

AMD Overview Report

Buller Plateaux Continuation Project

23 July 2026

J-NZ0480-001-R-FINAL

AMD Overview Report

Buller Plateaux Continuation Project

Document Number: J-NZ0480-001-R-FINAL

Document Date: 23 July 2026

Prepared for:

Bathurst Resources Limited

Level 2, 1 Willeston Street, Wellington 6011

Prepared by:

Mine Waste Management Limited

www.minewaste.com.au

REVISION	DATE	AUTHOR	RECORD OF REVIEW
J-NZ0480-001-R-FINAL	21307/2026	PW	PW

EXECUTIVE SUMMARY

Bathurst Resources Limited (BRL) is seeking to obtain authorisation through the Fast-track Approvals Act (FTAA) to progress development and mining of the coal resources across the wider Buller Plateaux. This project is referred to as the Buller Plateaux Continuation Project (BPCP or the Project).

The purpose of the BPCP is to re-consent the existing infrastructure and mining operations associated with the existing Stockton Mine and provide access to additional coal mining areas across the Buller Plateaux, as the coal resource in the current Stockton Mine is close to depletion, and further coal resources for blending are required. There are five key sub-areas:

- Stockton mining area (Stockton)
- Mount Frederick South (MFS)
- Escarpment Extended (ESE)
- Upper Waimangaroa Haul Road (UWHR)
- Cypress mining area (Cypress)

Mine Waste Management Limited (MWM) has been engaged to provide support for the BPCP on how acid and metalliferous drainage (AMD) will be assessed; managed to minimise effects to the receiving environment and achieve proposed closure objectives; and to develop this AMD Overview Report to summarise the water and environmental geochemistry studies that have been undertaken for BRL. Specifically, the assessment of environmental effects (AEE) covered by this report covers the MFS, ESE, and the UWHR sub-areas and includes:

- The assessment of geoenvironmental hazards.
- The effects of these geoenvironmental hazards on water quality.
- Engineering controls that are proposed to ensure that water quality limits (Hickey, 2026) developed for the BPCP are achieved during all Project mine phases.

AMD effects at the Stockton and Cypress sub-areas and how AMD is managed is covered by GHD Limited (2026) and BRL (2022, 2024).

Synopsis

A concise high-level summary is provided in Section 2 of this report on the work undertaken for the BPCP to understand the AMD hazards, the potential AMD effects, and how these AMD risks will be managed through industry leading practice engineering controls to achieve the proposed closure objectives. The remainder of this report summarises the studies that have been completed for each report and provides key recommendations (Section 9).

Report Objectives

The AEE has been used to support the development of the AMD Engineered Landform Management Plan (AMD ELFMP) and the AMD Water Management Plan (AMD WMP), which were developed by BRL for the BPCP and are provided as separate documents to ensure the effects of AMD on the receiving environment are managed and minimised.

The objectives of this AMD overview report are to:

- Summarise and facilitate understanding the geoenvironmental hazards for the MFS, ESE, and the UWHR as part of the AEE.
- Explain how these geoenvironmental hazards can generate AMD.
- Identify potential effects of AMD on downstream receiving environments.
- Describe the proposed engineering controls developed for the MFS, ESE, and the UWHR to mitigate potential effects of AMD.
- Support the development of management plans to ensure the recommendations identified by the various studies, presented in this overview report, are undertaken.

Key Findings

The two key issues relating to mine-impacted water (MIW) that need to be managed for the BPCP are:

- Elevated total suspended solids (TSS).
- AMD which is typically low pH and elevated in acidity, sulfate (SO_4), and certain potential constituents of concern (PCOC) such as aluminium (Al), iron (Fe), and lesser amounts of trace metals that include cadmium (Cd), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and zinc (Zn).

This report addresses AMD only. Details relating to the potential effects of TSS and its management are provided in the Sediment Overview Report (MWM, 2026w), the Water Infrastructure Design Plan (BRL, 2026a) and the Erosion and Sediment Control Plan for Land-Disturbance Activities (BRL, 2026f).

Studies indicate that the environmental risks associated with AMD at the MFS, ESE, and the UWHR can be successfully managed if the appropriate management processes are utilised, suitable engineering controls are implemented, and performance monitoring is undertaken to support adaptive management principles if there is variation from the expected case.

Management Approach

To manage the potential risks associated with AMD at MFS, ESE, and the UWHR, a hierarchy of controls (Management Steps) has been developed, which are in alignment with international guidance documents (e.g., INAP, 2014; DFAT, 2016):

1. Determine the closure objectives for the mine.
2. Understand the source hazards.
3. Engineering Control: Prevent oxidation of sulfide minerals.
4. Engineering Control: Minimise the mobilisation of stored oxidation products.
5. Engineering Control: Control and treatment of AMD-impacted waters.
6. Complete an assessment of the potential effects.
7. Monitor performance to facilitate adaptive management.

Study Summary

Site specific studies have been completed to address the AMD Management Steps. This report summarises these studies, which include the reports in Table E1. Reports that are summarised in this overview report are provided as appendices. Recommendations provided in these reports and this AMD overview report are addressed in the AMD ELFMP and the AMD WMP.

Table E1: Environmental Geochemistry Report Summary

REPORT NAME	REPORT NUMBER	REFERENCE	APPENDIX
Closure Objectives			
Background Water Quality Report	J-NZ0472-001-R-FINAL	(MWM, 2026a)	A
Prediction			
Upper Waimangaroa Haul Road Site Visit	J-NZ0453-001-M- FINAL	(MWM, 2026b)	B
Factual Report. Geoenvironmental Hazards, MFS	J-NZ0377-001-R- FINAL	(MWM, 2026c)	C
Factual Report: Column Leach Testing, MFS	J-NZ0377-005-R- FINAL	(MWM, 2026d)	D
UWHR Geochemistry ABA Summary	J-NZ0453-009-M-FINAL	(MWM, 2026e)	E
BPCP AMD Hazard Classification Summary	J-NZ0453-003-M-FINAL	(MWM, 2026f)	F
Cypress pXRF Summary	J-NZ0453-010-M-FINAL	(MWM, 2026g)	G
Annual Overburden Schedule: MFS, ESE, UWHR	J-NZ0453-011-M-FINAL	(MWM, 2026w)	H
Escarpment Mine - Barren Valley ELF Water Quality Model	J-NZ0349-008-R-FINAL	(MWM, 2026h).	I
Water and Load Balance Model - Source Term Definition	J-NZ0433-004-R-FINAL	(MWM, 2026i).	J
Prevention and Minimisation			
Engineered Landform Design Philosophy	J-NZ0453-004-R-FINAL	(MWM, 2026j)	K
Cover System Field Investigation	J-NZ0349-004-M-FINAL	(MWM, 2026k)	L
Cover System Technical Report	J-NZ0349-013-R-FINAL	(MWM, 2026l)	M
Control and Treatment			
Water Treatment Report: MFS and ESE	J-NZ0480-004-R-FINAL	(MWM, 2026m)	N
Passive Treatment System Design Toolkit	J-NZ0453-005-R-FINAL	(MWM, 2026n)	O
AMD Sludge Management	J-NZ0349-015-R-FINAL	(MWM, 2026o)	P
Assessment of Potential Effects			
Mount Frederick South - Groundwater Technical Report	J-NZ0377-004-R-FINAL	(MWM, 2026p)	Q
Escarpment Extended Mine Project - Groundwater Technical Report	J-NZ0433-002-R-FINAL	(MWM, 2026q)	R
ELF Water Quality and MSR Design Summary	J-NZ0453-006-R-FINAL	(MWM, 2026r)	S

REPORT NAME	REPORT NUMBER	REFERENCE	APPENDIX
Construction Phase Report	J-NZ0453-007-R-FINAL	(MWM, 2026s)	T
MFS - Water and Load Balance Model	J-NZ0377-003-R-FINAL.	(MWM, 2026t)	U
ESE - Water and Load Balance Model Report	J-NZ0433-003-R-FINAL	(MWM, 2026u)	V

Recommendations

Recommendations to manage the potential effects of AMD for MFS, ESE, and the UWHR to ensure operational and closure objectives for water quality are met are provided in this report (see Section 9).

Management Plans

This work has identified that two management plans are needed to manage the risks associated with AMD including:

- AMD Engineered Landform Management Plan (AMD ELFMP).
- AMD Water Management Plan (AMD WMP).

Review

The reports presented in this AMD Overview Report have been peer reviewed by:

- Dr James Pope of Strata Geoscience Limited (Pope, 2026) who is recognised as a subject matter expert (SME) for AMD.
- Dora Avaniidou (GHD Limited) who is an advisor to the FTAA Panel (Bendigo-Ophir Gold Project) for groundwater and hydrogeology.

These reviews are provided as part of the substantive FTAA application.

TABLE OF CONTENTS

1	Introduction	1
1.1	Purpose	1
1.2	Study Objectives.....	1
1.3	Report Structure	2
1.4	Abbreviations	2
1.5	Project Background	5
1.5.1	Stockton Sub-area.....	8
1.5.2	Escarpment Extended Sub-area	8
1.5.3	Mount Frederick South Sub-area	8
1.5.4	Upper Waimangaroa Haul Road Sub-area	8
1.6	Project Site and Schedule Overview	8
1.7	AMD Source Hazards	10
1.8	Materials Characterisation	12
1.9	Material Quantities	12
1.9.1	ESE Overburden Schedule	12
1.9.2	MFS Overburden Schedule.....	14
1.9.3	UWHR Construction Quantities and Rock Types.....	15
1.9.4	Overburden Summary	15
1.10	Climate	16
1.11	Legacy Mine Effects.....	17
1.12	Acid and Metalliferous Drainage	18
1.13	Industry Guidance	20
1.14	AMD Management Approach.....	20
1.15	Project Documentation.....	22
2	Synopsis	24
2.1	AMD Management Approach	24
2.2	Background Water Quality.....	24
2.3	AMD Closure Objectives	25
2.4	Geoenvironmental Hazards.....	25
2.5	Material Quantities	26
2.6	Potential Effects	26
2.7	Engineered Landform Geochemical Models	27
2.8	Engineering Controls	27
2.9	Assessment of Effects	27
2.9.1	WLBM Methodology	28
2.9.2	Effects.....	28
2.9.3	Risk Management	29
2.9.4	Betterment	29
2.10	Recommendations	30

2.11	Summary	30
3	Closure Objectives	31
3.1	Introduction	31
3.2	Background Water Quality Report	31
3.2.1	Report Purpose	31
3.2.2	Review	32
3.2.3	Proposed Monitoring Programme	34
3.2.4	Potential Constituents of Concern	36
3.2.5	Recommendations	38
3.3	Proposed Water Quality Limits	39
3.4	AMD Closure Criteria	40
3.5	Water Quality Objectives	41
3.5.1	MFS and UWHR Sub-areas	42
3.5.2	ESE Sub-area	2
4	Source Hazard Characterisation - Prediction	4
4.1	Introduction	4
4.2	Upper Waimangaroa Haul Road Site Visit	4
4.2.1	Report Purpose	4
4.2.2	Background	5
4.2.3	Key Findings	5
4.2.4	Recommendations	6
4.3	Factual Report: Geoenvironmental Hazards - Mount Frederick South Project	8
4.3.1	Report Purpose	8
4.3.2	Geochemical Investigations	8
4.3.3	AMD Source Hazards	9
4.3.4	Block Model	10
4.3.5	Summary: AMD Classification	10
4.3.6	Recommendations	10
4.4	Factual Report: Column Leach Testing - MFS	10
4.4.1	Report Purpose	11
4.4.2	Sample Selection Rational	11
4.4.3	Geochemical Investigation	11
4.4.4	Shake Flask Testing	13
4.4.5	Column Leach Testing	13
4.4.6	Summary	15
4.5	Upper Waimangaroa Haul Road Acid Base Accounting Summary	15
4.5.1	Report Purpose	15
4.5.2	Introduction	16
4.5.3	Geochemical Data	16
4.6	BPCP AMD Hazard Classification Summary	18
4.6.1	Report Purpose	18

4.6.2	AMD Classification	18
4.6.3	Cypress AMD Classification	18
4.6.4	ESE AMD Classification	19
4.6.5	Mount Frederick South AMD Classification.....	20
4.6.6	Upper Waimangaroa Haul Road	20
4.6.7	Summary	20
4.7	Cypress pXRF	22
4.7.1	Report Purpose	22
4.7.2	Summary	22
4.8	Annual Overburden Schedule: MFS, ESE, and UWHR	23
4.8.1	Report Purpose	23
4.8.2	Summary	23
4.9	Escarpment Mine - Barren Valley ELF Water Quality Model	23
4.9.1	Report Purpose	23
4.9.2	BV ELF Water Quality Load Model	24
4.9.3	BV ELF Seepage Quality	25
4.9.4	ELF Seepage Water Quality Model.....	26
4.9.5	Sensitivity Modelling.....	27
4.9.6	Nitrogenous Compounds.....	28
4.9.7	Risk Management	29
4.9.8	Recommendations	30
4.10	Water and Load Balance Model - Source Term Definition	30
4.10.1	Report Purpose	31
4.10.2	Introduction.....	31
4.10.3	Derivation of Source Terms.....	31
4.10.4	Summary	33
5	Prevention and Minimisation	34
5.1	Introduction	34
5.2	Engineered Landform Design Philosophy	34
5.2.1	Report Purpose	34
5.2.2	Findings	34
5.2.3	Management.....	35
5.2.4	Summary	37
5.2.5	Monitoring.....	37
5.3	Cover System Field Investigation	38
5.3.1	Report Purpose	38
5.3.2	Key Findings.....	38
5.3.3	Summary	39
5.4	Cover System Technical Report.....	39
5.4.1	Report Purpose	39
5.4.2	Introduction.....	39

5.4.3	Approach	39
5.4.4	Results.....	40
5.4.5	Summary	41
6	Control and Treatment	42
6.1	Introduction	42
6.2	Water Treatment.....	42
6.3	Treatment Technology Selection: Active Treatment versus Passive Treatment.....	42
6.4	Water Treatment Report: MFS and ESE	43
6.4.1	Report Purpose	43
6.4.2	Findings	43
6.4.3	Water Treatment Overview	44
6.4.4	Active Water Treatment.....	45
6.4.5	Passive Treatment Systems.....	46
6.4.6	Summary	49
6.4.7	Performance Monitoring	49
6.5	Passive Treatment System Design Toolkit.....	50
6.5.1	Report Purpose	50
6.5.2	Report Content	50
6.5.3	Report Objectives.....	50
6.5.4	Multi-component Analysis	50
6.5.5	MSR Design Criteria.....	51
6.5.6	Detailed Design	52
6.6	AMD Sludge Management	52
6.6.1	Report Purpose	52
6.6.2	Introduction.....	52
6.6.3	AMD Sludge Quantities	53
6.6.4	Pond Fines	54
6.6.5	Active Treatment: AMD Sludge Quantities.....	54
6.6.6	Passive Treatment: AMD Sludge Quantities.....	56
6.6.7	AMD Sludge Disposal	57
6.6.8	AMD Sludge Overview	59
6.6.9	AMD Sludge Risks	59
6.6.10	AMD Sludge Management	59
7	Assessment of Environmental Effects.....	61
7.1	Introduction	61
7.2	MFS - Groundwater Technical Report.....	61
7.2.1	Report Purpose	61
7.2.2	Potential Effects.....	61
7.2.3	Groundwater Quantity	62
7.2.3.1	Groundwater Levels:	62
7.2.3.2	Groundwater Flows:	62

7.2.4	Groundwater Quality	62
7.2.5	Recommendations	63
7.2.6	Performance Monitoring	63
7.3	ESE - Groundwater Technical Report	64
7.3.1	Report Purpose	64
7.3.2	Potential Effects.....	64
7.3.3	Groundwater Quantity	65
7.3.3.1	Groundwater Levels:	65
7.3.3.2	Groundwater Flows:	65
7.3.4	Groundwater Quality	65
7.3.4.1	ELF Seepage	65
7.3.4.2	Cascade Creek AMD Load	66
7.3.5	Recommendations	66
7.3.6	Performance Monitoring	66
7.4	ELF Water Quality and MSR Design Summary	67
7.4.1	Introduction.....	67
7.4.2	Report Purpose	68
7.4.3	Acidity Loads	71
7.4.3.1	Peak Acidity Loads.....	71
7.4.3.2	Long Term Acidity Loads	72
7.4.4	Passive Treatment	74
7.4.5	Summary	76
7.5	Construction Phase Report	76
7.5.1	Report Purpose	76
7.5.2	AMD Source Hazards.....	77
7.5.3	AEE: UWHR and MFS Access Road	77
7.5.4	MFS and ESE Infrastructure Areas	78
7.5.5	Summary	79
7.6	MFS Water and Load Balance Model.....	81
7.6.1	Report Purpose	81
7.6.2	Model Summary	81
7.6.3	Findings.....	82
7.6.3.1	Base Case Model Results.....	82
7.6.3.2	Alternative Scenario Model Results	84
7.7	ESE Water and Load Balance Model Report	84
7.7.1	Report Purpose	84
7.7.2	Model Summary	84
7.7.3	Findings.....	85
7.7.3.1	Base Case Model Results.....	85
7.8	MFS and ESE WLBM Recommendations.....	87
7.8.1	Operational Management Recommendations.....	87

7.8.2	Closure Management Recommendations	88
7.9	Performance Monitoring	89
7.10	Performance Monitoring.....	89
8	Summary	90
8.1	Management of AMD.....	90
8.2	Findings	91
8.3	Report Structure	91
8.4	Peer Review	91
9	Recommendations.....	92
9.1	Background Water Quality.....	92
9.2	Water Quality Objectives	92
9.3	Closure Objectives.....	92
9.4	Source Hazard Characterisation: Prediction	94
9.4.1	UWHR	94
9.4.2	MFS	94
9.4.3	ESE	95
9.4.4	Other.....	95
9.4.5	Escarpment Barren Valley ELF Model	96
9.4.6	Source Terms	97
9.5	Engineering Controls	98
9.5.1	ELF and EFA Construction.....	98
9.5.2	Cover System Construction.....	99
9.5.3	Active Water Treatment.....	99
9.5.4	Passive Water Treatment.....	100
9.5.5	AMD Sludge Disposal	101
9.6	Assessment of Potential Effects	102
9.6.1	Groundwater Effects.....	102
9.6.2	ELF Seepage Water Quality.....	104
9.6.3	Betterment	104
9.6.4	Construction Phase	104
9.6.5	Water and Load Balance Model	105
10	References	107
11	Limitations	113
Appendix A	Background Water Quality Report.....	114
Appendix B	Upper Waimangaroa Haul Road Site Visit	115
Appendix C	Factual Report: Geoenvironmental Hazards - MFS	116
Appendix D	Factual Report: Column Leach Testing - MFS.....	117
Appendix E	Upper Waimangaroa Haul Road Acid Base Accounting Summary	118
Appendix F	BPCP AMD Hazard Classification Summary	119
Appendix G	Cypress pXRF Summary.....	120
Appendix H	Annual Overburden Schedule	121

Appendix I	Escarpment Mine - Barren Valley ELF Water Quality Model	122
Appendix J	Water and Load Balance Model - Source Term Definition.....	123
Appendix K	Engineered Landform Design Philosophy	124
Appendix L	Cover System Field Investigation.....	125
Appendix M	Cover System Technical Report.....	126
Appendix N	Water Treatment Report.....	127
Appendix O	Passive Treatment System Design Toolkit	128
Appendix P	AMD Sludge Management	129
Appendix Q	MFS - Groundwater Technical Report.....	130
Appendix R	ESE - Groundwater Technical Report.....	131
Appendix S	ELF Water Quality and MSR Design Summary	132
Appendix T	Construction Phase Report	133
Appendix U	MFS - Water and Load Balance Model	134
Appendix V	ESE - Water and Load Balance Model Report.....	135
Appendix W	Limitations	136

LIST OF TABLES

Table 1: Abbreviations	2
Table 2: BPCP sub-areas (ha).....	6
Table 3: ABA sample numbers	12
Table 4: ESE overburden.....	13
Table 5: MFS overburden quantities	14
Table 6: UWHR material balances (8.6 m pavement width).....	15
Table 7: Standards and Guidelines for AMD Management	20
Table 8: Studies reviewed and/or undertaken by MWM in relation to AMD management.	22
Table 9: Water quality monitoring site explanation	35
Table 10: Proposed water quality monitoring program (MFS, ESE, UWHR).	35
Table 11: PCOC identified at water quality compliance monitoring sites (MFS, ESE, UWHR).....	37
Table 12: Potential constituents of concern for the BPCP	39
Table 13: High-level AMD closure objectives.	40
Table 14: MFS compliance monitoring locations	42
Table 15: ESE proposed compliance monitoring locations.	2
Table 16: Site visit summary: risks and opportunities.....	7
Table 17: ABA data for AMIRA CLT samples	13
Table 18: Summary site specific AMD classification systems.	21
Table 19: Nitrate and ammoniacal-N data for various mine domains (Stockton and Escarpment).....	28
Table 20: ELF Design objectives and materials management recommendations.....	35
Table 21: General guidelines for selection of active versus passive treatment.....	43
Table 22: WTP effluent discharge design standards.	45

Table 23: MSR treatment efficiencies.	48
Table 24: MSR polishing pond treatment of MSR Stage 1 treated effluent.....	48
Table 25: Mine Phases and AMD treatment sludge quantities.....	54
Table 26: AMD Sludge volumes (m ³) for ESE and MFS WTP	55
Table 27: AMD Sludge Generation Rates for ESE and MFS MSR	57
Table 28: AMD sludge disposal summary.	57
Table 29: ELF acidity load summary – ELF Construction Phase.	71
Table 30: MSR treatment capacity summary.....	75
Table 31: Construction Phase acidity loads and AMD sludge volumes	79
Table 32: AMD and TSS Source Hazard Management.....	79

LIST OF FIGURES

Figure 1: Location map for the BPCP sub-areas.	7
Figure 2: BPCP timelines (by stage and by indicative year).....	10
Figure 3: Stratigraphic column of the Denniston and Stockton Plateaux.	11
Figure 4: Proposed coal production schedule by BPCP Sub-Area.	12
Figure 5: ESE overburden summary based on AMD classification	13
Figure 6: MFS overburden summary based on AMD classification.....	14
Figure 7: Lake Brazil monthly rainfall and PE.	17
Figure 8: Denniston Plateau historic mine workings.....	19
Figure 9: AMD Management Steps.....	21
Figure 10: Acidity (mg/L) as a function of flow rate: St Patrick's Stream - Stockton.....	33
Figure 11: Flow versus pH data for Mangatini Stream	34
Figure 12: BRL detailed mine closure planning timeframes	40
Figure 13: Location of UWHR and MFS water monitoring sites.	1
Figure 14: Location of MFS water monitoring sites.	1
Figure 15: ESE catchments and water monitoring sites.	3
Figure 16: MFS AMD Process Flow Classification	9
Figure 17: Palaeogeological environment for MFS with MFS AMD drill hole locations.....	12
Figure 18: CLT samples and MFS ABA data classified by the MFS processes flow classification.	14
Figure 19: Map of sampling locations for the UWHR.....	17
Figure 20: Denniston 3D Block Model boundary and sulfur content.	20
Figure 21: BV ELF acidity concentration.....	26
Figure 22: Calculated ELF load models and BV ELF sulfate data.	27
Figure 23: BV ELF nitrate-N model.....	29
Figure 24: Indicative MFS proposed groundwater monitoring locations.....	64
Figure 25: Indicative ESE proposed groundwater monitoring areas.	67
Figure 26: Escarpment Extended Project ELF basal sub-catchments and indicative MSR locations..	69
Figure 27: MFS project ELF basal sub-catchments and indicative MSR locations (yellow boxes)	70

Figure 28: ESE peak ELF acidity loads.	72
Figure 29: MFS Peak ELF acidity loads.....	72

1 INTRODUCTION

Bathurst Resources Limited (BRL) is seeking to obtain authorisation through the Fast-track Approvals Act 2024 (FTAA) to progress development and mining of the coal resources across the wider Buller Plateaux. This project is referred to as the Buller Plateaux Continuation Project (BPCP or Project).

The purpose of the BPCP is to re-consent the existing infrastructure and mining operations associated with the existing Stockton Mine and provide access to additional coal mining areas across the Buller Plateaux, as the coal resource in the current Stockton Mine is close to depletion and further coal resources for blending are required. There are five key project sub-areas:

- Stockton mining area (Stockton).
- Mount Frederick South (MFS).
- Escarpment Extended (ESE).
- Upper Waimangaroa Haul Road (UWHR).
- Cypress mining area (Cypress).

Mine Waste Management Limited (MWM) has been engaged to provide support for the BPCP on how acid and metalliferous drainage (AMD) will be assessed; managed to minimise effects to the receiving environment and achieve proposed closure objectives; and to develop this AMD Overview Report to summarise the water and environmental geochemistry studies that have been undertaken for BRL. Specifically, the assessment of effects covered by this report covers the MFS, ESE, and the UWHR sub-areas and includes:

- The assessment of geoenvironmental hazards.
- The effects of these geoenvironmental hazards on water quality.
- Engineering controls that are proposed to ensure that water quality limits developed for the BPCP are achieved (Hickey, 2026).

AMD effects at the Stockton and Cypress mining areas and how AMD is managed is covered by GHD Limited (2026) and BRL (2022, 2024).

1.1 Purpose

The purpose of this report is to:

- Provide a concise summary of all AMD and AMD water-related studies completed by MWM for MFS, ESE, and the UWHR.
- Explain how the potential risks associated with AMD were assessed and how they will be managed to achieve operational and closure water quality objectives.

1.2 Study Objectives

The objectives of this AMD Overview Report are to:

- Summarise and facilitate understanding the geoenvironmental hazards (e.g., AMD) for the BPCP sub-areas (MFS, ESE, and the UWHR) as part of the assessment of environmental effects (AEE).
- Explain how these geoenvironmental hazards can generate AMD.
- Identify potential effects of AMD on the downstream receiving environment.
- Describe the proposed engineering controls for MFS, ESE, and the UWHR to mitigate potential effects of AMD.
- Support the development of management plans to ensure the recommendations identified by the various AEE studies, presented in this overview report, are implemented.

The AEE has been used to support the development of the AMD Engineered Landform Management Plan (AMD ELFMP) and the AMD Water Management Plan (AMD WMP), which have been developed by BRL for the BPCP and are provided as separate documents, to ensure the effects of AMD on the receiving environment are minimised.

1.3 Report Structure

The report structure is based around the steps of AMD management, which is in alignment with international guidance documents (e.g., INAP, 2014; DFAT, 2016) on how to manage the potential effects of AMD:

1. Determine the closure objectives for the Project.
2. Understand the source hazards.
3. Prevent oxidation of sulfide minerals – Engineering Control.
4. Minimise the mobilisation of stored oxidation products – Engineering Control.
5. Control and treatment of AMD-impacted waters – Engineering Control.
6. Complete an assessment of the potential effects.
7. Monitor performance to facilitate adaptive management.

1.4 Abbreviations

A list of abbreviations is provided to enable clear communication of commonly used terminology.

Table 1: Abbreviations

ABBREVIATION	DEFINITION
ABA	Acid base accounting
AEE	Assessment of Environmental Effects
Al	Aluminium
AMD	Acid and metalliferous drainage. Sometimes this is referred to as acid mine drainage.
AMIRA	Australian Mineral Industry Research Association
AMD ELFMP	AMD Engineered Landform Management Plan

ABBREVIATION	DEFINITION
AMD WMP	AMD Water Management Plan
ANC	Acid neutralisation capacity
ANFO	Ammonium nitrate fuel oil
ANZG	Australian and New Zealand guidelines for fresh and marine water quality
ARD	Acid rock drainage
BCM	Brunner Coal Measures
bcm	Bank cubic metres
BPCP	Buller Plateaux Continuation Project
BRL	Bathurst Resources Limited
BV	Barren Valley
BV ELF	Barren Valley Engineered Landform
Ca	Calcium
CaO	Calcium oxide (Burnt Lime)
Cd	Cadmium
CHPP	Coal handling and processing plant
CLT	Column leach testing
CMER	Centre for Minerals Environmental Research
Co	Cobalt
Cr	Chromium
CSM	Conceptual site model
Cu	Copper
Cypress	Cypress mining area
DGV	Default guideline values
EFA	Engineered fill area
ELF	Engineered landform
ELFMP	Engineered Landform Management Plan
EoR	Engineer of Record
ESE	Escarpment Extended
ESNZ	Earth Sciences New Zealand
Fe	Iron
FTAA	Fast-track Approvals Act 2024
FY	Financial Year (ending)
GARD	Global Acid Rock Drainage (Guide)
GCL	Geosynthetic clay liners
GML	Growth medium layer
HAF	High acid forming
HDS	High density sludge
HRT	Hydraulic residence time

ABBREVIATION	DEFINITION
ICMM	International Council on Mining and Metals
INAP	Internation Network for Acid Prevention
K	Permeability
Kfs	Field saturate hydraulic conductivity
km	kilometres
KMS	Kaiata Mudstone
LOM	Life of mine
LOR	Limit of reporting
L/s	Litres per second
LPL	Low permeability layer
LR	Low Risk (for AMD)
m	metre
MCA	Multi-component analysis
MEND	Mine Environment Neutral Drainage organisation - Canada
MEQ	Metal ecotoxicity quotient
MfE	Ministry for the Environment
MFS	Mount Frederick South
mg/L	Milligrams per litre
MIW	Mine impacted water (includes AMD and TSS effects)
mm	Millimetre
Mn	Manganese
MP	Management Plan
MPA	Maximum potential acidity
m/s	Metres per second
Mt	Million tonnes
mRL	Metres relative level
MSR	Mussel shell bioreactor
MWM	Mine Waste Management Limited
NAF	Non-acid forming
NAG	Net acid generation test
NAPP	Net acid production potential
Ni	Nickel
NP	Net percolation
NPS	National Policy Statement
PAF	Potentially acid forming
PCOC	Potential constituents of concern
PE	Potential evaporation
PFS	Pre-feasibility Study

ABBREVIATION	DEFINITION
PTS	Passive treatment system
pWTP	Portable water treatment plant
pXRF	Portable x-ray fluorescence
QA/QC	Quality assurance and quality control
RC	Reverse circulation drilling method
SME	Subject matter expert
S	Sulfur
SO ₄	Sulfate
SOP	Stored oxidation product
SPA	Soil-plant-atmosphere modelling
SQEP	Suitably qualified and experienced person
SOX	Sulfide oxidation
Stockton	Stockton mining area
t	Tonne
t/yr	Tonnes per year
TCLP	Toxicity characteristic leaching procedure
Tl	Thallium
TSS	Total suspended solids
UC	Uncertain
UWHR	Upper Waimangaroa Haul Road
WCRC	West Coast Regional Council
WLBM	Water and load balance model
WMP	Water Management Plan
WQ Ref Value	Water quality reference value
WTP	Water treatment plant
WRD	Waste rock dump
Zn	Zinc

1.5 Project Background

The Buller Plateaux are located approximately 15 kilometres (km) northeast of Westport on the West Coast of the South Island. The BPCP comprises five key sub-areas (Figure 1), each with defined Project scopes and water treatment requirements:

- Stockton: Completion of mining of existing pits and remaining coal resources. Ongoing utilisation of existing infrastructure.
- MFS: A new opencast mining area with initial mining through existing historical underground workings, and extension into unmined areas to the northwest along with the extension of the UWHR road into the MFS mine area. Coal will be transported to Stockton via the UWHR.

- ESE: Mining is a combination of an existing pit (Escarpment), mining through existing historical underground workings (Whareatea, Escarpment), and an extension into unworked areas (West Whareatea). Coal will be transported to Stockton via the UWHR. The ESE sub-area includes the Waimangaroa Storage Yard, located at the bottom of the Denniston Road which will be used as a laydown area.
- UWHR: Road connecting Stockton (Cypress South) with MFS and ESE operations. The road is a combination of upgrades to existing roads and the development of a new section through the Waimangaroa Valley. This will be used for transport of coal from MFS and ESE to Stockton.
- Cypress: Cypress is an existing operational mine that has existing consents and water management plans and procedures in place. The BPCP will interact with Cypress via the UWHR, and it is on that basis alone that Cypress is considered further in this assessment.

Each sub-area includes a “buffer area”, which is included within the proposed land use consent area. The buffer area encircles the planned disturbance footprints to provide some operational flexibility. The existing and proposed disturbance areas for the sub-areas are detailed in Table 2.

Table 2: BPCP sub-areas (ha)

AREA	STOCKTON	UWHR	MFS	ESE	WAIMANGAROA
Total consenting footprint	1814	89	216	540	2
Existing Disturbance (includes up to 31 March 2027)	1319	15	6	40	2
Proposed Disturbance Areas	29	37	170	442	0
Buffer Areas*	466	37	40	59	0

* While Bathurst does not intend to disturb the buffer areas, consent is being sought to do so for contingencies or where further detailed designs are yet to be completed.

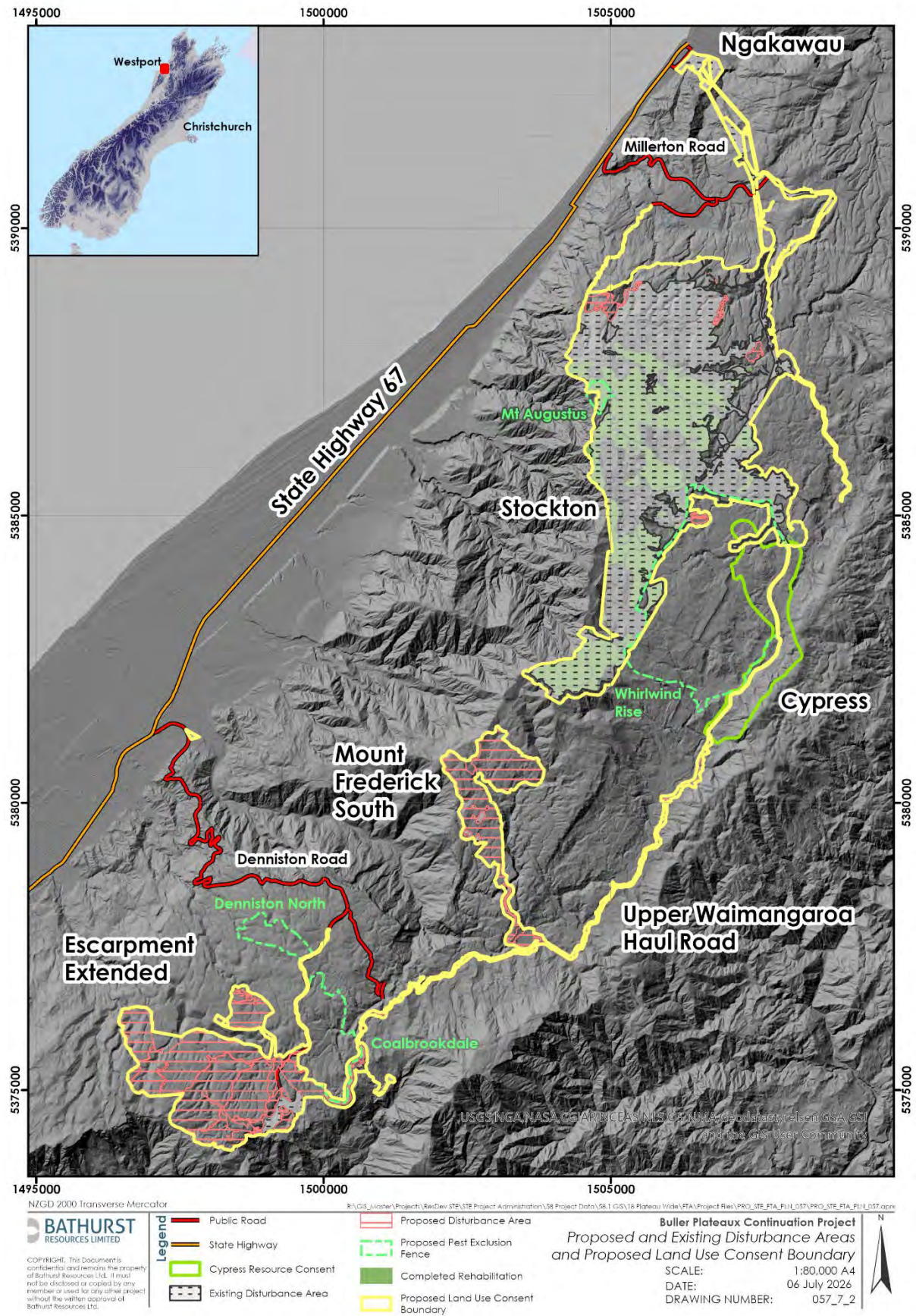


Figure 1: Location map for the BPCP sub-areas.

1.5.1 Stockton Sub-area

BRL propose to mine additional areas in the north of the Stockton Mine, continue using the existing infrastructure and facilities, develop new water management infrastructure in the north of the Stockton Mine, carry out further extraction of rock from the A Drive Borrow Pit to provide aggregate for the construction of haul roads including the proposed UWHR, and develop three additional Coal Fines Storage Facilities.

Coal mined in the ESE and MFS sub-areas will be transported to Stockton via the UWHR for processing, blending or washing as required at the Stockton Coal Handling and Processing Plant (CHPP) or clean coal handling facilities, and then transported via the existing aerial ropeway to the Ngakawau Rail Loadout.

1.5.2 Escarpment Extended Sub-area

Coal will be mined by conventional truck and shovel operation. Coal won from the ESE sub-area will be stockpiled at the ESE Coal Storage Pad and will then be transported to Stockton via the UWHR for washing, processing, and blending as required at the CHPP, or clean coal handling facilities, before being transported via the aerial ropeway to the Ngakawau Rail Loadout.

Ancillary infrastructure will be in place to support the mine, such as a water treatment plant (WTP), workshop, office, warehouse, tyre handling facility, coal haulage infrastructure area, bulk explosives plant and magazine, and fuel storage facilities.

Access to the ESE area is currently provided via the existing public road network on the Denniston Road, but it will be connected to the Stockton sub-area by the proposed UWHR.

1.5.3 Mount Frederick South Sub-area

MFS will be mined in two pits: West Pit and East Pit. These pits will be accessed off the proposed UWHR, with a haul road being constructed off the UWHR to reach up into the MFS mine area. MFS will be mined by conventional truck and shovel operation, where coal will be stockpiled at the MFS coal stockpile area (coal transfer pad), and transported to the Stockton sub-area via the UWHR.

MFS will be supported by Stockton and ESE for infrastructure and facilities, where workshops, vehicle washes, explosive magazines, tyre facilities and coal processing will be located at Stockton or ESE. The mine will be limited to infrastructure and facilities such as offices, crib rooms, a coal stockpile area, fuel tank and water treatment plant.

1.5.4 Upper Waimangaroa Haul Road Sub-area

The UWHR Project sub-area will link the ESE and MFS sub-areas with Stockton and Cypress. It is an essential link between the various mine areas to prevent the need for heavy machinery and trucks to utilise the public road network and make coal cartage economically viable.

1.6 Project Site and Schedule Overview

Indicative BPCP timelines are reflected in Figure 2. There are four distinct Project phases that are defined by the way mine-impacted waters (MIW) elevated in Total Suspended Solids (TSS) and AMD are managed:

- Construction Phase: defined by the commencement of earthworks on site up until the permanent active WTPs and associated WTP ponds are commissioned. This will require routing of water and minor water management / treatment using a small portable water treatment plant(s) to neutralise acidity using either $\text{Ca}(\text{OH})_2$ (hydrated lime/calcium hydroxide¹) or NaOH (caustic); and the addition of flocculants as required to treat TSS. AMD sludge management is also required.
- Operational Phase: Water Management and active water treatment using CaO, flocculants, and metal-chelating agents with AMD sludge being separated from treated discharge water by lamella clarifiers and mechanical sludge dewatering using pressure filtration (plate and frame filters (Process Flow, 2026a)) with AMD sludge disposal to Engineered Landforms (ELF). Some passive treatment commences for ELFs that are completed.
- Active Closure Phase: Active water treatment continues with a gradual transition to passive treatment of ELF basal seepage. AMD sludge disposal will either be onsite at an appropriate location, disposal at Stockton, or by other approved methods that may be developed over the Operational Phase of the BPCP.
- Post Closure Phase: defined by the decommissioning of the WTPs with water treatment being completed by gravity fed passive treatment systems. The proposed technology is a Mussel Shell Bioreactor (MSR). AMD sludge disposal will either be onsite at an appropriate location, disposal at Stockton, or by other approved methods that may be developed over the Operational Phase of the BPCP. Back-up options include disposal to approved offsite landfills.

The transition from active treatment to passive treatment is expected to occur over a period of ~20 years, following closure and final rehabilitation of ELFs. The location of the MFS and ESE Project sub-areas, in the context of the BPCP, is presented in Figure 1.

¹ Noting: MgO may also be used as a neutralising agent.

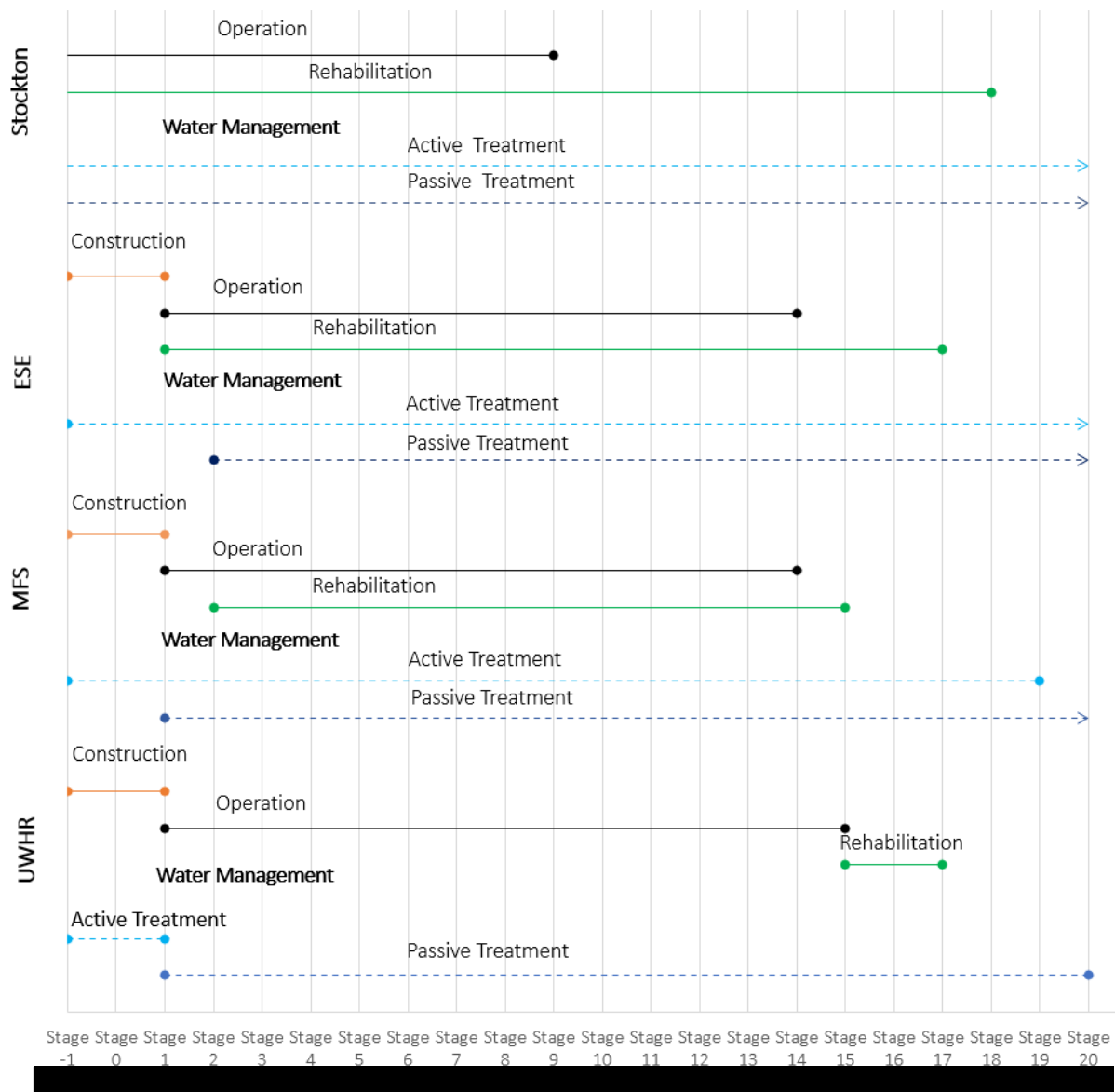


Figure 2: BPCP timelines (by stage and by indicative year).

1.7 AMD Source Hazards

AMD on the Buller Plateaux is characterised by high acidity and elevated metal concentrations. Materials that will contribute to AMD within the BPCP include the Brunner Coal Measures (BCM), host to economic coal resources, and the overlying Kaiata Mudstone (KMS).

Regional variability for AMD source hazards across the Project sub-areas (i.e., Stockton, MFS, ESE, and the UWHR) is heavily influenced by paleo-depositional environment of the BCM and to a lesser extent the KMS. The BCM form the foundational layer of a transgressive sequence of fluvial to estuarine high sulfur sedimentary rocks consisting of clastic sediments and coal seams. The sequence is 70 to 130 m thick and was deposited in a fluvio-paralic environment consisting of braided and meandering streams within a deltaic, barrier, tidal environment. The BCM are conformably overlain by, and laterally interfingered with, the Eocene marine KMS, which has increasing carbonate content upwards away from the BCM contact (Flores and Sykes, 1996). Geochemical AMD risks decrease away from the BCM/KMS contact such that at approximately 30m above the BCM/KMS contact (Hughes, 2007) the acid generating potential is equivalent to the net acid neutralisation capacity resulting in a net acid

producing potential (NAPP) of ~ 0 kg H_2SO_4 per tonne of rock. Materials stratigraphically higher (younger) above the NAPP = 0 surface are non-acid forming (NAF) and materials below the NAPP = 0 surface are potentially acid forming (PAF) as shown in Figure 3.

As noted in literature (e.g., Pope et al., 2010), fluvial systems tend to be lower in pyrite compared to marine-influenced systems. The BCM at ESE and MFS sub-areas have a lower sulfur content than at the adjacent Stockton Coal Mine and accordingly the AMD risks at ESE and MFS are lower. This lower sulfur/AMD risk at ESE and MFS is due to the depositional environment being strongly influenced by fresh water fluvial sediments (low sulfur) south of Stockton with occasional periodic marine incursions (high sulfur), whereas the depositional environment at Stockton was predominantly a marine-influenced environment with higher sulfur materials (e.g., estuarine).

The BCM are typically deficient in acid neutralising carbonate minerals such that the oxidation of pyrite typically leads to the rapid formation of AMD with little time lag to acid onset (Weber et al., 2008).

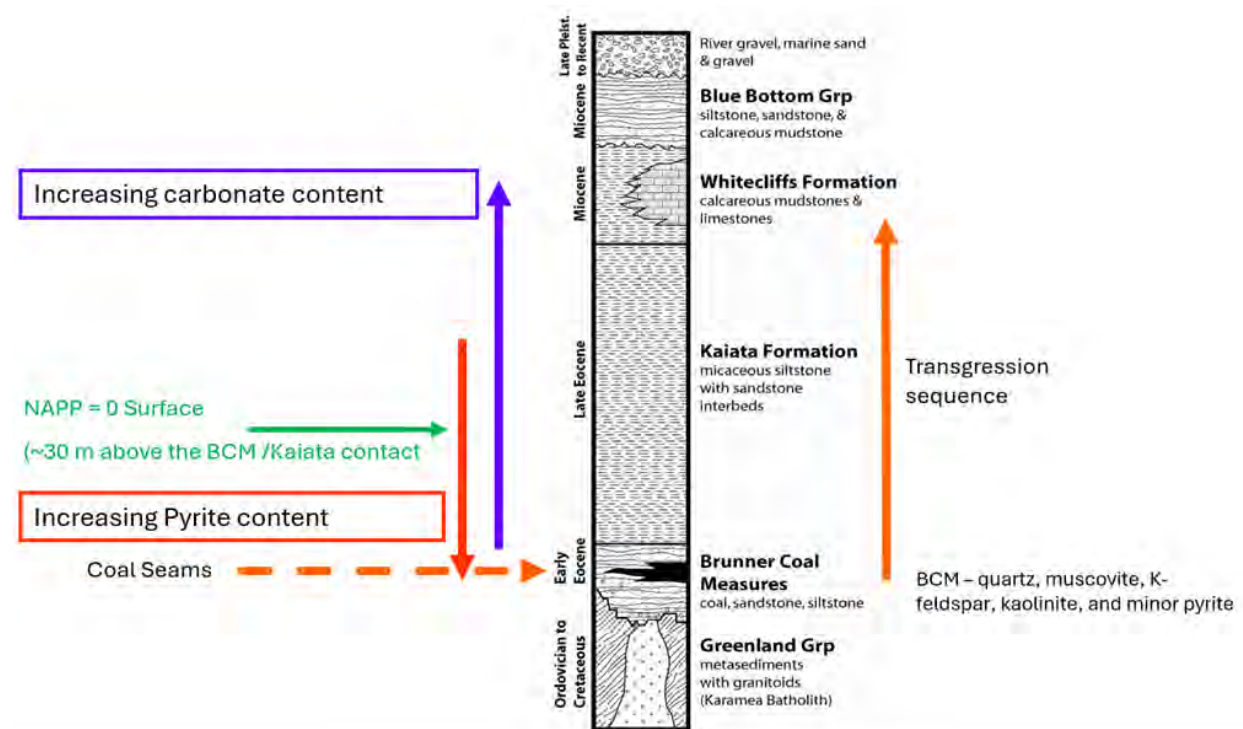


Figure 3: Stratigraphic column of the Denniston and Stockton Plateaux.

Water and oxygen interacting with materials that contain sulfide minerals can generate AMD. The mine domain with the greatest source hazard risks (60-80% of the total AMD load for any project) are waste rock storage facilities (e.g., INAP, 2020), that include waste rock dumps (WRDs), having no engineering controls to reduce sulfide mineral oxidation or the mobilisation of secondary sulfide oxidation products.

PAF waste rock disposal in engineered landforms (ELFs) is proposed for ESE and MFS to minimise the generation of AMD arising from waste rock storage. Further details are provided in the ELF Design Philosophy Report (see Section 5.2 of this report), which explains source control technologies for prevention and minimisation of AMD.

1.8 Materials Characterisation

Materials need to be classified with regards to their AMD potential so that they can be managed in an appropriate manner to minimise the risks to the receiving environment. Numerous studies have been undertaken across the Buller Plateaux, and four site-specific AMD classification processes have been developed for the BPCP for ESE, MFS, and UWHR. These classification systems, applied to the geological model have been used to determine material schedules for these BPCP sub-areas.

Over 1,500 samples have been analysed as part of the geoenvironmental hazard assessment for the MFS, ESE, and UWHR project sub-areas, including acid-base accounting (ABA), compositional and mineralogical studies, and leachate testing (Table 3). These data provide a robust dataset to assess the AMD risks for the BPCP. Sample numbers are in alignment with industry guidance to ensure sufficient samples are available to characterise a project (e.g., Price 2009; DFAT, 2016).

Table 3: ABA sample numbers

BPCP SUB-AREA	PASTE pH	TOTAL SULFUR	ANC	NAPP
MFS	91	472	472	472
ESE	907	1380	856	709
UWHR	283	434	384	384

1.9 Material Quantities

BRL propose to mine approximately 20 million tonnes of coking coal for the export market (Figure 4). Material schedules have been developed by BRL for the BPCP, with the specific sub-area AMD classification criteria (see Section 4.5) being applied to the material quantities.

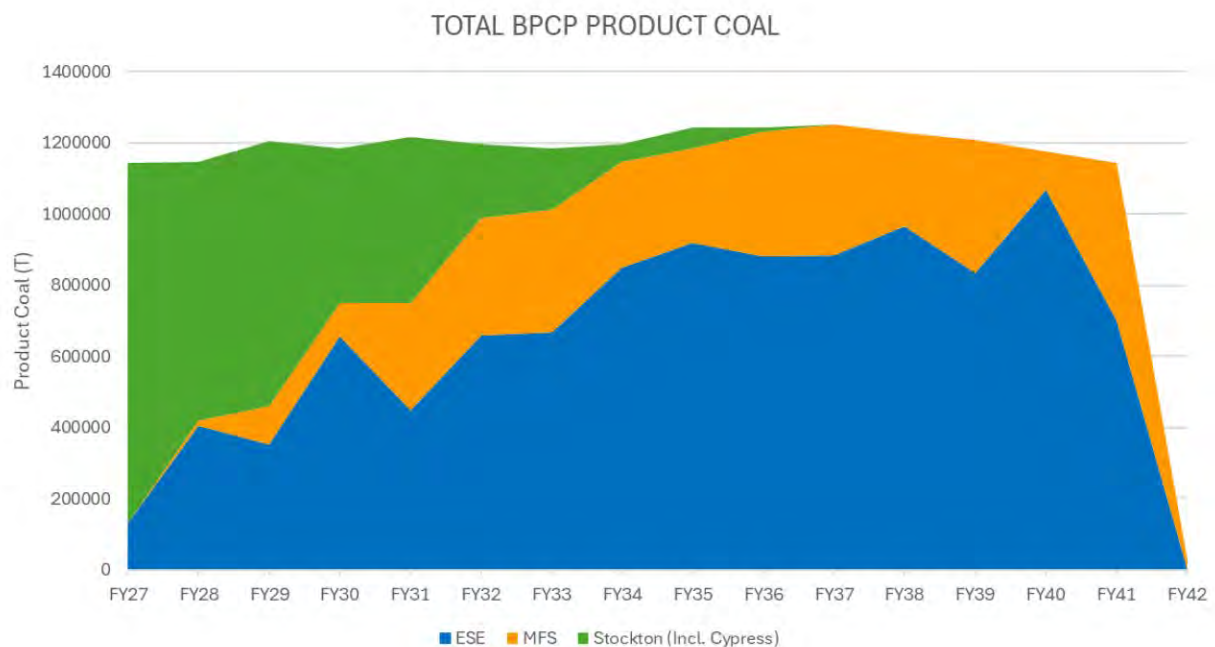


Figure 4: Proposed coal production schedule by BPCP Sub-Area.

1.9.1 ESE Overburden Schedule

The materials schedule for ESE is provided in Table 4. Overburden materials are predominantly comprised of PAF (46%) with moderate quantities of high acid forming (HAF) (16%), NAF (29%), and

Low Risk materials (9%) (Figure 5). The excavation, transport, and placement of these disturbed materials have the potential to generate AMD that could affect local waterways.

Table 4: ESE overburden

INDICATIVE YEAR	PROJECT STAGE	NAF	LOW RISK	PAF	HAF	TOTAL OVERBURDEN ¹
FY27 ²	Stage -1	83,800	23,000	503,500	48,900	659,200
FY28 ²	Stage 0	258,700	403,800	2,428,700	1,257,100	4,348,200
FY29	Stage 1	820,400	679,500	3,888,400	2,041,700	7,429,800
FY30	Stage 2	610,200	294,000	4,935,700	1,763,300	7,603,100
FY31	Stage 3	1,591,700	694,800	5,957,300	1,560,500	9,804,100
FY32	Stage 4	2,421,200	482,500	4,202,500	2,819,600	9,925,600
FY33	Stage 5	3,779,500	378,400	2,958,200	2,822,500	9,938,500
FY34	Stage 6	3,536,300	481,300	5,185,700	636,600	9,839,800
FY35	Stage 7	3,123,300	1,798,600	3,105,600	1,886,100	9,913,400
FY36	Stage 8	2,670,100	2,446,800	3,882,200	803,700	9,802,600
FY37	Stage 9	3,862,300	1,615,500	3,250,200	1,195,200	9,923,000
FY38	Stage 10	4,403,500	1,131,400	3,013,400	983,700	9,531,900
FY39	Stage 11	3,126,900	514,100	4,659,400	1,146,900	9,447,200
FY40	Stage 12	1,862,300	432,800	5,672,800	1,062,500	9,030,200
FY41	Stage 13	3,260,800	540,200	4,040,300	962,600	8,803,800
FY42	Stage 14	1,418,800	27,600	720,200	19,400	2,185,800
Grand Total ¹		36,828,900	11,943,600	58,403,500	21,009,600	128,185,500

All results in bcm (bank cubic metres)

¹ Total overburden and grand totals are calculated and rounded from source data; therefore, may not equal the sum of the rounded figures shown.

² Green cells represent the Construction Phase.

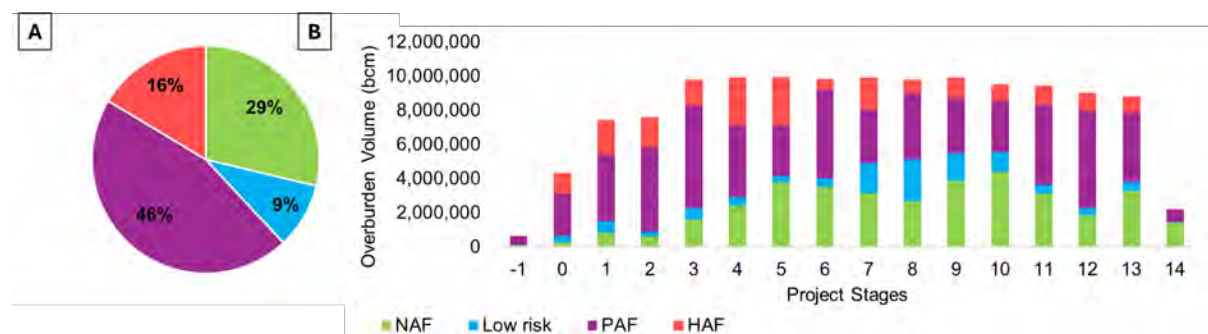


Figure 5: ESE overburden summary based on AMD classification

(A) Summary of ESE overburden volume by classification (Stage -1 – Stage 14).

(B) Total forecasted ESE overburden volumes and proportional composition by mine development stage.

1.9.2 MFS Overburden Schedule

The materials schedule for MFS is provided in Table 5. Table 5 Overburden materials are predominantly comprised of NAF (67%) with moderate quantities of PAF, (15%), Low Risk (15%) and minor amounts of HAF (3%) materials (Figure 6). The excavation, transport, and placement of these disturbed materials have the potential to generate AMD that could affect local waterways.

Table 5: MFS overburden quantities

INDICATIVE YEAR	PROJECT STAGE	NAF	LOW RISK	PAF	HAF	TOTAL OVERBURDEN ¹
	Stage -1	-	365,500	30,100	-	395,600
	Stage 0	599,300	210,800	414,100	169,900	1,394,100
	Stage 1	724,100	87,000	38,100	1,700	850,700
	Stage 2	529,300	80,200	17,000	300	626,600
	Stage 3	149,100	154,700	150,300	5,700	459,700
	Stage 4	413,400	107,800	39,800	500	561,400
	Stage 5	130,800	64,100	61,700	-	256,600
	Stage 6	1,023,500	55,600	25,200	5,700	1,109,800
	Stage 7	1,108,300	143,500	198,800	9,300	1,459,700
	Stage 8	771,900	239,200	499,900	1,500	1,512,400
	Stage 9	1,845,900	108,200	154,700	4,500	2,113,100
	Stage 10	980,000	216,100	181,400	44,900	1,422,200
	Stage 11	367,700	125,100	227,800	151,300	871,900
	Stage 12	1,809,000	255,300	202,700	66,800	2,333,600
	Stage 13	405,000	170,000	200,200	2,300	777,300
	Stage 14	8,300	14,400	41,300	1,500	65,400
Grand Total ¹		10,865,600	2,397,500	2,483,100	465,900	16,212,100

All results measured in bcm (bank cubic metres), - indicates no volume to be extracted during this Stage.

¹Total overburden and grand total are calculated and rounded from source data; therefore, may not equal the sum of the rounded figures shown.

²Green cells represent the Construction Phase.

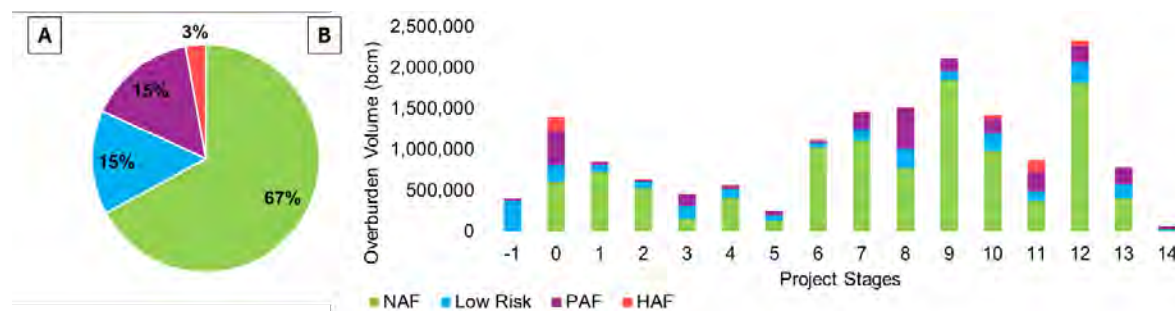


Figure 6: MFS overburden summary based on AMD classification

(A) Summary of MFS overburden volume by classification (Stage -1 – Stage 14).

(B) Total forecasted MFS overburden volumes and proportional composition by mine development stage.

1.9.3 UWHR Construction Quantities and Rock Types

UWHR bulk fill requirements have been determined by BRL and are summarised in this section.

The bulk fill strategy for the construction of the UWHR relies exclusively on ~76,000 m³ of competent rock sources recovered from cut operations within the BCM (Table 6) and ~130,000 m³ of imported granite which is classified as NAF from the A Drive Borrow Pit.

No KMS or colluvial materials will be used in the construction of the UWHR due to their poor geotechnical performance. The total excavated BCM volumes available for reuse have been quantified by road section (Table 6), along with the total volume of BCM unsuitable for placement, due to geochemical or lithological constraints. Unsuitable material will be transported to either ESE or Stockton for disposal within an ELF.

Table 6: UWHR material balances (8.6 m pavement width)

ROAD SEC	CATCHMENT	BCM DESIGN CUT TO FILL	UNSUITABLE FOR CONSTRUCTION*			
			ESE PAF ELF	ESE NAF ELF	PAF - STOCKTON	NAF - STOCKTON
		(m ³)	(m ³)	(m ³)	(m ³)	(m ³)
E2C	Burnett's	14,049	-	-	-	-
C2B	Burnett's	26,455	-	-	-	-
B2B	Burnett's	3,528	-	-	-	-
B2B	Gomorra Ck	7,928	3,374	-	-	-
B2B	Upper Waimangaroa	-	322	932	-	-
B2F	Upper Waimangaroa	24,368	-	7,358	-	-
F2C	Upper Waimangaroa	-	-	-	3,266	4,894
Total	-	76,327	3,696	8,290	3,266	4,894

*Fill North of ford and south of Cypress Mine, A mixture of colluvium and basement, which may include KMS (NAF or PAF) – percentage uncertain.

BCM = Brunner Coal Measures, ESE = Escarpment Extended

1.9.4 Overburden Summary

Based on the material schedule data provided in Table 4, Table 5, and Table 6 the following is noted:

- ESE volumes indicate that PAF material accounts for approximately 46% of total projected overburden. From Stages -1 to 7 high-risk materials (HAF & PAF) are projected to comprise > 50% of extracted materials, which requires consideration for mine planning. There is a relative increase in low-risk materials (NAF and Low Risk) for Stage 7 – Stage 14.
- MFS waste schedule indicates overburden is predominantly low-risk (82% NAF and Low Risk); however, variability is evident throughout the reporting timeframe, including periods of increased proportions of higher risk (PAF & HAF) materials (> 40%) across Stage 0, Stage 11 and Stage 14.

- UWHR bulk fill demand is primarily met by granite (~130,000 m³) and BCM material (76,000m³), with major fills concentrated at a limited number of locations. Further details are provided in the Construction Phase Report (MWM, 2026s).

1.10 Climate

The Denniston Plateau, located on the West Coast of New Zealand's South Island, experiences a temperate maritime climate characterised by high annual average rainfall, cool temperatures, and frequent cloud cover. Annual precipitation often exceeds 5,000 millimetres (mm), due to prevailing westerly winds that bring moisture-laden air from the Tasman Sea. Temperatures on the plateau are moderate, with colder and damp winters and mild summers. The combination of geology, high rainfall and moderated temperatures creates the unique ecological and hydrological characteristics of the Denniston Plateau.

Rainfall and potential evaporation (PE) representative of the Lake Brazil Meteorological Station are summarised on a monthly basis (Figure 7) from 25 January 2013 through 31 December 2023 (~11 years). PE was calculated based on the Penman method (Penman, 1948) using daily data from Lake Brazil Meteorological Station and estimates of solar radiation based on the position of the projects on the surface of the earth. An energy deficit² is apparent for all months, with PE calculated as approximately 15% of mean annual rainfall (5,414 mm/yr for the 11-year period). The median rainfall intensity was relatively high at ~1 mm/hour, with 90% of the rainfall amount occurring at intensities greater than 1 mm/hour. The numerical simulation models for rainfall in this assessment used an hourly time step.

The lowest monthly rainfall over the 11-year dataset was ~100 mm (December 2021) while the highest was 1,390 mm (January 2022). Monthly PE only exceeded monthly rainfall on two occasions out of 132 months on record, or ~1.5% (January 2013 and December 2021).

Lake Brazil climate data is representative of the ESE area. For MFS, PE will likely be similar, but rainfall is expected to be higher given the higher elevation of the project compared to Lake Brazil and is estimated to be 10% to 15% higher on average based on a rainfall-elevation relationship developed by Chater (2024).

Climate change for the West Coast region is anticipated to increase annual rainfall by between 4% to 8% by 2101–10 for Representative Concentration Pathways (RCP) 2.6 and RCP 8.5, respectively (MfE, 2018). Mean annual daily temperature changes ranged between 0.7 °C and 3.7 °C, which translate to an increase in PE by 2% to 10% (similar magnitude to rainfall increases).

² The term energy deficit used here refers to the difference between rainfall and potential evaporation. In other words, rainfall is higher than evaporation on an annual and monthly basis.

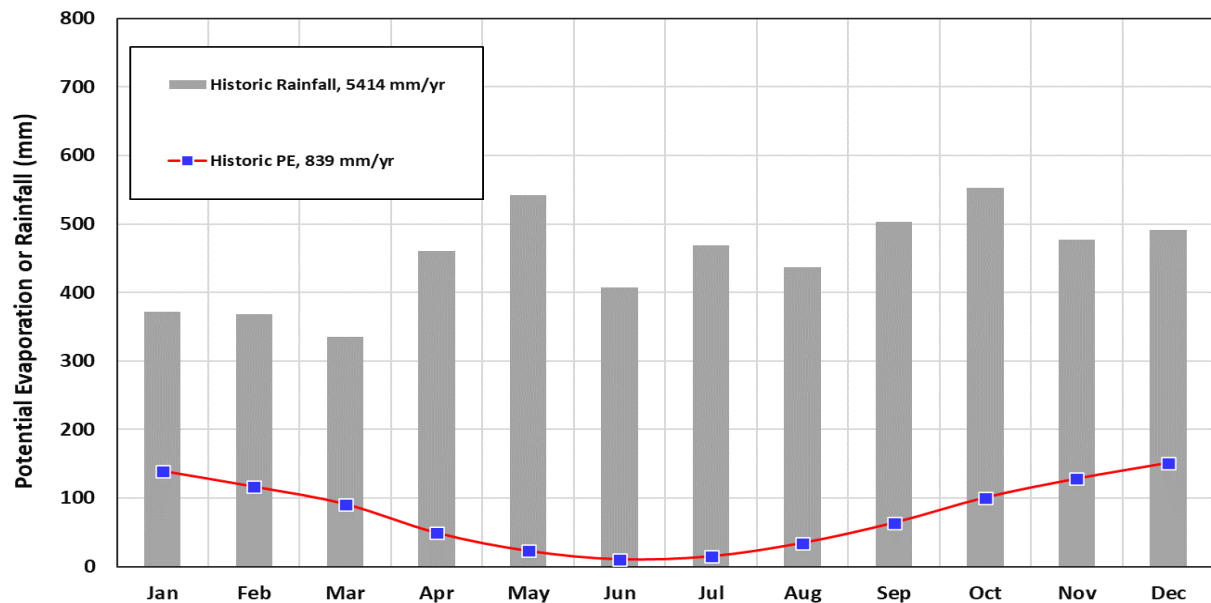


Figure 7: Lake Brazil monthly rainfall and PE.

Note: PE represents potential evaporation.

1.11 Legacy Mine Effects

Extensive historic mining activities are present in the BPCP area (Figure 8), which have led to degraded water quality and the contamination of many surface waterways from AMD. The following is noted:

- At the MFS sub-area there are numerous adits, waste rock disposal areas, and collapsed workings due to historic underground and minor outcrop mining activities. The historic underground Taipo and Koranui Mines are within the footprint of the MFS West Pit.
- Within the ESE sub-area there are several areas of historic underground workings including the Sullivan Mine, Sullivan West Mine, historical Escarpment Mine, Whareatea Mine, Davies & Party Mine, Plateau Mine, Coalbrookdale Mine, and Cascade Mine. For instance, AMD discharge from historic underground workings of the Denniston Plateau discharges into Cascade Creek, Waimangaroa River, Rapid Stream, and Whareatea River (near the coast where Rapid Stream enters) (Jewiss, 2018; Jewiss et al., 2020).
- The most recent mining operations on the Denniston Plateau took place at the existing opencut Escarpment Mine from 2014 to 2016 including development of infrastructure for the treatment of AMD using passive treatment technologies. These mining operations (currently under care and maintenance) are contained within the ESE sub-area footprint. The existing open cut Escarpment operation also developed MIW treatment systems and continues to treat AMD from the historic escarpment underground mine as well as the recent seepage from the Barren Valley ELF. AMD from the historic site flowed into several lakes near the existing Escarpment Mine all of which were acidic and severely impacted by AMD. Currently these lakes are circum-neutral and have low trace element concentrations due to the treatment processes implemented by BRL.
- The southern portion of the UWHR to the intersection of the proposed MFS Access Road has historically been mined via underground extraction and pre-existing impacts associated with

the exposure of PAF materials are present. The proposed UWHR alignment is over the Coalbrookdale and Ironbridge mine underground workings. Ironbridge Mine operated between 1889 and 1944, closing due to fires. The workings stretched from Burnett's Stream to Deep Creek (Wright, 2008). Historic information suggests these underground workings are within 10 m of the proposed UWHR in some sections. The upper coal seam floor is more than 14 m below the surface, dipping to the south away from the Waimangaroa River. A drainage drive continues to drain workings to the Waimangaroa River and this drive (as shown on historic mine plans) intersects coal floor at 475m RL suggesting workings that lie below this level are likely flooded, but all areas close to the UWHR corridor are unlikely to be flooded. Further details on historic mining activities in the area are provided by Clough & Associates (2025). The northern portion of the route from the MFS access road to Cypress has not previously been mined.

Studies completed as part of the BPCP FTAA application indicate that the proposed MFS and ESE mining activities will contribute to an improvement in water quality and aquatic ecology in several of the above AMD affected streams (e.g., Cascade Creek, V37 Creek) by the removal of some historical underground workings and the capture of associated legacy discharges. This is considered further by ESNZ (2026).

1.12 Acid and Metalliferous Drainage

AMD is a general term used to describe waters impacted chemically by mining activities and can contain significant quantities of metals/metalloids, salts, and acidity. AMD is typically generated by the excavation of rocks that contain sulfide minerals, such as pyrite. When exposed to oxygen and water, these minerals oxidise, generating acidity and releasing metals / metalloids.

Mining at MFS and ESE will affect waters within these sub-areas and these effects will include:

- Elevated total suspended solids (TSS).
- AMD which is typically low pH and elevated acidity, sulfate (SO_4), and potential constituents of concern (PCOC) that include aluminium (Al), iron (Fe), and lesser amounts of trace metals that include cadmium (Cd), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and zinc (Zn).

This report addresses AMD only, and only for the MFS, ESE, and UWHR sub-areas. Details relating to the potential effects of TSS and its management are provided in the Sediment Overview Report (MWM, 2026w), the Water Management Infrastructure Design Plan (BRL, 2026a) and other supporting documents referenced in that MP (e.g., BRL, 2026f).

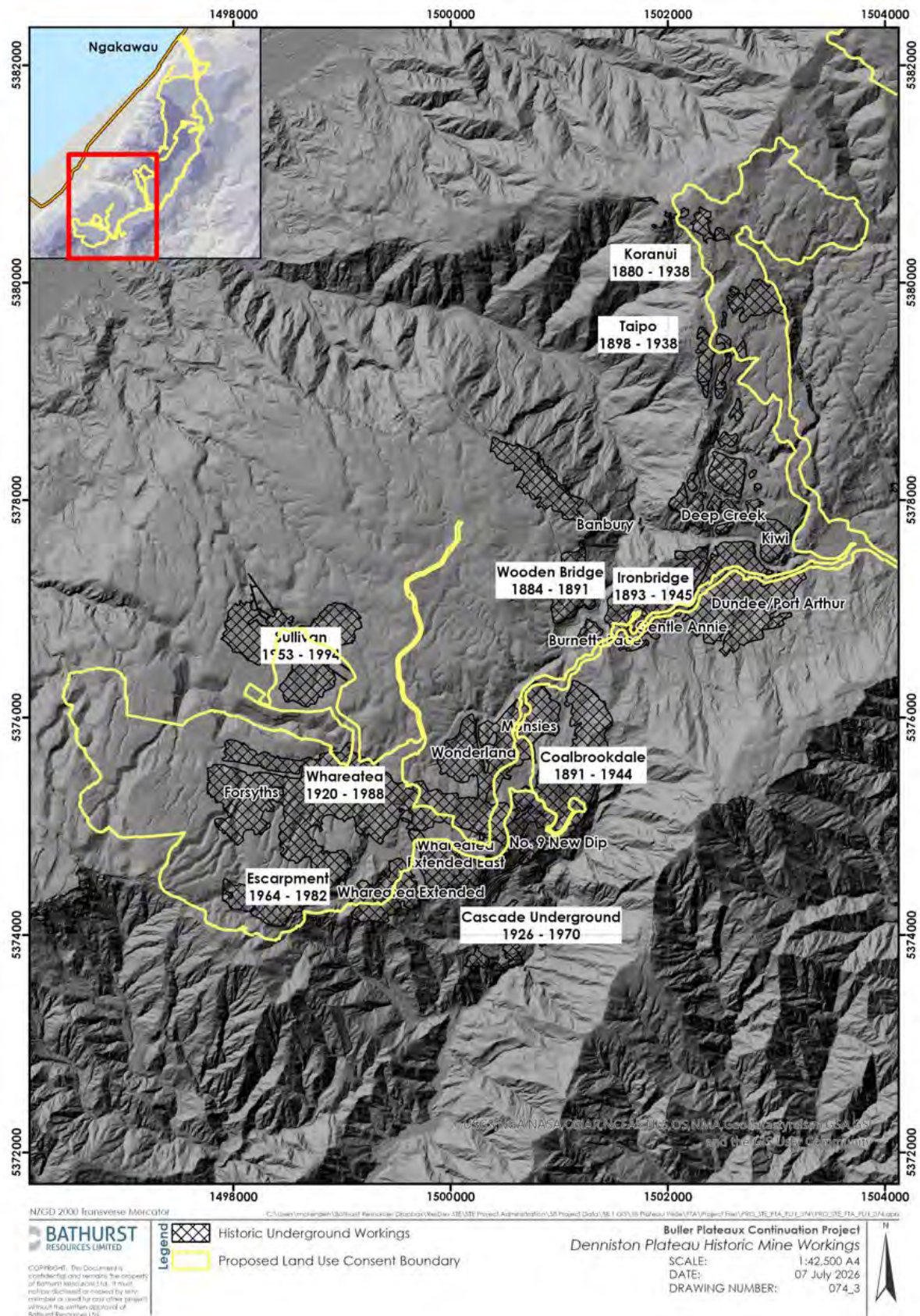


Figure 8: Denniston Plateau historic mine workings

1.13 Industry Guidance

This assessment of AMD and the associated management of the potential risks for the BPCP is based on national and international guidance (Table 7). These documents have been referred to in the associated technical studies summarised in this report and have been relied on to inform the decision-making process on how to manage AMD.

Table 7: Standards and Guidelines for AMD Management

STANDARD/GUIDELINE	RELEVANCE
AMIRA, 2002	Acid Rock Drainage (ARD) test handbook.
CMER, 2018	Centre for Mineral Environmental Research – New Zealand (Cavanagh et al., 2018).
DFAT, 2016	Australasian leading practice sustainable development program for the mining industry - preventing acid and metalliferous drainage.
ICMM, 2019	Integrated mine closure, good practice guide.
INAP, 2014	Global Acid Rock Drainage Guide (GARD Guide) – created by the International Network for Acid Prevention
INAP, 2020	Rock placement strategies to enhance operational and closure performance of mine rock stockpiles.
INAP, 2024	ARD/AMD source control for mine rock stockpiles.
MEND, 2009	Prediction manual for drainage chemistry from sulfidic geologic materials.

1.14 AMD Management Approach

MWM has developed a hierarchy of controls to manage the potential risks associated with AMD, (Management Steps), which is in alignment with international guidance documents (e.g., INAP, 2014; DFAT, 2016):

1. Determine the closure objectives for the mine.
2. Understand the source hazards.
3. Engineering Control: Prevent oxidation of sulfide minerals.
4. Engineering Control: Minimise the mobilisation of stored oxidation products.
5. Engineering Control: Control and treatment of AMD-impacted waters.
6. Complete an assessment of the potential effects.
7. Monitor performance to facilitate adaptive management.

The hierarchy of control (i.e., management steps) is shown visually in Figure 9. The following comments are provided:

- It is essential that closure objectives are understood to ensure that the appropriate engineering controls are in place to achieve these closure goals, and to ensure that all stakeholders, regulators, and partners understand what represents closure success.

- Performance monitoring is required to ensure the Project is on track to achieve these closure objectives. If monitoring data suggest there is variance that could compromise closure objectives, then the engineering controls need to be reviewed and adjusted to ensure that successful closure can be achieved (i.e., adaptive management). This process is shown in Figure 9.

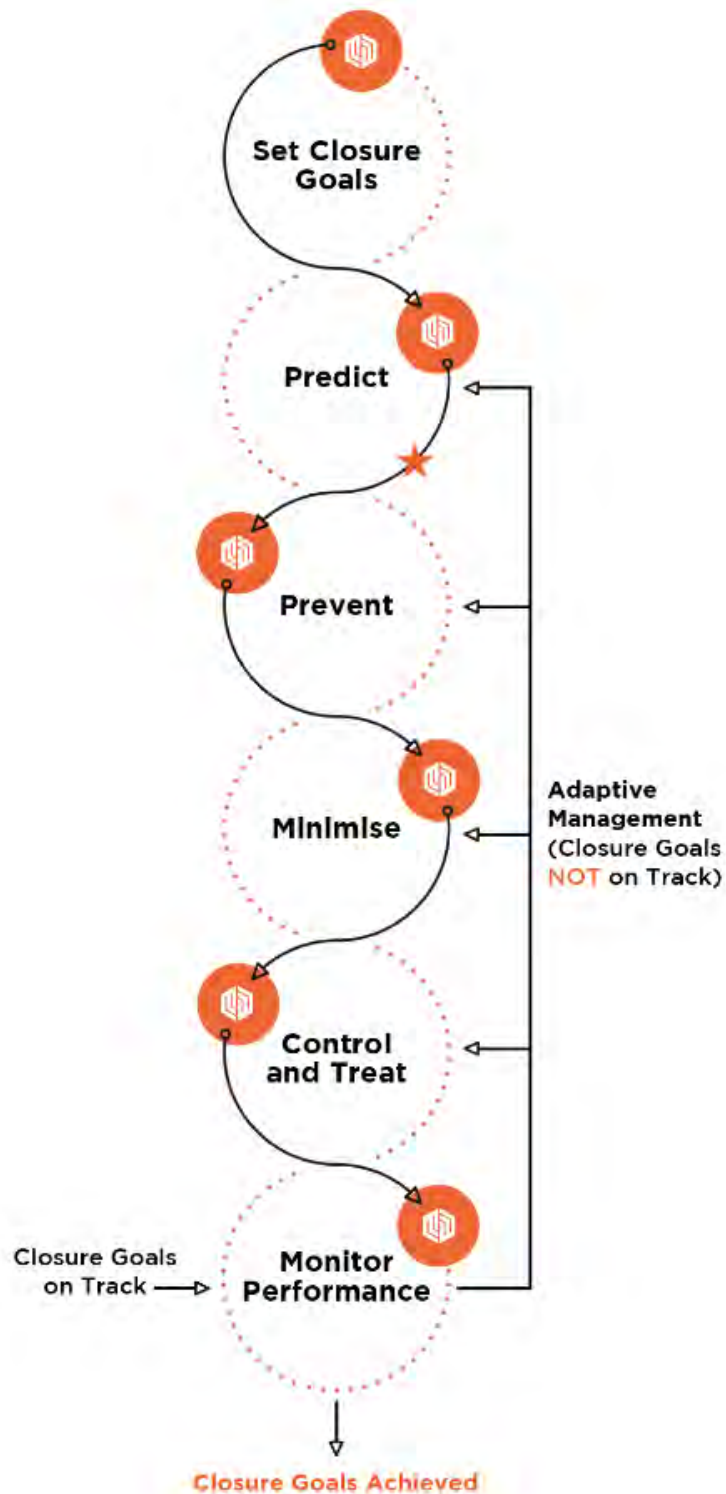


Figure 9: AMD Management Steps.

1.15 Project Documentation

Table 8 summarises the steps of AMD management for the ESE, MFS, and UWHR sub-areas including the purpose, objectives, and reference studies that have been completed. Other studies are also noted.

Table 8: Studies reviewed and/or undertaken by MWM in relation to AMD management.

PURPOSE	OBJECTIVES	REFERENCE
Set Closure Goals	<ul style="list-style-type: none"> Meet required water quality criteria in receiving waters. Transition to passive treatment of AMD impacted waters. Closure goals are set in order to minimise legacy issues associated with AMD sources and any in-perpetuity uncontrolled AMD from mine domains containing AMD generating materials. These goals are re-evaluated throughout the mine life against performance monitoring results. Closure goals should consider baseline conditions. Betterment is proposed for some waterways impacted by AMD. 	<ul style="list-style-type: none"> Background Water Quality Report (MWM, 2026a). Upper Waimangaroa Haul Road Site Visit (MWM, 2026b). Mine Closure Concept Strategy (BRL, 2026b). Water quality objectives (Hickey, 2026). Proposed Consent Conditions. Ecological Betterment studies (ESNZ, 2026)
Predict	<ul style="list-style-type: none"> Prediction is critical to understanding the potential, severity, and longevity of AMD. Prediction is facilitated by geochemical analysis, interpretations and a risk assessment. A key prediction objective is to estimate, by modelling, water quality generated by various materials and mine domains that have the potential to generate AMD. 	<ul style="list-style-type: none"> Upper Waimangaroa Haul Road Site Visit (MWM, 2026b). Factual Report. Geoenvironmental Hazards, MFS (MWM, 2026c). Factual Report: Column Leach Testing, MFS (MWM, 2026d). UWHR Geochemistry ABA Summary (MWM, 2026e) BPCP AMD Hazard Classification (MWM, 2026f). Cypress pXRF Summary (MWM, 2026g). Escarpment Mine - Barren Valley ELF Water Quality Model (MWM, 2026h). Broad Brush Risk Assessment: AMD (BRL, 2026e). Water and Load Balance Model - Source Term Definition (MWM, 2026i). Annual Overburden Schedule: MFS, ESE, UWHR (MWM, 2026v) AMD: ELF Management Plan (BRL, 2026d)
Prevent and minimise	<ul style="list-style-type: none"> Prevention of sulfide mineral oxidation, where practicable, is a key management step for AMD. The prevention of AMD relates to reducing sulfide mineral oxidation as much as practicable by limiting the ingress of oxygen into a mine domain where it can oxidise sulfide minerals prevention strategies are implemented during operations to manage a future risk. Where prevention is not practicable, or has already occurred, the next management step involves minimising the 	<ul style="list-style-type: none"> Engineered Landform Design Philosophy (MWM, 2025j) Cover System Field Investigation (MWM, 2026k). Cover System Technical Report (MWM, 2026l). AMD: ELF Management Plan (BRL, 2026c). AMD: Water Management Plan (BRL, 2026d). Mine Closure Concept Strategy (BRL, 2026b).

PURPOSE	OBJECTIVES	REFERENCE
	<p>contaminant load reporting to the receiving environment.</p> <ul style="list-style-type: none"> This often involves progressive rehabilitation strategies focused on minimising ongoing sulfide oxidation (potential oxidation products) and the mobilisation of oxidation products with net percolation through the waste rock. 	
Control and Treatment	<ul style="list-style-type: none"> Control and treat measures are an important step in managing the effects of AMD to the receiving environment should AMD be identified in site impacted water. 	<ul style="list-style-type: none"> Water Treatment Report: MFS and ESE (MWM, 2026m). Passive Treatment System Design Toolkit (MWM, 2026n) AMD Sludge Management (MWM, 2026o). Active Water Treatment Plant – Basis of Design (Process Flow, 2026a). Active Water Treatment Testing Report – Summary of Tests (Process Flow, 2026b). AMD: Water Management Plan (BRL, 2025d/2026d).
Assessment of Effects	<ul style="list-style-type: none"> Predict potential effects to the wider environment from the MFS, ESE, and UWHR sub-areas of the BPCP. 	<ul style="list-style-type: none"> Mount Frederick South - Groundwater Technical Report (MWM, 2026p). Escarpment Extended Mine Project - Groundwater Technical Report (MWM, 2026q). ELF Water Quality and MSR Design Summary (MWM, 2026r). Construction Phase Report (MWM, 2026s). Mount Frederick South - Water and Load Balance Model (MWM, 2026t). Escarpment Extended Mine Project - Water and Load Balance Model Report (MWM, 2026u). Hydrological Assessment (MWM, 2026x). Water quality objectives (Hickey, 2026).
Monitor Performance	<ul style="list-style-type: none"> Performance monitoring should be conducted to regularly evaluate how AMD management techniques are performing openly and objectively against closure goals and success criteria (e.g., ICMM, 2019). Performance monitoring is used to validate and improve model results. Performance monitoring is used to support adaptive management. 	<ul style="list-style-type: none"> AMD: ELF Management Plan (BRL, 2026c). AMD: Water Management Plan (BRL, 2026d). Routine and targeted sampling and analysis Management processes. Proposed Consent Conditions. Annual Work Plans.

The data and learnings obtained from these studies have been incorporated into the AMD ELFMP (BRL, 2026c) and the AMD WMP (BRL, 2026d) to ensure the appropriate AMD management processes are utilised, appropriate engineering controls are implemented, and performance monitoring is undertaken to support adaptive management principles if there is variation from the expected case.

2 SYNOPSIS

This section provides a high-level summary of the work undertaken to understand the AMD hazards, the potential effects, and how the risks to the receiving environment will be managed.

The potential AMD effects associated with the proposed BPCP are minimised by adhering to the AMD management approach explained in Section 2.1. This involved a methodical approach to the identification of geoenvironmental hazards and the potential effects on water quality. Additional engineering controls (ELF design, water management, water treatment, mine schedule, and mine plans) were introduced where water quality effects were deemed unacceptable in an iterative manner to achieve satisfactory outcomes at the proposed water monitoring locations. Effects were determined by BRL's multi-disciplinary technical advisors.

2.1 AMD Management Approach

This assessment of AMD and the associated management of the potential risks for the BPCP is based on national and international guidance (AMIRA, 2002; CMER, 2018 (Cavanagh et al., 2018); DFAT, 2016; ICMM, 2019; INAP, 2014, 2020, 2024; MEND, 2009). To manage the potential risks associated with AMD at MFS, ESE, and the UWHR, a hierarchy of controls (Management Steps) has been developed, which are in alignment with international guidance documents (e.g., INAP, 2014; DFAT, 2016):

1. Determine the closure objectives for the mine.
2. Understand the source hazards.
3. Prevent oxidation of sulfide minerals – Engineering Controls.
4. Minimise the mobilisation of stored oxidation products – Engineering Controls.
5. Control and treatment of AMD-impacted waters – Engineering Controls.
6. Complete an assessment of the potential effects.
7. Monitor performance to facilitate adaptive management.

These steps provide the necessary tools to understand the AMD hazards, the potential AMD effects, and how these AMD risks will be managed through industry leading practice engineering controls to achieve the proposed closure objectives. They are an integral part of the management approach for AMD at the BPCP, which is detailed in this report and all other associated documents that are provided as appendices to this report.

2.2 Background Water Quality

Extensive historic mining activities are present in the BPCP area, which have led to degraded water quality and the contamination of many surface waterways from AMD. A comprehensive assessment of background water quality was undertaken to understand these effects as part of the BPCP AEE studies. Such data are used to define baseline conditions for the proposed compliance monitoring locations and define water quality limits based on historical AMD impacts.

Four compliance monitoring sites are proposed for the MFS and the UHWR. Noting there is overlap between some monitoring sites selected for the UWHR and MFS sub-areas:

- SW01: Deep Stream
- SW03: Deep Stream
- 2W (Smokestack): Waimangaroa River
- 17W: Waimangaroa River

Four compliance monitoring locations are proposed for ESE sub-area:

- MM1: Cascade Creek Tributary V8
- W07: Rapid Stream
- KEL: Whareatea River
- V62: V62 Stream

The AEE compiled by BRL confirm these sites are suitable for compliance monitoring of the proposed BPCP, which were developed by multiple subject matter experts providing advice to the BPCP as summarised by Hickey (2026).

2.3 AMD Closure Objectives

High level AMD closure criteria for MFS, ESE, and the UWHR have been developed for the Post Closure Phase (on-going passive water treatment only) and include:

- Landform Stability (geotechnical, geomorphic, geochemical) objectives.
- Water Management Infrastructure (safe, stable, and fit for purpose) objectives.
- Water Quality (objectives)

These high-level AMD closure criteria may be refined over the life of the Project using experience and information gained during the Operational and Active Closure phases of the BPCP and will be used to update the Mine Closure Plan. Further details are available in Table 13.

2.4 Geoenvironmental Hazards

AMD on the Buller Plateaux is characterised by high acidity and elevated metal concentrations. Materials that will contribute to AMD within the BPCP include the Brunner Coal Measures (BCM), host to economic coal resources, and the overlying Kaiata Mudstone (KMS). The BCM are typically deficient in acid neutralising carbonate minerals such that the oxidation of pyrite typically leads to the rapid formation of AMD with little time lag to acid onset (Weber et al., 2008). A time lag to acid onset can occur with KMS materials due to a high acid neutralisation capacity (ANC). If sulfide minerals in these materials oxidise then AMD impacted waters can be generated and could be either acid rock drainage (ARD) or neutral metalliferous drainage (NMD) – both subgroups of AMD. Identification of key material hazards and mine domains that contain these materials is required to employ effective engineering controls to minimise uncontrolled release of AMD and achieve closure objectives.

INAP (2020) notes that “direct and indirect measurements of acidity load from various site domains at more than 40 sites over the past 25 years have revealed that mined sulfidic rock typically contributes to the majority of the total acidity load (60 to 80%) from most mine sites”. Hence the greatest long term source hazard for AMD is acid forming waste rock dumps.

To address this risk, BRL will implement proven industry best practice engineering controls for the ELFs and Engineered Fill Areas (EFA) that will contain the waste rock to ensure long term effects of mine impacted water are minimised. Whilst source control technologies are the preferred approach for the MFS, ESE, and UWHR sub-areas of the BPCP to reduce long term AMD liabilities, at Stockton due to significant and extensive historic AMD, the approach is control and treatment of AMD.

2.5 Material Quantities

Mine schedules indicate that:

- 128 Mm³ of overburden will be moved at ESE of which 29% will be NAF.
- 16 Mm³ of overburden will be moved at MFS of which 67% will be NAF.
- Average sulfur content will be ~ 0.13 wt% at MFS and ~ 0.35 wt% at ESE, which is significantly lower than Stockton and reflects a stronger fluvial influence on the BCM during deposition of the sediments and a lesser risk for AMD at MFS and ESE. Nevertheless, engineering controls are required to minimise the potential effects of the BPCP at these sub-areas.
- BCM and KMS materials along the length of the UWHR have a higher sulfur content of 0.82 wt% and 2.13 wt% respectively, although materials quantities use for road fill are only 0.076 Mm³.

These materials could contribute to AMD impacted drainage that could impact the receiving environment if engineering controls and management processes were not implemented. However, it is noted that MFS and ESE sub-areas have a lesser marine influence during formation of the coal measures compared to Stockton, which is strongly influenced by high sulfur estuarine sediments. Hence AMD loads will be significantly lesser at MFS and ESE compared to Stockton.

2.6 Potential Effects

AMD is a general term used to describe waters impacted chemically by mining activities and can contain significant quantities of metals/metalloids, salts, and acidity. AMD is typically generated by the excavation of rocks that contain sulfide minerals, such as pyrite. When exposed to oxygen and water, these minerals oxidise, generating acidity and releasing metals / metalloids. Mining at MFS and ESE will affect waters within these sub-areas and these effects will include:

- Elevated total suspended solids (TSS).
- AMD which is typically low pH and elevated acidity, sulfate (SO₄), and potential constituents of concern (PCOC) that include aluminium (Al), iron (Fe), and lesser amounts of trace metals that include cadmium (Cd), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and zinc (Zn).

These PCOCs have been defined by detailed studies conducted to assess geoenvironmental source hazards, geochemical modelling, and water and load balance modelling for each project sub-area.

Some PCOCs have been screened out as being potentially of concern through these detailed studies. This includes nitrogenous compounds, arsenic (As), lead (Pb), and chromium (Cr) – and will be assessed by performance monitoring to confirm that they are not an issue in receiving waterways. This monitoring will be undertaken on ELF seepage (being the mine domain having the greatest long term AMD risk) to confirm this assessment is correct.

2.7 Engineered Landform Geochemical Models

Robust estimates of water quality from ELF's are required to understand long term risks for AMD given they represent the greatest source hazard for AMD at the proposed BPCP. To establish reliable outcomes, an empirical model was developed, which included the proposed engineered controls to prevent oxidation and minimise of the mobilisation of sulfide oxidation products.

A water quality model for the Barren Valley Engineered Landform (BV ELF), located at the existing Escarpment Mine, which is currently under care and maintenance, was developed and is used to forecast water quality for the ELF's proposed for MFS and ESE. Three phases were developed for the model including the construction phase, stabilisation phase, and long-term decay phase. Acidity decay rates of 9.6% measured at BV ELF (i.e., empirical site-specific data) were applied to the model after the stabilisation phase that eventually transitions to a long-term acidity load of 2.7 t/ha/yr (determined by numerical modelling), which then decays at the long-term acidity decay rate of 0.62% per year (Gandy and Younger, 2007; Treasury, 2017).

The model was construed to estimate sulfate concentrations based on empirical data. Other PCOC, linked to the sulfate concentration were then derived from relationships derived from multiple datasets at the existing Escarpment and Stockton mines. The model was applied to 20 ELF's (6 at ESE and 14 at MFS). Results conclude that basal seepage from PAF and NAF ELF's will require management (i.e., passive treatment) for numerous decades after closure and that in perpetuity is reasonable for consideration of ongoing effects and management requirements.

2.8 Engineering Controls

Three primary engineering controls are proposed for the BPCP including:

1. Prevent oxidation of sulfide minerals – which will be undertaken by the construction of ELF's and EFAs to prevent advective airflow into waste rock storage facilities. Further details are provided in Section 5.2.
2. Minimise the mobilisation of stored oxidation products – which will focus on clean water diversion and shedding water from ELF's as quickly as practicable. Further details are provided in Section 5.2.
3. Control and treatment of AMD impacted waters – which will be undertaken by active water treatment plants that eventually transition into passive treatment systems once PCOC loads decrease. Further details are provided in Section 6.

These engineering controls are based on industry accepted processes, that have been tested at numerous operations within New Zealand and internationally. The proposed engineering controls will minimise the potential effects on receiving waters around the MFS, ESE, and UWHR sub-areas.

2.9 Assessment of Effects

The following studies were undertaken to assess potential effects:

- Mount Frederick South - Groundwater Technical Report (MWM, 2026p).
- Escarpment Extended Mine Project - Groundwater Technical Report (MWM, 2026q).
- ELF Water Quality and MSR Design Summary (MWM, 2026r).

- Construction Phase Report (MWM, 2026s).
- Mount Frederick South - Water and Load Balance Model (MWM, 2026t).
- Escarpment Extended Mine Project - Water and Load Balance Model Report (MWM, 2026u).

Water and load balance models (WLBMs) were developed for the Project as the principal tool to understand key risks and estimate the potential effects of the Project after the implementation of engineering controls to prevent and minimise AMD from the storage of waste rock (i.e., ELF) and control, management, and treatment of AMD by active and passive treatment technologies.

2.9.1 WLB Methodology

The WLBMs for MFS and ESE were developed to achieve the following objectives:

- Forecast changes to flows within waterways as a result of the project-related activities.
- Support design of water management and water treatment infrastructure.
- Forecast downstream water quality as a result of the project-related activities.

The WLBMs use multiple static and dynamic source terms to understand the potential effects coupled with engineering controls using proven technologies to minimise the effect on the receiving environment:

- The source terms are constructed from empirical datasets developed from ~25 years of data, experience, and operational management associated with mining on the Buller Plateaux and are considered reliable to understand the potential effects.
- Engineering controls to mitigate the magnitude of AMD impacted waters from waste rock are based on proven technologies to mitigate advective airflow and ongoing oxidation of sulfidic rock. BRL and its predecessor (Solid Energy (New Zealand) Limited) has successively demonstrated that eliminating airflow to the core of ELFs is practicable.
- Engineering controls to manage the effects have a proven track record at Stockton (e.g., CaO active water treatment) and passive treatment using mussel shell bioreactors (Canterbury Coal Mine, Stockton, and the existing Escarpment Mine), where the treatment efficiencies have been integrated into the WLBMs after other engineering controls (e.g., ELF source control) are implemented.

Some uncertainties remain in regards to the exact performance of the proposed engineering controls. However, these can be effectively managed by adaptive management processes through evolving project knowledge, monitoring, and data analysis throughout the Operational Phase of the Project.

2.9.2 Effects

The key mine domain representing the majority of AMD impacted water at closure are the ELFs. This is in alignment with INAP (2020) that states mined sulfidic rock typically contributes to the majority of the total acidity load (60 to 80%) from most mine sites. Model results indicate that:

- The peak MIW PCOC loads reporting to the MFS WTP occur in 2040, with approximately 324 tonnes per year (t/year) of acidity, 31 t/year of aluminium (Al), and 13 t/year of iron (Fe). Modelling also indicates that 2041 is the peak year for TSS load, with 870 t/year of TSS.

- Peak MIW PCOC loads reporting to the ESE WTP occur in 2036/37, with approximately 4,700 tonnes per year (t/year) of acidity, 460 t/year of aluminium (Al) and 210 t/year of iron (Fe). 2035 was the peak year for sediment load, with 1,550 t/year.
- Active treatment at MFS will be required for about 4 years after completion of rehabilitation before MSRs can treat PCOC loads to meet the water quality limits proposed by Hickey (2026) in receiving waterways. This is related to lower sulfur content and smaller quantities of overburden disturbance compared to ESE.
- Active treatment at ESE will be required for ~15 years after mining operations cease before MSRs can treat PCOC loads to meet the limits proposed by Hickey (2026) in receiving waterways. Some ELF seepage will be able to be treated effectively with MSRs earlier than this.
- Models demonstrate that at transition from active water treatment plants to passive treatment systems the acid loads will range from ~1 t/yr to ~300 t/yr, which will require treatment for many decades for the PCOCs identified in Section 2.6.

2.9.3 Risk Management

Comprehensive risk assessments have been undertaken (BRL, 2026e) to determine potential AMD risks for MFS and ESE. To better understand the potential AMD effects on the receiving environment due to these risks, scenario modelling of has been undertaken including:

- Base Case model, with approximate annual average rainfall conditions and typical source terms based on best available empirical water quality datasets. The adopted water management strategy is based on over 25 years of practical experience in similar environments.
- Scenario 1, with *high*³ annual rainfall conditions and typical source terms.
- Scenario 2, with *variable* rainfall every year (stochastic rainfall) and typical source terms.
- Scenario 3, with approximate annual average rainfall conditions and a +30% increase to typical ELF seepage source terms.
- Scenario 4, with approximate annual average rainfall conditions and a -30% decrease to typical ELF seepage source terms.

Studies summarised in this report (and the associated appendices) indicate that the environmental risks associated with AMD at the MFS, ESE, and the UWHR can be successfully managed if the appropriate management processes are utilised, suitable engineering controls are implemented, and performance monitoring is undertaken to support adaptive management principles if there is variation from the expected case.

2.9.4 Betterment

Studies indicate that the proposed MFS and ESE mining activities will contribute to an improvement in existing water quality and aquatic ecology in a number of AMD affected streams (e.g., Cascade Creek

³ The wettest year on record for Lake Brazil meteorological station was used to represent high rainfall conditions.

and V37 Creek) by capturing and removing legacy uncontrolled releases of AMD from some historical underground workings. This 'betterment' is outlined in ESNZ (2026).

2.10 Recommendations

Key recommendations derived from the technical studies are provided in this report and relate to:

- Background water quality monitoring and water quality objectives.
- Closure objectives.
- Source hazard characterisation.
- Engineering controls.
- Assessment of potential effects.

Noting that many recommendations relate to the validation of models, water quality expectations, and processes to confirm predictions and understand effects, which is fundamental to adaptive management processes. This ongoing validation will confirm that the assessment of environmental effects remains appropriate and the management controls proposed are suitable.

2.11 Summary

The work presented in this report is based on >25 years of experience, research, analysis, and operational knowledge of mining on the Buller Plateaux. AMD risks are understood. Comprehensive management plans supported by performance monitoring have been developed based on the assessment of environmental effects and identified risks to ensure effects are managed. If engineering controls do not perform as expected and PCOC loads are higher, then the active treatment period may need to be extended.

The work has been reviewed by BRL mine engineers and planners; BRL technical AMD staff; BRL project managers, BRL consultants, and third-party subject matter experts who have provided independent peer review.

3 **CLOSURE OBJECTIVES**

This section discusses the closure objectives for ESE, MFS, and the UWHR in regards to water quality. It summarises the following MWM report:

- Background Water Quality Report (MWM, 2026a).

3.1 **Introduction**

Closure objectives for any project need to be defined at the start of the project to ensure that the appropriate AMD management steps are developed and implemented to achieve the agreed closure objectives. For AMD, the key objective is water quality that is suitable for subsequent purposes or ecological outcomes.

As noted in Section 1.11, the existing environment of the Project area is affected by historic mining and AMD (to varying degrees) that continues to impact receiving waterways, which requires consideration for understanding closure objectives.

Water quality closure objectives for ESE, MFS, and UWHR have been defined as part of the BPCP AEE studies to ensure that closure objectives can be achieved. The following is noted:

- Derivation of operational and closure water quality is in alignment with the Australian and New Zealand guidelines for fresh and marine water quality (ANZG, 2018) with acknowledgement of site-specific conditions.
- Further details on water quality objectives are provided in proposed water quality guidelines by Hickey (2026).
- Studies indicate that the proposed MFS and ESE mining activities will contribute to an improvement in water quality and aquatic ecology in a number of AMD affected streams (e.g., Cascade Creek and V37 Creek) by capturing and removing AMD in some historical underground workings and the associated legacy discharges. This 'betterment' is outlined in ESNZ (2026).

3.2 **Background Water Quality Report**

This report provides details of the water quality dataset for the ESE, MFS, and UWHR areas and is provided as Appendix A (MWM, 2026a).

3.2.1 *Report Purpose*

A water quality dataset is required to:

- Understand background conditions within waterways.
- Identify locations for ongoing monitoring and the development of targeted water quality sampling programmes at these locations.
- Support the development of water quality models.
- Understand potential effects of the BPCP.
- Support the definition of water quality closure objectives for the project.

- Identify ecological 'betterment' opportunities where waterways currently impacted by AMD will be improved as an outcome of the BPCP.

This work was used by Hickey (2026) to identify waterways impacted by AMD, the severity of this impact, and unimpacted stream water quality to identify suitable monitoring locations and establish water quality compliance criteria.

3.2.2 Review

A significant water quality database is available for the MFS, ESE, and the UWHR sub-areas to provide guidance on potential constituents of concern (PCOC) within these sub-areas with data being collected for many decades. For instance:

- Extensive water quality monitoring has been undertaken at the Stockton Mine with records in the Stockton Water Quality Database⁴ commencing in 1987. Such data has application to the wider BPCP as the same lithological materials will be excavated.
- It is noted that observations, interpretations, and about 120,000 samples⁵ from 125 sites over 45 years demonstrate that the Denniston and Stockton catchments are amongst the most well understood catchments in New Zealand with regards to water quality.
- The AMD risks are well understood for the Project areas and the materials that will be disturbed by the BPCP activities.

Although background water data is robust, it is recommended it be continually verified through the life of the BPCP to validate the proposed management processes.

Generally, site-specific guideline values (as proposed by Hickey (2026) for the BPCP) should be derived from at least 2 years of monthly data collected from suitable sites to constitute a baseline dataset to understand any seasonal effects⁶. Water quality data provided in this report includes sites with extensive water quality data sets and sites where additional monitoring has been recommended to meet the definition of baseline (and which is underway). Hence, this report is referred to as a background water quality report to acknowledge variable data availability at all sites covered by this report.

In many surface water quality environments, seasonality is the largest cause of variation in stream chemistry due to factors that include strongly seasonal rainfall patterns, snow melt, seasonal variation in groundwater recharge/discharge, or seasonal biological processes. However, on the Buller Plateaux, where close to four decades of data are available (e.g., Stockton Mine), these types of seasonal factors have been identified as being of much lesser importance. The strongest driver for stream water chemistry is the rapid response of headwater streams to rainfall (i.e., rapid changes in stream flow rate).

For instance, this is shown by water quality monitoring at Stockton where data for St Patrick's Stream (Figure 10) demonstrates >4-fold dilution in water quality over flows rates that increase by an order of magnitude.

⁴ As provided by BRL

⁵ As sourced from the BRL water quality database, including Sonde measurements.

⁶ <https://www.waterquality.gov.au/anz-guidelines/guideline-values/derive/reference-data>

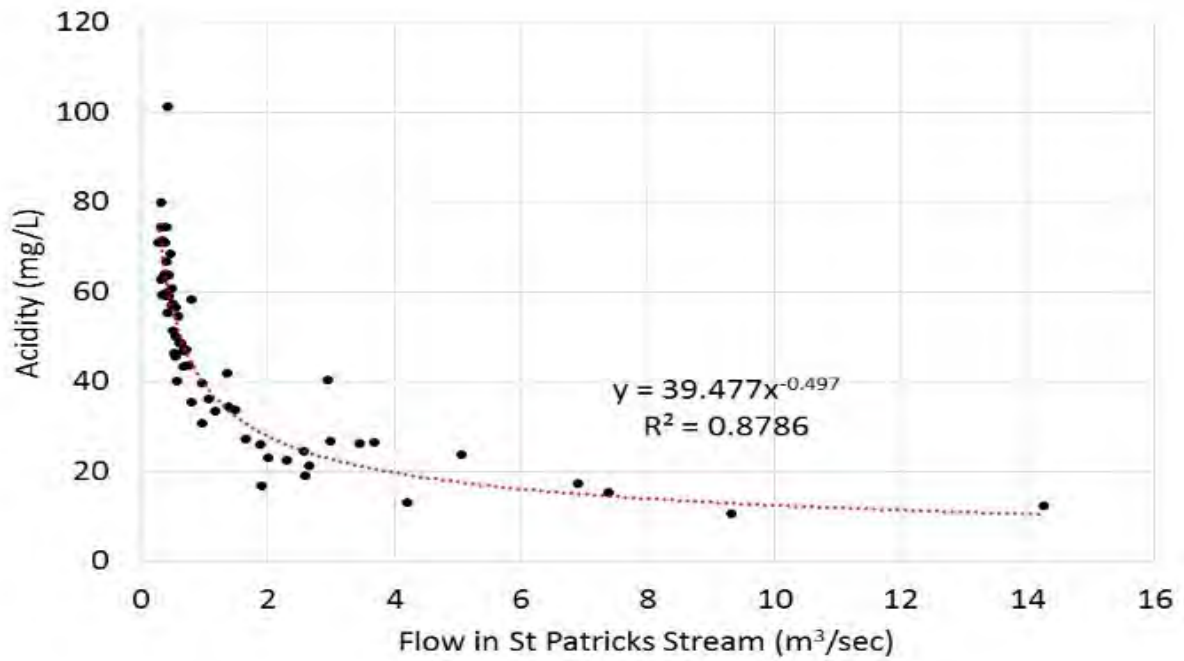


Figure 10: Acidity (mg/L) as a function of flow rate: St Patrick's Stream - Stockton

Source: Weber et al., 2015

Other substantive studies have been undertaken by Davies (Davies, 2009; Davies et al., 2011) which also show increasing pH with increasing flow due to the significant dilution of AMD impacted waters by rainfall and rapid runoff (Figure 11).

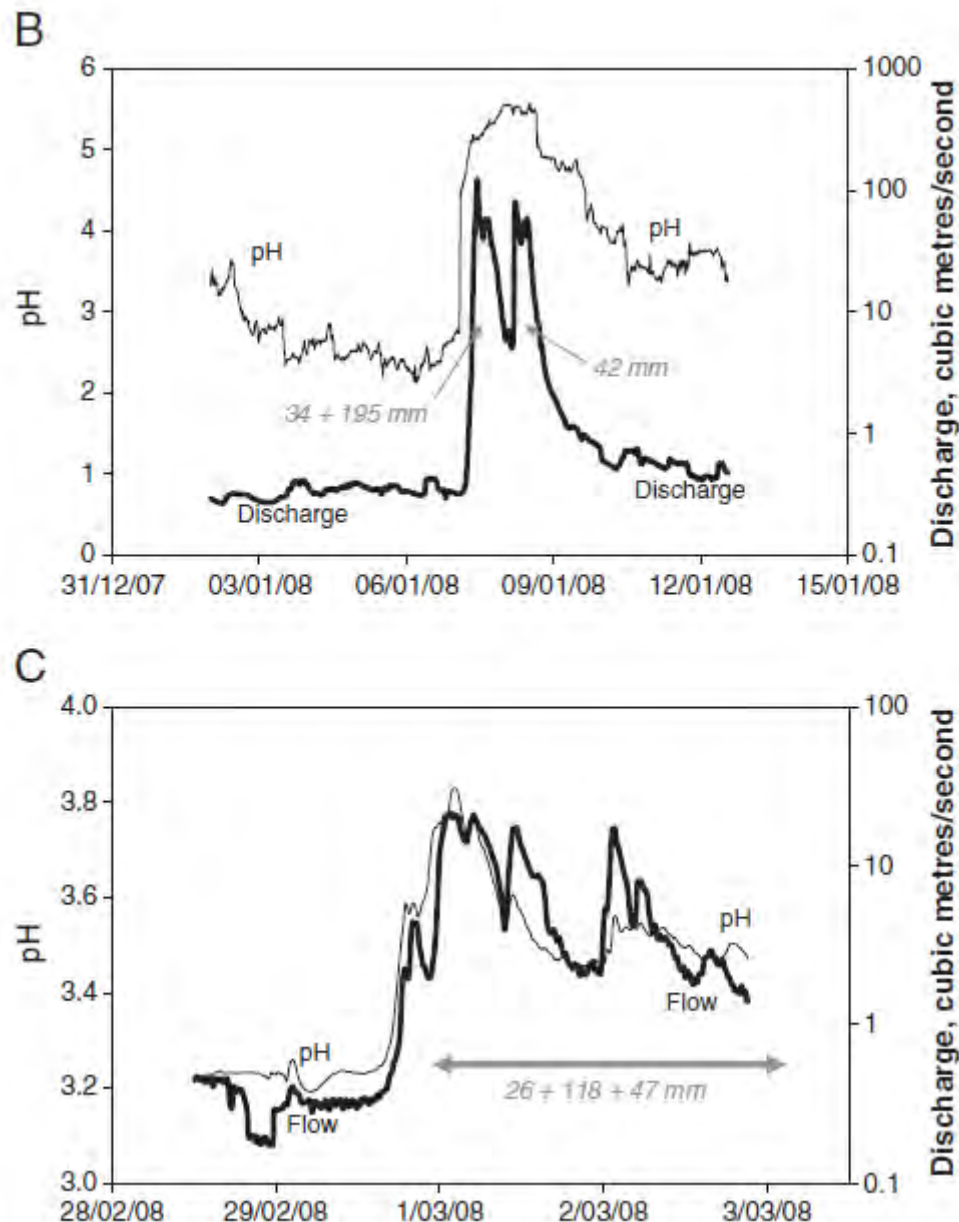


Figure 11: Flow versus pH data for Mangatini Stream

Source: Davies et al. (2011) where C = January Event; and D = March Event

Hence, water quality compliance monitoring sites with > 24 individual discrete samples are considered representative of baseline water quality for the BPCP provided these samples were collected over an extended timeframe (many months) and the samples included seasonal data and higher and lower flow periods. It is acknowledged this may not consider longer term climatic variations (e.g., El Niño Southern Oscillation) but many baseline datasets would not capture such variation in 2 years. Hence water quality reference sites have been established as part of the BPCP to understand long term climatic cycles.

3.2.3 Proposed Monitoring Programme

The following major catchments are proposed for ongoing monitoring within the MFS, ESE, and the UWHR sub-areas:

- UWHR and MFS sub-areas:

- o Waimangaroa River catchment.
- o Deep Stream catchment.
- ESE sub-area:
 - o Cascade Creek catchment.
 - o Rapid Stream catchment.
 - o Whareatea River catchment.

The forward water quality monitoring programme for sites within these waterways is tailored to individual sites dependent on the purpose of the water quality monitoring site. Three types of monitoring locations have been proposed as shown in Table 9.

Table 9: Water quality monitoring site explanation

MONITORING TYPE	EXPLANATION
Performance	to ensure compliance (and betterment) water quality is on track and will be achieved and provide data for adaptive management purposes.
Compliance	to ensure the project is achieving its approved water quality objectives.
Reference	to provide baseline data to understand climatic variables (e.g., El Niño Southern Oscillation) within unimpacted catchments.

Table 10 provides a summary of the proposed monitoring programme for MFS, ESE, and the UWHR. Details on proposed water quality monitoring frequency, parameters tested, and relationship to project activities are provided in the AMD WMP (BRL, 2026c). The following is noted:

- At least 24 samples are available for all compliance water quality monitoring locations.
- Performance and reference monitoring locations with <24 samples at the time of data compilation are shown in blue. These sites will be continually verified through the life of the BPCP to validate the proposed management processes.

Table 10: Proposed water quality monitoring program (MFS, ESE, UWHR).

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	NO. OF SAMPLES COLLECTED
UWHR	Waimangaroa River	WRBBC	Performance	97
UWHR	Waimangaroa River	14W	Performance	10
UWHR	Waimangaroa River	15W	Performance	11
MFS	Waimangaroa River	16W ¹	Performance	6
MFS / UWHR	Waimangaroa River	2W (Smokestack)	Compliance	29 + 17 high flow samples
MFS / UWHR	Waimangaroa River	17W	Compliance	24
MFS	Waimangaroa River	18W	Performance	7
MFS / UWHR	Wilson Creek (Waimangaroa River tributary)	WIL.MS1	Reference	7

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	NO. OF SAMPLES COLLECTED
MFS / UWHR	Cedar Creek (Waimangaroa River tributary)	CED.MS1	Reference	7
UWHR	Burnetts Stream	BUR.L1	Performance (turbidity)	17
MFS	Deep Stream	SW01	Compliance	26 + 28 high flow samples
MFS	Deep Stream	SW03	Compliance	26
MFS	Deep Stream	SW04	Performance	24
MFS	Billo Stream	BS01	Performance (turbidity)	24 + 8 high flow samples
MFS	Billo Stream tributary	BIL.L1	Reference	9
MFS	Deep Stream unnamed tributary	SW02	Performance ²	24
ESE	V8 Creek (Cascade Creek tributary)	MM1	Compliance	149
ESE	V37 Stream (Cascade Creek tributary)	V37-F ³	Performance	-
ESE	V37 Stream (Cascade Creek tributary)	V37-G ³	Performance	-
ESE	Cascade Creek	DS.V37	Performance (ecology)	1
ESE	Rapid Stream	W07	Compliance	26
ESE	Rapid Stream	W08	Performance	21
ESE	Rapid Stream	W09	Performance	24
ESE	Rapid Stream tributary	RAP.R1	Reference	4
ESE	Whareatea River	KEL	Compliance	51 + 3 high flow samples
ESE	Whareatea River	WM-3	Performance	116
ESE	V70 (Whareatea River tributary)	V70	Reference and Performance (turbidity)	19
ESE	V62 (Whareatea River tributary)	V62	Compliance	24 + 2 high flow samples

¹ = no data available as at Q4 2025.

¹ Consider the pre-BPCP 2W data will reflect the background conditions at 16W. This site is included as an add to background site for assessing compliance at 2W (Smokestack).

² To take over from BIL.L1 and become a reference site at the start of the Post Construction phase.

³ These sites will be monitored once disturbed, currently insufficient flow to sample.

3.2.4 Potential Constituents of Concern

All major catchments within the MFS, ESE, and the UWHR contain areas affected to varying degrees by AMD from historic mining (see also Section 1.11):

- At the MFS sub-area there are numerous adits, overburden disposal areas, and collapsed workings due to historic underground and minor opencast mining activities. The historic underground Taipo and Koranui Mines are within the footprint of the MFS West Pit.

- Within the ESE sub-area there are several areas of historic underground workings including the Sullivan Mine, Sullivan West Mine, Escarpment Mine (not the existing open pit Escarpment mine, but the previous underground mine), Coalbrookdale Mine, and Cascade Mine. AMD discharge from historic underground workings of the Denniston Plateau discharges into Cascade Creek, Waimangaroa River, Rapid Stream, and Whareatea River (near the coast where Rapid Stream enters).
- The southern portion of the UWHR to the intersection of the MFS Access Road has historically been mined and pre-existing impacts associated with the exposure of PAF materials may be present. The proposed UWHR alignment is over the Ironbridge Mine underground workings.

Some of the underground historic workings are proposed to be excavated within the Cascade Stream and Deep Stream (a tributary of the Waimangaroa River) catchment areas. This will have the effect of reducing the PCOC load from uncontrolled AMD discharging from historic underground workings into these catchments.

To provide an indication of background historic AMD effects on water quality, a metal ecotoxicity quotient (MEQ) is used to identify PCOC that may be elevated with respect to screening criteria (water quality reference values). The MEQ value for a PCOC is determined by dividing the measured concentration (maximum values used in this report) by the water quality reference value (WQ Ref Value). MEQ values greater than 1 indicate parameters that exceed the relevant WQ Ref Value. Conversely, MEQ values less than 1 are below the relevant WQ Ref Value

The following WQ Ref Value were applied where appropriate:

- Proposed water quality criteria developed for the BPCP (Hickey, 2026).
- 95% ANZG (2018) Default Guideline Values (DGVs).
- ANZG (2018) for unknown protection level for Sb.
- ANZG Livestock Drinking Water Guidelines (Draft) (2023) for sulfate.
- Canadian water quality guidelines for the protection of aquatic life (CCME, 2014) for thallium of 0.8 µg/L (0.0008 mg/L).

Where maximum data exceeded a WQ Ref Value, this was identified as a PCOC. Table E2 provides PCOC identified for the proposed compliance monitoring sites and classification as per the system developed by Hickey (2026)⁷. PCOC data indicates the potential for elevated Cu and Zn at sites not impacted by historic mining as indicated by sites classified as 'Good' (Hickey, 2026).

Table 11: PCOC identified at water quality compliance monitoring sites (MFS, ESE, UWHR).

LOCATION	WATER QUALITY COMPLIANCE MONITORING SITE	NO. OF SAMPLES COLLECTED	PCOC ¹	CLASSIFICATION ²
Waimangaroa River	2W (Smokestack)	29 + 17 high flow samples	Al, Cd, Co, Zn	Fair

⁷ Biological and chemical baseline data were used to determine AMD influence on streams with increasing levels classified from 'good' to 'poor'.

LOCATION	WATER QUALITY COMPLIANCE MONITORING SITE	NO. OF SAMPLES COLLECTED	PCOC ¹	CLASSIFICATION ²
Waimangaroa River	17W	24	Al, Cd, Co, Zn	Fair
Deep Stream	SW01	26 + 28 high flow samples	Zn	Good
Deep Stream	SW03	26		Good
Cascade Creek tributary (V8 Creek)	MM1	149	Al, Cd, Co, Cu, Ni, Zn	Poor
Rapid Stream	W07	26	Cd	Good
Whareatea River	KEL	51 + 3 high flow samples	Cd, Cr	Good
Whareatea River tributary (V62)	V62	24 + 2 high flow samples	Cd, Cu	Good

1. Where MEQ > 1 for maximum recorded data and all data is not < LOR.

2. As developed by Hickey (2026).

3.2.5 Recommendations

Recommendation #1: Continue Water Quality Monitoring

Continue further water quality monitoring at compliance, performance, and reference monitoring sites over the construction, operational, and closure phases of the project.

Recommendation #2: Validate baseline water quality

- Undertake continuous monitoring data (flow, EC, pH and turbidity) to provide time-based data to fully characterise the relationships between flow and physicochemistry at compliance monitoring locations (e.g., 2W: Smokestack) prior to construction commencing and then continuing throughout life of mine phases.
- Validate and refine flow weighted water quality source terms (mg/L).
- Validate storage and WTP capacity required to manage extreme rainfall events or wet years.

Recommendation #3: Define AMD Closure Objectives

- Integrate closure objectives in the AMD ELF MP and the AMD Water MP to facilitate satisfactory relinquishment processes and include definitions of:
 - o Safe, stable, non-polluting.
 - o Stable water quality.

Recommendation #4: Define AMD Closure Objectives

- Undertake a SQEP⁸ review of monitoring data during Operational, Active Closure, and Post Closure phases. Validate data against model predictions and incorporate changes to monitoring type and frequency changes into the following management plans:

⁸ Suitably qualified and experienced person

- o AMD ELF Management Plan
- o AMD Water Management Plan.
- o Water Infrastructure Design.
- o Mine Closure Concept Strategy.
- o Erosion and Sediment Control Plan for Land Disturbance Activities.

3.3 Proposed Water Quality Limits

Water quality parameters proposed by Hickey (2026) for the PCOC shown in Table 12.

Table 12: Potential constituents of concern for the BPCP

PCOC	WATER QUALITY LIMIT	COMMENT
pH	✓	Required to monitor AMD effects and management
Al	✓	Required to monitor AMD effects and management
Cd	✓	Required to monitor AMD effects and management
Co	✓	Required to monitor AMD effects and management
Cu	✓	Required to monitor AMD effects and management
Fe	✓	Required to monitor AMD effects and management
Mn	✓	Required to monitor AMD effects and management
Ni	✓	Required to monitor AMD effects and management
Zn	✓	Required to monitor AMD effects and management
Nitrate-N	✓	Required to monitor AMD effects and management
Ammoniacal-N	✓	Required to monitor AMD effects and management
TSS	✓	Required to monitor AMD effects and management
Turbidity	✓	Required to monitor AMD effects and management
NOT INCLUDED		
As	✗	Arsenic (As) is not assessed as previously studies on the Barren Valley ELF (MWM, 2026h) indicate that it is below the limit of reporting (< 0.001 mg/L) and data from Stockton (provided in MWM, 2026h) indicates that after treatment and removal of iron (Fe), As concentrations are typically < 0.005 mg/L as compared to the ANZG (2018) 95% trigger value of 0.013 mg/L.
Cr	✗	This has been resolved through the WLBm process for the MFS sub-area (MWM, 2026t) and the ESE sub-area (MWM, 2026u). Modelling results indicate compliance ¹ for all scenarios for the active period for both project sub-areas indicating consent limits are not required (Hickey, 2026).
Pb	✗	This has been resolved through the WLBm process for the MFS sub-area (MWM, 2026t) and the ESE sub-area (MWM, 2026u). Modelling results indicate compliance ² for all scenarios for the active period for

both project sub-areas indicating consent limits are not required (Hickey, 2026).

¹ For 95% of the time applying Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2026) DGVs for Cr(III).

² For 95% of the time applying Canadian Council of Ministers of the Environment federal environmental quality guidelines for Pb (CCME, 2020).

3.4 AMD Closure Criteria

High level AMD closure criteria for MFS, ESE, and the UWHR have been developed for the Post Closure Phase (on-going passive water treatment only) and are summarised in Table 13. These high level AMD closure criteria may be refined over the life of the project using experience and information gained during the Operational and Active Closure phases of the BPCP and will be used to update the Mine Closure Plan based on timelines proposed in Figure 12.

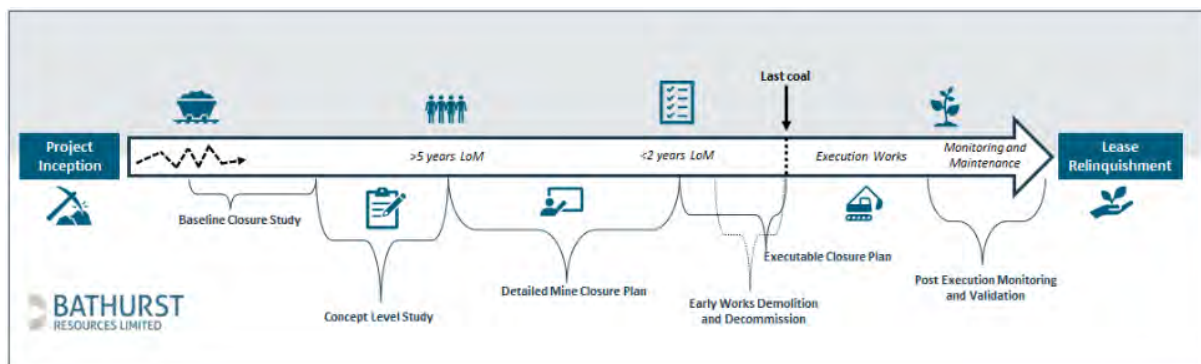


Figure 12: BRL detailed mine closure planning timeframes

Source: BRL (2026b)

Justification for completion criteria in Table 13 is based on the AMD broad-brush risk assessment (BRL, 2026e), which has identified key risks for closure as being final landform stability, water management infrastructure, and water quality.

Table 13: High-level AMD closure objectives.

CLOSURE CRITERION	JUSTIFICATION	HIGH LEVEL COMPLETION CRITERIA	VALIDATION
Landform stability	<p>Stable landforms are required for closure to ensure:</p> <ul style="list-style-type: none"> Geotechnical stability Geomorphic stability Geochemical stability 	<ul style="list-style-type: none"> Highwalls are deemed competent noting that with time these surfaces could be subject to erosion and collapse. ELFs are geotechnically stable. ELFs are considered geomorphically stable landforms resistant to elevated erosion and the loss of sediment ELFs are geochemically stable with oxygen ingress limited to diffusive airflow and underdrain water quality 	<p>The following performance monitoring is required to demonstrate the closure criteria has been achieved:</p> <ul style="list-style-type: none"> Highwalls are signed off by the engineer of record as being acceptable. ELFs geotechnical stability is signed off by the engineer of record as being acceptable. Rehabilitation and revegetation activities are complete and are signed off as stable by a suitably qualified and experienced person (SQEP). Oxygen ingress is low and limited to diffusive airflow as determined by monitoring data.

CLOSURE CRITERION	JUSTIFICATION	HIGH LEVEL COMPLETION CRITERIA	VALIDATION
		stable and decreasing in solute concentrations.	<ul style="list-style-type: none"> o ELF underdrain seepage water quality is stable and decreasing in PCOC. o Geochemical stability is signed off by a SQEP – noting that ongoing treatment may be required for many years, yet PCOC loads are not expected to increase.
Water Management infrastructure	<ul style="list-style-type: none"> o Safe and stable water management infrastructure are required for closure. o Post Closure water management infrastructure must be fit for purpose. 	<ul style="list-style-type: none"> o Road cuttings and pit voids (water management infrastructure and ecosystem services) are geotechnically stable and safe. o Water management infrastructure is meeting design criteria for effluent water quality. o All unnecessary infrastructure removed. 	<p>The following performance monitoring is required to demonstrate the closure criteria has been achieved:</p> <ul style="list-style-type: none"> o Highwall and pit void geotechnical stability is signed off by the engineer of record as being acceptable. o Monitoring of passive treatment system influent and effluent water quality/quantity. o Water Management and water treatment systems signed off by a SQEP.
Water Quality	<ul style="list-style-type: none"> o Water quality needs to achieve agreed water quality objectives. o Water quantity needs to achieve water quantity objectives. o The project needs to demonstrate betterment of several waterways. 	<ul style="list-style-type: none"> o Consistently meeting water quality and quantity objectives at all water compliance monitoring locations. o Stability of treated AMD discharges. o Betterment is proposed for Rapid Stream, Cascade Creek Trib (V8), V37 Creek, and Cascade Creek. 	<ul style="list-style-type: none"> o Water quality monitoring data – performance and compliance monitoring. o Water quality of treated AMD remains stable for 2 years after transition to the Post Closure Phase. o Water quality signed off by a SQEP.

1. Where geotechnically stability is signed off by the engineer of record.

Once these closure criteria are achieved, then the Project could transition to relinquishment.

In general, it is anticipated that there will be an overall betterment in water quality for the ESE area, which is built on 20 years of water management at existing Stockton and Escarpment mines. However, there will remain a long-term water management requirement.

3.5 Water Quality Objectives

Water quality limits have been defined for the BPCP by Hickey (2026) for the proposed water quality compliance monitoring locations. This includes pH, metals, and turbidity (as shown in Table 12). The PCOC were identified from the water quality studies, ecotoxicological assessments, source hazard assessment, geochemical modelling, and the water and load balance modelling to understand potential effects of the activities proposed at ESE, MFS and the UWHR. Water quality monitoring locations are proposed to monitor performance in meeting the proposed water quality limits, which will be reflected in resource consent conditions.

3.5.1 MFS and UWHR Sub-areas

Four compliance monitoring sites are proposed for the MFS and the UWHR and are described in Table 14. There is overlap between some monitoring sites selected for the UWHR and MFS sub-areas. Performance and Compliance monitoring site locations are provided in Figure 13 and Figure 14.

Table 14: MFS compliance monitoring locations

MONITORING LOCATION	WATERWAY	CONTRIBUTING WATERS
SW01	Deep Stream	East Pit mining activities, Limited West Pit mining activities, Upstream Deep Stream catchment.
SW03	Deep Stream	All MFS mining activities (less, ancillary areas located within the Waimangaroa River catchment), MFS access road, Upstream Deep Stream catchment.
2W (Smokestack)	Waimangaroa River	Stockton Mine, Cypress Mine, historic underground workings, UWHR, MFS WTP and direct discharge waters, MFS ancillary infrastructure area, MFS access road, Upstream Waimangaroa River catchment.
17W	Waimangaroa River	All mining activities, UWHR. Deep Creek catchment, Upstream Waimangaroa River catchment (noting waters through 2W (smokestack)).

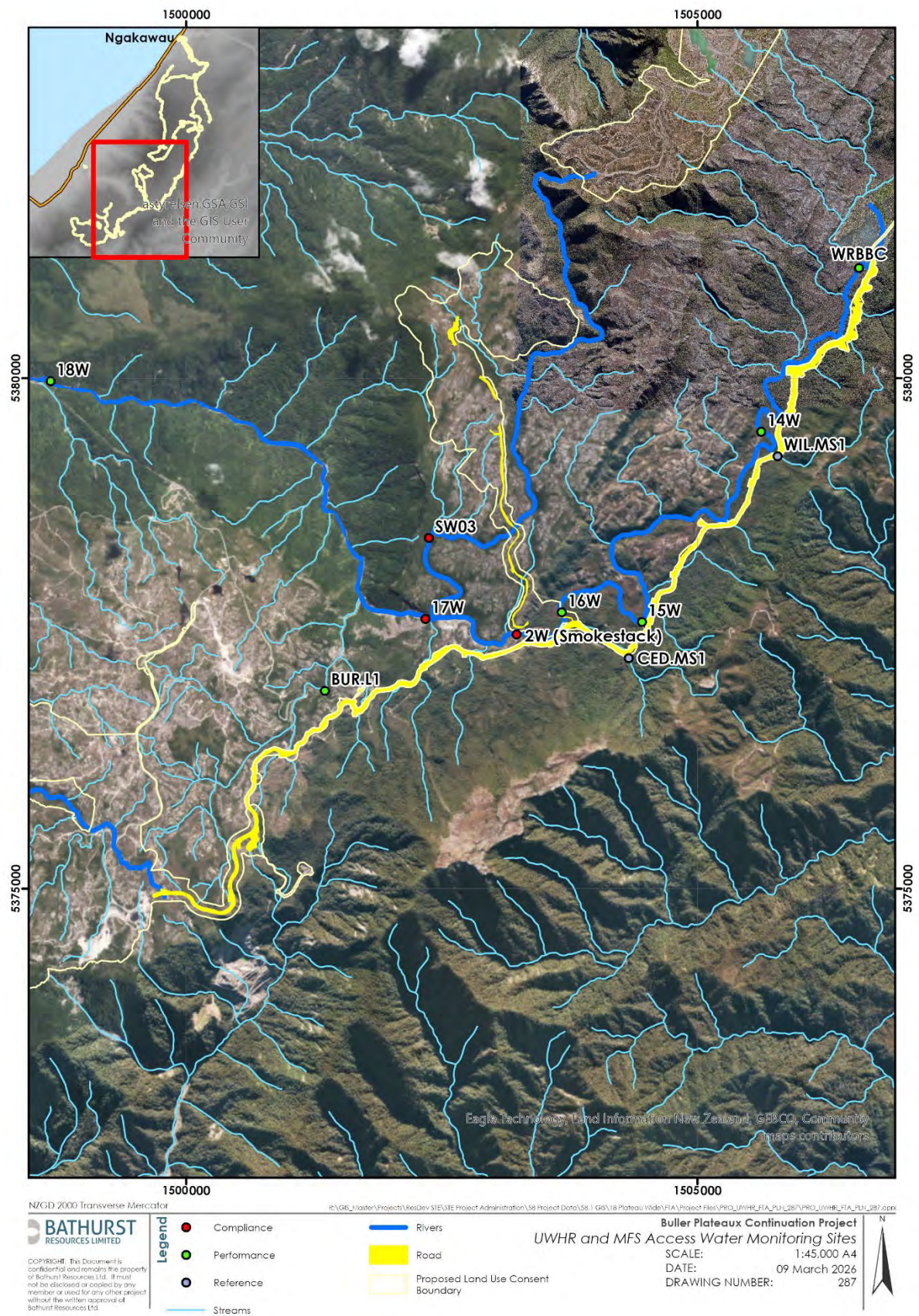


Figure 13: Location of UWHR and MFS water monitoring sites.

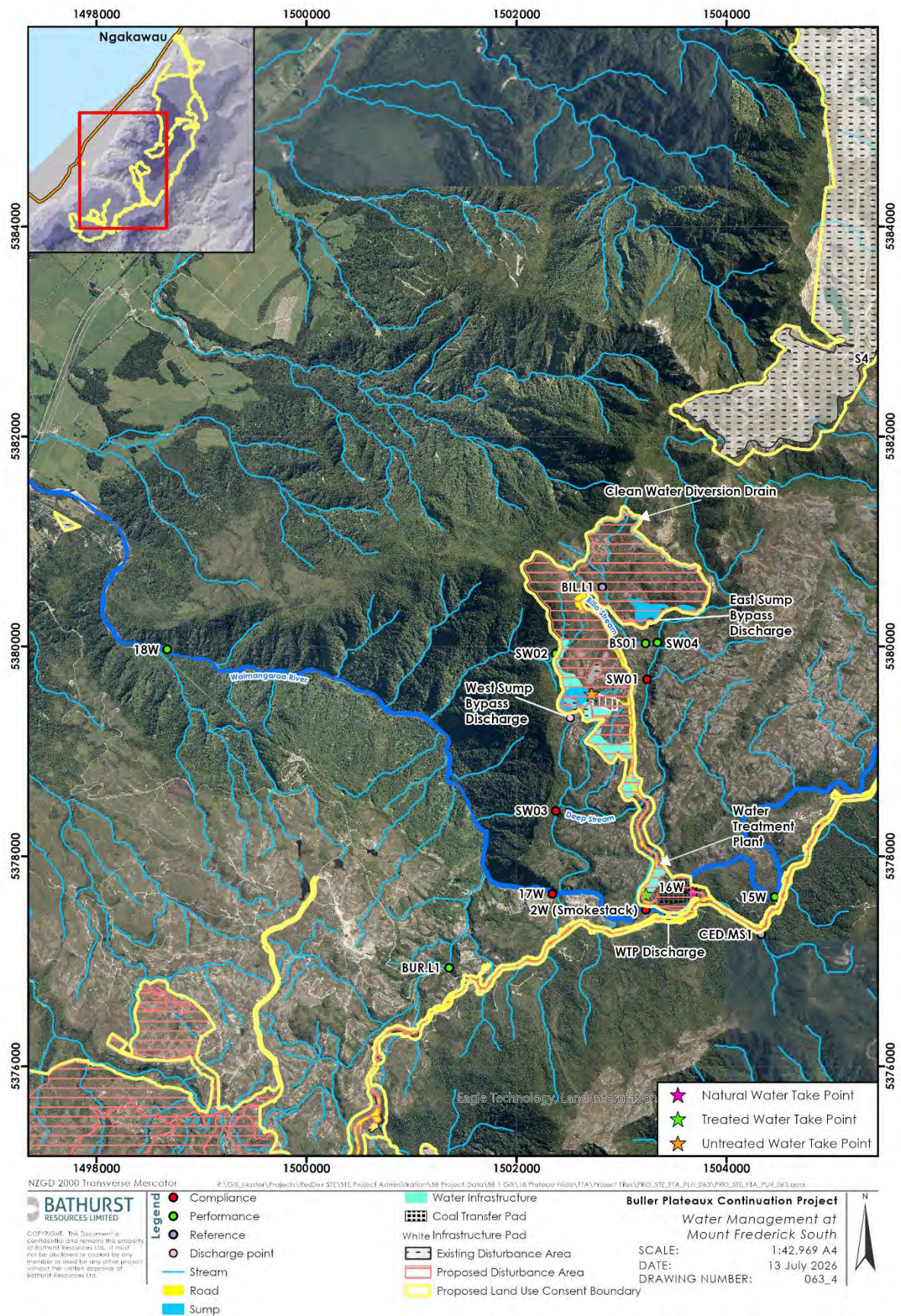


Figure 14: Location of MFS water monitoring sites.

3.5.2 ESE Sub-area

Four compliance monitoring locations are proposed for ESE sub-area and are described in Table 15. Compliance monitoring site locations are provided in Figure 15 along with performance monitoring locations.

Table 15: ESE proposed compliance monitoring locations.

MONITORING LOCATION	RECEIVING WATERWAY	CONTRIBUTING WATER
MM1	Cascade Creek Trib (V8)	ESE Mine Operations
W07	Rapid Stream	Seepage and runoff from SULL NAF ELF
KEL	Whareatea River	ESE Mine Operations
V62	V62 Stream	ESE Mine Operations

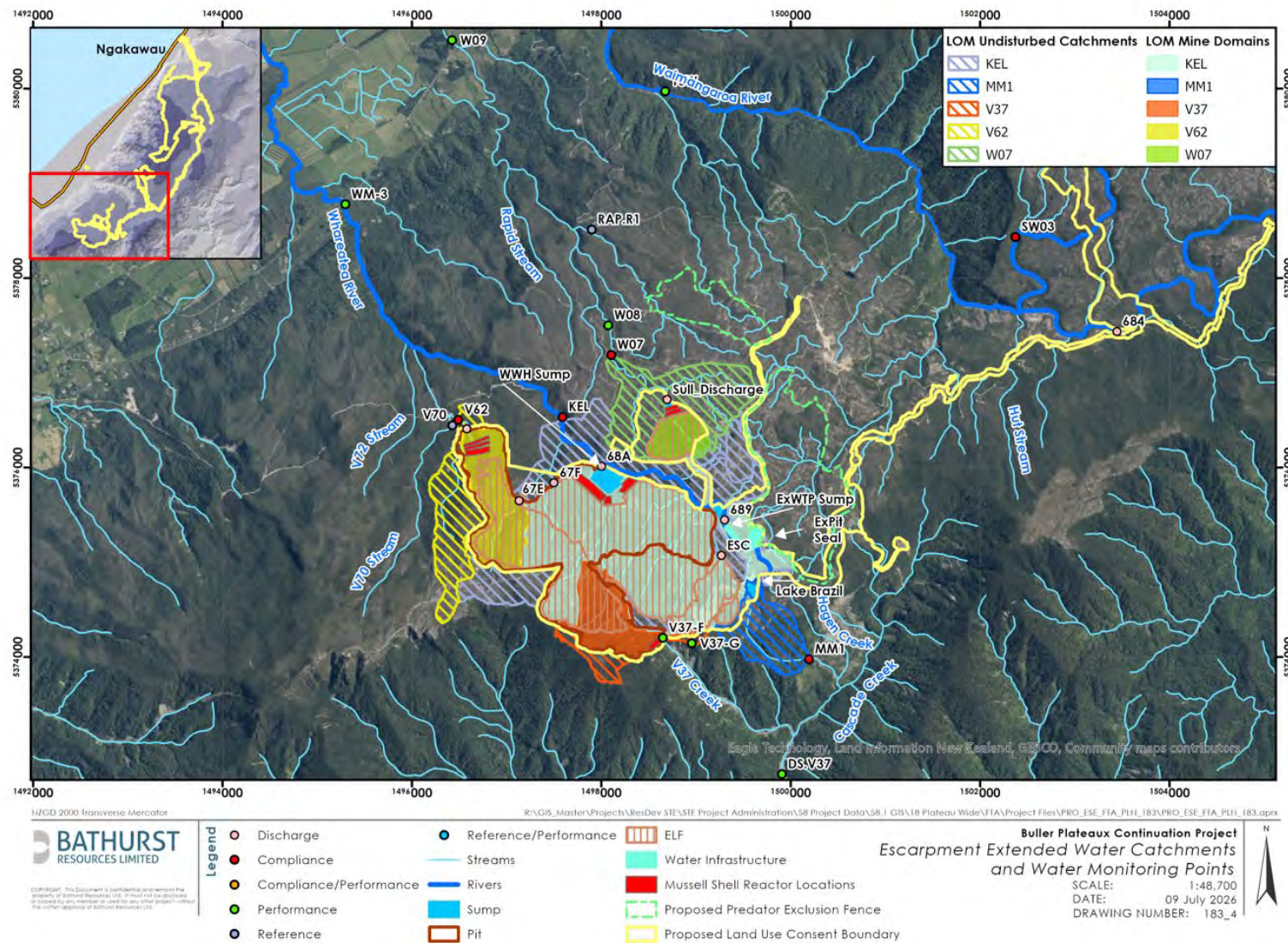


Figure 15: ESE catchments and water monitoring sites.

4 **SOURCE HAZARD CHARACTERISATION - PREDICTION**

This section assesses the environmental geochemistry source hazards that could affect water quality at the proposed MFS, ESE, and the UWHR sub-areas of the BPCP. These source hazards were identified in the following MWM reports:

- Upper Waimangaroa Haul Road Site Visit (MWM, 2026b).
- Factual Report: Geoenvironmental Hazards - MFS (MWM, 2026c).
- Factual Report: Column Leach Testing - MFS (MWM, 2026d).
- UWHR Geochemistry ABA Summary (MWM, 2026e)
- BPCP AMD Hazard Classification (MWM, 2026f).
- Cypress pXRF Summary (MWM, 2026g).
- Escarpment Mine - Barren Valley ELF Water Quality Model (MWM, 2026h).
- Water and Load Balance Model - Source Term Definition (MWM, 2026i).
- BPCP Annual Overburden Material Schedule (MWM, 2026v).

4.1 **Introduction**

Predicting the potential effects of AMD due to the project materials is essential to understand the source hazards that may require management. This section reviews the studies that have been completed to assess these source hazards. Identification of source hazards and potential effects are obtained from:

- Analogue site data of mine domains that contain BCM and KMS materials.
- Geochemical laboratory testing and analysis.
- Geochemical modelling.

Data are used to understand the material quantities, provide inputs into WLBM to understand potential effects, and determine subsequent engineering controls to mitigate these potential effects. The ongoing assessment of material properties for AMD potential and management requirements are discussed in the BRL management plans for AMD (BRL, 2026c,d).

4.2 **Upper Waimangaroa Haul Road Site Visit**

This memorandum is provided as Appendix B (MWM, 2026b). It provides a summary of the site visit to the UWHR from ESE through to the end of the public access track.

4.2.1 *Report Purpose*

A site visit was undertaken in June 2024 to look at the UWHR alignment and obtain rock samples for geochemical classification to understand the AMD source hazards and assess run-off water quality from exposed PAF and NAF materials in this sub-area. Recommendations developed were used to guide subsequent Project studies.

4.2.2 Background

Key features of the UWHR are:

- An alignment of 11.5 km long; most of which crosses areas that are already disturbed (e.g., existing roading infrastructure) to minimise the disturbance footprint and connects into Cypress South.
- 4 km of the haul road traverses previously undisturbed ground, comprising 1 km adjacent to the ESE mining area and 3 km connecting the haul road to Cypress mining operations in the north.
- A pavement width of 8.6 m, designed for a double lane roadway for use of road train style haul trucks, cambered road design, with drainage channels and safety berms each side of the road.
- A number of cuts surfaces will be created (e.g., road cuttings) during construction of the road totalling ~ 2-3 ha in surface area with overburden being carted to Stockton or ESE.
- A number of fill areas will be developed that will use ~70,000 m³ of BCM that is acid forming and ~130,000 m³ of NAF granite. In the context of the proposed earthworks at MFS and ESE this is negligible (i.e., 16 Mm³ at MFS and 128 Mm³ at ESE).
- The risks for AMD are notably low due to the minor amount of PAF materials that will be placed as fill, provided the management of materials minimises the risk for AMD.

4.2.3 Key Findings

The observations and supplementary data from laboratory testing of samples (water and rock) collected from the site visit included:

- The site visit provided a good perspective of the proposed UWHR alignment.
- BRL advised that cut material, which is geotechnically (or otherwise) unsuitable to be used within fill sections (such as Kaiata Mudstone and colluvium) is to be removed from the site and will be disposed of accordingly within existing waste disposal areas at Stockton and ESE in accordance with existing operational waste management practices.
- The proposed UWHR alignment is over the Ironbridge Mine underground workings. Management of these workings to address health and safety risks could contribute to AMD. This issue is discussed in Table 16.
- Highly weathered Kaiata Mudstone was identified in a few locations. There may be benefit in using these materials as a capping layer to limit water and oxygen ingress into PAF materials. The quantities (hence the actual opportunity) are not defined. This issue is discussed in Table 16.
- The UWHR sub-area has significant colluvium, landslide deposits, and talus, which has been mobilised from further up the slope. If these materials are from rocks that can generate AMD (e.g., a PAF material source upslope), then further characterisation is required on the geochemical nature of the colluvium. This has been seen at other projects in the area due to the deposition of landslide materials (e.g., Malloch et al., 2017). This issue is discussed in Table 16.

- The geological / geochemical model needs to be validated during construction of the UWHR. For instance, further consideration is required for leaching of NAF Kaiata mudstone by net infiltration of rainfall over geological timeframes as this can leach out carbonate minerals yet preserve sulfides such that the 30 m cut-off above the Kaiata/BCM contact observed at Cypress (i.e., $\text{NAPP} = 0 \text{ kg H}_2\text{SO}_4/\text{t}$) may not apply. This has been demonstrated at Cypress Mine (McLachlan, 2022) where NAF Kaiata Mudstone has been converted to PAF (Weathered Kaiata) over such geological time frames. This issue is discussed in Table 16.
- ABA testing of the colluvium is required, however for this study it is assumed all colluvium is PAF and will be disposed into an engineered landform at ESE or Stockton, unless testing confirms otherwise.
- As part of road construction, further geotechnical drilling and geochemical analysis along the length of the UWHR, will be undertaken. This issue is discussed in Table 16.
- Seepage from undisturbed catchments/ drainage paths was elevated in Fe (pH 4-5), most likely a function of groundwater interacting with geological materials elevated in Fe-bearing minerals (e.g., pyrite; Fe-carbonates). This suggests that Fe will be present in seepage from NAF Kaiata Mudstone engineered landforms.
- A number of rock samples and water samples were collected during the site visit. Results indicated the presence of PAF material and poor water quality in some areas (e.g., roadside ditches through BCM). This included elevated Al, Cu, and pH that is non-compliant with resource consent limits (RC10193) for the existing Escarpment Mine (both $> \text{pH } 6$ and also $< \text{pH } 4.5$).

4.2.4 Recommendations

A number of risks and opportunities were identified by the site visit. These issues are tabulated in Table 16. Further discussion is provided in the Construction Phase Report (MWM, 2026s) and the Water Treatment Report (MWM, 2026m).

Table 16: Site visit summary: risks and opportunities

ISSUE	SUMMARY	COMMENTS
Effects of UWHR on Ironbridge underground workings.	<p>The management of these underground workings could generate AMD. Hence, BRL has completed a void impact assessment on the UWHR alignment to address health and safety, and environmental risks (BRL, 2026g).</p> <p>BRL (2026g) note that any underground workings beneath the UWHR could be managed by a number of processes including:</p> <ol style="list-style-type: none"> 1. Probe drilling before any construction activities, targeting areas of suspected underground workings to confirm the depth of in-situ cover to the underlying coal seam and underground void (if any). 2. Excavation to remove the void hazard, then replace them with compacted backfill. 3. Collapse blasting and then backfill. 4. Grouting is also an option <p>If these workings discharge to the receiving environment, then further assessment is required as part of the void assessment studies (BRL, 2026g) as the UWHR is constructed.</p>	<ul style="list-style-type: none"> o BRL advise that historic information suggests these underground workings are within 10 m of the road surface. The upper coal seam floor is more than 14 m below the surface, dipping away from the Waimangaroa River, suggesting workings without openings to the surface are flooded. o The workings may require dewatering prior to collapse of the roof. This will be assessed as part of the void assessment studies (BRL, 2026g) as the UWHR is constructed. This water may require treatment through a portable water treatment plant for AMD and for TSS. Further details on this portable treatment system are provided in MWM (2026m).
Highly weathered Kaiata Mudstone was identified in a few locations along the UWHR.	<p>There may be benefit in using these materials as a capping layer to limit water and oxygen ingress into PAF materials (i.e., creation of a low permeability layer: LPL).</p>	<p>Consider opportunities to use these materials to construct LPL. This will be subject to materials quantities and AMD geochemistry data.</p> <p><u>Further work:</u></p> <ul style="list-style-type: none"> o Undertake geochemistry testing of materials that will be excavated as part of the UWHR construction. o NAF Kaiata may be leached of carbonates near the surface such that it is PAF. Testing is required on materials as part of the geotechnical drill program to confirm AMD characteristics.
Colluvium may contain BCM and/or KMS.	<p>Geochemical classification is underway as part of the Feasibility studies and will confirm if colluvium is PAF.</p>	<ul style="list-style-type: none"> o ABA testing of the colluvium is required, however for this study it is assumed all colluvium is PAF and will be disposed into an engineered landform at ESE or Stockton, unless testing confirms otherwise.
Material Properties	<p>Confirm the geochemical properties of disturbed materials.</p>	<ul style="list-style-type: none"> o Complete (as part of the feasibility study) further infill drilling ahead of construction along the UWHR and MFS Access Road to confirm the AMD and geotechnical nature of materials.

4.3 Factual Report: Geoenvironmental Hazards - Mount Frederick South Project

This report is provided as Appendix C (MWM, 2026c).

4.3.1 Report Purpose

This report focuses on understanding the environmental implications and the potential for AMD for the MFS sub-area. The geoenvironmental hazards associated with the MFS project were investigated using ABA data from 24 spatially representative drillholes completed in the MFS area during 2023/2024. Samples were analysed to determine the AMD potential of the materials.

4.3.2 Geochemical Investigations

A total of 472 samples from 24 drillholes were analysed by ABA methods. General findings of the geochemical analysis and characterisation are:

- Total sulfur content varies from <0.005 wt% (LOR⁹) to 13.1 wt%.
 - o 95 % of samples ≤ 1.1 wt % sulfur.
 - o 75 % of samples ≤ 0.34 wt % sulfur.
 - o 50 % of samples ≤ 0.06 wt % sulfur.
 - o 25 % of samples ≤ 0.019 wt % sulfur.
- Paste pH ranges from 3.3 to 8.2 and paste EC varies from 4 to 670 µS/cm.
- NAG¹⁰ pH ranges from 2.3 to 6.8 and NAG acidity ranges from 2 to 297 kg H₂SO₄/t.
- NAPP¹¹ ranges from -20 to 401 kg H₂SO₄/t.

Relationships between total sulfur and pXRF¹² analysis of ABA samples were analysed. A strong relationship was identified between pXRF derived sulfur values and total wt% sulfur values. Results suggest the potential for pXRF analysis of sulfur to be a useful tool for field-based classification at MFS, provided sample preparation is appropriate (poor sample preparation can affect pXRF results).

Samples were often, but not always, taken over different lithological units with the sample description assigned to the lithological code of the largest unit within the sampled interval. Observations of sampled material include:

- 49% of samples were within the granule sized or coarser fraction (breccia and conglomerate).
- 28% of samples were very fine to coarse sandstone (non-laminated).
- 9% carbonaceous mudstones.
- 8% Greenland Group basement.
- 4% laminated sandstones.

⁹ Limit of Reporting

¹⁰ Net acid generation

¹¹ Net Acid Producing Potential

¹² Portable x-ray fluorescence

- 2% siltstone and low carbonaceous mudstone.

Drillholes generally terminated in Greenland Group or conglomerate/breccia up to 10 m below the coal floor. This introduces material into the sample population that potentially will not be significantly represented within the final pit shell. Subsequently, the pit shell was used to constrain material types to determine the annual overburden schedule for MFS, ESE, and the UWHR (data are presented in Section 1.9).

AMIRA (2002) column leach tests have been completed on four samples from drillhole DC16 (commenced April 2024), which was located in the centre of the MFS East Pit. Samples were selected from a range of total sulfur values (0.009, 0.084, 0.174 and 0.581 wt% sulfur). Results have been reported by MWM, (2026a).

4.3.3 AMD Source Hazards

Results were classified using a process flow model approach (e.g., Olds et al., 2015). The model allows for rapid identification of the lowest risk (< 0.05 wt% sulfur) and highest risk materials (> 0.33 wt% sulfur) based only on total sulfur. This has benefits for operational testing (turn-around time and costs).

The following summary of the MFS process flow model is provided as shown in Figure 16 :

- All material < 0.05 wt% sulfur is classified as NAF.
- Material between 0.05 and 0.33 wt% sulfur is tested for NAG pH. This material is classified as NAF where NAG pH is > 4.5, LR where NAG pH ≤ 4.5 and ≤ 0.2 wt% S and PAF where NAG pH ≤ 4.5 and > 0.2 wt% S.
- Material between 0.33 wt% and 0.7 wt% sulfur is classified as PAF.
- All material > 0.7 wt% sulfur is classified as HAF.

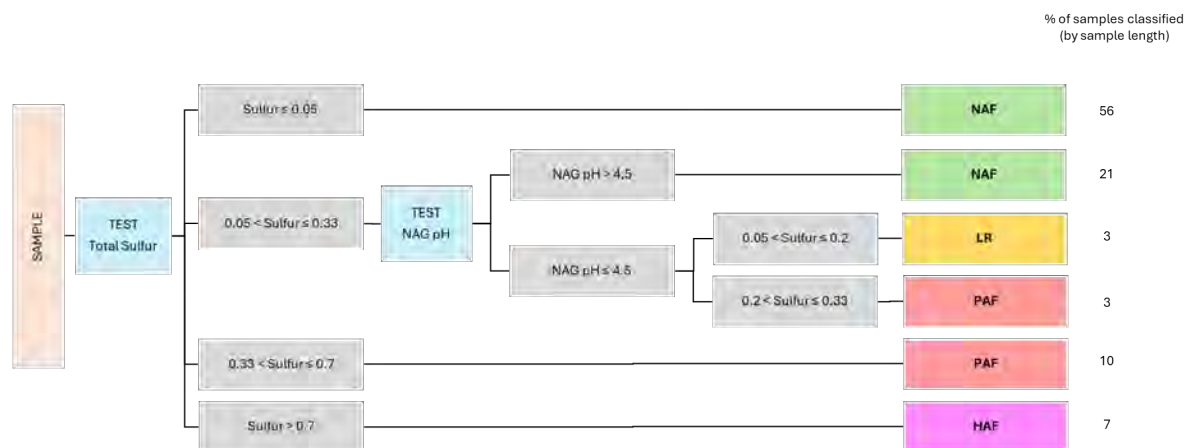


Figure 16: MFS AMD Process Flow Classification

Note: Percentages are based on sample length as a function of the total population sample length

Results of material classification (as per sample interval length and sample population total length) using the proposed MFS process flow model indicated:

- 77% NAF
- 3% low risk (LR)

- 13% PAF
- 7% HAF (>0.7 wt%)

The Process Flow model introduces a HAF category that is not present within the AMIRA (2002) and Price (2009) classifications. The inclusion of a HAF category provides an opportunity for alternative management of this higher risk material. Low paste pH results for PAF and HAF materials indicate rapid to immediate acid generation. With little acid neutralisation capacity (ANC) in PAF and HAF units this test is likely to be a reasonable indication of immediate acid generation rates / severity.

Laminated units and mudstone that are more consistent of a marine depositional environment are more likely to be classified as HAF or PAF material. These observations are consistent with results for drillhole DC16 with a predominantly fluvial environment with marine incursions.

4.3.4 Block Model

BRL applied the MFS AMD Process Flow classification to available drillhole data to form the MFS AMD block model (2025a). The MFS AMD block model identifies 1.9% of the total waste rock is HAF, with this material accounting for approximately 15.9% of the total acid load for the MFS Project. Remaining waste rock within the block model was classified as PAF (14.4%), LR (14.5%), and NAF (69.1%). The average mass weighted sulfur content of the proposed MFS Project is 0.12 wt% S. This is significantly lower than the neighbouring Stockton Coal Mine, hence AMD risks are also lower and water treatment requirements (acidity loads) will also be lower. Further details are provided in Section 1.9.2.

4.3.5 Summary: AMD Classification

- Data indicates that a process flow model approach, based on the Escarpment Mine process flow model (Olds et al., 2015), allows for fast identification of the lowest risk (< 0.05 wt% sulfur) and highest risk material (> 0.33 wt% sulfur) with 72.2% of samples classified on total sulfur only.
- NAG pH is essential to classify other samples.
- The use of ANC data has lesser value, due to minor quantities of neutralising minerals, and was not used to classify samples at MFS.

4.3.6 Recommendations

Based on the investigation presented in this report, several key recommendations are proposed to further optimise the MFS AMD block model. By implementing these recommendations, and utilising adaptive management processes, the characterisation of the materials and the potential impact of the source hazards will continue to be improved. The following recommendations are proposed:

- Continue detailed geochemical analysis of samples including sulfur speciation testing.
- Additional drilling to further refine the MFS block model.
- Development of quality assurance/quality control procedures for laboratory ABA testing.

4.4 Factual Report: Column Leach Testing - MFS

This report is provided as Appendix D (MWM, 2026d).

4.4.1 Report Purpose

Column leach testing (CLT) was completed on samples from MFS sub-area to provide a comprehensive geochemical assessment and characterisation of materials associated with the MFS Project. Such data are used to understand geoenvironmental hazards and confirm whether materials are comparable to other project areas (e.g., Stockton Coal Mine, Escarpment Coal Mine) to ensure that no unusual geochemical processes are expected from the BCM.

4.4.2 Sample Selection Rational

Samples were selected using initial ABA data from drillhole DC16, located in the proposed MFS Project East Pit (Figure 17). This drillhole was selected as it was one of the first holes drilled (thereby providing samples early for CLT) and provided a range of higher and lower sulfur materials and different lithologies, representative of the MFS sub-area and its potential geoenvironmental hazards. A total of 4 samples were selected for shake flask and CLT:

- Granule conglomerate (AMD-DC16-005-GRCG B) low sulfur (0.011 wt% S) fluvial material.
- Medium to fine sandstone (AMD-DC16-007-MSS) higher sulfur material (0.59 wt% S), potentially deposited during a marine incursion.
- Granule breccia (AMD-DC16-010-GRBX) lower sulfur content compared to sample AMD-DC16-007-MSS (0.15 wt% S), representative of coal roof material.
- Sandstone and high carbonaceous mudstone with minor coal (AMD-DC16-013-HCM) representative of the coal floor (0.09 wt% S).

4.4.3 Geochemical Investigation.

Selected samples were analysed for a typical ABA static testing suite. General findings are:

- Total sulfur content varies from 0.01 wt% to 0.59 wt%.
- Paste pH ranges 5.0 – 6.1 and paste EC varies from 190 to 850 $\mu\text{S}/\text{cm}$.
- NAG pH ranges from 3.8 to 5.9; NAG acidity (to pH 7.0) ranges from 13 to 32 kg $\text{H}_2\text{SO}_4/\text{t}$.
- NAPP ranges from -1 to 18 kg $\text{H}_2\text{SO}_4/\text{t}$.

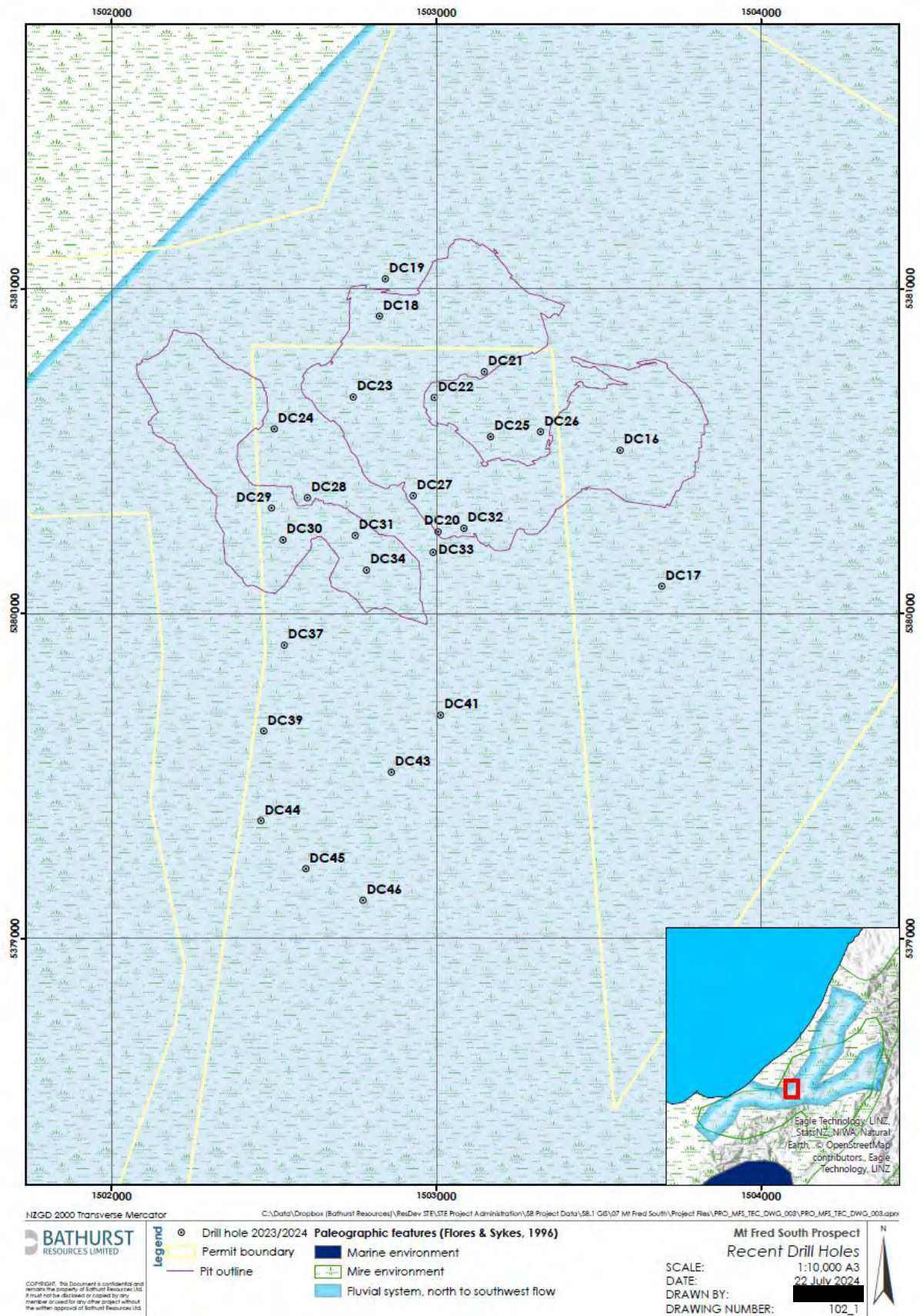


Figure 17: Palaeogeological environment for MFS with MFS AMD drill hole locations.

Note: DC16 sites to the eastern side of the proposed MFS East Pit

ABA data for the CLT samples are provided in (Table 17).

Table 17: ABA data for AMIRA CLT samples

COLUMN	LITHOLOGY	PASTE pH	S (wt%)	MPA (kg/H ₂ SO ₄ /t)	ANC (kg/H ₂ SO ₄ /t)	NAPP (kg/H ₂ SO ₄ /t)	NAG pH	CLASS. ¹
DC16-005	Conglomerate	6.1	0.011	0.34	1	-0.66	5.9	NAF
DC16-007	Sandstone	5.0	0.587	17.96	-1	17.96	3.8	PAF
DC16-010	Breccia	5.1	0.174	5.3	1	4	4.5	Low Risk
DC16-013	Sst + Carb. Mst + coal (Coal Floor)	6.1	0.089	2.72	1	1.72	4.1	Low Risk

1. Classification is based on the Process Flow Classification method

2. Sst = sandstone; Carb. Mst = carbonaceous mudstone

4.4.4 Shake Flask Testing

Shake Flask data provides an indication of the immediate water quality of the materials once wetted:

- DC16-005 results indicated the sample did not generate acidity with a pH of 6.4 and most metals were below the LOR¹³.
- DC16-007 results indicated the sample generated acidity with a pH of 3.7; acidity to pH 7.0 of 240 mg CaCO₃/L, and elevated metals, notably Al (30.1 mg/L), Co (0.361 mg/L), Cu (0.139 mg/L), Fe (19 mg/L), Ni (0.63 mg/L), Zn (3.92 mg/L).
- DC16-010 results indicated the sample generated acidity with a pH of 3.9 and elevated metals notably Al (6.52 mg/L), Fe (4.89 mg/L), Ni (0.026 mg/L), and Zn (0.33 mg/L).
- DC16-013 results indicated the sample did not generate acidity with a pH of 7 and most metals were below LOR. The notable high result was for Zn at 0.055 mg/L.

Full tabulated results are available in the MWM report (MWM, 2026d).

4.4.5 Column Leach Testing

CLT were run for eight months from April 2024 until November 2024 with results consistent with shake flask testing. Full tabulated results are available in the MWM report (MWM, 2026d). Testing was halted as geochemical stability was achieved and geochemical trends confirmed AMD risk:

- DC16-005 data supported the classification of the sample as NAF with pH between 8 (month 1) and 5 (month 7); low acidity; low concentrations of trace metals; and a maximum sulfate of 14.2 mg/L. Data are representative of a low sulfur depositional environment (e.g., fluvial sediments).
- DC16-007 data supported the classification of the sample as acid forming with pH between 2 to 3; maximum sulfate of 5,300 mg/L; and elevated metals, notably maximum Ni of 11.8 mg/L

¹³ Limit of Reporting.

and maximum Zn of 56.4 mg/L. Data indicates that all metals are elevated above the WQ Ref Values used for Al, Cd, chromium (Cr), Co, Cu, Fe + Mn, Pb, Ni, Zn; notably Al 660 mg/L (WQ Ref Value 0.5 mg/L), Ni 11.8 mg/L (WQ Ref Value 0.068 mg/L), and Zn 56.4 mg/L (WQ Ref Value 0.054 mg/L). Data indicate that metals, acidity, and sulfate decrease over time.

- DC16-010 results supported the classification of the sample as acid-forming (Low Risk) with a pH between 2.8 to 2.5. Maximum sulfate was at month 4 (1,410 mg/L) then decreases. Data indicates metals are elevated above WQ Ref Value for Al, Cr, Cu, Fe + Mn, Ni, and Zn.
- DC16-013 results suggest the sample is lower risk for AMD, with pH decreasing from 6.6 to 5 (but not below pH 4.5), low sulfate (22 to 38 mg/L) and overall low metals. Data indicates metals are elevated above WQ Ref Values for Cd, Cu, Ni, and Zn, which suggests classification of the sample as Low Risk (as identified by more recent NAG pH data) is appropriate.

Additional CLT data were available (n=4) from earlier geochemistry studies for the existing Escarpment Mine (Pope et al., 2011; CRL, 2012). These data were also discussed in the report to provide a more comprehensive dataset. The representativeness of the CLT data from MFS and Escarpment Mine are shown in Figure 18.

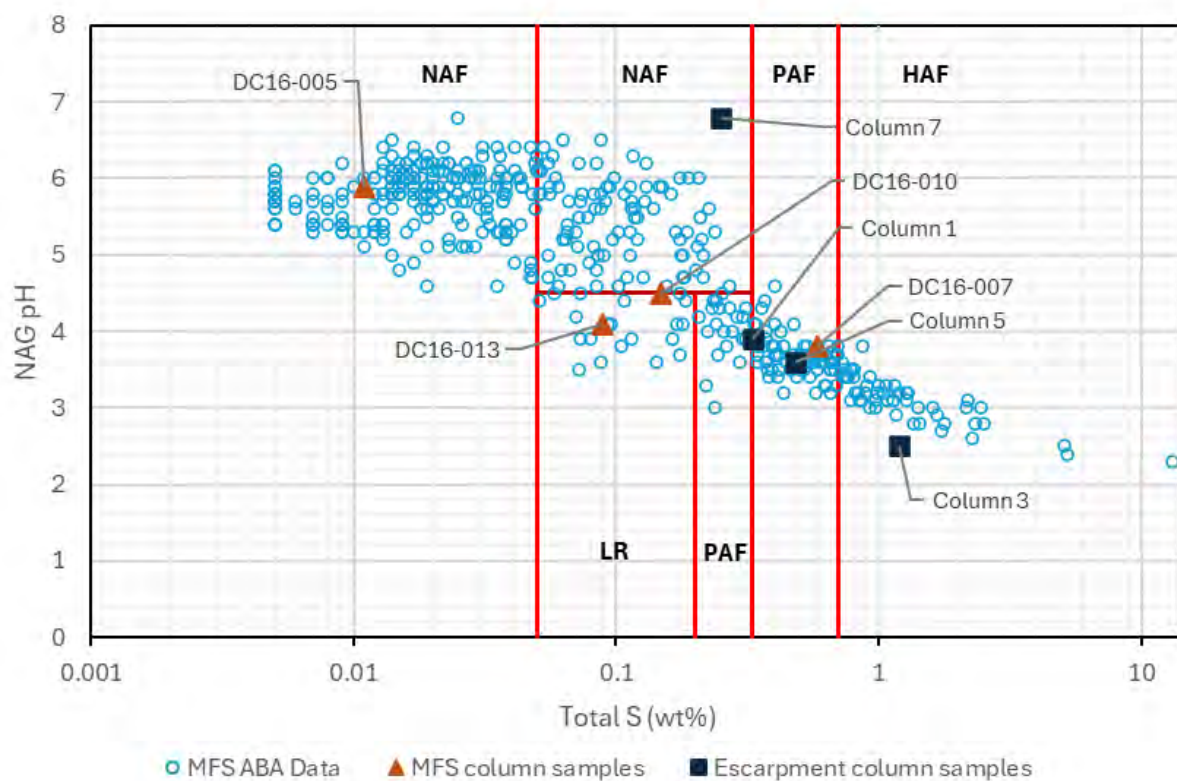


Figure 18: CLT samples and MFS ABA data classified by the MFS processes flow classification.

Note: DC samples from MFS; Column samples from Escarpment Mine.

4.4.6 Summary

A variety of PAF, NAF, and Low Risk materials were assessed by column leach testing. Results indicate that:

- Total S remains the best indicator of AMD risk and is also the most reliable/rapid test. This is validated by higher sulfate loads (and higher acidity loads) from materials that have a higher sulfur content. Hence, the use of total S as the principal screening tool for AMD risk/classification using the Process Flow Classification approach (e.g., MWM, 2026a) is reasonable.
- MFS CLT data and the identified PCOC are similar to CLT data for the Escarpment Mine, collected for the consenting of the Escarpment Mine in ~2013. This suggests water quality effects are likely to be similar and the observations / water quality for the Barren Valley Engineered Landform can be transferred to the MFS Project and be considered a suitable analogue model.
- CLT data indicates that PCOC that may require management (as compared to WQ Ref Values) include Al, Cd, Co, Cu, Cr¹⁴, Ni, and Zn.
- Low Risk materials (e.g., DC16-010) generate lower PCOC loads compared to PAF materials, yet still generate poor water quality (e.g., high sulfate, low pH) under laboratory conditions. However, Low Risk materials are likely to have better water quality in the longer term as the total reservoir of pyrite (i.e., wt% S) is lower than PAF samples and will be exhausted (oxidised) faster than PAF samples. In this regard Low Risk material should be treated with caution and be managed in the same manner as PAF to avoid high acid generation rates on disturbance.
- CLT data were used to develop some source terms for the project WLBM. A similar approach was undertaken for consenting the existing Escarpment Mine (Pope et al., 2011; CRL, 2012). These data are presented in this report.
- A high level of effort (e.g., sample preparation and laboratory QA/QC processes) is required for the quality assurance / quality control (QA/QC) of laboratory ABA data to ensure the samples are classified correctly. The correct laboratory analysis and classification of samples will be critical for materials management at the BPCP. A QA/QC management process should be developed.

4.5 Upper Waimangaroa Haul Road Acid Base Accounting Summary

This memorandum is provided as Appendix E (MWM, 2025e).

4.5.1 Report Purpose

The purpose of this memorandum is to:

- Present available ABA data (surface and drillhole samples) from the proposed UWHR transport corridor to demonstrate what data are available.

¹⁴ Subsequent water and load balance modelling indicated that Cr was not elevated (MWM, 2026t,u).

- Assess ABA data utilising AMIRA (2002) and Price (2009) guidelines as a screening tool to assess the acid generation risk across the main lithologies in the UWHR area.

4.5.2 Introduction

The proposed UWHR is located within the Waimangaroa Valley, on the western side of the Mount William Range and will be constructed between the ESE project sub-area and the existing Cypress Mine (located at Stockton).

4.5.3 Geochemical Data

Material characterised to understand the AMD hazards for the UWHR project area include:

- Surface rock samples were collected (n= 12) along the southern length of the Haul Road. Sample locations are shown in Figure 19. These data have been presented in MWM (2026b).
- ABA data are available from drillholes, and results were obtained from the BRL geological database. This included 18 drillholes where:
 - o 435 samples having a range of ABA data including wt% S, ANC, and NAG data
 - o 179 samples from the KMS.
 - o 234 samples from the BCM.
 - o 21 misc. samples (superficial soils, undifferentiated basement, quaternary materials).

Key findings arising from the analysis of samples include:

- BCM has an average sulfur content of 0.82 wt% and a maximum of 7.12 wt%, which indicates a high acid generating potential. KMS have the highest risk for acid generation with an average total sulfur of 2.13 wt% and a maximum of 3.49 wt%. The miscellaneous samples have the lowest average sulfur of 0.33%.
- ANC is highest in KMS (average of 29 kg H₂SO₄/t), which can generate a time delay before acid onset due to carbonate mineral buffering of acidity. BCM has a low average ANC of 4.54 kg H₂SO₄/t indicating limited acid buffering capacity.
- BCM materials had a minimum paste pH of 2.3 indicating the potential for immediate acid generation. KMS and miscellaneous samples had a higher minimum paste pH (4.55 and 4.56 respectively).
- Miscellaneous samples included and are characterised predominantly as NAF.

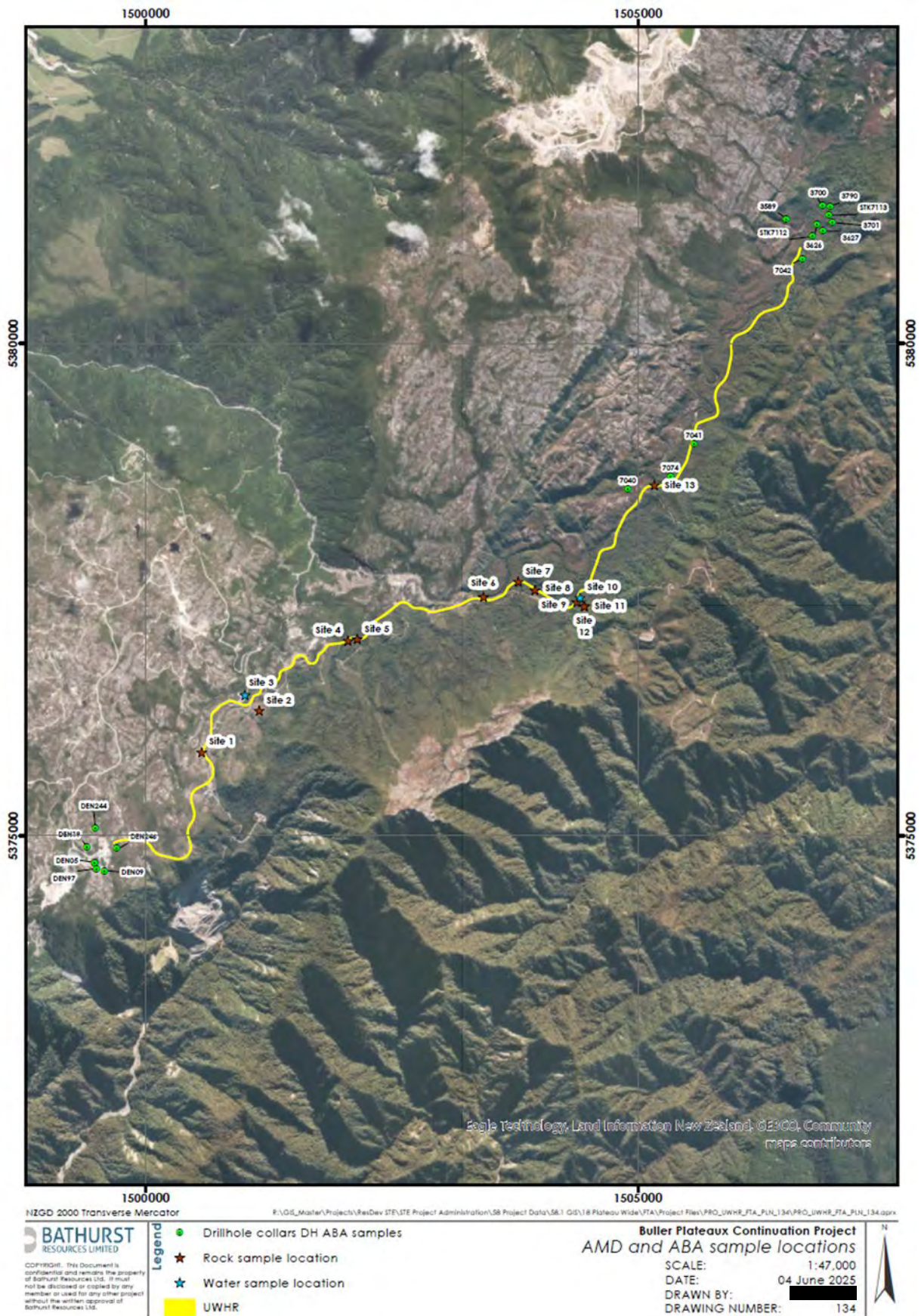


Figure 19: Map of sampling locations for the UWHR

4.6 BPCP AMD Hazard Classification Summary

This memorandum is provided as Appendix F (MWM, 2025f).

4.6.1 Report Purpose

This memorandum outlines the AMD classification systems developed for various sub-areas of the BPCP to classify materials with regards to their geochemical nature. These studies were used to understand the quantities of materials within each sub-area to support the assessment of environmental effects (AEE) for the BPCP. The following notes are provided:

- The ESE classification system has been approved previously for the Escarpment Mine (Resource Consent RC10193) by the West Coast Regional Council and its appointed Peer Review Panel.
- The Cypress classification system is used to characterise KMS at Cypress. It is based on the study by McLachlan (2022). This has been presented to the Cypress Peer Review Panel.
- The MFS classification system has been developed for the BPCP and is very similar to the approved ESE classification system, with minor changes to some of the classification boundaries.

4.6.2 AMD Classification

Regional variability for AMD source hazards across the BPCP sub-areas has been identified, which is heavily influenced by paleo-depositional environment of the BCM and KMS. The use of the AMIRA (2002) and Price (2009) classification schemes resulted in many samples being classified as uncertain (UC) due to negligible ANC and low sulfur content, which generates operational issues for materials scheduling, management, and placement as well as AMD treatment requirements.

Therefore, three site-specific AMD classification systems have been developed for the BPCP, which can be applied to the MFS, ESE, and UWHR sub-areas of the BPCP.

4.6.3 Cypress AMD Classification

The Cypress classification process is used to classify KMS, which is present in the northern sections of the UWHR.

Overburden at the Cypress Mine consists of BCM and KMS where geochemical variation is observed through a marine transgression sequence from PAF at the base to NAF higher (younger) in the stratigraphic column. The transition from NAF to PAF (where ANC > MPA) occurs ~30 m above the BCM/KMS contact as shown in Figure 3.

ABA and pXRF data obtained from a reverse circulation (RC) drilling programme were used to develop a site-specific classification scheme and establish a relationship between the pXRF and laboratory NAPP data, which indicated that:

- Laboratory total wt% sulfur data demonstrated that pXRF is not sufficiently sensitive to detect the small changes in sulfur that occur throughout the Kaiata Mudstone (where there is a change from NAF to PAF).

- Sulfur content is relatively consistent within the Cypress sub-area and is not the determining factor for classification of Kaiata Mudstone as PAF or NAF. Rather the ANC was the driving factor.
- pXRF-Ca (between 5,000 and 30,000 mg/kg) is well correlated with ANC across the project area.
- A relationship between pXRF-Ca and laboratory ANC and NAPP data was defined with a value of 14,000 mg/kg Ca most closely representing the PAF/NAF cutoff of NAPP = 0 (McLachlan, 2022). Samples with > 14,000 mg/kg of Ca are classified as NAF.

4.6.4 ESE AMD Classification

A geochemical classification model was developed for the existing Escarpment Mine (currently on care and maintenance) utilising a process flow approach that was validated by column leach test data (Olds et al., 2015). The model incorporated aspects of the original Escarpment Mine AMD classification resource consent (RC10193).

This process flow approach reduces the requirement of blanket testing of samples reducing costs and optimising turn-around times. The following comments are provided:

- The key defining attribute of whether a sample will generate AMD is the sulfur content. If there is no sulfur, then there is no AMD potential. Hence total sulfur is used as a screening tool for classification of materials.
- If the maximum expected ANC in a dataset is never greater than a certain value, then this value can be used to classify materials as PAF if the MPA (calculated from sulfur content is greater than this value). For instance:
 - o At ESE, the majority of samples had an ANC < 10 kg H₂SO₄/t. To be conservative, an ANC of 14 kg H₂SO₄/t was chosen as the threshold for PAF and NAF (where the ANC is equivalent to an MPA of 14 kg H₂SO₄/t; or for screening of samples a sulfur content of 0.45 wt%).
 - o Hence, any sample with an MPA > 14 kg H₂SO₄/t (i.e., >0.45 wt% S) was classified as PAF as it was assumed there is insufficient ANC available to change the PAF classification.
- Other classifications were developed and included:
 - o Low Risk (NAPP ≤ 5 kg H₂SO₄/t) to align with previous resource consent conditions (RC10193).
 - o High acid forming (HAF) (wt% S > 0.7) to identify the highest risk PAF materials (Olds et al., 2015).

This report by MWM (2026f) also included a summary (by BRL) of the Denniston ABA block model, which is part of the ESE sub-area of the BPCP. The summary indicates that 1,380 samples have been tested for total sulfur providing a good understanding of AMD risk for the ESE sub- area. However, the quantity of data is sparse in the northwest of the ESE sub-area (Figure 20) but additional drilling will be undertaken prior to mining.

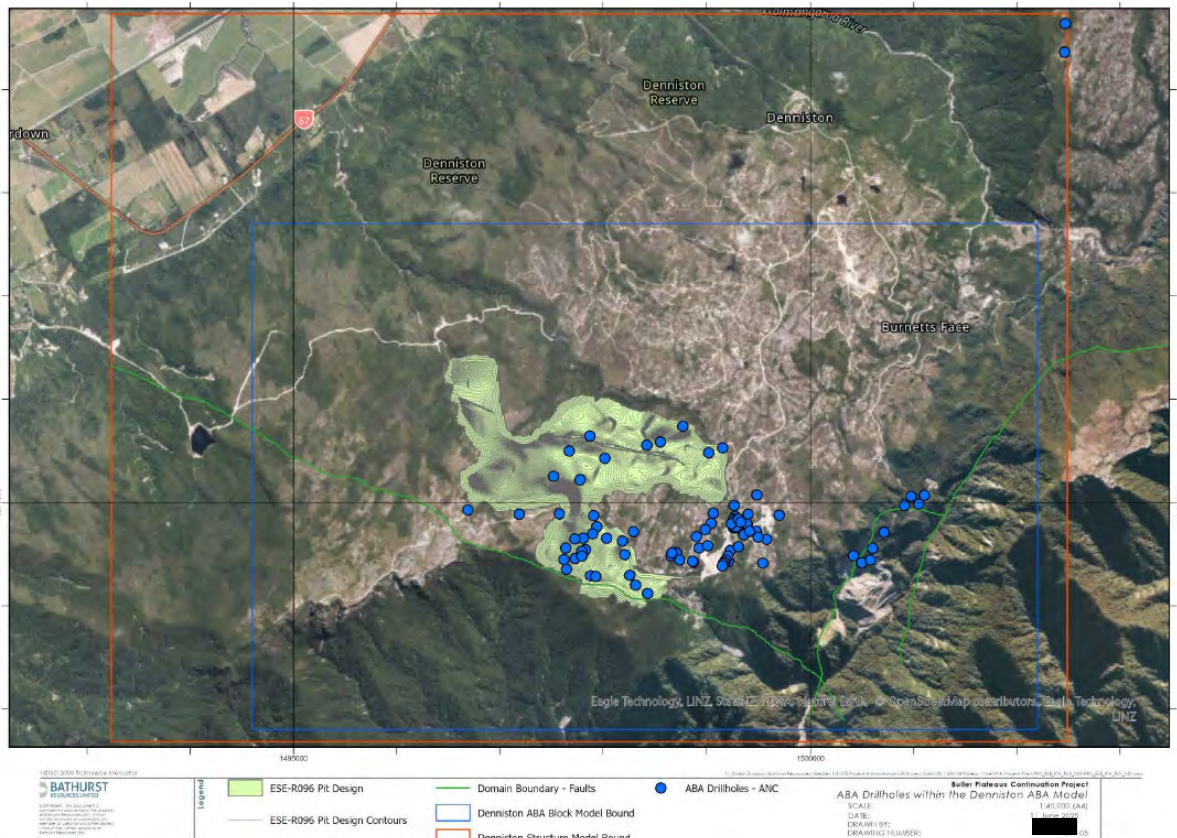


Figure 20: Denniston 3D Block Model boundary and sulfur content.

Source: MWM (2026f): Attachment D (provided by BRL)

4.6.5 Mount Frederick South AMD Classification

The classification scheme for MFS, discussed previously, is provided in Figure 16.

4.6.6 Upper Waimangaroa Haul Road

BCM, KMS, and colluvium materials are present within this proposed road corridor. KMS includes both NAF and PAF materials according to the geological model. Data also suggest significant colluvium sourced from the Mount William Range, some of which represents landslide material:

- KMS will be classified using McLachlan (2002) and BRL (2022).
- BCM will be classified using the MFS Classification process (Figure 16).
- Colluvium remains of unknown origin and could include BCM, KMS, and/or basement materials. Colluvium is considered PAF unless proven otherwise as previous studies (Malloch et al., 2017) have indicated landslide materials (i.e., colluvium) derived from the Denniston area can be PAF. Testing, being completed as part of the Feasibility Study, will confirm geochemical nature and hence management requirements.

4.6.7 Summary

Three classification systems have been developed for MFS, ESE, and the UWHR (Table 18), which uses the Cypress classification scheme for KMS that will be excavated along the UWHR; and the MFS and ESE classification schemes for those sub-areas.

Table 18: Summary site specific AMD classification systems.

SITE	NAF	LOW RISK	PAF	HAF
Cypress: For KMS along the UWHR	NAPP < 0 / pXRF-Ca > 14,000 mg/kg	NA	NAPP ≥ 0/pXRF-Ca ≤ 14,000 mg/kg	NA
ESE	S wt% ≤ 0.015 0.015 < S wt% ≤ 0.2, NAPP ≤ 0 0.015 < S wt% ≤ 0.45, NAG pH > 4.5	0.015 < S wt% ≤ 0.2, NAG pH ≤ 4.5, 0 < NAPP ≤ 5	0.015 < S wt% ≤ 0.2, NAG pH ≤ 4.5, NAPP > 5 0.2 < S wt% ≤ 0.45, NAG pH ≤ 4.5 0.45 < S wt% ≤ 0.7	S wt% > 0.7
MFS	S wt% ≤ 0.05 0.05 < S wt% ≤ 0.33, NAG pH > 4.5	0.05 < S wt% ≤ 0.2, NAG pH ≤ 4.5	0.2 < S wt% ≤ 0.33, NAG pH ≤ 4.5 0.33 < S wt% ≤ 0.7	S wt% > 0.7

4.7 Cypress pXRF

This memorandum is provided as Appendix G (MWM, 2025g).

4.7.1 Report Purpose

This memorandum presents the Cypress pXRF data that supports the AMD classification system for KMS that was developed by McLachlan (2022). AMD classification of KMS is important for the northern areas of the UWHR as these lithologies will be intersected during the development of the transport corridor for the BPCP.

4.7.2 Summary

A RC drilling Programme comprising 50 holes was completed in late 2021 across Stages 3 and 4 of the Mount William push-back at the Cypress Mine to define the $\text{NAPP} = 0$ ($\text{kg H}_2\text{SO}_4/\text{t}$) surface. This surface is approximately 30 m above the BCM:KMS contact and is the cut-off between PAF materials and overlying NAF materials.

The RC drilling Programme also led to the identification of a second $\text{NAPP} = 0$ surface, located ~5–10 m below the ground surface. It is assumed this $\text{NAPP} = 0$ surface has developed due to leaching of NAF KMS by net infiltration of rainfall/organic acids over geological timeframes, which has leached out carbonate minerals yet preserved sulfides due to low oxygen ingress (McLachlan, 2022).

Hence, AMD classification of the KMS will be required for the UWHR, particularly at:

- ~30 m above the BCM/KMS contact; and
- Within ~5–10 m of the current ground surface.

Data from the RC drilling programme indicated:

- That there is a strong relationship between the measured ANC and pXRF Ca content (hence pXRF Ca content is a suitable substitute for ANC).
- That there is a strong relationship between NAPP and pXRF Ca content (hence pXRF Ca content is a suitable method to determine NAPP).
- That the pXRF-Ca value identified by McLachlan (2022) of 14,000 mg Ca/kg for use in field classification of Kaiata Mudstone is appropriate.

The results confirmed that the $\text{NAPP} = 0$ $\text{kg H}_2\text{SO}_4/\text{t}$ corresponds to pXRF Ca range of ~14,000 and hence this provides:

- A suitable tool for the classification of KMS as either PAF or NAF; and
- A rapid field AMD classification of RC samples to accurately assess the $\text{NAPP} = 0$ surface.
- Ongoing validation of the pXRF data against laboratory data is recommended as part of ongoing QA/QC process for the UWHR.

4.8 Annual Overburden Schedule: MFS, ESE, and UWHR

This memorandum is provided as Appendix H (MWM, 2025y).

4.8.1 Report Purpose

Understanding PAF and NAF material schedules are critical for understanding material quantities for material management, construction of infrastructure areas (e.g., haul roads), and ELF construction purposes. Hence, the objectives of this memorandum are to:

- Summarise overburden schedules for ESE and MFS by mine stage (i.e., financial year).
- Present UWHR bulk fill and overburden quantities (Year 1 and 2).

4.8.2 Summary

The materials schedule was developed by BRL and has been provided in this report previously (Section 1.9). The following high-level summary indicates that:

- The ESE waste rock schedule indicates that NAF material accounts for ~29% of total overburden.
- The MFS waste rock schedule indicates that NAF material accounts for ~67% of total overburden.
- UWHR bulk fill demand is primarily met by granite and BCM material with NAG granite accounting for ~63% of total overburden used for road fill. Any material unsuitable for construction (KMS and colluvium) will be placed in an ELF at Stockton or ESE.

Material schedules should be updated annually in the annual work plan or whenever there is a change to the mine plan and/or significant variance from the waste rock block model is identified.

4.9 Escarpment Mine - Barren Valley ELF Water Quality Model

This memorandum is provided as Appendix I (MWM, 2026h).

4.9.1 Report Purpose

The purpose of this report is to develop a water quality model for the Barren Valley Engineered Landform (BV ELF), located at the existing Escarpment Mine, which is currently under care and maintenance, that can then be applied to other ELFs proposed for MFS and ESE.

The BV ELF was chosen as it was constructed using engineering controls to minimise oxygen ingress, hence its applicability to other ELFs that will be constructed as part of the BPCP.

The objectives of this report are:

- Update the BV ELF water quality model using new data to understand flow, water quality, and PCOC.
- Develop a load model, based on empirical data from the BV ELF, to estimate seepage water quality for ELFs associated with ESE and MFS sub-areas of the Project.

4.9.2 BV ELF Water Quality Load Model

The BV ELF has been monitored and studied since 2014, when construction commenced and provides a full-scale landform to understand geochemical trends. The empirical data from this site (flow and quality) provides a strong analogue dataset to construct water quality models for other ELFs that are proposed as part of the BPCP. However, unlike the proposed BPCP ELFs there are some minor variances that need to be considered. For instance:

- The BV ELF has been covered with NAF overburden but is not rehabilitated or revegetated. Therefore, the net percolation and oxygen flux rates are likely to be higher in the BV ELF compared to BPCP ELFs as determined by cover system studies (MWM, 2026k).
- Performance monitoring data for the BV ELF demonstrates that the ELF construction technique has, in places, limited oxygen ingress to diffusion, however parts of the ELF are affected by advective ingress of oxygen. This means that oxidation processes and acid generation rates are likely to be higher in the BV ELF than an ELF that limits advective oxygen flux.

Hence, the BV ELF provides a unique opportunity to confidently model and scale water quality results from an ELF that is analogous to those that are proposed at ESE and MFS.

The BV ELF water quality model involved the development of a conceptual site model (CSM) to support the derivation of flow rates and PCOC loads based on measured water quantity and quality. Components of the model include:

- Run-on seepage (the Pluto Bund, Red Shed Adit, Red Shed Pit Pond).
- AMD generated within the BV ELF that reports to the BV ELF underdrain.

The purpose of understanding the acid and metalliferous drainage (AMD) sources is to understand the acidity loads discharging from the BV ELF, and by difference, determine the acidity load mobilised by net percolation (NP) of rainfall, through the ELF materials.

Results indicate the following:

- The average flow rate was 3.35 L/s based on sonde data (May 2023 to July 2024). This is assumed to fairly represent the flow derived from NP after consideration of run-on water and water loss due to seepage from the ELF.
- A peak acidity from the BV ELF of 183 mg CaCO₃/L.
- The peak sulfate (SO₄) concentration was 386 mg/L, which corresponds to a peak acidity load of 42.5 t CaCO₃/yr (assuming all sulfate is derived from pyrite oxidation). Results indicate that the sulfate : measured acidity ratio is 2.1 indicating significant neutralisation (i.e., ~50%) within the ELF, relating to minor ANC and the addition of limestone (1.16 kg/t) during construction (~962 t). This is supported by empirical data that indicates from March 2017 to April 2024:
 - o that ANC/limestone (based on dissolved Ca) contributed to the neutralisation of 75 mg CaCO₃/L.
 - o that acidity derived from sulfate (i.e., pyrite) was 185 mg CaCO₃/L.
 - o that measured acidity (pH 8.3) was 117 mg CaCO₃/L.

This indicates that measured acidity is within ~5% of calculated acidity (based on SO₄ acidity minus Ca alkalinity). Data indicates that ANC and limestone provide significant neutralisation and is of benefit to the Project to mitigate the effects of sulfide mineral oxidation.

4.9.3 BV ELF Seepage Quality

Three distinct water quality phases were identified for the BV ELF, which are shown in Figure 21:

Phase 1: Construction Phase

- August 2014 – April 2016.
- Low PCOC concentrations that increase with an increasing amount of waste rock placement within the ELF and gradual wetting up of the materials.
- Generally, peak concentrations coincide with maximum material placement.

Phase 2: Stabilisation Phase

- May 2016 – December 2017 (20 months).
- Flow rates are generally stable as the ELF wets up and then flushes stored oxidation products from the waste rock. For the BPCP, it is assumed the duration of the Stabilisation Phase for final rehabilitated areas of the ELF also aligns with the duration of the draindown phase (created by the installation of a lower permeability cover system).
- Concentrations of PCOC remain stable.
- The majority of stored oxidation products are flushed by the end of the Stabilisation Phase.

Phase 3: Decay Phase

- January 2018 – onwards.
- Phase 3 relates to the decrease in PCOC concentrations from peak concentrations observed in the Stabilisation Phase.
- During this phase, water infiltration rates remain steady, but the rate of solute generation declines (lesser oxidation of sulfides and minor flushing out of stored oxidation products).

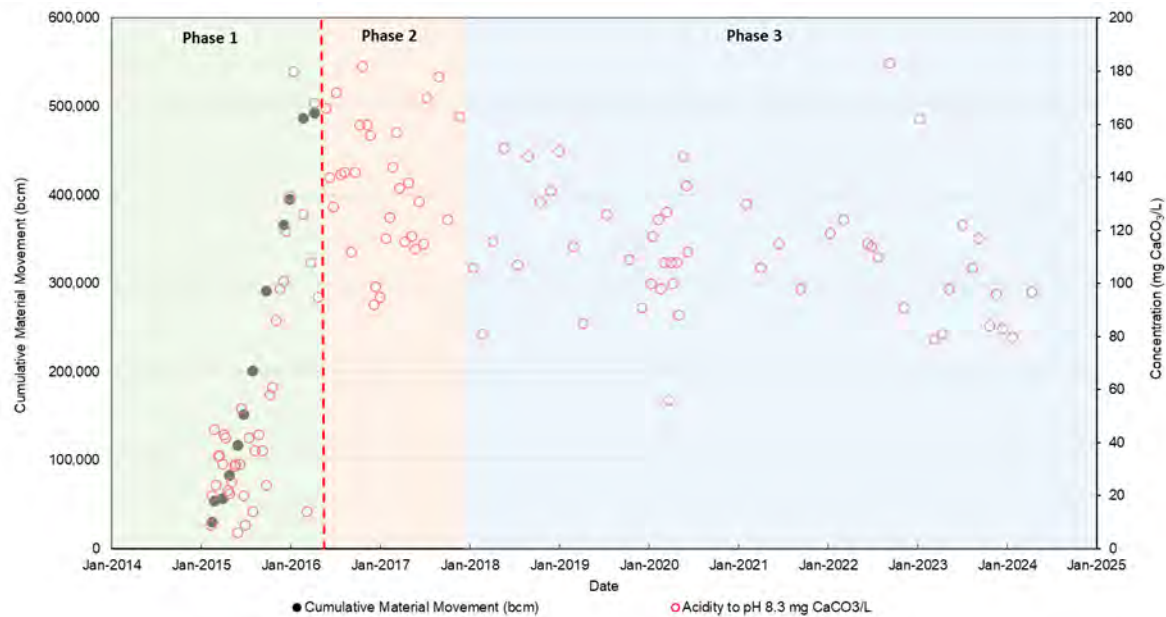


Figure 21: BV ELF acidity concentration.

The red line indicates when the BV ELF underdrain was flooded in ~ April 2016.

Green shading indicates Phase 1: Construction Phase.

Yellow shading indicates Phase 2: Stabilisation Phase.

Blue shading indicates Phase 3: Decay Phase.

Note: Volumes do not match the total tonnes presented in Table 3. Table 3 relates to the materials that are within the catchment that reports to the BV ELF v-notch weir. This figure presents all material movements.

4.9.4 ELF Seepage Water Quality Model

Two ELF load models were developed including the stored oxidation product (SOP) load model and the sulfide oxidation (SOX) load model, which were developed using empirical data from the BV ELF and other supplementary data sources to derive:

- Sulfate concentration over the three water quality phases considering two processes:
 - o Dissolution of stored oxidation products: This relates to the release of solutes in the short term due to flushing of readily available soluble minerals by net percolation through the ELF. This was assessed using the SOP load model.
 - o Oxidation of sulfides: This relates to ongoing generation of sulfate and associated solutes over the long term due to oxygen ingress and the oxidation of sulfide minerals. This was assessed using the SOX load model.
- PCOC concentrations were derived from sulfate relationships, observed in the BV ELF Drainage and other empirical datasets (e.g., Stockton Mine AMD and column leach tests).
- The duration of the Stabilisation Phase is based on the average height of the ELF and aligns with previous studies of the draindown phase duration for the original Escarpment ELF (e.g., Okane Consultants (2014)).
- The Decay Phase is due to:

- o Natural decay of acidity loads due to flushing out of stored oxidation products and decreasing oxidation rates of reactive sulfides.
- o ELF design where rocks > 10 m depth are within a sub-oxic zone and are not generally generating further acidity.
- o The load model uses a 9.6% annual decrease per year to align with BV-ELF empirical data before transitioning to a long-term acidity load decay 0.62% per year.

The model for the BV ELF is provided in Figure 22. Further details on the model approach are provided in the MWM report (MWM, 2026h).

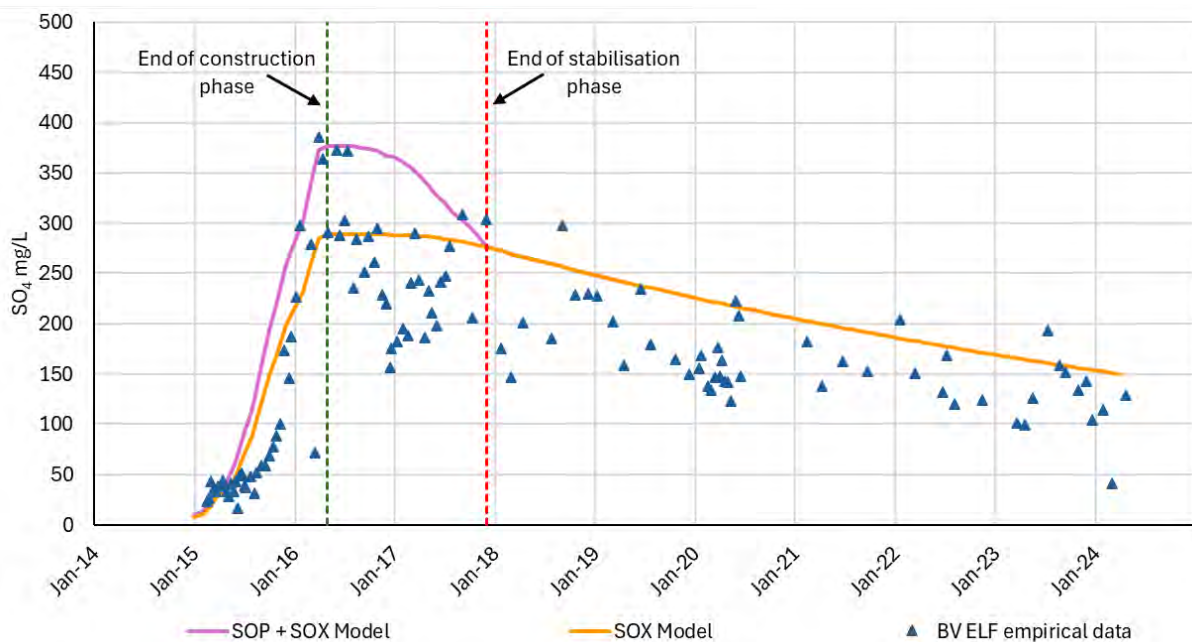


Figure 22: Calculated ELF load models and BV ELF sulfate data.

4.9.5 Sensitivity Modelling

Sensitivity modelling was undertaken during the development of the ELF seepage water quality model. This included:

- Application of the calculated total SOP load produced by the BV ELF to varying BV ELF volumes. A 15 m shell was selected as a conservative approach where all load was assigned to the 15 m shell. This is considered conservative as there are parts of the ELF, at depth > 15 m horizontal that are oxidising, contributing to load, hence incorporating this load generates a higher load, which is assigned to the rocks in the shell
- Estimation of SOP load through investigation of a range of sulfate water quality data from the Stabilisation Phase from the BV ELF.
- Assessment of the wt% sulfur and sulfate decay rates from column leach testing of MFS and the existing Escarpment Mine material to estimate stored oxidation load.
- Estimation of SOP load from the difference between sulfate water quality data from the Stabilisation Phase and one year post stabilisation from the BV ELF.

One model scenario was chosen to represent BV ELF seepage, which was fitted to empirical data, and this was used to forecast the water quality from the six engineered landforms at the proposed ESE area and the fourteen engineered landforms at the proposed MFS area. This provided a deterministic estimate for water quality, based on empirical data and trends that was adjusted for varying ELF sulfur content. Given the reliance on these deterministic model values, the WLBM that were undertaken for ESE and MFS (MWM, 2026u,t) were stress tested with metal loads in ELF seepage being run at $\pm 30\%$ of the Base Case scenario.

4.9.6 Nitrogenous Compounds

The risks associated with the uses of ammonium-nitrate fuel oil (ANFO) explosives was assessed. Water quality data from Stockton and Escarpment mines indicates that nitrate nitrogen and ammoniacal nitrogen are low in recently blasted pit water, seepage to pits from backfill, and from seepage from ELFs.

The development of a model, based on empirical data from the BV ELF and the ELF Seepage Water Quality Model suggested that nitrogenous compounds will be low in BPCP ELF seepage. Performance monitoring is recommended this assumption.

These data are presented in Table 19. The data from the BV ELF was used to construct a water quality model for nitrate (Figure 23). This model was then used to derive water quality for other ELFs proposed for MFS and ESE.

Table 19: Nitrate and ammoniacal-N data for various mine domains (Stockton and Escarpment)

SITE	SAMPLING DATE	NITRATE - N		AMMONIACAL - N	
		Count of Records	Concentration ¹ (mg/L)	Count of Records	Concentration ¹ (mg/L)
Cypress Pit S5	9/5/2024 to 27/3/2025	31	0.071 (0.001 – 0.434)	-	-
Cypress Pit	9/5/2024 to 27/3/2025	32	0.239 (0.029-0.990)	-	-
BV ELF	30/11/2017 to 11/12/2024	16	0.08 (0.01 – 0.10)	3 3	0.083 (0.05-0.11) < LOR of 1.0 ²
NELF (sump inlet)	9/4/2025	1	0.16	1	0.21
NAF NELF (seepage)	9/4/2025	1	0.04	1	<0.01

Note: 1. for the site with more than 1 sample collected, the unbracketed numbers are the average and the bracketed numbers indicate the concentrations range (min and max).
2. Limit of Reporting, this has varied over the sampling period.

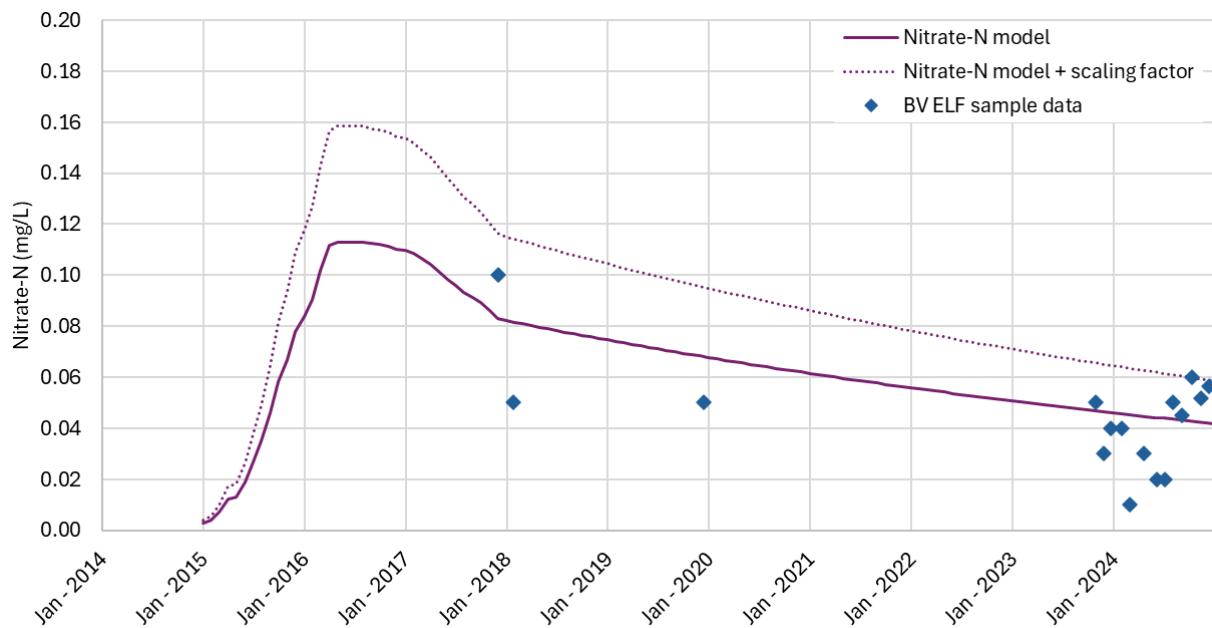


Figure 23: BV ELF nitrate-N model.

Note: Scaling factor of 1.4 applied (based on long term data variance)

The development of a model, based on empirical data from the BV ELF and the ELF Seepage Water Quality Model suggested that nitrogenous compounds will be low in ESE and MFS ELF seepage. Performance monitoring is recommended. Performance monitoring for nitrogenous compounds, and the potential for cumulative effects, is discussed further in Hickey (2026).

4.9.7 Risk Management

The overarching objectives of the water quality modelling is to ensure the risks for BPCP ELF seepage are understood and that appropriate engineering controls are in place to minimise AMD effects on the receiving environment. The following comments are provided on the conceptual model and model construct:

- The use of upper quartile sulfate concentration data from the BV ELF for construction of the model provides conservatism to ensure potential effects are understood and managed.
- Lateral flow along running surfaces leading to seepage on the batters of an ELF is a risk for closure (i.e., Not all seepage will drain to the toe of the ELF, some may percolate sub-horizontally surfacing along batter slopes), as it will have poor water quality, and if this flow generates surface seepage this could affect surface rehabilitation outcomes and surface water quality. The NAF cover system needs to ensure this lateral drainage discharges to the toe of the ELF for treatment (i.e., runs down the PAF/NAF boundary – achieved by permeability contrast).
- The duration of the Stabilisation Phase will be a function of stored oxidation products, material properties (e.g., grainsize, porosity, etc), and the time to wet up and draindown. Results are in alignment with other studies (e.g., O’Kane, 2014) but could be longer. A longer duration could result in a longer time frame for active treatment.

- Load will be driven by flow rate. This is currently set at 40% of rainfall in the model. This could be higher or lower and performance monitoring is required to confirm flows at closure. This may extend / shorten the active treatment phase.
- The decay rate of 9.6% assumes that the ELF is built to exclude oxygen at depth within the ELF (> 10 m horizontally). If performance monitoring during the operational phase of the BPCP determines that this is not achieved and there is advective oxygen ingress, then the most appropriate model to use for ongoing water quality projections would be the Stockton AMD Liability Model (Gandy and Younger, 2007; Treasury, 2017).

4.9.8 Recommendations

The ELF water quality model should be refined and updated as the earthworks are undertaken. Areas of focus should include:

- Confirmation of the effect of multiple compacted lifts on lateral flow and further quantification of the effect on net percolation rates through the total ELF height. This may reduce net percolation rates.
- Lateral flow along compacted lifts to batter slopes will require the construction of a low permeability NAF layer to drain this water to the ELF toe for AMD control and management. Continual assessment on constructability and geotechnical risks (e.g., slumping) need to be considered. A management process should be developed if this water becomes a surface seep that could impact rehabilitation efforts.
- Continue monitoring of the BV ELF seepage for flow and quality to validate the 9.6% decay trends.
- Validation of the duration of the Stabilisation Phase, which is currently based on the BV ELF Stabilisation Phase of 20 months for an ELF with an average height of 10.71 m and the O’Kane (2014) study.
- Monitoring for nitrogenous compounds in pit sumps and ELF seepage.
- Ongoing monitoring of the ratio for H₂SO₄ acidity: CaCO₃ neutralisation to confirm the ratio is not increasing, which would suggest limestone / ANC is being exhausted. This will be important to validate limestone dose rates and longevity of its benefits.
- Limestone will not be needed in NAF ELFs and variable dose rates may be suitable for differing sulfur content, for instance:
 - o Limestone dose rates could be adjusted based on the expected acidity load, which is a function of the sulfur content of the proposed ELF.
 - o Lower sulfur ELFs with low modelled acidity could be treated more effectively using passive treatment technologies rather than dosing with limestone.

4.10 Water and Load Balance Model - Source Term Definition

This memorandum is provided as Appendix J (MWM, 2026i).

4.10.1 Report Purpose

This report relates to the development of source terms for the WLBM that have been created for MFS, ESE, and the UWHR. Modelling is undertaken using GoldSim modelling platform¹⁵ to develop a WLBM. Further details of the WLBM are contained in:

- MWM (2026u) for the ESE sub-area.
- MWM (2026t) for the MFS sub-area.

The WLBM for the UWHR does not use GoldSim for modelling as the amount of material disturbance and effects are expected to be lesser. Instead, a Microsoft Excel based numerical analysis was undertaken. Further details of the WLBM are contained in:

- MWM (2026s) for the UWHR sub-area.

4.10.2 Introduction

WLBM that contain water flow and water quality data are required and have been developed for the BPCP to understand the potential effects of AMD and sediment on surrounding waterways. Key water quality inputs (source terms) are required for the WLBM that include:

- Waterways within the project sub-areas.
- PAF ELF seepage.
- NAF ELF seepage.
- Active WTP discharge.
- MSR and MSR polishing pond effluent (treated ELF seepage).
- Runoff from pit walls, pit floors, and clean water diversion through acid-forming materials.
- Active pits and active PAF ELF running surfaces.
- ELF surface run-off (NAF ELF surfaces, unrehabilitated NAF batter slopes, and rehabilitated surfaces).
- Hardstand and coal stockpile areas runoff.
- Underground adit discharge.

Note: TSS source terms are also included in the models. Derivation of these source terms is provided in other reports (e.g., MWM, 2026w).

4.10.3 Derivation of Source Terms

Water quality source terms were developed from a variety of sources including analogue data sources, background water quality studies, and laboratory derived data from environmental geochemistry testing. This report provides an explanation of how the source terms for modelling were developed for the WLBM.

¹⁵ <https://www.goldsim.com>

- Water quality limits have been derived by an independent subject matter expert (SME) (Hickey, 2026). These are used to understand the effects to the receiving environment for each project sub-area.
- Background water quality data for streams in the BPCP area have used:
 - o Average concentration data for dissolved parameters (e.g., potential constituents of concern (PCOC))
 - o TSS has been derived from available W-M2 monitoring site data.
 - o These data are assigned in the WLBM to background catchments within the model bounds. These data are summarised in this report.
- ELF seepage water quality has been developed from analogue datasets (Barren Valley ELF). These data are summarised in this report, and the process is applied to:
 - o ELF seepage from PAF materials
 - o ELF seepage from NAF materials.
- Water quality for other mine impacted waters (MIW) has been derived from a variety of sources. These data are summarised in this report and include:
 - o Highwall run-off derived from empirical datasets, scaled for sulfur content to consider higher and lower AMD risk surfaces where constant load models are developed (kg/ha/day) and are applied to the WLBM to account for variation in flow rates/rainfall. PAF, NAF, and granite highwall surfaces are assessed using different methods. Similar data are used for drains cut into bedrock materials that are acid forming (e.g., Brunner Coal Measures).
 - o Active pit water quality and active ELF surfaces, which is derived from:
 - Empirical TSS datasets from the Stockton Coal Mine.
 - The existing Escarpment Mine, Pit 3 empirical water quality during the early stages of filling to be representative of the dissolved parameters (e.g., PCOC). Two datasets are used to represent lower and higher rainfall periods with a gradational change introduced into the WLBM between the two datasets.
 - o Coal floor run-off, which uses the highwall constant load model approach, scaled for sulfur content and concentration as a function of rainfall.
 - o Unrehabilitated ELF surface runoff, which uses NAF water quality data derived from the column leach testing. Noting that due to progressive rehabilitation only 2-3 lifts containing PAF rock will be exposed before they are recontoured and capped with NAF rock. A constant source term is applied.
 - o Rehabilitated ELF surfaces, which uses:
 - Background stream water quality data based on W-M2 data.
 - In the absence of representative empirical data, source terms were adopted from previous studies on the Buller Plateaux.

- o Hardstand runoff, which uses a constant load model approach for PAF surfaces (same as highwall source terms).
 - o Underground workings / adit discharge that use empirical average data from the Escarpment Adit. Constant data are used in the WLBMs
- Water treatment efficiency assumptions have been developed for both active and passive treatment technologies. These efficiencies are summarised in this report and include:
 - o Passive treatment efficiencies using MSRs, which are based on empirical field data and laboratory trials.
 - o Active treatment performance is based on laboratory water treatability trials.

4.10.4 Summary

The purpose of creating the Source Term Report was to provide a transparent approach on how source terms were derived for the WLBMs.

There are a number of interpretations used to generate the source terms that are used in the WLBMs. The following comments are provided:

- ELF basal seepage is the key long-term load that determines the ability to transition from active to passive treatment. The source terms for each ELF seepage point need to be reviewed against empirical water quality and quantity data once construction of the ELFs commence (i.e. commencing in the construction phase when the first ELFs begin to be constructed and continuing through the operational phase). Where there is significant variance outside model sensitivity modelling (+/- 30%) the models should be revised.
- The source term for surfaces (highwalls, pit floors, hard stands) are based on the acidity loads (kg/ha/day) from the Millerton Road Cutting adjusted for sulfur content for a water quality sample obtained from the UWHM that was not affected by ELF seepage. A decay function is also included based on the work by Pope et al. (2018). Continual performance monitoring during the Operational Phase is required to validate water quality as a function of rainfall. Where there is significant variance (+/- 30%) the models should be revised.
- The source term for pit water quality is derived from the Escarpment Mine Pit 3 Pit Lake for higher and lower rainfall events. The model does not take into account the sulfur content of pit voids. Where there is significant variance (+/- 30%) the models should be revised.
- ELF rehabilitated surfaces use monitoring site W-M2 data. It is important that low sulfur materials are used below soil layers. A QA/QC process is needed to ensure no high sulfur material is placed near the ELF surface – this QA/QC process is described in the AMD ELFMP.
- Performance of active and passive treatment systems need to be validated early in the project life (i.e., early in the Operational Phase).

5 PREVENTION AND MINIMISATION

This section assesses the engineering controls required to minimise the effects of waste rock storage at the BPCP. Three reports are discussed:

- Engineered Landform Design Philosophy (MWM, 2026j)
- Cover System Field Investigation (MWM, 2026k).
- Cover System Technical Report (MWM, 2026l).

5.1 Introduction

Engineering controls are required for the ELF's that will be constructed at MFS and ESE and the engineered fill areas (EFAs) as part of constructing the UWHR to prevent the mobilisation of PCOC from the proposed waste rock storage facilities. This includes identifying the landform design objectives that will:

- Prevent oxygen ingress into the landform that causes the oxidation of sulfide minerals; and
- Minimise the ingress of water into the landform that mobilises the stored oxidation products.

Prevention and minimisation utilise source control technologies that are industry proven approaches, which are in alignment with international guidance documents (e.g., INAP, 2014; DFAT, 2016) of how to manage the potential effects of sulfide mineral oxidation.

5.2 Engineered Landform Design Philosophy

A full report on the ELF Design Philosophy is provided as Appendix K (MWM, 2026j).

5.2.1 *Report Purpose*

This report describes the design philosophy for the proposed ESE and MFS ELF's to prevent the oxidation of sulfides and minimise the mobilisation of any oxidation products by water. The objectives of this study were to:

- Summarise literature and provide industry proven design objectives for ELF's.
- Provide recommendations to prevent and minimise the potential risks associated with AMD using source control technologies.
- Provide recommendations on how waste rock could be managed within ELF's at the proposed ESE and MFS sub-areas.

Whilst source control technologies are the preferred approach for the MFS and ESE sub-areas of the BPCP, which will reduce long term AMD liabilities, at Stockton due to significant and extensive historic AMD, the approach is control and treatment of AMD. Retrospective source control is a difficult task when rocks are already oxidised.

5.2.2 *Findings*

Previous studies (e.g., Elder et al., 2011) have indicated that waste rock associated with the BPCP will generate significant quantities of acidity and metals, which could have an effect on the downstream environment if the project materials are not managed in an appropriate manner. One aspect of AMD

management is source control to prevent sulfide mineral oxidation and the mobilisation of these oxidation products and other PCOC from ELF.

BRL has committed to proactive source control for the ESE, MFS, and UWHR project sub-areas, using ELFs and EFAs (for the UWHR), which provides a foundation for sustainable waste rock management, aligning with INAP¹⁶ (2024) principles for long-term environmental stewardship.

5.2.3 Management

This report provides a design philosophy for the ESE and MFS ELFs to prevent the oxidation of sulfides and minimise the mobilisation of any oxidation products by water. The design objectives are applicable to ELFs and EFAs and are incorporated into the AMD ELFMP (MWM, 2026d).

ELF construction will use industry best practice techniques (e.g., INAP, 2020, 2024) to minimise oxygen and water ingress into sulfide-bearing materials and hence control the potential geochemical hazards at their source. The current proposed design objectives are explained in Table 20 and focus on minimising oxidation of sulfide minerals and mobilisation of oxidation products (e.g., water management). Further details are provided in the AMD ELF MP (MWM, 2026d); this document also explains what design features are incorporated into EFAs.

Table 20: ELF Design objectives and materials management recommendations.

DESIGN FEATURE	DESIGN OPPORTUNITIES
Foundation Preparation and Earthworks	<ul style="list-style-type: none"> ○ Mapping of the ELF basal footprint to ensure there are no direct pathways to underground workings such that ELF seepage could drain to these workings and then discharge to the natural environment. Where these workings are identified and could be pathways for AMD, they should be sealed to prevent seepage loss to the receiving environment. An adaptive management approach within a conditions framework should be developed for this process. • Clean water diversion to minimise water/rock interaction during construction and minimise the volumes of water requiring treatment. • Any topographic surface level seeps emanating from within the footprint of the ELF should be directed into basal underdrainage network. ○ Non-Acid Forming (NAF) should be used as basal materials to minimise PCOC mobilisation due to seepage of water through these materials that could contribute to increased solute concentrations. ○ Construction of a basal underdrainage network to minimise water/rock interaction and reduce uncontrolled seepage pathways to ensure waters report to designated locations for management/treatment. • Construction of sediment ponds to flood the underdrain(s) and be available for passive treatment at closure (if required).

¹⁶ International Network for Acid Prevention: <https://www.inap.com.au/acid-drainage>

DESIGN FEATURE	DESIGN OPPORTUNITIES
Clean Water Management	<ul style="list-style-type: none"> • Clean water diversion to minimise water/rock interaction and minimise the volumes of water requiring treatment. ○ ELF design to shed water as quickly as practical to reduce infiltration¹. ○ Compaction of final PAF surfaces (batter slopes by dozer) to shed water. Noting that compaction of NAF is to be avoided if lateral seepage will report to the batter slope. ○ Restrict/prevent ponding of water on the ELF footprint to reduce net percolation¹.
Materials Management	<ul style="list-style-type: none"> ○ Development of a material schedule and management process. • Where practicable, minimise time between blasting and placement of materials in the ELF. ○ Ensure blasting generates materials that will create matrix supported materials rather than generating coarse materials that will create clast supported materials that will enable advective oxygen flow. ○ The management process will ensure the correct materials are available and are placed in the correct location. This will be completed for all stages of mine planning, ideally avoiding a double handle of materials and limiting the amount of time that PAF materials are exposed before being covered. This will include topsoil and NAF scheduling for progressive rehabilitation.
Lift Height	<ul style="list-style-type: none"> ○ Commence construction of new ELFs using a 2-5 m lift height and validate that oxygen ingress is limited to diffusion. • Operate low tip heads (e.g., ~3 m in height) and confirm that advective airflow is eliminated. ○ Undertake studies to confirm whether higher lifts (e.g., > 5m) can be used, yet advective oxygen ingress is prevented and diffusion of oxygen is limited to 10 m horizontal depth into the ELF. ○ Confirm grainsize segregation does not occur via test pitting or tip head inspections. ○ Ensure compaction of lift running surfaces to minimise advective airflow using traffic management procedures.
Encapsulation	<ul style="list-style-type: none"> ○ Placement of PAF and Highly acid forming waste rock in the core of the ELF surrounded by low risk (lower sulfur materials) and then NAF materials. ○ Avoid PAF and HAF being placed on the outside edge of each lift during ELF construction. ○ Ensure a minimum of 1 m (thickness) of NAF is placed over PAF materials before soil placement. Based on mine scheduling a thicker NAF layer may be achievable.
Geochemical Controls	<ul style="list-style-type: none"> • Limestone dosing to the ELF materials will be undertaken. ○ Undertake trials to optimise limestone dosing (e.g., higher application rates in the oxidising outer sections of the ELF and lesser rates in the core of the ELF).
Geotechnical Stability	<ul style="list-style-type: none"> ○ Long term geotechnical stability is required to ensure ELFs are safe and stable. Stability is required to ensure that PAF materials will not be exposed in the long term, which could lead to AMD.

DESIGN FEATURE	DESIGN OPPORTUNITIES
Cover System	<ul style="list-style-type: none"> o Develop and install a final rehabilitated cover system to limit net percolation and oxygen flux (further details in MWM, 2026b). o Measure cover system performance in regard to oxygen and water flux.
Progressive Rehabilitation	<ul style="list-style-type: none"> o During construction of the ELF, where practical, provide immediate surfaces for rehabilitation. o Placement of NAF, soils, and vegetation to reduce net percolation of rainfall. o Direct vegetation transfer should be considered where practicable and will reduce sediment loss from the ELF.
Performance Monitoring	<ul style="list-style-type: none"> o Geochemical characterisation and quality assurance / quality control (QA/QC) o Grainsize segregation and lift height o Compaction of running surfaces o Oxygen ingress depth o Net percolation rates (as measured by seepage flow rates) o Seepage water quality
Sign-off	<ul style="list-style-type: none"> • Confirmation that final landforms (ELFs and water management infrastructure) are acceptable for closure requires sign-off by the Engineer of Record (EoR). • Confirmation that final landforms are geochemically stable at closure and water treatment is appropriate requires sign-off by a suitably qualified and experienced person (SQEP).

1 – Some areas of the ELFs will be rehabilitated as tarns. These areas will be constructed to retain water (i.e., a low permeability base). Further details are in the AMD ELF MP (BRL, 2026d). Noting that a water cover is an effective mechanism to prevent oxygen ingress.

5.2.4 Summary

INAP (2020) notes that “direct and indirect measurements of acidity load from various site domains at more than 40 sites over the past 25 years have revealed that mined sulfidic rock typically contributes to the majority of the total acidity load (60 to 80%) from most mine sites”. Hence the greatest long term source hazard for AMD is acid forming waste rock dumps.

To address this risk, BRL will implement proven industry best practice engineering controls for the ELFs and EFAs that will contain the waste rock to ensure long term effects of mine impacted water are minimised.

5.2.5 Monitoring

Performance monitoring is recommended as explained in Table 20. This should be managed by the following management processes:

1. Rock Sampling and Analysis – ABA and Materials Classification
2. AMD material management.
3. Sealing of underground workings.
4. ELF construction requirements and QA/QC.
5. EFA construction requirements and QA/QC.

5.3 Cover System Field Investigation

A full report on the BV ELF cover system field investigation is provided as Appendix L (MWM, 2026k).

5.3.1 Report Purpose

This factual memorandum documents the field characterisation program carried out to support the cover system design for the BPCP ELFs. Cover systems are utilised to prevent oxygen and water ingress into ELFs. Quantification of oxygen and water flux rates have been used to estimate long term PCOC loads.

5.3.2 Key Findings

The existing BV ELF and soil stockpiles at Escarpment Mine provide representative analogues of the material that will be used to support cover system construction for the BPCP. The field investigations involved:

- Excavation of four (4) test pits in mine rock at the BV ELF and the soil stockpile.
- Collection of seven (7) total mine rock and soil samples.
- Completion of one (1) standpipe piezometer falling head test on the BV ELF.
- Completion of seven (7) permeameter tests in mine rock and soils.

The physical properties testing involved particle size distribution, water content, and solid density. The findings from the field investigation are summarised as follows:

- Soil from the Escarpment soil stockpile was well-graded, consisting of approximately 18% cobbles and gravel, 40% sand, and 42% silt and clay size particles on average, based on the Unified Soil Classification System.
- The mine rock is also a well-graded material. On average (n=4) the BV ELF mine rock consists of approximately 28% cobbles and gravel, 56% sand, and 16% silt and clay-size particles. Note that clasts >106 mm were not accounted for in these proportions due to lab testing limitations. Visual estimates place this unaccounted fraction to be in the range of 5 to 10%, which is unlikely to change findings of this investigation.
- Gravimetric water content for the soil was higher (~24%) than mine rock (~9%) reflecting greater capillarity forces of the finer textured soil.
- Solid density was 2.54 t/m³ on average for mine rock, and 2.46 t/m³ for soil.
- Average degree of saturation was estimated to be ~56% for mine rock and ~80% for soil.
- Soil material K_{fs} ¹⁷ was estimated to be 3×10^{-7} m/s (metres per second).
- Mine rock K_{fs} varied by depth/level of compaction, and fines content:
 - o Shallow depth of mine rock was estimated to have an average K_{fs} of 4×10^{-6} m/s.
 - o The near surface layer of mine rock, which appeared compacted, provided a K_{fs} that was approximately one half of an order of magnitude to one order of magnitude lower than

¹⁷ Field saturated hydraulic conductivity

material deeper in the test pit. The lower K_{fs} at surface were attributed to both compaction level and fines content variation.

- Observed runoff that occurred during the investigation was consistent with estimates of near surface K_{fs} . The lack of runoff observed on batter slopes suggest a K_{fs} for this portion of the BV ELF to be greater than the maximum rainfall intensity (i.e., $>3 \times 10^{-6}$ m/s).

5.3.3 Summary

The data provided in this report was used within the cover system modelling that is reported in the next section of this report.

5.4 Cover System Technical Report

A full report on the ESE and MFS cover system is provided in Appendix M (MWM, 2026l).

5.4.1 Report Purpose

This report documents soil-plant-atmosphere (SPA) modelling completed to estimate net percolation (NP) and diffusive oxygen ingress through cover systems planned by BRL at the MFS and ESE sub-areas. Outputs from the SPA modelling will support the WLBM modelling for ESE and MFS, where water and oxygen ingress results will be translated into water volumes and acidity loads (based on oxygen flux) to understand post closure collection and treatment requirements. Other sub-areas were not within the scope of this assessment.

5.4.2 Introduction

PAF mine rock will be stored in ELFs. The ELFs will be constructed and rehabilitated with strategies that focus on reducing AMD risks associated with PAF storage. The AMD risks associated with advective oxygen (airflow) supply to PAF materials will be managed through the design and construction of elements which reduce airflow. Long-term AMD emanating from the ELF (requiring active or passive treatment technologies) can be forecast from estimates of NP and oxygen ingress into the ELFs through the cover system.

5.4.3 Approach

One-dimensional numerical simulations were completed to evaluate cover system net percolation and diffusive oxygen ingress for the MFS and ESE sub-areas. The NP and oxygen ingress numerical simulations were used within parallel studies to support the development of the WLBM for MFS and ESE to estimate post closure AMD and subsequent collection and treatment requirements. The numerical simulations were completed with SEEP/W and CTRAN/W (GeoStudio 24.1.0.1406) software. The primary objective of the numerical simulation is to establish rates of NP and oxygen ingress, inform the relative performance of alternate cover system scenarios, and develop an understanding for the influence of estimated / assumed boundary conditions and material properties.

Numerical simulation model input parameters were based on material index properties, a literature search, and professional experience with similar textured materials. Two cover system designs were considered in the analysis, based on revegetation objectives:

- Shrubland/wetland – 0.25 m soil-based growth medium layer (GML) overlying 2 m of non-acid forming (NAF) mine rock. This cover system is also considered to be representative of Pakihi wetland type rehabilitation.
- Forest – 0.5 m of a GML overlying 2 m of NAF mine rock.

The performance of the aforementioned cover system designs was simulated using 7 scenarios to assess the effect of alternate hydraulic properties, boundary conditions, and alternative cover designs.

The key advantage to the numerical modelling results summarised herein is the ability to enhance judgment. Hence, rather than a focus on the absolute results predicted, it is recommended that the modelling results be viewed as a tool to understand key processes and characteristics that will influence performance of the cover systems for the ESE and MFS sites, and to develop engineering decisions based on this understanding.

5.4.4 Results

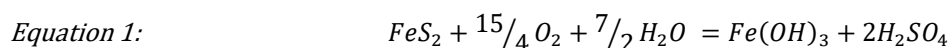
The shrubland/wetland and forest cover numerical simulations suggest:

- NP varied between approximately 15% and 60% of annual rainfall, with the lower percentages observed for the finer textured GML scenarios. Simulated runoff and NP were sensitive to the permeability of the surface GML, which was anticipated given high annual average rainfall at the site.
- The favourable water retention properties of the GML and high rainfall enable this layer to typically retain a high degree of saturation. As a result, mean annual oxygen ingress was simulated to fall within the low to medium category, ranging between approximately 100 and 230 g/m²/yr, with exceedances of 320 g/m²/yr (high category) occurring at a rate of 10% or less.
- Better performance (lower oxygen ingress) was achieved with finer textured mine rock and to a lesser extent, a finer textured and/or thicker GML. A higher degree of saturation with finer textured mine rock limited oxygen ingress when the GML desaturated during dry periods.

A sensitivity scenario that represented compacted running surfaces within the ELF showed promising results, with very low oxygen ingress. Further work is required to confirm this level of performance is achievable in the field.

Pakihi wetland type rehabilitation is expected to perform similarly or have lower oxygen ingress due to the wetland type setting.

Modelling suggests that the long-term average diffusive oxygen flux through the cover system could range between ~100 to 230 g/m²/yr for shrubland and forest, which translates to an acidity load of 1.6 to 3.8 t/ha/yr based on the stoichiometry of pyrite oxidation (Equation 1). A midpoint of 2.7 t/ha/yr is used for modelling.



Model results determined from this study, used in the WLBM are:

- Operational ELFs (unrehabilitated): 60% NP, see Appendix U and V (MWM, 2026t, 2026u).

- Rehabilitated ELFs (cover system installed): 40% NP, see Appendix U and V (MWM, 2026t, 2026u).
- Oxygen flux: Assumed to be equivalent to an acidity load of 2.7 t/ha/yr, see Appendix S (MWM, 2026r).

5.4.5 *Summary*

It is recommended that within the first two years of mine life, once suitable material is available, cover system trials are initiated to confirm modelling results presented herein are representative of as built conditions in the field. Such a study would provide confidence that water quality closure objectives can be achieved and support closure planning.

In addition to field trials, it is recommended the full-scale constructed cover system be instrumented to allow for direct performance monitoring and confirmation the system is performing to expectations on built. If it is found through monitoring that the system is not performing such that closure objectives cannot be met, contingency measures can be considered, such as a longer active treatment period or increased semi-passive treatment capacity. Completion of adequately designed and constructed field trials and appropriate construction quality assurance and construction quality control will improve the likelihood of the full-scale constructed cover system performing to expectations and achieving closure objectives.

Performance monitoring is required to validate both NP and oxygen flux to ensure model outputs are reliable.

6 CONTROL AND TREATMENT

6.1 Introduction

Effective control and treatment of AMD is critical to protect downstream ecosystems and water quality. Control strategies, e.g., the diversion of clean water and the capture of mine impacted seepage is covered in other reports (e.g., the ELF Design Philosophy Report: MWM, 2026j). Treatment is split into two broad categories: active treatment and passive treatment.

This section summarises the technical studies completed to support active and passive treatment of AMD impacted waters at MFS and ESE. The following reports are discussed in this section:

- Water Treatment Report: MFS and ESE (MWM, 2026m).
- Passive Treatment System Design Toolkit (MWM, 2026n).
- AMD Sludge Management (MWM, 2026o).

Whilst this AMD overview report focuses on AMD, for treatment there is no ability to separate AMD from TSS (i.e., MIW). Hence the same infrastructure is used to convey MIW to treatment locations and the same treatment systems (active and passive) are used to treat these MIW.

6.2 Water Treatment

Source control engineering options can reduce the quantity of AMD; however, treatment is also required due to the significant amounts of rainfall and water movement expected at MFS and ESE. Key AMD risks are addressed through an integrated approach combining source control and active and passive treatment processes:

- Source Control: Design of ELF's to minimise long term AMD loads through source control technologies and practices (MWM, 2026l; BRL, 2026d)
- Active treatment: provides reliable control of acidity, metal concentrations, and TSS (e.g., MIW) under variable flow and load conditions, ensuring compliance with discharge requirements through proven chemical and process-based technologies.
- Passive treatment: succeeds active treatment of ELF seepage, providing ongoing attenuation of residual acidity and metals, promoting long-term water quality stability and reducing operational demands.

Together, these processes provide robust risk management across the Construction, Operational, Active Closure, and Post Closure Phases for MIW.

6.3 Treatment Technology Selection: Active Treatment versus Passive Treatment

Passive systems are usually designed for relatively small flows (typically less than 50 L/s) unless a significant area is available for passive treatment to be successful (INAP, 2021). A common reference document (Taylor et al., 2005) provides general criteria for passive and active treatment (Table 21).

Table 21: General guidelines for selection of active versus passive treatment

TREATMENT SYSTEM	AVERAGE ACIDITY RANGE (mg CaCO ₃ /L)	AVERAGE ACIDITY LOAD (kg CaCO ₃ /day)	AVERAGE FLOW RATE (L/s)	TYPICAL pH RANGE	MAX pH ATTAINABLE
Passive	1 - 800	1 – 150	< 50	>2	7.5 – 8.0
Active	1 – 10,000	1 – 50,000	No defined limit	No defined limit	14

Source: Taylor et al. (2005).

INAP (2021) note that most successful passive treatment projects are treating less than 1,000 m³ per day, however there are two examples where treatment of 6,500 m³ per day (~75 L/s) was maintained for up to 19 years.

It is anticipated, based on experience at Stockton Mine, and the forecast peak acidity loads of ~4,500 t/yr at ESE and ~350 t/yr at MFS (as summarised in Table 29), that during the Construction, Operational, and Active Closure Phases any MIW will be treated by WTPs, although as ELF's are rehabilitated it is possible to commence passive treatment of ELF seepage. In the Post Closure Phase there will be a transition to passive treatment technologies. If passive treatment cannot yet be reliably implemented because of high acidity loads, or high trace element concentrations then a longer active treatment phase will be required.

6.4 Water Treatment Report: MFS and ESE

This report is provided as Appendix N (MWM, 2026m).

6.4.1 Report Purpose

The objectives of this report are to:

- Provide guidance on the interim water treatment requirements during the Construction Phase for MFS and ESE.
- Review the water treatment requirements (active and passive) during the Operational, Active Closure, and Post Closure phases when MIW will be released from ESE and MFS (after treatment).

6.4.2 Findings

Studies undertaken as part of the assessment of environmental effects for the BPCP for ESE and MFS highlight that management of MIW and the treatment of AMD and TSS are critical priorities.

The following is required to achieve the proposed water quality limits (as determined by Hickey, 2026) for MFS and ESE:

- pH correction to achieve water quality limits at water quality compliance monitoring locations.
- Treatment of acidity.
- Treatment of TSS
- Treatment of key PCOC that include iron (Fe), aluminium (Al), and trace metals that include cadmium (Cd), cobalt (Co), copper (Cu), manganese (Mn), nickel (Ni), and zinc (Zn).

6.4.3 Water Treatment Overview

During the Construction, Operational, and Active Closure phases, active treatment of MIW is required by a water treatment plant (WTP) at ESE and MFS, noting during the Construction Phase this will be a small portable water treatment system(s) that transitions to the permanent WTP during this phase. As engineered landforms (ELFs) are progressively rehabilitated during the Operational and Active Closure phases, and where acidity loads allow, the treatment of AMD impacted seepage will transition into numerous (n=20) passive treatment systems (PTS).

Mussell shell Bioreactors (MSRs) are proposed for the passive treatment of basal seepage from ELFs at the ESE and MFS sub-areas. MSRs will be installed progressively as mining operations in specific catchments are completed and land rehabilitated (some MSRs starting within a few years). The start of the Post Closure Phase commences once all ELF basal seepage is being treated passively.

For the purposes of this report there are four distinct project phases that are defined by the way MIW elevated in TSS and AMD are managed:

- Construction Phase: defined by the commencement of earthworks on site up until the active WTPs and associated WTP ponds are commissioned. This will require routing of water and minor water management / treatment using a small portable water treatment plant(s) to neutralise acidity using either $\text{Ca}(\text{OH})_2$ (hydrated lime/calcium hydroxide¹⁸) or NaOH (caustic); and the addition of flocculants as required to treat TSS. AMD sludge management is also required.
- Operational Phase: Water Management and active water treatment using calcium oxide (CaO), flocculants, and metal-chelating agents with AMD sludge being separated from treated discharge water by lamella clarifiers and mechanical sludge dewatering using pressure filtration (plate and frame filters (Process Flow, 2026a)) with AMD sludge disposal to ELFs. Some passive treatment commences for ELFs that are completed.
- Active Closure Phase: Active water treatment continues with a gradual transition to passive treatment of ELF basal seepage. AMD sludge disposal will either be onsite at an appropriate location, disposal at Stockton, or by other approved methods that may be developed over the Operational Phase of the BPCP.
- Post Closure Phase: defined by the decommissioning of the WTPs with water treatment being completed by gravity fed passive treatment systems. The proposed technology being a MSR. AMD sludge disposal will either be onsite at an appropriate location, disposal at Stockton, or by other approved methods that may be developed over the Operational Phase of the BPCP. Back-up options include disposal to approved offsite landfills.

The management of water treatment sludge is a critical aspect of water treatment. This is discussed separately in MWM (2026o). Flow rates that will be treated during Operational, Active Closure, and Post Closure phases have been determined from the WLBM for ESE and MFS (MWM, 2026u,t).

¹⁸ Noting: MgO may also be used as a neutralising agent.

6.4.4 Active Water Treatment

Active treatment is expected for a total of approximately 18 years at MFS and 30 years at ESE (noting this excludes the Construction Phase, prior to the WTP being commissioned (~2 years). The WTPs include the following treatment infrastructure and processes:

- WTP Surge Ponds (the “Stockpile Surge Pond” at MFS and the Ex-Pit Seal Pit at ESE) – receiving water from the run-off, seepage areas, and from pumping from the pit sumps.
- Powdered CaO silos and mixing tanks to generate a neutralising slurry for MIW water from the surge ponds.
- Pontoon mounted pumps to transfer water from the surge ponds to the acidity neutralisation tank.
- pH controlled CaO slurry dosing of AMD in the acidity neutralisation tank.
- Flocculant and metal-chelating agent dosing to CaO neutralised water prior to transfer to the Lamella Clarifiers.
- Separation of suspended and precipitated solids in the Lamella Clarifier with partial sludge return to the Lamella Clarifier in-flow (i.e., High Density Sludge (HDS) loop).
- Lamella Clarifier sludge is thickened with flocculant and pumped to a pressure filter for dewatering to create a “filter cake”. Dewatered filter cake is discharged to a bunker for loadout and trucking to disposal areas.
- Sulfuric acid (i.e., pH) trimming of the Lamella Clarifier thickener overflow (treated supernatant) where required to remove additional metals and meet pH compliance limits.
- Treated supernatant will report to a polishing pond after the pH correction before discharge to the receiving environment.
- Under high rainfall conditions the following may occur:
 - o Bypass and direct discharge from pit sumps when river flows are >95th %ile and >90th %ile respectively.
 - o Mine pit surge sumps and WTP surge ponds spill no more than 5% of the time on average.
- This is discussed in more detail in the WLBM reports MWM (2026t,u).

Water treatability trials conducted by Process Flow (2026b) determined that neutralisation with calcium oxide (CaO), coagulation with Metalzorb FZ, and flocculation with Rheomax 1030 effectively reduces TSS and dissolved metals in the supernatant, producing water quality consistent with ESE and MFS guideline values (Hickey, 2026). WTP effluent discharge design standards are shown in Table 22 and are applied to WTP discharge at both ESE and MFS within the WLBM to understand effects on the receiving environment.

Table 22: WTP effluent discharge design standards.

PARAMETER	INFLUENT (mg/L) ³	TREATED EFFLUENT CONCENTRATION (mg/L)	TREATMENT EFFICIENCY (%)
Acidity	360	2.5	99.3
Alkalinity	0.5	5.5	-

PARAMETER	INFLUENT (mg/L) ³	TREATED EFFLUENT CONCENTRATION (mg/L)	TREATMENT EFFICIENCY (%)
Ca	62	Calculated ¹	-
Mg	19.2	Mg input water quality ²	-
Na	3.1	Na input water quality ²	-
K	7.1	K input water quality ²	-
SO ₄	570	SO ₄ input water quality ²	-
Al	44	0.074	99.8
Fe	9.5	0.01	99.9
Ni	0.197	0.0027	98.6
Mn	1.78	0.18	89.9
Cr	0.0045	0.0011	75.6
Cd	0.00088	0.000025	97.2
Co	0.081	0.001	98.8
Cu	0.0133	0.00025	98.1
Pb	0.00116	0.00005	95.7
Tl	0.0026	0.00117	55.0
Zn	1.04	0.0058	99.4
DOC	1	0.25	75.0
TSS	16	1.5	90.6
pH	3.2	6.4	-

¹ Calcium is calculated (as is done in the WLBM). The amount of Ca in the WTP effluent is a function of influent Ca concentration and the amount of CaO required to neutralise the influent acidity.

² These parameters are not affected by active treatment. Hence the inflowing concentration is the same as the effluent concentration.

³ Influent data collected from Manchester Street drain at Stockton Mine.

AMD sludge management will comprise thickening and dewatering of sludge for final disposal. Further details on AMD sludge disposal are provided in MWM (2026o). Further discussion on AMD Sludge is provided in Section 6.6 of this report.

6.4.5 Passive Treatment Systems

Studies indicate that ~20 passive treatment systems are required for the treatment of mine affected waters at MFS and ESE, with six PTSs being established at the ESE project sub-area and 14 PTSs being established at the MFS project sub-area (and another system is required for the ESE Coal Storage and Infrastructure pads). Flow rates reporting to these facilities range from < 1 litre per second (L/s) up to ~120 L/s and acidity loads range from ~1 tonne per year (t/yr) up to ~ 300 t/yr.

MSRs were selected as the chosen technology for PTS based on:

- **Renewable Material:** The materials used in a MSR are derived from waste mussel shells, a by-product of the seafood industry, which supports a circular economy. Furthermore, the CO₂ within the shells, that are used for neutralisation of acidity, is renewable (i.e., not fossil CO₂)
- **Treatment Performance:** MSRs have shown to consistently remove PCOC such as acidity, Fe, and Al, and to a slightly lesser extent, trace metals such Ni and Zn under both acidic and alkaline conditions. Secondary MSR treatment (polishing pond) have been proposed for further removal of residual trace metals and secondary contaminants as required. Site-specific operational field trials will be completed in the first 1-3 years of the Operational Phase of the

BPCP to validate previous laboratory studies that the designs of these MSR polishing ponds are suitable to achieve closure water quality objectives in the targeted timeframe.

- **Sludge Management:** AMD sludge (predominantly Fe and Al) is generated from the treatment of acidic AMD impacted waters. Downflow MSRs are an efficient process to remove Fe and Al, acting as a vertical flow reactor as well as a neutralising PTS with pH correction such that AMD sludge forms at the surface of the MSR. This sludge can effectively be removed as part of routine maintenance as demonstrated at existing operating MSRs. Higher acidity loads (i.e., higher dissolved Fe and Al loads) can be managed by increased maintenance frequencies once treatment performance decreases. When active treatment is still occurring after ELFs have been rehabilitated (i.e., Active Closure Phase), AMD sludge disposal will either be onsite at an appropriate location (e.g., AMD sludge disposal cells at ESE Coal Pad), disposal at Stockton, or by other approved methods that may be developed over the Operational Phase of the BPCP. In the Post Closure Phase similar locations will be used. A back-up option includes disposal to offsite landfills.

Noting: Other options for AMD sludge management will be evaluated during the Operational Phase. If studies indicate that the method can provide geochemical stability, containment integrity, and cost-effective handling to align with closure objectives then this may be implemented at a later date (with additional regulatory approval as required).

- **Maintenance:** For maintenance of the MSRs (e.g., desludging) the system or part of the system needs to be taken off-line. This could involve dosing of bypass water with CaO or NaOH, designing MSRs to incorporate bays such that individual bays can be bypassed and drained for desludging while others remain operating. MSR Polishing ponds could also be constructed deeper to accommodate all sludge generation or be desludged periodically, if required. Further details are provided in the AMD WMP (BRL, 2026c).
- **Spatial Requirements:** MSRs can be sized for the expected flow (where 100 m² of MSR surface area with a minimum depth of 1.5 m is needed for 1 L/s) provided sufficient surface area is available. For ESE and MFS, MSR surface area requirements have been factored into mine plans based on net percolation rates of 40% into ELFs after closure (MWM, 2026i), which drives treatment requirements. Additional space is provided for the MSR polishing ponds. Space for maintenance activities (e.g., desludging, vehicle access, etc is also required).
- **Demonstrated Experience and Longevity:** BRL has successfully implemented MSRs, with systems operating effectively for nearly a decade while showing low maintenance requirements.

While MSRs are the proposed passive treatment technology for the BPCP, other passive treatment options may be viable and have not been excluded from future consideration. Passive treatment technologies are advancing rapidly, e.g., enhanced passive treatment systems (Christenson et al., 2018)) and/or the use of a series of biogeochemical processes (i.e., a treatment train) to treat AMD characteristics (Nairn et al., 2023) may have application to the BPCP in the future.

Early construction of the MSR in the first 1-3 years of the Operational Phase will enable site-specific testing and validation through performance monitoring to demonstrate the system's effectiveness early in the project's implementation.

MSR treatment systems will include:

- Sediment management systems to mitigate any residual TSS and prevent the PTS from being overwhelmed with sediment (i.e., diversion of surface flow away from the MSR).
- Mussel shells to neutralise acidity (carbonate neutralisation) and precipitate Fe- and Al-hydroxides, a key component of acidity, and remove metals by adsorption / co-precipitation.
- Anaerobic treatment to remove nitrate, reduce sulfate concentrations, and precipitate metals as sulfides.
- A polishing pond to remove secondary contaminants generated in the anaerobic treatment stage (e.g., sulfide (HS^-), ammoniacal nitrogen, and low dissolved oxygen) as well as treat residual Fe, Ni, and Zn by oxidation and adsorption.
- Sludge management, which is discussed further in MWM (2026d).

MSR treatment efficiencies for different PCOC are shown in Table 23. The process is well understood and documented at several operations (Stockton Mine, Canterbury Coal Mine, Echo Coal Mine).

Table 23: MSR treatment efficiencies.

PARAMETER	TREATMENT EFFICIENCIES (%)
SO_4	10.4
Al	99.7
Fe	80 ¹
Ni	40.2
Mn	58.6
Cd	1.89
Co	82.8
Cu	96.6
Pb	85.8
Zn	63.7

1. A nominal efficiency of 80% is used rather than the measured 99.7% to account for the ELF being sub-oxic and some Fe(II) passing through the MSR untreated.

MSR effluent flows into a polishing pond for aerobic treatment. This promotes $\text{Fe}(\text{OH})_3$ formation supporting further Ni and Zn removal (by adsorption / co-precipitation) and oxidation of secondary contaminants. The removal efficiencies for Ni and Zn are shown in Table 24 as determined by MWM (2026n) and in Section 6.6 of this report.

Table 24: MSR polishing pond treatment of MSR Stage 1 treated effluent

PARAMETER	TREATMENT EFFICIENCIES (%)
Fe	99.0
Zn	59.0
Ni	12.5

Studies indicate the pH of MSR effluent can be ~pH 8 (MWM, 2026c). This may require pH correction or mixing/dilution with surface flows so that water quality is compliant with proposed water quality pH

limits at downstream compliance monitoring locations (Hickey, 2026). pH correction may use ferric chloride (FeCl_3), which will also support the removal of trace metals such as Zn and Ni if Fe concentrations in the MSR effluent are lower than expected. Ferric chloride dosing would involve a small dosing system (e.g., a 1,000L IBC connected to a small battery-operated dosing pump).

6.4.6 Summary

The following summary and recommendations are provided from this report.

- MSR can effectively treat flow rates > 50 L/s (as recommended by international literature (INAP, 2021) by ensuring sufficient space is available to build larger passive treatment systems (i.e., 1 L/s per 100 m^2 of MSR surface area).
- It is expected that MSR can also handle higher acidity loads than those proposed by international literature by ensuring regular AMD sludge removal and the addition of shells to replace those consumed in the upper layers of the MSR. Studies can be undertaken in the first few years of the project to validate these expectations (i.e., once the first ELF's are completed (e.g., ESC ELF)).
- Site-specific operational field trials are recommended to validate previous laboratory studies that MSR polishing ponds can achieve final water quality objectives (PCOC and secondary contaminants) in the proposed timeframe. Studies can be undertaken in the first few years of the project to validate these expectations (i.e., once the first ELF's are completed (e.g., ESC ELF)).
- The work undertaken at MFS and ESE will lead to betterment of some waterways (e.g., Rapid Stream and Cascade Creek). It is recommended that water quality and ecology monitoring is undertaken to understand betterment of waterways. The approach is discussed in ESNZ (2026). This should include quantification of the change in PCOC loads at suitable monitoring locations to support these studies.

6.4.7 Performance Monitoring

Performance monitoring is required to ensure the WTP, MSR, and MSR Polishing Ponds are working to design expectations. The following is proposed:

- Flow monitoring for water treatment (active and passive) influent and effluent flow rates. Water treatment by-pass flow (quality and quantity) should also be monitored.
- Water quality monitoring is recommended for water treatment (active and passive) influent and effluent. Monitoring parameters and frequency should be based on key water quality risks that will be influenced by influent water quality, treatment efficiencies, and secondary contaminants.
- Monitoring of the MSR polishing pond influent and effluent is recommended to confirm that secondary contaminants are being managed.
- Performance monitoring will validate the quantity of Fe that passes through the MSR and whether any FeCl_3 dosing is required for the polishing pond to treat residual Ni and Zn (i.e., validate whether 20% of influent Fe reporting to the polishing pond is reasonable).

6.5 Passive Treatment System Design Toolkit

This report is provided as Appendix N (MWM, 2026n).

6.5.1 Report Purpose

The report presents the design criteria for MSRs that will be used to treat AMD from the seepage of ELF's that are proposed as part of the BPCP. The criteria are informed by comprehensive assessment of the performance of existing MSR to treat waters impacted by AMD from the existing Escarpment Mine (BV ELF MSR), Canterbury Coal Mine (Tara MSR), and the Stockton Coal Mine (Whirlwind MSR).

6.5.2 Report Content

The report is a summary report for seven other technical documents that are provided as appendices to that report, namely:

- Multi-Component Analysis Approach
- Escarpment Mine - MSR Performance Review.
- MSR Mn Treatment Efficiencies.
- MSR Treatment - Secondary Contaminants.
- Escarpment Mine MSR Maintenance Summary.
- MSR Sludge Trials.
- Whareatea MSR Design.

6.5.3 Report Objectives

The objectives of this report are to:

- Provide a summary of the multi-component analysis (MCA) undertaken for the selection of the preferred passive treatment system (PTS) for the BPCP that being MSR.
- Provide a summary of relevant MSR literature to demonstrate the applicability and robustness of the technology for treating AMD-impacted waters.
- Present empirical data on MSR treatment efficiencies, hydraulic retention times (HRT), sizing requirements, and estimated operational lifespans.
- Provide the MSR design criteria for the BPCP.
- Recommend monitoring and performance evaluation requirements to verify treatment effectiveness, support compliance reporting, and guide long-term optimisation.

6.5.4 Multi-component Analysis

MSR were selected as the chosen technology based on an MCA designed to evaluate PTS options for managing AMD during the Post Closure Phase of the BPCP after the cessation of active treatment. The aim was to identify a technically defensible and context-appropriate passive treatment approach aligned with project constraints and objectives. MSR were selected as the chosen technology for PTS (as discussed above in Section 6.4.5) based on:

- Renewable Material
- Treatment Performance
- Sludge Management
- Maintenance Requirements
- Spatial Requirements
- Demonstrated Experience and Longevity

6.5.5 MSR Design Criteria

Design criteria have been developed based on demonstrated performance and comprehensive assessment, with successful implementation at other BRL sites (e.g., Escarpment, Stockton, and Canterbury Coal mines).

Passive treatment using MSR will utilise two treatment stages:

- Stage 1: MSR treatment to remove PCOC within the MSR substrate.
- Stage 2: MSR Polishing Pond treatment to remove additional quantities of trace metals such as Zn and Ni through adsorption to Fe-hydroxides and treatment of secondary contaminants (e.g., ammoniacal nitrogen, hydrogen sulfide, etc).

The following key design criteria are provided for the MSR:

- MSR are designed for long term flow rates and loads that are a function of oxygen flux rates through the proposed ELF cover system.
- MSR are not designed for high sediment loads (e.g., sediment derived from erosion). High sediment loads will choke the MSR surface leading to poor flow rates and poor treatment performance. Sediment control structures are needed to ensure surface flows are directed away from the MSR stage 1 treatment system.
- Downflow MSR design to enable effective AMD sludge removal.
- MSR surface area design to accommodate anticipated flow rates where ~100 m² will treat 1 L/s and an additional similar sized facility is required as a MSR Polishing Pond. Flow rates are based on 40% net percolation of rainfall into each ELF.
- Shell depth of 1.5 m with shells being either weathered or fresh.
- Hydraulic residence time (HRT) of 24 hours within the MSR and equivalent minimum 24 hours HRT in the MSR Polishing Pond.
- MSR AMD sludge removal (desludging) is likely to be required every ~5 years. The specific timing will be determined by performance monitoring.
- Performance monitoring of influent and effluent water quality and flow rates.

BRL have been operating MSR for over 10 years at three sites, demonstrating experience in the design, operation, and maintenance of such systems.

6.5.6 Detailed Design

During the first 1-3 years of the Operational Phase, the following work needs to be completed for ELF seepage to validate the approach will achieve closure water quality objectives:

- Performance monitoring of ELF seepage to confirm flow rates and water quality that will require treatment.
- Detailed design of individual passive treatment systems.
- Ensure an adequate supply of shells are available.
- Confirm the benefits of Fe and Al addition to the MSR Polishing Pond to improve trace metal removal
- Determine methods of aeration for the MSR Polishing Pond, if required and confirm secondary contaminants are successfully treated.
- Confirm opportunities for MSR sludge disposal during the Post Closure Phase (e.g., disposal to pit voids).
- Confirm the requirement to remove shells in the MSR from below the Al- and Fe- hydroxide layers with time. If a slow buildup of precipitates occurs, then these materials may require disposal as AMD sludge.

6.6 AMD Sludge Management

This report is provided as Appendix P (MWM, 2026o).

6.6.1 Report Purpose

This report evaluates the requirements and options associated with the management of AMD sludge from water treatment processes proposed for MFS and ESE. AMD sludge management at Stockton is discussed in the Stockton Operational Sludge Management Report (BRL 2025b).

The objectives of this report are to:

- Provide background information on AMD sludge generation processes.
- Summarise the quantities of the AMD sludge that will be generated by the BPCP at ESE and MFS.
- Explain how this AMD sludge will be managed over the project life.

6.6.2 Introduction

AMD generated during mining requires treatment, which produces metal-rich sludge as a by-product. Both active treatment (e.g., calcium oxide dosing) and passive treatment (e.g., MSR) precipitate metals like iron (Fe) and aluminium (Al), forming AMD sludge that requires management and disposal. During the construction and operational phases of the BPCP, AMD sludge will be heavily influenced by suspended sediments generated by ground disturbance (i.e., TSS), which will decrease as rehabilitation activities are completed, whilst the AMD component of the sludge will increase during the Operational Phase and then decrease during the Post Closure Phase. In the Post Closure Phase AMD will be dominated by Fe- and Al- hydroxide precipitates and TSS will be low.

The existing Stockton Mine AMD sludge management experience provides a practical analogue for managing these risks and future AMD sludge management at MFS and ESE, demonstrating the importance of:

- Understanding TSS and AMD components that contribute to AMD sludge and how to minimise TSS and AMD in mine-impacted waters.
- Reagent selection on AMD sludge volume and stability (e.g., limestone versus burnt and/or hydrated lime).
- Maintaining geochemical control (pH ≥ 5) to prevent metal leaching from AMD sludge.
- Management costs.
- AMD sludge disposal options.

6.6.3 AMD Sludge Quantities

For the BPCP, AMD sludge management must integrate site-specific chemistry, treatment system methods, availability of on-site disposal locations, and closure objectives, prioritising stable cost-effective disposal and long-term environmental safety. For the BPCP, AMD sludge will be generated over the four project phases as shown in Table 25.

The greatest quantities of AMD sludge will be generated in the Operational and Active Closure phases of the project when acidity loads are highest. Contributors to AMD sludge quantity include TSS and AMD (Fe, Al, calcium carbonate (CaCO_3)) as shown in Table 25.

Although quantities of AMD sludge are significant, they are low compared to the total quantity of overburden placed in the proposed ELF's. For instance, when peak AMD sludge is generated at ESE in FY36:

- MFS: In FY37 there is 2,113,100 bank cubic metres (bcm) of rock (MWM, 2026h) placed in the MFS ELF's (i.e., 5.07 Mt, based on a density of 2.4 t/m³) and 847 t of AMD sludge (dry basis) as shown in Table 26, which is a small proportion of the rock placed.
- ESE: In FY36 there is 9,802,600 bcm of rock (MWM, 2026h) placed in the ESE ELF's (i.e., 23.5 Mt, based on a density of 2.4 t/m³) and 4,353 t of AMD sludge (dry basis) as shown in Table 26, which is a small proportion of the rock placed.
- Across MFS and ESE this equates to 0.02% AMD sludge placed in the ELF's in FY36.

Table 25: Mine Phases and AMD treatment sludge quantities

PHASE	TREATMENT METHOD	TSS CONTRIBUTION	AMD CONTRIBUTION	SLUDGE QUANTITIES (WET)
Construction Phase	Portable active treatment systems	Moderate	Low	Moderate (10,000 to 20,000 m ³ /yr) ¹
Operational Phase	Active water treatment	High	High	High (~40,000 m ³ /yr) ²
Active Closure Phase	Active and passive water treatment	Moderate to low	High decreasing to moderate	High decreasing to moderate (~16,000 m ³ /yr decreasing) ³
Post Closure Phase	Passive water treatment	Low	Moderate	Moderate (~1,000 m ³ /yr) ⁴

Note: General annual estimates of sludge quantities are provided from the WLBM for BPCP sub-areas ESE and MFS (MWM, 2026u,t) for the Operational, Active Closure, and Post Closure phases.

1. Based on 3 wt% solids for the 2-year Construction Phase.

2. Based on 12 wt% solids for the Operational Phase.

3. Based on 12% solids for FY2045.

4. Passive treatment estimated to be >20% solids.

6.6.4 Pond Fines

It is anticipated that high quantities of pond fines will be generated on a weekly basis as part of sediment and erosion control procedures (e.g., check dams, silt ponds, active working pits, etc) during the Operational Phase (as well as to a much lesser extent during the Construction Phase). These materials may contain PAF materials but will not contain WTP or PTS AMD sludge.

The materials will be disposed into pond fine disposal areas, which are simple bunded cells built in the advancing tiphead of the ELF at ESE and MFS, which is the generally accepted approach for the management of these materials. There is no specific designation for where the materials will be placed, other than within an ELF (where sediment loss from the facility is controlled).

6.6.5 Active Treatment: AMD Sludge Quantities

AMD sludge volumes have been calculated based on estimated WTP influent water quality derived from the 'Base Case Water Model' derived in the WLBM for ESE and MFS (MWM, 2026u,t). These data are presented in Table 26 and shows expected sludge volumes from the bottom of the lamella clarifier (e.g., 3 wt%) and after additional mechanical dewatering (e.g., >12 wt%).

AMD sludge quantities (Base Case Water Model) were determined by the following process with the main contributors to AMD sludge being TSS, Fe, and Al and unreacted CaO used to neutralise acidity:

- Data for influent water to the WTP at ESE and MFS were obtained from the WLBM with data being summed into annual loads as tonnes per year (t/yr).
- TSS (t/yr) was provided by the WLBM (dry weight equivalence).
- Al and Fe (t/yr) were converted to Al(OH)₃ and Fe(OH)₃ with a subsequent increase in weight by 2.89 and 1.91 times respectively.

- Acidity (t CaCO₃/yr) was used to determine the amount of unreacted limestone present in the CaO (estimated to be 5% based on typical safety data sheet results for CaO). Hence unreacted limestone (CaCO₃) in the sludge was calculated as 5% of the annual acidity load to the WTP.
- The contribution to sludge volume by trace metals is not significant with regards to the total sludge volume.
- The formation of gypsum was considered minor, mostly because the concentration of sulfate was <1,800 - 2,000 mg/L and hence gypsum is assumed to be under saturation (i.e., will not precipitate).
- TSS + Al(OH)₃ + Fe(OH)₃ + CaCO₃ was then used to calculate the AMD sludge content (dry weight basis).
- AMD sludge was then converted to a wet volume (m³) based on 3 wt% solids (lamella clarifier) and 12 wt% solids (by mechanical dewatering: Process Flow, 2026a) where 1 t = 1 m³ to simplify the calculation.
- An assessment of the acidity load versus the volume of AMD sludge generated (3 wt% solids) was undertaken (i.e., AMD sludge (m³) per tonne of acidity treated). Data indicates that:
 - o Over the active water treatment period the ESE and MFS water treatment plants generate an average of 38 m³ of AMD sludge per tonne of acidity. This is comparable to estimates at Stockton of ~20 – 40 m³ (MWM, 2026o) derived from earlier assessments and site-based experience.
 - o Maximum estimated MFS and ESE AMD sludge volume to acidity load ratios (67 – 117 m³/t) occur in the early years of the BPCP (MFS and ESE) when acidity loads are low in comparison to TSS loads (i.e., TSS loads are higher and acidity loads are lower during this phase of the project). These higher numbers are likely overly conservative as a heavy sediment load will have a higher sludge density, which would decrease the volume of sludge generated per tonne of acidity neutralised.
 - o Lower AMD sludge volumes to acidity loads occurs in the later years of the project when acidity loads are high in comparison to TSS loads (17 - 21 m³/t).

Table 26: AMD Sludge volumes (m³) for ESE and MFS WTP

INDICATIVE YEAR	TOTAL SLUDGE WET 3% SOLIDS		TOTAL SLUDGE WET 12% SOLIDS		TOTAL SLUDGE DRY	
	ESE	MFS	ESE	MFS	ESE	MFS
Year 2027	*	*	*	*	*	*
Year 2028	47,114	*	11,779	*	1,413	*
Year 2029	60,619	10,388	15,155	2,597	1,819	312
Year 2030	65,838	12,313	16,459	3,078	1,975	369
Year 2031	88,960	12,844	22,240	3,211	2,669	385
Year 2032	88,898	15,097	22,225	3,774	2,667	453
Year 2033	103,857	17,441	25,964	4,360	3,116	523
Year 2034	117,838	19,707	29,459	4,927	3,535	591
Year 2035	132,928	27,177	33,232	6,794	3,988	815

INDICATIVE YEAR	TOTAL SLUDGE WET 3% SOLIDS		TOTAL SLUDGE WET 12% SOLIDS		TOTAL SLUDGE DRY	
	ESE	MFS	ESE	MFS	ESE	MFS
Year 2036	145,091	28,247	36,273	7,062	4,353	847
Year 2037	123,436	31,906	30,859	7,977	3,703	957
Year 2038	123,090	32,985	30,773	8,246	3,693	990
Year 2039	107,442	30,099	26,861	7,525	3,223	903
Year 2040	121,239	29,149	30,310	7,287	3,637	874
Year 2041	128,821	33,207	32,205	8,302	3,865	996
Year 2042	113,369	30,930	28,342	7,732	3,401	928
Year 2043	104,894	15,766	26,224	3,942	3,147	473
Year 2044	72,627	3,038	18,157	759	2,179	91
Year 2045	62,137	1,185	15,534	296	1,864	36
Year 2046	20,455	1,173	5,114	293	614	35
Year 2047	17,617	-	4,404	-	529	-
Year 2048	16,083	-	4,021	-	482	-
Year 2049	14,824	-	3,706	-	445	-
Year 2050	13,743	-	3,436	-	412	-
Year 2051	12,972	-	3,243	-	389	-
Year 2052	12,485	-	3,121	-	375	-
Year 2053	12,023	-	3,006	-	361	-
Year 2054	11,619	-	2,905	-	349	-
Year 2055	11,248	-	2,812	-	337	-
Year 2056	10,918	-	2,730	-	328	-
Year 2057	10,721	-	2,680	-	322	-
Total	1,972,905	352,653	493,226	88,163	59,187	10,580

‘-’ Active water treatment is not proposed

* - Construction Phase (green) – Minor AMD treatment with AMD sludge being disposed to Pit 3 Pit Lake at ESE (200,000 m³ capacity) and within a purpose-built construction facility at MFS near the MFS Coal Storage Pad (10,000 m³).

Red text relates to the Active Closure Phase and expected AMD sludge quantities.

The data presented in Table 26 indicates that total AMD sludge quantities that will be generated over the BPCP life of mine at MFS and ESE will be in the vicinity of 600,000 m³ (based on 12% solids), which will be disposed predominantly into ELF's as backfill to purpose constructed cells. Based on 171 Mm³ that will be placed in the ELF's, this quantity of AMD sludge represents 0.4% (wet basis) and 0.04 wt% on a dry basis of the total material placed at ESE and MFS.

6.6.6 Passive Treatment: AMD Sludge Quantities

MSRs are proposed for the passive treatment of basal seepage from ELF's at the ESE and MFS sub-areas. MSR will be installed progressively as mining operations in specific catchments are completed and land rehabilitated.

Projected sludge quantities generated by MSRs at ESE and MFS are shown in Table 27. MSRs require desludging every 5-years with desludging volumes varying depending on acidity and contaminant loads and the size of MSR.

Table 27: AMD Sludge Generation Rates for ESE and MFS MSR

BPCP SUB-AREA	ELF	MSR ACTIVATION DATE	MSR DESIGN ACIDITY (t/yr) ¹	MSR SURFACE AREA (m ²) ¹	SLUDGE QUANTITY AFTER 5 YEARS (m ³)	SLUDGE THICKNESS AFTER 5 YEARS (mm)
-	BV-ELF	-	10	350	74.9	214
ESE	BVE	2058	38.2	1,537	286	186
ESE	CON	2058	174.4	8,339	1,308	157
ESE	NSUL	2046	5.1	1,994	39	19
ESE	PPG	2058	0.1	306	1	3
ESE	WWH	2030	299.1	12,991	2,243	173
ESE	ESC	2030	11.9	245	89	363
MFS	MSR1	2045	11.2	512	84	165
MFS	MSR2	2045	2.7	128	20	159
MFS	MSR3	2045	3.8	345	28	82
MFS	MSR4	2045	16.1	345	121	351
MFS	MSR5	2045	24.2	1,582	182	115
MFS	MSR6	2045	5.3	375	39	105
MFS	MSR7	2045	28.5	1,683	214	127
MFS	MDC1	2029	0.1	49	0.7	15
MFS	MDC2	2029	0.1	42	0.4	10
MFS	MSR8	2047	43.3	2,644	325	123
MFS	MSR9	2047	5.1	331	38	115
MFS	MSR10	2047	2.7	204	20	98
MFS	MSR11	2029	8.6	244	65	265
MFS	MSR12	2029	8.9	244	67	274
Total					5,170	

1. Data from MWM (2026c). Acidity loads are based on the activation date of the MSR as per the WLBM's.

Data indicates that the quantity of sludge generated after 5 years is variable and is a function of the influent acidity load, normalised against the existing BV ELF MSR acidity loads (MWM, 2026h). A total of ~5,170 m³ of sludge will be generated every 5 years once all MSRs are operating at MFS and ESE, although there is a steady decay in loads with time. A time period of 5 years is used as this relates to the expected desludging requirements (e.g., MWM, 2026n).

6.6.7 AMD Sludge Disposal

Proposed AMD sludge disposal options are summarised in Table 28.

Table 28: AMD sludge disposal summary.

MINE PHASE	SELECTED OPTION		EXPLANATORY NOTES
Construction Phase	o	ESE – within Pit 3	Minor AMD treatment is expected in the Construction Phase (~60 t H ₂ SO ₄ /yr and 90 t H ₂ SO ₄ /yr at ESE and MFS respectively) ESE: The existing Pit 3 Pit Lake will be used to settle sludge. Backfill of mine rock will eventually bury this AMD sludge (noting the pit lake will be drained first by pumping to Lake Brazil to drain into Cascade Creek Trib (V8)).
	o	MFS – within a temporary sump built for construction phase water management.	
	o		

MINE PHASE	SELECTED OPTION	EXPLANATORY NOTES
		<ul style="list-style-type: none"> o MFS: A temporary sump of 10,000 m³ will be built near the MFS Coal Storage Pad. This will be operational until the MFS WTP is constructed and will manage treatment (e.g., Ca(OH)₂, MgO, or NaOH) of any AMD and TSS during the Construction Phase. Once the WTP is operating this AMD sludge sump will be backfilled. The MFS facility will require periodic cleaning and removal of AMD sludge to ESE or Stockton to ensure sufficient capacity for AMD sludge settlement in this sump. o In the second year of Construction at MFS and ESE, AMD sludge will be placed in unlined cells within ELF's (BRL, 2026b). o Management processes will be developed to dewater AMD sludge prior to removal and disposal.
Operational Phase	<ul style="list-style-type: none"> o Placement within cells within the ELF's as they are being constructed. AMD Sludge will not be placed in cover layers, NAF¹⁹ layers, or lower sulfur zones (10 m ELF shells, i.e., within 10 m of the ELF final surface). 	<ul style="list-style-type: none"> o Unlined cells within ELF's (BRL, 2025b) where high acid forming (HAF) materials are avoided. o Seepage from ELF's will be fully managed and treated by the two WTP. o AMD sludge may be disposed of with Pond Fines. o Other options for AMD sludge disposal may be investigated during the Operational Phase.
Active Closure Phase	<ul style="list-style-type: none"> o Disposal of AMD sludge onsite. 	<ul style="list-style-type: none"> o AMD sludge from MFS and ESE will be disposed into engineered cells (or other similar management processes) on the ESE Coal Infrastructure area. o AMD sludge may also be transported to Stockton for disposal, which will have operating AMD sludge disposal facilities. o Other AMD sludge disposal options assessed during the Operational Phase will also be considered.
Post Closure Phase	<ul style="list-style-type: none"> o Disposal of AMD sludge onsite. 	<ul style="list-style-type: none"> o AMD sludge will be disposed at Stockton (which will have ongoing AMD treatment), or by other approved methods that may be developed over the Operational Phase of the BPCP for minor quantities of AMD sludge generated in the Post Closure Phase by the MSR.

¹⁹ Non-acid forming

MINE PHASE	SELECTED OPTION	EXPLANATORY NOTES
		<ul style="list-style-type: none"> Other options include disposal to approved offsite landfills.

6.6.8 AMD Sludge Overview

Site-specific studies, discussed in the AMD Sludge Management Report (MWM, 2026o) have highlighted the following AMD sludge management considerations:

- Lower AMD sludge generation rates in the early years of the project that tend to be dominated by sediment rather than Fe- and Al- precipitates.
- High sludge generation volumes during the operational and active closure phases are expected (e.g., prior to transition to passive treatment and lower acidity loads).
- Fe- and Al- rich AMD sludges are sensitive to acidic conditions (higher metal leaching below pH 5–6). Data indicates that trace metals are preferentially mobilised where $Mn > Co = Zn > Ni$.
- Dewatering risks and the ability to influence disposal options (e.g., transportation of sludge material).

6.6.9 AMD Sludge Risks

The contribution to sludge volume by trace metals is not considered significant with regards to volume effects as explained below:

- Al and Fe hydroxides contribute to ~ 95% of the sludge volume (dry weight basis).
Major trace metals (Mn, Ni, Zn hydroxides) contribute ~5% of the sludge volume (1.6%, 0.5%, 2.9% respectively).
- All other trace metals contribute to < 0.5% of the sludge volume (dry weight basis).
- During the Construction Phase the ratio of TSS to Al + Fe load is low with Al + Fe contributing to ~5% of the total sludge volume (dry weight basis) for ESE Year 2028; at the end of the Active Treatment Phase Fe + Al load contributes to ~42% of the total sludge volume (dry weight basis) for ESE Year 2057.

However, studies indicate that trace metals that are preferentially mobilised from sludge ($Mn > Co = Zn > Ni$) are also more difficult to remove by passive treatment using MSR (Mn – 58.6%; Co – 82.8%, Zn, 63.7%, Ni – 40.2%). A higher trace metal load may require a longer active treatment period.

6.6.10 AMD Sludge Management

The following management processes are proposed:

- Develop a management process for AMD sludge disposal that is supported by performance monitoring and adaptive management. This should include recording of AMD sludge volumes and disposal locations within any landforms.

- Performance water quality monitoring of ELF basal seepage should be undertaken to detect any increase in PCOC concentrations due to AMD sludge disposal. This would be identified by an increasing trend in trace metals such as Zn and might require a longer active treatment phase.
- Other AMD sludge disposal options may be assessed throughout Operational Phase for implementation in Active and Pot Closure phases.

7 ASSESSMENT OF ENVIRONMENTAL EFFECTS

7.1 Introduction

Understanding the water balances and PCOC loads for MFS and ESE are critical for assessing potential impacts on the surrounding environment and identifying any requirements for additional treatment or management. It also provides a framework for comparing predictions with monitoring data once the ESE and MFS project sub-areas are operational, helping to refine understanding of potential water-related impacts.

This section summarises the technical studies completed by MWM to understand potential effects of the BPCP on waterways within the MFS, ESE and the UWHR sub-areas. The following reports have been completed:

- Mount Frederick South - Groundwater Technical Report (MWM, 2026p).
- Escarpment Extended Mine Project - Groundwater Technical Report (MWM, 2026q).
- ELF Water Quality and MSR Design Summary (MWM, 2026r).
- Construction Phase Report (MWM, 2026s).
- Mount Frederick South - Water and Load Balance Model (MWM, 2026t).
- Escarpment Extended Mine Project - Water and Load Balance Model Report (MWM, 2026u).

7.2 MFS - Groundwater Technical Report

This report is provided as Appendix Q (MWM, 2026p).

7.2.1 Report Purpose

This report documents the assessment of potential environmental effects related to groundwater for MFS and the report was prepared to achieve the following objectives:

- Develop a Hydrogeological conceptual model for the MFS sub-area to develop an understanding of the system in regard to groundwater and interaction with other environmental receptors.
- Assess potential effects of the MFS sub-area on the environment via groundwater effect pathways during operations and post-closure.

7.2.2 Potential Effects

Potential effects to groundwater quantity and quality were identified, including changes to:

- Groundwater levels, mainly from pit excavation.
- Groundwater flow, mainly from pit excavation.
- Groundwater quality, mainly from seepage from ex-pit and in-pit ELFs.

Potential effects were assessed conceptually, with supporting calculations where appropriate. Findings from the assessment are summarised below in the following sections.

7.2.3 Groundwater Quantity

7.2.3.1 Groundwater Levels:

- Pit excavation and dewatering will intercept the water table, with the degree of drawdown differing between the East Pit and West Pit. During operations and post-closure, the passive drainage of backfilled pit voids will mean this condition likely remains.
- On the eastern side of MFS, the East Pit void is typically deeper and the water table shallower, resulting in localised lowering of the water table by approximately 30 m in the long term, with the cone of depression close to the pit walls given the low permeability geological units intercepted.
- On the western side of MFS, the West Pit void is shallower, and in areas the water table is deeper, meaning that while the pit voids will intercept the groundwater system, the magnitude of drawdown will be lower (e.g., 5 m or less) than at the East Pit void.

7.2.3.2 Groundwater Flows:

- A number of factors indicate changes to the amount of groundwater discharging to streams are likely to be low, including:
 - o (i) pit voids positioned above adjacent stream levels
 - o (ii) lower hydraulic conductivity (K) rock with a localised cone of depression, and
 - o (iii) sealing of intercepted underground workings to prevent uncontrolled discharge.
- The MFS water and WLBM accounts for reduction in groundwater discharge to streams by reductions in natural catchment areas reporting to streams (MWM, 2026t). Other inputs to streams, such as treated water, are also included. Overall, the modelling results suggest an increase in lower flow conditions in the long term (i.e., post-closure) compared to baseline. The discharge of treated water from MSRs greatly offsets any reduction in groundwater discharge.

7.2.4 Groundwater Quality

ELF seepage poses the largest potential risk to groundwater quality.

- The lower K in situ rock compared to the higher K backfill material, coupled with basal and perimeter drainage systems, will promote ELF seepage to collection locations and subsequent treatment. Performance monitoring will be required to confirm ELF seepage is not being transported via groundwater pathways to surface water receptors (e.g., streams).
- At the MFS coal handling area (Coal Transfer Pad, Coal Stockpile Area) the available data suggest a thin soil/unconsolidated deposit profile (~ 3-4 m) underlain by mudstone bedrock. These conditions coupled with basal drainage systems would promote effective collection of any sub-surface seepage.

Runoff from pit floors that remain post-closure is also a risk to groundwater quality should a portion infiltrate to the groundwater system. The lower K pit floor would behave hydrologically in a similar manner to exposed bedrock surfaces, where the majority of rainfall is translated to surface runoff. Infiltration would therefore be a lower proportion of rainfall, potentially in the order of 5% of annual

average rainfall based on regional recharge estimates. Performance monitoring is required to confirm pit floor runoff does not impact groundwater quality.

Known groundwater users are over 4 km away, located on the coastal flats and unlikely to be impacted by the MFS sub-area activities. Any potential effect would be negligible.

7.2.5 *Recommendations*

Although available data suggest favourable conditions for subsurface seepage collection at the Coal Transfer Pad, further investigations to confirm assumptions, including the installation of groundwater monitoring wells are recommended to be completed during the Construction Phase. (these sites are presented in Figure 24).

7.2.6 *Performance Monitoring*

The existing groundwater monitoring network will be impacted by the MFS sub-area, with all except three wells (DC33, DC45, and DC46) likely to be decommissioned. As such, additional groundwater monitoring wells should be installed in key locations. Areas for long term performance monitoring are recommended to target locations positioned between potential sources (e.g., ELF) and receptors (e.g., streams), and in close proximity to sources to provide warning of potential seepage impacting groundwater. Timing of new well installation should occur as far ahead of mining disturbance as is practicable. Hydrogeological testing of wells (e.g., slug tests) would be beneficial to improve the site-specific K dataset.

Efficient collection of in-pit ELF seepage is predicated on maintaining a lower phreatic surface within the backfilled material than that external to the pit (i.e., pit acts as a hydraulic sink to maintain hydraulic containment of seepage). Although the higher K backfill material (compared to in situ rock) and use of underdrains will act to lower the phreatic surface within the in-pit ELFs, high rainfall conditions could theoretically counteract this leading to a higher in-pit phreatic surface than anticipated (and the pit no longer being a hydraulic sink everywhere). Therefore, to complement groundwater monitoring external to the pit, the phreatic surface within the ELF should be monitored to confirm the basal drainage network is performing adequately and the pit remains a hydraulic sink, thereby minimising the potential for ELF seepage to reach surface water receptors. This can be achieved by installing nested vibrating wire piezometers following rehabilitation. In addition, periodic seepage surveys should be completed following rehabilitation to identify any unexpected seepage emerging through the rehabilitation surface. Collection of recommended data will support management processes.

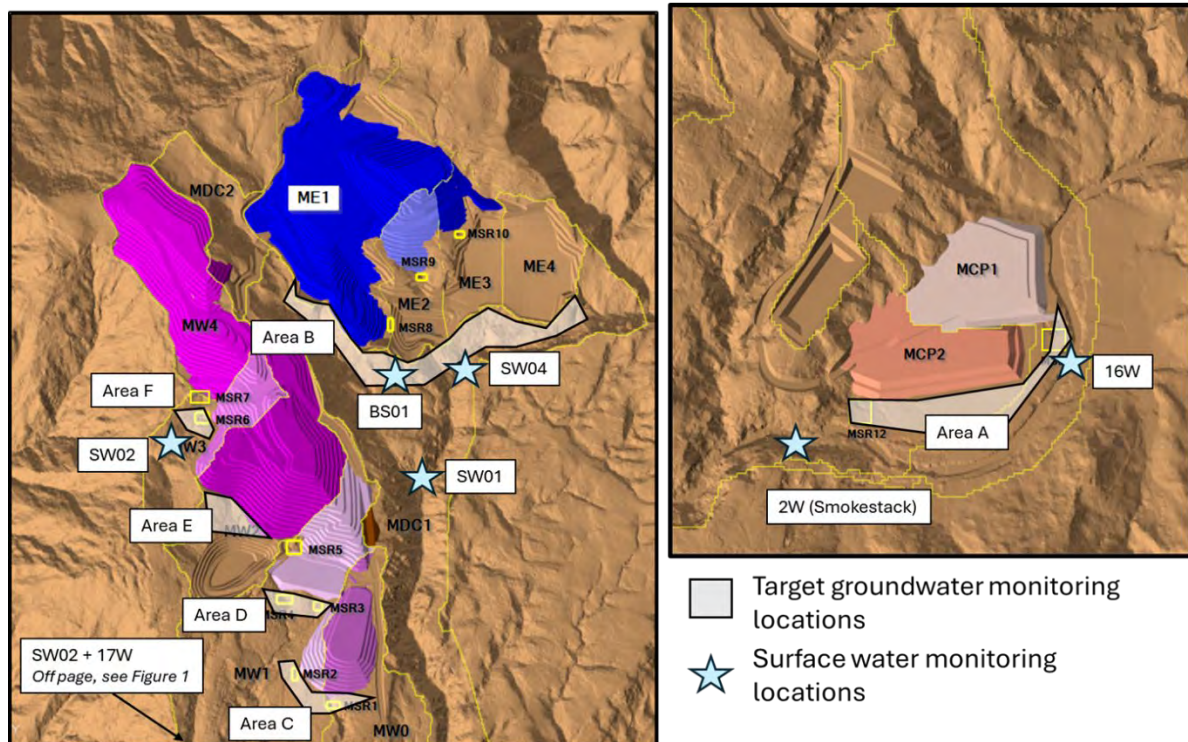


Figure 24: Indicative MFS proposed groundwater monitoring locations.

Basal ELF catchments are shown (e.g., MF4) and final ELFs (purple = West ELF; Blue = East ELF).

7.3 ESE - Groundwater Technical Report

This report is provided as Appendix R (MWM, 2026q).

7.3.1 Report Purpose

This report documents the assessment of potential environmental effects related to groundwater for the ESE project sub-area.

This report was prepared to achieve the following objectives:

- Develop a hydrogeological conceptual model for the ESE project sub-area to develop an understanding of the system in regard to groundwater and interaction with other environmental receptors.
- Assess potential effects of activities at the ESE project sub-area on the environment via groundwater pathways during operations and post-closure.

7.3.2 Potential Effects

This report was prepared to assess potential environmental effects related to groundwater for the ESE project sub-area. Potential effects to groundwater quantity and quality were identified, including changes to:

- Groundwater levels, mainly from pit excavation.
- Groundwater flow, mainly from pit excavation and sealing of underground workings.

- Groundwater quality, from seepage from ex-pit and in-pit ELF's and sealing of underground workings.

Potential effects were assessed conceptually, with supporting calculations where appropriate. Findings from the assessment are summarised below in the following sections.

7.3.3 Groundwater Quantity

7.3.3.1 Groundwater Levels:

- o Pit excavation and dewatering will intercept the water table, forming a groundwater sink during operations. During operations and post-closure, the passive drainage of backfilled pit voids will mean this condition likely remains.
- o The degree of change in groundwater level will vary by location across the ESE sub-area. Near existing underground workings (BRL, 2024) that have already lowered groundwater levels on the eastern side of the ESE sub-area (~40% of the pit area), pit excavation and dewatering are estimated to reduce groundwater levels in the region of 5 m in the long term. Given the interpreted low permeability nature of the hydrogeological units, the cone of depression is estimated to remain close to the pit footprint, with limited drawdown away from the pit walls
- o On the western side of the ESE sub-area where groundwater levels are interpreted to be shallower with an absence of existing underground workings, groundwater levels may be lowered in the range of 50 to 70 m in places close to the pit in the long term.
- o Given the distance between the ESE pit and groundwater users (>4 km), effects are interpreted to be less than minor.

7.3.3.2 Groundwater Flows:

- In the Whareatea River catchment, discharge of groundwater to streams and rivers will be reduced as contributing catchment is mined out and the pit void acts as a groundwater sink. However, the more permeable nature of ELF's compared to the undisturbed insitu BCM means treated ELF seepage will offset any changes in groundwater discharge to the Whareatea River. Overall, changes in groundwater flow to streams and rivers is interpreted to be negligible relative to treated water discharges. Changes in low flow conditions are assessed further in the ESE WLBM provided by MWM (2026u).
- Mining out and sealing off the existing underground workings within the pit footprint will reduce the amount of underground mine discharge to the Cascade Creek catchment by approximately 40%. Changes in low flow conditions are assessed further in the ESE WLBM.

7.3.4 Groundwater Quality

7.3.4.1 ELF Seepage

- In most cases, ex-pit and in-pit ELF seepage will be collected for treatment. Areas where ELF seepage could pool and develop a driving head towards surface water receptors were identified. Calculated flow rates were orders of magnitude lower than anticipated low flow

conditions, suggesting dilution factors of 10^3 or more. In stream water quality is assessed further in the ESE WLBM.

7.3.4.2 Cascade Creek AMD Load

- Mining out and sealing off of existing underground workings is estimated to reduce the AMD load by similar amounts as to reductions in flow (i.e., ~40%) with discharge water quality remaining similar.

Recommendations for forward works to confirm assumptions made in this assessment are as described below.

7.3.5 *Recommendations*

This assessment has been completed based on estimates of hydraulic properties (e.g., hydraulic conductivity, K) of the BCM and Basement units documented in other areas of the Buller Plateaux. Available data is considered sufficiently representative to be applied to the ESE sub-area for this assessment. Prior to operations commencing in the ESE sub-area it is recommended that a hydrogeological characterisation programme is completed to confirm this assumption remains appropriate. The following programme partitioning is proposed:

- Prior to operations commencing, complete a hydrogeological characterisation programme focused on the eastern portion of the ESE-sub area (Stage 1 through 4). Performance monitoring wells will be established in Area B (Figure 25).
- During operations, complete a hydrogeological characterisation programme focused on the western portion of the ESE-sub area (Stage 5 onwards). Performance monitoring wells will be established in Area A. MWM recommend this second programme occur no less than one year before Stage 5 occurs to advance understanding of pre-mining groundwater condition in the western portion of the ESE sub-area.

Both programmes will focus on confirming hydraulic properties, groundwater levels and background groundwater quality

7.3.6 *Performance Monitoring*

Based on interpretation of currently available data, the pit is anticipated to act as a groundwater sink long term (except for the identified zone of sub-ELF pooling). A reasonable amount of groundwater level data to the eastern side of the pit is available to support this interpretation. However, performance monitoring is required to confirm this condition is maintained. It is recommended further hydrogeological characterisation works be completed during the construction phase to (i) confirm groundwater levels on the western side of the pit area remote from underground workings, and (ii) allow for groundwater monitoring (water levels and quality) between the in-pit ELFs and surface water receptors to confirm the pit does act as a groundwater sink, thereby limiting potential pathways to receptors (i.e., performance monitoring). Monitoring areas are shown in Figure 25.

Efficient collection of in-pit ELF seepage is predicated on maintaining a lower phreatic surface within the backfilled material than that external to the pit (i.e., pit acts as a hydraulic sink to maintain hydraulic containment of seepage). Although the higher K backfill material (compared to in-situ rock) and use of underdrains will act to lower the phreatic surface within the in-pit ELFs, high rainfall conditions could theoretically counteract this leading to higher in-pit phreatic surface than anticipated (and the pit no

longer being a hydraulic sink everywhere). Therefore, to complement groundwater monitoring external to the pit, the phreatic surface within the ELF should be monitored to confirm the basal drainage network is performing adequately and the pit remains a hydraulic sink, thereby minimising the potential for ELF seepage to reach surface water receptors. This can be achieved by installing nested vibrating wire piezometers following rehabilitation. In addition, periodic seepage surveys should be completed following rehabilitation to identify any unexpected seepage emerging through the rehabilitation surface. Collection of this data will support management processes.

Changes to underground workings flows and AMD loads reporting to Cascade Creek should be confirmed by monitoring creek flow and water quality in this catchment. This monitoring programme needs to be developed to confirm betterment opportunities.

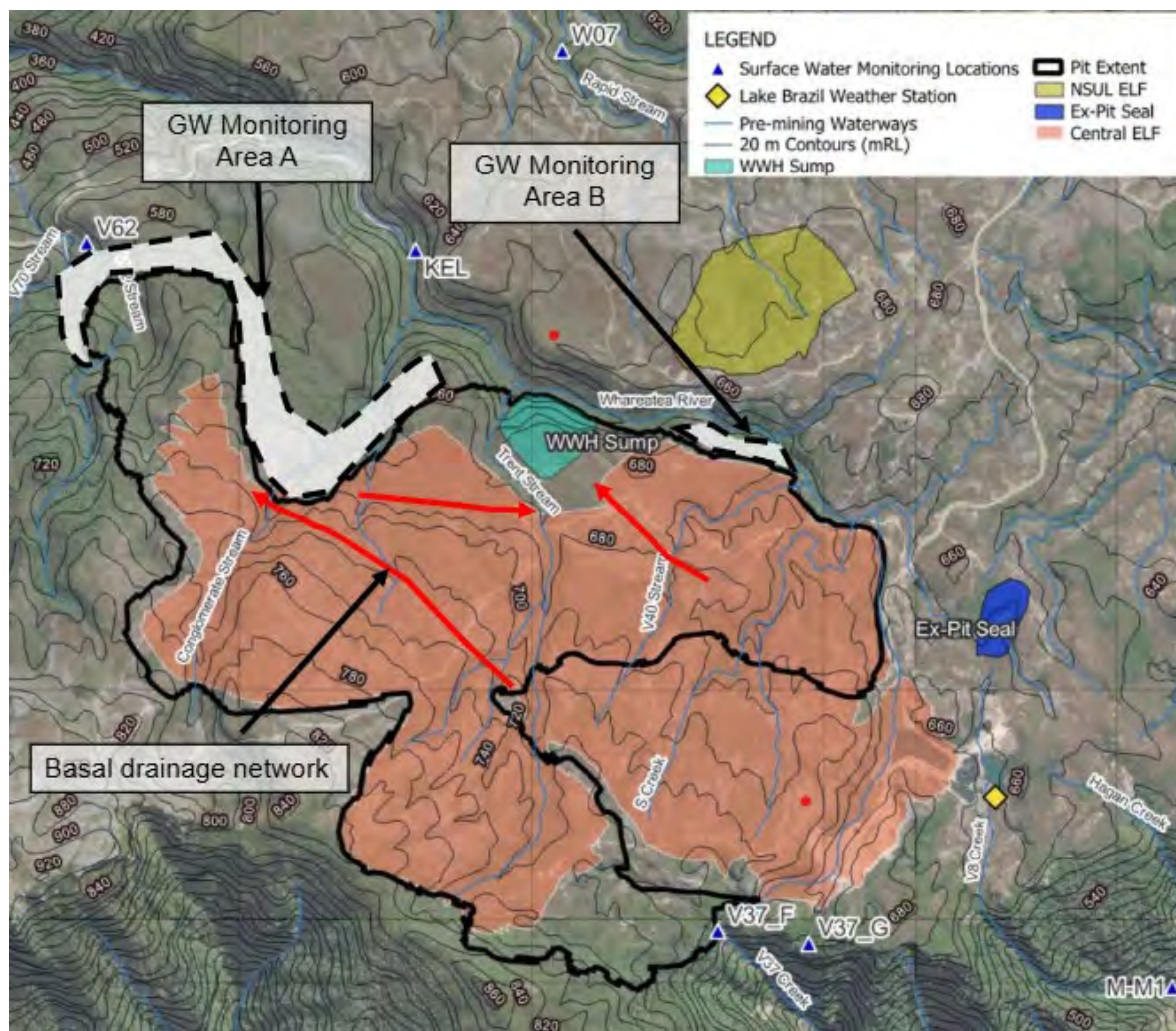


Figure 25: Indicative ESE proposed groundwater monitoring areas.

7.4 ELF Water Quality and MSR Design Summary

This report is provided as Appendix S (MWM, 2026r).

7.4.1 Introduction

The mine domain with the greatest source hazard risks (60-80% of total site AMD load) are waste rock storage facilities (e.g., INAP, 2020), that include waste rock dumps having no engineering controls to

control sulfide mineral oxidation or the mobilisation of secondary sulfide oxidation products. ELF's are proposed for the BPCP to minimise the generation of AMD arising from waste rock storage, although poor water quality associated with AMD is expected for many decades and will require management.

To understand effects of ELF basal seepage water quality over the Operational, Active Closure, and Post Closure phases required understanding individual ELF water quality for each basal catchment during the construction, stabilisation and decay phases as shown in Figure 21.

7.4.2 Report Purpose

The purpose of this report was to address the following:

- Provide water quality (source terms) for the ELF basal sub-catchment flows that may require management/treatment. These ELF basal sub-catchments are shown in Figure 26 for ESE and in Figure 27 for MFS. Dynamic source terms for each ELF basal catchment were derived that show evolution of ELF water quality with time. ELF basal catchment source terms were developed for:
 - o Concentrations / loads at the end of the ELF stabilisation period.
 - o Decay curves for concentration / load of PCOC, which are extrapolated forward in time from the end of the stabilisation phase.
 - o Long term concentrations / loads of PCOC due to oxygen flux through the cover system (with and without the benefits of acidity neutralisation by limestone).
- Provide a summary of the key design criteria for each MSR based on the preliminary ELF seepage source terms and forecast load / flow rates for each ELF where flow rate drives the basis of these designs.
- Identify when the transition from active treatment to passive treatment of AMD is considered feasible.

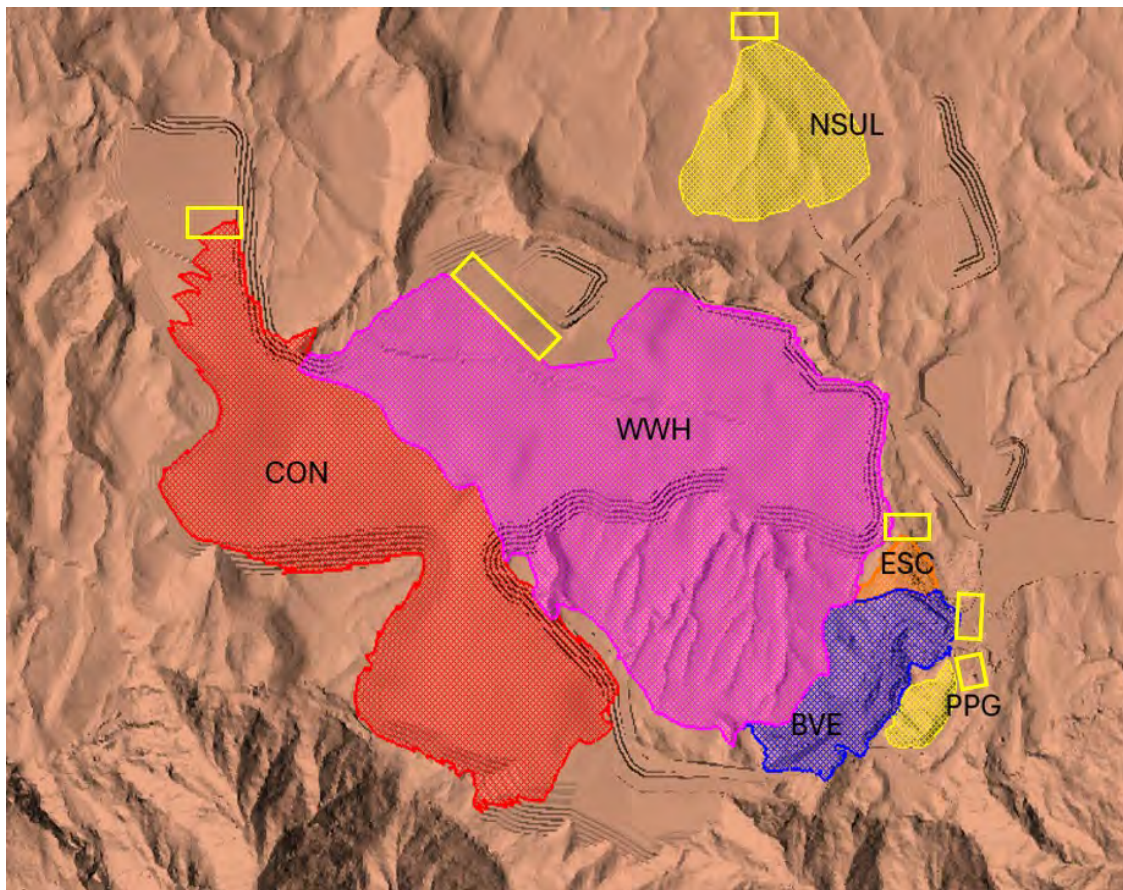
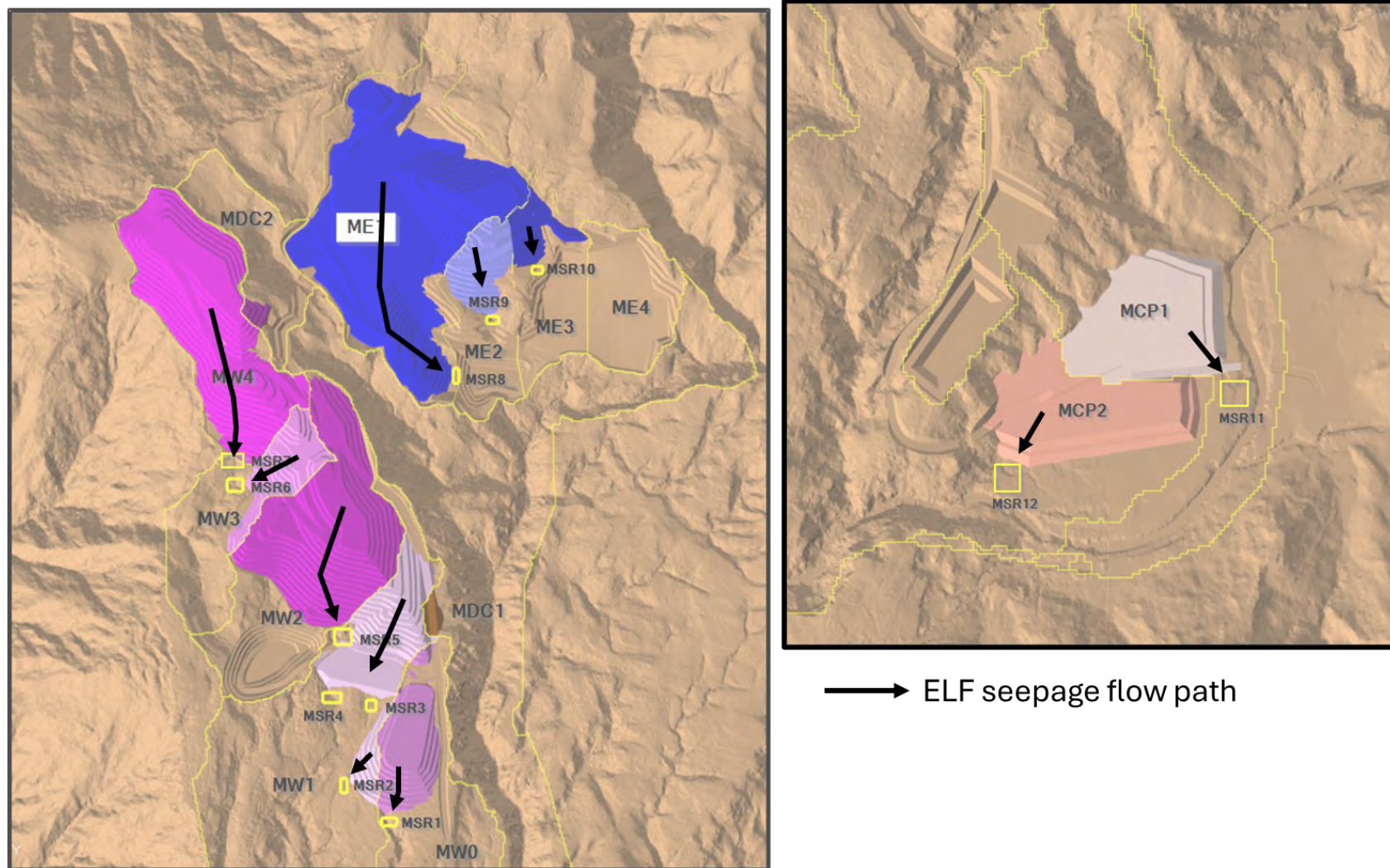


Figure 26: Escarpment Extended Project ELF basal sub-catchments and indicative MSR locations.
MSR Locations shown by yellow boxes



7.4.3 Acidity Loads

The report summarised the acidity loads for each proposed ELF basal sub-catchment associated with the MFS and ESE. The estimated PCOC loads were based on the BV ELF water quality model that was developed to understand water quality expectations for the project and potential AMD risks (i.e., treatment AMD treatment requirements). This provides a reliable estimate of water quality based on known relationships to sulfate in water and measured sulfur within the source hazard materials.

Three ELF water quality phases were considered in the modelling:

- Construction Phase
- Stabilisation Phase
- Decay Phase

7.4.3.1 Peak Acidity Loads

Maximum acidity loads for each ELF are summarised Table 29. Typically, the highest loads occur during the ELF construction phase, which is a function of material movement and stored oxidation products being mobilised. Figure 28 and Figure 29 present this data graphically for ESE and MFS respectively.

These peak acidity loads will be treated in ESE and MFS active WTPs.

Table 29: ELF acidity load summary – ELF Construction Phase.

BASAL ELF SUB-CATCHMENT	PEAK ACIDITY t/yr	FY
BVE	352.6	2029
CON	1551.3	2041
NSUL - Closure	28.7	2032
PPG	2.5	2030
ESC	28.8	2028
WWH	3802.1	2037
MSR1	35.5	2029
MSR2	6.6	2028
MSR3	9.0	2029
MSR4	62.3	2037
MSR5	58.4	2035
MSR6	11.1	2035
MSR7	62.7	2037
MDC1	0.10	2029
MDC2	0.08	2037
MSR8	133.4	2041
MSR9	10.9	2038
MSR10	3.2	2040
MSR11	17.9	2028
MSR12	19.5	2028

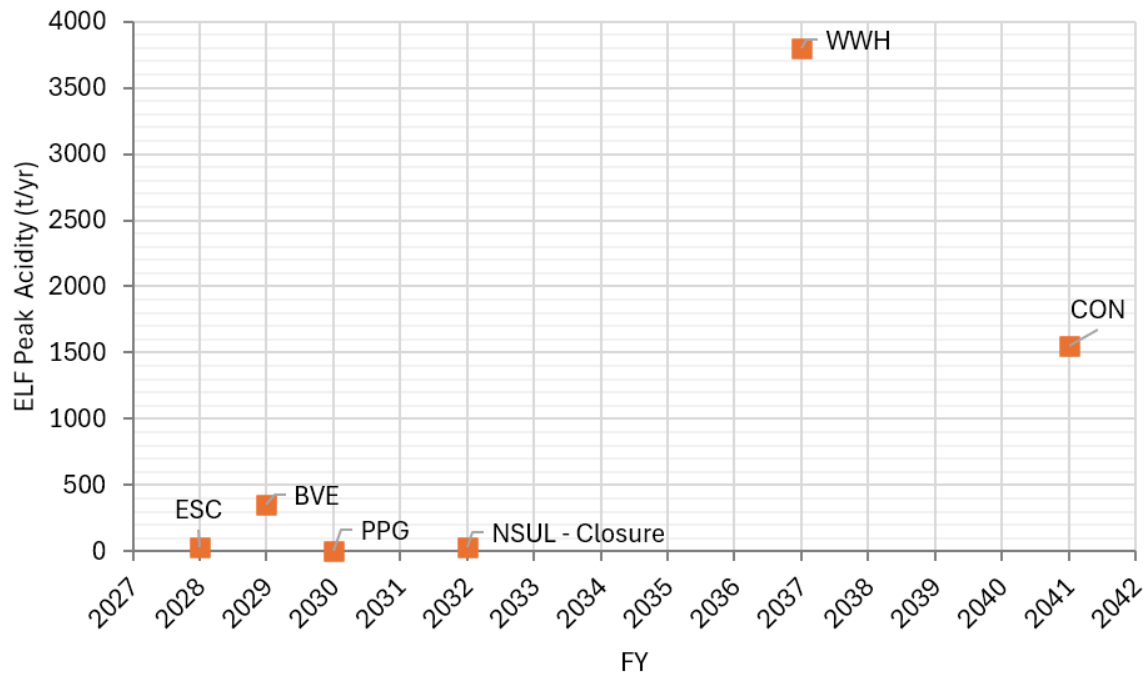


Figure 28: ESE peak ELF acidity loads.

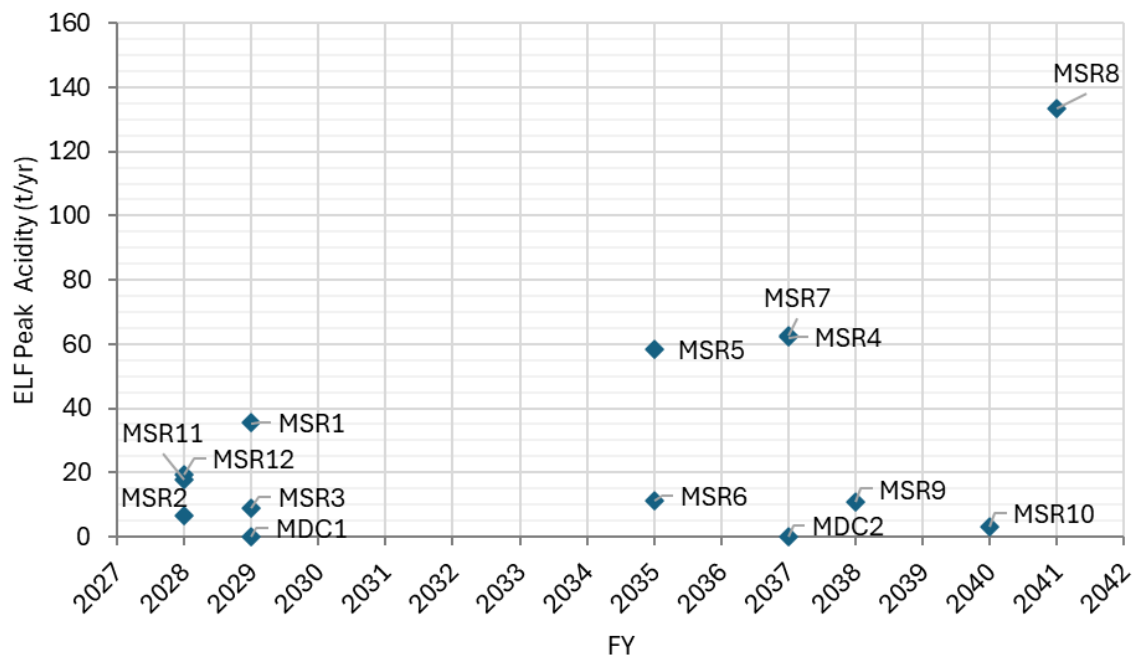


Figure 29: MFS Peak ELF acidity loads.

7.4.3.2 Long Term Acidity Loads

In the long term, the ongoing acidity generation risk (and other PCOC) is driven by oxygen flux through the rehabilitated surfaces (with the assumption that significant ingress of oxygen is excluded by ELF design to eliminate advective airflow pathways).

Cover modelling (Section 5.4.5) suggests that the long-term average diffusive oxygen flux through the cover system could range between ~100 to 230 g/m²/yr for shrubland and forest, which translates to an acidity load of 1.6 to 3.8 t/ha/yr.

The midpoint between the reported acidity load range, 2.7 t/ha/yr, was adopted as a starting point for the BPCP ELF, with the following adjustments made:

- It is expected that parts of the ELF contain materials that are effectively unreactive and do not contribute to the PCOC load or water chemistry. Price (1997) notes that >75% of the mass in a waste rock landform occurs as coarse particles in which the mineralogy is almost entirely occluded from oxygen and water with drainage chemistry being controlled by a relatively small portion of the mass, which is finer grained particles. Malmström et al. (2000) noted that ~65% of the water in a waste rock stack was mobile and 35% was immobile at the Aitik Copper mine (Sweden). At the Island Copper Mine (Vancouver), Lopez et al. (1997) notes that only 42% of the total area of the waste rock pile contributes to flow. Such studies indicate that 35 – 58% of water interacting in a waste rock landform may be immobile and will not contribute to drainage water chemistry.
 - o For this study it is assumed that 65% of the rock contributes to the observed acidity load that will be measured as ELF toe seepage and that oxidation may occur in the other 35% yet the oxidation products are immobile. Based on an initial load of 2.7 t/ha/yr, the long-term loads are assumed to be ~1.8 t/ha/yr with the assumption that parts of the acidity generated is occluded and will not be mobilised.
 - o For NAF ELFs, acidity is not expected due to neutralisation of any sulfide mineral oxidation acidity by the inherent ANC of the materials. Hence the acidity load of ~1.8 t/ha/yr is represented by a comparable sulfate load that is obtained from the model (MWM, 2026a). This is then used to forecast other PCOC to provide an indication of passive treatment duration for NAF ELFs.
- Data from the BV ELF water quality study (Section 4.9.2) indicates that half the acidity that is generated by sulfide mineral oxidation is neutralised by limestone (and ANC) within the ELF. This will also contribute to lower long-term acidity loads reporting from the ELF as toe seepage. Hence, based on a load of ~1.8 t/ha/yr this would suggest that the long-term acidity load could be as low as 0.9 t/ha/yr provided the limestone treatment (and ANC) of the ELF remains effective into the future.
- Two long term acidity models are presented for PAF ELFs using acidity loads derived from oxygen flux of to acknowledge that the limestone neutralisation may not be available in the long term:
 - o 1.8 t/ha/yr for oxygen flux derived loads (without limestone/ANC benefits).
 - o 0.9 t/ha/yr for oxygen flux derived loads with limestone/ANC benefits on acidity loads.
- The derivation of this long-term load provides an estimate of when passive treatment of ELF seepage could be considered.
- In the longer-term it is anticipated that the rate of oxygen flux through the cover system will decrease as vegetation becomes established, soils become thicker, and the depth of oxygen ingress to react with pyrite is greater. This will lead to lower acidity generation rates:
 - o A decrease in acidity loads of 0.62% per year is applied to the model once long-term rates are met. This is comparable to the Stockton AMD Liability model for long term

acidity decay (O'Kane Consultant, 2015). Further details of this model are provided in MWM (2026h).

- o The longer-term rate commences at the point the decay model decay matches the long-term acid load derived from oxygen flux

7.4.4 *Passive Treatment*

The proposed approach using MSR to treat AMD impacted waters is based on ~20 years of experience and research with over a decade of operational experience at Stockton as discussed by MWM (2026e). These studies indicate a key design standard of MSR is the surface area. Numerous studies show that for 1 L/s flow, a surface area of ~100 m² is required. Space has been provided in mine planning to ensure this key design feature is not compromised.

However, there are potential treatment capacity risks for long term passive treatment of AMD impacted waters associated with ELF basal seepage. Passive treatment capacity risk (based on industry guidance (e.g., INAP, 2021)) for each ELF basal sub-catchment have been assessed to identify that in most cases MSR flows and loads are appropriate except for the larger ELFs. This is discussed below:

Suitable:

- **Green:** ≤ ~50 t/yr acidity.
- **Green:** ≤ ~50 L/s average flow rate.

Suitable but two systems may be required:

- **Orange:** < ~100 t/yr acidity (two reactors may be required) but > 50 t/yr acidity.
- **Orange:** < ~100 L/s average flow rate (two reactors may be required) but > 50 L/s average flow rate.

Suitable but multiple systems may be required:

- **Red:** > ~100 t/yr acidity (multiple reactors may be required).
- **Red:** > ~100 L/s average flow rate (multiple reactors may be required).

Results (Table 30) indicate that two MSR treatment systems may have capacity constraints. Performance monitoring work is recommended to confirm that multiple MSR reactors are effective and/or the use of other technologies that can increase treatment rates / treatment efficiencies are suitable. The timeframe to transition from active treatment to passive treatment will be reconsidered depending on the outcome of operational monitoring of MSR's. If a passive system is found to comprise water treatment, active treatment will be continued.

Water management scheduling provided by BRL has been used to identify the MSR scheduled start dates.

Table 30: MSR treatment capacity summary.

MSR	FLOW RATE (L/S) ¹	ACIDITY LOAD RANGE (t/yr) ^{2,3}	ACIDITY LOAD AT MSR START DATE (t/yr) ²	MSR ACTIVATION DATE (FY) ⁴	COMMENTS
BVE	13.9	21.1 (42.7)	38.2	2058	No issues anticipated
CON	75.3	86.0 (174.4)	174.4	2058	Potential capacity constraints (flow and load). Consider: <ol style="list-style-type: none"> 1. Multiple MSR (possibly up to 4) 2. Increased desludging to maintain optimal flow rates 3. Other treatment technologies. 4. Longer term active treatment
NSUL-Closure	14.7	(10.5) ²	3.4	2046	No issues anticipated: NAF ELF – treatment for Zn + other PCOC
PPG	2.76	(1.6) ²	0.1	2058	No issues anticipated: NAF ELF – treatment for Zn + other PCOC
ESC	2.36	3.1 (6.2)	11.9	2030	No issues anticipated
WWH	117	153.1 (310.4)	299.1	2058	Potential capacity constraints (flow and load). Consider: <ol style="list-style-type: none"> 1. Multiple MSR (possibly up to 6) 2. Increased desludging to maintain optimal flow rates. 3. Other treatment technologies. 4. Longer term active treatment
MSR1	4.63	5.8 (11.7)	11.2	2045	No issues anticipated
MSR2	1.15	1.4 (2.9)	2.7	2045	No issues anticipated
MSR3	3.12	2.0 (4.1)	3.8	2045	No issues anticipated
MSR4	3.12	5.3 (10.7)	16.1	2045	No issues anticipated
MSR5	14.3	16.7 (25)	24.2	2045	No issues anticipated
MSR6	3.39	4.0 (5.5)	5.3	2045	No issues anticipated
MSR7	15.2	17.7 (29.6)	28.5	2045	No issues anticipated
MDC1	0.45	(0.1)	0.1	2029	No issues anticipated; potential to use low S overburden (i.e., <0.015 wt%) and remove the need for Post Closure Phase passive treatment.
MDC2	0.40	(0.1)	0.1	2038	No issues anticipated; potential to use low S overburden (i.e., <0.015 wt%) and remove the need for Post Closure Phase passive treatment.
MSR8	23.9	29.1 (43.5)	43.3	2047	No issues anticipated
MSR9	2.99	3.4 (5.2)	5.1	2047	No issues anticipated
MSR10	1.84	2.3 (2.8)	2.7	2047	No issues anticipated
MSR11	2.20	2.6 (5.2)	8.6	2029	No issues anticipated
MSR12	2.21	2.6 (5.3)	8.9	2029	No issues anticipated

1. Final catchment data as provided by BRL in the WLBM
2. From BRL rehabilitation model data
3. Numbers relate to oxygen flux based on limestone being available (1.35 t/ha/yr) and numbers in brackets represent the potential acidity load if the limestone was exhausted (2.7 t/ha/yr). Numbers are prior to exclusion of occluded zones in the ELF (35%).
4. As provided in the WLBM

7.4.5 Summary

Estimated total flow rates that will require passive treatment for MFS and ESE (Table 30) was determined to be ~300 L/s across all MSRs. Based on MSR sizing this will require ~50,000 m³ of shells for the construction of these systems.

The completion of the transition from active treatment of ELF seepage to all seeps being treated by passive treatment technologies would be in approximately FY 2058 (transition to passive treatment of CON ELF at Stage 20) with transition to total passive treatment at MFS in 2057 (Stage 19).

The following variables will influence this timeframe:

- Mining rates.
- Accuracy of the models to forecast ELF basal seepage quantity and quality.
- Longer active treatment requirements
- Financial drivers to switch from an existing active treatment plant (sunk capex) to a passive treatment system (new capex), and comparative operating costs
- The ability to treat higher flow rates, higher acidity loads, and PCOC loads to achieve water quality objectives.
- Passive treatment technology advances over the next few decades.
- Water quality objectives and community expectations.

7.5 Construction Phase Report

This report is provided as Appendix T (MWM, 2026s).

7.5.1 Report Purpose

This report provides an assessment of effects and identifies management strategies to address the management of AMD and TSS associated with the Construction Phase of the BPCP that is two years of duration across the sub-areas, which includes:

- Road Construction (UWHR and the MFS Access Road).
- Construction activities at MFS and ESE sub-areas (e.g., preliminary earthworks to construct water management infrastructure and ancillary infrastructure, and mine pre-development activities).

The proposed management activities relate to the BPCP time-period when the active water treatment plants (WTPs) and associated ponds (e.g., surge ponds) have not yet been constructed and commissioned at MFS and ESE in their entirety, and small portable water treatment plants, or engineering controls, are required. The Construction Phase is two years at ESE and MFS.

The objectives of this report, based on a traditional Source-Pathway-Receptor (SPR) risk assessment process, are to:

- Identify the potential source hazards for elevated AMD and TSS within these locations during the Construction Phase.

- Identify potential receptors (i.e., waterways) that could be affected by TSS and AMD, given pathways exist from the source hazards to the receptor during the Construction Phase.
- Explain how related risks will be minimised and what mitigation methods will be utilised.
- Explain what performance monitoring will be undertaken.

Some infrastructure, such as the haul and access roads, will remain into the Post Closure Phase. Hence, to minimise long term management requirements, it is proposed that source control technologies are utilised to minimise effects for the long term (i.e., utilise controls in the Construction Phase that will be suitable for the Closure Phase). Therefore, the assessment of effects for the UWHR and MFS Access Road during the Construction Phase may be relied on to manage effects during the later mining phases.

7.5.2 AMD Source Hazards

Two AMD source hazards have been identified for the BPCP prior to the commissioning of the WTP at ESE and MFS:

- Cut surfaces (e.g., road cuttings, infrastructure area cuttings, soil stripping) through BCM and KMS (and potentially quaternary materials) with the potential to generate AMD.
- Fill areas (i.e., where depressions in the topography are filled with rock to raise the original surface as part of construction of a road or infrastructure area) and engineered landforms (ELFs) that have the potential to generate AMD seepage from these fill structures.

7.5.3 AEE: UWHR and MFS Access Road

An assessment was undertaken to quantify the potential effects to the receiving environment using the Waimangaroa River water monitoring location 2W ('Smokestack'). This location was selected as:

- The location is below the initial section of MFS Access Road crossing over the Waimangaroa River and the MFS infrastructure area.
- The location is downstream of a significant portion of the proposed UWHR.
- The location has a longer history of water quality data collection when compared to site 17W further downstream.

Monitoring of any effects on water quality during the Construction Phase will be undertaken at:

- Deep Stream at SW01 and SW03 relating to the construction of the MFS Access Road and initial access to the MFS mining area.
- Waimangaroa River at 2W (Smokestack) relating to the construction of the UWHR and initial section of the MFS Access Road.
- Waimangaroa River at 17W to assess effects of MFS and the UWHR.
- Burnetts Creek at BUR.L1 relating to the construction of the UWHR, where turbidity data are used for performance monitoring.
- Waimangaroa River at WRBBC, 14W, 15W and 16W relating to the construction of the UWHR, as performance monitoring.

The following potential effects were identified:

- For cut road surfaces, the screening assessment for AMD indicates that the additional AMD load from cut surfaces has limited impact based on the amount of exposed cut surfaces (2.63 ha). The key driver of poor water quality at 2W (Smokestack) is the current background water quality associated with historic mining activities.
- For fill areas, load modelling indicates that acidity could increase by 0.94 mg CaCO₃/L at Smokestack, which is ~16% of the current (background) acidity measured at Smokestack (6.0 mg CaCO₃/L) if no management was undertaken.
- Management of the larger fill areas associated with the UWHR and the MFS Access Road (nominally identified as > 2 m high and >10,000 m³, identified as ~62% of the total BCM fill areas) is recommended to minimise AMD effects in the longer term (i.e., planning for closure) by undertaking source control activities during the Construction Phase by:
 - Construction of larger fill areas as engineered fill areas (EFA) using design principles discussed in the engineered landform (ELF) design philosophy report (MWM, 2026n). The specific design objectives for EFA are explained in the AMD ELF MP (BRL, 2026d).
 - Installing a low permeability layer (LPL) or geosynthetic clay liner (GCL) atop PAF fill material to minimise net percolation into these materials.
- A suitable performance monitoring program for the roads to ensure that any AMD effects are acceptable is described in the AMD Water Management Plan (Ref 2026c).

TSS (in the absence of AMD) was not considered herein as it is assumed that management processes within the Erosion and Sediment Control Plan for Land-Disturbance Activities (BRL, 2026f), which is considered best practise for managing TSS and follows guidance from GD05 (Auckland Regional Council, 2023), are implemented and achieve appropriate management of TSS.

7.5.4 MFS and ESE Infrastructure Areas

Infrastructure will be constructed at ESE, in the vicinity of disturbance at the existing Escarpment Mine, with ancillary structures constructed around the planned ESE mine site. A box cut and mine development activities will be undertaken. At MFS, infrastructure will be placed at the bottom of the MFS Access Road, adjacent to the Waimangaroa River, and at the base of the planned MFS West Pit.

Monitoring of any effects on water quality during the Construction Phase will be undertaken at:

- Deep Stream at SW03, relating to the MFS West Pit Sump and associated ELF's, and Infrastructure Pad construction.
- Waimangaroa River at 2W (Smokestack) relating to the MFS WTP Infrastructure Area and Coal Pad.
- Waimangaroa River at 17W relating to all MFS construction cumulative effects.
- Cascade Creek Trib (V8) at MM1 relating to the ESE construction effects.
- Performance monitoring of BUR.L1 (Burnett Stream), and compliance monitoring of KEL (Whareatea River) and W07 (Rapid Stream), to identify any effects from the Construction Phase on these waterways.

Moderate amounts of overburden will be moved during the Construction Phase, which could generate moderate acidity and AMD sludge loads (Table 31). The derivation of these loads (acid and AMD sludge) is explained in MWM (2026o).

Table 31: Construction Phase acidity loads and AMD sludge volumes

BPCP SUB-AREA	INDICATIVE YEAR	PROJECT STAGE	OVERBURDEN MOVED (bcm)	ACID LOAD (t/yr)	AMD SLUDGE (3 wt% SOLIDS) m ³
MFS		Stage -1	395,600	42	4,831
MFS		Stage 0	1,394,100	147	17,023
MFS		Stage 1	850,700	89	10,388
ESE		Stage -1	659,200	61	7,143
ESE		Stage 0	4,348,200	404	47,114

Green cells relate to the Construction Phase. Grey Cells are the first year of the WLBM for MFS and ESE (MWM, 2026j,k).

AMD sludge quantities explained in MWM (2026l).

bcm = bank cubic metres.

For reference, the Barren Valley ELF (~350,000 m³; ~750,000 t) that has been constructed at the existing Escarpment Mine generates 10-20 t/yr of acidity, which indicates the proposed acidity loads are suitable as analogue data for planning purposes (i.e., treatment requirements). The acidity and TSS loads that can be practicably captured and controlled will be treated by pWTPs and/or passive treatment processes until the permanent WTP can be commissioned.

During the Construction Phase, AMD treatment is expected to generate AMD sludge, which will be disposed of within Pit 3 Pit Lake at ESE (200,000 m³ capacity) and within a purpose-built 10,000 m³ sump at MFS near the MFS Coal Pad.

7.5.5 Summary

Table 32 provides a summary of AMD and TSS source hazards and potential risks before and after engineering controls are proposed. Performance monitoring is also proposed to ensure that the engineering controls are effective.

Table 32: AMD and TSS Source Hazard Management.

SOURCE HAZARD	PRIOR TO ENGINEERING CONTROLS	AFTER ENGINEERING CONTROLS ARE IMPLEMENTED	MONITORING
AMD			
Cut Surfaces	Wall runoff and cut surfaces can generate AMD.	Clean water diversion, control and direction of waters to sediment retention ponds. Ensure surfaces are clean with minimal fines left in place that could generate AMD. If required direct break-in waters to the pWTP.	Targeted monitoring at source (i.e., at the base of highwalls) to confirm effects are minor. Compliance and Performance monitoring.
Rock Fill Areas	Larger fill areas could generate AMD seepage.	Construct fill area as EFAs to minimise oxidation of materials. Install low permeability layers (LPLs) or Geosynthetic Clay Liners (GCLs) to minimise NP.	Targeted monitoring at source (i.e., seepage) to confirm effects are minor.

SOURCE HAZARD	PRIOR TO ENGINEERING CONTROLS	AFTER ENGINEERING CONTROLS ARE IMPLEMENTED	MONITORING
			Compliance and Performance monitoring.
Infrastructure areas, ELF's and Coal Pads	Larger fill areas could generate AMD seepage.	Construct fill area as ELF's to minimise oxidation of materials. Collect all seepage and treat, either through a mussel shell bioreactor (MSR) or by a pWTP.	Targeted monitoring at source (i.e., seepage) to confirm effects are minor. Compliance and Performance monitoring.
TSS			
Cut Surfaces	Wall runoff and cut surfaces can erode leading to elevated TSS in runoff.	Clean water diversion, control and direction of waters to sediment retention ponds. Ensure surfaces are clean with minimal fines left in place that could contribute to sediment loss. Sediment control as proposed in the erosion and sediment control management plans (BRL, 2026a, 2026f)	Targeted monitoring at source (i.e., at the base of highwalls) to confirm effects are minor. Compliance and Performance monitoring.
Rock Fill Areas	Surfaces can erode leading to elevated TSS in runoff.	Clean water diversion, control and direction of waters to sediment retention ponds. Sediment control as proposed in the erosion and sediment control management plans (BRL, 2026a, 2026f)	Targeted monitoring to confirm effects are minor. Compliance and Performance monitoring.
Infrastructure areas, ELF's and Coal Pads	Surfaces can erode leading to elevated TSS in runoff.	Clean water diversion, control and direction of waters to sediment retention ponds. Sediment control as proposed in the erosion and sediment control management plans (BRL, 2026a, 2026f)	Targeted monitoring to confirm effects are minor. Compliance and Performance monitoring.

Red = higher risk; orange = moderate risk; green = lower risk

The following recommendations are provided:

- Complete (as part of the feasibility study) further infill drilling ahead of construction along the UWHR and MFS Access Road to confirm the AMD and geotechnical nature of materials.
- Complete during the detailed design phase an assessment of AMD seeps (natural and historic) along the UWHR to map the specific sources of baseline effects.
- Ensure construction of EFAs to minimise AMD meets design requirements as explained in the AMD ELFMP (BRL, 2026d).
- Update the water and load balance model prior to the commencement of the Construction Phase for ESE and MFS to ensure effects are understood and water treatment infrastructure is appropriate.

- Undertake an adaptive management approach for the Construction Phase and ensure adaptive management processes are in place and are explained in the AMD WMP (BRL, 2026c).

7.6 MFS Water and Load Balance Model

This report is provided as Appendix U (MWM, 2026t).

7.6.1 Report Purpose

The WLBM for MFS was developed to achieve the following objectives:

- Forecast changes to flows within waterways as a result of the project-related activities at MFS.
- Support design of water management infrastructure.
- Forecast downstream water quality as a result of the project-related activities at MFS Model Summary.

7.6.2 Model Summary

The WLBM represents the Operations Phase, Active Closure Phase, and Post-Closure Phase, simulating a duration of 100 years at a daily timestep resolution. Key elements represented in the model included:

- Runoff from background catchments.
- Runoff from mine domains (e.g., pit voids, ELFs, etc.).
- Seepage from ELFs.
- Collection and conveyance (channel flow and pumping) of MIW.
- Loading rates of solutes generated from source terms (both from constant concentrations and constant loads).
- Mixing parameters (conservative) and calculation of concentrations in each flow path.
- Solute load changes through the water treatment plant (WTP) and mussel shell bioreactors (MSRs). Effects on downstream water quality and comparison to proposed compliance criteria.

The modelling included the following scenarios:

- Base Case model, with approximate annual average rainfall conditions and typical source terms based on best available empirical water quality datasets. The adopted water management strategy is based on over 25 years of practical experience in similar environments.
- Scenario 1, with *high*²⁰ annual rainfall conditions and typical source terms.
- Scenario 2, with *variable* rainfall every year (stochastic rainfall) and typical source terms.

²⁰ The wettest year on record for Lake Brazil meteorological station was used to represent high rainfall conditions.

- Scenario 3, with approximate annual average rainfall conditions and a +30% increase to typical ELF seepage source terms.
- Scenario 4, with approximate annual average rainfall conditions and a -30% decrease to typical ELF seepage source terms.

No model was constructed for the Construction Phase of the MFS sub-area, that being the time period that haul roads and infrastructure pads are being constructed, and the WTP is not commissioned.

7.6.3 Findings

The primary outcome of the MFS WLBM is that water quality simulated at compliance locations remained below the proposed guideline values derived for the Project throughout the simulation, including for the Base Case model and the four scenarios which test uncertainties of the model including rainfall variability as well as uncertainty in source terms for ELF seepage water quality (which is the largest influence on solute loads at closure).

Modelling incorporated high intensity rainfall events (24-hour periods) corresponding to a 1 in 20-year event during the Operations Phase and a 1 in 100-year climate adjusted event occurring during the Post Closure Phase (Scenario 2). Dry periods were also incorporated in the model with a maximum dry period of 41 consecutive days included within Scenario 2

The assessment findings are summarised below for the Base Case and Alternative Scenarios (i.e. Scenario 1 through 4).

7.6.3.1 Base Case Model Results

The water balance model results suggest the following:

- The proposed mine water infrastructure and treatment systems deliver compliance including when stress tested against high and low rainfall conditions. Under the Base Case the mine captures and treats all flows associated with rainfall events up to the 95th percentile, bypassing ~5% of the time (>P95²¹) and direct discharging²² ~10% of the time (>P90²³).
- The combination of the East and West Pit Sump volumes with the WTP capacity of 235 L/s is suitable for management of predicted stormwater flows.
- The maximum modelled bypass or direct discharge event duration was 2 days. Most events were less than two days (88% of bypass events and 78% of direct discharge events)
- Under average rainfall conditions, mine pit sumps will be bypassed ~5% of the time, leading to untreated discharge to the receiving environment under high flow conditions.
- With the adopted water management strategy sump spilling did not occur in the Base Case model simulation.

²¹ 95th %ile

²² Bypass: MIW bypass (by gravity) the East and West Pit Sumps inlets based on a 95th percentile flow criteria (waters remain within the Deep Stream catchment). Direct discharge: at times where the Waimangaroa River flows exceed the 90th percentile flow criteria, MIW within the East and West Pit Sumps are pumped directly to the Waimangaroa River.

²³ 90th %ile

- Seepage rates from the ELF's ranged from approximately 0.4 - 29 L/s (varying as a function of landform size) in the Post Closure Phase, the highest being from MSR's 5, 7, and 8.
- The model predicts a total of 71,460,000 m³ (126 L/s on average) of water will be treated by the WTP over the life of the MFS sub-area.
- The following changes to flow dynamics are predicted to environmental flows (at compliance locations positioned within receiving waterways):
 - o A reduction of all flows at surface water monitoring location SW01 during the Operations and Active Closure Phases (-2 to -12% from simulated baseline conditions), as a result of waters being pumped out of SW01 catchment for treatment and an increase in mean and median flows during the Post Closure Phase (+5 to +23%) along with a significant increase in low flow conditions (+555%), relating to ELF's being modelled with a higher net percolation than the background catchment, with outflows represented as stable seepage (e.g., not fluctuating significantly).
 - o Similarly, a reduction in flows occur at surface water monitoring location SW03 within the Operations and Active Closure Phases (-14 to -15%), outside of a modest increase in the 7-day mean annual low flow (+32%). During Post Closure Phase, mean and median flows increase (+5 to +41%) as well as a marked increase in low flows (+895%). These results are reflective of the same outcomes as SW01.
 - o Model results for water monitoring location 2W (Smokestack) suggest an increase in mean, median, and low flows over the entire modelled period (+5 to +225%), as a result of waters being pumped into the catchment for treatment. The largest increase of flows occurs in the lower end during active treatment with the presence of the WTP discharging upstream.
 - o Water quality monitoring location 17W results suggest the same trend as Smokestack, however, a large increase in low flows also occurs during the Post Closure Phase as noted as reporting via SW01 and SW03 (+223%) due to seepage from ELF's being modelled as stable flow.

The load balance model results suggest the following:

- The peak MIW PCOC loads reporting to the WTP occur in 2040, with approximately 324 tonnes per year (t/year) of acidity, 31 t/year of aluminium (Al), and 13 t/year of iron (Fe). Modelling also indicates that 2041 is the peak year for total suspended solids (TSS) load, with 870 t/year of TSS.
- Active treatment will be required for about 4 years after completion of rehabilitation before MSR's can treat loads to meet proposed water quality limits proposed by Hickey (2026).
- Cadmium (Cd) and Zinc (Zn) were typically the PCOC that were closest to the proposed water quality guideline values.
- Model results were below acute and chronic guideline values for metals and turbidity (Hickey, 2026) over the proposed exposure periods.

Overall, Base Case results suggest discharge of mine impacted water via 'bypass' and 'direct discharge' at proposed frequencies (95% and 90% of the time, respectively) will not elevate PCOC above proposed guideline values over relevant exposure periods.

7.6.3.2 Alternative Scenario Model Results

The key findings of the alternative scenario simulations are summarised below:

- Scenario 1 (High Annual Rainfall) model results suggested an increased bypass rate (from 5% to 7% of the time on average) and direct discharge rate (from 10% to 12% of the time on average). No exceedance of chronic or acute water quality guideline values over their exposure periods.
- Scenario 2 (Stochastic rainfall) model results suggested an increased bypass rate (from 5% to 6% of the time on average, with an annual variance from 2% to 9%) and decreased direct discharge rate (from 10% to 9% of the time on average, with an annual variance from 5.5% to 12%). No exceedance of chronic or acute water quality guideline values over their exposure periods.
- Scenario 3 and 4 (ELFs varying $\pm 30\%$ of the contaminant load compared to base case scenario) do not result in exceedance of chronic or acute guideline values over their exposure periods.

In summary, modelling results suggest MFS will be able to achieve water quality within proposed compliance limits and exposure periods (at defined water quality compliance monitoring locations), even when stress tested with either, wet conditions, prolonged dry periods, and ELF source terms that are 30% worse than expected.

7.7 **ESE Water and Load Balance Model Report**

This report is provided as Appendix V (MWM, 2026u).

7.7.1 *Report Purpose*

The ESE WLBM was developed to achieve the following objectives:

- Forecast changes to flows within waterways as a result of the project-related activities at ESE.
- Support design of water management infrastructure.
- Forecast downstream water quality as a result of the project-related activities at ESE.

7.7.2 *Model Summary*

The WLBM represents the Construction Phase (final year), Operations Phase, Active Closure Phase, and Post Closure Phase, simulating a duration of 116 years (100 years post-closure) at a daily timestep resolution. Key elements represented in the model included:

- Runoff from background catchments.
- Runoff from mine domains (e.g., pit voids, ELFs, etc).
- Seepage from ELFs.

- Collection and conveyance (channel flow and pumping) of MIW water that is affected by TSS and AMD.
- Loading rates of solutes generated from source terms (both from constant concentrations and constant loads)
- Mixing parameters (conservative) and calculation of concentrations in each flow path.
- Solute load changes through WTP and MSRs.
- Effects on downstream water quality (for both acute and chronic exposures).

The modelling included the following scenarios:

- Base Case model, with approximate annual average rainfall conditions and typical source terms²⁴ based on best available empirical water quality datasets. The adopted water management strategy is based on over 25 years of practical experience in similar environments.
- Scenario 1, with *high*²⁵ annual rainfall conditions and typical source terms.
- Scenario 2, with *variable* rainfall every year (henceforth referred to as stochastic rainfall) and typical source terms.
- Scenario 3, with approximate annual average rainfall conditions and a 30% increase to typical ELF seepage source terms.
- Scenario 4, with approximate annual average rainfall conditions and a 30% decrease to typical ELF seepage source terms.

7.7.3 Findings

The primary outcome of the ESE WLBM is that water quality simulated at compliance locations remained below the proposed guideline values derived for the Project throughout the simulation, including for the Base Case model and the four scenarios which test uncertainties of the model including rainfall variability as well as uncertainty in source terms for ELF seepage water quality (which is the largest influence on solute loads at closure).

Modelling incorporated high intensity rainfall events (24-hour periods) corresponding to a 1 in 10-year event during the Operations Phase and a 1 in 100-year climate adjusted event occurring during the Post Closure Phase (Scenario 2). Dry periods were also incorporated in the model with a maximum dry period of 41 consecutive days included within Scenario 2.

Key findings regarding the results of the water balance model, load balance model, and alternative scenarios are summarised within this section.

7.7.3.1 Base Case Model Results

The water balance model results suggest the following:

²⁴ Source terms are derived from empirical or analogue site data to characterise water quality associated with different components of the model (e.g., pit surfaces), expressed as constituent concentrations or constant loads.

²⁵ The wettest year on record for Lake Brazil meteorological station was used to represent high rainfall conditions.

- The proposed mine water infrastructure and treatment systems achieve compliance including when stress tested against high and low rainfall conditions. Under the Base Case the mine captures and treats all MIW flows 95% of the time, with bypass events up to ~5% of the time in a given year (i.e., ~18 days per year). Spills occur up to 5% of the time for years when bypass infrastructure is not established.
- The “WWH” and “CON” ELF s contribute the vast majority of ELF seepage (combined 77% of final ELF surface catchment) during the model simulation.
- The model predicts a total of 358,000,000 m³ of water will be treated by the WTP over the 30 years that it is active.
- Sump volumes, pumping rates, and a maximum WTP throughput of 635 litres per second (L/s) managed the simulated MIW volumes (under approximately annual average conditions), with spilling and bypass occurring 5% of the time or less. Note that spilling and bypass do not occur concurrently for a given sump (as per the water management strategy).
- The following changes to flow dynamics are predicted to environmental flows (at compliance monitoring locations positioned within waterways):
 - o For the Active Treatment Phase²⁶, KEL had the largest mean flow increase (+16%) while W07 had the greatest reduction (-16%).
 - o For the Post Closure Phase, V62 had the largest mean flow increase (+108%) while M-M1 had the greatest reduction (-24%).
 - o For low flow conditions, all sites show an increase for both phases, with M-M1 the highest (+8,650%) during the Active Treatment Phase and V62 the highest (+16,100%) during the Post Closure Phase.

The load balance model results suggest the following:

- Active treatment will be required for ~14 after mining operations cease before MSRs can treat all ELF seepage loads to meet proposed limits proposed by Hickey (2026). Some ELF seepage will be able to be treated effectively with MSRs earlier than this.
- Screening of model results against acute and chronic guideline values for metals and turbidity (Hickey, 2026) did not suggest exceedance over the proposed exposure periods. Zinc (Zn) and Nickel (Ni) were the parameters that approached closest to guideline values, although always less than 50% of guideline values during the Operations Phase when the WTP is active. Concentrations of Zn and Ni were typically 13-19% below chronic exposure guideline values upon initial release of passive treatment water to compliance sites KEL and V62, before concentrations reduce. Larger margins were simulated both for other monitoring locations and for acute exposure periods. Overall, model results suggest discharge of MIW via bypass and

²⁶ 'Active Treatment Phase' includes the Construction Phase, Operations Phase, and Active Closure while the active WTP is operating.

sump spilling at proposed quantities and frequencies (<5%) will not elevate potential constituents of concern (PCOC) above proposed guideline values.

- Peak MIW PCOC loads reporting to the WTP occur in 2036/37, with approximately 4,700 tonnes per year (t/year) of acidity, 460 t/year of Aluminium (Al) and 210 t/year of Iron (Fe). 2035 was the peak year for Total Suspended Solids (TSS) load, with 1,550 t/year

7.7.3.2 Alternative Scenario Model Results

The key findings of the scenario modelling are summarised below:

- All scenario model results were below proposed chronic (annual median) and acute (annual 95th percentile (P95)) guideline values for the duration of each simulation. As noted previously, these results incorporate testing of the model against high intensity rainfall events and extended dry conditions.
- Scenario 1 resulted in an increase (19%) in the total water treated by the WTP, although it's noted that this outcome is not significant as cumulative 'wet' years for the duration of the model simulation are improbable. Scenario 2 volumes were similar to the Base Case.
- Scenario 1 and Scenario 2, each resulted in a low number of spill events (10) at the WTP Surge Pond over the ~100-year simulation period. These spill events result in higher concentrations of some PCOCs within the receiving environment (modelled at M-M1), but concentrations remain below guideline values.
- Scenario 1 total water to be treated by the WTP is 428,000,000 m³, and a maximum capacity of 700 L/s is required to be processed through the WTP.
- With Scenarios 1 and 2, higher rates of MIW water capture and WTP capacity were required (compared to the Base Case) for wet years.
- Scenario 3, with higher ELF seepage sources terms showed higher metals concentrations, particularly in the Post Closure Phase. However, toxicity modified guideline values (Hickey, 2026) also increased (due to additional water hardness). Ultimately, modelled downstream concentrations remained below guideline values for the chronic and acute exposure periods.
- Scenario 4, with lower ELF seepage source terms showed lower metal concentrations particularly in the Post Closure Phase. Toxicity modified guideline values also reduced (due to lower water hardness), however modelled downstream concentrations remained below guideline values for the chronic and acute exposure periods.

7.8 MFS and ESE WLBM Recommendations

The following recommendations are provided for both model domains.

7.8.1 *Operational Management Recommendations*

The following management recommendations are proposed based on WLBM for the Operations Phase:

- Active treatment is required from the start of mine operations. Commissioning of the WTP is therefore required during the Construction Phase. Noting that portable treatment plants will be used in the Construction Phase to treat MIW.
- The majority of PCOC loads originate from the ELF's and collection of their seepage is important for minimising potential effects on waterways. As such, it is recommended that design, construction, and ongoing operation of ELF's and associated seepage systems are undertaken at a high standard to ensure high levels of seepage collection are achieved (as per model assumptions).
- Performance monitoring, as described in the AMD ELF and AMD Water Management Plans, to confirm model inputs and results are reasonable with as-built conditions, including water quality and quantity data from:
 - o Background catchments.
 - o ELF seepage and runoff.
 - o Haul road runoff.
 - o Open pit runoff.
 - o Sump MIW.
 - o Sediment control structures.
 - o Sump bypass MIW.
 - o WTP discharge.
 - o MSRs discharge.
- Sump bypass infrastructure should be instrumented such that the frequency, duration, and water volume discharges is recorded and reviewed annually. Similar metrics should be recorded for WTP discharges and direct discharges.
- Demonstrate that adopted net percolation rates can be achieved through a cover system trial. Such a study would provide confidence that water quality closure objectives can be achieved in the proposed timeframes and support closure planning.
- Adaptive management processes should be followed to proactively manage water related risks.
- As more empirical data becomes available as the mines are developed, the WLBMs should be periodically benchmarked to new data and updated as needed to improve confidence in model results.

7.8.2 Closure Management Recommendations

The following management recommendations are proposed for the Active and Passive Closure phases:

- The model suggests active treatment will be required for approximately 15 years following completion of mining and rehabilitation works (Operations Phase) before switching solely to passive treatment in 2058. Performance monitoring during operations will improve understanding of the likely duration of active treatment. Passive treatment such as MSRs are

an important element of achieving water quality objectives post-closure. As such, early implementation of passive treatment systems and associated performance monitoring should be used as an opportunity to validate expected treatment performance and inform closure planning.

- The WLBM should be updated on a routine basis to include additional performance monitoring data to calibrate the model (e.g., cover system performance and net percolation rates; source terms; water treatment efficiencies, etc.) to improve confidence in model results for closure.

7.9 Performance Monitoring

Management plans have been developed to ensure that AMD risks for the BPCP are managed to minimise the potential effects on the receiving environment. The specific plans for MFS, ESE, and the UHWR include:

- AMD ELF Management Plan (BRL, 2026d)
- AMD Water Management Plan (BRL, 2026c)

These management plans have been developed based on the identified source hazards that could generate AMD issues, potential pathways from these materials, risks for key receptors (i.e., waterways) that could be affected by surface and groundwater flow from AMD generating materials; and performance monitoring that is required to ensure the effects are being managed.

7.10 Performance Monitoring

It is essential that closure objectives are understood to ensure that the appropriate engineering controls are in place to achieve these closure goals, and to ensure that all stakeholders, regulators, and partners understand what closure success represents.

Performance monitoring is required to ensure the project is on track to achieve these closure objectives. If monitoring data suggest there is variance that could compromise closure objectives, then the engineering controls need to be reviewed and adjusted to ensure that successful closure can be achieved (i.e., adaptive management).

The following high-level performance monitoring objectives are proposed:

- Monitoring of materials that will be mined to confirm AMD characteristics to guide management requirements for these materials.
- Monitoring of ELF's to confirm design objectives are met (leading and lagging performance indicators).
- Monitoring of mine waters to confirm water quality estimates are reasonable.
- Monitoring of water treatment effectiveness (active and passive treatment).
- Monitoring at water quality compliance locations.

8 SUMMARY

This report provides an overview of the studies that have been completed to assess the potential effects of AMD from the proposed BPCP for MFS, ESE, and the UWHR project sub-areas. This includes:

- Understanding background water quality data in the project sub-areas of MFS, ESE, and UWHR through compilation of available data.
- Understanding the source hazards for AMD by characterisation studies that have been supported with >25 years of operational management of AMD and detailed scientific reports on this issue.
- The development of an analogue model to forecast AMD from the proposed BPCP ELF.
- The development of source terms for AMD impacted waters.
- The development of water and load balance models, using these source terms to understand potential effects of AMD for MFS, ESE, and UWHR.
- Using early model results to guide decision making processes on how better to manage potential effects.
- Identification and development of water treatment technologies for all phases of the BPCP.
- An assessment of environmental effects after engineering controls have been included.

These documents and the knowledge gained have been used to inform and develop suitable management plans for ELF construction and water management that contain management processes for key AMD risks.

8.1 Management of AMD

AMD has the potential to be mobilised from the MFS, ESE, and UWHR project sub-areas to downstream waterways through the disturbance of materials that contain sulfide minerals (e.g., pyrite). Studies indicate that high concentrations of PCOC can be generated from mining activities associated with the BPCP sub-areas, and, as such, can negatively impact the receiving environment if left unmanaged; therefore, management of impacted waters are required to mitigate the effects.

To mitigate the risks associated with elevated AMD, a hierarchy of controls (Management Steps) was utilised

1. Determine the closure objectives for the mine.
2. Understand the source hazards.
3. Prevent, control, and treat AMD.
4. Complete an assessment of the potential effects.
5. Monitor performance.

Studies have been completed to address these management requirements. These reports are contained in this document (as shown in Table E4 of the executive summary) and the studies have been used to develop AMD management processes. The following documents have been developed to ensure the risks for AMD in receiving waterways are managed in an appropriate manner.

- AMD ELF Management Plan (BRL, 2026d)
- AMD Water Management Plan (BRL, 2026c)
- Mine Closure Concept Strategy (BRL, 2026b).

8.2 Findings

Studies indicate that the environmental risks associated with AMD at the MFS, ESE, and the UWHR can be successfully managed if the appropriate management processes are utilised, suitable engineering controls are implemented, and performance monitoring is undertaken to support adaptive management principles if there is variation from the expected case.

8.3 Report Structure

All reports that are summarised in this overview report are provided as appendices. Recommendations provided in these reports, and this overview report are addressed in the AMD ELFMP and the AMD WMP.

8.4 Peer Review

The reports presented in this this AMD overview report has been peer reviewed by:

- Dr James Pope of Strata Geoscience Limited (Pope, 2026) who is recognised as a subject matter expert (SME) for AMD.
- Dora Avaniidou of GHD Limited reviewed the hydrogeology reports.

These reviews are provided as part of the substantive FTAA application.

9 **RECOMMENDATIONS**

The following overarching recommendations are provided for AMD risks based on the work completed by MWM for the BPCP FTAA application.

9.1 **Background Water Quality**

Understanding background water quality is essential to develop water quality objectives for the project given that many waterways in the area are degraded by historical mining activities and the discharge of untreated AMD to streams. Although background water data is robust, it is recommended that it will be continually verified through the life of the mine.

Recommendation #1	Expand knowledge base	<ul style="list-style-type: none"> Continue further water quality monitoring at compliance, performance and reference monitoring sites over the construction, operational, and closure phases of the project.
Recommendation #2a	Validate baseline water quality	<ul style="list-style-type: none"> Undertake continuous monitoring data (flow, EC, pH and turbidity) to provide time-based data to fully characterise the relationships between flow and physicochemistry at compliance monitoring locations (e.g., 2W: Smokestack) prior to construction commencing and then continuing throughout life of mine phases.
Recommendation #2b	Validate baseline water quality	<ul style="list-style-type: none"> Validate TSS and turbidity equation with field and laboratory data during operational phase as listed in the TSS Overview Report.
Recommendation #2c	Validate baseline water quality	<ul style="list-style-type: none"> Validate and refine flow weighted water quality source terms (mg/L).
Recommendation #2d	Validate baseline water quality	<ul style="list-style-type: none"> Validate storage and WTP capacity required to manage extreme rainfall events or wet years.
Recommendation #2e	Validate baseline water quality	<ul style="list-style-type: none"> Update the water and load balance models to validate management and monitoring measures prior to each stage commencing.

9.2 **Water Quality Objectives**

Water quality objectives for the Construction, Operational, Active Closure, and Post Closure phases of the project for MFS, ESE, and UWHR have been defined by Hickey (2026). Please refer to that document for further detail.

9.3 **Closure Objectives**

The following overarching closure objectives for AMD are proposed:

- Safe, stable, and non-polluting.

- Achieve stable water quality that complies with closure objectives.
- Provide confidence that the risks of AMD have been managed in an appropriate manner.
- Facilitates relinquishment of the project area back to landowners.

It is essential that closure objectives are understood to ensure that the appropriate engineering controls are in place to achieve these closure goals, and to ensure that all stakeholders, regulators, and partners understand what closure success represents.

Recommendation #3	Define AMD Closure Objectives	<ul style="list-style-type: none"> o Integrate closure objectives into the AMD ELF and Water MPs to facilitate satisfactory relinquishment processes and include definitions of: <ul style="list-style-type: none"> o Safe, stable, non-polluting o Stable water quality
--------------------------	-------------------------------	--

An essential part of demonstrating that AMD management is appropriate during the Post Closure Phase is a suitable monitoring program that shows that geochemical stability has been achieved over an appropriate timeframe. Statistically representative long-term Post Closure Phase monitoring programs acknowledge that with increasing confidence in data trends (over time) that there is a decreasing monitoring intensity if WQO and closure targets are being met.

Recommendation #4	Closure Monitoring Frequency	<ul style="list-style-type: none"> o Undertake a SQEP review of monitoring data during Operational, Active Closure and Post Closure phases of the monitoring data. o Validate data against model predictions and incorporate changes to monitoring type and frequency changes into the following management plans: <ul style="list-style-type: none"> o Water Management Plan o Water Infrastructure Design o Mine Closure Concept Strategy o Erosion and Sediment Control Plan for Land Disturbance Activities
--------------------------	------------------------------	--

Three high level closure objectives have been developed for MFS, ESE, and the UWHR for AMD including landform stability, water management infrastructure, and water quality. Successful closure and the ability to relinquish the project to the appointed regulatory authorities requires sign-off by a suitably qualified and experienced person (SQEP) and/or the Engineer of Record (EoR). The decision should also be accepted by the West Coast Regional Council (WCRC).

Recommendation #5a	Closure Objectives Achieved	<ul style="list-style-type: none"> o Confirm that final landforms (ELFs and water management infrastructure) are acceptable for closure sign-off by the SQEP and/or EoR.
Recommendation #5b	Closure Objectives Achieved	<ul style="list-style-type: none"> o Confirm that final landforms are geochemically stable at closure and water treatment is appropriate for sign-off by a SQEP.

Recommendation #5c	Closure Objectives Achieved	o Establish and maintain detailed record keeping providing the necessary documentation for the EoR and SQEP.
---------------------------	-----------------------------	--

Other closure objectives relating to AMD and management processes are explained in the AMD ELFMP and AMD WMP.

9.4 Source Hazard Characterisation: Prediction

Studies indicate that the disturbance of overburden to access the coal resources will generate AMD. Two lithological units contribute to AMD within the BPCP area including the BCM that host the coal resources and the overlying KMS. Approximately 140 million bcm of overburden will be excavated at MFS and ESE. Over 1,500 samples have been tested to confirm AMD characteristics of these materials and construct waste rock block models for MFS and ESE. However, ongoing monitoring and reporting is required to validate these models as mining proceed, which is an industry standard approach. The following recommendations are provided in regard to assessment of geoenvironmental source hazards for MFS, ESE, and the UWHR

9.4.1 UWHR

Further work is required to confirm the AMD geochemical characteristics of materials disturbed during construction of the UWHR.

Recommendation #6a	UWHR AMD Characterisation	o Undertake continual AMD assessment of the materials that will be disturbed during construction of the UWHR using geotechnical drillhole core.
Recommendation #6b	UWHR AMD Characterisation	o Complete, ahead of construction, an assessment of AMD seeps (natural and historic) along the UWHR to map the specific sources of baseline effects.

Impact to water quality from controlled collapse of the Ironbridge underground mine workings is required, during construction of the UWHR. This will be addressed during the detailed design phase and potential discharges to the receiving environment will be assessed and managed such that water quality limits are achieved.

Recommendation #7a	Ironbridge Underground Mine Water Quality	o Complete, ahead of construction, an assessment of the effects of collapsing the Ironbridge underground mine workings on water quality.
Recommendation #7b	Ironbridge Underground Mine Water Quality	o Develop a SOP to manage the Sealing of Underground Workings to minimise continual potential discharges from underground mine water to the receiving environment.

9.4.2 MFS

Comprehensive AMD geochemistry studies have been undertaken at MFS. The additional AMD geochemistry improvements are recommended

Recommendation #8a	MFS AMD Characterisation	o	Complete detailed geochemical analysis of samples including sulfur speciation testing including the assessment of 10% of the original samples to validate that total sulfur is a suitable analogue for calculations to determine the maximum potential acidity (MPA). This will provide a fairer (lesser) estimate of MPA to understand AMD risk.
Recommendation #8b	MFS AMD Characterisation	o	Update the MFS block model with the additional drilling ABA data prior to commencement of mining and refine materials scheduling for ELF construction.
Recommendation #8c	MFS AMD Characterisation	o	Undertake a review of Zn pXRF results to assess the Zn hazard at MFS to understand if there are paleoenvironmental drivers for Zn distribution.
Recommendation #8d	MFS AMD Characterisation	o	Review the HAF cutoff value once pit shells are finalised based on the costs and benefits of managing differing HAF volumes.

9.4.3 ESE

BRL indicate that 1,380 samples have been tested for total sulfur within the Denniston Block Model providing a good understanding of AMD risk for the project area.

Recommendation #9	ESE Material AMD Characterisation	o	Complete infill resource definition drilling and update the ESE block model as required prior to mining to validate block models.
--------------------------	-----------------------------------	---	---

9.4.4 Other

Improve staff competencies through procedures and training for the QA/QC of laboratory ABA data to ensure the samples are classified correctly. The correct laboratory analysis and classification of samples will be critical for materials management.

Recommendation #10	QA/QC	o	Develop QA/QC procedures for laboratory ABA testing, training requirements, and include within the ABA and materials classification SOP and the AMD ELFMP.
---------------------------	-------	---	--

Material schedules are required to be updated annually in the annual work plan or whenever there is a change to the mine plan and/or significant variance from the waste rock block model is identified.

Recommendation #11	Material Schedules	<ul style="list-style-type: none"> o Maintain a material schedule for each sub-area of the BPCP and updated annually or: o When mine plans change. o When there is significant variance in the waste rock block model (defined as a change of +/- 10%).
---------------------------	--------------------	--

9.4.5 Escarpment Barren Valley ELF Model

A water quality model for the BV ELF, located at the existing Escarpment Mine was developed as an analogue model that can then be applied to ELF's proposed for MFS and ESE. The BV ELF was chosen as it was constructed using engineering controls to minimise oxygen ingress, hence its applicability to other ELF's that will be constructed as part of the BPCP.

The study also reviewed the hydrogeochemistry of waste rock storage. Lateral flow along running surfaces leading to seepage on the batters of an ELF is a risk for closure due to poor water quality. If this flow generates surface seepage this could affect surface rehabilitation outcomes and surface water quality.

Recommendation #12	Lateral ELF Seepage	<ul style="list-style-type: none"> o Integrate lateral drainage management measures into adaptive management processes including: o Running surfaces are angled downwards away from the tiphead such that lateral seepage runs into the core of the ELF. Note: this is a preferred approach but can lead to high tipheads if the running surface is of significance lateral distance. o NAF cover system allows lateral drainage discharge to the toe of the ELF for treatment (i.e., runs down the PAF/NAF boundary – achieved by permeability contrast).
---------------------------	---------------------	---

Monitoring needs to be undertaken on the ESC ELF that will be constructed within the first few years of the ESE project to validate the key ELF water quality model assumptions.

Recommendation #13	ELF Water Quality Model	<ul style="list-style-type: none"> o Undertake monitoring on the ESC ELF to validate: o Net percolation rates o Water quality as compared to sulfur content for ELF basal seepage. o Sulfate concentrations. o The duration of the stabilisation phase before water quality concentrations start to decline. o Depth of oxidation with advective airflow being constrained to < 10 m horizontal depth. o Long-term decay rates.
---------------------------	-------------------------	---

Data indicates that ANC and limestone provide significant neutralisation (~50% of the acidity generated) and is of benefit to MFS and ESE to mitigate the effects of sulfide mineral oxidation.

Recommendation #14a	Limestone Addition to ELF's	<ul style="list-style-type: none"> o Utilise limestone addition, in combination with ANC to neutralise ~50% of the acidity generated. Validate then adjust if required the limestone dose rate (5 kg limestone/m² per 2 m lift or 1.16 kg limestone/tonne) to meet neutralisation targets.
Recommendation #14b	Limestone Addition to ELF's	<ul style="list-style-type: none"> o Monitor and review limestone addition rates during construction to confirm if these rates can be adjusted for: <ul style="list-style-type: none"> o Higher and lower sulfur content materials. o Internal versus external materials (i.e., oxidising versus non-oxidising zones of the ELF).

Elevated nitrate is not expected in drainage waters from ELF's at MFS and ESE. However, ongoing performance monitoring is recommended to support this assessment as there is a risk that construction of the ELF's may generate sub-oxic conditions that may convert any remnant nitrate to ammoniacal nitrogen.

Recommendation #15a	Performance monitoring for Nitrogenous Compounds	<ul style="list-style-type: none"> o Undertake performance monitoring of: <ul style="list-style-type: none"> o Pit sumps for nitrogenous compounds. o ELF seepage for nitrogenous compounds.
Recommendation #15b	Performance monitoring for Nitrogenous Compounds	<ul style="list-style-type: none"> o Adjust performance monitoring frequency based on the monitoring data results.

9.4.6 Source Terms

Water quality source terms were developed for modelling to understand potential effect for the BPCP from a variety of sources including analogue data sources, background water quality studies, and laboratory derived data from environmental geochemistry testing. The purpose of creating the Source Term Report was to provide a transparent approach on how source terms were derived.

There are a number of assumptions used to generate the source terms that are used in the WLBMs. Performance monitoring is required to confirm these source terms are suitable by monitoring the individual components of the model once the project commences.

Recommendation #16a	WLB Source Terms	<ul style="list-style-type: none"> o Validate performance monitoring data against model predictions and update the WLB during operation, prior to Active and Post Closure phases. o Where WLB variance exceeds +/- 30%, implement adaptive management measures into management plans and SOPS. Key source terms include: <ul style="list-style-type: none"> o ELF basal seepage once ELF construction commences. o Surfaces (highwalls, coal floors, hardstands) o Pit water quality o ELF rehabilitated surface
Recommendation #16b	WLB Source Terms	<ul style="list-style-type: none"> o Validate performance monitoring data for passive and active treatment systems and update the WLB models where variance exceeds +/- 30%. Implement adaptive management measures into management plans and SOPS.

9.5 Engineering Controls

An assessment of the potential effects of mining at MFS and ESE and construction of the UWHR indicates that engineering controls are required to prevent, minimise, control, and treat AMD. This includes ELFs at MFS and ESE and EFA for the UWHR. Studies completed as part of this AEE indicate that:

- ELFs are required to prevent sulfide mineral oxidation and minimise the mobilisation of stored oxidation products. This is in alignment with industry best practicable approaches to source control (e.g., INAP, 2014; 2020; 2024). This will reduce the amount of AMD that requires treatment.
- Water treatment is required including active treatment during the Construction, Operational, and Active Closure phases and passive treatment in the Post Closure Phase, with the Post Closure Phase being this transition point.

9.5.1 ELF and EFA Construction

Design objectives have been proposed for ELFs at MFS and ESE and for EFAs associated with the UWHR. Key design features are explained in Table 20 and performance monitoring is recommended to ensure the structures are built to exclude oxygen and water. Management processes need to be developed to ensure the ELFs and EFAs are constructed appropriately.

Recommendation #17	ELF / EFA Construction	<ul style="list-style-type: none"> o Undertake performance monitoring and inspections to ensure that ELF and EFA are built in accordance with design objectives. This includes: <ul style="list-style-type: none"> o Geochemical characterisation of placed materials and QA/QC. o Grainsize segregation and lift height. o Compaction of running surfaces. o Oxygen ingress depth. o Net percolation rates (e.g., as measured by seepage flow rates). o Seepage water quality.
Recommendation #18	ELF / EFA Construction	<ul style="list-style-type: none"> o Develop and implement the following management processes: <ul style="list-style-type: none"> o Rock sampling and analysis – ABA and materials classification. o AMD material management. o Sealing of underground workings. o ELF construction requirements and QA/QC. o EFA construction requirements and QA/QC.

9.5.2 Cover System Construction

The cover system modelling (MWM, 2026l) indicated the following:

- Operational ELFs (unrehabilitated): 60% NP
- Rehabilitated ELFs (cover system installed): 40% NP
- Oxygen flux: Assumed to be equivalent to an acidity load of 2.7 t/ha/yr

Performance monitoring is required to validate these processes to ensure model outputs are reliable.

Recommendation #19a	ELF Cover System Construction	<ul style="list-style-type: none"> o Implement performance monitoring for the cover system and validate design objectives on the first ELF construction (e.g. ESC ELF) including: <ul style="list-style-type: none"> o Net percolation rate – Operational Phase. o Net percolation rate – Post Closure Phase. o Draindown phase (as a function of ELF height) o Oxygen flux rate
Recommendation #19b	ELF Cover System Construction	<ul style="list-style-type: none"> o Utilise performance monitoring data and adaptive design modifications to update the WLBM during Operation, Active and Post Closure phases to refine Cover System closure objectives.

9.5.3 Active Water Treatment

Active water treatment studies were completed by Process Flow (2026a,b). Portable water treatment plant (pWTP) and permanent WTP designs need to be completed as part of the detailed design stage for MFS, ESE, and the UWHR.

Recommendation #20a	Construction Phase Water Treatment	o Utilise pWTP for MFS, ESE, and potentially the UWHR to treat AMD and TSS.
Recommendation #20b	Construction Phase Water Treatment	o Confirm during the detailed design that the estimated acidity load of 40 - 150 t/yr at MFS and 60 t/yr at ESE during the Construction Phase is reasonable for planning water treatment infrastructure.
Recommendation #21a	Operational and Active Closure Phase Water Treatment	o Utilise WTPs for MFS and ESE for the treatment of AMD and TSS.
Recommendation #21b	Operational and Active Closure Phase Water Treatment	o Develop detailed design of the MFS and ESE WTPs such that the infrastructure will achieve water quality objectives.
Recommendation #22	MSR PTS	o Establish and confirm the timing of the transition from active treatment to passive treatment as 2 years after final rehabilitation of the respective ELF (i.e., TSS and PCOC are low from surface runoff) based on monitoring and review during the Operational Phase.

9.5.4 Passive Water Treatment

The following recommendations are provided.

Recommendation #23	MSR PTS	o Undertake monitoring and review during the Operational Phase (upon completion of the first ELF) to validate that MSR can manage higher acidity and flow rates than recommended by international literature (e.g., INAP, 2021) to meet water quality objectives.
Recommendation #24a	MSR PTS	o Undertake monitoring and review during the Operational Phase (upon completion of the first ELF) to validate that the MSR Polishing Pond will achieve water quality objectives for PCOC and secondary contaminants (e.g., ammoniacal nitrogen, nitrate, hydrogen sulfide).

Recommendation #24a	MSR PTS	<ul style="list-style-type: none"> o Validate through performance monitoring data that the quantity of Fe that passes through the MSR and whether any FeCl₃ dosing is required for the polishing pond to treat residual Ni and Zn (i.e., validate whether 20% of influent Fe reporting to the polishing pond is reasonable).
Recommendation #25	PTS Suitability	<ul style="list-style-type: none"> o Evaluate efficacy of the MSRs based on performance monitoring data and continue investigation into alternate passive treatment options to extend or supplement the MSR PTS. o Undertake a literature review of PTS suitability to support the decision-making process.

Climate change is anticipated to increase rainfall at the MFS and ESE project sub-areas. An increase in rainfall will potentially result in an increase in net percolation into ELF's and hence a greater quantity of ELF basal water that will require treatment. The effect is unlikely to be observed during the Operational and Active Closure phases of the BPCP but could be seen during the Post Closure Phase (i.e., passive treatment).

Recommendation #26	PTS Design Requirements	<ul style="list-style-type: none"> o Update MSR design to incorporate an increase by 10% (i.e., 10% additional surface area to account for increased flows due to climate change forecasts).
---------------------------	-------------------------	---

9.5.5 AMD Sludge Disposal

AMD sludge disposal options are available for the BPCP although other disposal options need to be considered. The following recommendations are provided.

Recommendation #27	AMD Sludge Disposal	<ul style="list-style-type: none"> o Investigate additional disposal options for AMD sludge during the Operational Phase of the BPCP.
---------------------------	---------------------	--

Disposal of AMD sludge within ELF's is the most practicable solution and least risk given AMD engineering control and treatment systems that will be developed for ELF seepage. However, the following recommendations are noted.

Recommendation #28a	AMD Sludge Disposal	<ul style="list-style-type: none"> o Avoid placement of AMD sludge with acid forming materials as some trace metals (Mn > Co = Zn > Ni) are preferentially mobilised from AMD sludge under acidic conditions).
Recommendation #28b	AMD Sludge Disposal	<ul style="list-style-type: none"> o Include water quality monitoring at strategic locations within catchments and sub-catchments to detect any increase in PCOC concentrations due to AMD sludge disposal. This includes performance monitoring of ELF basal seepage.

Recommendation #28c	AMD Sludge Disposal	o Calibrate basal seepage performance monitoring data against model predictions and based on update WLBM, determine timing of the transition to passive treatment.
Recommendation #29	AMD Sludge Disposal	o Develop a management procedure for the AMD sludge disposal that is supported by adaptive management processes including performance water quality monitoring, recording of AMD sludge volumes, and disposal locations within any ELFs. This will support signoff of the process by the appointed SQEP.

9.6 Assessment of Potential Effects

9.6.1 Groundwater Effects

Groundwater studies were completed for MFS and ESE project sub-areas. The following recommendations are provided:

Recommendation #30	MFS and ESE Groundwater	o Develop and implement a management procedure including performance monitoring for the sealing of underground workings to manage the loss of AMD impacted waters to the receiving environment.
Recommendation #31	MFS and ESE Groundwater	o Undertake performance monitoring to confirm pit floor runoff does not impact groundwater quality post-closure.
Recommendation #32	MFS Groundwater	<ul style="list-style-type: none"> o Undertake investigations to validate the hydrogeological condition for subsurface seepage collection at the MFS Coal Transfer Pad. o Install and monitor wells to validate and compare against baseline conditions as part of adaptive management measures.

Recommendation #33a	MFS Groundwater	<ul style="list-style-type: none"> o Install and monitor additional groundwater monitoring wells in target locations positioned between potential sources (e.g., ELF) and receptors (e.g., streams), and in close proximity to sources to confirm ELF seepage is not migrating via groundwater pathways (noting the existing groundwater monitoring network will be impacted by the MFS project sub-area, with all except three wells (DC33, DC45, and DC46) likely to be decommissioned).
Recommendation #33a	MFS Groundwater	<ul style="list-style-type: none"> o Undertake hydrogeological testing of wells (e.g., slug tests) during well installation to improve the site-specific K dataset and model calibration.
Recommendation #34	MFS + ESE Groundwater	<ul style="list-style-type: none"> o Install nested vibrating wire piezometers following rehabilitation to monitor the phreatic surface within the ELF to confirm the basal drainage network is performing adequately and the pit remains a hydraulic sink, thereby minimising the potential for ELF seepage to reach surface water receptors. o Undertake seepage surveys following rehabilitation to validate seepage rates through the rehabilitation surface. o Develop and implement an ELF cover system management procedure that incorporate ELF phreatic surface data, and external groundwater level and quality data which enables proactive management of unexpected seepage pathways.
Recommendation #35a	ESE Groundwater	<ul style="list-style-type: none"> o Continue and complete groundwater quality sampling to confirm baseline conditions and support performance monitoring, particularly between ELFs and surface water receptors.
Recommendation #35b	ESE Groundwater	<ul style="list-style-type: none"> o Prior to operations commencing in the ESE sub-area, validate the ESE groundwater assessment (including estimates of hydraulic properties (e.g., hydraulic conductivity, K) of the BCM and Basement units documented in other areas of the Buller Plateaux with ESE data. Available data is considered sufficiently representative to be applied to the ESE sub-area for this assessment.
Recommendation #36	ESE Groundwater	<ul style="list-style-type: none"> o Undertake monitoring in the Cascade Creek catchment to detect any changes to underground workings flows and AMD loads reporting to Cascade Creek to validate betterment opportunities.

9.6.2 ELF Seepage Water Quality

The mine domain with the greatest source hazard risks (60-80% of total site AMD load) are waste rock storage facilities (e.g., INAP, 2020), that includes waste rock dumps having no engineering controls to control sulfide mineral oxidation or the mobilisation of secondary sulfide oxidation products. ELFs are proposed for the BPCP to minimise the generation of AMD arising from waste rock storage. Models have been developed to understand the long-term water quality of ELF seepage including peak acidity loads and longer-term loads that need to be managed by passive treatment technologies.

Recommendation #37	ELF Water Quality	<ul style="list-style-type: none"> o Undertake performance monitoring to validate that WLBM remain reasonable over the life of the project and into the commencement of the Post Closure Phase. This includes leading and lagging performance indicators: <ul style="list-style-type: none"> o Oxygen flux into the ELFs o Net percolation rates o Water quality and quantity of ELF seepage. o Peak acidity loads and longer-term loads managed by passive treatment technologies
---------------------------	-------------------	--

9.6.3 Betterment

The work undertaken at MFS and ESE will lead to betterment of some waterways (e.g., Rapid Stream, Cascade Creek Trib (V8), V37 Creek, and Cascade Creek). This is discussed by ESNZ (2026). Understanding the change in PCOC loads will be important to support the ESNZ study into betterment.

Recommendation #38	Betterment	<ul style="list-style-type: none"> o Undertake performance monitoring of PCOC loads to validate and improve betterment outcomes for certain waterways (e.g., Rapid Stream, Cascade Creek Trib (V8), V37 Creek, and Cascade Creek). o Validate ESE groundwater studies that indicate that flow rates could be reduced by 40% contributing to a significant reduction in the AMD load reporting to the Cascade Creek catchment and removal of the Escarpment Adit discharge to V37 Creek that reduces load to the Cascade Creek through a monitoring program to confirm these improvements. This will be developed as part of future Betterment studies (e.g., ESNZ, 2026).
---------------------------	------------	---

9.6.4 Construction Phase

Further studies are required for the Construction Phase of the BPCP for MFS, ESE, and the UWHR

Recommendation #39	Construction Phase	<ul style="list-style-type: none"> o Update the water and load balance model prior to the commencement of the Construction Phase for ESE and MFS to ensure effects are understood and water treatment infrastructure is appropriate.
---------------------------	--------------------	---

-
- o Develop a suitable water management system for MFS and ESE infrastructure areas to ensure AMD and TSS effects are managed.
 - o Monitor and review PCOC loads during the construction phase through performance monitoring. Update water and load balance modelling, as required, for ESE and MFS, ensuring that the current estimated PCOC loads reflect real outcomes, and water treatment infrastructure is appropriate.
-

9.6.5 Water and Load Balance Model

The WLBM utilising the source terms that were developed and the proposed engineering controls (ELF construction and active and passive treatment) concluded that modelling results suggest the MFS and ESE project sub-areas will be able to achieve water quality within proposed compliance limits and exposure periods (at defined compliance locations), even when stress tested with wet conditions and ELF source terms that are 30% worse than expected. However, it is recommended that the model is updated as part of the performance monitoring program to ensure the model remains a reliable tool for understanding effects during the Project life. The majority of PCOC loads originate from net percolation through the ELFs. Collection of their seepage is important for minimising potential effects on waterways. Collection of ELF seepage is critical to ensure such waters are treated (as per model assumptions).

Recommendation #40	WLBM	<ul style="list-style-type: none"> o Avoid spilling from pit sumps during repeat wet years by maintaining low sump water levels where practical to allow for sufficient storage capacity.
---------------------------	------	--

Recommendation #41	WLBM	<ul style="list-style-type: none"> o Ensure monitoring during construction of the ELF is undertaken to confirm that seepage water and flow is collected and incorporated into the ELF construction requirements and construction QA/QC procedure.
---------------------------	------	--

Recommendation #42	WLBM	<ul style="list-style-type: none"> o Operate the bypass in tandem with real time hydrological conditions.
---------------------------	------	--

Recommendation #43	WLBM	<ul style="list-style-type: none"> o Update the WLBM once sufficient data are available to calibrate the model (e.g., cover system performance and net percolation rates; source terms; water treatment efficiencies, etc.) to validate confidence in model results for closure.
---------------------------	------	---

Recommendation #44	WLBM	<ul style="list-style-type: none"> o Optimise the sump and WTP capacity sizing, also making considerations for finer scale hydrological events during the detailed design stage of the project.
---------------------------	------	--

Recommendation #45	WLBM	<ul style="list-style-type: none">o Install instrumentation to sump bypass infrastructure, WTP discharges and direct discharges such that the frequency, duration, and water volume discharges is recorded and reviewed annually.
---------------------------	------	---

Recommendation #46	WLBM	<ul style="list-style-type: none">o Confirm through monitoring that the water quality of clean water drains is suitable.
---------------------------	------	--

Recommendation #47	WLBM	<ul style="list-style-type: none">o Undertake performance monitoring to ensure observed water quality and is in alignment with expectations of the WLBM.
---------------------------	------	--

10 REFERENCES

- AMIRA, 2002. ARD Test Handbook - Project P387A Prediction and Kinetic Control of Acid Mine Drainage. AMIRA International Limited. Melbourne, Australia.
- ANZG, 2018. Australian and New Zealand guidelines for fresh and marine water quality. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource Management Council of Australia and New Zealand.
- BRL, 2022. Cypress Mine Geochemistry and Overburden Management Plan, 22 pp.
- BRL, 2022. Cypress Mine Geochemistry and Overburden Management Plan, 22 pp.
- BRL, 2024. Acid and Metalliferous Drainage (AMD) Environment Management Sub Plan, Stockton Mine. STO-ENV-PLN-016.
- BRL, 2024. Sullivan and Central Engineered Land Form Footprint Mapping Memo. Dated 4 October 2024.
- BRL, 2025a. MFS ABA Block Model Memo V3 - Buller Coal Plateaux Continuation Project.
- BRL, 2025b. Stockton Operational AMD Sludge Management. December 2025.
- BRL, 2026a. Water Management Infrastructure Design Plan. Bathurst Resources Limited Document: BPCP-ENV-PLN-012.
- BRL, 2026b. Mine Closure Concept Strategy. Bathurst Resources Limited Document: BPCP-ENV-PLN-050.
- BRL, 2026c. AMD Water Management Plan. Bathurst Resources Limited Document: BPCP-ENV-PLN-010.
- BRL, 2026d. AMD ELF Management Plan. Bathurst Resources Limited Document: BPCP-ENV-PLN-011.
- BRL, 2026e. AMD Broad Brush Risk Assessment.
- BRL, 2026f. Erosion and Sediment Control Plan for Land-Disturbance Activities. Bathurst Resources Limited Document: BPCP-ENV-PLN-013.
- BRL, 2026g. Upper Waimangaroa Haul Road & Mount Frederick South Access Road Void Assessment. Version 1.2 dated 24 March 2026.
- Cavanagh, J.E., Pope, J., Simcock, R., Harding, J.S., Trumm, D., Craw, D., Weber, P., Webster-Brown, J., Eppink, F., Simon, K., 2018. Mine Environment Life-cycle Guide: potential acid-forming and non-acid-forming coal mines. https://www.cmer.nz/publications/2018/MELG_Coal_PAFV1.3.pdf, 177 pp.
- CCME, 2014. Canadian water quality guidelines for the protection of aquatic life: Thallium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, p. 11, Canadian Council of Ministers of the Environment, Winnipeg, Canada.

- Chater, M. 2024. Memo - Climatic Conditions for the Mt Fred Project Drainage Area for BRL, pp 9. Dated March 2024.
- Christenson, H., Weber, P., Pope, J., Newman, N., Olds, W., & Trumm, D. (2018). Enhanced passive treatment systems: addition of nutrients to bioreactors. In *AusIMM New Zealand Branch Annual Meeting, Tauranga, AusIMM NZ Ltd* (pp. 97-104).
- Clough & Associates, 2025. Buller Plateaux Continuation Project, Archaeological and Historic Heritage Assessment. A report prepared for Bathurst Resources Limited.
- Davies, H., 2009. Geochemical change following pH remediation in Mangatini Stream, Stockton Coal Mine, New Zealand. M.Sc. thesis, University of Otago.
- Davies, H., Weber, P., Lindsay, P., Craw, D., Pope, J., 2011. Characterisation of acid mine drainage in a high rainfall mountain environment, New Zealand. *Science of the Total Environment* 409 (2011) 2971–2980.
- DFAT, 2016. Preventing acid and metalliferous drainage, Leading Practice Sustainable Development Program for the Mining Industry, September 2016, Commonwealth of Australia, Canberra, 211 pp.
- Elder, D.M., Pizey, M.H., Weber, P.A., Lindsay, P., Rossiter, P.J., Rutter, G.A., Thomas, D.G., Crombie, F.M., Cooper, T., Wildy, J.J., 2011. Addressing the environmental effects of mining on the Ngakawau River. New Zealand Water Conference, Rotorua 9-10 November 2011.
- ESNZ, 2026. Buller Plateaux Continuation Project - Assessment of Environmental Effects: Aquatic Ecology. Earth Sciences New Zealand report prepared for Bathurst Resources Limited.
- Flores, R.M., Sykes, R., 1996. Depositional controls on coal distribution and quality in the Eocene Brunner Coal Measures, Buller Coalfield, South Island, New Zealand. *International Journal of Coal Geology* 19: 291-336.
- Gandy, C.J., Younger, P.L., 2007. Predictive Modelling of Waste Rock Leaching at Stockton Mine. Report to Solid Energy New Zealand Ltd by the Hydrogeochemical Engineering Research and Outreach Institute for Research on Environment and Sustainability, Newcastle University, UK
- GHD, 2026. Stockton Water Management and Assessment of Effects on Waterways from BPCP Stockton Mining Activities. GHD Limited report for BT Mining Limited. GHD Project Number 12601658.
- Hayton, S., Olds, W., Matheson, L., Wu, C., Ross, D., Nyenhuis, J., Williams, M., Weber, P., 2020. Globe Progress Pit Closure Planning. 3rd International Congress on Planning for Closure of Mining Operations, Santiago, 7 – 11 September.
- Hickey, C.W., 2026. Buller Coal Plateaux Continuation Project: Water quality protection guidelines. Report prepared by RMA Science Ltd for Bathurst Resources Ltd.
- Hughes, J.B., Craw, D., Peake, B., Lindsay, P., Weber, P.A., 2007. Environmental characterisation of coal mine waste rock in the field: an example from New Zealand. *Environmental Geology* 52: 1501-1509.

- ICMM. 2019. Integrated mine closure, good practice guide. <https://www.icmm.com/integrated-mine-closure>.
- INAP, 2014. Global Acid Rock Drainage Guide (GARD Guide) – Rev1 International Network for Acid Prevention. <http://www.gardguide.com/images/5/5f/TheGlobalAcidRockDrainageGuide.pdf>.
- INAP, 2020. Rock Placement Strategies to Enhance Operational and Closure Performance of Mine Rock Stockpiles. Phase 1 Work Program – Review, Assessment & Summary of Improved Construction Methods. Report prepared for the International Network for Acid Prevention (INAP) by Okane and Earth Systems. 105 pp.
- INAP, 2024. ARD/AMD Source Control for Mine Rock Stockpiles Phase 3. Report prepared for the International Network for Acid Prevention (INAP) by Okane. 53 pp.
- Jewiss, C., 2018. The Water Quality and Geochemistry of Legacy Acid Mine Drainage on the Denniston Plateau, West Coast. MSc thesis, University of Otago.
- Jewiss, C., Craw, D., Pope, J., Christenson, H., Trumm, D., 2020. Dilution Processes of Rainfall-Enhanced Acid Mine Drainage. *Mine Water and the Environment* (2020) 39:27–41.
- Lopez, D.L., Smith, L., & Beckie, R., 1997. Modelling water flow in waste rock piles using kinematic wave theory. In proceedings of the Fourth International Conference on Acid rock Drainage, Vancouver, B.C., Canada, May 31 – June 6, 1997. Vol. 2, pp. 497–513.
- Leckie, J.M.G., and Weber, P.A., 2024. Planning for Closure and the Management of Uncertainty – In a Mining Context. New Zealand Annual AusIMM Branch Conference, Wellington, 19 - 21 August, 9 pp.
- Malloch, K.R., Weber, P.A., Olds, W.E., 2017. Acid and Metalliferous Drainage Potential of an Alluvial Gold Mine Operation. New Zealand Annual AusIMM Branch Conference, Christchurch, 10 - 13 September, 154 – 163.
- Malmström, M. E., Destouni, G., Banwart, S. A., & Strömberg, B. H. (2000). Resolving the scale-dependence of mineral weathering rates. *Environmental science & technology*, 34(7), 1375–1378.
- McLachlan, C., 2022. Determination of Acid Producing Potential Using pXRF: A Case Study from Cypress Mine, Stockton Plateau. In IMWA 2022 Proceedings, Pope, J.; Wolkersdorfer, C.; Rait, R.; Trumm, D.; Christenson, H.; Wolkersdorfer, K. (Editors), pp 253 - 258.
- MEND, 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials Report, MEND Report 1.20.1.
- Ministry for the Environment (MfE) 2018. Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition.
- MWM, 2026a. Background Water Quality Report - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0472-001-R- FINAL.
- MWM, 2026b. Upper Waimangaroa Haul Road Site Visit. Mine Waste Management Report: J-NZ0453-001-R- FINAL.

- MWM, 2026c. Factual Report. Geoenvironmental Hazards, Mount Frederick South Project. Mine Waste Management Report: J-NZ0377-001-R-FINAL.
- MWM, 2026d. Factual Report: Column Leach Testing, Mount Frederick South Project. Mine Waste Management Report: J-NZ0377-005-R-FINAL.
- MWM, 2026e. Upper Waimangaroa Haul Road Acid Base Accounting Summary. Mine Waste Management Report: J-NZ0453-009-M-FINAL.
- MWM, 2026f. BPCP AMD Hazard Classification Summary. Mine Waste Management Report: J-NZ0532-003-M-FINAL.
- MWM, 2026g. Cypress pXRF Summary. Mine Waste Management Report: J-NZ0453-010-M-FINAL.
- MWM, 2026h. Escarpment Mine Barren Valley ELF Water Quality Model. Mine Waste Management Report: J-0349-008-R-FINAL.
- MWM, 2026i. Water Load and Balance Model – Source Term Definition. Mine Waste Management Report: J-NZ0433-004-R-FINAL.
- MWM, 2026j. Engineered Landform Design Philosophy. Mine Waste Management Report: J-NZ0453-004-R-FINAL.
- MWM, 2026k. Cover System Field Investigation. Mine Waste Management Report: J-NZ0349-004-M-FINAL.
- MWM, 2026l. Cover System Technical Report. Mine Waste Management Report: J-NZ0349-013-R-FINAL.
- MWM, 2026m. Water Treatment Report: MFS and ESE - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0480-004-R-FINAL.
- MWM, 2026n. Passive Treatment System Design Toolkit. Mine Waste Management Report: J-NZ0453-005-R-FINAL.
- MWM, 2026o. AMD Sludge Management - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0349-015-R-FINAL.
- MWM, 2026p. Mount Frederick South Groundwater - Technical Report. Mine Waste Management Report: J-NZ0377-004-R-FINAL.
- MWM, 2026q. Escarpment Extended Mine Project - Groundwater Technical Report. Mine Waste Management Report: J-NZ0433-002-R-FINAL.
- MWM, 2026r. ELF Water Quality and MSR Design Summary - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0453-006-R-FINAL.
- MWM, 2026s. Construction Phase Report - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0453-007-R-FINAL.
- MWM, 2026t. Mount Frederick South Water and Load Balance Model. Mine Waste Management Report: J-NZ0377-003-R-FINAL.

- MWM, 2026u. Escarpment Extended Mine Project - Water and Load Balance Model Report. Mine Waste Management Report: J-NZ0433-003-R-FINAL.
- MWM, 2026v. Annual Overburden Schedule: MFS, ESE, UWHR. Mine Waste Management Report: J-NZ0453-011-R-FINAL.
- MWM, 2026w. Sediment Overview Report - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0480-002-R-FINAL.
- MWM, 2026x. Hydrological Assessment - Buller Plateaux Continuation Project. Mine Waste Management Report: J-NZ0494-001-FINAL.
- Nairn, R.W., Dorman, D.M., McCann, J.I., Shepherd, N.L., & Knox, R.C. 2023. Nature-based solutions for mine water challenges: sequential biogeochemical passive treatment systems.
- O’Kane Consultants Ltd., 2015. Acid Mine Drainage Liabilities – Stockton and Cypress Operations. Technical report prepared for Solid Energy New Zealand Ltd. Report No. 949/01-01. Dated July 2015.
- O’Kane Consultants Ltd, 2014. Escarpment Mine Project – Estimation of Draindown Seepage for Engineered Landform (ELF). Okane Consultants Memorandum dated 17 January 2014.
- Olds, W.E., Bird, B., Pearce, J.I., Sinclair, E., Orr, M., Weber, P.A., 2015. Geochemical Classification of Waste Rock using Process Flow Diagrams. New Zealand Annual AusIMM Branch Conference, Dunedin, 31 August – 2 September 2015, pp 307-318.
- Pearce, S., Orr, M., Sinclair, E., Pearce, J., Olds, W., Weber, P., 2016. A risk-based approach using process flow diagrams for operational waste rock classification – case studies. 11th International Conference on Mine Closure, 15-17 March 2016, Perth, Western Australia.
- Pope, J., 2026. Peer Review – Environmental Geochemistry. Report 2025 0018 by Strata Geoscience Limited for Bathurst Resources Limited.
- Pope, J., Christenson, H., Gordon, K., Newman, N., Trumm, D., 2018. Decrease in acid mine drainage release rate from mine pit walls in Brunner Coal Measures. New Zealand Journal of Geology and Geophysics, Vol. 61, No. 2, 195–206.
- Pope, J., Weber, P., Mackenzie, A., Newman, N., Rait, R., 2010. Correlation of acid base accounting characteristics with the geology of commonly mined coal measures, West Coast and Southland, New Zealand. New Zealand Journal of Geology and Geophysics Special Edition: Mine Drainage Vol 53 (2&3): 153 - 166.
- Price, W.A. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1 December 2009.
- Price, W.A., 1997. Guidelines and Recommended Methods for the Prediction of Metal leaching and Acid Rock Drainage at Minesites in British Columbia.
- Process Flow Limited, 2026a. Active Water Treatment Plant – Basis of Design. Document Number: PFL-2408-PRO-BOD-00001.

- Process Flow Limited, 2026b. Active Water Treatment Testing Report – Summary of Tests. Document Number: PFL-2408-PRO-RPT-00001.
- Robertson, C., Weber, P., & Olds, W., 2017. AMD Passive Treatment System: A Case Study– Escarpment Mine, Denniston Plateau. In New Zealand Annual AusIMM Branch Conference, The Australasian Institute of Mining and Metallurgy, Melbourne, pp. 243-252.
- Sinclair, E.J.P., Weber, P., 2022. Good acid and metalliferous drainage management begins well before mine closure: a New Zealand example. Mine Closure 2022 - M Tibbett, AB Fourie & G Boggs (eds), 6-10 October 2022, Brisbane, Australia.
- Sinclair, E.J.P., Weber, P., 2022. Managing Legacy AMD to Achieve Successful Mine Closure. Proceedings of the 15th International Mine Water Association (IMWA) conference, 6-10 November 2022, Christchurch New Zealand, pp 469 - 481.
- Taumata Arowai, 2022. Water Services (Drinking Water Standards for New Zealand) Regulations 2022.
- Taylor, J., Pape, S., & Murphy, N. 2005. A Summary of Passive and Active Treatment Technologies for Acid and Metalliferous Drainage (AMD).
- Treasury, 2017. AMD Liability Model. New Zealand Government
- Weber, P.A., Lindsay, P., Hughes, J.B., Thomas, D.G., Rutter, G.A., Weisener, C.G., Pizey, M.H., 2008. ARD minimisation and treatment strategies at Stockton Coal Mine, New Zealand. In "Proceedings of the Sixth Australian Workshop on Acid and Metalliferous Drainage", Burnie, Tasmania. 15-18 April 2008. (Eds LC Bell, BMD Barrie, B Baddock, and RW MacLean) pp. 113 - 138 (ACMER: Brisbane).
- Wright, L., 2008, Denniston Heritage Management Plan, prepared for the Denniston Heritage Charitable Trust, 2008.

11 LIMITATIONS

Attention is drawn to the document “Limitations”, which is included in Appendix W of this report. The statements presented in this document are intended to provide advice on what the realistic expectations of this report should be, and to present recommendations on how to minimise the risks associated with this project. The document is not intended to reduce the level of responsibility accepted by Mine Waste Management, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so.

APPENDIX A BACKGROUND WATER QUALITY REPORT

Background Water Quality Report

Buller Plateaux Continuation Project

22 July 2026

J-NZ0472-001-R-FINAL

Background Water Quality Report

Buller Plateaux Continuation Project

Document Number: J-NZ0472-001-R-FINAL

Document Date: 22 July 2026

Prepared for:

Bathurst Resources Limited

[REDACTED]

[REDACTED]

[REDACTED]

Prepared by:

Mine Waste Management Limited

[REDACTED]

[REDACTED]

www.minewaste.com.au

REVISION	DATE	AUTHOR	RECORD OF REVIEW
J-NZ0472-001-R-FINAL	22-07-2026	SH	PW

EXECUTIVE SUMMARY

Mine Waste Management Limited (MWM) was engaged by Bathurst Resources Limited (BRL) to provide a report summarising the surface water quality for waterways within the proposed Buller Plateaux Continuation Project (BPCP) within the following project sub-areas:

- Mount Frederick South (MFS).
- Escarpment Extended (ESE).
- Upper Waimangaroa Haul Road (UWHR).

These data are used in the assessment of environmental effects (AEE) for the Fast-track Approvals Act 2024 (FTAA) application.

Purpose

A water quality dataset is required to:

- Understand background conditions within waterways and the effects of historic mining activities.
- Identify locations for ongoing monitoring and the development of targeted water quality sampling programmes at these locations.
- Support the development of water quality models.
- Understand potential effects of the BPCP.
- Support the definition of water quality closure objectives for the project.
- Identify ecological 'betterment' opportunities where waterways currently impacted by AMD will be improved as an outcome of the BPCP.

This report summarises the water quality data for the MFS, ESE, and the UWHR. This work was used by Hickey (2026) to identify waterways impacted by acid and metalliferous drainage (AMD), the severity of this impact, and unimpacted stream water quality to identify suitable monitoring locations and establish water quality compliance criteria.

Review

A significant water quality database is available for the MFS, ESE, and the UWHR sub-areas to provide guidance on potential constituents of concern (PCOC) within these sub-areas with data being collected for many decades at some sites. For instance:

- Extensive water quality monitoring has been undertaken at the Stockton Mine with records in the Stockton Water Quality Database¹ commencing in 1987. Such data has application to the wider BPCP as similar lithological materials will be excavated with similar effects on interacting waters.

¹ As provided by BRL

- It is noted that observations, interpretations, and about 120,000 samples² from 125 sites over 45 years demonstrate that the Denniston and Stockton catchments are amongst the most well understood catchments in New Zealand with regard to water quality.
- The AMD risks are well understood for the Project areas and the materials that will be disturbed by the BPCP activities.

Although background water data is robust, it is recommended that the water quality for the project area be continually verified through the life of the BPCP to measure the performance of the proposed management processes.

Generally, site-specific guideline values (as proposed by Hickey (2026) for the BPCP) should be derived from at least 2 years of monthly data collected from suitable sites to constitute a baseline dataset to understand any seasonal effects³. Water quality data provided in this report includes sites with extensive water quality data sets and sites where additional monitoring has been recommended to meet the definition of baseline (and which is underway). Hence, this report is referred to as a background water quality report to acknowledge variable data availability at all sites covered by this report.

In many surface water quality environments, seasonality is the largest cause of variation in stream chemistry due to factors that include strongly seasonal rainfall patterns, snow melt, seasonal variation in groundwater recharge/discharge, or seasonal biological processes. However, on the Buller Plateaux, where close to four decades of data are available (e.g., Stockton Mine), these types of seasonal factors have been identified as being of much lesser importance. The strongest driver for stream water chemistry is the rapid response of headwater streams to rainfall (i.e., changes in stream flow rate).

Hence, water quality compliance monitoring sites with > 24 individual discrete samples are considered to be representative of baseline water quality for the BPCP provided these samples were collected over an extended timeframe (many months) and the samples included seasonal data and higher and lower flow periods. It is acknowledged this may not consider longer term climatic variations (e.g., El Niño Southern Oscillation) but many baseline datasets would not capture such variation in 2 years. Hence water quality reference sites have been established as part of the BPCP to understand long term climatic cycles that will be monitored over the project life to understand any effects for the BPCP and its associated compliance monitoring locations.

Proposed Water Quality Monitoring Programme

The following catchments are proposed for ongoing monitoring within the MFS, ESE, and the UWHR sub-areas:

- UWHR and MFS sub-areas:
 - o Waimangaroa River catchment.
 - o Deep Stream catchment.
- ESE sub-area:
 - o Cascade Creek catchment.

² As sourced from the BRL water quality database, including Sonde measurements.

³ <https://www.waterquality.gov.au/anz-guidelines/guideline-values/derive/reference-data>

- o Rapid Stream catchment.
- o Whareatea River catchment.

The forward water quality monitoring programme for sites within these waterways is tailored to individual sites dependent on the purpose of the water quality monitoring site. Three types of monitoring locations have been proposed:

- Performance monitoring – to ensure compliance (and betterment) water quality is on track and will be achieved and provide data for adaptive management purposes.
- Compliance monitoring – to ensure the Project is achieving its approved water quality objectives.
- Reference site monitoring – to provide baseline data to understand climatic variables (e.g., El Niño Southern Oscillation) within unimpacted catchments that can be used to understand longer term trends in waterways affected by mine impacted water.

Table E1 provides a summary of the proposed monitoring programme for MFS, ESE, and the UWHR. Details of the proposed water quality monitoring frequency, parameters tested, and relationship to project activities are provided in AMD WMP⁴ (BRL, 2026). The following is noted:

- At least 24 samples are available for all compliance water quality monitoring locations.
- Performance and reference monitoring locations with <24 samples at the time of data compilation are shown in blue. These sites will be continually verified through the life of the BPCP to validate the proposed management processes.

Table E1: Proposed water quality monitoring program (MFS, ESE, UWHR).

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	NO. OF SAMPLES COLLECTED
UWHR	Waimangaroa River	WRBBC	Performance	97
UWHR	Waimangaroa River	14W	Performance	10
UWHR	Waimangaroa River	15W	Performance	11
MFS	Waimangaroa River	16W ¹	Performance	6
MFS / UWHR	Waimangaroa River	2W (Smokestack)	Compliance	29 + 17 high flow event samples
MFS / UWHR	Waimangaroa River	17W	Compliance	24
MFS	Waimangaroa River	18W	Performance	7
MFS / UWHR	Wilson Creek (Waimangaroa River tributary)	WIL.MS1	Reference	7
MFS / UWHR	Cedar Creek (Waimangaroa River tributary)	CED.MS1	Reference	7
UWHR	Burnetts Stream	BUR.L1	Performance (turbidity)	17

⁴ AMD Water Management Plan

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	NO. OF SAMPLES COLLECTED
MFS	Deep Stream	SW01	Compliance	26 + 28 high flow event samples
MFS	Deep Stream	SW03	Compliance	26
MFS	Deep Stream	SW04	Performance	24
MFS	Billo Stream	BS01	Performance (turbidity)	24 + 8 high flow event samples
MFS	Billo Stream tributary	BIL.L1	Reference	9
MFS	Deep Stream unnamed tributary	SW02	Performance ²	24
ESE	V8 Creek (Cascade Creek tributary)	MM1	Compliance	149
ESE	V37 Stream (Cascade Creek tributary)	V37-F ³	Performance	-
ESE	V37 Stream (Cascade Creek tributary)	V37-G ³	Performance	-
ESE	Cascade Creek	DS.V37	Performance (ecology)	1
ESE	Rapid Stream	W07	Compliance	26
ESE	Rapid Stream	W08	Performance	21
ESE	Rapid Stream	W09	Performance	24
ESE	Rapid Stream tributary	RAP.R1	Reference	4
ESE	Whareatea River	KEL	Compliance	51 + 3 high flow event samples
ESE	Whareatea River	WM-3	Performance	116
ESE	V70 (Whareatea River tributary)	V70	Reference and Performance (turbidity)	19
ESE	V62 (Whareatea River tributary)	V62	Compliance	24 + 2 high flow event samples

¹ = no data available as at Q4 2025.

¹ Consider the pre-BPCP 2W data will reflect the background conditions at 16W. This site is included as an add to background site for assessing compliance at 2W (Smokestack).

² To take over from BIL.L1 and become a reference site at the start of the Post Construction phase.

³ These sites will be monitored once disturbed, currently insufficient flow to sample.

Potential Constituents of Concern

All major catchments within the MFS, ESE, and the UWHR contain areas affected to varying degrees by AMD from historic mining:

- At the MFS sub-area there are numerous adits, overburden disposal areas, and collapsed workings due to historic underground and minor opencast mining activities. The historic underground Taipo and Koranui Mines are within the footprint of the MFS West Pit.
- Within the ESE sub-area there are several areas of historic underground workings including the Sullivan Mine, Sullivan West Mine, Escarpment Mine (not the existing open pit Escarpment

mine, but the previous underground mine), Coalbrookdale Mine, and Cascade Mine. AMD discharge from historic underground workings of the Denniston Plateau discharges into Cascade Creek, Waimangaroa River, Rapid Stream, and Whareatea River (near the coast where Rapid Stream enters this river).

- The southern portion of the UWHR to the intersection of the MFS Access Road has historically been mined and pre-existing impacts associated with the exposure of PAF materials is present along the existing road. The proposed UWHR alignment is over the Iron Bridge Mine underground workings.

Some of the underground historic workings are proposed to be excavated within the Cascade Stream catchment areas. This will have the effect of reducing the PCOC load from uncontrolled AMD discharging from historic underground workings into these catchments.

To provide an indication of background historic AMD effects on water quality, a metal ecotoxicity quotient (MEQ) is used to identify PCOC that may be elevated with respect to screening criteria (water quality reference values). The MEQ value for a PCOC is determined by dividing the measured concentration (maximum values used in this report) by the water quality reference value (WQ Ref Value). MEQ values greater than 1 indicate parameters that exceed the relevant WQ Ref Value. Conversely, MEQ values less than 1 are below the relevant WQ Ref Value

The following WQ Ref Values were applied where appropriate:

- Proposed water quality criteria developed for the BPCP (Hickey, 2026).
- 95% ANZG (2018) Default Guideline Values (DGVs).
- ANZG (2018) for unknown protection level for Sb.
- ANZG Livestock Drinking Water Guidelines (Draft) (2023) for sulfate.
- Canadian water quality guidelines for the protection of aquatic life (CCME, 2014) for thallium of 0.8 µg/L (0.0008 mg/L).

Where maximum data exceeded a WQ Ref Value, this was identified as a PCOC. Table E2 provides PCOC identified for the proposed compliance monitoring sites and classification as per the system developed by Hickey (2026)⁵. PCOC data indicates the potential for elevated Cu and Zn at sites not impacted by historic mining as indicated by sites classified as 'Good' (Hickey, 2026).

Table E2: PCOC identified at water quality compliance monitoring sites (MFS, ESE, UWHR).

LOCATION	WATER QUALITY COMPLIANCE MONITORING SITE	NO. OF SAMPLES COLLECTED	PCOC ¹	CLASSIFICATION ²
Waimangaroa River	2W (Smokestack)	29 + 17 high flow samples	Al, Cd, Co, Zn	Fair
Waimangaroa River	17W	24	Al, Cd, Co, Zn	Fair

⁵ Biological and chemical baseline data were used to determine AMD influence on streams with increasing levels classified from 'good' to 'poor'.

LOCATION	WATER QUALITY COMPLIANCE MONITORING SITE	NO. OF SAMPLES COLLECTED	PCOC ¹	CLASSIFICATION ²
Deep Stream	SW01	26 + 28 high flow samples	Zn	Good
Deep Stream	SW03	26	-	Good
Cascade Creek tributary (V8 Creek)	MM1	149	Al, Cd, Co, Cu, Fe, Ni, Zn	Poor
Rapid Stream	W07	26	Cd	Good
Whareatea River	KEL	51 + 3 high flow event samples	Cd, Cr	Good
Whareatea River tributary (V62)	V62	24 + 2 high flow event samples	Cd, Cu	Good

1. Where MEQ > 1 for maximum recorded data and all data is not < LOR.

2. As developed by Hickey (2026).

Recommendation

Recommendation #1: Continue water quality monitoring *Water Quality Monitoring*

- Continue further water quality monitoring at compliance, performance, and reference monitoring sites over the construction, operational, and closure phases of the BPCP.

Recommendation #2: Validate baseline water quality

- Undertake continuous monitoring data (flow, EC, pH and turbidity) to provide time-based data to fully characterise the relationships between flow and physicochemistry at compliance monitoring locations (e.g., 2W: Smokestack) prior to construction commencing and then continuing throughout life of mine phases.
- Validate and refine flow weighted water quality source terms (mg/L).

TABLE OF CONTENTS

1	Introduction	1
1.1	Project Description.....	1
1.2	Objectives and Scope of Work	1
1.2.1	Objectives.....	1
1.2.2	Scope of Work	3
2	Background.....	5
2.1	Surface Water.....	5
2.1.1	Escarpment Extension Area.....	5
2.1.2	Mount Frederick South	5
2.2	Groundwater	8
2.3	Climate and BPCP Water Quality	8
3	Analysis Procedure	9
3.1	Water Quality Reference Values	9
3.2	Metal Ecotoxicity Quotient	10
3.3	Limit of Reporting.....	11
3.4	Erroneous Data.....	11
3.5	Data Management	11
3.6	Surface Water Quality Data Analysis	12
3.7	High Flow Event Samples	13
4	UWHR / MFS	15
4.1	Proposed UWHR / MFS Monitoring Locations	15
4.2	Waimangaroa River	21
4.2.1	Water Quality Data	21
4.2.2	Data Summary.....	35
4.2.2.1	2W Smokestack	36
4.3	Deep Stream Catchment	37
4.3.1	Water Quality Data	39
4.3.2	Data Summary.....	46
4.3.3	Sonde Data.....	47
4.3.3.1	SW01.....	47
4.3.3.2	BS01.....	48
4.3.3.3	SW05.....	50
4.3.4	Grab Sample Water Quality Data	54
4.3.4.1	Sample Event 1: August 2023 Site Visit	54
4.3.4.2	Sample Event 2: October 2023 Site Visit.....	56
4.4	Legacy Mine Drainage Water Quality	58
5	Escarpment Extension Area	60
5.1	Proposed ESE Monitoring Locations	60
5.2	Cascade Creek	64

5.2.1	Water Quality Data	64
5.2.2	Data Summary.....	72
5.2.3	Escarpment Mine Discharge	74
5.3	Rapid Stream.....	76
5.3.1	Water Quality Data	76
5.3.2	Data Summary.....	83
5.4	Whareatea River Catchment	86
5.4.1	Water Quality Data	86
5.4.2	Data Summary.....	98
6	Summary.....	104
6.1	Introduction	104
6.2	Proposed Water Quality Monitoring Programme Summary	104
6.3	Recommendation.....	105
7	References.....	107
8	Limitations.....	109
Appendix A	Waimangaroa River – Excel File	110
Appendix B	Deep Stream – Microsoft Excel File	111
Appendix C	Cascade Creek – Microsoft Excel File.....	112
Appendix D	Rapid Stream – Microsoft Excel File	113
Appendix E	Whareatea River – Microsoft Excel File	114
Appendix F	Limitations.....	115

LIST OF TABLES

Table 1: Monthly climate data.	8
Table 2: Water quality reference values.	10
Table 3: Water quality monitoring sites and data range.	12
Table 4: Proposed monitoring sites for the UWHR and MFS from upstream to downstream.	16
Table 5: Water quality data and MEQ analysis for Waimangaroa River sites.	23
Table 6: Water quality data and MEQ analysis for Waimangaroa River sites.	24
Table 7: Water quality monitoring data and MEQ analysis for 2W (Smokestack).	26
Table 8: Water quality monitoring data and MEQ analysis for 17W and WR at DC Confluence.	28
Table 9: Water quality monitoring data and MEQ analysis for 18W and WR at State Highway.	30
Table 10: Water quality monitoring data and MEQ analysis for Cedar Creek and Wilsons Creek.	31
Table 11: Water quality monitoring data and MEQ analysis for Burnetts Stream.	31
Table 12: MEQ summary for the Waimangaroa River catchment.	32
Table 13: Water quality data and MEQ analysis for Deep Stream SW04, SW01 and SW01 high flow event samples.	40
Table 14: Water quality data and MEQ analysis for Deep Stream and tributaries SW03, SW02 and SW05.	41
Table 15: Water quality data and MEQ analysis for Billo Stream and tributary BS01, BS01 high flow event samples and BIL.L1.	42
Table 16: MEQ summary for the Deep Stream catchment.	44
Table 17: Sonde data for SW01.	47
Table 18: Sonde data for BS01.	48
Table 19: Sonde data for SW05.	50
Table 20: Deep Stream water quality results: August 2023 site visit.	55
Table 21: October 2023 site visit sample locations.	56
Table 22: Deep Stream water quality results: October 2023 site visit.	57
Table 23: Water quality of Deep Stream compared to Trigger Values.	58
Table 24: Water quality of Deep Stream adits 1 and 3.	58
Table 25: Iron Bridge water quality data.	59
Table 26: Proposed monitoring sites ESE.	61
Table 27: Water quality data and MEQ analysis for Cascade Creek monitoring sites (X7, X6, and X4).	66
Table 28: Water quality data and MEQ analysis for Cascade Creek monitoring sites (Cascade Upper, X3 and Cascade Lower).	66
Table 29: Water quality data and MEQ analysis for tributaries of Cascade Creek monitoring sites (X8, X5, MM1).	67
Table 30: Water quality data for V37 Creek.	68
Table 31: MEQ summary for the Cascade Creek catchment.	69
Table 32: Water quality data and MEQ analysis for Rapid Stream monitoring sites (W07, Sullivan Adit, W08).	79
Table 33: Water quality data and MEQ analysis for Rapid Stream monitoring sites (W09, RAP.R1).	80
Table 34: MEQ summary for the Rapid Stream catchment.	81

Table 35: Water quality data and MEQ analysis for Whareatea River catchment monitoring sites (WM0 and WM1).	88
Table 36: Water quality data and MEQ analysis for Whareatea River catchment monitoring sites (W-M2 and W-M2 high flow event samples).	88
Table 37: Water quality data and MEQ analysis for Whareatea River monitoring sites (KEL, KEL high flow event samples and W-M3).	90
Table 38: Water quality data and MEQ analysis for Whareatea River tributary monitoring sites (C-M1 and C-M1 high flow event samples).	91
Table 39: Water quality data and MEQ analysis for Whareatea River tributaries monitoring sites (S Creek, V40, Trent Stream).	92
Table 40: Water quality plot for Whareatea River tributaries monitoring sites (V62, V62 high flow event samples and V70).	93
Table 41: Water quality data and MEQ analysis for Gate Pond and Whareatea Dam.	94
Table 42: MEQ summary for the Whareatea River catchment.	94
Table 43. Proposed water quality monitoring program (MFS, ESE, UWHR).	104

LIST OF FIGURES

Figure 1: Acidity (mg/L) as a function of flow rate: St Patrick's Stream - Stockton.	2
Figure 2: Flow versus pH data for Mangatini Stream	3
Figure 3: Water monitoring sites within the BPCP.	7
Figure 4: Location of UWHR and MFS water monitoring sites.	18
Figure 5: Location of MFS water monitoring sites.	19
Figure 6: Cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites.	20
Figure 7: Waimangaroa River (and tributaries) water quality monitoring sites.	22
Figure 8: EC and pH for Waimangaroa River monitoring sites.	34
Figure 9: Box plots of pH and EC for Waimangaroa River monitoring sites.	35
Figure 10: Trend analysis of SO ₄ and DOC with flow at 2W (Smokestack).	36
Figure 11: Relationship of selected parameters with flow at 2W (Smokestack).	37
Figure 12: Deep Stream (and tributaries) water monitoring sites.	38
Figure 13: EC and pH for tributaries of Deep Stream and tributaries monitoring sites.	45
Figure 14: Box plots of pH and EC for Deep Stream monitoring sites.	46
Figure 15: Water quality plots for zinc (Zn) in the Deep Stream catchment.	47
Figure 16: SW01 Sonde data time series plot for pH and flow.	48
Figure 17: SW01 Sonde data time series plot for EC and flow.	48
Figure 18: BS01 Sonde data time series plot of pH and flow.	49
Figure 19: BS01 Sonde data time series plot of EC and flow.	49
Figure 20: SW05 Sonde data time series plot of pH and flow.	50
Figure 21: SW05 Sonde data time series plot of EC and flow.	51
Figure 22: Box and whisker plots for pH versus flow quartile.	52
Figure 23: Box and whisker plots for conductivity versus flow quartile.	53

Figure 24: ESE catchments and water monitoring sites.	62
Figure 25: Cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites.	63
Figure 26: Cascade Creek water quality monitoring sites.	65
Figure 27: EC and pH for Cascade Creek catchment monitoring sites.	71
Figure 28: Box plots of pH and EC for the Cascade Creek catchment monitoring sites.	73
Figure 29: Water quality plots for select metals (Al, Fe, Ni, and Zn) from Cascade Creek and tributaries.....	73
Figure 30: Water quality plots for select metals (Al, Co, Cu, Fe, Ni, and Zn) from Cascade Upper, Cascade Lower and M-M1.	74
Figure 31: Rapid Stream monitoring locations.	77
Figure 32: Sullivan Mine adits, W07 and W08 monitoring sites.....	78
Figure 33: EC and pH for Rapid Stream monitoring sites from upstream to downstream.	82
Figure 34: Box plots of pH and EC for Rapid Stream monitoring sites.....	84
Figure 35: Water quality plots for select metals (Al, Cu, Fe, Ni and Zn) for Rapid Stream.	85
Figure 36: Whareatea River Catchment water monitoring sites.	87
Figure 37: EC and pH plots for Whareatea River catchment monitoring sites WM0, WM1, W-M2, KEL, and W-M3).....	96
Figure 38: EC and pH plots for Whareatea River catchment tributaries monitoring sites (S Creek, V40 [V40 Stream], Trent, C-M1, V62, and V70).	97
Figure 39: Box plots of pH and EC for Whareatea River monitoring sites.....	100
Figure 40: Box plots of pH and EC for Whareatea River tributaries monitoring sites.....	101
Figure 41: Select metal concentrations (Al, Cu, Fe, and Zn) for Whareatea River catchment monitoring sites.	102
Figure 42: Select metal concentrations (Al, Cu, Fe, and Zn) for Whareatea River tributary monitoring sites.	103

1 INTRODUCTION

Mine Waste Management Limited (MWM) was engaged by Bathurst Resources Limited (BRL) to provide a report defining the background surface water quality dataset for waterways within the Buller Plateaux Continuation Project (BPCP, or the Project) area that can be used in the assessment of environmental effects (AEE) for the Fast-track Approvals Act 2024 (FTAA) Application.

1.1 Project Description

The purpose of the Project is to secure the existing infrastructure and mining operations associated with the Stockton Mine and provide access to additional mining areas as the coal resources in the current operations are depleted. The Project proposes to mine approximately 20 million tonnes of coking coal utilising existing infrastructure facilities over a 25-year timeframe to support and extend the mine life of the current Stockton Mine operations. There are five key Project sub-areas:

1. Stockton Mining Area (Stockton).
2. Mount Frederick South (MFS).
3. Escarpment Extended (ESE).
4. Upper Waimangaroa Haul Road (UWHR).
5. Cypress Mining Area (Cypress)

Mine Waste Management Limited (MWM) has developed this report to support BRL with the assessment of environmental effects (AEE) for its proposed mining activities for sub-areas 2 - 4. Stockton and Cypress sub-areas are addressed in other reports.

BRL have requested support to review surface water quality for monitoring and alignment of current and future water quality sampling programs across the sub-areas of the BPCP.

1.2 Objectives and Scope of Work

1.2.1 Objectives

A water quality dataset is required to:

- Understand background conditions within waterways and the effects of historic mining activities.
- Identify locations for ongoing monitoring and the development of targeted water quality sampling programmes at these locations.
- Support the development of water quality models.
- Understand potential effects of the BPCP.
- Support the definition of water quality closure objectives for the Project.
- Identify 'betterment' opportunities where waterways currently impacted by acid and metalliferous drainage (AMD) will be improved as an outcome of the BPCP.

Generally, site-specific guideline values (as proposed by Hickey (2026) for the BPCP) should be derived from at least 2 years of monthly data collected from suitable sites to constitute a baseline dataset to understand any seasonal effects⁶. Water quality data provided in this report includes sites with extensive water quality data sets and sites where additional monitoring has been recommended to better inform the baseline (and which is underway). Hence, this report is referred to as a background water quality report to acknowledge variable data availability at all sites covered by this report.

In many surface water quality environments, seasonality is the largest cause of variation in stream chemistry due to factors that include strongly seasonal rainfall patterns, snow melt, seasonal variation in groundwater recharge/discharge, or seasonal biological processes. However, on the Buller Plateaux, where close to four decades of data are available (e.g., Stockton Mine), these types of seasonal factors have been identified as being of much lesser importance. The strongest driver for stream water chemistry is the rapid response of headwater streams to rainfall (i.e., changes in stream flow rate).

For instance, this is shown by water quality monitoring at Stockton where data for St Patrick's Stream (Figure 1) demonstrates >4-fold dilution in water quality over flows rates that increase by an order of magnitude.

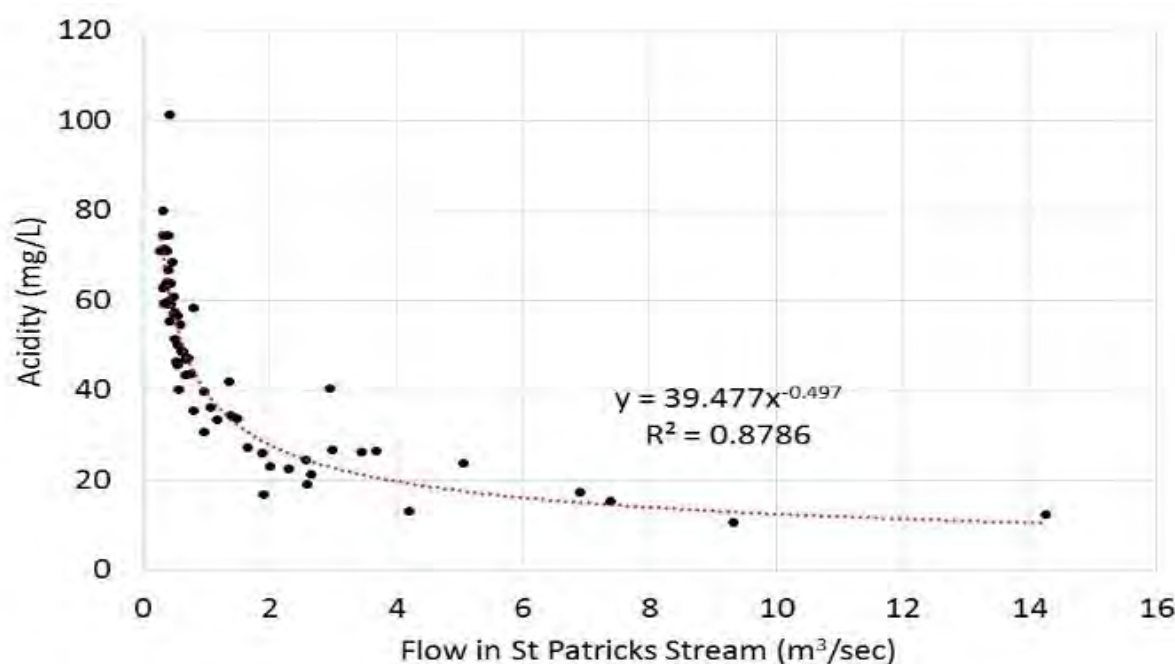


Figure 1: Acidity (mg/L) as a function of flow rate: St Patrick's Stream - Stockton

Source: Weber et al. (2015)

Other substantive studies have been undertaken by Davies (Davies, 2009; Davies et al., 2011) which also show increasing pH with increasing flow due to the significant dilution of AMD impacted waters by rainfall and rapid runoff (Figure 2).

⁶ <https://www.waterquality.gov.au/anz-guidelines/guideline-values/derive/reference-data>

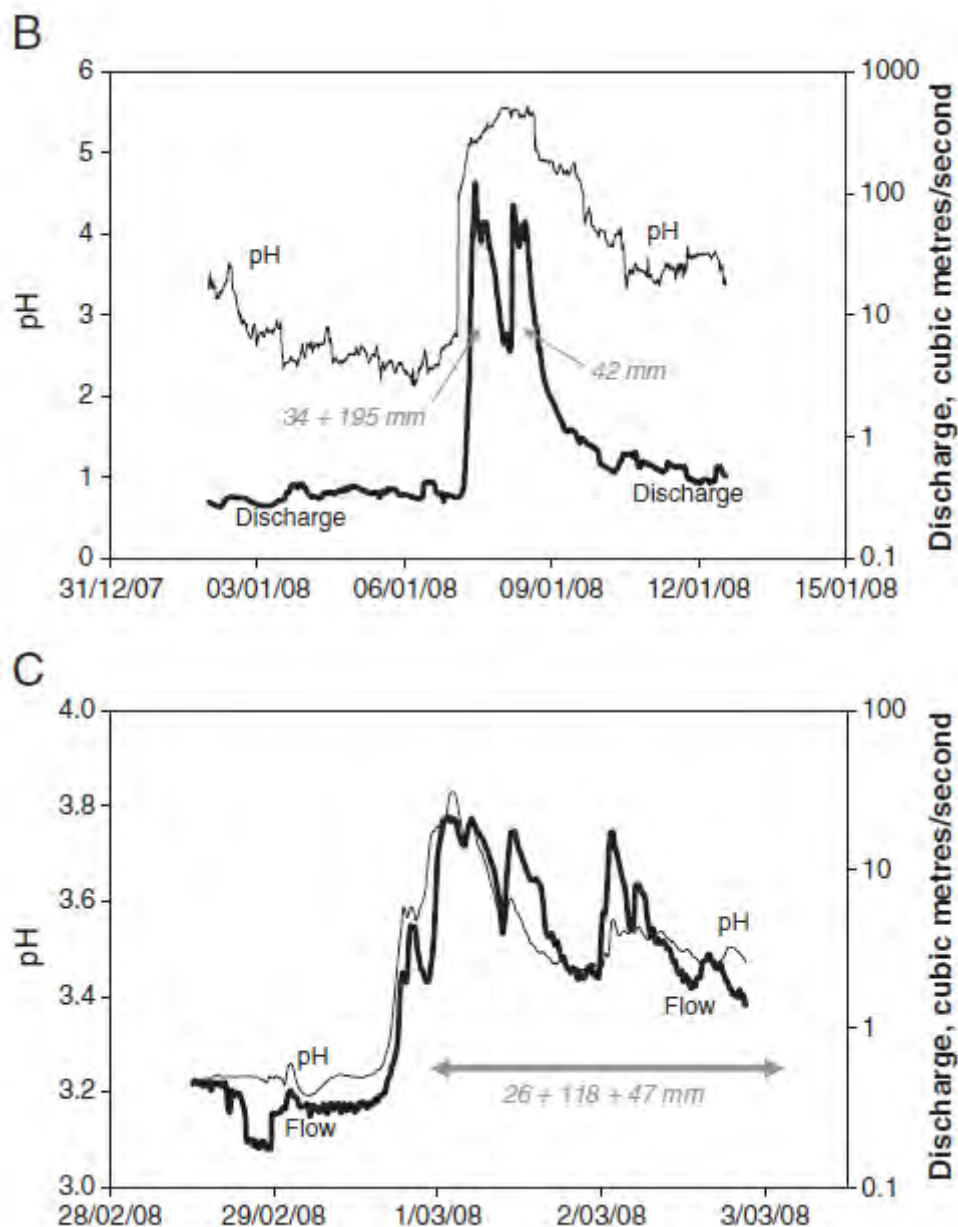


Figure 2: Flow versus pH data for Mangatini Stream

Source: Davies et al. (2011) where B = January Event; and C = March Event

The data review provided in this report will also assist in identifying appropriate locations for ongoing water quality (and quantity) monitoring and the development of targeted water quality sampling programs at these locations.

1.2.2 Scope of Work

The scope of this report is the compilation of all surface water quality data for the following BPCP sub-areas:

- UWHR and MFS sub-areas:
 - o Waimangaroa River.

- o Deep Stream.
- Escarpment Extension Area:
 - o Cascade Creek.
 - o Rapid Stream.
 - o Whareatea River.

For the purposes of water quality data screening, this report compares water quality data against water quality criteria for developed for the BPCP (Hickey, 2026), supplemented by other water quality standards (e.g., ANZG (2018)) as required.

2 BACKGROUND

The Stockton coal mining region is part of the Buller Coalfield on the West Coast of the South Island. The Buller Coalfield includes the Stockton Coal Mine, Cypress Coal Mine, Cascade Coal Mine, Escarpment Coal Mine, and historic workings on the Denniston and Stockton Plateaux (collectively referred to as the Buller Plateaux). Coal has been mined in the Buller Coalfield since 1872 (Flores and Sykes, 1996) with early mining operations underground.

2.1 Surface Water

The Stockton and Denniston Plateaux are deeply incised by streams and contain the headwaters and tributaries of the Waimangaroa River. Additional important catchments for this Project include Deep Stream, Cascade Creek, Whareatea River, and Rapid Stream. Figure 3 illustrates the extent of historic and current water sampling of these catchments within the BPCP area.

2.1.1 Escarpment Extension Area

The ESE is located on the Denniston Plateau, which is elevated at 600 to 1,100 m above sea level and hosts several current and former coal mining operations. The area is located within moderately sloping, hilly terrain with deeply incised drainage channels. The site has an overall slope to the northwest and has several watercourses draining to the north or southeast via a steep topographical drop into the Cascade Creek catchment. Cascade Creek ultimately drains into the Buller River that bisects the Westport township.

The main drainage feature within the ESE is the Whareatea River. The Whareatea River becomes deeply incised to the north and receives flows from numerous tributaries on the Denniston Plateau. Ultimately, the river drains in a north-westerly direction towards the coast and discharges into the Tasman Sea, approximately 10 km east of Westport. An additional major drainage feature within the ESE sub-area east of the Whareatea River is Rapid Stream. Rapid Stream drains in a north-westerly direction and is influenced by mine affected water from the historic Sullivan North underground workings.

Opencast mining in the ESE area commenced in 2014 at the east of the Denniston Plateau. Pit 3 was constructed as a water treatment facility for mine impacted water and has now formed a pit lake (Pit 3 Pit Lake). Immediately to the east of the Pit 3 Pit Lake is an artificial lake named Lake Brazil.

Mining activity is currently on care and maintenance at the Escarpment Mine on the Denniston Plateau. The site is host to a network of historical underground mines that were worked between the 1890's and 1980's including the Sullivan Mine, Sullivan West Mine, Escarpment Mine, Coalbrookdale Mine, and Cascade Mine. AMD discharge from historic underground workings ultimately discharges into the Cascade Creek, Rapid Stream, Waimangaroa River, and Whareatea River (near the coast where Rapid Stream enters) (Jewiss et al., 2020). The proposed footprint of the BPCP includes excavation of areas of historic workings within the Rapid Stream catchment providing a reduction in uncontrolled AMD discharge from these workings.

2.1.2 Mount Frederick South

The MFS area is bounded by Webb Stream in the north, the coastal ridgeline south of Mount Frederick in the west, the steep scarp of the Waimangaroa River Gorge in the south, and the Waimangaroa River valley/headwaters in the east. It is deeply incised by several streams including Billo and Deep Stream in the south and L75 Stream in the north, which flow east or southeast (Rough Milne Mitchell Landscape

Architects, 2021). Within the MFS sub-area there are numerous adits, overburden disposal areas, and collapsed workings related to historical mining operations. The historic underground Koranui, and Taipo Mines are within the footprint of the MFS West Pit. These historical underground workings are to be mined out preventing further collapse of underground workings and reducing the effect of untreated AMD discharge into the Deep Stream catchment.

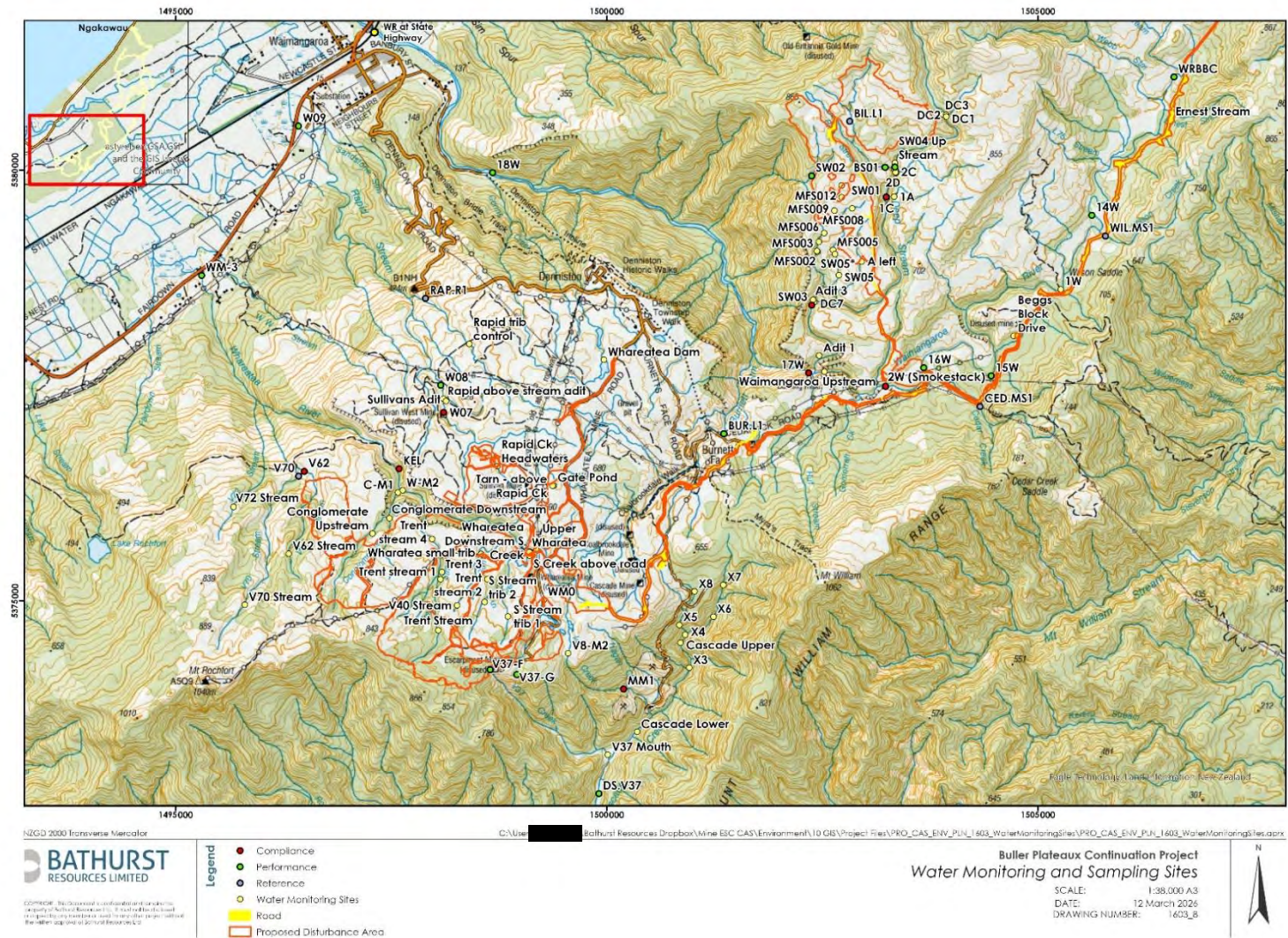


Figure 3: Water monitoring sites within the BPCP.

Source: BRL

2.2 Groundwater

Further details on groundwater quality are provided in (MWM, 2026a,b).

2.3 Climate and BPCP Water Quality

Water quality monitoring programmes across the Buller Plateaux have varied over time with changing operators and mining operations. Extensive water quality monitoring has occurred across and beyond the spatial extents of the BPCP. The dataset presented in this report covers this spatial area and includes records dating back to 1995 (refer to Figure 3). Extensive water quality monitoring has been undertaken at the Stockton Mine with records in the Stockton Water Quality Database⁷ commencing in 1987, this data is not presented in this report.

Site-specific guideline values are recommended to be based on at least 2 years of monthly monitoring data to be considered a baseline dataset⁸, to allow for two annual seasonal cycles within the data. Some of the specific water quality monitoring sites used to support the BPCP application have less than 2 years of monthly data. However, BRL (and previous operators) have extensive experience monitoring water quality in this environment and have a thorough understanding of background and baseline conditions. Observations, interpretations, and about 120,000 samples⁹ from 125 sites over 45 years (pers. comm. [REDACTED], email dated 12/01/2026) demonstrates that the Denniston and Stockton catchments are among the most well understood catchments in New Zealand with regard to water quality. The Buller Plateaux has a temperate maritime climate characterised by high annual mean rainfall, cool temperatures, and frequent cloud cover. Table 1 presents the climate records between 2011 to 2023 from the project climate dataset¹⁰ (refer to MWM, 2026c for further details). Temperature on the Buller Plateaux shows low annual variation and a monthly range of 5.2 to 14.0 °C (Table 1) and rainfall patterns are not strongly seasonal.

Table 1: Monthly climate data.

SOURCE TERM	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
RAINFALL (BRAZIL - ESE)	mm	423	366	341	448	548	410	476	408	481	591	471	505	5,468
RAINFALL ¹ (MFS)	mm	458	397	370	486	594	444	516	442	522	641	511	547	5,928
AIR TEMP.	°C	13.5	14.0	12.7	10.3	8.4	6.5	5.2	5.7	6.8	8.0	9.9	12.3	-
POTENTIAL EVAPORATION	mm	139	117	91	49	23	10	15	34	64	101	128	151	922

¹Rainfall adjusted based on rainfall-altitude relationship for the Denniston Plateau derived by Chater (2024), assuming a mean site elevation of 812 mRL. Potential evaporation calculated by the penman formulation (Penman 1948)

Due to low seasonal temperature variability, rainfall events are the primary driver (i.e., flow, flushing, dilution) of water quality within waterways on the Buller Plateaux (see Section 4.3.3 for examples).

⁷ As provided by BRL

⁸ <https://www.waterquality.gov.au/anz-guidelines/guideline-values/derive/reference-data>

⁹ As sourced from the BRL water quality database, including Sonde measurements.

¹⁰ derived from the Lake Brazil weather station located on-site at an elevation of 640 m.

3 ANALYSIS PROCEDURE

The following section details the background water quality data analysis procedure. Water sampling data was provided by BRL with data spanning from 1995 to 2026. Data from the BPCP is reported by Project sub-areas then grouped into the following catchment areas for analysis and reporting:

- MFS and UWHR
 - o Waimangaroa River
 - o Deep Stream
- ESE Area
 - o Cascade Creek
 - o Rapid Stream
 - o Whareatea River

3.1 Water Quality Reference Values

Water Quality Reference Values (WQ Ref Values) are compared to background water quality data in this report to:

- Provide a placeholder water quality criteria for the Project; and
- Determine at a screening level whether any Potential Constituents of Concern (PCOC) are elevated.

Site-specific water quality criteria have been developed for the BPCP by Hickey (2026). Where a reference value was not available, the default guideline value (DGV) from ANZG (2018) 95% level of protection was used to obtain a WQ Ref Value or, in the absence of DGVs, other guidelines were used.

For this report, the following WQ Ref Values were applied:

- Hickey (2026) chronic 95% level of protection (LoP) water quality criteria where criteria is defined using toxicity modifying factors (TMFs). As water quality criteria is used as a screening tool, water quality criteria with the following TMF are applied: pH 7.0, hardness 50 mg/L CaCO₃ and DOC 3.5 mg/L (Hickey, 2026).
- 95% ANZG (2018) DGVs.
- ANZG (2018) for unknown protection level for Sb.
- Where appropriate, other guideline values were applied:
 - o ANZG Livestock Drinking Water Guidelines (Draft) (2023) for sulfate (SO₄): 500 mg/L.
 - o Canadian water quality guidelines for the protection of aquatic life (CCME, 2014) for thallium of 0.8 µg/L (0.0008 mg/L).

No hardness modification¹¹ were applied to ANZG DGVs as this was conducted as a screening assessment to determine the potential for exceedances of consent limits. Omission of hardness corrections is conservative because in general these corrections result in reduced metal toxicity and enable higher concentrations of trace elements.

Table 2: Water quality reference values.

PARAMETER		UNIT	COMMENTS	SOURCE
pH	4.5 - 7.0	pH units	Maintain in range 4.5 – 7.0 for WTP ¹² discharge	Hickey (2026)
SO ₄	500	mg/L	Livestock Drinking Water Guidelines	ANZG (2023)
NO ₃ -N	2.4	mg/L	Chronic 95% limit	Hickey (2026)
NH ₄ -N	0.58	mg/L	Chronic 95% limit	Hickey (2026)
Al	0.37	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
As	0.013	mg/L	95% protection level	ANZG (2018)
B	0.94	mg/L	95% protection level	ANZG (2018)
Cd	0.00009	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Co	0.0014	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Cr	0.001	mg/L	Cr(VI), 95% protection level	ANZG (2018)
Cu	0.0029	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Fe	0.5	mg/L	Chronic limit	Hickey (2026)
Hg	0.0006	mg/L	95% protection level	ANZG (2018)
Mn	0.43	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Ni	0.017	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Pb	0.0034	mg/L	95% protection level, toxicity modifier available	ANZG (2018)
Sb	0.009	mg/L	Unknown protection level	ANZG (2018)
Se	0.011	mg/L	Total Se, 95% protection level	ANZG (2018)
Tl	0.0008	mg/L	-	CCME (2014)
Zn	0.023	mg/L	Chronic 95% limit where pH 7.0, hardness 50 mg/L CaCO ₃ , DOC 3.5 mg/L	Hickey (2026)
Turbidity	25	NTU	Chronic performance site limit, 15 sample rolling median	Hickey (2026)

3.2 Metal Ecotoxicity Quotient

A metal ecotoxicity quotient (MEQ) is used in this report to identify PCOC that may be elevated with respect to screening criteria (Weber and Olds, 2016).

The MEQ value for a PCOC is determined by dividing the measured concentration (maximum values used in this report) by the WQ Ref Value. MEQ values greater than 1 indicate parameters that exceed the relevant WQ Ref Value. Conversely, MEQ values less than 1 are below the relevant WQ Ref Value. If any PCOC are within 50% of the WQ Ref Value (i.e., $MEQ \geq 0.5$) they are considered elevated (and

¹¹ Hardness correction algorithms used to convert chronic toxicity data for Cr and Pb at a given test water hardness to a hardness of 30 mg CaCO₃/L (ANZG, 2018).

¹² Water Treatment Plant

are noted as being elevated in this report) and ongoing monitoring is recommended to confirm trends and/or potential hazards. This approach is similar to using 50% of maximum acceptable value (MAV) for drinking water where it is used as a screening level for follow up action (Taumata Arowai, 2022).

MEQ data are colour coded for ease of analysis and data interpretation where:

- **Red MEQ** indicates that maximum concentrations exceed the WQ Ref Values (> 1.0)
- **Orange MEQ** indicate MEQ between ≤ 1.0 and ≥ 0.5 , maximum concentrations were elevated.
- **Blue MEQ** indicates the maximum value reported for an analyte is at the analytical limit of reporting (LOR) and this value is higher than the WQ Ref Value. Therefore, concentrations may not be elevated for MEQ data presented in blue.
- **Green MEQ** indicates all data are reported as being below the WQ Ref Values, and the MEQ is calculated using half of the LOR.

3.3 Limit of Reporting

All data recorded at the LOR have been analysed for screening as half of the supplied analytical LOR value. The LOR data have been recorded on spreadsheets as supplied by BRL as either denoted with "<" or formatted in bold and/or italics. Variable LOR exist for singular analytes as sampling spans a period of over 20 years with analyses conducted at multiple laboratories. Where the LOR affects the MEQ, this has been identified, as discussed above.

3.4 Erroneous Data

Instances of erroneous data have been highlighted and investigated where available laboratory certificates were supplied by BRL. For this analysis, erroneous data refers to parameter spikes that are an order of magnitude higher than other measurements at the monitoring location. Instances of erroneous data where lab certificates are not available have been analysed as supplied with unvalidated erroneous data noted under the applicable site analysis. Except for the anomalous data points, MWM has not validated the data provided by BRL for this analysis.

3.5 Data Management

The following additional data management processes were applied to tabulated data:

- WQ Ref Values for arsenate (As(V)) were applied instead of arsenite (As(III)) as a conservative approach¹³.
- No hardness modification has been applied to the MEQ analysis to provide a simple screening tool.
- Mean and median (MDN) pH data has been determined based on hydrogen ion concentration.
- Dissolved Organic Carbon (DOC) is presented as dissolved non-purgeable organic carbon (DNPOC), measured as the portion of organic carbon remaining after volatile inorganic carbon compounds are removed through acidification (e.g., carbonates).

¹³ The ANZG (2018) 95% level of protection DGV for As(V) of 0.013 mg/L is lower than the DGV for As (III) at 0.024 mg/L.

- A hyphen (-) indicates no data are available.
- Sample count (n) is provided per site and typically represents pH, EC, or turbidity data. Sample count for metals is generally lower. Tabulated data for all sites is available in Appendix A through Appendix E.
- All metals are dissolved unless otherwise specified.
- Mean data for SW01 and WM2 are used as the source term for the WLBM (MWM, 2026c).

3.6 Surface Water Quality Data Analysis

Surface water quality monitoring data from the BPCP, covering multiple locations from 1995 to 2026, have been analysed. The data, provided by BRL in MS Excel files, are presented and discussed in the following sections, focussing on key water quality parameters from each location. The water quality data consists of 1,826¹⁴ samples collected from the water quality monitoring locations as presented in Table 3.

Table 3: Water quality monitoring sites and data range.

SITE NAME	COMMENTS	n	DATA RANGE PRESENTED
WAIMANGAROA RIVER			
WRBBC	Waimangaroa River above Byrne Creek.	97	March 2022 to June 2024
14W	Waimangaroa River	10	April 2019 to May 2026
1W	Waimangaroa Ford	123	October 1995 to March 2013
15W	Waimangaroa River	11	April 2019 to May 2026
16W	Waimangaroa River	6	January 2026 to May 2026
2W Smokestack	Upstream of the confluence with Deep Stream	29 + 17 ¹ high flow event	February 2025 to May 2026
Waimangaroa Upstream	Waimangaroa River upstream of the confluence with Deep Stream	4	December 2024 to February 2025
WR at DC Confluence	Waimangaroa River at the confluence with Deep Stream	8 high flow event	February 2025 to April 2025
17W	Waimangaroa River downstream of the confluence with Deep Stream	24	December 2024 to May 2026
18W	Waimangaroa River upstream of Conns Creek confluence	7	December 2025 to May 2026
WR at State Highway	Waimangaroa Bridge at SH 67	68	February 2009 to October 2025
CED.MS1	Cedar Creek (Waimangaroa River tributary)	7	April 2019 to May 2026
WIL.MS1	Wilson Creek (Waimangaroa River tributary)	7	April 2019 to May 2026
BUR.L1	Burnetts Stream (Waimangaroa River tributary)	17	January 2026 to May 2026
Burnetts Stream	Burnetts Stream (Waimangaroa River tributary)	6	December 2009 to March 2010
DEEP STREAM			
SW04	Deep Stream	24	June 2024 to June 2026
SW01	Deep Stream	26 + 28 high flow event	June 2024 to June 2026
SW03	Deep Stream	26	September 2024 to June 2026
SW02	Deep Stream unnamed tributary	24	June 2024 to June 2026
SW05	Deep Stream unnamed tributary	24	June 2024 to June 2026
BS01	Billo Stream (Deep Stream tributary)	24 + 8 high flow event	July 2024 to June 2026
BIL.L1	Billo Stream tributary	9	January 2026 to June 2026

¹⁴ Where at least one parameter has been analysed.

SITE NAME	COMMENTS	n	DATA RANGE PRESENTED
Deep Stream Grab Samples	Grab samples collected during two sample events within the Deep Stream catchment.	8 + 7	August 2023 and October 2023
Deep Stream Adits	Grab samples from Deep Stream adits	2	2006
Iron Bridge Mine	Discharge from the historic Iron Bridge Mine	3	March to May 2026
Sonde Data	Monitoring sites SW01, SW05 and BS01	9 months	November 2024 to July 2025
CASCADE CREEK			
X7	Upper Cascade Creek	8	June 2002 to May 2007
X6	Upper Cascade Creek	8	June 2002 to May 2007
X8	Upper tributary of Cascade Creek	8	June 2002 to May 2007
X5	Upper tributary of Cascade Creek	8	June 2002 to May 2007
X4	Cascade Creek downstream of X5 and X8	8	June 2002 to May 2007
Cascade Upper	Cascade Creek	44	June 2014 to January 2024
X3	Cascade Creek	8	June 2002 to May 2007
Cascade Lower	Cascade Creek	43	June 2014 to June 2022
V37	V37 Creek	3	May 2025 to March 2026
DS.V37	Cascade Creek downstream of V37 Creek	1	2025
M-M1	V8 Creek (Cascade Creek tributary)	149	August 2014 to April 2026
RAPID STREAM			
W07	Rapid Stream upstream of the Sullivan Mine	26	July 2018 to May 2026
Sullivan Mine	Drainage from the historic Sullivan Mine, combined data from the upper and lower adits	33	February 2001 to May 2026
W08	Rapid Stream downstream of the Sullivan Mine	21	October 2018 to May 2026
W09	Rapid Stream at State Highway 67	24	July 2018 to May 2026
Rap.R1	Tributary of Rapid Stream	4	March to May 2026
WHAREATEA RIVER			
WM0	Whareatea River	37	August 2014 to March 2016
WM1	Whareatea River	65	November 2010 to August 2014
W-M2	Whareatea River	182 + 2 high flow event	December 2010 to May 2026
KEL	Whareatea River	51 + 3 high flow event	July 2014 to May 2026
W-M3	Whareatea River at State Highway 67	116	February 2011 to May 2026
S Creek	South Creek (Whareatea River tributary)	13	November 2010 to May 2011
V40 Stream	V40 Stream (Whareatea River tributary)	35	November 2010 to June 2012
Trent Stream	Trent Stream (Whareatea River tributary)	8	November 2010 to May 2011
C-M1	Conglomerate Stream (Whareatea River tributary)	149 + 3 high flow	December 2010 to May 2026
V62	V62 Stream (Whareatea River tributary)	24 + 2 high flow event	July 2018 to May 2026
V70	V70 Stream (Whareatea River tributary)	19	July 2018 to May 2026
Gate Pond	Gate Pond	43	February 2014 to April 2016
Whareatea Dam	Whareatea Dam	13	July 2014 to March 2016
Miscellaneous Samples		13	January 2024

¹Includes 12 high flow event samples from WR above Smokestack, approximately 20m upstream of 2W (Smokestack) monitoring location.

The data summary, MEQ analysis, and time series trends for key parameters are presented in the following sections. Additional high flow event sample data and sonde data are provided where available.

3.7 High Flow Event Samples

High flow event sample data has been collected from a number of surface water catchments including Waimangaroa River, Deep Stream, Billo Stream, Whareatea River, V62 Stream, and Conglomerate Stream (Table 3). Samples are collected using automated samplers during high flow events to provide

data on the effect of high rainfall events on water quality within the catchment. High flow event data is distinguished from routine sample data in this report due to the intensive sample collection process where up to three samples are collected within a 24 hour period.

4 UWHR / MFS

This section discusses the proposed monitoring locations for UWHR and MFS sub-areas of the BPCP and examines the surface water quality data pertaining to each sub-area.

4.1 **Proposed UWHR / MFS Monitoring Locations**

Proposed BPCP compliance, performance, and reference monitoring sites for the UWHR and MFS sub-areas include both established water monitoring sites and new locations (Table 4). Sites are selected to provide compliance, performance, and reference monitoring coverage across the wider Project sub-area and target specific BPCP activities (Figure 4 and Figure 5). Details on water quality monitoring frequency, parameters tested, and relationship to Project activities are provided in BRL (2026).

Background water quality monitoring data are presented in Section 4.2 for the Waimangaroa River (and tributaries) and in Section 4.3 for Deep Stream (and tributaries). This includes data from sites identified in Table 4, and monitoring sites within the wider Project area (Figure 3).

The combination of available data sources provides a background dataset for the UWHR and MFS sub-areas. All compliance sites have a minimum of 24 samples and data collection is ongoing for all monitoring locations in Table 4 after completion of this report.

Figure 6 presents the cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites (2W [Smokestack], 17W, SW01, and SW03) within the UWHR and MFS sub-areas. Data presented in Figure 6 demonstrates samples have been collected under a wide range of flow conditions to provide a robust data set for the compliance sites.

Additional assessment of higher and lower flow conditions is required. This can guide the refinement of flow weighted water quality source terms (mg/L) for the water and load balance models and improves understanding of pre-BPCP mining variability of measured components. Such assessments need to be undertaken over the mine life.

Table 4: Proposed monitoring sites for the UWHR and MFS from upstream to downstream.

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	COMMENTS	EXISTING MONITORING DATA
UWHR	Waimangaroa River	WRBBC	Performance	In the upper Waimangaroa River catchment.	March 2022 to ongoing (n=97)
UWHR	Waimangaroa River	14W	Performance	-	April 2019 to ongoing (n=10)
UWHR	Waimangaroa River	15W	Performance	-	April 2019 to ongoing (n=11)
MFS	Waimangaroa River	16W	Performance	Above WTP ¹⁵ discharge. This site is included as an add to background site for assessing compliance at 2W (Smokestack)	January 2026 to ongoing (n=6)
MFS / UWHR	Waimangaroa River	2W (Smokestack)	Compliance	Above Deep Stream Confluence and below WTP discharge	February 2025 to ongoing (n=29) High flow samples ¹ (n=17)
MFS / UWHR	Waimangaroa River	17W	Compliance	Below Deep Stream confluence	December 2024 to ongoing (n=24)
MFS	Waimangaroa River	18W	Performance	Waimangaroa River upstream of Conns Creek confluence	December 2025 to ongoing (n=7)
MFS / UWHR	Wilson Creek (Waimangaroa River tributary)	WIL.MS1	Reference	Waimangaroa Tributary upstream of 15W	April 2019 to ongoing (n=7)
MFS / UWHR	Cedar Creek (Waimangaroa River tributary)	CED.MS1	Reference	Waimangaroa Tributary upstream of 16W	April 2019 to ongoing (n=7)
UWHR	Burnetts Stream	BUR.L1	Performance (turbidity)	Tributary of the Waimangaroa River	January 2026 to ongoing (n=17)
MFS	Deep Stream	SW01	Compliance	Upper Deep Stream catchment. Includes continuous monitoring by Sondes	June 2024 to ongoing (26) High flow samples (28) Sonde commenced December 2024
MFS	Deep Stream	SW03	Compliance	Lower Deep Stream catchment	September 2024 to ongoing (n=26)
MFS	Deep Stream	SW04	Performance	Deep Stream above Billo Stream confluence	June 2024 to ongoing (n=24)
MFS	Billo Stream	BS01	Performance (turbidity)	Deep Stream tributary. Includes continuous monitoring by Sondes.	July 2024 to ongoing (n=24) High flow samples (n=8) Sonde commenced December 2024

¹⁵ Water Treatment Plant

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	COMMENTS	EXISTING MONITORING DATA
MFS	Billo Stream tributary	BIL.L1	Reference	-	January 2026 to ongoing (n=9)
MFS	Deep Stream unnamed tributary	SW02	Performance ²	-	June 2024 to ongoing (n=24)

¹ Includes high flow event data at 2W (Smokestack) (n=5) and high flow event data 20m upstream of 2W (Smokestack) (n=12).

² To take over from BIL.L1 and become a reference site at post-construction phase.

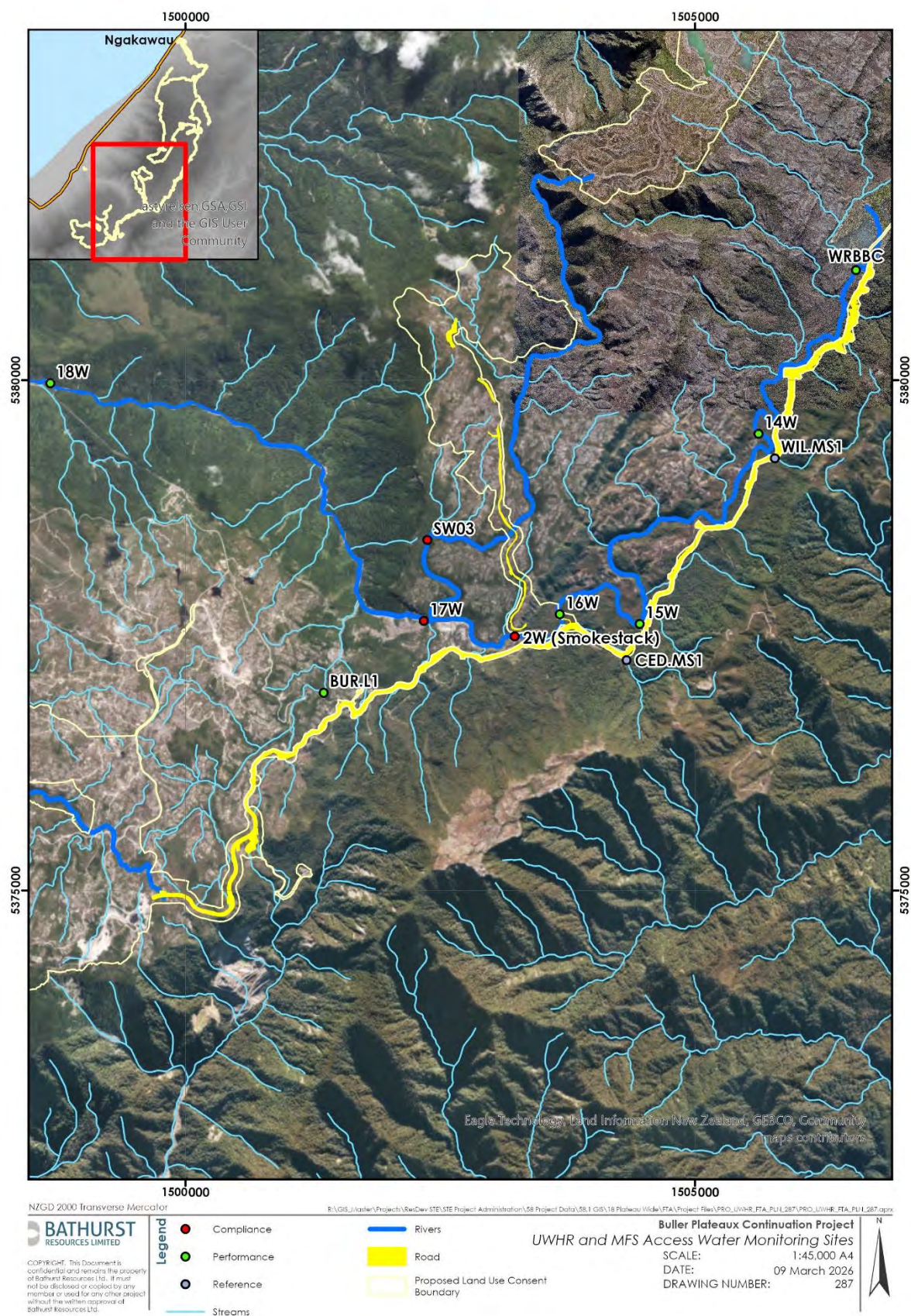


Figure 4: Location of UWHR and MFS water monitoring sites.



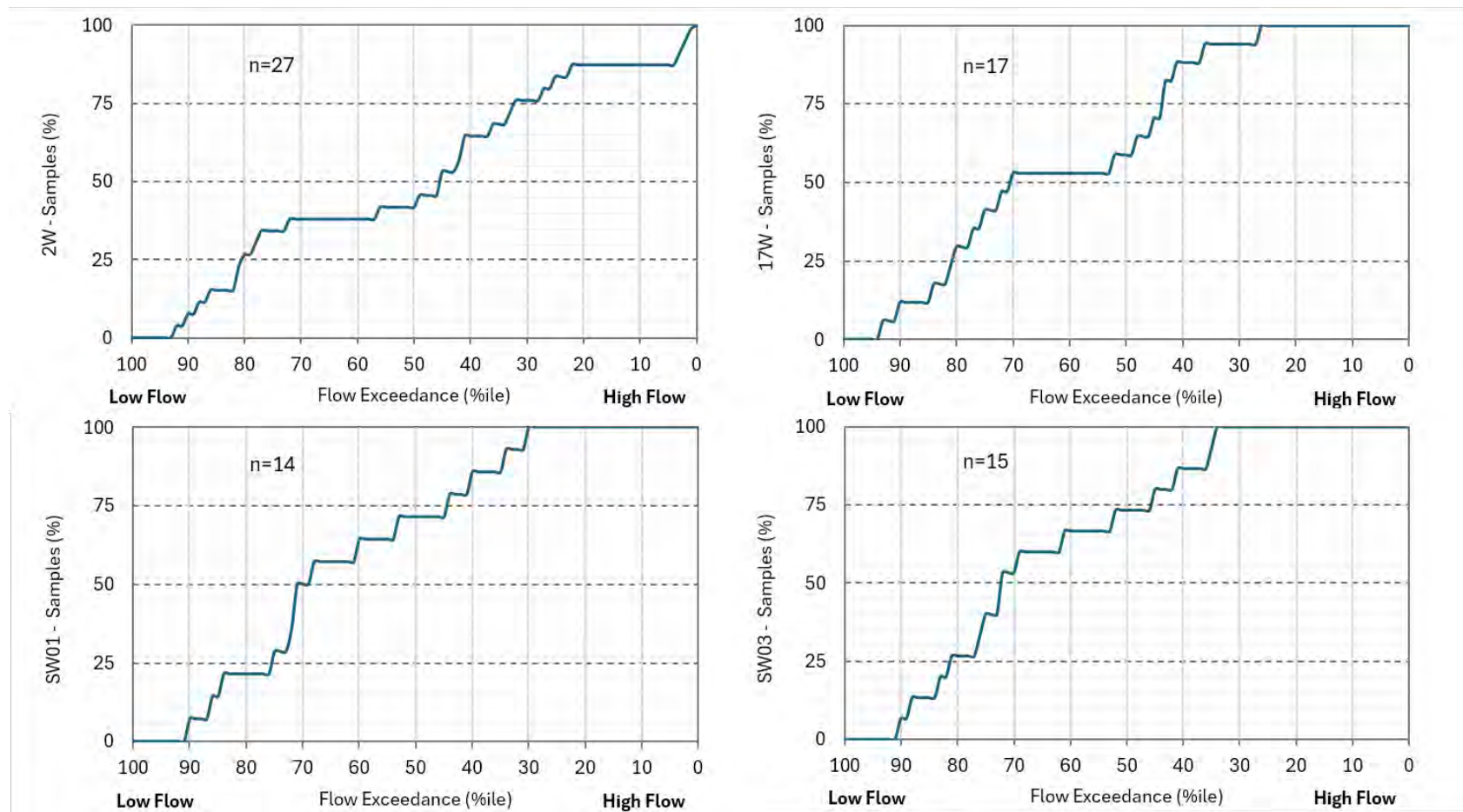


Figure 6: Cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites.

Coupled flow rate measurement and derived flow percentile at time of sample provided by BRL (██████) email dated 29 June 2026. Note only samples with time of collection available are presented. Data do not include high flow event samples available for 2W (Smokestack), 17W, and SW01.

4.2 Waimangaroa River

The following section examines the surface water quality data for the Waimangaroa River (and tributaries). Time series trends are summarised and discussed where applicable. Full tabulated water quality data are presented in Appendix A as a digital Microsoft (MS) Excel file. Site locations are provided in Figure 3 and Figure 7.

4.2.1 Water Quality Data

Water quality data and MEQ values for the following Waimangaroa River and tributaries monitoring sites are presented in order from upstream to downstream.

- Waimangaroa River upstream of the confluence with Deep Stream:
 - o WRBC, 14W, and 1W in Table 5
 - o 15W, 16W, and Waimangaroa Upstream in Table 6
 - o 2W Smokestack and high flow event samples at 2W (Smokestack) in Table 7
- Waimangaroa River at the confluence with Deep Stream and downstream:
 - o 17W and high flow event samples WR at DC Confluence in Table 8
 - o 18W and WR at State Highway in Table 9
- Waimangaroa River tributaries:
 - o CED.MS1 (Cedar Creek) and WIL.MS1 (Wilsons Creek) in Table 10
 - o BUR.L1 and Burnetts Stream (Burnetts Stream) in Table 11

Table 12 summarises MEQ data for all monitoring sites within the Waimangaroa River catchment. Plots of pH and EC for each monitoring site are presented in Figure 8.

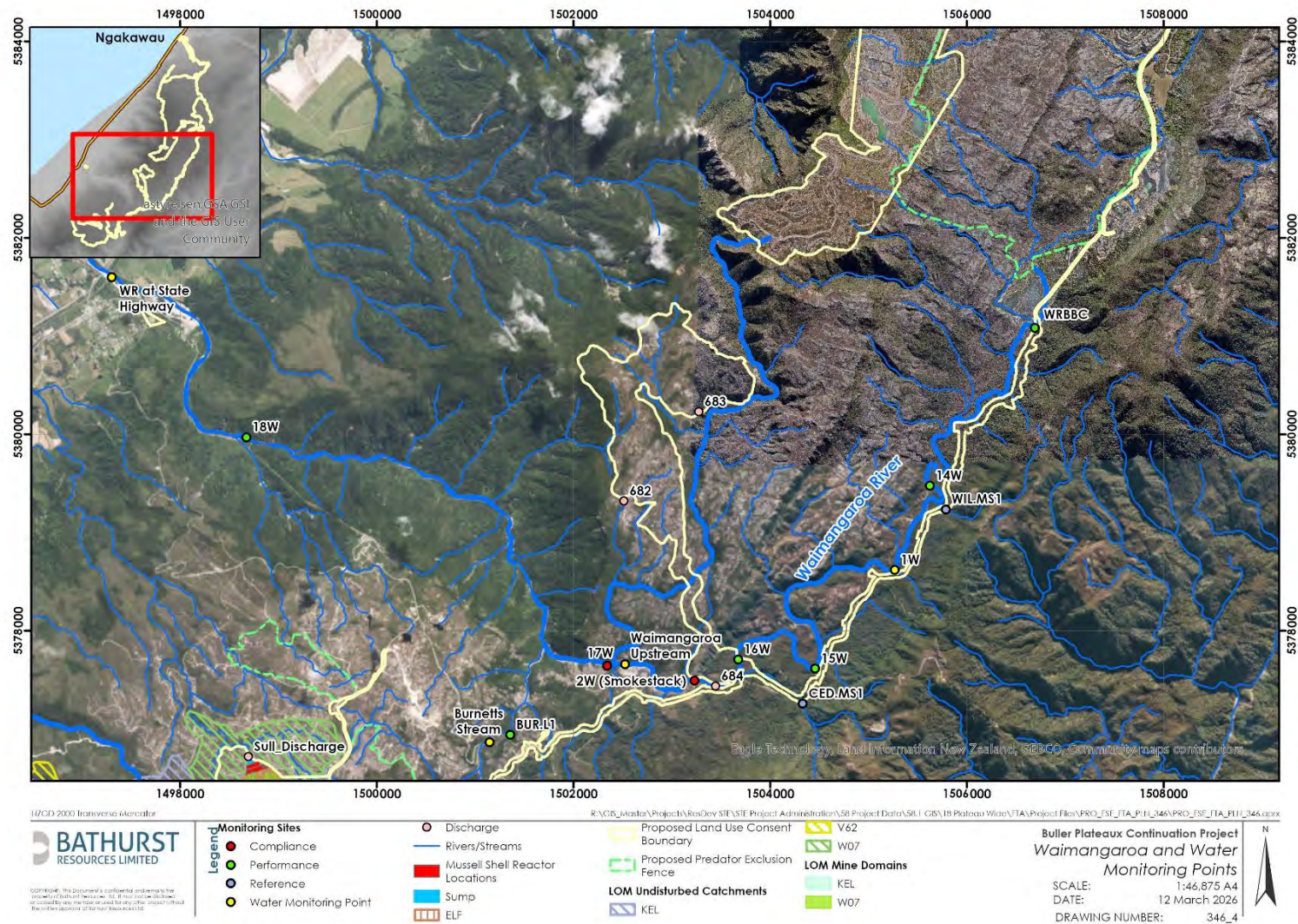


Figure 7: Waimangaroa River (and tributaries) water quality monitoring sites.

Table 5: Water quality data and MEQ analysis for Waimangaroa River sites.

PARAMETER	UNIT	WQ REF VALUE	WRBBC (n=97)					14W (n=10)					1W (n=123)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH*	pH unit	4.5 - 7.0	4.6	4.6	4.17	7.1	-	4.81	4.8	4.58	4.9	-	4.76	5	3.9	7.8	-
EC	mS/m	-	12.1	12.8	1.9	37.2	-	9.30	9.19	5.1	13.8	-	4.1	4	0.2	7.7	-
Acidity*	mg/L CaCO ₃	-	16.7	16.5	3.8	68.9	-	10.81	11.3	6.7	15.8	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	-	-	-	-	-	-	-	-	-	-	8	8.7	2.2	12.4	-
Ca	mg/L	-	-	-	-	-	-	5.72	6.7	2.4	8.5	-	1.66	1.59	2.75	0.44	-
Mg	mg/L	-	-	-	-	-	-	2.37	2.7	1.21	3.5	-	0.06	0.053	0.27	1.34	-
Na	mg/L	-	-	-	-	-	-	-	-	-	-	-	2.48	2.51	2.98	1.4	-
K	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.68	0.755	0.97	0.28	-
Cl	mg/L	-	-	-	-	-	-	-	-	-	-	-	3.8	3.9	2	5	-
SO ₄	mg/L	500	106	53	7.87	637	1.27	30.76	35	10.3	50	0.10	20.55	25	4	34.6	0.069
NO ₃ -N	mg/L	2.4	-	-	-	-	-	-	-	-	-	-	0.0079	0.004	0.018	0.002	0.001
NO ₂ -N	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.0021	0.002	0.003	0.002	-
NH ₄ -N	mg/L	1.2	-	-	-	-	-	-	-	-	-	-	0.011	0.01	0.02	0.01	0.008
Total N	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.011	0.01	0.02	0.01	-
DOC	mg/L	-	-	-	-	-	-	1.56	1.3	0.4	3.6	-	-	-	-	-	-
Al	mg/L	0.37	2.12	2.3	0.13	5.8	15.7	1.26	1.34	0.55	2.3	6.22	0.78	0.45	0.21	1.5	4.05
As	mg/L	0.013	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.04
B	mg/L	0.94	-	-	-	-	-	-	-	-	-	-	0.021	0.005	0.05	0.002	0.002
Cd	mg/L	0.00009	0.0002	0.0002	0.00005	0.0007	7.78	-	-	-	-	-	0.00008	0.0001	0.0001	0.00004	0.44
Cr	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.50
Cu	mg/L	0.0029	-	-	-	-	-	-	-	-	-	-	0.00053	0.00050	0.0008	0.0003	0.10
Fe	mg/L	0.5	-	-	-	-	1.54	0.065	0.065	0.06	0.07	0.14	0.079	0.079	0.079	0.079	0.16
Mn	mg/L	0.43	-	-	-	-	-	-	-	-	-	-	0.09	0.11	0.0171	0.113	0.26
Ni	mg/L	0.017	0.016	0.017	0.0009	0.039	2.29	-	-	-	-	-	0.0045	0.0042	0.0081	0.0013	0.08
Pb	mg/L	0.0034	0.0026	0.0025	0.0025	0.005	1.47	-	-	-	-	-	0.00012	0.00011	0.00009	0.00016	0.05
Se	mg/L	0.011	-	-	-	-	-	-	-	-	-	-	0.001	0.001	0.001	0.001	0.09
Zn	mg/L	0.023	0.055	0.059	0.004	0.15	6.52	0.037	0.041	0.013	0.062	2.70	-	-	-	-	-
TDS	mg/L	-	-	-	-	-	-	-	-	-	-	-	4	3	3	9	-
TSS	mg/L	-	2.5	1.5	0	112.5	-	1.94	1.5	1.5	4	-	4.2	3	2	20	-
Turbidity	NTU	25	1.2	0.9	0.25	8.8	0.35	2.79	0.87	0.32	18	0.72	1.7	1.2	0.313	11	0.44

Table 6: Water quality data and MEQ analysis for Waimangaroa River sites.

PARAMETER	UNIT	WQ REF VALUE	15W (n=11)					16W (n=6)					Waimangaroa Upstream* (n=4)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH*	pH unit	4.5 - 7.0	5.51	6.05	5.00	6.5	-	5.10	5.09	4.8	6.9	-	5.12	5.20	4.9	5.3	-
EC	mS/m	-	7.07	7.5	4.0	9.9	-	7.88	7.95	4.1	10.7	-	5.50	6.20	2.7	7.6	-
Acidity*	mg/L CaCO ₃	-	5.98	5.15	2.8	11	-	6.52	7.1	4	8.9	-	6.0	6.0	4	8	-
Alkalinity	mg/L CaCO ₃	-	-	-	-	-	-	-	-	-	-	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	-	-	-	-	-	-	-	-	-	-	18.3	17.5	6.5	31.8	-
Ca	mg/L	-	4.89	5.3	2.3	6.9	-	5.37	5.6	2.1	7.6	-	4.06	4.32	1.61	6	-
Mg	mg/L	-	2.01	2.15	1	2.9	-	2.06	2.025	0.88	3.1	-	1.99	1.64	0.61	4.09	-
Na	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.99	0.99	0	1.98	-
K	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.72	0.86	0.36	0.95	-
Cl	mg/L	-	-	-	-	-	-	-	-	-	-	-	4.77	3.45	2.16	10	-
SO ₄	mg/L	500	19.86	21.5	5.3	33	0.066	23.08	24	9.4	36	0.07	15.94	19.1	3.81	24.9	0.05
NO ₃ -N	mg/L	2.4	-	-	-	-	-	-	-	-	-	-	0.005	0.005	0.005	0.005	0.002
NO ₂ -N	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	0.005	0.005	-
DOC	mg/L	-	1.66	1.1	0.4	4.7	-	1.77	1.6	0.3	4.6	-	2.77	1.80	1.1	5.4	-
Al	mg/L	0.37	0.35	0.27	0.093	0.82	2.22	0.60	0.53	0.197	1.28	3.46	0.66	0.37	0.27	1.63	4.41
As	mg/L	0.013	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.04
B	mg/L	0.94	-	-	-	-	-	-	-	-	-	-	0.0063	0.0038	0.0025	0.015	0.02
Cd	mg/L	0.00009	0.00007	0.00007	0.000025	0.00011	1.22	0.00005	0.00003	0.000025	0.0001	1.11	0.0001	0.0001	0.0001	0.0001	1.11
Co	mg/L	0.0014	0.0036	0.0036	0.001	0.0062	4.43	0.0042	0.0042	0.003	0.0054	3.86	0.0045	0.0045	0.001	0.0081	5.79
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.00025	0.25	0.00025	0.00025	0.00025	0.00025	0.25	0.0005	0.0005	0.0005	0.0005	0.50
Cu	mg/L	0.0029	0.00025	0.00025	0.00025	0.00025	0.09	0.00025	0.00025	0.00025	0.00025	0.09	0.0006	0.00043	0.00025	0.0013	0.45
Fe	mg/L	0.5	0.075	0.075	0.03	0.13	0.26	0.07	0.07	0.04	0.1	0.20	0.060	0.036	0.02	0.15	0.30
Hg	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-
Mn	mg/L	0.43	0.11	0.11	0.036	0.191	0.44	0.106	0.094	0.056	0.167	0.39	0.17	0.13	0.0316	0.404	0.94
Ni	mg/L	0.017	0.0055	0.0055	0.002	0.009	0.53	0.0051	0.0045	0.0028	0.008	0.47	0.0074	0.0077	0.0018	0.0125	0.74
Pb	mg/L	0.0034	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.07
Sb	mg/L	0.009	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.06
Se	mg/L	0.011	-	-	-	-	-	-	-	-	-	-	0.0025	0.0025	0.0025	0.0025	0.23
Si	mg/L	-	-	-	-	-	-	-	-	-	-	-	4.45	5.27	2.17	5.92	-
Sn	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-

PARAMETER	UNIT	WQ REF VALUE	15W (n=11)					16W (n=6)					Waimangaroa Upstream* (n=4)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
TI	mg/L	0.0008	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.31
Zn	mg/L	0.023	0.024	0.027	0.0061	0.04	1.74	0.029	0.031	0.0102	0.042	1.83	0.027	0.028	0.007	0.044	1.91
TDS	mg/L	-	-	-	-	-	-	-	-	-	-	-	25.3	23	20	33	-
TSS	mg/L	-	7.35	5	1.5	29	-	2.33	1.5	1.5	4	-	2.9	3	2.5	3	-
Turbidity	NTU	25	4.50	2.7	0.76	17	0.68	1.66	1.31	0.42	3.6	0.14	1	0.8	0.45	2.09	0.08

*Sampling at this site ceased in February 2025 with monitoring moved upstream to 2W (Smokestack).

Table 7: Water quality monitoring data and MEQ analysis for 2W (Smokestack).

PARAMETER	UNIT	WQ REF VALUE	2W (SMOKESTACK) (n=29)					2W HIGH FLOW EVENT MONITORING (n=17)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	5.7	5.6	5	6.6	-	5.24	5.3	5	5.5	-
EC	mS/m	-	5.56	4.4	1.1	10.2	-	3.15	3	2	5.2	-
Acidity*	mg/L CaCO ₃	-	4.86	4.3	0	9	-	6.62	7	4.2	8	-
Alkalinity	mg/L CaCO ₃	-	1.53	2.	0.5	2.1	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	14.5	11.14	1.70	31.55	-	6.18	7.19	2.69	9.65	-
Ca	mg/L	-	3.58	2.7	0.4	7.7	-	1.45	1.76	0.55	2.4	-
Mg	mg/L	-	1.36	1.07	0.17	3	-	0.62	0.68	0.31	0.95	-
Na	mg/L	-	2.20	2.2	2.1	2.3	-	-	-	-	-	-
K	mg/L	-	0.78	0.7	0.64	1	-	-	-	-	-	-
Cl	mg/L	-	3.6	3.6	3.6	3.6	-	-	-	-	-	-
SO ₄	mg/L	500	14.78	9.8	1.1	35	0.07	4.85	2.3	1.4	10.4	0.02
NO ₃ -N	mg/L	2.4	0.003	0.003	0.001	0.005	0.002	-	-	-	-	-
NO ₂ -N	mg/L	-	0.003	0.003	0.001	0.005	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.005	0.005	0.005	0.005	0.004	-	-	-	-	-
DOC	mg/L	-	3.05	2.90	0.25	8.4	-	7.58	5.60	4.2	19.3	-
Al	mg/L	0.37	0.35	0.32	0.161	0.94	2.54	0.33	0.33	0.194	0.48	1.3
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-
B	mg/L	0.94	0.0025	0.0025	0.0025	0.0025	0.003	-	-	-	-	-
Cd	mg/L	0.00009	0.00006	0.00003	0.000025	0.00015	1.67	0.000025	0.000025	0.000025	0.000025	0.28
Co	mg/L	0.0014	0.0032	0.0024	0.0001	0.0078	5.57	-	-	-	-	-
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.0005	0.5	-	-	-	-	-
Cu	mg/L	0.0029	0.00030	0.00025	0.00025	0.0009	0.31	-	-	-	-	-
Fe	mg/L	0.5	0.071	0.080	0.01	0.17	0.34	-	-	-	-	-
Hg	mg/L	-	0.00012	0.00005	0.00005	0.00025	-	-	-	-	-	-
Mn	mg/L	0.43	0.1	0.07	0.0084	0.25	0.58	-	-	-	-	-
Ni	mg/L	0.017	0.0049	0.0028	0.00025	0.012	0.71	-	-	-	-	-
Pb	mg/L	0.0034	0.00025 ¹	0.00005	0.00005	0.00025	0.07	-	-	-	-	-
Sb	mg/L	0.009	0.0002	0.0001	0.0001	0.0005	0.06	-	-	-	-	-
Se	mg/L	0.011	0.00087	0.00005	0.00005	0.0025	0.23	-	-	-	-	-
Si	mg/L	-	5.77	5.77	5.77	5.77	-	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-

PARAMETER	UNIT	WQ REF VALUE	2W (SMOKESTACK) (n=29)					2W HIGH FLOW EVENT MONITORING (n=17)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Tl	mg/L	0.0008	0.00011	0.000065	0.000025	0.00025	0.31	-	-	-	-	-
Zn	mg/L	0.023	0.018	0.015	0.0012	0.04	1.74	0.059	0.066	0.0083	0.097	4.22
TDS	mg/L	-	45	45	45	45	-	-	-	-	-	-
TSS	mg/L	-	4.34	1.5	1.5	29	-	126.64	74	12	350	-
Turbidity	NTU	25	2.62	1.66	0.66	15.5	0.62	21.69	14	1.95	71	2.84

Table 8: Water quality monitoring data and MEQ analysis for 17W and WR at DC Confluence.

PARAMETER	UNIT	WQ REF VALUE	17W (n=24)					WR AT DC CONFLUENCE - HIGH FLOW EVENT MONITORING (n=8)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	5.35	5.4	4.9	6.8	-	5.14	5.19	4.9	5.3	-
EC	mS/m	-	5.55	6.15	2.5	8	-	16.60	11.55	8.4	31	-
Acidity*	mg/L CaCO ₃	-	4.48	5	1	7	-	6.67	7	6	7	-
Alkalinity	mg/L CaCO ₃	-	0.5	0.5	0.5	0.5	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	12.97	14.19	5.079	21.61	-	16.65	15.61	2.28	32.56	-
Ca	mg/L	-	3.06	3.42	0.49	5.2	-	4.15	3.9	0.55	8.02	-
Mg	mg/L	-	1.3	1.41	0.51	2.1	-	1.53	1.43	0.22	3.05	-
Na	mg/L	-	1.96	1.96	1.96	1.96	-	-	-	-	-	-
K	mg/L	-	0.72	0.86	0.38	0.92	-	-	-	-	-	-
Cl	mg/L	-	3.12	3.51	2.14	3.71	-	-	-	-	-	-
SO ₄	mg/L	500	14.41	15.4	3.45	26.3	0.053	18.84	18.19	1.76	38.2	0.08
NO ₃ -N	mg/L	2.4	0.020	0.005	0.001	0.07	0.027	-	-	-	-	-
NO ₂ -N	mg/L	-	0.004	0.005	0.001	0.005	-	-	-	-	-	-
DOC	mg/L	-	2.51	1.8	0.7	6.7	-	4.42	4.95	1.4	7	-
Al	mg/L	0.37	0.29	0.27	0.026	0.522	1.41	0.54	0.46	0.21	0.995	2.69
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-
B	mg/L	0.94	0.0056	0.0025	0.0025	0.015	0.016	-	-	-	-	-
Cd	mg/L	0.00009	0.00005	0.00006	0.000025	0.00009	1.0	-	-	-	-	-
Co	mg/L	0.0014	0.0030	0.0031	0.0007	0.0052	3.71	-	-	-	-	-
Cr	mg/L	0.001	0.00033	0.00025	0.00025	0.0005	0.5	-	-	-	-	-
Cu	mg/L	0.0029	0.00033	0.00025	0.00025	0.0008	0.28	-	-	-	-	-
Fe	mg/L	0.5	0.062	0.05	0.01	0.19	0.38	0.054	0.054	0.009	0.099	0.20
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-
Mn	mg/L	0.43	0.084	0.084	0.023	0.16	0.37	0.26	0.26	0.231	0.29	0.68
Ni	mg/L	0.017	0.0047	0.005	0.0012	0.0087	0.51	0.013	0.013	0.011	0.015	0.87
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.07	-	-	-	-	-
Sb	mg/L	0.009	0.0005	0.0005	0.0005	0.0005	0.06	-	-	-	-	-
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-	-
Si	mg/L	-	4.42	5.42	2.07	5.78	-	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-

PARAMETER	UNIT	WQ REF VALUE	17W (n=24)					WR AT DC CONFLUENCE - HIGH FLOW EVENT MONITORING (n=8)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
TI	mg/L	0.0008	0.00011	0.00013	0.00005	0.00017	0.21	-	-	-	-	-
Zn	mg/L	0.023	0.017	0.017	0.005	0.034	1.48	0.072	0.072	0.024	0.13	5.78
TDS	mg/L	-	29.33	28	20	40	-	-	-	-	-	-
TSS	mg/L	-	2.22	1.5	1.5	4	-	104.83	111.5	39	173	-
Turbidity	NTU	25	1.56	1.58	0.64	3.23	0.13	22.47	20.25	11.3	38	1.52

Table 9: Water quality monitoring data and MEQ analysis for 18W and WR at State Highway.

PARAMETER	UNIT	WQ REF VALUE	18W (n=7)					WR at State Highway (n=68)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	6.12	6.75	5.5	6.9	-	5.04	5.4	4.1	6.9	-
EC	mS/m	-	5.42	6.4	1.2	7.6	-	6.4	6.51	1.5	14.3	-
Acidity*	mg/L CaCO ₃	-	2.28	1.95	1.1	4	-	3.24	3	1.7	5	-
Alkalinity	mg/L CaCO ₃	-	-	-	-	-	-	2.50	2.5	2.5	2.5	-
Ca	mg/L	-	4.32	5.1	0.44	6.8	-	3.05	2.5	0.78	6.5	-
Mg	mg/L	-	1.04	1.2	0.17	1.59	-	0.84	0.7	0.28	1.63	-
SO ₄	mg/L	500	11.55	14.45	1.2	17.3	0.035	8.52	6.6	1.6	19	0.04
NO ₃ -N	mg/L	2.4	0.014	0.014	0.002	0.024	0.009	-	-	-	-	-
NO ₂ -N	mg/L	-	0.001	0.001	0.001	0.001	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.005	0.005	0.005	0.005	0.004	-	-	-	-	-
Total N	mg/L	-	-	-	-	-	-	-	-	-	-	-
DOC	mg/L	-	1.93	1.05	0.6	4.7	-	4.3	4.3	4.3	4.3	-
Al	mg/L	0.37	0.108	0.028	0.019	0.34	0.92	0.18	0.25	0.032	0.29	0.78
Cd	mg/L	0.00009	0.000025	0.000025	0.000025	0.000025	0.28	0.000040	0.000025	0.000025	0.0001	1.11
Co	mg/L	0.0014	0.0011	0.0013	0.0002	0.0016	1.14	0.0012	0.0012	0.0003	0.002	1.43
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.00025	0.25	-	-	-	-	-
Cu	mg/L	0.0029	0.00031	0.00025	0.00025	0.0006	0.21	0.00038	0.00038	0.00025	0.0005	0.17
Fe	mg/L	0.5	0.045	0.010	0.01	0.12	0.24	0.065	0.065	0.0025	0.13	0.26
Mn	mg/L	0.43	0.025	0.027	0.0073	0.039	0.09	0.0082	0.0082	0.0082	0.0082	0.02
Ni	mg/L	0.017	0.0027	0.003	0.0005	0.004	0.24	0.0021	0.0017	0.0007	0.004	0.24
Pb	mg/L	0.0034	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.07
Tl	mg/L	0.0008	-	-	-	-	-	0.00013	0.00013	0.00013	0.00013	0.16
Zn	mg/L	0.023	0.012	0.013	0.0034	0.0171	0.74	0.0094	0.0087	0.0033	0.02	0.87
DRP	mg/L	-	0.002	0.002	0.002	0.002	-	-	-	-	-	-
TSS	mg/L	-	5.9	1.5	1.5	25	-	6.7	4.1	1	106	-
Turbidity	NTU	25	3.2	1.6	1.07	10.6	0.42	3.2	2.6	0.5	18.5	0.74

Table 10: Water quality monitoring data and MEQ analysis for Cedar Creek and Wilsons Creek.

PARAMETER	UNIT	WQ REF VALUE	CED.MS1 (n=7)					WIL.MS1 (n=7)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	7.00	7.10	6.58	7.3	-	6.72	7	5.15	7.4	-
EC	mS/m	-	5.00	41.46	47.04	34.9	-	32.92	34.6	19.8	40.7	-
Acidity*	mg/L CaCO ₃	-	2.75	2.45	2.4	4	-	3.25	3.1	2.8	4	-
Ca	mg/L	-	4.35	4.5	2.6	5.5	-	4	4.5	1.99	6.2	-
Mg	mg/L	-	1.25	1.3	0.86	1.54	-	0.83	0.92	0.44	1.19	-
SO ₄	mg/L	500	0.98	1	0.8	1.1	0.002	1.12	1.2	0.6	1.4	0.003
DOC	mg/L	-	3.05	3	1.7	4.7	-	3.05	3	1.7	4.7	-
Al	mg/L	0.37	0.066	0.056	0.036	0.114	0.31	0.085	0.054	0.037	0.174	0.47
Cd	mg/L	0.00009	0.000025	0.000025	0.000025	0.000025	0.28	0.000025	0.000025	0.000025	0.000025	0.28
Co	mg/L	0.0014	0.0001	0.0001	0.0001	0.0001	0.07	0.0001	0.0001	0.0001	0.0001	0.07
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.00025	0.25	0.00025	0.00025	0.00025	0.00025	0.25
Cu	mg/L	0.0029	0.00025	0.00025	0.00025	0.00025	0.09	0.00025	0.00025	0.00025	0.00025	0.09
Fe	mg/L	0.5	0.11	0.12	0.08	0.12	0.24	0.17	0.16	0.14	0.2	0.40
Mn	mg/L	0.43	0.005	0.005	0.0045	0.0045	0.01	0.005	0.005	0.0052	0.0052	0.01
Ni	mg/L	0.017	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.01
Zn	mg/L	0.023	-	-	-	-	-	0.001	0.001	0.0005	0.0012	0.05
TSS	mg/L	-	-	-	-	-	-	1.75	1.50	1.5	3	-
Turbidity	NTU	25	2.80	0.37	0.18	17	0.68	3.02	0.45	0.38	17	0.68

Table 11: Water quality monitoring data and MEQ analysis for Burnetts Stream.

PARAMETER	UNIT	WQ REF VALUE	BUR.L1 (n=17)					Burnetts Stream (n=6)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.36	4.4	4.17	4.1	-	4.2	4.2	4.1	4.3	-
EC	mS/m	-	5.38	5.9	6.5	1.1	-	6.9	6.7	5.3	7.5	-
Acidity*	mg/L CaCO ₃	-	9.6	10	12.2	4.1	-	-	-	-	-	-
Ca	mg/L	-	1.12	1.24	1.74	0.11	-	-	-	-	-	-
Mg	mg/L	-	0.59	0.64	0.74	0.09	-	-	-	-	-	-
SO ₄	mg/L	500	9.49	11.2	12.94	1.3	0.027	-	-	-	-	-
NO ₃ -N	mg/L	2.6	0.001	0.001	0.001	0.001	0.003	-	-	-	-	-
NO ₂ -N	mg/L	-	0.001	0.001	0.001	0.001	-	-	-	-	-	-

PARAMETER	UNIT	WQ REF VALUE	BUR.L1 (n=17)					Burnetts Stream (n=6)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
NH ₄ -N	mg/L	1.2	0.005	0.005	0.005	0.005	0.004	-	-	-	-	-
DOC	mg/L	-	2.76	1.8	5.92	0.6	-	-	-	-	-	-
Al	mg/L	0.37	0.58	0.66	0.796	0.115	2.22	0.72	0.72	0.62	0.81	2.19
Cd	mg/L	0.00009	0.000025	0.000025	0.000025	0.000025	0.28	-	-	-	-	-
Co	mg/L	0.0014	0.0001	0.0001	0.0001	0.0001	0.07	-	-	-	-	-
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.00025	0.25	-	-	-	-	-
Cu	mg/L	0.0029	0.0013	0.0013	0.0013	0.0013	0.45	-	-	-	-	-
Fe	mg/L	0.5	0.14	0.19	0.199	0.03	0.40	0.2	0.2	0.19	0.2	0.40
Mn	mg/L	0.43	0.0033	0.0033	0.0033	0.0033	0.01	-	-	-	-	-
Ni	mg/L	0.017	0.000	0.000	0.000	0.00025	0.01	-	-	-	-	-
Zn	mg/L	0.023	0.028	0.031	0.038	0.0086	1.65	-	-	-	-	-
TSS	mg/L	-	1.9	1.5	2.8	1.5	-	-	-	-	-	-
Turbidity	NTU	25	0.9	0.7	2.37	0.2	0.16	-	-	-	-	-

Table 12: MEQ summary for the Waimangaroa River catchment.

DATA SOURCE	SO ₄	NO ₃ - N	NH ₄ - N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	TI	Zn	NTU ¹
WAIMANGAROA RIVER																				
WRBBC	1.27	-	-	15.68	-	-	7.78	-	-	-	1.54	-	-	2.29	1.47	-	-	-	6.52	0.35
14W	0.10	-	-	6.22	-	-	-	-	-	-	0.14	-	-	-	-	-	-	-	2.70	0.72
1W	0.07	0.001	0.01	4.05	0.04	0.00	0.44	-	0.50	0.10	0.16	-	0.26	0.08	0.05	-	0.09	-	-	0.44
15W	0.07	-	-	2.22	-	-	1.22	4.43	0.25	0.09	0.26	-	0.44	0.53	-	-	-	-	1.74	0.68
16W	0.07	-	-	3.46	-	-	1.11	3.86	0.25	0.09	0.20	-	0.39	0.47	-	-	-	-	1.83	0.14
2W	0.07	0.002	0.004	2.54	0.04	0.003	1.67	5.57	0.50	0.31	0.34	-	0.58	0.71	0.07	0.06	0.23	0.31	1.74	0.62
2W (High Flow Event)	0.02	-	-	1.30	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-	4.22	2.84
Waimangaroa Upstream	0.05	0.002	-	4.41	0.04	0.02	1.11	5.79	0.50	0.45	0.30	-	0.94	0.74	0.07	0.06	0.23	0.31	1.91	0.08
17W	0.05	0.03	-	1.41	0.04	0.02	1.00	3.71	0.50	0.28	0.38	-	0.37	0.51	0.07	0.06	0.23	0.21	1.48	0.13
WR at DC Confluence (High Flow Event)	0.08	-	-	2.69	-	-	-	-	-	-	0.20	-	0.68	0.87	-	-	-	-	5.78	1.52
18W	0.03	0.009	0.00	0.92	-	-	0.28	1.14	0.25	0.21	0.24	-	0.09	0.24	-	-	-	-	0.74	0.42

DATA SOURCE	SO ₄	NO ₃ -N	NH ₄ -N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	TI	Zn	NTU ¹
Waimangaroa at State Highway	0.04	-	-	0.78	-	-	1.11	1.43	-	0.17	0.26	-	0.02	0.24	0.07	-	-	0.16	0.87	0.74
WAIMANGAROA RIVER TRIBUTARIES																				
CED.MS1	0.002	-	-	0.31	-	-	0.28	0.07	0.25	0.09	0.24	-	0.01	-	-	-	-	-	-	0.68
WIL.MS1	0.003	-	-	0.47	-	-	0.28	0.07	0.25	0.09	0.40	-	0.01	0.01	-	-	-	-	0.05	0.68
BUR.L1	0.03	0.001	0.004	2.22	-	-	0.28	0.07	0.25	0.45	0.40	-	0.01	0.01	-	-	-	-	1.65	0.16
Burnetts Stream	-	-	-	2.19	-	-	-	-	-	-	0.40	-	-	-	-	-	-	-	-	-

¹NTU = turbidity

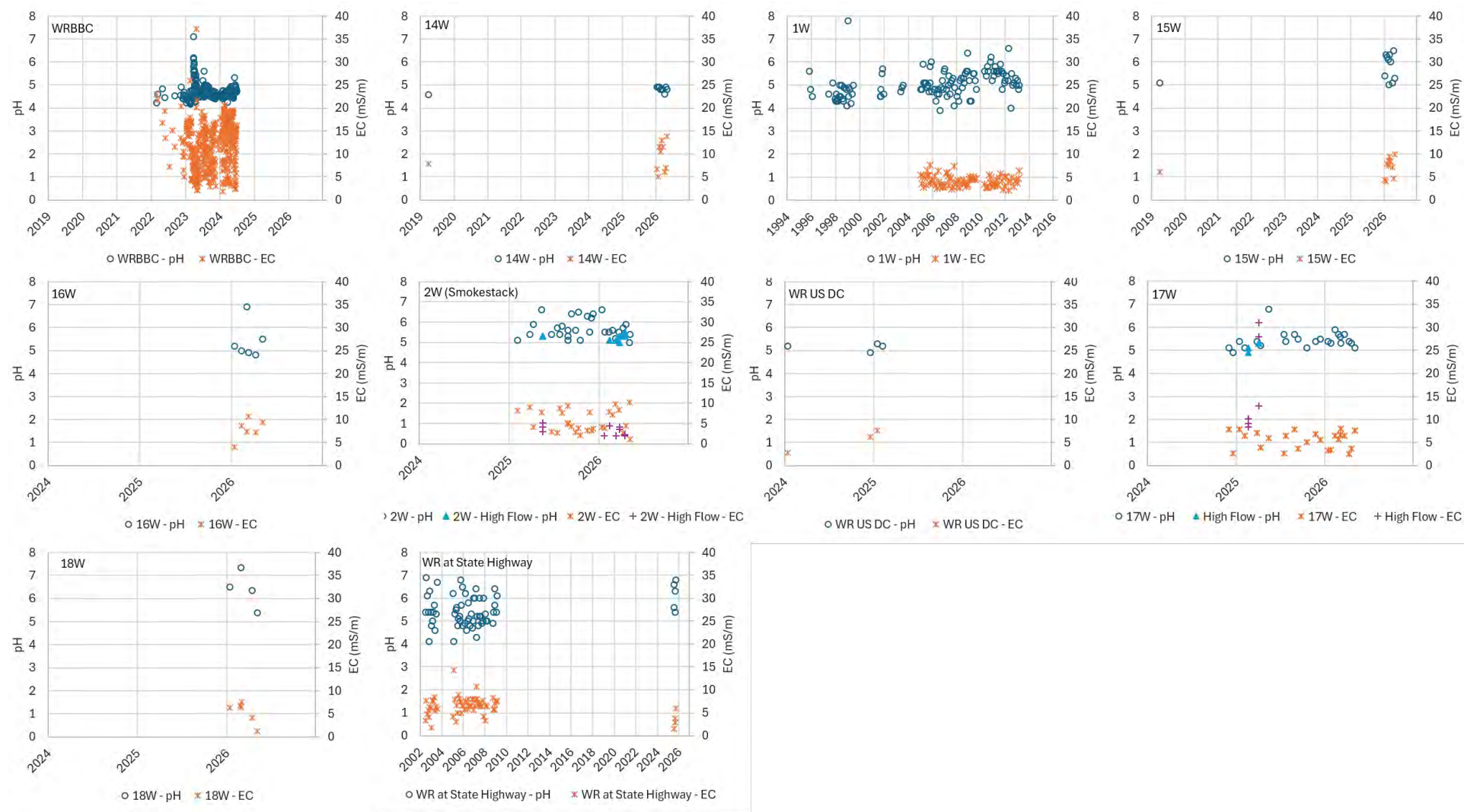


Figure 8: EC and pH for Waimangaroa River monitoring sites.

Note: plots in order of upstream to downstream.

4.2.2 Data Summary

The following are key observations from the data review of Waimangaroa River monitoring sites:

- pH and EC vary across the length of the Waimangaroa River as summarised in Figure 9 (for variation over time see Figure 8). All data is within WQ Ref Values for pH (4.5 to 7.0) with the exception of WRBBC and WR at State Highway.
- Co is elevated above the WQ Ref Value for all sites where analyses are available (15W, 16W, 2W [Smokestack], Waimangaroa Upstream, 17W and 18W).
- Maximum Al and Zn (excluding 1W where Zn data is not available) exceed the WQ Ref Values for all sites upstream of 18W.
- Maximum Cd exceeds the WQ Ref Value for all sites excluding 1W, 18W, and 2W (Smokestack) high flow event samples, MEQ is affected by the LOR at Waimangaroa at State Highway.
- Maximum Fe, Ni, Pb, and SO₄ exceeds the WQ Ref Values at WRBBC.

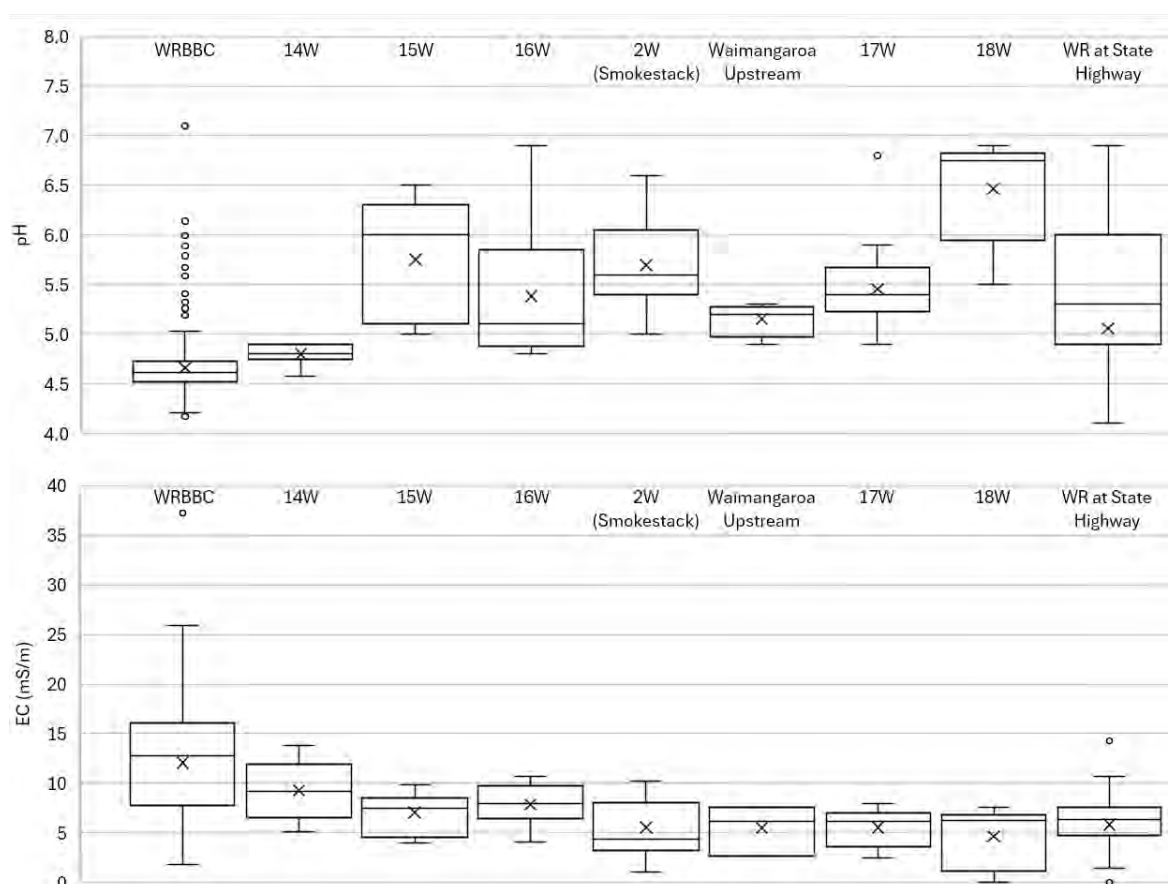


Figure 9: Box plots of pH and EC for Waimangaroa River monitoring sites.

An 'X' identifies the mean data for each monitoring site.

The following are key observations from water quality data for tributaries of the Waimangaroa River (see Figure 3):

- Maximum pH at CED.MS1 (7.3) and WIL.MS1 (7.4) is above the WQ Ref Value (4.5 to 7.0).

- Maximum Al and Zn data at Burnetts Stream and Zn at BUR.L1 exceeds the WQ Ref Values.

4.2.2.1 2W Smokestack

The availability of measured flow data over the duration of the water quality monitoring program at 2W (Smokestack) allows development of flow weighted source terms. Sample data has been coupled with measured flow data at 2W (Smokestack) to produce flow weighted source terms specific to 2W (Smokestack) for use in the WLBM (MWM, 2026c). Metals and metalloids generally occur at higher concentrations during lower-flow conditions and at lower concentrations as flow increases, with the greatest variability observed at the highest flows (e.g. SO_4 as shown in Figure 10). DOC concentrations (Figure 10) are lowest during low flow conditions and progressively increase, with flow, the highest variability in DOC concentrations occur during peak flow conditions (i.e., flushing of DOC from soils in the catchment).

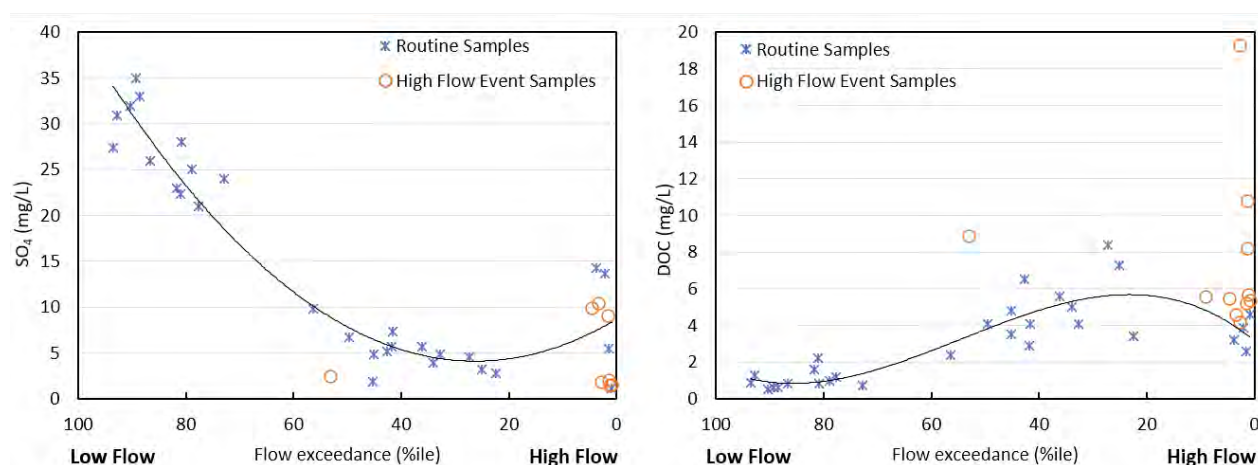


Figure 10: Trend analysis of SO_4 and DOC with flow at 2W (Smokestack).

Figure 11 provides the trend analysis for those parameters where concentration is variable. High flow event sample data are not applied to this analysis to avoid data bias, i.e., where up to three samples are taken over a short time interval (less than 24 hours) during periods of high flow (see Section 3.7).

Where data is predominantly below the limit of reporting (Cr, Cu, Pb, Tl, TSS), or limited data is available (alkalinity, Na, K) a mean value is applied. Concentration variation with flow is poorly defined for Al and pH and a mean value is applied (noting pH is calculated using $[\text{H}^+]$). This may suggest high flow conditions have a low impact on pH and Al in this section of the Waimangaroa River. However, continuous monitoring data is required to fully characterise the relationships between flow and physiochemistry.

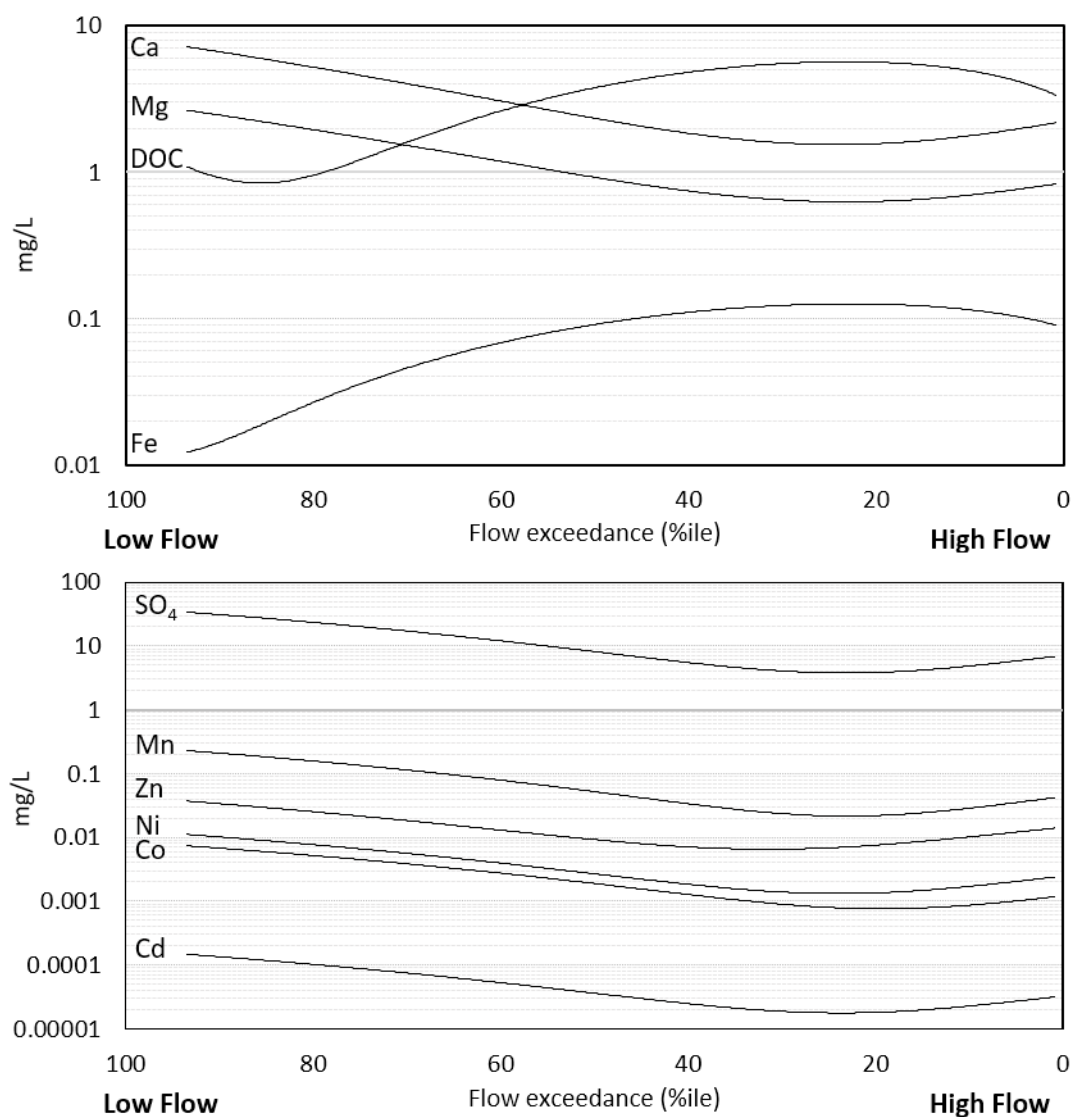


Figure 11: Relationship of selected parameters with flow at 2W (Smokestack).

Data trends are from routine monitoring and do not include high flow event samples.

4.3 Deep Stream Catchment

The following section summarises the surface water quality data for the Deep Stream catchment, site locations are provided in Figure 3 and Figure 12. Time series trends are summarised and discussed where applicable. Full tabulated water quality data are presented in Appendix B as a digital Microsoft (MS) Excel file.

Data presented includes: water quality monitoring sites (regular sampling and high flow event data), sonde data, and one-off samples collected during site visits.



Figure 12: Deep Stream (and tributaries) water monitoring sites.

4.3.1 Water Quality Data

Table 3 provides a summary of water quality monitoring sites within the Deep Stream catchment and the extent of data provided in this report. Water quality data and MEQs for tributaries of Deep Stream are presented in the following tables:

- Deep Stream monitoring sites SW04, SW01, and SW01 high flow event samples in Table 13
- Deep Stream monitoring site SW02 and unnamed Deep Stream tributaries SW02 and SW05 in Table 14
- Billo Stream monitoring site BS01, BS01 high flow event samples and Billo Stream tributary BIL.L1 in Table 15
- Sonde data for BS01, SW01, and SW03 in Table 17 to Table 19
- Grab samples taken within the Deep Stream catchment in Table 20 to Table 22
- Historic adit discharge from the Deep Stream catchment in Table 24 and Iron Bridge Mine in Table 25

Table 16 summarises MEQ data for all monitoring sites within the Deep Stream catchment. Plots of pH and EC are presented in Figure 13.

Table 13: Water quality data and MEQ analysis for Deep Stream SW04, SW01 and SW01 high flow event samples.

PARAMETER	UNIT	WQ REF VALUE	SW04 (n=24)					SW01 (n=26)					SW01 – HIGH FLOW EVENT (n=28)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	6.23	6.6	5.2	7	-	5.78	6.2	5.1	6.7	-	5.21	5.2	5.1	5.4	MEQ
EC	mS/m	-	3.74	3.95	1.7	4.8	-	3.12	3.05	1.7	4.7	-	3.33	1.8	1	21	-
Acidity	mg/L CaCO ₃	-	2.68	2.5	0.5	6	-	2.92	2.9	0.5	6	-	5.31	5	2.9	7	-
Alkalinity	mg/L CaCO ₃	-	2.75	3	0.5	5	-	1.43	0.5	0.5	3	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	8.93	9.57	4.4	11.1	-	5.95	5.99	2.32	8.26	-	2.14	2.09	1.083	3.544	-
Ca	mg/L	-	1.34	1.48	0.36	2	-	0.89	0.91	0.32	1.36	-	0.29	0.28	0.17	0.47	-
Mg	mg/L	-	1.26	1.4	0.43	1.7	-	0.91	0.90	0.36	1.29	-	0.35	0.35	0.13	0.59	-
Na	mg/L	-	0.32	0.38	0.0025	0.51	-	2.63	2.55	2.03	3.16	-	-	-	-	-	-
K	mg/L	-	3.03	3.12	2.32	3.52	-	0.27	0.27	0.0025	0.52	-	-	-	-	-	-
Cl	mg/L	-	3.53	3.56	2.86	4.17	-	3.4	3.28	2.79	4.07	-	-	-	-	-	-
SO ₄	mg/L	500	5.09	5.055	1.1	8.7	0.02	3.95	3.8	1.2	6.5	0.013	1.03	1	0.7	1.6	0.003
NO ₃ -N	mg/L	2.4	0.024	0.020	0.005	0.05	0.02	0.019	0.019	0.005	0.03	0.012	-	-	-	-	-
NO ₂ -N	mg/L	-	0.0066	0.005	0.005	0.013	-	0.004	0.005	0.001	0.005	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.0079	0.005	0.005	0.02	0.02	0.023	0.013	0.005	0.06	0.05	-	-	-	-	-
Total N	mg/L	-	0.083	0.083	0.072	0.094	-	0.074	0.074	0.073	0.074	-	-	-	-	-	-
DOC	mg/L	-	2.6	2	1.3	8.4	-	3.17	2.80	1.8	7.3	-	5.68	5.3	2.4	10.2	-
Al	mg/L	0.37	0.080	0.078	0.033	0.21	0.57	0.09	0.0905	0.037	0.166	0.45	0.11	0.09	0.064	0.169	0.46
As	mg/L	0.013	0.00056	0.0005	0.0005	0.001	0.08	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-
B	mg/L	0.94	0.0097	0.0025	0.0025	0.03	0.03	0.0075	0.0038	0.0025	0.015	0.016	-	-	-	-	-
Cd	mg/L	0.00009	0.000062	0.000025	0.000025	0.0002	2.22	0.000025	0.000025	0.000025	0.000025	0.28	0.000025	0.000025	0.000025	0.000025	0.28
Co	mg/L	0.0014	0.00026	0.00025	0.00025	0.0005	0.36	0.0001	0.0001	0.0001	0.0001	0.07	-	-	-	-	-
Cr	mg/L	0.001	0.00045	0.0005	0.00025	0.001	1.00	0.00038	0.0005	0.00025	0.0005	0.50	-	-	-	-	-
Cu	mg/L	0.0029	0.00027	0.00025	0.00025	0.0005	0.17	0.00030	0.00025	0.00025	0.001	0.34	-	-	-	-	-
Fe	mg/L	0.5	0.055	0.05	0.01	0.18	0.36	0.074	0.065	0.01	0.15	0.30	0.11	0.11	0.071	0.15	0.30
Hg	mg/L	-	0.00028	0.00025	0.00025	0.0005	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-
Mn	mg/L	0.43	0.0018	0.0014	0.00025	0.0047	0.01	0.003	0.00185	0.0005	0.0069	0.02	-	-	-	-	-
Ni	mg/L	0.017	0.00066	0.0006	0.00025	0.0013	0.08	0.0004	0.00025	0.00025	0.0008	0.05	-	-	-	-	-
Pb	mg/L	0.0034	0.00028	0.00025	0.00025	0.0005	0.15	0.00025	0.00025	0.00025	0.00025	0.07	-	-	-	-	-
Sb	mg/L	0.009	0.00056	0.0005	0.0005	0.001	0.11	0.0005	0.0005	0.0005	0.0005	0.06	-	-	-	-	-
Se	mg/L	0.011	0.0028	0.0025	0.0025	0.005	0.45	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-	-
Si	mg/L	-	5.54	5.5	1.94	7.49	-	4.43	4.33	2.53	6.24	-	-	-	-	-	-

PARAMETER	UNIT	WQ REF VALUE	SW04 (n=24)					SW01 (n=26)					SW01 – HIGH FLOW EVENT (n=28)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Sn	mg/L	-	0.00028	0.00025	0.00025	0.0005	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-
TI	mg/L	0.0008	0.00014	0.000025	0.000025	0.0005	0.63	0.000025	0.000025	0.000025	0.000025	0.03	-	-	-	-	-
Zn	mg/L	0.023	0.0026	0.002	0.0005	0.012	0.52	0.0037	0.0019	0.0005	0.036	1.57	0.08	0.076	0.035	0.23	10.00
TDS	mg/L	-	22.6	23.0	18	26	-	17.8	18	14	20	-	-	-	-	-	-
TSS	mg/L	-	2.5	1.5	1.5	7	-	4.2	2	1.5	35	-	59.28	56	1.5	250	-
Turbidity	NTU	25	0.3	0.3	0.13	0.49	0.02	0.5	0.3	0.14	2.18	0.09	3.53	2.65	0.3	16.3	-

Table 14: Water quality data and MEQ analysis for Deep Stream and tributaries SW03, SW02 and SW05.

PARAMETER	UNIT	WQ REF VALUE	SW03 (n=26)					SW02 (n=24)					SW05 (n=24)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	5.15	5.2	4.5	6.7	-	4.88	4.9	4.6	5.4	-	4.26	4.3	3.9	4.6	-
EC	mS/m	-	2.76	2.75	2	3.3	-	2.25	2.05	1.6	4.2	-	3.80	3.75	2.7	5.2	-
Acidity	mg/L CaCO ₃	-	4.31	3.75	0.5	15	-	6.40	6	0.5	11	-	7.54	7.90	1	14	-
Alkalinity	mg/L CaCO ₃	-	0.75	0.5	0.5	2	-	0.56	0.5	0.5	1	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	3.78	3.68	2.17	5.48	-	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	0.50	0.48	0.26	0.72	-	0.17	0.17	0.025	0.4	-	0.12	0.12	0.05	0.2	-
Mg	mg/L	-	0.62	0.595	0.37	0.9	-	0.28	0.28	0.18	0.38	-	0.31	0.3	0.2	0.43	-
Na	mg/L	-	2.58	2.58	2.21	2.95	-	1.59	1.98	1.54	2.85	-	2.31	2.34	1.84	2.8	-
K	mg/L	-	0.33	0.42	0.0025	0.69	-	0.15	0.12	0.0025	0.37	-	0.27	0.28	0.0025	0.58	-
Cl	mg/L	-	3.41	3.27	2.6	4.23	-	3.18	3.19	2.26	4.33	-	3.46	3.41	2.2	4.66	-
SO ₄	mg/L	500	3.17	2.93	1.1	5.3	0.01	0.93	0.96	0.67	1.3	0.003	3.90	3.68	2.61	5.9	0.01
NO ₃ -N	mg/L	2.4	0.007	0.005	0.003	0.01	0.004	0.006	0.005	0.001	0.01	0.004	0.0063	0.005	0.005	0.01	0.004
NO ₂ -N	mg/L	-	0.005	0.005	0.001	0.01	-	0.005	0.005	0.001	0.01	-	0.0057	0.005	0.005	0.01	-
NH ₄ -N	mg/L	1.2	0.0125	0.0075	0.005	0.03	0.03	0.0507	0.03	0.005	0.11	0.09	0.048	0.030	0.03	0.11	0.09
Total N	mg/L	-	0.10	0.10	0.067	0.13	-	0.072	0.072	0.066	0.077	-	0.14	0.14	0.13	0.15	-
DOC	mg/L	-	3.92	3.4	2.3	8.5	-	5.07	4.6	2.6	9.6	-	3.23	2.95	1.4	8.7	-
Al	mg/L	0.37	0.12	0.116	0.056	0.2	0.54	0.12	0.1125	0.067	0.21	0.57	0.27	0.28	0.18	0.46	1.24
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	0.00067	0.0005	0.0005	0.001	0.08	0.0006	0.0005	0.0005	0.001	0.08
B	mg/L	0.94	0.0076	0.006	0.0025	0.015	0.02	0.018	0.006	0.0025	0.08	0.09	0.011	0.008	0.0025	0.03	0.03
Cd	mg/L	0.00009	0.00003	0.000025	0.000025	0.000025	0.28	0.000062	0.000025	0.000025	0.0002	2.22	0.00006	0.00003	0.000025	0.0002	2.22
Co	mg/L	0.0014	0.00011	0.0001	0.0001	0.0002	0.14	0.00024	0.00025	0.0001	0.0005	0.36	0.0005	0.0005	0.00025	0.0009	0.64

PARAMETER	UNIT	WQ REF VALUE	SW03 (n=26)					SW02 (n=24)					SW05 (n=24)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Cr	mg/L	0.001	0.00037	0.00025	0.00025	0.0005	0.50	0.00045	0.0005	0.00025	0.001	1.00	0.00046	0.00050	0.00025	0.001	1.00
Cu	mg/L	0.0029	0.00025	0.00025	0.00025	0.00025	0.09	0.00048	0.00025	0.00025	0.0022	0.76	0.0006	0.0006	0.00025	0.0017	0.59
Fe	mg/L	0.5	0.081	0.08	0.03	0.16	0.32	0.25	0.25	0.12	0.42	0.84	0.086	0.080	0.06	0.17	0.34
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	0.00028	0.00025	0.00025	0.0005	-	0.00028	0.00025	0.00025	0.0005	-
Mn	mg/L	0.43	0.0028	0.0027	0.0012	0.0066	0.02	0.00701	0.00635	0.0019	0.0182	0.04	0.0026	0.0025	0.0013	0.0047	0.01
Ni	mg/L	0.017	0.0003	0.00025	0.00025	0.0007	0.04	0.00029	0.00025	0.00025	0.0006	0.04	0.001	0.001	0.0006	0.0016	0.09
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.07	0.00028	0.00025	0.00025	0.0005	0.15	0.00044	0.00025	0.00025	0.0017	0.50
Sb	mg/L	0.009	0.0005	0.0005	0.0005	0.0005	0.06	0.00056	0.0005	0.0005	0.001	0.11	0.0006	0.0005	0.0005	0.001	0.11
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	0.0028	0.0025	0.0025	0.005	0.45	0.0028	0.0025	0.0025	0.005	0.45
Si	mg/L	-	3.48	3.53	0.83	5.95	-	1.63	1.33	1.07	2.54	-	1.9	1.61	0.98	3.56	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	0.00028	0.00025	0.00025	0.0005	-	0.00028	0.00025	0.00025	0.0005	-
Tl	mg/L	0.0008	0.000025	0.000025	0.000025	0.000025	0.03	0.00014	0.000025	0.000025	0.0005	0.63	0.00021	0.00021	0.00009	0.0005	0.63
Zn	mg/L	0.023	0.0032	0.00255	0.0019	0.009	0.39	0.0038	0.002	0.0005	0.0112	0.49	0.009	0.009	0.0052	0.014	0.61
TDS	mg/L	-	15.4	16	11	19	-	10.3	11	5	18	-	21	21	16	26	-
TSS	mg/L	-	2.2	1.5	1.5	7	-	2.5	2	1.5	6	-	2.3	1.5	1.5	7	-
Turbidity	NTU	25	0.4	0.3	0.15	1.49	0.06	0.5	0.4	0.23	1.78	0.07	0.3	0.3	0.13	0.61	0.02

Table 15: Water quality data and MEQ analysis for Billo Stream and tributary BS01, BS01 high flow event samples and BIL.L1.

PARAMETER	UNIT	WQ REF VALUE	BS01 (n=24)					BS01 – HIGH FLOW EVENT (n=8)					BIL.L1 (n=9)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	5.13	5.2	4.8	6.1	-	5.05	5.05	4.9	5.3	-	5.02	5	5.2	4.8	-
EC	mS/m	-	2.07	1.9	1.4	3.9	-	6.03	2.1	1.1	22	-	2.01	2	1.8	2.3	-
Acidity	mg/L CaCO ₃	-	4.25	4.2	0.5	9	-	4.92	5	3.4	6.1	-	6.22	6.5	3.9	8	-
Alkalinity	mg/L CaCO ₃	-	0.57	0.5	0.5	1	-	-	-	-	-	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	8.93	9.57	4.44	11.06	-	1.01	1.08	0.36	1.58	-	-	-	-	-	-
Ca	mg/L	-	0.21	0.23	0.025	0.31	-	0.11	0.12	0.08	0.14	-	0.10	0.11	0.07	0.12	-
Mg	mg/L	-	0.26	0.25	0.16	0.4	-	0.18	0.19	0.04	0.3	-	0.26	0.26	0.2	0.33	-
Na	mg/L	-	1.58	2.02	0	2.93	-	-	-	-	-	-	-	-	-	-	-
K	mg/L	-	0.21	0.19	0.13	0.34	-	-	-	-	-	-	-	-	-	-	-
Cl	mg/L	-	3.29	3.37	2.34	4.29	-	-	-	-	-	-	-	-	-	-	-
SO ₄	mg/L	500	0.62	0.60	0.25	1	0.002	-	-	-	-	-	0.51	0.60	0.25	0.7	0.001
NO ₃ -N	mg/L	2.4	0.01	0.01	0.001	0.03	0.01	-	-	-	-	-	-	-	-	-	-

PARAMETER	UNIT	WQ REF VALUE	BS01 (n=24)					BS01 – HIGH FLOW EVENT (n=8)					BIL.L1 (n=9)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
NO ₂ -N	mg/L	-	0.0044	0.0050	0.001	0.005	-	-	-	-	-	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.02	0.02	0.005	0.04	0.03	-	-	-	-	-	-	-	-	-	-
Total N	mg/L	-	0.08	0.08	0.072	0.094	-	-	-	-	-	-	-	-	-	-	-
DOC	mg/L	-	2.55	1.95	1.3	8.4	-	6.74	6.45	3.9	9.6	-	5	4.8	3.2	7.4	-
Al	mg/L	0.37	0.10	0.09	0.05	0.185	0.50	0.08	0.07	0.045	0.127	0.34	0.11	0.1	0.064	0.165	0.45
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-	-	-	-	-	-
B	mg/L	0.94	0.01	0.0052	0.0025	0.03	0.03	-	-	-	-	-	-	-	-	-	-
Cd	mg/L	0.00009	0.000061	0.000025	0.000025	0.0001	1.11	0.000025	0.000025	0.000025	0.000025	0.28	0.000025	0.000025	0.000025	0.000025	0.28
Co	mg/L	0.0014	0.00017	0.0001	0.0001	0.00025	0.18	-	-	-	-	-	0.0001	0.0001	0.0001	0.0001	0.07
Cr	mg/L	0.001	0.00045	0.0005	0.00025	0.0005	0.50	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.25
Cu	mg/L	0.0029	0.00049	0.00025	0.00025	0.0018	0.62	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.09
Fe	mg/L	0.5	0.18	0.17	0.09	0.321	0.64	0.1	0.1	0.037	0.17	0.34	0.18	0.18	0.18	0.18	0.36
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-	-	-	-	-	-
Mn	mg/L	0.43	0.01	0.01	0.0033	0.0079	0.02	-	-	-	-	-	0.01	0.01	0.0076	0.0081	0.02
Ni	mg/L	0.017	0.00059	0.00025	0.00025	0.0061	0.36	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.01
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.07	-	-	-	-	-	-	-	-	-	-
Sb	mg/L	0.009	0.00050	0.00050	0.0005	0.0005	0.06	-	-	-	-	-	-	-	-	-	-
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-	-	-	-	-	-	-
Si	mg/L	-	1.75	1.41	0.93	3.15	-	-	-	-	-	-	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-	-	-	-	-	-
Tl	mg/L	0.0008	0.00014	0.00014	0.000025	0.00025	0.31	-	-	-	-	-	0.000025	0.000025	0.000025	0.000025	0.03
Zn	mg/L	0.023	0.0026	0.0020	0.0005	0.012	0.52	0.13	0.12	0.054	0.24	10.43	0.0009	0.0005	0.0005	0.002	0.09
TDS	mg/L	-	11.4	12.0	5	17	-	-	-	-	-	-	-	-	-	-	-
TSS	mg/L	-	2.4	1.5	1.5	10	-	45	31	15	107	-	1.6	1.5	1.5	2.5	-
Turbidity	NTU	25	0.5	0.3	0.19	2.63	0.11	3.9	3.1	2.7	7.2	0.29	0.4	0.4	0.26	0.57	0.02

Table 16: MEQ summary for the Deep Stream catchment.

DATA SOURCE	SO ₄	NO ₃ ⁻ N	NH ₄ ⁻ N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
DEEP STREAM																				
SW04	0.02	0.02	0.02	0.57	0.08	0.03	2.22	0.36	1	0.17	0.36	-	0.01	0.08	0.15	0.11	0.45	0.63	0.52	0.02
SW01	0.01	0.01	0.05	0.45	0.04	0.02	0.28	0.07	0.5	0.34	0.30	-	0.02	0.05	0.07	0.06	0.23	0.03	1.57	0.09
SW01 (High Flow Event)	0.003	-	-	0.46	-	-	0.28	-	-	-	0.30	-	-	-	-	-	-	-	10.00	0.65
SW03	0.01	0.004	0.03	0.54	0.04	0.02	0.28	0.14	0.5	0.09	0.32	-	0.02	0.04	0.07	0.06	0.23	0.03	0.39	0.06
DEEP STREAM TRIBUTARIES																				
SW02	0.003	0.004	0.09	0.57	0.08	0.09	2.22	0.36	1.00	0.76	0.84	-	0.04	0.04	0.15	0.11	0.45	0.63	0.49	0.07
SW05	0.01	0.004	0.09	1.24	0.08	0.03	2.22	0.64	1.00	0.59	0.34	-	0.01	0.09	0.5	0.11	0.45	0.63	0.61	0.02
BS01	0.002	0.01	0.03	0.50	0.04	0.03	1.11	0.18	0.5	0.62	0.64	-	0.02	0.36	0.07	0.06	0.23	0.31	0.52	0.11
BS01 (High Flow Event)	-	-	-	0.34	-	-	0.28	-	-	-	0.34	-	-	-	-	-	-	-	10.43	0.29
BIL.L1	0.00	-	-	0.45	-	-	0.28	0.07	0.25	0.09	0.36	-	0.02	0.01	-	-	-	0.03	0.09	0.02

¹Turbidity.

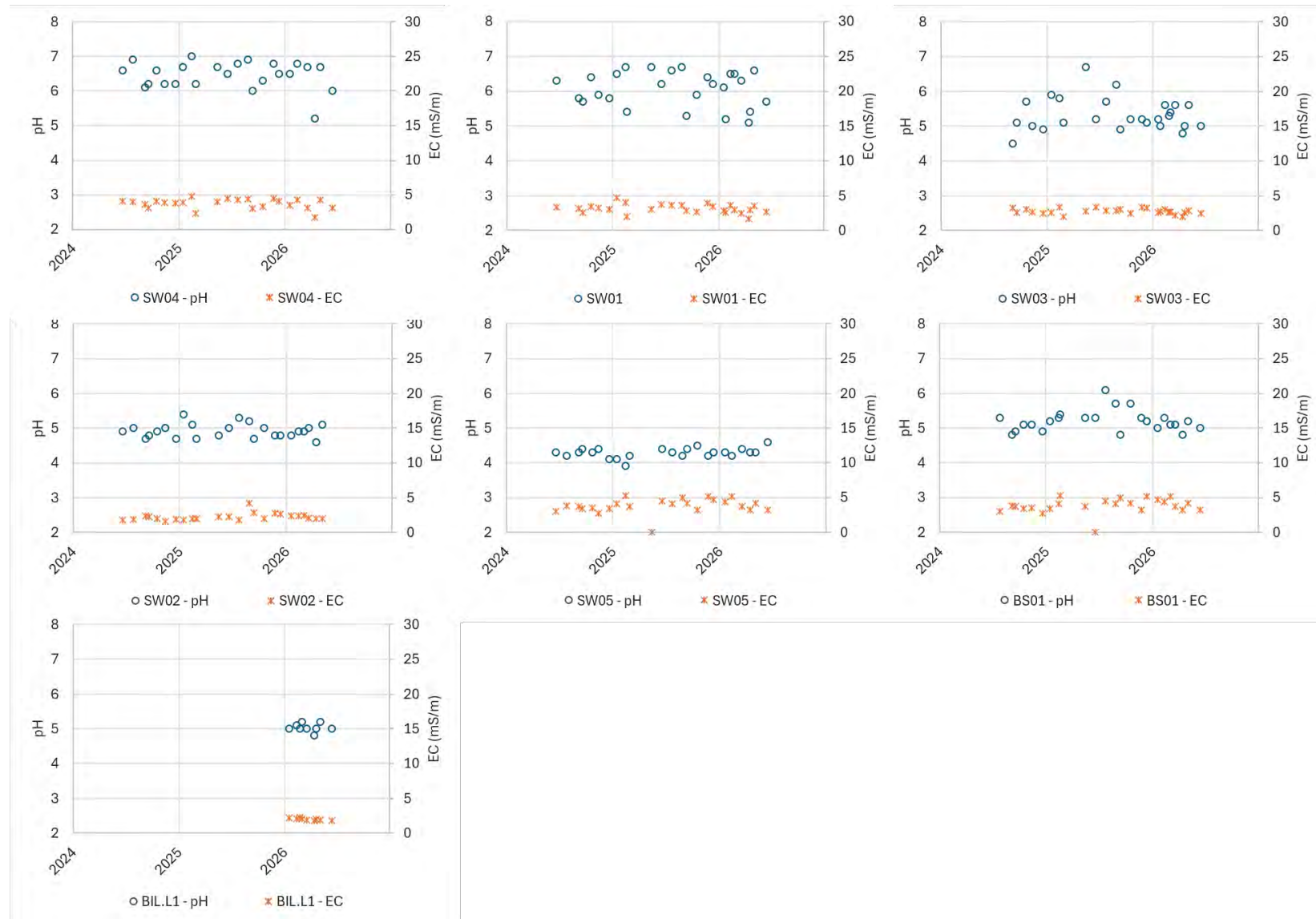


Figure 13: EC and pH for tributaries of Deep Stream and tributaries monitoring sites.

4.3.2 Data Summary

The following are key observations from the data review of the Deep Stream catchment monitoring sites:

- Within Deep Stream:
 - o Mean pH and EC decreased from upstream to downstream (Figure 14).
 - o Maximum Cd at SW04 exceeds WQ Ref Values
 - o Zn at SW01 (and SW01 high flow event samples) exceeds WQ Ref Values during high flow (Figure 15).
- Within tributaries of Deep Stream:
 - o Mean pH is lower than Deep Stream data (Figure 14); lowest pH and highest EC are observed at SW05.
 - o Maximum Al at SW05 and
 - o Maximum Cd at SW05 exceeds WQ Ref Values, MEQ of Cd is affected at SW02 and BS01 by the LOR.
 - o Zn at BS01 (high flow event samples) exceeds WQ Ref Values during high flow (Figure 15).

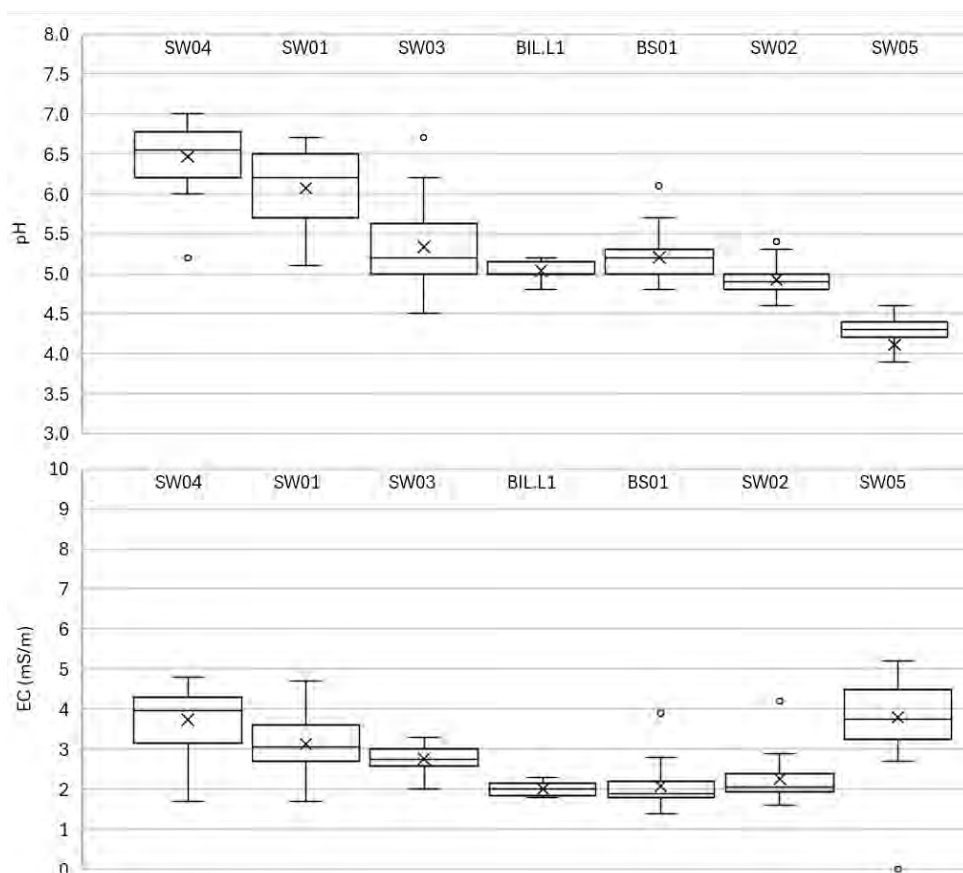


Figure 14: Box plots of pH and EC for Deep Stream monitoring sites.

An 'X' identifies the mean data for each monitoring site.

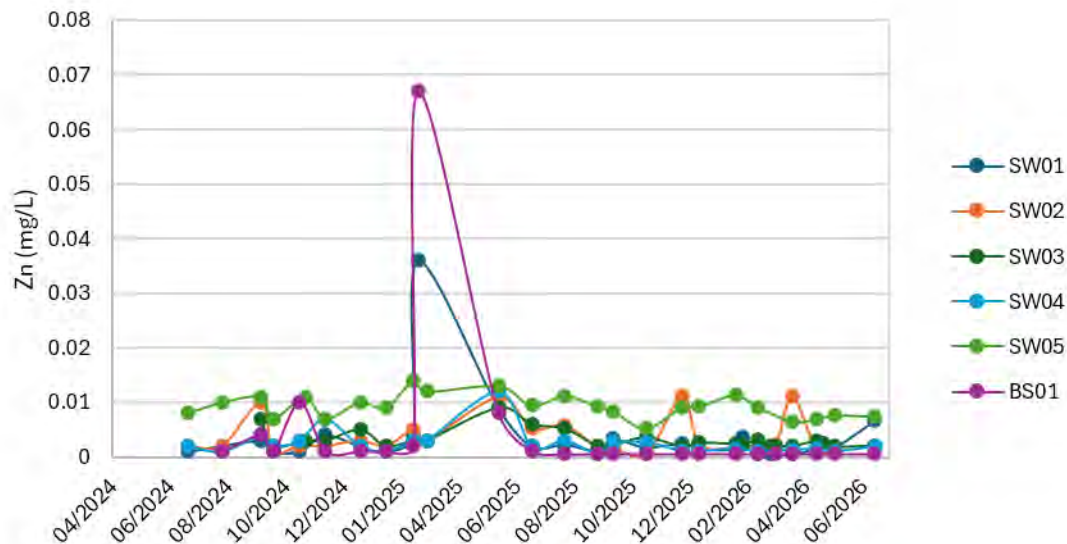


Figure 15: Water quality plots for zinc (Zn) in the Deep Stream catchment.

Sampling in February 2025 for SW01 and BS01 appears anomalous for Zn, these were sampled during a period of high flow.

4.3.3 Sonde Data

Sonde data is available for BS01 (Billo Stream), SW01 (Deep Stream), and SW05 (Deep Stream tributary). Data has been compiled into tables in the following sections with time series plots of key analytes.

4.3.3.1 SW01

Sonde data for SW01 at Deep Stream from 12/11/2024 to 11/07/2025 are summarised in Table 17.

Table 17: Sonde data for SW01.

SW01 (n=22,455 over 10-minute intervals)				
PARAMETER	MAX	MEAN	MEDIAN	MIN
pH	7.3	6.2	6.4	4.3
Flow (m ³ /sec)*	-	-	-	0.023
Turbidity (NTU)	25.53	0.67	0.51	0
EC (μS/cm)*	37.40	21.2	21.5	4.7

*Accuracy of high flow data readings at SW01 are currently affected by restrictions within the monitoring site for sensor placement (██████, email dated 21 July 2026). This only affects flow data above 0.5 m³/s (approximately the 92nd percentile), however due to the effect on maximum, mean and median values, these data are not provided.

Note: Sonde data is recorded in μS/cm and Deep Stream sample data is presented in mS/m (mS/m × 10 = μS/cm).

Figure 16 presents a time series plot for flow and pH sonde data at SW01. A correlation between incidence of elevated flow data and lower pH and EC data is observed (note there is reduced accuracy of high flow measurements greater than 0.5 m³/s). This is most likely due to the flushing of natural organic acids during higher rainfall events (e.g., King, 2019; McGlynn and McDonnell, 2003) that lower pH and EC due to dilution (noting that humic and fulvic acids do not contribute to EC). Hence, EC can be a useful determinant of potential AMD impacts as AMD will increase EC.

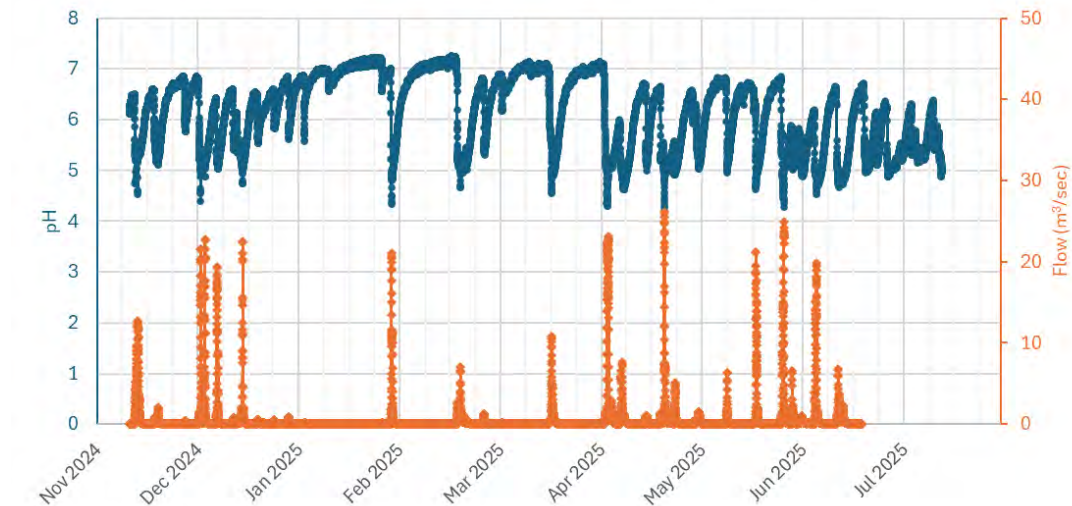


Figure 16: SW01 Sonde data time series plot for pH and flow.

Note reduced accuracy of flow readings greater than 0.5 m³/s, however timing of flow peaks are accurate.

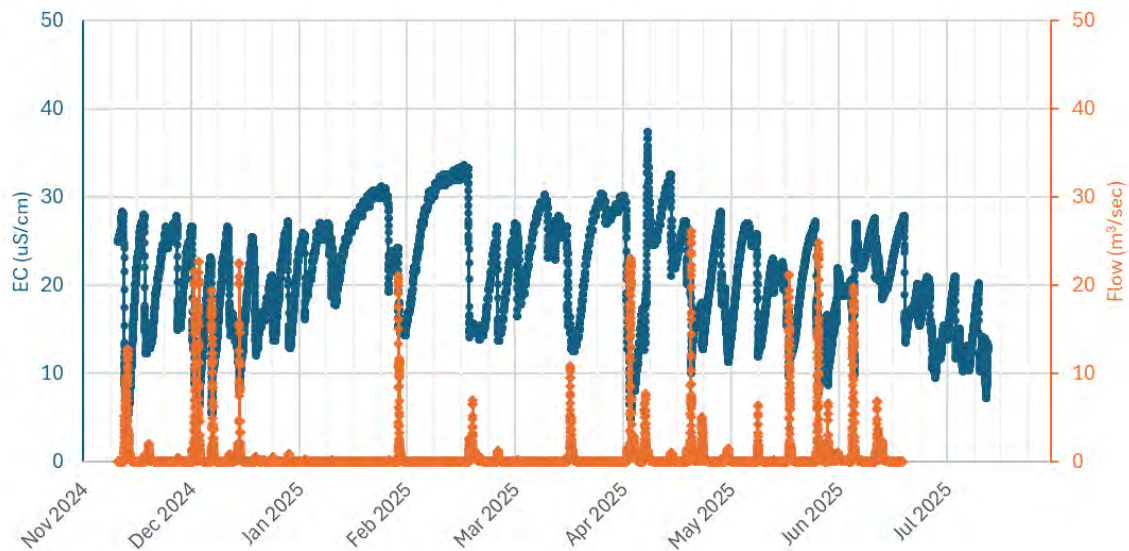


Figure 17: SW01 Sonde data time series plot for EC and flow.

Note reduced accuracy of flow readings greater than 0.5 m³/s, however timing of flow peaks are accurate.

4.3.3.2 BS01

Sonde data for BS01 from 12/11/2024 to 11/07/2025 are summarised in Table 18.

Table 18: Sonde data for BS01.

BS01 (n=22,456 over 10-minute intervals)				
PARAMETER	MAX	MEAN	MEDIAN	MIN
pH	5.7	5.2	5.1	4.1
Flow (m³/sec)	8.89	0.11	0.01	0.004
Turbidity (NTU)	21.25	0.64	0.34	0.07
EC (µS/cm)	45.30	14.32	13.90	4.10

Note: Sonde data is recorded in µS/cm and Deep Stream sample data is presented in mS/m ($mS/m \times 10 = \mu S/cm$).

Figure 18 presents the relationship between pH and flow and Figure 19 presents pH and EC at BS01. As observed at SW01, there is a notable relationship between peaks in flow rates and lower pH data. The decrease in pH is less than the pH difference observed at SW01 during these flushing events. This may be due to a number of contributing factors including, for instance:

- The BS01 catchment water quality already has a lower pH (~ pH 5.2) compared to SW01 (~pH 6.2); hence, the change at SW01 is more pronounced.
- The catchments may have differing amount of vegetation (e.g., organic matter) that contribute to the organic acidity load (i.e., flushing of riparian margins during the rising limb of a hydrograph (McGlynn and McDonnell, 2003).

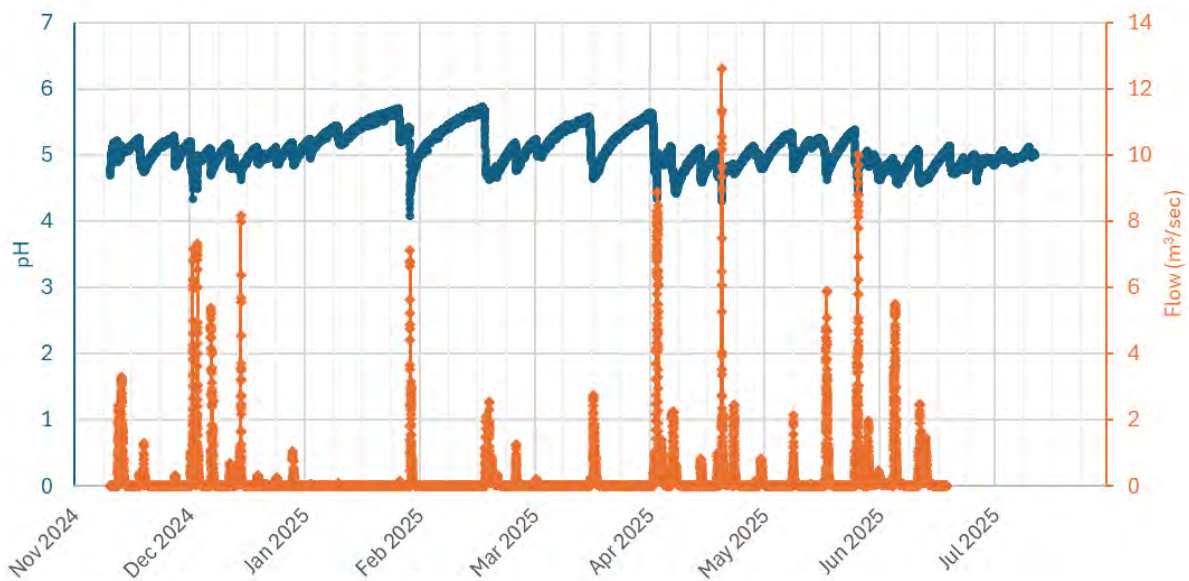


Figure 18: BS01 Sonde data time series plot of pH and flow.

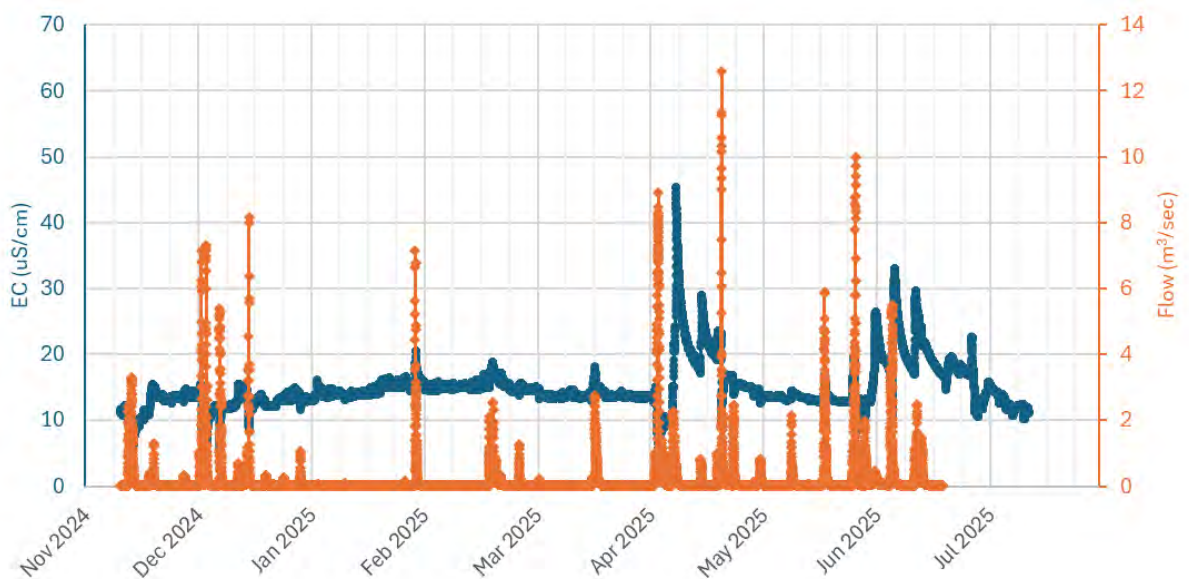


Figure 19: BS01 Sonde data time series plot of EC and flow.

4.3.3.3 SW05

Sonde data for SW05, a tributary of Deep Stream, from 12/11/2024 to 12/07/2025 are summarised in Table 19. Figure 20 presents the relationship between pH and flow, Figure 21 presents EC and flow. Flow volumes at SW05 (maximum of 2.72 m³/s) are lower than data provided for SW01 and BS01 (maximum of 23.09 m³/m and 8.89 m³/m). The lower range in pH observed at SW05 (4.1 to 5.1) is notable compared to the pH range identified at SW01 (4.3 to 7.3) and BS01 (4.1 to 5.7).

Table 19: Sonde data for SW05.

SW05 (n=35,036 over 10-minute intervals)				
PARAMETER	MAX	MEAN	MEDIAN	MIN
pH	5.1	4.4	4.4	4.1
Flow (m ³ /sec)	2.72	0.039	0.005	0.004
Turbidity (NTU)*	7.31	0.61	0.51	0.18
EC (μS/cm)	69.2	29.8	29.3	5.6

* Data available from 14/05/2025. Note: Sonde data is recorded in μS/cm and Deep Stream sample data is presented in mS/m (mS/m x 10 = μS/cm).

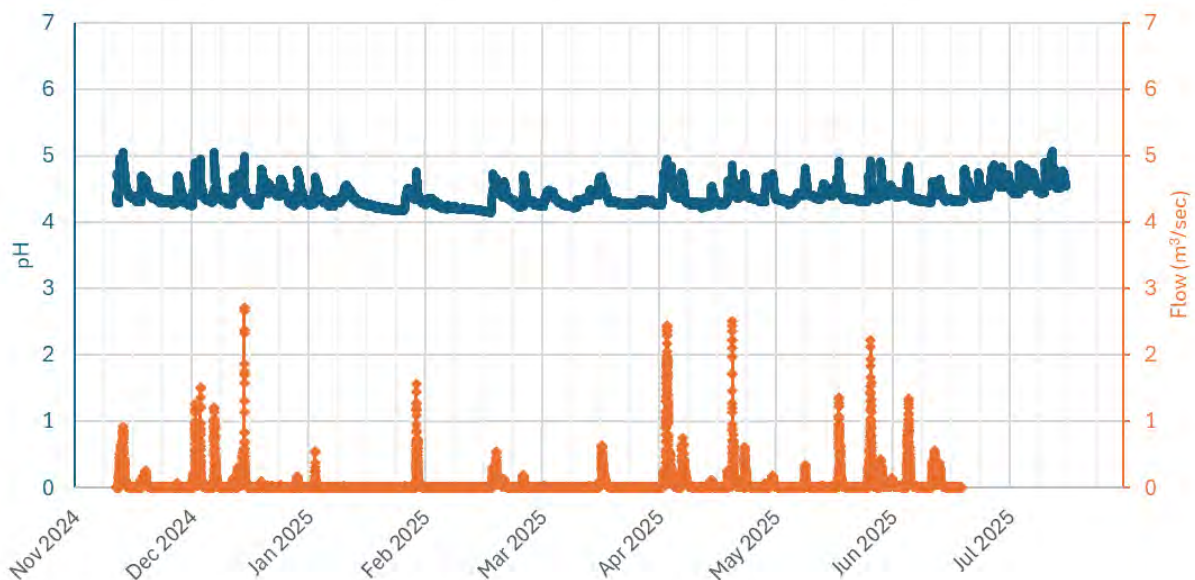


Figure 20: SW05 Sonde data time series plot of pH and flow.

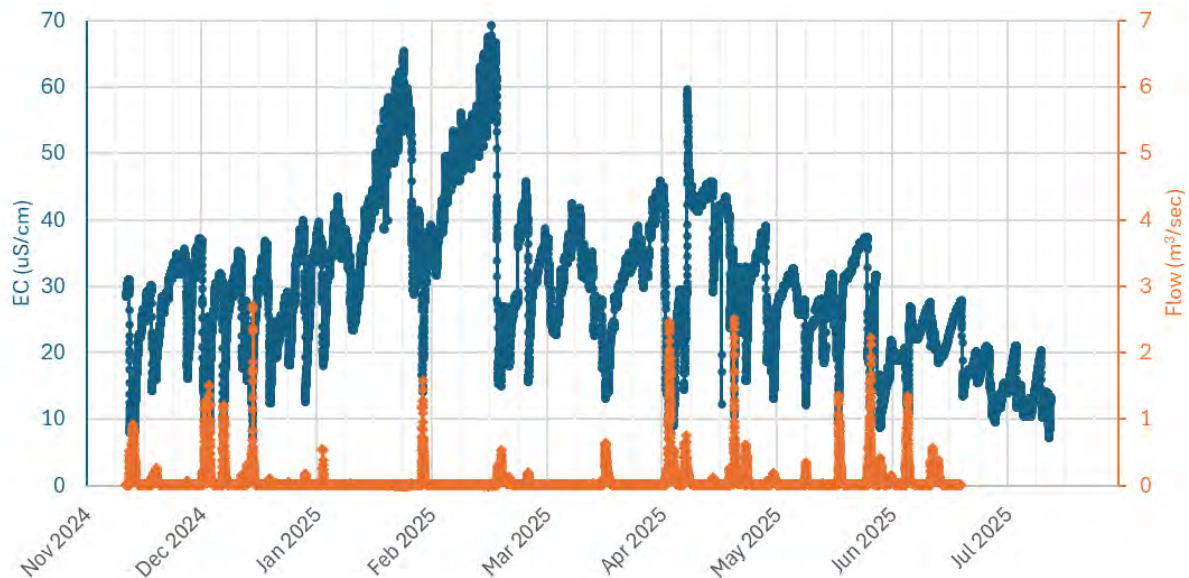


Figure 21: SW05 Sonde data time series plot of EC and flow.

SW05 has a varied flow–pH relationship compared to other sites, with pH increasing during rainfall events. In surrounding catchments, high flows usually lower pH due to organic-acid flushing, but SW05 shows the opposite: its low baseflow pH rises during storms. This may reflect the larger proportion of paved surfaces in the SW05 sub-catchment, which limits mobilisation of organic-rich water and allows rainfall-driven dilution of the acidic baseflow. Alternatively, this may reflect dilution of AMD impacted sub-catchment during higher flow.

Figure 22 presents box-and-whisker plots of pH data grouped into flow quartiles for the three sites with available sonde data and Figure 23 presents conductivity grouped into flow quartiles. Note these are not monitoring site specific flow quartiles, they represent quartiles of all available sonde data. Data suggests:

- SW01 pH and conductivity decrease with increasing flow.
- BS01 pH decreases with increasing flow, median conductivity remains similar across flow quartiles however a higher range of conductivity is recorded during higher flows.
- SW05 pH increases with increasing flow, however the range in pH is lower than for the other two sonde sites. Conductivity decreases with increasing flow with a higher conductivity range than the other two Sonde sites.
- Mean pH across the flow quartiles varies by over two orders of magnitude (of hydrogen ion concentration) for low flow conditions (<25th percentile flow data) between SW01 and SW05.

These data further support the variation in pH response to higher flows and demonstrates the variability in site response and the need for site specific monitoring.

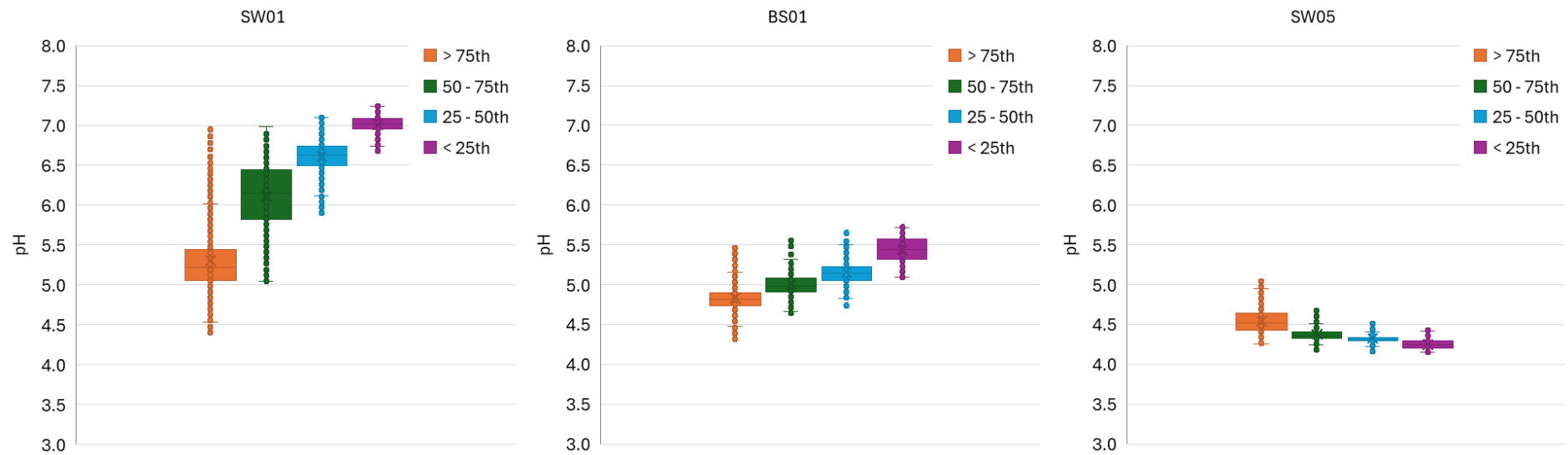


Figure 22: Box and whisker plots for pH versus flow quartile.

From left to right: Sites SW01, BS01, and SW05. Quartiles calculated from available Sonde data.

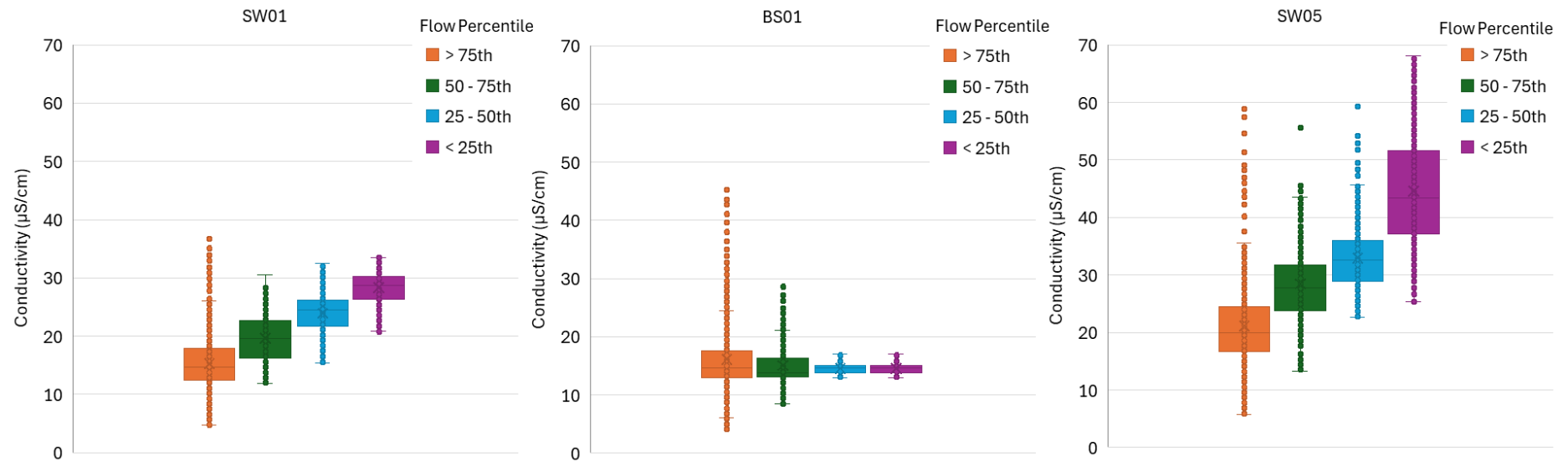


Figure 23: Box and whisker plots for conductivity versus flow quartile.

From left to right: Sites SW01, BS01 and SW05. Quartiles calculated from available Sonde data.

4.3.4 Grab Sample Water Quality Data

Two sets of samples were collected with locations provided in Figure 3:

- **Sample Event 1:** A one-off sample event was conducted during a site visit on the morning of 24/08/2023 by MWM staff (accompanied by BRL staff). A total of eight locations were sampled within the Deep Stream catchment area. The weather for the visit was sunny and dry, with the last rainfall recorded at the Stockton Mine on 21/08/2023 (1.4 mm).
- **Sample Event 2:** A one-off sample event was conducted during a site visit on 24/10/2023. A total of seven locations were sampled. 63.6 mm of rain was recorded at the Stockton Mine on this date (2.2 mm recorded the previous day preceded by four days of no recorded rainfall).

4.3.4.1 Sample Event 1: August 2023 Site Visit

Eight surface water samples were collected from the Deep Stream area in August 2023. The results of the laboratory analysis are presented in Table 20.

Based on the data the following observations were made:

- pH values were acidic and ranged from 4.0 to 4.6 across all sample locations.
- Acidity (pH 8.3) concentrations were low, ranging between 4– 10 mg CaCO₃/L.
- The EC ranged from 2.20 to 4.90 mS/m.
- Zn concentrations were elevated compared to WQ Ref Values at MFS003.
- Aluminium concentrations exceeded WQ Ref Values MFS002.
- MEQ for Cd is affected by the LOR.
- SO₄ concentrations were low (e.g., <10 mg/L).
- Mean Ca and Mg concentrations were consistent across all sample locations.

Table 20. Deep Stream water quality results: August 2023 site visit.

PARAMETER	UNIT	WQ REF VALUE	MFS003	MFS005	MFS009	MFS002	MFS006	MFS008	MFS013	MFS012	MEQ (MAX VALUE)
Site - Type			Stream-Below Adit MFS002	Stream	Seepage	Adit	Stream	Stream	Seepage	Seepage	
pH	pH unit	4.5 - 7.0	4.1	4.2	4.4	4	4	4.4	4.6	4.3	
EC	mS/m	-	4.6	3.9	2.7	4.9	5.3	2.5	2.2	2.8	-
Acidity (pH 8.3)	mg/L CaCO ₃	-	10	7	4	9	10	4	4	6	-
Hardness	mg/L	-	2.06	1.86	2.02	2.06	5.94	1.57	1.28	1.11	-
Ca	mg/L	-	0.2	0.2	0.2	0.2	1.8	0.2	0.1	0.05	-
Mg	mg/L	-	0.38	0.33	0.37	0.38	0.35	0.26	0.25	0.24	-
SO ₄	mg/L	500	5.24	4.29	1.66	7.08	3.34	1.53	0.72	2.12	0.01
Al	mg/L	0.37	0.35	0.34	0.12	0.44	0.27	0.055	0.07	0.079	1.19
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.04
Cd	mg/L	0.00009	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	1.11
Co	mg/L	0.0014	0.0013	0.0005	0.00025	0.0017	0.0007	0.00025	0.00025	0.00025	1.21
Cr	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.50
Cu	mg/L	0.0029	0.0014	0.001	0.0007	0.0015	0.0013	0.0012	0.00025	0.0007	0.52
Fe	mg/L	0.5	0.16	0.1	0.07	0.22	0.06	0.04	0.04	0.02	0.44
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	-
Mn	mg/L	0.43	0.004	0.0031	0.0012	0.0051	0.0025	0.00025	0.00025	0.0008	0.01
Ni	mg/L	0.017	0.0022	0.001	0.0008	0.0026	0.0011	0.00025	0.00025	0.00025	0.15
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.07
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	-
Tl	mg/L	0.0008	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.31
Zn	mg/L	0.023	0.028	0.009	0.011	0.037	0.023	0.004	0.001	0.005	1.61

4.3.4.2 Sample Event 2: October 2023 Site Visit

Seven surface water samples were collected from the Deep Stream area in October 2023 (Table 21). The results of the laboratory analysis are presented in Table 22.

Based on the data the following observations were made:

- pH values range from 4.5 to 6.2
- Acidity (pH 8.3) concentrations were low, ranging between 1– 4 mg CaCO₃/L.
- EC ranged from 3.0 to 4.3 mS/m.
- Cadmium concentrations at the sampling location 2a were reported as elevated. MEQ at all other sampling locations is affected by the LOR.
- MEQ of Cr (0.50) is affected by the LOR.
- SO₄ concentrations were low (e.g., <10 mg/L).
- Mean Ca and Mg concentrations were consistent across all sample locations.

Table 21. October 2023 site visit sample locations.

SAMPLE NAME	LOCATION DESCRIPTION
1a	Unnamed tributary of Deep Stream
1b	Upstream of 1a confluence
1c	Downstream of 1a confluence
2a	Deep Stream upstream of Billo stream confluence
2b	Billo Stream upstream of Deep Stream confluence
2c	Deep Stream upstream of unnamed tributary across from Billo Stream
2d	Deep Stream downstream of unnamed tributary across from Billo Stream

Table 22. Deep Stream water quality results: October 2023 site visit.

PARAMETER	UNIT	WQ REF VALUE	1a	1b	1c	2a	2b	2c	2d	MEQ (MAX VALUE)
pH	pH unit	4.5 - 7.0	4.7	5.9	5.8	6.2	4.7	4.5	6.1	-
EC	mS/m	-	3	3.7	3.7	4.3	3.3	3.3	3.9	-
Acidity (pH 8.3)	mg/L CaCO ₃	-	3	2	1	1	4	4	2	-
Hardness	mg/L	-	2.11	5.58	5.87	7.89	1.94	1.94	6.65	-
Ca	mg/L	-	0.2	0.7	0.8	1.1	0.1	0.1	0.9	-
Mg	mg/L	-	0.39	0.93	0.94	1.25	0.41	0.41	1.07	-
SO4	mg/L	500	1.34	6.03	5.49	8.37	1.03	1.03	5.93	0.02
NO3-N	mg/L	2.4	0.02	0.01	0.02	0.04	0.005	0.005	0.02	0.02
NO2-N	mg/L	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	-
NH4-N	mg/L	1.2	0.01	0.005	0.005	0.005	0.005	0.005	0.005	0.01
Total N	mg/L	-	0.07	0.05	0.025	0.08	0.06	0.06	0.025	-
DOC	mg/L	-	1.8	1.7	1.6	1.3	2.5	2.5	1.7	-
Al	mg/L	0.37	0.045	0.044	0.046	0.038	0.041	0.041	0.041	0.12
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.04
B	mg/L	0.94	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.02
Cd	mg/L	0.00009	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	2.22
Co	mg/L	0.0014	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.18
Cr	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.50
Cu	mg/L	0.0029	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.09
Fe	mg/L	0.5	0.04	0.02	0.03	0.02	0.03	0.03	0.02	0.08
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	-
Mn	mg/L	0.43	0.00025	0.0015	0.0029	0.0025	0.00025	0.00025	0.0032	0.01
Ni	mg/L	0.017	0.00025	0.00025	0.0006	0.0007	0.00025	0.00025	0.0005	0.04
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.07
Tl	mg/L	0.0008	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.00025	0.31
Zn	mg/L	0.023	0.002	0.003	0.002	0.002	0.001	0.001	0.002	0.13

Water samples presented in Table 23 were taken from Deep Stream to obtain background water quality data for the Solid Energy (2006) PAG2¹⁶ report.

Table 23. Water quality of Deep Stream compared to Trigger Values.

PARAMETER [#]	WQ REF VALUE	DC1	DC2	DC3	DC4	DC5	DC7	MEQ
pH (pH units)	-	6.29	6.69	6.51	6.47	6.9	5.42	-
Acidity to pH7 (mg CaCO ₃ /L)	-	0	0	0	0	0	2.5	-
SO ₄	500	1	1	1	1	1	0.6	0.002
Fe	0.5	0.01	0.01	0.01	0.01	0.01	0.11	0.02
Al	0.37	0.045	0.033	0.048	0.018	0.029	0.161	0.12
Ni	0.017	0.00025	0.00025	0.00025	0.00025	0.0008	0.00025	0.01
Zn	0.023	0.001	0.0005	0.001	0.002	0.003	0.003	0.04

[#]All units in mg/L unless otherwise noted.

Source: Solid Energy (2006).

4.4 Legacy Mine Drainage Water Quality

Water quality data are presented to understand the effects of legacy mining within the catchment. Water samples were taken from the Deep Stream catchment to obtain background water quality for the Solid Energy (2006) PAG2¹⁷ report. The results are presented below in Table 24, locations are provided in Figure 3. The results show that adit discharges had a pH of 3.74 to 4.0 and the discharge from Adit 1 contained elevated levels of Al, Fe and Zn. Solid Energy (2006) noted that this indicated historic underground workings were contributing AMD with low concentrations of acidity and some trace metals to Deep Stream. The low sulfate concentrations suggest the acidity (and pH) may not be due to mineral acidity (i.e., due to sulfide mineral oxidation) and likely to be related to minor organic acidity (e.g., humic and fulvic acids).

Table 24. Water quality of Deep Stream adits 1 and 3.

PARAMETER [#]	WQ REF VALUE	ADIT 1 DEEP STREAM	ADIT 3 DEEP STREAM	MEQ
pH	4.5 - 6.5	3.74	4.0	-
Acidity to pH 7 (mg CaCO ₃ /L)	-	10	15	-
SO ₄	500	7	3	0.01
Al	0.37	1.98	0.332	5.35
Fe	0.5	0.55	0.53	1.10
Ni	0.017	0.009	0.0008	0.53
Zn	0.023	0.093	0.012	4.04

[#]All units in mg/L unless otherwise noted.

The historic underground workings from the Iron Bridge Mine discharge into the Waimangaroa River catchment. Samples from the mine discharge are elevated in Al, Cd, Co, Fe, Mn, Ni, Tl, and Zn above WQ Ref Values (Table 25).

¹⁷ Project Approval Guideline (Level 2)- developed by Solid Energy (NZ) Limited

Table 25: Iron Bridge water quality data.

PARAMETER	UNIT	WQ REF VALUE	Iron Bridge (n=3)				
			MEAN	MEDIAN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	3.66	3.7	3.6	3.7	-
EC	mS/m	-	23.53	24.6	21.3	24.7	-
Acidity*	mg/L CaCO ₃	-	48.67	46	45	55	-
Ca	mg/L	-	8.67	9.20	7.3	9.5	-
Mg	mg/L	-	1.34	1.34	1.18	1.5	-
SO ₄	mg/L	500	68	67	59	78	0.16
DOC	mg/L	-	1.70	1.80	1	2.3	-
Al	mg/L	0.37	4.43	4.60	3.7	5	13.51
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04
Cd	mg/L	0.00009	0.00018	0.00018	0.00017	0.00018	2.0
Co	mg/L	0.0014	0.008	0.008	0.0084	0.0084	6.0
Cr	mg/L	0.001	0.00025	0.00025	0.00025	0.00025	0.01
Cu	mg/L	0.0029	0.0016	0.0016	0.0014	0.0017	0.59
Fe	mg/L	0.5	1.14	1.14	0.45	1.83	3.66
Mn	mg/L	0.43	0.56	0.1	0.088	1.5	3.49
Ni	mg/L	0.017	0.02	0.02	0.016	0.016	1.03
Tl	mg/L	0.0008	0.0011	0.0011	0.0011	0.0011	1.35
Zn	mg/L	0.023	0.14	0.14	0.13	0.15	6.39

5 ESCARPMENT EXTENSION AREA

5.1 Proposed ESE Monitoring Locations

Proposed BPCP compliance and performance monitoring sites for the ESE sub-area include both established water monitoring sites and new locations (Table 26). Sites are selected to provide monitoring coverage across the wider Project sub-area and target specific BPCP activities (Figure 24). Details on water quality monitoring frequency, parameters tested, and relationship to Project activities are provided in BRL (2025).

Background water quality monitoring data (for sites identified in Figure 3) are presented in Section 5.2 for Cascade Creek (and tributaries), Rapid Stream in Section 5.3, and Whareatea River (and tributaries) in Section 5.4. This includes data from sites identified in Table 26 (with existing monitoring data), and water monitoring sites within the wider Project area. Two of the water monitoring locations, are yet to be constructed (V37-F and V37-G). All proposed available compliance monitoring sites have at least 24 samples.

Figure 25 presents the cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites to demonstrate a range of flow conditions has been tested.

The combination of available data sources provides a background dataset for the ESE sub-area. Continual assessment of higher and lower flow conditions is required. This may guide the development of flow weighted water quality source terms (mg/L) for the water and load balance models.

Table 26: Proposed monitoring sites ESE.

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE	COMMENTS	EXISTING MONITORING DATA
ESE	Cascade Creek tributary (V8 Creek)	MM1	Compliance	Current Escarpment Mine discharge	August 2014 to ongoing (n = 149)
ESE	V37 Stream (Cascade Creek tributary)	V37-F	Performance	-	This site will be monitored once disturbed, currently insufficient flow to sample.
ESE	V37 Stream (Cascade Creek tributary)	V37-G	Performance	-	This site will be monitored once disturbed, currently insufficient flow to sample.
ESE	Cascade Creek	DS.V37	Performance (ecology)	Downstream of V37 stream	This site is for ecological performance only (n=1)
ESE	Rapid Stream	W07	Compliance	Upstream of Sullivan Mine Adit	April 2018 to ongoing (n=26)
ESE	Rapid Stream	W08	Performance	Downstream of Sullivan Mine adit	April 2018 to ongoing (n=21)
ESE	Rapid Stream	W09	Performance	At SH 67	July 2018 to ongoing (n=24)
ESE	Rapid Stream Tributary	RAP.R1	Reference	-	March 2026 to ongoing (n=4)
ESE	Whareatea River	KEL	Compliance	-	July 2014 to ongoing (n=51) High flow event samples (n=3)
ESE	Whareatea River	WM-3	Performance	At SH67	2011 to ongoing (n=116)
ESE	Whareatea River tributary (V70)	V70	Reference and Performance (turbidity)	-	July 2018 to ongoing (n=19) High flow event samples (n=2)
ESE	Whareatea River tributary (V62)	V62	Compliance	-	July 2018 to ongoing (n=24)

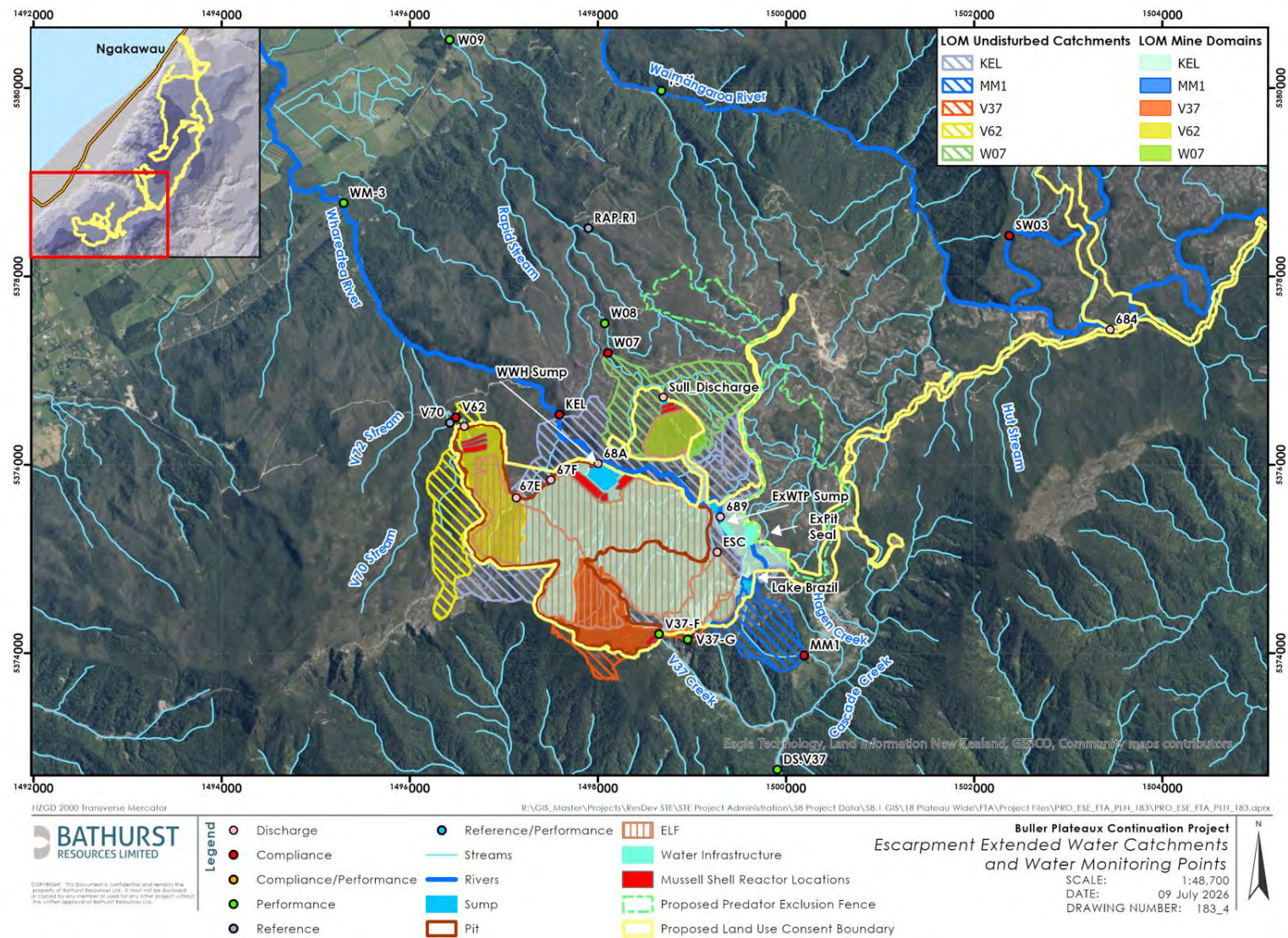


Figure 24: ESE catchments and water monitoring sites.

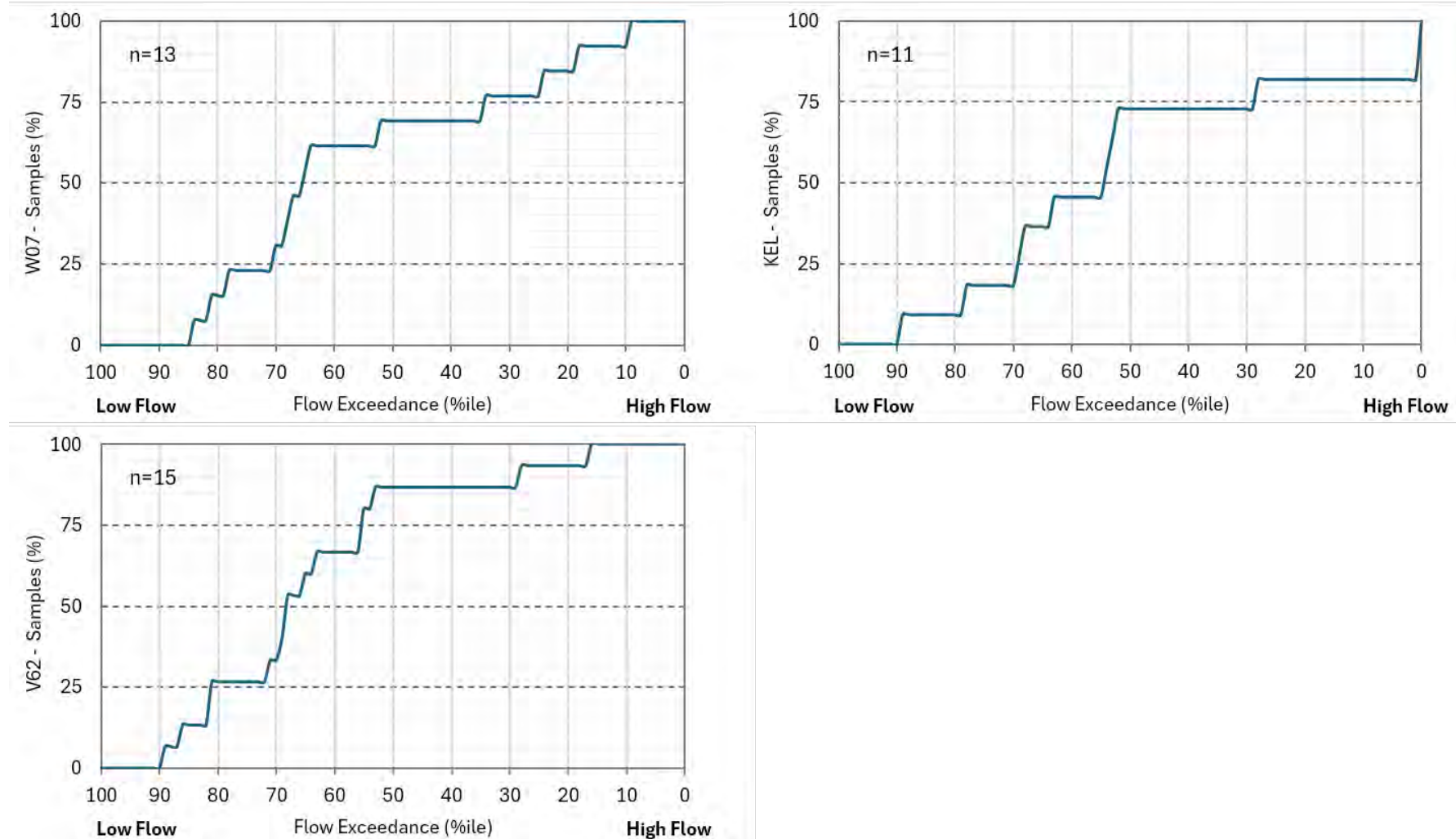


Figure 25: Cumulative distribution of water quality samples relative to long-term flow exceedance percentiles for compliance sites.

Coupled flow rate measurement and derived flow percentile at time of sample provided by BRL (██████) email dated 29 June 2026. Note only samples with time of collection available are presented. Data does not include high flow event samples available for V62 and KEL. Data is not provided for compliance site MM1 as 149 samples have been collected from this site over 12 years

5.2 Cascade Creek

The following section examines the surface water quality data for streams within the Cascade Creek area. Monitoring site locations are provided in Figure 3 and Figure 26. Time series trends are summarised and discussed where applicable. Full tabulated water quality data are presented in Appendix C as a digital Microsoft (MS) Excel file.

Extensive underground workings drain into the upper reaches of the Cascade Creek catchment including the Coalbrookdale Mine and Cascade Mine. Water quality monitoring sites X8 and X5 are AMD impacted and located within an upper tributary of Cascade Creek (Jewiss et al., 2020). Water quality monitoring sites X4, Cascade Upper, and X3 are within Cascade Creek, downstream of where AMD impacted tributaries enter Cascade Creek. Monitoring sites X7 and X6 are located in the upper reaches of Cascade Creek, upstream of the larger areas of historic workings.

The water quality of Cascade Creek is degraded from the impact of historic mining, as presented in Section 5.2.1. Discharge from the Escarpment Mine after treatment enters V8 Creek which ultimately drains into Cascade Creek and is monitored at site MM1. This site will continue to be a compliance monitoring location for the BPCP.

5.2.1 Water Quality Data

Table 3 provides a summary of water quality monitoring sites within the Cascade Creek catchment and the extent of data provided in this report. Water quality data and MEQs for Cascade Creek and tributaries are presented in the following tables:

Cascade Creek

- X7, X6, and X4 in Table 27
- Cascade Upper, X3 and Cascade Lower in Table 28

Cascade Creek tributaries

- X8, X5 (upper Cascade Creek Tributaries), and MM1 (V8 Creek) in Table 29
- DS.V37 and V37 (V37 Stream) in Table 30

Table 34 summarises MEQ data for all monitoring sites within the Cascade Creek catchment. Plots of EC and pH for monitoring sites within the Cascade Creek catchment are presented in Figure 27.

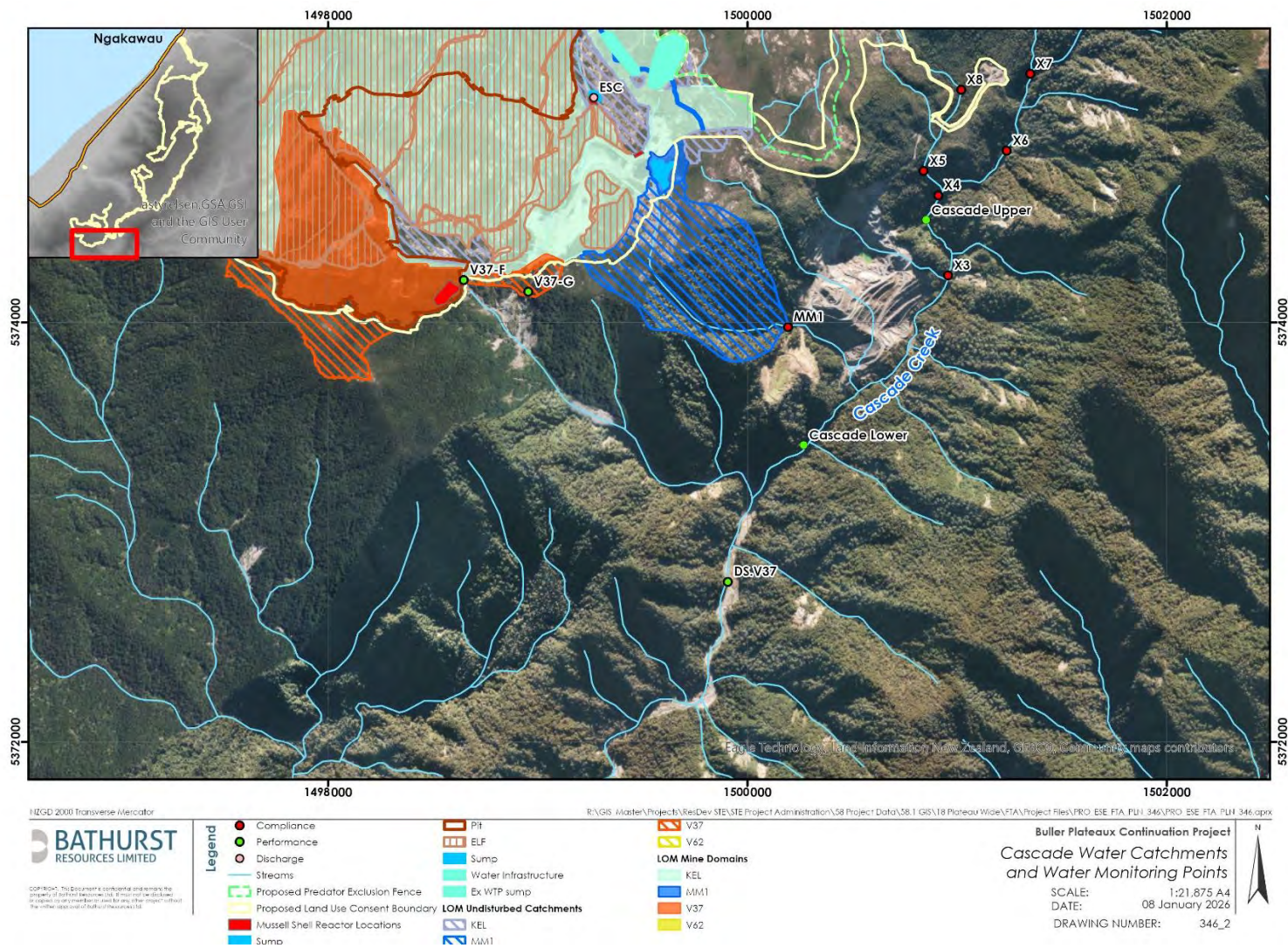


Figure 26: Cascade Creek water quality monitoring sites.

Source: BRL

Table 27: Water quality data and MEQ analysis for Cascade Creek monitoring sites (X7, X6, and X4).

PARAMETER	UNIT	WQ REF VALUE	X7 (n=8)					X6 (n=8)					X4 (n=8)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	7.2	7.4	6.2	7.5	-	6.9	7.7	5.6	7.7	-	3.5	3.6	3.2	4.4	-
EC	mS/m	-	5.3	5.4	3.9	6.7	-	5.9	6.1	4.3	7	-	27.5	25	15	55	-
Acidity	mg/L CaCO ₃	-	4.3	4.5	2	5.5	-	5.1	4.2	3.1	10	-	75	65	36	160	-
Alkalinity	mg/L CaCO ₃	-	22	23	18	27	-	20	23	1	28	-	0.6	0.5	0.5	1	-
SO ₄	mg/L	500	2.2	2.1	1.5	3	0.01	8	4	2	32	0.06	114	89	53	260	0.52
Al	mg/L	0.37	0.03	0.03	0.01	0.04	0.11	0.1	0.07	0.03	0.22	0.59	6.5	5.3	3	14	37.8
As	mg/L	0.013	0.004	0.005	0.001	0.005	0.38	0.004	0.005	0.001	0.005	0.38	0.004	0.005	0.001	0.005	0.38
Fe	mg/L	0.5	0.03	0.03	0.01	0.06	0.12	0.07	0.06	0.03	0.14	0.28	1.8	0.53	0.09	8.8	17.6
Ni	mg/L	0.017	0.0003	0.0003	0.0003	0.0009	0.05	0.0003	0.0003	0.0003	0.001	0.06	0.019	0.017	0.007	0.04	2.35
Zn	mg/L	0.023	0.005	0.003	0.003	0.014	0.61	0.003	0.003	0.003	0.006	0.26	0.15	0.13	0.04	0.31	13.5
TSS	mg/L	-	1.4	2	0.5	2	-	3.4	2	0.5	12	-	4.8	4.2	2	10	-
Turbidity	NTU	25	0.6	0.6	0.2	1	0.04	1.3	1.1	0.3	2.4	0.10	5	2.1	1.4	25	1.00

Table 28: Water quality data and MEQ analysis for Cascade Creek monitoring sites (Cascade Upper, X3 and Cascade Lower).

PARAMETER	UNIT	WQ REF VALUE	Cascade Upper (n=44)					X3 (n=8)					Cascade Lower (n=43)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	3.4	3.7	3.4	3.9	-	3.5	3.6	3.3	3.9	-	4	4	3.8	4.3	-
EC	mS/m	-	30.1	22.5	30.1	30.1	-	26.5	25	16	49	-	20.3	20.3	15.4	24.9	-
Acidity	mg/L CaCO ₃	-	66	46.5	66	66	-	69	62	36	150	-	29	30	17	40	-
Alkalinity	mg/L CaCO ₃	-	-	-	-	-	-	0.6	0.5	0.5	1	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	35	25	35	35	-	-	-	-	-	-	45	44	30	64	-
Ca	mg/L	-	11.7	8.4	11.7	11.7	-	-	-	-	-	-	13.9	13.8	9.5	20.7	-
Mg	mg/L	-	1.9	1.2	1.9	1.9	-	-	-	-	-	-	2.3	2.3	1.5	2.9	-
SO ₄	mg/L	500	-	-	-	-	-	108	89	53	240	0.48	-	-	-	-	-
Al	mg/L	0.37	8.4	4.7	8.4	8.4	22.7	6.5	5.1	3.1	15	40.5	3.6	3.5	2.1	5.9	15.9
As	mg/L	0.013	0.0011	0.0005	0.0011	0.0011	0.08	0.004	0.005	0.001	0.005	0.38	0.0005	0.0005	0.0005	0.0005	0.04
B	mg/L	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cd	mg/L	0.00009	0.0007	0.0001	0.0007	0.0007	7.78	-	-	-	-	-	0.0001	0.0001	0.0001	0.0001	1.11
Co	mg/L	0.0014	0.011	0.008	0.011	0.011	7.86	-	-	-	-	-	0.008	0.008	0.006	0.012	8.57
Cr	mg/L	0.001	0.001	0.001	0.001	0.001	1.00	-	-	-	-	-	0.001	0.001	0.001	0.001	1.00
Cu	mg/L	0.0029	0.006	0.003	0.006	0.006	2.07	-	-	-	-	-	0.002	0.002	0.001	0.004	1.38

PARAMETER	UNIT	WQ REF VALUE	Cascade Upper (n=44)					X3 (n=8)					Cascade Lower (n=43)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Fe	mg/L	0.5	1.49	0.6	1.49	1.49	2.98	1.59	1.1	0.16	6	12.0	0.36	0.35	0.03	0.85	1.70
Mn	mg/L	0.43	0.17	0.09	0.17	0.17	0.40	-	-	-	-	-	0.22	0.21	0.11	0.37	0.86
Ni	mg/L	0.017	0.023	0.016	0.023	0.023	1.35	0.019	0.017	0.009	0.038	2.24	0.017	0.017	0.009	0.025	1.47
Pb	mg/L	0.0034	0.0003	0.0003	0.0003	0.0003	0.09	-	-	-	-	-	0.0003	0.0003	0.0003	0.0003	0.09
Tl	mg/L	0.0008	0.108	0.0015	0.11	0.11	135	-	-	-	-	-	0.0096	0.001	0.0008	0.087	108
Zn	mg/L	0.023	0.16	0.13	0.16	0.16	6.91	0.14	0.13	0.04	0.29	12.61	0.098	0.098	0.053	0.16	6.96
TSS	mg/L	-	21	5	21	21	-	2.9	2.5	1	5.5	-	16	10.5	7	56	-
Turbidity	NTU	25	19	2	19	19	0.76	2	1.3	0.5	7.8	0.31	5	2	1	49	1.96

Table 29: Water quality data and MEQ analysis for tributaries of Cascade Creek monitoring sites (X8, X5, MM1).

PARAMETER	UNIT	WQ REF VALUE	X8 (n=8)					X5 (n=8)					MM1 (n=149)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.0	3.9	3.7	4.6	-	3.0	3.0	2.8	3.1	-	5.12	6.2	3.8	8.3	-
EC	mS/m	-	15.7	11	3.6	53	-	67.6	66	48.3	95	-	9.12	8.4	2.6	110	-
Acidity	mg/L CaCO ₃	-	30	32	10	45	-	190	160	150	330	-	4.0	2.5	1	37	-
Alkalinity	mg/L CaCO ₃	-	0.9	0.5	0.5	2	-	0.6	0.5	0.5	1	-	3.4	3.0	2	7	-
Hardness	mg/L CaCO ₃	-	-	-	-	-	-	-	-	-	-	-	24.17	24.56	6.81	47	-
Ca	mg/L	-	-	-	-	-	-	-	-	-	-	-	8.16	8.24	0.92	18	-
Mg	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.98	0.98	0.41	1.89	-
Na	mg/L	-	-	-	-	-	-	-	-	-	-	-	2.95	3.2	2.39	3.26	-
K	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.99	0.97	0.9	1.12	-
Cl	mg/L	-	-	-	-	-	-	-	-	-	-	-	5.53	3.36	2.3	22.8	-
SO ₄	mg/L	500	26.6	31	5.6	45	0.09	248	220	129	450	0.90	22.99	22	16.9	27.7	0.06
NO ₃ -N	mg/L	2.4	-	-	-	-	-	-	-	-	-	-	0.84	0.12	0.04	5.9	2.27
NO ₂ -N	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.01	0.005	0.001	0.05	-
NH ₄ -N	mg/L	1.2	-	-	-	-	-	-	-	-	-	-	0.096	0.005	0.005	0.5	0.42
Total N	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.092	0.099	0.05	0.12	-
DOC	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.6	0.5	0.2	1.9	-
Al	mg/L	0.37	1.85	2.05	0.37	3.2	8.65	16	12	11	29	78.4	0.36	0.13	0.01	4.07	11
As	mg/L	0.013	0.005	0.005	0.005	0.005	0.38	0.004	0.005	0.001	0.005	0.38	0.0005	0.0005	0.0005	0.0005	0.04
B	mg/L	0.94	-	-	-	-	-	-	-	-	-	-	0.011	0.015	0.0025	0.015	0.02
Cd	mg/L	0.00009	-	-	-	-	-	-	-	-	-	-	0.00009	0.0001	0.000025	0.0001	1.11

PARAMETER	UNIT	WQ REF VALUE	X8 (n=8)					X5 (n=8)					MM1 (n=149)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Co	mg/L	0.0014	-	-	-	-	-	-	-	-	-	-	0.0038	0.0025	0.0008	0.025	17.6
Cr	mg/L	0.001	-	-	-	-	-	-	-	-	-	-	0.00049	0.0005	0.00025	0.0005	0.5
Cu	mg/L	0.0029	-	-	-	-	-	-	-	-	-	-	0.0012	0.0006	0.00025	0.0058	2
Fe	mg/L	0.5	0.73	0.58	0.27	1.3	2.60	7	5	4	16	32.0	0.061	0.03	0.0006	0.51	1.02
Hg	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-
Mn	mg/L	0.43	-	-	-	-	-	-	-	-	-	-	0.028	0.025	0.004	0.085	0.20
Ni	mg/L	0.017	0.013	0.014	0.002	0.02	1.18	0.048	0.041	0.035	0.087	5.12	0.0073	0.00535	0.0005	0.0436	2.56
Pb	mg/L	0.0034	-	-	-	-	-	-	-	-	-	-	0.00027	0.00025	0.00025	0.0008	0.24
Sb	mg/L	0.009	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.06
Se	mg/L	0.011	-	-	-	-	-	-	-	-	-	-	0.0025	0.0025	0.0025	0.0025	0.23
Si	mg/L	-	-	-	-	-	-	-	-	-	-	-	4.81	4.84	2.7	7.3	-
Sn	mg/L	-	-	-	-	-	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-
Tl	mg/L	0.0008	-	-	-	-	-	-	-	-	-	-	0.00042	0.00025	0.00025	0.0009	1.13
Zn	mg/L	0.023	0.043	0.047	0.011	0.058	2.52	0.37	0.31	0.29	0.65	28.3	0.033	0.022	0.0025	0.24	10.4
TDS	mg/L	-	-	-	-	-	-	-	-	-	-	-	54.0	61	16	82	-
TSS	mg/L	-	9.6	5	0.5	36	-	1.3	1	0.5	3	-	6.2	3	1.5	76	-
Turbidity	NTU	25	5.2	1.7	0.1	21	0.84	0.9	0.6	0.2	2.9	0.12	5.8	1.2	0.17	118	4.72

Table 30: Water quality data for V37 Creek.

PARAMETER	UNIT	WQ REF VALUE	V37 CREEK SAMPLES				CASCADE CREEK DOWNSTREAM OF V37 CREEK	
			V37 mouth (n=1)	V37 (n=1)	V37 Creek (n=1)	MAX MEQ	DS.V37 ¹ (n=1)	MEQ
pH	pH unit	4.5 - 7.0	-	7.6	7.8	-	4.8	-
EC	mS/m	-	10.8	12.6	12.5	-	155	-
Acidity*	mg/L CaCO ₃	-	-	0.5	1.1	-	-	-
Alkalinity	mg/L CaCO ₃	-	-	38	-	-	-	-
Hardness	mg/L CaCO ₃	-	42.35	-	-	-	-	-
Ca	mg/L	-	15.2	19.7	19.1	-	15.2	-
Mg	mg/L	-	1.06	1.19	1.3	-	2	-
Na	mg/L	-	-	3.6	-	-	-	-
K	mg/L	-	-	0.85	-	-	-	-
SO ₄	mg/L	500	-	16.9	15.1	0.03	59	0.12
DOC	mg/L	-	-	0.25	0.15	-	3	-
Al	mg/L	0.37	0.02	0.014	0.01	0.05	2.4	6.49

PARAMETER	UNIT	WQ REF VALUE	V37 CREEK SAMPLES				CASCADE CREEK DOWNSTREAM OF V37 CREEK	
			V37 mouth (n=1)	V37 (n=1)	V37 Creek (n=1)	MAX MEQ	DS.V37 ¹ (n=1)	MEQ
As	mg/L	0.013	-	0.0005	-	0.04	-	-
B	mg/L	0.94	-	0.0025	-	0.003	-	-
Co	mg/L	0.0014	-	0.0001	0.0001	0.07	-	-
Cr	mg/L	0.001	-	0.00025	0.00025	0.25	-	-
Cu	mg/L	0.0029	-	0.00025	0.00025	0.09	0.0014	0.48
Fe	mg/L	0.5	0.01	0.01	0.01	0.02	0.03	0.06
Hg	mg/L	-	-	0.00004	-	-	-	-
Mn	mg/L	0.43	0.00025	0.00025	0.00025	0.001	0.15	0.35
Ni	mg/L	0.017	0.00025	0.00025	0.00025	0.01	0.011	0.66
Pb	mg/L	0.0034	-	0.00005	-	0.01	-	-
Sb	mg/L	0.009	-	0.0001	-	0.01	-	-
Se	mg/L	0.011	-	0.00005	-	0.005	-	-
Tl	mg/L	0.0008	-	0.000025	-	0.03	-	-
Zn	mg/L	0.023	0.001	0.0005	0.0005	0.04	0.067	2.91
TSS	mg/L	-	2.5	1.5	1.5	-	2.9	-
Turbidity	NTU	25	-	-	-	-	6	0.24

¹Source: NIWA (2025).

Table 31: MEQ summary for the Cascade Creek catchment.

DATA SOURCE	SO ₄	NO ₃ -N	NH ₄ -N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
CASCADE CREEK																				
X7	0.01	-	-	0.11	0.38	-	-	-	-	-	0.12	-	-	0.05	-	-	-	-	0.61	0.04
X6	0.06	-	-	0.59	0.38	-	-	-	-	-	0.28	-	-	0.06	-	-	-	-	0.26	0.10
X4	0.52	-	-	37.8	0.38	-	-	-	-	-	17.6	-	-	2.35	-	-	-	-	13.5	1.00
Cascade Upper	-	-	-	22.7	0.08	-	7.78	7.86	1.00	2.07	2.98	-	0.40	1.35	0.09	-	-	135	6.91	0.76
X3	0.48	-	-	40.5	0.38	-	-	-	-	-	12.0	-	-	2.24	-	-	-	-	12.6	0.31
Cascade Lower	-	-	-	15.9	0.04	-	1.11	8.57	1.00	1.38	1.70	-	0.86	1.47	0.09	-	-	108	6.96	1.96
CASCADE CREEK TRIBUTARIES																				
X8	0.09	-	-	8.65	0.38	-	-	-	-	-	2.60	-	-	1.18	-	-	-	-	2.52	0.84
X5	0.90	-	-	78.4	0.38	-	-	-	-	-	32.0	-	-	5.12	-	-	-	-	28.3	0.12

DATA SOURCE	SO ₄	NO ₃ - N	NH ₄ - N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
M-M1	0.06	2.27	0.42	11.00	0.04	0.02	1.11	17.64	0.50	2.00	1.02	-	0.20	2.56	0.24	0.06	0.23	1.13	10.4	4.72

¹Turbidity.

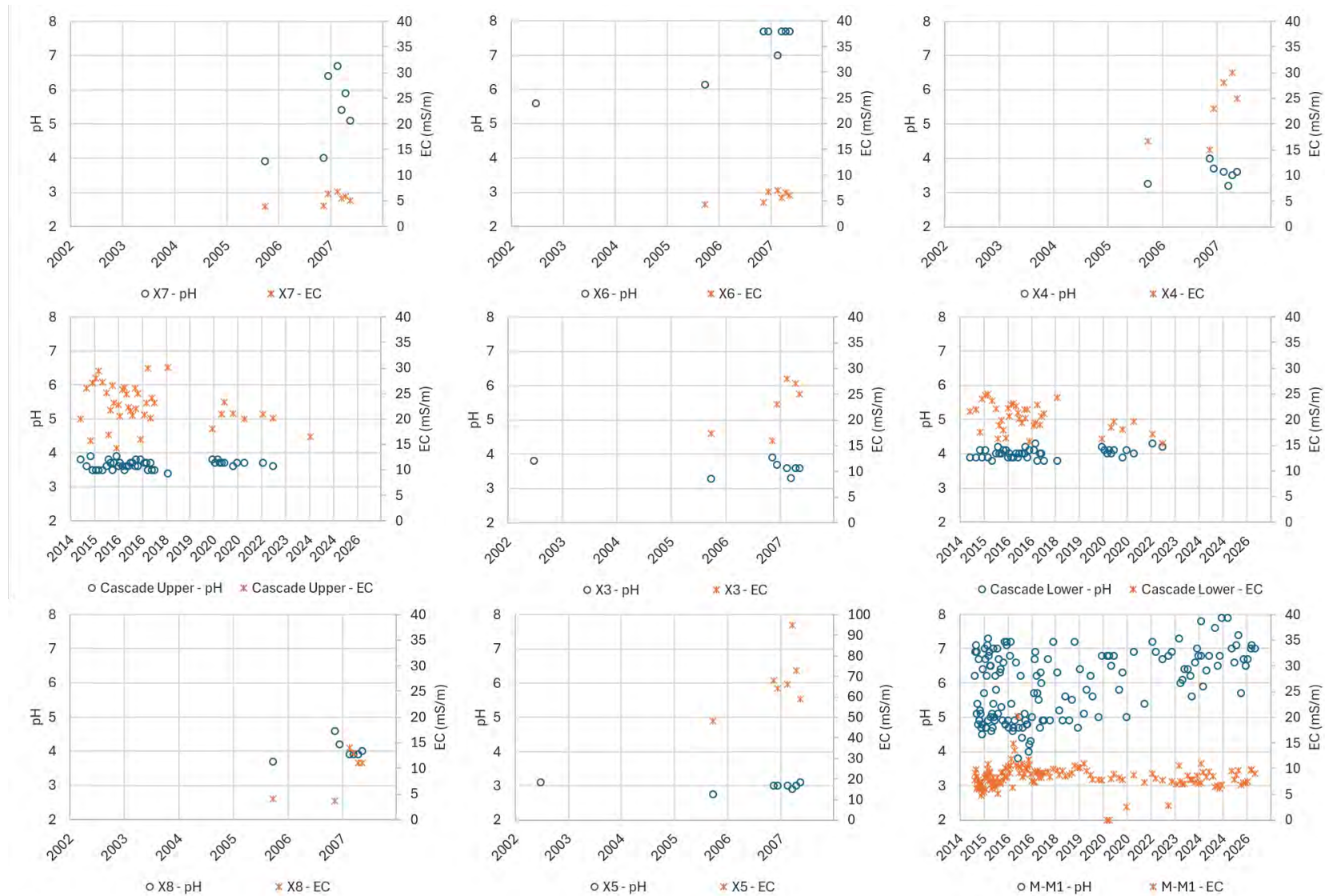


Figure 27: EC and pH for Cascade Creek catchment monitoring sites.

5.2.2 Data Summary

Figure 28 presents box plots of pH and EC for the Cascade Creek catchment. Figure 29 and Figure 30 present plots for key metals (Al, Fe, Ni and Zn) discussed in this section.

The following are key observations from the data review of the Deep Stream catchment monitoring sites:

- Upper catchment monitoring sites within Cascade Creek (X7 and X6)
 - o Mean pH is high (mean of 7.2 to 6.9) and EC is low (mean of 5.3 to 5.9 mS/m) (Figure 28).
 - o Maximum water quality data does not exceed WQ Ref Values.
- Cascade Creek (X4, Cascade Upper, X3, Cascade Lower and downstream of V37 Creek [DS.V37])
 - o Mean pH is low for these sites (mean range of 3.4 to 4.0) downstream of discharge from the historic workings at Coalbrookdale Mine, discharge from the historic Cascade Mine is upstream of the Cascade Lower monitoring site (Figure 28 and Table 27).
 - o EC is higher (mean range of 20.3 to 27.5 mS/m) than sites in the upper catchment.
 - o Maximum water quality data at X3 and X4 exceed WQ Ref values for Al, Fe, Ni and Zn. Note these sites do not have Cd, Co, Cr, or Cu data (Figure 29).
 - o Maximum water quality data at Cascade Upper and Cascade Lower exceed WQ Ref Values for Al, Cd, Co, Cr, Cu, Fe, Ni, Tl¹⁸ and Zn (Figure 30).
 - o Turbidity is elevated at X4 and Cascade Lower.
 - o Downstream of V37 Creek (DS.V37) maximum water quality data exceeds WQ Ref Values for Al and Zn (one sample).
- Cascade Creek tributaries (X8 and X5)
 - o X5 water quality data is low pH (mean 3.5) and high EC (mean 27.5), X8 has higher pH and lower EC (mean pH 4.0, EC 15.7 mS/m).
 - o Maximum water quality data at X8 and X5 exceed WQ Ref values for Al, Fe, Ni and Zn. Note these sites do not have Cd, Co, Cr, or Cu data¹⁹ (Figure 29).
- V37 Creek (V37 mouth, V37, V37 Creek)
 - o Mean pH is between 7.6 and 7.8 and mean EC is 12.5 to 12.6 mS/m.
 - o There is no exceedance of WQ Ref Values.

Water quality data from the Escarpment Mine monitoring site MM1 is discussed in Section 5.2.3 below.

¹⁸ Anomalous data for thallium (Tl), MWM was unable to confirm the results due to the absence of the laboratory report. It is likely to be a transcription error.

¹⁹ Sampling occurred for sites X3 to X8 from 2002 to 2007 where an extended metals suite was not analysed. Cascade Upper and Cascade Lower monitoring sites include analyses for these metals.

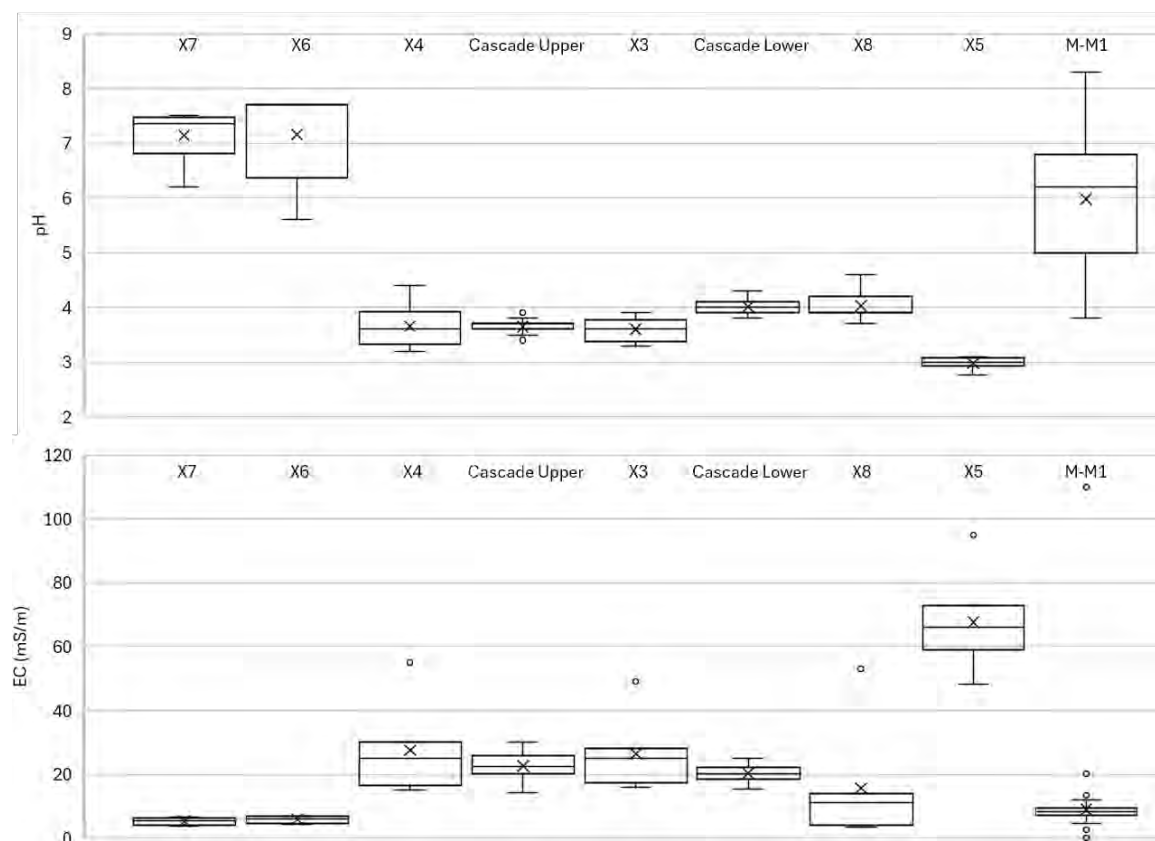


Figure 28: Box plots of pH and EC for the Cascade Creek catchment monitoring sites.

An 'X' identifies the mean data for each monitoring site.

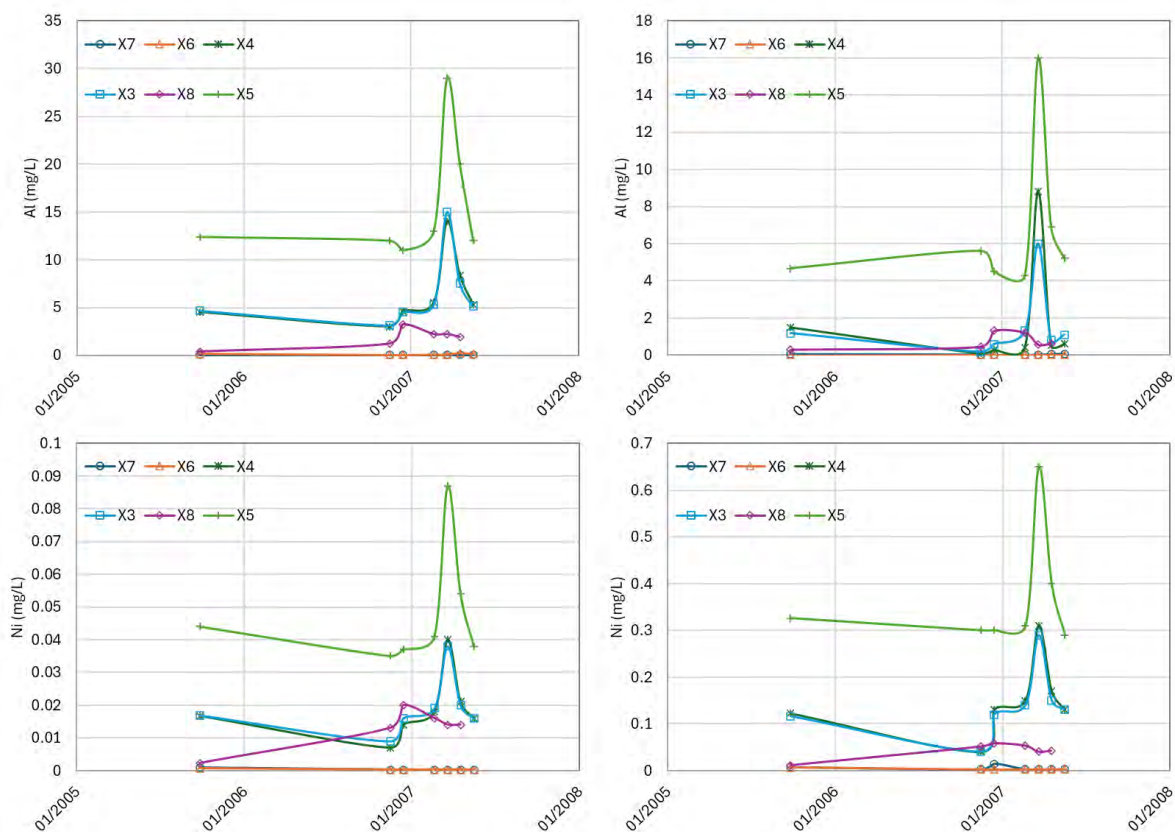


Figure 29: Water quality plots for select metals (Al, Fe, Ni, and Zn) from Cascade Creek and tributaries.

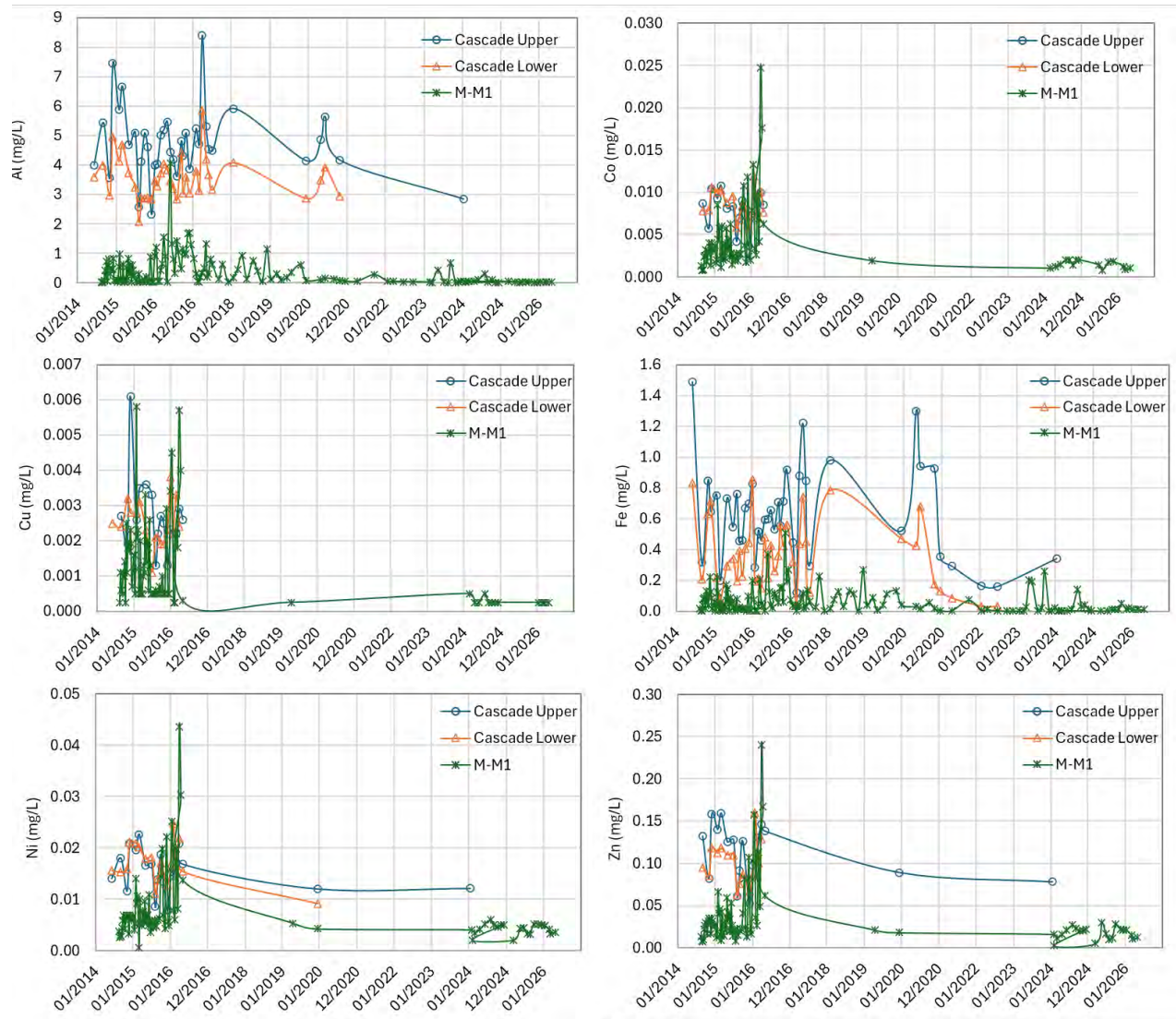


Figure 30: Water quality plots for select metals (Al, Co, Cu, Fe, Ni, and Zn) from Cascade Upper, Cascade Lower and M-M1.

5.2.3 Escarpment Mine Discharge

The following section examines the surface water quality data for V8 Creek measured at MM1 monitoring site that flows into the Cascade Creek (MM1 in Figure 3). V8 Creek is influenced by discharge from the existing Escarpment Mine (Figure 3) and is the only discharge from the current Escarpment Mine (operating under care and maintenance since 2016) to the receiving environment. BRL (pers. comm. Campbell Robertson; 22-9-24) notes that this site is influenced by underground mine drainage.

Based on the available data the following observations were made:

- The pH ranged from 3.8 to 8.3 for MM1, exceeding minimum and maximum WQ Ref Values with a mean value of 5.12.
- Acidity ranged from 1 to 37 mg CaCO₃/L with a mean value of 4.0 mg CaCO₃/L.
- Alkalinity ranged from 2 to 37 mg CaCO₃/L with a mean value of 3.4 mg CaCO₃/L.

- The EC ranged from 2.6 to 110 mS/m with a mean value of 9.12 mS/m.
- Maximum water quality data for Al, Cd, Co, Cu, Fe, Ni, Tl, Zn and turbidity exceed WQ Ref Values.
- Nitrate-N values exceeded the WQ Ref Value due to one sample reporting a concentration of 5.9 mg/L, which appears anomalous compared to data for the following months (0.1 and 0.09 mg/L).

5.3 Rapid Stream

The following section examines the surface water quality data for the Rapid Stream area. Time series trends are summarised and discussed where applicable. Full tabulated water quality data are presented in Appendix D as a digital Microsoft (MS) Excel file.

5.3.1 Water Quality Data

A summary of water quality data presented in this report are provided in Table 35 and locations are shown in Figure 31. Rapid Stream is affected by mine impacted water discharge from the Sullivan Mine underground workings, which is shown in more detail in Figure 32 as Upper Adit and Lower Adit. The Sullivan Adit is within the proposed mining footprint of the BPCP with historic workings to be excavated remediating AMD drainage from this adit.

Data is presented in the following tables:

- W07, Sullivan Mine, and W08 in Table 32
- W09 and Rap.R1 in Table 33

Table 34 summarises MEQ data for all monitoring sites within the Rapid Stream catchment. Plots for pH and EC for Rapid Stream catchment monitoring sites are presented in Figure 33.

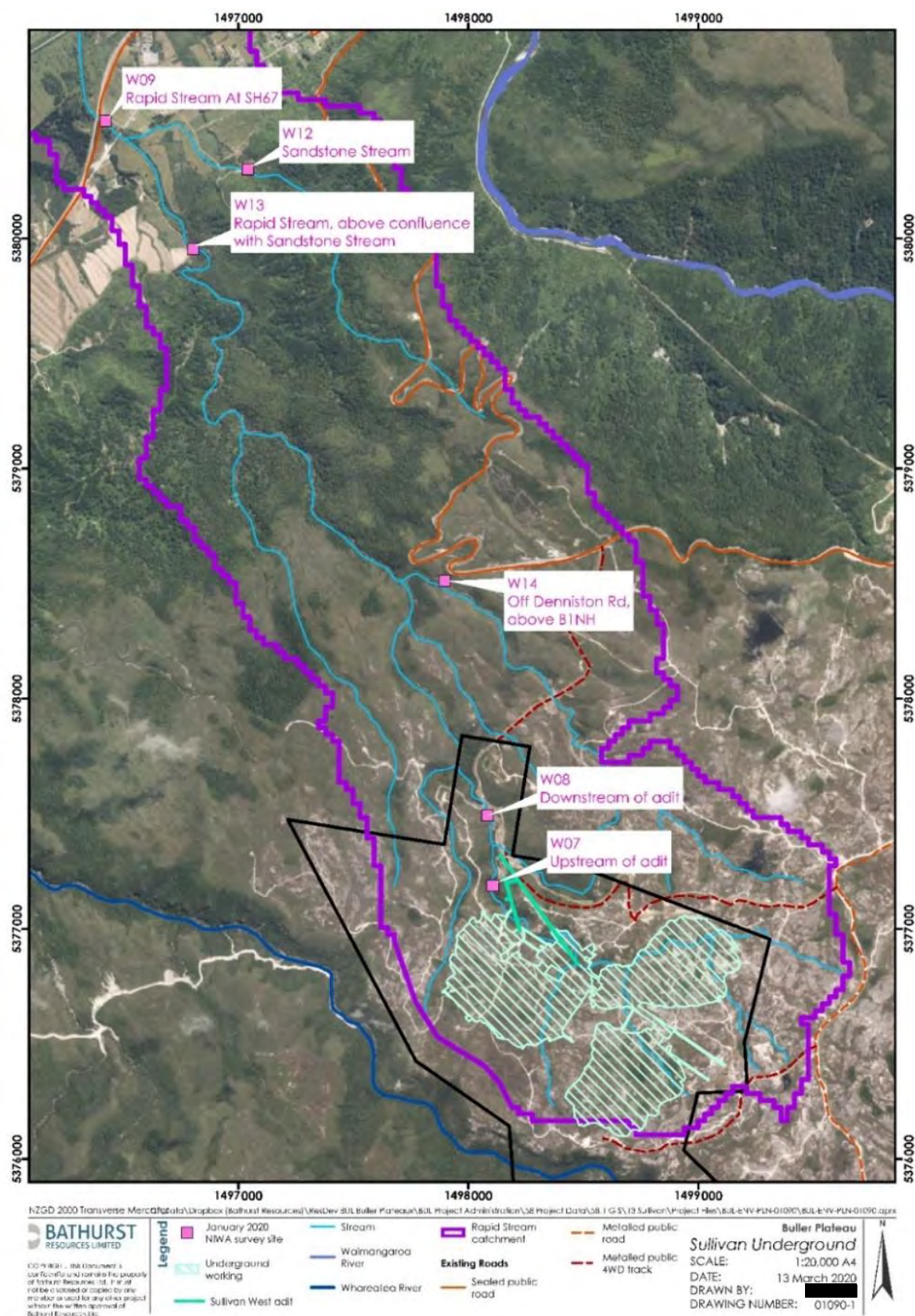


Figure 31. Rapid Stream monitoring locations.

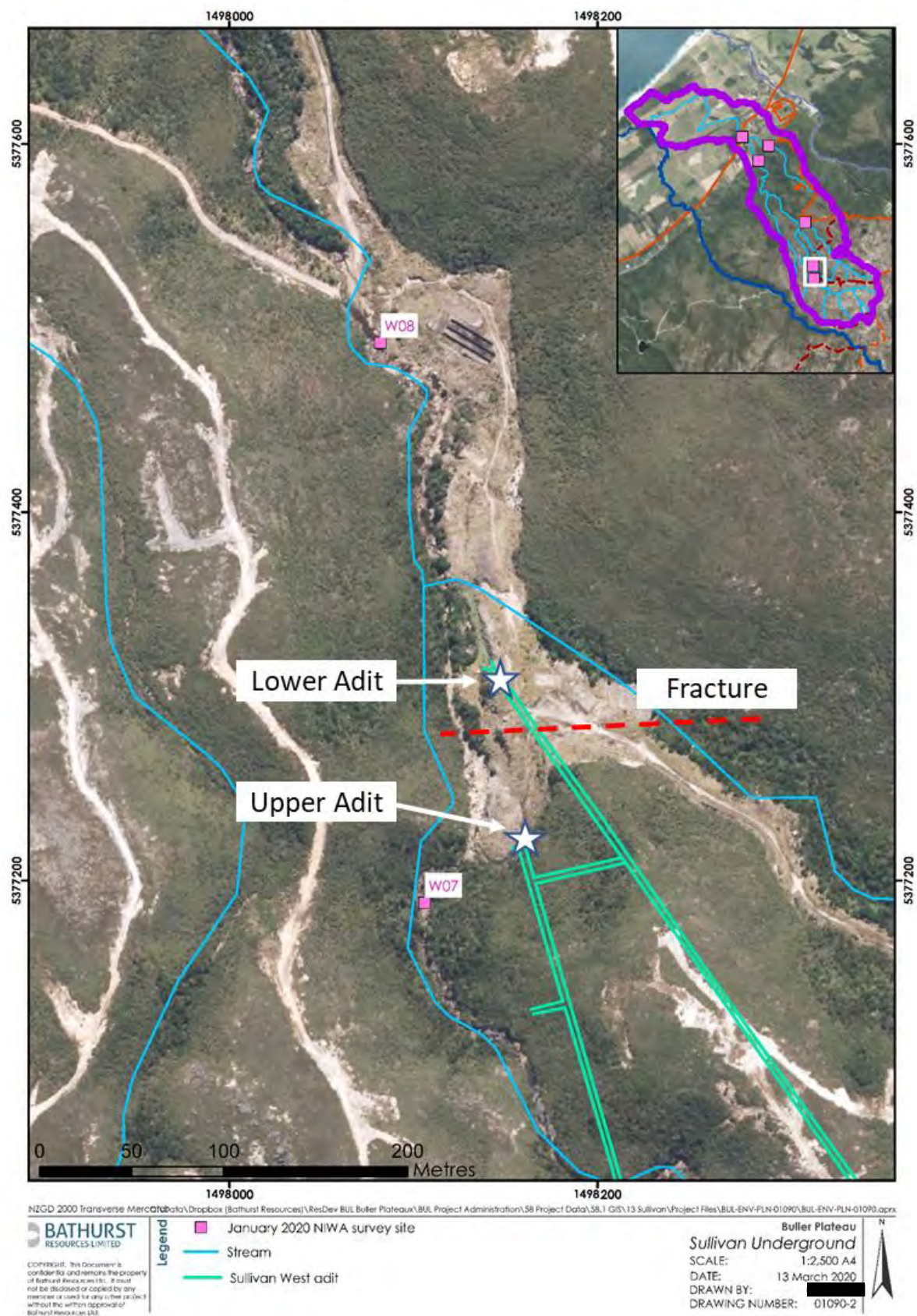


Figure 32. Sullivan Mine adits, W07 and W08 monitoring sites.

Table 32: Water quality data and MEQ analysis for Rapid Stream monitoring sites (W07, Sullivan Adit, W08).

PARAMETER	UNIT	WQ REF VALUE	W07 (N=26)					SULLIVAN ADIT (N=33)					W08 (N=21)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.76	4.9	3.8	6.4	-	2.90	2.90	2.6	3.2	-	3.09	3.1	2.6	3.8	-
EC	mS/m	-	6.2	2.9	2	26	-	84	91	38	100	-	50.13	55.1	9.5	74	-
Acidity	mg/L CaCO ₃	-	3.47	4	0.5	8	-	167	171	75	214	-	104	118	17	149	-
Alkalinity	mg/L CaCO ₃	-	1.17	0.5	0.5	2.5	-	-	-	-	-	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	2.32	2.14	1.63	3.84	-	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	0.18	0.16	0.1	0.3	-	8.2	11.2	2.1	11.3	-	6.62	7.5	0.8	11.3	-
Mg	mg/L	-	0.45	0.445	0.33	0.75	-	4.86	6.01	2.54	6.02	-	3.7	4.18	0.81	5.68	-
K	mg/L	-	0.4	0.4	0.4	0.4	-	-	-	-	-	-	2.3	2.3	2.2	2.4	-
Cl	mg/L	-	3.3	3.30	3	3.6	-	-	-	-	-	-	4.6	4.6	4.5	4.7	-
SO ₄	mg/L	500	3	1.97	1	26	0.05	314	342	57	460	0.92	127	144	14.3	190	0.4
NO ₃ -N	mg/L	2.4	0.063	0.025	0.001	0.2	0.08	-	-	-	-	-	0.0058	0.005	0.003	0.01	0.003
NO ₂ -N	mg/L	-	0.004	0.005	0.001	0.005	-	-	-	-	-	-	0.0037	0.005	0.001	0.005	-
NH ₄ -N	mg/L	1.2	0.25	0.25	0.005	0.5	0.42	-	-	-	-	-	0.25	0.25	0.005	0.5	0.4
DOC	mg/L	-	2.63	2.45	1.7	4	-	-	-	-	-	-	0.76	0.7	0.4	1.5	-
Al	mg/L	0.37	0.08	0.072	0.046	0.121	0.33	12.1	13	2.8	14.8	40	6.15	7	0.678	10.1	27.3
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	0.008	0.004	0.001	0.026	2	0.0022	0.002	0.0005	0.003	0.23
B	mg/L	0.94	0.0025	0.0025	0.0025	0.0025	0.003	-	-	-	-	-	0.0025	0.0025	0.0025	0.0025	0.003
Cd	mg/L	0.00009	0.00005	0.000025	0.000025	0.0001	1.11	0.0002	0.0002	0.0002	0.0002	2.22	0.00007	0.00008	0.000025	0.0001	1.11
Co	mg/L	0.0014	0.0002	0.00025	0.0001	0.0003	0.21	0.027	0.031	0.015	0.034	24.3	0.018	0.021	0.0021	0.0317	22.6
Cr	mg/L	0.001	0.00036	0.00025	0.00025	0.0005	0.50	0.002	0.002	0.001	0.002	2.0	0.00092	0.001	0.00025	0.002	2.0
Cu	mg/L	0.0029	0.00033	0.00025	0.00025	0.0009	0.31	0.008	0.01	0.002	0.012	4.14	0.0058	0.00565	0.0025	0.011	3.79
Fe	mg/L	0.5	0.077	0.07	0.04	0.16	0.32	33	31	8	56	111	8.75	9.6	0.59	13.7	27.4
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-
Mn	mg/L	0.43	0.003	0.003	0.0018	0.004	0.01	-	-	-	-	-	0.21	0.23	0.053	0.308	0.72
Ni	mg/L	0.017	0.0003	0.00025	0.00025	0.0008	0.05	0.1	0.11	0.031	0.134	7.88	0.042	0.047	0.0041	0.0645	3.79
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.07	0.0006	0.0006	0.0005	0.0007	0.21	0.00069	0.0007	0.00025	0.0011	0.32
Sb	mg/L	0.009	0.0005	0.0005	0.0005	0.0005	0.06	-	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.06
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-	-	0.0025	0.0025	0.0025	0.0025	0.23
Si	mg/L	-	0.82	0.815	0.76	0.87	-	-	-	-	-	-	8.15	8.15	7.6	8.7	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-	0.00025	0.00025	0.00025	0.00025	-
Tl	mg/L	0.0008	0.00025	0.00025	0.00025	0.00025	0.31	-	-	-	-	-	0.001	0.001	0.001	0.001	1.25

PARAMETER	UNIT	WQ REF VALUE	W07 (N=26)					SULLIVAN ADIT (N=33)					W08 (N=21)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Zn	mg/L	0.023	0.0039	0.00325	0.0025	0.013	0.57	0.29	0.36	0.15	0.38	16.5	0.23	0.26	0.024	0.354	15.4
TDS	mg/L	-	14.5	14.5	5	24	-	-	-	-	-	-	235	235	210	260	-
TSS	mg/L	-	1.56	1.5	1.5	2.5	-	-	-	-	-	-	2.9	1.5	1.5	8	-
Turbidity	NTU	25	0.54	0.45	0.15	1.1	0.04	22	22	0.15	44	1.76	1.5	0.7	0.15	4.8	0.19

Table 33: Water quality data and MEQ analysis for Rapid Stream monitoring sites (W09, RAP.R1).

PARAMETER	UNIT	WQ REF VALUE	W09 (N=24)					RAP.R1 (N=4)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.24	4.4	3.6	5.3	-	4.94	4.9	4.9	5.1	-
EC	mS/m	-	8.19	7.50	0.5	21.3	-	2.4	2.55	1.7	2.8	-
Acidity	mg/L CaCO ₃	-	12.68	13.20	3	32	-	-	-	-	-	-
Alkalinity	mg/L CaCO ₃	-	0.50	0.50	0.5	0.5	-	-	-	-	-	-
Ca	mg/L	-	3.15	3.40	0.54	5.7	-	0.11	0.10	0.09	0.13	-
Mg	mg/L	-	1.25	1.10	0.21	2.28	-	0.32	0.32	0.25	0.39	-
SO ₄	mg/L	500	20.89	21.60	1.4	50.4	0.1	-	-	-	-	-
NO ₃ -N	mg/L	2.4	0.0940	0.0025	0.001	0.37	0.14	-	-	-	-	-
NO ₂ -N	mg/L	-	0.0010	0.0010	0.001	0.001	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.01	0.01	0.005	0.005	0.004	-	-	-	-	-
DOC	mg/L	-	2.87	2.55	0.8	5.9	-	-	-	-	-	-
Al	mg/L	0.37	0.99	1.04	0.153	2.54	6.86	0.13	0.12	0.078	0.18	0.48
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-
Cd	mg/L	0.00009	0.00006	0.000025	0.000025	0.0001	1.11	0.000025	0.000025	0.000025	0.000025	0.28
Co	mg/L	0.0014	0.0035	0.0039	0.0001	0.0084	6.00	0.0001	0.0001	0.0001	0.0001	0.07
Cr	mg/L	0.001	0.00038	0.00038	0.00025	0.0005	0.50	0.00025	0.00025	0.00025	0.00025	0.25
Cu	mg/L	0.0029	0.0012	0.0012	0.00025	0.0031	1.07	0.00025	0.00025	0.00025	0.00025	0.09
Fe	mg/L	0.5	0.6	0.41	0.19	1.71	3.42	0.1	0.1	0.1	0.1	0.20
Mn	mg/L	0.43	0.034	0.021	0.0081	0.072	0.17	0.0006	0.0006	0.0006	0.0006	0.001
Ni	mg/L	0.017	0.0069	0.0061	0.00025	0.017	1.01	0.00025	0.00025	0.00025	0.00025	0.01
Pb	mg/L	0.0034	0.00031	0.00025	0.00025	0.0007	0.21	-	-	-	-	-
Tl	mg/L	0.0008	0.000025	0.000025	0.000025	0.000025	0.03	-	-	-	-	-
Zn	mg/L	0.023	0.034	0.039	0.0017	0.074	3.22	0.00065	0.0005	0.0005	0.0011	0.05

PARAMETER	UNIT	WQ REF VALUE	W09 (N=24)					RAP.R1 (N=4)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
DRP	mg/L	-	0.002	0.002	0.002	0.002	-	-	-	-	-	-
TSS	mg/L	-	40.2	4.0	1.5	470	-	-	-	-	-	-
Turbidity	NTU	25	11.3	3.7	0.098	132	5.28	0.42	0.4	0.24	0.64	0.03

Table 34: MEQ summary for the Rapid Stream catchment.

DATA SOURCE	SO ₄	NO ₃ - N	NH ₄ - N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
W07	0.05	0.08	0.42	0.33	0.04	0.003	1.11	0.21	0.50	0.31	0.32	-	0.01	0.05	0.07	0.06	0.23	0.31	0.57	0.04
Sullivan Mine Adits	0.92	-	-	40.0	2.00	0.003	2.22	24.07	2.00	4.10	111	-	0.87	7.88	0.18	0.06	-	-	31.30	1.75
W08	0.38	0.004	0.42	27.30	0.23	0.003	1.11	22.64	2.00	3.79	27.4	-	0.72	3.79	0.32	0.06	0.23	1.25	15.39	0.19
W09	0.10	0.14	0.004	6.86	0.04	-	1.11	6.00	0.50	1.07	3.42	-	0.17	1.01	0.21	-	-	0.03	3.22	5.28
RAP.R1	-	-	-	0.48	-	-	0.28	0.07	0.25	0.09	0.20	-	0.00	0.01	-	-	-	-	0.05	0.03

¹Turbidity

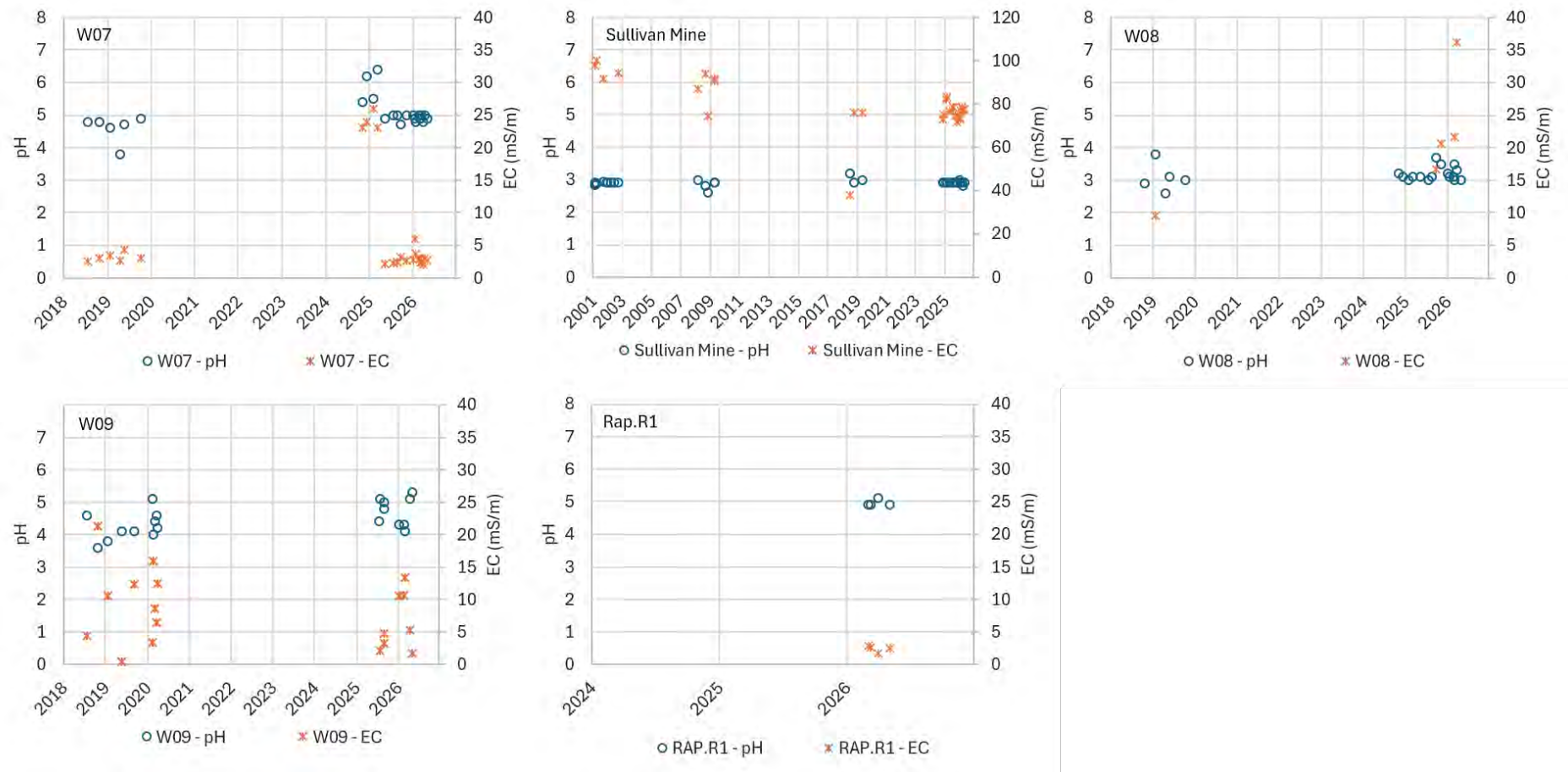


Figure 33: EC and pH for Rapid Stream monitoring sites from upstream to downstream.

5.3.2 Data Summary

Figure 34 presents box plots of pH and EC for the Rapid Stream catchment. Figure 35 presents plots for key metals (Al, Cu, Fe, Ni, and Zn) discussed in this section. The following are key observations from the data review of the Rapid Creek catchment monitoring sites:

- The pH ranged from 2.6 to 5.3 across all Rapid Stream locations, with values exceeding upper and lower WQ Ref Values and site specific mean values of 4.76 (W07), 3.09 (W08), 4.24 (W09), and Rap.R1 (4.94) (Figure 34).
- Acidity ranged from 0.5 to 149 mg CaCO₃/L across all locations. Site specific mean values were 3.47 mg CaCO₃/L (W07), 104 mg CaCO₃/L (W08), 12.68 mg and CaCO₃/L (W09).
- The EC ranged from <0.5 to 74 mS/m for all locations. Site specific mean value were 6.2 mS/m (W07), 50.13 mS/m (W08), 8.19 mS/m (W09) and 2.4 mS/m (Rap.R1).
- SO₄ concentrations were below the WQ Ref Value and ranged from <1 to 190 mg/L for all sites.
- The MEQ data in red (Table 32) indicates that the maximum value for a parameter exceeded the WQ Ref Value for the following parameters:
 - o W07: exceedance reported for Cd.
 - o W08: exceedances reported for Al, Cd, Co, Cr, Cu, Fe, Ni, Tl, and Zn.
 - o W09: exceedances reported for Al, Cd, Co, Cu, Fe, Ni, and Zn.
 - o No exceedances reported for RAP.R1

Discharge from the Sullivan Mine enters Rapid Stream upstream of W08 with a notable decrease in pH at W08 (mean of 3.09) compared to upstream site W07 (mean of 4.76). Water quality data from the Sullivan Mine adits are discussed below:

- The MEQ data in red (Table 32) indicates that the maximum value for a parameter exceeded the WQ Ref Value for Al, As, Cd, Co, Cr, Cu, Fe, Ni, and Zn.
- The pH values were below the lower WQ Ref Value and ranged from 2.6 to 3.2, with a mean value of 2.9.
- Acidity ranged from 75 to 214 mg CaCO₃/L, with a mean value of 167 mg CaCO₃/L.
- The EC ranged from 38 to 100 mS/m, with a mean value of 84 mS/m.
- SO₄ ranged from 57 to 460 mg/L.

Note that MEQ values are reduced for the site below the adit (W08) from values discharging from the Sullivan Adit, with the higher changes in MEQ including:

- o MEQ of Fe reduced from 55.5 to 13.70.
- o MEQ of Al reduced from 40.0 to 27.30.
- o MEQ of Ni reduced from 7.88 to 3.79.

- o MEQ of Zn reduced from 31.30 to 15.39.

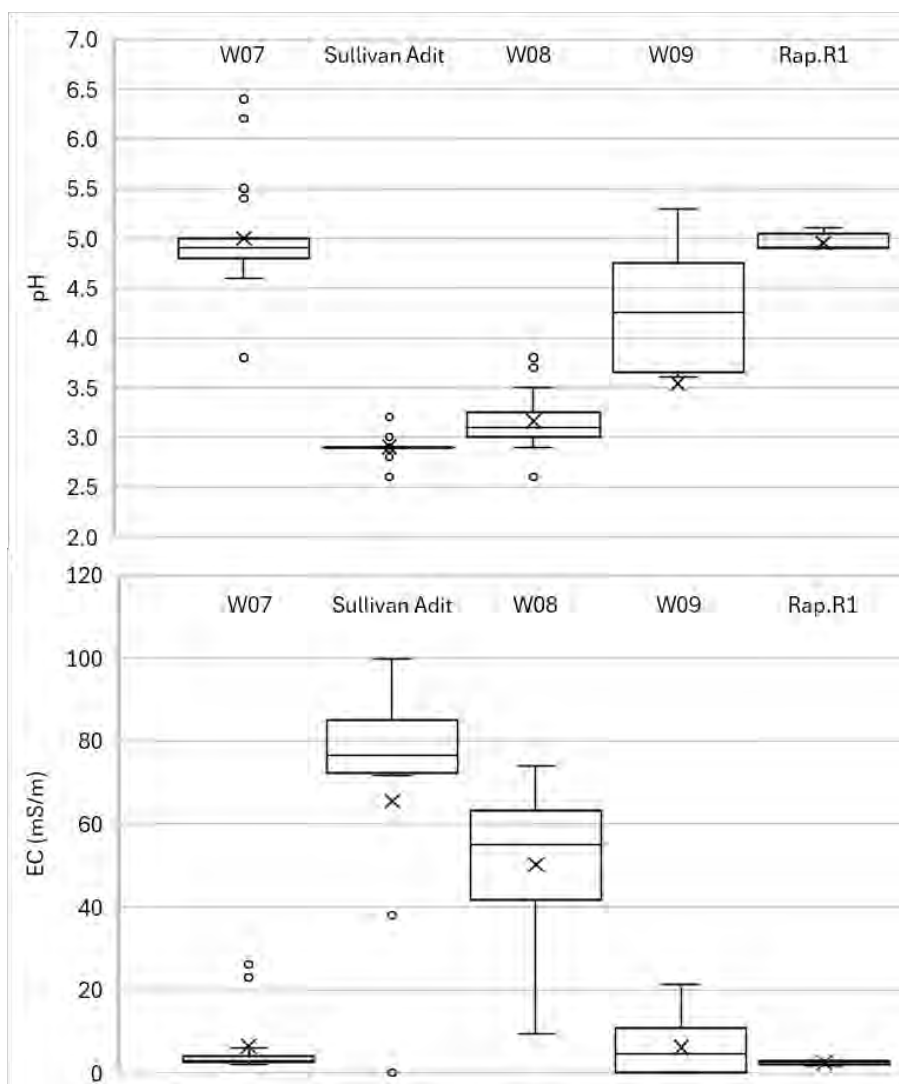


Figure 34: Box plots of pH and EC for Rapid Stream monitoring sites.

EC is notably lower and pH is higher at sites not impacted by the Sullivan adit discharge (W07 upstream of Sullivan adit discharge and Rap.R1 within a Rapid Stream tributary).

An 'X' identifies the mean data for each monitoring site.

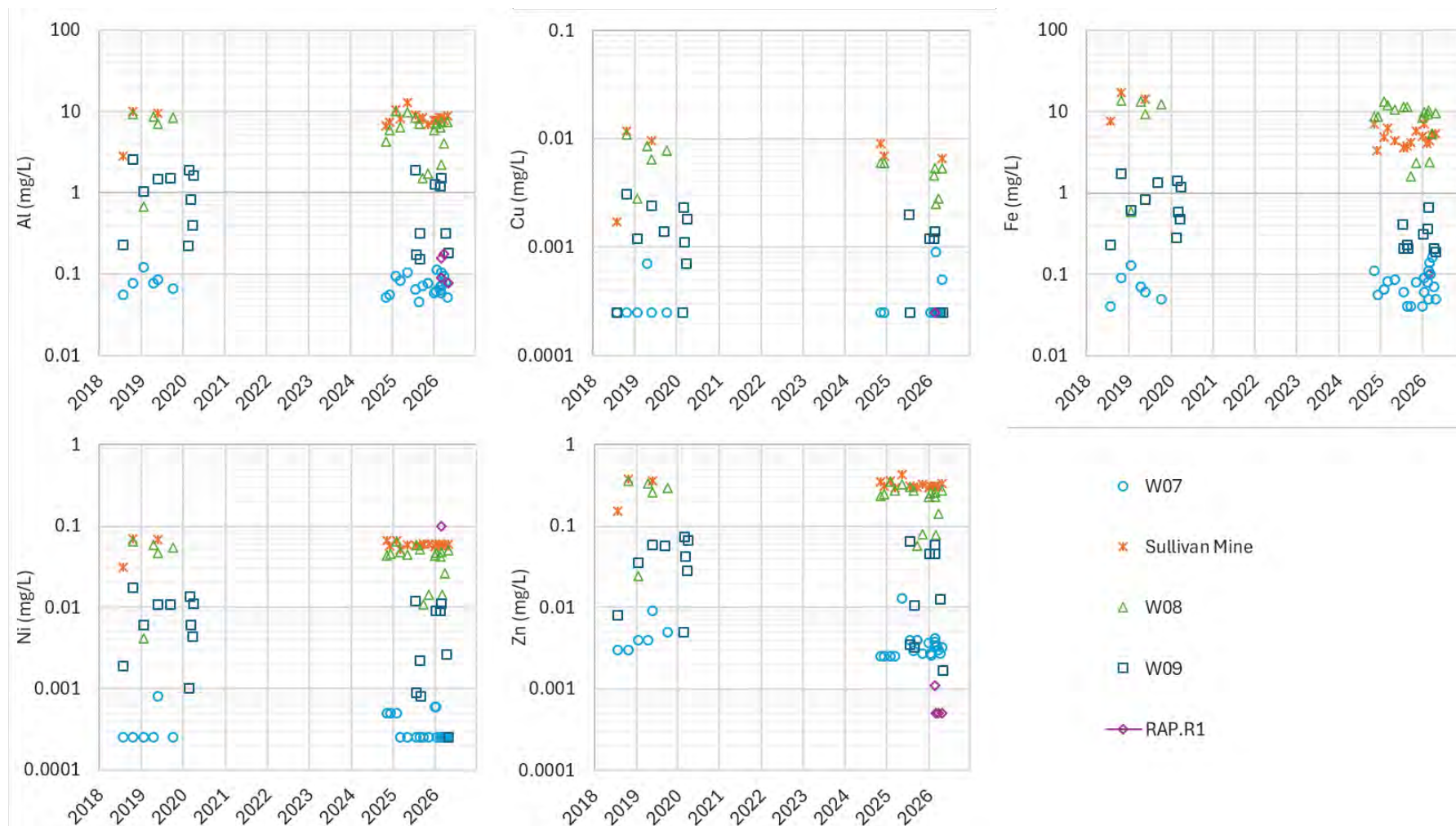


Figure 35: Water quality plots for select metals (Al, Cu, Fe, Ni and Zn) for Rapid Stream.

5.4 Whareatea River Catchment

The following section examines the surface water quality data for the Whareatea River catchment, locations provided in Figure 36. Time series trends are summarised and discussed where applicable. Full tabulated water quality data are presented in Appendix E as a digital Microsoft (MS) Excel file.

Several sites are present in this area, including waterways that drain to the west of the Denniston Plateau.

Sites sampled in this area from the Whareatea River and tributaries include WM0, WM1, W-M2, W-M3, KEL, C-M1, (Whareatea) S Creek, V40 Stream, Trent, V62, V70, Gate Pond and Whareatea Dam. Water quality monitoring sites are shown in Figure 3 and Figure 36.

5.4.1 Water Quality Data

Table 3 provides a summary of water quality monitoring sites within the Whareatea River catchment and the extent of data provided in this report. Water quality data and MEQs are presented in the following tables:

Whareatea River

- WM0 and WM1 in Table 35
- W-M2 and W-M2 high flow event samples in Table 36
- KEL, KEL high flow event samples, and W-M3 in Table 37

Whareatea River tributaries

- C-M1 and C-M1 high flow event samples in Table 38
- S Creek, V40 and Trent Stream in Table 39
- V62, V62 high flow event samples, and V70 in Table 40
- Gate Pond and Whareatea Dam in in Table 41

Table 42 summarises MEQ data for all monitoring sites within the Whareatea River catchment. Plots of pH and EC are provided in Figure 37 (Whareatea River monitoring sites) and Figure 38 (tributaries of the Whareatea River monitoring sites).

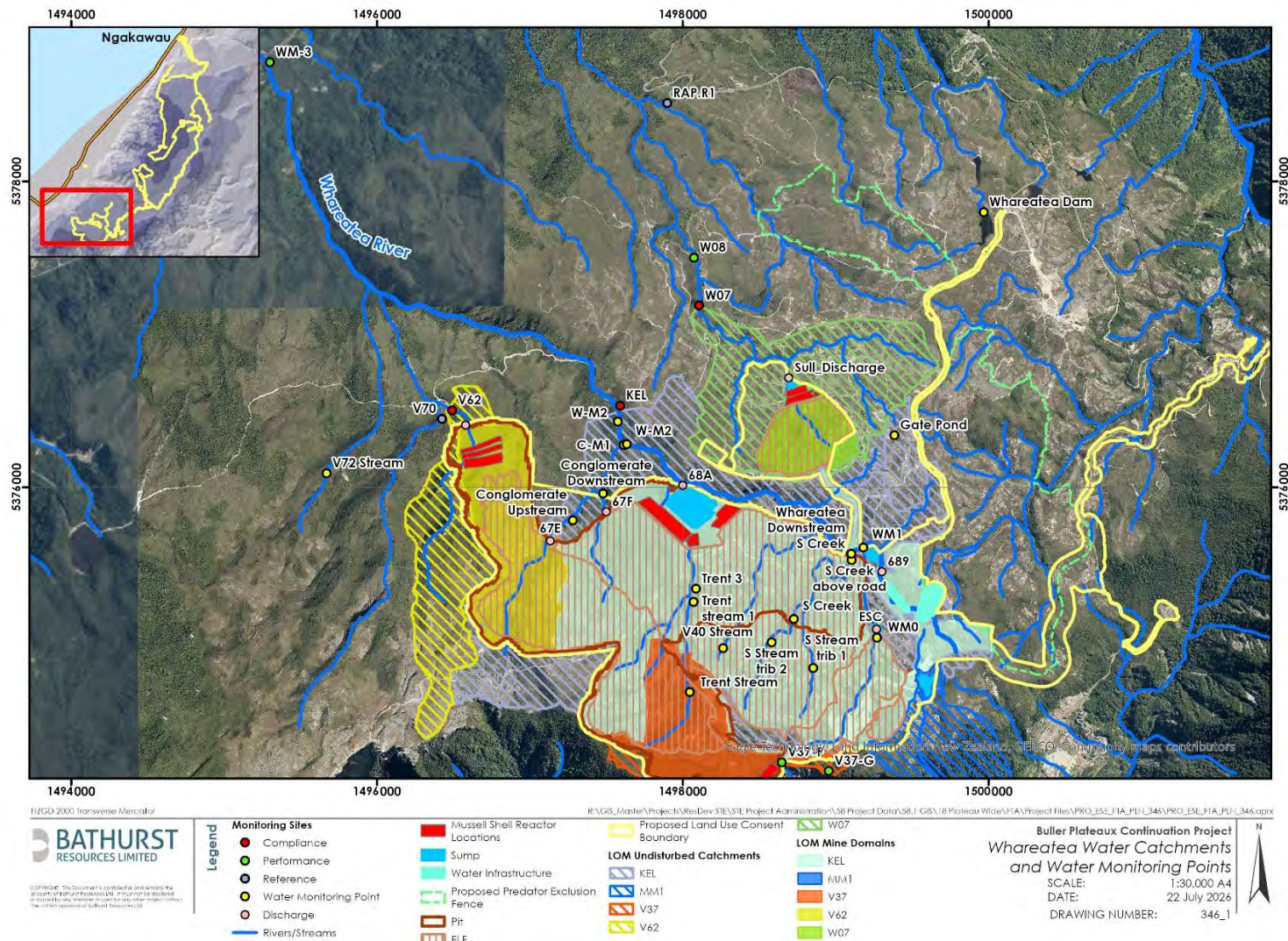


Figure 36: Whareatea River Catchment water monitoring sites.

Note compliance, performance and reference sites for the wider BPCP are shown.

Table 35: Water quality data and MEQ analysis for Whareatea River catchment monitoring sites (WM0 and WM1).

PARAMETER	UNIT	WQ REF VALUE	WM0 (N=37)					WM1 (N=65)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.2	4.3	3.8	6.6	-	4.5	4.5	4.2	6.1	-
EC	mS/m	-	32.6	6.3	1.7	100	-	3.8	4	1.3	5.8	-
Acidity	mg/L CaCO ₃	-	8.8	8	3	19	-	4.6	5.6	0.5	15	-
Alkalinity	mg/L CaCO ₃	-	-	-	-	-	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	4.3	4	1	16	-	2.9	3	0.5	7	-
Ca	mg/L	-	1.1	1	0.2	4.8	-	0.6	0.6	0.1	1.5	-
Mg	mg/L	-	0.4	0.4	0.1	1	-	0.4	0.3	0.03	0.8	-
DOC	mg/L	-	1.7	1.5	0.5	3.7	-	2.12	1.5	0.5	5.5	-
Al	mg/L	0.37	0.33	0.32	0.09	1.21	3.27	0.18	0.18	0.05	0.31	0.84
As	mg/L	0.013	0.001	0.001	0.001	0.001	0.08	0.003	0.005	0.0003	0.005	0.38
Cd	mg/L	0.00009	0.0001	0.0001	0.0001	0.0001	1.11	0.0005	0.0003	0.00003	0.02	222
Co	mg/L	0.0014	0.001	0.0008	0.0003	0.0081	5.79	0.0004	0.0005	0.0003	0.0006	0.43
Cr	mg/L	0.001	0.001	0.001	0.001	0.001	1.0	0.001	0.001	0.0005	0.025	25
Cu	mg/L	0.0029	0.001	0.001	0.0003	0.003	1.03	0.001	0.001	0.0003	0.035	12.1
Fe	mg/L	0.5	0.37	0.23	0.001	1.15	2.30	0.22	0.22	0.03	0.7	1.40
Mn	mg/L	0.43	0.03	0.02	0.003	0.13	0.3	0.01	0.01	0.001	0.03	0.07
Ni	mg/L	0.017	0.0018	0.0014	0.0003	0.0115	0.68	0.0008	0.0007	0.0003	0.0071	0.42
Pb	mg/L	0.0034	0.0003	0.0003	0.0003	0.001	0.29	0.002	0.002	0.0001	0.045	13.2
Sn	mg/L	-	3.7	3.7	3.7	3.7	-	-	-	-	-	-
Tl	mg/L	0.0008	0.0006	0.0008	0.0003	0.001	1.25	0.001	0.0003	0.00003	0.0025	3.13
Zn	mg/L	0.023	0.012	0.012	0.009	0.001	0.04	4.9	0.008	0.007	0.002	0.09
TSS	mg/L	-	52	6	2	672	-	3	2	1	26	-
Turbidity	NTU	25	81	6	0.4	1210	48.4	2	1	0.4	23	0.92

Table 36: Water quality data and MEQ analysis for Whareatea River catchment monitoring sites (W-M2 and W-M2 high flow event samples).

PARAMETER	UNIT	WQ REF VALUE	W-M2 (N=182)					W-M2 HIGH FLOW EVENT (N=3)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.87	4.9	4.5	7.4	-	5.07	5.2	4.8	5.5	-
EC	mS/m	-	3.0	2.8	0.05	24	-	1.73	1.9	1.3	2	-
Acidity	mg/L CaCO ₃	-	4.26	4.0	0.5	17	-	5.33	5	5	6	-
Alkalinity	mg/L CaCO ₃	-	1.64	2.21	0.5	2.5	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	3.09	3.0	0.5	10.2	-	1.54	1.42	1.32	1.88	-

PARAMETER	UNIT	WQ REF VALUE	W-M2 (N=182)					W-M2 HIGH FLOW EVENT (N=3)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Ca	mg/L	-	0.47	0.39	0.04	2.4	-	0.27	0.25	0.19	0.36	-
Mg	mg/L	-	0.47	0.44	0.04	1	-	0.21	0.23	0.17	0.24	-
Na	mg/L	-	2.66	2.73	2.3	2.96	-	-	-	-	-	-
K	mg/L	-	0.26	0.265	0.2	0.34	-	-	-	-	-	-
Cl	mg/L	-	3.85	3.915	2.74	5.4	-	-	-	-	-	-
SO ₄	mg/L	500	4.9	2.2	0.5	70	0.14	-	-	-	-	-
NO ₃ -N	mg/L	2.4	0.047	0.005	0.00445	0.2	0.08	-	-	-	-	-
NO ₂ -N	mg/L	-	0.0048	0.005	0.0033	0.005	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.18	0.025	0.005	0.5	0.42	-	-	-	-	-
Total N	mg/L	-	0.11	0.071	0.07	0.193	-	-	-	-	-	-
DOC	mg/L	-	3.72	3.55	1.2	9.2	-	5.4	5.3	4.9	6	-
Al	mg/L	0.37	0.14	0.107	0.033	3.65	9.86	0.11	0.11	0.104	0.11	0.3
As	mg/L	0.013	0.0022	0.0005	0.00025	0.05	3.85	-	-	-	-	-
B	mg/L	0.94	0.011	0.015	0.0025	0.015	0.02	-	-	-	-	-
Cd	mg/L	0.00009	0.000025	0.0001	0.000025	0.0011	12.22	-	-	-	-	-
Co	mg/L	0.0014	0.00038	0.00025	0.00025	0.0079	5.64	-	-	-	-	-
Cr	mg/L	0.001	0.00048	0.0005	0.00025	0.001	1.00	-	-	-	-	-
Cu	mg/L	0.0029	0.0006	0.0005	0.00025	0.0035	1.21	-	-	-	-	-
Fe	mg/L	0.5	0.15	0.148	0.0005	0.305	0.61	-	-	-	-	-
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-
Mn	mg/L	0.43	0.012	0.008	0.0009	0.257	0.60	-	-	-	-	-
Ni	mg/L	0.017	0.00056	0.00025	0.00025	0.0168	0.99	-	-	-	-	-
Pb	mg/L	0.0034	0.00054	0.00025	0.00005	0.0015	0.44	-	-	-	-	-
Sb	mg/L	0.009	0.0005	0.0005	0.0005	0.0005	0.06	-	-	-	-	-
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-	-
Si	mg/L	-	1.22	1.05	0.55	2.01	-	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-	-
Tl	mg/L	0.0008	0.0004	0.00025	0.000025	0.0025	3.13	-	-	-	-	-
Zn	mg/L	0.023	0.0051	0.0038	0.001	0.102	4.43	0.076	0.094	0.023	0.11	4.83
TDS	mg/L	-	15.9	13.0	5	46	-	-	-	-	-	-
TSS	mg/L	-	6.1	4.0	0.5	440	-	-	-	-	-	-
Turbidity	NTU	25	1.1	0.7	0.15	15.4	0.62	3.44	3.41	0.93	5.97	0.24

Table 37: Water quality data and MEQ analysis for Whareatea River monitoring sites (KEL, KEL high flow event samples and W-M3).

PARAMETER	UNIT	WQ REF VALUE	KEL (N=51)					KEL – HIGH FLOW EVENT (N=3)					W-M3 (N=116)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.82	4.80	4.5	5.3	-	5.1	5.1	5.1	5.1	-	6.07	6.8	5.2	7.6	-
EC	mS/m	-	2.99	3.00	1.8	4.8	-	2.17	2.2	1.8	2.5	-	4.28	4.55	1.2	9	-
Acidity	mg/L CaCO ₃	-	3.89	4.00	2	6	-	7.67	8	6	9	-	2.86	2.8	0.5	12	-
Alkalinity	mg/L CaCO ₃	-	-	-	-	-	-	1.73	1.7	1.7	1.8	-	-	-	-	-	-
Hardness	mg/L CaCO ₃	-	2.83	3.00	1	5	-	1.47	1.39	1.20	1.80	-	11.2	10.3	3	31	-
Ca	mg/L	-	0.38	0.34	0.14	1	-	0.14	0.13	0.12	0.18	-	2.84	2.57	0.28	8.9	-
Mg	mg/L	-	0.45	0.43	0.24	0.88	-	0.27	0.26	0.22	0.33	-	0.95	0.91	0.16	2.22	-
SO ₄	mg/L	500	1.94	1.90	1.3	3.6	0.007	0.97	1.10	0.7	1.1	0.002	-	-	-	-	-
NO ₃ -N	mg/L	2.4	0.001	0.001	0.001	0.001	0.001	-	-	-	-	-	-	-	-	-	-
NO ₂ -N	mg/L	-	0.001	0.001	0.001	0.001	-	-	-	-	-	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.0050	0.0050	0.005	0.005	0.004	-	-	-	-	-	-	-	-	-	-
DOC	mg/L	-	4.11	4.20	1.4	7.3	-	4.10	4.20	3.8	4.3	-	4.12	3.9	1	10	-
Al	mg/L	0.37	0.11	0.11	0.046	0.179	0.48	0.07	0.07	0.064	0.071	0.19	0.102	0.083	0.003	0.86	2.3
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	-	0.00204	0.0005	0.00025	0.005	0.4
B	mg/L	0.94	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cd	mg/L	0.00009	0.00009	0.00010	0.000025	0.0002	2.22	0.000025	0.000025	0.000025	0.000025	0.28	0.00014	0.0001	0.000025	0.0011	12.2
Co	mg/L	0.0014	0.0002	0.0003	0.0001	0.0008	0.57	-	-	-	-	-	0.00033	0.00025	0.0002	0.002	1.4
Cr	mg/L	0.001	0.00048	0.00050	0.00025	0.001	1.00	-	-	-	-	-	0.00048	0.0005	0.00025	0.0005	0.5
Cu	mg/L	0.0029	0.00053	0.00025	0.00025	0.0025	0.86	-	-	-	-	-	0.00065	0.0005	0.000005	0.0053	1.8
Fe	mg/L	0.5	0.131	0.120	0.00025	0.257	0.51	-	-	-	-	-	0.103	0.092	0.00025	0.56	1.10
Mn	mg/L	0.43	0.007	0.007	0.002	0.0206	0.05	-	-	-	-	-	0.0037	0.0033	0.001	0.0125	0.03
Ni	mg/L	0.017	0.0004	0.0005	0.00025	0.0007	0.04	-	-	-	-	-	0.00045	0.00025	0.00025	0.004	0.2
Pb	mg/L	0.0034	0.00028	0.00025	0.00025	0.0012	0.35	-	-	-	-	-	0.00060	0.00025	0.0001	0.0015	0.4
Tl	mg/L	0.0008	0.00025	0.00025	0.00025	0.00025	0.31	-	-	-	-	-	0.00030	0.00025	0.000025	0.0025	3.1
Zn	mg/L	0.023	0.0026	0.0020	0.001	0.011	0.48	0.15	0.14	0.12	0.18	7.61	0.00336	0.0019	0.000005	0.035	1.5
TSS	mg/L	-	3.3	2.5	1.5	29	-	69.3	61.0	46	101	-	12.8	4.0	0.5	341	-
Turbidity	NTU	25	1.8	0.5	0.21	38.5	1.54	2.2	2.0	1.71	2.9	0.12	9.9	2.3	0.28	344	13.8

Table 38: Water quality data and MEQ analysis for Whareatea River tributary monitoring sites (C-M1 and C-M1 high flow event samples).

PARAMETER	UNIT	WQ REF VALUE	C-M1 (N=149)				C-M1 HIGH FLOW EVENT (N=2)*				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.87	4.9	3.8	7.3	-	5.72	5.6	5.9	-
EC	mS/m	-	2.7	2.4	1.5	21	-	1.55	1.3	1.8	-
Acidity	mg/L CaCO ₃	-	3.68	3.7	0.5	10	-	5	4	6	-
Alkalinity	mg/L CaCO ₃	-	1.3	0.5	0.5	2.5	-	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	2.27	2	1	13	-	1.84	1.61	2.07	-
Ca	mg/L	-	0.23	0.19	0.1	3.2	-	0.42	0.38	0.45	-
Mg	mg/L	-	0.41	0.38	0.2	1.3	-	0.20	0.16	0.23	-
Na	mg/L	-	2.69	2.72	2.41	2.93	-	-	-	-	-
K	mg/L	-	0.25	0.26	0.19	0.31	-	-	-	-	-
Cl	mg/L	-	3.82	3.98	2.4	5.01	-	-	-	-	-
SO ₄	mg/L	500	2.86	1.18	0.64	28	0.06	-	-	-	-
NO ₃ -N	mg/L	2.4	0.089	0.018	0.0045	0.42	0.16	-	-	-	-
NO ₂ -N	mg/L	-	0.005	0.005	0.0033	0.005	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.18	0.05	0.005	0.5	0.42	-	-	-	-
Total N	mg/L	-	0.079	0.07	0.061	0.105	-	-	-	-	-
DOC	mg/L	-	4.37	4.1	1.6	9.3	-	5.95	5.4	6.5	-
Al	mg/L	0.37	0.11	0.1	0.025	0.21	0.57	0.12	0.12	0.126	0.34
As	mg/L	0.013	0.0013	0.0005	0.0005	0.005	0.38	-	-	-	-
B	mg/L	0.94	0.010	0.015	0.0025	0.015	0.02	-	-	-	-
Cd	mg/L	0.00009	0.00011	0.0001	0.000025	0.00025	2.78	-	-	-	-
Co	mg/L	0.0014	0.00028	0.00025	0.00025	0.0005	0.36	-	-	-	-
Cr	mg/L	0.001	0.00051	0.0005	0.00025	0.001	1.0	-	-	-	-
Cu	mg/L	0.0029	0.00044	0.00025	0.00025	0.0022	0.76	-	-	-	-
Fe	mg/L	0.5	0.15	0.15	0.00025	0.282	0.56	-	-	-	-
Hg	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-
Mn	mg/L	0.43	0.0038	0.0033	0.001	0.011	0.03	-	-	-	-
Ni	mg/L	0.017	0.00028	0.00025	0.00025	0.0006	0.04	-	-	-	-
Pb	mg/L	0.0034	0.00041	0.00025	0.00005	0.0015	0.44	-	-	-	-
Sb	mg/L	0.009	0.0005	0.0005	0.0005	0.0005	0.06	-	-	-	-
Se	mg/L	0.011	0.0025	0.0025	0.0025	0.0025	0.23	-	-	-	-
Si	mg/L	-	1.16	1.07	0.58	1.79	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	-	-	-	-
Tl	mg/L	0.0008	0.00043	0.00025	0.000025	0.0025	3.13	-	-	-	-
Zn	mg/L	0.023	0.0024	0.0020	0.0005	0.023	1.0	0.033	0.017	0.048	2.09
TDS	mg/L	-	12.8	13	5	26	-	-	-	-	-
TSS	mg/L	-	2.4	2.5	0.5	16	-	-	-	-	-
Turbidity	NTU	25	0.5	0.4	0.17	3.8	0.15	3.1	1.8	4.46	0.18

*no median provided as n=2

Table 39: Water quality data and MEQ analysis for Whareatea River tributaries monitoring sites (S Creek, V40, Trent Stream).

PARAMETER	UNIT	WQ REF VALUE	S CREEK (N=9)					V40 STREAM (N=66)					TRENT STREAM (N=8)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	4.6	4.6	4.5	4.8	-	4.7	4.7	4.4	4.7	-	4.8	4.8	4.6	4.9	-
EC	mS/m	-	3.3	3.2	2.1	5	-	3.4	3.2	2.2	5	-	2.8	2.7	1.9	4.6	-
Acidity	mg/L CaCO ₃	-	5.9	6.2	4.7	6.9	-	11	8.4	4.6	25	-	5.8	5.7	4.4	7.1	-
Alkalinity	mg/L CaCO ₃	-	0.5	0.5	0.5	0.5	-	0.7	0.5	0.5	1.3	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	3	3	1	5	-	3	3	1	8	-	2	2	1	3	-
Ca	mg/L	-	0.22	0.2	0.09	0.47	-	0.3	0.3	0.0001	1.2	-	0.14	0.13	0.09	0.19	-
Mg	mg/L	-	0.5	0.6	0.3	0.8	-	0.6	0.6	0.2	1.1	-	0.4	0.4	0.2	0.8	-
Na	mg/L	-	-	-	-	-	-	2.2	2.2	2.2	2.2	-	-	-	-	-	-
K	mg/L	-	0.5	0.5	0.5	0.5	-	0.5	0.5	0.3	0.5	-	0.5	0.5	0.5	0.5	-
Cl	mg/L	-	-	-	-	-	-	4.5	4.5	4.5	4.5	-	-	-	-	-	-
SO ₄	mg/L	500	3.4	3.6	1.3	5.8	0.01	3.5	3.2	1.2	8.5	0.02	1.5	1.5	0.3	2.7	0.01
NO ₃ -N	mg/L	2.4	-	-	-	-	-	0.01	0.01	0.01	0.01	0.00	-	-	-	-	-
DOC	mg/L	-	-	-	-	-	-	3.85	3.4	0.8	8.5	-	-	-	-	-	-
Al	mg/L	0.37	0.14	0.14	0.07	0.19	0.51	0.13	0.13	0.05	0.23	0.62	0.15	0.15	0.07	0.22	0.59
As	mg/L	0.013	0.005	0.005	0.005	0.005	0.38	0.005	0.005	0.001	0.005	0.38	0.005	0.005	0.005	0.005	0.38
B	mg/L	0.94	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Cd	mg/L	0.00009	0.0003	0.0003	0.0003	0.0003	3.33	0.0003	0.0003	0.0003	0.0003	3.33	0.0003	0.0003	0.0003	0.0003	3.33
Co	mg/L	0.0014	0.0012	0.001	0.0005	0.002	1.43	0.0009	0.0005	0.0003	0.002	1.43	0.0005	0.0005	0.0005	0.0005	0.36
Cr	mg/L	0.001	0.0005	0.0005	0.0005	0.0005	0.5	0.0005	0.0005	0.0005	0.0005	0.5	0.0005	0.0005	0.0005	0.0005	0.5
Cu	mg/L	0.0029	0.001	0.001	0.001	0.001	0.34	0.001	0.001	0	0.002	0.69	0.001	0.001	0.001	0.001	0.34
Fe	mg/L	0.5	0.11	0.11	0.06	0.18	0.36	0.14	0.14	0.04	0.43	0.86	0.12	0.12	0.06	0.18	0.36
Hg	mg/L	-	-	-	-	-	-	0.0003	0.0003	0.0003	0.0003	-	-	-	-	-	-
Mn	mg/L	0.43	0.01	0.01	0.002	0.01	0.02	0.01	0.01	0.001	0.12	0.28	0.004	0.004	0.002	0.01	0.02
Ni	mg/L	0.017	0.001	0.001	0.0003	0.002	0.12	0.001	0.001	0.0003	0.003	0.18	0.0004	0.0003	0.0003	0.001	0.06
Pb	mg/L	0.0034	0.002	0.002	0.002	0.002	0.59	0.001	0.002	0.0003	0.002	0.59	0.002	0.002	0.002	0.002	0.59
Sb	mg/L	0.009	0.0001	0.0001	0.0001	0.0001	0.01	0.0001	0.0001	0.0001	0.0005	0.06	0.0001	0.0001	0.0001	0.0001	0.01
Se	mg/L	0.011	0.001	0.001	0.001	0.001	0.09	0.001	0.001	0.001	0.003	0.27	0.001	0.001	0.001	0.001	0.09
Si	mg/L	-	-	-	-	-	-	2.36	2.36	2.36	2.36	-	-	-	-	-	-
Sn	mg/L	-	0.00025	0.00025	0.00025	0.00025	-	0.00025	0.00025	0.00025	0.00025	-	0.00025	0.00025	0.00025	0.00025	-
Ti	mg/L	0.0008	0.0025	0.0025	0.0025	0.0025	3.13	0.0025	0.0025	0.0025	0.0025	3.13	0.0025	0.0025	0.0025	0.0025	3.13
Zn	mg/L	0.023	0.01	0.011	0.003	0.027	1.17	0.009	0.007	0.003	0.061	2.65	0.005	0.004	0.003	0.01	0.43

PARAMETER	UNIT	WQ REF VALUE	S CREEK (N=9)					V40 STREAM (N=66)					TRENT STREAM (N=8)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
DRP	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TDS	mg/L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TSS	mg/L	-	2	1	1	4	-	3	1	1	22	-	3	2	1	5	-
Turbidity	NTU	25	2	1	1	3	0.12	2	1	1	5	0.2	2	2	1	4	0.16

Table 40: Water quality plot for Whareatea River tributaries monitoring sites (V62, V62 high flow event samples and V70).

PARAMETER	UNIT	WQ REF VALUE	V62 (N=24)					V62 HIGH FLOW EVENT (N=2)*				V70 (N=19)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH	pH unit	4.5 - 7.0	5.11	5.4	4.6	7.2	-	4.89	4.8	5	-	4.88	4.9	4.6	6	-
EC	mS/m	-	2.55	2.5	1.9	3.20	-	1.80	1.8	1.8	-	2.64	2.6	1.9	3.4	-
Acidity	mg/L CaCO ₃	-	4.62	4.5	3	6	-	7.50	7	8	-	6.17	6	2	12	-
Alkalinity	mg/L CaCO ₃	-	0.3	0.5	0.5	0.5	-	-	-	-	-	0.5	0.5	0.5	0.5	-
Hardness	mg/L CaCO ₃	-	2.56	2.56	1.89	3.14	-	1.35	1.186	1.516	-	2.29	2.25	1.86	2.80	-
Ca	mg/L	-	0.33	0.33	0.13	0.5	-	0.16	0.13	0.18	-	0.2	0.135	0.1	0.43	-
Mg	mg/L	-	0.42	0.42	0.34	0.5	-	0.24	0.21	0.26	-	0.36	0.36	0.26	0.51	-
SO ₄	mg/L	500	1.18	1.10	0.6	1.88	-	0.60	0.6	0.6	0.001	0.97	0.9	0.62	1.37	0.003
NO ₃ -N	mg/L	2.4	0.022	0.015	0.001	0.05	0.02	-	-	-	-	0.005	0.005	0.005	0.005	0.002
NO ₂ -N	mg/L	-	0.001	0.001	0.001	0.001	-	-	-	-	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.005	0.005	0.005	0.005	0.004	-	-	-	-	-	-	-	-	-
DOC	mg/L	-	4.19	4.10	1.4	8.4	-	7.15	7.1	7.2	-	-	-	-	-	-
Al	mg/L	0.37	0.12	0.12	0.043	0.216	0.58	0.17	0.149	0.2	0.54	0.1	0.077	0.031	0.2	0.54
As	mg/L	0.013	0.0005	0.0005	0.0005	0.0005	0.04	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.04
Cd	mg/L	0.00009	0.00004	0.00003	0.000025	0.0001	1.11	-	-	-	-	0.00005	0.000025	0.000025	0.0001	1.11
Co	mg/L	0.0014	0.0001	0.0001	0.0001	0.00025	0.18	-	-	-	-	0.00035	0.00025	0.0001	0.0008	0.57
Cr	mg/L	0.001	0.00031	0.00025	0.00025	0.0005	0.50	-	-	-	-	0.0005	0.0005	0.0005	0.0005	0.50
Cu	mg/L	0.0029	0.0043	0.00025	0.00025	0.057	19.7	-	-	-	-	0.0017	0.00025	0.00025	0.007	2.41
Fe	mg/L	0.5	0.087	0.080	0.03	0.19	0.38	-	-	-	-	0.104	0.1	0.04	0.18	0.36
Mn	mg/L	0.43	0.004	0.003	0.0023	0.016	0.04	-	-	-	-	0.0056	0.0013	0	0.026	0.06
Ni	mg/L	0.017	0.0003	0.0003	0.00025	0.00085	0.05	-	-	-	-	0.00034	0.00025	0.00025	0.00085	0.05
Pb	mg/L	0.0034	0.00025	0.00025	0.00025	0.00025	0.07	-	-	-	-	0.00025	0.00025	0.00025	0.00025	0.07
Zn	mg/L	0.023	0.0033	0.0025	0.001	0.011	0.48	0.033	0.017	0.048	2.00	0.0033	0.0025	0.0013	0.009	0.39
DRP	mg/L	-	0.002	0.002	0.002	0.002	-	-	-	-	-	-	-	-	-	-
TSS	mg/L	-	1.7	1.5	1.5	3	-	-	-	-	-	1.6	1.5	1.5	2.5	-

PARAMETER	UNIT	WQ REF VALUE	V62 (N=24)					V62 HIGH FLOW EVENT (N=2)*				V70 (N=19)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
Turbidity	NTU	25	0.5	0.4	0.19	1.02	0.04	3.1	1.8	4.46	0.96	0.5	0.3	0.2	1.09	0.04

*no median provided as n=2

Table 41: Water quality data and MEQ analysis for Gate Pond and Whareatea Dam.

PARAMETER	UNIT	WQ REF VALUE	GATE POND (N=43)					WHAREATEA DAM (N=12)				
			MEAN	MDN	MIN	MAX	MEQ	MEAN	MDN	MIN	MAX	MEQ
pH*	pH unit	4.5 – 7.0	5.3	5.3	5	6.8	-	5.2	5.3	4.9	5.4	-
Hardness	mg/L CaCO ₃		1.2	1	0.5	2	-	-	-	-	-	-
Ca	mg/L	-	0.14	0.13	0.05	0.5	-	-	-	-	-	-
Mg	mg/L	-	0.22	0.22	0.11	0.37	-	-	-	-	-	-
NH ₄ -N	mg/L	1.2	0.007	0.005	0.005	0.02	0.17	0.005	0.005	0.005	0.005	0.004
TSS	mg/L	-	5.4	5	3	18	-	-	-	-	-	-
Turbidity	NTU	25	2.79	2.3	1.07	5.34	0.21	3.31	3.38	1.65	4.73	0.19

Table 42: MEQ summary for the Whareatea River catchment.

DATA SOURCE	SO ₄	NO ₃ -N	NH ₄ -N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
WHAREATEA RIVER																				
WM0	-	-	-	3.27	0.08	-	1.11	5.79	1.00	1.03	2.30	-	0.30	0.68	0.29	-	-	1.25	0.04	48.4
WM1	-	-	-	0.84	0.38	-	222	0.43	25.0	12.1	1.40	-	0.07	0.42	13.24	-	-	3.13	0.09	0.92
WM2	0.14	0.08	0.42	9.9	3.85	0.02	12.2	5.64	1.00	1.21	0.61	-	0.60	0.99	0.44	0.06	0.23	3.13	4.43	0.62
WM2 (High Flow Event)	-	-	-	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.83	0.24
KEL	0.01	0.001	0.004	0.48	0.04	-	2.22	0.57	1.00	0.86	0.51	-	0.05	0.04	0.35	-	-	0.31	0.48	1.54
KEL (High Flow Event)	0.002	-	-	0.19	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-	7.61	0.12
WM3	-	-	-	2.32	0.38	-	12.2	1.43	0.50	1.83	1.12	-	0.03	0.24	0.44	-	-	3.13	1.52	13.76
WHAREATEA RIVER TRIBUTARIES																				

DATA SOURCE	SO ₄	NO ₃ -N	NH ₄ -N	Al	As	B	Cd	Co	Cr	Cu	Fe	Hg	Mn	Ni	Pb	Sb	Se	Tl	Zn	NTU ¹
S Creek	0.01	-	-	0.51	0.38	0.01	3.33	1.43	0.50	0.34	0.36	-	0.02	0.12	0.59	0.01	0.09	3.13	1.17	0.12
V40	0.02	0.004	-	0.62	0.38	0.02	3.33	1.43	0.50	0.69	0.86	-	0.28	0.18	0.59	0.06	0.27	3.13	2.65	0.20
Trent Stream	0.01	-	-	0.59	0.38	0.01	3.33	0.36	0.50	0.34	0.36	-	0.02	0.06	0.59	0.01	0.09	3.13	0.43	0.16
CM1	0.06	0.16	0.42	0.57	0.38	0.02	2.78	0.36	1.00	0.76	0.56	-	0.03	0.04	0.44	0.06	0.23	3.13	1.00	0.15
CM1 (High Flow Event)	-	-	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.09	0.18
V62	-	0.02	0.004	0.58	0.04	-	1.11	0.18	0.50	19.66	0.38	-	0.04	0.05	0.07	-	-	-	0.48	0.04
V62 (High Flow Event)	0.001	-	-	0.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.00	0.96
V70	0.003	0.002	-	0.54	0.04	-	1.11	0.57	0.50	2.41	0.36	-	0.06	0.05	0.07	-	-	-	0.39	0.04
Gate Pond	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.36
Whareatea Dam	-	-	0.004	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.19

¹Turbidity.

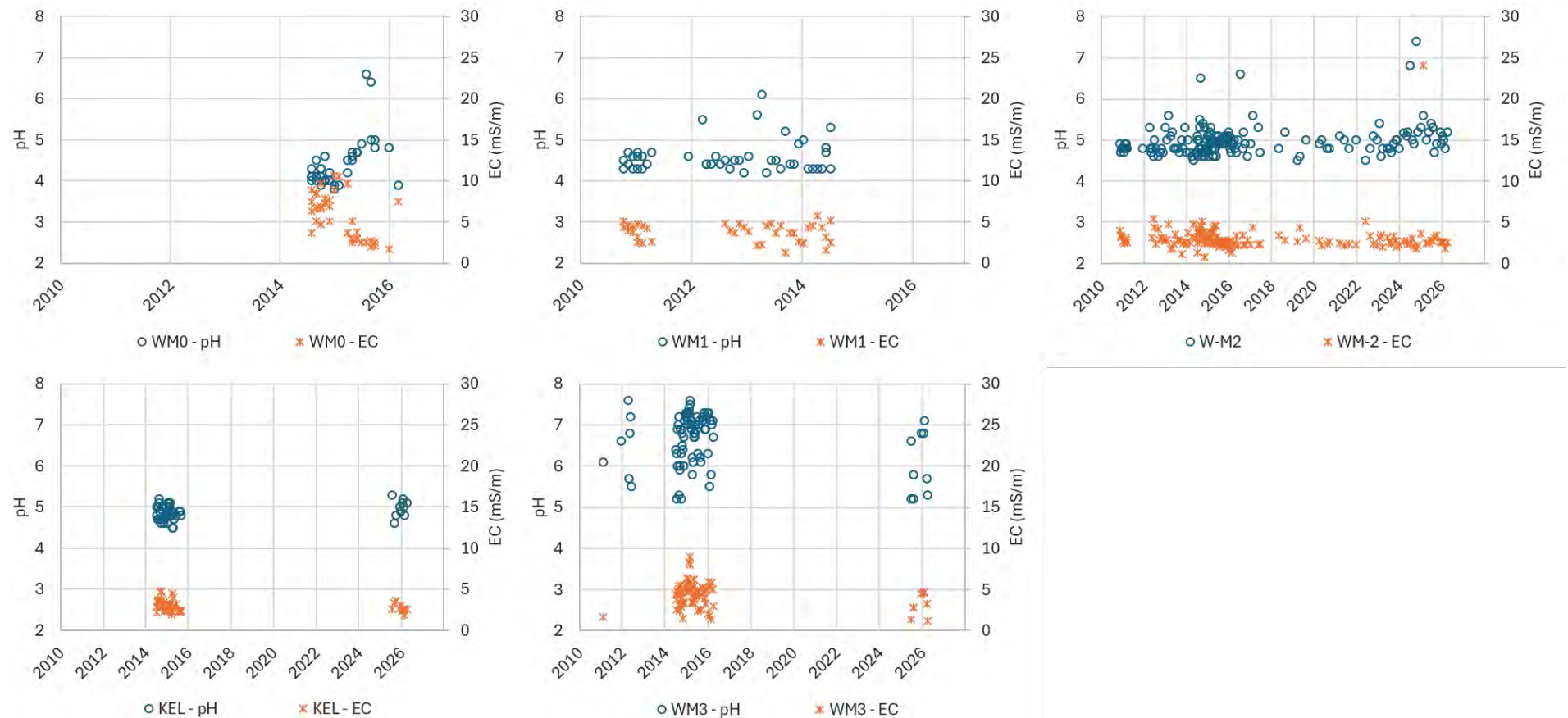


Figure 37: EC and pH plots for Whareatea River catchment monitoring sites WM0, WM1, W-M2, KEL, and W-M3).

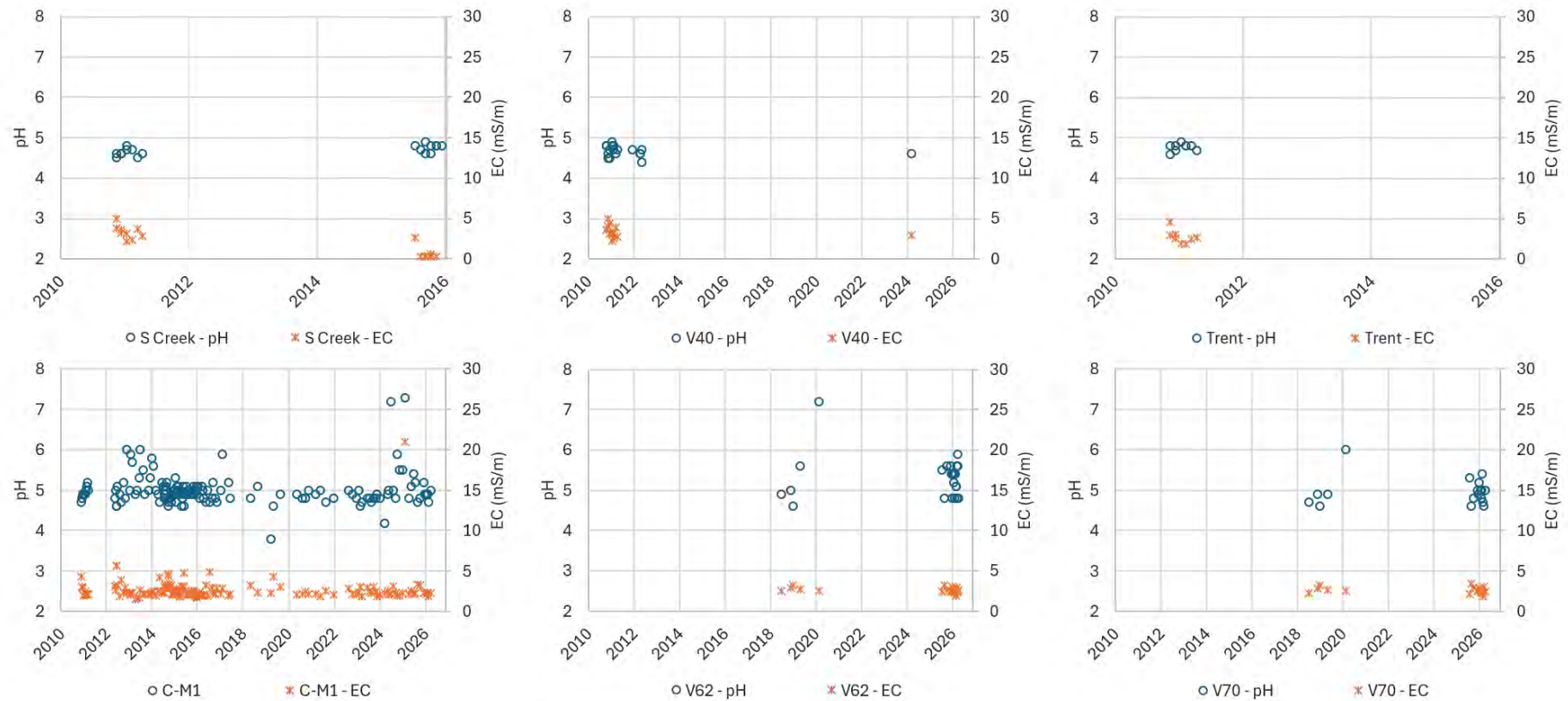


Figure 38: EC and pH plots for Whareatea River catchment tributaries monitoring sites (S Creek, V40 [V40 Stream], Trent, C-M1, V62, and V70).

5.4.2 Data Summary

Figure 39 and Figure 40 present box plots of pH and EC for the Whareatea River catchment. Figure 41 and Figure 42 present plots for key metals (Al, Cu, Fe and Zn) discussed in this section.

Based on the data for Whareatea River monitoring sites the following observations were made:

- The pH ranged from 3.8 to 7.6 across all Whareatea River locations, with values both below minimum and exceeding maximum WQ Ref Values. The mean pH for sampled sites were: 4.2 (WM0), 4.5 (WM1), 4.87 (W-M2), 6.07 (W-M3), and 4.82 (KEL) (Figure 39).
- Acidity ranged from 0.5 to 19 mg CaCO₃/L for all Whareatea River locations. Site specific mean values were 8.8 mg CaCO₃/L (WM0), 4.6 mg CaCO₃/L (WM1), 4.26 mg CaCO₃/L (W-M2), 2.86 mg CaCO₃/L (W-M3), and 3.89 mg CaCO₃/L (KEL).
- Alkalinity, where measured, is a maximum of 2.5 mg CaCO₃/L for all Whareatea River locations.
- The EC ranged from <0.5 to 100 mS/m for all Whareatea River locations. Site specific mean values were 32.6 mS/m (WM0), 3.8 mS/m (WM1), 3.8 mS/m (W-M2), 4.28 mS/m (W-M3) and 2.99 mS/m (KEL).
- SO₄ concentrations, where available, were under the WQ Ref Value and ranged from <1 to 70 mg/L for all sites.
- The MEQ data in red indicate that the maximum value for a parameter exceeded the WQ Ref Value:
 - o WM0: exceedances reported for Al, Cd, Co, Cr, Cu, Fe, Tl, and Zn.
 - o WM1: exceedances reported for Cd, Cr, Cu, Fe, Pb, and Tl.
 - o W-M2: exceedances reported for Al, As, Cd, Co, Cr, Cu, Tl, and Zn.
 - o KEL: exceedances reported for Cd and Cr.
 - o W-M3: exceedances reported for Al, Cd, Co, Cu, Fe and Zn.

Based on the data for monitoring sites within tributaries of the Whareatea River the following observations were made:

- The pH ranged from 3.8 to 7.6 across all monitoring sites, with values both below minimum and exceeding maximum WQ Ref Values. The mean pH for sampled sites were: 4.87 (C-M1), 4.6 (S Creek), 4.7 (V40 Stream), 4.8 (Trent Stream), 5.11 (V62), 4.88 (V70), 5.3 (Gate Pond) and 5.2 (Whareatea Dam) (Figure 39).
- Acidity ranged from 0.5 to 25 mg CaCO₃/L for all locations. Site specific mean values were 3.68 mg CaCO₃/L (C-M1), 5.9 mg CaCO₃/L (S Creek), 11 mg CaCO₃/L (V40), 5.8 mg CaCO₃/L (Trent Stream), 4.62 mg CaCO₃/L (V62) and 6.17 mg CaCO₃/L (V70).
- Alkalinity, where measured, is a maximum of 2.5 mg CaCO₃/L for all tributaries of the Whareatea River monitoring sites.

- The EC ranged from <0.5 to 21 mS/m for all locations. Site specific mean values were 2.7 mS/m (C-M1), 3.3 mS/m (S Creek), 3.4 mS/m (V40), 2.8 mS/m (Trent Stream), 2.55 mS/m (V62) and 3.64 mS/m (V70).
- SO₄ concentrations, where available, were under the WQ Ref Value and ranged from <1 to 28 mg/L for all sites.
- The MEQ data in red (Table 42) indicate that the maximum value for a parameter exceeded the WQ Ref Value for the following parameters:
 - o S Creek: exceedances reported for Cd, Co, Tl, and Zn.
 - o V40: exceedances reported for Cd, Co, and Zn.
 - o Trent Stream: exceedance reported for Cd and Tl.
 - o C-M1: exceedances reported for Cd, Cr, Tl, and Zn.
 - o V62: exceedance reported for Cd and Zn at high flow
 - o V70: exceedances reported for Cd.
 - o V62 and V70: exceedance reported for Cu, however, the data are anomalous (Figure 42) and these data are excluded from derivation of mean data for the development of a source term for the stream.
 - o Gate Pond: no exceedance reported.
 - o Whareatea Dam: no exceedance reported.

For Tl it is important to note that LOR was higher than WQ Ref Value with the exception of site WM0.

There is variability in the LOR over time, and the data review has identified an instance where variable LOR potentially elevates values presented in the statistical summary (Table 36). At monitoring site W-M2, Cd is consistently below LOR (139 samples) with only one sample recorded above the LOR. Over the dataset, LOR varies from <0.00005 mg/L to <0.0002 mg/L. Applying ½ the value of the lowest LOR provides a value of 0.000025 mg/L for Cd at this location.

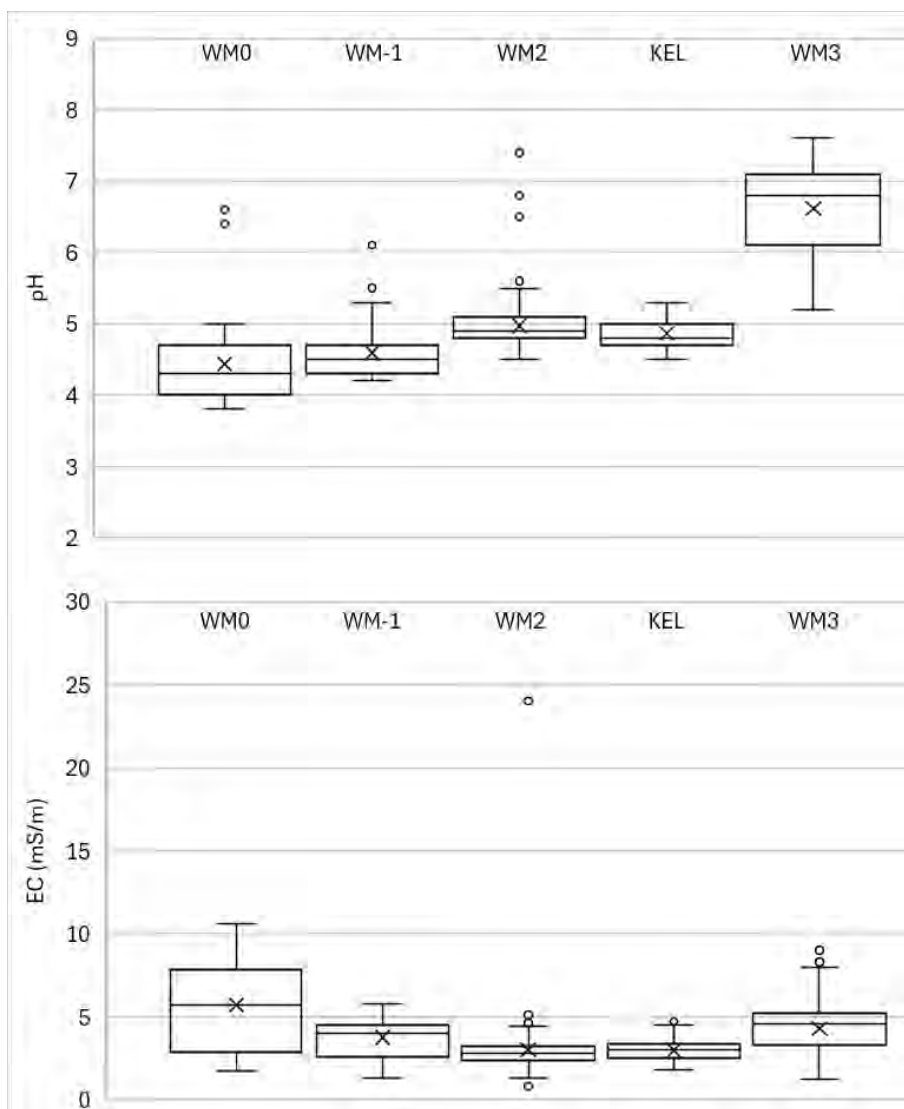


Figure 39: Box plots of pH and EC for Whareatea River monitoring sites.

An 'X' identifies the mean data for each monitoring site.

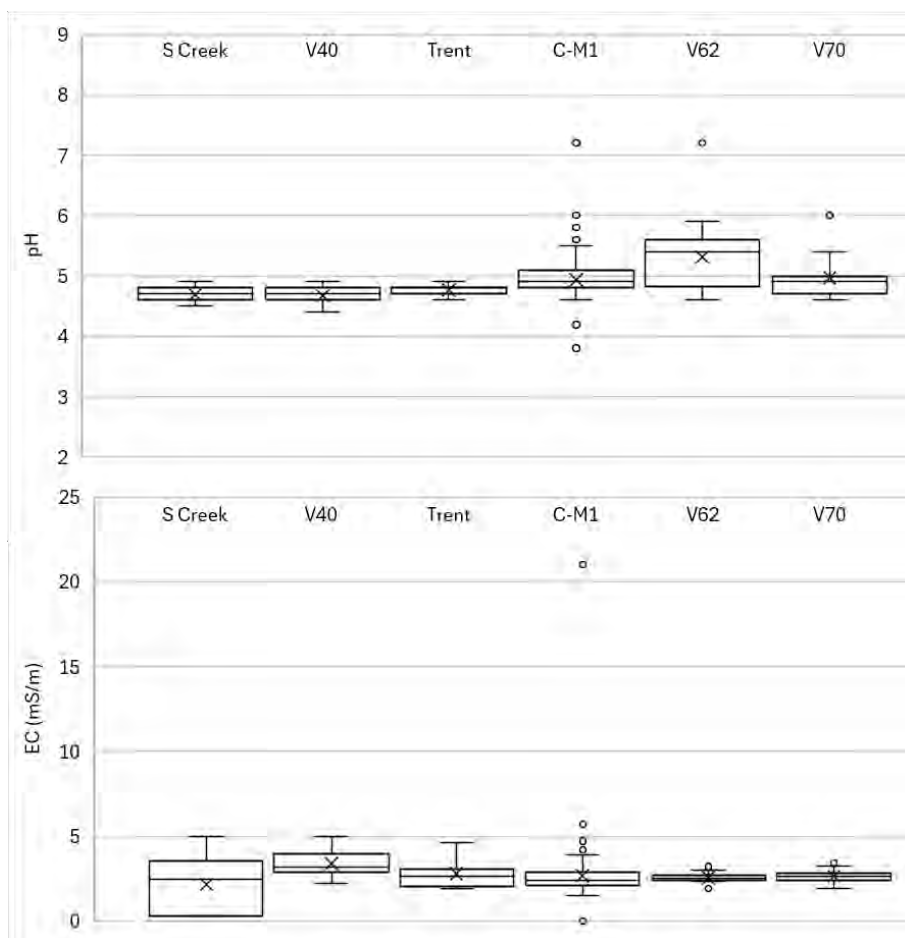


Figure 40: Box plots of pH and EC for Whareatea River tributaries monitoring sites.

An 'X' identifies the mean data for each monitoring site.

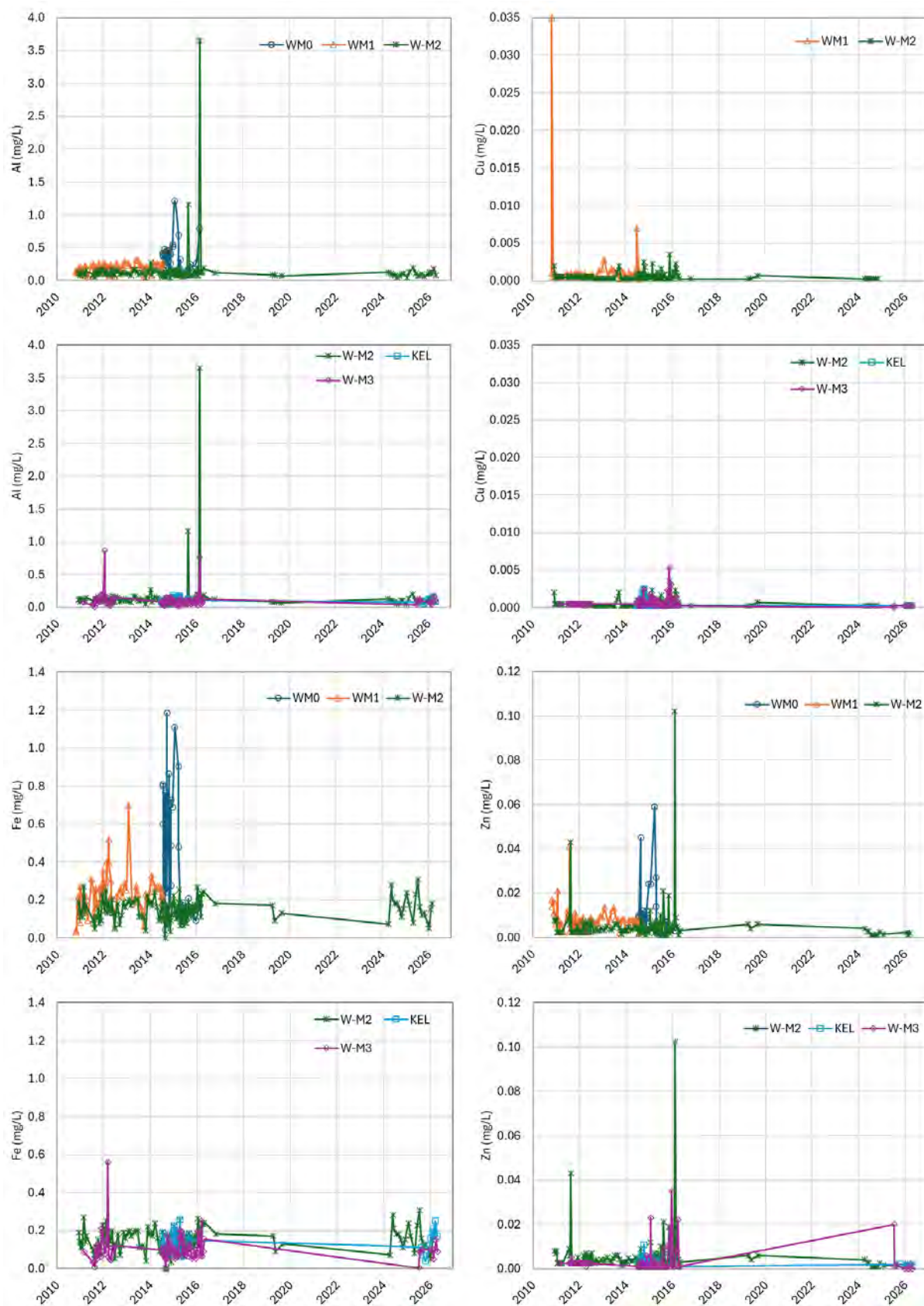


Figure 41: Select metal concentrations (Al, Cu, Fe, and Zn) for Whareatea River catchment monitoring sites.

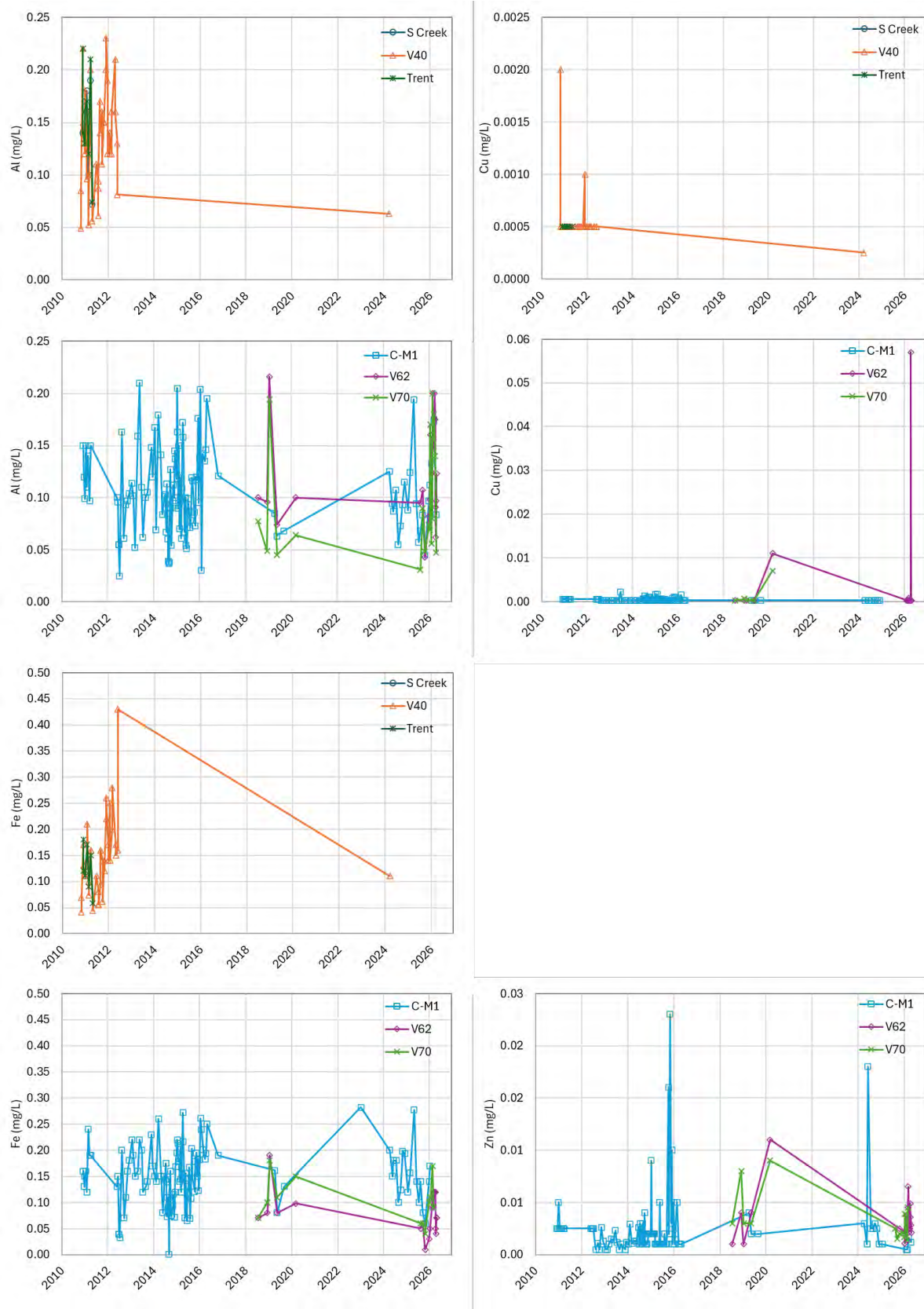


Figure 42: Select metal concentrations (Al, Cu, Fe, and Zn) for Whareatea River tributary monitoring sites.

6 SUMMARY

6.1 Introduction

A significant water quality database is available for the MFS, ESE, and the UWHR sub-areas to provide guidance on PCOC within these sub-areas with data being collected for many decades at some sites. For instance:

- Extensive water quality monitoring has been undertaken at the Stockton Mine with records in the Stockton Water Quality Database²⁰ commencing in 1987. Such data has application to the wider BPCP as the same lithological materials will be excavated.
- It is noted that observations, interpretations, and about 120,000 samples²¹ from 125 sites over 45 years demonstrate that the Denniston and Stockton catchments are among the most well understood catchments in New Zealand with regard to water quality.
- MEQ analysis indicates catchments within the BPCP currently have elevated solute concentrations through either natural sources or historic mining (e.g., Cd, Cr, and Zn is elevated above WQ Ref Values for at least one monitoring site within all catchments presented in this report).

The AMD risks are well understood for these Project areas and the materials that will be disturbed by the BPCP activities. Collection of water quality data is ongoing for all compliance and performance sites and additional detailed interpretation will continue to be made into the operational phase.

6.2 Proposed Water Quality Monitoring Programme Summary

Table 43 provides a summary of the proposed monitoring programme for MFS, ESE, and the UWHR. Details on proposed water quality monitoring frequency, parameters tested, and relationship to project activities are provided in the AMD WMP²² (BRL, 2026). The following is noted:

- At least 24 samples are available for all compliance water quality monitoring locations.
- Performance and reference monitoring locations with <24 samples at the time of data compilation are shown in Blue. These sites will be continually resampled through the life of the BPCP to validate the proposed management processes.

Table 43. Proposed water quality monitoring program (MFS, ESE, UWHR).

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE
UWHR	Waimangaroa River	WRBBC	Performance
UWHR	Waimangaroa River	14W	Performance
UWHR	Waimangaroa River	15W	Performance

²⁰ As provided by BRL

²¹ As sourced from the BRL water quality database, including Sonde measurements.

²² AMD Water Management Plan

PROJECT SUB-AREA	STREAM / RIVER	SITE NAME	TYPE
MFS	Waimangaroa River	16W ¹	Performance
MFS / UWHR	Waimangaroa River	2W (Smokestack)	Compliance
MFS / UWHR	Waimangaroa River	17W	Compliance
MFS	Waimangaroa River	18W	Performance
MFS / UWHR	Wilson Creek (Waimangaroa River tributary)	WIL.MS1	Reference
MFS / UWHR	Cedar Creek (Waimangaroa River tributary)	CED.MS1	Reference
UWHR	Burnetts Stream	BUR.L1	Performance (turbidity)
MFS	Deep Stream	SW01	Compliance
MFS	Deep Stream	SW03	Compliance
MFS	Deep Stream	SW04	Performance
MFS	Billo Stream	BS01	Performance (turbidity)
MFS	Billo Stream tributary	BIL.L1	Reference
MFS	Deep Stream unnamed tributary	SW02	Performance ²
ESE	V8 Creek (Cascade Creek tributary)	MM1	Compliance
ESE	V37 Stream (Cascade Creek tributary)	V37-F ³	Performance
ESE	V37 Stream (Cascade Creek tributary)	V37-G ³	Performance
ESE	Cascade Creek	DS.V37	Performance (ecology)
ESE	Rapid Stream	W07	Compliance
ESE	Rapid Stream	W08	Performance
ESE	Rapid Stream	W09	Performance
ESE	Rapid Stream tributary	RAP.R1	Reference
ESE	Whareatea River	KEL	Compliance
ESE	Whareatea River	WM-3	Performance
ESE	V70 (Whareatea River tributary)	V70	Reference and Performance (turbidity)
ESE	V62 (Whareatea River tributary)	V62	Compliance

Blue sites are performance and reference sites that will be continually verified through the life of the BPCP to validate the proposed management processes.

¹ Consider the pre-BPCP 2W data will reflect the background conditions at 16W. This site is included as an add to background site for assessing compliance at 2W (Smokestack).

² To take over from BIL.L1 and become a reference site at the start of the Post Construction phase.

³ These sites will be monitored once disturbed, currently insufficient flow to sample.

6.3 Recommendation

Recommendation #1: Continue water quality monitoring Water Quality Monitoring

- Continue further water quality monitoring at compliance, performance, and reference monitoring sites over the construction, operational, and closure phases of the BPCP.

Recommendation #2: Validate baseline water quality

- Undertake continuous monitoring data (flow, EC, pH and turbidity) to provide time-based data to fully characterise the relationships between flow and physicochemistry at compliance monitoring locations (e.g., 2W: Smokestack) prior to construction commencing and then continuing throughout life of mine phases.
- Validate and refine flow weighted water quality source terms (mg/L).

7 REFERENCES

- Australian and New Zealand Environment and Conservation Council (ANZG), 2023. Livestock drinking water guidelines (Draft). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra. <https://www.waterquality.gov.au/sites/default/files/documents/livestock-drinking-water-guidelines-draft.pdf>.
- Australian and New Zealand Environment and Conservation Council (ANZG) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Canberra.
- BRL, 2024. Acid and Metalliferous Drainage (AMD) Environment Management Sub Plan, Stockton Mine. STO-ENV-PLN-016.
- BRL, 2026. AMD: Water Management Plan. Bathurst Resources Limited Document: BPCP-ENV-PLN-010.
- CCME, 2014. Canadian water quality guidelines for the protection of aquatic life: Thallium. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, p. 11, Canadian Council of Ministers of the Environment, Winnipeg, Canada.
- Chater, M. (2024). Rainfall-altitude gradient, SH67 to Mt Rochford, Denniston Plateau.
- Davies, H., 2009. Geochemical change following pH remediation in Mangatini Stream, Stockton Coal Mine, New Zealand. M.Sc. thesis, University of Otago.
- Davies, H., Weber, P., Lindsay, P., Craw, D., Pope, J., 2011. Characterisation of acid mine drainage in a high rainfall mountain environment, New Zealand. Science of the Total Environment 409 (2011) 2971–2980.
- Flores, R.M., Sykes, R., 1996. Depositional controls on coal distribution and quality in the Eocene Brunner Coal Measures, Buller Coalfield, South Island, New Zealand. International Journal of Coal Geology 19: 291-336.
- Hickey, C.W., 2026. Buller Coal Plateaux Continuation Project: Water quality protection guidelines. Report prepared by RMA Science Ltd for Bathurst Resources Ltd.
- Jewiss, C., Craw, D., Pope, J., Christenson, H. and Trumm, D., 2020. Dilution processes of rainfall-enhanced acid mine drainage discharges from historic underground coal mines, New Zealand. Mine Water and the Environment, 39(1), pp.27-41.
- King, A., 2019. Conveyance of Inorganic and Organic Carbon in Mountainous Rivers: A Case Study from the Haast River, Southern Alps, New Zealand. Master of Science Thesis, university of Otago
- McGlynn and McDonnell, 2003. Role of discrete landscape units in controlling catchment dissolved organic carbon dynamics. Water Resources Research Vol 39, Issue 4: <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2002WR001525>
- MWM, 2026a. Escarpment Extension Project. Groundwater Technical Report. Report J-NZ0433-002-R-FINAL by Mine Waste Management for Bathurst Resources Limited.

- MWM, 2026b. Mount Frederick South Project. Groundwater Technical Report. Report J-NZ0377-004-R-FINAL by Mine Waste Management for Bathurst Resources Limited.
- MWM, 2026c. Water and Load Balance Model - Source Term Definition. Report J-NZ0433-004-R-FINAL by Mine Waste Management for Bathurst Resources Limited.
- NIWA, 2019. Stream ecology and water quality surveys in Waimangaroa and Whareatea River catchments. Prepared for Bathurst Resources Limited, May 2019.
- NIWA, 2025. Cascade Creek aquatic ecology baseline survey. Prepared for Bathurst Resources Limited, June 2025.
- Penman, H.L., 1948. Natural evaporation from open water, bare soil and grass. Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences, 193(1032), pp.120-145.
- Rough Milne Mitchell Landscape Architects Ltd., December 2021. Buller Plateaux Baseline Landscape Study.
- Solid Energy NZ Limited, October 2006. Deep Creek PAG 2 Environmental Report.
- Stark J.D. & Maxted J.R. (2007) A user guide for the Macroinvertebrate Community Index. Prepared for the Ministry for the Environment. Cawthron Report No. 1166.
- Taumata Arowai, 2022. Water Services (Drinking Water Standards for New Zealand) Regulations 2022. <https://www.legislation.govt.nz/regulation/public/2022/0168/latest/whole.html>
- Weber, P. and Olds, W., 2016. Optimised water assessment for the environmental management of mining projects. In: Fergusson, D (ed). Proc. AusIMM NZ Branch 2016 Conference, Wellington, p. 455–466.
- Weber, P.A., Olds, W.E., Bird, B., Pearce, J., 2015. Forecasting long term water quality at closure for current mining operations. New Zealand Annual AusIMM Branch Conference, Dunedin, 31 August – 2 September 2015, pp 495-505.

8 LIMITATIONS

Attention is drawn to the document “Limitations”, which is included in Appendix F of this report. The statements presented in this document are intended to provide advice on what the realistic expectations of this report should be, and to present recommendations on how to minimise the risks associated with this project. The document is not intended to reduce the level of responsibility accepted by Mine Waste Management, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so.

APPENDIX A WAIMANGAROA RIVER – EXCEL FILE

APPENDIX B DEEP STREAM – MICROSOFT EXCEL FILE

APPENDIX C CASCADE CREEK – MICROSOFT EXCEL FILE

APPENDIX D RAPID STREAM – MICROSOFT EXCEL FILE

APPENDIX E WHAREATEA RIVER – MICROSOFT EXCEL FILE

APPENDIX F LIMITATIONS

This Document has been provided by Mine Waste Management Ltd (MWM) subject to the following limitations:

This Document has been prepared for the particular purpose outlined in MWM's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of MWM's services are as described in MWM's proposal, and are subject to restrictions and limitations. MWM did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in this Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by MWM in regards to it.

Conditions may exist which were undetectable given the limited nature of the enquiry MWM was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. MWM's opinions are based upon information that existed at the time of the production of this Document. It is understood that the services provided allowed MWM to form no more than an opinion of the actual conditions of the site at the time the site was reviewed and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by MWM for incomplete or inaccurate data supplied by others.

MWM may have retained subconsultants affiliated with MWM to provide services for the benefit of MWM. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, MWM's affiliated companies, and their employees, officers and directors.

This Document is provided for use by Bathurst Resources Limited. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. MWM accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

MWM acknowledges that this report will be relied on by a Panel appointed under the Fast-track Approvals Act 2024 and these disclaimers do not prevent that reliance.



MINE WASTE MANAGEMENT

GREENROAD GROUP

APPENDIX B UPPER WAIMANGAROA HAUL ROAD SITE VISIT

MEMORANDUM

Recipient: [REDACTED] – Bathurst Resources Limited

From: [REDACTED] – Mine Waste Management Limited

Date: 20 July 2026

Cc: [REDACTED] (BRL); [REDACTED] (BRL)

Document Number: J-NZ0453-001-M-FINAL

Document Title: Upper Waimangaroa Haul Road Site Visit

Mine Waste Management Limited (MWM) has provided this memorandum to Bathurst Resources Limited (BRL) to summarise the field notes and observations from the site visit undertaken on the 25 July 2024 to assess the proposed path for the proposed Upper Waimangaroa Haul Road (UWHR).

BACKGROUND

A site visit was undertaken to look at the UWHR alignment and obtain rock samples for geochemical classification to understand the AMD¹ source hazards and assess run-off water quality from exposed PAF² and NAF³ materials in the area. This memorandum summarises the site visit observations and supplementary data from laboratory testing of samples collected (water and rock).

BRL note that no Kaiata Mudstone or colluvium will be used as foundations for the proposed UWHR due to its poor geotechnical properties. These materials will be carted to either end of the UWHR for disposal. Such materials may have benefits for the other project areas (i.e., cover/capping material).

OVERVIEW

The following provides an overview of the key findings from the site visit:

- The site visit provided a good perspective of the proposed UWHR alignment.
- BRL has advised that cut material, which is geotechnically (or otherwise) unsuitable to be used within fill sections (such as Kaiata Mudstone and colluvium) is to be removed from the site and will be disposed of accordingly within existing waste disposal areas at Stockton and Escarpment Extended (ESE) in accordance with existing operational waste management practices.
- The proposed UWHR alignment is over the Ironbridge Mine underground workings. An image of these workings is available in Attachment A.

¹ Acid and metalliferous drainage

² PAF – potentially acid forming

³ NAF = non-acid forming

- Highly weathered Kaiata Mudstone was identified in a few locations. There may be benefit in using these materials as a capping layer to limit water and oxygen ingress into PAF materials. The quantities (hence the actual opportunity) are not defined.
- The UWHR sub-area has significant colluvium, landslide deposits, and talus, which has been mobilised from further up the slope. If these materials are from rocks that can generate AMD (e.g., a PAF material source upslope), then further characterisation is required on the geochemical nature of the colluvium. This has been seen at other projects in the area due to the deposition of landslide materials (e.g., Malloch et al., 2017).
- The geological / geochemical model needs to be validated during construction of the UWHR. For instance, further consideration is required for leaching of NAF Kaiata mudstone by net infiltration of rainfall over geological timeframes as this can leach out carbonate minerals yet preserve sulfides such that the 30 m cut-off above the Kaiata/BCM contact observed at Cypress (i.e., $\text{NAPP} = 0 \text{ kg H}_2\text{SO}_4/\text{t}$) may not apply. This has been demonstrated at Cypress Mine (McLachlan, 2022) as shown in Figure 1 where NAF Kaiata Mudstone has been converted to PAF (Weathered Kaiata).
- As part of road construction, further geotechnical drilling and geochemical analysis along the length of the UWHR, should be undertaken to validate the geological and geochemical model.
- Seepage from undisturbed catchments/ drainage paths was elevated in Fe (pH 4-5), most likely a function of groundwater interacting with geological materials elevated in Fe-bearing minerals (e.g., pyrite; Fe-carbonates). Such seeps are shown in Figure 2. This suggests that Fe will be present in seepage from NAF Kaiata Mudstone engineered landforms.
- A number of rock samples and water samples were collected during the site visit. Data are presented in Table 1 and Table 2. Results indicated the presence of PAF material and poor water quality in some areas (e.g., roadside ditches through BCM). This included elevated Al, Cu, and pH that is non-complaint with resource consent limits (RC10193) for the existing Escarpment Mine (both $> \text{pH } 6$ and also $< \text{pH } 4.5$).

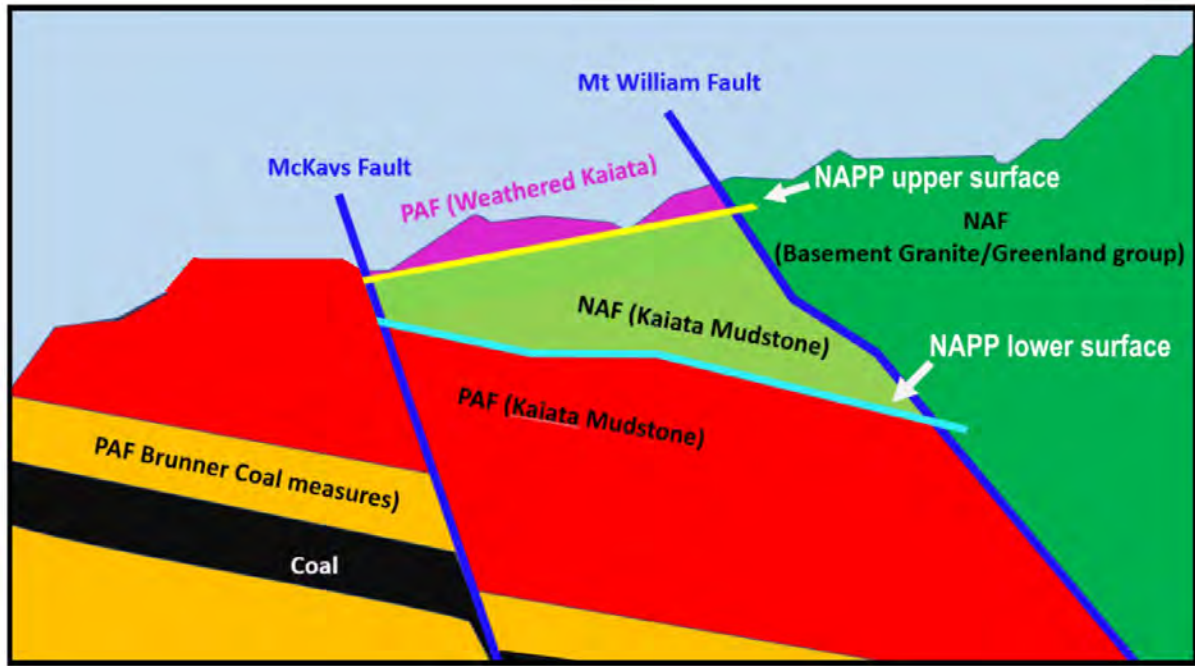


Figure 1. Geological / geochemical model for the Cypress Coal Mine.

Source: McLachlan (2022)



Site 7 – stream bank



Site 10 – water sample only

Figure 2: Fe-staining associated with seepage from groundwater / near surface flow through Kaiata Mudstone. These are naturally occurring seeps and are likely due to the underlying geology of immediate area.

SITE VISIT NOTES

The assessment of lithological units was completed using the BRL high level Cypress geological model (Geological Model). This model is contained in Attachment A

The following sites were visited:

Site 1: Brunner Coal Measures

- Coalbrookdale gate house and sign in to Cascade Mine.
- Exposed outcrops on plateau area.

- Laminated sandstone/siltstone with jarosite staining (weathered) – Sample WHR#1.
- Overlain by a sandstone pavement (indurated)– Sample WHR#2.

Site 2: Brunner Coal Measures

- Roadside cutting.
- Siltstone/mudstone/carbonaceous materials – Sample WHR#3.

Site 3: Brunner Coal Measures

- Roadside cutting.
- PAF drainage along road ditch. Upper sections (~10%) is coarse PAF sandstone
- ~100m of roadside drain.
- Near to G3 location sign.
- Water Sample: Sample Site 3 taken to understand PAF AMD runoff from exposed material/walls.

Site 4: Contact between Brunner Coal Measures and Kaiata Mudstone

- pH in Drain (indicator strips) ~ 4.
- Identified as PAF Kaiata Mudstone as indicated by the Geological Model.
- KM is dark brown and friable.
- Sample WHR#4 obtained.

Site 5: Kaiata Mudstone

- Kaiata Mudstone – Dark Brown and Friable.
- pH 4 in roadside ditch (indicator strips).
- Sample WHR#5.

Site 6: Kaiata Mudstone

- Kaiata Mudstone – potentially NAF as indicated by the Geological Model.
- Highly weathered (spheroidal weathering) – dark grey; iron oxidation.
- Riverbank of the Waimangaroa River.
- Sample WHR#6.

Site 7: Kaiata Mudstone

- Stream bank.
- Reasonably competent grey/brown Kaiata Mudstone.
- Seep pH 5 draining into stream – iron staining (see Figure 2).

- As indicated by the Geological Model, this sample was assumed to be PAF Kaiata - – Sample WHR#7.

Site 8: Kaiata Mudstone

- Access to Power Line.
- Grey Kaiata Mudstone – Sample WHR#8.

Site 9: Kaiata Mudstone

- Grey Kaiata Mudstone.
- The Geological Model suggest NAF Kaiata – Sample WHR#9.

Site 10: Natural AMD Seep

- AMD seep beside the road (Fe precipitates).
- Water Sample taken – Site 10.
- pH 5.
- Source is unknown (underground discharge / natural / road cutting?).

Site 11: Kaiata Mudstone

- Grey Kaiata Mudstone from roadside ditch – Sample WHR#11.

Site 12: Highly Weather Kaiata Mudstone

- Highly weathered Kaiata Mudstone.
- Sample 11 taken from grey materials below this sample.
- High clay content – Sample WHR#12.

Site 13: Kaiata Mudstone

- Grey Kaiata Mudstone – Sample WHR#13.

The site locations are shown in Figure 3.

GEOCHEMICAL DATA

Water samples and rock samples were collected along the southern length of the UWHR. Sample locations are shown in Attachment A and in Figure 3. The following samples were collected:

- 12 surface rock chip samples
- 3 water samples

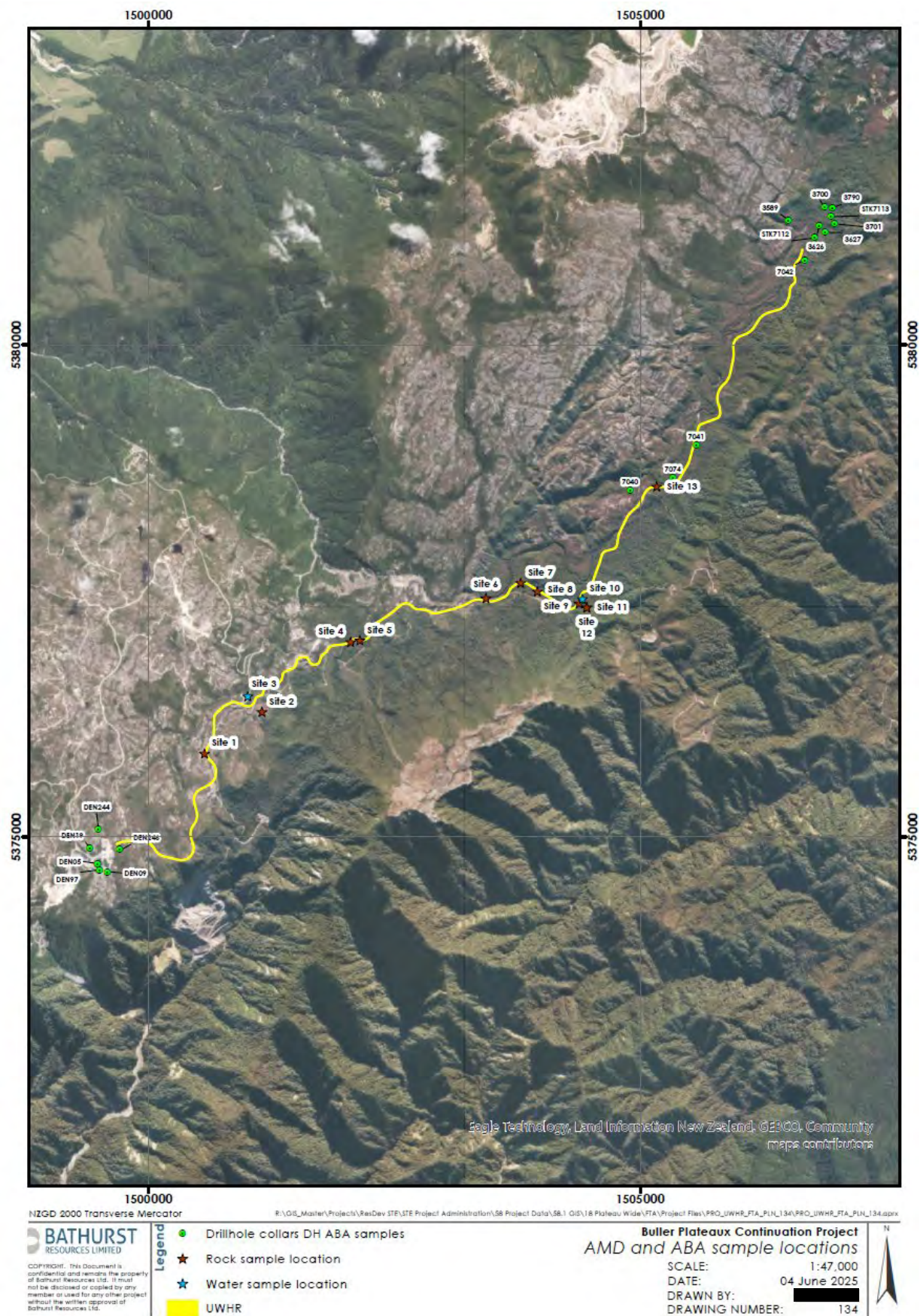


Figure 3: Map of sampling locations.

Note: Drillhole ABA data are discussed in MWM (2026).

Geochemical Data Review

Acid Base Accounting (ABA) data are provided in Table 1. The following comments are provided on these data:

- Rinse pH was generally low (< pH 5.3) for all samples except for one sample that had a rinse pH (Sample WHR#9) of 7.98. The most reasonable explanation for this is that these near surface samples have been weathered with the oxidation of sulfides (generating acidic oxidation products as evidenced by low rinse pH data).
- Brunner coal measure samples had very little ANC⁴, which is in agreement with general observations of this lithological unit elsewhere in the Buller coalfield.
- Three samples had negative ANC values, which align with low rinse pH values and demonstrate the samples contain acidic salts.
- A sample of sandstone pavement (Sample WHR#2) had very low sulfur and was classified as NAF by the NAPP⁵ calculation.
- Some samples identified as NAF Kaiata Mudstone in the Geological Model (see Attachment A) had very little ANC and were acid generating. This might be due to the leaching of carbonates within near-surface materials (as seen at Cypress – see Figure 1).
- There is a good relationship between NAPP and NAG acidity demonstrating the data are reliable.

⁴ Acid Neutralisation Capacity (determined by acid digestion of the sample followed by back titration to determine how much acid has been consumed – further details available [AMIRA, 2002]).

⁵ Where NAPP (Net Acid Producing Potential) = MPA – ANC (MPA = maximum potential acidity = wt% S x 30.6

Table 1: Acid Base Accounting Data – Proposed UWHR.

LOCATION	DESCRIPTION	SAMPLE NO	RINSE pH	RINSE EC	SULFUR	ANC	NAPP	NAG pH	NAG pH 4.5	NAG pH 7	AMIRA CLASSIFICATION
					wt%	kg H ₂ SO ₄ /t	kg H ₂ SO ₄ /t		kg H ₂ SO ₄ /t	kg H ₂ SO ₄ /t	
Site 1	Brunner Coal Measures-laminated sandstone/siltstone	WHR#1	3.12	546	2.46	-2.2	75.28	2.35	55.05	64.45	PAF
Site 1	Brunner Coal Measures-siltstone pavement	WHR#2	4.90	13.4	0.055	1.7	-0.03	4.75	-	5.67	NAF
Site 2	Brunner Coal Measures-siltstone/mudstone/carbonaceous materials	WHR#3	3.58	122	0.28	0.2	8.33	3.31	8.42	22.72	PAF
Site 4	Dark Brown friable Kaiata Mudstone	WHR#4	3.47	203	1.39	-3.7	42.53	2.68	18.80	31.14	PAF
Site 5	Dark Brown friable Kaiata Mudstone	WHR#5	3.61	238	1.64	3.7	46.49	2.57	25.47	43.49	PAF
Site 6	Weathered dark grey Kaiata Mudstone	WHR#6	3.49	305	0.68	-1.2	20.75	3.25	6.45	17.01	PAF
Site 7	Grey/brown Kaiata Mudstone	WHR#7	4.53	92.0	1.17	17.2	18.59	2.83	13.67	29.29	PAF
Site 8	Grey Kaiata	WHR#8	3.84	236	2.04	14.6	47.78	2.46	35.64	55.62	PAF
Site 9	Grey Kaiata	WHR#9	7.98	365	1.86	92.9	-36.00	6.62	-	0.59	NAF
Site 11	Grey Kaiata	WHR#11	5.29	129	1.72	25.6	27.00	2.58	26.82	43.85	PAF
Site 12	Grey Kaiata	WHR#12	4.14	75.3	0.087	2.4	0.22	4.18	1.37	16.23	PAF
Site 13	Grey Kaiata	WHR#13	3.61	318	2.83	11.0	75.60	2.24	54.54	77.8	PAF

Further details on test methods are available (AMIRA, 2002).

Water Quality Data

Two water samples (Site 3 and Site 10) were collected during the site visit. These data are presented in Table 2. The water quality consent conditions (RC10193) for the existing Escarpment Mine (Table 2) were used as reference values for determining potential constituents of concern (PCOC) that are elevated across the monitoring sites. Although the consent conditions are for compliance at the downstream monitoring site W-M2 below the Escarpment Mine, these limits are useful for contextualising the potential impacts of AMD for the Project.

Table 2: Water Quality Data – Proposed UWHR.

PARAMETER NAME	UNITS	SITE 3	SITE 10	WATER QUALITY REFERENCE VALUE ²
Lab ID		817-2024-00088098	817-2024-00088099	
Total Alkalinity	mg CaCO ₃ /L	<1	43	
Chloride	mg/l	3.57	4.65	
Sulfate	mg/l	17.2	4.22	
Conductivity	mS/m	7.9	12.0	
Dissolved Aluminium	mg/l	0.844	0.011	0.5
Dissolved Antimony	mg/l	<0.001	<0.001	
Dissolved Boron	mg/l	<0.03	<0.03	
Dissolved Cadmium	mg/l	<0.0002	<0.0002	0.0012 / 0.0003
Dissolved Calcium	mg/l	0.3	11.7	
Dissolved Chromium	mg/l	<0.001	<0.001	0.20 / 0.05
Dissolved Cobalt	mg/l	0.0012	0.0009	0.18 / 0.044
Dissolved Copper	mg/l	0.0030	<0.0005	0.0013 / 0.002
Dissolved Iron	mg/l	1.06	0.91	1.1 ¹
Dissolved Lead	mg/l	0.0007	<0.0005	0.026 / 0.0065
Dissolved Magnesium	mg/l	0.44	6.60	
Dissolved Manganese	mg/l	0.0238	0.383	1.1 ¹
Dissolved Mercury	mg/l	<0.0005	<0.0005	
Dissolved Nickel	mg/l	0.0058	0.0015	0.068 / 0.017
Dissolved Potassium	mg/l	0.52	0.32	
Dissolved Selenium	mg/l	<0.005	<0.005	
Dissolved Sodium	mg/l	3.05	3.75	
Dissolved Tin	mg/l	<0.0005	<0.0005	
Dissolved Zinc	mg/l	0.022	<0.002	0.054 / 0.012
pH		3.8	7.0	4.5 – 6.5
Suspended Solids	mg/l	26	13	15
Total Dissolved Solids	mg/l	44	79	
Turbidity	NTU	19.1	15.7	15
Acidity to pH 8.3	mg CaCO ₃ /L	15	14	
Dissolved Silica	mg/l	4.99	4.01	
Dissolved Arsenic	mg/l	<0.001	0.002	
Dissolved Thallium	mg/l	<0.0005	<0.0005	

1. The RC10193 compliance limit for Fe and Mn is a combined value of 1.1 mg/L
2. Several PCOC have two limits depending on whether the pH < 5.5 or the pH > 5.5 as per the RC10193 consent conditions for Escarpment Mine.
3. Red data are elevated against the water quality reference value.

Results show that a number of parameters exceed the water quality reference values for the two samples. The following comments are provided:

- The seepage identified at Site 10 had a pH > 6.5 as well as high alkalinity (43 mg/L CaCO₃ equivalent). Also in this location was site 9 with Sample WHR#9 being identified as NAF Kaiata Mudstone, which suggest the source of this seepage might be from NAF Kaiata Mudstone.
- The water sample collected in the roadside ditch (Site 3) was low pH (pH 3.8)
- Sulfate is low (< 20 mg/L), but higher in the roadside cutting water sample.
- Al and Cu are elevated in acidic drainage associated with the road cutting through BCM.
- The sample from Site 3 is likely to be a reasonable datapoint for water quality derived from highwalls cut through the BCM.

Summary

The following summary is provided:

- Geochemical data suggest the Geological Model is reasonably reliable, although some mudstone materials might be Brunner Coal Measures rather than Kaiata Mudstone. Regardless they are PAF. All materials should be treated as PAF unless geochemical data demonstrates otherwise.
- Leaching of carbonates within the Kaiata Mudstone is possible, as seen at Cypress (Figure 1), with surface materials more likely to be PAF than the same materials at depth. This might explain why some samples mapped as NAF Kaiata Mudstone are now PAF Kaiata Mudstone.
- Some highly weathered Kaiata Mudstone was identified, which was low in sulfur and low in ANC and might be useful capping materials for PAF materials. Further geochemical testing as part of road construction activities should be undertaken to confirm that such materials are benign, the quantity available, and the ability to be compacted into a low permeability layer.
- No colluvium materials were assessed as part of this study and may also have benefits for capping of PAF materials if future work, as part of road construction activities identified it is NAF.
- Water quality data indicates that poor water quality is present in the area associated with the road cutting and also natural seeps within the area.

CLOSING REMARKS

Please do not hesitate to contact Paul Weber at paul.weber@minewaste.com.au should you wish to discuss this memorandum in greater detail.

Attachments: Attachment A – UWHR Geochem Sampling
Attachment B – Laboratory Reports

REFERENCES

AMIRA, 2002. ARD Test Handbook - Project P387A Prediction and Kinetic Control of Acid Mine Drainage. AMIRA International Limited. Melbourne, Australia.

Malloch, K.R., Weber, P.A., Olds, W.E., 2017. Acid and Metalliferous Drainage Potential of an Alluvial Gold Mine Operation. New Zealand Annual AusIMM Branch Conference, Christchurch, 10 - 13 September, 154 – 163.

MWM, 2026. BPCP AMD Hazard Classification Summary. Mine Waste Management Report No. J-NZ0453-003-R-FINAL.

McLachlan, C., 2022. Determination of Acid Producing Potential Using pXRF: A Case Study from Cypress Mine, Stockton Plateau. IMWA 2022, Christchurch, New Zealand, pp. 253 – 258.

ATTACHMENT A – UWHR GEOCHEM SAMPLING

Upper Waimangaroa Haul Road

AMD sampling of Geology along Alignment

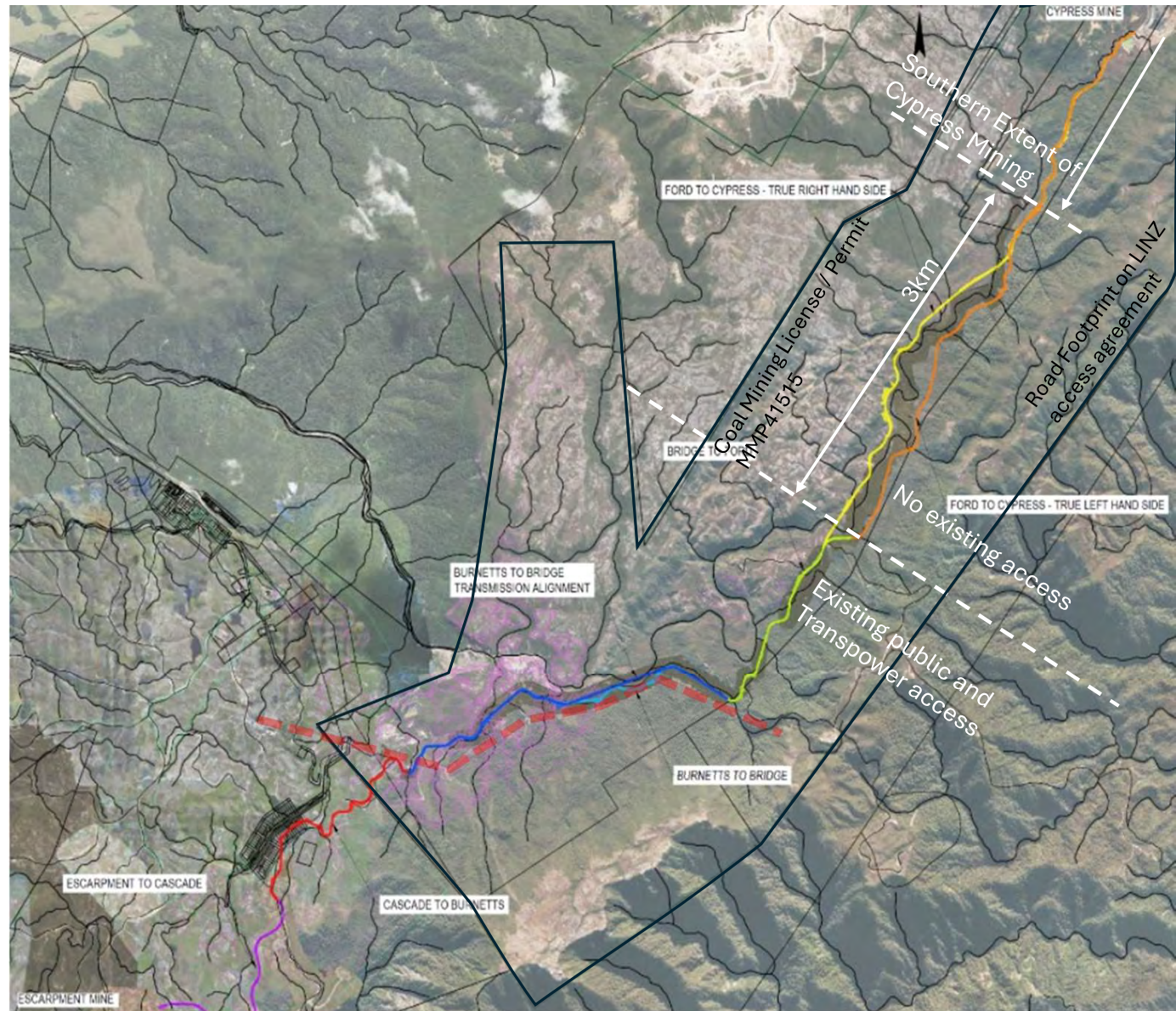
Objectives – AMD Sampling

- Confirm Geological classification of NAF and PAF Kaiata Mudstone
- Some Brunner Coal Measures sampled:
 - AMD potential very difficult to estimate as different lithologies have different sulphide contents
 - Will need sampling of drill core along road alignment to link AMD potential to Lithologies and volumes
 - The outcomes of this will be critical for the potential use of BCM as fill and rock armouring materials

GHD Alignment Options considered 2023 (concept)

19km haul (one way)

70min cycle time



Brunner Coal Measures (good road foundations) - NAF/PAF? - Excess of Engineering suitable fill (~20k BCM)

- Mix of coarse and fine sandstones (NAF?) with sandstone and siltstone (PAF?). ANC?



Sample sites

	Northing	Easting	Description	Notes
Site 1	-41.762969	171.80386	Brunner Coal Measures	Jarrasite
Site 2	-41.759234	171.810957	Brunner Coal Measures	Siltstone, Mudstone, Carbonaceous Units
Site 3	-41.757795	171.809245	Seepage	
Site 4	-41.752951	171.821913	Kaiata Mudstone PAF, pH4 water in drain	pH4 water in drain
Site 5	-41.752811	171.823044	Kaiata Mudstone PAF, pH4 water in drain	pH4 water in drain
Site 6	-41.749112	171.838523	Kaiata Mudstone NAF	
Site 7	-41.747756	171.842789	Kaiata Mudstone PAF	
Site 8	-41.748558	171.844815	Kaiata Mudstone PAF	Greyer than other PAF Kaiata
Site 9	-41.749698	171.849896	Kaiata Mudstone NAF	Grey colour
Site 10	-41.749303	171.850301	Typical weep expected	pH5.5 water in drain
Site 11	-41.750064	171.85083	Kaiata Mudstone NAF	Good Capping Material
Site 12	-41.750095	171.850817	Weathered Kaiata Mudstone Cap	potentially become PAF as carbonates have leached out
Site 13	-41.739106	171.859569	Kaiata Mudstone NAF	

Cascade to Burnetts Face

- Drill holes within 100m of road centerline

Rock Units intersected by Road Design

■ Brunner Coal Measures

GNS faults

— Inactive fault, exposed

GNS Geological Units

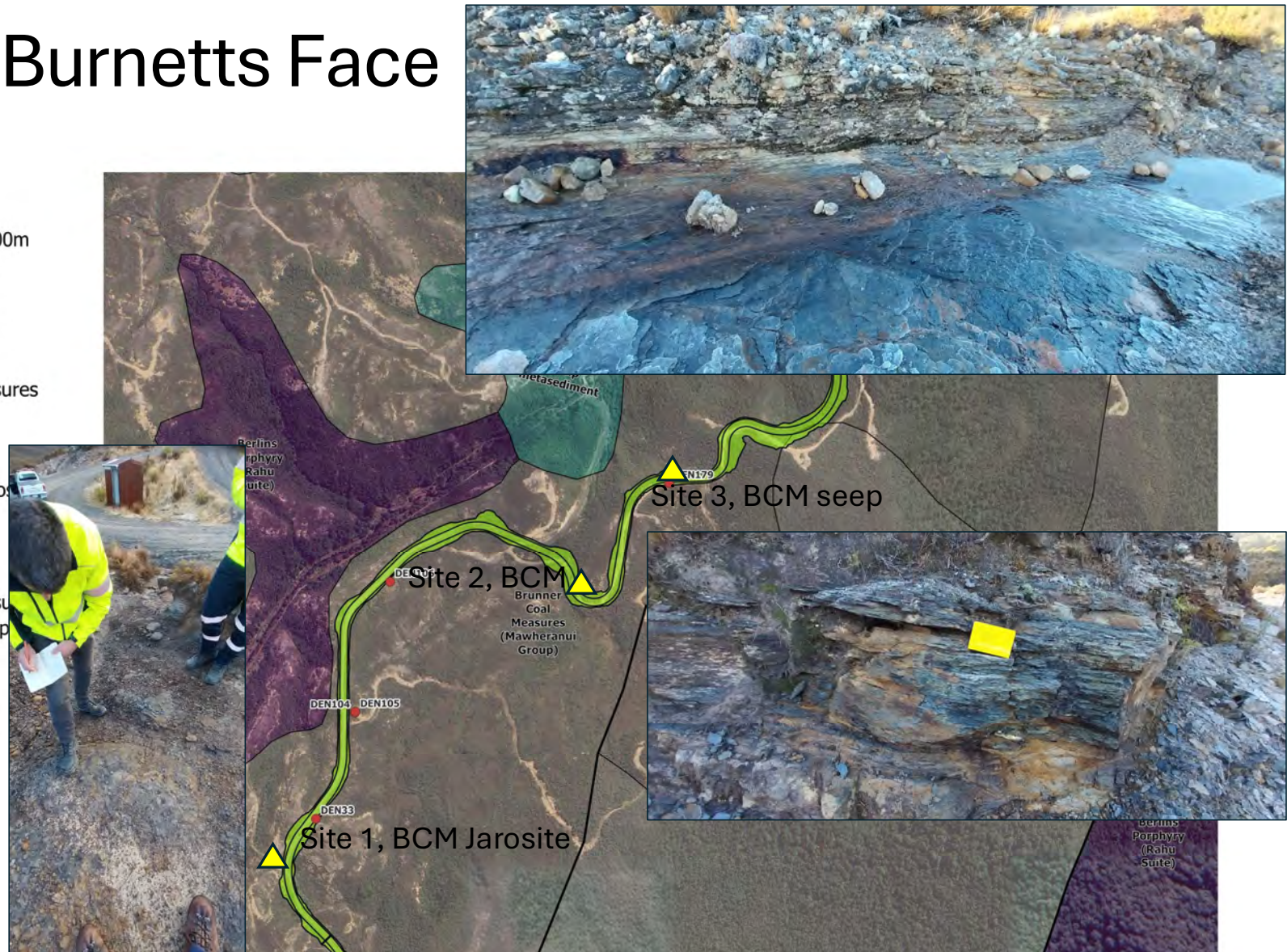
■ Berlins Porphyry (Rahu Suite)

■ Brunner Coal Measures (Mawheranui Group)

■ Greenland Group metasediment

■ Kaiata Formation (Rapahoe Group)

Google Satellite



Burnetts Face to Bridge

- Drill holes within 100m of road centerline

Rock Units intersected by Road Design

- Brunner Coal Measures
- NAF Kaiata Mudstone
- PAF Kaiata Mudstone

GNS faults

— Inactive fault, exposed

GNS Geological Units

- Berlins Porphyry (Rahu Suite)
- Brunner Coal Measures (Mawheranui Group)
- Greenland Group metasediment
- Kaiata Formation (Rapahoe Group)

Google Satellite



Burnetts Face to Bridge

- Drill holes within 100m of road centerline

Rock Units intersected by Road Design

- Brunner Coal Measures
- NAF Kaiata Mudstone
- PAF Kaiata Mudstone

GNS faults

— Inactive fault, exposed

GNS Geological Units

- Berlins Porphyry (Rahu Suite)
- Brunner Coal Measures (Mawheranui Group)
- Greenland Group metasediment
- Kaiata Formation (Rapahoe Group)

Google Satellite



Site 8, KMS PAF in geo model

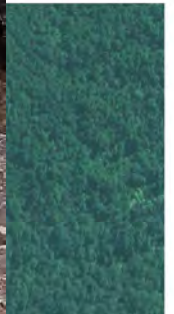
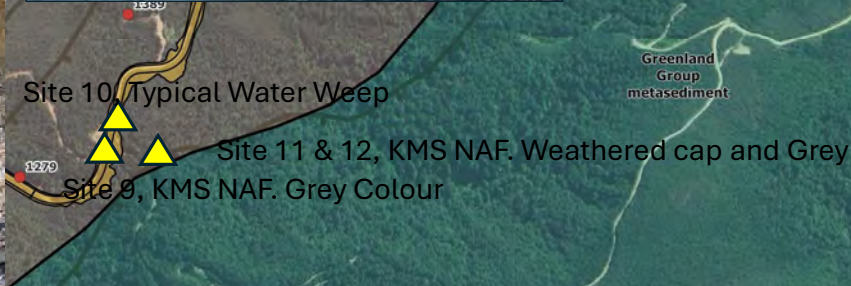
Site 8, KMS PAF. But Greyer



Bridge to Ford

- Drill holes within 100m of road centerline

Rock Units intersected



Ford to Cypress

- Drill holes within 100m of road centerline
- Cypress Consent Footprint

Rock Units intersected by Road Design

- Brunner Coal Measures
- NAF Kaiata Mudstone
- PAF Kaiata Mudstone

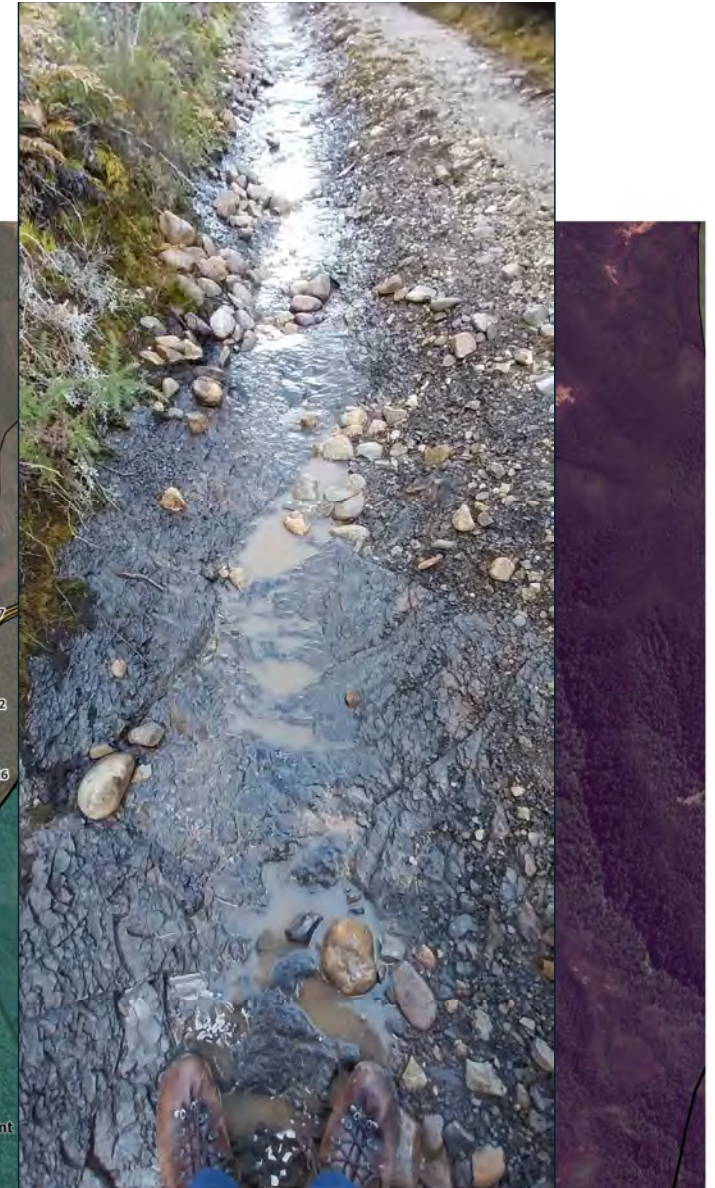
GNS faults

- Inactive fault, exposed

GNS Geological Units

- Berlins Porphyry (Rahu Suite)
- Brunner Coal Measures (Mawheranui Group)
- Greenland Group metasediment
- Kaiata Formation (Rapahoe Group)

Google Satellite



Road Alignment and Ironbridge UG workings

Workings are extensive and alignments that don't traverse the workings are not possible. Typical ground prep for traversing with heavy equipment will involve rubblisation of the road foundations with potential AMD consequences

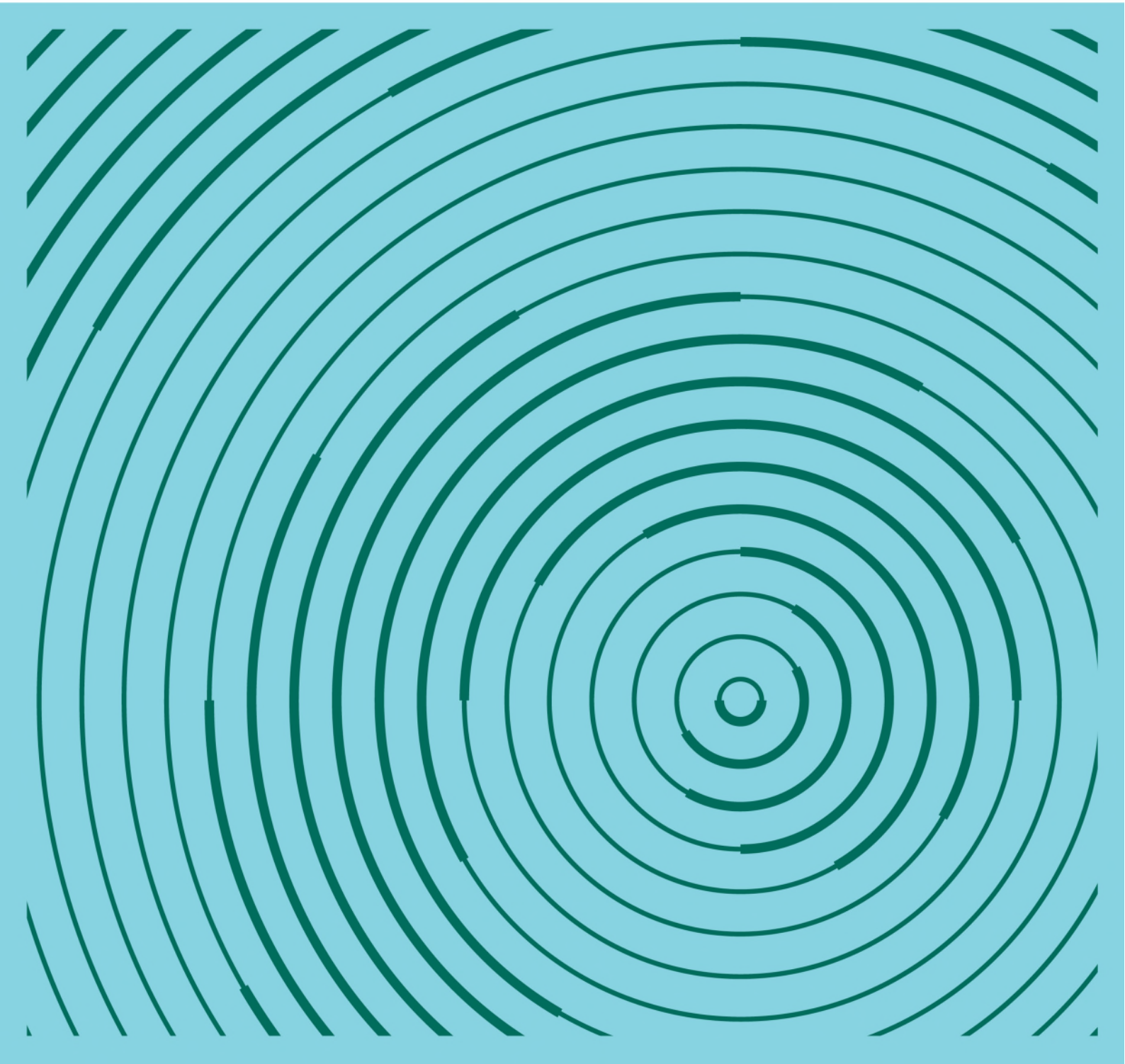


ATTACHMENT B – LABORATORY REPORTS

ABA analysis

Prepared for
Mine Waste
Management

August 2024
25-000676



Author M.Young

Verum Group reference 25-000676

Client name Mine Waste Management

Client address

**Distribution
(other than client)** Nil

Date of Issue 15/08/2024

Reviewed by Mike Young
National Laboratory Manager

Approved by Mike Young
National Laboratory Manager

Document tracking

Version	Date	Changes made	Reviewer(s)

Confidentiality Clause:

This document and any accompanying attachments are confidential to the intended recipient. The document may contain information that is subject to legal privilege. The contents may not be passed on or copied in whole or part, for or by any third party. Any form of reproduction, dissemination, copying, disclosure, modification, distribution and/or publication of this document or attachments is strictly prohibited.

1. Method Notes

Sample prep	Samples were received were dried and crushed in a ring mill with a split then crushed in the ring mill and screened to confirm fineness.	
1 - Rinse pH/EC	Sample <6mm, 30g sample, 150mL water. Measured after 12 hours	
2 – Total Sulphur	Leco combustion furnace	
3 – ANC Acid Neutralising Capacity	AMIRA Handbook 2002 (App C)	Client provided fizz rating.
4 – NAG Net Acid Generation	AMIRA Handbook 2002 (App D)	Results for titration to pH 4.5 and/or pH 7.0. If the pH after H ₂ O ₂ digestion was greater than 7 no titration was required.

A total of 12 samples were received. Samples were identified with as WHR#1-13 (#10 was not included).

All samples were tested for the five properties listed in the table above.

Quality assurance and sample duplicates were run as required by the methods.

Data is included in this report and also supplied as an Excel file.

2. Sample and Analysis data

Rinse pH, Electrical Conductivity and Sulphur					
Location	Description	Sample No	Rinse pH	Rinse EC	Sulphur %w
Site 1	Brunner Coal Measures- laminated sandstone/siltstone	WHR#1	3.12	546	2.46
Site 1	Brunner Coal Measures- siltstone pavement	WHR#2	4.90	13.4	0.055
Site 2	Brunner Coal Measures- siltstone/mudstone/carbonaceous materials	WHR#3	3.58	122	0.28
Site 4	Dark Brown friable Kaiata Mudstone	WHR#4	3.47	203	1.39
Site 5	Dark Brown friable Kaiata Mudstone	WHR#5	3.61	238	1.64
Site 6	Weatherd dark grey Kaiata Mudstone	WHR#6	3.49	305	0.68
Site 7	Grey/brown Kaiata Mudstone	WHR#7	4.53	92.0	1.17
Site 8	Grey Kaiata	WHR#8	3.84	236	2.04
Site 9	Grey Kaiata	WHR#9	7.98	365	1.86
Site 11	Grey Kaiata	WHR#11	5.29	129	1.72
Site 12	Grey Kaiata	WHR#12	4.14	75.3	0.087
Site 13	Grey Kaiata	WHR#13	3.61	318	2.83
Acid Neutralising Capacity					
Location	Description	Sample No	Fizz rating*	Digested pH	kg H ₂ SO ₄ /t %CaCO ₃
Site 1	Brunner Coal Measures- laminated sandstone/siltstone	WHR#1	0	1.97	0.00
Site 1	Brunner Coal Measures- siltstone pavement	WHR#2	0	1.98	0.17
Site 2	Brunner Coal Measures- siltstone/mudstone/carbonaceous materials	WHR#3	0	2.05	0.02
Site 4	Dark Brown friable Kaiata Mudstone	WHR#4	2	1.39	0.00
Site 5	Dark Brown friable Kaiata Mudstone	WHR#5	2	1.52	0.38
Site 6	Weatherd dark grey Kaiata Mudstone	WHR#6	2	1.63	0.00
Site 7	Grey/brown Kaiata Mudstone	WHR#7	2	1.66	1.76
Site 8	Grey Kaiata	WHR#8	2	1.48	1.49
Site 9	Grey Kaiata	WHR#9	2	1.92	9.48
Site 11	Grey Kaiata	WHR#11	2	1.52	25.63
Site 12	Grey Kaiata	WHR#12	2	1.40	0.25
Site 13	Grey Kaiata	WHR#13	2	1.34	1.12
*ANC Fizz rating provided by client					
Net Acid Generation					
Location	Description	Sample No	NAG pH after digest	NAG pH 4.5 kg H ₂ SO ₄ /t	NAG pH 7 kg H ₂ SO ₄ /t
Site 1	Brunner Coal Measures- laminated sandstone/siltstone	WHR#1	2.35	55.05	64.45
Site 1	Brunner Coal Measures- siltstone pavement	WHR#2	4.75	-	5.67
Site 2	Brunner Coal Measures- siltstone/mudstone/carbonaceous materials	WHR#3	3.31	8.42	22.72
Site 4	Dark Brown friable Kaiata Mudstone	WHR#4	2.68	18.80	31.14
Site 5	Dark Brown friable Kaiata Mudstone	WHR#5	2.57	25.47	43.49
Site 6	Weatherd dark grey Kaiata Mudstone	WHR#6	3.25	6.45	17.01
Site 7	Grey/brown Kaiata Mudstone	WHR#7	2.83	13.67	29.29
Site 8	Grey Kaiata	WHR#8	2.46	35.64	55.62
Site 9	Grey Kaiata	WHR#9	6.62	-	0.59
Site 11	Grey Kaiata	WHR#11	2.58	26.82	43.85
Site 12	Grey Kaiata	WHR#12	4.18	1.37	16.23
Site 13	Grey Kaiata	WHR#13	2.24	54.54	77.8

Food & Water Testing

ANALYTICAL REPORT

REPORT CODE	AR-24-NC-024177-01	REPORT DATE	07/08/2024
Attention	BT Mining Ltd [REDACTED] [REDACTED] Chistchurch NEW ZEALAND		
Phone	[REDACTED]	Copy to:	[REDACTED]
Email	[REDACTED]		

Contact for your orders:	[REDACTED]	Order code:	EUNZCH-00185875
Submission Reference:	[REDACTED] haul road sampling	Purchase Order Number:	[REDACTED]

SAMPLE CODE	817-2024-00088098		
Sample Name	Site 3		
Reception Date & Time:	30/07/2024 8:30	Reception temperature:	14 °C
Analysis Started on:	30/07/2024	Analysis Ending Date:	07/08/2024
Product Type	Surface Water	Sampler(s)	[REDACTED]
Sampled Date & Time	24/07/2024 00:00		

		RESULTS		LOQ
②NW345	Acidity to pH 8.3			
	Acidity	15	mg CaCO3/l	1
②NW007	Chloride			
	Chloride (Cl)	3.57	mg/l	0.02
②NW023	Conductivity			
	Conductivity	7.9	mS/m	0.1
②NW098	Dissolved Aluminium			
	Aluminium	0.844	mg/l	0.002
②NW099	Dissolved Antimony			
	Antimony (Sb)	<0.001	mg/l	0.001
②NW583	Dissolved Arsenic			
	Arsenic (As)	<0.001	mg/l	0.001
②NW103	Dissolved Boron			
	Boron (B)	<0.03	mg/l	0.03
②NW104	Dissolved Cadmium			
	Cadmium (Cd)	<0.0002	mg/l	0.0002
②NW105	Dissolved Calcium			
	Calcium (Ca)	0.3	mg/l	0.1
②NW106	Dissolved Chromium			
	Chromium (Cr)	<0.001	mg/l	0.001
②NW107	Dissolved Cobalt			
	Cobalt (Co)	0.0012	mg/l	0.0005
②NW108	Dissolved Copper			
	Copper (Cu)	0.0030	mg/l	0.0005
②NW109	Dissolved Iron			
	Iron (Fe)	1.06	mg/l	0.01
②NW110	Dissolved Lead			
	Lead (Pb)	0.0007	mg/l	0.0005
②NW112	Dissolved Magnesium			

Food & Water Testing

RESULTS			LOQ
②NW112	Dissolved Magnesium Magnesium (Mg)	0.44 mg/l	0.01
②NW113	Dissolved Manganese Manganese (Mn)	0.0238 mg/l	0.0005
②NW114	Dissolved Mercury Mercury (Hg)	<0.0005 mg/l	0.0005
②NW116	Dissolved Nickel Nickel (Ni)	0.0058 mg/l	0.0005
②NW117	Dissolved Potassium Potassium (K)	0.52 mg/l	0.01
②NW118	Dissolved Selenium Selenium (Se)	<0.005 mg/l	0.005
②NW472	Dissolved Silica Sand/silica	4.99 mg/l	0.02
②NW120	Dissolved Sodium Sodium (Na)	3.05 mg/l	0.01
②NW584	Dissolved Thallium Thallium (Tl)	<0.0005 mg/l	0.0005
②NW122	Dissolved Tin Tin (Sn)	<0.0005 mg/l	0.0005
②NW125	Dissolved Zinc Zinc (Zn)	0.022 mg/l	0.002
②NW195	pH (Tested beyond 15 minute APHA holding time) pH	3.8	0.1
②NW011	Sulphate Sulphate	17.2 mg/l	0.02
②NW206	Suspended Solids Suspended Solids	26 mg/l	3
②NW003	Total Alkalinity Alkalinity total	<1 mg CaCO3/l	1
②NW208	Total Dissolved Solids Total dissolved Solids	44 mg/l	10
②NW212	Turbidity Turbidity	19.1 NTU	0.01

SAMPLE CODE	817-2024-00088099		
Sample Name	Site 10		
Reception Date & Time:	30/07/2024 8:30	Reception temperature:	14 °C
Analysis Started on:	30/07/2024	Analysis Ending Date:	07/08/2024
Product Type	Surface Water	Sampler(s)	
Sampled Date & Time	24/07/2024 00:00		

RESULTS			LOQ
②NW345	Acidity to pH 8.3 Acidity	14 mg CaCO3/l	1
②NW007	Chloride Chloride (Cl)	4.65 mg/l	0.02
②NW023	Conductivity Conductivity	12.0 mS/m	0.1

Food & Water Testing

RESULTS		LOQ	
②NW098	Dissolved Aluminium Aluminium	0.011 mg/l	0.002
②NW099	Dissolved Antimony Antimony (Sb)	<0.001 mg/l	0.001
②NW583	Dissolved Arsenic Arsenic (As)	0.002 mg/l	0.001
②NW103	Dissolved Boron Boron (B)	<0.03 mg/l	0.03
②NW104	Dissolved Cadmium Cadmium (Cd)	<0.0002 mg/l	0.0002
②NW105	Dissolved Calcium Calcium (Ca)	11.7 mg/l	0.1
②NW106	Dissolved Chromium Chromium (Cr)	<0.001 mg/l	0.001
②NW107	Dissolved Cobalt Cobalt (Co)	0.0009 mg/l	0.0005
②NW108	Dissolved Copper Copper (Cu)	<0.0005 mg/l	0.0005
②NW109	Dissolved Iron Iron (Fe)	0.91 mg/l	0.01
②NW110	Dissolved Lead Lead (Pb)	<0.0005 mg/l	0.0005
②NW112	Dissolved Magnesium Magnesium (Mg)	6.60 mg/l	0.01
②NW113	Dissolved Manganese Manganese (Mn)	0.383 mg/l	0.0005
②NW114	Dissolved Mercury Mercury (Hg)	<0.0005 mg/l	0.0005
②NW116	Dissolved Nickel Nickel (Ni)	0.0015 mg/l	0.0005
②NW117	Dissolved Potassium Potassium (K)	0.32 mg/l	0.01
②NW118	Dissolved Selenium Selenium (Se)	<0.005 mg/l	0.005
②NW472	Dissolved Silica Sand/silica	4.01 mg/l	0.02
②NW120	Dissolved Sodium Sodium (Na)	3.75 mg/l	0.01
②NW584	Dissolved Thallium Thallium (Tl)	<0.0005 mg/l	0.0005
②NW122	Dissolved Tin Tin (Sn)	<0.0005 mg/l	0.0005
②NW125	Dissolved Zinc Zinc (Zn)	<0.002 mg/l	0.002
②NW195	pH (Tested beyond 15 minute APHA holding time) pH	7.0	0.1
②NW011	Sulphate Sulphate	4.22 mg/l	0.02



NEW ZEALAND

Phone
www.eurofins.co.nz

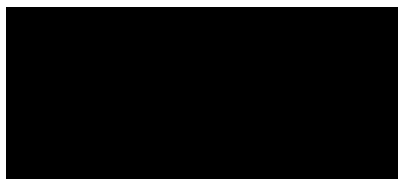
Food & Water Testing

	RESULTS		LOQ
②NW206 Suspended Solids			
Suspended Solids	13	mg/l	3
②NW003 Total Alkalinity			
Alkalinity total	43	mg CaCO ₃ /l	1
②NW208 Total Dissolved Solids			
Total dissolved Solids	79	mg/l	10
②NW212 Turbidity			
Turbidity	15.7	NTU	0.01

LIST OF METHODS

NW003 Total Alkalinity: APHA Online Edition 2320 B	NW007 Chloride: APHA Online Edition 4110 B
NW011 Sulphate: APHA Online Edition 4110 B	NW023 Conductivity: APHA 24th Edition 2510 B
NW098 Dissolved Aluminium: APHA Online Edition 3125 B mod.	NW099 Dissolved Antimony: APHA Online Edition 3125 B mod.
NW103 Dissolved Boron: APHA Online Edition 3125 B mod.	NW104 Dissolved Cadmium: APHA Online Edition 3125 B mod.
NW105 Dissolved Calcium: APHA Online Edition 3125 B mod.	NW106 Dissolved Chromium: APHA Online Edition 3125 B mod.
NW107 Dissolved Cobalt: APHA Online Edition 3125 B mod.	NW108 Dissolved Copper: APHA Online Edition 3125 B mod.
NW109 Dissolved Iron: APHA Online Edition 3125 B mod.	NW110 Dissolved Lead: APHA Online Edition 3125 B mod.
NW112 Dissolved Magnesium: APHA Online Edition 3125 B mod.	NW113 Dissolved Manganese: APHA Online Edition 3125 B mod.
NW114 Dissolved Mercury: APHA Online Edition 3125 B mod.	NW116 Dissolved Nickel: APHA Online Edition 3125 B mod.
NW117 Dissolved Potassium: APHA Online Edition 3125 B mod.	NW118 Dissolved Selenium: APHA Online Edition 3125 B mod.
NW120 Dissolved Sodium: APHA Online Edition 3125 B mod.	NW122 Dissolved Tin: APHA Online Edition 3125 B mod.
NW125 Dissolved Zinc: APHA Online Edition 3125 B mod.	NW195 pH (Tested beyond 15 minute APHA holding time): APHA 24th Edition 4500-H B
NW206 Suspended Solids: APHA Online Edition 2540 D	NW208 Total Dissolved Solids: APHA Online Edition 2540 C
NW212 Turbidity: APHA 24th Edition 2130 B	NW345 Acidity to pH 8.3: APHA Online Edition 2310 B (Free CO ₂)
NW472 Dissolved Silica: APHA Online Edition 3120 B mod.	NW583 Dissolved Arsenic: APHA Online Edition 3125 B mod.
NW584 Dissolved Thallium: APHA Online Edition 3125 B mod.	

Signature



Jonathan Williams Laboratory Manager
Laboratory Manager

EXPLANATORY NOTE

- ① Test is not accredited
- ② Test is subcontracted within Eurofins group and is accredited
- ③ Test is subcontracted within Eurofins group and is not accredited
- ④ Test is subcontracted outside Eurofins group and is accredited
- ⑤ Test is subcontracted outside Eurofins group and is not accredited
- ⑥ Test result is provided by the customer and is not accredited
- ⑦ Tested at the sampling point by Eurofins and is not accredited
- ⑧ Tested at the sampling point by Eurofins and is accredited
- ⑨ Test is RLP accredited
- ⑩ Test is subcontracted within Eurofins group and is RLP accredited

All test method Quality Controls including method blanks, reference samples, spikes, surrogates, and duplicate sample testing, have passed and are within the control limits.

N/A means Not Applicable

Not Detected means not detected at or above the Limit of Quantification (LOQ)

LOQ means Limit of Quantification and the unit of LOQ is the same as the result unit

✗ (Unsatisfactory) means does not meet the specification

✓ (Satisfactory) means meets the specification

Food & Water Testing

The Customer acknowledges and accepts that: (a) where Eurofins is not responsible for sampling, the test result(s) in this report apply only to the sample as received. Customer is solely responsible for the sampling process and warrants that the sample provided to Eurofins is representative of the lot / batch from which the samples were drawn; and (b) Eurofins expresses no opinion and accepts no liability in respect of the Customer's production process or homogeneity of the product.

This document can only be reproduced in full.

The tests are identified by a five-digit code, their description is available on request.

Accreditation does not apply to comments or graphical representations.

Unless otherwise stated, all tests in this analytical report (except for subcontracted tests) are performed at 43 Detroit Drive, Rolleston, Christchurch, NEW ZEALAND.

The laboratory is not responsible for the information provided by the customer which can affect the validity of the results, for example: sampling information such as date/time, field data etc.

Eurofins may subcontract the performance of part or all of the Services to a third party and the Customer authorises the release of all information necessary to the third party for the provision of the Services.

All samples become the property of Eurofins to the extent necessary for the performance of the Services.

Eurofins will not be required to store samples and may destroy or otherwise dispose of the samples or return the samples to the Customer (at the Customer's cost in all respects) immediately following analysis of the samples.

If the Customer pays for storage of the samples Eurofins will take commercially reasonable steps to store the samples for the agreed period in terms of industry practice.

The Eurofins water sampling service follows methodology based on AS/NZS 5667 and / or best practice to collect and transport samples that are fit for the purpose of analytical testing. The laboratory is not responsible for sampling activities unless explicitly indicated by the statement "Sampled by Eurofins" on the report for water samples.

The Customer acknowledges that the Services are provided using the current state of technology and methods developed and generally applied by Eurofins and involve analysis, interpretations, consulting work and conclusions. Eurofins shall use commercially reasonable degree of care in providing the Services.

This report is produced and issued on the basis of information, documents and/or samples provided by, or on behalf of, the Customer and solely for the benefit of the Customer who is responsible for acting as it sees fit on the basis of this report. Neither Eurofins nor any of its officers, employees, agents or subcontractors shall be liable to the Customer nor any third party for any actions taken or not taken on the basis of this report nor for any incorrect results arising from unclear, erroneous, incomplete, misleading or false information provided to Eurofins.

Eurofins shall have no liability for any indirect or consequential loss including, without limitation, loss of production, loss of contracts, loss of profits, loss of business or costs incurred from business interruption, loss of opportunity, loss of goodwill or damage to reputation and cost of product recall (including any losses suffered as a result of distribution of the Customer's products subject of the Services prior to the report being released by Eurofins). It shall further have no liability for any loss, damage or expenses arising from the claims of any third party (including, without limitation, product liability claims) that may be incurred by the Customer.

Eurofins General Terms and Conditions apply.

END OF REPORT