heights of walls	34 m	110 m
Heights of benches	none	12 m
Maximum number of benches	1	9
Widths of berms	n/a	10 m
Height of edge bund on berms	n/a	1 m
Batter angles in unweathered rocks	n/a	65°
Batter angles in weathered rocks	n/a	<18°
Inter-ramp angles	n/a	38°
Maximum overall slope angles (north/south/east/west)	34°	32° to 38°
Ramp type / Minimum width	linear / 17 m	linear / 30 m

[22] Graymont Mining Services (2021) Calliope: Hydrogeological Investigation of Excess Water in Pit 3 2018-2020. 27 pages.

Table 3. Dip directions of the walls of the pits at the EOML.

Pit	*North (South dip)*	*South (North dip)*	*East (West dip)*	*West (East dip)*
2	139°	303°	243°	086°
3-4	151°	306° to 355°	240° to 295°	082°

Table 4. Locations of water seeps in Pit 3-4.

Wall	*Easting*	*Northing*	*RL*
West	320785	7331969	32-35
East	321284	7332811	28-40

Table 5. Likelihood of seepage for various RLs of water in Awoonga Dam.

Dam Level (mRL)	*West Wall*	*East Wall*
<40	negligible	none
40-42.5	low	none
>42.5	progressively increasing	

4.3 Risk Management Strategies for the Pits at EOML

After the EOML, the key geotechnical related considerations that will be managed will be:

- Pit wall stability, particularly failure of multiple benches or an overall slope, actions which could result in retreat of a crest.
- Erosion of a crest of a pit wall due to typical surface flows or flows due to an extreme flood event.
- Restricting public access to, and around the site.

Achieving these outcomes will require implementing the following strategies:

- Install abandonment bunds behind the crests of the pits. The bunds are to be offset the appropriate distances behind the crests (Section 4.7).
- Reduce to <18° batter angles of sections of the upper benches that comprise extremely weathered rocks and soil filled karst. Cover the stripped ground with broken rocks.
- Restrict public access to the site.
- Rip all unrequired access routes to and within the pits.
- Install warning signs around the pits.
- Adhere to the requirements of the completion criteria (refer Section 8).
- Visually monitor and audit the performances of the walls (refer Section 9).
- Be prepared to modify the designs of the as-constructed pits if they deviate from the specified designs and/or their performances do not comply with the completion criteria.

4.4 Pit Water Management During Typical Conditions

Under typical conditions, inflows to Pit 3-4 comprise predominantly runoff from the walls, groundwater inflows, and direct impact by rainfall.

After the EOML, inflows will no longer be pumped out of the pit. As the pit is a passive hydraulic sink, the level of water within it will subsequently increase progressively to form a pit lake. The upper surface of the lake will stabilise at an elevation at which the surface area is large enough for losses due to evaporation and other outflows to equate to the inflows. The level of the surface will be similar to those of the water in Awoonga Dam and its tributaries, although there will be time lags for the levels to equate.

The lake will be contained within predominantly unweathered limestone exposed on the lower batters. These rocks are durable[23]. Hence, repeated cycles of wetting and drying of the rocks will not significantly reduce their strengths. Hence, progressive loss of the support these rocks provide to the toes of the walls is unlikely to occur.

As indicated in analyses in Section 6.3, water in the pit will not reduce the stabilities of the walls. The water will negate any deleterious effects[24] of excess hydrostatic pressures on stability due to flows of water through the walls into the pit. The exception could be if the level of the water in the pit is reduced (i.e., drawn down) rapidly. The resulting pressure differentials either side of rocks that were below the original level of the water could result in some rocks displacing towards the pit. However, this action is unlikely as there is no conceivable method by which a rapid draw-down will occur.

4.5 Overland Flows Around Pits

The areas around the pits, between the two levees and the natural contour highs to the north and east of the pits, are relatively flat. Most rainwater that falls during heavy intensity and/or long duration rainfall events pools in low points on the surfaces. Some of the water flows down ramps into the pits.

After the EOML, the abandonment bunds that will encircling the pits (refer Section 4.7) will modify the rates and directions of flows into the pits. Ripping the surfaces of the ramps and the surfaces between the abandonment bunds and the crests of the pit walls will also do so. The volume of water that will flow into the pits during a rainfall event will be less than the volume that flows into them pit prior to the EOML.

4.6 Management of Flood Events

Historical evidence indicates the eastern and western levees and natural contour highs north and east of the site prevent the walls of the pits being overtopped by flood water during most flood events originating from Awooga Dam and its tributaries. However, a rare Peak Maximum Flood event could result in some sections of some walls being overtopped (Figure 19). Experience in Pit 4 provides evidence that such an event does not cause significant instabilities of rocks exposed in the batters. However, soil within karst exposed in the upper batters can erode, resulting in gully erosion to the extent of the karst. Preventing this occurrence after the EOML will require earthworks in areas of soil and soil filled karst:

1. Reduce, to less than 18^{o} , the batter angle in sections of the upper benches that comprising soil.
2. In areas of extensive and/or deep soil filled karst, create a shallow V-drain that will cause water to migrate down the centreline of the karst (Figure 20).

[23] Slake durability tests indicate the limestone has a 2nd stage durability index exceeding 95%.

[24] No deleterious effects have been observed, and none are expected after the EOML.

3. Sheet the soil with a minimum 0.5 m thickness of well graded durable rocks of +0.25 mm size.
4. Spray the rocks with a cementitious binder of sufficient strength and quality to reduce the likelihood of the rocks that form the bed of the drain from detaching during flows.
5. Inspect drains and, if necessary, repair damage after flood events.

As flood water subsides, the level of water in the pits will reduce as water evaporates or dissipates into the walls through the strata. The levels will eventually stabilise at the level of water in the dam and its tributaries.

Additional flood modelling prior to the EOML will ascertain whether additional strategies may be required to further reduce the likelihood of water overtopping of the walls.

4.7 Abandonment Bund

4.7.1 General Requirements

The final landform will include an abandonment bund (Figure 21) behind the crest of each wall of each pit to:

- prevent inadvertent access to the crests by vehicles, and restrict access by motorbikes and persons on foot,
- provide areas between the crests and the bunds that are sufficiently clear and flat to enable evidence of crest retreat to be observed during inspections and to enable access by equipment for remediation.

In lieu of Queensland specific guidelines on abandonment bunds, the recommendations in the Western Australian Guideline (1997)[25] will be applied. Their intentions are for a bund to:

- be installed behind the crest of each wall beyond potential failure zones,
- encircle the pits with no gaps other than where locked gates provide restricted access through a bund,
- be obvious,
- have sufficient height to restrict access,
- have sufficient longevity to remain functional for the long-term[26].

The characteristics of the bunds are indicated in Figure 22. They have a 1 m high core of compacted clayey soil. They are sheeted in unweathered crushed limestone to a minimum height of 2 m. They are not vegetated to aid their inaccessibility. Their specifications are:

- Total height 2 m (minimum)
- Footing width 4.3 m (minimum)
- Slope angles Cover: 1.1H:1V (45^{o})
  Core: 1.3H:1V (38^{o})
- Cover Well-graded coarse unweathered limestone of +25 mm
- Core Well-compacted, well graded, clayey sand and/or sandy clay.

[25] 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.

[26] A bund remains in place for the long-term with negligible maintenance whereas a fence can deteriorate within 10 to 15 years if not maintained.

4.7.2 *Offsets from the Crests*

The Guideline recommends 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 are those listed in Tables 6 and 7.

Stability analyses (Section 6.3) indicate that the scarp of a large scale instability is unlikely to develop more than a few metres behind a crest. This understanding is consistent with the historical performances of the walls in Pits 2, 3 and 4. On this basis, the offsets in the table are the minimum distances the bunds are to be placed behind the crests albeit within the lease boundaries. Their actual locations will be established prior to the EOML, informed by the performances of the walls prior to then and the locations of the lease boundaries.

4.7.3 *Construction*

The cores of the bunds will be constructed by placing the specified material in a thin layer (i.e., <30 cm), moisture conditioning, then well-compacting the layer prior to placing the next layer. The process will be repeated until a height of approximtely 1 m is achieved. Doing so will aim to achieve the maximum practical compaction. The crushed rock sheeting will be end dumped or placed over the core to achieve an approximate height of 2m.

Table 6. Minimum abandonment bund offsets from the crests of the walls of Pit 2.

Wall	*Height of Wall (m)*	*Overall Slope Angle*	*Weathering Depth (m)*	*Minimum Offset (m)*
North	31	36°	31	34
South	16	38°	16	24
East	21	35°	21	25
West	37	36°	37	38

Table 7. Minimum abandonment bund offsets from the crests of the walls of Pit 3-4.

Wall	*Height of Wall (m)*	*Overall Slope Angle*	*Weathering Depth (m)*	*Minimum Offset (m)*
North	105	38°	20	10
South	107	30°	20	10
East	105	26°	20	10
West	116	38°	20	10

5 WASTE ROCK DUMP (WRD) CHARACTERISTICS AND RISK MANAGEMENT

5.1 Background

The current and final WRD is the sidehill fill type. The materials within the dump comprise low-grade limestone, limestone contaminated with clay, volcanics, and crusher fines.

The footing of the dump was constructed on a shallow (57H:1V) natural slope dipping towards the west. A thin layer of clay loam topsoil was stripped from the surface to achieve a relatively flat footing comprising bouldery silty clay having a shear strength greater than that of the topsoil. Subsequent lifts use the top down method whereby trucks end dump materials near the crests. A dozer then spreads and compacts some of the materials on the upper surface and pushes the remainder of the materials over crests where they are compacted and shaped. The slopes are advanced in the same directions as the topography. No significant drainage paths are blocked by the dump.

5.2 Specifications

Figure 2 shows the proposed final elevation of the dump at the EOML. It will be approximately rectangular, with the specifications listed in Table 8 and highlighted in Figure 25.

Table 8. Specifications of the WRD at the EOML.

Dimension	*Value*
Trend of major axis	105°
Length of major axis along footing	564 m
Length of minor axis along footing	362 m
Maximum height of dump	23 m
Maximum overall slope angles	7°
Minimum distance of the toe of a slope from a pit crest	58 m
Concave grade on upper levels for drainage	3°

5.3 Managing and Assessing the WRD Slopes at the EOML

After the EOML, the key geotechnical related considerations that will be managed will be:

- Geotechnical stability, particularly slumping of a slope potentially resulting in loss of material to the surrounding area (Section 7.1).
- Erosion, due possibly to failure of vegetation to establish and/or ineffective management of surface flows.
- Settlement of the upper surfaces (Section 5.4).
- Restricting public access to, and around the site.

Achieving these outcomes will require implementing the following strategy:

- Prior to the EOML, construct the cores of the outer slopes of the dump in a series of lifts from the bottom up, beginning on the natural surface. Doing so will compact the materials, so they achieve their greatest practical strength and lowest practical permeability:
  1. Strip topsoil and vegetation from the natural surface.
  2. Trucks dump waste materials in a pile.
  3. Spread the material in a near horizontal layer as thin as practical.
  4. Moisture condition (i.e., damp) the material.
  5. Use repeated passes of equipment to compact the material until no further compaction occurs with additional passes.
  6. Repeat stages 2 to 5 for subsequent lifts.
- Prior to the EOML, push down the slopes to 8.3H:1V (12%). Begin the work from the upper level. Recompact the material.
- Grade the upper surface at approximately 19H:1V (5.2%) towards the centre of the dump to direct water away from the slopes.
- Place a minimum 1 m high edge bund of unweathered rock approximately 2 m behind the crests of the slopes to provide an additional barrier to prevent water shedding over the crests.
- Rip all unrequired access routes to the dump.
- Visually monitor the performance of the dump over the medium to long-terms (Sections 8 and 9) to ascertain whether the design continues to perform acceptably.
- Be prepared 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.

The performances of the upper surface and the slopes of the dump will be visually monitored and assessed against the indicators and completion criteria outlined in Section 8 to demonstrate the success of the strategies.

5.4 Settlement of the WRD

Settlement of the upper surface of the dump will occur over the long-term as the materials within the dump spatially rearrange to minimise the inter-granular void spaces. This action will be exacerbated by the weight of the materials, by water infiltrating through the dump and by the water causing rocks to degrade. Crushing of grains is unlikely to occur at the low vertical pressures that will apply within this relatively low dump (i.e., <23 m).

Settlement will occur slowly as >90% of the materials within the dump are high strength and durable; a moderate proportion of which are oversize. Based on a relationship by Kermani (2018)[27], the maximum settlement ΔH over the long-term will be relatively small (i.e., 21 mm $\leq \Delta H \leq$ 42 mm). This range is insignificant, particularly because no infrastructure will be constructed on any surface of the dump. The associated increases in the bulk densities of the materials due to consolidation will reduce their permeabilities and enhance their stabilities. Both actions will reduce the rates of subsequent settlement.

[27] 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.

5.5 Water Management

A bund will be placed up contour of the dump on the western levee to reduce the volume of water that flows off the levee on to the upper surface of the dump.

Water on the upper surface will migrate to its centre. Some of this water will evaporate. Some will be retained within voids and pores in the near surface materials from where it will eventually evaporate. Some water will migrate into and be retained within the body of the dump. The small volume of this water that subsequently migrates to the footing of the dump will seep from the toe of the eastern slope. A drain installed along the toe will direct this water to a natural contour low thereby preventing erosion, which could result in instability at the toe of the dump. The drain will be a minimum 1.5 m wide and 0.5 m deep. It will be lined with well graded unweathered rocks.

6 STABILITIES OF THE WALLS OF THE PITS

6.1 Rockfalls and Bench Scale Stabilities

The final berms in Pit 3-4 will be 10 m wide, sufficient to contain 1 m high edge bunds (Table 2). The widths of the berms exceed the minimum 7 m width recommended by Ryan and Prior (2000[28]) for retention of individual rocks that fall from 12 m high benches. A series of rockfall simulations[29] (Appendix 5) were undertaken to confirm this theory and to inform an understanding of the trajectories of rocks that release from, and traverse down, a batter and the likelihoods for these rocks to traverse over the crest of a berm. The simulations confirmed (Figure 23) that rocks are unlikely to traverse beyond the edge bunds.

Theoretically[30], the largest bench height wedge[31] that could develop in a bench will have a volume and a length along the crest of approximately 265 m^3 and 13 m respectively (Figure 24). Based on relationships of Gibson et. al. (2006[32]), a 10 m wide berm is likely to be sufficient to prevent almost all rocks involved in detachment of a wedge of this volume from traversing beyond the edge bund[33]. Those rocks that do so will be retained on the berm below.

On the bases of the empirical evidence, the results of the simulations and observations of rockfalls in Pit 4, the specified final berms are likely to have sufficient retention capacities to control and retain individual rocks and masses of rocks up to bench scale. In addition, the likelihood of a person being below a rock that detaches at the time it detaches is extremely low as access into the pit will be restricted, the pit floor will be a lake and access on to a berm will not possible. For these reasons, the risk applicable to rockfall hazards will be acceptable.

---

[28] Ryan TM and Pryor PR (2000). Designing catch benches and interramp slopes. In *Slope Stability in Surface Mining* (eds WA Hustrulid, MK McCarter & DJA Van Zyl), pp. 27-38. SME. Colorado.

[29] The simulations used the software Rocfall2.

[30] Historically, a wedge of the indicated volume has never formed on any bench in any of the three pits.

[31] A large wedge could comprise many individual rocks.

[32] Gibson, W, de Bruyn, I A and Walker, D J H, 2006. Considerations in the optimisation of bench face angle and berm width geometries for open pit mines, in *Proc. South African IMM Int Symp on Stability of Rock Slopes*, Symp. Series S44 Stability of rock slopes in open pit mining and civil engineering situations, pp. 557 – 579.

[33] The berm width is based on two equations for calculating the required berm width from the wedge failure volumes, which depend on the geometry of the failed material on the berm (conical vs pyramid shape). Assumed is a swell volume of 1.2, volume of wedge of 265 m^3, wedge width along crest of 13 m and 38^o angle of repose of the failed rock.

6.2 Inter-ramp Scale Stabilities

No inter-ramp (IR) scale instabilities have occurred in any of the pits at this site since mining commenced. None is expected to occur after the EOML as the IR angle of the final walls (i.e., 38^{o}) will be less than it is for the current walls (i.e., 40^{o} to 48^{o}). Nonetheless, a series of analyses (Appendix 2) were undertaken for Pit 3-4 to confirm this understanding. An analysis was not undertaken for Pit 2 as this pit is not benched. The analyses indicate:

- Toppling will be the most likely mode of instability in unweathered rocks on all walls (e.g., Figure 11). The mode will involve masses of rocks toppling from discontinuities that dip steeply into the walls. This result is consistent with occurrences in Pit 4.
- Instabilities involving masses of rocks sliding along underlying discontinuities (i.e., planar sliding) or pairs of intersecting discontinuities (i.e., wedge failure) will be less prevalent.

Over the long-term, as weathering reduces the shear strengths of the discontinuities, toppling may become less prevalent and wedge sliding (e.g., Figure 10) may become increasingly more prevalent. These modes will be most apparent in the upper benches, within which will be the most weathered discontinuities. They will be less frequent on the lower benches where discontinuities will be less weathered. The relationships between weathering and the modes of instability are consistent with occurrences in Pit 4.

The results of the analyses are listed in Tables A2.1 and A2.2 in terms of likelihood for instability (P_f) values[34]. The acceptabilities of these values can be considered by comparing them to values typically considered acceptable in the mining industry.

Read and Stacey (2009)[35] recommend maximum P_f values of 20% as a general guide for inter-ramp scale instabilities where the consequence of instability could be "low" to "medium". These classifications are appropriate due to access into hazardous area by persons during the PMLU being significantly restricted, interramp scale breakback at a crest being within the area bounded by the abandonment bunds and no inter-ramp scale instability having occurred in any pit since mining commenced even though the inter-ramp angles have exceeded those that will be applicable after the EOML.

The results from the analyses indicates that the P_f values are approximately 20% or less, hence are within the range of acceptability. On this basis, the proposed bench specifications are likely to be to be acceptable.

6.3 Wall Scale Stabilities

No instability of wall scale (i.e., wall crest to toe) has occurred in any pit at this site since mining commenced. However, if such an instability occurs during the PMLU it would likely result in a section of the crest of a wall retreating. A series of analyses were therefore undertaken to quantify the likelihood of such an event and to highlight the likely maximum offsets from the crests of potential surfaces of instability. These offsets inform the area that should be inspected for evidence of instability during the PMLU. They also inform the abandonment bund set back to ensure a section of a bund is not subsumed by crest retreat.

[34] The likelihood of sliding quantifies the probability that a particular location on a wall will experience a sliding instability.

[35] Acceptance criteria are listed in Read, J. and Stacey, P. (2009) Chapter 9: Acceptance Criteria. *Guidelines for Open Pit Slope Design*. CSIRO Publications.

Details of the analyses are discussed in Appendix 3. The results indicate:

- A wall scale instability is unlikely during the PMLU. This result is consistent with the performances of the walls in all pits to date.
- The largest surfaces likely to develop have toes that daylights within weathered limestone in the upper two benches. If large instabilities develop, they will likely occur in, and be limited to, these benches with crest retreat being less than 3 m. Retreat is therefore unlikely to extend to an abandonment bund.
- Water within either pit does not have a significant influence on the stabilities of the walls.

The results of the analyses (Figures A3.4 to A3.8) are quantified in terms of Factor of Safety (FoS)[36] values. Read and Stacey (2009) recommend a minimum value of 1.3 under static loading conditions and 1.05 under dynamic (earthquake) loading conditions where the consequence of instability could be "medium". This classification is appropriate for the reasons noted in Section 6.2. The results from the analyses indicate that no wall scale surface in either pit has a FoS value less than 1.5 for both loading states, hence are within the ranges of acceptability. On this basis, the wall specifications are deemed to be acceptable.

7 STABILITIES OF THE SLOPES OF THE WRD

7.1 Slope Scale Stabilities

The current slopes of the WRD dip at approximately 33°. No significant instability has occurred within these slopes to date. At the EOML, the slope angles will be reduced to 7°. The likelihood of an instability developing at these angles is significantly less than at the current date. A series of analyses were undertaken to quantify the stabilities of the highest of the final slopes during the long-term as the rocks within the dump weather. The analyses also highlight the likely offset of the lowest strength surfaces within the slope. This offset informs the extents of the areas behind the crests of the slopes that should be inspected for evidence of instability. It also informs the locations where edge bunds should be placed. Details of the analysis are discussed in Appendix 4.

The results of the analysis 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 indicate that no overall slope scale surface has a FoS value less than 4.0. The acceptability of this lower bound value is considered by comparing it to values typically considered acceptable in the mining industry. Subsummation within flowing rocks at the toe of a slope or within a collapsing crest are high consequence events. However, these events are very unlikely to occur due to the risk mitigation strategies that will be implemented (Section 5.3). They are therefore medium risk events[37]. Hawley and Cunning (2017)[38] recommend a minimum FoS of 1.5 under static loading and 1.15 under dynamic loading be applied for these events. A comparison of the results from the analysis with these criteria indicates the FoS values exceed significantly the guideline values. Hence, the slopes are likely to be acceptably stable during the long-term post EOML.

[36] 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 for an unstable scenario.

[37] Risk classification terms are consistent with AS/NZS ISO 31000-2009 Risk management— Principles and guidelines. Standards Australia

[38] 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.

During the long-term, weathering of the materials within the dump will create additional fines which will increase the bulk densities of the materials. They will also reduce the permeabilities of the materials which could enable pore water pressures to develop. These actions may result in the angles of the slopes reducing progressively. As they do, the slopes will become more stable. Extension of any toe will be negligible and will not result in any additional geotechnical hazard. A drain and bunds placed beyond the toes of the slopes will prevent any material from traversing beyond their locations.

8 COMPLETION CRITERIA

Table 9 lists the general objectives relevant to geotechnical aspects of the pits and the WRD during the short- to long-terms. Milestone criteria relevant to these aspects are listed in Table 10. The respective landforms will be considered suitable for relinquishment when these objectives and criteria have been met.

Table 9. General Objectives Relevant to Geotechnical Aspects of the Landform

Short-term	*Medium to Long-term*
• Minimise the areas disturbed by limiting clearing to the minimum area required for the operation and by progressively rehabilitating areas as they become available. • Install erosion control measures prior to the commencement of soil stripping and rehabilitation activities. • Strip soil from areas of disturbance only as, when, and where required to reduce the potential for erosion and to minimise the volumes of soil stockpiled and the period of storage. • In preference to stockpiling soil, replace stripped soil directly on to completed sections of the final landform where practical. • 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 pits and the slopes of the WRD as soon as practical. • Visually monitor the performances of the walls of the pits and the slopes of the WRD and the surrounding landforms.	• Provide self-maintaining, geotechnically stable and safe landforms that compliment with the surrounding landforms in terms of slopes, geomorphological characteristics, and postmining land use. • Remediate hazards associated with the pits and the WRD that may increase the risks applicable to persons and/or animals. • Construct the upper surfaces on the WRD to ensure rainfall runoff drains away from the crests of the slopes towards the centres of the surfaces. • Minimise the catchment areas applicable to the pits and the toes of the WRD with up contour bunds and the abandonment bunds.

Table 10. Proposed Geotechnical Rehabilitation Milestone Criteria for the Residual Voids and WRD.

Landform	*Rehabilitation milestone reference*	*Rehabilitation milestone*	*Milestone criteria*
Residual voids (Pit 2 and Pit 3-4)	RM3	Landform development and reshaping / re-profiling of residual void	• An AQP[39] has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.2) has been achieved. • Pit 3-4 batter slopes meet final design specifications (18° in weathered rock, 65° in unweathered rock) • Pit 2 maximum overall slope angle meets final design specifications (34°) • Perimeter abandonment bund and safety signage installed offset, as specified by an AQP, from the crest of the voids • Locked gates and signage installed at access points to the residual voids to prevent unauthorised access • AQP certifies that void final landform design intent has been achieved
	RM10	Achievement of post-mining land use to stable condition (water storage)	• Visual inspection by an AQP provides evidence that the stabilities of the residual void crests and walls have remained constant or increased following cessation of mining and rehabilitation activities
WRD	RM4	Landform development and reshaping / re-profiling of waste rock dump.	• As built inspection by an AQP confirms that the final landform design intent has been achieved, and batter slopes do not exceed 12%
	RM11	Achievement of post-mining land use to stable condition (grazing)	• Visual inspection by an AQP provides evidence that the geotechnical stability of the WRD has remained constant or increased following completion of rehabilitation activities

[39] AQP = Appropriately qualified person (such as a qualified geotechnical consultant)

9 GEOTECHNICAL MONITORING

Calliope's Ground Control Management Plan (GCMP) requires the following geotechnical monitoring and management strategies be implemented until the EOML:

- Profiles of the walls of the pits and the slopes of the WRD will be collected annually using drone based photogrammetry. Surfaces will be created from the point clouds. The surfaces will be compared to previous surfaces to highlight changes. Excessive deformations will require strategies to be implemented to ensure the deformation mechanisms are understood and, if necessary, ensure the risk to persons and the operation remain acceptable.
- Data quantifying the orientations of the discontinuities most recently exposed in Pit 3- 4 will be collected using discontinuity mapping techniques if changes to the geology occurs. The data will be compared to data collected elsewhere to highlight whether the characteristics of the discontinuities are consistent with those recorded previously. If different, the data will be used as input to kinematic analyses to ascertain whether the specifications of the walls are still appropriate or require modification.
- Visual inspections of the walls of the pits and the slopes of the WRD will be undertaken weekly. Hazards and strategies for managing any increase in risk will be recorded in the daily log.
- An audit of geotechnical risk issues will be undertaken by an independent geotechnical consultant every 18 months.

A programme for visually monitoring and auditing the walls, slopes, and the landforms after the EOML will be established prior to then.

10 SUMMARY

10.1 Conclusions

- The proposed landform designs satisfy the geotechnical related requirements of the PRCP Guideline.
- The long term stabilities of the walls of Pit 2 and Pit 3-4 and the slopes of the southern WRD will be within the ranges typically considered acceptable in the mining industry.
- After the EOML, the water level in Pit 3-4 will increase. A pit lake will form with a final level being controlled by the heights of water in Awoonga Dam and its tributaries. The water will not significantly reduce the performances of the pit walls unless rapid drawdown occurs, which is unlikely.

10.2 Risk Management Strategies

After the EOML, the principal strategies to reduce the risks applicable to the walls of the pits and the slopes of the WRD will be:

- restricting public access to the site,
- ripping access routes within and into the pits and to the upper surfaces and toes of the WRD,
- installing abandonment bunds behind the crests of the pits and edge bunds behind the crests of the WRD and ensuring the offset of the abandonment bunds are as specified in Section 4.7.2,
- visually monitoring and auding the performances of the walls of the pits and the slopes of the WRD,
- routinely inspecting the areas behind the crests of the pit walls and the slopes of the 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 8),
- 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.

10.3 Limitations in the Stability Analyses

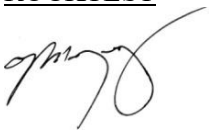
The stability analyses for the walls of the pits and the slopes of the WRD and the risk assessment process are based on limited data. For example, no information is available on the locations, extents, or characteristics of any very persistent structures (e.g., faults, shear zones etc.) that may occur behind a pit wall prior to the EOML and how these structures may influence the performance of the wall during the PMLU. The implications of these limitations are:

- the geotechnical model will be updated if information becomes available prior to the EOML that could influence the conclusions and recommendations,
- adherence to the recommended strategies will be necessary to ensure the risks to persons and the post-closure landform remain acceptable.

11 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. Current view of the site highlighting the approximate footprints of the final landforms of Pit 2, Pit 3-4 and the WRD .

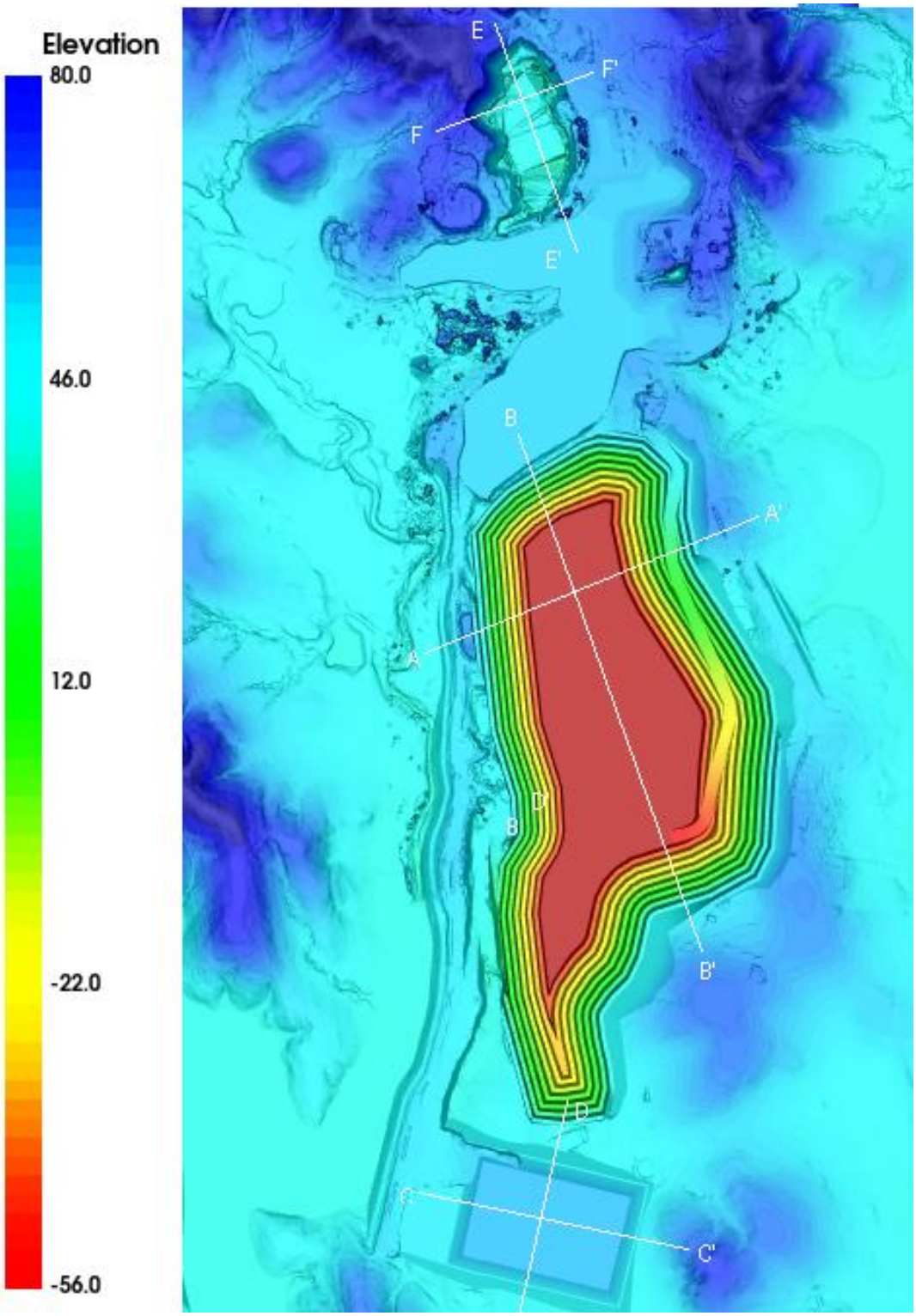


Figure 2. Elevations of landforms around Pit 3-4 and locations of cross sections.

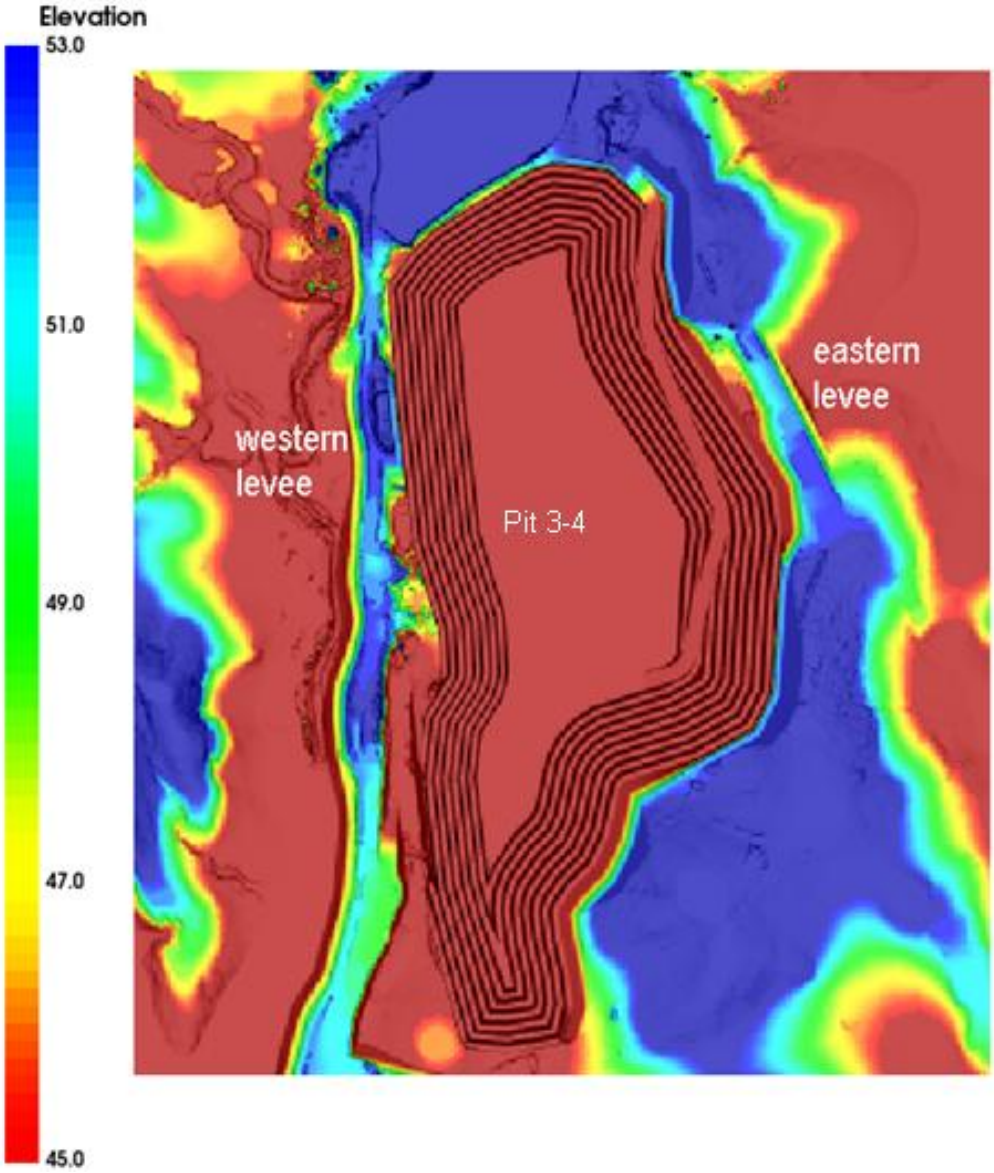


Figure 3. Elevations of landforms around Pit 3-4 highlighting the RLs of the eastern and western levees.



Figure 4. Eastern levee looking south. Awoonga Dam is to the left and Pit 4 is to the right.



Figure 5. Western levee looking north. Ragotte Creek is to the left and Pit 4 is to the right.



(a)



(b)

Figure 6. Basalt lava flows exposed in the upper benches of the east wall of Pit 4 and andesite dykes daylighting within the (a) floor and (b) south wall.



(a)



Figure 7. Bouldery clay overlying limestone on the (a) east wall and (b) north wall of Pit 4.

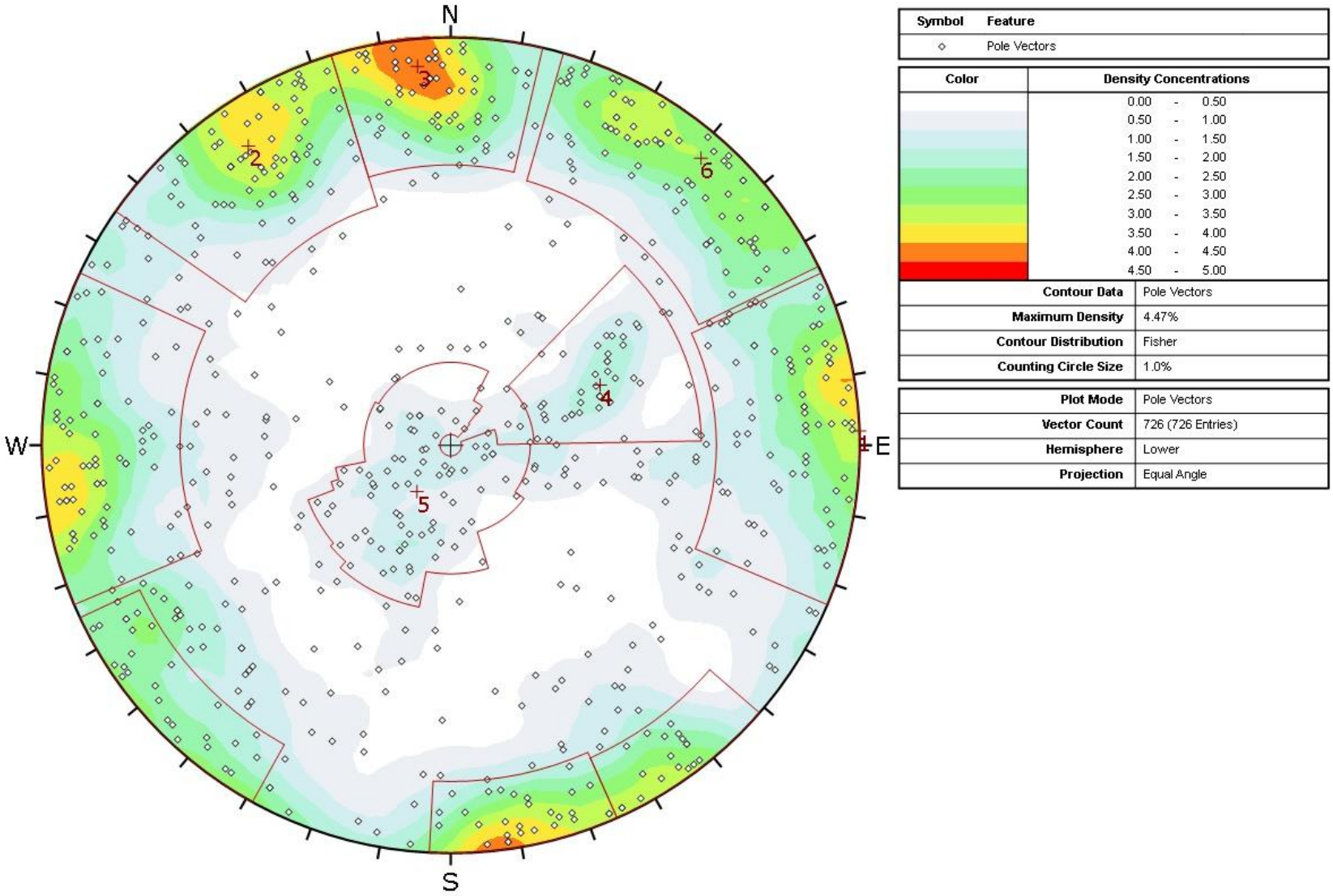


Figure 8. Stereonet highlighting the orientations of poles to 726 discontinuities within the fresh limestone, the boundaries of the 6 sets into which the discontinuities have been assigned and the mean orientations of the sets.



Figure 9. Examples of planar sliding on the west wall of Pit 4 involving bench scale masses of rocks sliding along bedding/cleavage from Set 1 and joints from Set 5.

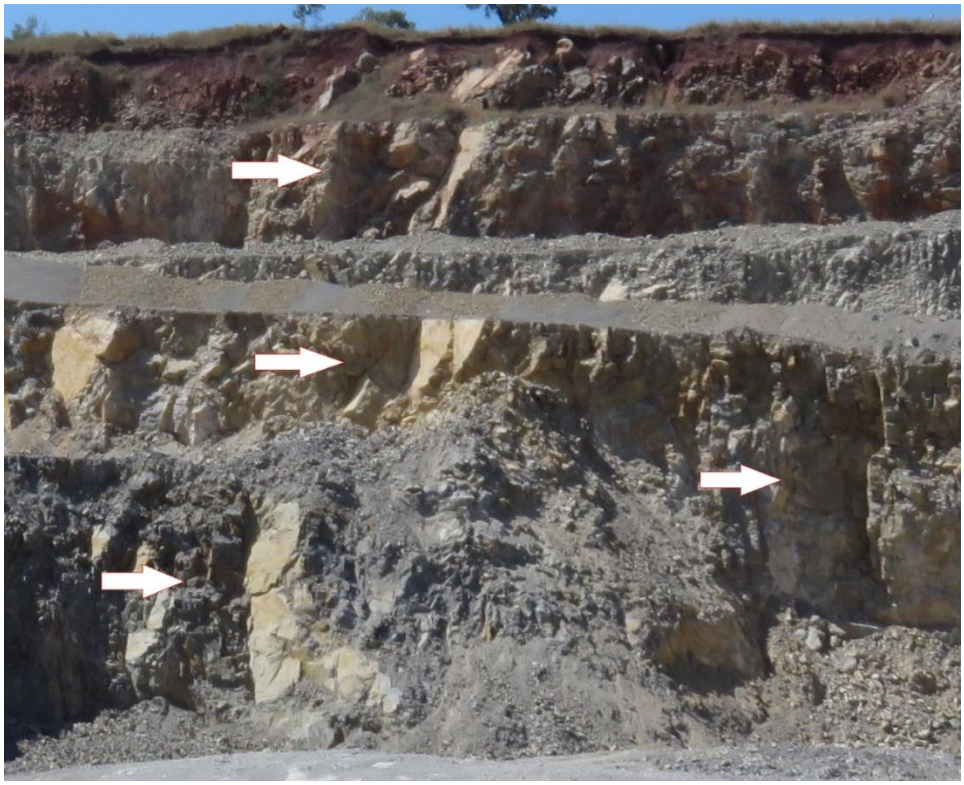


Figure 10. Examples of wedge sliding on the east wall of Pit 4 involving bench scale masses of limestone sliding along steep dipping joints from Sets 3 and 4 having medium to high persistences.



Figure 11. Example of toppling on the north wall of Pit 4 involving bench scale masses of rocks bounded to the rear by steep dipping joints from Set 3 having high persistences..



(a) Apertures within discontinuities daylighting in the north wall of Pit 4.



(b) Cavern on the south wall.

Figure 12. Examples of clay filled karst structures within the upper benches of Pit 4.



Figure 13. Pit 1 (upper) was fully backfilled in 2024 (lower) with well compacted blasted rocks and fines.



Figure 14. Pit 2 has not been mined since the 1970s and will not be mined prior to the EOML.

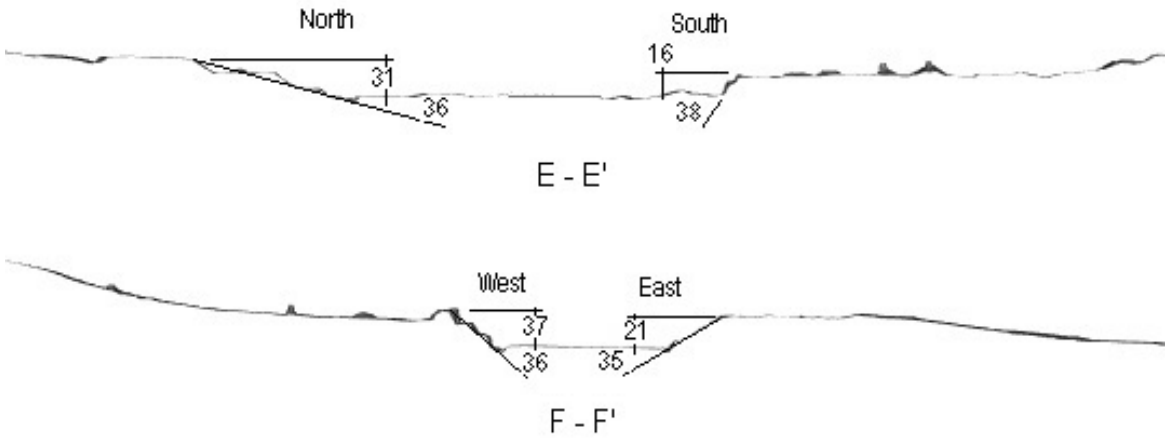


Figure 15. Cross-sections through the walls of Pit 2 at the EOML. Refer Figure 2 for locations.

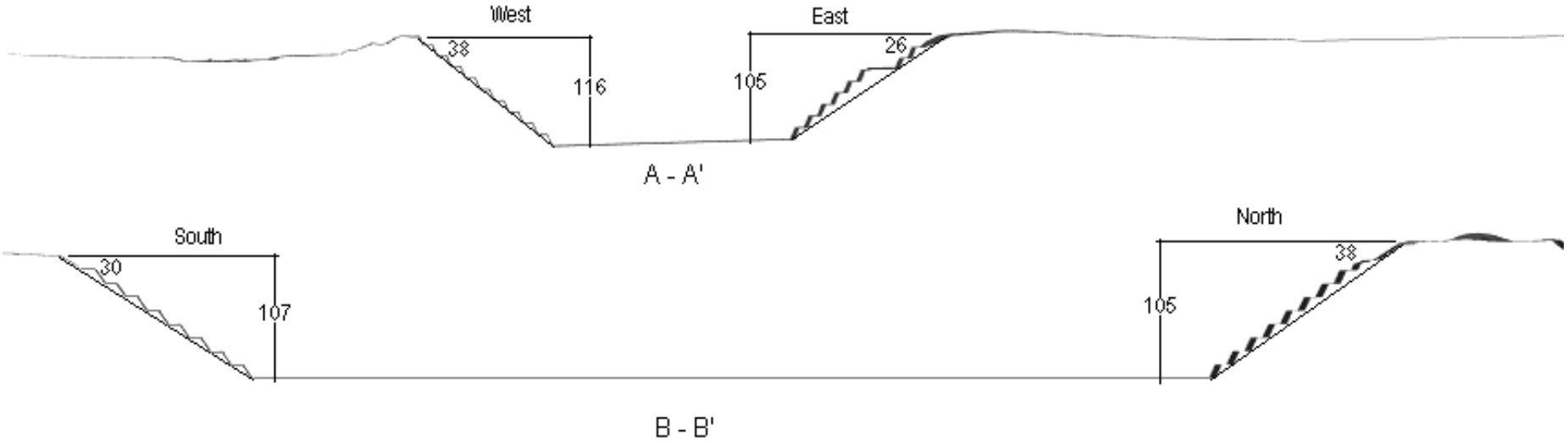


Figure 16. Cross-sections through the walls of Pit 3-4 at the EOML. Refer Figure 2 for locations. .



Figure 17. Water can seep from the batter of the upper bench on the east wall of Pit 4 when the level of water in Awoonga Dam exceeds ≈40 mRL.

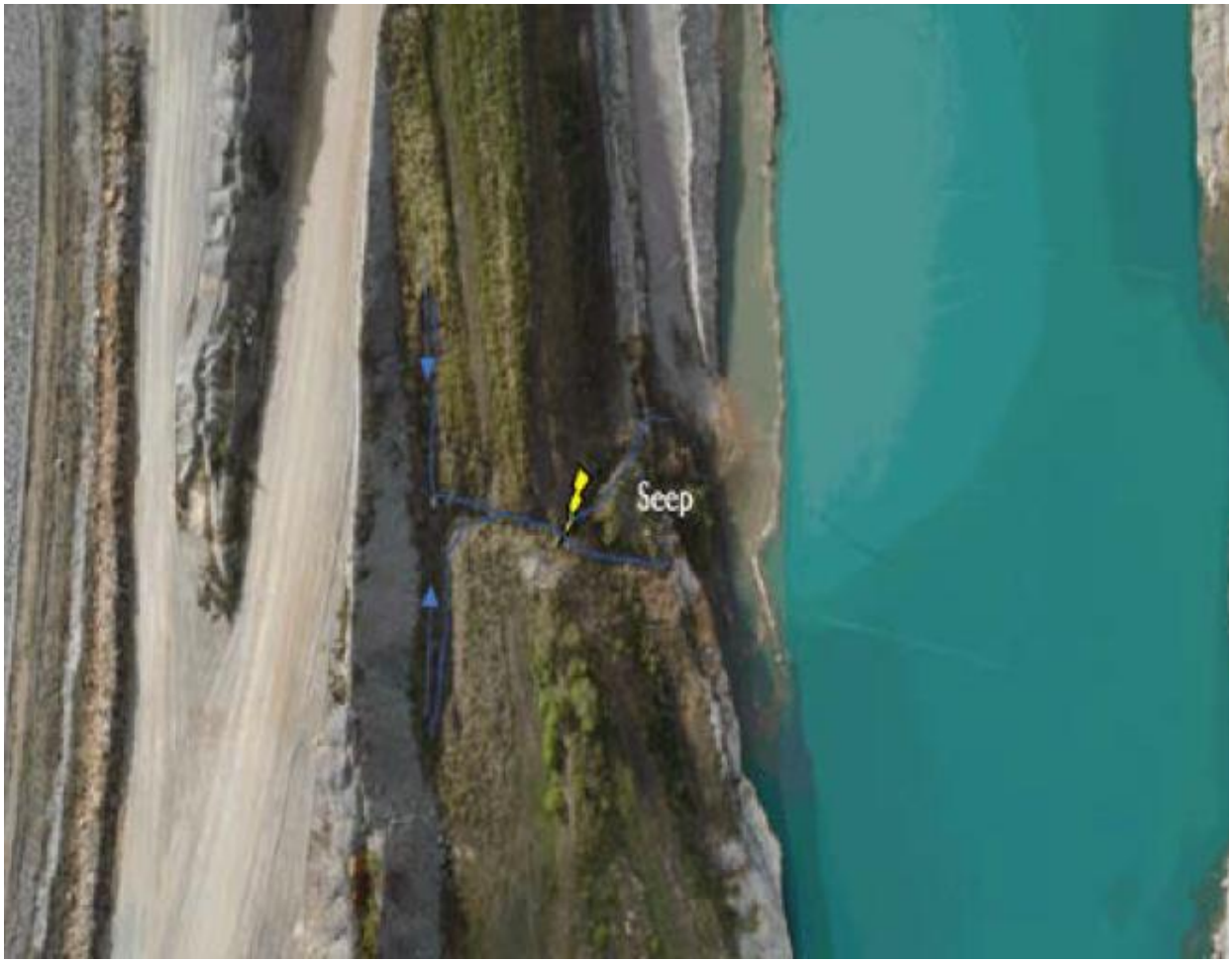


Figure 18. Water can seep from the upper batter on the west wall of Pit 3 when the level of water in Awoonga Dam exceeds ≈40 mRL.

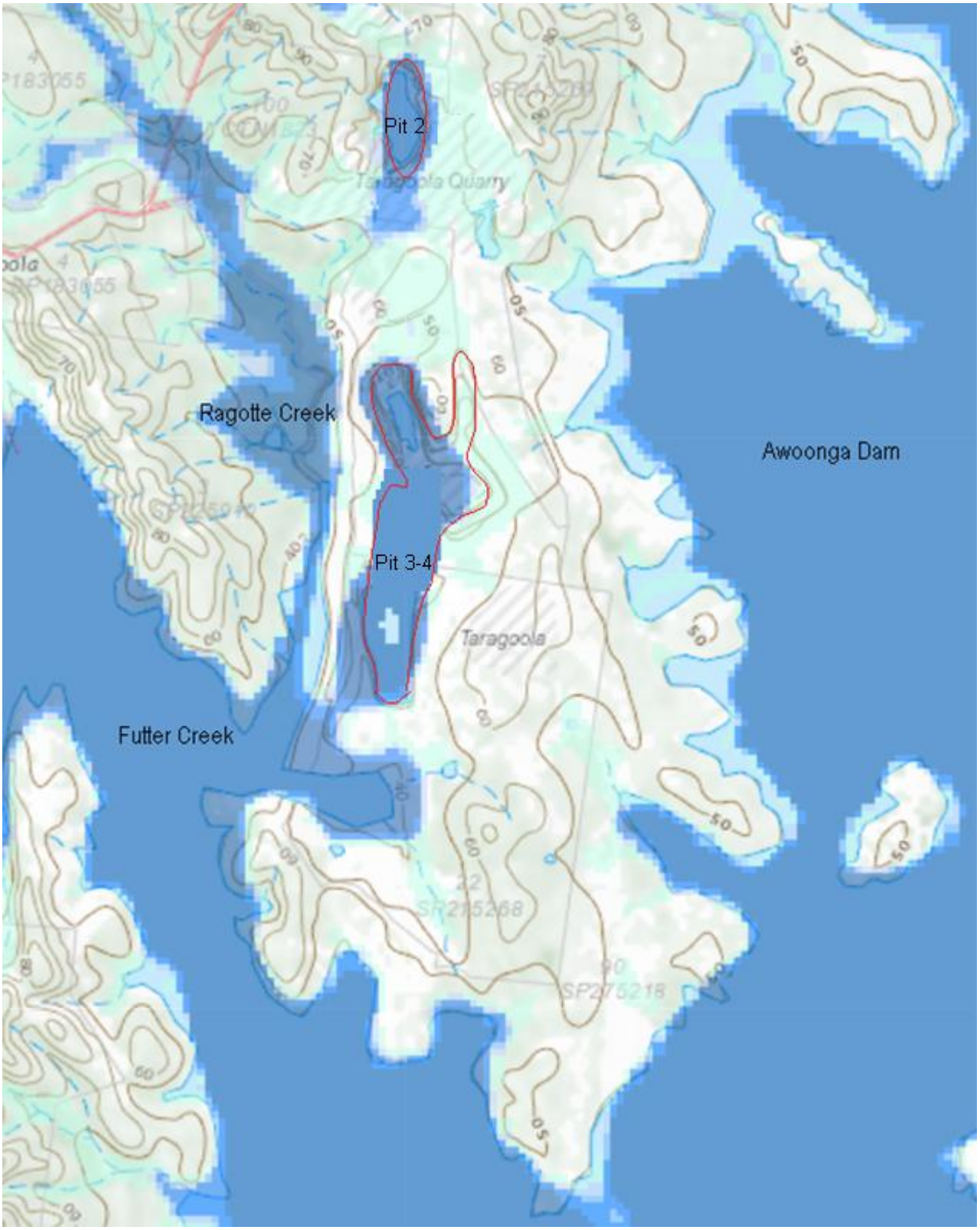


Figure 19. Estimated water level for an extreme flood event.
(Source: https://floodcheck.information.qld.gov.au).



Figure 20. Example of a shallow rock lined v-drain constructed down a slope comprising erodible soil to prevent gully erosion. Similar drains will be required in sections of final upper benches comprising soil filled karst.



Figure 21. Example of an abandonment bund similar to those to be placed around Pits 2 and 3-4.

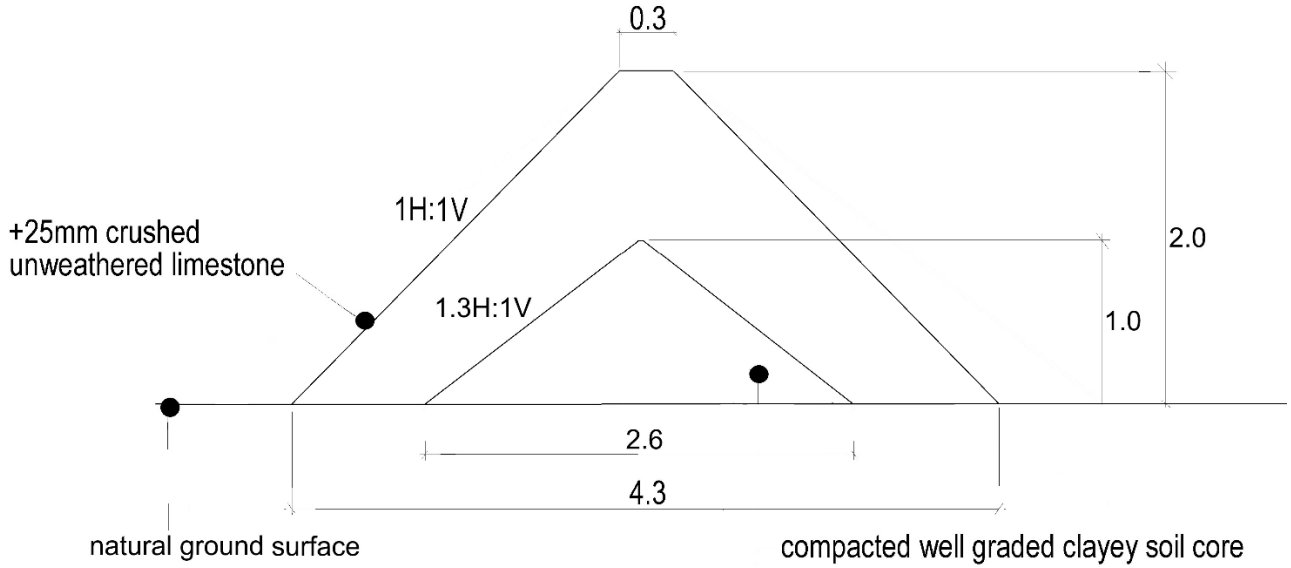


Figure 22. Nominal specifications of the abandonment bunds to encircle Pits 2 and 3-4.

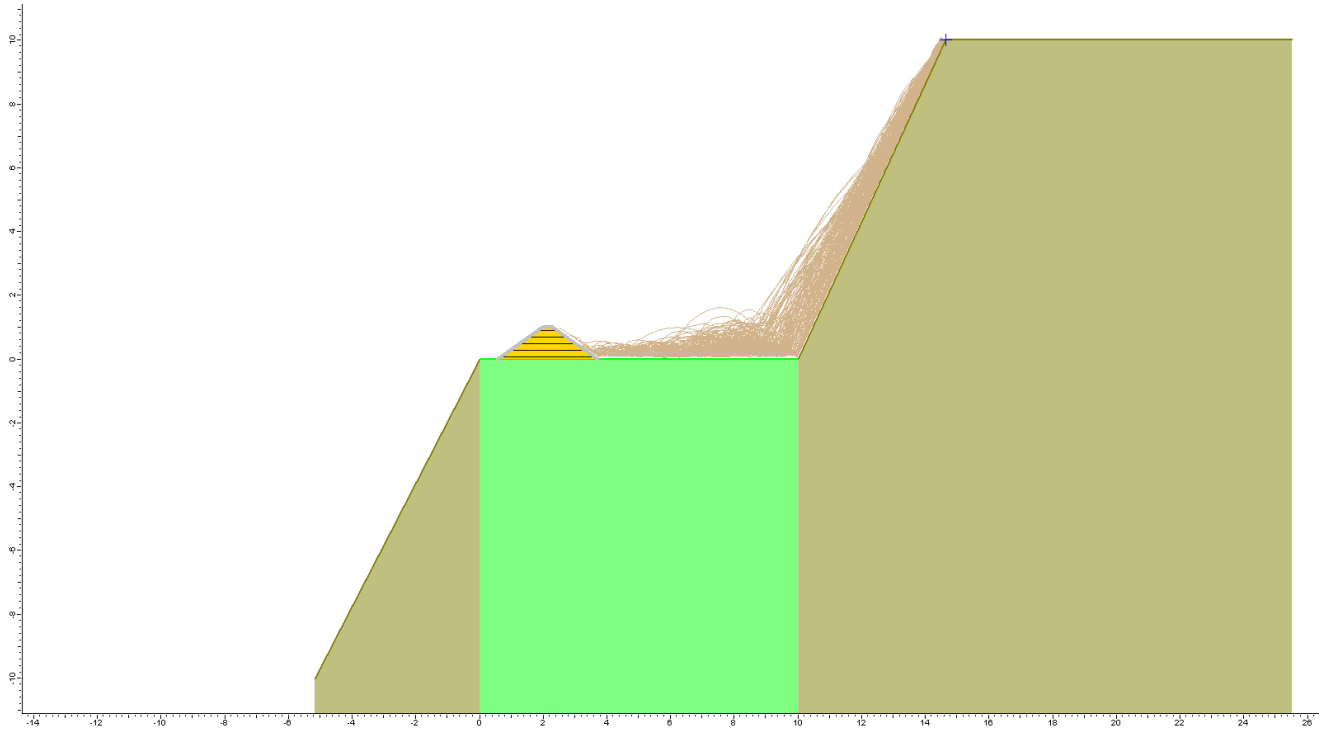


Figure 23. Rockfall simulations of 1000 rocks detaching from the crest of a batter indicate that no rocks are likely to traverse beyond the edge bund.

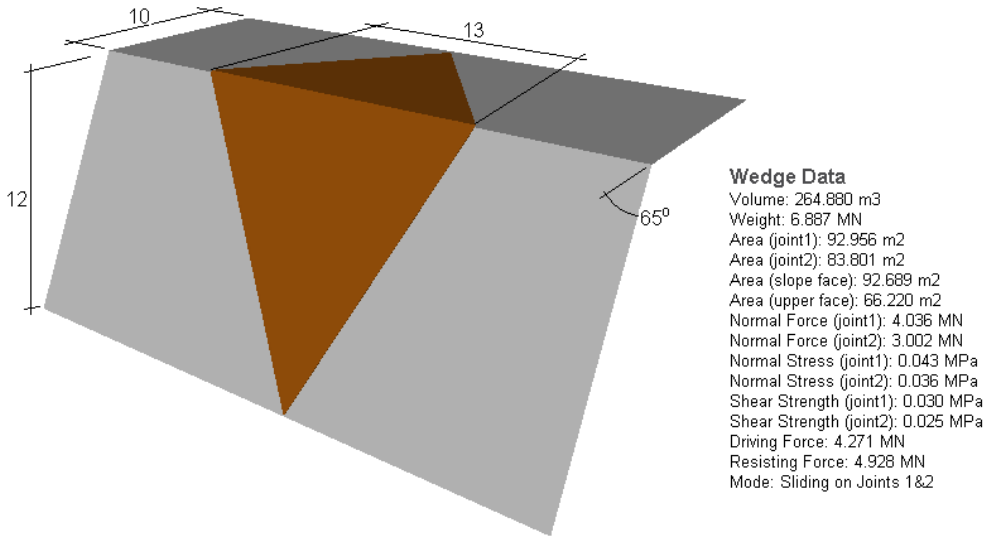


Figure 24. Largest wedge that could develop within a bench. Spill volume analyses indicate that almost all rocks will be retained on the specified 10 m wide berms.

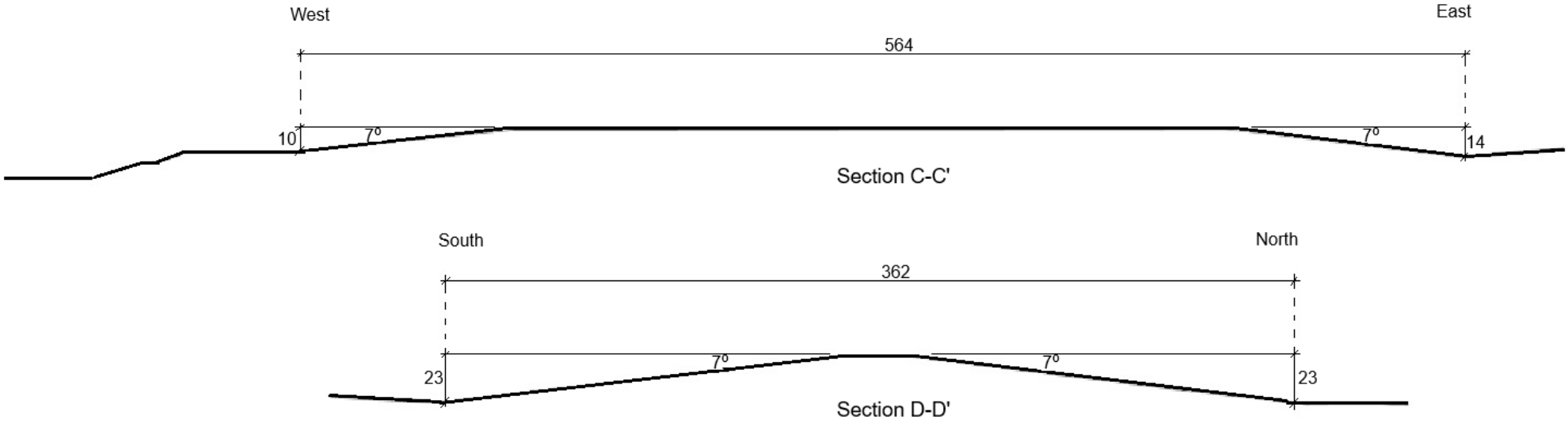


Figure 25. Cross-sections through the steepest slopes of the WRD at the EOML. Refer Figure 2 for locations of cross sections.

ADDITIONAL INFORMATION

- The recommendations in this report have been based on certain assumptions and very few observations. It would be very rare if the conditions at the site did not vary from those observed even if exhaustive investigations had been undertaken. Hence, it is unlikely that the conditions observed will represent the extremes of conditions that exist. As such, even though the aim of this report is to address issues influencing geotechnical related risks applicable to the landforms at the Calliope mine during the PMLU, 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 effects 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 compressive 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[40]) and AS 4133.4.1 9 (1993[41]).

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[42] 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.

Grade	*Number of tests*	*Minimum (MPa)*	*Mean (MPa)*	*Maximum (MPa)*
weathered	4	1.5	2.0	2.6
unweathered	11	2.1	3.6	6.3

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.

$$\text{Density} = \frac{1000\, M_d}{M_w - M_s}$$

[40] 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

[41] 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.

[42] 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.

Grade	*Number of tests*	*Minimum (kg/m³)*	*Mean (kg/m³)*	*Maximum (kg/m³)*
weathered	8	2511	2576	2617
unweathered	10	2575	2631	2679

A1.3 Basic Friction Angles

The basic friction angles[43] (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. Pitting of the surfaces contributes to the values for the weathered rocks being higher than those for the unweathered rocks.

Table A1.3. Summary of basic friction angles test data.

Grade	*Number of tilts*	*Minimum*	*Mean*	*Maximum*
weathered	50	23°	25°	27°
unweathered	54	16°	21°	24°

A1.4 Discontinuity Shear Strengths

Bench scale instabilities within the pits 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[44]. In this study, these strengths are quantified in terms of minimum and mean peak friction angles[45]. 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.

[43] The basic friction angle quantifies the inter-granular friction after all roughness asperities have been abraded from opposing surfaces of a discontinuity.

[44] Assuming rocks are free to move out from a bench.

[45] Any movement along a discontinuity destroys any cohesive bonds leaving a surface that is purely frictional.

The "shape" of the shear strength/normal stress curve is described by the non-linear Barton-Bandis (BB) shear strength criterion[46]. The criterion is defined in terms of the following parameters. Their assumed values are listed in Table A1.4:

- 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[47] (JRC) was quantified by comparing the surfaces of in-situ discontinuities to standard roughness profiles. The values are listed in Table A1.5.

The estimated peak friction angles are listed in Table A1.6. The range of values is typical for limestone. The values for the unweathered limestone are lower than those for the weather limestone as a pitted surface due to weathering increases the shear strength of the surface. The lowest value, 18°, is used in stability analyses as a lower bound shear strength.

Table A1.5. Summary of Joint Roughness Coefficient (JRC) values.

Number of observations	*Minimum*	*Mean*	*Maximum*
532	1	4	10

Table A1.6. Summary of peak friction angles for limestone based on B-B model.

Grade	*Minimum*	*Mean*
weathered	25°	35°
unweathered	18°	32°

[46] 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.

[47] 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.

A1.5 Rock Mass Strengths

The shear strength of the limestone rockmass was estimated using the Generalised Hoek-Brown Rock Mass Strength criterion[48]. The criterion is defined in terms of the parameters listed in Table A1.8.

- 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[49]. A value of 0.5 is applied as controlled blasting is not used and hence benches undergo some disturbance.
- The Geological Strength Index (GSI)[50] is a quantitative value that defines the quality of the rockmass in terms of the parameters[51]:
  - Rock volume (Table A1.7) is a function of the set spacing values listed in Table 1. Characteristics of the sets of discontinuities in the limestone. Only the minimum and mean values are calculated. A maximum value of 1 m^3 is based on observation of oversize rocks[52].

Table A1.7. Summary of block volumes (m^3).

Minimum	*Mean*	*Maximum*
3 x 10^{-14}cc	4.2 x 10^3cc	1.0 x 10^6cc

  - Joint Condition Factor (J_c) is the ratio of the following qualitative parameters from the Q[53] rock mass classification system:
    - Joint Roughness number (J_r) is a function of the surface of the discontinuities. Most surfaces are smooth planar resulting in a value of 1.0/
    - Joint Alteration number (J_a) 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 43 to 24 as the limestone weathers. These values are low, reflecting the highly discontinuous nature of the rock mass. Although the 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.

[48] 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.

[49] D varies from 0 for undisturbed rockmasses to 1 for very disturbed rockmasses.

[50] The geological strength index (GSI) produces quantitative values used to calculate the strength properties of a rockmass.

[51] 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

[52] A maximum value is not calculated as a lack of wide spacing value data produces erroneous results.

[53] Barton and Choubey (1977) The shear strength of rock joints in theory and practice. *Rock Mechanics* **6** 183-236.

Table A1.8. Rock mass shear strength parameters for limestone.

Characteristic		*Grade*	*Minimum*	*Mean*
Intact rock constant, m_i.		all	9	12
Unit weight, (kN/m^3)		weathered	24.6	25.3
		unweathered	25.3	25.8
Disturbance factor, D.		all	0.5	
Uniaxial compressive strength, UCS (MPa)		weathered	27	36
		unweathered	38	65
Rock volume (cm^3)		weathered	100	2000
		unweathered	1000	4200
Joint condition factor, $J_c = J_r/J_a$		weathered	0.3	0.5
		unweathered	1.0	1.3
Geological Strength Index, GSI. (Figure A1.1)		weathered	24	33
		unweathered	38	43
Rock mass shear strength	friction angle	weathered	29^o	35^o
	cohesion (MPa)		0.29	0.60
	friction angle	unweathered	29^o	37^o
	cohesion (MPa)		0.41	1.31

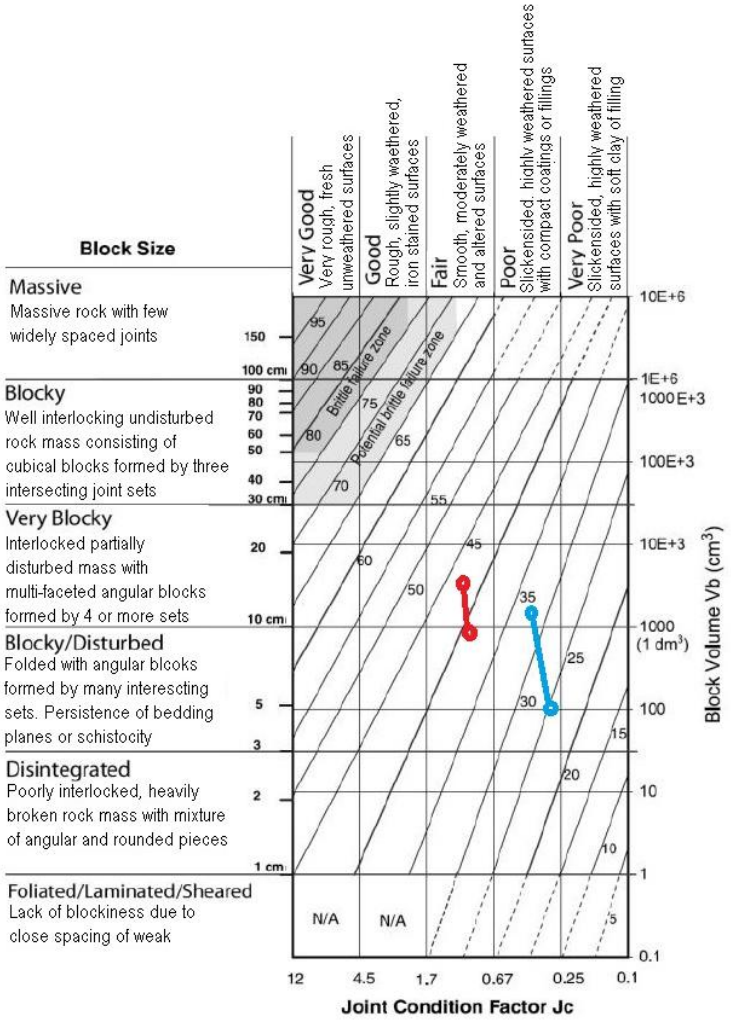


Figure A1.1. Ranges of GSI values for (red) unweathered and (blue) weathered limestone.

A1.6 Rockfill Shear Strength

Table A1.9 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 within the dump 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 A1.9, the friction angle likely ranges from approximately 34^{o} to 40^{o}. As the rocks in the WRD are generally free-draining, the values when saturated will differ little from these values when dry.

Table A1.9. Observed angle of repose and estimated friction angles of weathered rocks in the WRD.

Parameter	*minimum*	*average*	*maximum*
Angle of repose	32^{o}	35^{o}	37^{o}
Estimated friction angle	34^{o}	37^{o}	40^{o}

The friction angle of the materials within the dump can also be estimated by applying a non-linear function proposed by Barton (2008)[54]. The function is defined in terms of the parameters listed in Table A1.10. 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 A1.9. On this basis, a lower bound value of 31^{o} is assumed for the long-term friction angle of the materials.

Table A1.10. Estimated parameters for the weathered waste rock.

Parameter	*Source*	*Value*
Basic friction angle, ϕ_b	A1.2	23^{o}
Compressive strength of intact rock, UCS	A1.1	27MPa
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	6.8MPa
Equivalent roughness, R = *f*[n]	chart	7.3
Friction angle = *f*[S, R, ϕ_b]	calculated	31^{o} to 39^{o}

[54] Shear Strength of Rockfill, Interfaces and Rock Joints, and their Points of Contact in Rock Dump Design. N.R. Barton. Rock Dump 2008, Perth, Australia 15 pages

APPENDIX 2 PIT INTER-RAMP SCALE STABILITY

Stability analyses were undertaken to quantify the likelihoods[55] for discontinuity controlled modes of instabilities at inter-ramp scales[56] in Pit 3-4. The analyses used the stereographic method, implemented in the software Dips[57], to assess whether the kinematics[58] applicable to the benches are conducive to instabilities. The method calculates the proportions of the logged discontinuities that are conducive to masses of rocks:

- sliding from the walls along underling single (planar) or multiple (wedge) discontinuities
- or toppling from the walls bounded to the rear by single 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 for the modes to occur.

The assessments assumed the following:

- The six sets of discontinuities have the orientation characteristics listed in Table 1.
- An inter-ramp angle of 38^o as listed in Table 2.
- The slopes dip towards the medians of the ranges of directions listed in Table 3.
- The shear strengths of the discontinuities transition from a friction angle $\phi = 32^o$ 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[59] to discontinuities that are within "critical zones[60]".
- 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 for 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.

As discussed in Section 3.3.2, discontinuities are likely to generally have medium persistences. A conservative value for P_l of 0.7 is assumed to characterise this feature i.e., 70% of discontinuities may have sufficient persistences to influence inter-ramp scale instabilities.

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.

---

[55] 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.

[56] 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.

[57] The kinematic analysis software, Dips, is produced by Rocscience Inc, Toronto.

[58] 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.

[59] 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.

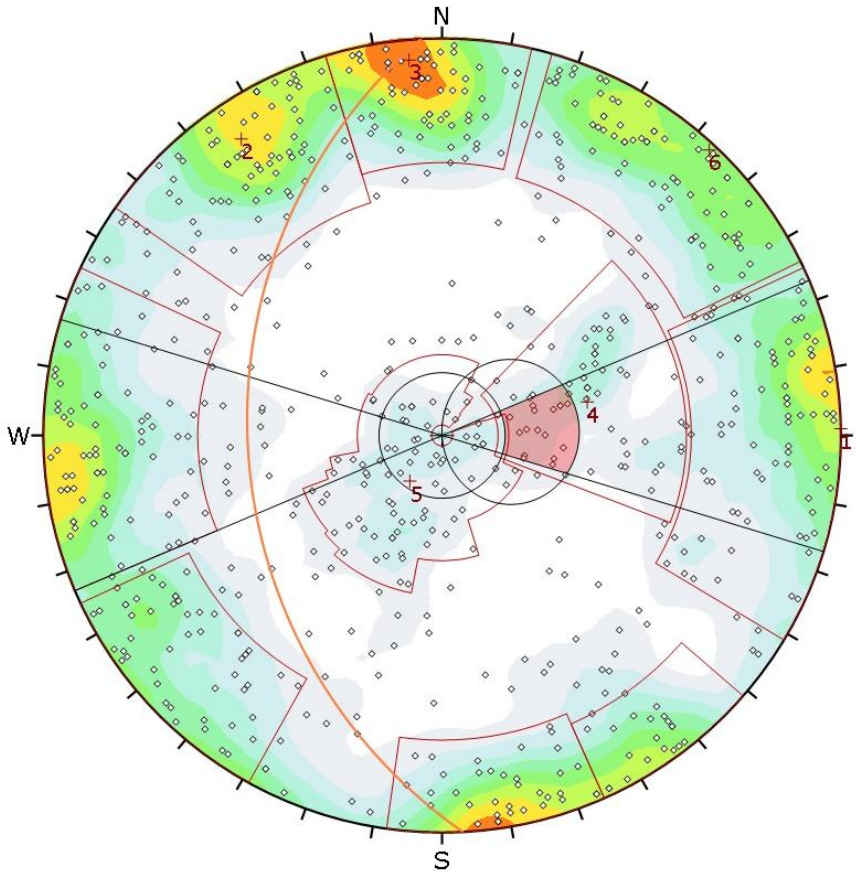
[60] "Critical zones" are areas on a stereonet within which a pole is deemed to have the orientation characteristics conducive to sliding.

Table A2.1. Results of analyses in unweathered limestone ($\phi = 32^{o}$).

	Wall (dip direction)			
	North (151°)	South (330°)	East (267°)	West (082°)
Failure Mode	Percentage of poles in critical area/s (%)			
Planar sliding, P_{fp}	0.0	0.0	0.3	0.1
Wedge sliding, P_{fw}	0.2	0.2	0.3	0.3
Flexural toppling, P_{ff}	1.9	2.2	1.5	1.5
Direct toppling, P_{fd}	3.2	6.4	5.4	5.9
Oblique toppling, P_{fo}	14.3	19.2	17.0	15.4
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	18.8	26.2	23.1	21.9
Likelihood for failure, $P_f = P_u \times P_i$	13.1	18.4	16.2	15.3

Table A2.2. Results of analyses in weathered limestone ($\phi = 18^{o}$)

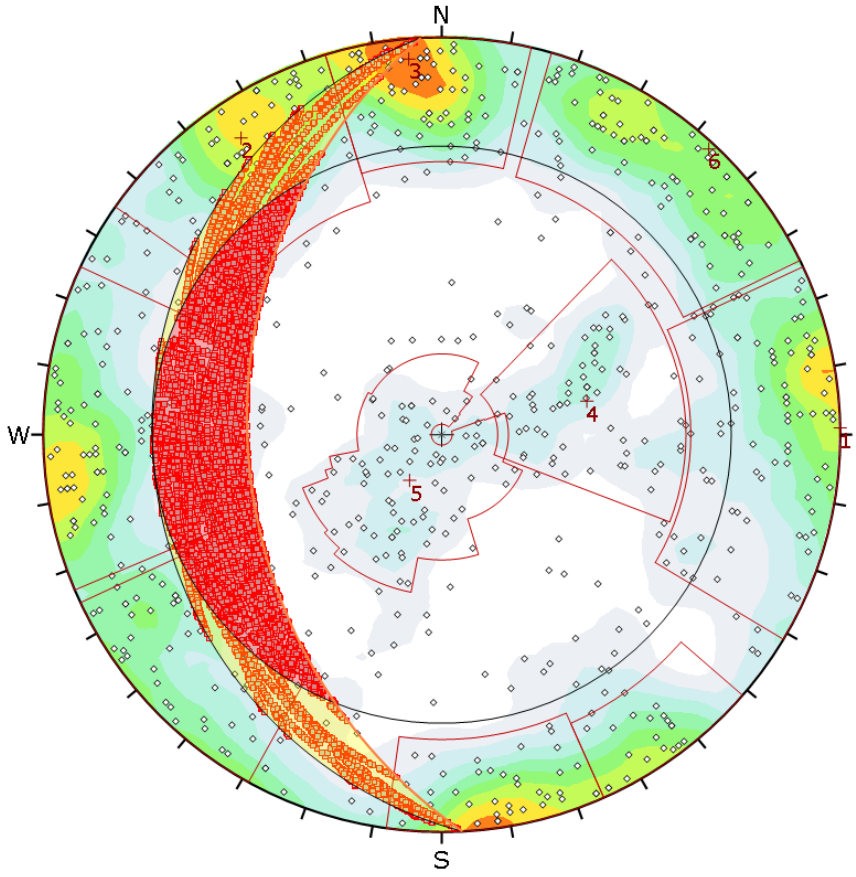
	Wall (dip direction)			
	North (151°)	South (330°)	East (267°)	West (082°)
Failure Mode	Percentage of poles in critical area/s (%)			
Planar sliding, P_{fp}	0.6	0.3	2.3	1.0
Wedge sliding, P_{fw}	4.6	6.0	6.5	4.9
Flexural toppling, P_{ff}	6.1	9.8	8.0	7.6
Direct toppling, P_{fd}	3.2	6.4	5.4	5.9
Oblique toppling, P_{fo}	7.4	10.6	9.5	8.3
Total, $P_u = f(P_{fp}, P_{fw}, P_{ff}, P_{fd}, P_{fo})$	20.1	29.3	28.1	24.9
Likelihood for failure, $P_f = P_u \times P_i$	14.1	20.5	19.7	17.4



Kinematic Analysis	Planar Sliding		
Slope Dip	38		
Slope Dip Direction	267		
Friction Angle	18°		
Lateral Limits	20°		
	Critical	Total	%
Planar Sliding (All)	17	726	2.34%
Planar Sliding (Set 30: 4)	17	64	26.56%

Plot Mode	Pole Vectors
Vector Count	726 (726 Entries)
Hemisphere	Lower
Projection	Equal Angle

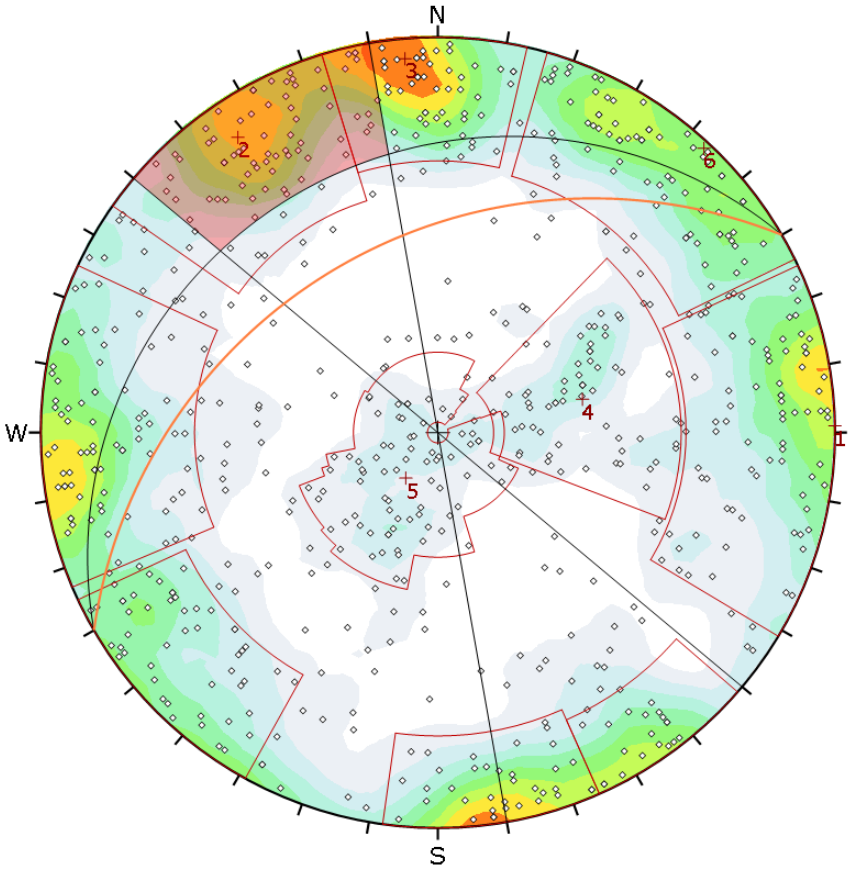
Figure A2.1. Stereonet applicable to planar sliding on the east wall during the long-term.



Kinematic Analysis	Wedge Sliding		
Slope Dip	38		
Slope Dip Direction	267		
Friction Angle	18°		
	Critical	Total	%
Wedge Sliding	17119	263124	6.51%

Plot Mode	Pole Vectors
Vector Count	726 (726 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	263124
Hemisphere	Lower
Projection	Equal Angle

Figure A2.2. Stereonet applicable to wedge sliding on the east wall during the long-term.

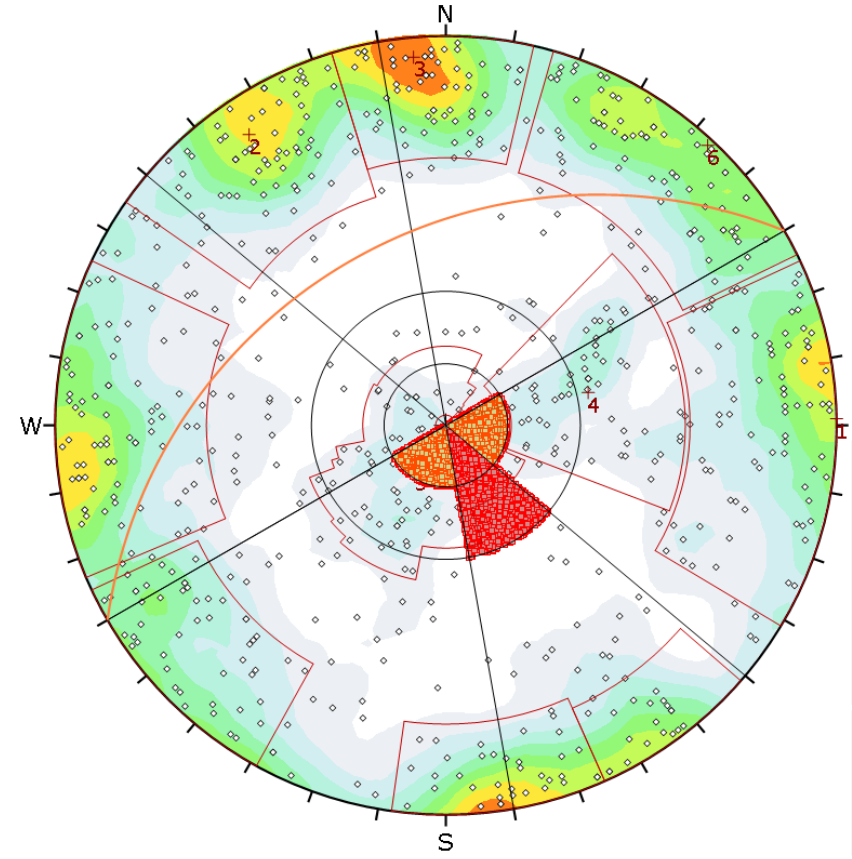


Kinematic Analysis	Flexural Toppling
Slope Dip	38
Slope Dip Direction	330
Friction Angle	18°
Lateral Limits	20°

	Critical	Total	%
Flexural Toppling (All)	71	726	9.78%
Flexural Toppling (Set 27: 2)	61	89	68.54%
Flexural Toppling (Set 31: 3)	10	98	10.20%

Plot Mode	Pole Vectors
Vector Count	726 (726 Entries)
Hemisphere	Lower
Projection	Equal Angle

Figure A2.3. Stereonet applicable to flexural toppling on the south wall during the long-term.



Kinematic Analysis	Direct Toppling
Slope Dip	38
Slope Dip Direction	330
Friction Angle	18°
Lateral Limits	20°

	Critical	Total	%
Direct Toppling (Intersection)	16844	263124	6.40%
Oblique Toppling (Intersection)	27938	263124	10.62%
Base Plane (All)	21	726	2.89%
Base Plane (Set 30: 4)	1	64	1.56%
Base Plane (Set 32: 5)	20	77	25.97%

Plot Mode	Pole Vectors
Vector Count	726 (726 Entries)
Intersection Mode	Grid Data Planes
Intersections Count	263124
Hemisphere	Lower
Projection	Equal Angle

Figure A2.4. Stereonet applicable to direct and oblique block toppling on the south wall during the long-term.

APPENDIX 3 PIT WALL SCALE STABILITY

The stabilities of wall scale surfaces through the highest and steepest walls[61] in both pits and through the north wall of Pit 3-4 were assessed using a limit-state equilibrium method implemented in the software *Slide2*[62]. The two-dimensional analysis code is applicable for these walls as they are wide relative to their heights and they are relatively straight.

The following characteristics were assumed:

- The walls have the specifications listed in Table 2. Figures A3.1 to A3.3 show the specifications. In both pits weathered limestone is underlain by less weathered limestone.
- The shear strength characteristics of the limestone rockmass is described by Generalised Hoek-Brown shear strength models discussed in Appendix A1.5. Lower bound values are assumed as these values become progressively more applicable over 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 $90^o \pm 20^o$. This strength is described by the Barton-Bandis (B-B) discontinuity shear strength criterion defined in terms of the parameters listed in Table A1.4. Conservative values applicable to weathered limestone are assumed (i.e., $\phi = 18^o$).
- A PGA of 0.001g is represented as a pseudo-static horizontal force directed out of the wall. The horizontal component (A_H) of the acceleration is conservatively[63] estimated by $A_H = k_H \times A_e$ where $k_H = 0.45$. On this basis, $A_H = 0.0005g$.
- Two groundwater scenarios are considered for both pits: no water and water at 40 mRL, the level of the spillway on the dam wall.

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 A3.3 to A3.7. The results of the analyses are discussed in Section 6.3.

[61] 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.

[62] *Slide2 Ver 9.02* is developed by RocScience Inc. Toronto, Ontario.

[63] 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).

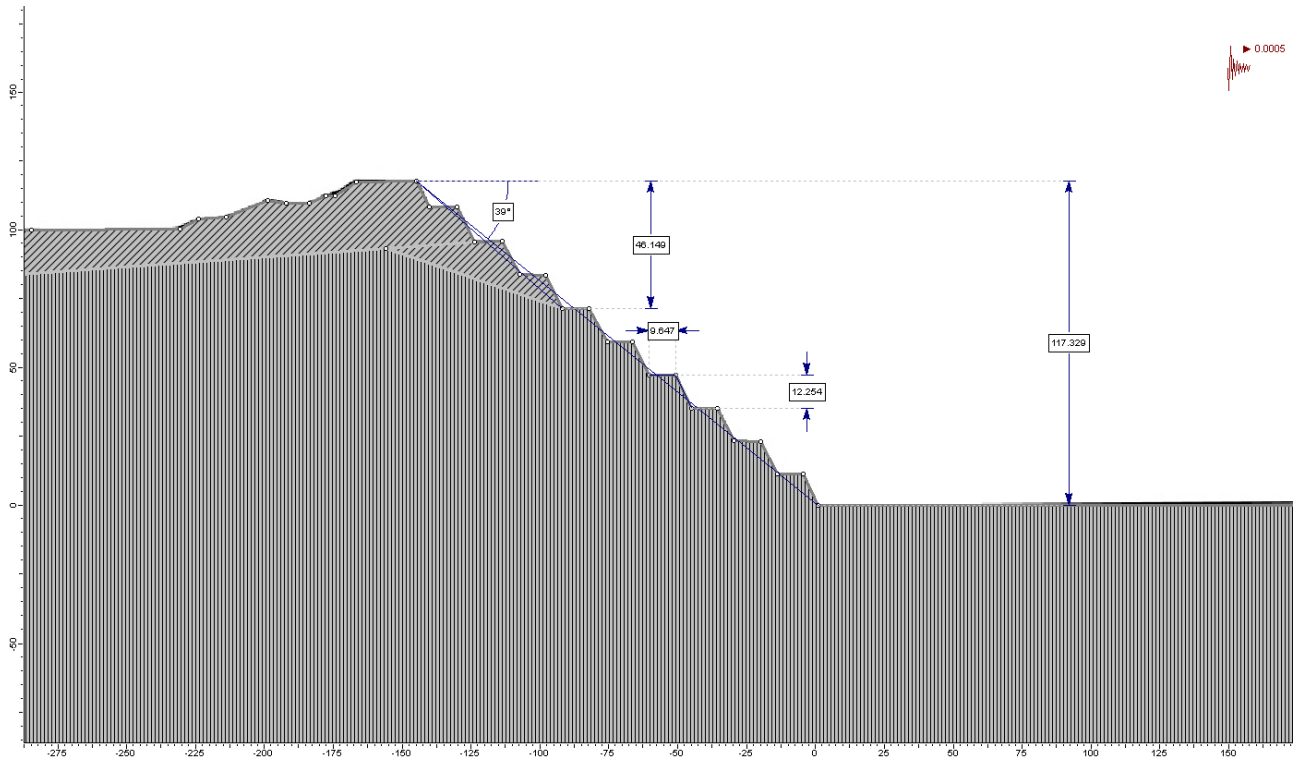


Figure A3.1. Cross-section through the west wall of Pit 3-4.

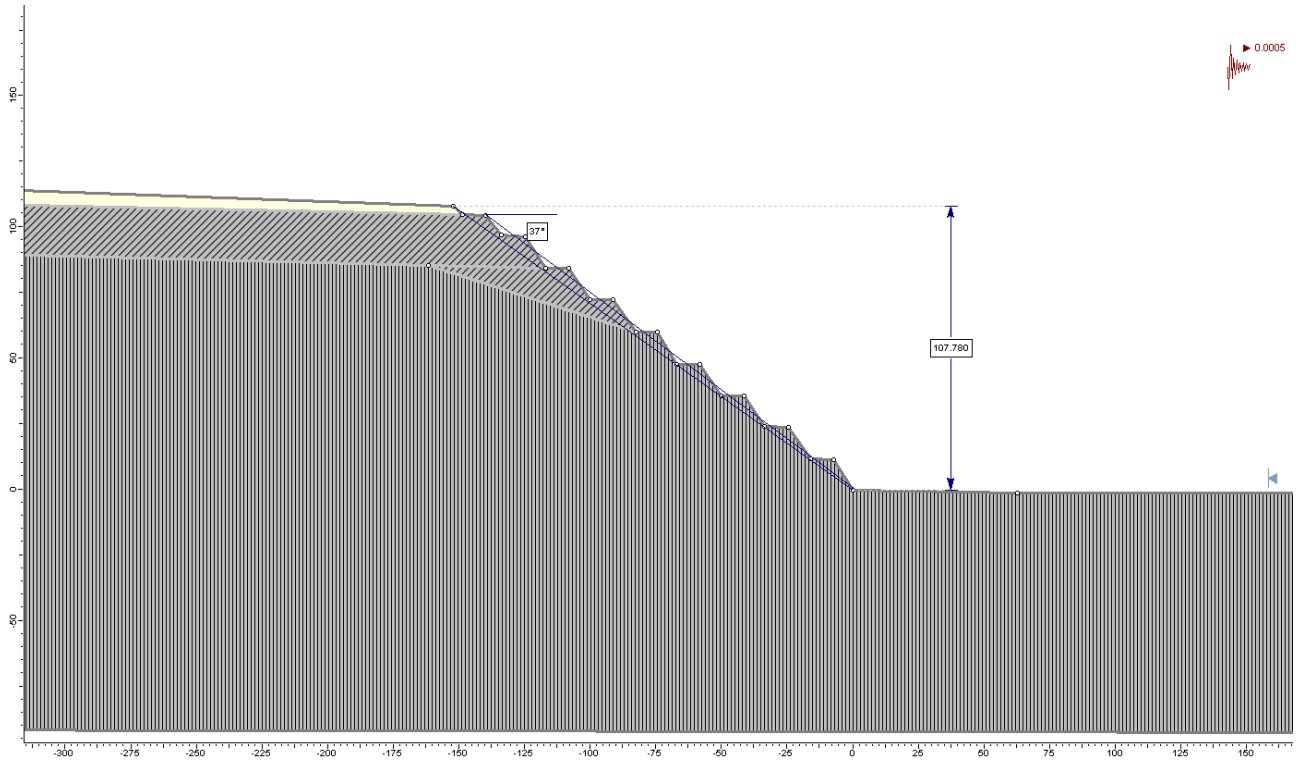


Figure A3.2. Cross-section through the north wall of Pit 3-4.

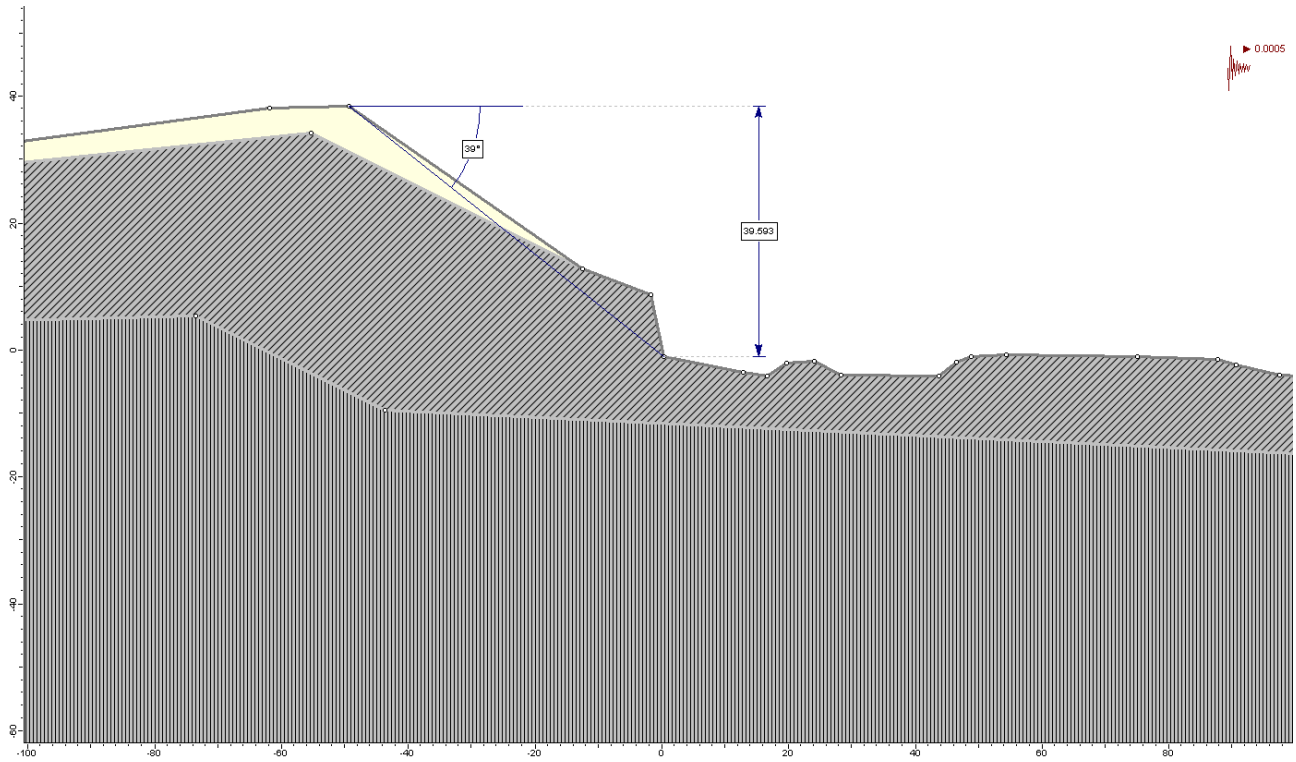


Figure A3.3. Cross section through the west wall of Pit 2.

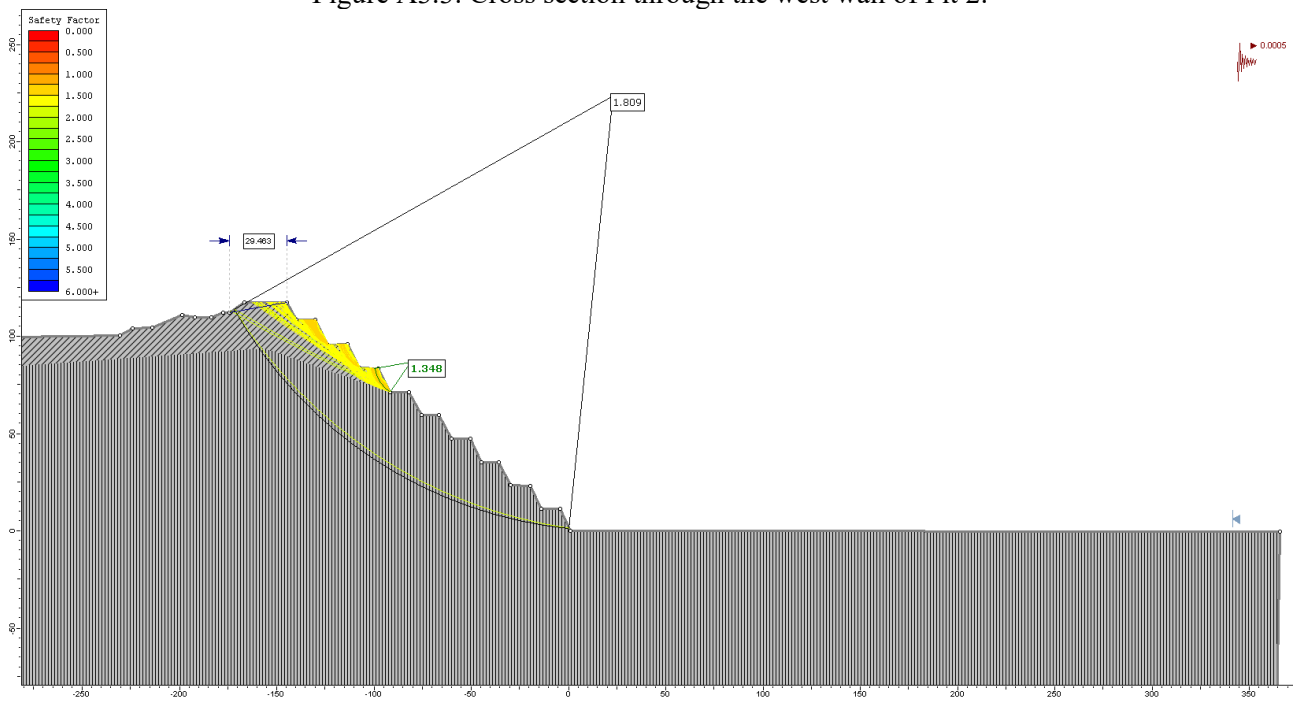


Figure A3.4. Highlighted are surfaces within the west wall of Pit 3-4 that have FoS values less than 1.8.

.

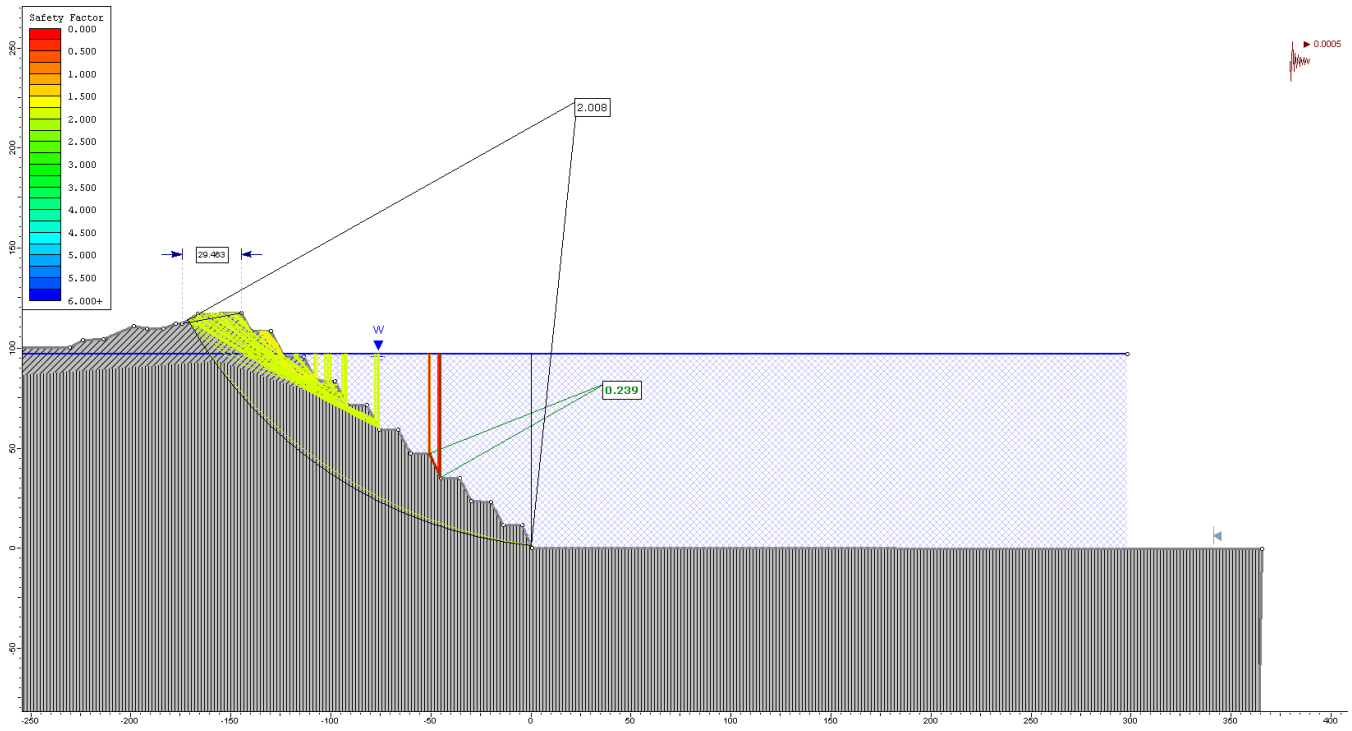


Figure A3.5. Highlighted are surfaces within the west wall of Pit 3-4 as a lake having FoS values less than 2.0.

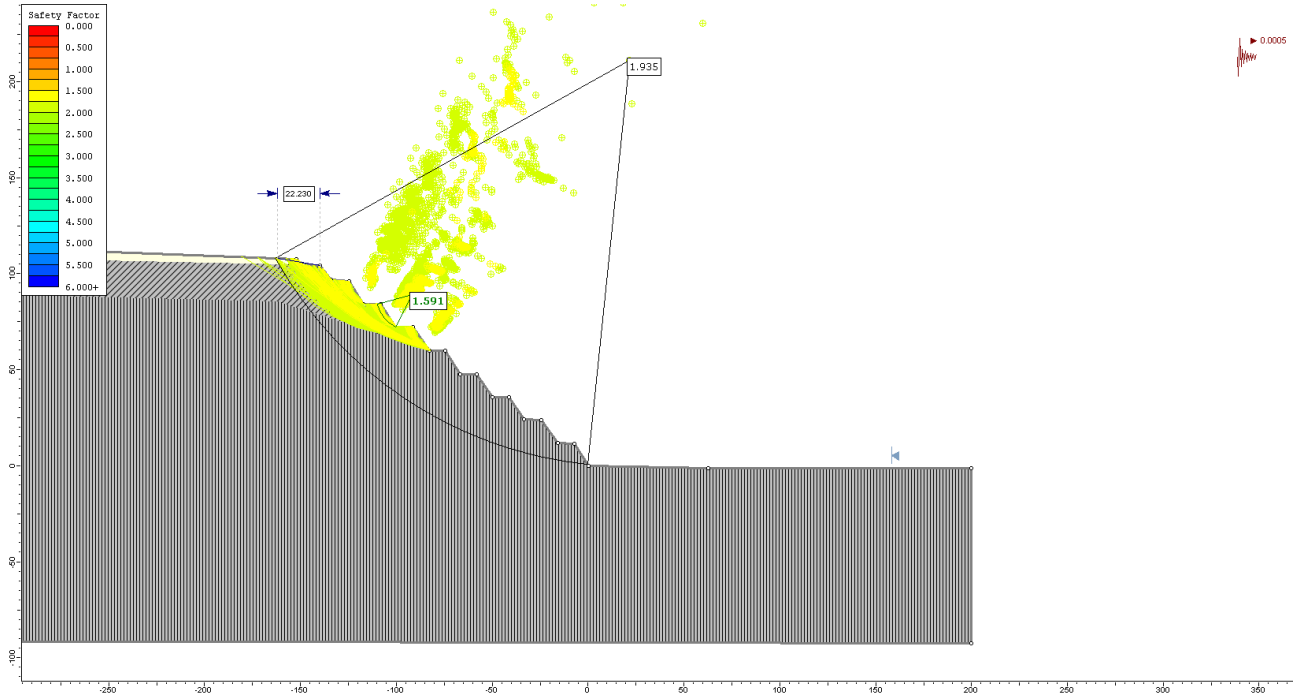


Figure A3.6. Highlighted are surfaces within the north wall of Pit 3-4 having FoS values less than 1.9.

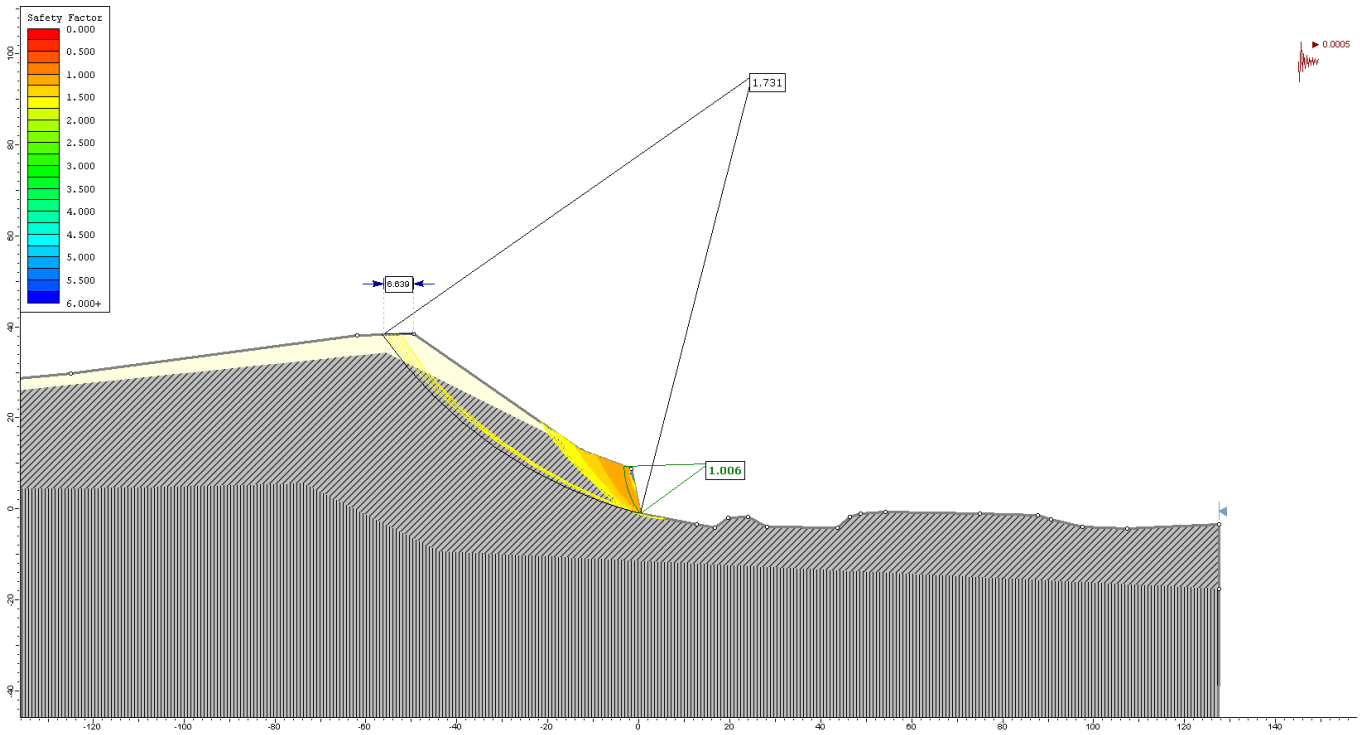


Figure 3.7. Highlighted are surfaces within the west wall of Pit 2 that have FoS values less than 1.7.

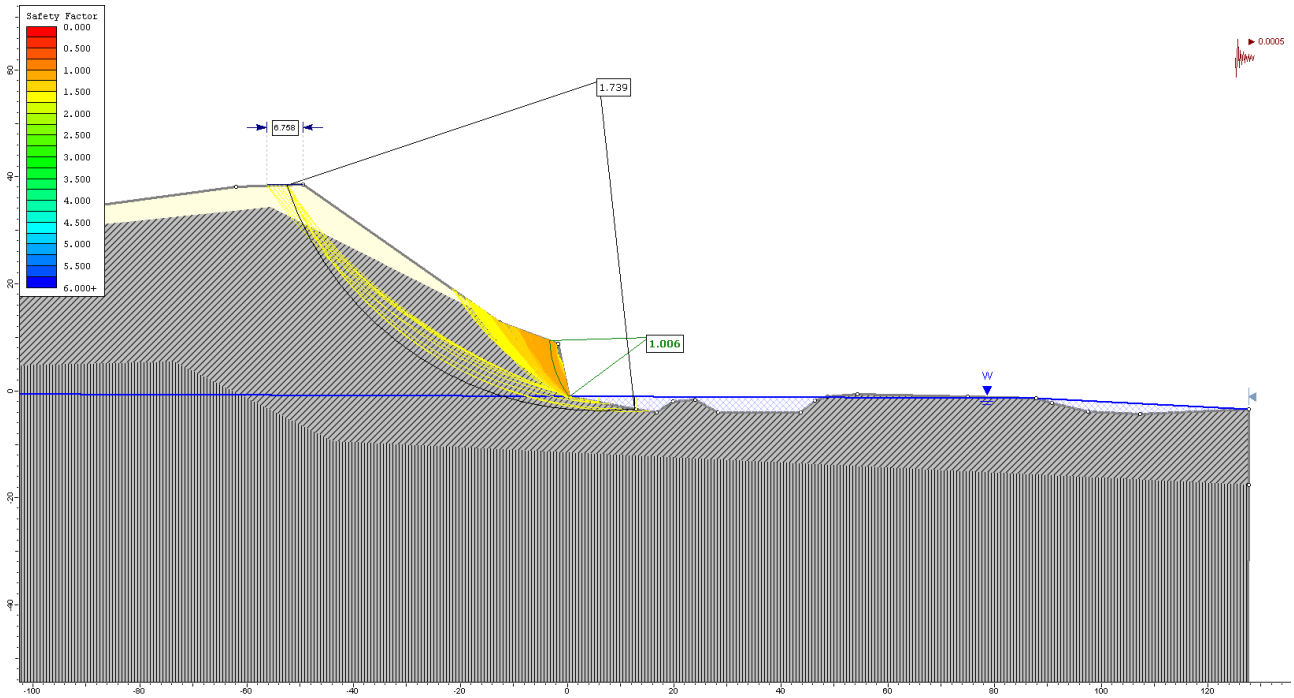


Figure A3.8. Highlighted are surfaces within the west wall of Pit 3-4 with water at floor level having FoS values less than 1.74.

APPENDIX 4 WRD SLOPE STABILITY

The stabilities of surfaces through the highest slope of the WRD was 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 8.
- The shear strength characteristics of all materials are described using a linear Mohr-Coulomb model defined in terms of a friction angle and a cohesion:
  - The footings comprise clayey silt defined in terms of a friction angle of 25° and a cohesion of 45 kPa, as discussed in Section 3.2.1.
  - The materials within the dump are defined in terms of a conservative 25° friction angle, as discussed in Section A1.6 in Appendix 1. This value is likely to be appropriate during the long-term.
- As evidenced by observation, the materials within the dump are assumed to be permeable. Water that infiltrates the surfaces and does not subsequently evaporate, seeps from the down contour toe. Excess hydrostatic pressures do not develop within the materials.
- Earthquake loading applies an acceleration of 0.0005, 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 7.1.

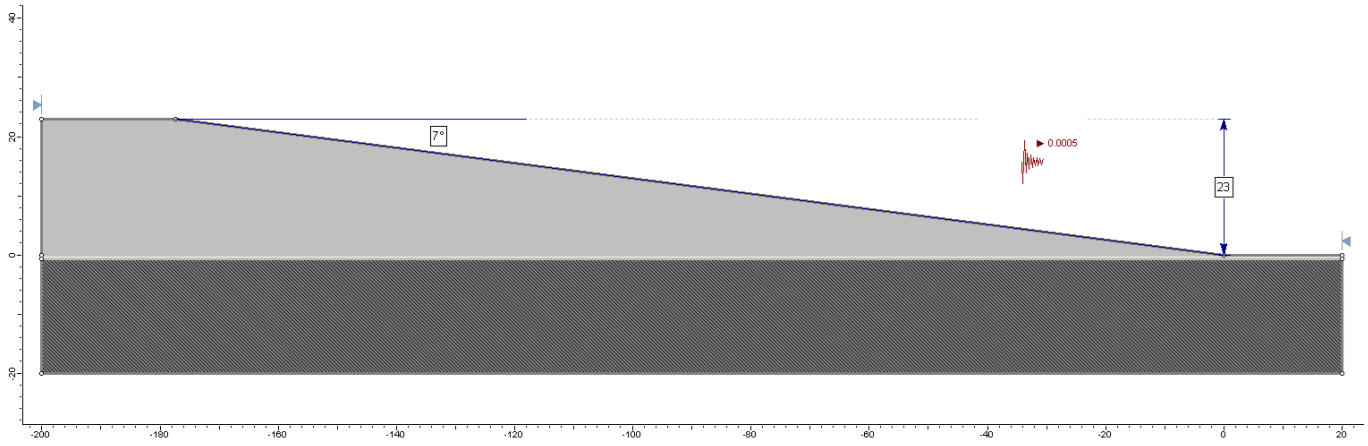


Figure A4.1. Cross-section through the highest slope of the WRD.

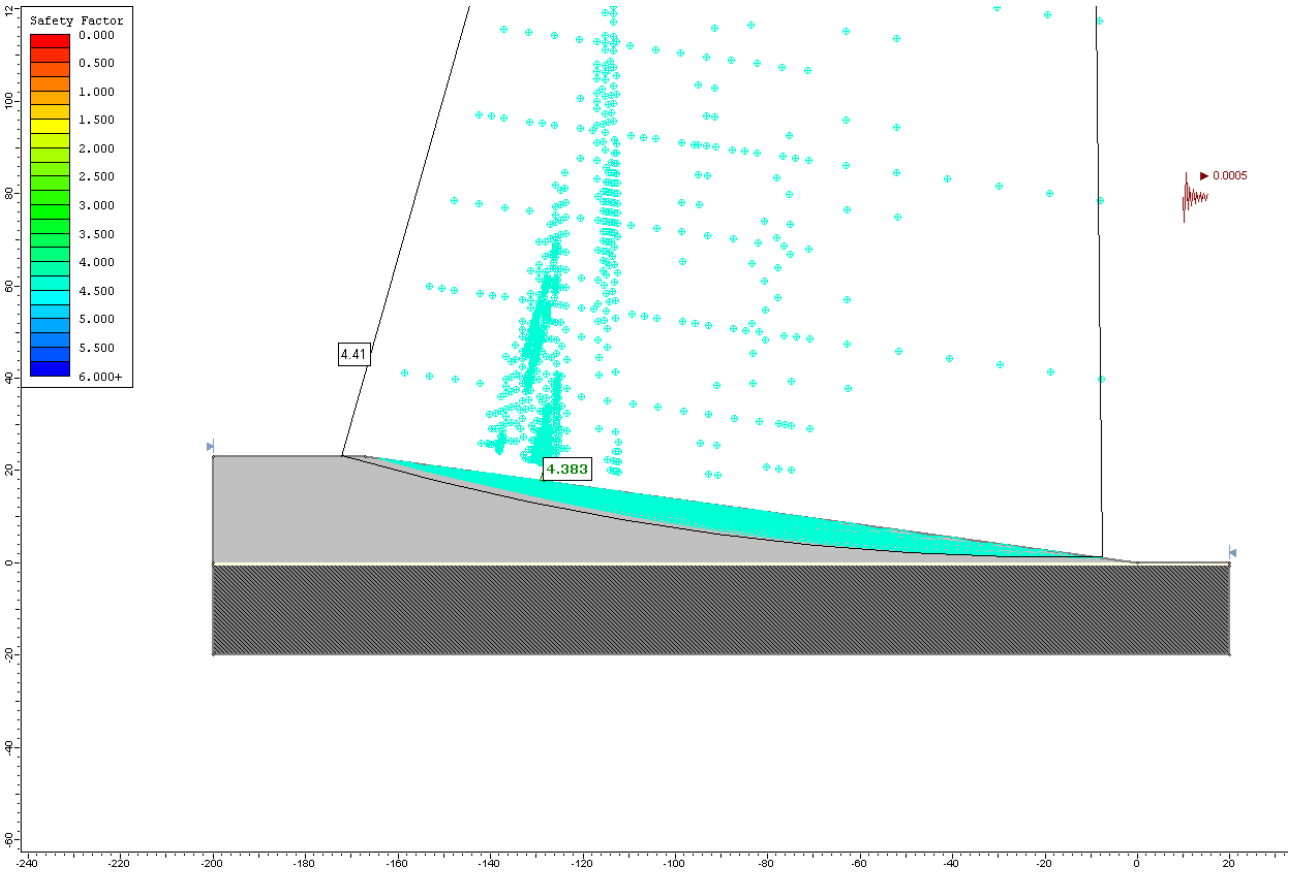


Figure A4.2. Highlighted are surfaces within the WRD having the lowest FoS values. All values exceed 4.4.

APPENDIX 5 BENCH SCALE ROCKFALL ANALYSES

A series of rockfall simulations[64] were undertaken to inform an understanding of the trajectories of rocks that release from and traverse down a final batters in Pit 3-4 and the likelihoods for these rocks to traverse over the crest of the berm. The simulations used the rigid block method as implemented in the software *Rocfall2*[65]. This two-dimensional analysis code is applicable as no evidence has been observed indicating that falling rocks traverse significant distances in the third dimension i.e. along strike of a batter.

- Figure 23 is the cross section of the bench. It is 12 m high with a 65^{o} batter angle. The berm is 10 m wide and contains a 1 m high edge bund. These values are consistent with the values listed in Table 2.
- Table A5.1 lists the values of the parameters assumed for the rebound characteristics of the batter and the berm[66]. The batter is assumed to comprise exposed rocks; the berm to comprise fines and rockfall debris.
- Tables A5.2 and A5.3 summarise the sizes and shapes assumed for the rocks based on observation (Figure A5.1). The shapes are typically rounded and non-rounded blocks (i.e., uniform side lengths) and rounded and non-rounded rectangles (i.e., non-uniform side lengths).

The source for the rocks is assumed to be the crest; rockfalls being triggered by overland flows. This assumption is conservative as rocks typically fall from anywhere on a batter. A simulation involved generating a thousand rocks.

Figure 23 shows the trajectories of 1000 rocks generated. None of the rocks traverses beyond the edge bund. The combination of a 10 m wide berm and 1 m high edge bund is likely to be sufficient to terminate the trajectories of rocks that detach from the adjacent batters.

Table A5.1. Normal distribution parameters assumed for the batter.

Parameter	*Normal restitution*	*Tangential restitution*	*Dynamic friction*	*Rolling friction*
Mean	0.45	0.85	0.75	0.40
Standard deviation	0.04	0.04	0.04	0.04
Relative minimum	0.12	0.12	0.12	0.12
Relative maximum	0.12	0.12	0.12	0.12

[64] The simulations used the software Rocfall2.

[65] The proprietary software Rockfall 2 Version 8.024 is developed by Rocscience.

[66] Some values of the parameters listed in Table A5.1 are different to the default values suggested by Rocscience. The four mean values "suggested" by Rocscience for the normal and tangential coefficients of restitution (0.35 and 0.85) and the coefficients of dynamic and rolling friction (0.75 and 0.40) are default values. Some, or all, values rarely reflect the actual values at any site as the geology, surface characteristics and profile and weathering characteristics differ between sites. Rocscience provides tables of values that have been used by other practitioners. In these tables, the ranges of coefficients and the mean value assumed in the report are approximately those as follows: normal restitution: 0.25 to 0.60 (0.45), tangential restitution: 0.55 to 0.95 (0.85), dynamic friction: 0.5-inadequate data (0.75) and rolling friction: 0.4 to 0.9 (0.4). The values used in the current study are within the ranges applied by other practitioners. The upper bound value for dynamic friction seeks to quantify the significant braking effect the roughness of the weathered surface and rocks have on sliding. The values assumed in this study are deemed appropriate based on observations of the trajectories of rocks that have fallen within the pits at this site. The end locations of the rocks in the simulations are acceptably similar to the actual end locations of the rocks that have ended up on the berms, ramps and pit floors, which provides evidence that the values assumed for the parameters are "in the ballpark".

Table A5.2. Normal distribution parameters assumed for the berm.

Parameter	*Normal restitution*	*Tangential restitution*	*Dynamic friction*	*Rolling friction*
Mean	0.32	0.80	0.50	0.30
Standard deviation	0.04	0.04	0.04	0.04
Relative minimum	0.12	0.12	0.12	0.12
Relative maximum	0.12	0.12	0.12	0.12

Table A5.2. Parameters assumed for the rocks.

Parameter	*Edge length (m)*	*Volume (cc)*	*Mass (kg)*	*Density (kg/m^3)*
Mean	0.20	7,990	21.1	2,650
Standard deviation	0.05	3,560	9.4	50
Relative minimum	0.19	7,391	19.5	200
Relative maximum	0.80	22,230	56.7	50

Table A5.3. Shapes assumed for the rocks.

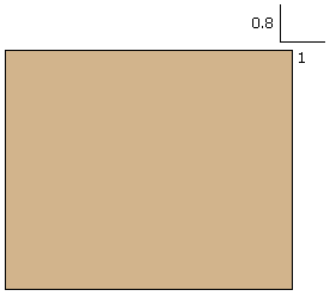
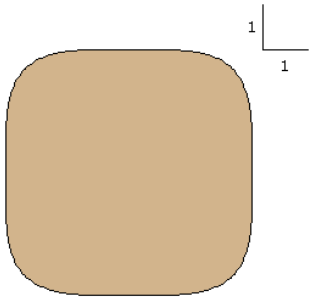
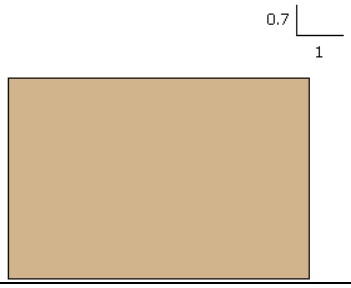
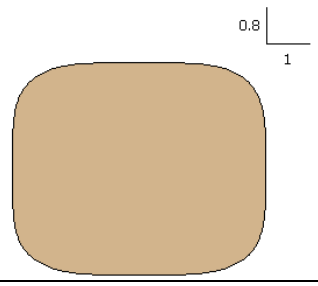
Blocks	*Rounded blocks*
	
	



Figure A5.1. Typical muckpile highlighting the range of rock shapes and sizes generally exposed on the benches. The sizes and shapes generated in the simulation are consistent with these observations.

APPENDIX E HYDROGEOLOGICAL ASSESSMENT

GRAYMONT

Calliope

Hydrogeological Assessment for Operations Progressive Rehabilitation and Closure Plan and Environmental Authority amendment



Contributors: **Mineral Resource Development**
Operations
Consultants

GRAYMONT

Rev	Date	Prepared By	Comments
3	June 2025	Ian Oppy	Hydrogeological Report for PRC Plan
2	February 2024	Stephen Feiss	Hydrogeological Report for PRC Plan
1	March 2023	Stephen Feiss	Hydrogeological Report for PRC Plan

FORWARD

This Hydrogeological Assessment report has been prepared to support a Progressive Rehabilitation and Closure (PRC) Plan application in consideration of a planned EA (EA) amendment.

The previous Hydrogeological Report version 2 (v2) was prepared by Steve Feiss who was site hydrogeologist for Sibelco from 2013-18 and for Graymont from 2022-24. This version (v3) has been prepared by Ian Oppy who was Sibelco's hydrogeologist from 2010-13, 2018-19 and for Graymont since 2010. The report versions have many common threads but there is a technical difference between v2 and v3 with change of authorship.

Elevated water levels in Pit 3 following large rainfall events were attributed in v2 to be from leakage through the western bund wall, in conjunction with large groundwater volumes entering the pit void by groundwater discharge. A final pit void (Pit 3-4) Water Balance based on this technical understanding predicted extreme groundwater inflows and a high storage volume of pit water which could potentially overflow into Awoonga Dam.

Historical and further investigations in 2025 are outlined in this report, which demonstrate that elevated water levels in Pit 3 following large rainfall events are from surface water capture and that there is little groundwater flow at the Calliope mine. Multiple lines of evidence include water investigative drilling; surface water and groundwater sampling and characterisation of Pit 3 water flow using data logger water level results. A final void Pit 3-4 Water Balance Model has been constructed based on the technical understanding outlined in this report and a prediction made of water fill in Pit 3-4 final void. The future climate is predicted to be hotter and drier and with increased evaporation pit water level will equilibrate within the final pit void with no overflow to Awoonga Dam.

GRAYMONT

CONTENTS

1 INTRODUCTION 1

1.1 Project Location 1

1.2 Report Structure 4

1.3 Assessment Method 12

2 REGULATORY FRAMEWORK 14

2.1 Project Environmental Approvals 14

2.1.1 Water License 14

2.1.2 Environmental Authorities 14

2.2 PRC Plan 17

3 PROJECT SETTING -BOYNE RIVER BASIN 18

3.1 Boyne River Basin and Calliope 18

3.2 Environmental values 20

3.2.1 Upper northern creeks 20

3.2.2 Awoonga Dam 20

3.2.3 Groundwater 20

3.3 Climate 20

3.3.1 Rainfall and evaporation data used for final void Water Balance model 21

3.4 Topography 23

3.5 Regional Geology 24

3.6 Land use and local resources 25

3.7 Vegetation 25

3.8 Surface water 25

3.9 Regional Groundwater and its beneficial use 25

3.9.1 Regional groundwater recharge and discharge 25

3.9.2 Regional groundwater bores 25

4 PROJECT DESCRIPTION – CALLIOPE 28

4.1 Mining voids and mining created sub-catchments 28

4.1.1 Site History 28

4.1.2 Mining Summary 29

4.1.3 Mining created sub-catchments 29

4.2 The Calliope Geology 36

4.3 Soils 39

4.4 Voids, mineral dissolution salt stores 39

4.5 Quarry aquifers and aquitards 40

4.6 Environmental values 41

4.6.1 Potential impacts to Calliope Environmental values 42
4.6.2 Potential contaminants 42
4.6.3 Mechanisms of potential impacts and risks to environmental values 42
4.6.4 Monitoring – asssessing against Water Quality Guidelines 44
5 CALLIOPE WATER INVESTIGATIONS 45
5.1 Predicted water impacts in Pit 3 prior to raising the western bund wall 47
5.2 Source of excess water in Pit 3 49
5.2.1 Awoonga Dam possible leakage to Pit 3 50
5.2.2 Groundwater seepage contribution to Pit 3 water 52
5.2.3 Surface water source of excess water in Pit 3 56
5.3 Groundwater behaviour from investigative water drilling 59
5.3.1 Interpreting drilled water intersections 59
5.3.2 Pit 3 investigative drilling in 2018 59
5.3.3 Site-wide investigative drilling in 2025 59
6 CONCEPTUAL MODEL OF PIT WATER 70
6.1 Pit 3-4 void Conceptual Model 70
7 PROJECT HYDROGEOLOGY 72
7.1 Pit water 72
7.1.1 Pit water level and void capacities 72
7.1.2 Surface water inflow to pit voids 72
7.1.3 Final landform abandonment bund 72
7.1.4 Stratification of pit water bodies 72
7.1.5 Pit water pumping 73
7.1.6 Pit water chemistry 73
7.1.7 Potential contaminants in pit water 74
7.2 Surface water release 76
7.3 Groundwater inflow to pit void 78
7.3.1 Resource definition and production drilling 78
7.3.2 Groundwater Monitoring Network 80
7.3.3 Aquifer hydraulic properties 82
7.3.4 Groundwater recharge and discharge 82
7.3.5 Groundwater level and flow 83
7.3.6 Groundwater Chemistry 84
7.3.7 Potential contaminants in groundwater 88
7.3.8 Groundwater use and re-use 90
7.4 Awoonga Dam water interaction with pit voids 90
7.4.1 Awoonga Dam water level 90

7.4.2 Pit water discharge to Awoonga Dam 91
7.4.3 Awoonga Dam interaction with Pit 3 91
7.4.4 Awoonga Dam interaction with Pit 4 91
8 WATER BALANCE MODEL OF FINAL PIT VOID 92
8.1 Methodology 92
8.1.1 Pit 3 Water Balance modelling 92
8.1.2 Surface water runoff coefficents 92
8.1.3 Pit 3-4 Water Balance Model setup from from Pit 3 Water Balance Model 93
8.2 Predicted pit water fill 95
8.3 Model uncertainty and sensitivity testing 96
8.4 Predicted water quality 96
9 WATER MANAGEMENT 97
9.1 Water Management Plan 97
9.1.1 Water Use and Water Supply 97
9.1.2 Potential surface water contaminant sources 98
9.1.3 Surface water Release 98
9.2 Groundwater Management and Monitoring Plan 99
9.2.1 Water Use and Water Supply 99
9.2.2 Potential groundwater contaminant sources 99
9.2.3 Groundwater affecting activities and impacts 99
9.3 Compliance Monitoring and Reporting 99
10 REFERENCES 100

FIGURES

Figure 1 Calliope Tenure Map 1
Figure 2 Calliope Property Map 2
Figure 3 Site Map 3
Figure 4 Surface water and groundwater monitoring locations 15
Figure 5 Boyne River Basin (from Boyne River Basin Plan) 18
Figure 6 Ragotte Creek catchment 19
Figure 7 Monthly Rainfall, Evaporation and Temperature 1975-2025 21
Figure 8 Climate categories 21
Figure 9 Boyne River Basin Global Climate Model scenarios 22
Figure 10 Regional topography 23
Figure 11: Regional Geology 24
Figure 12 Bores within 9km of Calliope from QGlobe 26
Figure 13: Calliope 29 November 1969 28
Figure 14 Pit 3 catchment in June 1997 30
Figure 15 Spoil heaps used in the construction of the Western Bund wall (GAWB, 2002) 31
Figure 16 Pit 3 void and Farm Dam sub-catchments in September 2004 32
Figure 17 Pit 3 and Farm Dam sub-catchments November 2012 33

Figure 18 Mine sub-catchments 34
Figure 19 Calliope geology 36
Figure 20 Black mafic volcanic in the eastern wall of Pit 4 (from Rocktest, 2023) 37
Figure 21 Weathering of limestone in the western wall of Pit 4 37
Figure 22 Cross-section 7332650N showing Pit 4 geology 38
Figure 23 Cross-section 7332175N showing Pit 4 geology 38
Figure 24 Cross-section 7332650N showing Pit 4 geology and groundwater intersections 40
Figure 25 Cross-section 7332175N showing Pit 4 geology and groundwater intersections 41
Figure 26 Mining area map (Kalf and Associates, 2003) 48
Figure 27 Pit 3 sectional conceptual model (Kalf and Associates, 2003) 48
Figure 28 Pit 3 sectional numerical model (Kalf and Associates, 2003) 49
Figure 29 Surface water salinity sampling results 2011 and 2018 51
Figure 30 Awoonga Dam with Pit 3 and Farm Dam sub-catchment major ion chemistry 52
Figure 31 Map of groundwater investigative drilling in 2018 53
Figure 32 The Seep and groundwater seepage into Pit 3 – 4 March 2015 54
Figure 33 Groundwater chemistry and seepage into Pit 3 56
Figure 34 Western bund wall surface water flow into Pit 3 on 22 February 2015 57
Figure 35 Calibration events obtained in Pit 3 from January 2017 to April 2018 57
Figure 36 Awoonga Dam with Pit 3 and Farm Dam major ion chemistry 58
Figure 37 Drilled groundwater intersection types 59
Figure 38 Groundwater Investigative drilling with surface water sites 2025 61
Figure 39 Groundwater level May 2025 63
Figure 40 Water sampling results for bicarbonate 2025 65
Figure 41 Water sampling results for chloride 2025 66
Figure 42 Water sampling results for sulphate 2025 67
Figure 43 Investigative drilling 2025 with 2018 drillhole data 68
Figure 44 Pit Water Conceptual Model of future combined Pits 3-4 70
Figure 45 Pit 3 and Pit 4 major ions water chemistry 72
Figure 46 Pit 3 and Pit 4 major ions water chemistry 73
Figure 47 Sulphate in discharge water, pit water, other surface water and groundwater 75
Figure 48 Groundwater Monitoring Network 81
Figure 49 FM5, FM5B and FM6 groundwater levels 83
Figure 50 FM5, FM5B and FM6 groundwater levels with Awoonga Dam water level 84
Figure 51 FM5, FM5B and FM6 salinity 85
Figure 52: FM5, FM5B and FM6 groundwater pH with bicarbonate 85
Figure 53: FM5, FM5B and FM6 calcium and groundwater level 86
Figure 54: FM5, FM5B and FM6 bicarbonate and groundwater level 86
Figure 55: FM5, FM5B and FM6 sodium and groundwater level 87
Figure 56: FM5, FM5B and FM6 chloride and groundwater level 87
Figure 57: FM5, FM5B and FM6 magnesium and groundwater level 88
Figure 58: FM5, FM5B and FM6 sulphate and groundwater level 89
Figure 59 Awoonga Dam water level 1969-2019 (Boyne River Water Basin Plan, 2019) 91
Figure 60 Water Balance Model precited water level behaviour post mining 95
Figure 61 Water Balance Model with groundwater increased to 25l/s 96

GRAYMONT

TABLES

Table 1 Cross-Reference Report Table 12
Table 2 Calliope EAs 14
Table 3 Surface water release points 14
Table 4 Surface Water Contaminant release limits 16
Table 5 Groundwater trigger values 16
Table 6 Groundwater monitoring frequency 17
Table 7 Boyne River Basin Environmental values relevant to Calliope 20
Table 8 Registered bores constructed in Calliope Beds within 9km of the Calliope 27
Table 9 Calculation of dissolved minerals 39
Table 10 Potential impacts to Calliope Environmental values 42
Table 11 Monitoring bores compared to Water Quality Guidelines 44
Table 12 Water Investigation summary timeline 47
Table 13 Water sampling results from March 2011 50
Table 14 Pit 3 Groundwater investigative drilling in 2018 53
Table 15 Groundwater monitoring of the 2018 drillholes 54
Table 16 Groundwater and surface water major ion chemistry from 2018-19 investigation 55
Table 17 Groundwater investigative drilling in 2025 60
Table 18 Groundwater level monitoring of the 2025 drillholes 62
Table 19 Groundwater and surface water major ion from 2025 investigation 64
Table 20 Groundwater and surface water nitrogen results from 2025 investigation 69
Table 21 Pit water level and void capacities 72
Table 22 Surface water release samples from 2012 in a wetter climate 76
Table 23 Surface water release samples from 2020 in a drier climate 77
Table 24 Surface water release samples from 2023 with Pit 33 sampling results 78
Table 25 Drilled groundwater intersections 79
Table 26 Resource definition drilling groundwater intersections 79
Table 27 Quarry bore drilling and construction details 80
Table 28 Slug test results 82
Table 29 Monitoring bores FM1-6 83
Table 30 FM5, FM5B and FM6 metals 90
Table 31 Pit 3 Water Balance Model 92
Table 32 Pit 3-4 Water Balance Model climate categories with run-off coefficients 93
Table 33 Pit 3-4 Water Balance Model set-up 95

1 INTRODUCTION

A Hydrogeological Assessment report has been prepared to support a Progressive Rehabilitation and Closure (PRC) Plan and a planned Environmental Authority (EA) amendment for the Calliope Limestone mine.

1.1 Project Location

The Calliope Limestone mine (Calliope) is located 12 kilometres south of the township of Calliope and 36km south of the major centre of Gladstone, Queensland Australia. The Calliope is covered by nineteen Mining Leases as shown in Figure 1 and is bordered to the east, west and south by Awoonga Dam, which is the fresh water source for the Gladstone and Calliope region.

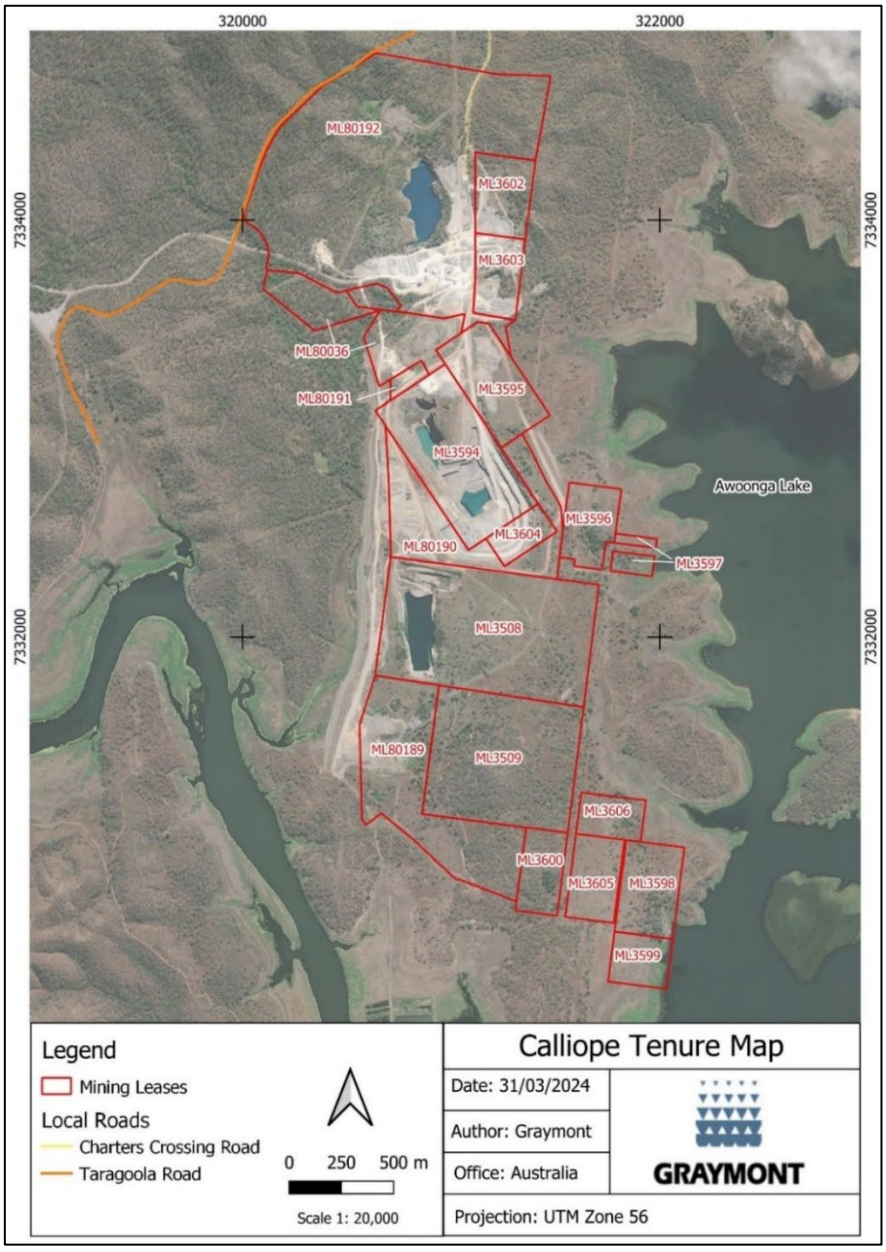


Figure 1 Calliope Tenure Map

The Calliope operational areas are predominately located on Graymont freehold land with the exception of Lot 90 on SP275218 (Figure 2) which is freehold owned by the Gladstone Area Water Board (GAWB), who manage the Awoonga Dam water storage. Graymont has a land access agreement with GAWB.

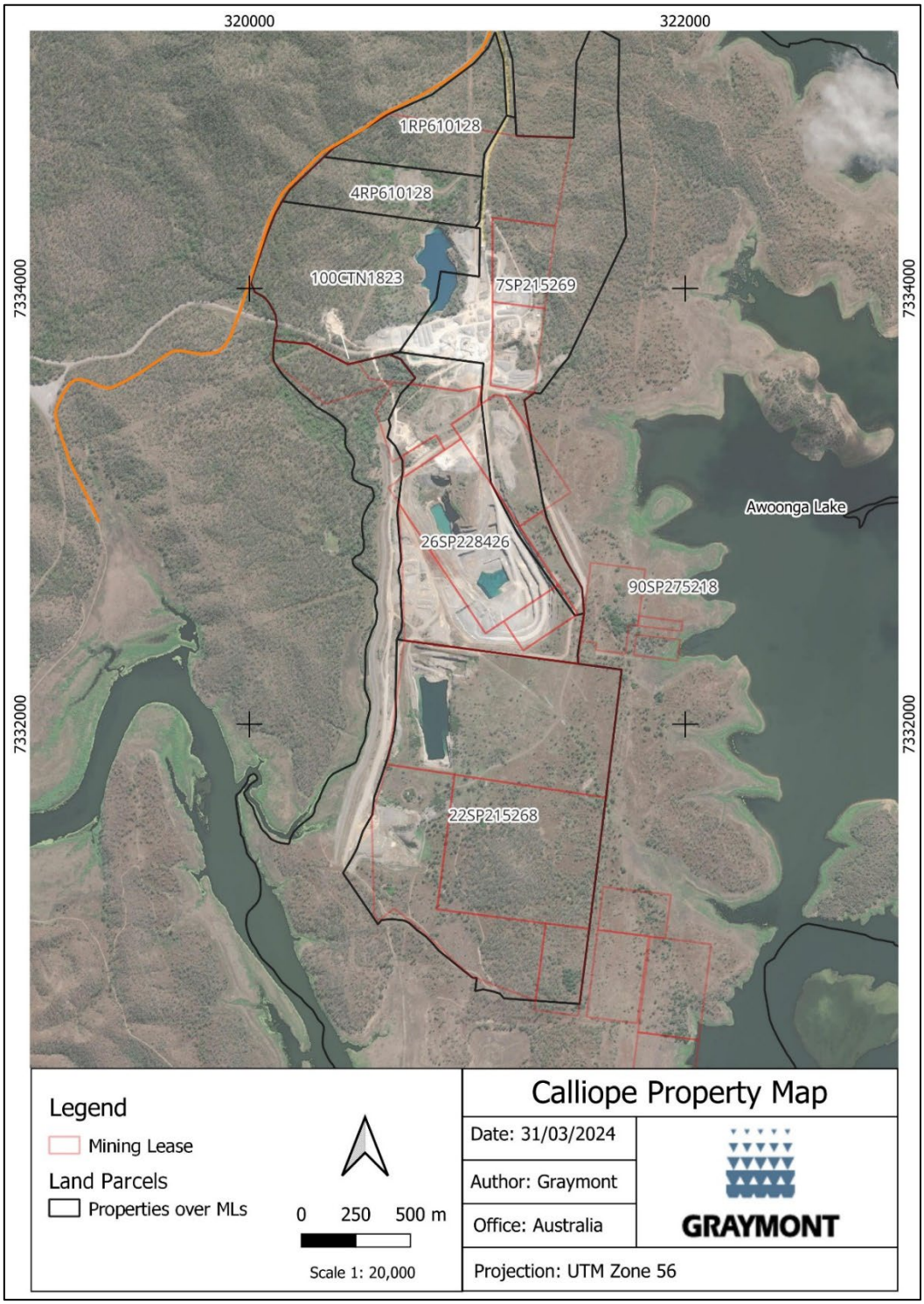


Figure 2 Calliope Property Map

A site map is provided below in Figure 3 which shows site elements which relevant to this report, including mining voids, flood protection bund walls, Waste Dump, Farm Dam and Awoonga Dam.

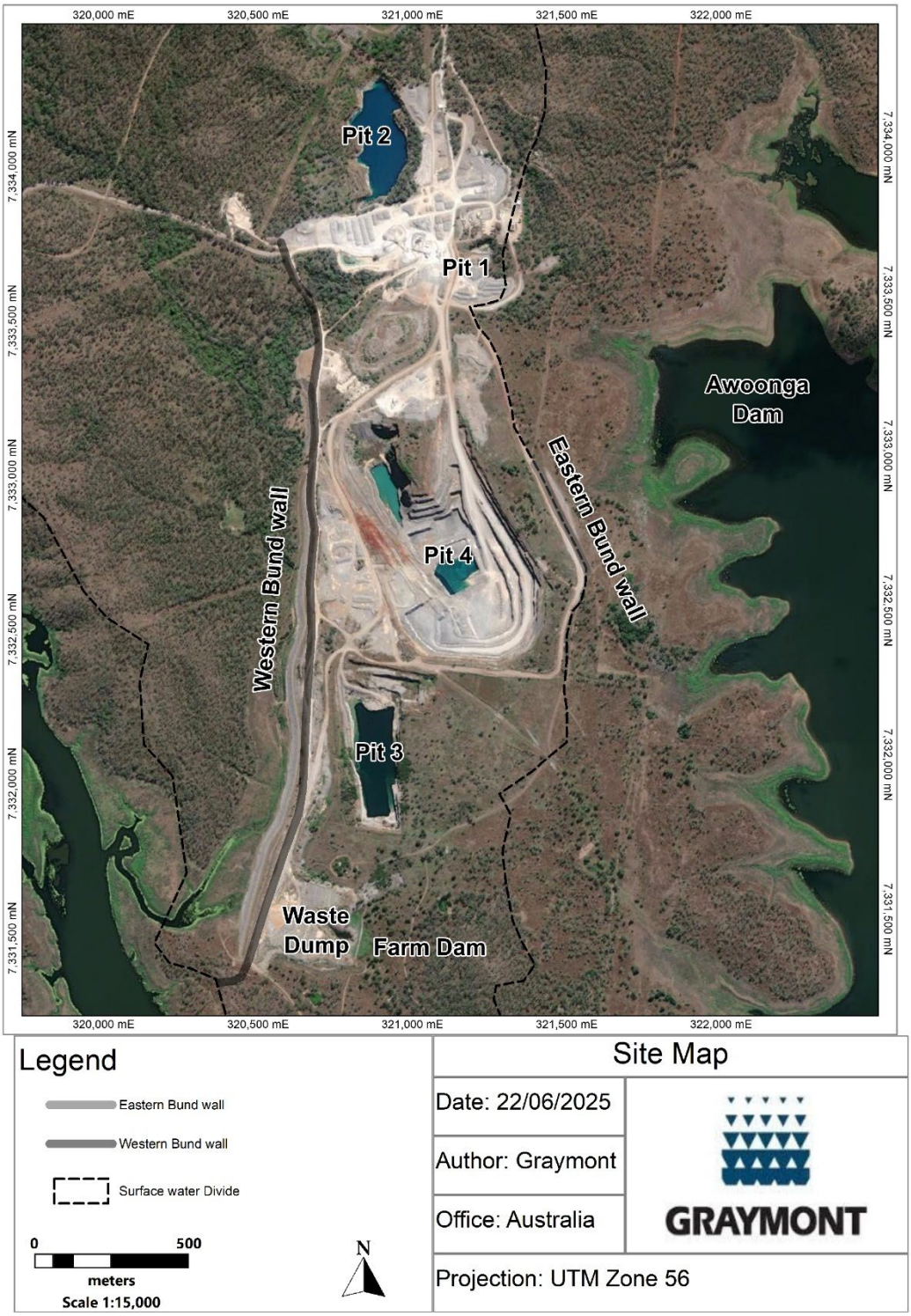


Figure 3 Site Map

At the time of this report only one of the four pits, Pit 4, was active in the mining of limestone. It is planned in future decades to extend the active mine to include Pit 3 immediately south of Pit 4. The combined future mine pit will be herein referred to as Pit 3-4. The main high water bunds protecting the site from rising surface water levels in Lake are the Western Bund and Eastern Bund Report.

1.2 Report Structure

The report has been structured to address the requirements of the following as they relate to groundwater impacts, including:

- Sections 2, 3, and 4 of the *Guideline for Application requirements for activities with impacts to water* (ESR/2015/1837)
- Sections 3.1 and 3.6.1 of the *Statutory guideline Progressive rehabilitation and closure plans (PRC plans)* (ESR2019/4964)
- Items 6 and 7 of the *Information Request Notice* for the amendment application for the EA (reference: C-EA-100720590)
- Items 16, 17 and 18 of the *Information Request Notice* for the application of a PRCP schedule (reference: C-EATPRCP-100177101)

A cross-reference table detailing the relevant requirements and how these have been addressed throughout the report is provided below.

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
Guideline for Application requirements for activities with impacts to water			
2	The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment.	Storm water runoff is managed in accordance with the Calliope Water Management Plan (WMP). Details of how the WMP ensures no contamination of water values has been provided in this Rreport.	9.1
2	Any discharge to water or a watercourse or wetland will be managed so that there will be no adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland.	Pit water discharge is in accordance with the WMP which provides control measures for managing water discharge to achieve the EA surface water contaminant release limits.	9.1
2	The activity will be managed so that adverse effects on environmental values are prevented or minimised.	The WMP describes the risks and control measures required to manage water flow and quality on site.	9.1
2	There will be no direct or indirect release of contaminants to groundwater from the operation of the activity.	There is little groundwater at Calliope. Groundwater outside the pit voids slowly drains into the pit voids where it is mixed with surface water to become pit water. Pit water is released in accordance with EA conditions.	7.3.5 7.3.6
2	There will be no actual or potential adverse effect on groundwater from the operation of the activity. Or, the activity will be managed to prevent or minimise adverse effects on groundwater or any associated surface ecological systems.	Groundwater monitoring is undertaken in accordance with EA license requirements to assess potential adverse effects to groundwater and any non-compliances are investigated and any required control measures would be implemented.	2.1.2
3	Site plan Identify on a scaled site plan 1. Topographical contours 2. Identify the direction(s) of surface water runoff and drainage lines that pass through, or are near, the site and any surface waters 3. Any existing or proposed water bores or groundwater monitoring wells within or on land adjacent to the site.	A plan of the Groundwater Monitoring Network is provided with drainage lines and topographical contours	7.3.1
3	Provide a conceptual model showing the movement (including direction and rate of flow) of groundwater in the area. This requirement is essential for activities which have a high risk of contaminating groundwater to determine appropriate locations for compliance monitoring.	A conceptual model is provided showing the movement of groundwater.	6
3	If the environmental authority application is for a resource ERA (mining or petroleum), identify any environmentally	The environmentally sensitive places adjacent to the project are Upper norther creeks area, which includes	3.2

GRAYMONT

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	sensitive places within or adjacent to the proposed mining tenement.	the Ragotte Creek catchment – Calliope; Awoonga Dam and groundwater. Environmental values for these have been provided in the report.	
3	Provide a description of hydrogeological features of the site which include soil and rock types (including porosity, permeability) and stratigraphy (including faulting and fracture propensity).	Project Description includes soil, geology and aquifers.	4.3 4.4 4.6
3	Identify and describe any barriers which are overlying and underlying aquifers.	The aquifer is unconfined and there are no overlying or underlying barriers identified.	4.6
3	Identify the environmental values of potentially affected groundwater the location and depth to groundwater (including perched aquifers or water tables) and the depth to water level/potentiometric surface on the site.	Calliope environmental values are described and are in alignment with Boyne River Basin environmental values.	4.6
3	Details of any groundwater bores in the vicinity of the proposal and the uses of extracted water.	A map of registered bores within 9 km of the site is provided and discussed.	3.9.2
3	Details of the background quality of groundwater, specifically for common anions and cations to characterise the water and for other qualities that may be affected by the proposed ERA e.g. hydraulic conductivity, transmissivity and flow rate. This is only required for activities which pose a material or significant risk of impacting on the quality of groundwater through direct or indirect releases or alteration of hydrology.	Groundwater chemistry based on historical sampling and analysis is provided and discussed.	7.3.5
3	Results of any testing to confirm aquifer properties.	Slug test results from 2002 and 2025 provide an estimate of Hydraulic conductivity but there is insufficient groundwater for pump testing.	7.3.2
3	Where there are underground ecosystems or groundwater dependant ecosystems associated with the groundwater and the proposed activity presents a real risk to these ecosystems, details of those ecosystems and their interactions with the groundwater will be required.	A search of Queensland Globe revealed that there are no GDE's in the Ragotte Creek catchment	3.9.3
4	Identification of potential contaminants and expected concentrations and/or daily and annual loads (including range)	EA conditions stipulate potential contaminants with release limits for surface water and trigger values for groundwater. Daily and annual loads have not been calculated.	2.1.2
4	Identification of whether any contaminants are persistent, toxic, or bio-accumulative and Description of the source(s) of contaminants	Potential contaminants of concern are listed on EA licence and discussed in Project Hydrogeology and the WMP.	7.1.3 7.3.6 9.1.2 9.2.2
4	Identify activities that could lead to direct or indirect impacts and unplanned / uncontrolled release of contaminants to waters, such as, spills, seeps, leaks, or stream bed and/or bank disturbance and describe the magnitude of the disturbance.	Potential contaminant sources are discussed for surface water and groundwater..	7.1.7 7.3.7
4	Where groundwater interacts with surface waters, it is necessary to identify whether the impacts on groundwater quality or elevation, will compromise any identified environmental values and water quality objectives for those waters, or adversely affect a surface ecological system (i.e. through surface–groundwater interactions), or impact on other surface environmental values e.g. agriculture, terrestrial ecosystems. In order to obtain approval for a direct release of contaminants to groundwater, the department must be satisfied that there are no other viable alternatives, and the release is to a confined aquifer and will not deteriorate the environmental values of the receiving groundwater.	Pit water, which is predominantly surface water but has a small groundwater component. Any pit water released in accordance with the EA is in accordance with the water quality limits.	2.1.2 9
4	Where the groundwater hosts an underground aquatic ecosystem, the ANZECC water quality guidelines recommends that that the highest level of protection should be provided to these ecosystems.	Not applicable – The operation does not host an underground aquatic ecosystem	n/a
4	Where the applicant proposes an impact to groundwater, monitoring is likely to be required prior to the commencement of the proposed ERA in order to collect	Groundwater monitoring has been undertaken since 2012 and EA EPML00969013 conditions C17-24 stipulate groundwater monitoring requirements for the	2.1.2

GRAYMONT

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	sufficient baseline information, as well as at regular intervals during the life of the ERA, including during establishment and any rehabilitation and site closure, to determine if there are any adverse impacts to groundwater as a result of the operation.	Calliope groundwater monitoring network, which is currently for bores FM5 and FM6.	
4	Where there is an indirect release or potential release of contaminants to groundwater, applicants must provide the following information:	Potential sources of contaminants include primary sources from the weathering rocks and secondary sources introduced by mining. The water quality parameters of concern are hydrocarbons and metals Hydrocarbons and metals are not routinely monitored in Pit 2 but FM6 provides groundwater quality data for flow in Pit2 from six monthly annually monitoring. Bore FM5 provides groundwater quality data for flow into Pit 4. Metal concentrations in both the bores are low and are at or near detection limits	7.3.6
	The geological stability of the relevant site for the ERA.	Geological stability is discussed in the geotechnical report.	n/a
	The location, quality and use, or potential use, of the receiving groundwater.	The regional groundwater and its use are described.	3.9
	The permeability of the earth under the place where the ERA is carried out.	Permeability of Waste Dumps is discussed in the geotechnical report. Permeability of groundwater in rock is determined from the slug tests.	7.3.2
	The presence of containment devices at the relevant site for the ERA and their effectiveness in preventing or minimising the release of the waste.	Not applicable – The operation does not have contaminant devices.	n/a
	The distance separating the receiving groundwater from any containment device.	Not applicable – The operation does not have contaminant devices.	n/a
	The potential for fluctuations in the level of the receiving groundwater.	Not applicable – The operation does not have contaminant devices.	n/a
	The way in which materials, including contaminants, will be removed from the containment system	Not applicable – The operation does not have contaminant devices.	n/a
	The way in which materials, including contaminants, will be removed from the containment system	Not applicable – The operation does not have contaminant devices.	n/a
4	Risk assessments are undertaken to determine the significance of a risk and to assist applicants and the assessing officers to decide whether it is acceptable for an ERA, or action, to proceed given the mitigation measures proposed. A risk assessment helps determine the level of environmental risk by quantifying the probability of an event happening, as well as its severity and consequences. A risk assessment may be qualitative or quantitative and can consider environmental, economic, social and other impacts. Risk assessments should not adopt assumptions that conflict with protection of water quality and environmental values of waters or compliance with s. 440ZG of the Act e.g. concluding contaminating waters in a green zone is acceptable because persons are not allowed to take the seafood for consumption.	The WMP forms part of site's Environmental Management Plan. The WMP describes the risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site	9.1
4	Groundwater impact assessment For activities that pose a high risk of impacting groundwater, a full groundwater impact assessment must be conducted including appropriate modelling to demonstrate that the ERA will not cause adverse impacts on groundwater resources.	Groundwater Impact Assessment undertaken There is little groundwater at Calliope. Modelling undertaken commensurate with the risk profile to groundwater users.	3.7 8
4	A groundwater impact assessment must include:		
	Detailed assessment of current groundwater resources including geological and geochemical characteristics.	Groundwater investigations and monitoring from these investigations, and from bores, have been used to characterise groundwater behaviour.	4.6 5.3 7.3
	Hydrogeological assessment of groundwater resources including groundwater flow characteristics, storativity, hydraulic conductivity and permeability in zones to be impacted by the proposed activities.	Groundwater flow has been determined from investigative drilling and bore monitoring. Permeability has been determined from a slug test of a monitoring bore because there is insufficient groundwater for a pumping bore to accurately determine aquifer parameters including storativity.	7.3.2

GRAYMONT

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	Details on how seepage detection between deep and shallow groundwater will be considered and managed.	Not applicable – Groundwater is shallow and unconfined.	4.6
	Connectivity with surface water resources.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water.	6
	Impact on groundwater quality as a result of the proposed ERA.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water.	6
	Impact on groundwater flow regimes and drawdown.	There is insufficient groundwater for a pumping licence so there is no dewatering of the aquifer or drawdown of the aquifer.	7.3
	Impact on existing users and future potential uses.	Groundwater slowly flows into mining voids so connectivity is restricted to mixing with surface water on the pit floor prior to the discharge of pit water. Assessment undertaken of pit water potential impacts on environmental values .	6 4.8
	Numeric groundwater modelling of groundwater resources and expected impacts of the proposed ERA.	Not applicable – Groundwater modelling has been undertaken commensurate with low groundwater risk profile. There is little groundwater at site and groundwater flow is towards the mining voids.	n/a
	Groundwater lowering/reduction in hydraulic head (from new voids e.g. caves/karst systems).	A groundwater level map has been created from groundwater monitoring and investigation level measurements. Blasting creates fractures which can extend into the pit floor which capture surface water which is artificial groundwater. There is no creation of larger scale voids.	5.3.3
	Cones of depression and associated impacts.	There is no groundwater pumping and no cone of depression from pumping because there is insufficient groundwater. There are no receiving environments potentially exposed to groundwater level drawdown from the project.	4.8
	Potential contaminants generated and the impacts on the identified environmental values. Potential sources for ground water contaminants include: − Waste rock dumps and tailings disposed underground/in pit − Workshops − Seepage from tailings dam, waste rock dumps, heap leach, process ponds or the direction of pits toward any relevant catchment or town water supply	Potential contaminants identified and control measures implemented in the Water Management Plan and the Groundwater Management Plan. Assessment undertaken of pit water potential impacts on environmental values	9.1 & 9.2 4.8
4.2	**Proposed management practices** Once the magnitude and risk of each impact to the environmental values is known, applicants must identify avoidance, mitigation, monitoring, reporting and offset strategies, where appropriate, to address the risks. These strategies can include physical works, processes or treatments. Similarly, they could include management or monitoring practices. In many cases, adequate environmental management will require both physical works as well as management practices. When identifying avoidance, mitigation, monitoring, reporting and offset strategies the applicant should clearly detail how the works or practices will link back to and address the previously identified risk.	Potential impacts identified and control measures implemented in the Water Management Plan and the Groundwater Management Plan. Assessment undertaken of pit water potential impacts on environmental values	9.1 & 9.2 4.8
4.4	**Groundwater monitoring program** One of the performance outcomes for water is establishing contingency measures. For activities that pose a high risk of impacting groundwater, applicants are strongly encouraged to establish a groundwater monitoring program for the site. The monitoring program should be suitable to monitor the impacts to the environment and provide a detection system to identity if environmental harm has or has the potential to occur.	Groundwater Monitoring network was established in 2012 and monitoring results and network suitability is annually reported to the EPA. An additional three bores are being added to the groundwater monitoring network.	7.3.1
4.4	**Water management plans**	The Water Management Plan (WMP) forms part of site's Environmental Management Plan	10.1

GRAYMONT

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	Applicants for mining ERAs are encouraged to develop a water management plan. The primary purpose of a mining project water management plan is to examine and address all issues relevant to the importation, generation, use, and management of water on a mining project in order to minimise the quantity of water that is contaminated and released by and from the project.		
Statutory guideline Progressive rehabilitation and closure plans			
3.1	**Baseline information** In addition to the legislative requirements, the following information about the site, where relevant, is considered necessary by the administering authority (as per section 126C(1)(j) of the EP Act) to decide whether to approve the PRCP schedule: • geological setting • site hydrology and fluvial networks • groundwater levels and properties	Project Description includes soil, geology and aquifers. The site hydrology, fluvial network, groundwater levels and properties are explained throughout the document.	4 7 8 9
3.6.1	Assess the hydrogeology of the site and all connected strata and develop a conceptual model of the mine site's groundwater systems. This information must be integrated into the design of rehabilitation strategies and choice of PMLU or NUMA.	A conceptual model is provided from an assessment of site hydrogeology.	6
3.6.1	The hydrogeological assessment should include the following steps:		
	determining the groundwater occurrence including the existence of, and depth to, aquifers and aquitards	Limestone and the volcanics can form either a weak, unconfined, fracture rock aquifer or an aquitard depending upon the connectivity of fractures in these rocks. The depth to groundwater is variably but is typically 15-20 metres depth below natural surface.	4.8
	locating groundwater recharge and discharge locations locally and regionally	Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith. Groundwater flow at Calliope is from topographic high to topographic low.	3.9.2 7.3.1
	groundwater quality within each of the aquifers and from surface expressions (i.e. seeps and springs)	Groundwater quality of limestone is not chemically distinguishable on a Piper plot from groundwater in volcanic rock. The limestone and volcanic rock are considered to be a single aquitard and a single aquifer when fractures in the rocks are connected.	5.3
	current and potential future uses of groundwater including existing groundwater extraction bores	Not applicable – No groundwater licence or extraction at Calliope because of an absence of groundwater.	2.1.2
	groundwater flow direction and velocity, including field tests to determine hydraulic conductivity	Groundwater flow has been determined by investigative drilling. Hydraulic conductivity has been determined by slug tests. There is insufficient groundwater for pump testing.	5.3 7.3.2
	the development of potentiometric mapping and hydro stratigraphic cross sections	Groundwater is a watertable not a potentiometric surface. Hydro stratigraphic cross-sections have been created from groundwater intersections from drillholes.	4.6
	groundwater modelling to determine contaminant transport and potential changes to groundwater level from dewatering or waste storage.	Not applicable - No dewatering of pit voids or waste storage	4.6
3.6.1	**Water management** The management of surface and groundwater is a key consideration in achieving long-term rehabilitation success. The rehabilitation planning part must include a description of the following:		
	a description of the contaminants that pose a risk to environmental values of the receiving environment	Potential contaminants identified and mitigations measures outlined in Water management Plans. An Assessment was undertaken of pit water potential impacts on environmental values.	10.1 4.8

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
	source, pathway and fate of contaminants that have the potential to impact environmental values	Pathway receptor linkages identified and assessed	4.7
	infiltration and seepage intervention and collection controls	The WMP outlines water control measures	10.1
	surface water diversions and long-term management requirements	The WMP outlines water control measures. In the long-term surface water diversion modifications will be required when Pit 3 combines with Pit 4 and works required will be addressed at that time.	9.1
	dewatering requirements	There is no groundwater dewatering.	2.1.2
	on-going water management and reduction requirements (i.e. treatment).	There is no groundwater dewatering.	2.1.2
3.6.3	**Voids** For mine sites with voids, the rehabilitation planning part must include a void closure plan that includes, but is not limited to, the following:		
	void hydrology, addressing the long-term water balance and water level in the voids, stratification connections to groundwater resources and potential for overflow	Water balance modelling shows that the Pit 3-4 void will remain a sink, despite increasing the groundwater inflow from the measured 1 l/s to 25l/s.	8.3
	groundwater modelling to determine whether the void is acting as a sink or a source for groundwater	Water balance modelling shows that the Pit 3-4 void will remain a sink, despite increasing the groundwater inflow from the measured 1 l/s to 25l/s. Current groundwater inflow is <1 l/s and a predicted, conservative, final void inflow of 5 l/s has been used for water balance modelling.	8
	a water balance study including an assessment of void surface and groundwater interactions such as: • groundwater lowering/reduction in hydraulic head (from new voids) (e.g. caves/karst systems) o cones of depression and associated impacts • the drainage and flooding behaviours of surface waters in the vicinity of the void • the potential extent of flooding and implications of interactions with the void • a conceptual model that incorporates all projected inflows, outflows, and recharge rates • water storage and long-term water balance • each of the major water fluxes into and out of the void • the sources of surface water within the mine catchment that are likely to influence the water quality in the void • predicted water quality in the long-term including potential stratification • a 3D void design plan • rehabilitation strategies	A water balance model has been derived from water investigations. Pit water stratification was investigated in Pit 3 which displays some stratification which is common for deeper water columns.	8 7.1.3
Information Request Notice for the amendment application for the EA			
6	The application provided a hydrogeological assessment for the site however the analytical modelling is based on the limited available groundwater data and did not consider the complexity of the geology associated with the site.	A total of 34 holes were drilled in 2025 around the perimeter of Pit 4, Pit 1 and east of Pit 3 which defined geology and groundwater behaviour. The majority of holes were drilled dry and slowly made water. All drillholes were capped and collars surveyed to ensure groundwater data integrity. Limestone in pit void is bedded sub-vertically and is flanked outside the pit void by volcanic rock. Geology is simple and there is sufficient groundwater data, in addition to drilling, to demonstrate that there is little groundwater and that analytical modelling is appropriate.	5.3
6	Provide a numerical hydrogeological model which considers the complexity of the mining site including but not limited to:	A numerical model was constructed in 2002 but this construction was hampered by an absence of hydraulic aquifer parameters, because of insufficient groundwater to undertake a pump test and modelled results have been proven to be unreliable. An example	8

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
		is that the model predicted a possible 10 fold increase in groundwater at 40mAHD. Pit 4 is currently at -20mAHD, being 78% the depth of modelled pit depth, and groundwater inflows remain very low. The analytical water balance model and predictions as outlined in the previous Hydrogeological Assessment is not in alignment with the 2011 conceptual and analytical mode. The 2011 model was derived from field sampling and showed that there is little groundwater entering Pit 3 void. The 2011 model was verified by investigative drilling in 2018, being 14 holes west of Pit 3, and recent investigation has showed that there is also little groundwater entering Pit 4 void. A numerical model has not been derived because sensitivity analysis of the updated analytical water balance model, based on all available water data, demonstrates that there is little groundwater at final void and numerical modelling of groundwater is not justifiable based on the negligible risk of groundwater interaction with any other water bodies outside the pit void.	
	Inclusion of cross section for all voids that identifies the limestone resource in comparison to the final projected void levels.	Cross-sections included for Pit 3 and Pit 4.	4.6
	Consideration of adjacent geological formations and faulting Further Clarification Note: Section 3.4 states, 'specific lithological boundaries are not necessarily constraining the flow of groundwater and hence a lithostratigraphic boundary for the aquifer is not appropriate' however, there is no discussion on the likely groundwater connectivity between Calliope beds and the other nearby geological formations and as such this statement appears unsupported by data. The interaction between the geological formations is critical for understanding potential impacts of mining and how modelling of the mining impacts should be undertaken	Groundwater -lithological relationship further investigated by drilling. The majority of drilled were dry with the most groundwater intersected at and near the volcanic -limestone contact. Site blast hole drilling driller logs of water intersection confirm that groundwater intersections are uncommon. There is no known faulting in Pit 3-4. Drilling confirm that groundwater occurrence is variable between lithologies. Groundwater chemistry of drillholes and bores from both lithologies are similarly variable and there is no clear distinction between groundwater from limestone and volcanic. A lithostratigraphic boundary can be defined but it is not a groundwater boundary condition.	4.6
	Consideration of recharge to the groundwater system through north-south groundwater gradient and rainfall Further Clarification Note: The application identifies that the groundwater flows eastward from the Boyne Range State Forest towards Lake Awoonga, however any recharge from this area may have limited impacts on the mining area given the faulting between the Rockhampton Beds and the Calliope Beds. The only certain groundwater gradient currently proven is from north to south from FM6 to FM5 and recharge in the area may be attributed to the elevated areas in the north (in the Calliope Beds) and draining south	Investigative drilling confirmed that groundwater divide aligns with surface water divide. Groundwater flow is north to south from Pit 2 to SE of Pit 4 while also flowing easterly and westerly from the groundwater divide. Groundwater at FM6 flows to Pit 1, and at FM5 to Pit 4. Rainfall response of groundwater is similar in both FM5 and FM6 which indicates similar recharge. Rockhampton Beds lie to the west of current and life of mine Pit 3-4 void and do not influence the conceptual and analytical water balance modelling presented in this report. Additional investigative drilling of 34 holes has proven that groundwater flow is easterly and westerly from the groundwater divide.	5.3
	Consideration of hydraulic connectivity that considers changing ground elevation Further Clarification Note: The model assumes constant hydraulic conductivity in all directions in what appears to be a single layer model which potentially does also not account for changing ground level elevations	Limestone and volcanic are primarily an aquitard but both can host groundwater in fractures but water level flow and chemistry is indistinguishable and there is only a single weak unconfined aquifer at Calliope. Pit 3 and 4 voids combined measured groundwater seepage is <1 l/sec and since Pit 4 floor is at -20mAHD, being 67% of final void depth, and is 95% of final void width.	5.3 7.3.3

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
		Groundwater has not been intersected from drilling below 5mAHD or in the pit floor. It is very unlikely that significant groundwater will be intersected in Pit 3-4 final void based on Resource drilling to a maximum depth of -105.1mAHD. An analytical water balance model has been derived based on a field measurements and metered data. Hydraulic conductivity estimates do not change modelled outcomes but slug test results from bores FM1-4 in 2002, with a hydraulic conductivity of 0.003 m/day, support findings that there is little groundwater seepage. Slug test results from bore FM6 in 2025, with a hydraulic conductivity of 0.042m/day further support findings there is little groundwater seepage.	
	Consideration of connectivity to Awoonga Dam and changes to water levels over time Further Clarification Note: It does not appear to consider the connection with Awoonga dam including the significant seepage that can occur at times from Awoonga dam to the pit/s or the changing water levels over time in Awoonga dam and how that is impacting groundwater.	Awoonga Dam leakage to Pit 3 was proposed by GHD in 2011, however no physical evidence has been found of piping from all Western Bund wall inspections. Water chemistry confirms that water flowing into Pit 3 is not related to Awoonga Dam water because it is 2.5 times the salinity of Awoonga Dam and Piper Plots confirm that it is of a different chemistry. Water chemistry shows that the Pit 3 water is from surface water flowing from the Farm Dam. Investigative drilling in 2018 delineated groundwater at 32mAHD being approx. 5m below water inflow which provides dampness on bench but no groundwater inflow into Pit 3. The 2018 drilling was undertaken when Awoonga Dam water level was 38.8mAHD and demonstrates that only very minor seepage occurs beneath the western bund wall when Awoonga Dam water level is elevated. The water inflow into Pit 3 is not from Awoonga Dam leakage or groundwater seepage. There is no relationship between water flow into Pit 3, aka “significant seepage” and groundwater seepage.	5.2
	Consideration of clarification of the limestone resource and final water bodies Further Clarification Note: The assessment lacks consistency and clarity on the limestone resource in relation to the site hydrogeology. Section 1.2 of the report gives the appearance that the limestone extends to 8 m below the surface by identifying that grey limestone with clay filled cavities is present to a depth of between 5 to 8 meters however, section 2.3.2 assumes that the void will be approximately 100 m below the natural surface.	Drilling confirms that the limestone Resource extends to -105.1mAHD being m below the natural surface but limestone is weathered with some voids, that are generally clayed, at shallow depths beneath the natural surface.	4.3 4.5
	Consideration of the influence of all voids when determining the impacts to groundwater and the inclusion of a map identifying the location of each pit. Further Clarification Note: Appendix 6 Figure 2 appears to indicate that the proposed future combined pit 3 and pit 4 has been represented by two extraction points. This does not appear to be representative of the full pit area or any impacts that pit 2 may be continuing to have.	End of mine life Pit 3-4 will remain a void, Pit 1 has been filled and Pit 2 will also remain a void. Groundwater is mounded at Pit 1 between Pit 2 and Pit 3-4. Pit 2 is currently used for water storage of pumped Pit 4 water to be used on site. Groundwater will slowly flow and seep into Pit 2 void but is unlikely to measurably change water quality given the large volumetric difference between pit water and groundwater seepage. A map of all pits is included.	5, 8
	Consideration of limitations associated with this monitoring network and potential limitations that this places on the groundwater modelling Further Clarification Note: The inadequate groundwater monitoring network provides a significant limitation to modelling in its inability to provide an initial understanding of the groundwater levels and flow direction.	The current groundwater monitoring network is appropriate based on groundwater behaviour and groundwater risk profile but an additional 3 bores will be installed to at the site.	7.3.1
Information Request Notice for the application of a PRCP schedule			

Ref.	Regulatory Requirement	How addressed in this Report	Report Section
16	Appendix E *(F)* and section 7.2 of the PRC plan discusses drilling records for various bores but no information on these records is provided. There may also be some uncertainty in some hydraulic parameters used in groundwater modelling (section 2.2 of Appendix F). Provide: • Omitted information on monitoring bore construction details. • Update hydraulic parameters to reflect site geology and water flow dynamics.	Bore construction details are appended. Hydraulic parameters are updated to reflect site geology and water flow dynamics.	 7.3.2
17	Section 2.3 of Appendix E *(F)* includes a water balance model to predict water levels in the final void, but no information is provided on which model was used or the input parameter values used. The model must be referenced and described in the PRC plan document Include a detailed description of the water balance model used to predict final pit water levels.	The Water Balance Model in the previous report version used an average groundwater seepage of 43 l/s for the final Pit 3-4 void , based on interpreting water inflow to Pit 3 to be groundwater. The Water Balance Model in this report version used an average groundwater seepage of 5 l/s. for the final Pit 3-4 void, based on observed and measured groundwater inflows <1 l/s for both pits. Sensitivity analysis of the Water Balance Model in this report shows that if average groundwater seepage is <45 l/s with seasonally varying rainfall pit water will remain contained within the pit void. A detailed description is provided of methodology, assumptions, parameters and predicted pit water fill under different climatic scenarios.	8.3
18	Appendix E *(F)* shows predicted groundwater contours and flow directions, with flow near the site to be west to east. The predicted future water table (Figure 10a) suggests the final void will be a flow through system. Figure 7 shows the bores on site but there appears to be few bores along the eastern boundary, across which is the predicted direction of groundwater flow. Additional groundwater monitoring bores are required to be installed, along this eastern boundary to confirm groundwater levels and flow directions, to better describe and model the hydrogeological character of the site (Section 2.10.3 of Appendix E *(F)*). This is important in terms of quantifying groundwater flow direction particularly as the final void will be a flow through landform in direct contact with the regional groundwater. Include a hydrogeological assessment that accurately describes the groundwater flow and velocity and provide modelling to determine contaminant transport.	Investigative drilling confirmed that groundwater divide aligns with surface water divide with groundwater flowing east and west from the divide. The predicted future water table will remain a closed system. Investigative drilling and subsequent water monitoring has confirmed groundwater levels and flow direction. Three monitoring bores are planned to be installed at investigation drilling locations. Currently there is <1 l/s of groundwater seepage into combined Pit 3 and Pit 4 voids and in accordance with the Water Balance Model if there is <35l/s of groundwater at final landform then the final landform Pit 3-4 void will remain a sink. This hydrogeological assessment accurately describes groundwater flow because it is based on recent intensive fieldwork and extensive historical fieldwork, some of which was not previously reported.	5.3

Table 1 Cross-Reference Report Table

1.3 Assessment Method

The Calliope is an established operation with an Environmental Authority license and an Environmental Management Plan (EMP). The EMP defines environmental protection measures for the management of impacts associated with the project and addresses Environmental Authority license conditions. The EMP outlines Water Management Objectives, Environmental Values, potential impacts, target and key performance indicators, control measures, monitoring and reporting. Further details on Water Management are provided in the Water Management Plan (WMP) and in the Groundwater Management and Monitoring Plan (GMMP). Surface water management structures at Calliope effectively controls the flow of rainfall run-off and store excess run-off to prevent uncontrolled releases and allow continued mining operations.

Pit water is composed of groundwater and surface water. Groundwater flow entering the active Pit 4 is monitored in accordance with EA conditions and groundwater unaffected by mining is also monitored in accordance with EA conditions. A suite of water quality parameters are analysed for the groundwater samples and groundwater triggers levels are applied to the monitoring bores. Pit water is either used, stored and/or discharged. Pit water that is used or stored onsite is not routinely sampled. Surface water that is discharged has regulatory controls being surface water release limits and licensed surface water discharge points. Pit Water to limits set for Electrical Conductivity (µS/cm), pH and Total Suspended Solids (mg/L).

The assessment method adopted in this study to address Regulatory requirements has been:

- Review and summarise existing Water Management
- Synthesis historical groundwater investigations, identify data gaps and to undertake a groundwater investigation in 2025 to bridge data-gaps relating to groundwater behaviour and risk profile
- Determine the Boyne River Basin Plan environmental values relevant to Calliope
    - Environmental values relevant to Calliope are: Upper northern creek catchment, Awoonga Dam and Groundwater (Bores…etc)
- Identify mechanisms of potential impact and risks to environmental values of the Boyne River Basin
    - Awoonga Dam and downstream environmental values
    - Bores
    - Mine voids groundwater interaction and water quality
    - Groundwater Dependent Ecosystems (GDE)

Assessment outcomes presented in this report demonstrate that groundwater at Calliope has a low risk profile because of a lack of groundwater and because mining voids act as sinks.

2 REGULATORY FRAMEWORK

2.1 Project Environmental Approvals

2.1.1 Water License

The Calliope is located in the Boyne River Basin, which has a water plan that :

- regulates the take and interference of surface water
- allows for the take of groundwater and overland flow water
- provides for water allocations, water licences and seasonal water assignment

Under the *Water Act 2000*, 'associated water' refers to underground water that is taken or interfered with as a result of an authorised activity (such as mining). This usually involves activities like dewatering mine pits. These activities are managed through the underground water management framework outlined in Chapter 3 of the *Water Act 2000*. As the Calliope only uses water stored in Pit 2 and does not access any additional surface water or groundwater, this is considered 'associated water' and therefore does require a water license under the *Water Act 2000.*

2.1.2 Environmental Authorities

Mining activities are undertaken in accordance with regulatory approved Mine Plans and Environmental Authority (EA) licence conditions. The current EAs for Calliope are listed in Table 1 and include a prescribed EA for the taking of quarry material and a Resource Activity EA for mining of limestone. The Resource Activity EA is the subject of this application and is discussed further below.

EA Reference	Permit Type	Approval Authority	Status	Date Granted
EPML00969013	Resource Activity	Dept of Environment and Science	Active	1st February 2021
EPPR00881913	Prescribed ERA	Dept of Environment and Science	Active	18th January 2019

Table 2 Calliope EAs

EA EPML00969013 outlines the requirement for Calliope Limestone Operation to ensure offsite impacts are minimised and any discharge waters are within acceptable limits. Release limits for licensed surface water discharge points and their monitoring frequency are shown below. Condition C2 of the EA states that the release of contaminants to waters must only occur from specified release points F1, F2, C1 and C2. See Table 1.

Release Point (RP)	Easting (GDA94)	Northing (GDA94)	Contaminant source and location	Monitoring point	Receiving waters
F1	321432	7332026	Pit 3 and Pit 4	End of pipe F1 (Discharge Monitoring Point)	Lake Awoonga Dam
F2	320399	7331469	Undisturbed natural flow and/or Pit 3	Raggote Ck at F2 (Downstream Monitoring Point)	Farmers Dam
C1	320757	7333601	Pit 1, Pit 2 and Pit 4	C1 dam spillway (Discharge Monitoring Point)	Pit 2 and/or Recycled Water Storage Dam
C2	320102	7333854	Undisturbed natural stormwater flow	C2 creek adjacent to rail siding road (Upstream Monitoring Point)	Ragotte Creek

Table 3 Surface water release points

A map of EA surface water release points and groundwater monitoring locations is shown in Figure 4.

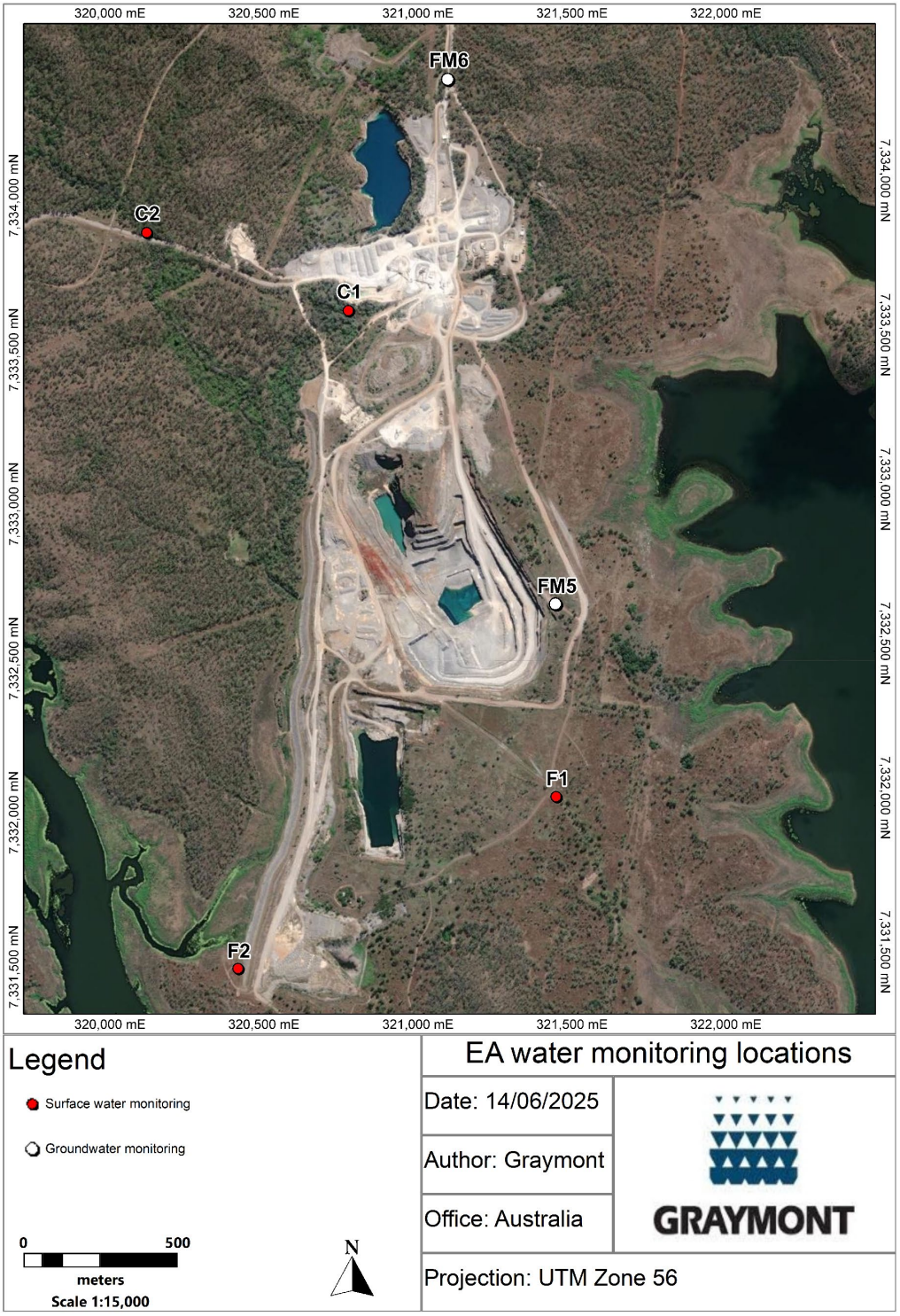


Figure 4 Surface water and groundwater monitoring locations

Surface water contaminant release limits are table below.

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical Conductivity (µS/cm)	900	Weekly during discharge
pH (pH Unit)	6.5 (minimum), 8.5 (maximum)	Weekly during discharge
Total Suspended Solids (mg/L)	100 (maximum), or when measured at C1, F2 or F1 not more than 110% of the value at monitoring point C2.	Weekly during discharge

Table 4 Surface Water Contaminant release limits

The origins of the release limits is not known but they are similar to, but more stringent than, the ANZECC Guidelines for the default maximum values for Tropical Australia freshwater lakes & reservoirs which are 900 µS/cm, pH 6.0-8.0 and turbidity 200NTU. The risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site, are described in the Calliope Water Management Plan (WMP) forms part of Calliope Environmental Management Plan. See Section 9.

Groundwater

There is insufficient groundwater for pumping and aquifer dewatering and Calliope does not have a groundwater take and use licence. Groundwater outside the pit voids slowly drains into the pit voids where it is mixed with surface water to become pit water. Pit water is released in accordance with EA conditions. In July 2012 Sibelco developed and implemented a Background Groundwater Monitoring Program in accordance with MINB100942509 groundwater conditions C17-25. The aim of the Background Groundwater Monitoring Program (BGMP) was to provide sufficient data for developing a Groundwater Management and Monitoring Plan (GMMP). Groundwater monitoring bores FM5 and FM6 were installed in July 2012. Bore FM5 benchmarks groundwater at the active Pit 4 whereas Bore FM6 benchmarks groundwater at the inactive Pit 2. Comparative Analysis of the water quality from bores is undertaken to assess FM5 water quality changes against FM6 water quality changes. Groundwater monitoring results taken from FM5 and FM6 in the period July 2012 to October 2013 were used to benchmark groundwater water quality parameters results, from which EPML00969013 groundwater trigger values were derived. Sinclair Knight Merz Pty Ltd was engaged by Sibelco to develop the GMMP for the Calliope Quarry which, in accordance with EA conditions the GMMP, must:

i. Be able to detect a significant change to groundwater quality values due to activities that are part of this mining project
ii. Include measures to minimise the impact of the mining activities on groundwater resources

EA (EA) EPML00969013 conditions C17-24 stipulate groundwater monitoring requirements for the Calliope groundwater monitoring network, which is currently for bores FM5 and FM6. Groundwater monitoring locations were shown in Figure 4. EPML00969013 groundwater trigger values are shown in Table 3.

Water Quality Indicator	Unit	Trigger Value
Calcium (Ca)	mg/L	250
Chloride (Cl)	mg/L	200
CO3	mg/L	500
Electrical Conductivity (EC)	µS/cm	1500
HCO3	mg/L	500
Magnesium (Mg)	mg/L	35
Petroleum Hydrocarbons (Total)	mg/L	1.0
pH	pH units	6.5 – 8.5
Potassium (K)	mg/L	5.0
SO4	mg/L	20
Sodium (Na)	mg/L	100
Total Suspended Solids (TSS)	mg/L	1500

Table 5 Groundwater trigger values

Groundwater level monitoring of the bores is undertaken quarterly. Groundwater quality sampling of EC, TSS, pH and major anions (and cations) is six monthly, whereas metal screen and hydrocarbons are monitored annually. See Table 6.

Monitoring point	Easting (GDA 94)	Northing (GDA94)	Monitoring frequency			
			Groundwater level	EC, TSS, pH and Major Anions	Metal Screen	Hydrocarbon
FM5	321430	7332650	Quarterly (Jan, Mar, Jul, Sep)	Six monthly (Jan, Jul)	Annual (Jul)	Annual (Jul)
FM6	321080	7334350				

Table 6 Groundwater monitoring frequency

Analysis of FM5 and FM6 monitoring data is provided in Section 7.3

Groundwater sampling which exceeds trigger levels is investigated and investigation results reported with 28 days to DETSI in accordance with EA conditions.

Calliope Water Management is discussed in Section 9.

2.2 PRC Plan

A PRC Plan is required for all mines with a site-specific EA for a resource activity. In accordance with the *Environmental Protection Act 1994,* all site-specific EAs for resource activities must also have an approved PRC Plan. The site is currently progressing a transitional approvals process for the Calliope Limestone PRC Plan.

Decision criteria used by the administering authority when assessing a PRC Plan is outlined in Section 2.5.1 of the PRC Plan guidelines and includes:

- Regulatory Requirements
- Site Specific EA application
- Proposed PRC Plan schedule
- Response to an information request
- Standard criteria
- PRC plan guideline

In 2023, Graymont developed a PRC Plan (PRC Plan-EPML00969013-v1) to meet the requirements of:

- The transition notice issued to Graymont on 31 March 2021 by the DETSI (formerly DES)
- The Mining *and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act)
- Sections 126B, 126C and 126D of the *Environmental Protection Act 1994* (EP Act)
- PRC Plans Guideline (ESR/2019/4964) (PRC Plan Guideline) (DESI 2024g)
- Schedule 8A of the *Environmental Protection Regulation 2019* (EP Regulation)

To ultimately align this PRC Plan with the EA, an EA amendment application (the EA amendment) was submitted to the Administrating Authority on 10 September 2024 and is in Information Request (IR) phase.

GRAYMONT

3 PROJECT SETTING -BOYNE RIVER BASIN

3.1 Boyne River Basin and Calliope

The Boyne River Basin (Basin) is located in Queensland's central coast region. The Calliope is located within the Basin adjacent to Awoonga Dam at the northern end of the Basin catchment (Figure 5).

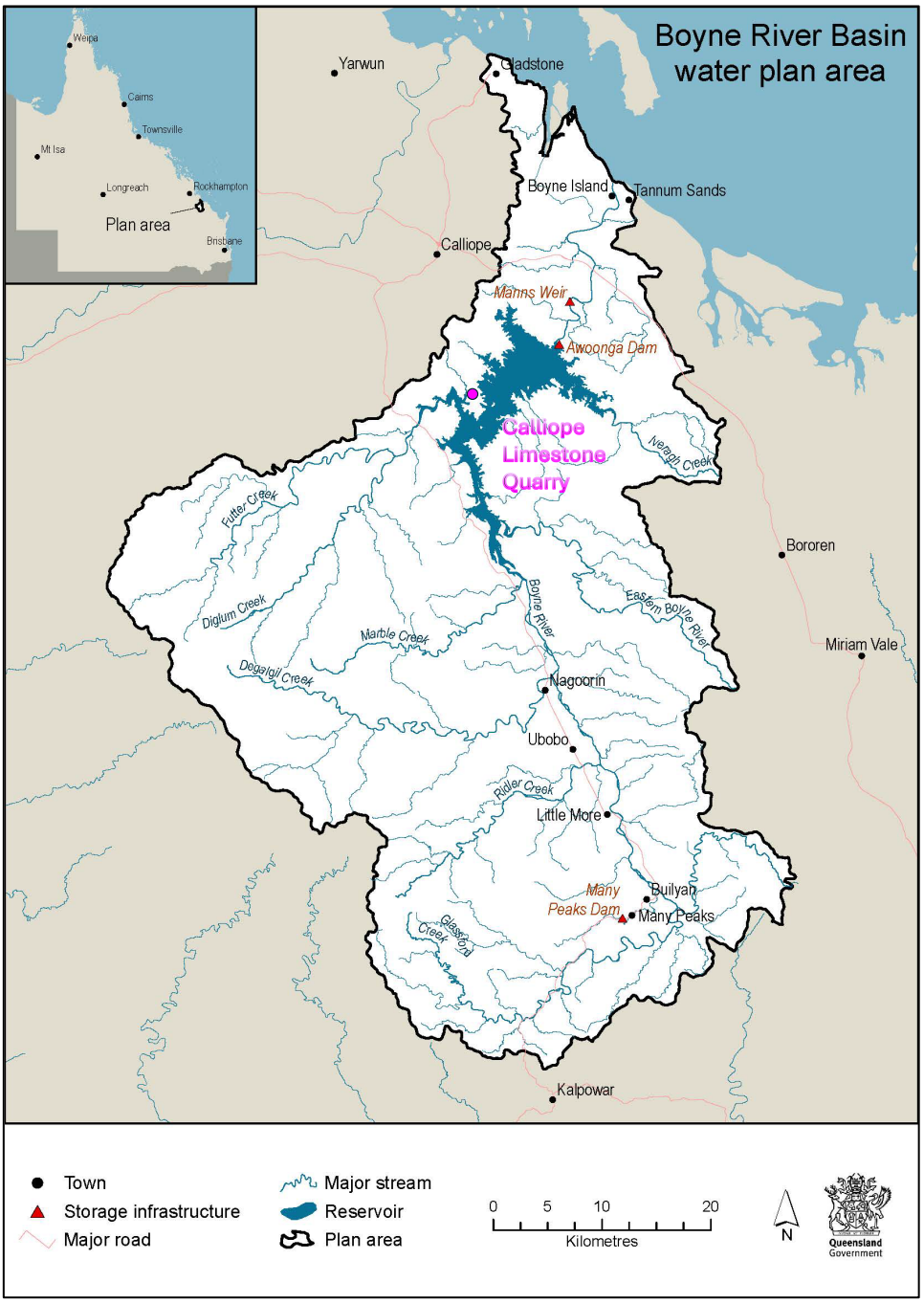


Figure 5 Boyne River Basin (from Boyne River Basin Plan)

The Calliope is located at the southern end of the Ragotte Creek catchment. Ragotte Creek flows into Awoonga Dam which is located approximately 20 km upstream of the mouth the Boyne River. Figure 6.

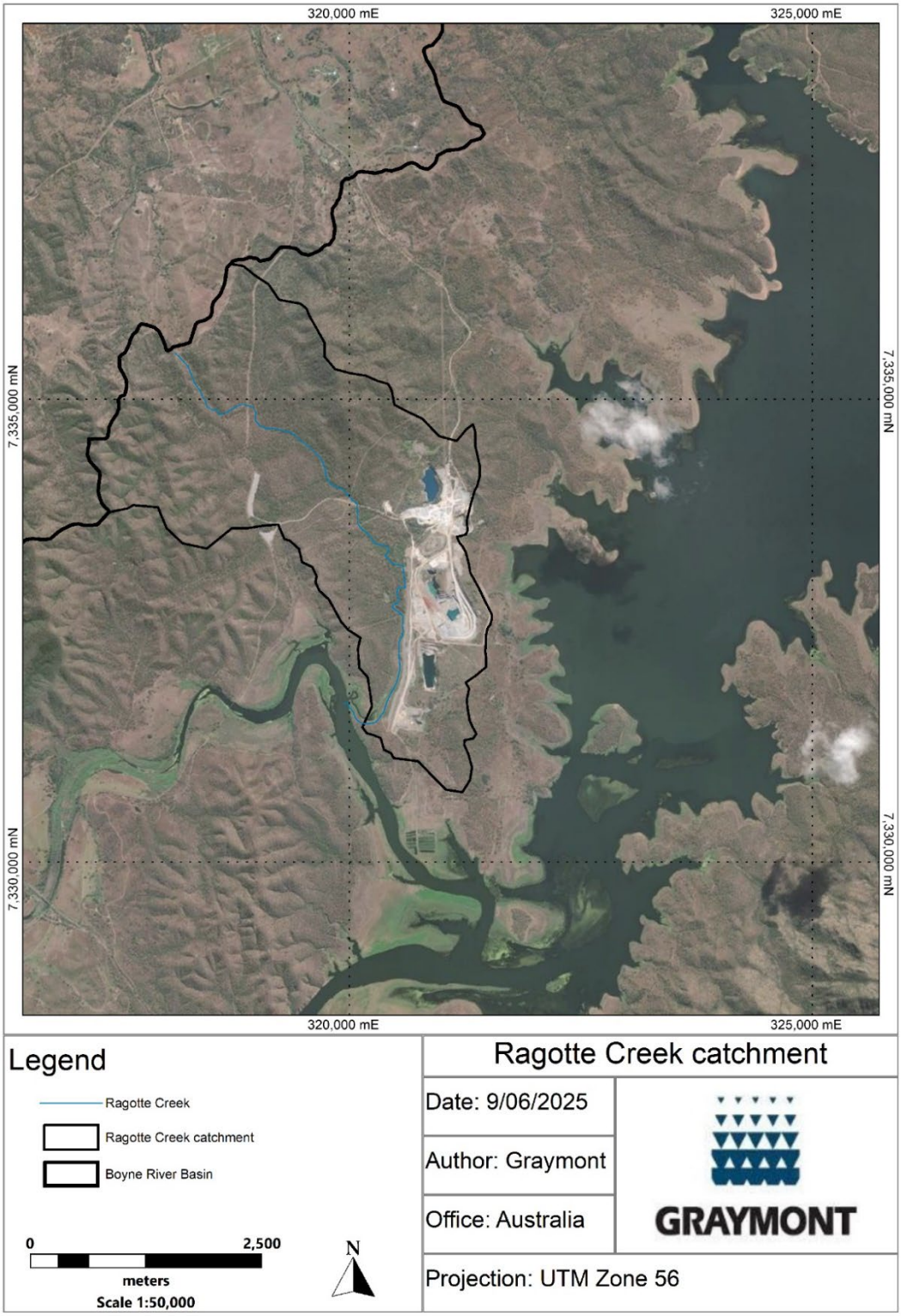


Figure 6 Ragotte Creek catchment

Mining creates sub-catchments at the southern end of the Ragotte Creek catchment. See Section 4.1.3.

3.2 Environmental values

The Boyne River Basin Environmental Protection (Water) Policy 2009 Central Queensland map outlines environmental values across the Boyne River Basin. The Boyne River Basin Plan Environmental values relevant to Calliope are shown below in Table 7.

Boyne River Basin Environmental values			
Environmental values	Upper northern creeks	Awoonga Dam	Groundwater (bores, etc)
Aquatic ecosystems	✓	✓	✓
Drinking water	✓	✓	✓
Primary recreation	✓	✓	
Secondary recreation	✓	✓	
Visual recreation	✓	✓	
Human consumer	✓	✓	
Cultural and spiritual values	✓	✓	✓
Aquaculture	✓	✓	
Farm supply/use	✓		✓
Irrigation	✓		✓
Stock water	✓	✓	✓
Industrial use		✓	✓

Table 7 Boyne River Basin Environmental values relevant to Calliope

3.2.1 Upper northern creeks

The upper northern creeks are unregulated and flow into Awoonga Dam. The Ragotte Creek catchment lies within the Upper norther creeks sub-zone, which has a moderately disturbed aquatic environmental value.

3.2.2 Awoonga Dam

Awoonga Dam was constructed in the Boyne River to supply water for industrial and urban use and is the main source of drinking water for the greater Gladstone region. The Awoonga Dam is owned and operated by the Gladstone Area Water Board. The Awoonga Dam water supply is the key environmental value in the local area and due to the downstream connection with the Boyne River valley, may indirectly impact downstream environmental values. The quality of water within Awoonga Dam is significantly influenced by the type and management of land use activities in the catchment, with nutrients and sediment levels attributed to the land clearing and cattle grazing that has occurred in the Boyne Valley over the past 100 years. (GAWB, 2025).

3.2.3 Groundwater

Regional groundwater beneficial use is discussed in Section 3.9 and Calliope water quality objectives are outlined in Section 4.7.

3.3 Climate

The climate of the Boyne River Basin is classified as sub-tropical with warm to hot summers and mild dry winters. The average daily temperature is 22°C/year; annual potential evapotranspiration ranges from 1750-2300 mm/year for an average of 1870mm and annual rainfall ranges from 500-1875 mm/year for an average of 1000 mm/year (Queensland Government, 2023).

Daily rainfall and evaporation from Long Paddock for a node located being approximately 1km west of Pit 2. Average annual rainfall is 880mm and average annual evaporation 1900mm. Monthly rainfall, evaporation and temperature is shown in Figure 7 from 1975-2025 and from 2002-2025, since the raising of Awoonga Dam wall.

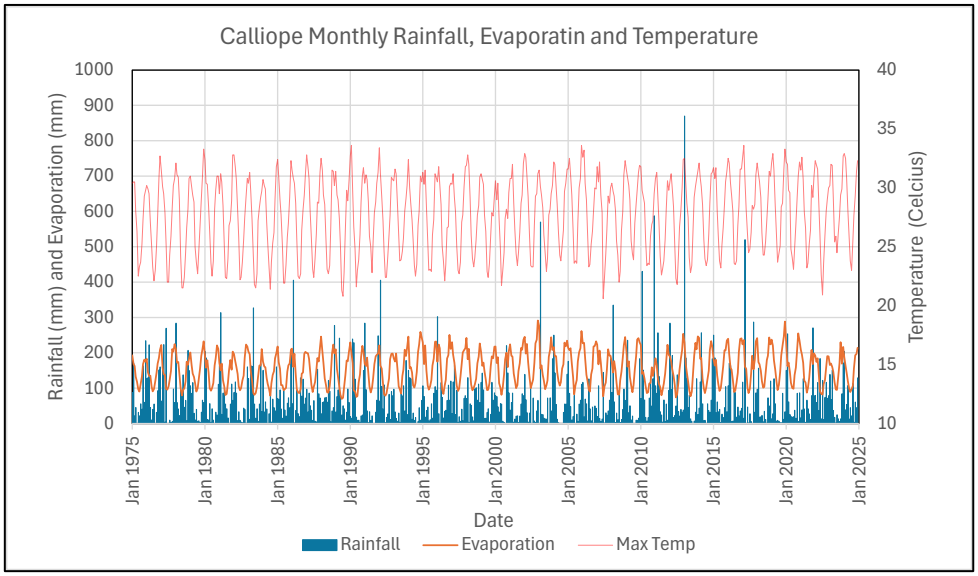
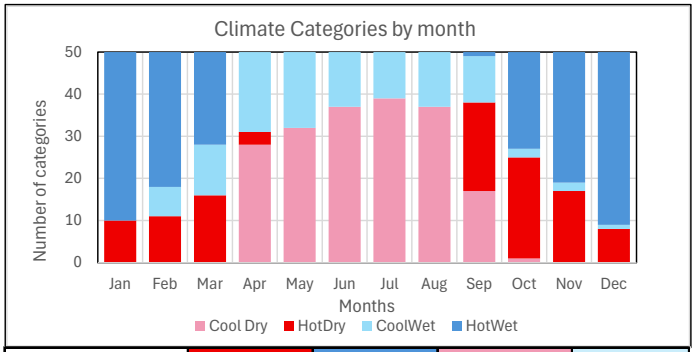


Figure 7 Monthly Rainfall, Evaporation and Temperature 1975-2025

From 2003-2017 there were six extreme rainfall events which elevated Awoonga dam water level and led to excess pit water capture but there have been none since 2017. The 50 year rainfall and evaporation record was analysed and it was determined that monthly median rainfall is 45mm and monthly median evaporation is 157mm. This data was used to categorise monthly climate into the four categories of Hot Dry, Hot Wet, Cool Dry and Cool Wet (Figure 8).



Category	Hot Dry	Hot Wet	Cool Dry	Cool Wet
Rainfall (mm)	<45	>45	<45	>45
Evaporation (mm)	>157	>157	<157	<157

Figure 8 Climate categories

The monthly categories had surface water runoff coefficients derived for each category which were used in the Water Balance model estimate of Pit 3-4 predicted pit water fill level (Section 8.1.2).

3.3.1 Rainfall and evaporation data used for final void Water Balance model

The 1975 to 2025 Monthly rainfall and evaporation records were used to predict the 2100-2200 rainfall and evaporation for the Water Balance model by replicating and repeating this 50 year cycle

Global Climate Models are provided by the Queensland Government which display projected impact of high (RCP8.5) and lower (RCP4.5) greenhouse gas emission (GHGE) scenarios on the Boyne River Basin. See Figure 9. Climate change trends are discussed in respect to projected change (no trend/increase/ decrease), magnitude of change (none/slight/small/ medium/large) and the level of confidence in the projection (weak/moderate/strong).

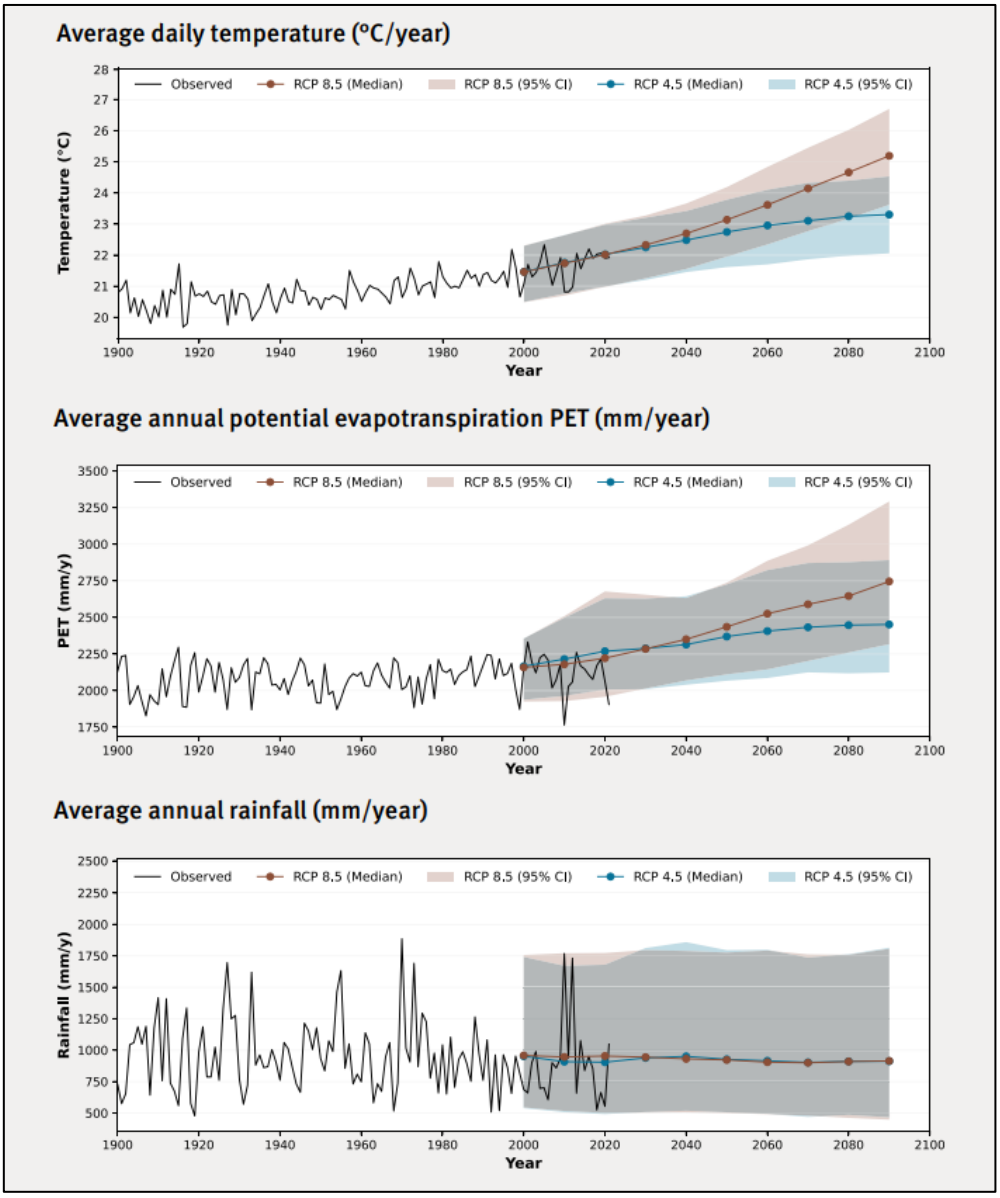


Figure 9 Boyne River Basin Global Climate Model scenarios

The climate at 2100 is projected to be hotter (large increase, strong confidence), drier (medium increase, strong confidence) with a slight decrease in rainfall (weak confidence). Projected seasonal climate trends are an average monthly temperature increase for all seasons; evaporation increase for all seasons, particularly in summer and spring and rainfall decrease in winter and spring but with an increase in summer.

Climate Models (GCM) show a general warming across the state and for the Boyne River Basin the higher GHGE scenarios indicate a 6.3% increase in evaporation and the lower GHGE a 3.8% in evaporation. A 2% Water Balance model

Monthly rainfall and evaporation records from 1975-2025 for the Calliope are provided in Section 4.2. The 1975-2025 rainfall and evaporation record was used to predict rainfall and evaporation from 2100 by applying GHGE estimate high and lower scenarios to this climate record. See Section 8.2.

3.4 Topography

The Calliope Limestone operation is located within the Boyne River catchment of the Fitzroy Region. Topography of the Boyne River catchment varies from steep ranges down to the river valleys and Awoonga Dam. (Figure 10).

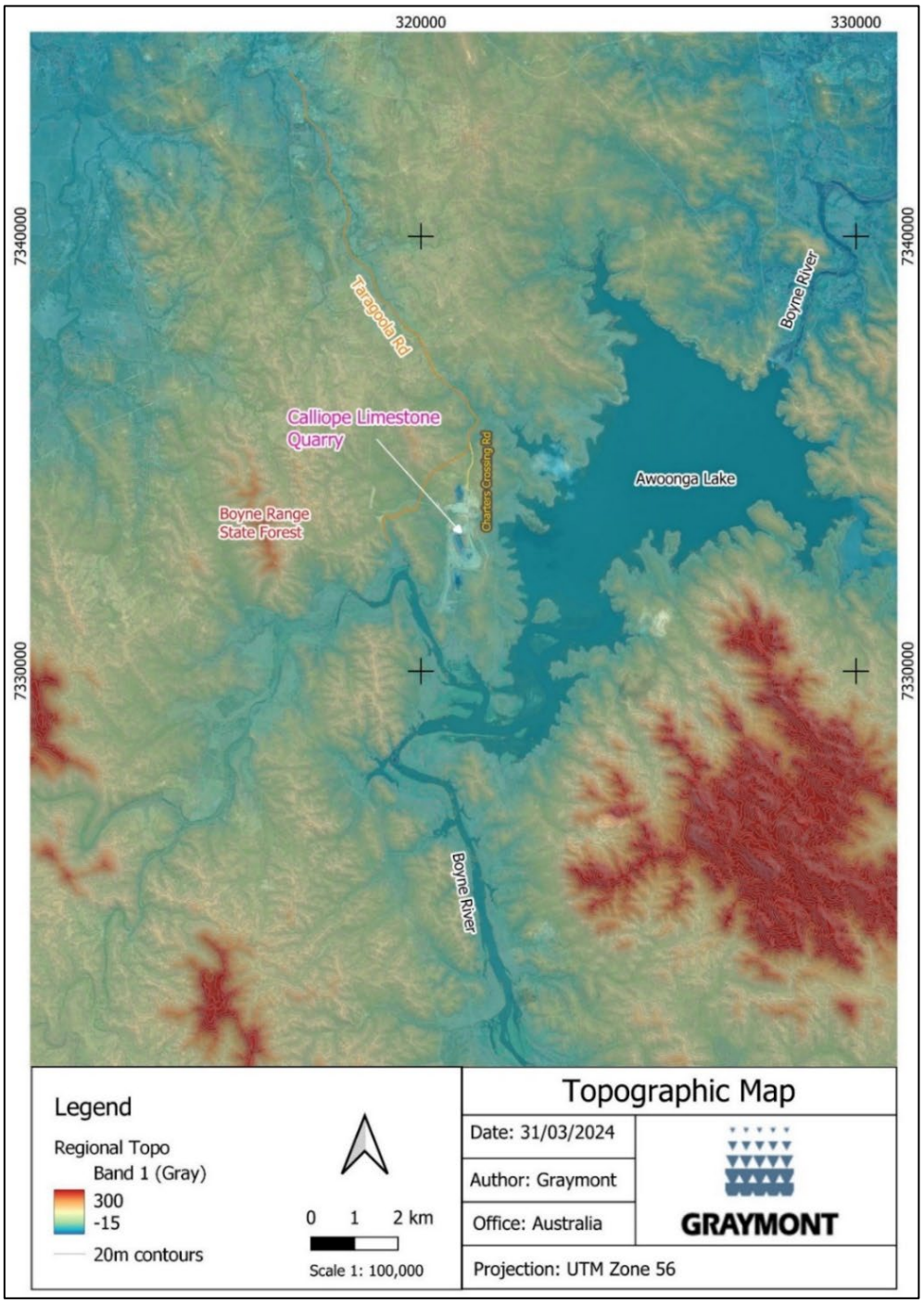


Figure 10 Regional topography

3.5 Regional Geology

The Calliope lies within the New England Orogen, part of Tasman Orogenic Belt, a Palaeozoic continental convergent plate margin. The belt is composed of Palaeozoic deep and shallow water marine sedimentary rocks, mafic volcanic rocks and is intruded by granitic plutons with extensive Quaternary cover. Around Calliope the area is divided into the Calliope, Coastal, and the Rockhampton Sub-provinces which are separated and bounded by regional faults. The Calliope is located in the Silurian-Devonian aged Calliope Beds. (Figure 11).

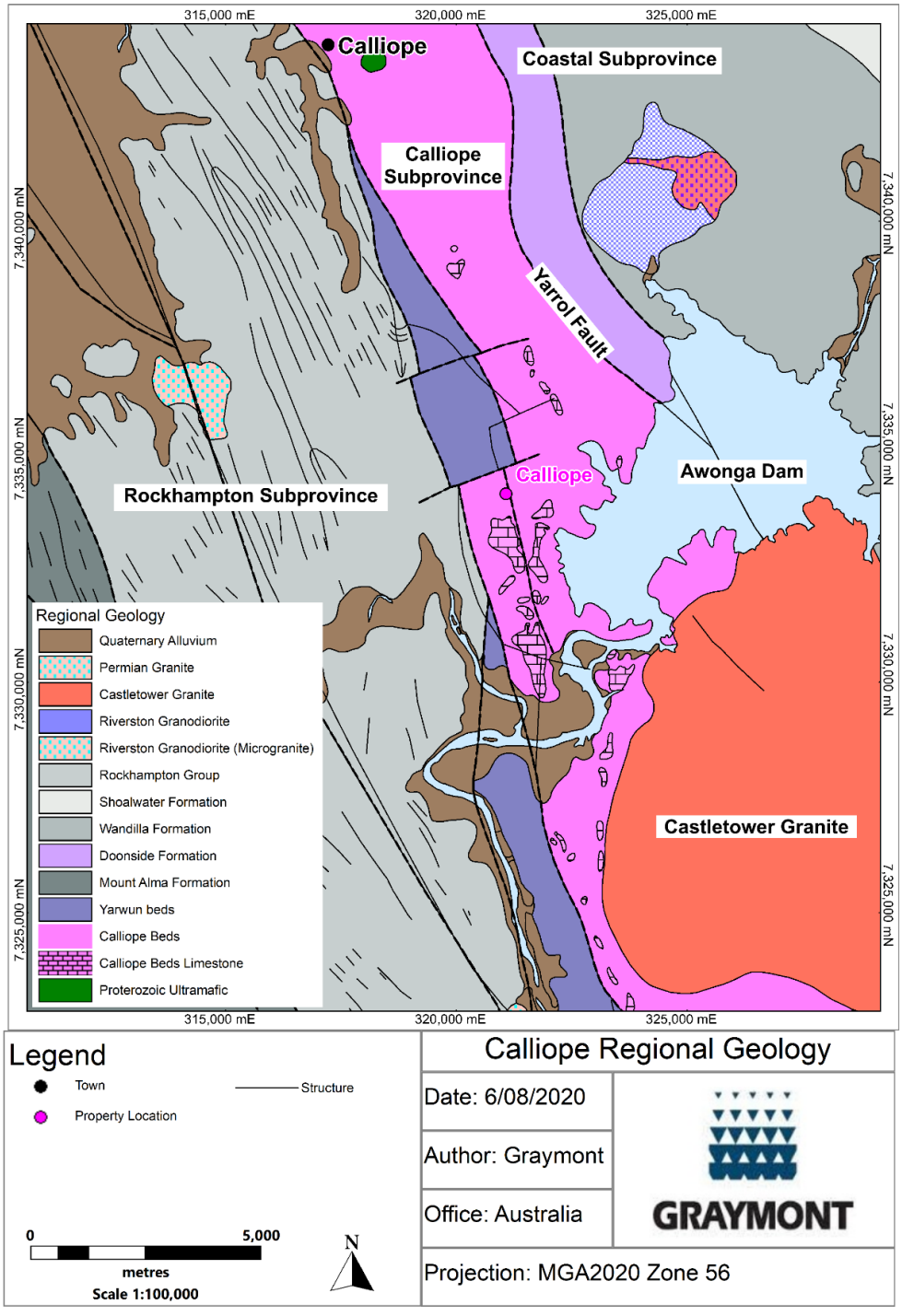


Figure 11: Regional Geology

3.6 Land use and local resources

Land uses of the Boyne catchment include grazing (74%), nature conservation (16%) and forestry (5%). Recreation including camping, fishing hiking and mountain biking in the region provides an economic boost to the region. Mining (limestone) is a small part of the catchment. The Awoonga Dam provides recreation facilities for picnicking and camping and is a popular spot for boating and fishing. Offshore from the Gladstone area lies several Great Barrier Marine Park zones that aim to manage the waterway use for the protection of the Reef. Curtis Island, hosts a large National Park and Conservation area just north of Gladstone offers recreational activities including rainforest walks and camping.

3.7 Vegetation

Catchment vegetation includes eucalypt woodland dominated by Narrow-leaved Ironbark (*Eucalyptus crebra*) with an understorey of native tussock grasses. The eucalyptus woodland is described as open woodland often with a shrubby layer and occurs on undulating rises and low hills, often with distinct strike pattern formed on moderately to strongly deformed and metamorphosed sediments and interbedded volcanics and Permian sediments.

3.8 Surface water

The Boyne River and its tributaries flow northerly into Awoonga Dam. The Awoonga Dam weir is located on the downstream side (northern end) of the dam. Awoonga Dam is operated by the Gladstone Area Water Board, is a regulated structure providing water supply to the region. Downstream of the Weir, the Boyne River continues northeast toward the coast between the towns of Boyne Island and Tannum Sands 12 kilometres south of Gladstone. The Boyne River is joined by several tributaries along its length. The Awoonga Dam at full supply level (FSL) of 40m AHD holds 778,900 ML and a surface area of 6,791 hectares. The maximum water level recorded at the spillway was 48.3m AHD on 27th January 2013, and the lowest levels on 4th February 2003 of 20.84m AHD. The Awoonga Dam receives surface water discharge from Calliope. Calliope water quality objectives are outlined in Section 4.7.

3.9 Regional Groundwater and its beneficial use

The *Boyne River Basin Water Plan 2013* allows for the take of groundwater and overland flow water but because groundwater take is not licensed, there is potential to extract water using bores from groundwater adjacent to the watercourse, which may impact on surface water availability. This is considered a low risk. (*Ministers Performance assessment Report - Boyne River Basin Plan, 2019*). Regional groundwater in the Boyne Basin is primarily used for pastoral, horticultural, and domestic purposes.

3.9.1 Regional groundwater recharge and discharge

Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith.

3.9.2 Regional groundwater bores

A search of bores on the Queensland State database within a 9 km radius of the project showed 39 bores. Of the 39 bores, 28 are classified as 'Existing', and the remaining 11 are classified as 'Abandoned and Destroyed'. See Figure 12. Hydrogeological information from the data is limited. Water level data is sporadic, and no continuous data exists to derive trends for water levels or water quality. The closest bore to the site is Bore ID 111,148 which is located 2.8km up catchment from Calliope. This bore is in the Yarwun beds, which have been fault offset from the Calliope beds and which a different aquifer system from the Calliope Beds aquifer system. Bore ID 111,148 has a yield of 1.15l/s.

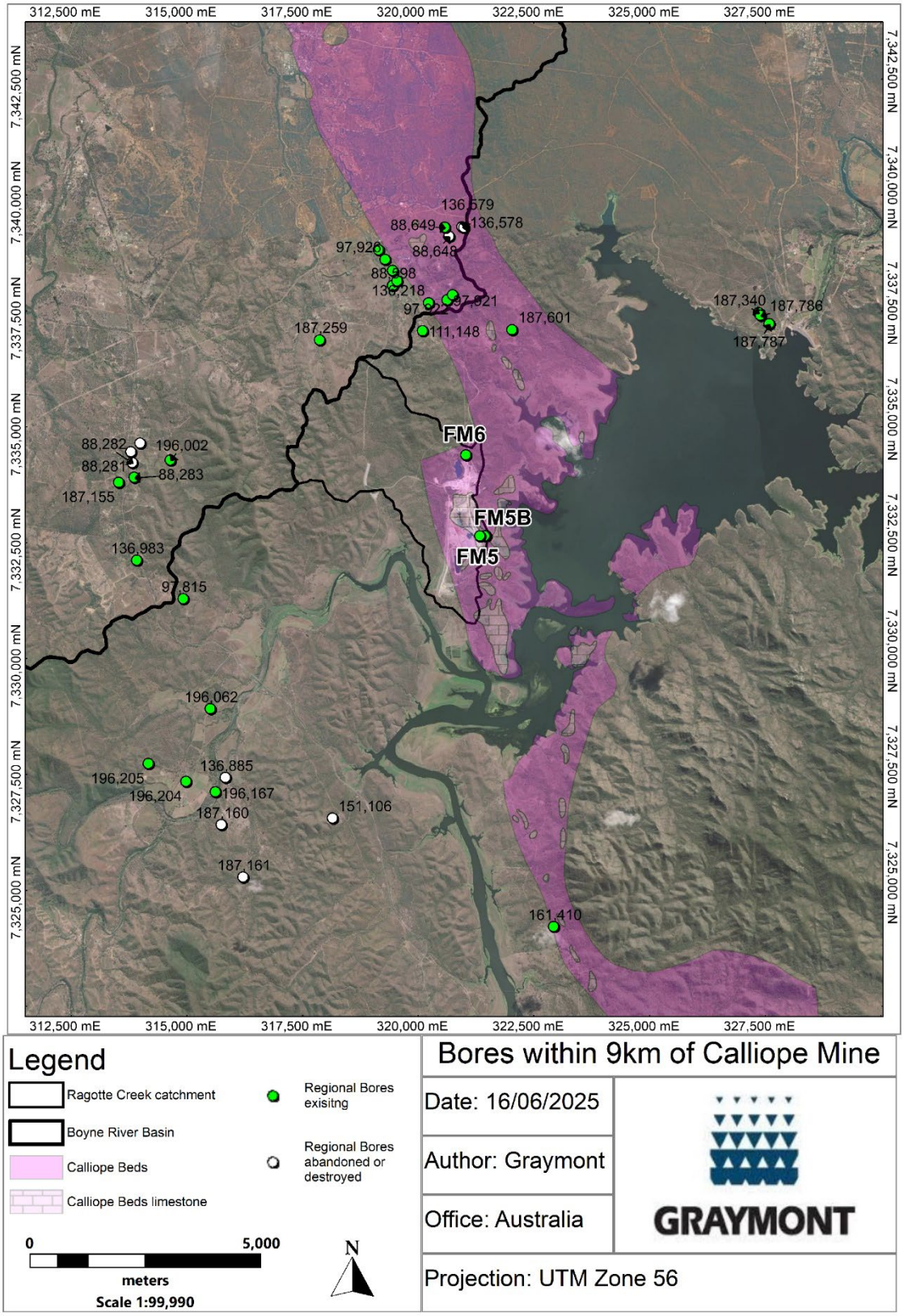


Figure 12 Bores within 9km of Calliope from QGlobe

A summary of registered bores constructed in the Calliope Beds within 9km of the Calliope is provided below in Table 8.

Registered number	Status	Bore depth	Yield l/s	Aquifer	Aquifer depth interval
88648	Abandoned and destroyed	75	None	Limestone	Dry
88649	Existing	47	1.5	Limestone	15 - 47m
97921	Existing	31	1.01	Andesite	27 - 31m
97922	Existing	14	0.74	Andesite	7.3 - 14m
136218	Existing	13.5	0.51	Limestone	
136578	Abandoned and destroyed	60.96	None	Limestone	Dry
136579	Abandoned and destroyed	18.29	None	Limestone	Dry
151688 (FM6)	Existing	60.5	n/a	Andesite	
151689	Existing	16		unknown	15 - 16m
161410	Existing	17.68	1.26	Limestone	6.71 - 17.68
187601	Existing	25	0.65	Andesite	8 -13.8m
187861	Abandoned and destroyed	51	None	Limestone	Dry
187863 (FM5)	Existing	30	n/a	Limestone	18 - 24m
187863 (FM5B)	Existing	30	n/a	Andesite	

Table 8 Registered bores constructed in Calliope Beds within 9km of the Calliope

The Calliope beds limestone and andesite is predominantly an aquitard but with connected fractures can form a yielding fracture rock aquifer. The maximum recorded bore yield from the Calliope Beds within 9km of the Calliope is 1.5l/s.

GRAYMONT

4 PROJECT DESCRIPTION – CALLIOPE

4.1 Mining voids and mining created sub-catchments

4.1.1 Site History

Limestone Exploration in the early 1960's led to the granting of mining leases to Frost Enterprises and Comalco with mining commencing in 1967 coinciding with the development of the Queensland Alumina Limited (QAL) alumina refinery at Gladstone. Limestone extraction began at Pit 1 (ML3603) and on the Comalco lease now called Pit 4 (ML3594). A 1969 aerial photograph of the Calliope is provided below as Figure 13.

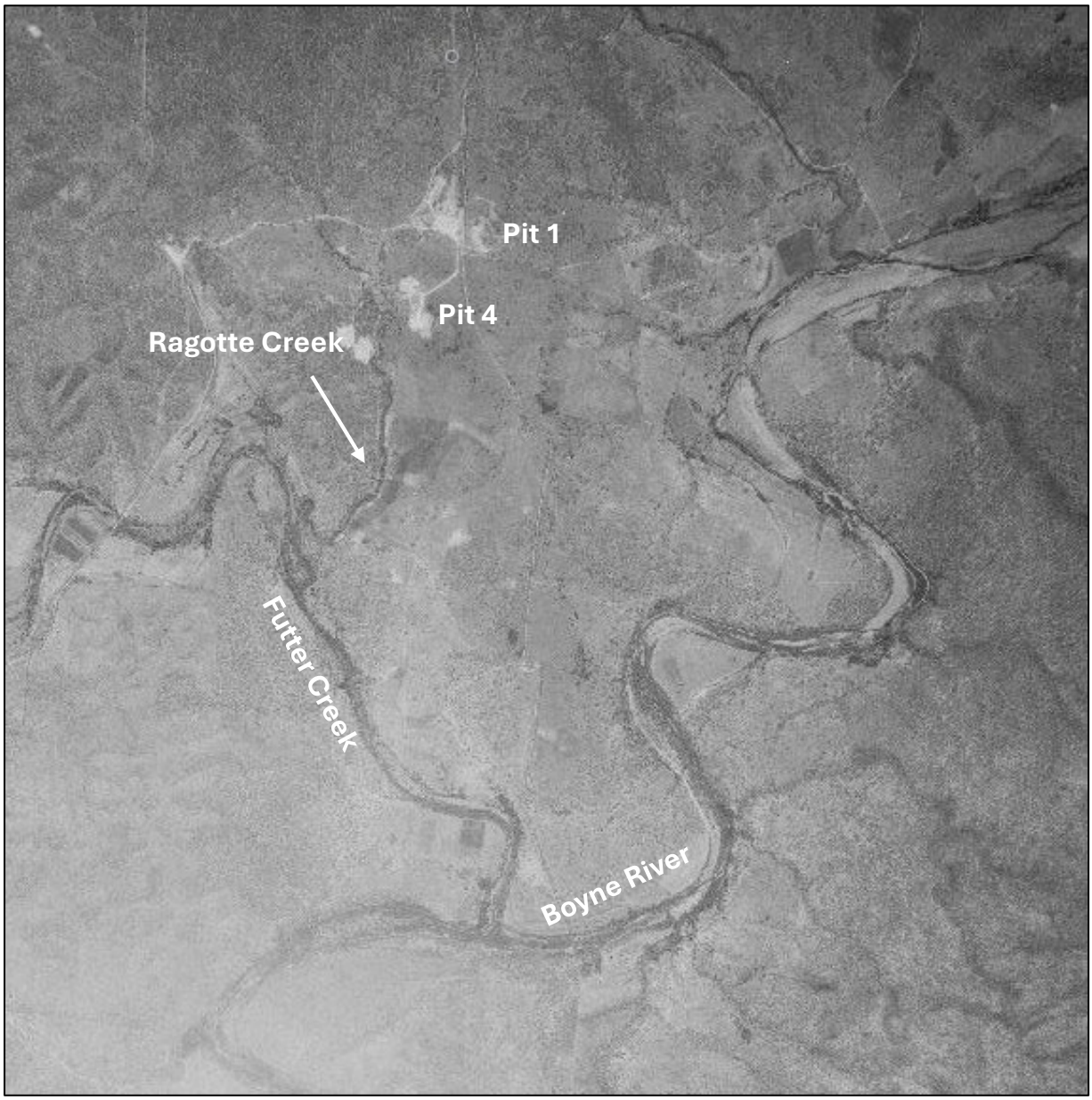


Figure 13: Calliope 29 November 1969

Limestone is extracted by conventional open cut benching methods. Four pits have been excavated at the Calliope, being Pits 1-4, although Pit 1 has now been backfilled.

In the 1980s the raising of Awoonga Dam wall by 24 metres did not impact the Calliope but the planned raising of the Awoonga Dam wall by a further 11 metres to 47mAHD in 2001 led GAWB to initiate earthworks for flood protection of the then named 'Frost Quarry. Frost Enterprises provided the construction services to widen and raise the spoil heaps, supply of crusher dust and haul trucks for material transport. The earthworks were completed in 2002.

Unimin acquired Frost Enterprises in September 2004. At this time, Unimin operated the two pits, the 'Frost Pit' now called Pit 3 and the 'Comalco Pit' now called Pit 4. Unimin merged with Sibelco Australia in 2011 assuming ownership of the site. Several additional mining leases were granted in 2013 to make the tenure more contiguous. In 2019 Graymont took ownership of the Calliope Limestone operation.

4.1.2 Mining Summary

Limestone is mined by conventional open cut benching methods. Mining begins with topsoil stripping and removal of clay rich overburden and waste rock. This material has been used for the construction of the western and eastern bund walls, which are large barriers to prevent surface water inundation of the quarry workings, as well as for safety bunding around pit voids and for surface water flow control. Excess overburden waster material is hauled to the Waste Dump, located south of Pit 3. The Waste Dump extends from the western bund wall as an increasingly widening barrier against potential flood inundation from Awoonga Dam.

Limestone is extracted by drilling and blasting to produce a high-quality limestone suitable for calcination and hydration and a medium quality limestone suitable for crushed rock and aggregates.

There are no geochemically reactive or acid forming wastes, tailings dams, or heap leach pads onsite, and the environmental risks from the inert waste rock is considered low/negligible.

The Calliope currently operates three pits with only Pit 4 currently used for extraction. Mining over the next 70 years will lead to the am amalgamation of Pit 4 with Pit 3 (Pit3-4) and end of mine life is currently scheduled for 2100, but this may change depending on reserves and yearly sales quantities. A PRC Plan amendment will be undertaken if there are any material changes to operations that will impact the rehabilitation staging of the Project. All future disturbance until EOML will be authorised by, and undertaken in accordance with, the amended EA.

4.1.3 Mining created sub-catchments

Prior to the commencement of mining surface water flow in Ragotte Creek catchment was inward and southerly to Futter Creek. A June 1997 aerial photograph of Pit 3 catchment is provided as Figure 14.

In 1997 waste material was being placed to the west of Pit 3, in as southerly direction, which provided a barrier between Ragotte Creek and mine workings. Surface water at this southern end of the Calliope Mine flowed southerly into Pit 3 and westerly into Ragotte Creek. Surface water and groundwater flowed into the Pit 3 from the western wall of Pit 3 as marked in Figure 14. Surface water flowed along an unnamed drainage line into Ragotte Creek through what is now the Farm Dam.

An organic rich black clay is shown on Figure 14 which indicates that this area is a natural topographical low. Prior to mining modifying surface water flow, surface water would have flowed southerly to the unmade drainage line and then into Ragotte Creek. This organic black clay layer provides the conduit for the current northerly flow of surface water from the Farm Dam to Pit 3.

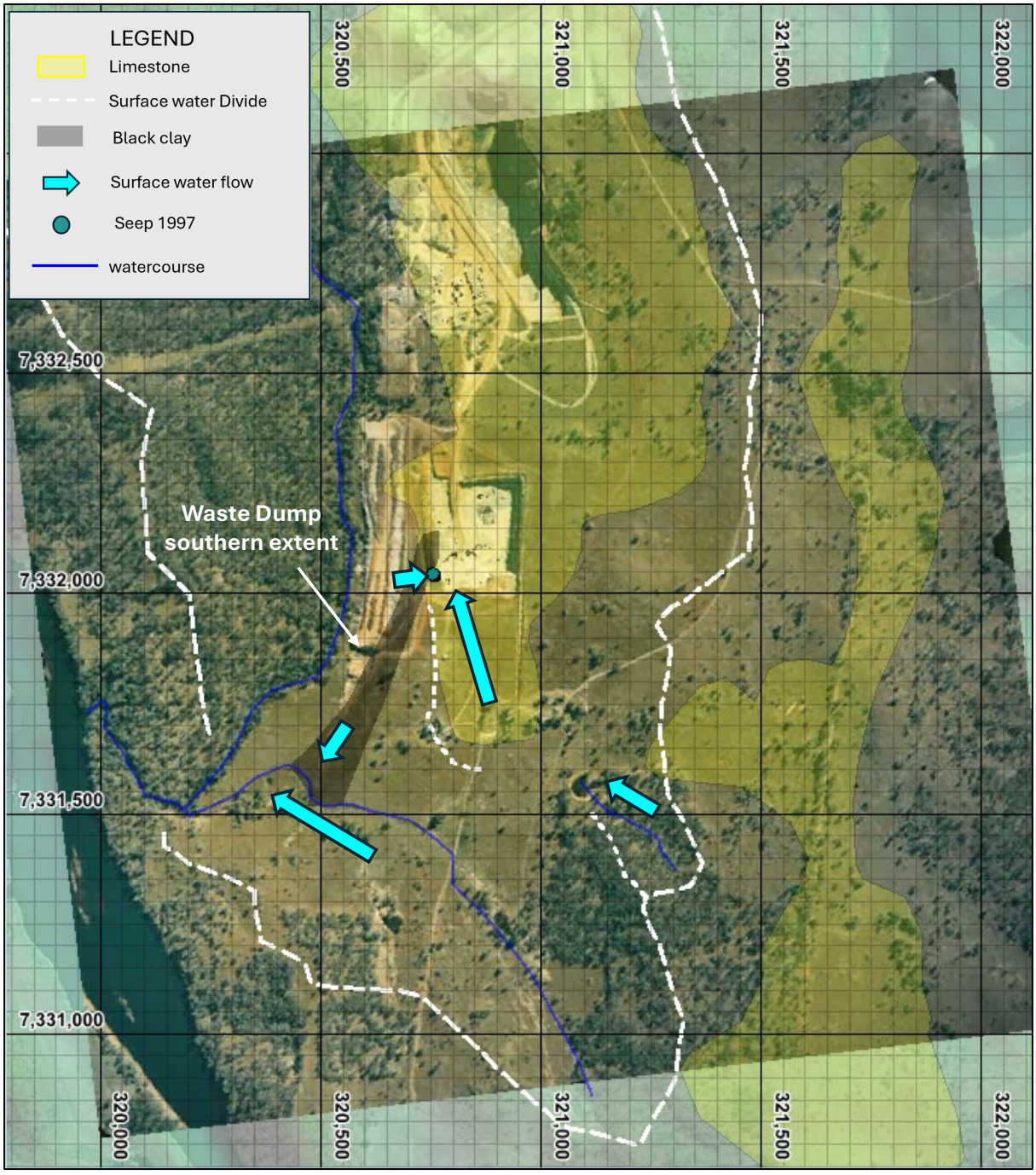


Figure 14 Pit 3 catchment in June 1997

A coinciding surface water and groundwater inflow point source into Pit 3 (Seep) is observable in the June 1997 as marked in Figure 14. The Seep was present in 1997, when the Waste Dump was adjacent to the Seep, prior to the completion of the construction of the western bund wall. The Waste Dump was a source of surface water run-off for the Seep.

The construction of the Western Bund Wall in 2002 impeded westerly surface water flow to Ragotte Creek and created the closed Pit 3 and Farm Dam sub-catchments. A 2002 Calliope map of spoil heaps used in the construction of the Western Bund Wall is shown as Figure 15.

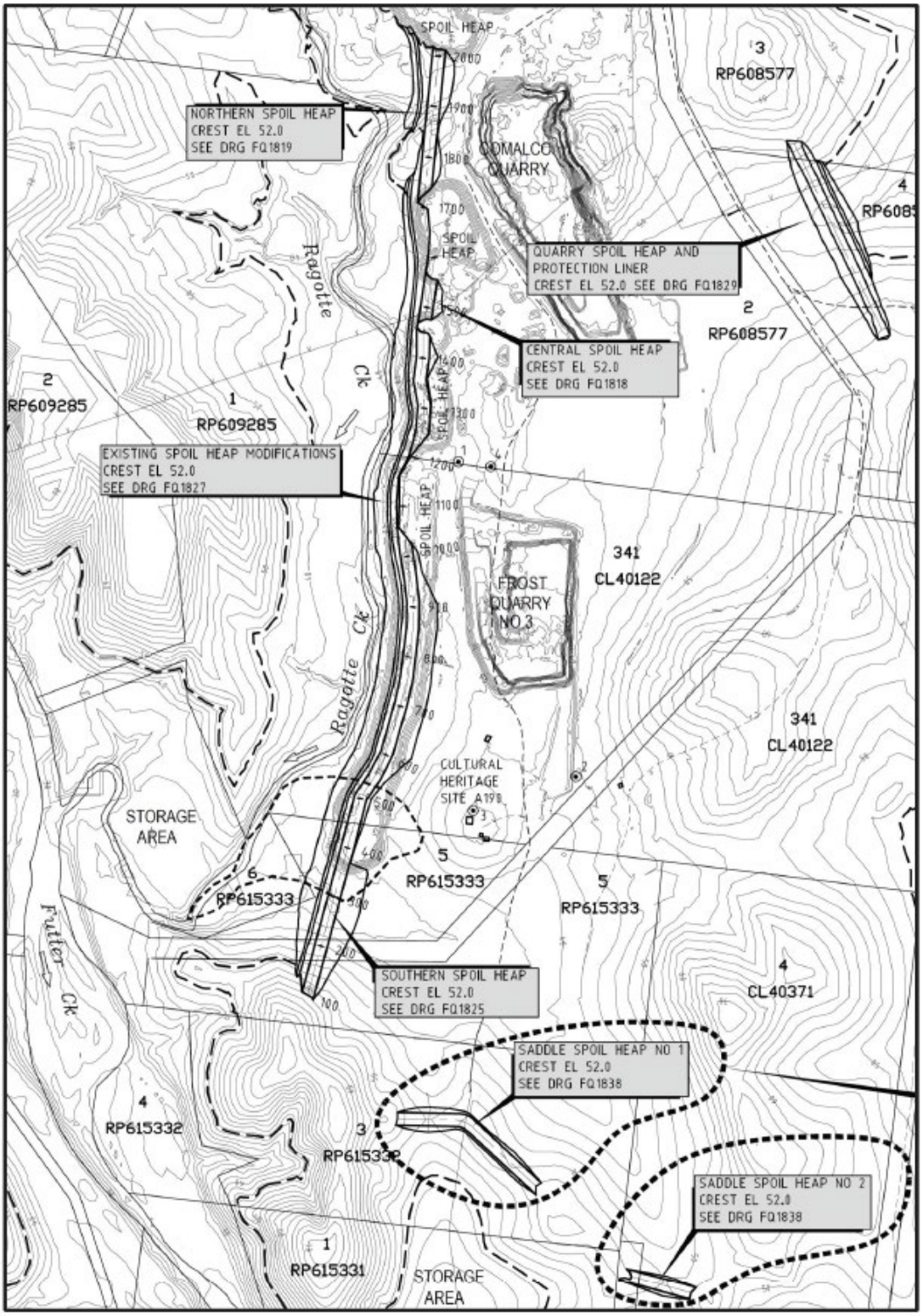


Figure 15 Spoil heaps used in the construction of the Western Bund wall (GAWB, 2002)

The construction map provides a chainage distance for the western bund wall, from south to north, which is referenced by later investigations of potential leakage of this wall. The Seep is located at chainage 860. A September 2004 aerial photograph of Pit 3 catchment is provided as Figure 16.

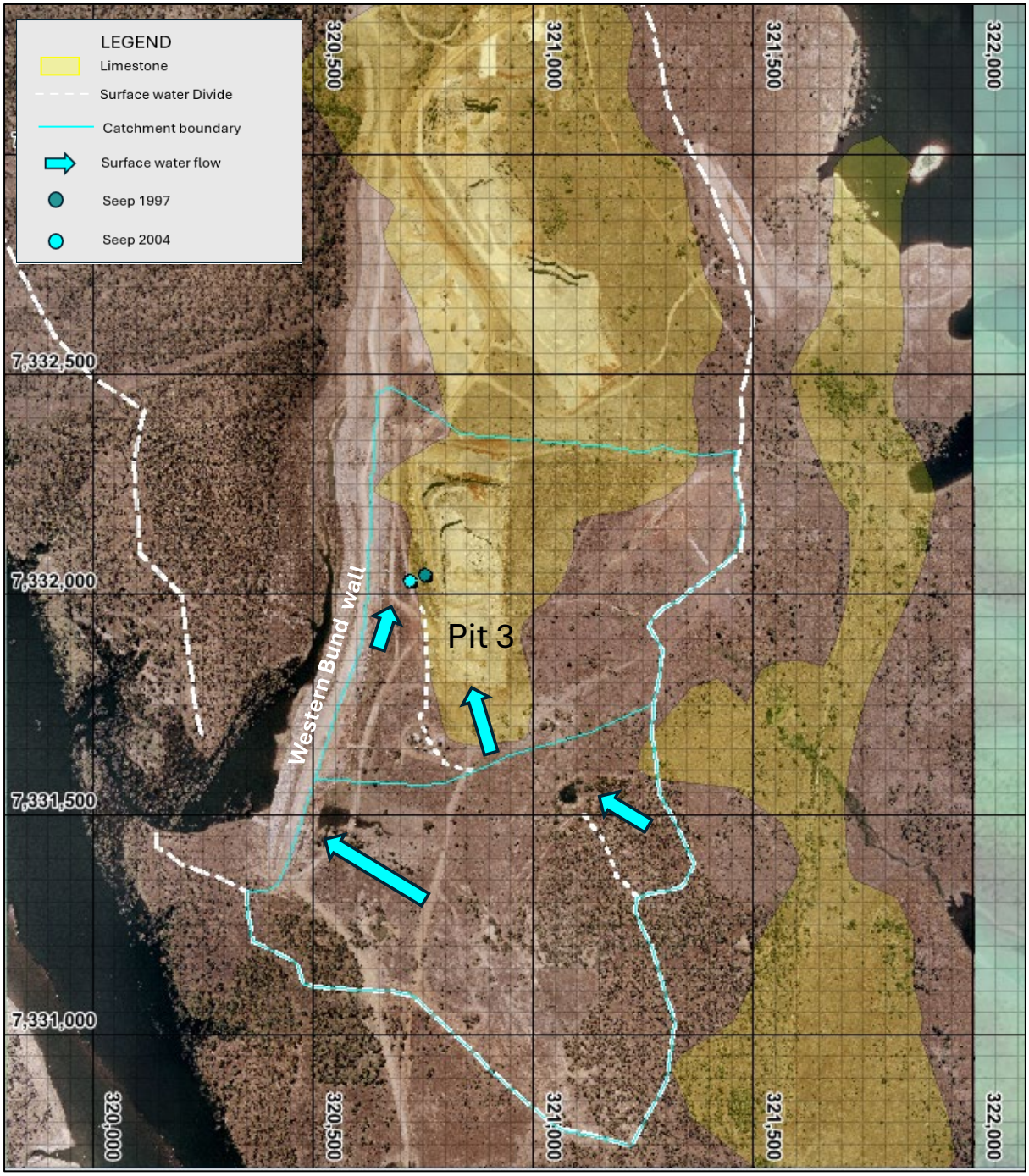


Figure 16 Pit 3 void and Farm Dam sub-catchments in September 2004

In September 2004 Pit 3 was dry but erosion had caused the Seep to migrate westerly as shown in Figure 16. Although Pit 3 was dry at this time there was water in Ragotte Creek and minor water in the Farm Dam. The relevance of observed water in the Farm Dam and Ragotte Creek is that GHD in 2011 proposed that excess water in Pit 3 following an extreme rainfall event was due to a possible piping failure mechanism from the ponding of water by the Farm Dam against the unlined eastern side of the Western Bund Wall. In 2004 water was ponding on the eastern side of the western bund wall because the Western Bund Wall impeded surface water flow that used to flow into Ragotte Creek.

In March 2011 a high rainfall event led to excess water in Pit 3. The point source of the excess water is the Seep (Figures 12 and 14) and the water dynamics of the Seep are discussed in detail in Section 5.2. The Pit 3 catchment in November 2012 is shown in Figure 17.

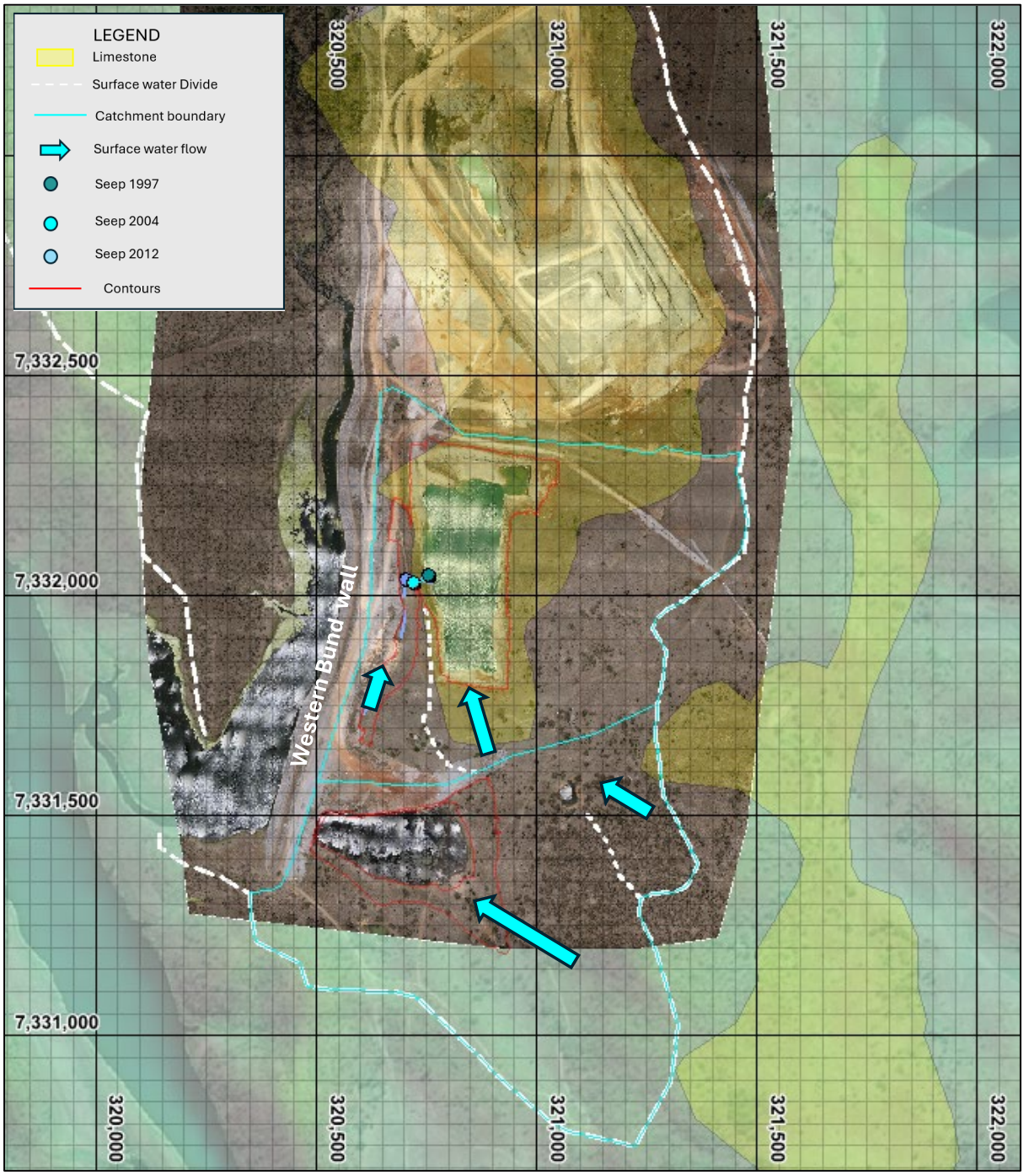


Figure 17 Pit 3 and Farm Dam sub-catchments November 2012

In November 2012 surface water flowed along the western bund wall from the Farm Dam and into Pit 3 at the Seep. The Seep had further migrated to the west with erosion and during a high rainfall event in 2013 slumping occurred creating the current scoured channel from the Western Bund Wall into Pit 3. Further discussion on surface water flow from the Farm Dam to Pit 3 is provide in Section 5.2.

The landform has been modified since 2012 by expansion of Pit 4 void, expansion of the Waste Dump in the 'Farm Dam' area and the infill of Pit 1. Current mine sub-catchment boundaries are shown below in Figure 18.

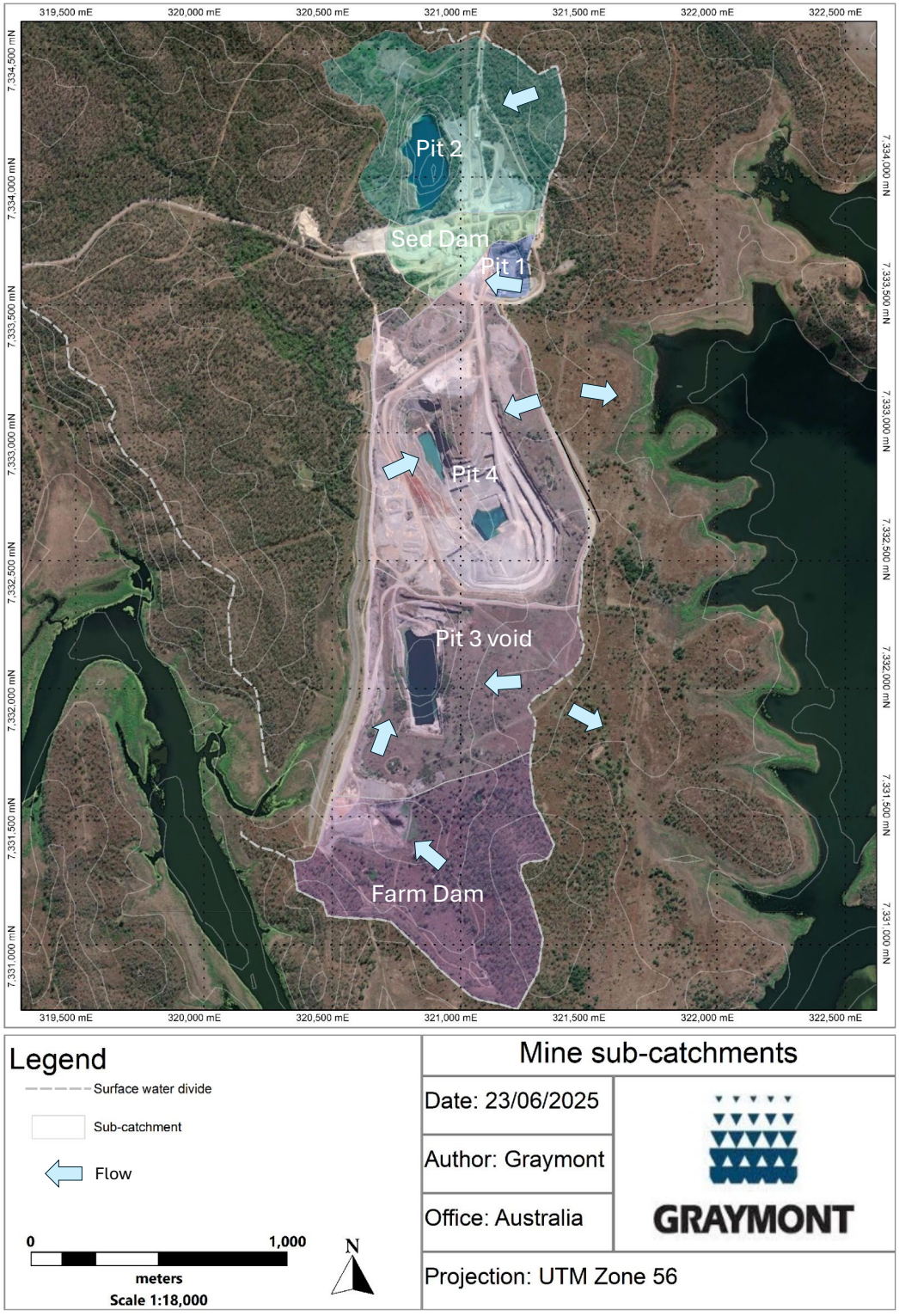


Figure 18 Mine sub-catchments

A description of the individual sub-catchments is provided below .

Pit 1

The Pit 1 catchment area has a roadside bund separating clean rainfall run-off water from the active mine area on the east side of the catchment. Pit 1 has been backfilled and drainage within the catchment is directed northwest and into the Sediment Dam catchment. Surface water run-off that has come in contact with stockpiled limestone material flows into the Sediment Dam catchment. The northern part of the catchment includes the employees crib room, workshop and access track.

Pit 2

Pit 2 catchment area includes the main entrance to the site, the contractor truck waiting area at the site entrance, main office and plant stockpile storage areas. Pit 2 is an inactive pit void for mining purposes and acts as a water storage facility for the site. Process water for the plant operation is obtained from Pit 2 storage. Water is also used for dust suppression purposes and washdowns. The Pit 2 void is the focus for drainage for this catchment. Overflow from the adjacent slurry dam catchment area will flow to the Pit 2 void under higher run-off conditions.

Sediment Dam and Slurry Pond

Run-off from the wash plant and screening area flows west toward the sediment dam which captures and settles sediment before discharge through release point C1. Release only occurs in wet climate conditions and after monitoring has confirmed water quality compliance. Run-off from Pit 1 area is also directed into the Sediment Dam catchment.

Run-off from the crushed limestone stockpiles which can include fine material, flows west into the slurry pond where settling occurs. During higher wash plant water use and wet climate periods, overflow is directed northward to Pit 2 void via subsurface pipeline.

Pit 4

Pit 4 currently has two void compartments. The main water supply and storage void is the northern compartment with a pontoon and pump system installed. The southern void compartment is the active mine area. Pit 4 water is primarily pumped from Pit 4 to Pit 2, and if required to C1 release point provided water quality parameters are met.

Pit 3

Pit 3 is currently inactive for mining but will become active in the future. The void receives surface water run-off, groundwater seepage and potentially leakage from Awoonga Dam. The relative contribution of these water sources has been subject to numerous investigations which is discussed in Section 5.2. In more extreme wet climate conditions if storage capacity is significantly reduced, water can be pumped to the F1 release point provided water quality parameters are met.

Farm Dam and Waster Rock Dump

The Farm Dam and its sub-catchment have been created by the construction of the western bund wall which impounded surface water which prior to the construction of the western bund wall flowed into Ragotte Creek. The western side of the Farm Dam catchment is progressively being developed as a waste dump. Water storage in the Farm Dam is continually modified by the ongoing placement of waste material against the eastern side of the Western Bund Wall. The Farm Dam has a theoretical run-off overflow at 43mAHD to Pit 3 but does not fill beyond 38mAHD because of sub-surface water flow beneath the western wall of the Waste Dump which becomes. surface water flow along the western bund wall from the Farm Dam to the Seep and then into Pit 3 void. See Section 5.2..

4.2 The Calliope Geology

A map of Calliope geology is provided below in Figure 19.

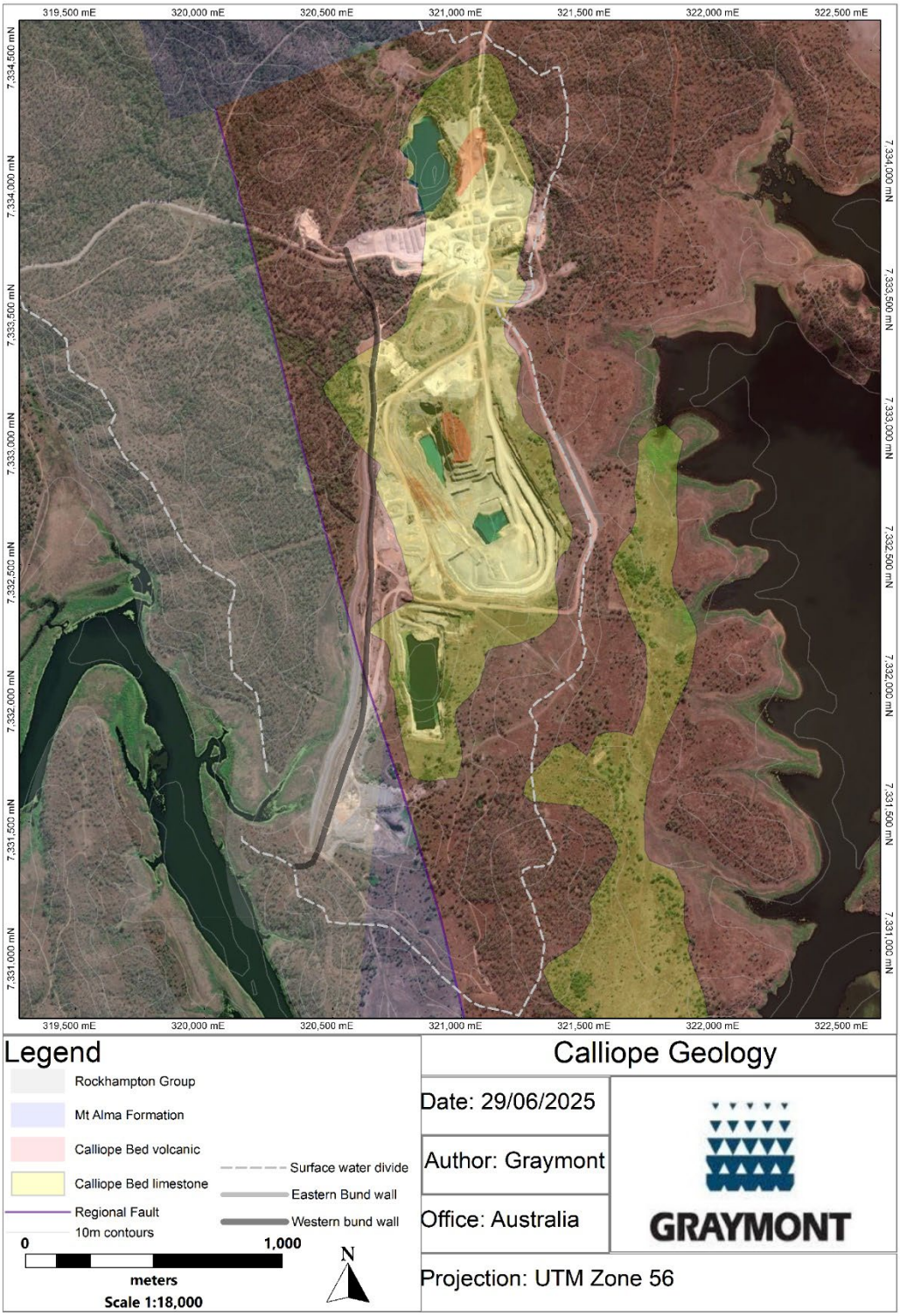


Figure 19 Calliope geology

The Calliope is located in the Silurian-Devonian aged Calliope Beds of limestone and volcanic rocks. Limestone outcrops as two well defined, elongated north-south lenses flanked by volcanic. The limestone-volcanic contacts are sub-vertical, with the exception of isolated remnant sub-horizontal volcanic caps. Bedding and cleavage are orientated north-south and joint direction generally vary between northeast-southwest and southeast-northwest. The younger Rockhampton Group sediments lie to the west of a north north-west trending fault, which lies outside Pit 3 and 4 voids. The fault is to the east of the Farm Dam abutment with the western bund wall and to the west of the Seep and has no apparent relationship to both these features. See Figure 19.

Volcanics rocks vary in colour from being blue grey to black and from green-grey to purple-red to red. Volcanic is present as a sub-vertical sills and sub-horizontal dykes. This is unusual because sills are mainly sub-horizontal and dykes sub-vertical and imply regional thrusting. The volcanic rocks are mainly basaltic and are typically 40-55% SiO_2, 4-10% CaO, 3-7% MgO, 2-4% Na_2O, 9-13% Fe_2O_3 and 0.3% SO_3. Fresh Limestone is typically 0.5% SiO_2, 54.5%CaO, 0.3%MgO, 0.01% Na_2O, 0.2% Fe_2O_3 and 0.05% SO_3.

The limestone has been subjected to regional metamorphism, folding and faulting with numerous joint sets. The limestone is massive, fine grained and even textured, light to dark grey but can vary to pink, red and pale brown in zones around faults and dykes. A photograph of a black mafic volcanic exposed by mining in the eastern wall of Pit 4 is shown as Figure 20.



Figure 20 Black mafic volcanic in the eastern wall of Pit 4 (from Rocktest, 2023)

The limestone has been weathered and clayed as shown in a photograph mosaic of the western wall of Pit 4 in Figure 21.



Figure 21 Weathering of limestone in the western wall of Pit 4

An E-W, north viewing, geological cross-section 7332650N of Pit 4 is shown below in Figure 22.

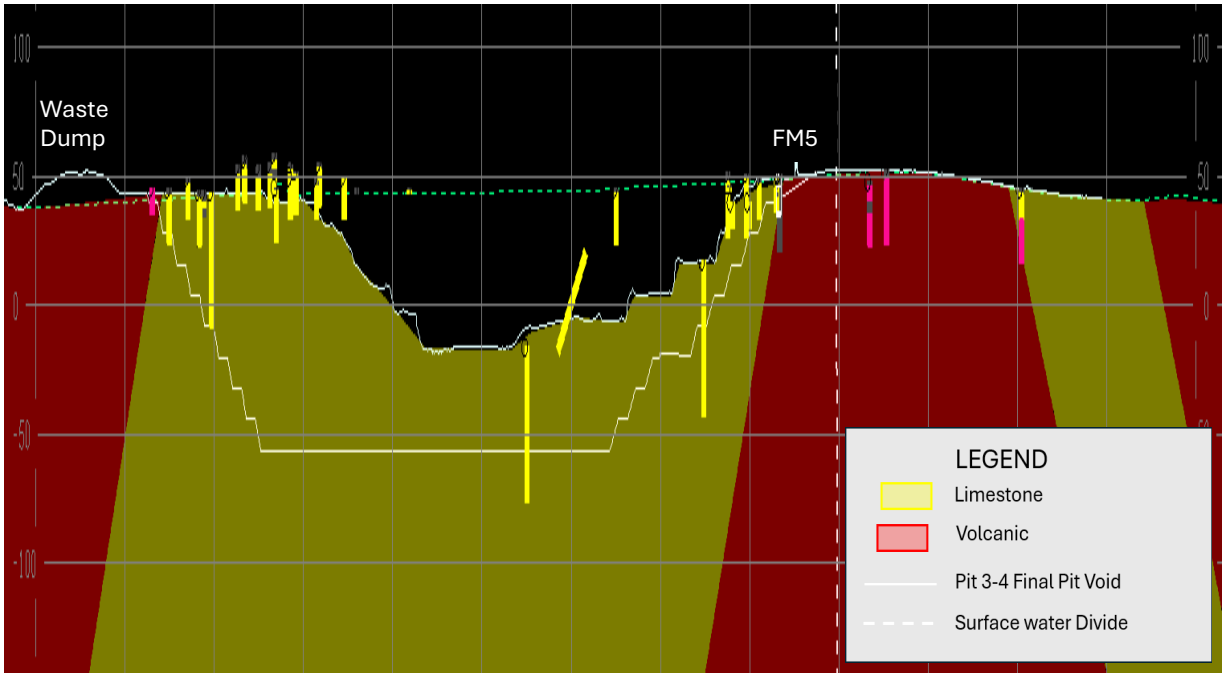


Figure 22 Cross-section 7332650N showing Pit 4 geology

Limestone in Pit 4 is bounded by volcanic which is exposed as fresh rock in Figure 20 in an upper bench. An E-W, north viewing, geological cross-section 7332175N of Pit 3 is shown below in Figure 23.

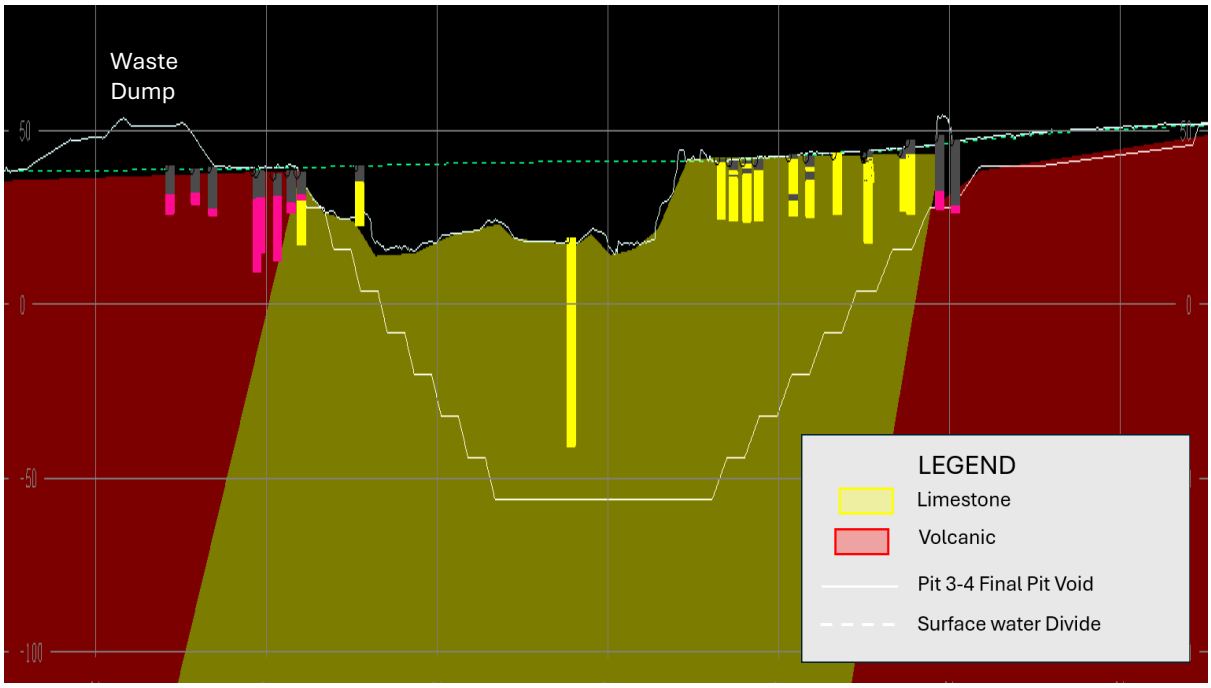


Figure 23 Cross-section 7332175N showing Pit 4 geology

The geological cross-section in Pit 3 is very similar to Pit 4.

4.3 Soils

Limestone occurs as either low outcrops or beneath a shallow cover of dominantly red-brown earths, topsoil and clay. Limestone is flanked by volcanic rocks which to the east are overlain by red-brown earths and red hematite iron-oxides associated with this topographic high. Overburden depth ranges from 10-15 metres. Volcanic rocks to the east are overlain by yellow brown earths and yellow brown goethite, which is a hydrated iron-oxide, in the topographic low. Black organic rich clay is present along the eastern flank of the western bund wall being on the western high wall of Pit 3, which includes the Seep into Pit 3.

4.4 Voids, mineral dissolution salt stores

Mining of limestone in places exposes volcanic contacts. The contacts are sub-vertical with the exception of isolated remnant sub-horizontal volcanic caps. Limestone is weathered and clayed near the surface with voids created by dissolution of infiltrating slightly acidic rainfall. Voids are filled by red to orange clay. Clayed and cavitied limestone is currently exposed on the western side of Pit 4 to an average depth of 10 metres. Limestone becomes fresher with depth to form a massive crystalline layer, Volcanic rocks are also weathered, clayed and cavitied and fresher with depth to form a massive crystalline layer.

The voids have formed by water dissolving minerals in the rock and releasing cations and anions to the regolith. Weathering of volcanic rocks releases the cations Ca, Mg, Na, Fe and some S to the regolith, and limestone weathering releases Ca. XRF results reveal that the SO_3% of volcanic is a low 0.28% and for limestone a very low 0.05%. Carbon is added to groundwater via CO_2 in soil water at roots of plants and by $CaCO_3$ dissolution and anions and cations are leached to groundwater.

The primary source of salinity in Central Queensland is the deposition of cyclic salts by precipitation and aeolian dust. (Oppy, 1999). There is an additional contribution from mineral weathering of cations and CO_3 anion from the dissolution of CO_2 in soil water. Stream salinity is attributed to salting in dryland and irrigation areas, discharges of saline groundwater, cyclic salt and the dissolution of surface salts in run-off water. The salinisation of groundwater is generally attributed to a changing water balance associated with salt affected regolith. Rainfall typically causes an initial increase in surface water salinity from flushing of salts out of the regolith (first flush) but extended rainfall causes a decrease in salinity by dilution. Rainfall typically causes an increase in groundwater salinity by leaching of salts from the regolith. The regolith salt store decreases in wet periods. Evaporation, in extended dry periods typically causes an increase in salinity by concentration. Groundwater salinity decreases in extended dry periods as groundwater lowers and salt is precipitated out of groundwater into the regolith. The regolith salt store increases in dry periods. Rainfall adds major ions to the regolith, groundwater and surface water which leads to the formation of the salts halite NaCl and gypsum $CaSO_4$. Kalf and Associates (2002) calculated dissolved minerals in water samples from bores FM1 and FM4, located west of Pit 4 and of the seepage into the western edge of Pit 3. See Table 9.

Location	FM1			FM4			Pit3 seep top			Pit3 seep bottom		
	mg/L	mmol/L	%	mg/L	mmol/L	%	mg/L	mmol/L	%	mg/L	mmol/L	%
Halite NaCl	2.14	0.037	1%	33.08	0.566	12%	89.06	1.522	23%	86.52	1.479	22%
Carbonate CaCO3	184.04	1.840	53%	164.18	1.642	58%	203.41	2.034	54%	214.44	2.144	55%
Dolomite (Ca,Mg)CO3	151.46	0.823	43%	68.46	0.370	24%	53.01	0.288	14%	53.01	0.288	14%
Anhydrite CaSO4	11.34	0.083	3%	18.43	0.135	6%	34.03	0.250	9%	32.61	0.239	8%

Table 9 Calculation of dissolved minerals

Groundwater in bores FM1 and FM4 have lower carbonates than the Pit 3 seep but higher dolomite whereas the Pit 3 seep has higher halite and anhydrite than groundwater in the bores. Mining operations can sometimes lead to Acid Mine Drainage however, this is not considered to be likely given the nature of the

geology, carbonate based, which leads to near neutral groundwater. Groundwater chemistry is discussed in Section 7.3.5. The source of the Pit 3 seep is discussed in Section 5.2.

4.5 Quarry aquifers and aquitards

Limestone and volcanic rock are both weathered near the surface but with depth form a massive crystalline layer. Massive crystalline limestone and volcanic rock have negligible primary porosity, but are variably finely fractured which can form a weak secondary porosity from connected fractures. The Calliope beds limestone and volcanics are predominantly an aquitard but with connected fractures can form a low yielding fractured rock aquifer. The depth to groundwater is variable at the Calliope, but is typically 15-20 metres depth below natural surface. Groundwater is primarily hosted in volcanic rock and not limestone. Limestone aquifers are unconfined and low yielding. Groundwater occurs at or near volcanic-limestone contacts. Drilling records indicate that most holes are drilled dry but slowly make water through fractures. Fractures are sufficiently open to allow some groundwater flow but are too closed for appreciable groundwater flow. Previous testing indicated a low bulk hydraulic conductivity in the order of 0.003 m/day (Kalf, 2003). Groundwater levels indicate that the surface water divide which lies to east of Pit 4, coincides with a groundwater divide, and that groundwater flows westerly towards Pit 4 and easterly to Awoonga Dam. Groundwater flow is most pronounced north-south indicating a north-south stratigraphic and structural control on groundwater flow. Groundwater levels rapidly respond to rainfall recharge an indicate hydraulic conductivity anisotropy.

The groundwater divide provides a natural buffer against Awoonga Dam water level rises. Groundwater flow from this divide remaining easterly even when the Awoonga Dam water was elevated above 40 mAHD. Groundwater has been intersected by drilling at and near the eastern wall and also outside the western wall of Pit 4 near the volcanic-limestone contact. Groundwater has apparently been observed in the eastern wall but this is not substantiated by photographic evidence as no seepage is observed in wall photographs. See Figure 20. Groundwater is connected by fracturing and forms a watertable, but groundwater flow into Pit 4 is so minor that evaporation exceeds seepage and the pit remains dry. Seepage has been observed in Pit 4 at the volcanic cap contact with limestone contact, but dries up during extended dry periods. An E-W, north viewing, hydrogeological cross-section 7332650N of Pit 4 is shown in Figure 24.

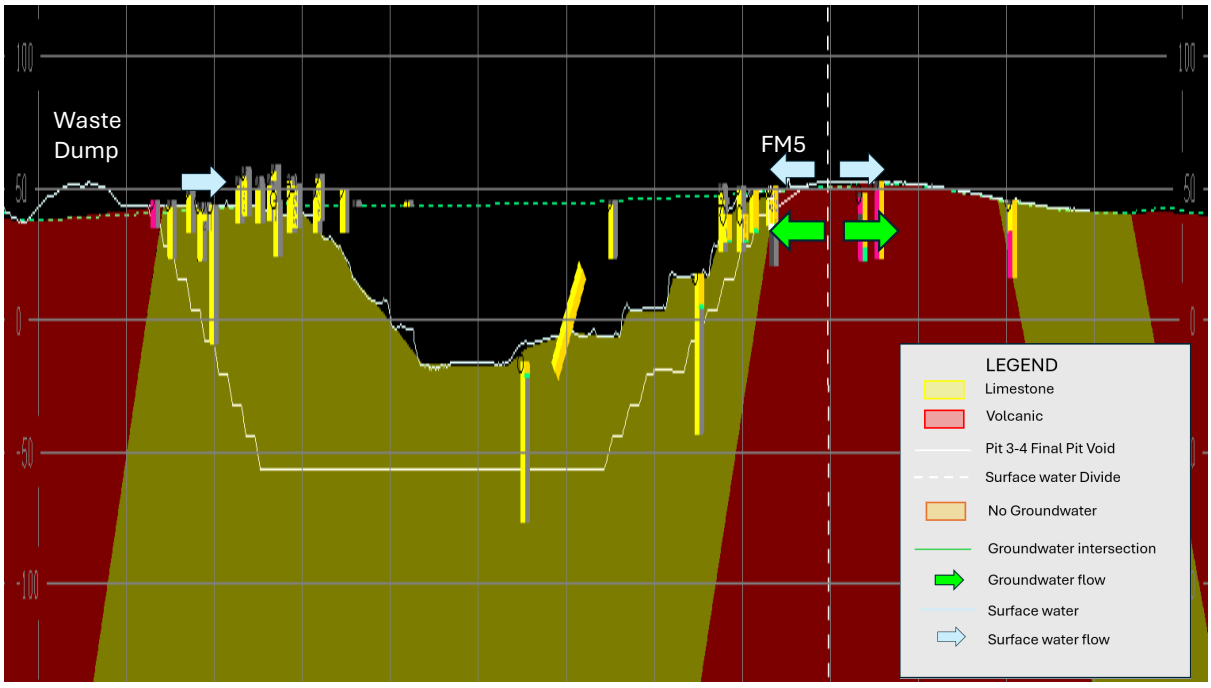


Figure 24 Cross-section 7332650N showing Pit 4 geology and groundwater intersections

Groundwater was observed by Kalf (2003) in the eastern most limestone but was considered not to be connected with the quarry limestone. An E-W, north viewing, hydrogeological cross-section 7332175N of Pit 3 is shown in Figure 25.

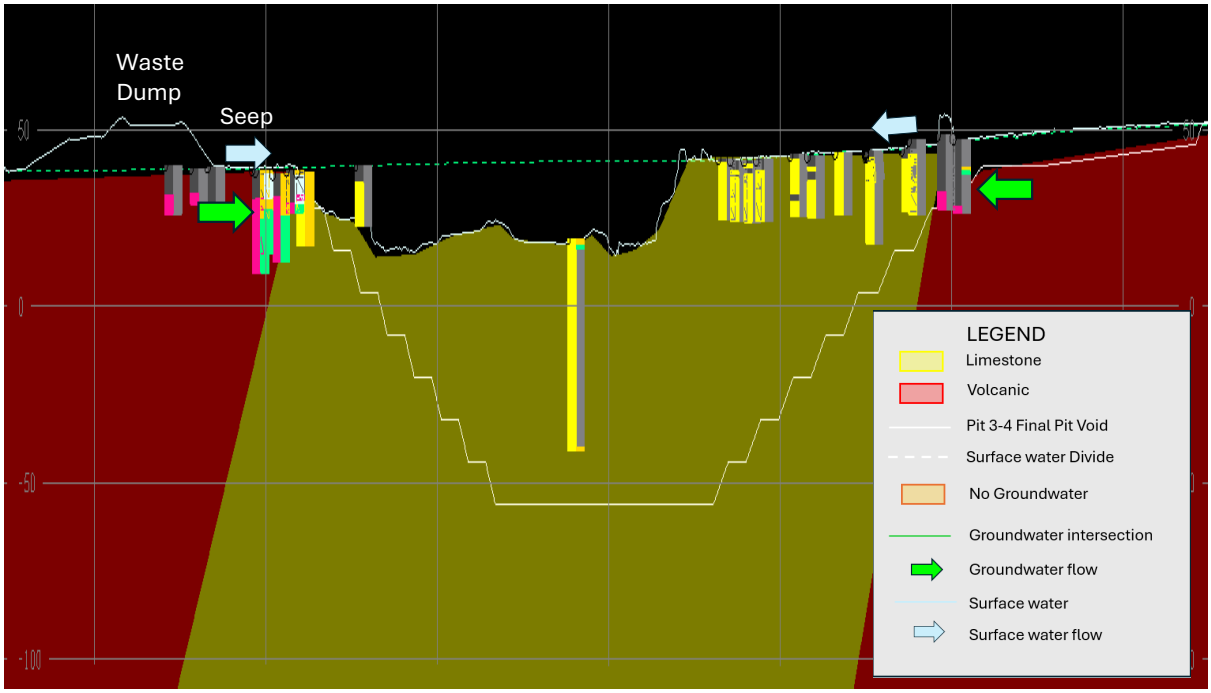


Figure 25 Cross-section 7332175N showing Pit 4 geology and groundwater intersections

Groundwater was intersected by drilling in 2018 near the Western Bund wall as discussed in Section 4.2 but water inflow to Pit 3 is mainly surface water with little groundwater.

Limestone is karstic near the surface but voids are clay filled and both the limestone and volcanic rock have low permeability (Section 6.3.5) and there is no evidence for hydraulic head being impacted by mining. Groundwater is discussed in detail in Sections 5.3 and 7.3.

4.6 Environmental values

Boyne River Basin Plan Environmental values relevant to Calliope were discussed in Section 3.2 and are:

- Upper northern creeks
- Awoonga Dam
- Groundwater (bores…etc)

The Awoonga Dam lies within the Boyne River catchment which has water quality targets under the Reef 2050 Water Quality Improvement Plan for sediment, nutrients (nitrogen and phosphorus) and pesticides flowing to the reef. GAWB manage the Awoonga Dam water supply which may indirectly impact downstream environmental values but do not manage control impacts from land use activities in the catchment such as land clearing and cattle grazing. Released dam water is assessed against Water Quality Guidelines and specifically Australian Drinking Water Guidelines as water supply is the primary function of Awoonga Dam. GAWB cannot control downstream impacts of released water as the Boyne River flows through rural and urban environments to the coast.

The Calliope lies within the Ragotte Creek catchment (Section 3.1) and surface water and groundwater is contained within this catchment. Surface water is discharged from Calliope to Ragotte Creek (upper northern

creek) and Awoonga Dam in accordance with EA release criteria. Groundwater at Calliope is low flow and insufficient for bore extraction and use. Groundwater flow is towards mining voids and there is no uncontrolled seepage outside the mining envelope.

4.6.1 Potential impacts to Calliope Environmental values

The Boyne River Basin Plan Environmental values relevant to Calliope were identified in Table 7. The potential impact to Calliope Environmental values and pathway receptor linkage are provided below in Table 10.

Calliope Environmental values			
Environmental values	Description		Pathway Receptor Linkage
Aquatic ecosystems	✓	Calliope Mine is located in Ragotte Creek adjacent to Awoonga Dam, a tributary to Boyne River. Areas downstream may support aquatic ecosystems. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Drinking water	✓	Raw water from Lake Awoonga is processed at water treatment plants for drinking. Graymont annual. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Primary recreation	✓	Areas adjacent to the site support recreational activities including swimming and diving. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Secondary recreation	✓	Lake Awoonga supports recreational fishing and boating activities. Water discharges from the site are in accordance with EA licence conditions.	Unlikely
Visual recreation	✓	The site is located approximately 7km south west of the Lake Awoonga lookout, boat ramp, and camping area, and is not clearly visible from this location. Potential contamination at the site is unlikely to be contributing to deterioration of the aesthetics of Lake Awoonga.	Unlikely
Human consumer	✓	Areas downstream from the site may be utilised for the consumption of aquatic foods, including fish.	Unlikely
Cultural and spiritual values	✓	Mining is in accordance with Regulatory approved cultural heritage requirements and it seems unlikley that the cultural and spiritual values of Lake Awoonga are impacted, but it is acknowledged that they may possibly be impacted.	Possible
Aquaculture	✓	The site is not located in proximity to any aquaculture facilities.	Unlikely
Farm supply/use	✓	The site is bounded by woodland is not located in proximity to any farms and groundwater flow is toward voids and surface water flow to Awoonga Dam.	Unlikely
Irrigation	✓	There are no groundwater bores in the Ragotte catchment. Pit water is mainly surface wtare and any groundwater in pit voids is naturally mixed on the pit floor and pit water is then released in accordance with EA licence conditions.	Unlikely
Stock water	✓	Water discharges from the site are in accordance with EA licence conditions, which is suitable for livestock.	Unlikely
Industrial use	✓	Not applicable	Unlikely
Groundwater	✓	Mining voids are groundwtaer sinks.	Unlikely

Table 10 Potential impacts to Calliope Environmental values

4.6.2 Potential contaminants

Potential contaminants in pit water are salinity, pH, suspended solids, sulphate, nitrate, metals and hydrocarbons (Section 7.1.7) and similarly for groundwater (Section 7.3.7).

4.6.3 Mechanisms of potential impacts and risks to environmental values

The mechanisms of potential impacts and risks to environmental values are:

- Mixing of potentially contaminates pit water and Awoonga Dam water
- Seepage of potentially contaminated pit water into Awoonga Dam
- Mine void interaction with potentially contaminated groundwater
- Reduced groundwater supply to regional bores
- Reduced groundwater supply to Groundwater Dependent Ecosystems

Mixing of pit water and Awoonga Dam water

The potential impacts arising from the formation of the pit void may occur via several mechanisms.

A connection between the final void pit water and Awoonga Dam water may occur via overland flow in a scenario where Lake Awoonga floods to the extent that floodwater enter the void and pt lake water is released into the flood waters. The highest Awoonga Dam water levels recorded was in January 2013 which peaked at 48.3m AHD without breaching the levees surrounding the mine. The rainfall event that caused the maximum water level observed at Awoonga Dam was 870mm in 24 hours (SILO data, Queensland Government "Long Paddock database) and is equivalent to greater than 1 in 2000-year event (BoM rainfall designs database). According to the 'Awoonga Dam Emergency Action Plan', the top of the flood control bunds (at 52.0 mAHD) would not be breached until an event less likely than a 1 in 10,000 AEP flood event (that would result in a dam height of 50.12 m). Modelling outputs presented in the 'Flood Mapping for the Boyne River Basin' suggest that flooding of Awoonga Dam may result in floodwaters entering the Calliope voids. However, given the unlikely nature of the event, the benign nature of the pit lake water and the vast dilution of pit water that would result from a PMF, the risk to downstream environmental values from this mechanism is negligible.

Flooding of the final void due to inflows from on-site catchments could resulting in water overtopping the void and perimeter bunds and reaching Awoonga Dam. The flood modelling prepared by Engen showed that even during a PMF, the water level in the final voids was below the crest of the voids and do not indicate a risk of voids overtopping. This consistent with Water Balance modelling predicted water fill of Pit 3-4 void post mining which is -10mAHD. See Section 8.3.

Seepage of pit water into Awoonga Dam

Seepage of pit water through the bedrock to Awoonga Dam is extremely low to negligeable because the long-term void water levels will be lower than the Awoonga Dam water levels, hence the groundwater gradient will be towards the mining void.

Mine voids interaction with groundwater

The main mining void (combined Pit 3 and Pit 4) will be dewatered progressively as required to access the limestone resource and will remain a water storage post-mining. Pit 2 void is planned to remain a water storage facility for the current life of mine and post-mine. The Pit 2 water level is assumed to continue at current water levels 40 m RL. Pit 1 void has been filled, and post-mine will be used for light grazing. The pit will continue to be dewatered while mining and following cessation of mining, the mine voids will be recharged by direct rainfall, surface run-off and minor groundwater seepage until an equilibrium is reached with evaporation. The predicted final equilibrium void water level will be -10mAHD (Section 8.2) which is 23.6m lower than the Awoonga Dam dead storage water level. The hydraulic gradient toward the final void means there is not likely to be seepage through the bedrock toward the Awoonga Dam. Therefore, the void is demonstrated to act as a groundwater sink.

Reduction in groundwater supply to regional bores

Two monitoring bores, FM5 (State water database RN187863) and FM6 (Queensland State water database RN151688), are the current registered groundwater monitoring bores for the site as required under the current Environmental Authority (EA). Groundwater levels and groundwater quality data are obtained 6-monthly to analyse and report trends. An additional monitoring bore (RN187863, also known as FM5B) located close to the original FM5 was drilled in January 2021 due to low groundwater levels in FM5 during mid-2019 to late-2020. FM6 (State water database RN151688) is located at the northern end of the Calliope.

There are no pumping bores in the Ragotte Creek catchment or the Calliope because only minor groundwater has been intersected which is insufficient for the construction of a groundwater pumping bore (Kalf and

Associates, 2002). The Calliope beds limestone and andesite is predominantly an aquitard but with connected fractures can form a low yielding fractured rock aquifer. The maximum recorded bore yield from the Calliope Beds is 1.5l/s. Regional drilling of the Calliope Beds is in alignment with the Calliope drilling results which are discussed in Section 5.3. Groundwater seepage at the Calliope is <1 l/s which is in alignment with a maximum yield from the Calliope Beds of 1.5l/s from regional drilling. Investigative groundwater drilling is discussed in Section 5.3. There are two bores within the Boyne catchment, excluding the Calliope monitoring bores, that are located in the Calliope Beds. One bore is located south of Awoonga Dam and the other in another catchment east of the Calliope. Groundwater behaviour in both bores is not related to groundwater observed at the Calliope, because of geographical position and groundwater flow is under gravity towards the Awoonga Dam. Mining activities at the Calliope are a negligible risk to human groundwater beneficial users in the Boyne River Basin.

Reduction on groundwater supply to Groundwater Dependent Ecosystems

A search of Queensland Globe was undertaken to assess whether mining activities could impact other biological organisms in groundwater. The results from this search was that there are no Groundwater Dependent Ecosystems (GDE) in the Ragotte Creek and adjacent catchment. GDE's categories investigated were surface expression, terrestrial, subterranean and potential GDE's. Since there are no GDEs in Ragotte Creek catchment and groundwater flows under gravity towards the Awoonga Dam, mining activities at the Calliope are a negligible risk to GDE's in the Boyne River Basin.

4.6.4 Monitoring – asssessing against Water Quality Guidelines

The Australian Drinking Water Guidelines (ADWG) (NHMRC 2011) provide a basis for determining the quality of water to be supplied to consumers in all parts of Australia. The Guidelines are not mandatory legally enforceable standards, and the implementation of the guidelines is at the discretion of each state and territory. With a few exceptions (e.g. nitrate, copper, sulphate, fluoride), all health-based guideline values relate to lifetime exposure, such that a single result above the guideline value is unlikely to present an immediate health risk (Australian Drinking Water Guidelines, 2025). Water quality data presented in Table 11 indicates that physical and chemical characteristics of pit water and groundwater within the mining lease currently meets the drinking water and stock water quality guidelines except for the aesthetic drinking water salinity guideline value and would be expected to meet the guidelines post-mining.

Parameter	Water Guidelines			EA Compliance		FM5 groundwater		FM6 groundwater		Pit 4 active pit		Pit 3 inactive pit		Pit 2 water storage		Discharge F1 (2023-25)		Discharge C1 (2023-25)		Discharge C2 (2023-25)	
	Drinking		Stock	Surface water discharge	Ground water trigger	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count	Median	Count
	Health	Aesthetic																			
Salinity (µS/cm)	NA	938	5,970	**900**	**1500**	1212	24	1184	32	489	3	750	2	570	1	738	19	574	36	197	2
pH	NA	6.5 – 8.5	NA	**6.5-8.5**	**6.5-8.5**	6.7	24	6.8	32	7.97	3	8.4	2	8.7	1	8.1	19	8.1	36	7.6	2
TSS (mg/L)	-	-	-	**100**	**1500**	181	24	19	32						1	6	19	7	36	10	2
Ca (mg/L)	-	-	-		250	180	24	159	32	57	3	62	9	42	1						
Mg (mg/L)	-	-	-		35	14	24	25	32	11	3	7	9	12	1						
Na (mg/L)	-	-	-		100	59	24	66	32	24	3	60	9	53	1						
K (mg/L)	-	-	-		5	1	24	2	32	0.5	3	0.5	9	0.5	1						
HCO_3 (mg/L)	-	-	-		500	455	24	468	32	116	3	121	9	137	1						
CO_3 (mg/L)	-	-	-		500	<1	24	<1	32	0.5	3	0.5	9	0.5	1						
Cl (mg/L)	NA	250	NA		200	91	24	114	32	18	3	119	9	43	1						
SO_4 (mg/L)	NA	250	1,000		20	15	24	10	32	88	3	33	9	50	1						
TPH (mg/L)	-	-	-		1	<0.05	24	<0.05	32	<0.05	3	<0.05	2	<0.05	1						
As (mg/L)	0.01	-	5			<0.001	5	0.002	8	<0.001	3	<0.001	2	0.001	1						
Cd (mg/L)	0.02	-	0.01			<0.0001	5	<0.0001	8	<0.0001	3	<0.0001	2	<0.0001	1						
Cr (mg/L)	-	-	-			0.001	5	<0.001	8	<0.001	3	<0.001	2	<0.001	1						
Cu (mg/L)	2	1	1			0.005	5	0.005	8	<0.001	3	<0.001	2	<0.001	1						
Pb (mg/L)	-	-	-			0.031	5	0.009	8	<0.001	3	<0.001	2	<0.001	1						
Ni (mg/L)	0.02	-	1			0.005	5	0.002	8	<0.001	3	<0.001	2	<0.001	1						
Zn (mg/L)	NA	3	20			0.038	5	0.014	8	<0.005	3	<0.05	2	0.020	1						
nitrate (mg/L)	50	-	-			5.1	1	0.04	1	3.27	2	0.36	1	0.23	1						
TN (mg/L)	-	-	-			5.7	1	0.1	1	3.88	2	0.57	1	0.34	1						

Table 11 Monitoring bores compared to Water Quality Guidelines

GRAYMONT

5 CALLIOPE WATER INVESTIGATIONS

Calliope water investigations can be broadly categorised as follows:

1. Predicted water impacts in Pit 3 prior to western bund wall construction
2. Source of excess water in Pit 3 after western bund wall construction
3. Groundwater behaviour based on water investigative drilling

A summary timeline of categorised investigations is provided in Table 12 below.

Year	Author - Report	Investigation	Outcomes	Discussion
1. Predicted water impacts in Pit 3 prior to western bund wall construction				
2002	Awoonga Alliance - Frost Quarry Protection Works Design and Investigation	Identified that the 10 m raising of Awoonga Dam would inundate the quarry site unless protected. The solution was based on the use of the existing spoil heaps	Permeability tests of existing spoil heap and found them to be permeable and so a clay liner was proposed on western side of the bund wall	A liner consisting of crusher dust, clay, and rock was placed on the reservoir side of the bank to a height 47mAHD.
2003	Kalf and Associates - Hydrogeological Model assessment of sub-surface inflow due to increase in Awoonga Dam storage level - Taragoola Mining Lease Area	Investigated whether increased dam water level would induce increased groundwater flow into existing and future deeper pits. Fieldwork was undertaken by GEMS. MODFLOW numerical groundwater modelling was undertaken by Kalf and Associates	Mine staff estimated that 1.2-3.5 litres/sec continuously flowed into Pit 3 from rock at 32mAHD prior to dam construction. The contribution of direct rainfall/run-off of this flow was unknown. Modelled outcomes indicated that seepage into Pit 3 would increase by about a factor of 2 at 47RL. Groundwater inrushes unlikely as a result of Awoonga Dam storage levels being increased to 47mAHD.	Investigative drilling in October 2018 demonstrated that groundwater intersected at 32mAHD is approx. 5m below water inflow at 37mHD, which is surface water flowing from the Farm Dam. Seepage observed at 32mAHD on the bench was insufficient for flow and there is little groundwater at Calliope.
2. Source of excess water in Pit 3 after western bund wall construction				
2011	GHD - Investigation of inflows to Pit 3	Possible failure mechanism from a March 2011 rainfall event involves the ponding of water within the rocky fill of the bund between the clay liner and the natural material at seepage site, Chain 800-850m, when the lake level is in excess of RL 38m	Created a Water Balance model based on the assumption that Pit 3 was empty prior to March 2011 rainfall. GHD estimated 600ML of water inflow entering Pit 3 via the seepage site is a mixture of water derived from the reservoir and the Farm Dam. The water balance carried out by GHD suggests an average leakage rate through the Bund Wall of between 45 L/s and 62 L/s between September 2010 and March 2011, when the Awoonga Dam level was between 38.8 m and 42.5 mAHD.	No field evidence for proposed failure in bund wall. Hypothesis disproved as water inflow continued when the lake level fell below 38mAHD. The Seep was sampled in March 2025 when Awoonga Dam water level was at 32mAHD.
2011	GHD - Investigation of inflows to Pit 3	A possible failure mechanism was proposed being ponding of water by the Farm Dam, Chain 300m, against the unlined eastern side of the Western Bund Wall caused piping failure.	Pit 3 is derived predominantly from a combination of direct rainfall; runoff from the surrounding catchment area; and direct or indirect seepage from the reservoir and Farm Dam.	No field evidence for proposed failure in bund wall. From 2011-25 water has been observed flowing along western bund wall from Farm Dam to Pit 3.

Year	Author - Report	Investigation	Outcomes	Discussion
2013	GHD - Repair to Flood Damage on Western Bund Wall	Possible erosion or pipe on Western Bund in spoil heap material, north of "seep", at Chain 1300m.	Proposed approaches to repair the dam being localised repair and raising of clay liner	No earthworks undertaken
2011	Sibelco - Investigation of inflows to Pit 3	Investigate possible Awoonga Dam leakage by undertaking water sampling and reviewing GHD Water Balance model	Water sampling of seep was twice the salinity of Awoonga Dam and water chemistry was different from Awoonga Dam water. Turbidity of seep was less than turbidity of Awoonga Dam. GHD model incorrectly assumed that Pit 3 was empty as evidence by site photographs. Surface water inflow was calculated to be around 600ML based on catchment area which aligned with GHD estimated seep.	Water salinity, chemistry and estimated inflow volumes did not support the hypothesis that Awoonga Dam was leaking. Further work was proposed, which included salinity profiling of Awoonga Dam so to discount stratification as an explanation for why Awoonga Dam is much fresher than the water inflow and Pit 3 water. Geophysical work was not recommended. Salinity profiling of Awoonga Dam in 2018 showed that water quality remained unchanged at depth and also remained at the similar salinity. Further water chemistry confirmed that water inflow and Pit 3 water is distinct from Awoonga Dam which supports the conclusion that Awoonga Dam leakage is not the water source of the water inflow to Pit 3.
2016	Sibelco and GAWB Meeting to discuss seepage between lake Awoonga Dam and Pit 3.	Further investigation proposed to address uncertainty as to the exact sources and pathways of increased water seepage	GAWB proposed to undertake geophysical investigations during future flood events.	No geophysical investigations undertaken
2017-2018	Sibelco - data loggers in Pit 3	Data loggers were installed in Pit 3 to measure water level variation over time and to use this data to quantify water inflows into Pit 3	Sibelco (Feiss) created a Water Balance model using the pit water level data and proposed that pit water level variations were due to groundwater seepage rates of 36l/s in a wet cycle from 15th March 2017 to 31st March 2017, 20 l/s in a draining cycle from 15th April 2017 to 30th June 2017, and 5.4 l/s during a dry cycle from 8th March 2018 to 7th April 2018 and that there is currently significant groundwater seepage at the Calliope.	Sibelco (Feiss) has not differentiated between Farm Dam surface water flow and groundwater flow into Pit 3. The Water Balance model has no flow from Farm Dam during the investigative period which is not in accordance with site observations that water continues to flow into Pit 3 from the Farm Dam when there is water in the Farm Dam.
3. Groundwater behaviour based on water investigative drilling				
2002	GEMS	A total of 8 holes were drilled east of Pit 4 to further investigated groundwater behaviour following the installation of monitoring bores FM1-4	A total of 5 holes were drilled dry, 2 holes had some moisture at the base and groundwater was intersected in only one drillhole. This drilling supported the conclusion that there is little groundwater.	There is little groundwater east o Pit 4
2012	Sibelco - Background Groundwater Monitoring Program	Installation of monitoring bores and derivation of water quality parameter trigger values from benchmark readings.	Monitoring bores FM5 and FM6 were installed to create a Groundwater Monitoring Network at the Calliope. FM5 was installed adjacent to active Pit 4 and FM6 was installed adjacent to inactive Pit 2. Trigger values were derived based on benchmark results.	Monitoring results have informed groundwater behaviour at the site. Groundwater in FM5 and FM6 behave similarly. An additional monitoring bore FM5B was installed in 2021 when FM5 ran dry.

Year	Author - Report	Investigation	Outcomes	Discussion
2018	Sibelco - Investigative drilling and water sampling	A total of 14 holes were drilled west of Pit 3 to investigate the nature of water inflow into Pit 3. Groundwater intersection and later water level measurements, with sampling, was undertaken of drillholes. Surface water bodies including water seep to Pit 3, Pit 3, Farm Dam and Awoonga Dam were sampled.	Investigative drilling in October 2018 demonstrated that groundwater intersected at 32mAHD is approx. 6m below water inflow at 38mHD, which is surface water flowing from the Farm Dam. Salinity and surface water chemistry demonstrated that Awoonga Dam is distinct from Farm Dam and Pit 3. The water quality of the Farm Dam and Pit 3 is chemically similar.	Groundwater is a negligible source of water to Pit 3. Water chemistry does not support Awoonga Dam leakage. Pit 3 water has mixed sources of water from (1) rainfall runoff, (2) surface water flow from the Farm Dam with (3) minor groundwater seepage from floor of Ragotte Creek through bedrock fractures being ~32RL beneath Bund Wall to Pit 3 and (4) very minor groundwater seepage from country rock surrounding Pit 3.
2025	Graymont - investigative drilling and water sampling	A total of 34 holes were drilled across the site including around Pit 4, Pit 1 and south-west of Pit 3.	Drilling was undertaken primarily targeting the limestone volcanic contact where it is most likely to intersect groundwater. A total of 21 holes were drilled dry and groundwater was intersected in 13 holes. Some dry holes slowly made water. Water level measurement and sampling were undertaken and results used to derive a groundwater level map and characterise groundwater across Calliope.	Groundwater chemistry in limestone is similar to groundwater in the volcanics and there is no clear distinction between groundwater from limestone and volcanics

Table 12 Water Investigation summary timeline

5.1 Predicted water impacts in Pit 3 prior to raising the western bund wall

The proposed 10 m raising of Awoonga Dam wall from a full supply water level of 30 to 40mAHD was identified as potentially causing inundation and flooding of Pit 3 and that the increased dam water level could induce increased groundwater flow into existing and future deeper pits. Groundwater Environmental Management Services Pty Ltd (GEMS) in 2002 undertook a hydrogeological assessment to investigate and predict possible future water impact. Field work in November 2002 involved investigative water drilling, sampling and bore installation and water sampling. Investigation drilling results are discussed in Section 5.3.

A planned pumping bore was mot installed because of insufficient groundwater but monitoring bores FM1-4 were installed to the east of Pit 4. Recovery tests were undertaken on these bores and a hydraulic conductivity of 0.003m/day was derived using the Hvorslev Analytical solution. Ragotte Creek was dry at the time of the investigation.

Two dominant spring zones were identified in the map. Groundwater flow in the spring in the north west corner of Pit 4 is rainfall driven and is dry during drier weather irrespective of water level in Ragotte Creek, and will be incorporated by final void Pit 3-4, so no further discussion of this spring is provided. The dominant Pit 3 spring,is referred to in this report as the Seep.

A map of Pits 3 and 4 by Kalf and Associates is provided below as Figure 26

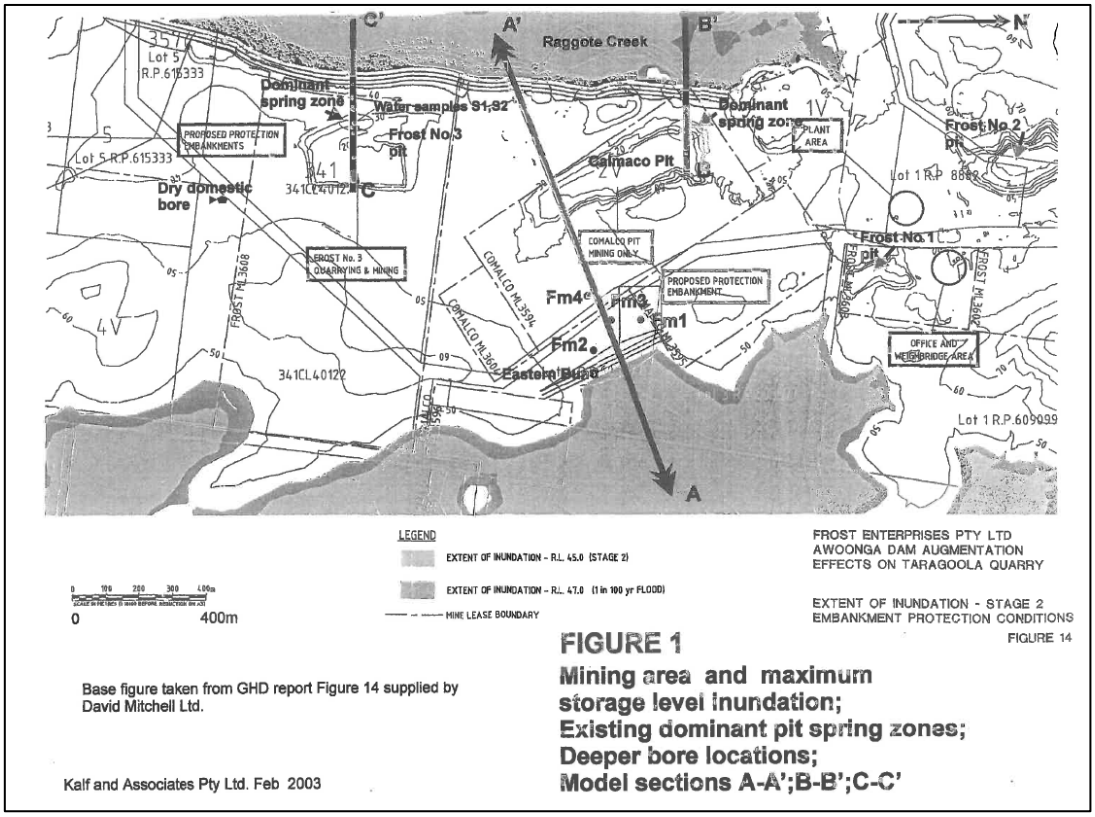


Figure 26 Mining area map (Kalf and Associates, 2003)

A cross-section of Pit 3 (C'-C) is provided as Figures 27.

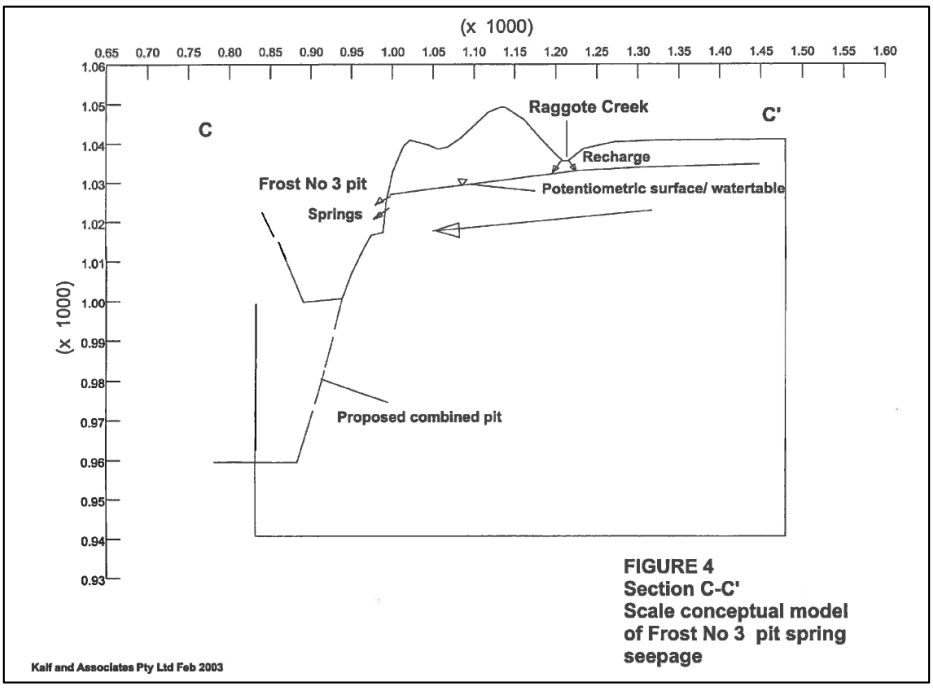


Figure 27 Pit 3 sectional conceptual model (Kalf and Associates, 2003)

MODFLOW numerical models were constructed for Pit 4 Eastern bund wall, Pit 4 north west seepage zone and the Pit 3 pit western seepage zone (Seep).The models created were a variably saturated finite element model based on the scale conceptual models. See Figure 27. The permeability of the fracture zone and inflow rate is not known precisely and therefore absolute inflow rate cannot be simulated easily or precisely (Kalf and Associates, 2002). A simulation was made using a higher permeability in section, with k=0.5m/day arbitrarily chosen ((Kalf and Associates, 2002). No permeability testing was undertaken near Pit 3 but hydraulic conductivity testing results from near Pit 4 indicated a very low value of 0.003m/day, being 2 orders of magnitude lower than values used in the model. Modelled outcomes are shown in Figure 28.

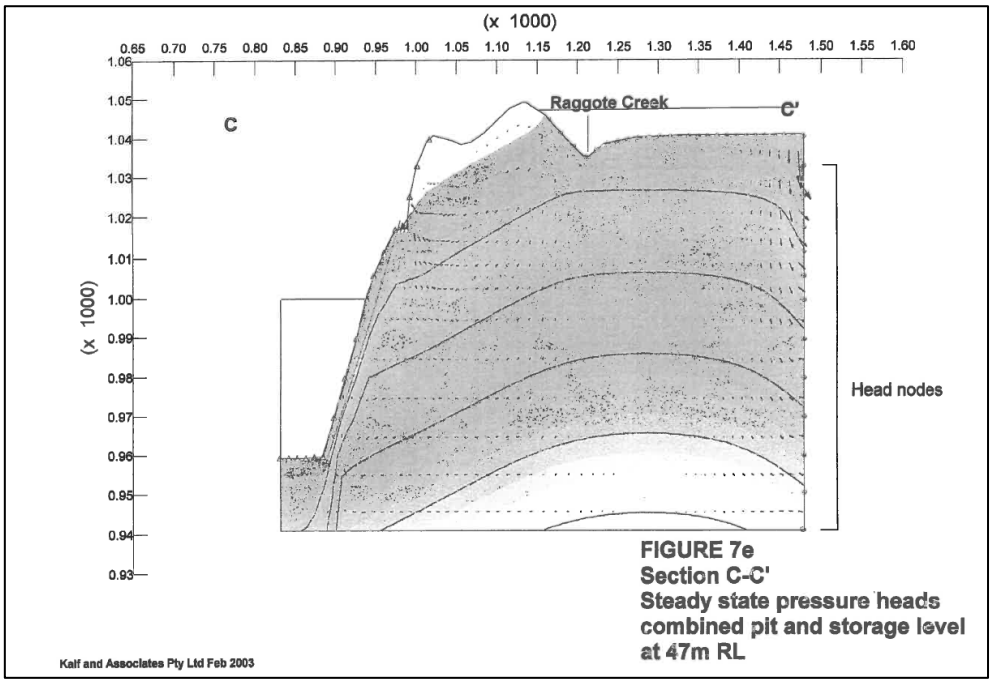


Figure 28 Pit 3 sectional numerical model (Kalf and Associates, 2003)

The Pit 3 modelled outcomes do not align with the conceptual model which shows a watertable in an unconfined aquifer seeping into the pit whereas the numerical shows groundwater, as a potentiometric surface, being drawn down below the pit which requires a bore to be installed in the pit floor.

Model simulation results indicate that current inflows for both Pit 3 and Pit 4 could increase by a factor of 2 when Awoonga Dam reaches 47RL. It was also proposed that excavation to -40mAHD could increase inflow by a factor of 10 but the probability of a fracture extending uniformly to the base of such a pit is considered to be very low based on the data available (Kalf and Associates, 2002). The current Pit 4 floor is at -20mAHD being 78% of modelled depth and groundwater inflows remain unchanged which suggests that the modelled outcomes are unreliable.

5.2 Source of excess water in Pit 3

Calliope is bounded by Awoonga Dam. In December 2010 a high rainfall event elevated Awoonga Dam water levels and large water inflows were observed to enter Pit3. From 2010-2019 the primary cause of excess water in Pit 3 has been investigated by site hydrogeologists, consultants engaged by both Sibelco/Graymont and the Gladstone Area Water Board (GAWB).

Potential sources of excess water in Pit 3 include :

- A possible piping failure mechanism by ponding of water against the unlined eastern side of the Western Bund Wall (GHD, 2011b), where the Farm Dam was created by the construction of the Western Bund Wall at Chain 300 as per Figure 13. Other locations for proposed locations of piping failure are west of Pit 3 at Chain 850 (GHD, 2011a) as per Figure 13. Piping failure was also proposed north of the Western Bund in spoil heap material at Chain 1300 by GHD (2013) from the 2013 flood reservoir peak of 48.3 mAHD
- Groundwater seepage (Sibelco- Feiss, 2017)
- Surface water run-off from the Farm Dam area (Sibelco, 2011)

Multiple lines of evidence have been used to determine the sources of excess water in Pit 3 including geological mapping and drilling; water investigative drilling; surface water and groundwater sampling; water chemistry which includes salinity, pH and major ion; photographic records, accurate volumetric estimate of Pit 3 water using data loggers and catchment analysis.

5.2.1 Awoonga Dam possible leakage to Pit 3

The GHD hypothesis that excess water in Pit 3 was possibly leakage through the Western Bund Wall was investigated by Sibelco (2011). At the time of this investigation water freely flowed along the western bund from the Farm Dam along the bund wall to the Seep and then flowed into Pit 3 as described in Section 4.1.3. Awoonga Dam water level at this time was at 40.3 mAHD.

Water sampling in March 2011 was undertaken which included Awoonga Dam, the Farm Dam, the water flowing along the western bund wall and the Seep into Pit 3. Water salinity and chemistry results from this sampling event are shown in Table 13.

Water Quality parameters		Awoonga Dam	Farm Dam	Water flow along Western Bund Wall	Seep into Pit 3
Electrical Conductivity @ 25°C	µS/cm	282	601	632	618
Total Dissolved Solids @180°C	mg/L	161	341	345	325
Redox Potential	mV	144	167	158	164
pH	pH Unit	7.8	7.3	7.4	7.2
Hydroxide Alkalinity as CaCO3	mg/L	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	mg/L	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	mg/L	93	106	134	141
Total Alkalinity as CaCO3	mg/L	93	106	134	141
Sulfate as SO4 2-	mg/L	8	4	27	13
Chloride	mg/L	22	115	85	92
Calcium	mg/L	23	38	62	57
Magnesium	mg/L	8	12	7	8
Sodium	mg/L	19	58	48	51
Potassium	mg/L	2	3	2	2
Total Anions	meq/L	2.64	5.45	5.64	5.69
Total Cations	meq/L	2.68	5.49	5.85	5.82

Table 13 Water sampling results from March 2011

Water salinity and chemistry of Awoonga Dam is distinct from the Farm Dam, water flow along the western bund wall and the Seep and it was concluded that Awoonga Dam was not the water source of the Seep

because water leaking through the dam wall could not double in salinity while passing quickly through the dam wall and that the water was primarily surface run-off from the Farm Dam.

To further test this conclusion salinity profiling was undertaken in 2018 of Awoonga Dam to investigate whether there was salinity stratification of the water column; specifically whether water on the floor of the Dam was twice as saline as at the surface. Salinity profiling was undertaken from a boat on Awoonga Dam at eight locations and no change in salinity with depth was observed.

Water sampling undertaken in 2018 in addition to Awoonga Dam included a catchment dam, the Farm Dam, water flow along the western bund wall, the Seep and Pit 3. Further follow-up water sampling was undertaken in2025 which included Awoonga Dam, catchment dams, the Farm Dam, the Seep and Pit 3.

The 2011,2018 and 2025 monitoring demonstrated that Awoonga Dam salinity of 250+/50µS/cm was much fresher than Pit 3 salinity which is typically 630+/-100µS/cm. A map showing the location of the 2011, 2018 and 2025 monitoring points with salinity sampling results is presented as Figure 29.

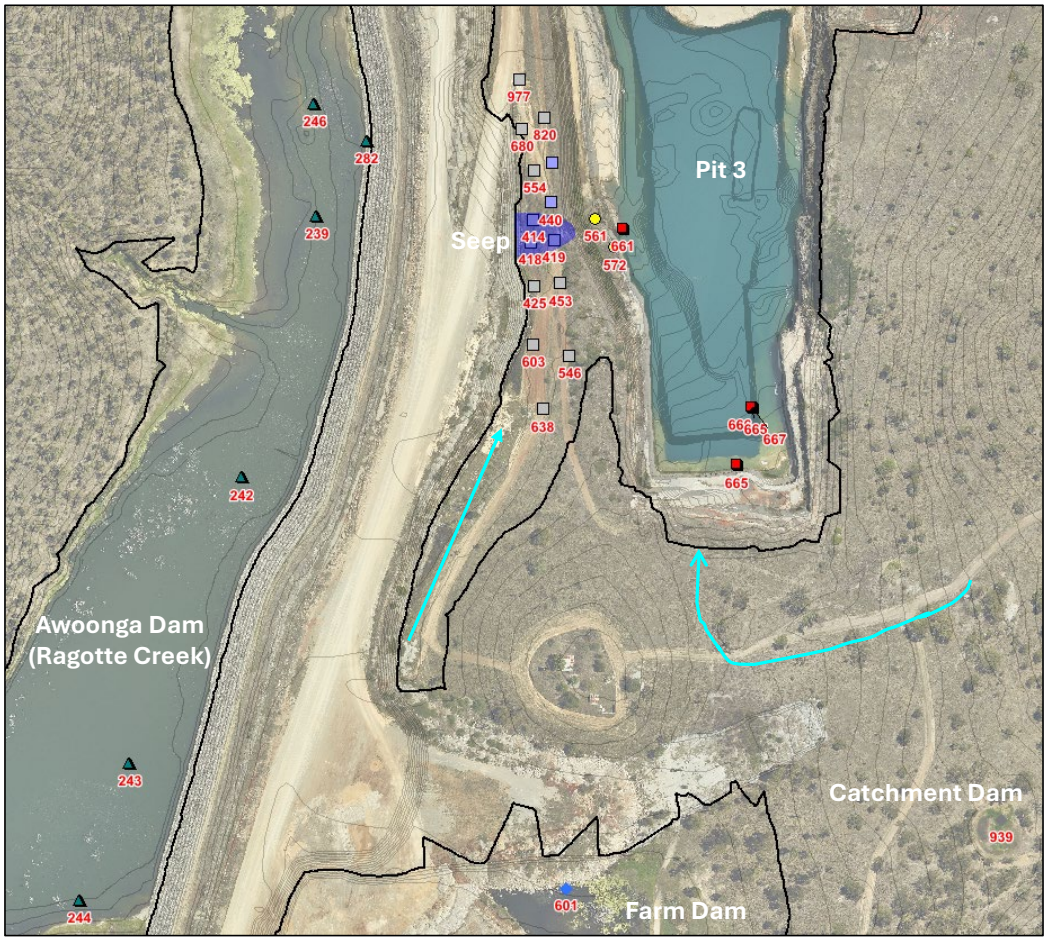


Figure 29 Surface water salinity sampling results 2011 and 2018

Major Ion water chemistry of surface water results are presented as a Piper plot in Figure 30. Awoonga Dam water is chemically distinct from Pit 3 sub catchment and Farm Dam sub-catchment water. Awoonga Dam water is Ca-Mg-HCO3 type water whereas the Farm Dam and water flowing along the bund wall and Pit 3 water are mixed type water with similar chemistry and the catchment dam is a Na-K-Cl-SO4 type water. Water chemistry also does not support leakage and it is concluded that Awoonga Dam does not leak through the western bund wall.

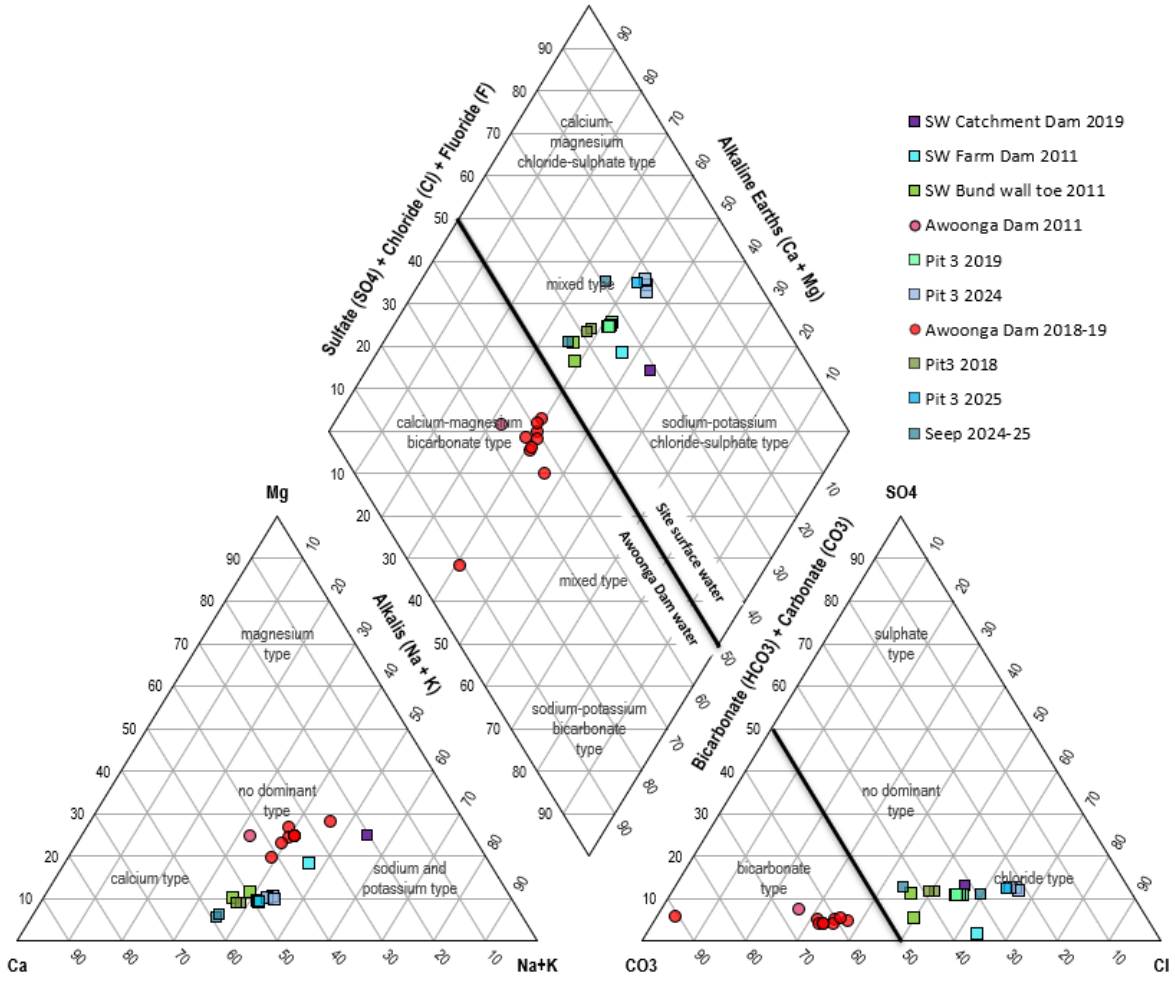


Figure 30 Awoonga Dam with Pit 3 and Farm Dam sub-catchment major ion chemistry

5.2.2 Groundwater seepage contribution to Pit 3 water

Seepage is considered to be the normal flow of water through an embankment or natural material, while leakage is considered to be flows resulting from a failure or deficiency in the embankment or foundation. Mine staff estimated that 1.2-3.5 litres/sec continuously flowed into Pit 3 from rock at 32mAHD prior to dam construction. This inflow is thought to be primarily from spring seepages but the contribution of direct rainfall/run-off of flow is unknown (Kalf and Associates, 2002). The Seep was present in 1997, when the Waste Dump was adjacent to the Seep, as a source of surface water run-off for the Seep, prior to the completion of the construction of the western bund wall.

The Seep was considered by Sibelco (Feiss) in 2017 to be exclusively groundwater and there was no differentiation between Farm Dam surface water flow and groundwater seepage into Pit 3. Investigative drilling was undertaken from the 2-3 October 2018 to further assess the relationship between the Seep and groundwater and to better define groundwater behaviour between the Western Bund wall and Pit 3. At the time of drilling surface water was flowing along the western bund wall to the Seep then entering Pit 3. A total of 14 holes were drilled with location and groundwater intersection details shown in Table 14 with an accompanying drillhole location map in Figure 31.

GRAYMONT

Location Details				Drilling Details					
Drill site	Easting	Northing	Natural surface mAHD	Dril Date	Hole Depth	Clay Depth	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
C01	320712	7332119	38	2/10/2018	12	9.5	Volcanic	9.5	28.5
C02	320694	7332110	38.3	2/10/2018	23.5	7.6	Volcanic	11	27.3
C03	320718	7332083	38.3	2/10/2018	21	6.7	Volcanic	dry	
C04	320704	7332077	37.5	2/10/2018	25	6.3	Volcanic	12	25.5
C05	320717	7332051	38	2/10/2018	25	10	Limestone	12	26
C06	320703	7332037	37.7	2/10/2018	25	8	Volcanic	dry	
C07	320701	7332019	37.4	2/10/2018	25	10.5	Volcanic	dry	
C08	320720	7332021	38	2/10/2018	26	11	Volcanic	dry	
C10	320704	7331984	37.9	3/10/2018	16.5	6	Volcanic	7	30.9
C11	320732	7331928	39.2	3/10/2018	25	7	Volcanic	7	32.2
C12	320703	7331937	38.2	3/10/2018	22	8	Volcanic	7	31.2
C13	320711	7331885	38.6	3/10/2018	25	8.5	Volcanic	10	28.6
C14	320692	7332150	38.6	3/10/2018	29	8.4	Volcanic	dry	

Table 14 Pit 3 Groundwater investigative drilling in 2018

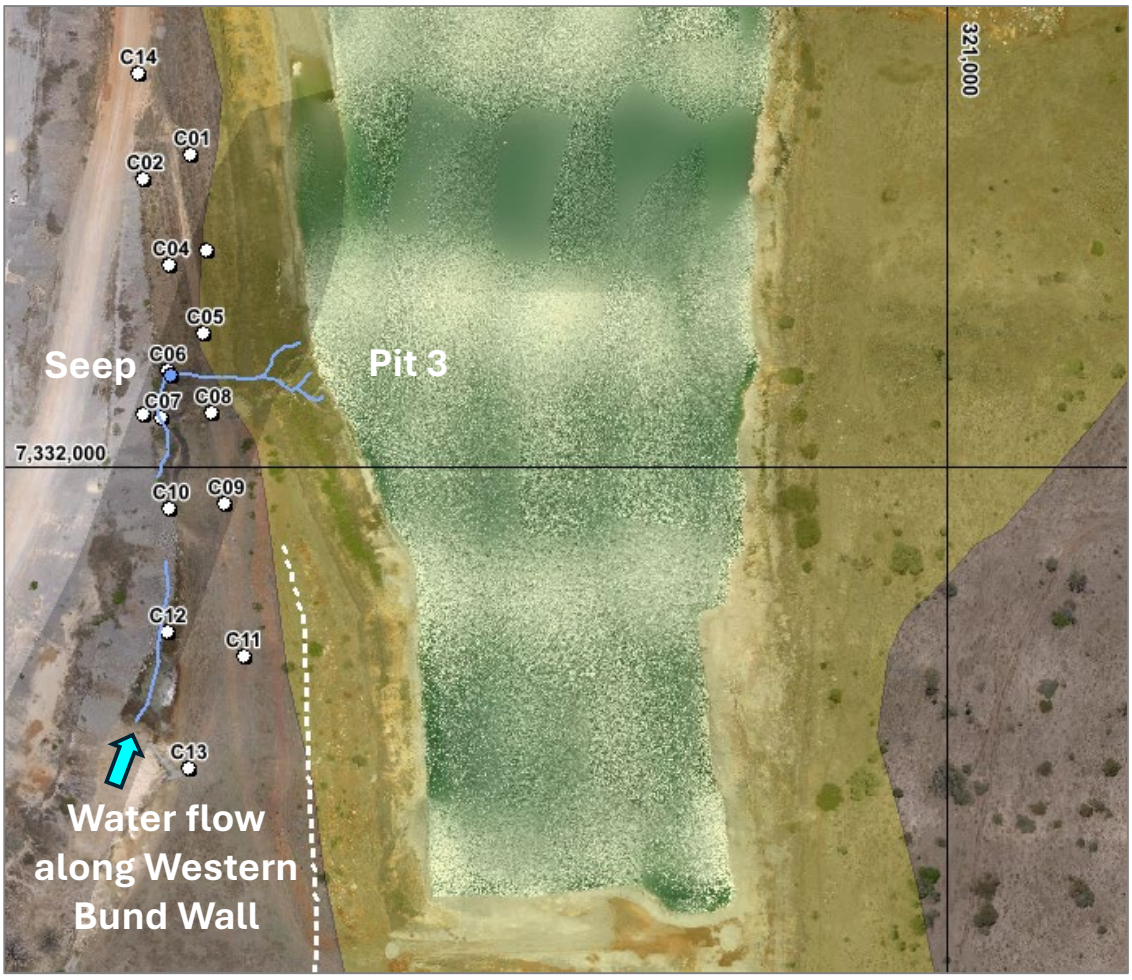


Figure 31 Map of groundwater investigative drilling in 2018

Groundwater level and flow

The drilling was undertaken with a 3 metre pre-collar which provided stability around the hole collar to help prevent hole collapse. All of the holes were drilled in volcanic rock except for C05 which was drilled in limestone. Five of the fourteen holes were drilled dry. Groundwater was intersected at 26-32mAHD. All drillholes were capped and collars surveyed to ensure groundwater data integrity. Most of the holes slowly made water and were water level tested either the next day or late in the same day. C06 was drilled into Seep and groundwater was 5.15m below the surface at this location. Water samples were obtained from the drillholes. A year later on the 8 October 2019 eight of the 14 drillholes had partially collapsed while five of the drillholes were intact and water level measurements were undertaken from these holes. Following this sampling all holes were backfilled. A summary of monitoring results is provided in Table 15.

Groundwater Monitoring									
Drill site	Monitor Date	GW DBNS	Hydraulic head mAHD	Field EC	Water Sample	Monitor Date	GW DBNS	Hydraulic head mAHD	Field EC
C01	3/10/2018	6.79	31.21	820	✓	×			
C02	3/10/2018	6.45	31.85	680	✓	×			
C03	3/10/2018	dry			×	×			
C04	3/10/2018	6.47	31.03	554	✓	8/10/2019	6.91	30.59	391
C05	3/10/2018	6.50	31.50	440	✓	×			
C06	3/10/2018	3.50	34.20	414	✓	8/10/2019	5.15	32.55	303
C07	3/10/2018	3.24	34.16	418	✓	8/10/2019	3.74	33.67	306
C08	3/10/2018	6.84	31.16	419	✓	8/10/2019	7.34	30.66	319
C10	3/10/2018	5.67	32.23	425	✓	×			
C11	3/10/2018	5.36	33.84	546	✓	×			
C12	3/10/2018	7.24	30.96	603	✓	×			
C13	3/10/2018	5.52	33.08	638	✓	×			
C14	3/10/2018	8.37	30.23	977	✓	8/10/2019	7.63	30.97	781

Table 15 Groundwater monitoring of the 2018 drillholes

Groundwater is elevated at 34mAHD in holes C06 and C07 at the Seep which is 38mAHD. Groundwater level varies from 31-34mAHD with an average of 32mAHD being approximately 5 metres below the Seep entry site at 37mAHD and therefore seep inflow is not groundwater. A March 2015 photograph of the Seep into Pit 3 (Figure 32) shows the Seep surface water inflow at 37mAHD and groundwater seepage at 32mAHD.



Figure 32 The Seep and groundwater seepage into Pit 3 – 4 March 2015

Groundwater and surface water chemistry

Sampling of the drillholes and surface water bodies was undertaken to characterise groundwater and its relationship with surface water. Groundwater and surface water major ion chemistry from the 2018-19 water investigation is shown in Table 16 below.

Site	Type	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
C01	Groundwater	3/10/2018	106	8	88	0.5	334	0.5	100	24
C02	Groundwater	3/10/2018	94	9	88	0.5	343	0.5	68	16
C04	Groundwater	3/10/2018	71	8	63	0.5	295	0.5	40	10
C05	Groundwater	3/10/2018	70	3	37	0.5	230	0.5	35	5
C06	Groundwater	3/10/2018	68	3	39	0.5	192	0.5	52	6
C07	Groundwater	3/10/2018	70	3	32	0.5	208	0.5	35	4
C08	Groundwater	3/10/2018	69	3	28	0.5	201	0.5	35	6
C10	Groundwater	3/10/2018	74	3	28	0.5	220	0.5	36	4
C11	Groundwater	3/10/2018	95	4	36	0.5	256	0.5	41	32
C12	Groundwater	3/10/2018	102	6	41	0.5	270	0.5	57	27
C13	Groundwater	3/10/2018	105	6	48	0.5	262	0.5	62	40
C14	Groundwater	3/10/2018	150	14	70	0.5	300	0.5	167	32
Awoonga Dam	Surface water	3/10/2018	21	6	22	2	87	0.5	31	6
Awoonga Dam	Surface water	3/10/2018	19	7	22	2	79	9	30	5
Pit 3	Surface water	3/10/2018	67	7	56	0.5	135	0.5	106	33
Pit 3	Surface water	3/10/2018	69	7	56	0.5	140	0.5	104	33
Seep	Surface water	3/10/2018	65	4	56	0.5	233	0.5	42	10
Seep2	Surface water	3/10/2018	80	3	36	0.5	205	0.5	48	19
Awoonga Dam	Surface water	15/01/2019	12	8	24	2	83	0.5	24	5
Awoonga Dam	Surface water	15/01/2019	17	7	21	2	77	0.5	26	5
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	81	0.5	24	4
Awoonga Dam	Surface water	15/01/2019	17	8	21	2	81	0.5	25	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	81	0.5	25	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	80	0.5	27	4
Awoonga Dam	Surface water	15/01/2019	16	7	21	2	84	0.5	26	4
Catchment Dam1	Surface water	15/01/2019	39	29	119	3	117	0.5	124	141
Pit 3	Surface water	15/01/2019	62	7	61	0.5	120	0.5	121	31
Pit 3	Surface water	15/01/2019	62	7	61	0.5	121	0.5	119	31
Pit 3	Surface water	15/01/2019	62	7	60	0.5	123	0.5	116	30
Pit 3	Surface water	15/01/2019	61	7	60	0.5	121	0.5	116	30

Table 16 Groundwater and surface water major ion chemistry from 2018-19 investigation

Groundwater chemistry is variable with concentration of the anions HCO_3, Cl and SO_4 being higher in drillholes north of the Seep such as C14 and C01 which were the northern most drilled holes (Figure 13) and the lowest concentrations were C05-C10 which are located at the Seep. The lower concentrations in the Seep indicate leaching of groundwater from the Seep, which is surface water flow from the Farm Dam, into Pit 3. Groundwater has a sulphate concentration of 4-6mg/L which is the same as Awoonga Dam water which indicates that there is minor groundwater seepage beneath the Western Bund wall through bedrock fractures at approximately 32mAHD. Groundwater has a bicarbonate concentrations over double Awoonga Dam which indicates a residence and geochemical processes that are different from Awoonga Dam. Groundwater cannot leak or flow rapidly, in seconds, from Awoonga Dam through the Western Bund wall and over double the concentration of HCO_3.

A Piper plot of groundwater chemistry west of Pit 3 and surface water shows that they are chemically different with groundwater being Ca-MG-HCO3 type and the Seep mixed type (Figure 33).

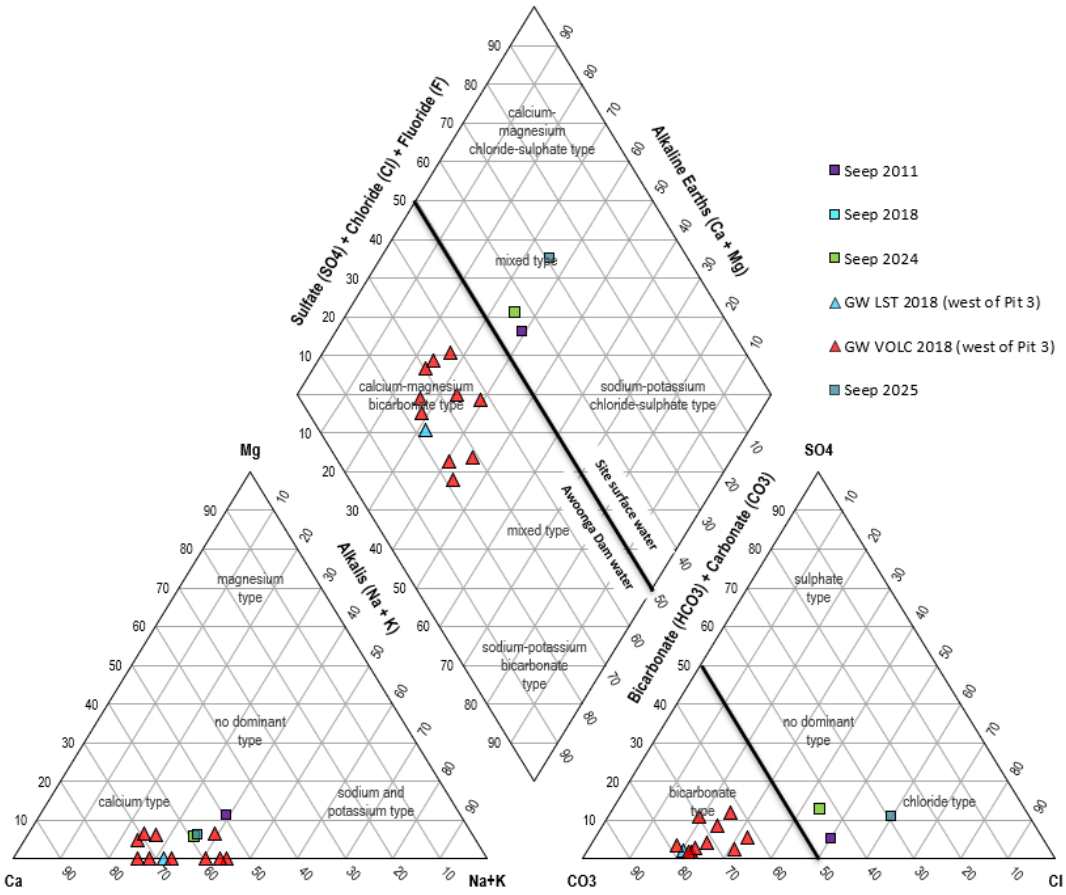


Figure 33 Groundwater chemistry and seepage into Pit 3

The water chemistry of groundwater is distinct from the chemistry of the seep (Figure 33) but is similar to Awoonga Dam as shown in Table 15 and in Figure 30.

The Seep is not groundwater and there is insufficient groundwater on the bench to be sampled and it is concluded that there is a groundwater contribution to Pit 3 form seepage below the Western Bund wall, but this is <1 l/s and cannot be sampled where observed on the bench surface.

5.2.3 Surface water source of excess water in Pit 3

Surface water collected in the Farm Dam seeps beneath and exits the uncompacted northern edge of the Waste Dump and then flows along the western bund wall to the Seep and into Pit 3. The Farm Dam theoretical overflow is at 43mAHD, being the elevation of material extending north-easterly from the Waste Dump, but water is regulated such that the water level in the Farm Dam does not exceed 38mAHD.

A February 2015 photograph (Figure 34) shows surface water pooled in the Farm Dam, water flowing between pools along the edge of the Western Bund wall to the Seep and then into Pit 3. The water quality of Awoonga Dam, Farm Dam and Pit 3 is visually very different with Awoonga Dam water having a brown discolouration and high turbidity from the agitation of clay by the previous 3 days of high rainfall. The Farm Dam water is black and indicates a contribution of organic matter and tannins, with no evidence of clayed material entering the Farm Dam; and Pit 3 water is the typical green-blue tinged colour of pit water in limestone.



Figure 34 Western bund wall surface water flow into Pit 3 on 22 February 2015

Data loggers were installed in Pit 3 in 2017/18 to further investigate the source of excess pit water and this data has been used to set-up and calibrate the final pit void Water Balance Model. A hydrograph of Pit 3 water levels for the period January 2017 to April 2018 is presented below in Figure 35.

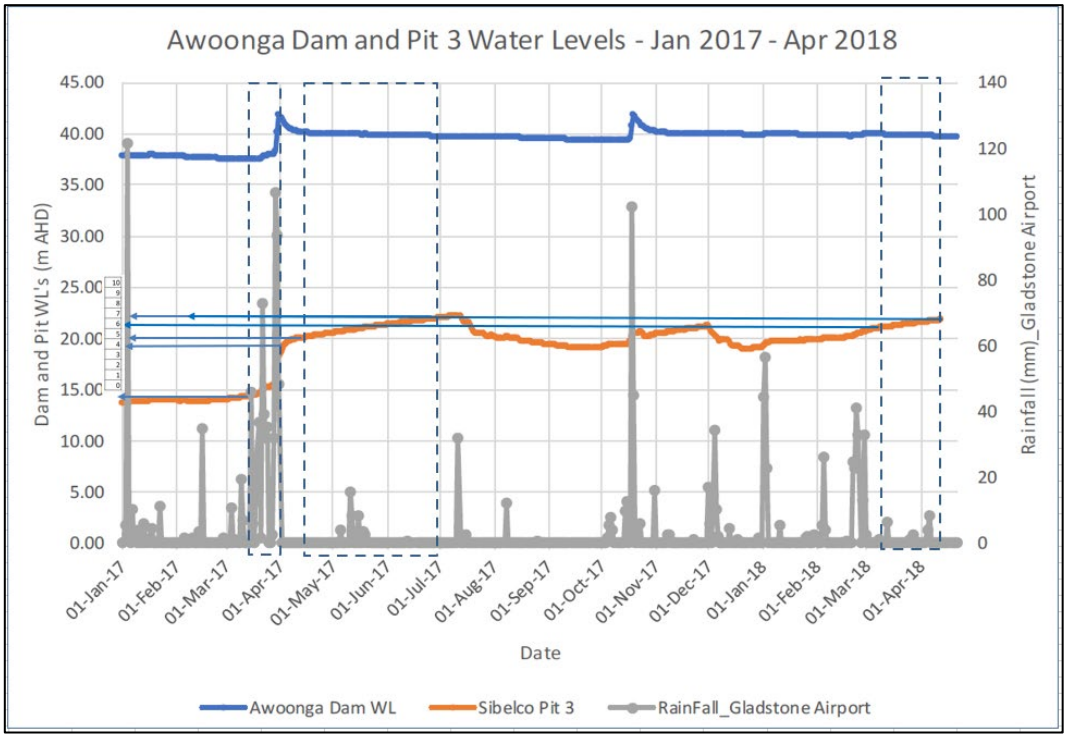


Figure 35 Calibration events obtained in Pit 3 from January 2017 to April 2018

Three calibration periods were identified by a Sibelco hydrogeologist (Feiss) and the Pit 3 water fluctuations for these calibration events were calculated to yield “seepage” rates of 36l/s (3.1ML/day) in a wet cycle from 15th March 2017 to 31st March 2017, 20 l/s (1.7ML/day) in a draining cycle from 15th April 2017 to 30th June 2017, and 5.4 l/s (0.5ML/day) during a dry cycle from 8th March 2018 to 7th April 2018. The dam water level was proposed to create a potentiometric surface in a semi-confined aquifer driven and equivalent to Awoonga Dam water level and at final pit void groundwater seepage would increase by a factor of 10.

This assessment of the Pit 3 data logger water levels did not differentiate between surface water flow from the Farm Dam and groundwater or the observed absence of groundwater at the Calliope. If the Awoonga Dam was leaking 3.1ML/day into the Farm Dam then at least 10ML of turbid clayed Awoonga Dam water should have leaked into the Farm Dam on the 22 February 2015 as per Figure 34. There is no clayed water in the Farm Dam and photographic evidence supports the hypothesis that excess Pit water following high rainfall events is not from Awoonga Dam leakage (Figure 34) and is not from groundwater (Figure 32). A Piper plot of Awoonga Dam, Farm Dam, water flow along the Western Bund Wall, the Seep and Pit 3 is shown as Figure 36.

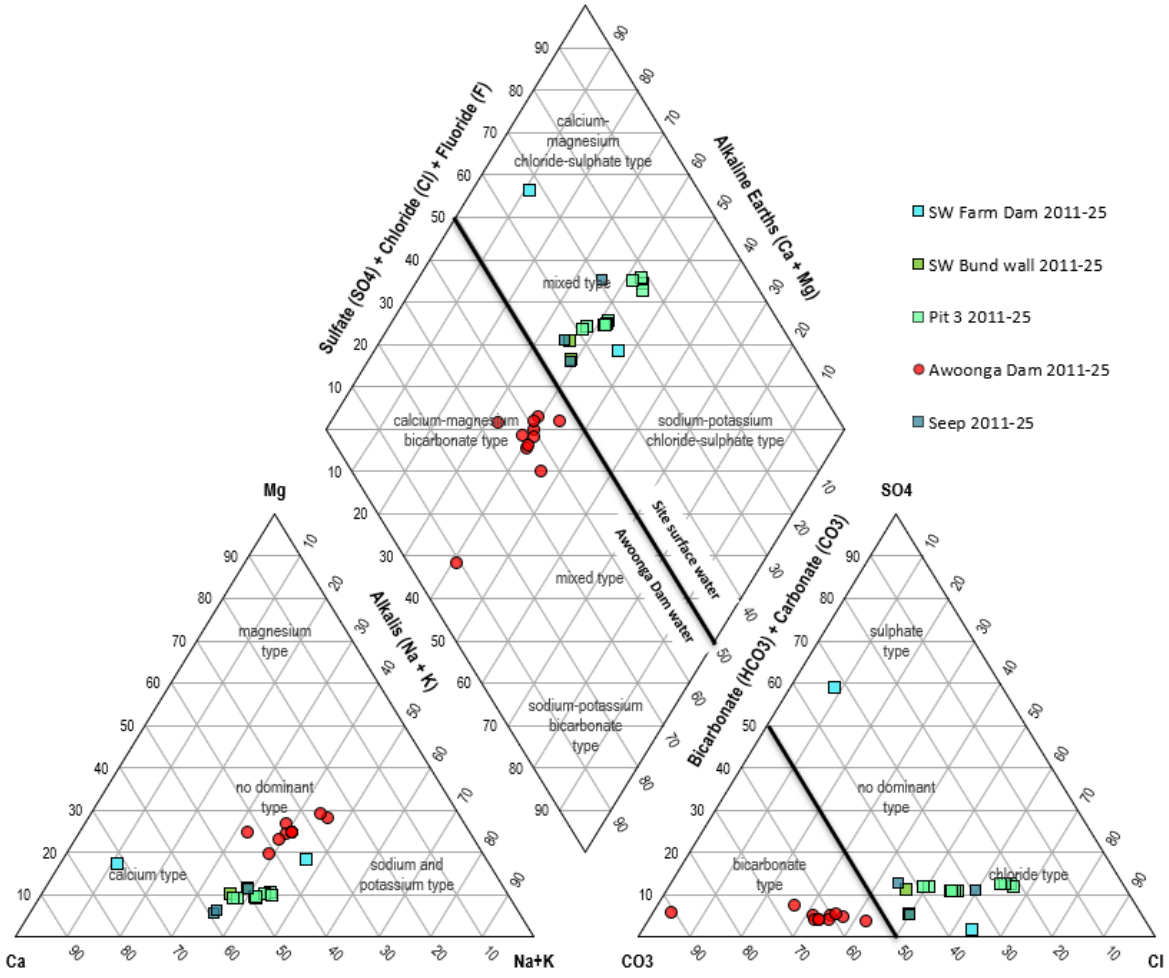


Figure 36 Awoonga Dam with Pit 3 and Farm Dam major ion chemistry

Awoonga Dam water is chemically distinct from Pit 3 and Farm Dam sub-catchment surface water. Awoonga Dam water is Ca-Mg-HCO3 type. Farm Dam and water flowing from the Farm Dam to Pit 3 and Pits 3 water are chemically similar being mixed type. Surface water flows from the Farm Dam to Pit when there is water in the Farm Dam.

Excess Pit 3 water following heavy rainfall is attributed to surface water run-off in the Pit 3 catchment with prolonged inflow following rainfall due to seepage and flow of water from the Farm Dam.

5.3 Groundwater behaviour from investigative water drilling

5.3.1 Interpreting drilled water intersections

Rotary Air Blast (RAB) drilling is routinely undertaken for drill and blast production at the quarry as well as geological resource definition drilling and investigative water drilling. Groundwater intersected by geological and investigative drilling is recorded. During an investigative groundwater drilling program groundwater measurements were made of the drilled hole void to determine whether the groundwater elevation of intersected groundwater has changed post-drilling or if a dry hole has slowly made water.

Drilled water intersections and post drilling groundwater measurements assist with interpretating groundwater behaviour and the host aquifer. See Figure 37.

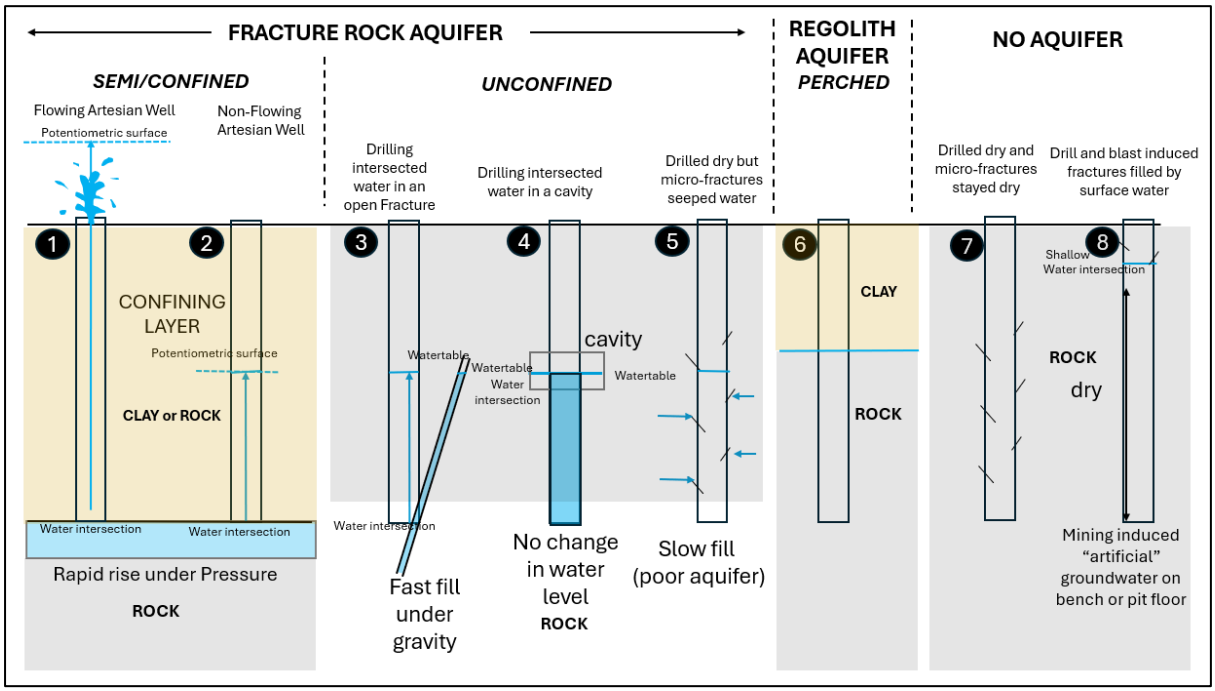


Figure 37 Drilled groundwater intersection types

At Calliope there has been no artesian flow observed in any drilled holes (1) whereas groundwater level has been observed to rise in an open drillhole post-drilling. The rise of groundwater post-drilling could possibly be interpreted as (2) but because of the delayed slow response are generally interpreted as (3) to (5) although (6) has been observed outside the pit envelope. Some holes were drilled dry and remained dry (7). Blasting on benches and the pit floor has created fractures that have led to the sub-surface capture of water in the fractures, being an artificial groundwater (8). Artificial groundwater is usually within 5 metres from the surface and can be distinguished from natural groundwater based on water chemistry.

5.3.2 Pit 3 investigative drilling in 2018

The 2018 investigation drilling west of Pit 3 and outcomes from this drilling was discussed in Section 5.2.2.

5.3.3 Site-wide investigative drilling in 2025

A total of 34 holes were drilled in 2025 around the perimeter of Pit 4, Pit 1 and east of Pit 3 define groundwater behaviour and further investigate groundwater -lithological relationships. Drillhole location and groundwater intersection details are shown in Table 17

GRAYMONT

Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	Clay Depth (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
D01	320722	7332520	46	4/03/2025	25	13	Volc	13	33
D02	320806	7332367	46.4	4/03/2025	29	14	Volc	14	32.4
D03	320916	7332338	42.2	4/03/2025	25	20	LST	dry	
D04	321127	7332322	45.7	4/03/2025	25	8	LST	dry	
D05	321334	7332305	52.8	4/03/2025	29	4	LST	dry	
D06	321510	7332466	58.2	4/03/2025	29	10	Volc	dry	
D07	321551	7332638	52.8	4/03/2025	29	4	Volc	dry	
D08	321532	7332742	48.1	4/03/2025	25	12.5	Volc	21	27.1
D09	321702	7332679	45.2	4/03/2025	29	2	Volc	dry	
D10	321374	7333021	52.4	4/03/2025	25	3	Volc	24.5	27.9
D11	321318	7333156	61.8	4/03/2025	29	3	Volc	dry	
D12	321270	7333333	58.5	5/03/2025	29	9	Volc	dry	
D13	321195	7333480	56.5	5/03/2025	29	2	Volc	23.5	33
D14	321239	7333633	60.1	5/03/2025	29	2	Volc	dry	
D15	321135	7333732	61.5	5/03/2025	8	6.5	LST	dry	
D16	321133	7333734	61.4	5/03/2025	29	6.5	LST	14.5	46.9
D17	320986	7333320	50.6	5/03/2025	29	4	LST	dry	
D18	320740	7333178	44.6	5/03/2025	29	4	LST	dry	
D19	320700	7332964	45.7	5/03/2025	29	4	LST	dry	
D20	320704	7332752	44.4	5/03/2025	29	9	Volc	dry	
D21	321323	7332317	51.5	31/03/2025	29	3 (fill)	LST	24	27.5
D22	321212	7332216	49.7	1/04/2025	29	2	LST	dry	
D23	321433	7332040	61	1/04/2025	29	2	Volc	dry	
D24	321184	7331834	58.7	1/04/2025	29	2	Volc	dry	
D25	320819	7331696	42.3	1/04/2025	14.5	3	Volc	dry	
D26	320963	7331713	43.5	1/04/2025	13.5	2	LST	12	31.5
D27	320970	7331477	42.4	1/04/2025	14	1	Volc	14	28.4
D28	321029	7331167	43.6	1/04/2025	18	1	Volc	17.5	26.1
D29	321085	7330868	54	1/04/2025	23	3	Volc	dry	
D30	320743	7331231	45.1	1/04/2025	18	3	MetaSED	17.5	27.6
D31	320815	7331556	40.1	1/04/2025	18	3 (fill)	Volc	17.5	22.6
D32	320662	7333082	51.4	31/03/2025	18	4.5	LST	18	33.4
D33	321139	7333273	54	31/03/2025	29	3 (fill)	LST	dry	
D34	321409	7332693	47.3	31/03/2025	29	3 (fill)	Volc	dry	

Table 17 Groundwater investigative drilling in 2025

The drilling intersected volcanics in 20 holes, limestone in 13 holes, with these 33 holes being in Calliope Beds. One drillhole, D30, intersected metasediment, being metamorphosed and Rockhampton Group sedimentary rock. The holes were capped at the completion of drilling. A drillhole map is shown as Figure 38.

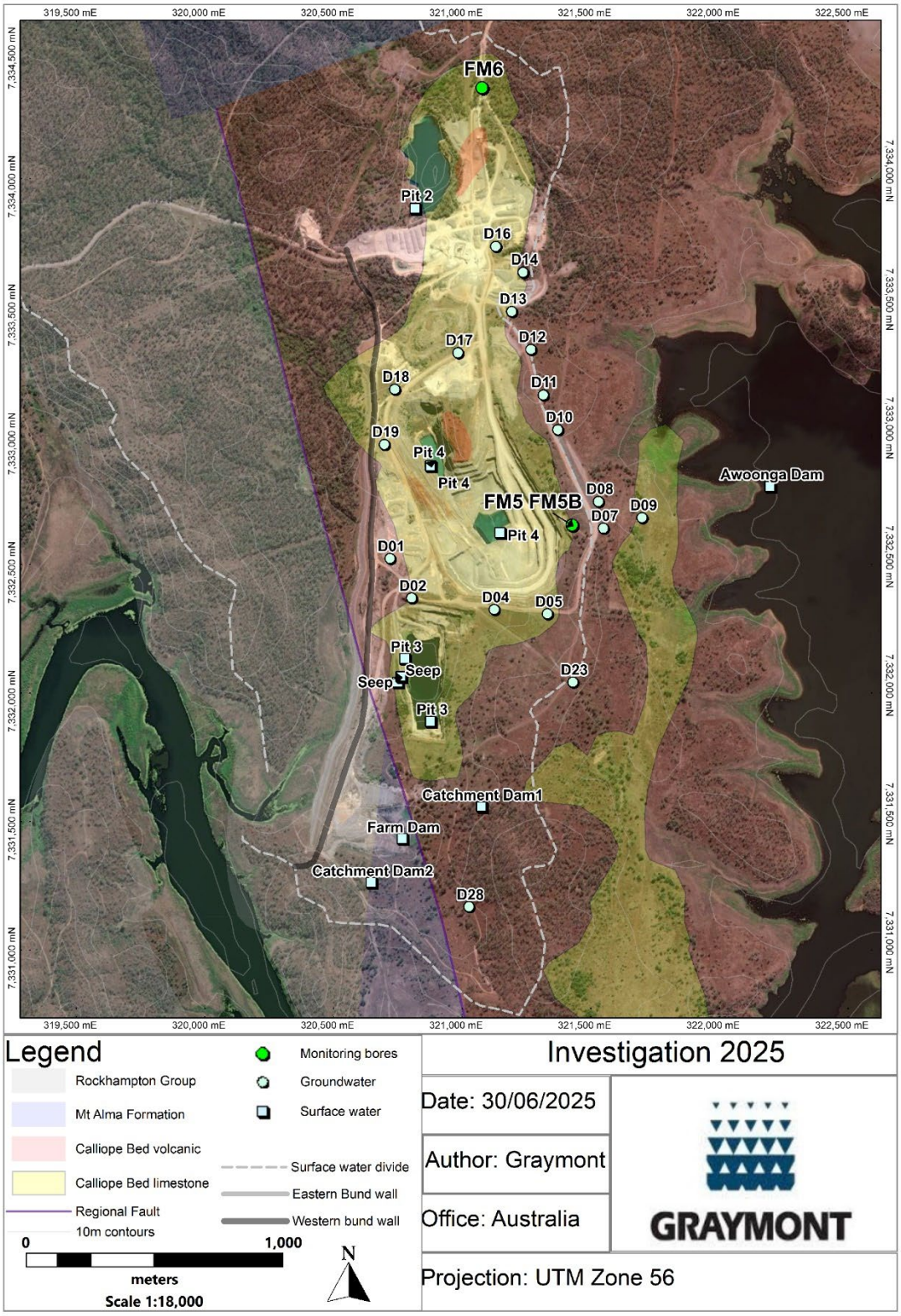


Figure 38 Groundwater Investigative drilling with surface water sites 2025

GRAYMONT

Groundwater level and flow

The majority of drilled were dry with the most groundwater intersected at and near the volcanic -limestone contact. Site blast hole drilling driller logs of water intersection confirm that groundwater intersections are uncommon. Most of the holes slowly made water and were water level tested either the next day or late in the same day. Water samples were obtained from the drillholes. All the 2025 drillholes were capped and collars surveyed to ensure groundwater data integrity. Monitoring results are provided in Table 18.

Groundwater Monitoring														
Hole ID	Monitor Date	DBNS (m)	Hydraulic head mAHD	Field EC	Monitor Date	DBNS (m)	Hydraulic head mAHD	EC	Water Sample	Monitor Date	DBNS (m)	Hydraulic head mAHD	EC	Water Sample
D01	4/03/2025	10.53	35.47	813	10/03/2025	10.6	35.4	331	✓	29/05/2025				×
D02	4/03/2025	12.96	33.44	1002	10/03/2025	12.8	33.6	419	✓	29/05/2025				×
D03	4/03/2025	dry			10/03/2025	dry			×	29/05/2025				×
D04	4/03/2025	dry			10/03/2025	19.8	25.9	4310	✓	29/05/2025				×
D05	4/03/2025	dry			10/03/2025	27.3	25.5	975	✓	29/05/2025				×
D06	4/03/2025	dry			10/03/2025	dry			×	29/05/2025				×
D07	4/03/2025	28.18	24.62	1689	10/03/2025	23	29.8	221	✓	29/05/2025	14.76	38.04		×
D08	4/03/2025	12.14	35.96	1928	10/03/2025	12.2	35.9	741	✓	29/05/2025				×
D09	4/03/2025	28.5	16.7	503	10/03/2025	27.6	17.6	875	✓	29/05/2025	12.2	33		×
D10	4/03/2025	16.33	36.07	2107	10/03/2025	15.8	36.6	382	✓	29/05/2025				×
D11	4/03/2025	27.91	33.89	2640	10/03/2025	23.5	38.3	3250	✓	29/05/2025				×
D12	5/03/2025	28.56	29.94	796	10/03/2025	16.4	42.1	377	✓	29/05/2025	15.1	43.4		×
D13	5/03/2025	16.65	39.85	1277	10/03/2025	10.7	45.8	120	✓	29/05/2025	14.7	41.8		×
D14	5/03/2025	19.63	40.47	864	10/03/2025	13.2	46.9	780	✓	29/05/2025	13.1	47		×
D15	5/03/2025	dry			10/03/2025	dry			×	29/05/2025	14	47.5		×
D16	5/03/2025	14.72	46.68	1328	10/03/2025	12.8	48.6	1022	✓	29/05/2025	10.65	50.75		×
D17	5/03/2025	28.58	22.02	930	10/03/2025	12.8	37.8	1022	✓	29/05/2025	12	38.6		×
D18	5/03/2025	27.57	17.03	823	10/03/2025	6.5	38.1	646	✓	29/05/2025	6.5	38.1		×
D19	5/03/2025	dry			10/03/2025	25.4	20.3	447	✓	29/05/2025				×
D20	5/03/2025	dry			10/03/2025	dry			×	29/05/2025	24.6	19.8		×
D21										29/05/2025				×
D22										29/05/2025				×
D23										29/05/2025	25	36	3700	✓
D24										29/05/2025	12.4	46.3		×
D25										29/05/2025	14.65	27.65		×
D26										29/05/2025				×
D27										29/05/2025				×
D28										29/05/2025	14.4	29.2	5240	✓
D29										29/05/2025				×
D30										29/05/2025				×
D31										29/05/2025	7.8	32.3		×
D32										29/05/2025				×
D33										29/05/2025				×
D34										29/05/2025				×

Table 18 Groundwater level monitoring of the 2025 drillholes

An interpreted groundwater level map was constructed from investigative drilling monitoring (Table 17) and current bores FM5, FM5B and FM6 in consideration of destroyed bores FM1-4. See Figure 3.

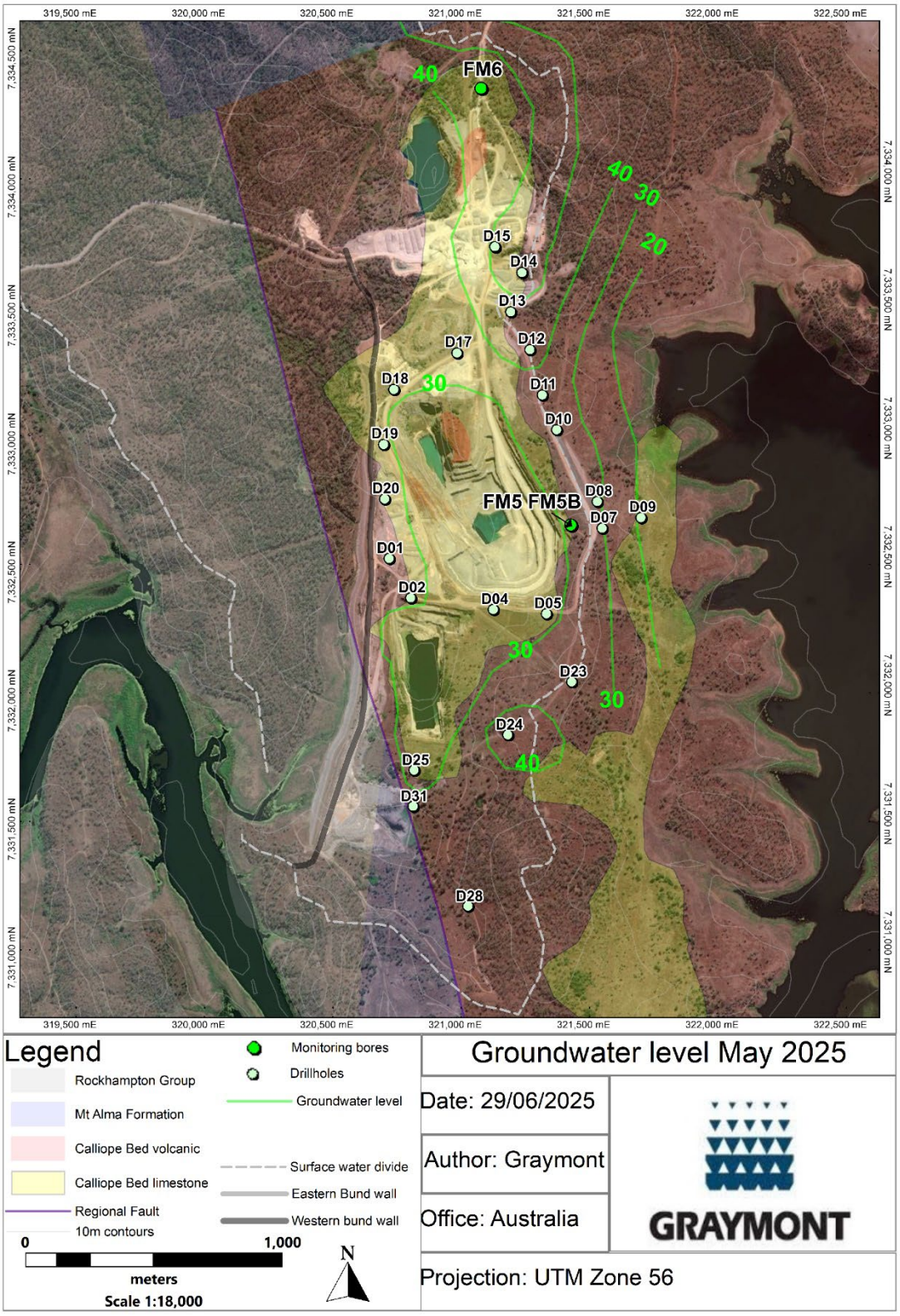


Figure 39 Groundwater level May 2025

The 2025 Investigative drilling confirmed that a groundwater divide aligns with the surface water divide. Groundwater flow is north to south from Pit 2 to SE of Pit 4 while also flowing easterly and westerly from the groundwater divide. Groundwater at FM6 flows westerly and does not flow toFM5, and groundwater at FM5 flows to Pit 4. Investigative drilling and subsequent water monitoring has confirmed groundwater levels and flow direction and that Pit 3 and Pit 4 voids are groundwater sinks. The predicted future water table will remain a closed system. Three monitoring bores are planned to be installed at investigation drilling locations. See Section 7.3.1.

Groundwater and surface water chemistry

Sampling of the drillholes and surface water bodies was undertaken to characterise groundwater and its relationship with surface water. Groundwater and surface water major ion chemistry from the 2025 water investigation is tabled below with May 2025 monitoring bore results.

Site	Aquifer	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
D01	Volc	10/03/2025	47	5	5	0.5	125	0.5	9	18
D02	Volc	10/03/2025	39	10	17	0.5	123	0.5	23	12
D04	LST	10/03/2025	376	10	464	0.5	323	0.5	1180	27
D05	LST	10/03/2025	156	18	23	2	23300	0.5	28	31
D07	Volc	10/03/2025	21	8	9	1	101	0.5	4	3
D08	Volc	10/03/2025	66	62	130	2	712	0.5	65	13
D09	Volc	10/03/2025	120	28	14	3	408	0.5	29	138
D10	Volc	10/03/2025	32	9	23	1	156	0.5	2	3
D11	Volc	10/03/2025	59	105	291	4	886	0.5	221	20
D12	Volc	10/03/2025	27	11	31	0.5	154	0.5	4	4
D13	Volc	10/03/2025	15	3	9	1	98	0.5	5	4
D14	Volc	10/03/2025	95	19	17	0.5	237	0.5	8	95
D16	LST	10/03/2025	122	12	66	2	383	0.5	40	48
D17	LST	10/03/2025	114	19	57	0.5	278	0.5	31	122
D18	LST	10/03/2025	104	4	18	0.5	1970	0.5	20	38
D19	LST	10/03/2025	70	2	9	0.5	157	0.5	16	13
D23	Volc	29/05/2025	78	182	522	3	788	0.5	910	47
D28	Volc	29/05/2025	369	206	468	4	703	0.5	1510	52
FM5	LST	29/05/2025	185	14	63	0.5	370	0.5	59	151
FM5B	Volc	29/05/2025	198	15	67	0.5	374	0.5	61	148
FM6	Volc	29/05/2025	144	9	34	1	409	0.5	18	10
Pit 3	n/a	19/03/2025	60	7	59	0.5	89	0.5	142	37
Pit 4	n/a	19/03/2025	50	7	24	0.5	116	0.5	18	47
Seep	n/a	19/03/2025	126	7	87	0.5	242	0.5	143	55
Awoonga Dam	n/a	29/05/2025	18	12	33	3	95	0.5	44	5
Catchment Dam1	n/a	29/05/2025	9	4	11	9	52	0.5	16	0.5
Catchment Dam2	n/a	29/05/2025	15	5	18	5	67	0.5	22	0.5
Farm Dam	n/a	29/05/2025	96	14	14	6	86	0.5	14	124
Pit 2	n/a	29/05/2025	42	12	53	0.5	137	0.5	43	50
Pit 3	n/a	29/05/2025	71	8	63	0.5	117	0.5	147	41
Pit 4	n/a	29/05/2025	58	11	18	0.5	90	0.5	17	89
Pit 4	n/a	29/05/2025	57	12	47	0.5	128	0.5	37	88
Seep	n/a	29/05/2025	130	8	93	0.5	242	0.5	178	57

Table 19 Groundwater and surface water major ion from 2025 investigation

Groundwater level maps with bicarbonate, chloride and sulphate from Table 19 are provided in Figures 40-42 respectively.

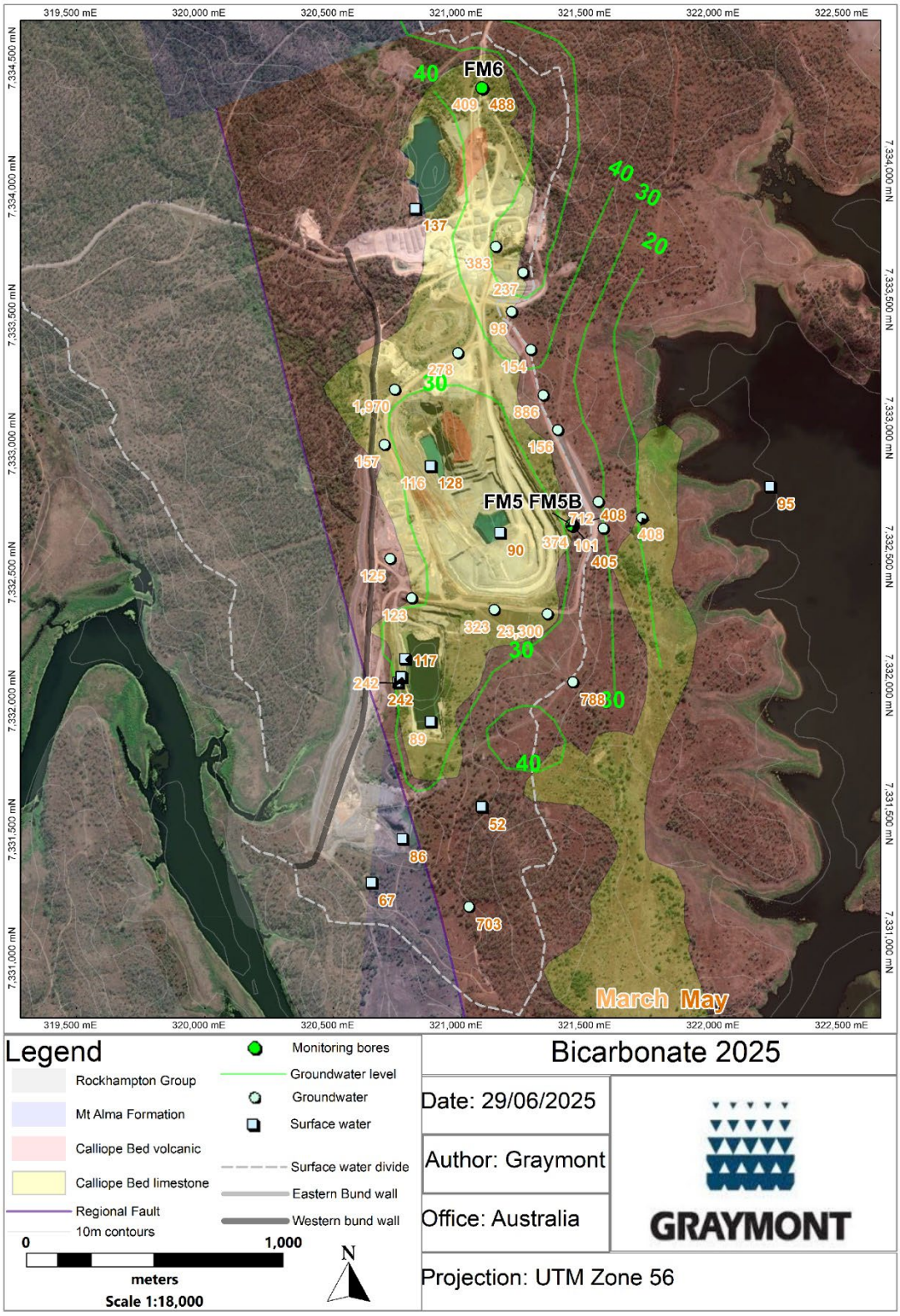


Figure 40 Water sampling results for bicarbonate 2025

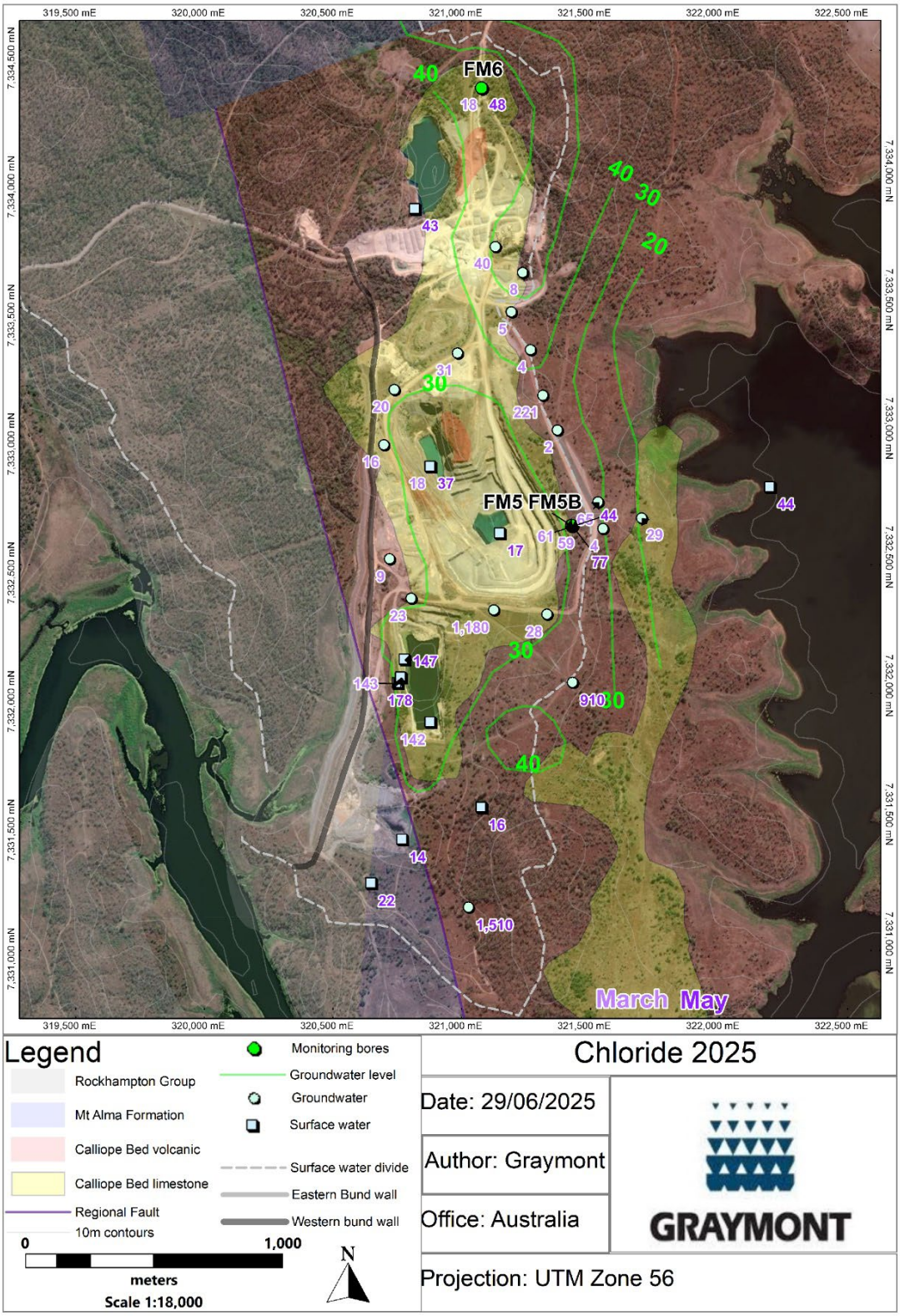


Figure 41 Water sampling results for chloride 2025

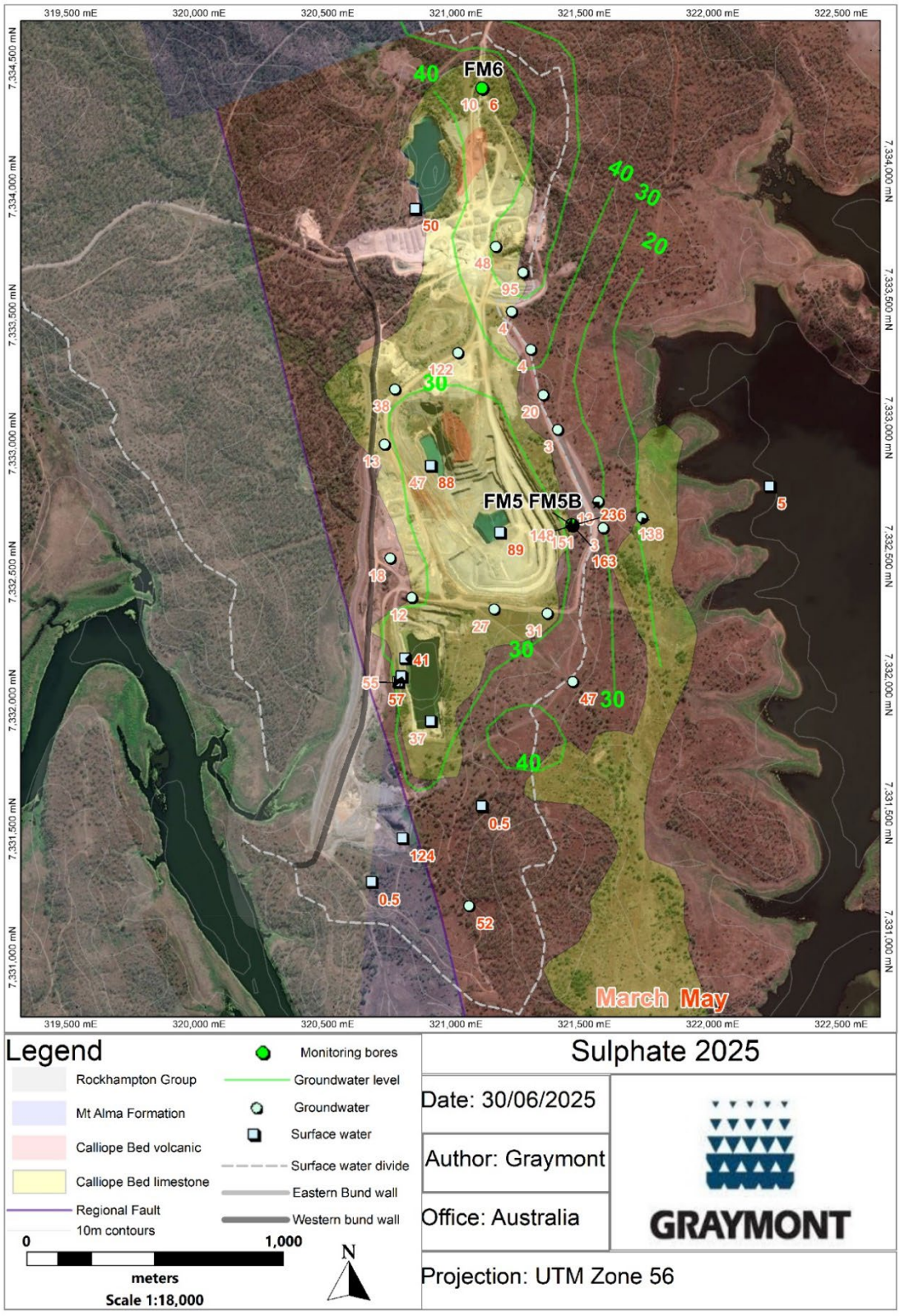


Figure 42 Water sampling results for sulphate 2025

Chloride and Sulphate are both low in groundwater at the ground divide east of Pit 4 which is a recharge zone. Sulphate increases with flow both westerly and easterly from the groundwater divide. The concentration of anions naturally vary and sulphate in pit water is discussed in Section 7.1.4. Sulphate in pit water is a potential contaminant of concern as discussed in Section 7.1.5. A Piper plot of 2025 drillhole is presented with 2018 drillhole data as Figure 43.

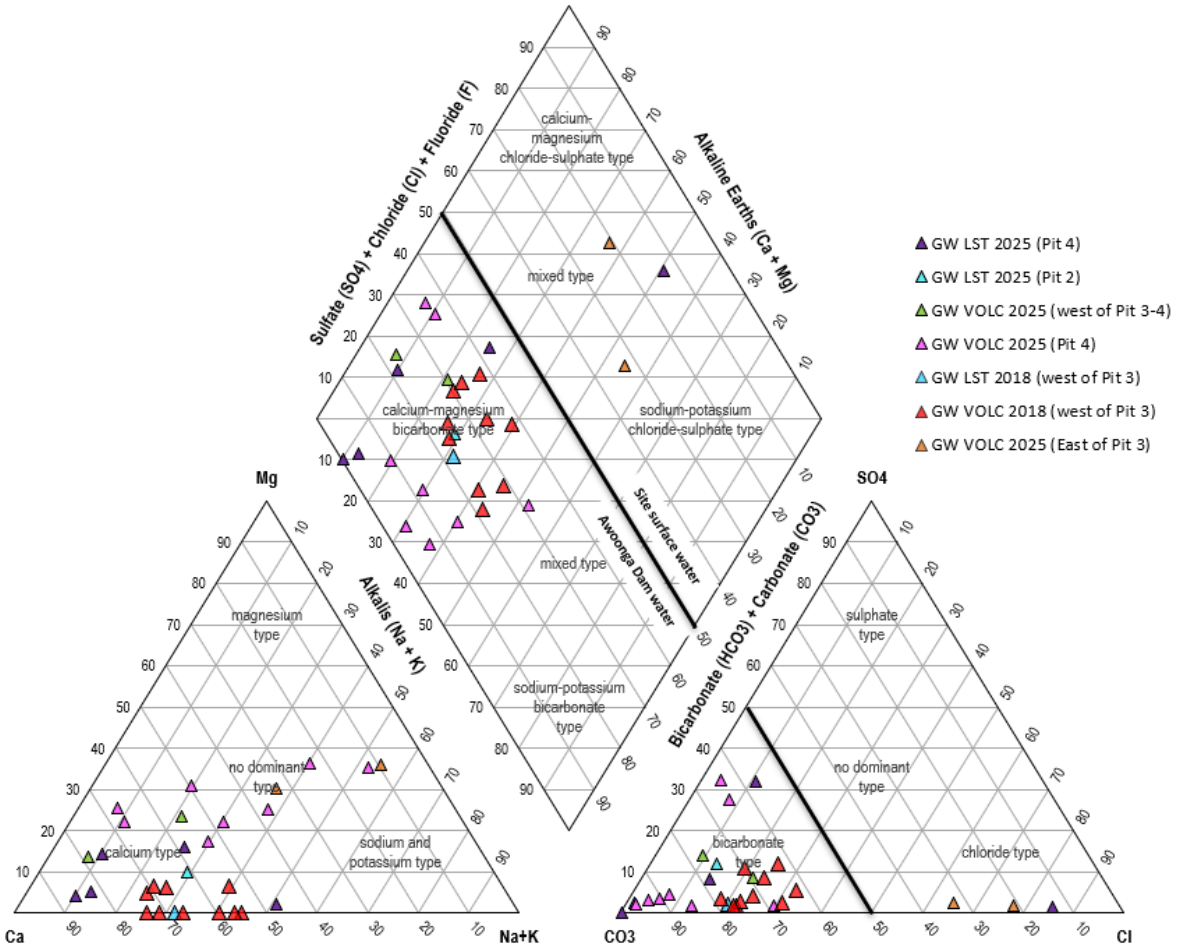


Figure 43 Investigative drilling 2025 with 2018 drillhole data

Groundwater is Ca-Mg-HCO3 with the exception of a limestone drillhole (D04) which is south of Pit 4 and has elevated NaCl and the two volcanic drillholes east of Pit which have elevated NaCl. Elevated NaCl in groundwater south and east of the pit voids is attributed to halite stored in the regolith.

Investigative drilling has confirmed that groundwater for limestone and volcanic are similarly variable and there is no clear distinction between groundwater from limestone and volcanic (Figure 39). A lithostratigraphic boundary can be defined but it is not a groundwater boundary condition.

The geology at Calliope is simple with sub-vertical lithological contacts. There is sufficient groundwater data to demonstrate that there is little groundwater and that the Water Balance analytical modelling approach outlined in Section 8 is appropriate.

Nitrogen

Nitrogen sampling was under taken in 2025 and the results are presented in Table 20.

Site	Aquifer	Date	Ca	Mg	Na	K	HCO3	CO3	Cl	SO4	Ammonia	Nitrite as N	Nitrate as N	TKN as N	TN as N
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
D23	Volc	29/05/2025	78	182	522	3	788	0.5	910	47	0.90	0.67	0.64	2.90	4.21
D28	Volc	29/05/2025	369	206	468	4	703	0.5	1510	52	2.46	0.01	0.01	3.40	3.41
FM5	LST	29/05/2025	185	14	63	0.5	370	0.5	59	151	0.005	0.01	5.10	0.60	5.71
FM5B	Volc	29/05/2025	198	15	67	0.5	374	0.5	61	148	0.005	0.01	5.69	0.80	6.50
FM6	Volc	29/05/2025	144	9	34	1	409	0.5	18	10	0.005	0.01	0.04	0.05	0.10
Awoonga Dam	n/a	29/05/2025	18	12	33	3	95	0.5	44	5	0.01	0.01	0.07	0.40	0.48
Catchment Dam1	n/a	29/05/2025	9	4	11	9	52	0.5	16	0.5	0.19	0.01	0.02	3.30	3.33
Catchment Dam2	n/a	29/05/2025	15	5	18	5	67	0.5	22	0.5	0.16	0.01	0.03	0.90	0.94
Farm Dam	n/a	29/05/2025	96	14	14	6	86	0.5	14	124	0.01	0.01	0.19	0.90	1.10
Pit 2	n/a	29/05/2025	42	12	53	0.5	137	0.5	43	50	0.01	0.01	0.23	0.10	0.34
Pit 3	n/a	29/05/2025	71	8	63	0.5	117	0.5	147	41	0.04	0.01	0.36	0.20	0.57
Pit 4	n/a	29/05/2025	58	11	18	0.5	90	0.5	17	89	0.01	0.01	4.27	0.60	4.88
Pit 4	n/a	29/05/2025	57	12	47	0.5	128	0.5	37	88	0.01	0.01	2.27	0.50	2.78
Seep	n/a	29/05/2025	130	8	93	0.5	242	0.5	178	57	0.01	0.01	0.11	0.10	0.22

Table 20 Groundwater and surface water nitrogen results from 2025 investigation

Total Nitrogen (TN) in groundwater in the Farm dam sub-catchment, represented by drillholes D23 and D28, is similar to TN of groundwater in FM5 and FM5B but the composition of TN is very different. D23 has proportionally elevated organic nitrogen, D28 has proportionally elevated ammonia and FM5 and FM5B have proportionally higher nitrate. Catchment Dam 1 has proportionally elevated organic nitrogen.

The concentration of nitrogen forms vary with changing conditions N_2 in the atmosphere can be fixed (converted to ammonia and nitrate) by rainfall and by bacteria and archaea in soil and water. . Plants decompose to organic nitrogen and in warm moist conditions bacteria in soil convert organic nitrogen to ammonia and in oxidising conditions ammonia is converted to nitrite then nitrate. Nitrate concentrations can be reduced by plant uptake or in reducing conditions denitrified to ammonium. Nitrate not taken up by plants can be leached into groundwater. Table 20 shows that the water samples have been taken at different stages of nitrogen conversion and that similar TN in samples near and away from mining voids indicate natural processes.

6 CONCEPTUAL MODEL OF PIT WATER

The Calliope Limestone mine is located in the Silurian-Devonian aged Calliope Beds as limestone and volcanic rocks. Limestone outcrops as two well defined, elongated north-south sub-vertical lenses which abut the volcanics and in places is capped by volcanic rock. Limestone and volcanic rock are both weathered near the surface. Massive crystalline limestone and volcanic rock below the weathered rock have negligible primary porosity, but are variably finely fractured, which can form weak secondary porosity from connected fractures. The Calliope beds limestone and volcanics are predominantly an aquitard but with connected fractures can form a low-yielding fractured rock aquifer.

The groundwater quality of a fractured rock aquifer affected by rainfall weathering is dependent upon the nature of rainfall, such as timing, intensity and duration; and on salt storage in the regolith, which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals. The fractured rock aquifers at Calliope are low yielding and are generally unsuitable for groundwater pumping. The maximum yield from bores in the Calliope Beds within 9km of the Calliope is 1.5l/s.

A natural topographic high and surface water divide lies to the east of Pit 3-4 within volcanic rock, which is a local recharge area for infiltration to groundwater. To the west of Pit 3-4 is a natural topographic low and is an area for potential groundwater discharge. Mining of limestone in Pit 3 has exposed the volcanic-limestone contact and the only known permanent groundwater seepage into Pits 3-4 which is west of Pit 3. Seepage has also been observed in the north-east corner of Pit 4 at the volcanic cap and limestone contact, but this seep dries during extended drier conditions and will be swallowed up by the future Pit 3-4 and so is not considered a future seepage source.

6.1 Pit 3-4 void Conceptual Model

A diagram of the Pit 3-4 final void pit water conceptual model has been created from the outcomes of Pit 3 and Pit water investigations and is shown below (Figure 44).

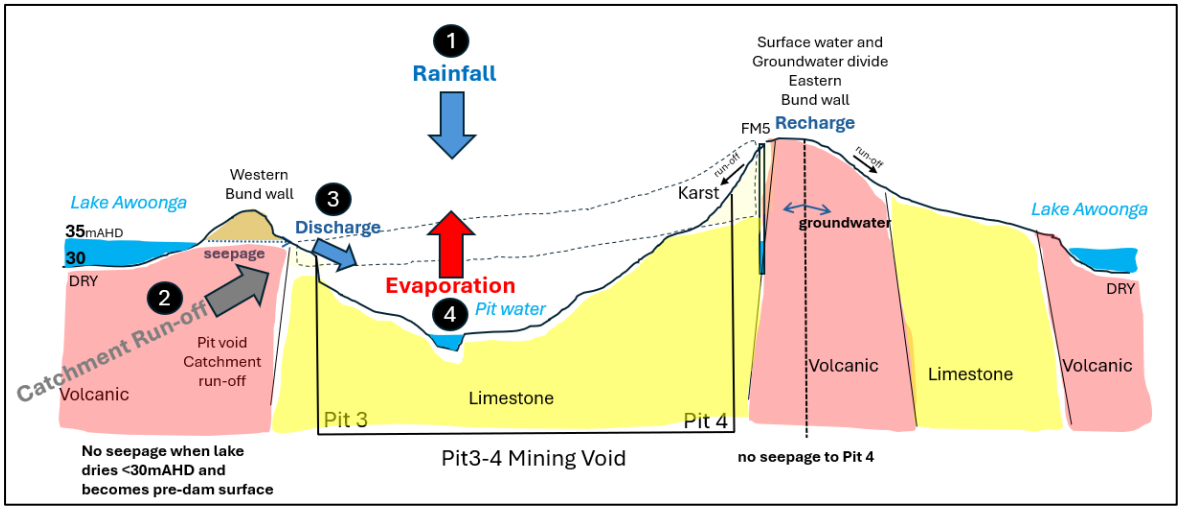


Figure 44 Pit Water Conceptual Model of future combined Pits 3-4

Pit water is created by:

1. Direct Rainfall onto pit floor
2. Surface water runoff into the pit void from the Pit 3 void and Farm Dam sub-catchments
3. Groundwater inflow into the pit void
4. Evaporation of pit water

Some features of the Conceptual Model are:

- Pit water is created in a mining void from direct rainfall, surface water run-off and limited groundwater seepage. Pit water levels are naturally lowered by evaporation or by pumping from the pit floor
- The Pit envelope is bunded for edge protection and this also redirects rainfall and surface water run-off away from the pit edge
- Pit water is driven by rainfall directly in the void and by surface water run-off from the Pit 3 void and Farm Dam sub-catchments
- During, and post- high rainfall events, surface water runoff occurs from the Farm Dam/Waste Dump area along the western bund wall to the topographic low west of Pit 3, referred to in this report as the Seep, from which this surface water flows in to Pit 3
- Pit water collected on the pit floor evaporates
- Pit floor pumping is intermittent and seasonal. In 5 months from January-July 2025 only 1.4ML of pit water was pumped from Pit 4. has been pumped from Pit 4 Pit water is pumped and released to Awoonga Dam through authorised release point in accordance with EA water release conditions.
- Lithological boundaries appear to constrain groundwater flow with nearly all groundwater in volcanic rock or at the limestone-volcanic contact
- Groundwater levels are considered to represent the watertable in an unconfined aquifer.
- Currently the only permanent groundwater inflow into a mining void is into Pit at a rate <1l/s
- There are no effective confining layers. There is no observed discharge under pressure either laterally or upward into the pit void and no evidence of a potentiometric surface or artesian conditions have been observed. .
- Groundwater discharge into the pit is limited. If there was significant groundwater discharge into the pit, then large volumes of water would need to be dewatered from the pit to prevent the pit from filling to a potentiometric surface at the elevation of the dam water level. This is not the case. Pit floor pumping is intermittent and seasonal , as the pit dries in the dry season there is little evidence of groundwater seepage.
    - Historical and current metering data is being compiled to quantify water inflows
- Groundwater levels and chemistry respond to recharge and therefore groundwater is driven by infiltration (rather than seepage from Awoonga Dam)
- Groundwater in Volcanic rock west of Pit 3 is approximately twice the salinity of Awoonga Dam water and groundwater east of Pit 4 is approximately four times the salinity of Awoonga Dam water. Awoonga Dam chemistry is different from groundwater at and near the pit void.
- The lines of evidence indicate that Awoonga dam does not leak into Pit 3
- Awoonga Dam cannot pressure pit water at depth because when Awoonga Dam recedes the land dries and Awoonga Dam eventually becomes dead storage at 13mAHD
- There is no groundwater extraction outside the pit void so the aquifer is not being depressurized as groundwater approaches the pit void
- There is little groundwater present in the limestone and therefore there is no cone of depression extending beyond the mined area or associated impacts to potential receptors.
- The planned life of mine Pit 3-4 created by combining Pit 3 and Pit 4 is also expected to have minimal groundwater inflow
- In the absence of groundwater pumping pit water levels are equilibrated when water inflows are balanced by evaporation. In the final pot void this is predicted to be at -10mAHD.

A Water Balance Model to assess future water levels within the pits has been created based on the Conceptual Model (Section 8).

GRAYMONT

7 PROJECT HYDROGEOLOGY

7.1 Pit water

7.1.1 Pit water level and void capacities

Pit water level and void capacities are estimated below in Table 21.

Catchment Pit Void	Maximum water level (mAHD)	Void empty capacity (ML)
Pit 2		655
Pit 4	42.4	10,580
Pit 3	42.4	861
Pit3-4	50 (crest 52)	58,171

Table 21 Pit water level and void capacities

7.1.2 Surface water inflow to pit voids

Pit 1 has been backfilled. Pit 2 is an inactive pit void and acts as a water storage facility for the site which is filled by direct rainfall capture, surface water run-off and pumped Pit 4 water. Pit 3 is an inactive pit void. Pit 3 water is mainly surface water run-off and modified by rainfall and evaporation (Section 4.2). There is <1l/s of groundwater entering Pit 3 void which slowly seeps at approximately 32mAHD onto the bench (Section 5.2.2). Pit 4 is an active pit. This pit has little surface water inflow because of mounding at the top of the access ramp redirects surface water but rainfall is captured directly on the pit benches and floor. There is negligible groundwater entering the pit void and groundwater has not been sampled (Section 4.5).

7.1.3 Final landform abandonment bund

Abandonment bunds will reduce particulate matter and nutrients entering the pit voids, which is anticipated to provide a control measure for minimising the risk of algae growth.

7.1.4 Stratification of pit water bodies

Salinity profiling of Pit 3 was undertaken from a boat on the 4 October 2018. See Figure 45.

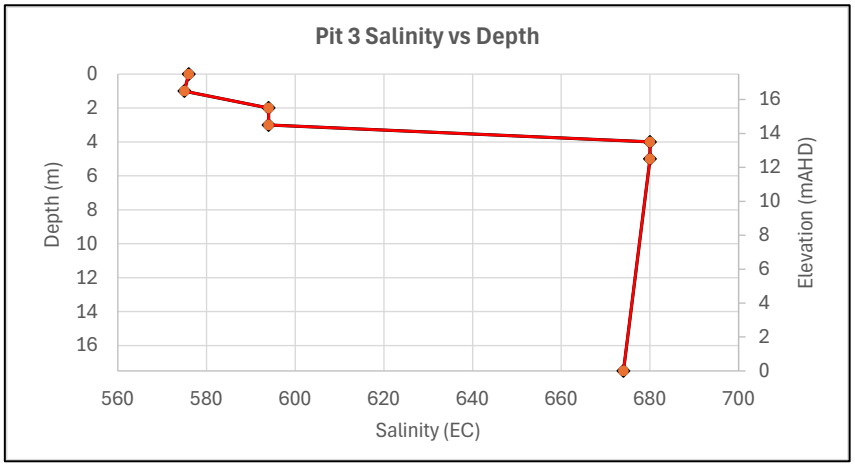


Figure 45 Pit 3 and Pit 4 major ions water chemistry

Stratification of the Pit 3 water profile was observed at 4 metres depth which equated to 17.5mAHD, where pit water salinity increased by 86 µS/cm from 594 to 680 µS/cm. This is common for deeper water columns. The salinity of the water column beneath this depth was uniform. Salinity profiling of Awoonga Dam next to Ragotte Creek whose depth is typically less than 2.5 metres, shows that there is no stratification of Awoonga Dam water in Ragotte Creek.

7.1.5 Pit water pumping

Pit 2 water is pumped to surface water release point C1. Pit 4 water is also pumped to this release point. Pit 3 water is pumped to surface water release point F1. Pit 4 water is pumped to surface water release point F1 and C1. Additional meters were installed to January 2025 to quantify groundwater component of pt water. Pit water pumping from 1 January to 30 June 2025 was 19ML from Pit 2; 35ML from Pit 3 and 18.3ML from Pit 4. The pumping volumes are low which indicates that there has to be little to no groundwater entering the pit voids and that pit water levels, which fluctuate with rainfall and surface water run-off, are naturally regulated by evaporation.

7.1.6 Pit water chemistry

Pit 3 and Pit water major ion chemistry A Piper plot of Pit 3 and Pit 4 major ion chemistry is provided below. See Figure 46.

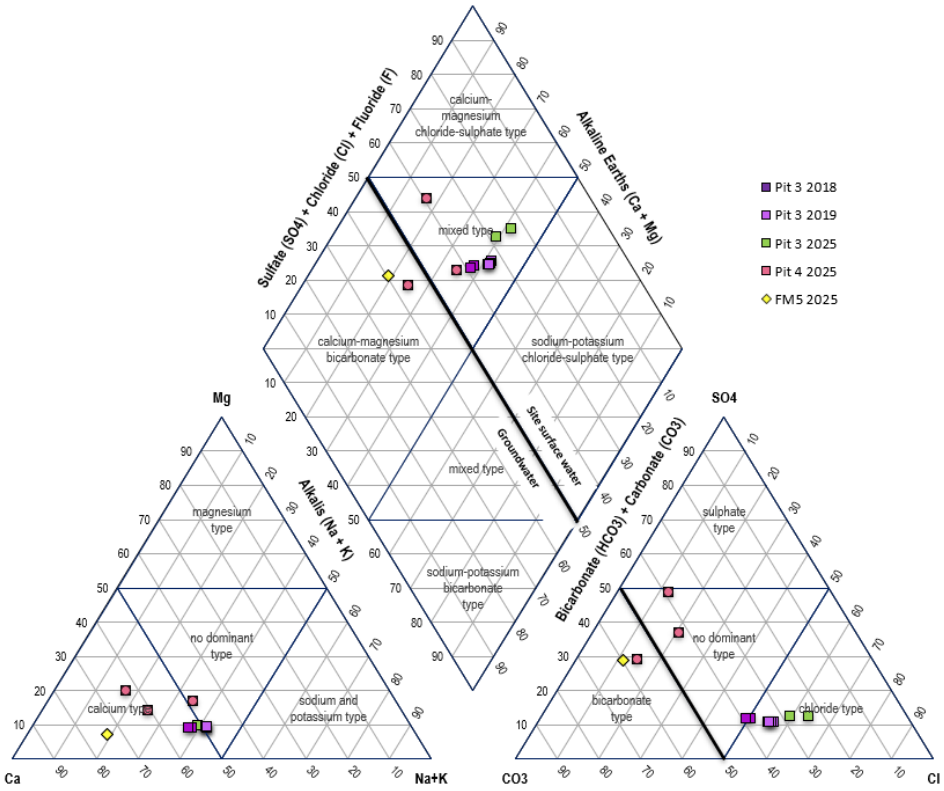


Figure 46 Pit 3 and Pit 4 major ions water chemistry

Pit 3 water has been extensively studied as discussed in Section 5.2 and has a surface water origin from surface water run-off and seepage from the Farm Dam. Large volumes of surface water have been observed to enter Pit 3 during and following heavy rainfall events. Direct rainfall capture causes dilution and pit water concentration and these effects modify Pit 3 salinity which is typically 630+/-100 µS/cm. The salinity of Pit 3 on 19 March 2025 was 733 µS/cm.

Pit 4 water chemistry indicates a predominantly surface water origin whereby salinity changes by dilution and evaporation effects with rainfall and evaporation. Pit 4 water has little surface water entering the pit following heavy rainfall but weathered material within the pit void may be washed onto the pit floor modifying pit water salinity and chemistry. The salinity of Pit 4 on 19 March 2025 was 472 µS/cm. The salinity of Bore FM5 replacement FM5B was 1384 µS/cm on the 29 January 2025.

7.1.7 Potential contaminants in pit water

Pit water can be the source of potential contaminants and can also be the sink of potential contaminants from surface water runoff from mining areas and from undisturbed areas.

Potential sources of contaminants in pit water include primary sources from natural processes and secondary sources introduced by mining. Primary sourced potential contaminants include salinity, pH, suspended solids, sulphate, nutrients (nitrate) and metals which all form by natural processes but mining activities can potentially disrupt, change and redistribute these water quality parameters. Secondary sourced potential contaminants include hydrocarbons and pesticides.

Hydrocarbons are managed through bunding and refuelling procedures and pesticides are not used on site. Hydrocarbons have not been detected in pit water samples. Metal concentrations are low.

Oxidisation of limestone and volcanic rocks is a natural process which is accelerated on the waste dump but limestone purity and low volumes of volcanic material ensures that pH remains near neutral and there are no acid forming waters at site.

Pit water within the Calliope Limestone Operation is considered a low risk source of contaminants. The generation of salts within the mining operations and accumulated within the pits is low, and on-going monitoring has shown the pit water is within the EA limits. Other potential contaminants such as pH and suspended solids within in the pits also achieve the required EA criteria.

The site essentially operates as a closed system with flood protection bunds and natural topographic highs preventing overland flow off-site to Awoonga Dam and conversely, protection from inundation from high water levels from Awoonga Dam. The pits are also closed systems and are sinks for surface water run-off and groundwater flow.

Nitrates

Nitrates are naturally occurring in surface water and groundwater from nitrogen transforming processes. See Section 5.3.3. Nitrate concentrations seasonally and water sampling on the 29 May 2025 gave results of 4.37mg/L and 2.27mg/L from Pit 4 and 0.36mg/L from Pit 3. Drinking water quality recommended limit is 50mg/L.

Sulphates

Sulphate is a major ion and a component of salinity and is regularised analysed for in groundwater samples but not pit water. Although sulphate is not regularly analysed for in pit water it was historically analysed for in discharge water until 2013 after which changed EA conditions no longer routinely required this analysis. A graph of sulphate concentrations at surface water release points is provided below with pit water, other surface water and groundwater results. See Figure 47.

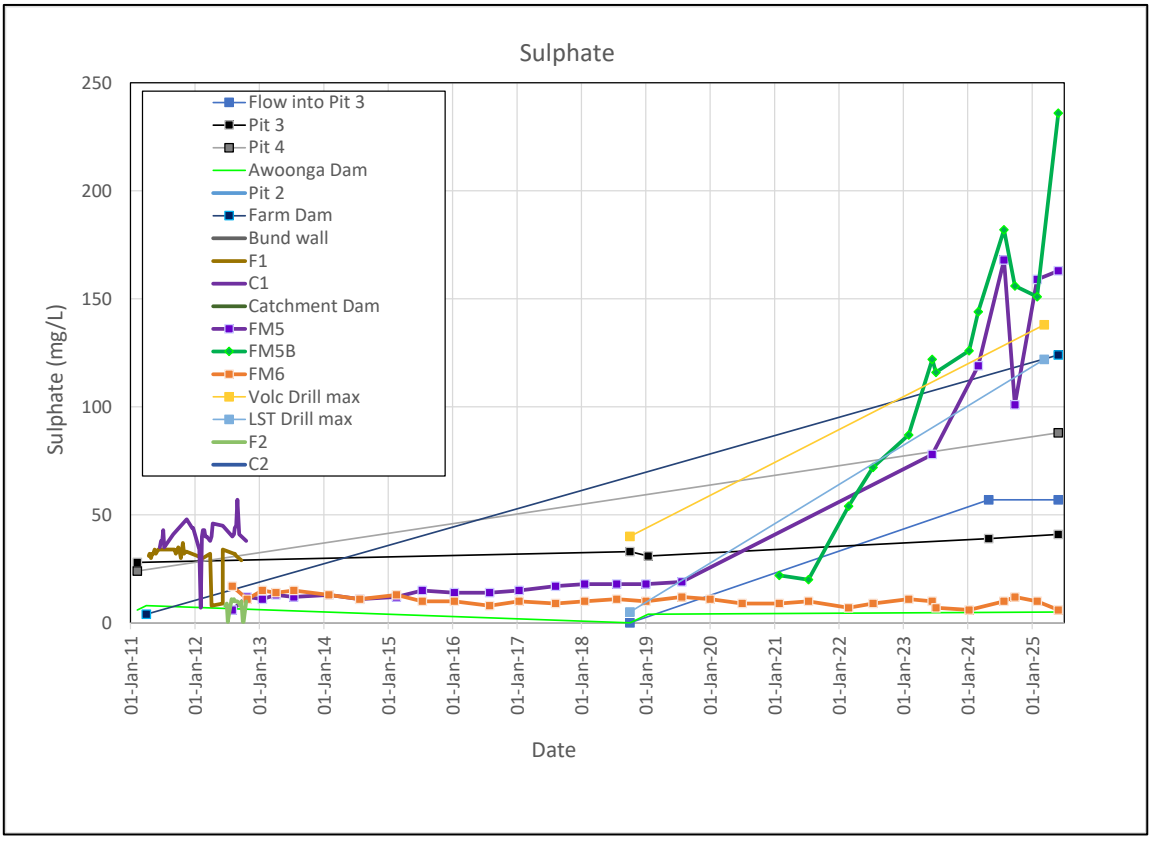


Figure 47 Sulphate in discharge water, pit water, other surface water and groundwater

Surface water at F1 is from Pits 3 and 4, F2 from natural flow and/or Pit 3 and C1 from Pits 1,2 and 4. Sulphate concentrations in surface water discharged in 2011-12 at F1 and C1 was in the 35-45 mg/L range. Sulphate concentrations in May 2025 for Pit 3 was 41mg/L and for Pit 4 was 88mg/L. Sulphate concentrations have increased across the mine sub-catchments and the Farm Dam has increased from 4mg/L in March 2011 to 124mg/L in May 2025. See Figure 43.

Sulphate concentrations in October 2012 for FM5 was 12 mg/L and FM6 was 11 mg/L. Following a period during which FM5 was dry, an adjacent deeper nested bore FM5B was installed in 2021. Sulphate concentrations for FM5B have increased since this time. In May 2025 FM5 sulphate concentrations were 163mg/L, whereas the FM6 concentration remained low at 6mg/L. The bores benchmark groundwater flow with FM5 benchmarking groundwater into the active Pit 4 and FM6 benchmarking groundwater into the inactive Pit 2. In 2012-13 sulphate in groundwater was lower than sulphate in surface water that was pumped from the Pit 3 and Pit 4 voids and therefore the source of elevated sulphate in these pit voids is not considered to be groundwater. Elevated sulphate in the pit voids is understood to result from rainfall and surface water inflow and the primary source is the dissolution of gypsum ($CaSO_4$). See Section 7.3.5. Elevated sulphate in pit water is from cyclic salts and the dissolution of surface salts in run-off water to the pit voids, with sulphate concentrations modified by evaporation. In the absence of mining and the construction of the Western Bund wall, surface salts in run-off water at Calliope were discharged to the Boyne River via Ragotte Creek. This natural salt discharge path has now been modified to collection in a mine void and salt collected in the mining voids is pumped to Awoonga Dam. The concentration of sulphate in Awoonga Dam in May 2025 was 5mg/L.

GRAYMONT

7.2 Surface water release

When surface water is planned to be released surface water sampling is undertaken weekly from the specified release points F1, F2, C1 and C2 to test suitability for release. The water quality parameters tested are Electrical Conductivity (µS/cm), pH (pH Unit) and Total Suspended Solids (mg/L). Surface water release sampling results in a wetter climate is represented by 2012 sampling results. See Table 22.

Parameter	EC (µS/cm)				pH				SS (mg/L)				Sulphate (mg/L)			
EA Limit	< 900 µS/cm				6.5 (min) 8.5 (max)				< 100 mg/L				< 500 mg/L			
Date	F1	F2	C1	C2	F1	F2	C1	C2	F1	F2	C1	C2	F1	F2	C1	C2
25/01/2012			434				8.0				100				34	
2/02/2012				194				7.8				8				7
9/02/2012			437				7.9				<5				40	
15/02/2012			457				8.0				<5				43	
20/02/2012	556				8.1				<5				30			
23/02/2012			487				8.3				<5				43	
29/02/2012			448				8.0				9				40	
7/03/2012			525				8.0				<5				40	
14/03/2012																
21/03/2012																
22/03/2012	555		322	91	8.2		8.1	7.8	5		38	20	32		30	2
27/03/2012	559		406		8.1		8.1		<5		<5		32		38	
4/04/2012		242	445			7.9	8.0			6	10			8	40	
11/04/2012			498				8.1				<5				46	
18/04/2012																
19/04/2012			568				7.6				9				44	
26/04/2012	592	256	478		8.1	8.1	8.0		<5	8	20		29	8	33	
3/05/2012		272				8.0				8				12		
14/05/2012	269				8.0				<5				9			
30/05/2012		268				8.2				<5				10		
6/06/2012		260				8.6				<5				9		
7/06/2012	563		533		8.2		8.1		83		24		33		45	
13/06/2012																
20/06/2012		262				8.1				<5				8		
29/06/2012		252				7.8				6				9		
5/07/2012		264				8.3				<5				<1		
27/07/2012		275				8.5				5				11		
31/07/2012		293	560			8.4	8.1			5	15			10	40	
9/08/2012	591	274	546		8.0	8.0	8.1		<5	<5	24		32	11	41	
14/08/2012	589	269	578		7.7	8.0	7.9		<5	<5	<5		32	10	44	
22/08/2012	598	273	609		8.0	8.2	8.1		<5	11	20		31	10	45	
29/08/2012		281	662			7.8	8.1			8	6			10	57	
5/09/2012		267	511			8.0	8.1			7	5			9	41	
12/09/2012		276				8.2				14				8		
20/09/2012	652	298	709		8.2	8.6	8.1		<5	8	8		29	10	50	
28/09/2012		1650				8.2				<5				<1		
3/10/2012		286				8.3				7				<1		
10/10/2012																
17/10/2012		296	630			8.3	8.1			7	6			10	38	
24/10/2012		285				8.1				8				11		
31/10/2012		291				8.2				7				8		
7/11/2012		267				8.3				9				11		
12/11/2012		294				8.0				8				9		
14/11/2012																
22/11/2012	618	301			8.0	8.7			19	8			36	10		
28/11/2012	602	290	622		8.0	8.7	7.9		8	6	24		28	8	45	
12/12/2012	617				8.1				<5				31			
19/12/2012	585				8.1				12				30			
Maximum	652	1650	709	194	8.2	8.7	8.3	7.8	83	14	100	20	36	12	57	7
Median	590	275	518	143	8.1	8.2	8.1	7.8	12	8	15	14	31	10	41	5
Minimum	269	242	322	91	7.7	7.8	7.6	7.8	5	5	5	8	9	8	30	2

Table 22 Surface water release samples from 2012 in a wetter climate

In 2012, which was a wetter year, most surface water sample results met surface water release criteria. Sulphate was routinely sampled and the median sulphate concentration from F1 was 31mg/L. Surface water release sampling testing in a drier climate is represented by 2020 sampling results. See Table 23.

Parameter	EC (µS/cm)			pH			TSS (mg/L)		
EA Limit	< 900 µS/cm			6.5 (min) 8.5 (max)			< 100 mg/L		
Date	F1	F2	C1	F1	F2	C1	F1	F2	C1
6/01/2020	706	273		7.9	9.0		5	13	
3/02/2020	703	267		8.2	9.1		<5	<5	
26/02/2020	716	277	760	7.9	8.6	8.0	<5	<5	<5
11/03/2020	704	302	712	8.2	8.1	7.4	<5	<5	<5
18/03/2020	695	279		8.1	9.6		<5	<5	
25/03/2020	710	273		8.0	9.3		<5	<5	
1/04/2020	704	280		8.0	8.8		<5	8	
9/04/2020	699	258		7.6	9.5		<5	<5	
15/04/2020	711	274		8.1	8.8		<5	<5	
28/04/2020	700	268		7.9	9.6		<5	5	
5/05/2020	692	698		3.1	3.0		<5	<5	
15/05/2020	696	298		7.3	7.9		<5	<5	
19/05/2020	727	267		7.6	9.5		<5	6	
26/05/2020	702	269		7.9	9.7		<5	<5	
2/06/2020	702	265		7.9	9.9		<5	<5	
9/06/2020	7	265		7.9	9.7		<5	<5	
16/06/2020	7	3		7.8	9.7		<5	<5	
21/06/2020	7	3		7.7	9.7		<5	<5	
30/06/2020	6	3		6.1	7.6		<5	<5	
7/07/2020	7	3		7.7	8.9		<5	<5	
21/07/2020	700	278		8.0	8.6		11	<5	
29/07/2020	702	280		8.0	8.9		6	8	
4/08/2020	700	267		7.4	8.1		<5	<5	
11/08/2020	7	298		6.8	7.6		<5	<5	
18/08/2020	775	300		4.8	6.6		<5	<5	
26/08/2020	786	306		7.6	6.9		<5	<5	
3/09/2020	762	303		8.2	8.1		<5	<5	
8/09/2020	765	297		7.2	7.6		<5	14	
15/09/2020	791	289		8.0	12.4		<5	9	
22/09/2020	741	294		7.2	7.2		<5	<5	
30/09/2020	795	276		7.1	9.0		<5	<5	
7/10/2020	795	318		7.4	8.0		<5	64	
14/10/2020	783	360		9.3	8.6		<5	6	
10/11/2020	769	281		5.9	7.7		<5	18	
19/11/2020	759	289		6.9	7.2		<5	14	
24/11/2020	823	307		5.9	4.2		<5	<5	
2/12/2020	7	318		7.0	791.0		<5	<5	
7/12/2020	722	259		8.1	9.7		<5	5	
Maximum	823	698	760	9	791	8	11	64	
Median	704	279	736	8	9	8	6	9	
Minimum	6	3	712	3	3	7	5	5	

Table 23 Surface water release samples from 2020 in a drier climate

In 2020, which was a drier year, numerous surface water sample results did not meet surface water release criteria. Surface water release in 2023 is provided in Table 24 with discharge volumes and Pit 3 water sampling results.

Parameter	EC (µS/cm)				pH				TSS (mg/L)				Flow		
EA Limit	< 900 µS/cm			n/a	6.5 (min) 8.5 (max)			n/a	< 100 mg/L			n/a	Discharge ML		
Date	F1	F2	C1	Pit 3	F1	F2	C1	Pit 3	F1	F2	C1	Pit 3	F1	F2	C1
13/01/2023			534				8.3				8				0.01
16/01/2023			520				8.3				11				0.02
24/01/2023			539				7.6				5				0.02
31/03/2023			546				8.0				9				0.02
2/02/2023			537				8.0				<5				0.02
7/02/2023			561				8.0				6				0.02
15/02/2023			564				7.8				<5				0.01
3/03/2023			573				7.9				12				0.01
15/03/2023			489				8.1				8				0.02
21/03/2023			485				8.3				7				0.02
28/03/2023			520				8.2				12				0.02
4/04/2023			592				8.1				15				0.01
11/05/2023			540	725			8.1	8.1			<5	<5			0.01
22/05/2023				726				8.1				15			
31/05/2023				740				8.2				<5			
6/06/2023				718				8.1				<5			
14/06/2023				710				8.2				5			
22/06/2023				745				8.4				<5			
27/06/2023				745				8.3				<5			
3/07/2023				729				8.1				7			
14/07/2023				780				8.0				<5			
18/07/2023			611	787			8.1	8.2			5	<5			0.01
27/07/2023	782			781	8.2			8.1	<5			<5	18.55		
2/08/2023	763			748	8.1			8.2	<5			<5	20.76		
9/08/2023	758			737	8.1			8.0	5			<5	22.28		
16/08/2023	739			748	8.2			8.1	<5			<5	22.38		
23/08/2023	769			763	8.2			8.2	<5			<5	21.97		
30/08/2023	729			727	8.1			8.1	<5			<5	21.47		
6/09/2023	756			755	8.2			8.1	<5			<5	10.03		
27/09/2023				769				8.0				<5			
1/11/2023				773				8.0				<5			
8/11/2023				770				8.2				<5			
Maximum	782		611	787	8		8	8			15	15			
Median	758		540	747	8		8	8			8	7			
Minimum	729		485	710	8		8	8			5	5			
Total													137.4		0.2

Table 24 Surface water release samples from 2023 with Pit 33 sampling results

In 2023 a total of 137.4ML was discharged at surface water release point F1. Surface water at this release point is sourced from Pit 3 and Pit 4. In 2023 additional sampling was undertaken of Pit 3. Pit 3 water quality is very similar to F1 water quality which indicates that F1 discharge was almost exclusively from Pit 3.

7.3 Groundwater inflow to pit void

7.3.1 Resource definition and production drilling

Geological drilling results from resource definition and production are housed in a database which currently contains 800 drillholes. Groundwater intersection data is routinely recorded and groundwater was intersected in 20 drillholes (3%). The drillholes which intersected groundwater are shown in Table 25.

Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	EOH mAHD (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
64T3	321148	7332854	47.7	29/08/1964	86.9	-39.2	CAVITY	13.7	34.0
65T14	320759	7333060	47.9	8/11/1964	19.1	28.8	LST	16.5	31.4
AH2	320623	7332994	45.6	18/11/1965	14.5	31.1	LST	12.9	32.7
1E	320092	7333729	49.1	1/01/1966	7.7	41.4	VOLC	7.6	41.5
F9524	321086	7334064	58.5	3/11/1995	19.5	39.0	AND	17.4	41.1
F9537	320751	7331949	39.0	3/11/1995	3.0	36.0	CLAY	0.0	39.0
F9631	321101	7332143	47.3	1/04/1996	21.0	26.3	CLAY	9.0	38.3
F9607	320939	7331928	41.6	21/12/1996	18.0	23.6	LST	10.0	31.6
F99058	321633	7331720	45.2	1/12/1999	24.6	20.6	LST	13.8	31.4
F99059	321639	7331771	46.6	1/12/1999	24.6	22.0	LST	13.8	32.8
F99068	321531	7331690	46.6	1/12/1999	24.6	22.0	AND	20.0	26.6
F99084	321474	7331683	48.3	1/12/1999	24.6	23.7	LST	17.4	30.9
F99093	321347	7331591	52.9	1/12/1999	24.6	28.3	LST	22.0	30.9
CAB0004	320849	7333263	46.2	20/01/2009	16.0	30.2	CLAY/LST	14.0	32.2
CAB0006	321397	7332651	40.0	5/07/2011	10.0	30.0	LST	9.9	30.1
CAB0007	321378	7332637	40.0	5/07/2011	10.0	30.0	LST	9.9	30.1
CAB0008	321427.41	7332611.55	50.0	5/07/2011	14.0	36.0	LST	13.9	36.1
CAB0009	321408.25	7332597.98	50.0	5/07/2011	16.0	34.0	LST	15.9	34.1
CRC02	320985	7333012	66.3	15/08/2022	108.0	-41.7	LST	49.0	17.3
CRC05	321346	7332597	17.4	18/08/2022	60.0	-42.6	LST	12.0	5.4

Table 25 Drilled groundwater intersections

There has been no groundwater intersected by drilling below 5.4mAHD. In 2020-22 Resource drilling was undertaken to create a life of mine geological model, which was then used to create the final void pit design. A total of 12 holes were drilled to a maximum depth of -105.1mAHD and groundwater was intersected in 2 drillholes (17%) at 17.3mAHD in CRC02 and 5.4mAHD in CRC05. A summary of groundwater intersection data form the 2020-22 Resource drilling is provided in Table 26.

Location Details				Drilling Details					
Hole ID	East	North	Natural surface mAHD	Drill Date	Hole Depth (m)	EOH mAHD (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD
CDD01	321054.50	7332823.20	-5.1	18/03/2020	100.0	**-105.1**	LST	dry	
CRC01	320997.00	7333107.00	55.8	18/03/2020	22.1	33.8	LST	dry	
CDD02	321200.50	7332433.20	5.1	19/03/2020	63.9	**-58.8**	LST	dry	
CDD03	320794.50	7332699.10	43.8	20/03/2020	52.1	-8.3	LST	dry	
CRC02	320985	7333012	66.3	15/08/2022	108.0	-41.7	LST	49	17.3
CRC03	320974	7333040	66.0	17/08/2022	48.0	18.0	LST	dry	
CRC04	321230	7332846	16.0	17/08/2022	60.0	-44.0	LST	dry	
CRC05	321346	7332597	17.4	18/08/2022	60.0	-42.6	LST	12	5.4
CRC06	321148	7332576	-16.3	19/08/2022	60.0	**-76.3**	LST	4#	
CRC07	320876	7332231	19.2	20/08/2022	60.0	-40.8	LST	2#	
CRC08	320879	7332531	43.9	22/08/2022	78.0	-34.1	LST	dry	
CRC09	320800	7332900	28.2	23/08/2022	78.0	**-49.8**	LST	dry	

Water intersected is surface water in fractures from blasting based on shot drilling results

Table 26 Resource definition drilling groundwater intersections

Water was intersected at a shallow depth in holes CR06 and CR07 in fractures from blasting and was surface water as demonstrated by water in the drillhole drying up with further drilling. Resource and production drilling supports hydrogeological findings that there is little groundwater at Calliope.

7.3.2 Groundwater Monitoring Network

A total of six piezometers have been installed at the quarry as shown in Figure 34, but FM1-4 have been destroyed and so the network currently consists of piezometers FM5, FM5B and FM6. A summary of the construction details for piezometers FM1-6 is provided below in Table 27.

Location Details				Drilling Details						Construction	
Hole ID	Easting	Northing	Natural surface mAHD	Drill Date	Hole Depth (m)	Clay Depth (m)	Aquifer	Groundwater intersection DBNS	Groundwater intersection mAHD	Casing (mm)	Screen (m)
FM1	321336	7332963	47.4	28/10/2002	60	2	LST	12.5	34.9	50	24.0-60.0
FM2	321411	7332814	43.7	29/10/2002	24	9.6	Volc	dry	25.7	50	6.0-24.0
FM3	321331	7332864	44.5	29/10/2002	66	2	LST	dry	14.5	50	open hole
FM4	321256	7332789	45.0	30/10/2002	72	1	LST	dry	n/a	50	18.0-72.0
FM5	321430	7332650	50.7	3/07/2012	16		LST	15	n/a	50	5.7-14.7
FM5B	321431	7332650	50.7	12/01/2021	30		Volc	no record	n/a	50	17.0-30.0
FM6	321080	7334350	65.3	26/06/2012	60.5		Volc	54.5	n/a	50	48.5-60.5

Table 27 Quarry bore drilling and construction details

Piezometers FM1-4 were installed In October 2002 by Groundwater EMS Pty Ltd as part of a field investigation with an aim of installing groundwater and pumping bores east of Pit 4. The aim of installing a pumping bore was to obtain pump test data to support groundwater modelling. Exploratory drilling was undertaken but three of the four holes were dry while drilling except for very occasional and limited moist zones. Test bore results did not encourage continuation of constructing a pumping bore and FM1 was constructed as a monitoring bore along with FM2, FM3 and FM4. Bores FM1-4 have since been destroyed by mining. In 2012 two piezometers were installed and added to a new amalgamated EA. The installed monitoring bores were FM5 (State water database RN187863) and FM6 (State water database RN151688). Groundwater levels are monitored quarterly and groundwater quality data obtained 6-monthly to analyse and report trends. An additional monitoring bore FM5B (RN187863) was drilled approx. 1m east of FM5 in January 2021 due to low groundwater levels in FM5 during mid-2019 to late-2020.

Future Groundwater Monitoring Network

Graymont (Sibelco) have annually reported to DETSI (DES) on compliance and the suitability of the groundwater monitoring network since 2014. Bore FM5 benchmarks groundwater at the active Pit 4 whereas Bore FM6 benchmarks groundwater at the inactive Pit 1. Comparative Analysis of the bores is undertaken to assess FM5 variability against FM6 variability to determine whether FM5 may be impacted by mining. Long term monitoring has demonstrated that FM5 variability is similar to FM6 except for recent elevated sulphate associated with the construction of FM5B. See Section 7.3.5 The current network to date been considered suitable based on known groundwater behaviour at the site. The monitoring bores are upgradient of the mining activities/pit floor, and describe the surrounding/background groundwater conditions and a component of groundwater flow into the pit void. Groundwater has not been detected beneath the floor of Pit 4 and if any groundwater made its way to the pit floor it would be mixed with surface water. Surface water is discharged in accordance with surface water release EA conditions (Table 4) which are not aligned with the groundwater EA trigger levels (Table 5) and any exceedances of groundwater trigger levels does not influence the release of surface water. Recent investigative drilling has provided an improved understanding of groundwater levels and flow and has confirmed that there is little groundwater flow at the site. . Graymont plans to install three additional bores at investigation drilling sites D01, D07 and D016 to provide long term monitoring data for the future planned Pit 3-4. See Figure 44.

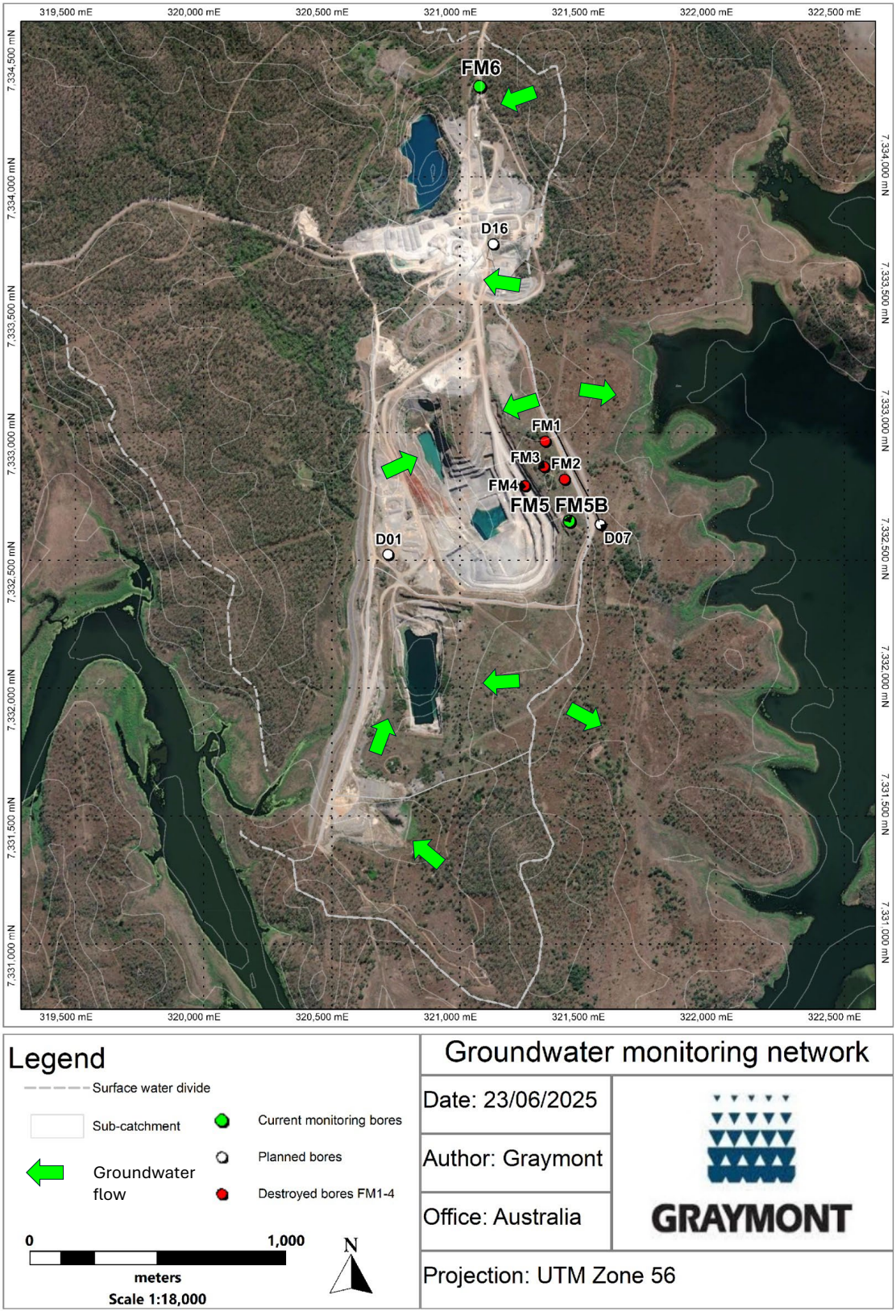


Figure 48 Groundwater Monitoring Network

7.3.3 Aquifer hydraulic properties

Hydraulic properties of groundwater systems can be obtained from the pumping of bores constructed for groundwater pumping purposes. Hydraulic conductivity and transmissivity can be determined by pumping and slug tests. Pump tests stress the aquifer and the aquifer response is quantifiable. Slug tests provide an estimate of near bore hydraulic conductivity.

A pumping bore was not installed following water investigative drilling because a lift test yielded insufficient groundwater to proceed with drilling a larger diameter hole and constructing a pumping bore. No pumping bores have been installed at the quarry and pump testing cannot be undertaken. Piezometers have been installed, which are non-pumping bores, and are suitable for slug testing. The fracture zone in FM1 gave an estimated airlift of 0.4l/s and an estimated bore yield of <0.1l/s (Groundwater EMS, 2002). Air lift pump testing by drilling operators tend to be approximate instantaneous yield only rather than an estimate of long-term yield potential. Therefore, this information should not be taken as accurate yield estimates.

Recovery hydraulic conductivity testing was undertaken of bores FM1-4 in 2002 (Kalf, 2003) and slug testing of bore FM6 was conducted in 2025. A summary of results is provided in Table 28.

Year	Bore	Aquifer Screened	Slug Test method	Analysis Method	Hydraulic Conductivity m/day
2002	FM1	Limestone	Recovery	Hvorslev	0.0030
2002	FM2	Volcanic	Recovery	Hvorslev	0.0038
2002	FM3	Limestone	Recovery	Hvorslev	0.0030
2002	FM4	Limestone	Recovery	Hvorslev	0.0019
2025	FM6	Volcanic	Recovery	Bouwer-Rice	0.0360
2025	FM6	Volcanic	Drawdown	Bouwer-Rice	0.0560

Table 28 Slug test results

A seepage velocity estimate of 0.002m/day was made of advective travel time between drill holes 7 and 12, which are located near FM1-3, using a US EPA online tools for Site Assessment calculation tool. Drillholes 7 and 12 are both located near the groundwater divide.

7.3.4 Groundwater recharge and discharge

Regional recharge is in topographic elevated positions associated with thin soil cover and discharge is in topographic lows associated with deep soil and regolith.

Mining can disrupt groundwater flow with the creation of voids which in mines with low permeability host rock can result in groundwater seepage from benches faces, and in high permeability environments groundwater can be drawdown to the pit floor by groundwater pumping as the pit floor is being dewatered.

Investigative drilling demonstrated that groundwater flow at the quarry is southerly along the groundwater divide and from the groundwater divide groundwater flow is easterly and westerly. Groundwater testing at Calliope has shown that the limestone and volcanic rock have relatively low bulk permeability, which is also supported by dry benches faces with evaporation exceeding any seepage, with the exception of intermittent rainfall driven seepage at the north-east corner of Pit 4 at the volcanic -limestone contact. Groundwater flow in Pit 4 is inward towards the pit floor.

Groundwater seepage has been observed west of Pit 3 beneath the surface water flow from the Farm Dam Seep, as discussed in Section 5.2. Groundwater is present in the western wall of Pit 3 at approx. 32mAHD. A black large organic clay ed area located west of Pit 3 indicates that prior to mining a surface depression existed at this location as discussed in Section 4.1.3. The Seep is located in a natural topographic low and any water shedding from within or from the Waste Dumps, which are permeable as identified by GAWB in 2002, will naturally flow into the topographic low and then into Pit 3.

7.3.5 Groundwater level and flow

A summary of groundwater intersections and first monitoring reading of groundwater for Bores FM1-4 is provided below in Table 29.

Bore	Groundwater Intersection		Groundwater Measurement		
	DBNS (m)	SWL mAHD	Monitoring Date	DBNS (m)	Hydraulic head mAHD
FM1	12.5-13.0m	34.9	1/11/2002	13.3	34.1
	43.5-44m	3.9			
FM2	hole dry, moist at 18 & 23m	25.7	1/11/2002	9.85	33.9
FM3	hole dry, moist at 30m	14.5	1/11/2002	12.2	32.3
FM4	hole dry, no moisture	n/a	1/11/2002	56.8	-11.8
FM5	15	n/a	3/07/2012	12.0	33.0
FM5B	no record	n/a	27/01/2021	16.5	28.5
FM6	54.5	n/a	26/06/2012	21.0	24.0

Table 29 Monitoring bores FM1-6

A hydrograph of FM5, FM5B and FM6 water monitoring results is presented below in Figure 49.

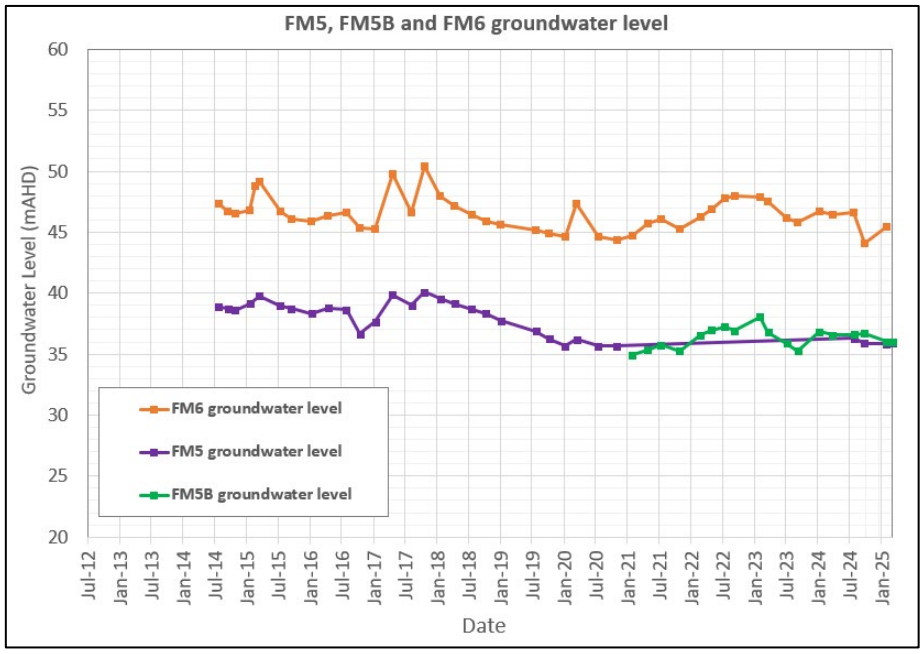


Figure 49 FM5, FM5B and FM6 groundwater levels

A groundwater level map was constructed from investigative drilling monitoring and current bores FM5, FM5B and FM6 in consideration of destroyed bores. See Figure 39.

Monitoring bore FM6 is located on the edge of the inactive Pit 2 whereas FM5 is located on the edge of the active Pit 4 but behave similarly. Groundwater in the bores respond to rainfall and drain equally well and naturally seasonal fluctuate greater than 2 metres/year. Groundwater levels declined from 2018-19 during a drier climate. A hydrograph of bores FM1, FM5 and FM5B are presented below with Awoonga Dam water levels. See Figure 50.

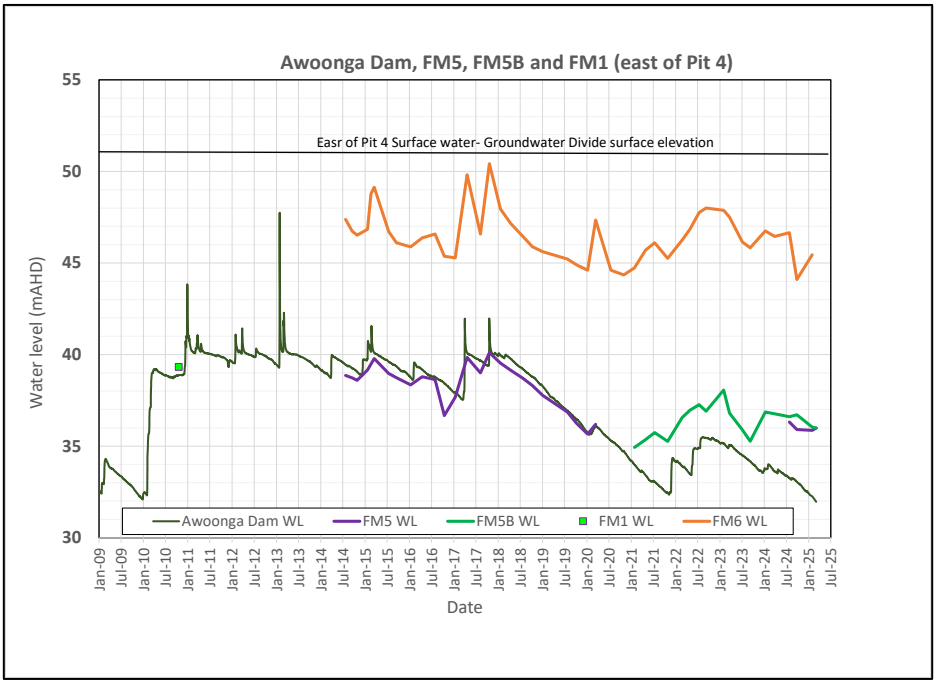


Figure 50 FM5, FM5B and FM6 groundwater levels with Awoonga Dam water level

The relationship between Awoonga Dam water and groundwater determines whether elevated Awoonga Dam water can potentially enter the mining voids by groundwater flow. If Awoonga Dam is hydraulic connected to groundwater at Calliope then investigation drilling should have the same pressure head but this is not the case. See Table 17. Drilling on the pit floor has not intersected groundwater but if it did it would be artesian if connected to Awoonga Dam. Groundwater levels in FM5 and FM6 behave similarly as does Awoonga Dam when water levels are above 36mAHD. See Figure 46. When groundwater levels are less then 35mAHD groundwater behaves differently from Awoonga Dam which proves that groundwater is not connected to Awoonga Dam water level. There is no relationship between FM6 groundwater and Awoonga dam water as FM6 is at the northern end of Calliope. Groundwater in FM6 and FM5 behave similarly to Awoonga Dam water level during wetter periods but during drier periods they drain differently. Awoonga Dam water level is regulated and water is released based on downstream user demands but releases do not affect the relationship between Awoonga Dam water level and groundwater. When Awoonga water level rises above 36maHD so does groundwater and this relationship provides a natural protection against elevated Awoonga Dam water levels. The surface elevation east of Pit 4 is 51mAHD (Figure 46) so the protection elevation, less some scouring of clay, is interpreted to be 50mAHD. The maximum elevation of Awoonga Dam water in 2013 measured at Calliope was 48.3mAHD. Egress of Awoonga Dam water level into Pit3-4 mining void will occur when Awoonga Dam water levels are elevated above 50mAHD and egress will cease when Awoonga Dam water levels are below 50mAHD. Conversely pit water will flow into Awoonga Dam when elevated above 50maHD and will cease when pit water is below 50mAHD.

Groundwater behaviour near Pit 1

Pit 1 has been back-filled and the post mining land use at this location is grazing. Groundwater was intersected in the recently drilled hole 16 which is planned to be constructed as a bore and added to the Groundwater Monitoring Network (Figure 34). The investigation is ongoing.

7.3.6 Groundwater Chemistry

Groundwater chemistry data from bores FM5 and FM6 and is annually reported and analysed. Graphs of salinity, pH and major ion chemistry results from FM5, FM5B and FM6 are presented below in Figures 51-57.

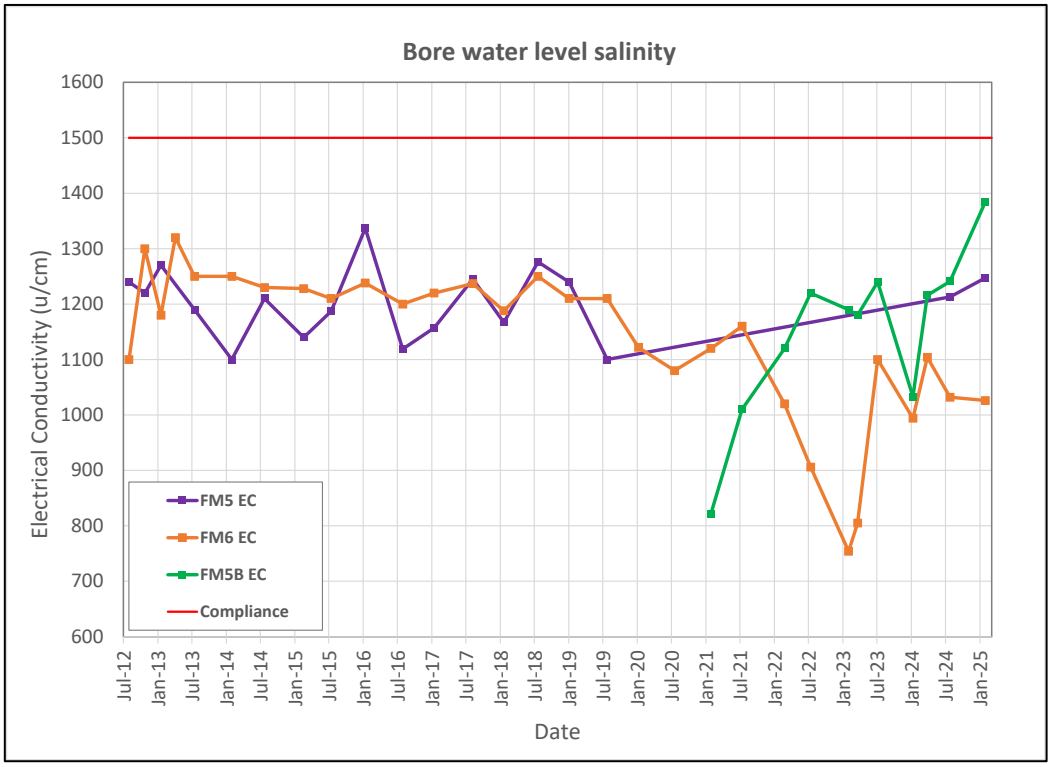


Figure 51 FM5, FM5B and FM6 salinity

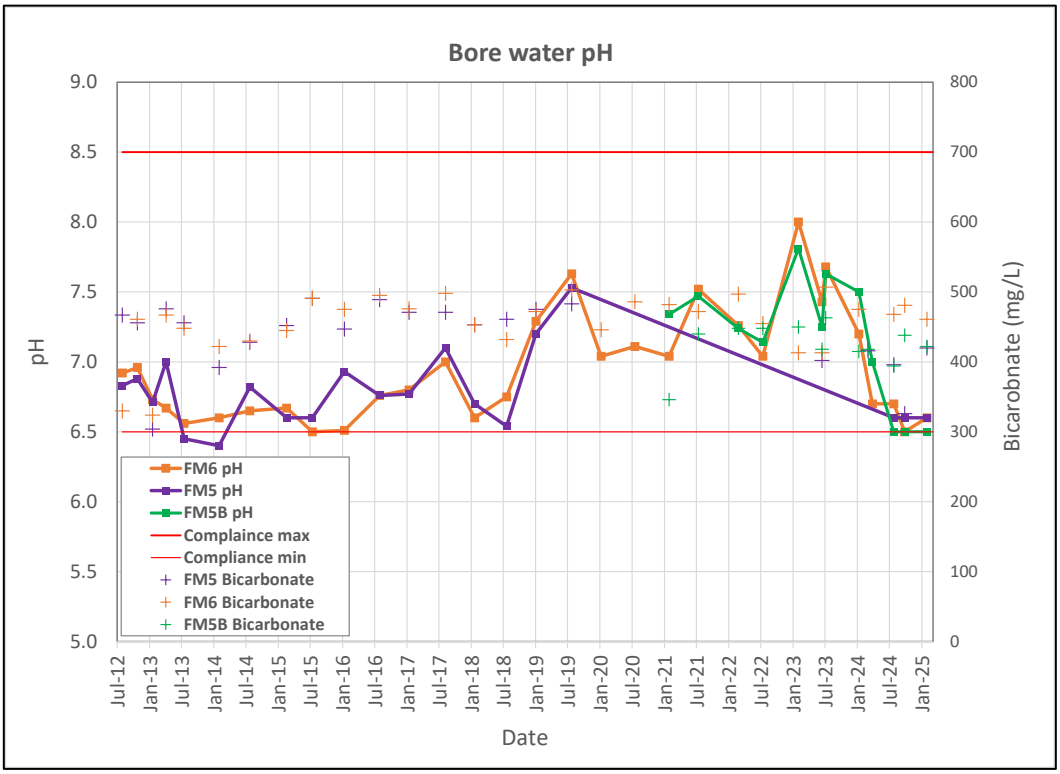


Figure 52: FM5, FM5B and FM6 groundwater pH with bicarbonate

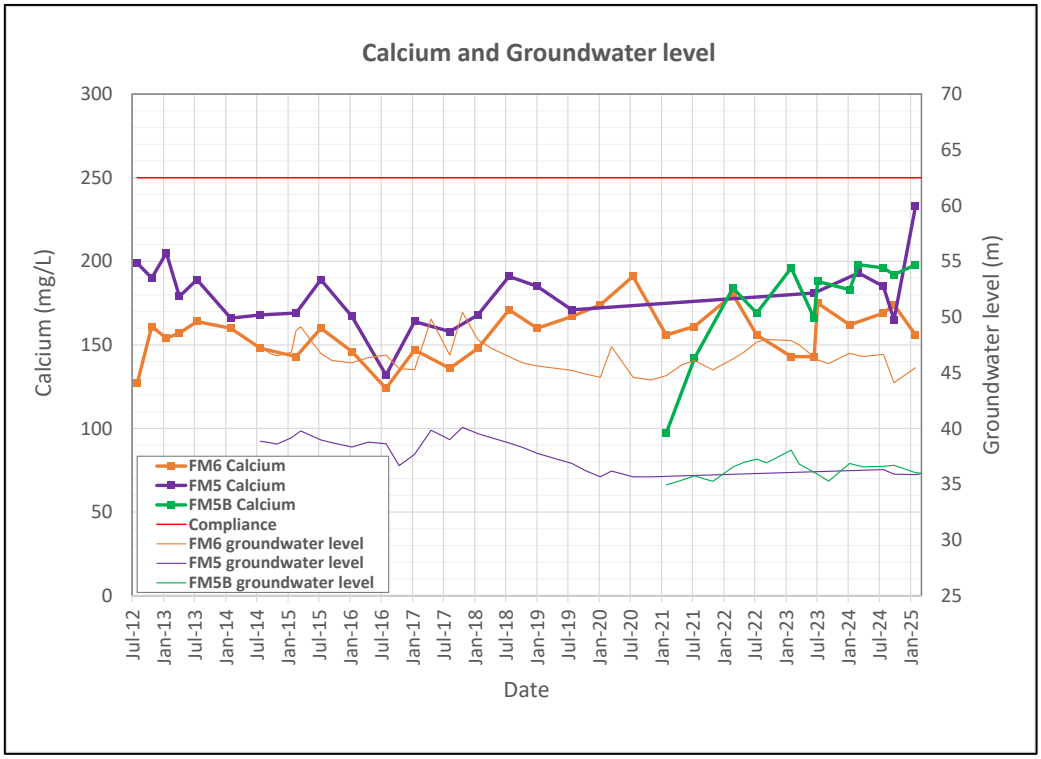


Figure 53: FM5, FM5B and FM6 calcium and groundwater level

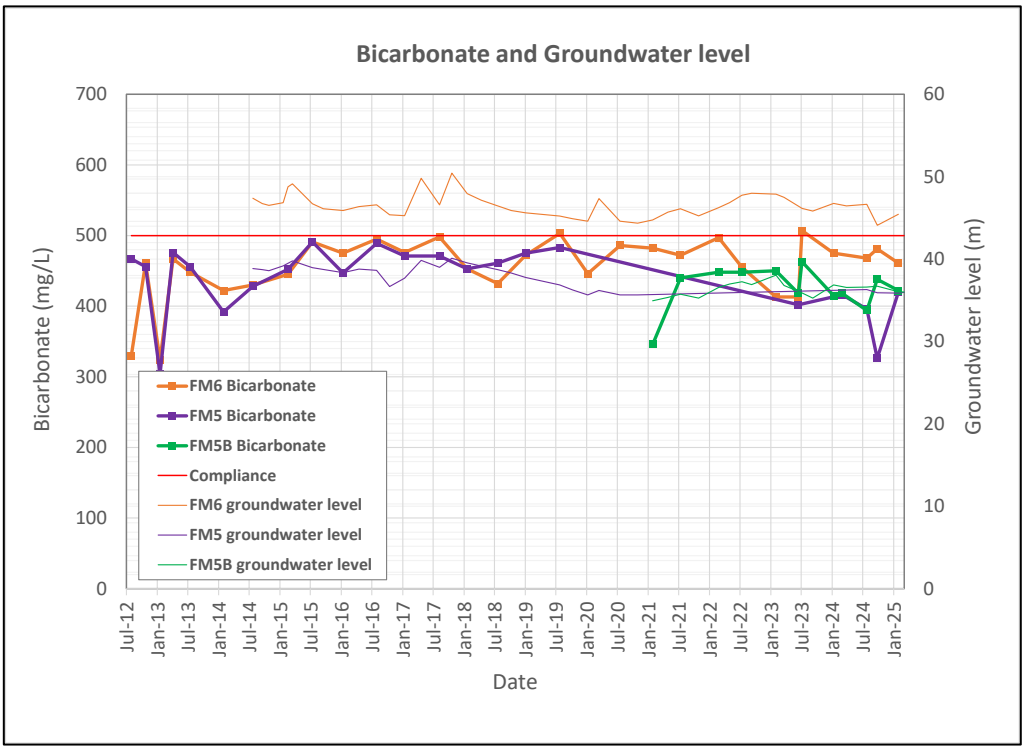


Figure 54: FM5, FM5B and FM6 bicarbonate and groundwater level

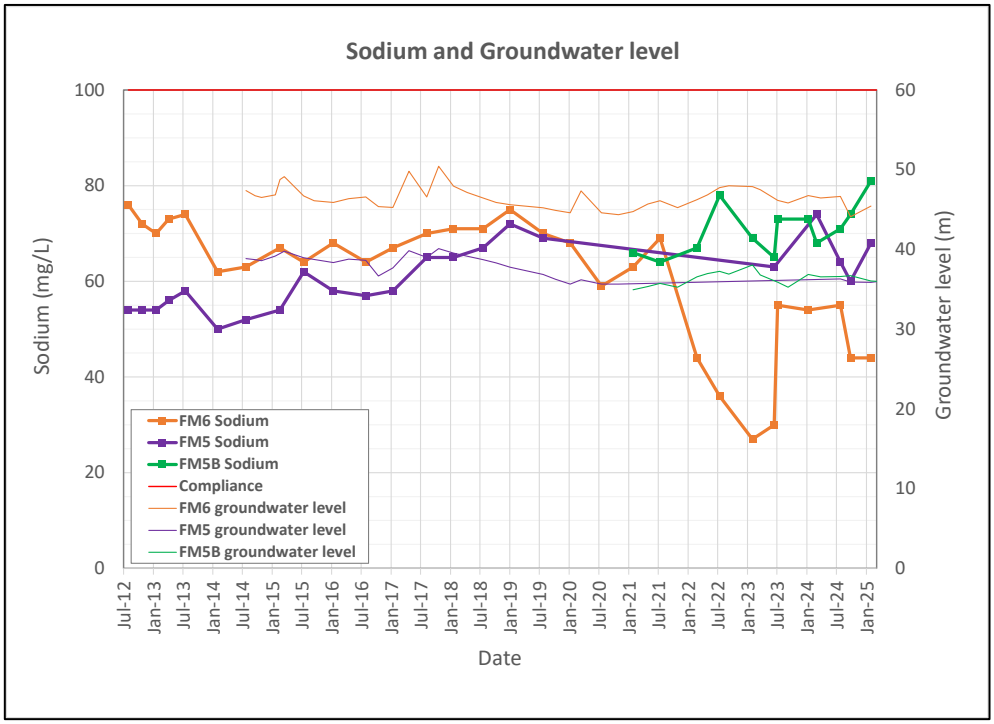


Figure 55: FM5, FM5B and FM6 sodium and groundwater level

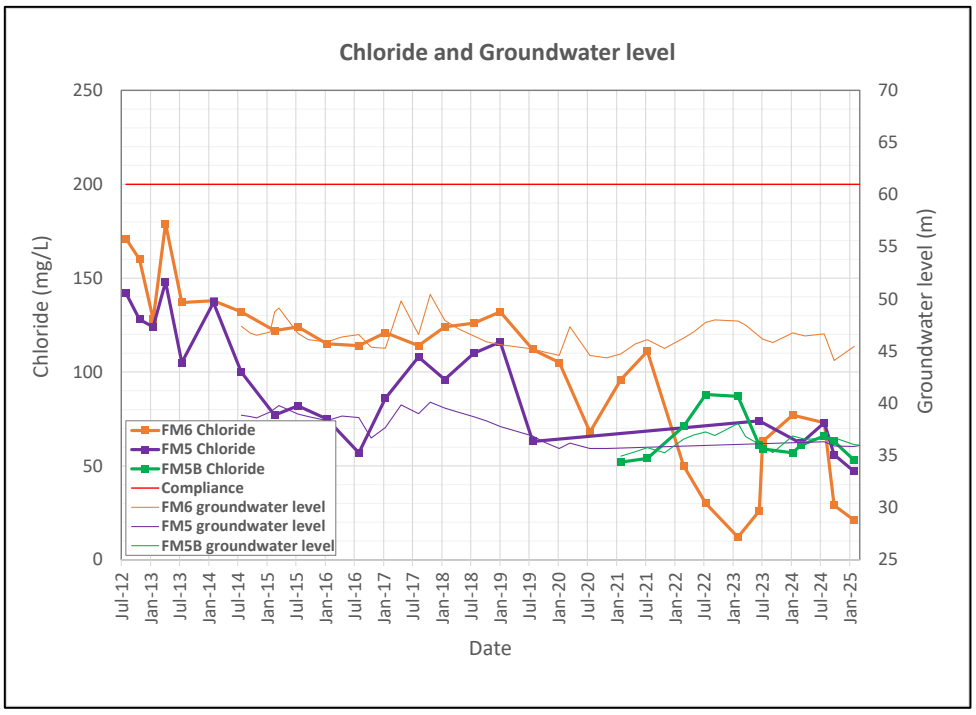


Figure 56: FM5, FM5B and FM6 chloride and groundwater level

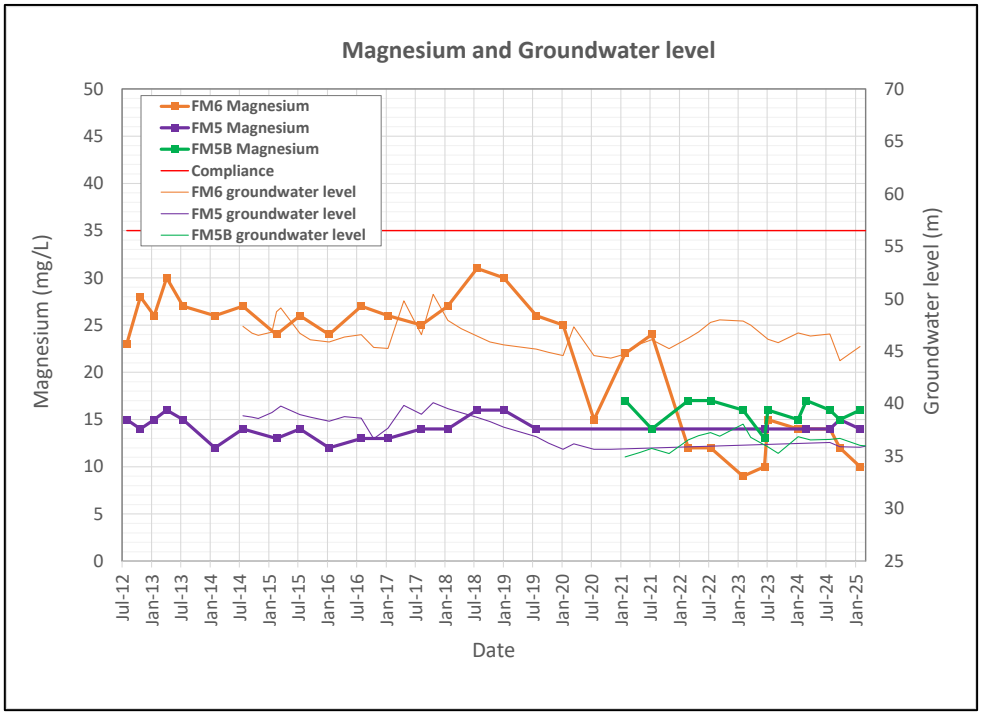


Figure 57: FM5, FM5B and FM6 magnesium and groundwater level

The salinity of FM5 and FM6 is similar, generally being approx. 1200 µ/cm. Groundwater in limestone is similar to groundwater in volcanics. The major ion chemistry between FM5 and FM6 is generally similar, with the exception of sulphate in FM5B and FM5 since 2024, Sulphate in FM5 and FM6 was similar until the installation of Bore FM5B. Similar groundwater levels and the observation of drawdown in FM5 during sampling of FM5B indicates hydraulic connection between the two wells

Limestone vs Volcanic rock aquifer

A Piper Plot of major ion water chemistry of all groundwater was presented as Figure 24. Groundwater in the volcanic rock is more variable than in limestone, but both have a similar salinity, being fresh to moderately saline and similar chemistry being Ca-Mg-HCO3 type water, so the aquifers are considered to behave as one hydraulically connected system, comprising an unconfined aquifer.

7.3.7 Potential contaminants in groundwater

Groundwater is generally microbiologically safe and chemically stable; however, shallow or unconfined aquifers can be subject to contamination from discharges or seepages associated with agricultural practices (pathogens, nitrates and pesticides), septic tank discharges (pathogens and nitrates) and industrial wastes.

Surface water potential contaminants include salinity, pH, suspended solids, sulphate, nutrients (nitrate) and metals as well as hydrocarbons and pesticides See Section 7.1.7. These are also potential contaminants for groundwater noting that pesticides are not used on site.

Sulphate

A hydrograph of groundwater level and sulphate with rainfall is presented as Figure 58.

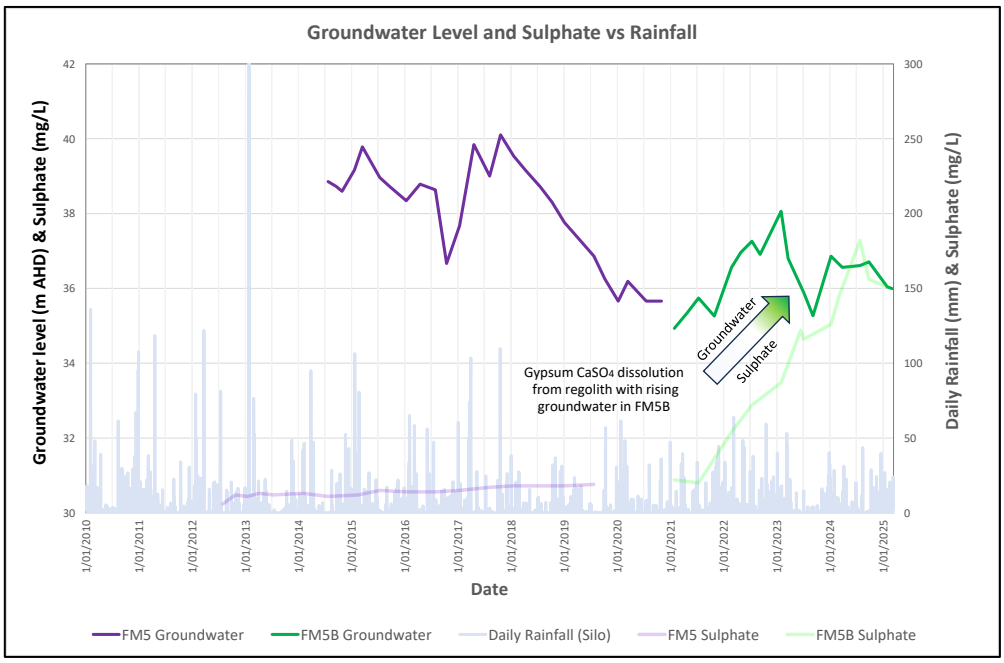


Figure 58: FM5, FM5B and FM6 sulphate and groundwater level

The cause of sulphate increase in FM5B and FM5 is attributed to dissolution of gypsum ($CaSO_4$) and leaching sulphate ions into groundwater. The groundwater chemistry of Groundwater chemistry in Bores FM5 and FM5B appears to be equilibrating following the installation of FM5B.

The primary source of major ions is the deposition of cyclic salts by precipitation and aeolian dust with additional cations added by mineral weathering and CO_3 anion from the dissolution of CO_2 in soil water.

Groundwater quality is driven by the nature of rainfall and properties of the unsaturated zone. Rainfall entering the soil zone undergoes significant changes in chemical composition and pH by processes such as root respiration and decomposition of organic matter via chemical reactions such as sorption and redox. The chemical constituency of infiltrating water in turn modifies groundwater chemistry by processes such as leaching, dilution/concentration as well as dissolution/precipitation. Water quality is dependent upon the nature of rainfall (ie. timing, intensity, duration...etc) and salt storage in the regolith, which determines whether infiltration provides a diluting effect and/or a leaching effect on ions and/or metals. (Graymont, 2019)

In near coastal Central Queensland rainfall typically provides a leaching effect with infiltration causing a deterioration of water quality as salts are flushed into groundwater whereas water quality improves in extended dry periods (Graymont, 2021).

Nitrate

Nitrates are naturally occurring in surface water and groundwater from nitrogen transforming processes. See Section 5.3.3.

Metals

Metals in groundwater are analysed six monthly and a table of results for Bores FM5, FM5B and FM6 are presented in Table 30.

Date	Site	Arsenic mg/L		Cadmium mg/L		Chromium mg/L		Copper mg/L		Nickel mg/L		Lead mg/L		Zinc mg/L	
		Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total
20/07/18	FM5	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005
	FM5B														
	FM6	0.008	0.010	<0.0001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.067	0.014
24/07/19	FM5														
	FM5B														
	FM6														
17/07/20	FM5														
	FM5B														
	FM6	<0.001		<0.0001		<0.001		<0.001		0.008		<0.001		0.128	
12/07/21	FM5	<0.001		<0.0001		<0.001		0.002		0.002		<0.001		0.006	
	FM5B														
	FM6	0.006		<0.0001		<0.001		<0.001		<0.001		<0.001		0.092	
24/02/22	FM5	0.001		<0.0001		<0.0001		0.047		0.003		0.003		0.064	
	FM5B														
	FM6	0.002		<0.0001		<0.0001		0.052		0.004		<0.001		0.035	
13/07/22	FM5	0.001		<0.0001		0.003		0.108		0.005		0.038		0.155	
	FM5B														
	FM6	0.003		<0.0001		0.003		0.032		0.006		0.011		0.083	
31/01/23	FM5														
	FM5B														
	FM6														
5/07/23	FM5														
	FM5B		0.004		<0.0001		0.004		0.081		0.004		0.019		0.094
	FM6		0.001		<0.0001		<0.001		<0.001		0.002		0.009		0.007
9/01/24	FM5														
	FM5B		0.004		<0.0001		0.004		0.081		0.004		0.019		0.094
	FM6		0.001		<0.0001	0.001	0.001		<0.001		0.002		0.009		0.007
1/03/24	FM5	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005
	FM5B	<0.001	<0.001	<0.0001	<0.0001	0.001	0.001	0.006	0.006	<0.001	<0.001	<0.001	<0.001	<0.005	0.007
	FM6														
25/07/24	FM5	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.001	0.002	0.005	0.001	0.001	0.003	0.013	0.023	0.011
	FM5B	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	0.006	0.006	0.001	<0.001	<0.001	<0.001	0.054	0.010
	FM6	0.002	0..003	<0.0001	<0.0001	<0.001	0.002	0.002	0.006	0.002	0.004	0.002	0.010	0.019	0.028

Table 30 FM5, FM5B and FM6 metals

7.3.8 Groundwater use and re-use

Groundwater use in the region, apart from re-use of mine pit water, is primarily for stock and domestic use. The mine operations re-use water collected in the operating pit void for the plant operation and dust suppression on roads. The reason for low regional groundwater use is attributed to low yields associated with low hydraulic conductivity and high rainfall makes surface water a more cost-effective water supply option.

Currently the mine operation uses approximately 33,000 litres per month for the wash plant (5% of all pit re-use water) and 727,000 litres average per month for dust suppression (95% of all re-used pit water). The water is a combination of rainfall run-off and groundwater seepage.

The site does not have a pumping bore because of poor yields and so there will be no future groundwater use at or near the site.

7.4 Awoonga Dam water interaction with pit voids

7.4.1 Awoonga Dam water level

Awoonga Dam full storage level was raised to 30mAHD in 1984 and then to 40mAHD in 2002. Historical water levels for Awoonga Dam from 1969 to 2019 is shown in Figure 59.

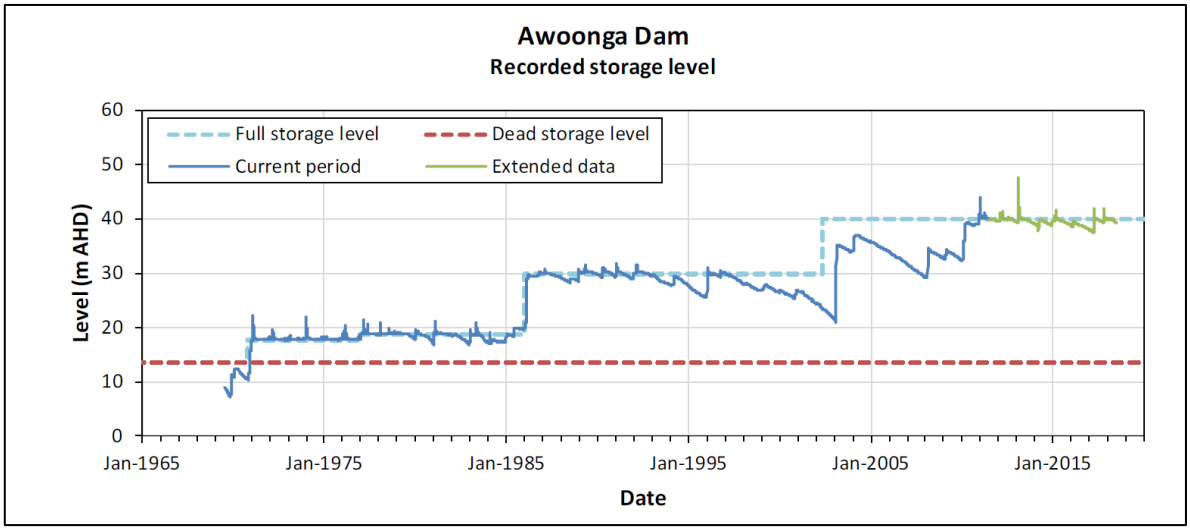


Figure 59 Awoonga Dam water level 1969-2019 (Boyne River Water Basin Plan, 2019)

The Awoonga Dam full supply level is 40mAHD and the dead storage level is 13.6mAHD.

7.4.2 Pit water discharge to Awoonga Dam

Pit water is discharged to Awoonga Dam in accordance with EA conditions as outlined in Table 2.

7.4.3 Awoonga Dam interaction with Pit 3

The limestone quarry is partially bounded by Awoonga Dam and the interaction between Awoonga Dam and pit water has been subject to numerous investigations. See Section 5.2. There is no direct interaction between Awoonga Dam and Pit 3 water.

7.4.4 Awoonga Dam interaction with Pit 4

A surface water and groundwater divide exists lies between Pit 4 and Awoonga Dam and there is no evidence of interaction between Awoonga Dam water and Pit 4 water. There is negligible risk from Awoonga Dam water entering Pit 3-4 from the eastern side of Pit 4 if dam levels rise to the recorded maximum of 48.3mAHD. Egress of Awoonga Dam water level into Pit3-4 mining void will occur when Awoonga Dam water levels are elevated above 50mAHD and egress will cease when Awoonga Dam water levels are below 50mAHD as discussed in Section 7.3.5.

GRAYMONT

8 WATER BALANCE MODEL OF FINAL PIT VOID

8.1 Methodology

An analytical Water Balance model has been developed to predict water fill of the final void at life of Mine. This modelling approach is commensurate with the lack of groundwater at Calliope and the negligible risk that mining poses to groundwater beneficial users. The simplest modelling approach would be to meter for a long enough period to establish a relationship between pumped pit water and rainfall and then predict pit water fill based on the rainfall record without having to quantify all the water inflows and outflows. Additional meters were installed in January 2025 for this measure.

8.1.1 Pit 3 Water Balance modelling

Data loggers were installed in Pit 3 in 2017/18 to further investigate the source of excess pit water as discussed in Section 5.2 and a hydrograph pf this data was presented as Figure 34. The identified seepage calibration events were reassessed in the context that the "seepage" is surface water flow from the Farm Dam and that there is <1/s of groundwater inflow at the Calliope as observed and supported by photographs of dry pit walls; low yielding regional bores in the Calliope beds; insufficient groundwater at Calliope to install a bore and low hydraulic conductivity from slug tests. The reassessed calibration events are presented in Table 31.

Parameters	Investigation Period	15 Mar 2017 - 31 Mar 2017	15 Apr 2017 - 30 Jun 2017	8 Mar 2018 - 7 Apr 2018
Climate	Calibration Events	Cool Wet	Cool Dry	Hot Dry
	Days	17	77	31
	Rainfall (mm)	491	48.6	25
	Rainfall rate (mm/day)	28.9	0.6	0.8
	Pit 3 Evaporation (mm)	70	264	159
	Evaporation rate (mm/day)	4.1	3.4	5.1
	Pit 3 Evaporation (ML)	-3	-13	-8
Pit 3 void	Pit 3 Rainfall Capture Area (sqm)	48000	48000	48000
	Pit 3 Direct Rainfall capture (ML)	**24**	**2**	**1**
	Pit 3 water level change mAHD	14-19	20-22.5	21.5-22.5
	Pit 3 water volume storage change	**252**	**152**	**61**
Pit 3 void sub-catchment	Pit 3 Void sub-catchment excluding void (sqm)	496000	496000	496000
	Run-off coefficient	**0.8**	**0.3**	**0**
	Surface water runoff to Pit 3 input (ML)	195	7	0
Farm Dam sub-catchment	Farm Dam sub-catchment (sqm)	595000		
	Run-off coefficient	**0.8**		
	Surface water runoff to Farm Dam input (ML)	234		
	Farm Dam flow to Pit 3 calculated from run-off coefficient (ML)	**28.8**		
	Surface water flow from Farm Dam to Pit 3 rate (ML/day)	**1.7**	1.7	1.7
	Farm Dam flow to Pit 3 calculated from Hot Wet flow rate (ML)		130.3	52.5
Groundwater	Groundwater seepage rate (litres/sec)	1	1	1
	Groundwater seepage rate (ML/day)	0.1	0.1	0.1
	Groundwater seepage to Pit 3 (ML)	1.5	6.7	2.7
Total surface water runoff inflow		**251**	**153**	**61**

Table 31 Pit 3 Water Balance Model

8.1.2 Surface water runoff coefficents

A run-off coefficient of 0.7 was initially applied to the Cool Wet 15 March 2017 – 31 March 2017 calibration event which yielded a surface flow rate of 3.1 ML/day from the Farm Dam to Pit 3 which is identical to the 3.1ML/day "seepage rate" calculated by a Sibelco hydrogeologist (Feiss). Applying a constant Farm Dam flow rate of 3.1ML/day to the Cool Dry 15 April-30 June 2017 calibration event gave an in-balanced calculation of

Total surface water run-off inflow of 263ML. Based on the assumption that surface water flow from the Farm Dam is constant the run-coefficient and the Farm Dam flow were adjusted to honour all calibration events data. Surface water flow from the Farm Dam, when water is present in the Farm Dam, is calculated to be 1.7mL/day. Based on this calculation the surface water run-off coefficient for the Cool Dry 15 April-30 June 2017 calibration event was 0.3. The surface water run-off coefficient for the Hot Dry 8 March 2018-7 April 2018 was zero meaning that there was no surface water run-off when the catchment became very dry and rainfall was captured in the soil and regolith.

A 50 year rainfall and evaporation record from 1975-2025 was obtained from the BOM Long Paddock website (Figure x). Monthly rainfall and evaporation data for 1975-2025 was replicated for 2 centuries to provide a long rainfall record for the Pit 3-4 Water Balance Model. The 50 year rainfall and evaporation record was analysed and it was determined that:

- Monthly median rainfall is 45mm
- Monthly median evaporation is 157mm

This data was used to categorise monthly climate into the four categories of Hot Dry, Hot Wet, Cool Dry and Cool Wet. The surface water run-off coefficients of monthly data shown in Table 31 were assessed to be representative of climate for the calibration events and an estimate for Hot Wet months was estimated to be 0.5. The Monthly climate categories and their surface water run-off coefficients are presented in Table 32.

Category	Hot Dry	Hot Wet	Cool Dry	Cool Wet
Rainfall (mm)	<45	>45	<45	>45
Evaporation (mm)	>157	>157	<157	<157
Coefficient	0	0.5	0.3	0.8

Table 32 Pit 3-4 Water Balance Model climate categories with run-off coefficients

8.1.3 Pit 3-4 Water Balance Model setup from from Pit 3 Water Balance Model

Climate Models (GCM) show a general warming across the state and for the Boyne River Basin the higher GHGE scenarios indicate a 6.3% increase in evaporation and the lower GHGE a 3.8% in evaporation. A 2% decrease in rainfall is predicted for both scenarios. Monthly rainfall and evaporation records from 1975-2025 for the Calliope are provided in Section 4.2. The 1975-2025 rainfall and evaporation record was used to predict rainfall and evaporation from 2100 by applying GHGE estimate high and lower scenarios to the monthly rainfall and evaporation data. The predicted pit water fill is based on the lower GHGE scenario and is presented with current climate and a higher GHGE scenario.

The analytical final void Pit 3-4 Water Balance model has been created based on the formula:

Pit water inflow = direct rainfall capture +surface water run-off + groundwater inflow – pit evaporation

Model Assumptions were:

- No dam leakage
- Groundwater inflow of 1l/s
- Farm Dam flow has a base flow of 1.7ML/day but there is no flow during Hot Dry conditions

The model was setup using the final landform of the Pit 3-4 pit design which was sliced into 1m blocks with a calculated volume (ML) and an associated elevation (RL). Surface water areas used in this Water Balance are:

- Pit 3-4 Void (for direct rainfall capture)

- Pit 3-4 Void Boundary Catchment (for surface water run-off entering Pit 3 and Pit 4 voids excluding surface water run-off from the Farm Dam catchment)
- Farm Dam Catchment (for surface water currently entering Pit 3 void)

Water Inputs

- Direct rainfall capture to Pit 3-4 void.
- Surface water inflow to Pit void.
- Groundwater inflow

Water Outputs

- Evaporation of pit water

Water Balance

End of month Void Water Volume (and resultant water level) = previous month Void water volume + water volume IN – water volume OUT (ML/month)

Source data

- Monthly rainfall and evaporation 50 year record from 1975-2025 replicated for 2 centuries under the different GHGE scenarios
- Pit void surface area from pit design for Pit 3-4
- One meter high bench blocks derived in SURPAC from the pit design. The area of the top of the bench block provides the evaporation surface area of pit water. The volume of the pit block is the water volume which the model fills and then rises to the next 1 meter block.
- Catchment areas were derived in MapInfo
- Surface run-off co-efficient derived for Pit 3 by analysing pit water data-logger data against rainfall applied to Pit3-4 void
- Model calibrated against recent discharge gauging
- Monthly Evaporation acquired from a node in Long Paddock

A monthly timescale was adopted for the model. The final landform design has the main open pit void being the combined present day Pit 3 and Pit 4 with an abandonment bund surrounding the void and partial backfill of the north end of the pit. The abandonment bund is planned as rock fill and not a flood mitigation structure. Surface water run-off inflow into Pit3-4 void was capped at 42.4mAHD because of the natural ground elevation. The broad bench floor evaporates most water as compared to sumps and internal voids on the pit floor which store some water.

A summary of model setup is provided in Table 33.

Climate	Rainfall (mm)	Evaporation (mm)
Current climate		
50 year record 1975-2024 repeated for base data	100%	100%
Climate Change Modelling		
Predicted Higher Greenhouse gas hotter drier climate	98%	106%
Predicted Lower Greenhouse gas hotter drier climate	98%	104%
Water input (variables)		
Groundwater inflow l/s		**1**
Groundwater inflow ML/month (calculated from l/s)		2.6
Farm Dam flow to Pit 3 (ML/day)		1.7
Catchment areas (constants)		
Pit 3-4 Catchment (sqm)		1,929,200
Pit 3-4 Void Direct Capture (sqm)		905,600
Pit 3-4 Void Boundary sub-catchment (sqm)		428,100
Farm Dam cub-catchment (sqm)		595,500

Table 33 Pit 3-4 Water Balance Model set-up

8.2 Predicted pit water fill

Pit void water balance and final water level equilibrium is shown below for the predicted lower greenhouse gas emission scenario. See Figure 60.

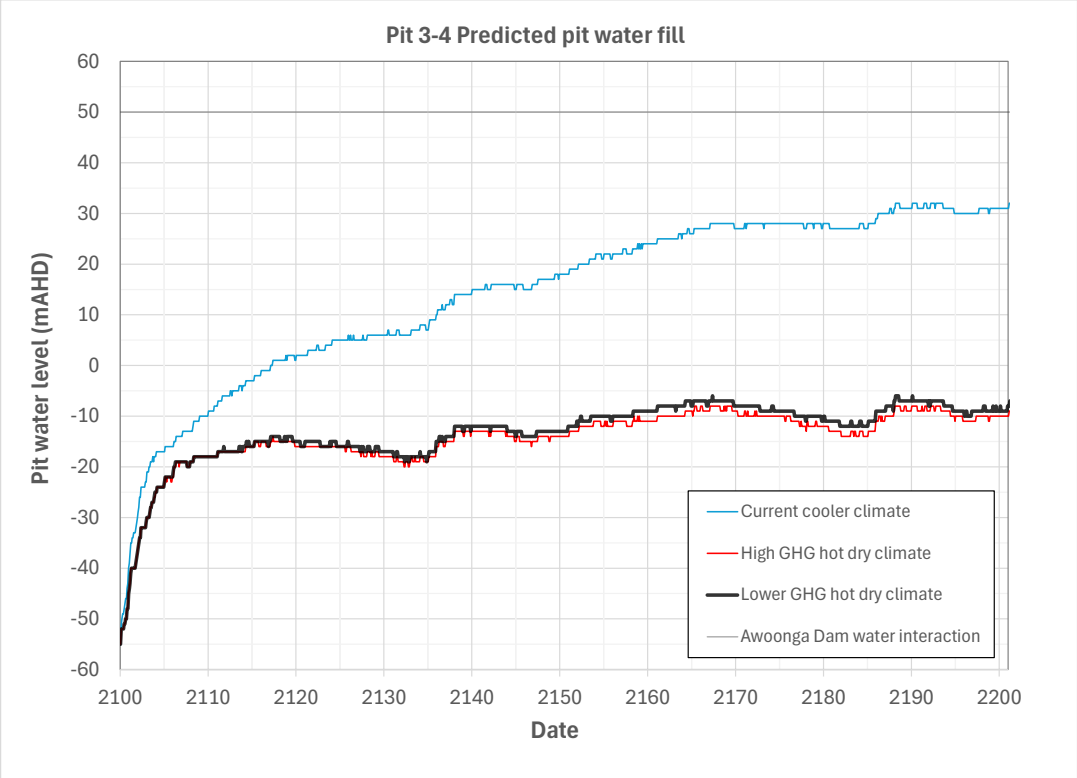


Figure 60 Water Balance Model precited water level behaviour post mining

The pit water is predicted not to fill beyond -10mAHD in the predicted future lower greenhouse gas emission scenario. If the current climate remains unchanged then pit water will fill to 30mAHD.

8.3 Model uncertainty and sensitivity testing

The model was sensitivity tested by changing parameters variables in consideration of model assumptions. The variable with the greatest influence on water inputs is climate change. The model is not sensitive to monthly total water inflow changes of 10-20 ML because it can be a relatively small percentage of total inflow. The modelled outcome is sensitive to groundwater inflow and groundwater inflow volumes is a determining factor on whether pit water equilibria is achieved within the pit void and pit water is contained within the pit void or if pit water escapes the pit void to Awoonga Dam.

Increase groundwater flow to 25 l/s (See Figure 61)

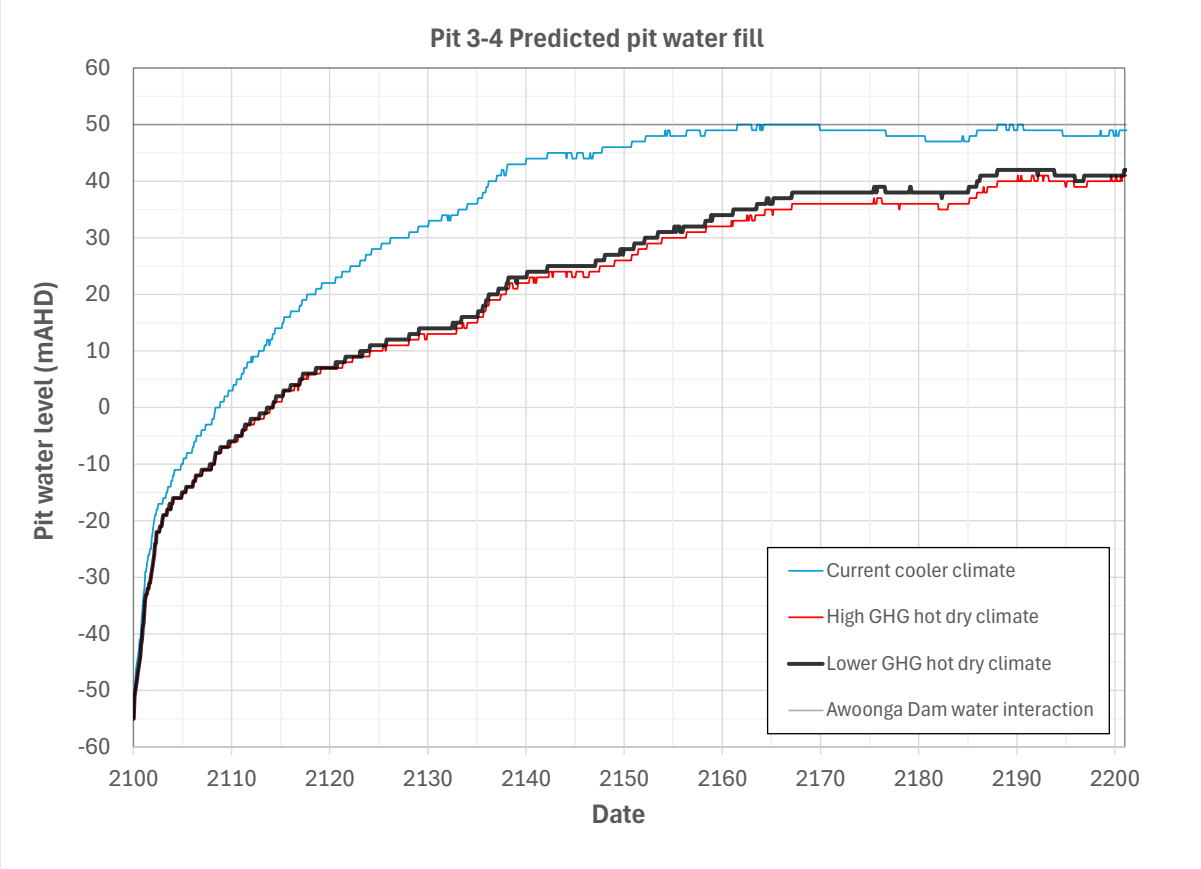


Figure 61 Water Balance Model with groundwater increased to 25l/s

Groundwater inflows were increased from the current observed and modelled 1 l/s to 25l/s and the pit, which is currently a sink (Section 5.3.3), will remain a sink because groundwater will be at 40mAHD which is less than 50mAHD groundwater interaction threshold with Awoonga Dam.(Section 7.3.5).

8.4 Predicted water quality

The water quality of the final pit void is predicted to be a mix of current Pit 3 and Pit 4 water quality. Pit 3 water is a mixed type whereas Pit 4 a Ca-Mg-HCO3 type water and with surface water inflow s predicted to exceed groundwater inflows the final pit void is predicted to be a mixed type with some stratification near the surface.

9 WATER MANAGEMENT

9.1 Water Management Plan

The Water Management Plan (WMP) forms part of site's Environmental Management Plan. The WMP describes the risks and control measures required to manage water flow and quality on site, monitor water quality and regulate safe water discharge from site to achieve ---the following objectives:

- Manage discharge waters leaving site to within water quality limits as prescribed in the EA.
- Manage rainfall run-off to ensure 'clean' (uncontaminated by mine operation areas) is separated from 'dirty water' (rainfall run-off that has been in contact with disturbed areas of the operation).
- Design, construct and maintain Water management structures to effectively control the flow of rainfall run-off and store excess run-off to prevent uncontrolled releases and allow continued mining operations.
- Transfer captured dirty water between water management structures on site to optimise the reuse of dirty water on site for mine plant use and dust management, minimising the need for off-site discharge.
- Treat captured 'dirty water' through natural settling processes via sediment dams and natural drainage filtration routes prior to discharge.
- Ensure hydrocarbon sources are suitably bunded to prevent contamination off-site.
- Monitoring of water including in-pit accumulation, discharge, water transfer and re-use
- Monitoring of condition and performance of water management structures

Historically the Site has operated four mining pits at various periods. The current status is as follows.

- Pit 1 has been infilled and currently forms part of the stockpile storage facility.
- Pit 2 is an inactive mine pit and provides water storage in the void.
- Pit 3 is currently inactive from mining but will become active again in the future.
- Pit 4 is the current active mining pit.

Pit 2 is an inactive pit void for mining purposes and acts as a water storage facility for the Site. Process water for the plant operation is obtained from Pit 2 storage. Water is also used for dust suppression purposes and washdowns. Excess water runoff from the limestone processing area is directed to the Slurry Dam where overtopping discharges back to Pit 2.

Drainage channels and diversion bunds control rainfall run-off from mine affected areas to the relevant pit void or sediment control structure. Clean water drainage control bunds separate clean rainfall run-off from mine affected run-off. Run-off from 'Sediment Dam' catchment, which includes the Production office area and mobile crushing plant area, is directed to the sediment dam for settling prior to discharge through a small wetland system and then past the C1 discharge site.

Pit 3 is currently a water storage facility collecting run-off water. Water transfer is undertaken as required via a mobile pump and pipe system to and from Pit 2 or direct extraction by water carts and used for dust suppression. Excess Pit 3 water is discharged at the F1 discharge site.

Mining in Pit 4 requires dewatering intermittently to allow mining operations to continue. Water is primarily pumped from Pit 4 to Pit 2, and if required, excess water can be pumped to discharge location C1.

9.1.1 Water Use and Water Supply

Minimal water is used on site for production purposes. The Plant uses on approximately 25 L/s when in use and is sourced from Pit 2 water storage via a pontoon based pump and pipe system. Water use includes.

- Dust suppression at the crushing and screening plant
- Wash plant

- Vehicle washdown
- Filling radiators
- Roadway dust suppression
- Mixing of wet road bases and
- Hosing down and cleaning under conveyers

Metering

There is no legislative requirement to meter pumped water but pumps in Pts 2-4 are metered with incomplete meter records. Additional meters have been installed in 2025 to evaluate groundwater seepage in dry periods and to determine the groundwater percentage of pit water.

9.1.2 Potential surface water contaminant sources

Potential contaminant sources include:

- Pit Water
- Runoff of Mine Affected Water
- Runoff of Non-Mine Affected Water
- Sewage Effluent
- Fuels, Oils and Lubricants

Pit water accumulates in the pit voids due to rainfall run-off that can mobilise sediment from the catchment including the roads and walls of the open pit. The pit water will also include a component of groundwater seepage through the fractured bedrock. The pit water quality to date does not vary significantly because sediment settles out and increase in salinity is negated by dilution from rainwater.

Pit water within the Calliope Limestone Operation is considered a low risk source of contaminants. The generation of salts within the mining operations and accumulated within the pits is low, and on-going monitoring has shown the pit water is within the EA limits. Other potential contaminants such as pH and suspended solids within in the pits also achieve the required EA criteria.

The site essentially operates as a closed system with flood protection bunds and natural topographic highs preventing overland flow off-site to Awoonga Dam and conversely, protection from inundation from high water levels from Awoonga Dam.

Run-off from disturbed areas of the mine would be classified as mine-affected run-off water. Some of this end up in the pit voids and some is managed through the slurry dam and sediment dam. This can include run-off from stockpiles, processing areas, waste dump and connecting roads. A component of the run-off can originate from 'Non-Mine affected' areas such as the west and northeast sides of Pit 2 and the east side of Pit 3.

Treatment and disposal of sewage effluent is managed by a dedicated septic system and is not considered significant in the water management system.

Fuels and oil storages are located east of Pit 2. The storage area for fuel is bunded for containment purposes. Any overflow or leakages are directed via a drain to a humeceptor. Any potential overflow from this system is directed to Pit 2 and therefore remains within a closed system. Management of hydrocarbon waste is dealt with under the site Environmental Management Plan.

9.1.3 Surface water Release

Monitoring is undertaken of water planned to be released from a licensed surface water release point (Table 3, Figure 4). If water sampling results meet Release limit requirements (Table 4) then the surface water is released. If water sampling results do not meet Release limits then this water is not released but is used in operational activities. Surface water is released only when Release limit requirements are met.

9.2 Groundwater Management and Monitoring Plan

The current level of groundwater management and monitoring at the Calliope Quarry is simple, yet sufficiently robust to minimise risks to related environmental values.

9.2.1 Water Use and Water Supply

There is no direct pumping of groundwater at the site for production or dewatering purposes.

9.2.2 Potential groundwater contaminant sources

Groundwater intercepted by mining activities accumulates in sumps and is pumped to surface water storages on site, transferring potential contaminants. The potential contaminant sources for groundwater are:

- Sewage Effluent
- Fuels, Oils and Lubricants

The Quarry utilises a septic system located to the west of the site office to treat its sewage effluent and has a separate, dedicated and contained treatment system of its own.

The storage area for fuels, oils and lubricants is located directly east of Pit 2 and north of Pit 1. There is potential for any leakage from these storages to seep into groundwater beneath the site. Ongoing maintenance of these storages and control systems is required to minimise the potential for leaks to occur. Because the pits appear to be capture zones for all groundwater on site, there would be no off-site discharge of contaminated groundwater if any leaks were to occur.

Mining operations can sometimes lead to Acid Mine Drainage however, this is not considered to be likely at this site given the nature of the geology, carbonate based, which leads to near neutral groundwater.

9.2.3 Groundwater affecting activities and impacts

The primary groundwater affecting activity at the site is the mining void creation which can disrupt groundwater flow, although there is little groundwater at the site and flow. There is no direct groundwater discharge from the site, there are no receiving environments potentially exposed to groundwater level drawdown or potential contamination. The groundwater that discharges internally at the site (to the pits) is mixed with surface water and this is monitored regularly to ensure quality specifications are met before being released to the Awoonga Dam.

9.3 Compliance Monitoring and Reporting

Compliance monitoring and any identified non-compliances are investigated and reported in accordance with EA conditions. Water monitoring and compliance against EA conditions are annually reported in Annual Returns and the Annual Groundwater Report.

10 REFERENCES

ANZG 2023, *Livestock drinking water guidelines*, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra.

Freeze R.A., Cherry J.A. (1979). Groundwater. Prentice-Hall, Inc, Englewood Cliffs, NJ, 604 p.

Kalf 2003, *Hydrogeological model assessment of sub-surface inflow due to increase in Awoonga storage level – Tarragona Mining Lease area* (for Frost Enterprises Pty Ltd David Mitchell Ltd), 19th February 2003.

Gladstone Area Board 2025 website *https://www.gawb.qld.gov.au*

Graymont, 2020 internal report. *Calliope Hydrogeological Investigation of Excess Water in Pit 3 2018-20,* Graymont (Calliope) Pty Ltd

Oppy (1999) *Salinisation of the Dee River catchment, Central Queensland.* MSc Hydrogeology and Environmental Science, Melbourne University.

Sibelco, 2011, internal report appended to SKM 2012b *Assessment of excess water in Pit 3*, Sibelco Australia Limited

Sibelco, 2012, *Background Groundwater Monitoring program for Calliope Operation*, Sibelco Australia Limited

Sibelco 2018a, *Environmental Management Plan,* Frost Enterprises Taragoola Limestone Project (Calliope), Sibelco Australia Limited

Sibelco 2018b *Calliope Groundwater Annual Monitoring Report*, Sibelco Australia Limited

Sibelco 2019 *Calliope Groundwater Annual Monitoring Report*, Sibelco Australia Limited

Graymont 2019-2024 *Calliope Groundwater Annual Monitoring Reports*, Graymont (Calliope) Pty Ltd

SKM 2012a, *Calliope Water Management Plan,* Sinclair Knight Merz Pty Ltd

SKM 2012b, *Calliope Groundwater Management and Monitoring Plan,* Sinclair Knight Merz Pty Ltd

APPENDIX F WASTE CHARACTERISATION MEMORANDUM

Epic Environmental Pty Ltd
ABN: 54 169 57 92 75
Level 17, 95 North Quay
Brisbane QLD 4000
1800 779 363
www.epicenvironmental.com.au

technical memo

Date:	2 August 2024
To:	Vicki Robins, Graymont (NSW) Pty Ltd
From:	Andrew Butler and Natalie Chandra, Epic Environmental
Client name:	Graymont (NSW) Pty Ltd
Project name:	Calliope Limestone Quarry
Project number:	BAA220011.01
Subject:	Calliope Waste Rock Characterisation

1 INTRODUCTION

Epic Environmental Pty Ltd (Epic) has been engaged by Graymont (NSW) Pty Ltd (Graymont) for the continuation of environmental approvals support for their Calliope Limestone Quarry (the Project). The Project is located at Taragoola, Queensland (QLD).

The work has been undertaken to satisfy and information request from the QLD Department of Environment and Science and Innovation (DESI – previously Department of Environment and Science, DES) following submission of the Progressive Rehabilitation and Closure Plan (PRCP) for Calliope.

2 BACKGROUND

Graymont holds a site-specific Environmental Authority (EA) (reference: EPML00969013), enabling mining activities to be undertaken at their Calliope site.

The PRCP application was prepared in accordance with the Queensland Government's *Environment Protection Act 1994* (EP Act) and the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (MERFP Act). The application was initially submitted to DESI on 16 March 2023 and determined to be *Not Properly Made*, with a subsequent submission on 27 June 2023 determined by the DESI to be *Properly Made,* with an accompanying Information Request (IR) Notice received on 7 August 2023. The IR Notice identified information gaps or clarifications that need to be addressed for DESI to approve the PRCP. In particular, DESI identified gaps in waste rock characterisation.

A waste rock characterisation for the limestone quarry is therefore required to address the PRCP IR_1[1]. It would also be suitable to support an amendment to the EA. The submission date for the amended PRCP is 30 August 2024.

3 MATERIAL BEING CHARACTERISED

Waste rock from the mining operation has been placed on two (2) main waste rock dumps (WRDs), which have been labelled with the prefixes “northern” (NWRD) and “southern” (SWRD). The locations of the WRDs are shown on **Figure F1.**

Waste rock across the WRDs includes overburden, poor quality limestone (low specification, high clay fines content, such as that visible on the SWRD), andesite, greywacke (fault rock), and conglomerate. Of the sampled materials, andesite is considered to be the only rock exposed in the void wall to have any potential for acid generation and mixed andesite or andesite dominated waste was targeted during sampling.

[1] The waste rock characterisation presented herein may also be used to support an EA amendment to reflect and expansion of mining activities at Calliope.

Production bench blast drill chips have also collected from mining benches to characterise the main 'ore' exposed in the void walls. Similarly, samples of product stockpiled at the site were also analysed for mineralogy.

4 METHODOLOGY

The following section summarises the sampling methodology completed by staff from Graymont under the direction of Epic (refer **Section 4.1.1**) and the laboratory analysis undertaken.

4.1 Sampling

Sampling was completed for the northern and southern WRDs and production bench blast drill chips. Limestone (i.e., the rock which makes up a majority of the exposed void) was also sampled from blast drill holes on a production bench in the pit (refer **Section 4.1.2**).

4.1.1 Waste Rock Dumps

Graymont provided Epic with the current volumes of the WRDs which are summarised in **Table 1**. Given the low risk of acid generation, the sample density aimed to collect a minimum of one sample per 100,000 m^3 of waste rock.

Table 1. Waste rock dump volumes and samples

WRD ID	Estimated volume (m^3)	Number of bag samples collected	Number of jar samples collected	Sample IDs
NWRD	1,090,600	11	11	NW-S1-W NW-S2-W NW-S3-S NW-S4-S NW-S5-E NW-S6-E NW-S7-E NW-S8-TOP 1 NW-S9-TOP 2 NW-S10-TOP 3 NW-A (Andesite)
SWRD	850,100	10	10	SW-S1-S SW-S2-S SW-S3-S SW-S4-S SW-S5-S SW-S1-N SW-S2-N SW-S3-N SW-S4-N SW-F

The sampling methodology implemented by Graymont is provided in **Table 2**.

Table 2. Waste rock sampling methodology

Action	Description
Soil sampling	An excavator was used to obtain samples at various depths throughout the stockpiled material.
Sample collection	Samples of the material were collected directly from the excavator bucket using nitrile gloves. Material was screened using a 20 mm diameter sieve to obtain a homogenous sample and remove any large rock particles. Samples were placed into laboratory-supplied 150 mL glass jars (with Teflon-lined lids) for chemical analysis and 500 mL plastic zip-lock bags for acid-base accounting analysis.

Action	Description
	Samples were labelled and immediately stored on ice in eskies for transportation to the National Association of Testing Authorities (NATA) accredited laboratory (ALS Environmental Pty Ltd (ALS)).
Sample labelling, storage and transport	Samples were clearly labelled with unique sample identification numbers. Samples were kept chilled in an ice-filled esky prior to dispatch and during transport to the primary laboratory under chain-of-custody (COC) procedures.
Cross contamination	The excavator bucket was the only piece of equipment reused between sample points during the sampling. Samples were collected from the centre of the excavator bucket to minimise cross-contamination. A new pair of disposable nitrile gloves was worn for the collection of each sample.

4.1.2 Blast Drill Chips

A total of three (3) rock samples (DRILL-S1-S, DRILL-S2-N, DRILL-S3-M) were collected from a production bench associated with the drill cores/rock chips from the Project's exploration mining activities.

Samples were collected in the same containers and followed the same storage/transport methodology mentioned in **Table 2**.

4.1.3 Additional Product Stockpile

Petrographic (mineralogy and chemistry) analysis was previously commissioned by Graymont for product/stockpiled material including gabion rock, aggregate rock, and road base rock (Geochempet Services 2023, Groundwork Plus 2023, Groundwork Plus 2022, Superior Quarry Testing 2023). This data provides further evidence for the nature of the materials exposed in the pit walls and has been used in the assessment of acid mine drainage (AMD) potential.

4.1.4 Laboratory Analysis

Laboratory analysis for acid base accounting suite of static tests was completed by a NATA-accredited laboratory (ALS) to screen for AMD potential of the waste rock and void wall material. The following analysis was completed for each sample:

- Net Acid Producing Potential (NAPP), which includes Acid Neutralising Capacity (ANC) reported as $CaCO_3$ and H_2SO_4, fizz rating, and total sulfur (by LECO)
- Net Acid Generation (NAG)
- Chromium Reducible Sulfur (Scr) as a measure of sulfur present as sulfide
- Sulfate sulfur
- Laboratory certificates are provided in **Appendix A**.

The petrographic analysis conducted on samples of product material included mineralogy, carbonate, sulfide and chloride content. The reports are attached in **Appendix B**.

5 DATA ANALYSIS AND INTERPRETATION OF RESULTS

5.1 Acid Mine Drainage Potential

Acid base accounting was undertaken to determine the potential for waste samples to be acid generating. A summary of the analytical results for the assessed acid base characteristics is provided in **Table 3**.

Table 3. Waste rock analytical results – acid base accounting and sulfur characterisation

		ANC	Fizz rating	NAPP	NAG pH (Ox)	Max Potential Acidity (MPA)[2]	Net Potential Ratio (NPR)[3]	NAG (pH 4.5)	NAG (pH 7)	Total S	Scr	Sulfate (SO_4^{2-})
Location	**Laboratory ID**	kg H_2SO_4 /t	-	kg H_2SO_4/t	pH unit	kg H_2SO_4 /t	-	kg H_2SO_4/t	kg H_2SO_4/t	%	% S	mg/kg
Southern WRD	SW-S1-S	999	5	-998	11.5	0.61	1632	<0.1	<0.1	0.02	0.009	180
	SW-S2-S	564	5	-563	9.9	0.61	922	<0.1	<0.1	0.02	0.006	<100
	SW-S3-S	779	5	-778	9.5	0.61	1273	<0.1	<0.1	0.02	0.012	<100
	SW-S4-S	984	5	-983	11.5	0.61	1608	<0.1	<0.1	0.02	0.009	120
	SW-S5-S	575	5	-575	10	0.31	1879	<0.1	<0.1	0.01	0.009	<100
	SW-S1-N	821	5	-820	11.1	0.61	1342	<0.1	<0.1	0.02	<0.005	110
	SW-S2-N	897	5	-897	10.9	0.31	2931	<0.1	<0.1	0.01	0.008	100
	SW-S3-N	578	5	-578	10.5	0.31	1889	<0.1	<0.1	0.01	<0.005	<100
	SW-S4-N	746	5	-746	10.8	0.31	2438	<0.1	<0.1	0.01	0.006	<100
	SW-F	738	5	-738	11.2	0.31	2412	<0.1	<0.1	0.01	0.006	<100
Blast Drill Chips	DRILL-S1-S	1030	5	-1030	11.2	0.61	1683	<0.1	<0.1	0.02	0.008	<100
	DRILL-S2-N	1020	5	-1020	9.5	1.22	833	<0.1	<0.1	0.04	0.036	<100
	DRILL-S3-M	1020	5	-1020	11	2.14	476	<0.1	<0.1	0.07	0.074	<100
Northern WRD	NW-S1-W	1000	5	-1000	11.5	0.31	3268	<0.1	<0.1	0.01	0.008	<100
	NW-S2-W	986	5	-986	11.4	0.31	3222	<0.1	<0.1	0.01	0.005	210
	NW-S3-S	886	5	-885	11.4	0.61	1448	<0.1	<0.1	0.02	0.012	<100
	NW-S4-S	1010	5	-1010	11.3	0.61	1650	<0.1	<0.1	0.02	0.008	<100
	NW-S5-E	516	5	-515	11.7	0.61	843	<0.1	<0.1	0.02	0.016	<100
	NW-S6-E	942	5	-942	11.4	0.31	3078	<0.1	<0.1	0.01	<0.005	<100
	NW-S7-E	1030	5	-1030	11.4	0.61	1683	<0.1	<0.1	0.02	0.013	<100
	NW-S8-TOP 1	173	3	-173	10.2	0.15	1131	<0.1	<0.1	<0.01	<0.005	<100
	NW-S9-TOP 2	1000	5	-1000	11.2	0.31	3268	<0.1	<0.1	0.01	0.006	<100
	NW-S10-TOP 3	923	5	-922	11.5	0.61	1508	<0.1	<0.1	0.02	0.006	<100
	NW-A	996	5	-995	11.6	0.61	1627	<0.1	<0.1	0.02	0.008	140

[2] MPA = Total S% x .30.6
[3] NPR = ANC/MPA

The results showed the following:

- Very low levels of total sulfur (<0.1%) across all three locations, which, from the SCr test, appeared to be in the form of sulfides
- Strongly negative NAPP values (markedly less than negative 20 kg H2SO4/t) across all three locations, indicating the material is acid consuming
- NAG pH values above 7 across all three locations
- NPRs markedly greater than 3 across all samples (INAP 2009)

Due to the very low total sulfur concentrations, there is no need to further account for the different forms of sulfur present (such as oxidised forms of sulfur; sulfates) to improve the assessment of AMD risk.

NAG pH and NAPP have been plotted on **Figure 1**. All of the data confirms that the waste rock and production (drill chip) material is classified as **non-acid forming (NAF)** (AMIRA 2002).

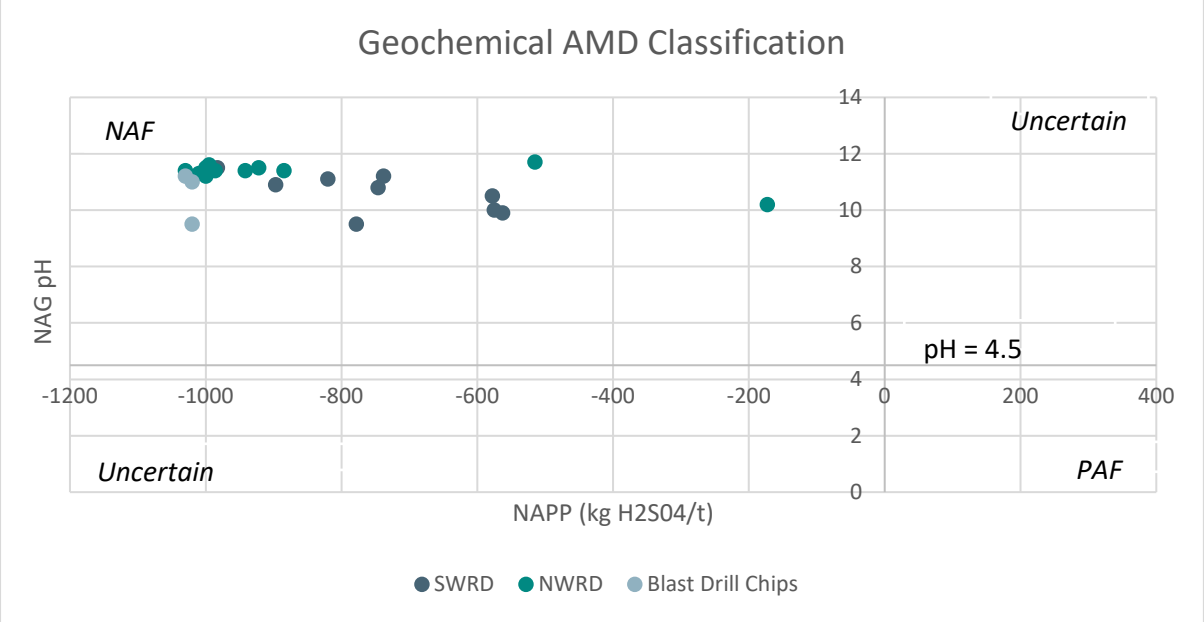


Figure 1. Geochemical AMD classification plot for the three locations based on NAG pH and NAPP (AMIRA 2002)

5.2 Petrographic Analysis

The petrographic analysis completed in 2023 has shown that the limestone rock produced at Calliope is 93%-99% calcite (calcium carbonate) with the balance being goethite (iron oxide-hydroxide). The analysis also indicated that sulfides were not observed in the samples.

Given that carbonate mineralogy of the material and the lack of observable sulfides, there is no risk of AMD generation from exposed limestone in the void wall.

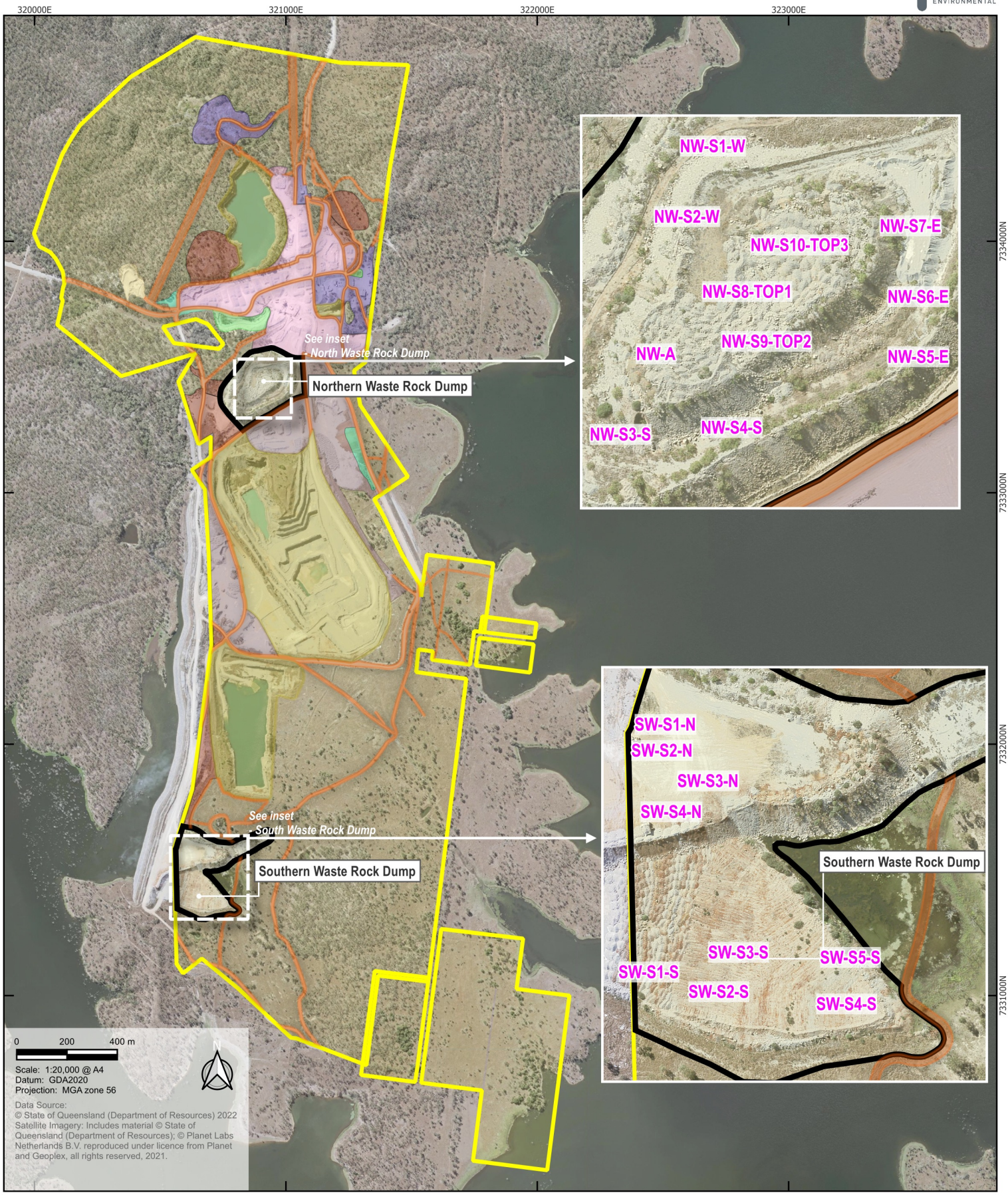
Additionally, the limestone contains negligible chloride. Together with the lack of AMD generation potential and the negligible risk of neutralisation salts formation, the results indicate a very low risk of saline mine drainage generation.

6 CONCLUSION

The materials described in this letter are categorised as **non-acid forming**. There is negligible risk of acid generation from the WRDs or exposed rocks in the void wall. The results are consistent with the geology of the Project and the lack of acid pH values in water quality results from water that collects in the void presented in the PRCP. No kinetic testing work is warranted.

7 REFERENCES

AMIRA, 2002. *Prediction & Kinetic Control of Acid Mine Drainage,* Melbourne: Environmental Geochemistry International.
INAP, 2019. *The GARD Guide,* Skelleftea: INAP.



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA220011.01 Waste Characterisation\2. Letter\Rev 0\Figure 1 Current disturbance area.qgz

Legend

- Site boundary
- **Current disturbane area**
- Waste rock dump
- Cleared areas and laydowns
- Infrastructure and plant
- Access tracks
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- SW-S3-S Waste characterisation samples

Graymont Limited
Calliope Limestone Quarry
Waste Characterisation Letter

Figure 1
Calliope limestone quarry - Waste rock dumps

APPENDIX A LABORATORY CERTIFICATES

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8160 5130 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4679 7944 E: ALSEnviro.Gladstone@alsglobal.com

MACKAY Unit 2/20 Carpenter Drive Peter QLD 4740 Ph: 07 4944 0796 E: ALSEnviro.Mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

EMUPARK 4/43 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

EMULDIGLE 10/1 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 PO: Woodpecker Road Smithfield NSW 2164 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: ALSEnviro.Townsville@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

WOLLONGONG Unit 2/ 21 Reliance Drive Tuggerah NSW 2259 Ph: 02 4286 3125 E: wollongong@alsglobal.com

CLIENT: Graymont Australia (GRAAUS)	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE: MS 24 Taragoola Rd Calliope Qld 4680		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Waste Dump Characteristics - Calliope PROJECT NO.:	ALS QUOTE NO.: BN/130/17 V2	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
PURCHASE ORDER NUMBER: 833739	COUNTRY OF ORIGIN: Australia	COC: (1) 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Vicki Robins	CONTACT PH: (07) 4975 7144	OF: 1 (2) 3 4 5 6 7	Other comment:
SAMPLER: Vicki Robins	SAMPLER MOBILE: 0437 921211		
COC Emailed to ALS? (YES / NO)	EDD FORMAT (or default):		
Email Reports to : vicki.robins@graymont.com			
Email Invoice to : calliopesales@graymont.com			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
A. Sykes	GJ 14.50	GJ 15.00	DM
DATE/TIME: 30.04.24 14/1/50.	DATE/TIME: 30.4.24	DATE/TIME: 30.4.24	DATE/TIME: 1020 2/5/24

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: ~~PLEASE LOG AS A PLANNED EVENT~~

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES + BAGS	Fluoride - Total	ICP/AES: 1st Metal (includes digestion) (Sb)	Mercury - Total Recoverable	- SCR (CRS)	NAPP (includes ANC, Total S)	Net Acid Generation (NAG)	Sulfate - Total as SO_4		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	SW-S1-S	30.04.2024 @ 8.25am	SOIL		2	X	X	X	X	X	X	X		
2	SW-S2-S	30.04.2024 @ 8.45am	SOIL		2	X	X	X	X	X	X	X		
3	SW-S3-S	30.04.2024 @ 8.39am	SOIL		2	X	X	X	X	X	X	X		
4	SW-S4-S	30.04.2024 @9.00am	SOIL		2	X	X	X	X	X	X	X		
5	SW-S5-S	30.04.2024 @9.00am	SOIL		2	X	X	X	X	X	X	X		
6	SW-S1-N	30.04.2024 @ 8.50am	SOIL		2	X	X	X	X	X	X	X		
7	SW-S2-N	30.04.2024 @ 9.10am	SOIL		2	X	X	X	X	X	X	X		
8	SW-S3-N	30.04.2024 @ 9.20am	SOIL		2	X	X	X	X	X	X	X		
9	SW-S4-N	30.04.2024 @ 9.40am	SOIL		2	X	X	X	X	X	X	X		
10	DRILL-S1-S	30.04.2024 @ 8.15am	SOIL		2	X	X	X	X	X	X	X		
11	DRILL-S2-N	30.04.2024 @ 8.15am	SOIL		2	X	X	X	X	X	X	X		
12	DRILL-S3-M	30.04.2024 @ 8.15am	SOIL		2	X	X	X	X	X	X	X		
				TOTAL	24									

Environmental Division
Brisbane
Work Order Reference
EB2414326

Telephone : + 61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; Li = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE: 21 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
BRISBANE: 32 Shand Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
CAIRNS: 48 Caltermoon Drive Gladstone QLD 4680 Ph: 07 4979 7544 E: AuSEnviro.Gladstone@alsglobal.com
EMU PLAINS: 1/28 Sydney Road Muogee NSW 2630 Ph: 02 4377 6735 E: mudgee.mail@alsglobal.com
GLADSTONE: 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4979 7544 E: AuSEnviro.Gladstone@alsglobal.com
MELBOURNE: 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MAREEBA: 4/13 Spurr Street Mareeba QLD 4880 Ph: 07 4092 5816 E: AuSEnviro.Mareeba@alsglobal.com
MAYFIELD: 4/69 Jet Drive Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
MURARRIE: 2 Byth Street Murarrie QLD 4172 Ph: 07 3902 4600 E: samples.murarrie@alsglobal.com
NEWCASTLE: 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
SMITHFIELD: 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE: 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: AuSEnviro.Townsville@alsglobal.com
WAGGA WAGGA: 4/13 Geary Place North Wagga NSW 2650 Ph: 02 6933 2003 E: wagga@alsglobal.com
PERTH: 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
WOLLONGONG: 4/19-21 Asquith Street Unanderra NSW 2526 Ph: 02 4271 3125 E: wollongong@alsglobal.com

CLIENT: Graymont Australia (GRAAUS)	TURNAROUND REQUIREMENTS : ☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: MS 24 Taragoola Rd Calliope Qld 4680	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes No N/A
PROJECT: Waste Dump Characteristics - Calliope PROJECT NO.:	ALS QUOTE NO.: BN/130/17 V2	Free ice / frozen ice bricks present upon receipt?	Yes No N/A
PURCHASE ORDER NUMBER: 833739	COUNTRY OF ORIGIN: Australia	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: Vicki Robins CONTACT PH: (07) 4975 7144	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7	Other comment:	
SAMPLER: Vicki Robins SAMPLER MOBILE: 0437 921211	RELINQUISHED BY: R. Somes	RECEIVED BY: GW 14.50	RELINQUISHED BY: GW 15.00
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	DATE/TIME: 30-04-24 14:50	DATE/TIME: 30.4.24	DATE/TIME: 30.4.24
Email Reports to : vicki.robins@graymont.com			RECEIVED BY:
Email Invoice to : calliopesales@graymont.com			DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL: ~~PLEASE LOG AS A PLANNED EVENT~~

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES + BAGS	Fluoride - Total	ICP/AES: 1st Metal (includes digestion) (Sb)	Mercury - Total Recoverable	- SCR (CRS)	NAPP (includes ANC, Total S)	Net Acid Generation (NAG)	Sulfate - Total as SO_4		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
13	NW-S1-W	30.04.2025 @ 9.50am	SOIL		2	X	X	X	X	X	X	X		
14	NW-S2-W	30.04.2025 @ 10.00am	SOIL		2	X	X	X	X	X	X	X		
15	NW-S3-S	30.04.2024 @ 10.10am	SOIL		2	X	X	X	X	X	X	X		
16	NW-S4-S	30.04.2024 @ 10.20am	SOIL		2	X	X	X	X	X	X	X		
17	NW-S5-E	30.04.2024 @ 10.30am	SOIL		2	X	X	X	X	X	X	X		
18	NW-S6-E	30.04.2024 @ 10.40am	SOIL		2	X	X	X	X	X	X	X		
19	NW-S7-E	30.04.2024 @ 10.45am	SOIL		2	X	X	X	X	X	X	X		
20	NW-S8-TOP 1	30.04.2024 @ 10.55am	SOIL		2	X	X	X	X	X	X	X		
21	NW-S9-TOP 2	30.04.2024 @ 11.10am	SOIL		2	X	X	X	X	X	X	X		
22	NW-S10-TOP 3	30.04.2024 @ 11.15am	SOIL		2	X	X	X	X	X	X	X		
23	NW-A	30.04.2024 @ 11.25am	SOIL		2	X	X	X	X	X	X	X		
24	SW-F	30.4.24 @9.50	Soil		2	X	X	X	X	X	X	X		
				TOTAL	24									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CERTIFICATE OF ANALYSIS

Work Order	: **EB2414326**	Page	: 1 of 12
Client	: **GRAYMONT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Vicki Robins	Contact	: Customer Services EB
Address	: MS 24 TARAGOOLA ROAD CALLIOPE 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Waste Dump Characteristics - Calliope	Date Samples Received	: 02-May-2024 10:20
Order number	: 833739	Date Analysis Commenced	: 03-May-2024
C-O-C number	: ----	Issue Date	: 16-May-2024 17:54
Sampler	: Vicki Robins		
Site	: ----		
Quote number	: BN/130/17 V4		
No. of samples received	: 24		
No. of samples analysed	: 24		

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

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

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

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

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

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

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

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

- ASS: EA033 (CRS Suite): Analysis is performed as per the Acid Sulfate Soils Laboratory Methods Guidelines (2004) and the updated National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, Department of Agriculture and Water Resources, Canberra, ACT (2018)
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- EK040T: EB2414326 #002 Poor matrix spike recovery for Total Fluoride due to sample matrix. Confirmed by re-extraction and re-analysis.
- ASS: EA033 (CRS Suite): Laboratory determinations of ANC needs to be corroborated by effectiveness of the measured ANC in relation to incubation ANC. Unless corroborated, the results of ANC testing should be discounted when determining Net Acidity for comparison with action criteria, or for the determination of the acidity hazard and required liming amounts.
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	SW-S1-S	SW-S2-S	SW-S3-S	SW-S4-S	SW-S5-S
			Sampling date / time	30-Apr-2024 08:25	30-Apr-2024 08:45	30-Apr-2024 08:39	30-Apr-2024 09:00	30-Apr-2024 09:00
Compound	CAS Number	LOR	Unit	EB2414326-001	EB2414326-002	EB2414326-003	EB2414326-004	EB2414326-005
				Result	Result	Result	Result	Result
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-998**	**-563**	**-778**	**-983**	**-575**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**11.5**	**9.9**	**9.5**	**11.5**	**10.0**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**999**	**564**	**779**	**984**	**575**
ANC as CaCO3	----	0.1	% CaCO3	**102**	**57.6**	**79.5**	**100**	**58.7**
Fizz Rating	----	0	Fizz Unit	**5**	**5**	**5**	**5**	**5**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**9.4**	**8.8**	**9.0**	**9.4**	**8.8**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.009**	**0.006**	**0.012**	**0.009**	**0.009**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**101**	**49.0**	**74.5**	**100**	**49.5**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**20200**	**9790**	**14900**	**20100**	**9880**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**32.4**	**15.7**	**23.9**	**32.2**	**15.8**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	SW-S1-S	SW-S2-S	SW-S3-S	SW-S4-S	SW-S5-S
			Sampling date / time	30-Apr-2024 08:25	30-Apr-2024 08:45	30-Apr-2024 08:39	30-Apr-2024 09:00	30-Apr-2024 09:00
Compound	CAS Number	LOR	Unit	EB2414326-001	EB2414326-002	EB2414326-003	EB2414326-004	EB2414326-005
				Result	Result	Result	Result	Result
EA033-E: Acid Base Accounting - Continued								
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**4.5**	**0.5**	**7.7**	**9.8**	**8.9**
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	**180**	<100	<100	**120**	<100
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.1**
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	<40	<40	<40	<40

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	SW-S1-N	SW-S2-N	SW-S3-N	SW-S4-N	DRILL-S1-S
			Sampling date / time	30-Apr-2024 08:50	30-Apr-2024 09:10	30-Apr-2024 09:20	30-Apr-2024 09:04	30-Apr-2024 08:15
Compound	CAS Number	LOR	Unit	EB2414326-006	EB2414326-007	EB2414326-008	EB2414326-009	EB2414326-010
				Result	Result	Result	Result	Result
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-820**	**-897**	**-578**	**-746**	**-1030**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**11.1**	**10.9**	**10.5**	**10.8**	**11.2**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**821**	**897**	**578**	**746**	**1030**
ANC as CaCO3	----	0.1	% CaCO3	**83.7**	**91.5**	**59.0**	**76.1**	**105**
Fizz Rating	----	0	Fizz Unit	**5**	**5**	**5**	**5**	**5**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**9.2**	**9.1**	**8.7**	**8.9**	**9.6**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	**0.008**	<0.005	**0.006**	**0.008**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**75.3**	**78.9**	**59.0**	**74.2**	**100**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**15000**	**15800**	**11800**	**14800**	**20000**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**24.1**	**25.2**	**18.9**	**23.8**	**32.0**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	SW-S1-N	SW-S2-N	SW-S3-N	SW-S4-N	DRILL-S1-S
			Sampling date / time	30-Apr-2024 08:50	30-Apr-2024 09:10	30-Apr-2024 09:20	30-Apr-2024 09:04	30-Apr-2024 08:15
Compound	CAS Number	LOR	Unit	EB2414326-006	EB2414326-007	EB2414326-008	EB2414326-009	EB2414326-010
				Result	Result	Result	Result	Result
EA033-E: Acid Base Accounting - Continued								
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**3.1**	**3.5**	**6.7**	**3.7**	**0.7**
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	**110**	**100**	<100	<100	<100
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.01**	**0.01**	**0.01**	**0.02**
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.4**	<0.1	<0.1	<0.1	<0.1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	<40	<40	<40	<40

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DRILL-S2-N	DRILL-S3-M	NW-S1-W	NW-S2-W	NW-S3-S
			Sampling date / time	30-Apr-2024 08:15	30-Apr-2024 08:15	30-Apr-2024 09:50	30-Apr-2024 10:00	30-Apr-2024 10:10
Compound	CAS Number	LOR	Unit	EB2414326-011	EB2414326-012	EB2414326-013	EB2414326-014	EB2414326-015
				Result	Result	Result	Result	Result
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-1020**	**-1020**	**-1000**	**-986**	**-885**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**9.5**	**11.0**	**11.5**	**11.4**	**11.4**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**1020**	**1020**	**1000**	**986**	**886**
ANC as CaCO3	----	0.1	% CaCO3	**104**	**104**	**102**	**100**	**90.4**
Fizz Rating	----	0	Fizz Unit	**5**	**5**	**5**	**5**	**5**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**9.6**	**9.6**	**9.6**	**9.6**	**9.3**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.036**	**0.074**	**0.008**	**0.005**	**0.012**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**23**	**46**	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**101**	**88.5**	**99.9**	**88.7**	**88.0**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**20100**	**17700**	**20000**	**17700**	**17600**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**32.3**	**28.4**	**32.0**	**28.4**	**28.2**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	DRILL-S2-N	DRILL-S3-M	NW-S1-W	NW-S2-W	NW-S3-S
			Sampling date / time	30-Apr-2024 08:15	30-Apr-2024 08:15	30-Apr-2024 09:50	30-Apr-2024 10:00	30-Apr-2024 10:10
Compound	CAS Number	LOR	Unit	EB2414326-011	EB2414326-012	EB2414326-013	EB2414326-014	EB2414326-015
				Result	Result	Result	Result	Result
EA033-E: Acid Base Accounting - Continued								
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.04**	**0.07**	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**23**	**46**	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	**2**	**3**	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**0.5**	**0.5**	**2.7**	**4.1**	**1.5**
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	<100	<100	**210**	<100
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.04**	**0.07**	**0.01**	**0.01**	**0.02**
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	**0.1**
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	<40	**60**	<40	<40

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	NW-S4-S	NW-S5-E	NW-S6-E	NW-S7-E	NW-S8-TOP 1
			Sampling date / time	30-Apr-2024 10:20	30-Apr-2024 10:30	30-Apr-2024 10:40	30-Apr-2024 10:45	30-Apr-2024 10:55
Compound	CAS Number	LOR	Unit	EB2414326-016	EB2414326-017	EB2414326-018	EB2414326-019	EB2414326-020
				Result	Result	Result	Result	Result
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-1010**	**-515**	**-942**	**-1030**	**-173**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**11.3**	**11.7**	**11.4**	**11.4**	**10.2**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**1010**	**516**	**942**	**1030**	**173**
ANC as CaCO3	----	0.1	% CaCO3	**103**	**52.6**	**96.0**	**105**	**17.6**
Fizz Rating	----	0	Fizz Unit	**5**	**5**	**5**	**5**	**3**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**9.6**	**9.1**	**9.6**	**9.6**	**8.2**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.008**	**0.016**	<0.005	**0.013**	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**99.8**	**48.5**	**88.1**	**101**	**14.0**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**19900**	**9690**	**17600**	**20200**	**2800**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**32.0**	**15.5**	**28.2**	**32.4**	**4.50**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	NW-S4-S	NW-S5-E	NW-S6-E	NW-S7-E	NW-S8-TOP 1
			Sampling date / time	30-Apr-2024 10:20	30-Apr-2024 10:30	30-Apr-2024 10:40	30-Apr-2024 10:45	30-Apr-2024 10:55
Compound	CAS Number	LOR	Unit	EB2414326-016	EB2414326-017	EB2414326-018	EB2414326-019	EB2414326-020
				Result	Result	Result	Result	Result
EA033-E: Acid Base Accounting - Continued								
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**2.1**	**2.0**	**0.5**	**3.4**	**5.6**
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	<100	<100	<100	<100
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	**0.01**	**0.02**	<0.01
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	**0.1**	**0.1**	<0.1	<0.1	<0.1
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	**110**	**190**	**60**	**240**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	NW-S9-TOP 2	NW-S10-TOP 3	NW-A	SW-F	----
			Sampling date / time	30-Apr-2024 11:10	30-Apr-2024 11:15	30-Apr-2024 11:25	30-Apr-2024 09:50	----
Compound	CAS Number	LOR	Unit	EB2414326-021	EB2414326-022	EB2414326-023	EB2414326-024	--------
				Result	Result	Result	Result	----
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-1000**	**-922**	**-995**	**-738**	**----**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**11.2**	**11.5**	**11.6**	**11.2**	**----**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	**----**
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	**----**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**1000**	**923**	**996**	**738**	**----**
ANC as CaCO3	----	0.1	% CaCO3	**102**	**94.1**	**102**	**75.2**	**----**
Fizz Rating	----	0	Fizz Unit	**5**	**5**	**5**	**5**	**----**
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**9.6**	**9.2**	**9.6**	**8.9**	**----**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	<2	**----**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	**----**
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.006**	**0.006**	**0.008**	**0.006**	**----**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	**----**
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**102**	**89.0**	**102**	**73.6**	**----**
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**20400**	**17800**	**20300**	**14700**	**----**
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**32.7**	**28.5**	**32.6**	**23.6**	**----**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**----**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	**----**
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	**----**
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	**----**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	NW-S9-TOP 2	NW-S10-TOP 3	NW-A	SW-F	----
			Sampling date / time	30-Apr-2024 11:10	30-Apr-2024 11:15	30-Apr-2024 11:25	30-Apr-2024 09:50	----
Compound	CAS Number	LOR	Unit	EB2414326-021	EB2414326-022	EB2414326-023	EB2414326-024	--------
				Result	Result	Result	Result	----
EA033-E: Acid Base Accounting - Continued								
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	0.1	%	**2.4**	**4.0**	**0.6**	**8.8**	----
ED040: Sulfur as SO4 2-								
Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	<100	**140**	<100	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.01**	**0.02**	**0.02**	**0.01**	----
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	**0.1**	<0.1	<0.1	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	<40	**50**	**90**	<40	----

Inter-Laboratory Testing

Analysis conducted by ALS Melbourne, NATA accreditation no. 825, site no. 13778 (Chemistry).

(SOIL) EK040T: Fluoride Total

QUALITY CONTROL REPORT

Work Order	: **EB2414326**	Page	: 1 of 7
Client	: **GRAYMONT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Vicki Robins	Contact	: Customer Services EB
Address	: MS 24 TARAGOOLA ROAD CALLIOPE 4680	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Waste Dump Characteristics - Calliope	Date Samples Received	: 02-May-2024
Order number	: 833739	Date Analysis Commenced	: 03-May-2024
C-O-C number	: ----	Issue Date	: 16-May-2024
Sampler	: Vicki Robins		
Site	: ----		
Quote number	: BN/130/17 V4		
No. of samples received	: 24		
No. of samples analysed	: 24		

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

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

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Soil Preparation, Stafford, QLD
Dilani Fernando	Laboratory Coordinator	Melbourne Inorganics, Springvale, VIC
Jarwis Nheu	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

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

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

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5766984)									
EB2414326-001	SW-S1-S	EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
EB2414326-011	DRILL-S2-N	EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
EG005(ED093)T: Total Metals by ICP-AES (QC Lot: 5766986)									
EB2414326-021	NW-S9-TOP 2	EG005T: Antimony	7440-36-0	5	mg/kg	<5	<5	0.0	No Limit
EA011: Net Acid Generation (QC Lot: 5778773)									
EB2414326-001	SW-S1-S	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	11.5	11.6	0.9	0% - 20%
EB2414326-011	DRILL-S2-N	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	9.5	9.6	1.0	0% - 20%
EA011: Net Acid Generation (QC Lot: 5778776)									
EB2414326-021	NW-S9-TOP 2	EA011: NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.0	No Limit
		EA011: pH (OX)	----	0.1	pH Unit	11.2	11.3	0.9	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 5778772)									
EB2414326-001	SW-S1-S	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	999	1000	0.7	0% - 20%
EB2414326-011	DRILL-S2-N	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1020	1020	0.1	0% - 20%
EA013: Acid Neutralising Capacity (QC Lot: 5778775)									

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EA013: Acid Neutralising Capacity (QC Lot: 5778775) - continued									
EB2414326-021	NW-S9-TOP 2	EA013: ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1000	1010	0.7	0% - 20%
EA033-A: Actual Acidity (QC Lot: 5778774)									
EB2414326-001	SW-S1-S	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	9.4	9.4	0.0	0% - 20%
EB2414326-011	DRILL-S2-N	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	9.6	9.6	0.0	0% - 20%
EA033-A: Actual Acidity (QC Lot: 5778777)									
EB2414326-021	NW-S9-TOP 2	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.0	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.0	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	9.6	9.6	0.0	0% - 20%
EA033-B: Potential Acidity (QC Lot: 5778774)									
EB2414326-001	SW-S1-S	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.009	0.012	21.6	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EB2414326-011	DRILL-S2-N	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.036	0.035	4.0	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	23	22	0.0	No Limit
EA033-B: Potential Acidity (QC Lot: 5778777)									
EB2414326-021	NW-S9-TOP 2	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.006	0.008	20.7	No Limit
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	0.0	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 5778774)									
EB2414326-001	SW-S1-S	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	101	101	0.0	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	32.4	32.4	0.0	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	20200	20200	0.0	0% - 20%
EB2414326-011	DRILL-S2-N	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	101	101	0.0	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	32.3	32.3	0.0	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	20100	20200	0.0	0% - 20%
EA033-C: Acid Neutralising Capacity (QC Lot: 5778777)									
EB2414326-021	NW-S9-TOP 2	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	102	102	0.0	0% - 20%

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EA033-C: Acid Neutralising Capacity (QC Lot: 5778777) - continued									
EB2414326-021	NW-S9-TOP 2	EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	32.7	32.6	0.0	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	20400	20400	0.0	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5766995)									
EB2414326-001	SW-S1-S	EA055: Moisture Content	----	0.1	%	4.5	4.6	2.4	0% - 20%
EB2414326-011	DRILL-S2-N	EA055: Moisture Content	----	0.1	%	0.5	0.5	0.0	No Limit
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 5766996)									
EB2414326-021	NW-S9-TOP 2	EA055: Moisture Content	----	0.1	%	2.4	2.4	0.0	0% - 20%
ED040T : Total Sulfate by ICPAES (QC Lot: 5766993)									
EB2414326-001	SW-S1-S	ED040T: Sulfate as SO4 2-	14808-79-8	100	mg/kg	180	180	0.0	No Limit
EB2414326-010	DRILL-S1-S	ED040T: Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	<100	0.0	No Limit
ED040T : Total Sulfate by ICPAES (QC Lot: 5766994)									
EB2414326-021	NW-S9-TOP 2	ED040T: Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	<100	0.0	No Limit
ED042T: Total Sulfur by LECO (QC Lot: 5780614)									
EB2414326-001	SW-S1-S	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.0	No Limit
EB2414326-011	DRILL-S2-N	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.05	0.0	No Limit
ED042T: Total Sulfur by LECO (QC Lot: 5780615)									
EB2414326-021	NW-S9-TOP 2	ED042T: Sulfur - Total as S (LECO)	----	0.01	%	0.01	0.01	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5766985)									
EB2414326-001	SW-S1-S	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EB2414326-011	DRILL-S2-N	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 5766987)									
EB2414326-021	NW-S9-TOP 2	EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	0.0	No Limit
EK040T: Fluoride Total (QC Lot: 5787232)									
EB2414326-001	SW-S1-S	EK040T: Fluoride	16984-48-8	40	mg/kg	<40	<40	0.0	No Limit
EB2414326-010	DRILL-S1-S	EK040T: Fluoride	16984-48-8	40	mg/kg	<40	50	0.0	No Limit
EK040T: Fluoride Total (QC Lot: 5787233)									
EB2414326-021	NW-S9-TOP 2	EK040T: Fluoride	16984-48-8	40	mg/kg	<40	<40	0.0	No Limit
EM2407337-011	Anonymous	EK040T: Fluoride	16984-48-8	40	mg/kg	50	50	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5766984)								
EG005T: Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES (QCLot: 5766986)								
EG005T: Antimony	7440-36-0	5	mg/kg	<5	----	----	----	----
EA011: Net Acid Generation (QCLot: 5778773)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.83 kg H2SO4/t	94.2	70.0	130
EA011: Net Acid Generation (QCLot: 5778776)								
EA011: NAG (pH 7.0)	----	----	kg H2SO4/t	----	22.83 kg H2SO4/t	96.7	70.0	130
EA013: Acid Neutralising Capacity (QCLot: 5778772)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	196 kg H2SO4 equiv./t	104	82.0	120
EA013: Acid Neutralising Capacity (QCLot: 5778775)								
EA013: ANC as H2SO4	----	----	kg H2SO4 equiv./t	----	196 kg H2SO4 equiv./t	104	82.0	120
EA033-A: Actual Acidity (QCLot: 5778774)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.7 pH Unit	102	80.0	120
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	116	80.0	120
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-A: Actual Acidity (QCLot: 5778777)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.7 pH Unit	103	80.0	120
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	23.5 mole H+ / t	118	80.0	120
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity (QCLot: 5778774)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.246 % S	88.0	77.0	121
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-B: Potential Acidity (QCLot: 5778777)								
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.246 % S	91.8	77.0	121
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 5778774)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	105	91.0	112
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
EA033-C: Acid Neutralising Capacity (QCLot: 5778777)								

Sub-Matrix: **SOIL**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EA033-C: Acid Neutralising Capacity (QCLot: 5778777) - continued								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	108	91.0	112
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----
ED040T : Total Sulfate by ICPAES (QCLot: 5766993)								
ED040T: Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	577.72262 mg/kg	88.5	79.0	121
ED040T : Total Sulfate by ICPAES (QCLot: 5766994)								
ED040T: Sulfate as SO4 2-	14808-79-8	100	mg/kg	<100	577.72262 mg/kg	85.0	79.0	121
ED042T: Total Sulfur by LECO (QCLot: 5780614)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.51 %	99.9	70.0	130
ED042T: Total Sulfur by LECO (QCLot: 5780615)								
ED042T: Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.51 %	102	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5766985)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.09199 mg/kg	111	70.0	125
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5766987)								
EG035T: Mercury	7439-97-6	0.1	mg/kg	<0.1	0.09199 mg/kg	112	70.0	125
EK040T: Fluoride Total (QCLot: 5787232)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	334 mg/kg	97.0	93.1	107
EK040T: Fluoride Total (QCLot: 5787233)								
EK040T: Fluoride	16984-48-8	40	mg/kg	<40	334 mg/kg	97.0	93.1	107

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **SOIL**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5766985)							
EB2414326-002	SW-S2-S	EG035T: Mercury	7439-97-6	0.5 mg/kg	88.9	70.0	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 5766987)							
EB2414326-022	NW-S10-TOP 3	EG035T: Mercury	7439-97-6	0.5 mg/kg	93.9	70.0	130
EK040T: Fluoride Total (QCLot: 5787232)							
EB2414326-002	SW-S2-S	EK040T: Fluoride	16984-48-8	400 mg/kg	# 67.0	70.0	130
EK040T: Fluoride Total (QCLot: 5787233)							
EB2414326-022	NW-S10-TOP 3	EK040T: Fluoride	16984-48-8	400 mg/kg	70.6	70.0	130

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB2414326**	Page	: 1 of 10
Client	: **GRAYMONT (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: Vicki Robins	Telephone	: +61-7-3243 7222
Project	: Waste Dump Characteristics - Calliope	Date Samples Received	: 02-May-2024
Site	: ----	Issue Date	: 16-May-2024
Sampler	: Vicki Robins	No. of samples received	: 24
Order number	: 833739	No. of samples analysed	: 24

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **SOIL**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EK040T: Fluoride Total	EB2414326--002	SW-S2-S	**Fluoride**	16984-48-8	67.0 %	70.0-130%	**Recovery less than lower data quality objective**

Outliers : Analysis Holding Time Compliance

Matrix: **SOIL**

Method / Container / Client Sample ID(s)		Extraction / Preparation: Date extracted	Due for extraction	Days overdue	Analysis: Date analysed	Due for analysis	Days overdue
ED040: Sulfur as SO4 2-							
Soil Glass Jar - Unpreserved							
SW-S1-S,	SW-S2-S,	09-May-2024	07-May-2024	**2**	----	----	----
SW-S3-S,	SW-S4-S,						
SW-S5-S,	SW-S1-N,						
SW-S2-N,	SW-S3-N,						
SW-S4-N,	DRILL-S1-S,						
DRILL-S2-N,	DRILL-S3-M,						
NW-S1-W,	NW-S2-W,						
NW-S3-S,	NW-S4-S,						
NW-S5-E,	NW-S6-E,						
NW-S7-E,	NW-S8-TOP 1,						
NW-S9-TOP 2,	NW-S10-TOP 3,						
NW-A,	SW-F						

Outliers : Frequency of Quality Control Samples

Matrix: **SOIL**

Quality Control Sample Type / Analytical Methods	Method	Count: QC	Count: Regular	Rate (%): Actual	Rate (%): Expected	Quality Control Specification
Laboratory Control Samples (LCS)						
Total Metals by ICP-AES	EG005T	0	24	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)						
Total Metals by ICP-AES	EG005T	0	24	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA011: Net Acid Generation								
Pulp Bag (EA011)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	06-Nov-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EA013: Acid Neutralising Capacity								
Pulp Bag (EA013)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	06-Nov-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EA033-A: Actual Acidity								
Pulp Bag (EA033)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	08-Aug-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity								
Pulp Bag (EA033)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	08-Aug-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EA033-C: Acid Neutralising Capacity								
Pulp Bag (EA033)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	08-Aug-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EA033-D: Retained Acidity								
Pulp Bag (EA033)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	08-Aug-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-E: Acid Base Accounting								
Pulp Bag (EA033)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	30-Apr-2025	✓	**10-May-2024**	08-Aug-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EA055: Moisture Content (Dried @ 105-110°C)								
Soil Glass Jar - Unpreserved (EA055)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**----**	----	----	**03-May-2024**	14-May-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
ED040: Sulfur as SO4 2-								
Soil Glass Jar - Unpreserved (ED040T)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**09-May-2024**	07-May-2024	×	**15-May-2024**	06-Jun-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED042T: Total Sulfur by LECO								
Pulp Bag (ED042T)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**10-May-2024**	27-Oct-2024	✓	**10-May-2024**	27-Oct-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EG005(ED093)T: Total Metals by ICP-AES								
Soil Glass Jar - Unpreserved (EG005T)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**09-May-2024**	27-Oct-2024	✓	**15-May-2024**	27-Oct-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							
EG035T: Total Recoverable Mercury by FIMS								
Soil Glass Jar - Unpreserved (EG035T)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**09-May-2024**	28-May-2024	✓	**15-May-2024**	28-May-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK040T: Fluoride Total								
Snap Lock Bag (EK040T)								
SW-S1-S,	SW-S2-S,	**30-Apr-2024**	**14-May-2024**	28-May-2024	✓	**15-May-2024**	28-May-2024	✓
SW-S3-S,	SW-S4-S,							
SW-S5-S,	SW-S1-N,							
SW-S2-N,	SW-S3-N,							
SW-S4-N,	DRILL-S1-S,							
DRILL-S2-N,	DRILL-S3-M,							
NW-S1-W,	NW-S2-W,							
NW-S3-S,	NW-S4-S,							
NW-S5-E,	NW-S6-E,							
NW-S7-E,	NW-S8-TOP 1,							
NW-S9-TOP 2,	NW-S10-TOP 3,							
NW-A,	SW-F							

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Acid Neutralising Capacity (ANC)	EA013	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate as SO4 2- Total	ED040T	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	4	29	**13.79**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	3	24	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Acid Neutralising Capacity (ANC)	EA013	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Net Acid Generation	EA011	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate as SO4 2- Total	ED040T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	24	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate as SO4 2- Total	ED040T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfur - Total as S (LECO)	ED042T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Fluoride	EK040T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Total Fluoride	EK040T	2	29	**6.90**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	24	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-AES	EG005T	0	24	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Net Acid Production Potential	EA009	SOIL	In house: Referenced to Coastech Research (Canada)(Mod.). NAPP = Acid Production Potential (APP or MAP-Maximum Acid Potential) minus Neutralising Capacity (ANC). NAPP may be +ve, zero or -ve.
Net Acid Generation	EA011	SOIL	In house: Referenced to Miller (1998) Titremetric procedure determines net acidity in a soil following peroxide oxidation. Titrations to both pH 4.5 and pH 7 are reported.
Acid Neutralising Capacity (ANC)	EA013	SOIL	In house: Referenced to USEPA 600/2-78-054, I. Miller (2000). A fizz test is done to semiquanititatively estimate the likely reactivity. The soil is then reacted with an known excess quanitity of an appropriate acid. Titration determines the acid remaining, and the ANC can be calculated from comparison with a blank titration.
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM Schedule B(3).
Sulfate as SO4 2- Total	ED040T	SOIL	In house: Total Sulfate is determined off a HCl digestion by ICPAES as S , and reported as SO4
Sulfur - Total as S (LECO)	ED042T	SOIL	In house: Dried and pulverised sample is combusted in a high temperature furnace in the presence of strong oxidants / catalysts. The evolved S (as SO2) is measured by infra-red detector
Total Metals by ICP-AES	EG005T	SOIL	In house: Referenced to APHA 3120; USEPA SW 846 - 6010. Metals are determined following an appropriate acid digestion of the soil. The ICPAES technique ionises samples in a plasma, emitting a characteristic spectrum based on metals present. Intensities at selected wavelengths are compared against those of matrix matched standards. This method is compliant with NEPM Schedule B(3)
Total Mercury by FIMS	EG035T	SOIL	In house: Referenced to APHA 3112 Hg - B (Flow-injection (SnCl2) (Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. Mercury in solids are determined following an appropriate acid digestion. Ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM Schedule B(3)
Total Fluoride	EK040T	SOIL	(In-house) Total fluoride is determined by ion specific electrode (ISE) in a solution obtained after a Sodium Carbonate / Potassium Carbonate fusion dissolution.

Preparation Methods	Method	Matrix	Method Descriptions
Total Fluoride	EK040T-PR	SOIL	In house: Samples are fused with Sodium Carbonate / Potassium Carbonate flux.
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house
HCl Digest	EN24	SOIL	1g of soil is digested in 30 ml of 30% HCl and the resultant digest bulked and filtered for analysis by ICP.

Preparation Methods	*Method*	*Matrix*	*Method Descriptions*
Hot Block Digest for metals in soils sediments and sludges	EN69	SOIL	In house: Referenced to USEPA 200.2. Hot Block Acid Digestion 1.0g of sample is heated with Nitric and Hydrochloric acids, then cooled. Peroxide is added and samples heated and cooled again before being filtered and bulked to volume for analysis. Digest is appropriate for determination of selected metals in sludge, sediments, and soils. This method is compliant with NEPM Schedule B(3).
Dry and Pulverise (up to 100g)	GEO30	SOIL	#

APPENDIX B PETROGRAPHIC ANALYSIS

Groundwork Plus Resources Environment Planning Laboratories
Phone: 1800 GW PLUS (1800 497 587)
Email: info@groundwork.com.au
Website: groundwork.com.au
ABN 13 609 422 791

Petrographic Inspection Report

Prepared for:	Superior Quarry Testing
Purchase Order:	Not Provided
Material Source:	Graymont (Taragoola) Quarry, QLD
Sample Type:	Type 2.1 Roadbase
Sample Number:	SN 5459
Date Sampled:	Not Provided
Date of Inspection:	17/01/2022
Report Issued:	18/01/2022
Project/ File Ref.:	P2021_213_01

Author:

Mathew Beddard (BSc)

Petrologist
Groundwork Plus

Reviewer:

Rod Huntley (BSc, M.App.Sc, M.Eng)
Principal Resource Consultant
Groundwork Plus

Enquiries regarding the content of this report should be directed to Groundwork Plus 07 3871 0411*. Samples are disposed of after 3 months from the date of report. Thin sections will remain on site indefinitely. The analysis is based on a limited number of thin sections and sample provided by client, further investigation may be required. Interpretations are specific to the sample examined only.*

Copyright © *These materials or parts of them may not be reproduced in any form, by any method, for any purpose except with written permission from Groundwork Plus.*

Executive Summary

Classification: Limestone

For Engineering Purposes AS 2758.1: Roadbase derived from derived from carbonate sedimentary rock

Key Material Risk: Negligible risk

Table 1 – Summary of Sample's Compositional Characteristics

Compositional Features	%	Comments
Strong Phases	93	Calcite; *trace:* opaques
Weak Phases	7	Goethite
Clays	0	None observed
Micas	0	None observed
Sulphides	0	None observed
Carbonates	93	Calcite
Textural Features	**Yes/ No**	
Fracturing/Veins	Yes	Abundant diagenetic sparry calcite veins. Minor goethite veins. No fractures observed
Voids	No	None observed
Free Silica	**%**	
Unstrained quartz	0	None observed
Optically strained quartz	0	None observed
Microcrystalline quartz	0	None observed
Siliceous volcanic glass	0	None observed
Opaline/chalcedonic quartz	0	None observed
Total	0	

Table 2 – Risk Rating for Specific Applications and Source Rock Quality

Specific Application	Low	Mod	High	Comments
Coarse Aggregate in Concrete (MRTS70)	✓			Texturally isolated weak/secondary phases unlikely to cause deleterious reactions or significantly increase water demand in concrete
Manufactured Sand	✓			Considered suitable after processing to remove goethitic fines
Aggregate Unbound Pavements (MRTS05)	✓			Suitable hardness, strength, and durability (after processing to remove goethitic fines)
Cover Aggregate (MRTS22)	✓			Suitable hardness, strength, and durability (after processing to remove goethitic fines)
Graded Asphalt Aggregate (MRTS101)	✓			Suitable hardness, strength, and durability (after processing to remove goethitic fines)
Gabion/Revetment	✓			Mechanically suitable
Material Characteristics	**Low**	**Mod**	**High**	**Comments**
Hardness	✓			Hard
Strength	✓			Strong
Durability	✓			Durable
ACR in concrete	✓			Innocuous. No dolomite detected.
ASR in concrete	✓			Innocuous. No reactive silica detected.

Introduction

This report provides the results of a general petrographic assessment of a roadbase sample, which was submitted to the Groundwork Plus petrographic laboratory, and describes the method and standards used to assess the sample. The supplied sample was sampled by the client and sent to the Groundwork Plus petrographic facility. The thin section was prepared and analysed by Groundwork Plus with instructions from the client to conduct petrographic testing to ASTM C295 and recommend further testing if significant deleterious characteristics are identified pursuant to Clause 16.3 of this standard. The provided modal mineral percentages relate to the supplied sample which is understood to be representative of material on site. Assessment regarding the Alkali-Silica Reactivity (ASR) potential of the aggregate has been advised by SA HB 79-2015. Communication of findings are advised by AS 1726-2017 Geotechnical Site Investigations.

Methodology

The petrographic assessment of the slide is carried out using a Nikon polarising microscope equipped with a digital camera at the Groundwork Plus petrographic laboratory. Photographs of the hand specimen and thin section photomicrographs showing grain sizes and any particular aspects of the minerals are included as part of the report (**Plates 1** to **6**). Modal analysis is conducted on the sample using a MA945/10 Mechanical Point Counter on 600 points (**Table 3 – Modal Analysis of Minerals**).

The petrology assessment is based on:

- ASTM C 295 – 2019 Standard Guide for Petrographic Examination of Aggregates for Concrete.
- AS 2758.1 – 2014 Aggregates and Rock for Engineering Purposes Part 1: Concrete Aggregates (Appendix B).
- AS 2758.2 – 2014 Aggregates and Rock for Engineering Purposes Part 2: Aggregate for sprayed bituminous surfacing.
- AS 2758.4 – 2014 Aggregates and Rock for Engineering Purposes Part 4: Aggregate for gabion baskets and wire mattresses.
- AS 2758.5 – 2014 Aggregates and Rock for Engineering Purposes Part 5: Asphalt Aggregates.
- AS 2758.6 – 2014 Aggregates and Rock for Engineering Purposes Part 6: Guidelines for the specification of Armourstone.
- AS 1141.26 – 2019 Standard Guide for the Method for Sampling and Testing Aggregates – Secondary Minerals Content in Igneous Rocks.
- The accepted definition of free silica is set out in the Queensland Department of Transport and Main Roads Test Method Q188, and tested pursuant to guidelines set in Standards Australia HB 79-2015 Alkali-Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structure in Australia - Cement and Concrete Association of Australia and Standards Australia.

Hand Specimen Description

In hand specimen, the roadbase sample is identified as being derived from a **limestone**, a carbonate sedimentary rock.

The sample consists of variably sized, poorly sorted aggregate particles and abundant fines. Particles measure up to 20mm in size. Particles are angular to very angular, with variable sphericity. Prior to washing, the sample contains abundant goethitic fines and dust, giving it an overall light orangish-brown colour. Goethite dust coats most particles as well as forming liberated binder. Washing removes most dust to produce a turbid orangish-brown water. The washed particles show variable colour, with most being light to dark grey. Acid testing indicates the sample is composed of calcite. The shade of grey is dependent upon the texture of calcite that makes up the particle, with micrite being darker grey and sparry calcite being lighter. A minor abundance of particles show extensive internal staining of goethite, giving them an orange to reddish-brown colour.

The sample particles are regarded as strong and hard, with competent faces. No fractures or voids are observed. No sulphides are observed and the sample is not appreciably magnetic.



Plate 1: Photograph of the sample as provided, showing the poorly sorted, angular roadbase particles coated in abundant, light orangish-brown fines.



Plate 2: Photograph of sample when wetted, which removes the goethitic fines leaving the variably coloured limestone particles.

Thin Section Description

In thin section, the sample is conformed to derive from a limestone. The limestone shows textures consistent with classification as a mudstone with minor wackestone regions. Diagenetic alteration has seen replacement of micritic calcite with sparry calcite veins and bands. A mode base on a count of 600 widely spaced points is shown in **Table 3 - Modal Analysis of Minerals**. Robust minerals make up 93% of the rock and include calcite (split into micrite and sparry varieties) and trace opaques. Goethite is the only observed weak phase and accounts for 7% of the sample.

Table 3 - Modal Analysis of Minerals

Primary Minerals	Mode (%)	Comments
Calcite – micritic	41	Calcite showing massive, micritic texture. Also includes rare bioclastic/wackestone texture
Calcite – sparry	52	Calcite crystals showing sparry texture including twinning. Occurs as replacement of micrite.
Opaques	Trace	Trace, 0.05mm sized, rounded, opaque, magnetite crystals
Secondary Minerals		
Goethite	7	Abundant in the fines and dust as orange-coloured accretions. Minor staining within some particles. Minor veins and veinlets observed
Total	**100**	

Calcite forms most of the sample at 93% of the mineral count. Calcite is observed showing micritic texture (41% of the sample) and sparry texture (52%). The micritic calcite is regarded as the primary texture prior to replacement by sparry crystals during diagenesis. The micritic regions are typical of carbonate mudstones, with expansive regions of microcrystalline, massive calcite. In some areas, rare bioclasts are observed giving a more wackestone texture. Bioclasts include gastropods and bivalves. The distribution of sparry calcite is variable, with veinlets, veins, and large bands and patches observed. Some areas contain abundant crosscutting veins and veinlets; others are dominated by wide bands of sparry crystals. The remaining robust phase observed is trace opaque magnetite, which is disseminated throughout the sample as small, 0.05mm sized, rounded crystals.

The finer material in the sample is dominated by goethite (7%). Goethitic accretions coat most particles, with a minor abundance of particles having interior ferruginous staining. The goethitic fines are easily removed by washing the sample. Minor veins and veinlets of goethite are also observed crosscutting the calcite and indicating later weathering of the rock.

Overall, the sample is considered hard, strong, and durable, and considered suitable for use as a roadbase. The goethitic fines are expected to perform well as binder for the roadbase. After processing to remove fines, the sample is regarded as suitable for use as coarse aggregate in concrete, unbound pavements, cover aggregate, graded asphalt, and gabion/revetment. Extensive crushing is expected to produce a quality carbonate manufactured sand.

Free Silica Content

After conducting a modal analysis using the MA945-10 mechanical point counter on 600 points, the total free silica content was found to be 0%. The sample was found to contain **no reactive silica.**

According to Standards Australia HB 79-2015 and Department of Transport and Main Roads test method Q188, the provided aggregate is assessed as **innocuous in regard to ASR** in concrete.

Asbestiform Minerals

Asbestos can be defined mineralogically and by crystal habit. For the purposes of health screening asbestiform habit is relevant, which is defined as being hair-like (filiform) and flexible with a high aspect ratio. Based on the thin section constructed from the material supplied, the sample contains **no observable asbestiform minerals**.

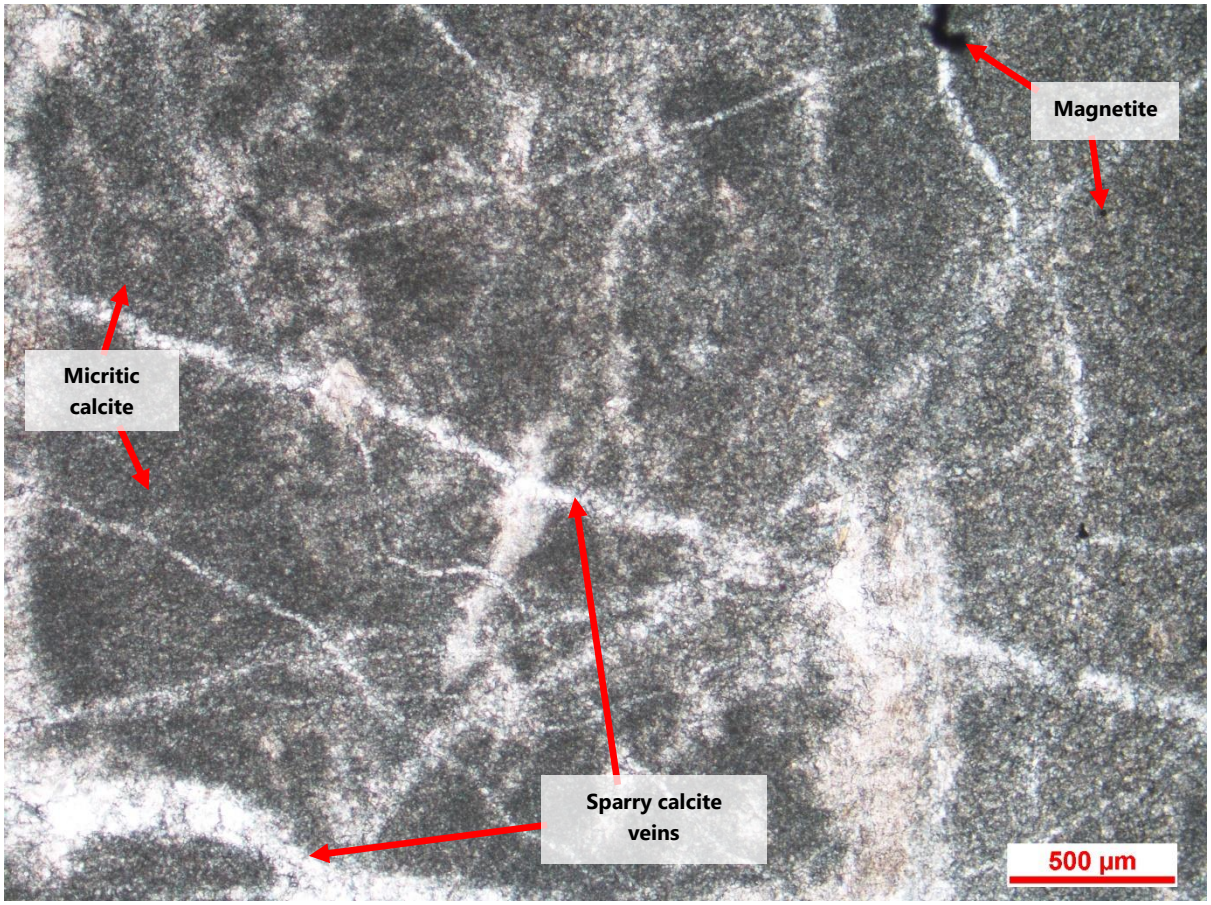


Plate 3: Microphotograph of the sample, showing abundant sparry calcite veins crosscutting the micritic calcite. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 5.2mm.

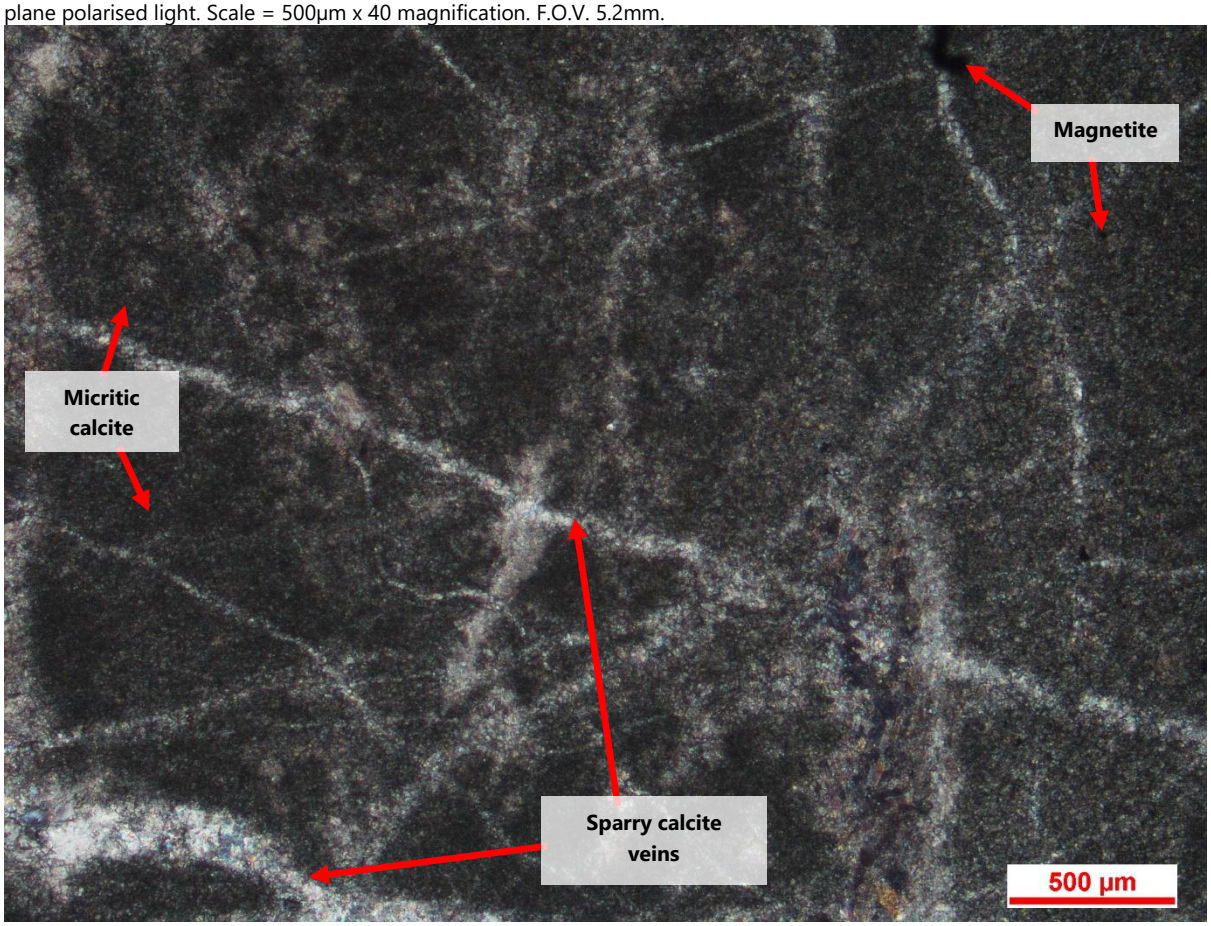


Plate 4: The same image from **Plate 3** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 5.2mm.

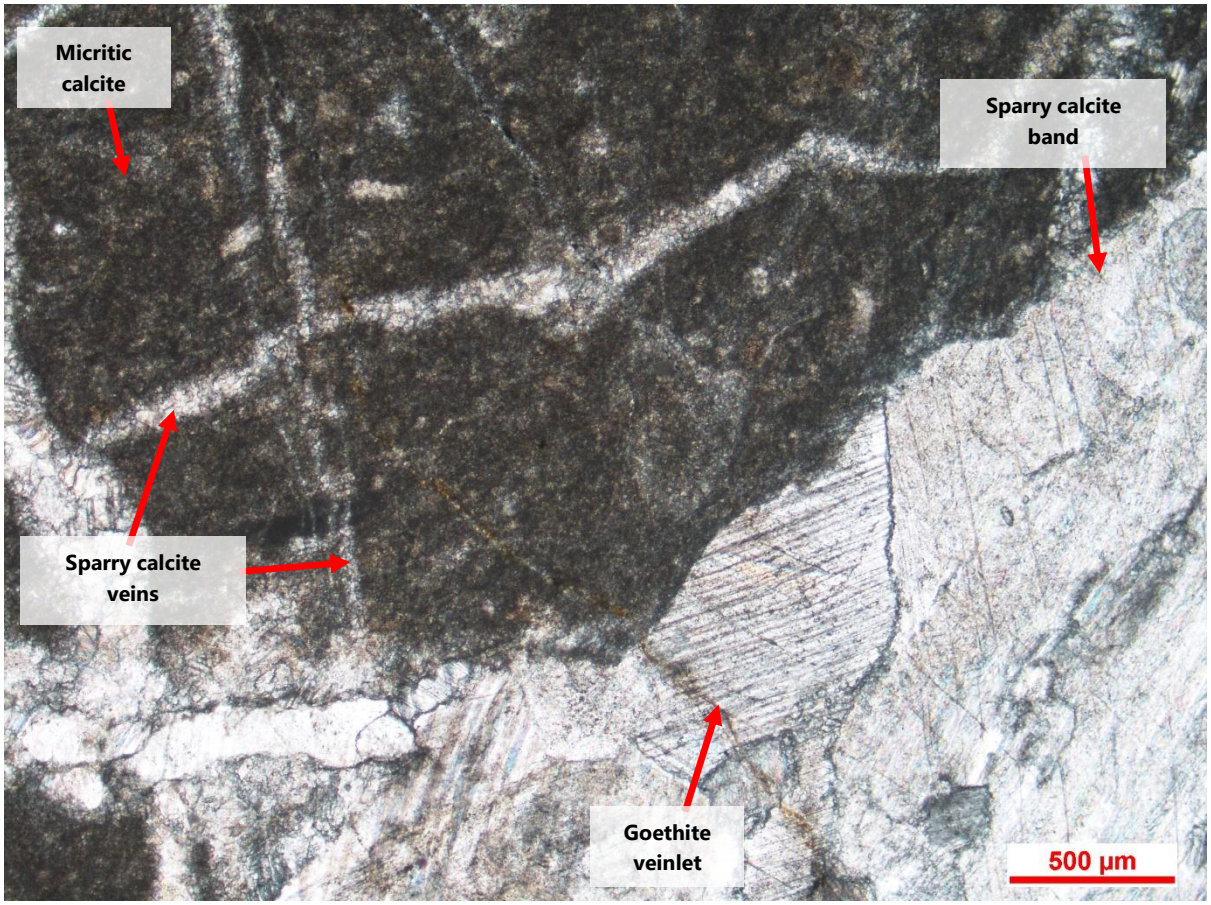


Plate 5: Microphotograph of the sample, showing sparry veins and a large sparry band crosscutting the micritic calcite. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 5.2mm.

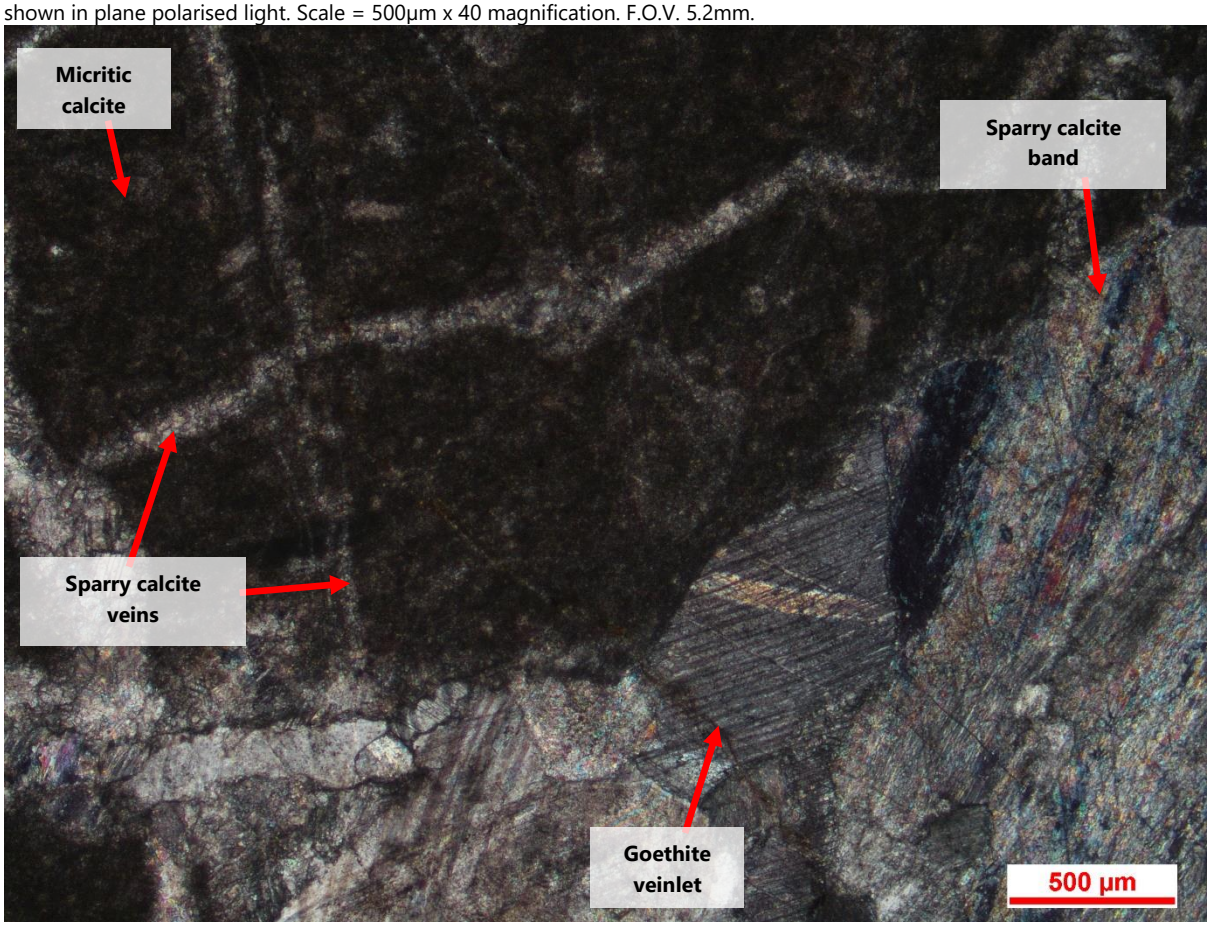


Plate 6: The same image from **Plate 5** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 5.2mm.

Summary

The roadbase sample is identified as being derived from a limestone source rock. The limestone is considered hard, strong, and is expected to be durable. Pending material testing, aggregate produced from this rock is regarded as suitable for use as coarse aggregate in concrete, unbound pavements, cover aggregate, graded asphalt and gabion/revetment. The sample is expected to perform well as roadbase. Extensive crushing to produce manufactured sand may submit elevated goethite particles but is otherwise considered suitable for use as fine aggregate in concrete.

For engineering purposes, the source rock may be summarised as:

- A **limestone**, a carbonate sedimentary rock.
- Slightly weathered with abundant goethitic fines, **non-porous** and without voids or extensive internal fracturing.
- Predominantly composed of **robust calcite (93%)**, with 7% weak goethite.
- Containing no free silica.
- Assessed as **innocuous in regard to ASR** in concrete.
- **Hard**, of predicted **high strength** and predicted to be **durable**.

Groundwork Plus Resources Environment Planning Laboratories
Phone: 1800 GW PLUS (1800 497 587)
Email: info@groundwork.com.au
Website: groundwork.com.au
ABN 13 609 422 791

Petrographic Inspection Report

Prepared for:	Superior Quarry Testing
Purchase Order:	329
Material Source:	Graymont (Australia) Pty Ltd – Calliope
Sample Type:	Source Rock – Coarse Aggregate
Sample Number:	7596
Date Sampled:	01/12/2022
Date of Inspection:	01/02/2023
Report Issued:	03/03/2023
Project/ File Ref.:	P2022_220_01

Author:

Mathew Beddard (BSc)

Petrologist
Groundwork Plus

Reviewer:

Rod Huntley (BSc, M.App.Sc, M.Eng)
Principal Resource Consultant
Groundwork Plus

Enquiries regarding the content of this report should be directed to Groundwork Plus 07 3871 0411*. Samples are disposed of after 3 months from the date of report. Thin sections will remain on site indefinitely. The analysis is based on a limited number of thin sections and sample provided by client, further investigation may be required. Interpretations are specific to the sample examined only.*

Copyright © *These materials or parts of them may not be reproduced in any form, by any method, for any purpose except with written permission from Groundwork Plus.*

Executive Summary

Classification: Limestone

For Engineering Purposes AS 2758.1: Coarse aggregate derived from carbonate sedimentary rock

Key Material Risk: Negligible risk

Table 1 – Summary of Sample's Compositional Characteristics

Compositional Features	%	Comments
Robust Phases	99	**Major (>20%):** calcite; **trace (<1%):** opaques
Weak Phases	1	**Minor (1-5%):** goethite
Clays	0	None observed
Micas	0	None observed
Sulphides	0	None observed
Carbonates	99	Calcite
Textural Features	**Yes/ No**	
Fracturing/veins	Yes	Abundant diagenetic sparry calcite veins. Minor goethite veins. No fractures observed
Voids	No	None observed
Free Silica	**%**	
Unstrained quartz	0	None observed
Optically strained quartz	0	None observed
Microcrystalline quartz	0	None observed
Siliceous volcanic glass	0	None observed
Opaline/chalcedonic quartz	0	None observed
Total	0	

Table 2 – Risk Rating for Specific Applications and Material Characteristics

Specific Application	Low	Mod	High	Comments
Coarse Aggregate in Concrete (MRTS70)	✓			Texturally isolated secondary/weak phases unlikely to cause deleterious reactions or significantly increase water demand in concrete
Manufactured Sand	✓			Expected to produce quality manufactured carbonate sand
Aggregate Unbound Pavements (MRTS05)	✓			Suitable hardness, strength, and durability
Cover Aggregate (MRTS22)	✓			Suitable hardness, strength, and durability
Graded Asphalt Aggregate (MRTS101)	✓			Suitable hardness, strength, and durability
Gabion/Revetment	✓			Suitable hardness, strength, and durability
Material Characteristics	**Low**	**Mod**	**High**	**Comments**
Hardness	✓			Hard
Strength	✓			Strong
Durability	✓			Durable
ACR in concrete	✓			Innocuous. No dolomite detected
ASR in concrete	✓			Innocuous. No reactive silica detected

Introduction

This report provides the results of a general petrographic assessment of an aggregate sample, which was submitted to the Groundwork Plus petrographic laboratory, and describes the method and standards used to assess the sample. The supplied sample was sampled by the client and sent to the Groundwork Plus petrographic facility. The thin section was prepared and analysed by Groundwork Plus with instructions from the client to conduct petrographic testing to ASTM C295 and recommend further testing if significant deleterious characteristics are identified pursuant to Clause 16.3 of this standard. The provided modal mineral percentages relate to the supplied sample which is understood to be representative of material on site. Assessment regarding the Alkali-Silica Reactivity (ASR) potential of the aggregate has been advised by SA HB 79-2015. Communication of findings are advised by AS 1726-2017 Geotechnical Site Investigations.

Methodology

The petrographic assessment of the slide is carried out using a Nikon polarising microscope equipped with a digital camera at the Groundwork Plus petrographic laboratory. Photographs of the hand specimen and thin section photomicrographs showing grain sizes and any particular aspects of the minerals are included as part of the report (**Plates 1** to **6**). Modal analysis is conducted on the sample using a Pelcon automatic point counter on at least 200 points (**Table 3 – Modal Analysis of Minerals**).

The petrology assessment is based on:

- ASTM C 295 – 2019 Standard Guide for Petrographic Examination of Aggregates for Concrete.
- AS 2758.1 – 2014 Aggregates and Rock for Engineering Purposes Part 1: Concrete Aggregates (Appendix B).
- AS 2758.2 – 2014 Aggregates and Rock for Engineering Purposes Part 2: Aggregate for sprayed bituminous surfacing.
- AS 2758.4 – 2014 Aggregates and Rock for Engineering Purposes Part 4: Aggregate for gabion baskets and wire mattresses.
- AS 2758.5 – 2014 Aggregates and Rock for Engineering Purposes Part 5: Asphalt Aggregates.
- AS 2758.6 – 2014 Aggregates and Rock for Engineering Purposes Part 6: Guidelines for the specification of Armourstone.
- The accepted definition of free silica is set out in the Queensland Department of Transport and Main Roads Test Method Q188, and tested pursuant to guidelines set in Standards Australia HB 79-2015 Alkali-Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structure in Australia - Cement and Concrete Association of Australia and Standards Australia.

Hand Specimen Description

In hand specimen, the sample is identified as a coarse aggregate derived from a **limestone**, a carbonate sedimentary rock.

The sample is composed of 5mm- to 20mm-sized particles. Particles are subangular to very angular, with low sphericity. The particles are an overall light to medium grey colour, with minimal variation. The shade of grey varies according to calcite texture, with micritic calcite being darker than sparry calcite. The particles react strongly with testing acid indicating a calcite composition. Rare ferruginous staining is observed on the faces of a minor abundance of particles.

The aggregate particles are regarded as strong and hard, with competent faces. No fractures or voids are observed. No sulphides are observed and the sample is not appreciably magnetic.



Plate 1: Photograph of the sample as provided.



Plate 2: Photograph of sample when wetted.

Thin Section Description

A mode base on a count of at least 200 widely spaced points is shown in **Table 3 - Modal Analysis of Minerals**. Robust minerals make up 99% of the sample and include calcite with trace opaques. Weak minerals make up 1% of the sample and include goethite.

The limestone shows textures consistent with classification as a mudstone with minor wackestone regions. Diagenetic alteration has seen replacement of micritic calcite with sparry calcite veins and bands.

Table 3 - Modal Analysis of Minerals

Robust Minerals	Mode (%)	Comments
Calcite (micritic)	51	Calcite showing massive, micritic texture. Also includes rare bioclastic/wackestone texture
Calcite (sparry)	48	Calcite crystals showing sparry texture including twinning. Occurs as replacement of micrite.
Opaques	Trace	Trace, 0.05mm sized, rounded, opaque, magnetite crystals
Weak Minerals		
Goethite	1	Minor veins and veinlets, and disseminated orange ferruginous staining
Total	**100**	

The sample is almost entirely composed of calcite at 99%. Approximately 51% of the limestone is composed of micritic calcite, with 48% being sparry. The micritic calcite is regarded as the primary texture prior to replacement by sparry crystals during diagenesis. The micritic regions are typical of carbonate mudstones, with expansive regions of microcrystalline, massive calcite. In some areas, rare bioclasts are observed giving a more wackestone texture. Bioclasts include gastropods and bivalves. The distribution of sparry calcite is variable, with veinlets, veins, and large bands and patches observed. Some areas contain abundant crosscutting veins and veinlets; others are dominated by wide bands of sparry crystals. The remaining robust phase observed is trace opaque magnetite, which is disseminated throughout the sample as small, 0.05mm sized, rounded crystals.

Goethite forms 1% of the sample and is the only observed weak phase. Goethite occurs as ferruginous veins and veinlets. Minor patches of ferruginous staining are also observed. No dolomitisation of the limestone is observed.

Overall, the sample is considered hard, strong, and durable, and considered suitable for use as a calcareous aggregate in all applications. The aggregate is regarded as suitable for use as coarse aggregate in concrete, unbound pavements, cover aggregate, graded asphalt, and gabion/revetment. Extensive crushing is expected to produce a quality carbonate manufactured sand.

Free Silica Content

After conducting a modal analysis using the Pelcon automatic point counter on at least 200 points, the total free silica content was found to be 0%. The sample was found to contain **no reactive silica.**

According to Standards Australia HB 79-2015 and Department of Transport and Main Roads test method Q188, the provided aggregate is assessed as **innocuous in regard to ASR** in concrete.

Table 4 – Calculation of Alkali-Silica Reactivity Value

Mineral Phase	Abundance	Critical concentration	ASR Value
Reactive silica phases	0%	3.0% to 5.0%	0
		Total	**0**

Asbestiform Minerals

Asbestos can be defined mineralogically and by crystal habit. For the purposes of health screening asbestiform habit is relevant, which is defined as being hair-like (filiform) and flexible with a high aspect ratio. Based on the thin section constructed from the material supplied, the sample contains **no observable asbestiform minerals**.

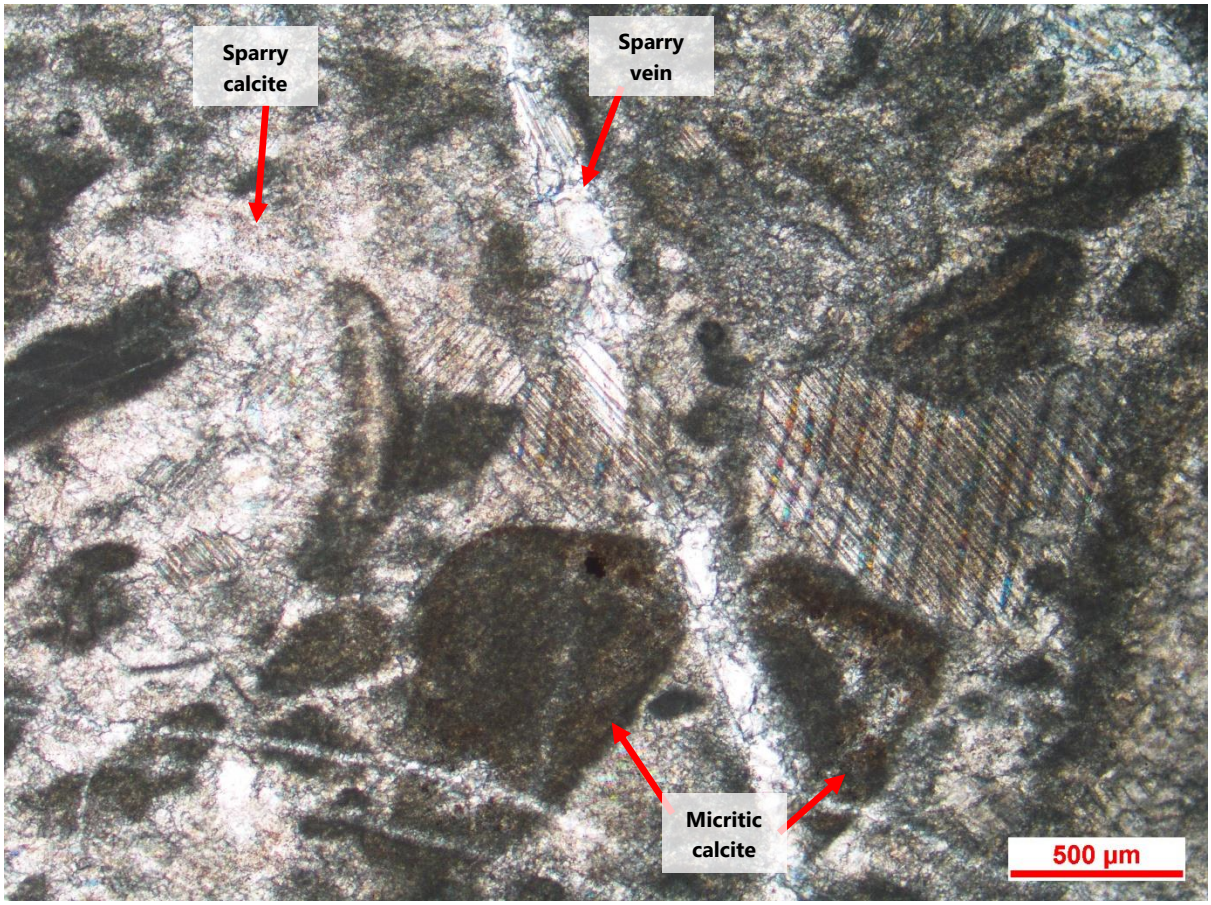


Plate 3: Microphotograph of the sample, showing remnant micritic bioclasts and regions surrounded by sparry calcite. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.2mm.

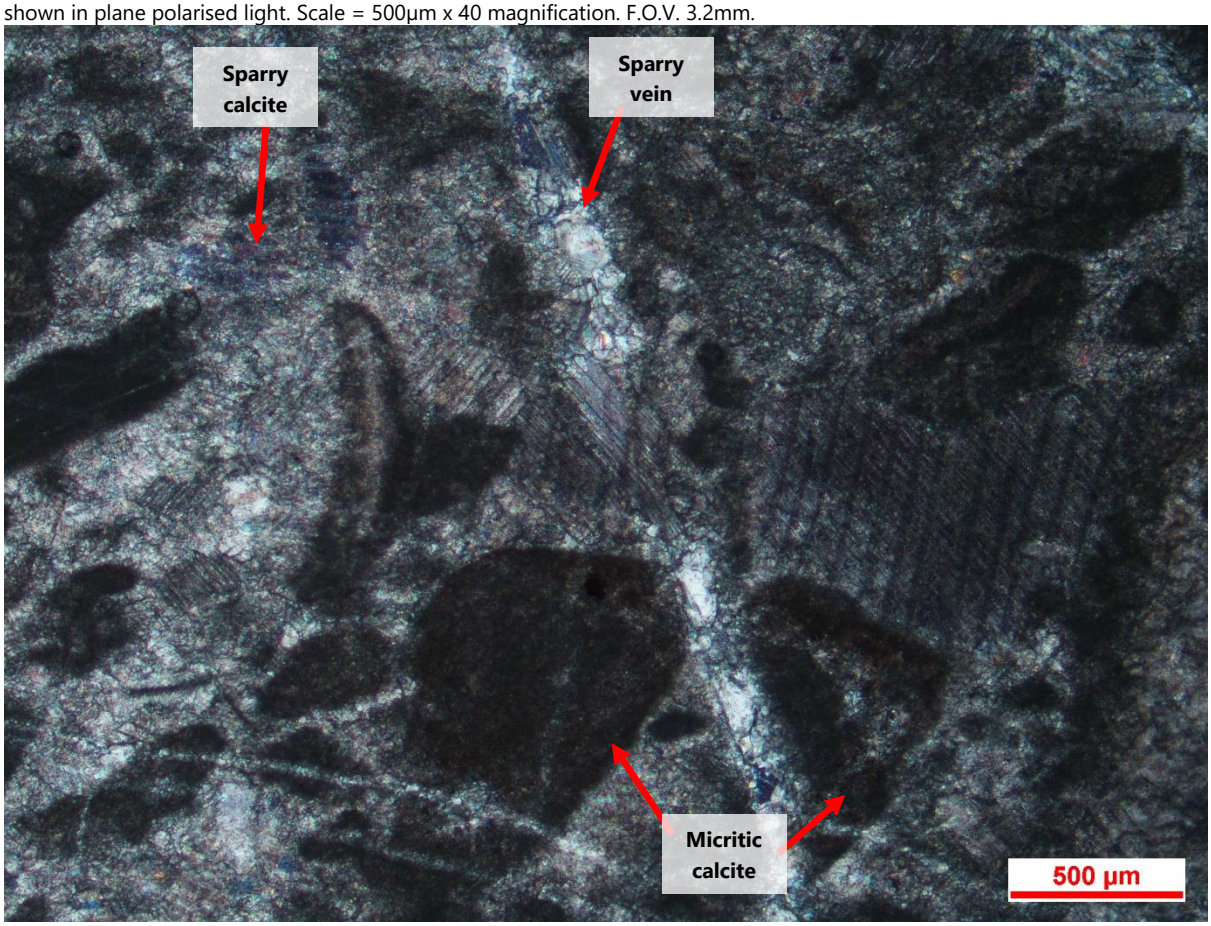


Plate 4: The same image from **Plate 3** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.2mm.

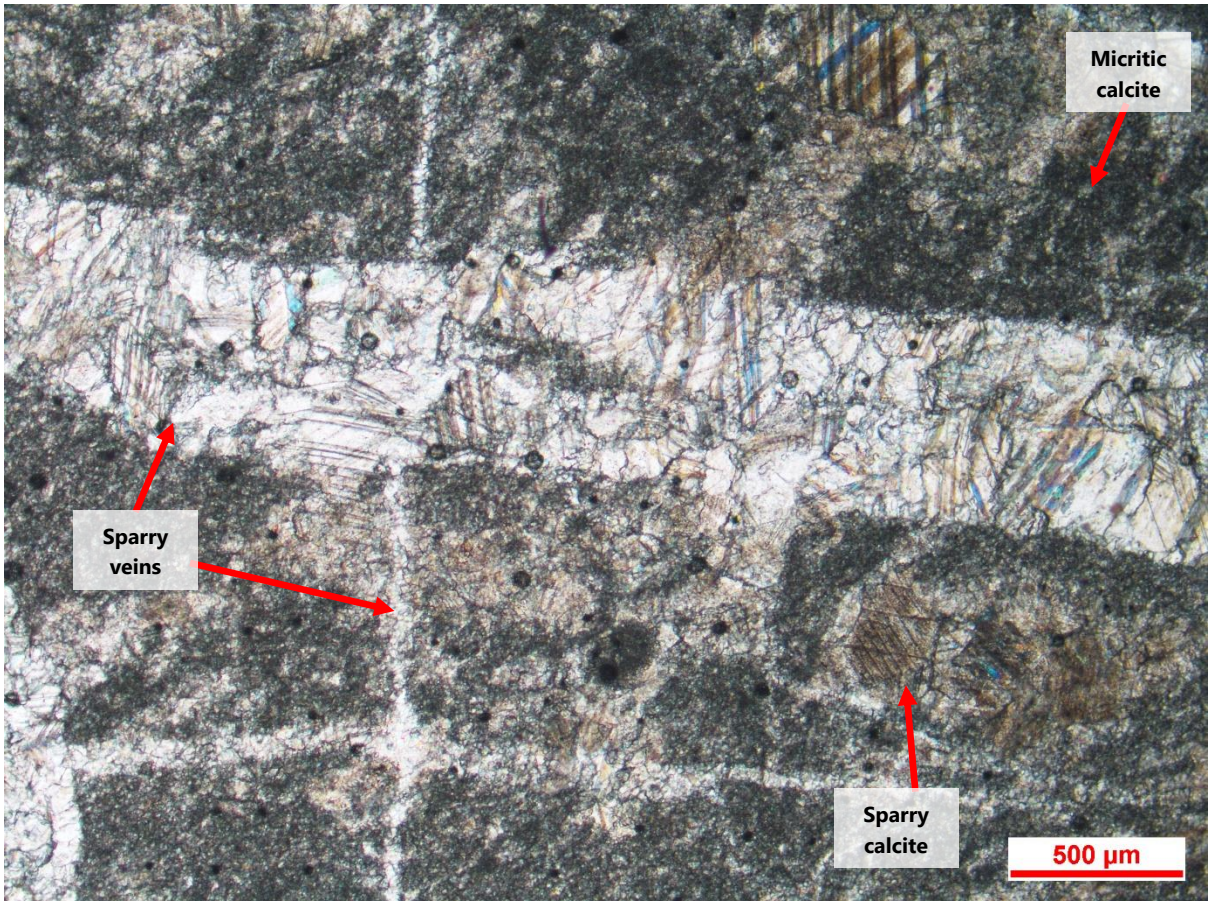


Plate 5: Microphotograph of the sample, showing crosscutting veins passing through micritic calcite. Image shown in plane polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.2mm.

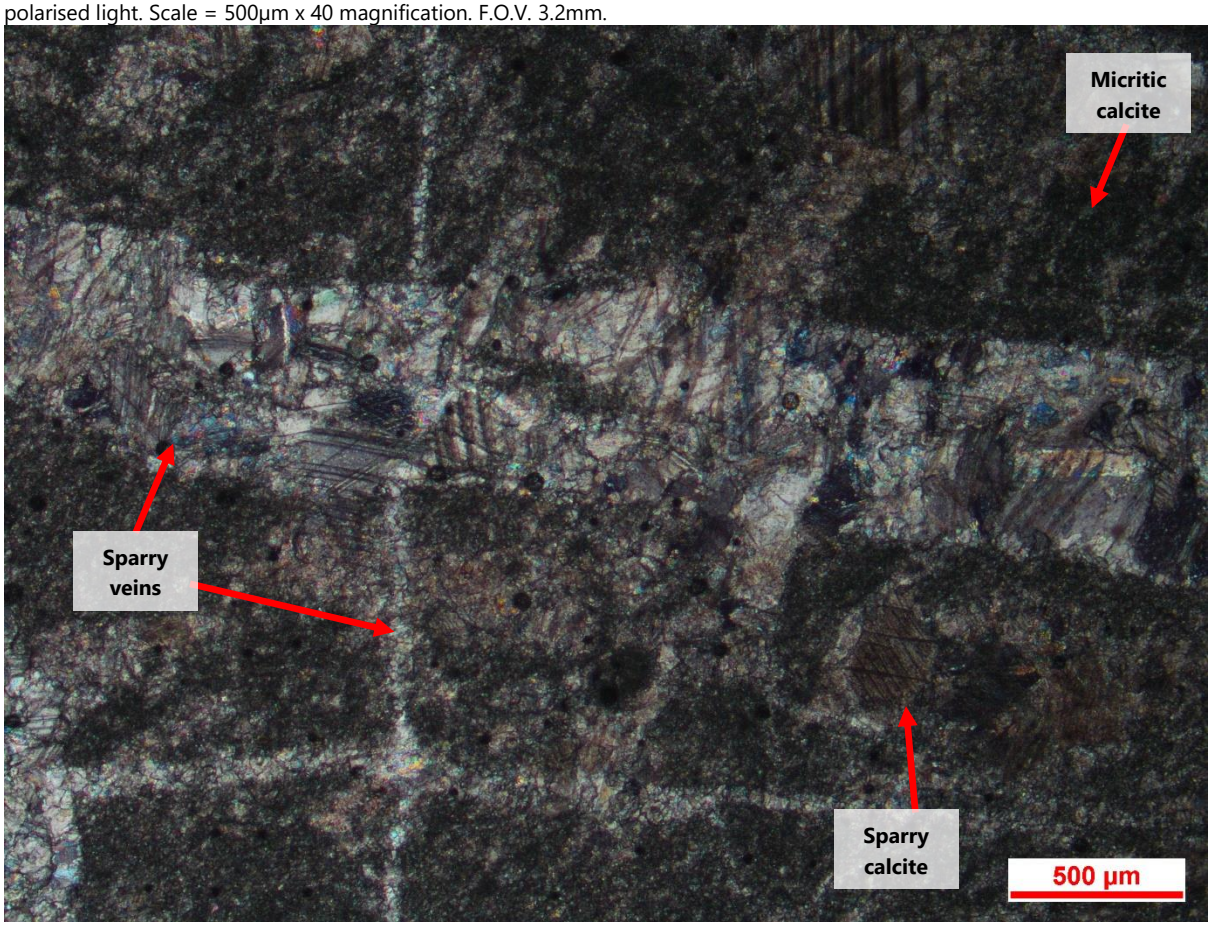


Plate 6: The same image from **Plate 5** under crossed polarised light. Scale = 500µm x 40 magnification. F.O.V. 3.2mm.

Summary

The sample is identified as a coarse aggregate derived from a limestone, a carbonate sedimentary rock type. The limestone is regarded as hard and strong, and is expected to be durable. Pending material testing, aggregate produced from this rock is regarded as suitable for use as coarse aggregate in concrete, unbound pavements, cover aggregate, graded asphalt, and gabion/revetment. Extensive crushing to produce manufactured sand is considered suitable for use as fine aggregate in concrete.

For engineering purposes, the rock may be summarised as:

- A **limestone**, a carbonate sedimentary rock.
- Mostly unweathered, **non-porous** and without voids or extensive internal fracturing.
- Predominantly composed of **robust calcite (99%)**, with 1% weak phases (goethite).
- Containing no free silica.
- Assessed as **innocuous in regard to ASR** in concrete.
- **Hard**, of predicted **high strength** and predicted to be **durable**.

ABN 25 065 630 506
PETROGRAPHIC, GEOLOGICAL & GEOCHEMICAL CONSULTANTS

28 Cameron Street
Clontarf, QLD 4019

Telephone: (07) 3284 0020
Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A 75-150 GABION ROCK (GL23-8830A) FROM GRAYMONT TARAGOOLA QUARRY

prepared for

BUTLER PARTNERS (REGIONAL)

Purchase Order: BPG4870

Invoice Number: G202307519

Client Ref: Simone Offord

Issued by

C. C. Angus
BSc, BA (Hons)
11 July 2023

Reviewed by

A.G. Christy
MA PhD FMinSoc
11 July 2023

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services

Sample ID: GL23-8830A **Date Sampled**: 17/05/2023

Geo Sample ID: G23050111 **Date Received**: 24/05/2023

Product Type: 75-150 Gabion Rock

Sample Location: Graymont Taragoola Quarry

Project: G19-121A – Quarry Quality Testing – MS24 Taragoola Rd, Calliope, QLD

Work Requested Petrographic analysis in relation to suitability for use as concrete aggregate; petrographic analysis in relation to potential for alkali-silica reactivity.

Methods Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 2015 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-2015) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia* and of the Queensland Transport and Main Roads Materials Testing Manual – Part 6 (September, 2020) *Test Method Q188: Petrographic assessment of aggregates.*

Identification Limestone

Description

The aggregate sample consisted of about 20 kg of angular and sub-angular, medium light-grey, finely crystalline limestone which is unweathered to less commonly slightly weathered (some fragments display brown limonitic and reddish hematitic staining), and apparently robust. A thin coating of white dust is easily removed by washing a small sub-sample.



Figure 1: Image of a washed subsample supplied aggregate.

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services

Mineralogy

A thin section was prepared to permit microscopic examination in transmitted polarized light of a fragment. An approximate composition, expressed in volume percent and based on a brief count of 100 widely spaced points falling within the sectioned random fragments, is:

96%	calcite (composed of 47% micritic calcite in the matrix and 49% sparry coarser calcite in veins)
<1%	quartz grains
4%	carbonaceous matter
<1%	sericite/illite
<1%	secondary iron oxide (limonite/goethite and hematite)

In thin section the rock fragments are seen to consist of abundantly veined, finely crystalline limestone; some of the fragments are fossiliferous.

The fragments display carbonate textures, now largely overprinted by fine mosaic recrystallization and cut by numerous veins of mobilized calcite; ghosted remnants of fossils are observed in some fragments. Matrix carbonate is of finely crystalline, micritic style (finer and slightly muddy), around 0.005 to 0.02 mm in grainsize. Numerous and irregular veins around 0.02 to several millimetres wide carry sparry calcite with a grainsize up to at least 2.5 mm associated with a little limonite/goethite and hematite. Some quite thin and complexly shaped stylolites are delineated by fine carbonaceous matter which is accompanied or replaced by limonite.

Normative Requirements

As per the Queensland Department of Main Roads Test Method Q188, the following normative requirements have been tabulated.

Requirement	Result
Quartz Content	<1%
Alkali Silica Reactivity (ASR) Potential[1]	Innocuous
Asbestos[2]	None observed
High sodium/potassium minerals	None observed
Sulphide content	None observed
Clays and moisture sensitive materials	4%
Carbonate Content	96%
Glass Content	None observed

[1] See ASR potential calculation below

[2] Not completed to the 2004 *Method for the Qualitative Identification of Asbestos in Bulk Samples*

Comments and Interpretations

This supplied 75-150 Gabion Rock sample (GL23-8830A) from Graymount Taragoola Quarry is interpreted to represent limestone, a biochemical sedimentary rock which has been indurated and rendered non-porous by diagenetic, fine recrystallization and by abundant veining by mobilized and coarsened calcite.

For engineering purposes, the rock in the supplied aggregate sample may be summarised as:

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services

- **limestone**, a biochemical sedimentary rock
- almost pure calcium carbonate (carrying 4% of other minerals)
- finely recrystallised
- abundantly veined
- non-porous
- unweathered and less commonly slightly weathered
- having a **hardness of only about 3** on the Mohs hardness scale (in contrast to a Mohs hardness of 7 for quartz) making it **moderately robust**.
- soluble in even dilute or weak, natural or synthetic acids

The product is interpreted to be **innocuous in relation to both alkali-silica**: it lacks the free silica necessary for deleterious alkali-silica reaction.

Optical differentiation between calcite and dolomite is inexact. The sample has the **potential to be reactive in relation to alkali-carbonate reactivity**. It is recommended that XRD analysis be carried out if detailed separation of carbonate species is required.

Thus, limestone equivalent to the supplied aggregate sample is predicted to be **suitable for use in concrete aggregate**, provided that it is not exposed to heavy abrasion and not exposed to attack by acids. It is also unsuitable for concrete intended for specialised high-temperature applications, since carbonates can decompose explosively under such conditions.

Free Silica Content

Apparently less than 1%.

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services

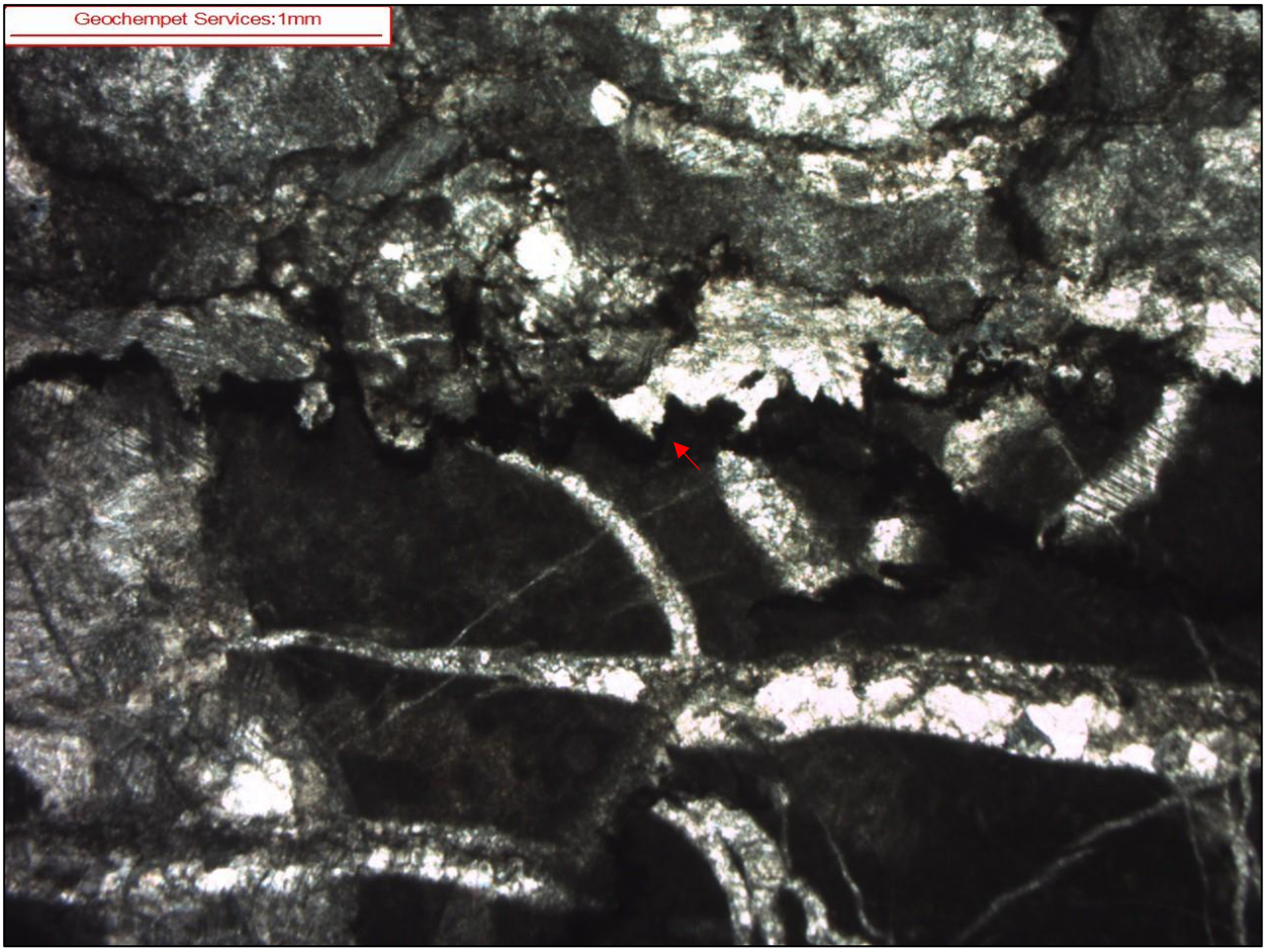


Figure 2: Micrograph taken at low magnification (2× objective) with transmitted cross-polarised light of a limestone fragment. Note the sparry calcite hosted within veins, the micritic calcite in the groundmass and stylolites carrying carbonaceous matter indicated by the red arrow.

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services

Material Test Report

Superior Quarry Testing Pty Ltd
ABN: 49 103 442 402
ACN: 614 194 900
Address: Unit 4/189 Anzac Avenue
Toowoomba Qld 4350
Phone: 0412 694 063
Email: mal@superiorquarrytesting.com

Client:	Graymont (Australia) Pty Ltd
	MS 24 Taragoola Road
	Calliope Qld 4680
Project:	Compliance

Report No:	**9611**
Issue No:	**1**

Sample Details

Sample Number:	8704
Client Reference:	-
Date Sampled:	14/6/2023
Date Received:	22/06/202320/6
Material Source:	Calliope
Material Type:	Source Rock - Coarse Aggregate
Specification:	-
Sampling Method:	Tested as Received
Sampled From:	-
Location:	-
Lot No:	232006
Sampled By:	Submitted By Client

NATA Accredited Laboratory Number:20085

ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory: Mal Nicholls

Date of Issue: 11/07/2023

Accredited for compliance with ISO/IEC 17025 - Testing

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Report Notes:

1. The results in this report relate only to the items tested.

2.The results in this test report apply to the sample as received. Sample information was provided by the client.

Testing Completed: 11/07/2023

Test Results

Test Method	Details	Results	Min	Max	Tar
AS1141.6.1	Particle Density Dry (t/m3)	**2.70**			
	Particle Density SSD (t/m3)	**2.71**			
	Apparent Particle Density (t/m3)	**2.72**			
	Water Absorption (%)	**0.2**			
AS1141.22	Nature of Bulk Sample	Crushed Rock			
	Nominal Size of Aggregate (mm)	20			
	Size Fraction of Test Portion (mm)	-13.2/+9.5			
	Dry Strength (kN)	**138**			
	Wet Strength (kN)	**133**			
	Wet/Dry Strength Variation (%)	**4**			
	Breakdown During Preparation	No			
	Size of Test Cylinder (mm)	150			
Q208B	Washington Degradation Factor	**34**			
AS1141.23	Los Angeles Value (%)	**26**			
	Selected Test Grading	B			
AS1141.24	Sodium Sulphate Soundness				
	Nature of Sample	Aggregate			
	19.0 - 13.2mm Loss (%)	0.2			
	13.2 - 9.5mm Loss (%)	0.3			
	9.5 - 4.75mm Loss (%)	0.5			
	Total Weighted Loss (%)	**0.2**			
AS1012.20.1	Qualitative Test- Positive/Negative	**Negative**			
	Chloride Content (%m/m)	**0.000**			
	Analysis Method	Volhard Titration			
AS1012.20.1	Qualitative Test- Positive/Negative	**Negative**			
	Sulfate Content - SO3 (%m/m)	**0.04**			
	Analysis Method	Gravimetric			

Comments:

APPENDIX G FINAL LANDFORM DESIGN REPORT

GRAYMONT

Calliope PRCP Final Landform Report

Author: Jared Parkes

Date: 19th June 25

Graymont Mining & Geology
Level 16, 111 Pacific Highway
North Sydney NSW 2060
AUSTRALIA

CONTENTS

CONTENTS **2**

TABLES **2**

FIGURES **2**

1. INTRODUCTION **4**

2. 3D DESIGN AND METHODS FOR CLOSURE **4**

2.1 Pit 3-4 4

2.2 Pits 1 and 2 5

2.3 Southern WRD 6

2.4 Void Closure Plan 7

3. DOCUMENTED TESTING REGIME **7**

4. LIMITATIONS AND ASSUMPTIONS OF THE FINAL LANDFORM DESIGN **8**

5. MATERIAL BALANCE **8**

6. MATERIAL AVAILABLE FOR LANDFORM REHABILITATION **8**

7. WASTE PLACEMENT STRATEGY **9**

7.1 Pit 4N Cut Stage 1 and Southern Waste Rock Dump 9

7.2 Pit 4N Cut stage 2 / Inpit backfill Stage 1 10

7.3 Pit 4N Cut stage 3 / Inpit backfill Stage 2 11

7.4 Pit 4N Cut stage 4 / Inpit backfill Stage 3 12

7.5 North out of pit dump, laydown area and abandonment bund 13

7.6 Reprofiling southern waste rock dump 14

7.7 Option 2 Working the pit from south to north 14

8. FINAL LANDFORM **15**

TABLES

Table 1: Proposed geotechnical rehabilitation milestone criteria for the residual voids and SWRD at Calliope 7

Table 2: Calliope Material Balance 8

FIGURES

Figure 1. Pit 4 cut stage 1 9

Figure 2. Southern Waste Rock Dump (Full Dump Footprint Extent) 10

Figure 3. In-pit backfill after north cut stage 2. 10
Figure 4. In-pit backfill after north cut stage 3 11
Figure 5. In-pit backfill after north cut stage 4 12
Figure 6. Inpit backfill at end of mine life, removal of the northern out of pit dump and levelling laydown area 13
Figure 7 Reprofile Southern WRD, southern in-pit fill and abandonment bund 14
Figure 8. Final Landform 15

1. INTRODUCTION

The Calliope Limestone Quarry is operated by Graymont (Calliope) Pty Ltd. The Project involves the operation of an open cut limestone quarry that produces approximately 0.8 million tonnes per annum (Mtpa) of limestone products. The Project commenced operations in 1967 and, noting potential future changes in reserves and yearly sales quantities, has a planned end of mine life (EOML) in 2100. The Project is located approximately 11 kilometres (km) south of the township of Calliope and 30 km south of Gladstone in Central Queensland within the Gladstone Local Government Area.

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 de-risking design and minimising footprint size, material balance, material available for landform rehabilitation, and the waste placement strategy.

2. 3D DESIGN AND METHODS FOR CLOSURE

There are approximately 30 landholders within a 5 km radius of the site, however, based on the topography, and the rural location of the quarry, there is not expected to be any visual impact from rehabilitation at these sensitive receptors. The quarry is surrounded by grazing land to the north, west, and south, and Lake Awoonga to the east. There was no feedback received during community consultation undertaken at the Quarry Open Day on 4th March 2023 that impacts the final landform design.

The long-term stability of the landforms has been considered within design and described further in the Geotechnical Assessment (GA) prepared by Rocktest for the Progressive Rehabilitation and Closure Plan (PRCP) and an erosion assessment included in the Rehabilitation Planning Part. Hydrological and hydrogeological assessments have informed the final landform design. Further discussion is provided in the hydrogeological assessment (Graymont).

2.1 PIT 3-4

Pit 3-4 is the main pit being currently mined at Calliope and will make up the largest void at closure. A mine optimisation study was completed to define the size of the economic pit limits. As the modelled ore body is massive and extends beyond mining leases and other surface constraints, the pit is planned to be mined to the full extent that these constraints allow. For this reason, there is no way that the final void can be reduced in surface area disturbance without sterilising viable reserves.

Pit 3-4 is planned to be mined in four stages, with indicative timeframes as follows:

Stage 1- 2027 - 2060

Stage 2- 2050 – 2070

Stage 3- 2060 - 2090

Stage 4- 2080 - 2100

Conceptual plans for the 4 stages are shown in Section 7 - Waste Placement Strategy of this report.

As the quarry produces between 10% and 20% 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 and 2 will occur over 35 years focusing on the northern extent of the Pit. To provide in-pit backfill room at final pit floor level, a large portion of the full pit surface extent will need to be disturbed in Stage 1. Stage 3 will commence approximately 10 years prior to Stage 1 and 2 being finalized. During Stage 3, Pit 3-4 will become amalgamated, with the eastern and western walls of the central Pit being pushed out to the maximum disturbance extent. Similarly, Stage 4 will commence approximately 10 years prior to Stage 3 being finalized and will involve final mining operations in the southern extent of the Pit.

Vertical and lateral expansion of Pit 4 is projected to occur in the form of a range of cutbacks (using conventional drilling and blasting methods) on the current pit. Blasting occurs approximately once a month within the confines of ML3594, ML3604, ML3608 and ML80190, and trucks transport loose material from Pit 4 to the ROM pad for processing. To efficiently mine Pit 3-4, access roads are required to be maintained above the eastern and western sides of the pit for the life of mine. Expansion of Pit 4 is proposed to occur in four stages from north to south, over a period of approximately 68 years. Expansion will involve widening Pit 4 to the final east and west limits and progressing to the south, with Pit 3 being amalgamated with Pit 4 to form the final pit shell. A south to north mining approach has also been considered in the final landform design report.

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.

The final Pit 3-4 void dimensions will be approximately 1,700m long by average 650m wide by up to 117m deep. Following further pit optimisation, it is possible that an updated design will propose to mine deeper than the current pit limit of -56mRL as ore exists below this level. Overall toe to toe slope angles are designed to be less than 38 degrees to comply with the GA. This void will be largely filled with water following closure.

Backfill in the Pit 3-4 void will be mostly constructed using waste material from mining, processing, and removal of the Northern Waste Rock Dump. Backfill is not required to provide stability of the final pit slopes, however it will generally be placed in layers less than 10m thick and either tracked with dozers or wheel rolled with trucks to provide a level of compaction. 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.

Pit structures will not require a lining to prevent water or air ingress as it is planned that the pit will be flooded and there is no contaminated or acid generating mine waste material (refer to the Waste Characterisation report appended to the PRCP) within the pit void.

An abandonment bund has been allowed for as close to the final pit crest as practicable considering 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 derisk the final landform are:

- Installing abandonment bunds behind the crests of each pit.
- Reducing batter angles of sections of the upper benches comprising extremely weathered rocks and soil.
- Installation of a lockable gate to prevent unauthorised access to the void
- Filling karst caverns then covering the stripped ground with broken rocks.
- Installing warning signs around the pits and restricting public access to the site.

2.2 PITS 1 AND 2

Pit 1 was a small void to the northeast of Pit 3-4 which has been backfilled with clean rock waste material from operations. The final landform of this area will be flat to gently inclined to make it suitable for the grazing post mine land use.

Pit 2 is an historic void mined from the mid ‘60s until the mid ‘70s. The pit is used to store water for operation of plant and facilities and therefore will be required to remain as a void till EOML. The pit is 435m

long and 235m wide and approximately 37m deep. At the end of operations upper slopes will be regraded in accordance with the recommendations in the GA and the pit allowed to fill with water.

2.3 SOUTHERN WRD

The Southern WRD will be constructed initially up to 72mRL which is below the highest level of ~74m RL of the existing landform to the east of the dump. Construction will be generally undertaken using a bottom-up approach in layers. At the end of mine life the WRD will be reprofiled with a maximum height of 23m at 62mRL and have slopes less than 12 percent. Stability of the final landform will be achieved following recommendations in the GA.

The final Southern WRD footprint within the mining lease is 19.7Ha. Access tracks around the base of the dump have been included to provide access to various parts of the site predominantly for monitoring purposes.

The cores of the outer slopes of the dump will be constructed in a series of lifts from the bottom up, beginning on the natural surface. The procedure used to do so will compact the materials, so they achieve their greatest practical strength and lowest practical permeability:

1. Strip topsoil and vegetation from the natural surface.
2. Trucks dump waste materials in a pile.
3. The material is spread in a near horizontal layer as thin as practical.
4. Moisture condition (i.e., damp) the material.
5. Use repeated passes of equipment to compact the material until no further compaction occurs with additional passes.
6. Repeat stages 2 to 5 for subsequent lifts.

The slopes are advanced in the same directions as the topography. No major drainage paths are blocked by the toes of the dump. As the Southern WRD is designed for grazing the slopes have very high factors of safety as calculated indicated in the GA.

After the EOML, the principal strategies to reduce the risks applicable to the WRD will be:

- Ensuring all slopes have acceptable stabilities and the toe of the northern slope is a sufficient distance from the crest of the south wall of Pit 4.
- 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 southern WRD are shown in tables 9 and 10 of the GA.

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 and is shown in **Table *1*** below.

Landform	Rehabilitation milestone reference	Rehabilitation milestone reference	Milestone criteria
Residual voids (Pit 2 and Pit 3-4)	RM3	Landform development and reshaping / re-profiling of residual void	• An Appropriately Qualified Person (AQP) has confirmed that geotechnical stability of the residual void walls (i.e., a factor of safety value of ≥1.2) has been achieved. • Pit 3-4 batter slopes meet final design specifications (18° in weathered rock, 65° in unweathered rock) • Pit 2 maximum overall slope angle meets final design specifications (34°) • Perimeter abandonment bund and safety signage installed offset, as specified by an AQP, from the crest of the voids • Locked gates and signage installed at access points to the residual voids to prevent unauthorised access • AQP certifies that void final landform design intent has been achieved
	RM10	Achievement of post-mining land use to stable condition (water storage)	• Visual inspection by an AQP provides evidence that the stabilities of the residual void crests and walls have remained constant or increased following cessation of mining and rehabilitation activities
Southern WRD	RM4	Landform development and reshaping / re-profiling of waste rock dump	• As built inspection by an AQP confirms that the final landform design intent has been achieved, and batter slopes do not exceed 12%
	RM11	Achievement of post-mining land use to stable condition (grazing)	• Visual inspection by an AQP provides evidence that the geotechnical stability of the southern WRD has remained constant or increased following completion of rehabilitation activities

Table 1: Proposed geotechnical rehabilitation milestone criteria for the residual voids and SWRD at Calliope

4. LIMITATIONS AND ASSUMPTIONS OF THE FINAL LANDFORM DESIGN

Quarrying activities in future Pit 3-4 will continue for approximately 80 years until EOML in 2100. 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 Calliope for a five-to-ten-year period, and it is likely that future mine plans and unforeseen mine parameters might delay or change intended schedules for future Pit 3-4.

Assumptions have been made about these mine parameters include 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 Calliope Limestone Quarry. It is noted that conservative estimates of the LOM, with an EOML of 2100, have been prepared based on the material balance and final landform design. However, if refinements from future calculations will impact when Pit 3-4 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 the18th Nov 24 survey is shown in **Table 2**. The total waste quantity has been calculated from the 2025 geological block model. It is noted that the actual waste generated over time may vary from that predicted in this model based on geological uncertainty, ore recovery and markets for ore and waste products.

The mass balance shows that the full Interim Southern WRD volume of 2.9 Mm3 is required to provide time to create in-pit backfill room. It is assumed that some in-pit backfill room will be available prior to completing each cut stage as shown in **Table 2**.

Calliope LOM Plan Cut vs Fill Material Balance							
Cut			Waste Rock Dump Capacity				
	Description	Waste lcm	South WRD Initial m3	Stage 1 Floor m3	Stage 2 Floor m3	Stage 3 Floor m3	In-Pit North & In-Pit South Dump m3
			2,858,945	**653,185**	**1,593,267**	**2,446,138**	**3,810,880**
Stage 1	Stage 1 cut to Southern WRD	2,936,373	2,858,945	77,428			
Stage 2	Stage 2 cut to Stage 1 floor	844,414		575,757	268,657		
Stage 3	Stage 3 cut to Stage 2 floor	1,476,049			1,324,610	151,439	
Stage 4	Stage 4 cut to Stage 3 floor	3,216,935				2,294,699	922,236
North Out of Pit WRD	North out of pit WRD to Stage 4 floor	1,081,159					1,081,159
Southern WRD reprofile	SWRD to South in-pit dump	1,423,490					1,423,490
Dump balance remaining room			-	-	-	-	**383,995**

Table 2: Calliope Material Balance

6. MATERIAL AVAILABLE FOR LANDFORM REHABILITATION

Material available for landform rehabilitation is overburden from the upper 5-30m and waste material from processing of the limestone. Total waste is expected to be in the vicinity of 10-20% of the total mined quantity. The approximate waste produced from the site including exiting waste that needs to be relocated from 2025 to the end of mine life is shown in **Table 2**.

No material will be required to complete rehabilitation of Pit 2 and Pit 3-4. The Interim Southern WRD will be formed with nominal 13° slopes using truck excavator and dozer push and reprofiled to 12 percent at the end

of mine life. As the overburden rock in this area will be used to form the final landform, no other additional material is required. Topsoil quality is considered further in the main PRCP document.

7. WASTE PLACEMENT STRATEGY

The conceptual LOM quarry and dump staging is shown in figures 1 to 7 below.

7.1 PIT 4N CUT STAGE 1 AND SOUTHERN WASTE ROCK DUMP

Pit 4N Cut Stage 1 concentrates on the northern end of Pit 4 to provide a void for placement of in-pit backfill as shown in **Figure *1***. During this stage backfill will be placed in the Southern WRD to the full dump footprint extent as shown in **Figure 2**. It is possible that a small amount of material may be able to be placed in the pit prior to mining the full stage 1 block.

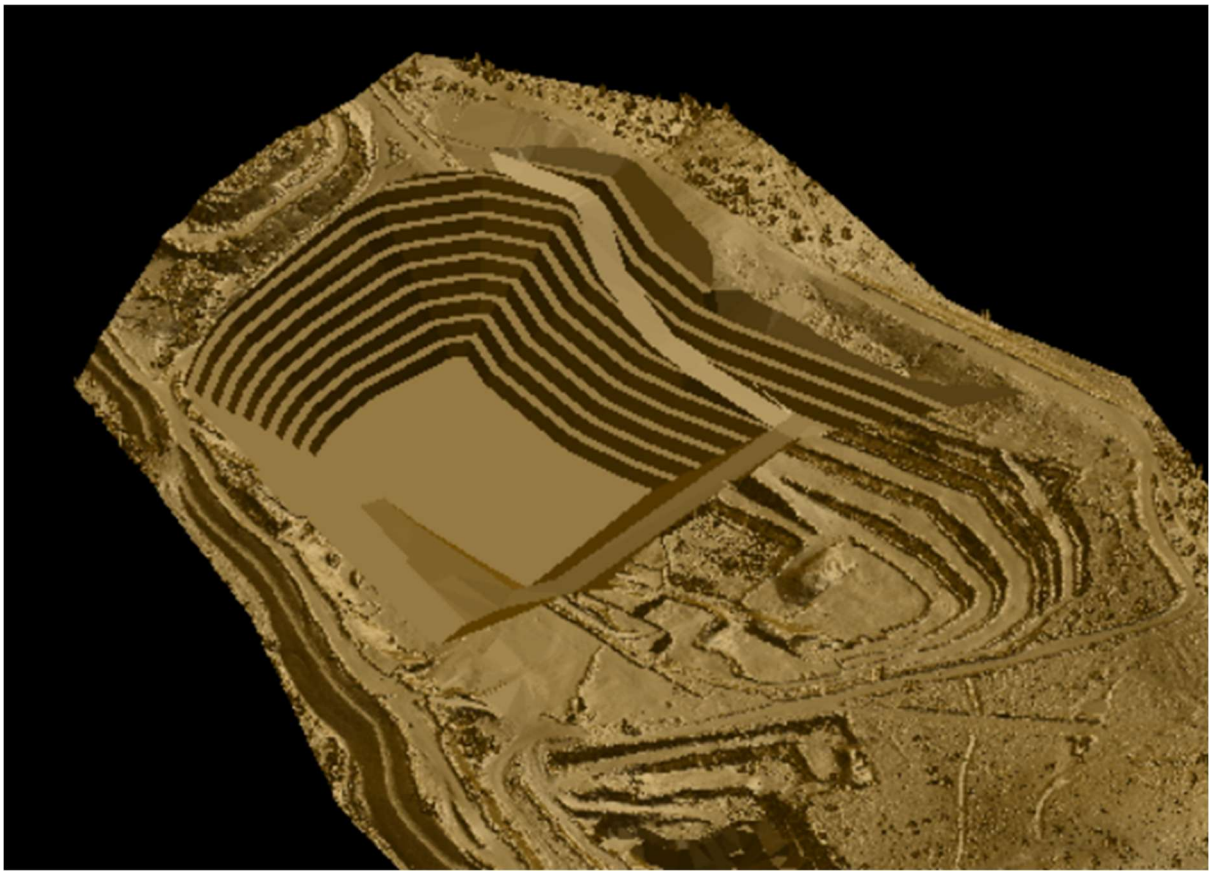


Figure 1. Pit 4 cut stage 1

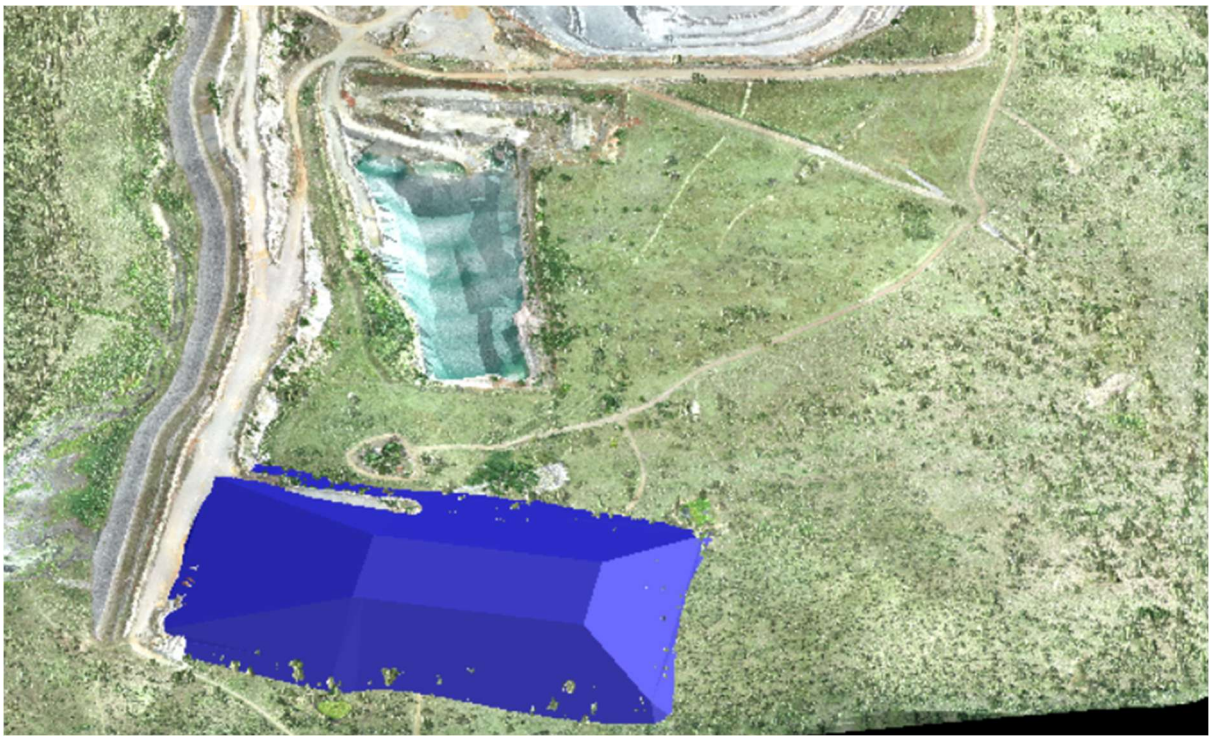


Figure 2. Southern Waste Rock Dump (Full Dump Footprint Extent)

7.2 PIT 4N CUT STAGE 2 / INPIT BACKFILL STAGE 1

Pit 4N Cut Stage 2 expands the Stage 1 cut to the south. This material is placed in the void that was created during Cut Stage 1 as shown in **Figure 3**.

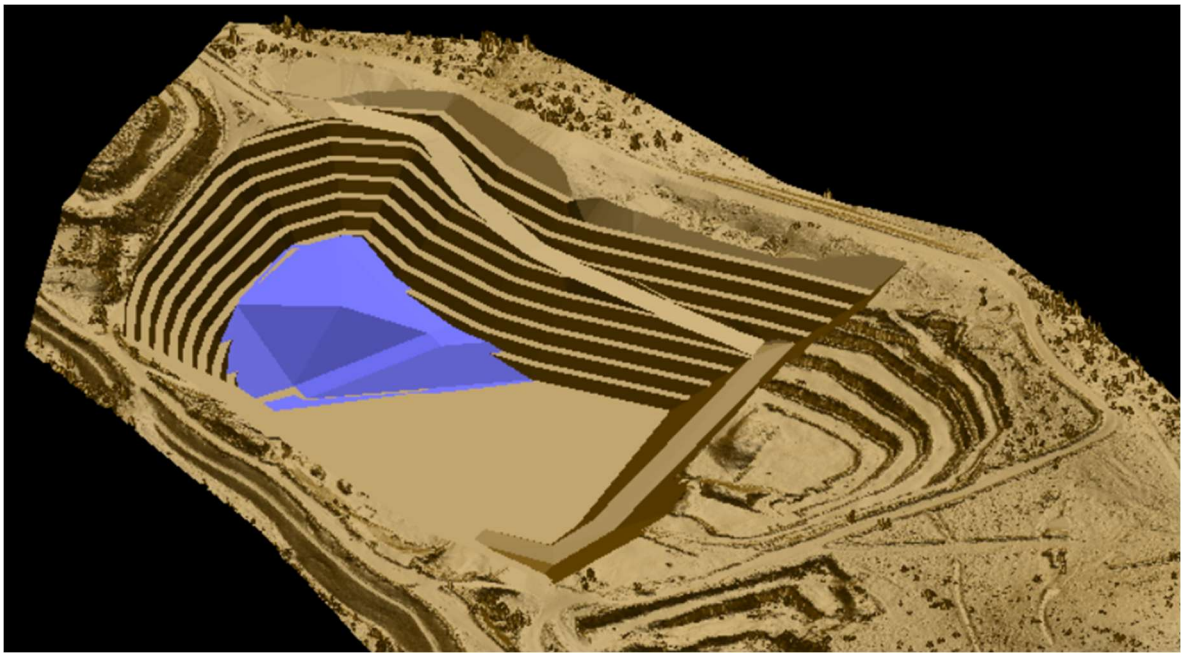


Figure 3. In-pit backfill after north cut stage 2.

7.3 PIT 4N CUT STAGE 3 / INPIT BACKFILL STAGE 2

Pit 4N Cut Stage 3 widens the stage 2 cut to the south. This material is placed in the void create during Stage 1 and 2 Cuts as shown in **Figure 4**. Access is maintained to the southern upper benches with a south-eastern ramp.

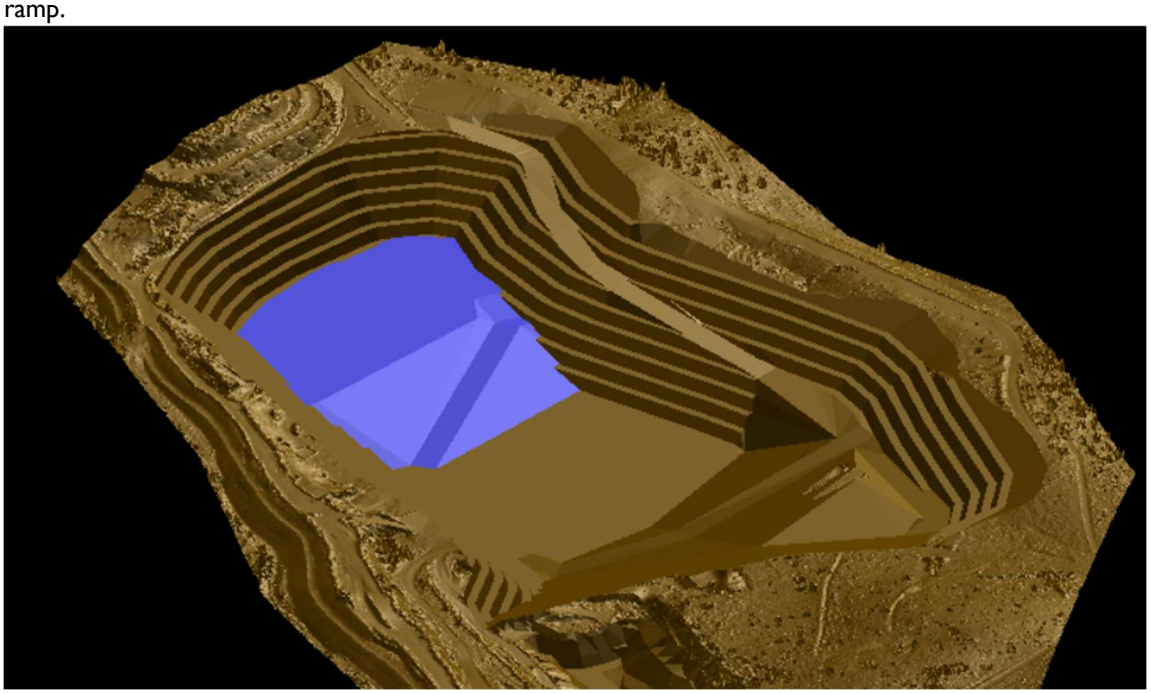


Figure 4. In-pit backfill after north cut stage 3

7.4 PIT 4N CUT STAGE 4 / INPIT BACKFILL STAGE 3

Pit 4N Cut Stage 4 takes out the highwall between Pit 4 and Pit 3 and completes mining of the combined pit to full extent. This material is placed in the void created during Cut Stage 3 as shown in **Figure *5***.

A void will remain in the southern end of the pit down to -56mRL as backfill cannot be placed on the floor while mining is still occurring during Cut Stage 4.

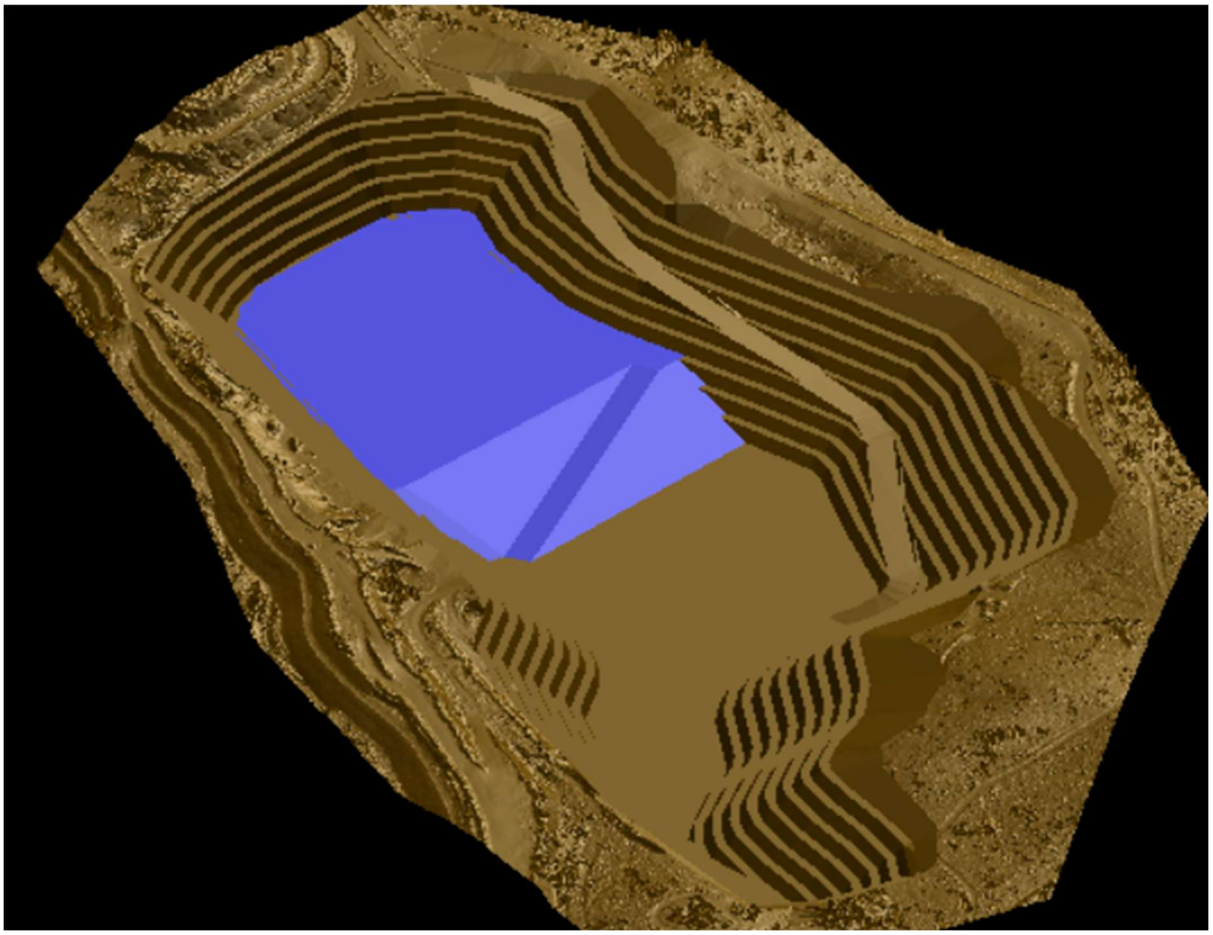


Figure 5. In-pit backfill after north cut stage 4

7.5 NORTH OUT OF PIT DUMP, LAYDOWN AREA AND ABANDONMENT BUND

During the final stages of mining, the northern out of pit dump is backfilled into the northern end of Pit 4 and the laydown area is levelled as shown in **Figure 6**.

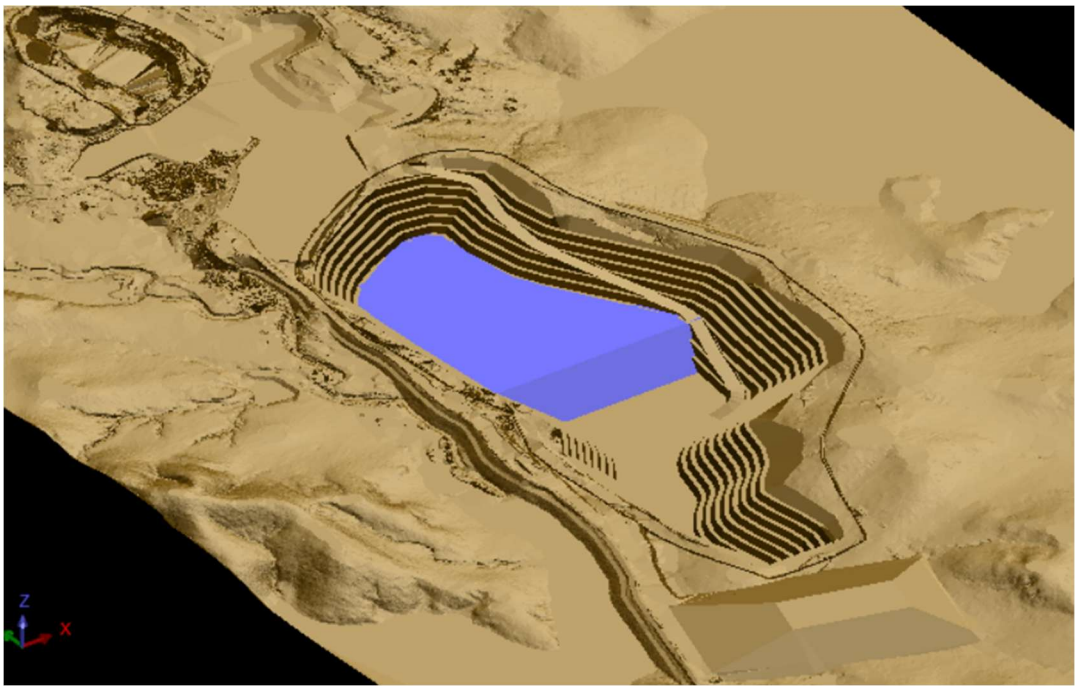


Figure 6. Inpit backfill at end of mine life, removal of the northern out of pit dump and levelling laydown area

7.6 REPROFILING SOUTHERN WASTE ROCK DUMP

At the end of mine life the Southern WRD is reprofiled, so the slopes are less than 12 percent. Any excess material will be placed in the southern end of the pit 3-4 void. The amount of excess material and size of the southern in-pit dump will vary depending on the actual quantity of waste produced during operations. Finally, an abandonment bund will be constructed around the top of pit 2 and pit 3-4 as shown in **Figure 7**.

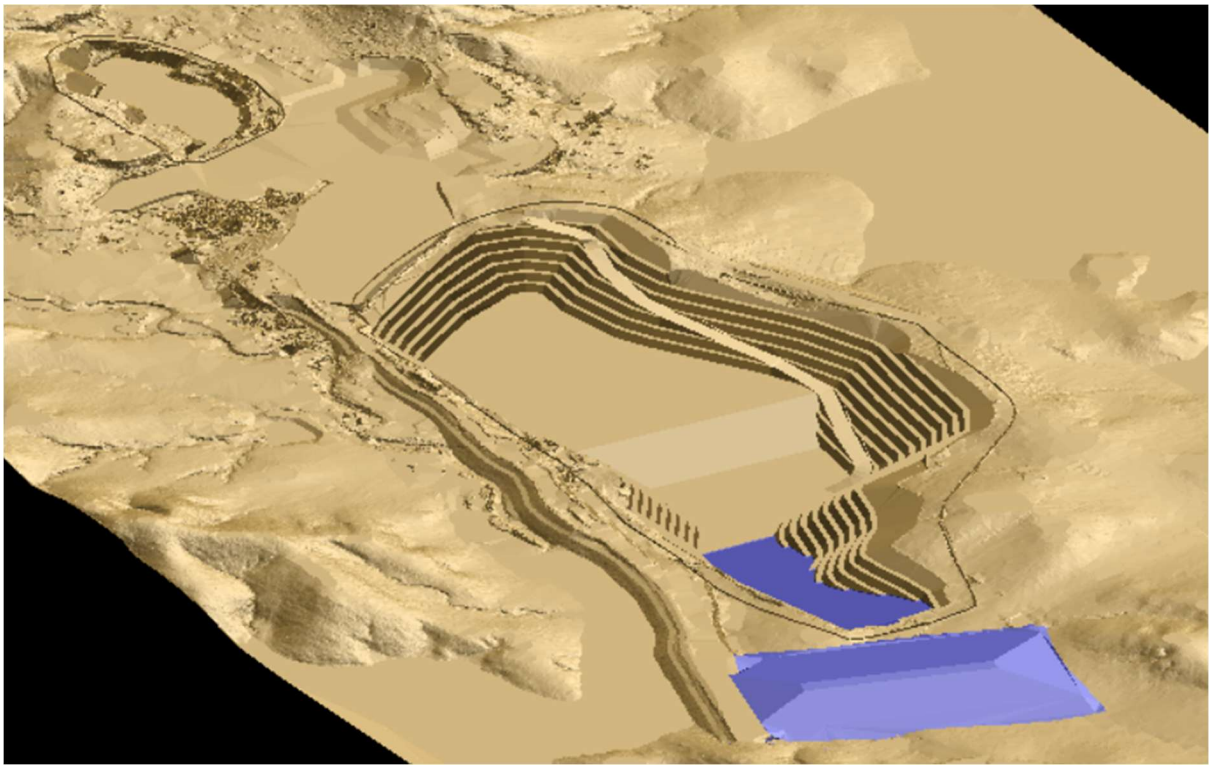


Figure 7 Reprofile Southern WRD, southern in-pit fill and abandonment bund

7.7 OPTION 2 WORKING THE PIT FROM SOUTH TO NORTH

Pit 3-4 may also be worked from south to north rather than north to south. To determine the best direction to mine the pit further consideration will be given to potential added limestone reserves in the area, water management of Pit 2 and further economic assessment of N-S and S-N scenarios.

A south to north mining direction will follow a similar strategy as described in figures 1 to 6 but in reverse. The southern end of the pit will be mined first to establish in-pit backfill room. Waste generated during this phase will be placed in the Southern WRD.

8. FINAL LANDFORM

The proposed final landform at closure is shown in **Figure *8***.

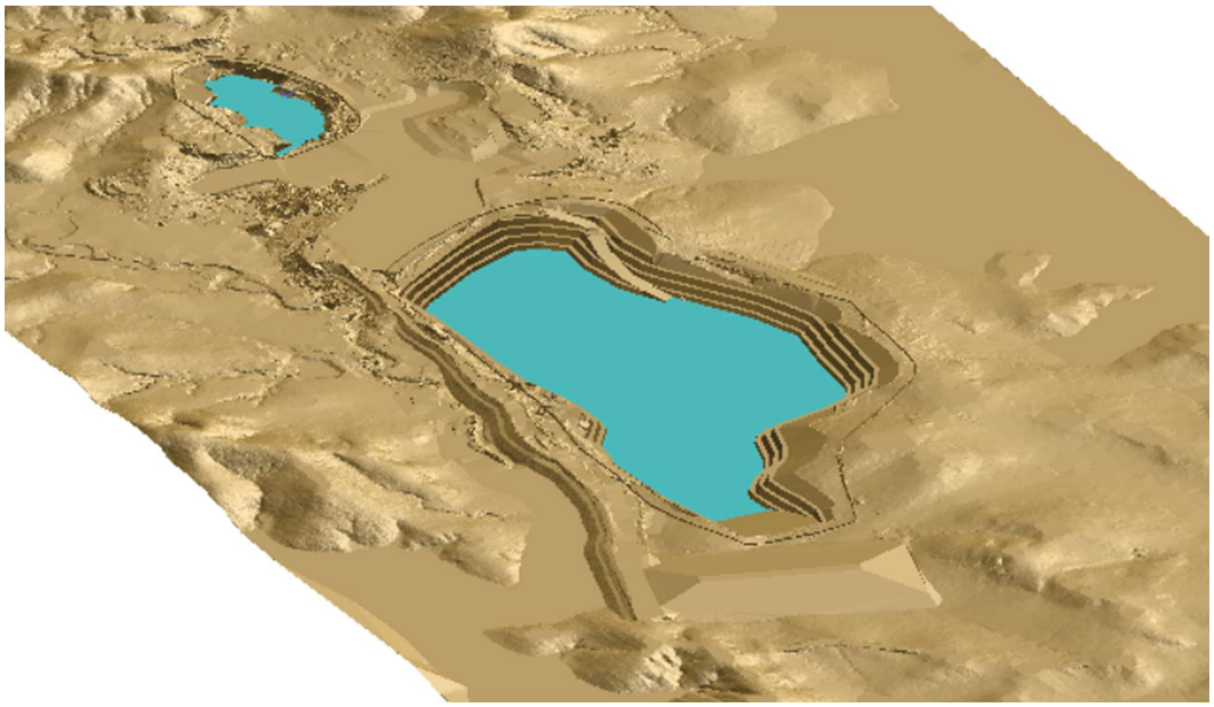


Figure 8. Final Landform

APPENDIX H FINAL LANDFORM FLOOD ASSESSMENT

MEMORANDUM

Project:	Calliope PRCP	Date:	27 June 2025
To:	Epic Environmental	From:	Engeny
ATT:	Shaille Hill	CC:	Romin Nejad
Subject:	Calliope Limestone Quarry PRCP – Final Landform Flood Assessment		

FINAL LANDFORM FLOOD ASSESSMENT

Engeny have been engaged by Epic Environmental (Epic) to undertake the flood assessment of the proposed final landform for the closure of the Calliope Limestone Quarry. Epic have supplied Engeny with the final landform surface which is proposed to be constructed by end of life in the year 2100. Engeny have undertaken flood modelling of the key waterways and 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 bounded by Awoonga Lake on the eastern side and a tributary of the Boyne River on the western side. The flood assessment was completed to comply with Section 3.6.1 of the *Progressive Rehabilitation and Closure Plans Guideline (DES, March 2021).*

Hydrology

Development of a hydrologic model of the catchment was undertaken to determine runoff hydrographs for a range of storm Annual Exceedance Probabilities (AEPs) and durations. The 1% AEP, 0.1% AEP, 0.01% AEP and Probable Maximum Flood (PMF) design storms were 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).* 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 was adopted. 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.

0.01% AEP rainfall depths were determined by interpolating between the 0.1% AEP and PMF storm depths. Losses for events exceeding the 1% AEP storm were interpolated between the 1% AEP and PMF.

The temporal patterns for the 1% AEP match the 10 ensemble patterns recommended in ARR 2019, events rarer than the 1% AEP adopted the same temporal patterns as the PMF.

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 design storms included the effects of the tributary waterway to represent any potential alteration of flows upstream and downstream of the Site. The effects of Awoonga Lake was considered by applying the tailwater level consistent with the design of the outlet weir control structure as extracted from the 1m LiDAR dataset. 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.

TABLE 1: FINAL LANDFORM MODEL ASSUMPTIONS

Model Item	Data Used	Source
Catchments	Gladstone 2009 1m LiDAR Final Landform Surface	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Rainfall	**1% & 0.1% AEP** BOM IFD's **0.01% AEP** Interpolated between 0.1% AEP and PMF **PMF** *The Estimation of Probably Maximum Precipitation in Australia: Generalised Short-Duration Method*	Bureau of Meteorology
Temporal patterns	**1% AEP** ARR ensemble patterns **Events rarer than the 1% AEP** 10 rarest temporal patterns BoM AVM	Australian Rainfall and Runoff (ARR) 2019 Bureau of Meteorology
Catchment hydrographs	WBNM hydrologic software package	
DEM	Gladstone 2009 1m LiDAR Final Landform Surface (dxf dated 250528)	Elevation and Depth Foundation Spatial Data (ELVIS) Epic Environmental
Hydraulic roughness	Final Landform Land Use	Epic Environmental
Tailwater	Gladstone 2009 1m LiDAR	Elevation and Depth Foundation Spatial Data (ELVIS)
Flood Extents	TUFLOW hydraulic software package	

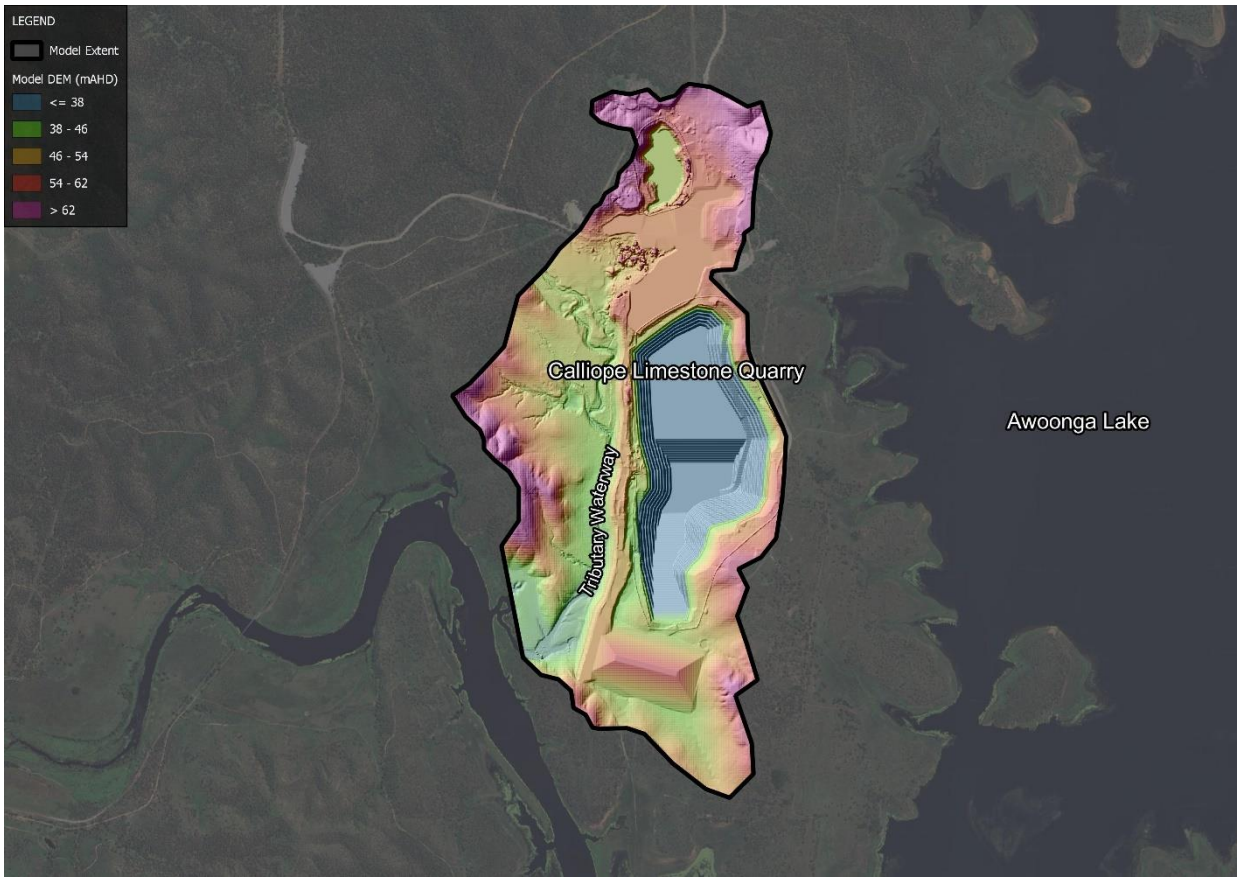


Figure 1: Final Landform DEM

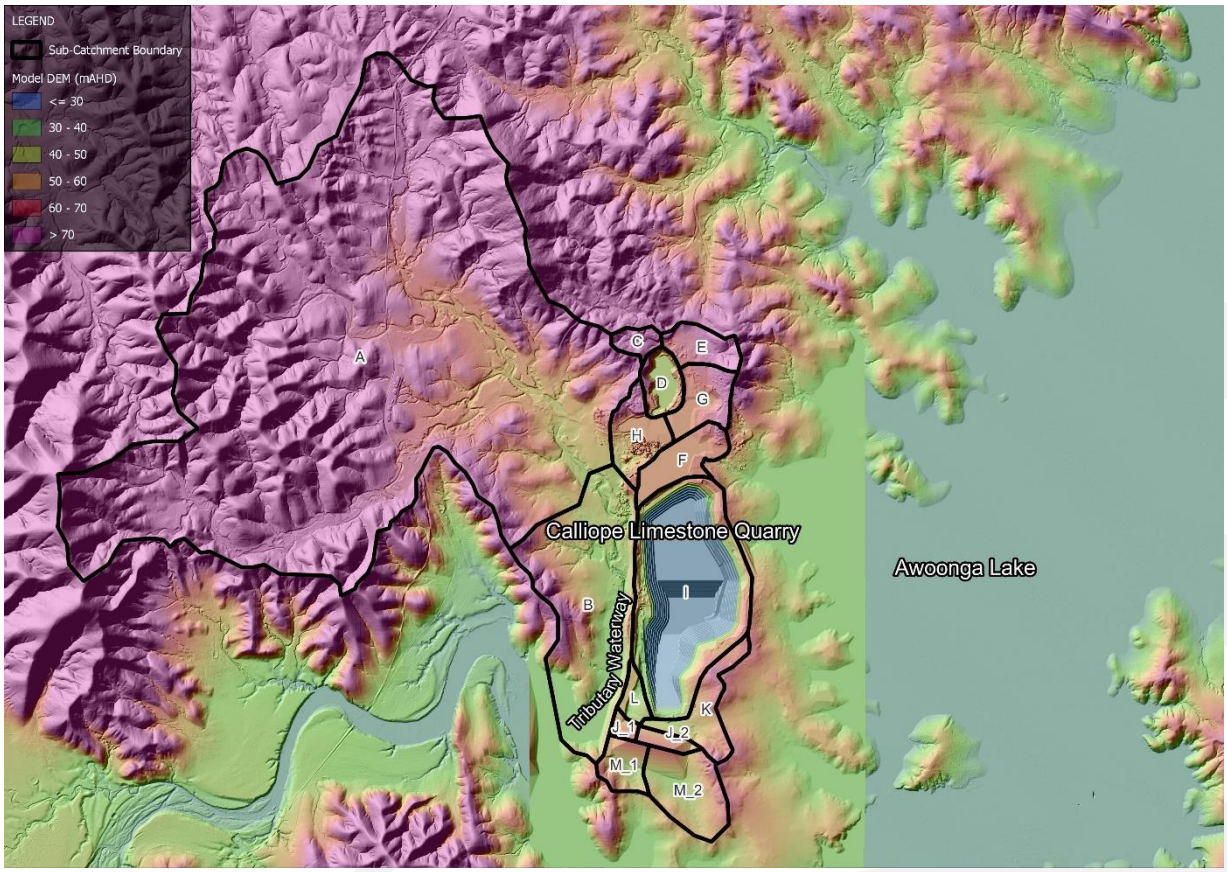


Figure 2: Catchment Breakdown

Final Landform Flood Risk Profile

The flood depth and velocity mapping of the final landform scenario is shown below in Figure 3 to Figure 10. The flood depth maps demonstrate that ponding is anticipated to occur across the Site following all simulated flood events, with standing water expected both within and external to the voids.

It is noted that there are 4 locations at Pit 3-4, and 1 location at Pit 2, where inflow to the voids is observed by overtopping of the pit protection structures. Overtopping of the pit protection structures is predicted to occur in all simulated design events. However, these void inflows are caused by local catchment runoff only and it is not anticipated that the flooding within the tributary of the Boyne River on the western side would generate any inflows to the voids based on the flood results and ground levels.

Velocities at the pit inflow locations are in excess of 1.5 m/s based on the velocity mapping. It is therefore recommended that these locations are suitably protected (i.e. with rock, or some alternative form of armouring), to minimise scour potential and ensure the longevity of the final landform. Velocities across the remainder of the landform are generally less than 1.5 m/s and can therefore be protected from erosion through application of revegetation outcomes. There is a location adjacent Pit 2 (east) and a single location south of the waste rock dump where velocities exceed 1.5 m/s, these areas should be considered for additional rock armouring controls for long term landform stability.

LEGEND

Model Extent

Flood Depth (m)

<= 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 1.00

> 1.00

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000

GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 3 - 100 Year Flood Depth

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Depth (m)

<= 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 1.00

> 1.00

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000

GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 4 - 1000 Year Flood Depth

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Depth (m)

<= 0.05

0.05 - 0.10

0.10 - 0.30

0.30 - 0.50

0.50 - 1.00

> 1.00

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000

GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

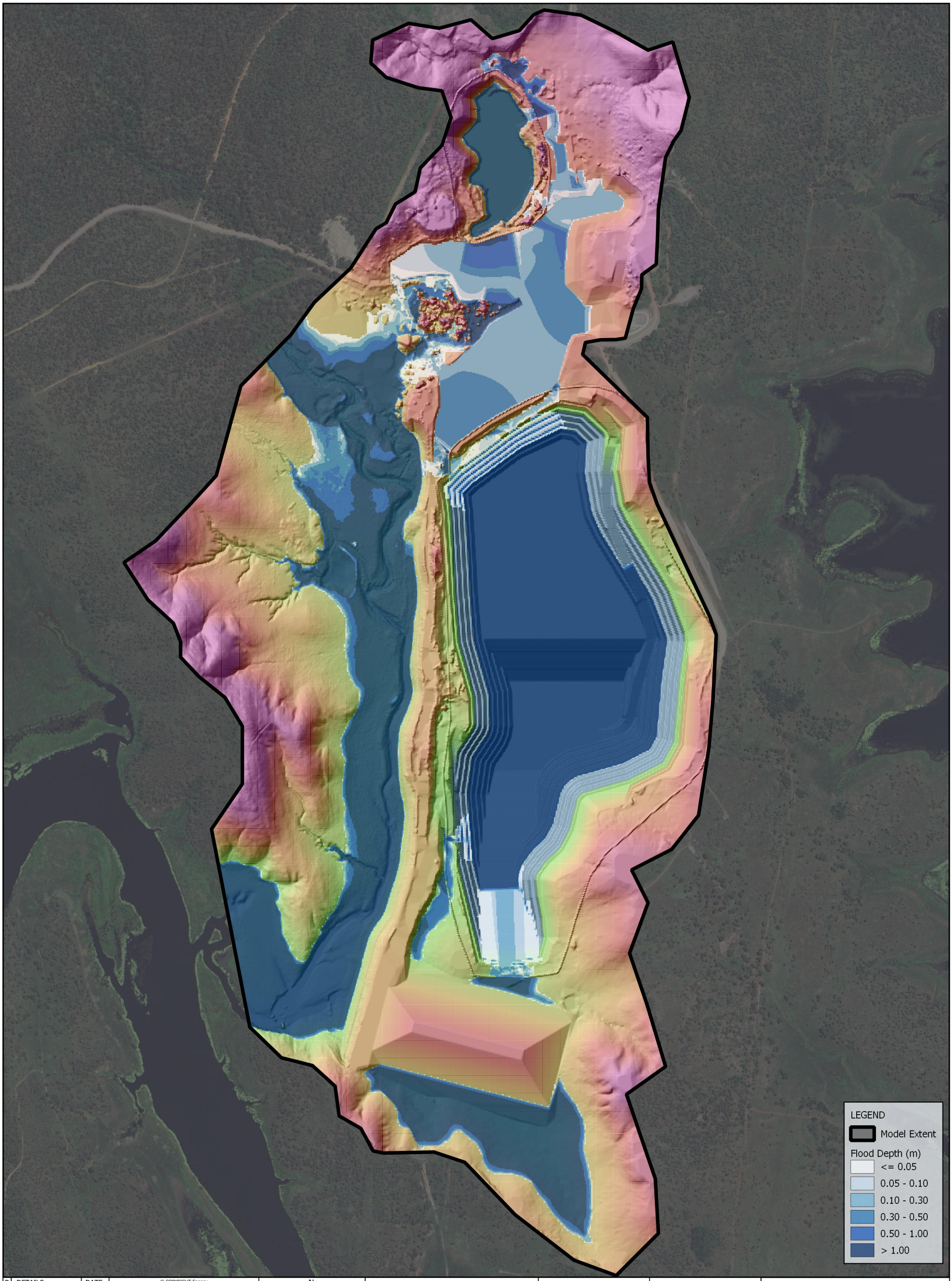
epic ENVIRONMENTAL

Figure 5 - 10000 Year Flood Depth

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz



R	DETAILS	DATE
0	Draft Issue	05/04/2023
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000
GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 6 - PMP Flood Depth

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Velocity (m/s)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000
GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 7 - 100 Year Flood Velocity

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Velocity (m/s)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000
GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 8 - 1000 Year Flood Velocity

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Velocity (m/s)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.5
- 0.5 - 1
- 1 - 1.5
- > 1.5

R	DETAILS	DATE
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000
GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 9 - 10000 Year Flood Velocity

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

LEGEND

Model Extent

Flood Velocity (m/s)

<= 0.1

0.1 - 0.2

0.2 - 0.5

0.5 - 1

1 - 1.5

> 1.5

R	DETAILS	DATE
0	Draft Issue	05/04/2023
1	Final Issue	27-06-2025

© COPYRIGHT Engeny
This drawing is confidential and shall only be used for the purpose of this project.

DRAWN	ZL	CHECKED	JH
APPROVED	SB	DATE	27-06-2025

NOTES:

N

0 0.1 0.2 km

SCALE @ A3 - 1:10,000

GDA94 / MGA zone 56

DISCLAIMER
Engeny has endeavoured to ensure accuracy and completeness of the data. Engeny assumes no legal liability or responsibility for any decisions or actions resulting from the information contained within this map.

DATA SOURCE
QLD Government Open Data Source

ENGENY

epic ENVIRONMENTAL

Figure 10 - PMP Flood Velocity

Epic Environmental
Calliope PRCP
Final Landform Flood Assessment

Drg Ref.

\\online.com\files\BNEManagement\Projects\QC4036 Epic Environmental\QC4036_004 Calliope PRCP Flooding\05 Design\QGIS\Workspaces\QC4036_004-WOR-002-A Figures.qgz

DISCLAIMER

This memorandum has been prepared on behalf of and for the exclusive use of Epic Environmental and is subject to and issued in accordance with Epic Environmental instruction to Engeny Australia Pty Ltd (Engeny). The content of this memorandum was based on previous information and studies supplied by Epic Environmental

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this memorandum by any third party. Copying this memorandum without the permission of Epic Environmental or Engeny is not permitted.

APPENDIX I EROSION AND SEDIMENT CONTROL PLAN

GRAYMONT

Sediment and Erosion Management Plan

Calliope Limestone Operation

Operated by Graymont (Calliope) Pty Ltd

Rev	Date	Prepared By	Comments
1	19/07/11	W. Speirs (SKM)	First draft
2	30/11/23	R. Lindner / A. Bishop (pitt&sherry)	Updated Draft

TABLE OF CONTENTS

1. Introduction 3
1.1. Background 3
1.1.1. Objectives 4
1.1.2. Authority / Legislative Details 4
1.1.3. Guidelines 5
1.1.4. Related Documents 5
1.1.5. Project Ownership 5
1.2. Site Description 5
1.2.1. Site Topography, Geology, and Soils 5
1.2.2. Hydrology and Water Storage 6
2. Relevant Activities 6
2.1. Project Overview 6
2.2. Environmental Values 6
2.3. Sources 6
2.3.1. Extraction 7
2.3.2. Material Handling 7
2.3.3. Transport 8
3. Control Measures 8
3.1. Planning and Design Strategy 8
3.2. Operational Strategy 8
3.2.1. Drainage and Diversions 9
3.2.2. Sediment Basin 9

3.3. Minimising Land Disturbance 10
3.4. Spill and Pollutant Containment 10
3.5. Emergencies 10
3.6. Water Management and Reuse 10
4. Monitoring 12
4.1. F1 Release Point 13
4.2. Rail Lay Down Area 13
4.3. Inspection Requirements 13
4.4. Maintenance Requirements 13
4.5. Targets and KPIs 14
5. Reporting 14
6. Audit and Review 15
6.1. Environmental Auditing 15
6.2. Sediment and Erosion Control Management Plan Review 15
7. Recommendations 15
APPENDIX A: Erosion and Sediment Control Checklist 16
APPENDIX B: Sediment Basin Calculations 16
APPENDIX C: Site Images 16

1. Introduction 3
1.1. Background 3
1.1.1. Objectives 4
1.1.2. Authority / Legislative Details 4
1.1.3. Guidelines 5
1.1.4. Related Documents 5
1.1.5. Project Ownership 5
1.2. Site Description 5
1.2.1. Site Topography, Geology, and Soils 5
1.2.2. Hydrology and Water Storage 6
2. Relevant Activities 6
2.1. Project Overview 6
2.2. Environmental Values 6
2.3. Sources 6
2.3.1. Extraction 7
2.3.2. Material Handling 7
2.3.3. Transport 8
3. Control Measures 8
3.1. Planning and Design Strategy 8
3.2. Operational Strategy 8
3.2.1. Drainage and Diversions 9
3.2.2. Sediment Basin 9

3.3. Minimising Land Disturbance 10
3.4. Spill and Pollutant Containment 10
3.5. Emergencies 10
3.6. Water Management and Reuse 10
4. Monitoring 12
4.1. F1 Release Point 13
4.2. Rail Lay Down Area 13
4.3. Inspection Requirements 13
4.4. Maintenance Requirements 13
4.5. Targets and KPIs 14
5. Reporting 14
6. Audit and Review 15
6.1. Environmental Auditing 15
6.2. Sediment and Erosion Control Management Plan Review 15
7. Recommendations 15
APPENDIX A: Erosion and Sediment Control Checklist 16
APPENDIX B: Sediment Basin Calculations 16
APPENDIX C: Site Images 16

1. Introduction

Graymont (Calliope) Pty Ltd owns and operates the Calliope Limestone Operation (CLO), which is located approximately 30km south of Gladstone, and 10km southeast of the township of Calliope in Central Queensland.

1.1. Background

The Erosion Sediment Management Plan (ESMP) aims to meet the conditions highlighted in the Environmental Authority Permit for site. Further, the ESMP aims to address issues relevant to the management and control of sediment and erosion on site. The ESMP is designed to provide consistency with the Environmental Management Plan (EMP) and regulatory requirements.

The nature of any open mining operation results in the disturbance of the natural ground cover through excavation, stockpiling and machine/vehicle movements. The purpose of the Erosion Sediment Management Plan (ESMP) is to prevent and/or manage sediment movement resulting from any land disturbance from water entering the receiving environment, as is relevant to the current mining operations.
There are a number of control measures that can be implemented on a site to reduce the risk of erosion and sediment movements off-site.

This plan outlines those techniques which best suit the operations of this site. The '*Best Practice Erosion and Sediment Control* (IECA 2008)' guideline has been used to design the required erosion and sediment control devices.

The magnitude of erosion problems experienced by a mine site, are similar to other construction type activities. They are proportional to the area of the site that is exposed / disturbed and the duration to which the area remains in this condition. As the duration of mining operations is generally longer than an average civil project, the implementation of a correct strategy is important. Focus is generally placed on site design, staged rehabilitation and minimising erosion, as opposed to temporary structures.

The management of these long periods of disturbance, and long operation of many erosion and sediment controls, requires a stronger emphasis on some management principles particularly:

- Erosion control, as a pollution prevention strategy,
- Runoff separation by diverting 'clean' stormwater runoff around the site or away from operational areas, and
- Management and maintenance of long-term controls.

1.1.1. Objectives

The objectives of this SEMP are as follows:

- To ensure the safety and health of personnel on the CLO;
- To comply with the relevant guidelines;
- To preserve the integrity and structure of the bunds and dam walls; and
- To maintain the current biodiversity on the CLO.
- To provide protection of receiving environment by eliminating or minimising the impacts of sediment laden water discharges from operations on the surrounding environment and meet community expectations regarding water quality. This can be done by:
    - Identifying, separating and controlling clean, dirty and contaminated water areas onsite;
    - Implementing appropriate erosion and sediment control techniques to suit the mining operations;
    - Ensuring the on-going maintenance and function of the implemented erosion and sediment controls.

These objectives will provide the framework for evaluating the successfulness of the SEMP.

1.1.2. Authority / Legislative Details

Environmentally Relevant Activities (ERAs) are activities that will or have the potential to release contaminants into the environment that may cause environmental harm. It is a requirement of the Environmental Protection Act 1994 (EP Act) and the Environmental Protection Regulation 2008 (EP Regs) that anyone who conducts an ERA must possess an environmental authority.

The project is approved as a resource activity under Chapter 5, Section 195 of the *Environmental Protection Act 1994* (EP Act). Under Section 608 of the EP Act.

Two Environmental Authority Permits are effective for this site:

- EA EPML00969013 for all mining leases, and
- EA EPPR00881913 (original permit # SPCE04023712 issued under the Sustainable Planning Act 2009) which covers all of the land held by Graymont including Mining leases and Freehold land.

The Environmental Authority EPML00969013 imposes specific conditions for the management of environmental impacts related to sediment and erosion:

- C14 Stormwater and water sediment controls
  An erosion and sediment control plan must be developed by an appropriately qualified person and implemented for all stages of the mining activities on the site to minimise erosion and the release of sediment to receiving waters and contamination of stormwater.

Environmental authority EPPR00881913 imposes specific conditions for the management of environmental impacts related to sediment and erosion:

- C1 Topsoil must be:
  a) removed, where practicable, from areas to be significantly disturbed prior to the commencement of extraction activities
  b) stockpiled in a manner that will preserve its biological and chemical integrity

c) used for onsite rehabilitation purposes revegetated when stockpiled, and prior to final use at end of quarry life, to minimise or prevent erosion.

- C5 Maintenance of rehabilitated areas must take place to ensure:
  a) erosion control measures remain effective;

- G4 Erosion protection measures and sediment control measures must be implemented and maintained to minimise:
  a) erosion of soils in areas disturbed by the activity;
  b) the release of sediment to any waters.

1.1.3. Guidelines

For the purpose of designing any required erosion and sediment control facilities, the '*Best Practice Erosion and Sediment Control* (IECA 2008)' guideline will be utilised.

1.1.4. Related Documents

Environmental Management Plan
Water Management Plan
Land and Rehabilitation Plan
Waste Management Plan
Ground Control Management Plan
Erosion and Sediment Control Management Plan

1.1.5. Project Ownership

The tenement mining leases are in the name of Graymont (Calliope) Pty Ltd.

1.2. Site Description

1.2.1. Site Topography, Geology, and Soils

The topography of the land is slightly undulating land that rises approximately 30m above the surface water level of Lake Awoonga Dam.

The site covers approximately 700ha, with approximately 685ha owned by Graymont Pty Ltd. The remainder is owned by the Gladstone Area Water Board (GAWB), who also own contiguous landholdings outside the operations area. With the exception of mining and quarrying activities, the land is put to no active use or is used for rural grazing activities.

The Taragoola limestone deposit comprises a large ore-body of steeply dipping, north-south, striking limestone. The limestone is fine grained to crystalline, light-grey with cream inclusions, very-high strength, fresh to slightly weathered, moderately-jointed to massive. Discontinuities are sharp and generally clean.

Dissolution of the upper surface has created some minor karst features; predominantly a slightly irregular surface, dilated joint apertures, small caverns, and shafts. These features are most obvious to a depth of ≈20m below surface. These features are likely to have negligible detrimental influences on the performances of the walls.

The limestone is overlain by red-brown clayey sand. The cover ranges in thickness from 0.5m to 5m. Where thickest, it contains boulders of limestone up to 1m diameter. Stripping of the upper bench involves stockpiling clean soil north of the pit for future use in rehabilitation and sending bouldery soil to the waste rock dump.

Basaltic to andesitic mafic volcanics have intruded around the site. The most obviously regions are centred north of the pit at 321000E 7333000N and south of the pit at 321500E 7333000N. There have not been many significant intrusions into the section of the ore body being mined; most notable are those on the north and south walls.

1.2.2. Hydrology and Water Storage

The CLO is bound by Lake Awoonga to the east, south and west. Lake Awoonga forms the drinking water supply dam from the surrounding catchment area for the GAWB. To the west of the site is a significant bund wall adjacent to Pit 3 and Pit 4. The water body adjacent to the bund wall is known as Raggote Creek, which is a tributary that flows into Lake Awoonga.

The eastern side of Pit 4 has another bund wall to prevent inundation of the mine site. GAWB has plans to increase the height of this bund wall in anticipation of raising the water level within Lake Awoonga.

Groundwater at the site is hosted by limestone as a variably connected, in places karstic aquifer.
The operation site has three main water storage areas:

- Pit 1 – a non-operational mining pit final void that is backfilled;
- Pit 2 - a water storage used for the supply of water to the wash plant; and
- Pit 3 - a final void pit used for water storage and stormwater capacity during periods of high rainfall. The final land use plan is to keep Pit 3 as a water storage dam for the local community.

2. Relevant Activities

2.1. Project Overview

The CLO conducts limestone mining and extraction to produce a range of agricultural and industrial limestone products for sale. Waste rock is also removed and either stockpiled on site or crushed for use as aggregate in a variety of applications such as road base construction.

Mining activities include topsoil stripping and removal of clay rich overburden and waste rock followed by extraction of limestone ore of appropriate grade and chemical properties suitable for quicklime, hydrate production and other end uses. Suitable limestone ore is then crushed, screened, and washed on site before being transported to customers off site for further downstream processing. Extractive activities are also conducted on site where limestone of different grades and suitable physical properties follow a similar process to mining for the production of road base and aggregates etc.

2.2. Environmental Values

Mining activities of the CLO are conducted within the catchment area for Lake Awoonga. The discharge of sediment laden water from the mining operation into the receiving environment has the potential to impact upon the environmental values of Raggote Creek and Lake Awoonga. Lake Awoonga is a freshwater dam which serves as the drinking water supply for the wider Gladstone Region. Implementation of appropriate erosion and sediment control measures is considered important in the protection of this receiving water body. Water quality is monitored at Monitoring Point C1 and F1 (downstream of sediment dam) to ensure the total suspended solids do not exceed a maximum 100 mg/L (and be less than 110% of the upstream reading at Monitoring Point C2).

2.3. Sources

Potential sources of pollutants relevant to erosion and sediment control include:

- Land clearing
- Topsoil and overburden stripping and stockpiling
- Shot rock loading
- Raw material hauling and tipping
- Crushing and Screening
- Conveying
- Stockpiling
- Rail loading (when being utilised)
- Wind acting on stockpiles and exposed areas

A risk assessment of these activities is provided in Table 1.

Table 1: Activities causing Sediment and Erosion risk

Activity	Location	Hazard	Risk	Likelihood	Consequence	Risk Rating
Blasting	On site	Generation of dust impacting local residences and surrounding land uses. Dust deposition affecting water quality	Complaints from local residences and surrounding land owners. Negative impacts on water quality. Graymont required to conduct complaint-based monitoring.	Unlikely	Moderate	6 - Medium
Movement and handling	On site			Unlikely	Moderate	6 - Medium
Crushing and screening	On site			Unlikely	Moderate	6 – Medium
Transportation of product	On site, Taragoola Road, near rail loading facility	Windblown dust generation impacting local residences and surrounding land uses. Dust deposition affecting water quality		Unlikely	Moderate	6 - Medium
Stockpiling	On site			Unlikely	Moderate	6 - Medium

2.3.1. Extraction

Open cut mining and quarrying are similar operations employing straight forward open cut mining/quarrying methods utilising a dedicated truck and excavator fleet. Vegetation, comprising mostly pasture grass, is removed together with an upper soil layer and stockpiled or used as a final surface layer on spoil embankments to facilitate revegetation. Underlying the surface soil/ clay layer is a clayey limestone strata. This layer is excavated by earthmoving equipment, usually following drill and blast. This material is either spoiled or, if appropriate, stockpiled for later separation of clay and limestone by a heavy duty rock screener.

Underlying the clayey limestone layer is dominantly homogeneous limestone which is drilled, blasted and loaded out by an excavator serviced by a number of ridged dump trucks. A second excavator is on site as a backup for the open cut operations. Drilling and blasting has been conducted at a rate of approximately one blast per week.

2.3.2. Material Handling

Material is hauled either to the Run-Of-Mine (ROM) pad for crushing, or to the stockpiles for screening or designated spoil dumps. Both a wet and dry plant are utilised. Via the ‘wet’ plant, material is washed with reclaimed water from Pit 2 whilst being crushed and screened into various sizes before being washed again. The washed, sized material is then stockpiled before being exported by truck to customers. Water discharged from this process is collected in a settling pond system before entering the wash plant dam.

The ‘dry’ plant sees material first screened by mobile rock screeners to separate oversized material and soils and scalping from the product. The material is then sent through the various crushers and stockpiled according to size.

2.3.3. Transport

Approximately 1.0 million tonnes per annum of limestone products are transported from site by road. The project used to also transport via rail, however this activity is not currently occurring at the project. All limestone products at the CLO site are loaded by wheeled loader into B-double road trucks. The trucks travel north on graded and paved roads to the town of Calliope where they connect to the Dawson Highway.

3. Control Measures

3.1. Planning and Design Strategy

The effectiveness of erosion and sediment controls during the operational and rehabilitation stages can be optimised through effective mine and quarry planning and design. Suitable strategies applicable to the CLO include:

- Designing any drainage systems operating for the life of the mine or quarry so that they do not cause erosion or increase sediment transport. This may involve scour protection of open drains and energy dissipaters located at drain outlets;
- Diverting runoff around the mine or quarry site where possible, to minimise external runoff flowing to operational areas;
- Separately considering sediment-contaminated stormwater from other sources of polluted water such as mine water, or runoff from stockpiles of coal or other mined or quarried product.
- Providing source controls to minimise the sediment load in stormwater, as well as “end of line” controls such as sediment basins to provide water quality improvement prior to offsite discharge
- The streams should be either separated to optimise their treatment prior to discharge or combined as part of an integrated water management strategy.
- Considering stormwater reuse as part of the overall water management strategy for the site to avoid or reduce discharge of polluted water. There are commonly a range of non-potable water uses on a mine or quarry site such as dust suppression and irrigation of revegetation areas. This may be more cost-effective than treatment of polluted runoff and will also reduce consumption from other water.

3.2. Operational Strategy

Whilst it is acknowledged that activities will vary throughout the life of a mine, it should also be accepted that erosion and sediment control measures will also evolve to suite. Erosion and sediment control strategies for mines should normally comprise the following:

- Minimisation of extent and duration of disturbed areas draining to waterways, and prompt revegetation of non-operational disturbed areas (using temporary revegetation if required);
- Ensuring both temporary earthworks and permanent land-shaping provide a landform whichminimises erosion hazard;
- Prompt stabilisation and rehabilitation of land following land-shaping (both temporary and permanent);
- Design of temporary surface-water collection, conveyance and disposal systems in a manner which minimises erosion.
- Ensuring dirty water catchments have appropriately designed and operated sediment basins at their downstream extremities

Where possible, stormwater should be diverted around any active or rehabilitated mine or quarry area. This will minimise both the flow rate and volume of runoff to be handled by on-site water management facilities and enable them to perform more effectively. Runoff from stable rehabilitated areas should also be diverted away from operational areas.

The site supervisor is responsible for maintaining erosion control due to mining operation, stockpiling, maintenance of roads, drains, sediment pits, and as a result of natural stormwater run-off or unseasonal high rainfall events. Sediment control devices such as silt fencing, bunding, berms, diversions and silt pits should be used to collect sediment from flowing outside of the mining lease area.

Stormwater drains, channels and diversions should be used to separate clean stormwater due to rainfall away from disturbed land areas. Disturbed or plant water should not be allowed to contaminate or mix with clean stormwater flow or storage.

3.2.1. Drainage and Diversions

Earth bunds and diversion drains are maintained around the perimeter of the site, particularly on the upslope of excavations, to prevent surface water entering these excavations and mixing clean with dirty water.

The majority of the disturbed catchments within the mining operation are controlled using appropriate drainage and a number of bund diversions. Runoff from the disturbed areas within the mining operation collects in one of the drainage channels. These drainage channels are then directed into either Pits 2, 3 or 4.

There are some bunds located around the site which prevent runoff from disturbed areas entering the receiving environment. In these locations, the bunds act to redirect runoff from disturbed areas back into one of the pits. Pit 3 is the only pit which has an external catchment. The farm dam catchment would have previously drained into Lake Awoonga. However, with the creation of the levee between Lake Awoonga and the mine, this catchment had no outlet. Waters from this catchment may rise and subsequently overtop into Pit 3 during high rainfall events. The only catchment which is not directed to a pit is the sediment basin catchment.

3.2.2. Sediment Basin

The basin located at the C1 discharge point has been sized for using the method for a C-type basin outlined in '*Best Practice Erosion and Sediment Control'* (IECA, 2008).

The following assumptions were made in the calculations in the absence of physical data:

- runoff for the Q-3 month (0.5 x 1 year ARI) was applied;
- approximately 90% of the sediment is larger than 0.05 mm diameter;
- bulk density of limestone used was 28 kN/m^3; and
- the Revised Universal Soil Loss Equation (RULSE) was used to estimate soil loss.
- Clean out frequency of basin is once per year.

The existing sediment basin located upstream of Release Point C2 presents the only possible uncontrolled release point from the site. The basin located at the C2 discharge point has been sized using the CALM method as outlined in 'Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites' (IEAUST, 1996).

The following assumptions were made in the calculations in the absence of physical data:

- the run-off co-efficient for the 1 in 10 year AEP event was 70%;
- approximately 70% of the sediment is larger than 0.2mm diameter;
- bulk density of limestone used was 28 kN/m3; and

The Revised Universal Soil Loss Equation (RULSE) was used to estimate soil loss.

The minimum required dimensions for the sediment basin above the discharge point C2 include:

- Dimensions Sediment Pond Surface Area (m2) 23.1
- Length (m) 8.3 Width (m) 2.8 Depth (m) 0.75
- Volume (m3) 17.2

The existing basin has measurements in excess of these recommendations, particularly if the 'Y-drain' which conveys water towards the final basin is included. However, it was observed that the sediment basin had become very full with deposited sediments, and it is recommended that it is cleaned out to provide the appropriate depth as soon as possible.

Releases of pumped void water to natural drainage system will be in accordance with water quality standards, monitoring locations and frequencies as nominated by EA conditions.

3.3. Minimising Land Disturbance

- Land disturbance will be restricted to that which is essential for mining purposes
- Disturbed land will be rehabilitated / revegetated as soon as is practicable to minimise erosionand sediment transport

3.4. Spill and Pollutant Containment

- Spill control equipment is stocked at specific locations around the site for spill response.
- Vehicles to be well maintained to avoid fuel and oil leakages
- Re-fuelling of trucks on site to take place away from drainage lines and in isolated/bunded areas to minimise the risk of environmental contamination and contain spills. Refueling will follow Refuelling Procedures
- Vehicle washdown to be carried out in a designated area so that washings (including concrete washings) will not enter waterways or storm drains
- Fuels, oils and chemicals required for construction and operation to be appropriately stored. Storage in open areas will be bunded to ensure any spills are contained
- Any spillages to be immediately contained and absorbed with a suitable material and disposed in an approved manner.
- Staff to be appropriately trained in procedures for the management of fuel and chemical spills and the location and use of spill kits

3.5. Emergencies

- In the event of imminent flooding, plant and equipment will be moved to the highest accessible points as per 4GN-P21- 12 Flood Emergency Plan
- If leaks are detected or an earthquake felt, 4GN-P21- 13 - Bund Wall Failure Emergency Plan will be implemented.
- If a contaminant release is observed this will be notified to the relevant authority immediately in line with the notification requirements of the EA.

3.6. Water Management and Reuse

To the extent practicable, all water pumped from mining/quarrying operational areas (except for water used for dust suppression) will be directed to the recycle water storage near the processing plant.

Water captured on site is used for dust suppression on haul roads, working benches, hardstands and stockpile areas. Water is applied at a controlled rate to prevent runoff. Water is also used for dust suppression at plant locations and for certain product washing, vehicle washdown, product moisture content control and product transportation. Excess water from product washing activities is directed to settling ponds essentially operating in a closed-circuit configuration.

Water entering Pit 1 and Pit 2 is not pumped offsite, but used for onsite purposes as follows:

- cool fog dust suppression units installed at the Hazemag Feeder and Main Screen House collection bays;
- washing down machinery at the wash down area;
- filling radiators;
- use in the main wash plant;
- dust suppression;
- mixing of wet road bases; and,
- hosing down and cleaning under conveyers.

The nature of this site lends itself to developing effective control measures to minimise the risk of sediment laden waters entering the receiving environment. Where the entrainment of sediments occur in surface water flows, sediment control measures will be necessary to prevent discharge from this site. The site currently does not have any external catchments entering disturbed parts of the sites. The majority of areas that are disturbed have been designed to flow back into the mining voids through appropriate drainage and bunds. A sediment dam is currently in

place to capture and treat runoff collected from the Process Area of the site. Waters from here discharges to Monitoring Point C1.

Table 2: Implementation of Erosion and Sediment Controls

Controls	Timing/ Frequency	Evidence of Implementation
Management of Air-Borne Dust on site	Ongoing	Review and audit of airborne dust emissions on site.
Vehicle operations on site follow Traffic Management Plan (speed, routes)	Ongoing	Review and audit of airborne dust emissions on site.
Deploy water carts to all unsealed roads to reduce the generation of dust from these areas	When required during dry days	Vehicle log detailing number of tank refills
Dust suppression devices installed on operating plant/crushers	When in use	Equipment equipped with dust collectors. Site supervisor daily inspection.
All trucks containing product must not leave the site without trailer covers	Ongoing	Weighbridge operator to report all instances of loads not securely covers to site supervisor.
Stockpiles to be located as far as practicable from residential areas	Ongoing	Site supervisor inspection report and environmental site audit report
Activities which have the potential to cause significant dust emissions should be modified or cease operation under adverse (high wind) weather conditions where sensitive receptors may be impacted.	When required	Start checklist includes details of weather conditions
Continuous visual surveillance of dust emissions to ensure effectiveness of control measures	Ongoing	Report any issue of excessive dust emissions into ORACLE incident and event reporting program
Mobile plant will be maintained to manufacturer's specifications to comply with dust and pollution emission control	Ongoing	Inspections to be recorded on vehicle pre-start inspection sheet
A continuous improvement program is actively undertaken on site to ensure that best work practices are implemented to avoid/or minimise generation of dust.	Ongoing	Regular internal audits of work practices, processes, and environmental objectives. Any corrective actions addressed in the audit are to be entered into ORACLE.
Installation of screens and windbreaks around areas of potential dust emissions	When required	Job start cards and JRAs are undertaken before commencing work to identify the need for screens or wind breaks to avoid excessive dust in work area.
Planting of trees and windbreaks to reduce wind corridors and create barriers to minimise dust emissions on site	As part of rehabilitation plan, or as part of continuous improvement process	Evidence of revegetation in areas that reduce dust emissions. Revegetation of areas will be reported in the Annual Return and Financial Assurance Audit report.

4. Monitoring

For the CLO, Graymont must ensure that a competent person conducts all monitoring where monitoring is a requirement of the relevant project permits.

Table 3 presents the routine monitoring conducted on site to meet OHS and environmental requirements.

Table 3: Care and Maintenance monitoring requirments

Management Issue	Timing/Frequency	Description of Monitoring	Monitoring Method
Erosion and Sediment	Quarterly	Visual inspection of sedimentation pond to ensure basin is free of weeds	Inspection by site supervisor
Erosion and Sediment	When required	Regular cleaning and removal of sediment from sediment collection devices, pits and dams	Following inspection report
Erosion and Sediment	Quarterly	Visual inspection of sediment control fencing to ensure its effectiveness	Inspection by site supervisor
Erosion and Sediment	Quarterly	Rehabilitated areas shall be monitored periodically to check for the possible onset of soil erosion	Inspection by site supervisor

Table 4: Monitoring Requirements when site is operational

Description of monitoring	Timing/ Frequency	Parameters	Monitoring method
Ambient air quality monitoring for TSP at monitoring sites N, SE, SW, and S.	Monthly	TSP (g/m2/month)	Dust deposition gauges using AS/NZS 3580
Monitoring of onsite weather conditions	Continuous	Rainfall, wind speed, wind direction	Onsite weather station
Visual inspection of wind speed and direction	Daily	Wind speed, wind direction	Beaufort wind scale and onsite weather vane. Observations documented in the onsite weather log
Visual inspection of dust suppression devices on equipment as part of prestart checklist	During activities	Device is correctly fitted	Inspections noted in vehicle prestart check logbook. Any defects are tagged out and/or reported to supervisor.
Visual inspection of dust emissions from the primary crushing and screening plant	Daily	Visible dust	Any defects are tagged out and/or reported to supervisor.
Visual inspection of dust emissions from drilling and blasting activities	During activities	Visible dust	Non-compliance with dust emissions will be entered into the incident and corrective action reporting: ORACLE
Visual inspection of dust control measures to ensure correct operation	During activities	Visible dust	Non-compliance with dust emissions will be entered into the incident and corrective action reporting, ORACLE
Site audit of operations by Graymont Advisory team	2 yearly	Audit checklist	Environmental audit procedure. Audit forms to be filed and any actions arising from audit will be entered into ORACLE

4.1. F1 Release Point

Controlled releases are permitted from release point F1. The discharge from F1 is released at a rate of approximately 200 litres per second (the pump capacity). The discharges from F1 are released directly into a rock lined channel. The gravel reduced the velocity and thereby reduces the risk of soil erosion and scour directly below the release point. Further downstream, the discharged water exhibits a laminar flow regime, at which point it enters Lake Awoonga.

The impacts of the mining operation on downstream water quality will be minimised by ensuring any release from the site do not exceed the criteria specified in the EA conditions as outlined below in Table 5.

Table 5: Water Quality Release Criteria

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical conductivity (µS/cm)	900	Weekly during discharge
pH (pH unit)	6.5 (minimum) 8.5 (maximum)	Weekly during discharge
Total Suspended Solids (mg/L)	100 (maximum) Or when measured at C1, F2 or F1 not more than 110% of value at monitoring point C2	Weekly during discharge

4.2. Rail Lay Down Area

Approximately 1.5 km to the west of the CLO is the train lay down area, where pre-washed 40 mm stone is stock piled prior to loading on the trains. The lay down area currently consists of a number of stockpiles of pre-washed 40 mm stone, truck manoeuvring area, drainages and bunds. The truck manoeuvring area is covered in the 40 mm stone as to prevent dirt contamination of the stockpile when loading onto the trains occurs. This will limit the amount of erosion occurring from this surface.

To ensure the on-going compliance with the erosion and sediment control objectives the following is recommended:

- Develop a monitoring program of runoff and / or creek flows to ensure suspended solids are within the identified limits;
- Ensure cover of 40mm stone over truck manoeuvring area is maintained;
- Ensure bunding around lay down area is maintained; and
- Place dumped rock over drains flowing to waterway where scour has or may occur.

4.3. Inspection Requirements

Inspection and reporting requirements associated with the operation of erosion and sediment control measures is important in ensuring their on-going performance. An “Erosion and Sediment Control Inspection Checklist” is provided in **Appendix A**. Notifications of non-compliance will specify the type(s) of non-compliance, the corrective actions needed and a time schedule for achieving compliance.

Normally, routine inspections of the site will be performed on a monthly basis and after heavy rainfall events. A record of device failure / non-compliance and corrective actions taken to prevent recurrence will be maintained.

4.4. Maintenance Requirements

The erosion and sediment control devices will be maintained on a regular basis as directed by the Environmental Manager. Defective devices will be repaired or replaced as required. Maintenance may include replacing structures that are not functioning properly.

4.5. Targets and KPIs

This ESCP aims to minimise and where possible eliminate the potential impact erosion and sediment discharge from the site to the receiving environment. The targets and key performance indicators are outlined below in Table 6.

Table 6: KPIs

Target	Key Performance Indicator
To minimise the impact of construction and operational activities on erosion and the sedimentation of disturbed land, watercourses and water bodies	• Water quality readings in relation to Erosion and Sediment Control are not exceeded at Monitoring Point C1 and F1. • Disturbance is restricted to those areas identified as at risk • Surface water discharges from disturbed areas are captured by sediment control systems or directed to pit. • No active erosion is observable in stabalised areas. • There is no increase in erosion/siltation in downstream watercourses. • The water quality in downstream watercourses and water bodies is within acceptable limits.
To minimise the loss of soil from areas disturbed by mining activities	

5. Reporting

For the CLO, Graymont is required to record, compile and keep for a minimum of five years all monitoring results and make available for inspection all or any of these records upon request.

Table 7 presents the routine monitoring conducted on site to meet reporting requirements.

Table 7: Environmental management responsibilities

Management Issue	Frequency of Reporting	Description	Responsible Authority
Air Quality	Monthly	Dust deposition gauge results	Graymont central monitoring and reporting database
Air Quality	Quarterly	Air emission related environmental incidents	Corporate EHS team

Description of reporting	Frequency of reporting	Reporting tool	Reporting to:
Dust deposition gauge results	Monthly	Monitoring data form	Graymont central monitoring and reporting database
Air emission complaints	Quarterly	ORACLE	Corporate EHS team
Air emission related environmental incidents	Quarterly	ORACLE	Corporate EHS team
Complaint Based Dust Monitoring Report	Within 14 days of complaint	Written advice	Administering Authority
Complaint Based Odour Monitoring Report	Within 14 days of complaint	Written advice	Administering Authority

6. Audit and Review

6.1. Environmental Auditing

Graymont (Australia) PTY LTD is required to carry out third-party audit of the site's compliance with the conditions of the Development Approval. The audit is scheduled every 2 years as per condition A10 of the Environmental Authority (EPPR00881913).

An internal environmental audit program is in place for the existing mining operation at CLO. These audits are used to monitor environmental performance of operations against the risks identified and commitments made within this EM Plan.

6.2. Sediment and Erosion Control Management Plan Review

This Plan will be reviewed every two years. The review shall be conducted with the QSE Coordinator, Environmental Advisor, and the Operations Manager. The Regional Manager and Environment and Sustainability Manager may also review the Plan depending on the perceived risk of site operations.

The review will involve the review of all monitoring data, complaints and incidents and comparing this data and information to mandatory limits and internal KPI's.

Procedural changes or a review of targets and/or KPI's should be employed if targets are not met. Should it become necessary to revise the information and/or control measures described in this Plan because the measures are not adequate or in order to more effectively prevent erosion and sediment control or storm water pollution at the site, the Plan will be amended.

Environmental Inspection Reports (EIRs) will include details about the observations, the responsible party, and when the situation will be mitigated. Findings will be entered into an Action Tracking database maintained by the Environmental Manager or Environment Safety & Health Manager, and the status of open actions will be tracked.

7. Recommendations

Following the review and on-going planning of erosion and sediment control techniques employed on the site the following is recommended to ensure protection of the receiving environment in relation to sediment transport on the site:

1) Ensure drains and bunds around pits are maintained to ensure contaminated runoff is directed into pits, and not release from site.

2) Upgrade sediment basin to comply with the dimensions outlined in **Section 3.5.3**;

3) Ensure the rock lined drain is maintained to manage scour at release point F1; and

4) Ensure monitoring at the prescribed monitoring points C1, C2, F1 and F2 is maintain in order to demonstrate on-going compliance with the requirements of the EA conditions.

To ensure the on-going compliance of the erosion and sediment control objectives at the train lay down area it is recommended:

- Develop a monitoring program of runoff and / or creek flows to ensure suspended solids are within the identified limits;
- Ensure cover of 40mm stone over truck manoeuvring area is maintained;
- Ensure bunding around lay down area is maintained;
- Place dumped rock over drains flowing to waterway where scour has or may occur.

APPENDIX A: Erosion and Sediment Control Checklist

APPENDIX B: Sediment Basin Calculations

APPENDIX C: Site Images

EROSION & SEDIMENT CONTROL CHECKLIST

TYPE OF INSPECTION:

ROUTINE [ ]
RAINFALL EVENT (BEFORE) [ ]
RAINFALL EVENT (AFTER) [ ] _____ (CM of rain/time period)
INTERMITTENT DEWATERING [ ]

AREA INSPECTED: _____

INSPECTED BY: _____ **DATE:** _____

		Is Condition Acceptable?			
	INSPECTION ITEMS	**YES**	**NO**	**N/A**	**Comments**
1	Is there any evidence that sediment is leaving the site? If yes, specify.				
2	Is there any evidence of erosion on cut or fill slopes, temporary soil stockpiles? If yes, specify.				
3	Does the sediment basin require repair or clean-out to maintain proper function? If yes, identify.				
4	Do any of the drains throughout the site suffer scouring, require repair or clean-out to maintain proper function? If yes, identify.				
5	Do any of the bund diversions throughout the site suffer scouring, require repair or clean-out to maintain proper function If yes, identify.				
6	Do any of the areas in which vegetative stabilisation measures are being taken show signs of bare spots, insufficient growth or germination? If yes, identify locations and specify remedial action (e.g., fertilisation, seeding, mulching, maintenance).				
7	Are onsite traffic, parking, equipment laydown, supply and waste storage restricted to those areas specifically designated for those purposes?				
8	Is there any evidence of sediment, debris or mud track-out on adjacent public roads?				

Note: Attach additional sheets if needed to identify plans for corrective actions, and if action will be delayed due to site conditions (*e.g.*, inaccessible to equipment) or safety issues - expected date of implementation, who is to perform work, and other specifics.

Project No: QE06585
Date: 19/07/2012
By: Brendon Bolt

CALM Method

RULSE

Step 1	Area				A	166.7184		
	Stockpile 1	1.734	ha					
	Vegetated	1.967	ha		R	4217.73	I(2,6hr)	13.9 mm/hr
	Road	3.494	ha		K	0.027		
	Total	7.195	ha		LS	1.22		
					P	1.2		
					C	1		
	ARI	3	month					
	Tc	17	min					
	I1	66	mm/hr					
	C3month	0.558		ASSUMED				
	Q3month	0.368024	m^3/s					
Step 2	Sieve Analysis	90	%	>	0.05 mm	ASSUMED		
Step 3	Settling Velocity from table C1.1	0.05	Fine Sand		707 m^2/m^3/	Surface Area Required for basin		
	Initial Estimate of basin surface area	260.04	m^2					
Step 4	Settling Depth							
		3 :			1 Basin L:W			
		27.93 :			9.31			
	Depth	0.139652	, if depth is less than 0.6m, adopt 0.6m					
	Adopted Settling Depth	0.6						
	Settling Volume	156.0221						
Step 5	RUSLE							
	A	166.7						
	b.d.	20.0	kn/m^3	ASSUMED				
	b.d.	2.0	t/m^3					
	2-month Sediment Loss	100.0						
	Sediment volume/yr	285.7	m^3/yr					
	90% capture volume	257.2	m^3/yr					
Step 6	Optimise Basin Size							
	Volume of Sediment Storage	257.2	m^3					
	Length	36.0	m					
	Width	12.0	m					
	Area	432.0	m^2					
	Depth	0.6	m					
	Storage Volume	259.2	m^3					
	Total Volume	518.4						
	Is Size Adequate	**OK**						



- **Figure 13: Discharge Point F1.**



- **Figure 14: Downstream of discharge point F1**



- **Figure 15: Sediment Dam at discharge point C1**



- **Figure 16: Directly downstream of discharge point C1**



- **Figure 17: Further downstream of discharge point C1**

APPENDIX J LANDHOLDER STATEMENT

GRAYMONT

Graymont Calliope
MS 24 Taragoola Road
Calliope QLD 4680

07 July 2025

Landholder Statement – Retention of Access Tracks and Eastern/Western Levees
Calliope Limestone Quarry (EPML00969013)

Graymont (Calliope) Pty Ltd is the landowner (Landowner) of Lot 7SP215269, 22SP215268, 26SP228426, 90SP275218, 100CTN1823, 1RP610128, and 4RP610128 (the Land) which contain the following mining leases (MLs); ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191 and ML80192. The Landowner agrees that all access tracks, as well as the eastern and western levees currently on the Land, as identified in the 2023 Progressive Rehabilitation and Closure Plan (PRC Plan) submission to the Department of Environment and Science, will be retained at end of mine life after relinquishment of all MLs, and that the Landowner will be responsible for these items.

Kind regards



Simon Havis
Site Manager, Graymont
T +61 418 816 510
Simon.havis@graymont.com

APPENDIX K SURFACE WATER IMPACT ASSESSMENT

A Montrose Environmental Company

Surface Water Impact Assessment

Graymont
Calliope Limestone Quarry Approvals
Calliope
BAA250025.01
3 July 2025

CONTENTS

EXECUTIVE SUMMARY **1**

1 INTRODUCTION **2**

1.1 Project Location 2

1.2 Objectives 2

1.3 Scope of Works 2

2 PROJECT DESCRIPTION AND BACKGROUND **6**

3 ASSESSMENT METHODOLOGY **7**

3.1 Project Area 7

3.2 Methodology 7

3.3 Relevant Legislation and Guidelines 7

3.3.1 Environmental Protection Act 1994 7

3.3.2 Best Practice Erosion and Sediment Control (IECA, 2008) 7

3.3.3 Reef Discharge Standards for Industrial Activities (DESI, 2024) 8

3.3.4 Environmental Protection (Water and Wetland Biodiversity) Policy 2019 8

3.3.5 Environmental Authority 9

3.4 Data Sources 10

4 EXISTING ENVIRONMENT **11**

4.1 Topography 11

4.2 Climate 11

4.3 Hydrology 11

4.3.1 Catchment Overview 11

4.3.2 Watercourses 12

4.3.3 Wetlands 12

4.4 Lake Awoonga Water Quality 12

4.5 Existing Water Quality 13

5 IMPACT ASSESSMENT **17**

5.1 Catchment Analysis 17

5.1.1 Current Disturbance 17

5.1.2 Maximum Disturbance 19

5.2 Stormwater Flow Assessment 21

5.3 Sediment Basin Capacity Assessment 22

5.4 Impacts to Great Barrier Reef 23

6 CONCLUSIONS **24**

7 REFERENCES **25**

8 LIMITATIONS AND DISCLAIMER **26**

LIST OF FIGURES

Body Report

Figure 1. Project Location 3
Figure 2. Current Disturbance Area 4
Figure 3. Maximum Disturbance Area 5
Figure 4. Topography 15
Figure 5. Hydrology 16
Figure 6. Current disturbance catchment areas 18
Figure 7. Maximum disturbance catchment areas 20

LIST OF TABLES

Body Report

Table 1. EVs of Project receiving surface waters 8
Table 2. Boyne River Basin WQOs relevant to the Project (EPP (Water) 2014) 9
Table 3. Contaminant release points, sources and receiving waters (EPM00969013, Table 2) 10
Table 4. Contaminant release limits (EPM00969013, Table 3) 10
Table 5. Summary of climate data, 1957 – 2025 (SILO data set from BOM station 39123) 11
Table 6. Lake Awoonga Water Quality 12
Table 7. C1 discharge water quality data – 2025 13
Table 8. F1 discharge water quality data - 2025 13
Table 9. Pit water quality (collected 19/03/25) 14
Table 10. Current Disturbance Catchments 17
Table 11. Maximum Disturbance Catchments 19
Table 12. Rational Method input parameters 21
Table 13. Current disturbance catchment areas and runoff coefficients 21
Table 14. Maximum disturbance catchment areas and runoff coefficients 21
Table 15. Peak discharge – Sediment basin 22
Table 16. Peak discharge – Pit 2 22
Table 17. Peak discharge – Pit 3 and Pit 4 22

DOCUMENT CONTROL

Revision	Revision date	Revision details	Author	Editorial review	Technical review	Approver
0	3/07/2025	Draft for Client Review	RF	RN	MM	RN

DISTRIBUTION

Revision	Revision date	Issued to
0	3/07/2025	

DOCUMENT INFORMATION

Printed:	3 July 2025
Last saved:	3 July 2025 03:38 PM
File name:	BAA250025.01_RPT_Graymont_Calliope_SWIA_Rev0.docx
Author:	Rachael Fletcher
Project manager:	Shaille Hargreaves
Client:	Graymont
Document title:	Surface Water Impact Assessment
Project number:	BAA250025.01

EXECUTIVE SUMMARY

Epic Environmental Pty Ltd (Epic) has been engaged by Graymont (NSW) Pty Ltd (Graymont) to provide ongoing environmental approvals support for the Calliope Limestone Quarry (the Project). This assessment has been prepared to satisfy an information request from the QLD Department of Environment, Tourism, Science and Innovation (DETSI), to assess potential surface water impacts associated with proposed landform changes over the life of mine.

Potential impacts associated with progressive disturbance throughout the life of mine and final landform have been assessed through a catchment and stormwater flow analysis. The existing sediment basin was also reviewed to confirm its capacity to capture sediment-laden runoff under both current and maximum disturbance scenarios.

The surface water impact assessment concludes that the potential risk of downstream surface water and receiving environment impacts associated with the proposed maximum disturbance landform is low, based on the following key findings:

- The site operates effectively as a closed surface water system, with all disturbed areas draining internally to site water storages
- Catchment changes in the maximum disturbance scenario are minimal, with the most notable change being the amalgamation of the Pit 3, Pit 4, and Farm Dam catchments
- The stormwater flow assessment undertaken indicates that the predicted changes in peak discharge between current and maximum disturbance scenarios are minimal
- Water balance modelling undertaken by Graymont (2025) suggests overtopping from site water storages is unlikely, even during extreme rainfall events
- An assessment of the sediment basin confirms that the current basin is adequately sized to capture runoff during both current and maximum disturbance, minimising the potential risk for uncontrolled releases to the receiving environment

The existing mitigation and management measures detailed in the site's Sediment and Erosion Management Plan are considered appropriate to manage the risks to the receiving surface water environment throughout the life of mine.

1 INTRODUCTION

Epic Environmental Pty Ltd (Epic) has been engaged by Graymont (NSW) Pty Ltd (Graymont) to provide ongoing environmental approvals support for the Calliope Limestone Quarry (the Project). This assessment has been prepared to support the preparation of a Progressive Closure and Rehabilitation Plan (PRCP) for the Project.

1.1 Project Location

The Project is located in Taragoola, approximately 11 kilometres (km) south of the township of Calliope and 30 km south of Gladstone in Central Queensland within the Gladstone Local Government Area (LGA) (see **Figure 1**). For the purpose of this report the Project refers to the Mining Leases (MLs) approved under the existing EA which comprise: ML3594, ML3595, ML3596, ML3597, ML3598, ML3599, ML3600, ML3602, ML3603, ML3604, ML3605, ML3606, ML3608, ML3609, ML80036, ML80189, ML80190, ML80191, and ML80192 (the MLs). The Project area comprises the current and proposed maximum disturbance areas within the MLs, as displayed in **Figure 2** and **Figure 3**.

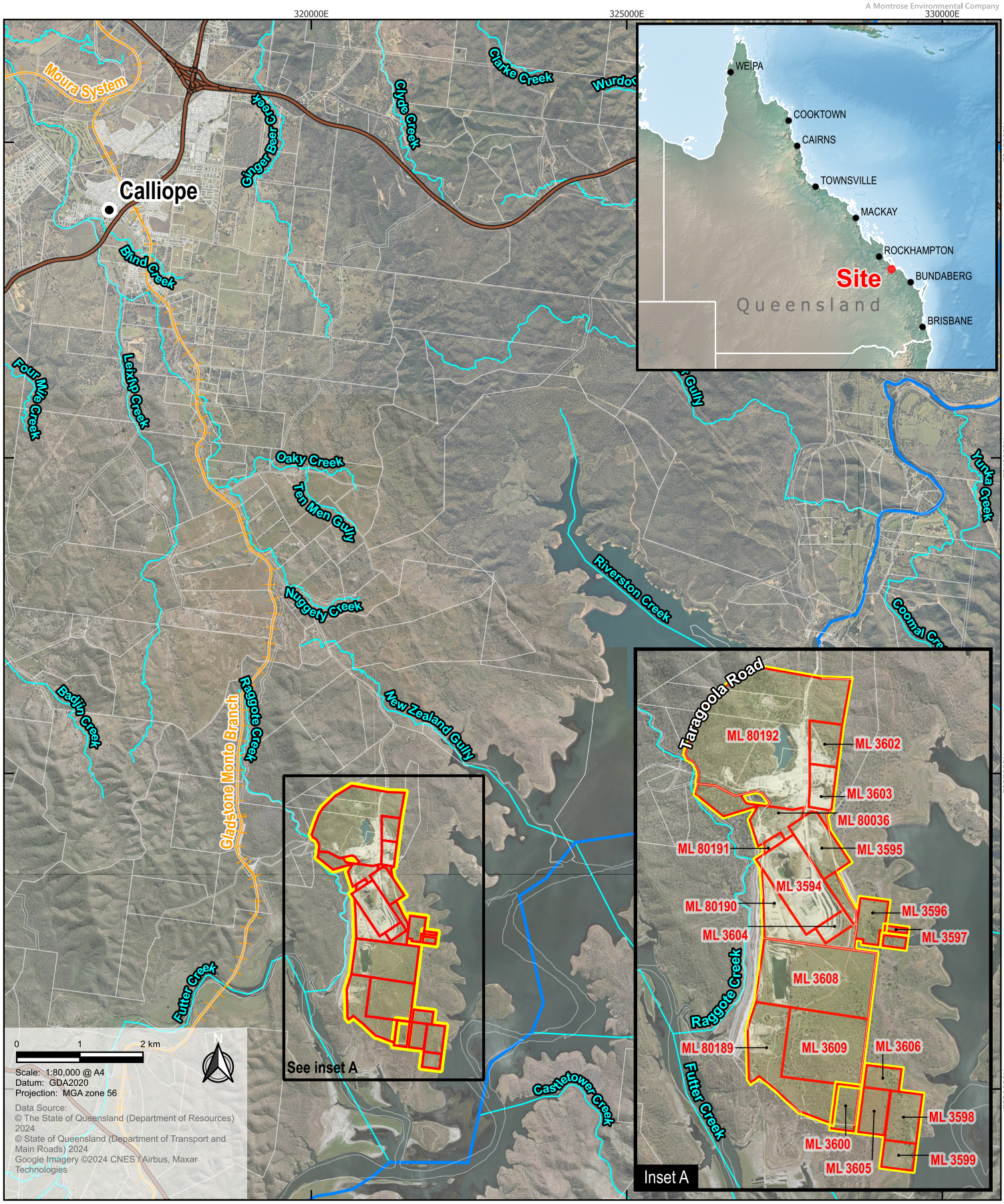
1.2 Objectives

The objective of this report is to assess potential impacts on surface water due to the proposed changes in land disturbance over the life of mine.

1.3 Scope of Works

The stated objectives have been achieved through the following scope of works undertaken by Epic:

- Desktop assessment including a summary of the following:
  - Regional and local geographic and climatic setting
  - Local hydrological conditions, including a description of:
    - Catchments and watercourses within the project area
    - Available existing water quality data
    - Flow conditions for watercourses
    - Relevant Environmental Values
- Hydrological assessment to determine the expected changes to the hydrological regime due to the proposed changes in landform, including:
  - Stormwater quantity assessment to predict the change in peak discharge of stormwater runoff, using the empirical rational method
  - Assessment of predicted changes to flow paths
  - Assessment of potential impacts to the Great Barrier Reef
  - Assessment of changes to sediment basin catchment and its capacity to limit sediment releases



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 1 Regional location.qgz

Legend

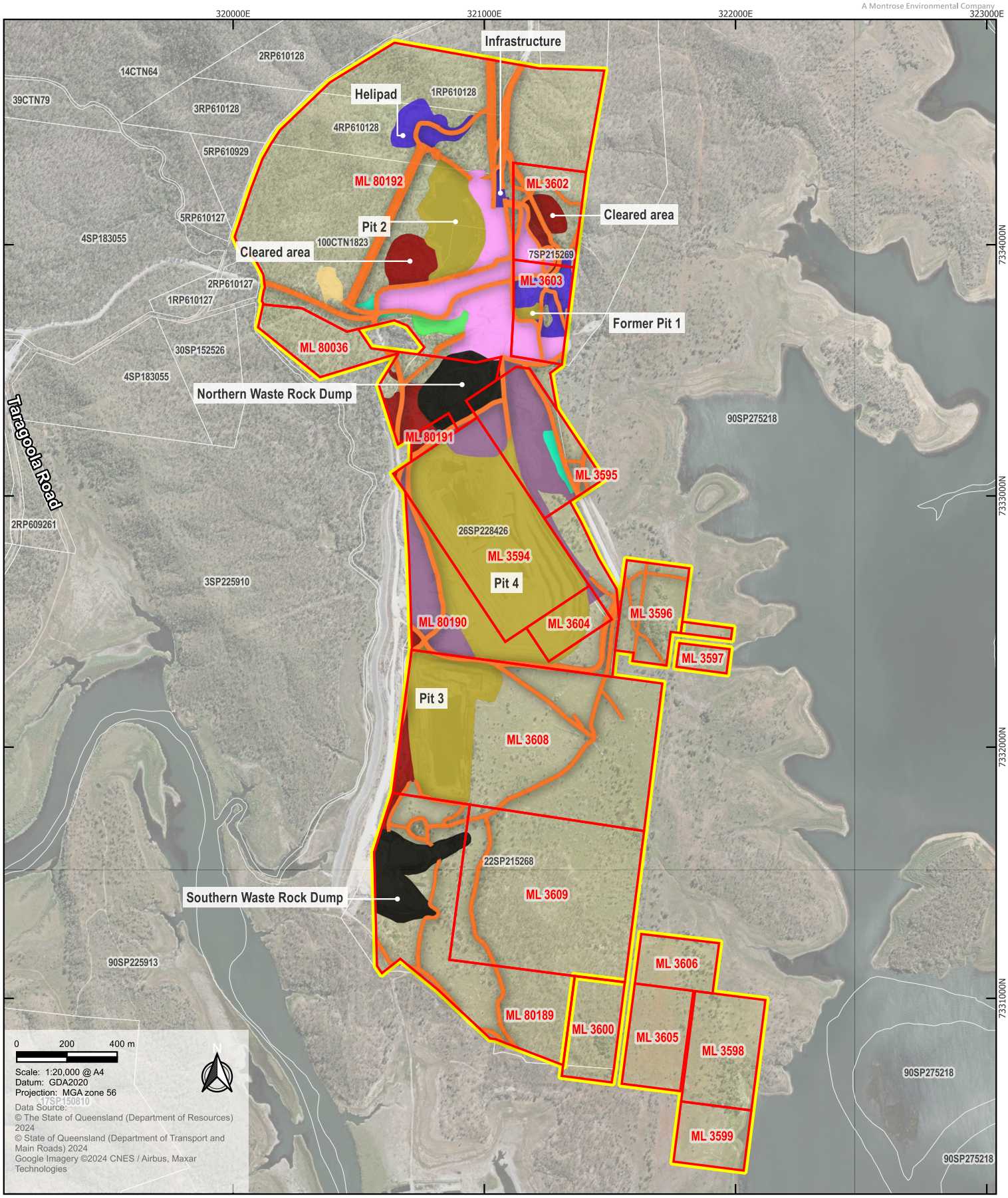
- Site boundary
- Mining leases
- Cadastre (DCDB)
- State controlled roads
- Railways

Watercourses

- Major
- Minor

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 1
Regional location



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 2 Current disturbance area.qgz

Legend

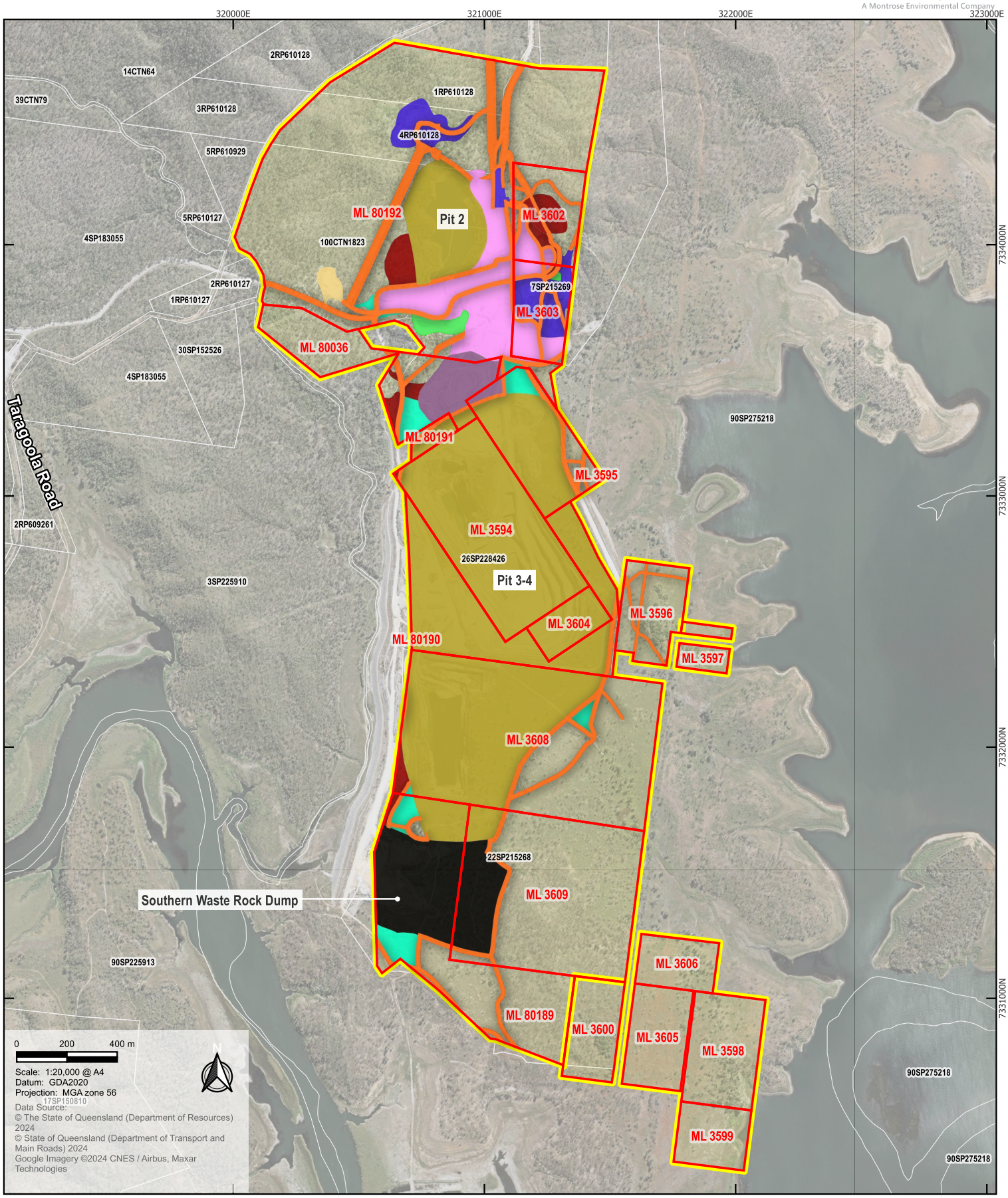
- Site boundary
- Mining Leases
- Cadastre (DCDB)

Current disturbance

- Access tracks
- Cleared areas and laydowns
- Infrastructure and plant
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 2
Current disturbance area



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 3 Maximum disturbance extent.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Mining Leases

Maximum disturbance

- Access tracks
- Cleared areas and laydowns
- Infrastructure and plant
- Sediment pond
- Pit
- ROM processing area
- Silt dump
- Temporary spoil storage area
- Topsoil stockpile
- Waste rock dump

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 3
Maximum disturbance extent

2 PROJECT DESCRIPTION AND BACKGROUND

Graymont holds a site-specific Environmental Authority (EA) (reference: EPML00969013), enabling limestone mining activities to be undertaken at the Project. Limestone mining has been ongoing at Calliope since 1967, with Graymont managing operations since 2019. The Project produces approximately 0.8 million tonnes per annum of limestone products.

The Project area covers 429.6 hectares (ha) and includes four open cut pits. The Project area includes 152.9 ha of existing disturbance (i.e. operational areas, pits etc) and 211.9 ha of proposed disturbance areas. Two non-operational pits (Pit 1 and Pit 2) are located in the northern end of the mine site. Pit 1 has recently been backfilled and Pit 2 is utilised for on-site water storage. Water from Pit 2 is primarily utilised at the wash plant. Pit 3 and Pit 4 are located to the southern extent of the mine MLs. The Project adjoins land owned and operated by the Gladstone Area Water Board (GAWB), with some access tracks in the area used by both Graymont and the GAWB.

Other infrastructure located on site includes the main office, weighbridge, run of mine (ROM) stockpile, access roads, crushing and screening plant, wash plant, main stockpile area of final product, silt ponds and spoil areas located in the northern portion of the Project.

Mining operations have remained consistent throughout the life of mine (LOM) and consists of conventional open cut benching methods which begins with topsoil stripping and removal of clay rich overburden and waste rock. Limestone ore is extracted by drilling and blasting, then crushed, screened and washed onsite before being loaded by a 120 tonne (t) excavator serviced by two 100 t and one 85 t off road dump trucks. There is a second 75 t excavator on site which is utilised as a backup for the open cut operations. Material is hauled either to:

- The ROM pad for crushing
- Stockpile for screening or placement in the designated spoil dumps

Extractive activities are also conducted following a similar process where limestone of different grades and suitable physical properties are mined for the production of road base and aggregates. Extractive activities are authorised and conducted under EA EPPR00881913.

The current Project schedule includes limestone ore to be mined exclusively from the existing open cut mining pit (Pit 4), which is located centrally within the Project area. Lateral and vertical expansion of Pit 4 is projected to occur over the next 70 years, with amalgamation of Pit 3 expected to occur during southern expansion. All future disturbance until end of mine life (EOML) will be authorised by, and undertaken in accordance with, an amended EA (to be amended in the future). Limestone ore will continue to be processed onsite utilising pre-existing purpose-built infrastructure in the crushing and screening plant and wash plant, with a rate of production of 10-20,000 t a week. Mine closure is scheduled for about 2100.

3 ASSESSMENT METHODOLOGY

3.1 Project Area

For the purposed of this assessment, the Project area is defined as the current and maximum disturbance areas within the MLs, as shown in **Figure 2** and **Figure 3**, respectively. The Project area includes both existing disturbances (i.e. operational areas, pits) and proposed disturbance areas. Some existing disturbance areas, including cleared areas, access tracks, waste rock dump, and spoil pile areas, will be overlapped by the proposed Pit 3-4 footprint, resulting in changes to the classification of disturbance by activity type.

The proposed new disturbance areas will be confined within the existing MLs for the Project (specifically ML80192, ML3594, ML3595, ML80190, ML3604, ML3608, ML80189, and ML3609), and will primarily occur within the land parcel described as Lot 22 on SP15268. Some minor additional disturbance will occur on land parcels described as Lot 4 on RP610128, Lot 100 on CTM1823, Lot 7 on SP215269, and Lot 26 on SP228426.

Existing disturbed areas will be preferentially used for alternative activities as the pit expands into adjacent areas. This approach will minimise additional environmental harm from new disturbance; however it will thereby require disturbed land to be used for operations until EOML.

3.2 Methodology

The methodology for this surface water impact assessment includes:

- Description of the existing environment relevant to the study area, through a desktop review of publicly available and client provided data and information
- Assessment of potential impacts on surface water associated with the proposed changes in Project disturbance

3.3 Relevant Legislation and Guidelines

This report has been prepared with reference to the applicable legislation and policies as below:

3.3.1 Environmental Protection Act 1994

The objective of the *Environmental Protection Act 1994* (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 requires an Environmental Authority and Progressive Rehabilitation and Closure (PRC) Plan to be approved under the EP Act.

3.3.2 Best Practice Erosion and Sediment Control (IECA, 2008)

The Best Practice Erosion and Sediment Control (IECA, 2008) guidelines contain the necessary strategies and techniques to assist erosion and sediment control practitioners to reduce the degradation of land and water from uncontrolled erosion and sedimentation. Erosion and Sediment Control is a primary pathway for contamination from the site and therefore this guideline is relevant to the Project.

3.3.3 Reef Discharge Standards for Industrial Activities (DESI, 2024)

This guideline outlines information an applicant should include in an environmental authority application to address section 41AA of the *Environmental Protection Regulation 2019*, where the proposed activity involves the discharge of fine sediment or dissolved inorganic nitrogen to the Great Barrier Reef (GBR) catchment waters. The Project is within the Boyne River Basin, which is located in the GBR catchment and therefore these standards are relevant to the Project.

3.3.4 Environmental Protection (Water and Wetland Biodiversity) Policy 2019

The purpose of the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water)) is to determine the environmental values (EVs) and associated water quality objectives (WQOs) for Queensland waters. Under the EPP (Water and Wetland Biodiversity), the Project is located within the Curtis Island, Calliope River and Boyne River Basins.

3.3.4.1 Environmental Values

Identification of environmental values (EVs) has been undertaken in accordance with the *Application requirements for activities with impacts to water guideline* (DESI 2024c). The EVs for the Project's receiving surface water environment has been defined as WQ13131— Boyne River in Schedule 1 of the *Environmental Protection Policy (Water and Wetland Biodiversity) 2019* (EPP (Water and Wetland Biodiversity). The specific EVs applicable to the Project are detailed in the supporting EPP (Water and Wetland Biodiversity) document, *Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives* (EPP 2014) and have been summarised in **Table 1**.

Table 1. EVs of Project receiving surface waters

Value	Icon	Discussion	Pathway/ Receptor Linkage
Aquatic Ecosystems		The Project is adjacent to Lake Awoonga, a tributary to Boyne River. Areas downstream may support aquatic ecosystems.	Possible
Irrigation		The Project is in proximity to a few groundwater bores that may be used for irrigation, however, the Project is not expected to impact irrigation use of Lake Awoonga.	Low
Farm Supply Use		The Project has a farm dam which does not support farming activities, and is therefore not expected to impact on water used for farming.	Low
Stock Water		The Project is not expected to impact on the water used for livestock on Lake Awoonga or Boyne River.	Low
Aquaculture		The Project is not located in proximity to any aquaculture facilities.	Unlikely
Human Consumer		Areas downstream from the Project may be utilised for the consumption of aquatic foods, including fish.	Possible
Primary Recreation		Recreational activities, including swimming and diving, occur in areas adjacent to the Project. Discharges from the Project are only expected to pose a potential contamination risk to Lake Awoonga during flood events associated with elevated dam levels.	Unlikely
Secondary Recreation		Lake Awoonga supports recreational fishing and boating activities.	Unlikely

Value	Icon	Discussion	Pathway/ Receptor Linkage
Visual Recreation		The Project is located approximately 7km south west of the Lake Awoonga lookout, boat ramp, and camping area, and is not clearly visible from this location. Potential contamination at the Project is unlikely to be contributing to deterioration of the aesthetics of Lake Awoonga.	Low
Drinking Water		Lake Awoonga supplies raw water that is processed at water treatment plants for potable use.	Low
Cultural and Spiritual Values		The Project is not considered to impact on the cultural and spiritual values of Lake Awoonga.	Low
Groundwaters (aquatic ecosystems, irrigation, farm supply/use, stock water, drinking water)		Mining activities occur above the groundwater table so any discharges to groundwater are unlikely.	Unlikely

3.3.4.2 Water Quality Objectives

Water Quality Objectives (WQOs) for the Boyne River Basin have been defined within the *Curtis Island, Calliope River and Boyne River Basins Environmental Values and Water Quality Objectives* (EPP (Water) 2014). The WQOs for the water areas relevant to the Project have been summarised in **Table 2** below. Lowland fresh waters considered relevant are Raggotte Creek and Futter Creek, which are tributaries of Lake Awoonga, and which have elevations less than 150 m.

Table 2. Boyne River Basin WQOs relevant to the Project (EPP (Water) 2014)

Water area/ type	Management Intent / level of protection	Amm (N) (µg/L)	Oxid N (µg/L)	Total N (µg/L)	FRP (µg/L)	Total P (µg/L)	Chl-a (µg/L)	DO (% sat)	Turb (NTU)	SS (mg/L)	pH
Lake Awoonga	Moderately Disturbed (MD)	-	-	<700	-	<40	-	85-105	<4.7	-	7.75-8.4
Lowland fresh <150m (other waters)	MD	<20	<60	<500	<20	<50	<5	85-110	<50	<10	6.5-8.0

The site is within the Boyne River Basin which is within the GBR catchment for which the GBR Water Quality Protection Plan (the Reef Plan) applies. The Reef Plan sets targets for improved water quality in terms of load reduction and land management practices which are implemented through each water quality improvement plan (WQIP).

3.3.5 Environmental Authority

The Project operates under Environmental Authority EPML00969013. The EA lists authorised surface water release points from the Project, as detailed in **Table 3**. The defined contaminant release limits for the release points are detailed in

Table 3. Contaminant release points, sources and receiving waters (EPM00969013, Table 2)

Release Point (RP)	Easting (GDA94)	Northing (GDA94)	Contaminant Source and Location	Monitoring Point	Receiving waters
F1	321 432	733 2026	Pit 3 and Pit 4	End of pipe F1 (Discharge Monitoring Point)	Lake Awoonga Dam
F2	320 399	733 1469	Undisturbed natural flow and/or Pit 3	Raggote Ck at F2 (Downstream Monitoring Point)	Farmers Dam
C1	320 757	733 3601	Pit 1, Pit 2 and Pit 4	C1 dam spillway (Discharge Monitoring Point)	Pit 2 and/or Recycled Water Storage Dam
C2	320 102	733 3854	Undisturbed natural stormwater flow	C2 creek adjacent to rail siding road (Upstream Monitoring Point)	Raggote Creek

Table 4. Contaminant release limits (EPM00969013, Table 3)

Quality Characteristic	Release Limits	Monitoring Frequency
Electrical conductivity (µS/cm)	900	Weekly during discharge
pH (pH Unit)	6.5 (minimum) 8.5 (maximum)	Weekly during discharge
Total Suspended Solids (mg/L)	100 (maximum) Or when measured at C1, F2 or F1 not more than 110% of value at monitoring point C2	Weekly during discharge

3.4 Data Sources

The following data sources have been used in preparation of this technical report:

- Climate data: SILO (Scientific Information for Land Owners)
- Topographic data (provided by Graymont)
- Water quality data (provided by Graymont)
- Sediment and Erosion Control Plan (prepared by Graymont)
- Water Management Plan (prepared by Graymont)
- Calliope Hydrogeology Report (prepared by Graymont)

4 EXISTING ENVIRONMENT

4.1 Topography

The topography surrounding the Project area is hilly, with elevations ranging from 40 to 100 mAHD. The land surface generally slopes to the east, south, and west towards Lake Awoonga. The land surrounding the Project is classified as low intensity cattle grazing. The topography of the Project is shown in **Figure 4**.

Two earthen bunds (Eastern and Western) have been constructed at the Project. A 1,900 m long earth and rock wall is located adjacent to Raggote Creek on the western side of the Project, and a smaller wall exists along the eastern perimeter of the Project area. Both bunds also function as access tracks with a crest elevation of approximately 52 mAHD.

4.2 Climate

The Project is located within Queensland's sub-tropical climatic zone which is characterised by high summer temperatures, warm dry winters, and distinct wet and dry seasons. It lies within the southeast trade wind belt but is too far south to experience monsoonal influence from the northwest and too far north to benefit from higher altitude cold fronts (Bureau of Meteorology (BoM) 2025a).

Median monthly rainfall and evaporation data are summarised in **Table 5**, based on data from SILO database (SILO, 2025), using data from the BOM station at Gladstone Radar (no. 39123). Median annual evaporation (1,855.5 mm) exceeds median annual rainfall (808.3 mm) by approximately 130% and evaporation is greater than rainfall on average in all months.

Table 5. Summary of climate data, 1957 – 2025 (SILO data set from BOM station 39123)

Month	Median Monthly Rainfall (mm)	Median Monthly Evaporation (mm)
January	106.5	207.8
February	85.6	170.2
March	61.2	172
April	32.7	136.1
May	29.7	108.2
June	18.4	89.5
July	21.9	97.1
August	20.8	119.2
September	13.1	150.7
October	54.8	188.6
November	65.8	199.5
December	86.5	213.4
Annual Total	**808.3**	**1855.5**

4.3 Hydrology

4.3.1 Catchment Overview

The Project is located within the Fitzroy catchment within the Boyne River Basin, which covers an area of approximately 2,590 km^2. The area is bound by Many Peaks Range to the east, Dawes Range to the south, Calliope Range to the south-west and Boyne Range to the west. The terrain of the bounding ranges is relatively steep with heights ranging from 600 to 850 m above sea level. Several towns are also located within the catchment including Nagoorin, Ubobo, and Builyan. The Boyne River Basin Plan area comprises a single catchment with one major river system (the Boyne River) and a number of tributaries (including Ridler, Degalgil, Marble and Diglum Creeks) that drain to Gladstone Harbour and the Great Barrier Reef (GBR).

4.3.2 Watercourses

The Project is located adjacent to Lake Awoonga which bounds the site in the east, south, and southwest. Raggote Creek, located to the west of the site, is a tributary of Lake Awoonga. The hydrology of the site is shown in **Figure 4**.

4.3.3 Wetlands

Lake Awoonga is mapped as a lacustrine wetland (QGlobe, 2025), as shown in **Figure 5.** The existing farm dam adjacent to the Southern WRD is mapped as a hydrologically modified or artificial lacustrine wetland. There are no internationally important wetlands within the vicinity of the Project area; the closest internationally Important Wetland is located greater than 1,000 km away. There are no MSES - High ecological significance wetlands mapped within the Project area. The closest of which is approximately 15 km northwest of the Project area.

4.4 Lake Awoonga Water Quality

Water quality data from Lake Awoonga is collected by Gladstone Regional Council as part of their annual Drinking Water Service Report (Gladstone Regional Council, 2024). The latest report presents data from 2023 – 2024, as summarised in **Table 6** and shows that there were no exceedances of the drinking water guideline values.

Table 6. Lake Awoonga Water Quality

Parameter	Unit	Australian Drinking Water Guideline Value	Min	Average	Max
Aluminium - Total	mg/L		0.02	0.06	0.08
Antimony - Total	mg/L	0.003	<	<	<
Arsenic - Total	mg/L	0.01	<	<	<
Barium - Total	mg/L	2	0.012	0.01	0.017
Boron - Total	mg/L	4	<	<	<
Bromate	mg/L	0.02	<	<	<
Bromide	mg/L		<	0.02	0.064
Bromodichloromethane	µg/L	250	<	25	41
Bromoform	µg/L	250	<	<	14
Cadmium - Total	mg/L	0.002	<	<	<
Chlorate	mg/L	0.8^	0.022	0.14	0.41
Chloride	mg/L		27	40	52
Chlorine (free)	mg/L	5	<	<	2.5
Chloroform	µg/L	250	6	30	60
Chromium - Total	mg/L	0.05	<	<	0.003
Copper - Total	mg/L	2	<	0.003	0.019
Dibromochloromethane	µg/L	250	8	18	28
E. coli (Colilert)	MPN/100mL	0	<	<	<
Electrical Conductivity	µS/cm		306	363	468
Fluoride	mg/L	1.5	<	<	0.1
HPC (22°C)	CFU/mL		<	15	>300
Iron - Total	mg/L		<	<	0.22
Lead - Total	mg/L	0.01	<	<	<
Manganese - Dissolved	mg/L	0.5	<	<	0.007
Manganese - Total	mg/L	0.5	<	<	0.008
Mercury - Total	mg/L	0.001	<	<	<
Molybdenum - Total	mg/L	0.05	<	<	<
Nickel - Total	mg/L	0.02	<	<	<
Nitrate as NO_3^-	mg/L	50	0.03	0.09	0.16
Nitrite NO_2	mg/L	3	<	0.006	0.07
pH	pH units		6.8	7.4	8.6
Phosphate PO_4	mg/L		<	0.007	0.08

Parameter	Unit	Australian Drinking Water Guideline Value	Min	Average	Max
Selenium - Total	mg/L	0.01	<	<	<
Sulfate as SO_4	mg/L		23	28	37
Temperature	°C		17.7	25.6	35.5
Total Alkalinity (as CaCO3)	mg/L		70	82	107
Total Coliforms (Colilert)	MPN/100mL		<	<	<
Total Hardness (as CaCO3)	mg/L		82	95	112
Trihalomethanes Total	µg/L	250	25	73	125
True Colour	HU		<	<	3
Turbidity (NTU)	NTU		<	0.15	1.2
Zinc - Total	mg/L		<	<	0.009

4.5 Existing Water Quality

There is limited available water quality data for the Project. Water quality samples are collected from the monitoring points defined in the EA during releases from the Project area. Monitoring point C1 is the discharge point for releases from the sediment basin. Available data from discharge point C1 during 2025 is summarised in **Table 7**, along with the site targets and EA limits. This shows that there have been no exceedances of the EA limits in 2025.

Monitoring point F1 is the discharge point for controlled releases from Pit 4. There is only one water quality sample available in 2025 for F1, as shown in **Table 8**. Water quality during this release was below the EA limits.

Table 7. C1 discharge water quality data – 2025

Parameter	Site Target	EA Limit	Minimum Recorded Value	Maximum Recorded Value
pH	6.5 – 8.5	6.5 – 8.5	7.64	7.84
EC	450	900	157	488
TSS	50	100	<5	10

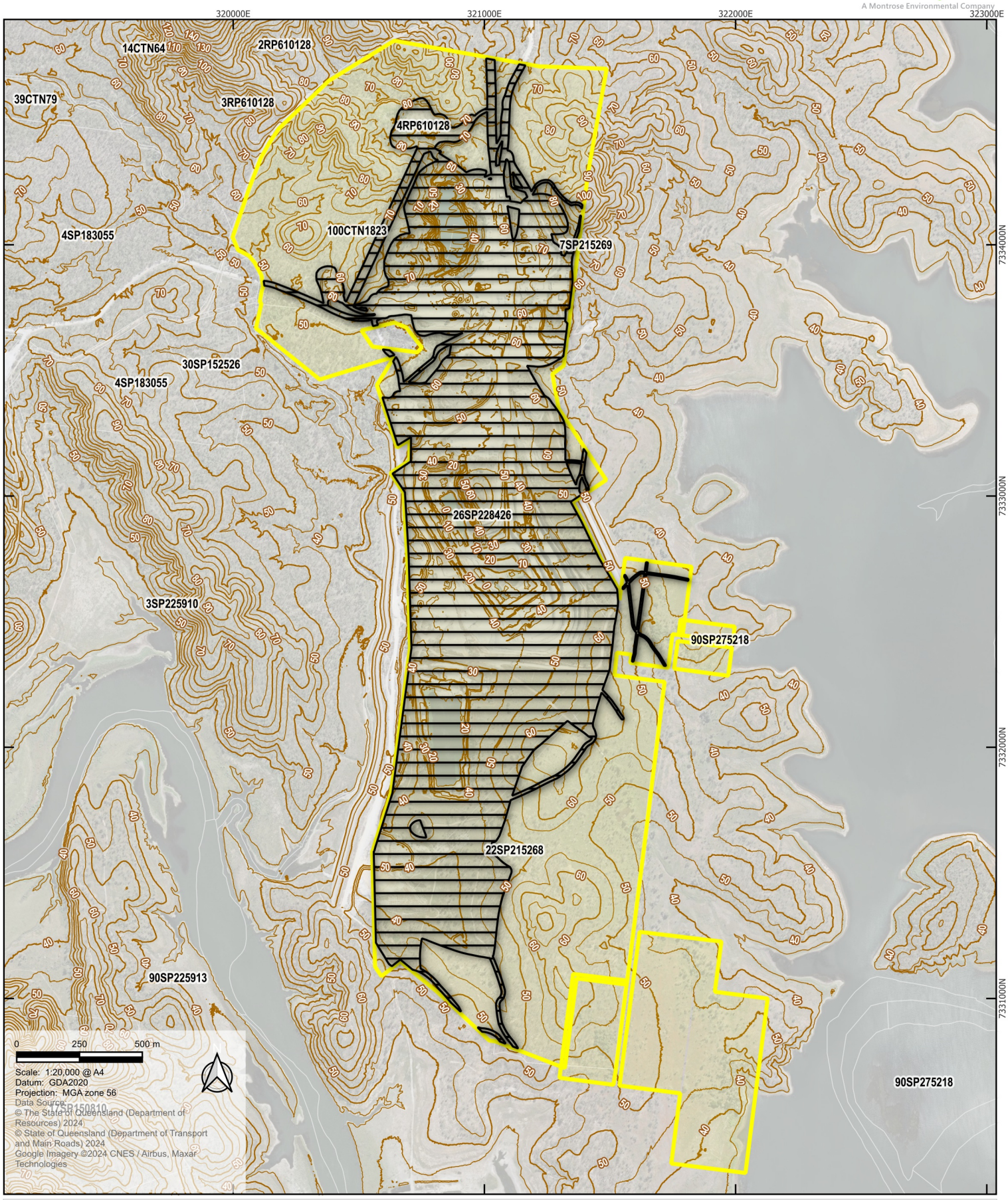
Table 8. F1 discharge water quality data - 2025

Parameter	Site Target	EA Limit	Recorded Value (13/03/25)
pH	6.5 – 8.5	6.5 – 8.5	7.85
EC	450	900	721
TSS	50	100	6

Water quality data from samples collected in March 2025 from Pit 3 and Pit 4 have been summarised in **Table 9,** along with the relevant water quality guidelines. This data shows that recorded water quality does not exceed guideline values.

Table 9. Pit water quality (collected 19/03/25)

Parameter	Units	Australian drinking water guideline	ANZECC stock watering guideline	Pit 3 Seepage	Pit 3	Pit 4
pH	pH units	6.5 - 8.5	6 - 8.5	8.1	8.1	8.2
Electrical Conductivity	µS/cm	-	5970	1144	733	472
Dissolved Oxygen	mg/l	-	-	6.5	5.7	3.9
Turbidity	NTU	-	-	24.1	9.59	5.7
Suspended Solids	mg/L	-	-	<5	<5	<5
Total Alkalinity as CaCO3	mg/L	-	-	242	89	116
Sulfate as SO4 - Turbidimetric	mg/L	-	-	55	37	47
Chloride	mg/L	-	-	143	142	18
Calcium - Dissolved	mg/L	-	-	126	60	50
Magnesium - Dissolved	mg/L	-	-	7	7	7
Sodium - Dissolved	mg/L	-	-	87	59	24
Potassium - Dissolved	mg/L	-	-	<1	<1	<1
Calcium - Total	mg/L	-	-	137	63	58
Magnesium - Total	mg/L	-	-	8	8	8
Sodium - Total	mg/L	-	-	94	64	26
Potassium - Total	mg/L	-	-	<1	<1	<1
Aluminium - Dissolved	mg/L	-	-	<0.01	<0.01	<0.01
Arsenic - Dissolved	mg/L	-	-	<0.001	<0.001	<0.001
Cadmium - Dissolved	mg/L	-	-	<0.0001	<0.0001	<0.0001
Chromium - Dissolved	mg/L	-	-	<0.001	<0.001	<0.001
Copper - Dissolved	mg/L	-	-	<0.001	0.001	<0.001
Nickel - Dissolved	mg/L	-	-	<0.001	<0.001	<0.001
Lead - Dissolved	mg/L	-	-	<0.001	<0.001	<0.001
Zinc - Dissolved	mg/L	-	-	0.007	0.01	<0.005
Iron - Dissolved	mg/L	-	-	<0.05	<0.05	<0.05
Aluminium - Total	mg/L	0.1	5	0.03	0.04	0.06
Arsenic - Total	mg/L	0.01	0.5	<0.001	<0.001	<0.001
Cadmium - Total	mg/L	0.002	0.01	<0.0001	<0.0001	<0.0001
Chromium - Total	mg/L	0.05	1	<0.001	<0.001	<0.001
Copper - Total	mg/L	2	1	<0.001	<0.001	<0.001
Nickel - Total	mg/L	0.02	1	<0.001	<0.001	<0.001
Lead - Total	mg/L	0.01	0.1	<0.001	<0.001	<0.001
Zinc - Total	mg/L	3	20	<0.005	<0.005	<0.005
Iron - Total	mg/L	-	-	<0.05	<0.05	0.06
Mercury - Dissolved	mg/L	-	-	<0.0001	<0.0001	<0.0001
Mercury - Total	mg/L	-	-	<0.0001	<0.0001	<0.0001



Legend

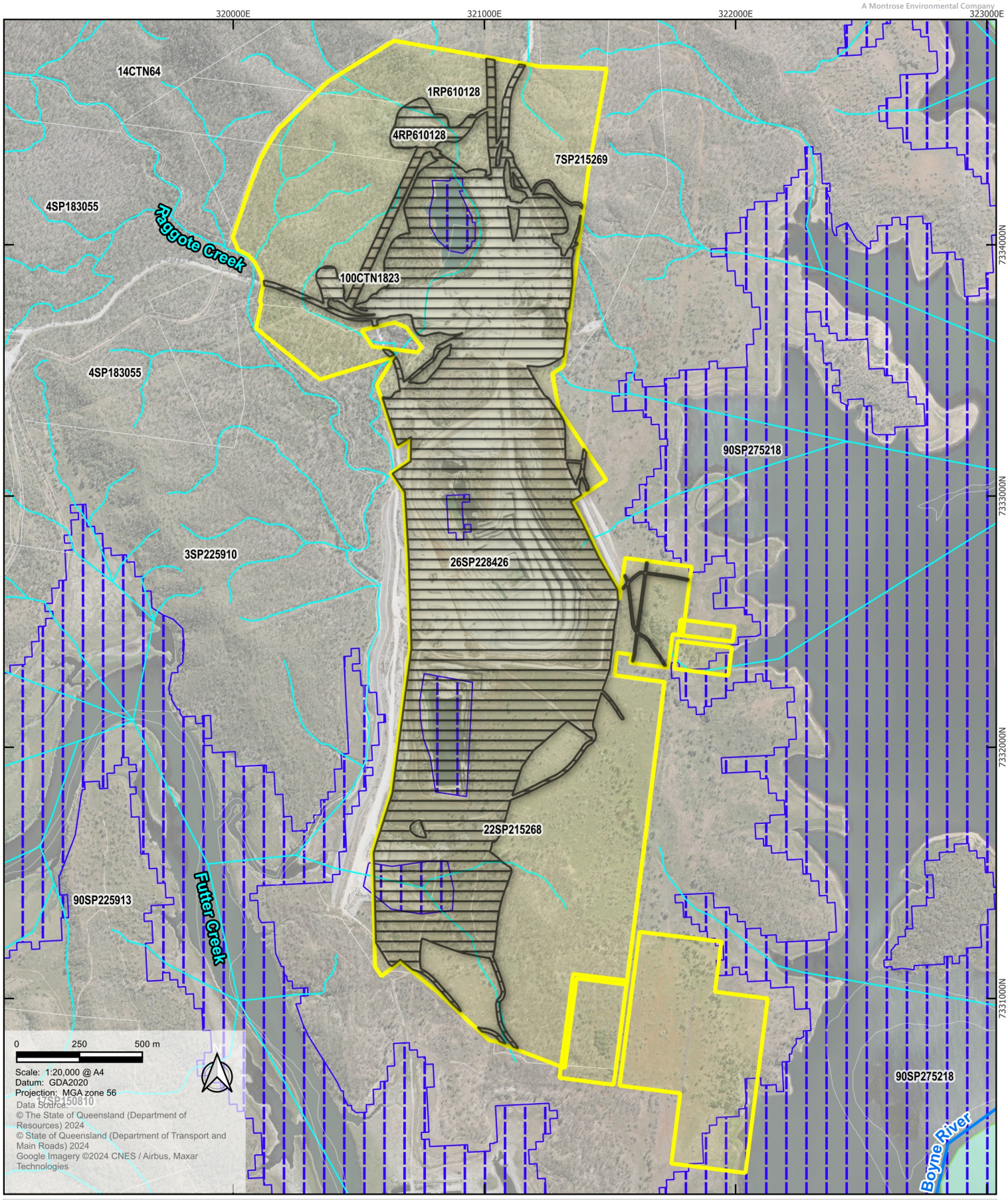
- Site boundary
- Maximum disturbance extent

Elevation contours

- 5m intervals
- 10m intervals

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 4
Topography



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 5 Hydrology.qgz

Legend

- Site boundary
- Cadastre (DCDB)
- Maximum disturbance extent
- MSES - Regulated vegetation (100m from wetland)

Wetland areas (Qld Wetland Mapping v5.0)

- Lacustrine

Watercourses

- Major
- Minor

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 5
Hydrology

5 IMPACT ASSESSMENT

5.1 Catchment Analysis

Catchment analysis has been undertaken using available topographic data to assess changes between the existing and final (maximum disturbance) landform. The following sections detail the current and final catchments, as well as the changes in catchment area and water flow paths.

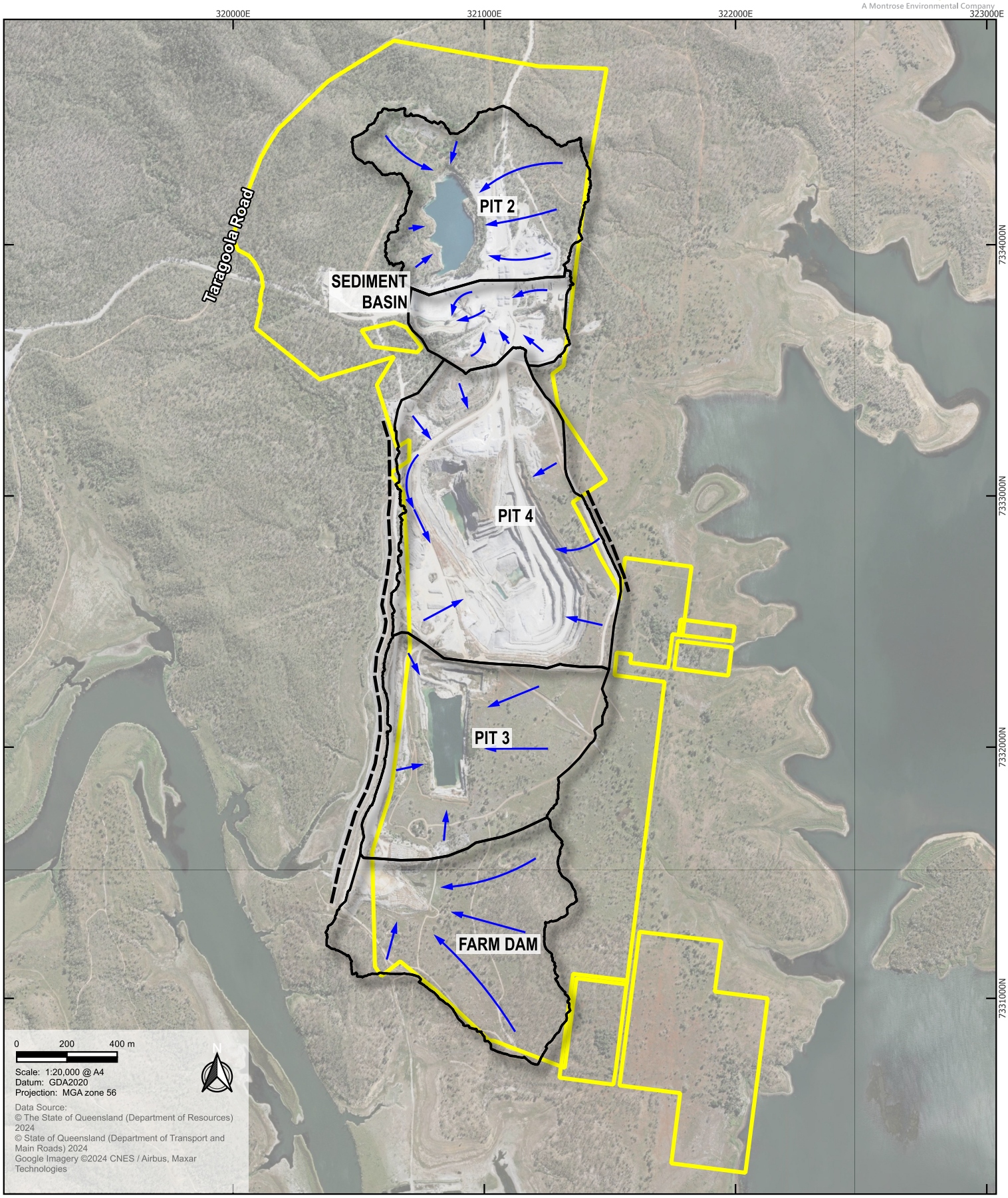
5.1.1 Current Disturbance

The surface water catchments within the current Project disturbance are detailed in **Table 10** and shown in **Figure 6**. These catchments have been derived using topographic survey data (2024 & 2025) provided to Epic by Graymont. Former Pit 1 has recently been backfilled, and surface runoff from this area now reports to the sediment basin catchment.

The current Project catchment has a naturally occurring north-south surface water divide located to the east of the Project, which prevents runoff discharging from that direction. The construction of a bund wall to the west of the Project has created another north-south surface water divide, similarity preventing runoff from leaving the Project to the west. Together, these surface water features form a closed surface water system within the Project with surface water runoff retained within the Project area and reporting to onsite water storages.

Table 10. Current Disturbance Catchments

Catchment	Description	Area (ha)
Pit 2	Includes: • Main site entrance • Contractor truck waiting area • Main office • Plant stockpile storage areas • Helipad	49.2
Sediment basin	Includes: • ROM processing area • Wash-plant and screening area • Backfilled Pit 1	18.1
Pit 3	Includes: • Northern portion of southern waste rock dump • Cleared areas and laydowns • Undisturbed area to the east of Pit 3	59.7
Pit 4	Includes: • Northern waste rock dump • Topsoil stockpile • Temporary spoil storage area	86.7
Farm Dam	Includes: • Southern waste rock dump • Undisturbed area previously draining into Raggotte Creek	56.8
	Total	270.5



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 6 Current disturbance catchment areas.qgz

Legend

- Site boundary
- Current disturbance catchment areas
- Bund wall
- Flow path

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 6
Current disturbance catchment areas

5.1.2 Maximum Disturbance

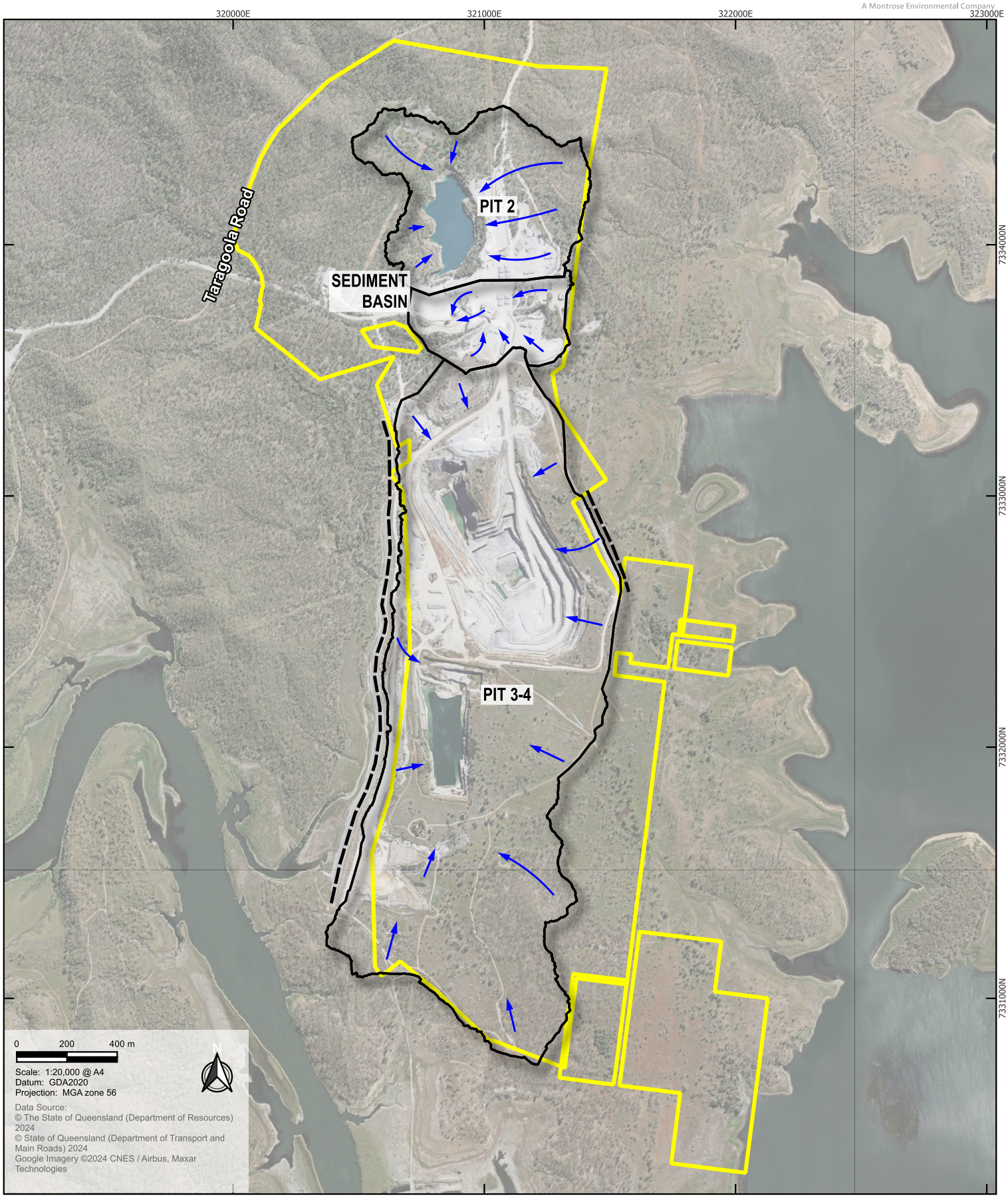
The surface water catchments associated with the maximum Project disturbance extent are detailed in **Table 11** and shown in **Figure 7**. These catchments have been derived from the maximum disturbance surface data, provided to Epic by Graymont.

The expanded disturbance area associated with the final development of Pit 3-4 will result in the removal of the existing Farm Dam. Under the maximum disturbance scenario, the existing farm dam catchment will flow into Pit 3-4. As a result the catchment area for Pit 3-4 in the maximum disturbance will encompass the current catchments for Pit 3, Pit 4, and the Farm Dam.

No changes are anticipated to the catchment areas for Pit 2 and the Sediment Basin in the maximum disturbance landform. Additionally, the existing natural and constructed surface water divides to the east and the west of the Project remain unchanged, maintaining a closed surface water system in which all runoff is contained within the Project area.

Table 11. Maximum Disturbance Catchments

Catchment	Description	Area (ha)
Pit 2	Includes: • Main site entrance • Contractor truck waiting area • Main office • Plant stockpile storage areas • Helipad	49.2
Sediment basin	Includes: • ROM processing area • Wash-plant and screening area • Backfilled former Pit 1	18.1
Pit 3 - 4	Includes: • Previous Pit 3 catchment • Previous Pit 4 catchment • Previous Farm Dam catchment, including southern waste rock dump and undisturbed area previously draining into Raggotte Creek	203.2
	Total	270.5



Filepath: ~BAA\BAA220011.01 Graymont Calliope PRCP Stage 2\Workspaces\BAA250025.01 Surface Water Impact Assessment\1. Surface Water Impact Assessment\Rev A\Figure 7 Maximum disturbance catchment areas.qgz

Legend

- Site boundary
- Maximum disturbance catchment areas
- Bund wall
- Flow path

Graymont
Calliope Limestone Quarry
Surface Water Impact Assessment

Figure 7
Maximum disturbance catchment areas

5.2 Stormwater Flow Assessment

A stormwater flow assessment has been completed to quantify potential changes in peak stormwater discharge from the site under the maximum disturbance scenario across a range of design rainfall events.

The Rational Method was used to estimate peak discharge rates for each catchment under both current and maximum disturbance conditions. This approach was selected in accordance with the Queensland Urban Drainage Manual (QUDM, 2016). Input parameters used in the calculations are summarised in **Table 12**, **Table 13**, and **Table 14**. The relative areas of land use within each catchment have been calculated based on topographic survey data provided by Graymont.

Table 12. Rational Method input parameters

Parameter	Value	Source
Site catchment area – Ha	See **Table 10** and **Table 11**	Calculated from topographic data (provided by Graymont)
Fraction impervious - unitless	Natural/Undisturbed = 0 Disturbed = 0.9 Pit/Pond = 1 Infrastructure/Buildings = 1	QUDM (dependent on land use)
Composite Runoff Coefficient (C) – unitless	See **Table 13** and **Table 14**	Calculated
Frequency factors (Fy)	QUDM table 4.5.2	QUDM
Time of concentration (t_c) – minutes	5	QUDM
Rainfall intensity - 1 hour, 10% AEP ($^1I_{10}$) – mm/hr	61.5	BOM IFD design rainfall (BOM, 2024)

Table 13. Current disturbance catchment areas and runoff coefficients

Catchment	Site catchment area per land use (ha)				Composite Runoff Coefficient (C) – unitless
	Natural/Undisturbed	Disturbed	Pit/Pond	Infrastructure/Buildings	
Pit 2	19.60	20.27	8.51	0.82	0.81
Sediment basin	0.67	12.25	1.91	3.27	0.87
Pit 3	36.15	7.82	15.74	0.00	0.77
Pit 4	11.93	32.61	42.15	0.00	0.86
Farm Dam	50.44	6.37	0.00	0.00	0.72

Table 14. Maximum disturbance catchment areas and runoff coefficients

Catchment	Site catchment area per land use (ha)				Composite Runoff Coefficient (C) – unitless
	Natural/Undisturbed	Disturbed	Pit/Pond	Infrastructure/Buildings	
Pit 2	17.91	19.00	11.47	0.82	0.82
Sediment basin	0.42	12.26	1.42	4.00	0.88
Pit 3-4	38.93	54.59	109.69	0.00	0.85

Table 15, **Table 16**, and **Table 17** show the estimated peak discharge for a range of design rainfall events under both current and maximum disturbance scenarios. As the total catchment areas remain largely unchanged, with the exception of Pit 3-4, the primary influence on peak discharge is the change in land use within the catchments. These modelling results show that the predicted changes in peak discharge are minimal, with a <1% change expected within the sediment basin catchment.

Table 15. Peak discharge – Sediment basin

AEP %	ARI (1 in x years)	Peak Discharge (m^3/s)		Change in peak discharge (m^3/s)	% change
		Current Disturbance	Maximum Disturbance		
39%	1 in 2 years	0.38	0.39	0.00	0%
18%	1 in 5 years	0.57	0.57	0.00	0%
10%	1 in 10 years	0.70	0.70	0.00	0%
5%	1 in 20 years	0.83	0.84	0.00	0%
2%	1 in 50 years	1.05	1.06	0.00	0%
1%	1 in 100 years	1.21	1.21	0.00	0%

Table 16. Peak discharge – Pit 2

AEP %	ARI (1 in x years)	Peak Discharge (m^3/s)		Change in peak discharge (m^3/s)	% change
		Current Disturbance	Maximum Disturbance		
39%	1 in 2 years	0.97	0.98	0.01	+1%
18%	1 in 5 years	1.44	1.45	0.01	+1%
10%	1 in 10 years	1.76	1.77	0.02	+1%
5%	1 in 20 years	2.10	2.12	0.02	+1%
2%	1 in 50 years	2.65	2.68	0.03	+1%
1%	1 in 100 years	3.05	3.08	0.03	+1%

Table 17. Peak discharge – Pit 3 and Pit 4

AEP %	ARI (1 in x years)	Current Disturbance Peak Discharge (m^3/s)				Maximum Disturbance Peak Discharge (m^3/s)	Change in peak discharge (m^3/s)	% change
		Farm Dam	Pit 3	Pit 4	Total	Pit 3-4		
39%	1 in 2 years	0.99	1.82	1.13	3.93	4.22	0.28	+7%
18%	1 in 5 years	1.48	2.70	1.67	5.85	6.27	0.42	+7%
10%	1 in 10 years	1.80	3.30	2.04	7.14	7.66	0.52	+7%
5%	1 in 20 years	2.16	3.94	2.44	8.54	9.16	0.62	+7%
2%	1 in 50 years	2.73	4.98	3.09	10.80	11.58	0.78	+7%
1%	1 in 100 years	3.13	5.72	3.55	12.40	13.30	0.90	+7%

5.3 Sediment Basin Capacity Assessment

An assessment of the existing sediment basin was undertaken to determine whether it provides sufficient capacity to prevent sediment-laden runoff from discharging to the receiving environment under the maximum disturbance scenario.

The sediment basin dimensions were estimated using topographic survey data collected in March 2025 (provided by Graymont). Based on this data, the existing sediment basin is estimated to have a surface area of approximately 4,950 m^2, and an available volume of approximately 5,330 m^3.

The sediment basin sizing calculations presented in the existing Sediment and Erosion Management Plan (Graymont, 2023) are based on a catchment size of 7.2 ha. However, catchment analysis undertaken as part of this assessment has redefined the sediment basin catchment area to be 18.1 ha for both the current and maximum disturbance scenarios.

The minimum required sediment basin sizing for this updated catchment area has been calculated using the methodology for a C-type basin as outlined in 'Best Practice Erosion and Sediment Control' (IECA, 2018).

The following assumptions were adopted in the absence of site-specific data to support the sediment basin sizing calculations:

- Runoff for the Q-3 month (0.5 x 1 year ARI) was applied
- Approximately 90% of the sediment is larger than 0.05 mm diameter
- Bulk density of limestone used was 28 kN/m^3
- Clean out frequency of basin is once per year

The minimum required dimensions for the sediment basin are as follows:

- Surface area = 532.2 m^2
- Volume = 470.9 m^3
- Width = 13.2 m, Length = 39.6 m

The existing sediment basin size (Surface ware of approximately 4,950 m^2, and volume of approximately 5,330 m^3) is significantly larger than the calculated minimum requirements and is therefore considered adequate to manage runoff and sediment loads under both the current and maximum disturbance scenarios.

5.4 Impacts to Great Barrier Reef

The catchment analysis completed as part of this assessment confirms that the surface water catchments within the Project area effectively act as a closed system under both the current and maximum disturbance conditions. A natural surface water divide is present to the east of the Project area, while a man-made bund aligned approximately north-south is located to the west of the Project area. These surface water divides prevent runoff from exiting the site, with surface water flows reporting internally to site water storages.

The site water balance included in the Hydrogeological report (Graymont, 2025) indicates that the storage capacities of Pit 2 and Pit 3-4 are sufficient under the maximum disturbance scenario. No uncontrolled releases are predicted to occur, even under extreme rainfall events.

The discharge of sediment laden water from mining operations is expected to have a negligible impact on the receiving environment, including the EVs of Raggote Creek and Lake Awoonga (as a lacustrine wetland). Waste characterisation studies undertaken by RGS (2023) and Epic (2024) confirm the absence of acid and metalliferous drainage (AMD) materials in waste rock. Therefore in the unlikely event of uncontrolled releases, potential impacts to water quality are expected to be limited to localised increases of turbidity, suspended solids and nutrients.

The potential residual impact of suspended solids and nutrients to the downstream Great Barrier Reef is also considered to be low. This assessment has confirmed that the sediment basin is adequately sized to capture sediment laden runoff from the processing areas, with no increase in catchment area expected under the maximum disturbance scenario. Water quality data from releases at discharge point C1 from the sediment basin during 2025 show that discharge water was within the release limits specified in the EA, and within the recorded historic range of water quality for Lake Awoonga in 2023-24. Therefore, it is expected that any releases into the receiving environment are unlikely to negatively impact the water quality of the receiving watercourses.

The Sediment and Erosion Management Plan outlines mitigation measures that are to be undertaken at the site, including regular visual inspections of the sediment basin, and cleaning as required. Monitoring of any water discharged from the site will continue to undertaken to ensure compliance with EA conditions. These measures will be continued to be implemented throughout the life of mine.

6 CONCLUSIONS

This surface water impact assessment concludes that the potential impact to downstream surface water and the receiving environment under the maximum disturbance landform is considered low based on the following factors:

- The site functions as a closed surface water system, with all disturbed areas draining internally into site water storages
- Changes to the current catchments are minimal in the maximum disturbance, with the primary change being the amalgamation of the Pit 3, Pit 4, and Farm Dam catchments
- The stormwater flow assessment undertaken demonstrates that the predicted changes in peak discharge between current and maximum disturbance scenarios are minor
- Water balance (Graymont,2025) indicates that overtopping of site water storages is unlikely, even during extreme rainfall events
- An assessment of the sediment basin indicates that the existing dam has sufficient capacity to manage runoff under both current and maximum disturbance conditions, thereby minimising the potential for uncontrolled releases into the receiving environment

In addition, existing mitigation and management measures, as outlined in the Sediment and Erosion Management Plan, are considered appropriate and will continue to minimise the risks to the receiving surface water environment throughout the life of mine.

7 REFERENCES

Epic 2024. Calliope Waste Rock Characterisation Letter.

Gladstone Regional Council, 2025. Drinking Water Service Report: 2023-24.

Graymont, 2025. Hydrogeological Assessment for Operations Progressive Rehabilitation and Closure Plan and Environmental Authority Amendment.

Graymont, 2023. Sediment and Erosion Management Plan. Calliope Limestone Operation.

IECA, 2018. Best Practice Erosion and Sediment Control

QGlobe, 2025. Queensland Globe. Accessed June 2025.

QUDM, 2016. Queensland Urban Drainage Manual

RGS, 2023. Mine Waste Characterisation Report- Calliope Limestone Mine.

8 LIMITATIONS AND DISCLAIMER

Epic Environmental Pty Ltd (Epic) has prepared the following report for the exclusive benefit of Graymont (Client) and for the singular purpose of Surface Water Impact Assessment at Calliope. All interpretations, finding or recommendations outlined in this report should be read and relied upon only in the context of the report as a whole.

The following report cannot be relied upon for any other purpose, at any other location or for the benefit of any other person, without the prior written consent of Epic. Except with Epic's prior written consent, this report may not be:

a. released to any other person, whether in whole or in part
b. used or relied upon by any other party
c. filed with any Governmental agency or other person or quoted or referred to in any public document

This report has been prepared based on information provided by the Client and other parties. In preparing this report Epic:

a. presumed the accuracy of the information provided by the Client (including its representatives)
b. has not undertaken any verification to the accuracy or reliability included in this information (with the exception where such verification formed part of the scope of works)
c. has not undertaken any independent investigations or enquiries outside the scope of works with respect to information provided for this report
d. provides no warranty or guarantee, expressed or implied, as to the accuracy or reliability of the information provided in this report

In recognition of the limited use of this report, the Client agrees that, to the maximum extent permitted by law, Epic (including its representatives and related entities) is not liable for any losses, claims, costs, expenses, damages (whether pursuant to statute, in contract or tort, for negligence or otherwise) suffered or incurred by the Client or any third party as a result of the information, findings, opinions, estimates, recommendations and conclusions provided in this report.

Without limiting the above, Epic (including its representatives and related entities) is not liable, in any way whatsoever:

a. for the use or reliance of this report for any purpose other than that for which it has been prepared
b. for any use or reliance upon this report by any person other than the Client
c. where another person has a different interpretation of the same information contained in the report
d. for any consequential or indirect losses, or for loss of profit or goodwill or any loss or corruption of any data, database or software

If a section of this disclaimer is determined by any court or other competent authority to be unlawful and/or unenforceable, the other sections of this disclaimer continue in effect. Where further information becomes available, or additional assumptions need to be made, Epic reserves its right to amend this report, but is not obliged to do so.

A Montrose Environmental Company

CONTACT US

www.epicenvironmental.com.au
https://www.linkedin.com/company/epic-environmental-pty-ltd/
1800 779 363
enquiries@epicenvironmental.com.au

APPENDIX L RUSLE MEMORANDUM

A Montrose Environmental Company

Epic Environmental Pty Ltd
ABN: 54 169 57 92 75
Suite 701, Level 7
1 York Street
Sydney NSW 2000
1800 779 363
www.epicenvironmental.com.au

technical memo

Date:	30 June 2025
To:	Maxime Descoteaux , Graymont
From:	Andrew Butler, Epic Environmental
Client name:	Graymont
Project name:	Calliope PRCP
Project number:	BAA250025.01
Subject:	Landform Design Soil Erosion Modelling to Support the Calliope PRC Plan

1 BACKGROUND

The Calliope Limestone Quarry (the Project) is operated by Graymont (Calliope) Pty Ltd (GCPL). The Project includes the operation of an open cut limestone quarry that produces approximately 0.8 million tonnes per annum (Mtpa) of limestone products. The Project commenced operations in 1967 and, noting potential future changes in reserves and yearly sales quantities, has a planned end of mine life (EOML) in 2100. The Project is located approximately 11 kilometres (km) south of the township of Calliope and 30 km south of Gladstone in Central Queensland within the Gladstone Local Government Area (LGA).

GCPL is required to prepare a Transitional Progressive Rehabilitation and Closure Plan (PRC Plan) for the Project. As part of the long-term rehabilitation strategy for the Project, an out of pit waste rock dump (referred to as the Southern Waste Rock Dump – SWRD) will remain at the end of mine life. According to the PRC Plan Guideline, (ESR/2019/4964 Version 3.01), a final landform design is a key component of rehabilitation and closure planning. The final landform design must be consistent with the proposed post mine land use (PMLU) and the proponent must demonstrate that the land will be safe and structurally stable. Therefore, as part of the development of the PRC Plan, there is an expectation that proponents will conduct appropriate soil erosion modelling to predict the long-term stability of the final landform design.

This memo provides the results of soil erosion modelling undertaken to support the development of a stable landform design for the SWRD that meets the requirements of the PRC Plan guidelines and is consistent with the nominated PMLU (grazing).

2 MODEL SELECTION

According to the Queensland Mine Rehabilitation Commissioner's Technical Paper *Applying erosion and Landscape Evolution Models to assess post-mining landform stability* (Hancock et al. 2025), the choice of model should reflect the prediction requirement, i.e., there is little point in using a complex Landform Evolution Model with many parameters if an erosion rate prediction is required for a simple hillslope for landform design purposes. Hancock et al. (2025) state that the Revised Universal Soil Loss Equation (RUSLE) erosion model is an ideal tool to quantify hillslope erosion rates for simple non-complex landforms. The RUSLE erosion model is also suitable for use on low risk waste landforms that do not contain high risk potentially acid forming (PAF) material for which a Landform Evolution Model would be more appropriate. Waste characterisation at Calliope has demonstrated that waste rock is non-acid forming (NAF) and has a very low risk of saline mine drainage generation (Epic 2024).

RUSLE has previously been employed by other proponents in the preparation of approved PRC Plans. It has been used for assessing post-mine landform stability, particularly for testing different design parameters such

as slope angle and minimum vegetation cover requirements to control erosion to acceptable levels including the following examples:

- Newmont Landco Pty Ltd, PRCP_EPML00863713_V1 (effective 02/02/2023). RUSLE was used to assess erosional stability of one of the final landforms, but not for the main post-mine landforms (waste rock dumps) which had already been constructed and revegetated. Rates of soil loss were predicted to be 150 t/ha/yr if groundcover reaches 60% (the benchmark used which came from an existing landform that had been demonstrated to be stable) and on average 11.2 t/ha/yr if 90% groundcover is achieved (Engeny 2023)
- Queensland Coking Coal Pty Ltd; Qld Coal Aust No.1 Pty Ltd, PRCP_EA0002912_V5 (effective 27/05/2023). RUSLE was used to assess the conceptual post-mining landform design and to inform ground cover requirements for the maintenance of erosion to below c. 6 t/ha/yr. The assessment identified that a ground cover of 100% (vegetation and rock combined) was required to achieve acceptable rates of erosion (Vitrinite 2021).
- Queensland Coking Coal Pty Ltd; Qld Coal Aust No.1 Pty Ltd, PRCP_ P-EA-10026508_V1 (effective 05/04/2024). RUSLE was used to assess the conceptual post-mining landform design and to inform ground cover requirements for the maintenance of erosion to below c. 6 t/ha/yr. The assessment and outcomes were identical to the previous example (Vitrinite 2023). RUSLE generated erosion rates similar to the values estimated using a SIBERIA landform evolution model

As the proposed SWRD landform at the Project is both simple in design and will not contain PAF, RUSLE was selected as an appropriate model for predicting erosion rates that could be used to progress the selection of appropriate landform design parameters.

3 MODEL DESCRIPTION AND INPUTS

The RUSLE erosion model is expressed as follows (Renard et al. 1997):

$$A = R \times K \times L \times S \times C \times P$$

Where:

A = estimated average soil loss in tonnes per hectare per year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

L = slope length factor

S = slope steepness factor

C = cover-management factor

P = support practice factor

The source of the site specific data for RUSLE inputs at the project is provided below:

- R Factor was derived from Q Spatial layer of USLE R factor centred on Calliope (https://www.data.qld.gov.au/dataset/soils-universal-soil-loss-equation-series/resource/802d9acc-241f-4430-b3ca-15b08b883b0f). The value used is 3897 MJ.mm/ha/hr/yr
- K Factor derivation described in **Section 3.1**
- L Factor was calculated from

  $L = (X_h / 22.13)^m$

  Where:

  X_h = the horizontal slope length in metres was derived the flow accumulation length using a hydrological and slope raster within a GIS application and a site specific digital elevation model (DEM) for the final landform

m = ß / (1 + ß)

Where:

ß = (sin a / 0.0896)/[3.0 × (sin a)$^{0.8}$ + 0.56], and where 'a' is slope in degrees

- S Factor was calculated from the following depending on slope angle:
  S = 10.8 sin a + 0.03 for slopes < 5.15 degrees (< 9%)
  S = 16.8 sin a - 0.50 for slopes ≥ 5.15 degrees (≥ 9%)
- C Factor was varied to simulate the effects of different rates of vegetation and groundcover. The C Factor values used for established vegetation cover were derived from published sources (IECA 2008) and ranged from 1 to 0.03 representing ground cover of between 0 and 80% newly established grass to be conservative. The adoption of well-established grass cover (more applicable to long-term stability assessment) would result in lower C Factor values and erosion rate predictions for any given cover %
- P Factor (erosion control practice factor) is the ratio of soil loss compared to a nominated surface condition ploughed up and down the slope. The value is reduced by practices that decrease both the velocity of runoff and the tendency of runoff to flow directly downhill. The rehabilitation will include cross ripping along the contour which provides additional erosion protection. Rip lines would be expected to result in ridges of at least 75 mm and a P Factor of 0.7 (based on calculations of P factor for contour cultivation in Rosewell 1993)

3.1 K Factor

Soil analytical data for the Project is available from 23 samples taken previously from five topsoil stockpiles for topsoil suitability assessment. The data included soil organic carbon content and laser diffraction particle size analysis. This data has been used to develop a site-specific K Factor value for the Project according to the RUSLE nomograph which is solved by the following equation (Rosewell 1993):

$$K = [(2.77 \times M^{1.14}) \times 10^{-7} \times (12 - OM)] + [4.28 \times 10^{-3} \times (SS - 2)] + [3.29 \times 10^{-3} \times (PP - 3)]$$

Where:

M = (silt % + very fine sand %) × (100 – clay %)

Silt plus very fine sand includes particles between 2 and 100 µm in diameter (derived from site data)

Clay includes particles less than 2 µm in diameter (derived from site data)

OM is soil organic matter % (derived from site organic carbon content data multiplied by 1.72)

SS is the soil structure class in RUSLE (as no data was available for stockpiled soil structure class 4 for massive unstructured soils was adopted to be very conservative)

PP is the permeability class in RUSLE (derived from a look up table based on site specific soil texture grade data)

Soil textures were generally silty loam to silty clay with a high proportion of silt plus very fine sand (median approximately 60%) and relatively low OM content (median approximately 0.6%). This resulted in a median K Factor of 0.051 (**Table 1**) which is 'high' according to the classification of Rosewell and Loch (2002). The K Factor is in line with expectations given the high proportion of silt plus very fine sand in the stockpiled topsoil.

Table 1: Details of site specific soil properties used for K Factor determination

Soil property	Median value
Clay content (%)	31.6
Very fine sand and silt content (%)	59.1
Soil organic matter content (%)	0.60
Soil structure class	4 (Massive)
Soil permeability class	4 (Slow to moderate - 5-20 mm/h)
M	4268

Soil property	Median value
K Factor	0.051

3.2 Landform Design

During Stage 1 development of Pit 4 North, from 2027 – 2060, waste rock will need to be stored in the out of pit SWRD (Graymont 2025) until the void floor is large enough to allow progressive void backfilling from north to south. The footprint of the SWRD is constrained by the topographic setting of the Project, the proximity of the final extent of open cut pit 3-4 and the flood protection bund to the west of the Project. The preliminary design specifications for the SWRD were developed within these constraints. This resulted in a proposed design with parameters shown in **Table 2** and **Figure 1**.

Table 2: Preliminary SWRD design parameters

Slope aspect	Average slope angle (%)	Slope length at mid-point (m)
North	23.1	95
East	23.0	95
South	22.6	95
West	10.1	141
Top	0.4	NA

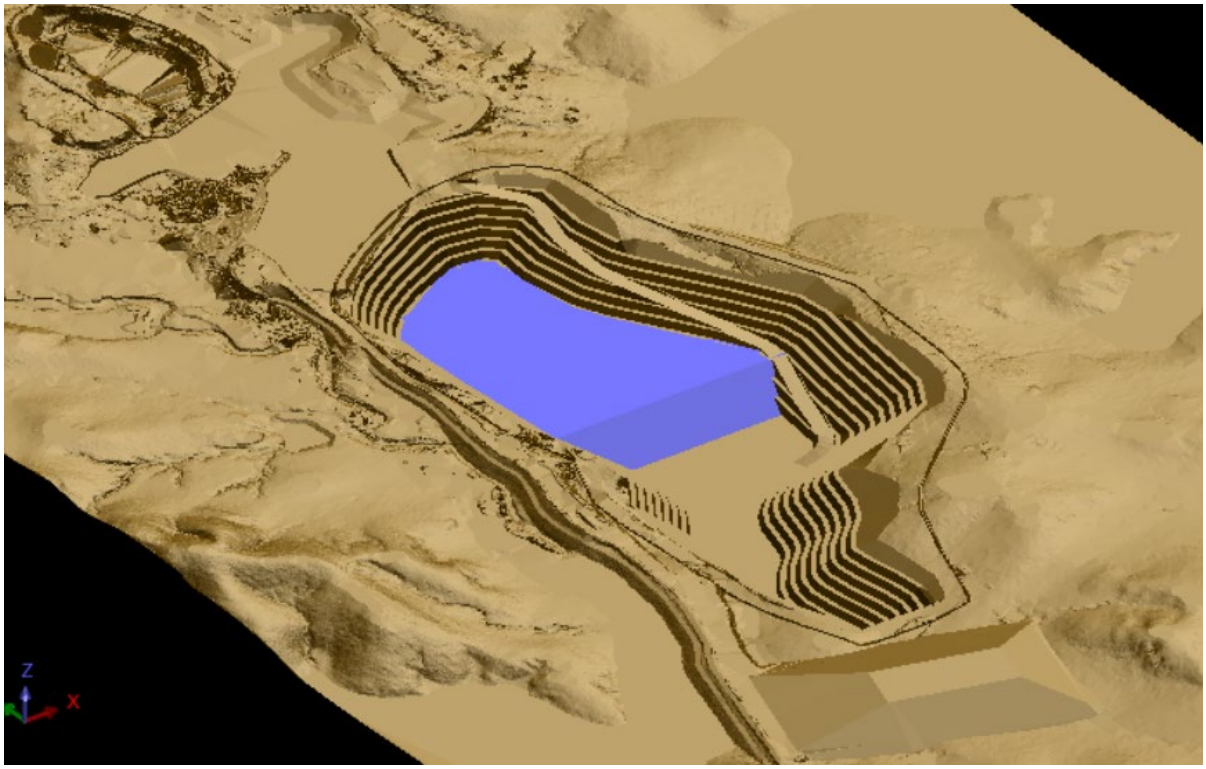


Figure 1: SWRD location and preliminary design (bottom right) and pit 3-4 final extent at end of mine life (Source: Graymont 2025)

However, initial RUSLE model runs based on this design indicated that the maximum rate of erosion for some of the slopes may be unacceptably high (greater than 10 t/ha/yr). In addition, the slopes for the preliminary SWRD design would exceed the maximum slope limitation for Class 3 land suitability for beef cattle grazing PMLU for the final landform (Short 2023). Class 3 land is defined by a maximum 15% slope for the topography limitation and 12% slope for the erosion hazard limitation (for non-sodic soils like those observed at the Project).

GCPL reviewed mine planning and waste placement sequencing to determine if additional pit backfilling could be conducted to reduce the amount of material remaining in the SWRD at end of mine life and allow for a final landform design that includes shallower slopes to minimise erosion and optimise slopes for the proposed grazing PMLU.

Although the SWRD will remain as per the preliminary design during the operational phase, at the end of mine life, the SWRD will be reprofiled to create slopes of 12% or less. Any excess material will be placed in the southern end of the pit 3-4 void. The proposed SWRD final landform (and proposed in-pit placement of waste rock) is shown in **Figure 2** and the design specifications are presented in **Table 3**.

Table 3: Proposed final SWRD design parameters

Slope aspect	Average slope angle (%)	Slope length at mid-point (m)
North	12.0	117
East	11.8	117
South	12.0	117
West	9.9	40
Top	0.2	NA

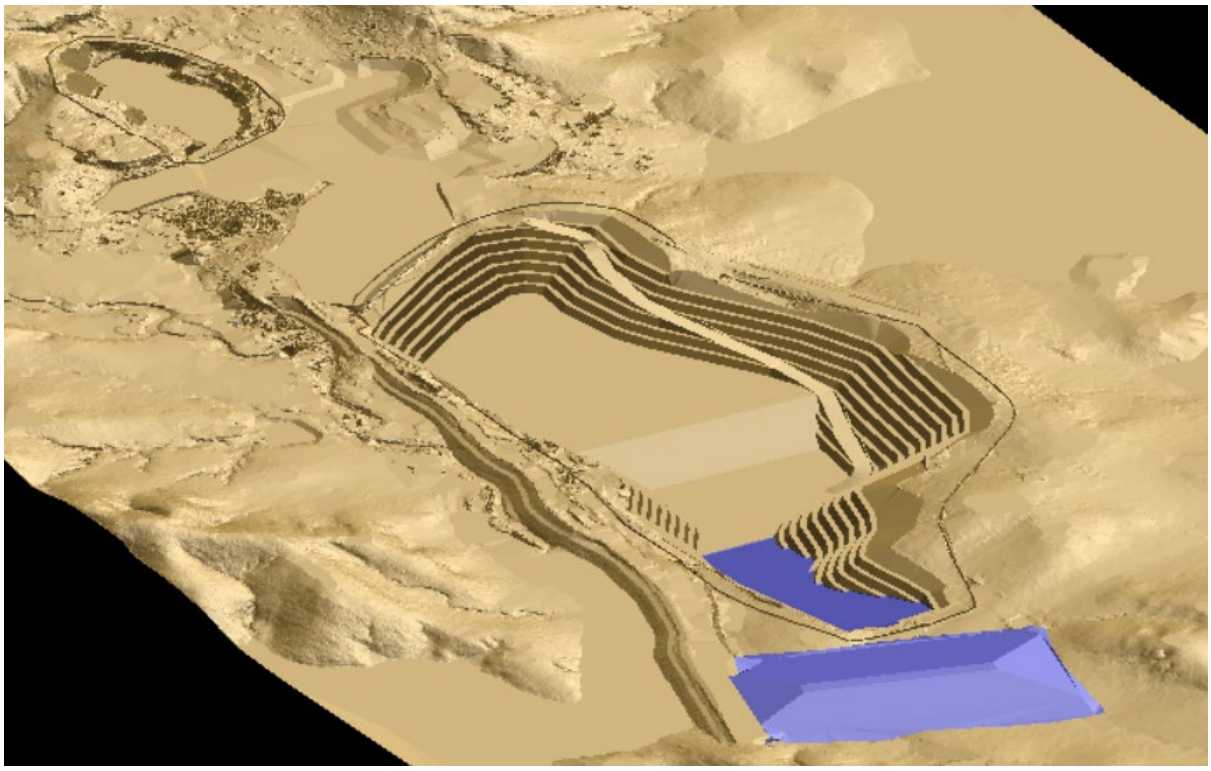


Figure 2: SWRD location and proposed final design (bottom right) showing in-filling of the southern end of pit 3-4 and end of mine life (Source: Graymont 2025)

4 RESULTS

The predicted erosion rates generated by the RUSLE modelling for the preliminary landform design are presented in Table 4. The results are based on the design parameters in **Table 2** and the RUSLE inputs in **Section 3** with a C factor or 0.03 (equivalent to 80% groundcover of newly established grass cover).

Table 4: Predicted erosion rate for the preliminary SWRD landform design

Slope aspect	Average erosion rate (t/ha/yr)
North	13.7
East	13.7
South	13.5
West	4.9
Top	0.37
Whole of landform	9.6

Although overall rates of erosion from the landform were below 10 t/ha/yr, the rates of erosion on three of the four sides of the SWRD exceeded 10 t/ha/yr, above generally accepted sustainable rates of erosion.

The predicted erosion rates generated by the RUSLE modelling for the proposed final landform design are presented in **Table 5** and shown in **Figure 3**. The results are based on the design parameters in **Table 3** and the RUSLE inputs in **Section 3** with a C Factor varying from 0.03 to 1 to reflect a range of groundcover scenarios.

Table 5: Predicted erosion rate for the proposed SWRD final landform design under a range of ground cover scenarios

C Factor (equivalent ground cover)	Slope aspect	Average erosion rate (t/ha/yr)
1.00 (0%)	North	210
	East	210
	South	210
	West	160
	Top	11
	Whole of landform	190
0.45 (20%)	North	93
	East	93
	South	93
	West	74
	Top	4.7
	Whole of landform	86
0.22 (40%)	North	46
	East	45
	South	46
	West	36
	Top	2.3
	Whole of landform	42
0.10 (60%)	North	21
	East	21
	South	21
	West	16
	Top	1.1
	Whole of landform	19
0.03 (80%)	North	6.2
	East	6.2
	South	6.2
	West	4.9
	Top	0.32
	Whole of landform	5.7

The proposed changes to final landform design for the SWRD reduced predicted maximum erosion rates to 6.2 t/ha/yr under 80% ground cover for individual slopes and to under 6 t/ha/yr for the whole landform. Predicted rates of erosion would be expected to fall in the long term once the grass cover is well established and the C Factor increases.

5 CONCLUSION

The erosion modelling has demonstrated that acceptable rates of erosion can be achieved through modifying the preliminary SWRD design. The improved design also provides a landform that is suited to the development of the nominated grazing PMLU.

Additionally, it has been demonstrated that acceptable rates of erosion can also be achieved through modification of the ground cover factor (C Factor). Additional modelling will be undertaken during the detailed design phase to determine the minimum groundcover requirements for long-established pasture prior to rehabilitation of the final landform.

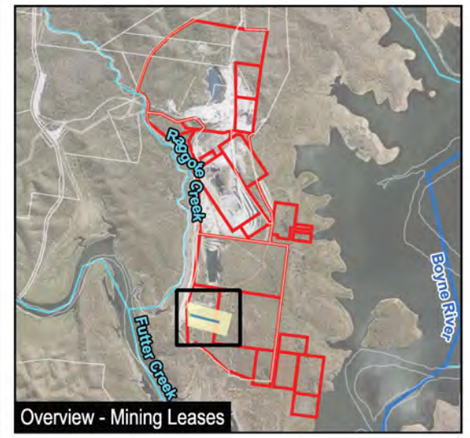
320500E
320750E
321000E
7331750N
7331500N
7331250N

ML 80189
ML 3609

0 30 60 m

Scale: 1:2,200@ A3
Datum: GDA2020
Projection: MGA zone 56

Data Source:
© The State of Queensland (Department of Resources) 2024
© State of Queensland (Department of Transport and Main Roads) 2023
Google Imagery: Data SIO, NOAA, U.S.Navy. NGA, GEBCO Image © 2024 Airbus



Legend

- Mining leases
- Cadastre (DCDB)

Waste rock dump annual soil loss with 80% vegetation cover (t/ha/yr)

- <= 2
- 2 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- > 20

This map has been compiled from the best information available to Epic Environmental. While effort has been made to create an accurate reference, it is not survey-verified, and some information may not be correct. Area calculations, boundaries and measurements displayed are GIS-derived approximations that may vary between datasets due to differences in projection systems and data collection methods.

Epic Environmental takes no responsibility for the accuracy, currency, reliability, and correctness of any spatial measurements or calculations derived from this map.

Epic Environmental does not warrant or accept any liability in relation to the accuracy of the map or any decisions made based on area calculations derived from it. For legally binding or precise boundary determinations, a licensed cadastral surveyor should be engaged.

Graymont
Calliope Limestone Quarry

Figure 3
Predicted erosion rate for the SWRD final landform design with 80% ground cover

6 REFERENCES

Engeny 2023, *Progressive Rehabilitation and Closure Plan - Mt Leyshon Mine*. Prepared for Newmont Landco Pty Ltd.

Epic Environmental (Epic). 2024, Calliope Waste Rock Characterisation. Technical memo prepared by Epic Environmental Pty Ltd for Graymont (Calliope) Pty Ltd, August 2024.

Graymont. 2025, *Calliope PRCP Final Landform Report*. Prepared by Jared Parkes, dated June 2025.

Hancock, G.R., Nicolson L., Purtill, J., and Dunlop, J. 2025, *Applying erosion and Landscape Evolution Models to assess post-mining landform stability*: Technical Paper. Brisbane, Office of the Queensland Mine Rehabilitation Commissioner, Queensland Government.

IECA. 2008, *Best Practice Erosion and Sediment Control*. International Erosion Control Association (Australasia), Picton, NSW.

Renard, K.G., Foster, G.R., Weesies, G.A., McCool, D.K. and Yoder, D.C. 1997, *Predicting Soil Erosion by Water: A guide to conservation planning with the revised Universal Soil Loss Equation (RUSLE).* U.S. Dept. of Agriculture, Agric. Handbook No. 703.

Rosewell, C.J. 1993, *SOILOSS – a program to assist in the selection of management practices to reduce erosion*. Technical Handbook No. 11, Soil Conservation Services, Sydney, NSW.

Rosewell, C. J., and Loch, R. J. 2002, Estimation of the RUSLE soil erodibility factor. In '*Soil physical measurement and interpretation for land evaluation*: *A laboratory handbook*'. (Eds N. J. McKenzie, H. Cresswell and K. Coughlan), CSIRO Publishing: Melbourne.

Short T.A. 2023, *Rehabilitated mined land suitability for beef cattle grazing in the Bowen Basin*: Technical Paper 1. Brisbane: Queensland Mine Rehabilitation Commissioner, Queensland Government.

Vitrinite 2021, *Progressive Rehabilitation and Closure Plan Vulcan Mine*, (reference PRCP_EA0002912_V5). Date of Submission 22 October 2021.

Vitrinite 2023, *Progressive Rehabilitation and Closure Plan Vulcan South*, (reference PRCP-P-EA-100265081-V1) Submitted 16 March 2023.

A Montrose Environmental Company

CONTACT US

www.epicenvironmental.com.au

https://www.linkedin.com/company/epic-environmental-pty-ltd/

1800 779 363

enquiries@epicenvironmental.com.au