MACHEnergy

Mount Pleasant Operation

A JOINT VENTURE WITH JCDA Japan Coal Development Australia

# Appendix K

Geochemistry Assessment

# TECHNICAL REPORT

# Geochemistry Assessment

## Mount Pleasant Optimisation Project

***Prepared for***: **MACH Energy Australia Pty Ltd**

MINE WASTE AND
WATER MANAGEMENT

# TECHNICAL REPORT

# Geochemistry Assessment

## Mount Pleasant Optimisation Project

*Prepared for*: **MACH Energy Australia Pty Ltd**

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# Glossary of Terms and Acronyms

| | |
|---|---|
| Acidity | A measure of hydrogen ion (H+) concentration; generally expressed as pH. |
| Acid Base Account | Evaluation of the balance between acid generation and acid neutralisation processes. Generally, determines the Maximum Potential Acidity (MPA) and the inherent Acid Neutralising Capacity (ANC), as defined below. |
| AMD | Acid and metalliferous drainage caused by exposure of sulfide minerals in mine waste materials to oxygen and water. Typically characterised by low pH and elevated concentrations of salts, sulfate and metals. |
| ANC | Acid neutralising capacity of a sample (as kilograms [kg] of sulfuric acid [$H_2SO_4$] per tonne of sample). |
| ANC:MPA Ratio | Ratio of the ANC and MPA of a sample. Used to assess the risk of a sample generating acid conditions. |
| Coal Rejects | Generally comprises coarse and fine rejects (waste) fractions generated from washing of coal at the Coal Handing and Processing Plant (CHPP). |
| EC | Electrical Conductivity, expressed as µS/cm. |
| eCEC | Effective cation exchange capacity provides a measure of the amount of exchangeable cations (Calcium [Ca], Magnesium [Mg], Sodium [Na] and Potassium [K]) in a sample. |
| ESP | Exchangeable sodium percentage provides a measure of the sodicity of a materials and propensity to erode. |
| Interburden | Material between coal seams at a coal resource that must be removed to mine the coal. |
| ICP-AES/MS | Inductively coupled plasma atomic emission spectroscopy/mass spectrometry. |
| KLC test | Kinetic leach column tests are procedures used to measure the geochemical/ weathering behaviour of a sample of mine material over time. |
| MPA | Maximum Potential Acidity calculated by multiplying the total sulfur content of a sample by 30.6 (stoichiometric factor) and expressed as kg $H_2SO_4$ per tonne. |
| NAF | Non-acid forming. Geochemical classification criterion for a sample that will not generate acid conditions. |
| NAPP | Net acid producing potential expressed as kg $H_2SO_4$ per tonne. Calculated by subtracting the ANC from the MPA. |
| Overburden | Material that overlays a coal resource and must be removed to mine the coal. |
| PAF | Potentially acid forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions. |
| pH | Measure of the hydrogen ion (H+) activity in a sample solution, expressed in pH units. |
| Static test | Procedure for characterising the geochemical nature of a sample at one point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid Base Account. |
| Total Sulfur | Total sulfur content of a sample generally measured using a 'LECO' analyser expressed as % S. |
| Uncertain | Geochemical classification criterion for a sample where the potential to generate acid conditions remains uncertain and may require further analysis. |
| VX, VA | Vaux seam. The two codes are used interchangeably throughout the report. |

# 1 Introduction

## 1.1 Overview of the Mount Pleasant Operation

The Mount Pleasant Operation Development Consent DA 92/97 was granted on 22 December 1999. The Mount Pleasant Operation was also approved under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) in 2012 (EPBC 2011/5795).

MACH Energy Australia Pty Ltd (MACH Energy) acquired the Mount Pleasant Operation from Coal & Allied Operations Pty Ltd on 4 August 2016. MACH Energy commenced construction activities at the Mount Pleasant Operation in November 2016 and commenced mining operations in October 2017, in accordance with Development Consent DA 92/97 and EPBC 2011/5795.

MACH Mount Pleasant Operations Pty Ltd manages the Mount Pleasant Operation as agent for and on behalf of the unincorporated Mount Pleasant Joint Venture between MACH Energy (95 per cent [%] owner) and J.C.D. Australia Pty Ltd (5 % owner)[1].

The approved Mount Pleasant Operation includes the construction and operation of an open cut coal mine and associated rail spur and product coal loading infrastructure located approximately 3 kilometres (km) north-west of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW) (**Figures 1.1** and **1.2**).

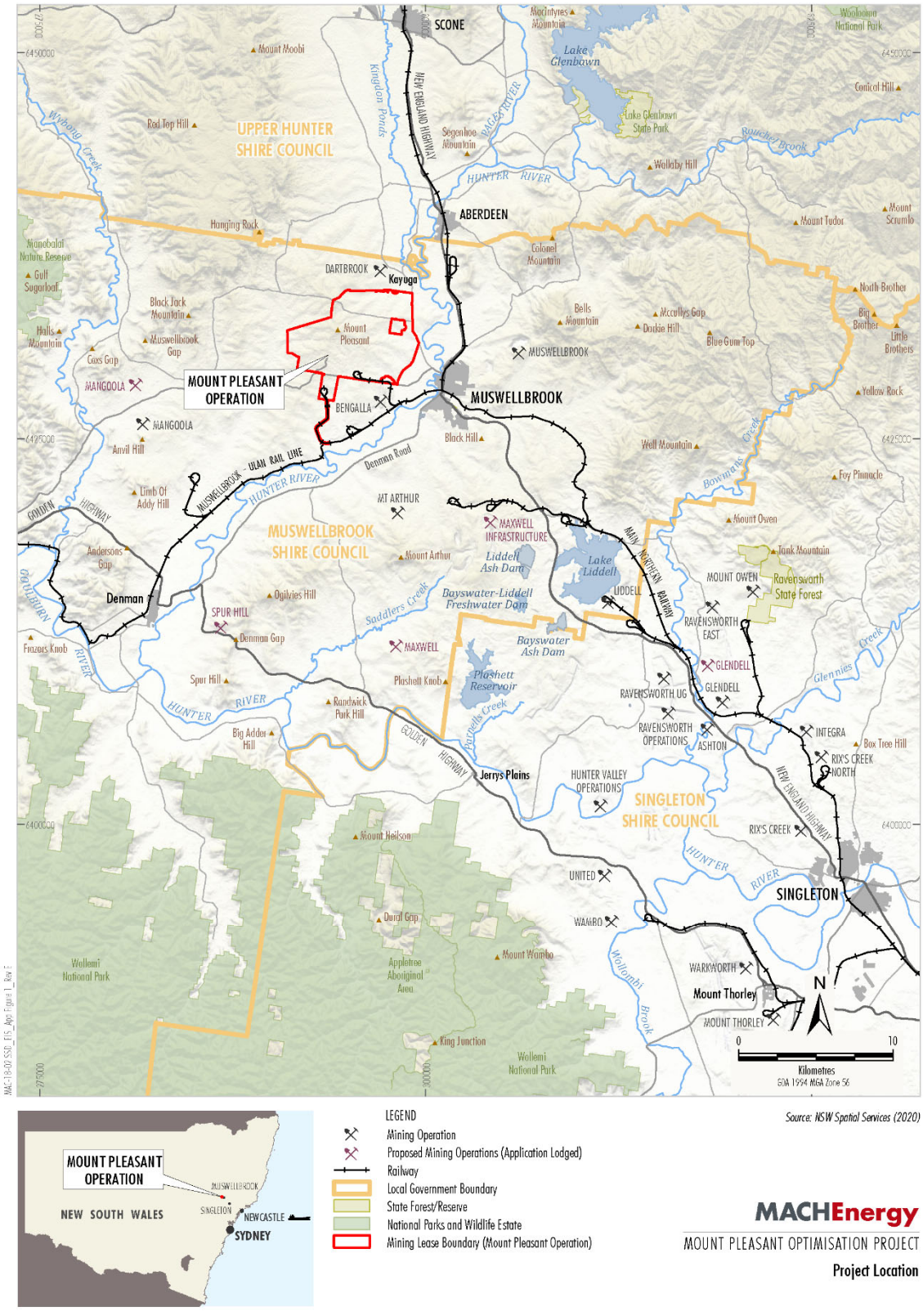
The mine is approved to produce up to 10.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal. Up to approximately 9 trains per day of thermal coal products from the Mount Pleasant Operation are transported by rail to the Port of Newcastle for export, or to domestic customers for use in electricity generation.

## 1.2 Overview of the Project

The Mount Pleasant Optimisation Project (the Project) would include the following development:

- increased open cut coal extraction within Mount Pleasant Operation Mining Leases by mining of additional coal reserves, including lower coal seams in North Pit;
- staged increase in extraction, handling and processing of ROM coal up to 21 Mtpa (i.e. progressive increase in ROM coal mining rate from 10.5 Mtpa over the Project life);
- staged upgrades to the existing Coal Handling and Preparation Plant (CHPP) and coal handling infrastructure to facilitate the handling and processing of additional coal;
- rail transport of up to approximately 17 Mtpa of product coal to domestic and export customers;
- upgrades to workshops, electricity distribution and other ancillary infrastructure;
- existing infrastructure relocations to facilitate mining extensions (e.g. local roads, powerlines and water pipelines);
- construction and operation of new water management and water storage infrastructure in support of the mine;
- additional reject dewatering facilities to allow co-disposal of fine rejects with waste rock as part of ROM waste rock operations;
- development of an integrated waste rock emplacement landform that incorporates geomorphic drainage design principles for hydrological stability, and varying topographic relief to be more natural in exterior appearance;
- construction and operation of new ancillary infrastructure in support of mining;
- extension to the time limit on mining operations to 22 December 2048;

[1] Throughout this report, MACH Mount Pleasant Operations Pty Ltd and the unincorporated Mount Pleasant Joint Venture will be referred to as MACH.


SCONE
ABERDEEN
MUSWELLBROOK
DARTBROOK
Kayuga
MOUNT PLEASANT OPERATION
BENGALLA
MANGOOLA
UPPER HUNTER SHIRE COUNCIL
MUSWELLBROOK SHIRE COUNCIL
SINGLETON SHIRE COUNCIL
NEW ENGLAND HIGHWAY
HUNTER RIVER
GOLDEN HIGHWAY
MUSWELLBROOK - ULAN RAIL LINE
MAIN NORTHERN RAILWAY
Denman
Denman Road
MT ARTHUR
MAXWELL INFRASTRUCTURE
Liddell Ash Dam
Lake Liddell
Bayswater-Liddell Freshwater Dam
Bayswater Ash Dam
Plashett Reservoir
LIDDELL
MOUNT OWEN
Ravensworth State Forest
RAVENSWORTH EAST
GLENDELL
RAVENSWORTH UG
RAVENSWORTH OPERATIONS
ASHTON
INTEGRA
RIX'S CREEK NORTH
RIX'S CREEK
HUNTER VALLEY OPERATIONS
Jerrys Plains
SPUR HILL
MAXWELL
UNITED
WAMBO
WARKWORTH
Mount Thorley
MOUNT THORLEY
SINGLETON
Lake Glenbawn
Lake Glenbawn State Park
Wollemi National Park
Appletree Aboriginal Area
Mount Wambo
Mount Owen
Tank Mountain
Foy Pinnacle
Yellow Rock
North Brother
Big Brother
Little Brothers
Mount Tudor
Colonel Mountain
Bells Mountain
Mccullys Gap
Dookie Hill
Blue Gum Top
Wollaby Hill
Segenhoe Mountain
Conical Hill
Mount Scumbo
Mount Pleasant
Black Hill
Well Mountain
Anvil Hill
Limb Of Addy Hill
Andersons Gap
Ogilvies Hill
Denman Gap
Spur Hill
Fraziers Knob
Plashett Knob
Saddlers Creek
Bowmans Creek
Glennies Creek
Wollombi Brook
Rouchel Brook
Kingdon Ponds
Wybong Creek
Big Adder Hill
Sandwick Park Hill
Mount Heilson
Durral Gap
King Junction
Box Tree Hill
Hanging Rock
Red Top Hill
Mount Moobi
Macintyres Mountain
Coxs Gap
Muswellbrook Gap
Black Jack Mountain
Halls Mountain
Gulf Sugarloaf
Manobalai Nature Reserve
Wollemi National Park
N
0
10
Kilometres
GDA 1994 MGA Zone 56
MAC-18-02 SSD_EIS_App Figure 1_Rev F
MOUNT PLEASANT OPERATION
NEW SOUTH WALES
MUSWELLBROOK
SINGLETON
NEWCASTLE
SYDNEY
LEGEND
Mining Operation
Proposed Mining Operations (Application Lodged)
Railway
Local Government Boundary
State Forest/Reserve
National Parks and Wildlife Estate
Mining Lease Boundary (Mount Pleasant Operation)
Source: NSW Spatial Services (2020)
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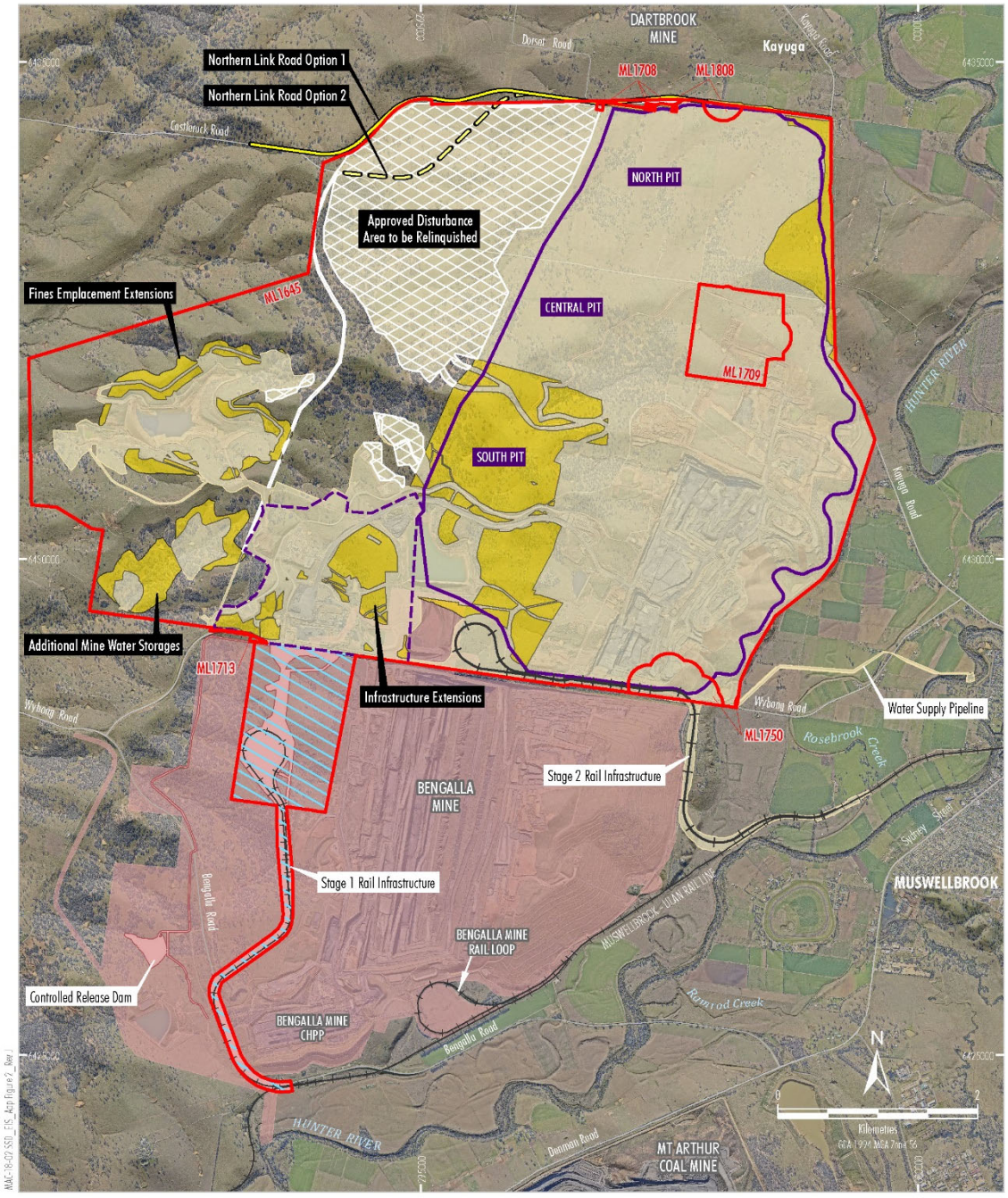
MOUNT PLEASANT OPTIMISATION PROJECT
Project Location

**Figure 1.1**




LEGEND

Existing Mine Elements

- Mining Lease Boundary (Mount Pleasant Operation)
- Approximate Extent of Existing/Approved Surface Development (DA92/97) [1]
- Infrastructure to be removed under the Terms of Condition 37, Schedule 3 (DA92/97)
- Bengalla Mine Approved Disturbance Boundary (SSD-5170)
- Existing/Approved Mount Pleasant Operation Infrastructure within Bengalla Mine Approved Disturbance Boundary (SSD-5170) [1]

Additional/Revised Project Elements

- Approved Disturbance Area to be Relinquished [2]
- Approximate Additional Disturbance of Project Extensions [1]
- Northern Link Road Option 1 Centreline [3]
- Northern Link Road Option 2 Centreline
- Approximate Extent of Project Open Cut and Waste Rock Emplacement Landforms
- Revised Infrastructure Area Envelope

NOTES

1. Excludes some incidental Project components such as water management infrastructure, access tracks, topsoil stockpiles, power supply, temporary offices, other ancillary works and construction disturbance.
2. Subject to detailed design of Northern Link Road alignment.
3. Preferred alignment subject to landholder access.

*Source: MACH (2020); NSW Spatial Services (2020); Department of Planning and Environment (2016)*
*Orthophoto: MACH (July 2020)*

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MOUNT PLEASANT OPTIMISATION PROJECT

**Project General Arrangement**

**Figure 1.2**

- an average operational workforce of approximately 600 people, with a peak of approximately 830 people;
- ongoing exploration activities; and
- other associated infrastructure, plant, equipment and activities.

## 1.3 Regional geology

The Mount Pleasant Operation is located on the western side of the Hunter Dome Belt, which is a section of the northern part of the early Permian to late Triassic aged Sydney Basin. The Hunter Dome Belt hosts north-south trending anticlines and synclines, of which one is the Muswellbrook Anticline.

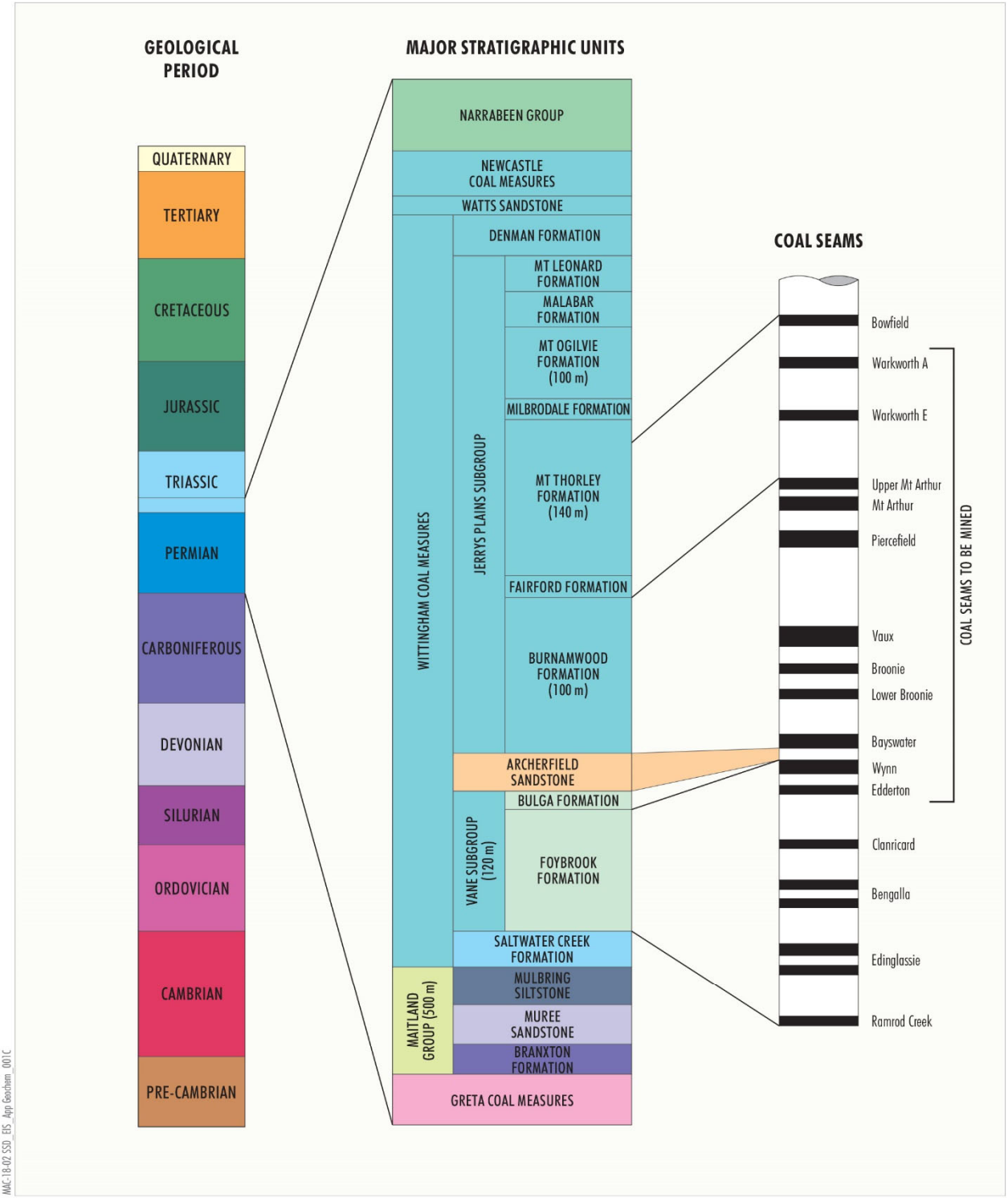
The Gyarran Volcanics form the basement unit of the Sydney Basin, which outcrops in the hinge of the Muswellbrook Anticline. This is overlain by the Greta Coal Measures, the Maitland Group and the Wittingham Coal Measures. The Wittingham Coal Measures host the seams targeted at Mount Pleasant. In the east of the Project area the outcropping coal measures have been covered by alluvium deposited by the Hunter River. To the west of the Project area, the Wittingham Coal Measures are overlain by the Watts Sandstone and Newcastle Coal Measures (previously called the Wollombi Coal Measures).

## 1.4 Local geology

The target coal seams are hosted within the Wittingham Coal Measures on the western limb of the Muswellbrook Anticline. The topography of the Wittingham Coal Measures, the major geological unit in the Project area, rises to the west with weathering extending to a depth of 9 to 35 metres (m), averaging 20m. The stratigraphy of the Wittingham Coal Measures is shown in **Figure 1.3**. The seams within the Wittingham Coal Measures that are targeted at the Project consist of the Jerry's Plains and Vane Subgroups, which are separated stratigraphically by the Archerfield Sandstone. There is a gradational boundary between the Archerfield Sandstone and Bulga Formation. Near Muswellbrook, the Bulga Formation-Archerfield Sandstone sequence combines to form a single unit (which shall be referred to as the Bulga Formation in this report) (Sniffin and Beckett, 1995). Typically, the Archerfield Sandstone contains finely disseminated pyrite, which imparts a characteristic bronze colour to the sandstone.

The coal seams in the Mount Pleasant area are split into 71 plies ranging from 0.3 to 2.3 m thick. Partings within the coal seams are generally less than 0.3 m thick and seams are identified using coal brightness properties, marker horizons and the stratigraphic relationships between the seams. The Jerry's Plains Subgroup includes (in descending order) the Bowfield, Warkworth, Mt Arthur, Piercefield (PF), Vaux (VA), Broonie (BR) and Bayswater (BY) seams, and is typically composed of sandstone, siltstone, coal and tuffaceous claystone. The Vane Subgroup, which underlies the Archerfield Sandstone, consists of (in descending order) the Wynn, Edderton, Clanricard, Bengalla, Edinglassie and Ramrod Creek seams, and typically consists of sandstone, siltstone and coal beds. The coal in the Project area has a moderate propensity for self-heating and spontaneous combustion, which is managed in accordance with the Spontaneous Combustion Management Plan.

The overburden and interburden materials in the Project area are predominantly sandstone, with some seam roof, parting and floor materials consisting of mudstone and claystone. The sandstone frequently contains bands of siderite. The basement unit of the area is the Gyarran Volcanics, which outcrops in the hinge of the Muswellbrook Anticline.




*Source: MACH (2020)*

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MOUNT PLEASANT OPTIMISATION PROJECT

Indicative Stratigraphy of the Mount Pleasant Operation

**Figure 1.3**

## 1.5 Scope of work

RGS Environmental Pty Ltd (RGS) was commissioned by MACH to complete a geochemistry assessment for the Project. The geochemistry assessment was completed in a series of stages, as summarised below.

Stage 1 involved a review of the existing information for the site geochemistry, as well as a review of geochemical assessments completed at the nearby Bengalla Mine and Mt Arthur Coal Mine. The surface water results for the Mount Pleasant Operation, Bengalla Mine and Mt Arthur Coal Mine were reviewed, as well as the available geological mapping and drill hole logs for the Mount Pleasant Operation area.

Stage 2 involved a program of sampling and static/kinetic geochemical testing of drill core in order to confirm the geochemical nature of the overburden and interburden materials.

Stage 3 involved a program of geochemical testing of coal reject materials when these washed samples became available from the Mount Pleasant Operation CHPP.

The objective of the work program was to complete a geochemical assessment of representative samples of the overburden, interburden, and coal reject materials as part of the Environmental Impact Statement (EIS) for the Project.

The scope of work also included:

- Coordination of the material sampling and geochemical analysis programs;
- Geochemical characterisation of the samples utilising both static and kinetic testing methods; and
- Preparation of a detailed “stand-alone” technical report (this report).

The geochemical program was designed to test the acid forming potential of the mining wastes and potential coal reject materials, and to identify any potential for the mobilisation of salts and metals/metalloids, or dispersive materials in surface water runoff and seepage from mine landforms.

The work program was designed and completed in accordance with relevant industry guidelines (COA, 2016; INAP, 2009).

## 1.6 Report structure

Background information on the sources of potential impacts on water quality from coal mines is presented in **Section 2** and a review of existing information on the Mount Pleasant Operation and nearby coal mining operations is provided in **Section 3** and **Attachment E**.

The detailed methodology used for the geochemical and physical sampling and testing program is described in **Section 4**. The geochemical (and physical) test results obtained from the testing program on the samples are presented in **Section 5**. A discussion of the geochemical (and physical) characteristics of the materials is presented in **Section 6**.

The main conclusions and recommendations generated from the Project are presented in **Section 7**. A complete list of references relied upon to complete this report are presented in **Section 8**.

# 2 Sources of potential impacts on water quality

## 2.1 Coal and sulfur

Sulfur in coal is derived from two sources, which include the original plant materials and ambient fluids in the coal forming environment. Abundance of sulfur in coal is controlled by depositional environments and the diagenesis of the coal seams and overlying strata. Typically, low-sulfur coal seams were deposited in an alluvial environment and the peat was not influenced by seawater. The sulfur in these low-sulfur coals is derived mostly from its parent plant materials.

In contrast, high sulfur coal seams are generally associated with marine strata where sulfate in the seawater diffuses into the peat and is reduced by microorganisms to hydrogen sulfide, elemental sulfur and polysulfides. During early diagenesis in a reducing environment, ferric iron is reduced to ferrous iron, which reacts with hydrogen sulfide to form iron monosulfide. Iron monosulfide is later transformed by reaction with elemental sulfur into reactive sulfide minerals such as pyrite or marcasite.

Organic sulfur is formed by reaction of reduced sulfur species with the humic substances formed by bacterial decomposition of peat. Organic sulfur species in coals are mainly thiols, sulfides, di-sulfides, and thiophene and its derivatives. The thiophenic fraction of organic sulfur increases with the carbon content of coals. Organic sulfur compounds formed in peat are mostly thiols and sulfides, which gradually convert to thiophenes with increasing coal maturation. Thus, the organic sulfur species in coal evolve during the history of coal formation.

At coal mines, Potentially Acid Forming (PAF) materials can be associated with specific coal seams (including roof, parting and floor materials), as well as some carbonaceous materials (e.g. mudstone) and uneconomic coal seams. It should be noted that in many coal materials the total sulfur concentration is dominated by low risk organic sulfur rather than sulfur in a reactive form such as pyrite or marcasite. The reactive forms of sulfide can be determined using sulfur speciation tests.

Coal reject materials (coarse and fine rejects) generated through washing the coal can also have elevated sulfur concentration and depending upon the coal seam or blend of coal seams being washed at the time may be classified as Non-Acid Forming (NAF) or PAF. In some cases, reactive pyrite can preferentially report to either the coarse or fine rejects streams and alter the material classification.

Weathered overburden materials generally have low sulfur concentrations as any reactive sulfur has long since reacted and leached from these materials. Some interburden strata can be PAF, although again the material characteristics are generally governed by the depositional environment in which the coal seams were formed.

## 2.2 Presence of sulfur and potential impacts on water quality

As coal and other geological units are blasted and then extracted from the deposit, the process of chemical weathering increases. If the geological units contain sulfide minerals such as pyrite, the chemical weathering process can increase exponentially due to the oxidation of pyrite and the production of sulfuric acid. The Maximum Potential Acidity (MPA) that the material can produce is calculated by multiplying the total sulfur content in a sample by a stoichiometric factor, which assumes that all sulfur is present as pyrite and that all pyrite will oxidise to produce acidity. In cases where the materials have some Acid Neutralising Capacity (ANC) the acidity that is produced by the oxidation of pyrite can be neutralised.

If there is more MPA than ANC, the material can potentially produce acidic drainage and the presence of the acidity will increase the concentrations of salts in the form of major ions (e.g. Calcium ions [$Ca^{2+}$], Magnesium ions [$Mg^{2+}$], Sodium ion [$Na^{+}$], Potassium ion [$K^{+}$], Chloride ion [$Cl^{-}$] and Sulfate ion [$SO_4^{2-}$]), metals (e.g. Aluminium [Al], Iron [Fe], Manganese [Mn] and Zinc [Zn]) and metalloids (e.g. Molybdenum [Mo] and Selenium [Se]). This type of drainage is referred to acid and metalliferous drainage (AMD), although it will also contain elevated concentrations of salts (COA, 2016).

If there is more ANC than MPA, the material may retain neutral (or alkaline) pH conditions. However, the acid production and neutralisation reactions may still produce elevated concentrations of salts and potentially some metals/metalloids. This type of drainage is referred to as neutral metalliferous drainage (NMD) or saline drainage (SD).

The potential for a material containing sulfide minerals to produce acidity is also influenced by the way the material is stored or contained. For example, if the material is fine-grained (e.g. fine rejects) and is contained within a saturated environment the potential for the sulfide minerals to oxidise and produce acidity is lower than if the material is stored in a free draining, oxic environment.

The classification of the samples can be derived using the Net Acid Producing Potential (NAPP) or an ANC:MPA ratio. In some instances, the classification can be confirmed using the Net Acid Generation (NAG) test, although in coal mines the standard single addition NAG test should be used with caution for carbonaceous materials, coal or coal reject, as samples with high organic carbon contents can cause interference with standard NAG tests due to partial oxidation of carbonaceous materials. This can lead to (false positive) low $NAG_{pH}$ values and high acidities in NAG solutions unrelated to acid generation from sulfides (ACARP, 2008).

In most instances the NAPP calculation and/or ANC:MPA ratio can be used as a screening tool to provide an indication of whether a material may be classified as PAF, Uncertain or NAF. The material classification can be further confirmed by using kinetic geochemical tests on selected mine materials and/or field trials.

When sufficient information is available regarding the geochemical characteristics of the various mine materials, a smaller suite of geochemical tests/data may be used to classify a larger number of samples (e.g., total sulfur data) and improve the level of confidence in the overall classification of bulk mine materials (e.g., in coal mines a sulfur grid layer model can be used to delineate the likely location of any PAF materials) and assist in the development of mine material management strategies.

## 2.3 Neutral metalliferous drainage and saline drainage potential

NMD and SD can occur even if the mined materials do not produce acidic drainage. SD can occur if sodium (and other major ions such as chloride) are leached from the mined materials. In Australia the presence of sodium is from rock weathering, and the accumulation of aerosols.

Sulfate is an anion that is also common in neutral pH drainage and is typically present due to the oxidation (and subsequent in-situ neutralisation) of sulfide minerals.

# 3 Review of existing information

As an integral component of the design of the geochemistry assessment program for the Project, RGS completed a review of the known geochemical characteristics of, and management practices for, mine waste materials generated at nearby coal mines, including the adjacent Bengalla Mine and nearby Mt Arthur Coal Mine sites. There was also some historical information available on the Project included in the review process.

The RGS review of available information on the Mount Pleasant Operation, Mt Arthur Coal Mine and Bengalla Mine sites found that:

- Overburden and interburden materials are likely to be NAF with a low salinity risk and no specific constraints are required for the handling and storage of these materials.
- The Bayswater-Wynn (BY-WN) interburden, Wynn (WN) interburden (roof, floor and parting) and coal rejects derived from processing the WN seam are generally expected to be PAF, reactive when exposed to air and moisture, and have a relatively short lag time preceding acid generation of up to a week.
- Some overburden and interburden materials are expected to be moderately sodic and could have structural stability issues related to potential dispersion and erosion.
- The concentration of trace metals/metalloids in solid overburden, interburden and coal reject materials is expected to be low compared to applied guideline criteria for soils and median crustal abundance in un-mineralised soils and is not expected to present any environmental issues associated with revegetation and rehabilitation.
- NAF overburden, interburden and coal reject materials are generally expected to generate low to moderate salinity values and relatively low concentrations of trace metals/metalloids and major ions in surface runoff and seepage. BY-WN interburden, WN interburden (roof, floor and parting), and PAF coal rejects (derived from processing the WN seam) are expected to have the potential to generate acidic leachate, with elevated salinity and elevated concentrations of some metals/metalloids, if exposed to oxidising conditions.

# 4 Methodology

RGS personnel (Dr Alan Robertson) worked closely with MACH (geological personnel) to facilitate the development of an appropriate sampling and geochemical testing plan for obtaining representative samples of overburden and interburden materials associated with the Mount Pleasant Operation mining area.

## 4.1 Sample selection and preparation

The sampling methodology used to obtain geochemical samples from the Project was undertaken in accordance with relevant guidelines documents. Whilst there are no specific regulatory requirements regarding the number of samples required, existing risk-based technical guidelines for the geochemical assessment of mine rock in Australia (AMIRA, 2002; COA, 2016) and worldwide (INAP, 2009) were used by RGS as a framework for the sampling program. Representative samples of fresh drill core and drill chips were identified and collected from overburden and interburden material from a recent exploration drilling program. Representative samples for coarse and fine rejects were also collected from processing available coal seam material at the CHPP.

### *4.1.1* Overburden and interburden

A total of 83 drill core samples were collected from four drill holes at Mount Pleasant Operation (12 samples from 2103LA, 11 samples from 2123L, 29 samples from 2133L and 31 samples from 2167L). The location of these drill holes with respect to the mine area is shown in **Figure 4.1.**

The samples represented the overburden and interburden (including some roof, floor and parting materials) expected to be encountered during development activities at the Mount Pleasant Operation, from the surface to a depth of approximately 120 m. This covers the entire stratigraphic profile. **Table 4.1** provides the number of samples of each type of material collected and used in the geochemical assessment. The number of samples was selected to provide a good statistical representation of the amount and types of mining materials expected to be encountered at the Project, considering the risk profile indicated from the geology at the Mount Pleasant Operation. Samples were collected by RGS personnel and dispatched to ALS Environmental Laboratory (ALS) in Stafford, Queensland for geochemical testing.

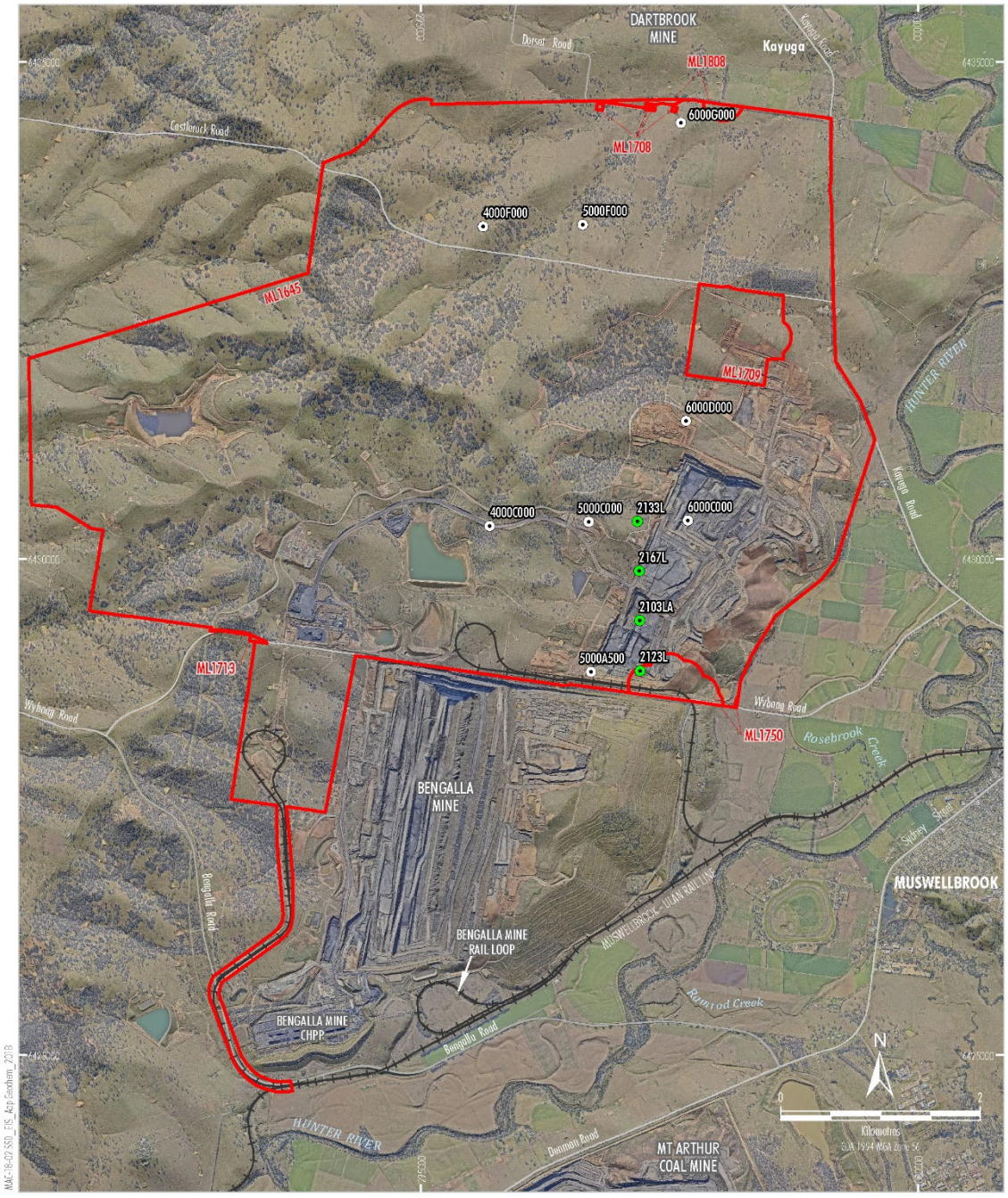
**Table 4.1: Overburden and interburden sample materials used for geochemical testing**

| Lithology | Material type | Number of samples |
|---|---|---|
| Weathered claystone, sandstone and siltstones | Overburden | 11 |
| Carbonaceous claystone and coal; claystone, conglomerate, sandstone, siltstone and tuff | Interburden | 44 |
| Claystone, sandstone and siltstone | Roof, floor and parting | 28 |
| **Total** | | **83 samples** |

### *4.1.2* Coarse and fine rejects samples

A total of 12 samples of coarse and fine rejects samples were collected from process streams generated from processing available coal seams at the CHPP.

**Table 4.2** provides the number of samples of each type of material collected and used in the geochemical assessment, selected to provide a good statistical representation of amount and type of coarse and fine rejects expected to be encountered.




LEGEND
Mining Lease Boundary (Mount Pleasant Operation)
1995 Drill Hole Sample
2019 Drill Hole Sample

*Source: MACH (2020); NSW Spatial Services (2020)*
*Orthophoto: MACH (July 2020)*

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**Drill Holes Sampled for the Geochemistry Assessment**

**Figure 4.1**

**Table 4.2: Coarse and fine rejects sample materials used for geochemical testing**

| Project material | Representative sample material | Number of samples |
|---|---|---|
| Coarse rejects | Edderton (ED) rejects, WN seams rejects, VA rejects, Broonie-Bayswater (BRBY) rejects | 6 |
| Fine rejects | ED fine rejects, WN seams fine rejects, PF fine rejects, VA fine rejects, Broonie-Bayswater (BRBY) fine rejects | 6 |
| | **Total** | **12 samples** |

Once received, samples were prepared by crushing and pulverising to less than 75 micrometre (µm) size. This method of sample preparation results in a homogenous sample, but also generates a large sample surface area in contact with the resultant assay solution. This provides a greater potential for dissolution and reaction and represents an assumed initial 'worst case' scenario for these materials.

## 4.2 Geochemical test program

A series of static geochemical and physical tests were completed on the collected Mount Pleasant Operation samples. The test program was designed to assess the degree of risk from the presence and potential oxidation of sulfides, and generation and the presence/leaching of soluble metals/metalloids and salts. The assessment also included characterisation of standard soil parameters including salinity, sodicity, cation exchange capacity, exchangeable sodium percentage (ESP), and major metal concentrations.

A summary of the parameters involved in completing a static and kinetic geochemical characterisation and assessment of mine materials is provided in **Attachment A**.

### *4.2.1* Static tests

Static geochemical tests provide a 'snapshot' of the characteristics of a sample material at a single point in time. These tests were staged to screen individual samples before selecting either individual and/or composite samples for more detailed static test work.

The Acid Base Account (ABA) method was used as a screening procedure whereby the acid-generating and acid-neutralising characteristics of a material are assessed. The 83 overburden and interburden samples and 12 coarse and fine rejects samples (i.e. a total of 95 samples) were screened using the ABA method. The ABA screening included static geochemical testing for the following parameters:

- pH [1:5 weight:volume (w:v), sample:deionised water];
- Electrical conductivity (EC) [1:5 w:v, sample:deionised water];
- Total sulfur [LECO method]; and
- ANC [AMIRA, 2002 method].

The results of the ABA screening assessment are discussed in **Section 5.1** and **Section 5.2**. After the results of the ABA screening test were received and interpreted, 40 of the 95 samples were also tested for sulfide sulfur, as chromium reducible sulfur (Scr), using the Australian Standard (AS 4969.7, 2008) method. From the total sulfur (or Scr where available), MPA values were calculated. Scr data was preferentially used, as it provides a more accurate representation of the potential MPA, as acid generation primarily forms from the reactive sulfide measured by this method.

After the results of the initial static geochemical tests were received and reviewed, all 83 overburden and interburden samples were used to create ten composite samples and all 12 coarse and fine rejects samples were used to create nine composite samples. The individual samples used to generate composite samples were selected based on the stratigraphic unit and the geochemical characteristics. All 19 composite samples were sent for whole rock multi-element testing at ALS. The samples were tested for:

- Paste pH and EC [1:5 w:v, sample:deionised water];
- Total and soluble major cations ($Ca^{2+}$, $Mg^{2+}$, $Na^{+}$ and $K^{+}$) [Hydrochloric acid (HCl) and Nitric acid ($HNO_3$) digest followed by inductively coupled plasma atomic emission spectroscopy/mass spectrometry (ICP-AES/MS)];
- Soluble major anions ($Cl^{-}$, $SO_4^{2-}$, Fluoride [$F^{-}$]) [ICP-AES/MS and PC Titrator (1:5 w:v water extracts)];
- Acidity and alkalinity as calcium carbonate ($CaCO_3$) milligrams per litre (mg/L) [PC Titrator (1:5 w:v water extracts)];
- Total metals (Al, Arsenic [As], Boron [B], Cadmium [Cd], Cobalt [Co], Chromium [Cr], Copper [Cu], Fluoride [F], Fe, Mn, Mo, Nickel [Ni], Lead [Pb], Antimony [Sb], Se, Thorium [Th], Uranium [U] and Zn) [HCl and $HNO_3$ acid digest followed by Flow Injection Mercury Systems (FIMS) and/or ICP-AES/MS]; and
- Soluble metals (Al, As, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Sb, Se, Th, U and Zn) [ICP-AES/MS and FIMS (1:5 w:v water extracts)].

Seven of the composite samples (i.e. those not associated with the WN seam) were also tested for exchangeable cations (Ca, Mg, Na and K) [ICP-AES], which was used to calculate the effective cation exchange capacity (eCEC) and ESP. The composite samples associated with the WN seam were not tested for echangeable cations as they will not be used in any site rehabilitation activities.

These composite samples were also sent for physical tests at the Trilab Laboratory in Geebung, where they were tested for percentage dispersion (including particle size analysis) and Emerson Aggregate (EA) class using the Australian Standard (AS1289.C8.1), 1980 method.

The ALS and Trilab test results for the static geochemical test program are provided in **Attachment D**. Summary results tables are provided in **Attachment B** and discussed in **Section 5**.

### *4.2.2* Kinetic tests

Following the receipt and interpretation of the static geochemical test results, five kinetic leach column (KLC) tests for overburden and interburden samples and nine KLC tests for coarse and fine rejects were set up at the RGS laboratory. The KLC tests comprised composite samples representing the main stratigraphic units that will generate overburden and interburden and the available coal seams that will produce coal reject materials. The overburden and interburden KLC tests were completed over a period of six months, from 31 January to 1 August 2019 using a monthly watering and leaching cycle. The nine KLC tests for coal rejects and fine rejects commenced in April 2020 and continued until October 2020 using a monthly watering and leaching cycle.

Approximately 2 kilograms (kg) of each composite sample was accurately weighed and used in each of the fourteen KLC tests. Heat lamps were used daily to simulate sunshine and ensure that the KLC materials were unsaturated and subject to oxidising conditions between leaching events (this is essentially an assumed “worst case” scenario for sulfide oxidation and potential acid/salt generation). Further details and a schematic of the KLC test arrangement are provided in **Attachment A**.

All leachate samples collected from the KLC tests were assayed at ALS Brisbane for:

- pH and EC;
- Acidity and alkalinity as $CaCO_3$ (mg/L) [PC Titrator (1:5 w:v water extracts)];
- Dissolved metals/metalloids (Al, As, B, Cd, Co, Cu, Fe, Mercury [Hg], Lithium [Li], Mn, Mo, Ni, Pb, Sb, Se, Strontium [Sr], Vanadium [V] and Zn) [ICP-AES/MS];

- Dissolved major cations ($Ca^{2+}$, $Mg^{2+}$, $Na^{+}$ and $K^{+}$) [ICP-AES/MS]; and
- Dissolved major anions ($Cl^{-}$, $SO_4^{2-}$) and $F^{-}$ [ICP-AES/MS].

Summary KLC results tables and trends are provided in **Attachment C** and the 'as received' ALS laboratory test results for the KLC test program are provided in **Attachment D**. The KLC test results are also discussed in **Section 5.7**.

# 5 Geochemical test results

## 5.1 Overburden and interburden

### *5.1.1* Acid-Base Account results

Acid-Base Account results for the 83 overburden and interburden samples collected from the Project are presented in **Table B1** (**Attachment B**) and summarised below. Results are shown by stratigraphic unit (as described in **Table 5.1**) to facilitate interpretation.

**Table 5.1: Stratigraphic description**

| Code | Stratigraphic Unit | Bounding coal seams |
|---|---|---|
| OVER | Overburden | Above the Lower Piercefield (LP) seam |
| LP – VA | Birnamwood Interburden | Between LP and VA seams |
| VA – BR | Birnamwood Interburden | Between VA and Broonie (BR) seams |
| BY – WN | Bulga Interburden | Between Bayswater (BY) and WN seams |
| WN – ED | Foybrook | Between WN and ED seams |
| ED – CL | Foybrook | Between ED and Clanricard (CL) seams |
| VX | Vaux | Roof, floor and parting from the VA seam |
| BR | Broonie | Roof, floor and parting from the BR seam |
| WN | Wynn | Roof, floor and parting within the WN seam |

### *5.1.2* pH and EC

The natural pH of the deionised water used in the pH tests is typically in the pH range 5.0 to 6.5. The $pH_{(1:5)}$ of the 83 overburden and interburden samples lies within the range of 3.4 to 9.0 (**Figure 5.1**). Apart from samples associated with the BY-WN interburden and the WN seam interburden (roof, floor and parting), the sample pH ranges from 6.8 to 9.0, indicating that material represented by these samples adds negligible acidity and some alkalinity to initial contact water. Samples that represent the BY-WN and WN strata show a large range in pH, from 3.4 to 8.7, indicating that this material has the potential to add acidity and/or alkalinity to contact water. Other than by stratigraphic unit, there is no other correlation between sample pH and sample location, depth or type.

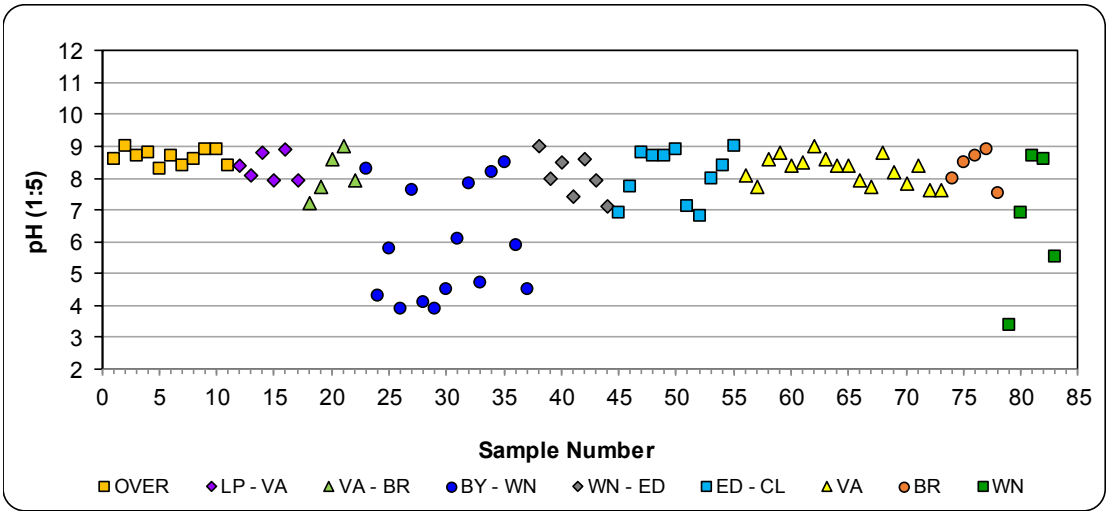


**Figure 5.1: pH values for overburden and interburden**

The current $EC_{(1:5)}$ of the samples ranges from 87 to 3,970 microsiemens per centimetre (µS/cm), with a median of 302 µS/cm (**Figure 5.2**). Two distinct populations of EC values are apparent, with most samples having an EC below 500 µS/cm. Approximately 60 % of the samples associated with the BY-WN and WN stratigraphic units show a distinctly higher EC population range of 2,060 to 3,970 µS/cm. These results are generally associated with samples that returned a low pH value as discussed earlier in this section, and reflects the higher conductivity associated with acidic samples.

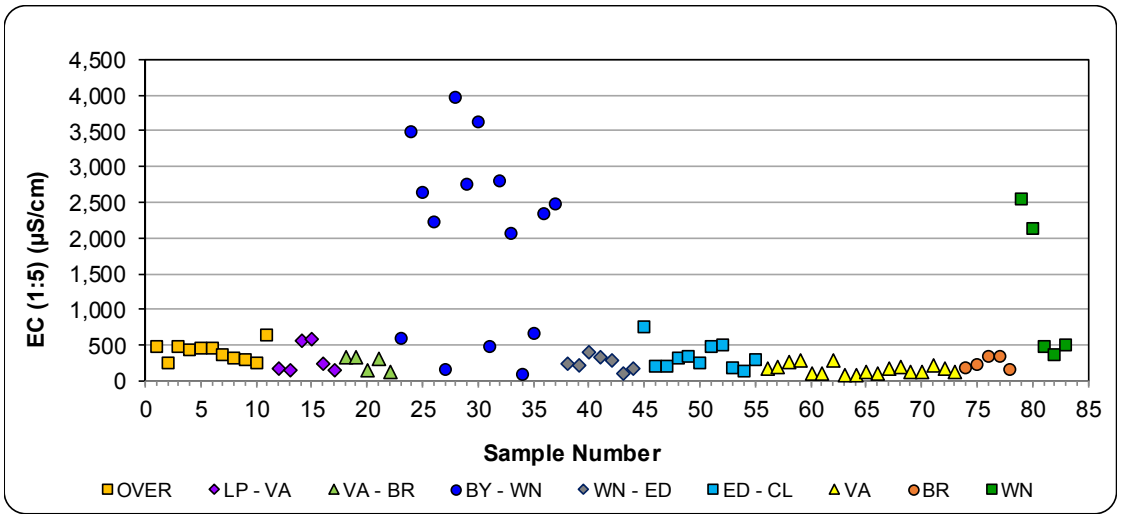


**Figure 5.2: EC values for overburden and interburden**

The pH and EC tests were completed on pulverised samples with a particle size of passing 75 µm. This results in a large surface area in contact with the leaching solution, providing a greater potential for dissolution and reaction. These results therefore represent what can be assumed as a 'worst case' scenario for initial screening tests.

It is also expected that the salinity of leachate (as represented by EC) from low sulfur overburden and interburden materials will diminish with time as salts are flushed from the rock matrix and a state of equilibrium develops. At that point, the salinity of seepage/runoff should stabilise at a lower asymptotic concentration relative to the weathering/erosion of materials. In contrast, the salinity of leachate from the higher sulfur materials associated with the BY-WN and WN stratigraphic units may increase, if these materials are exposed to oxidising conditions over time.

### *5.1.3* Sulfur

The total sulfur content (%S) of the overburden and interburden samples ranges from 0.01 to 3.59 %S and has a low median value (0.05 %S), compared with the global median crustal abundance value in unmineralised soils for this element of 0.07 %S (INAP, 2009; Bowen, 1979). Materials containing less than 0.07 %S are considered to be essentially barren of sulfur, represent background concentrations and have a negligible capacity to generate additional acidity. **Figure 5.3** shows the total sulfur content of the overburden and interburden materials and illustrates that most samples have very low sulfur content. Most of the samples with elevated sulfur content in excess of the global median crustal abundance value in unmineralised soils are associated with the BY-WN and the WN.

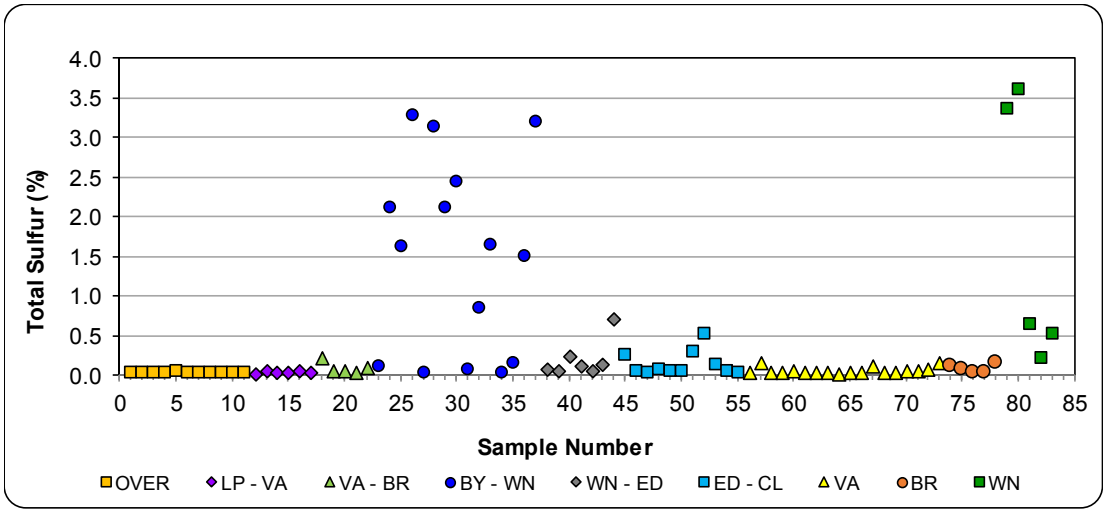


**Figure 5.3: Total sulfur values for overburden and interburden**

### *5.1.4* Sulfide sulfur

**Figure 5.4** shows a plot of total sulfur versus sulfide sulfur (as Scr) for samples with a total sulfur value over 0.1 %S. The sulfide sulfur content of the 28 samples with a total sulfur content greater than 0.1 %S was tested using the Scr method. The test results show a sulfide sulfur content ranging from 0.02 to 2.57 %Scr. Samples consisting of coal and other highly carbonaceous material showed a low amount of Scr as a percentage of total S; whereas for fine-grained sediments such as claystone and sandstone, approximately 50 % of the total sulfur content appears to be present as sulfide sulfur and may have some potential to generate acidity.

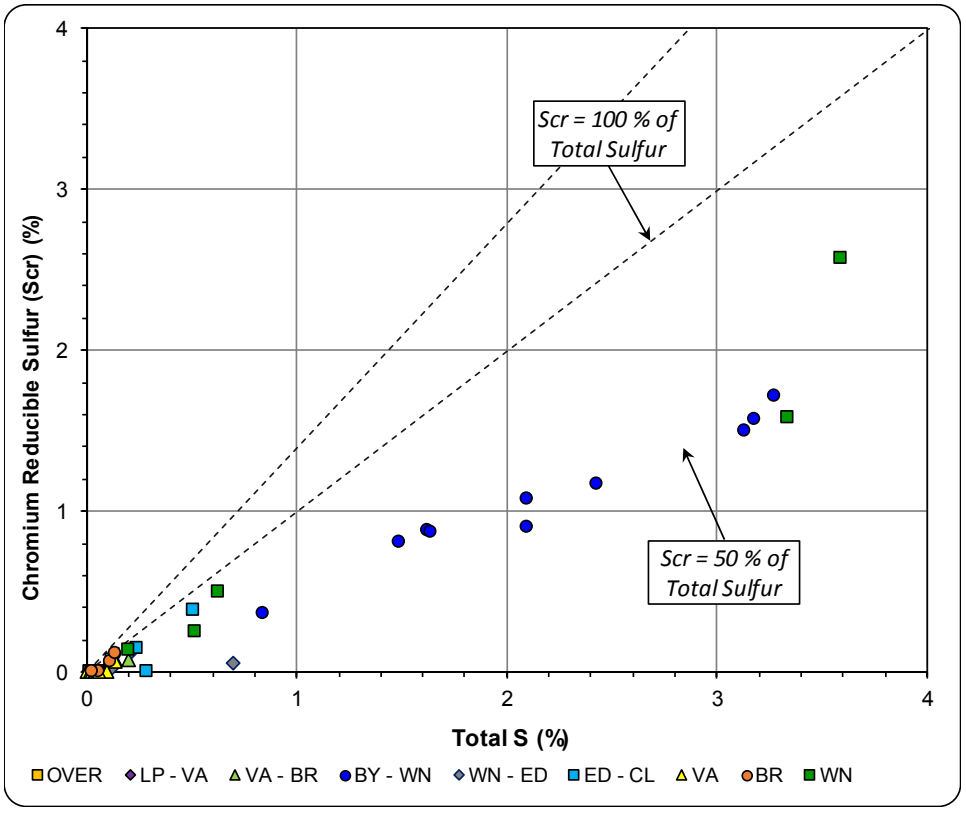


**Figure 5.4: Total sulfur versus sulfide sulfur for overburden and interburden**

### 5.1.5 Maximum Potential Acidity

The MPA for the overburden and interburden materials ranges from 0.2 to 78.7 kilograms of sulfuric acid per tonne (kg $H_2SO_4$/t), with a low median value of 1.5 kg $H_2SO_4$/t. Elevated MPA values were observed in some of the samples associated with the BY-WN and WN interburden.

### 5.1.6 Acid Neutralising Capacity

The ANC for the overburden and interburden samples ranges from 0.3 to 308.0 kg $H_2SO_4$/t, and has a median value of 19.2 kg $H_2SO_4$/t.

### 5.1.7 Net Acid Producing Potential

The NAPP is the capacity of a sample to generate acidity (MPA) minus its capacity to neutralise acidity (ANC). The calculated NAPP values for the samples range from -306.8 to 54.2 kg $H_2SO_4$/t, with a negative median value of -15.0 kg $H_2SO_4$/t. The NAPP data is presented in **Figure 5.5**. Apart from samples associated with the BY-WN and WN interburden highlighted in red, all other samples have NAPP values that are close to zero or are negative.

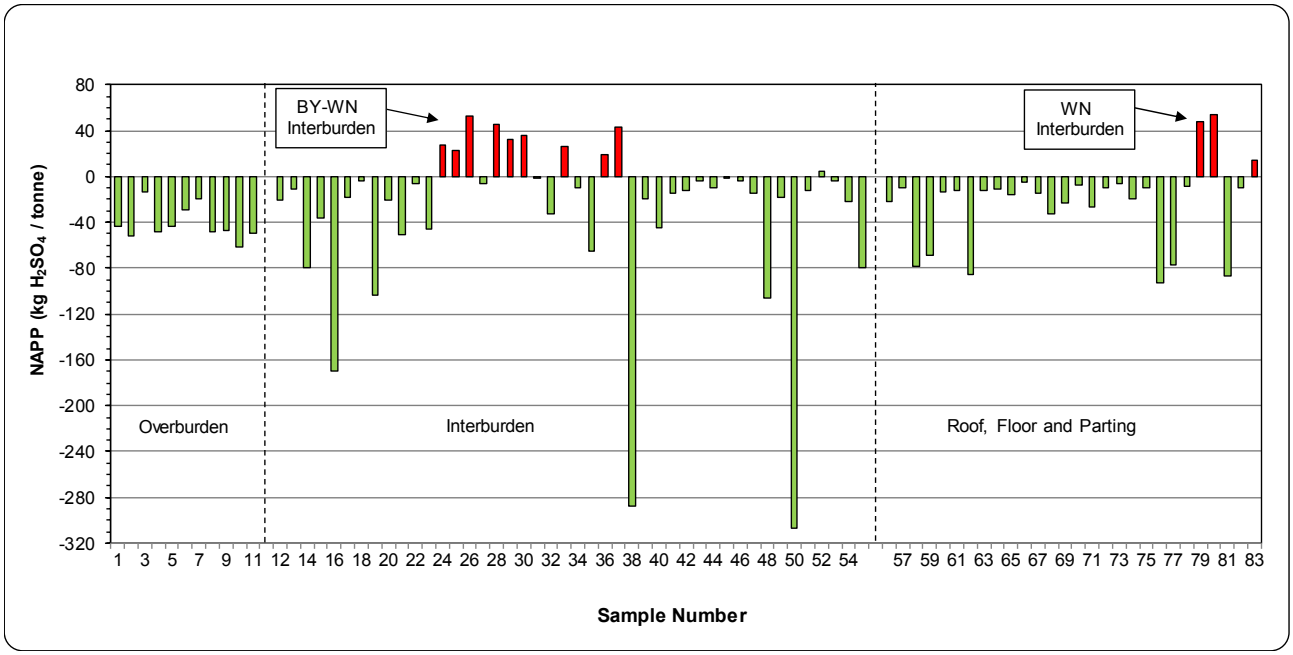


**Figure 5.5: NAPP values for overburden and interburden**

### 5.1.8 ANC:MPA ratio

The ANC:MPA ratio of the overburden and interburden samples ranges from 0.005 to 251.4 and has a median value of 13.9.

**Figure 5.6** shows a plot of the ANC versus MPA values for the samples. ANC:MPA ratio lines have been plotted on the figure to illustrate the factor of safety associated with the samples in terms of potential for generation of AMD. Generally, samples with an ANC:MPA ratio of greater than 2 or a sulfide content of ≤0.1 %S are considered to represent material with a low to negligible risk of acid generation and a high factor of safety in terms of potential for AMD (COA, 2016; INAP, 2009).

The majority of samples (69 out of 83) plot in the negligible to low risk domains in **Figure 5.6** and are considered to have negligible risk of acid generation. Of the remaining 14 samples, 12 are associated with the BY-WN and WN seam interburden and are considered to have a reduced factor of safety and some risk of AMD.

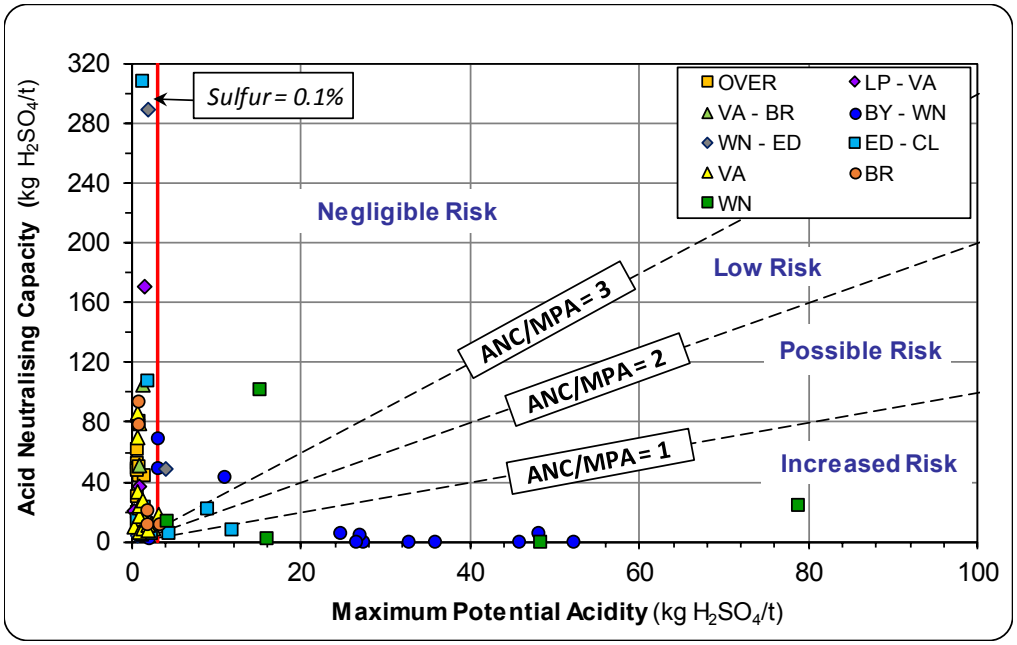


**Figure 5.6: ANC vs MPA for overburden and interburden**

### *5.1.9* Geochemical classification

The ABA test data presented in **Attachment B** and discussed in this section have been used to classify the acid forming nature of the samples. These classification criteria generally reflect Australian (COA, 2016) and international (INAP, 2009) guideline criteria for classification of mine waste materials. **Table 5.2** provides a summary of the geochemical classification criteria used by RGS to classify the acid forming nature of the 83 overburden and interburden samples from the Project, and a breakdown of the number of samples in each classification category.

**Table 5.2: Geochemistry classification criteria for overburden and interburden**

| Geochemical Classification | Total Sulfur[1] (%) | ANC:MPA Ratio | NAPP (kg $H_2SO_4$/t) | Samples (n=83) |
|---|---|---|---|---|
| NAF-Barren[2] | ≤ 0.1 | - | - | 63 |
| NAF | > 0.1 | > 2 | ≤ -5 | 6 |
| Uncertain[3] | > 0.1 | < 2 | > -5 and ≤ +5 | 2 |
| PAF | > 0.1 | < 2 | > 5 | 12 |

1. If total sulfur is less than or equal to 0.1 %, the NAPP and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur.
2. A sample classified as NAF can be further described as 'barren' if the total sulfur and/or sulfide sulfur content is less than or equal to 0.1 %, as the sample essentially has negligible acid generating capacity.
3. Samples that fall outside the stated NAF/PAF classification categories based on the criteria provided are classified as Uncertain.

The criteria presented in **Table 5.2** illustrate that most of the samples representing overburden and interburden materials are classified as NAF, as they are essentially devoid of oxidisable sulfur. For the material represented by these samples, the sulfur content and excess ANC demonstrated in the ABA results confirm a low risk of generating AMD and a high factor of safety. Two samples are classified as Uncertain and 12 samples are classified as PAF and are associated with the BY-WN and WN interburden. Material represented by these samples has a reduced factor of safety and therefore may have some risk of generating AMD.

## 5.2 Coal rejects

### *5.2.1* Acid-Base Account results

ABA results for the 12 coal reject samples (6 coarse reject and 6 fine reject samples) collected from the Project are presented in **Table B2** (**Attachment B)** and summarised below. Results are shown by coal reject source (as described in **Table 5.3)** to facilitate interpretation.

**Table 5.3: Coal reject description**

| Code | Stratigraphic Unit | Coal Reject Source |
|---|---|---|
| ED | Edderton | Coarse and fine rejects from the ED seam |
| VX | Vaux | Coarse and fine rejects from the VA seam |
| WN | Wynn | Coarse and fine rejects within the WN seam |
| BR – BY | Broonie – Bayswater | Coarse and fine rejects from BR – BY seams |
| PF | Piercefield | Fine rejects from PF seam |

### *5.2.2* pH and EC

The $pH_{(1:5)}$ of the coal reject samples ranges from 5.6 to 8.6 and has a median value of pH 7.7 (**Figure 5.7**). Generally, coarse reject has a slightly lower pH than fine reject. The natural pH of the deionised water used in the pH tests is typically in the pH range of 5.0 to 6.5. The pH results therefore indicate that some of the coal reject material represented by these samples adds some alkalinity to initial contact water.

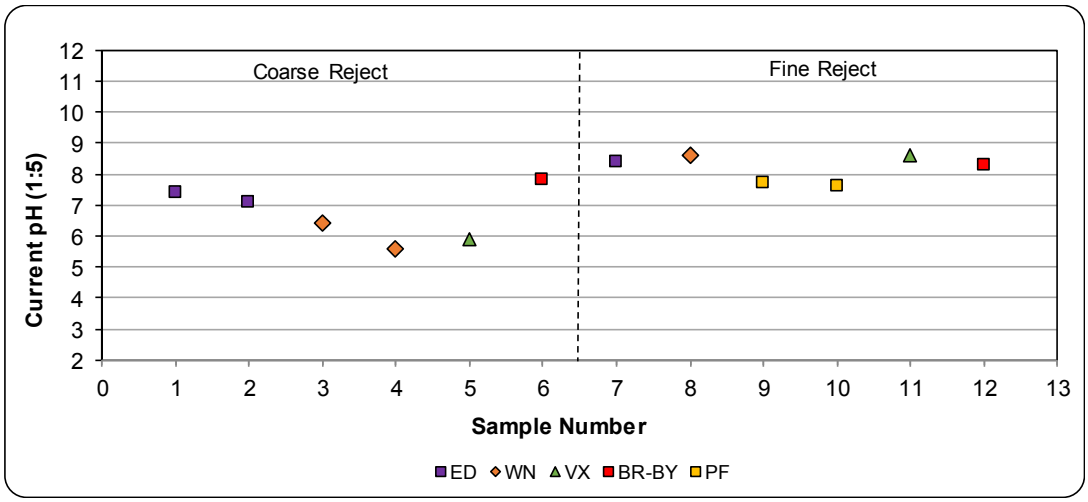


**Figure 5.7: pH values for coal reject**

The current $EC_{(1:5)}$ of the samples ranges from 98 to 1,590 µS/cm, with median values of 325 µS/cm for coarse reject and 145 µS/cm for fine reject (**Figure 5.8**). Two distinct populations of EC values are apparent, with the majority of samples having an EC of below 500 µS/cm. Coarse reject samples associated with the WN show a higher EC value than the other samples tested.

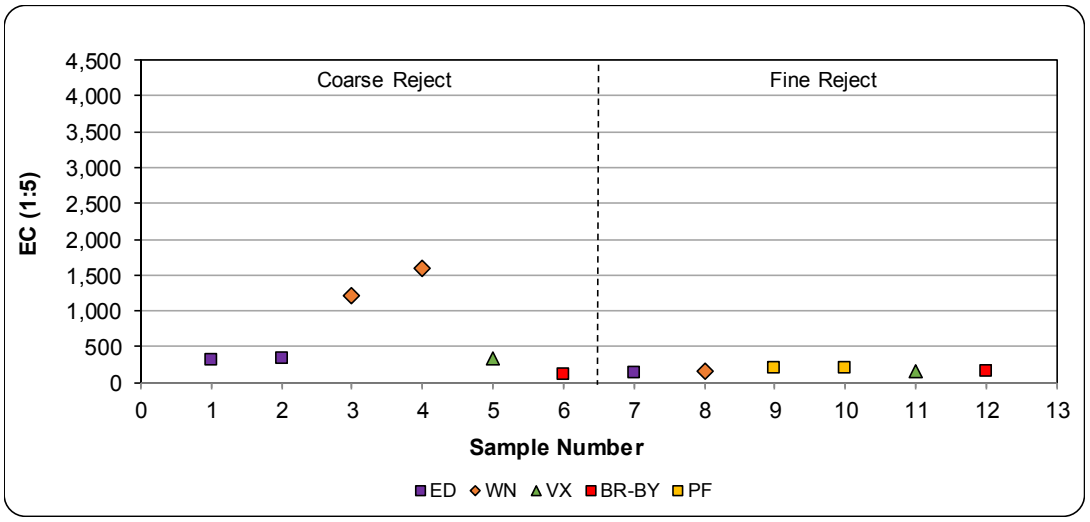


**Figure 5.8: EC values for coal reject**

As previously discussed, the pH and EC tests were completed on pulverised samples with a particle size of passing 75 µm. This results in a large surface area in contact with the leaching solution, providing a greater potential for dissolution and reaction. These results therefore represent what can be assumed as a 'worst case' scenario for initial screening tests.

It is also expected that the salinity of leachate (as represented by EC) from low sulfur coal rejects will diminish with time as salts are flushed from the material matrix and a state of equilibrium develops. At that point, the salinity of seepage/runoff should stabilise at a lower asymptotic concentration relative to the weathering/ erosion of materials. In contrast, the salinity of leachate from higher sulfur coal reject materials may increase, if these materials are exposed to oxidising conditions over time.

### *5.2.3* Sulfur

The total sulfur content of the coal reject samples ranges from 0.24 to 2.8 %S (median 0.69 %S). **Figure 5.9** shows the total sulfur content of the coarse and fine reject materials and illustrates that the samples with the highest total sulfur content are generally associated with the WN, although the total sulfur values for the two coarse reject samples from the ED seam are also elevated.

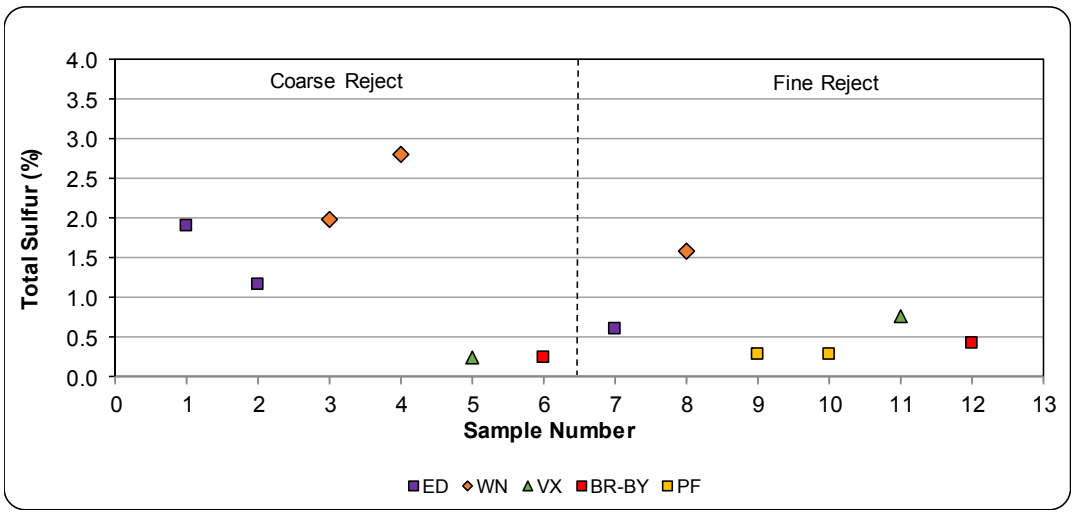


**Figure 5.9: Total sulfur values for coal reject**

### 5.2.4 Sulfide sulfur

The sulfide sulfur content of the 12 coal reject samples was tested using the Scr method. **Figure 5.10** shows a plot of the total sulfur versus sulfide sulfur (as Scr) for the samples. The test results show a sulfide sulfur content ranging from 0.09 to 2.14 %Scr. On average, approximately 57 % of the total sulfur in the coal reject samples is present as sulfide sulfur and may have the potential to oxidise and generate acidity.

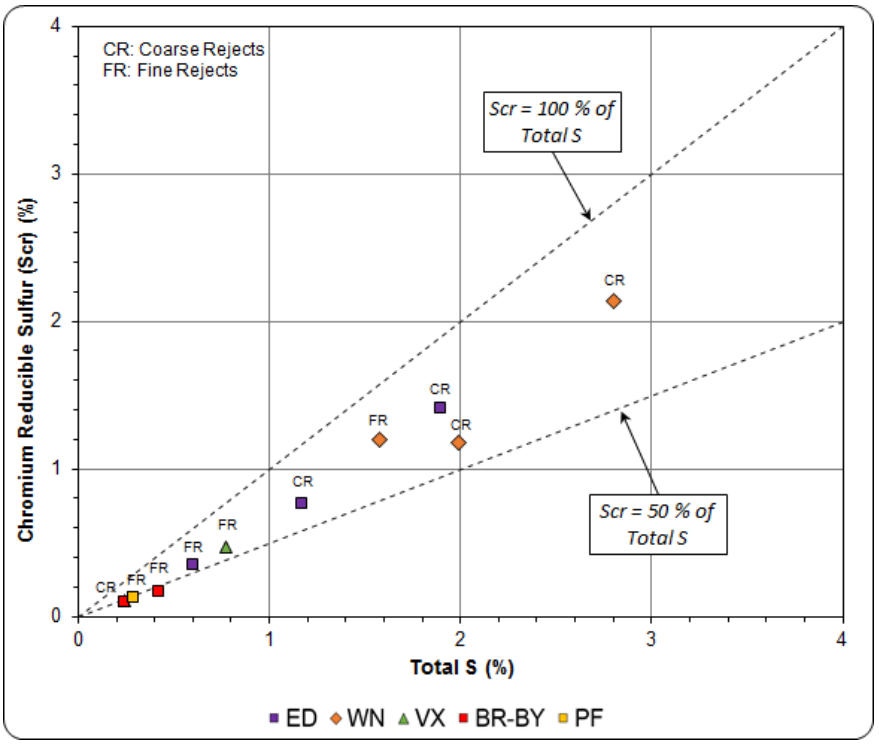


**Figure 5.10: Total sulfur versus sulfide sulfur for coal reject**

### 5.2.5 Maximum Potential Acidity

The MPA for the six coarse reject samples ranges from 2.8 to 65.5 kg $H_2SO_4$/t and has a median value of 29.7 kg $H_2SO_4$/t. In contrast, the MPA for the six fine reject samples ranges from 4.0 to 36.8 kg $H_2SO_4$/t, and has a lower median value of 7.9 kg $H_2SO_4$/t. The highest MPA values were generally related to coarse reject samples associated with the WN and ED and the fine reject sample from the WN.

### 5.2.6 Acid Neutralising Capacity

The ANC for the 12 coal reject samples ranges from 15.2 to 44.1 kg $H_2SO_4$/t and has a median value of 19.4 kg $H_2SO_4$/t. The ANC in the coarse and fine reject samples is similar and median values are 21.2 and 18.3 kg $H_2SO_4$/t for the coarse and fine reject samples, respectively.

### 5.2.7 Net Acid Producing Potential

The calculated NAPP values for the six coarse rejects samples ranges from -30.3 to 50.4 kg $H_2SO_4$/t (median 8.5 kg $H_2SO_4$/t) and for the six fine reject samples ranges from -15.3 to -5.3 kg $H_2SO_4$/t, (median -9.8 kg$H_2SO_4$/t). The NAPP data is presented in **Figure 5.11** and shows that the only samples with positive NAPP values are associated with the WN and ED coarse rejects (highlighted in red). All other samples have NAPP values that are close to zero or are negative.

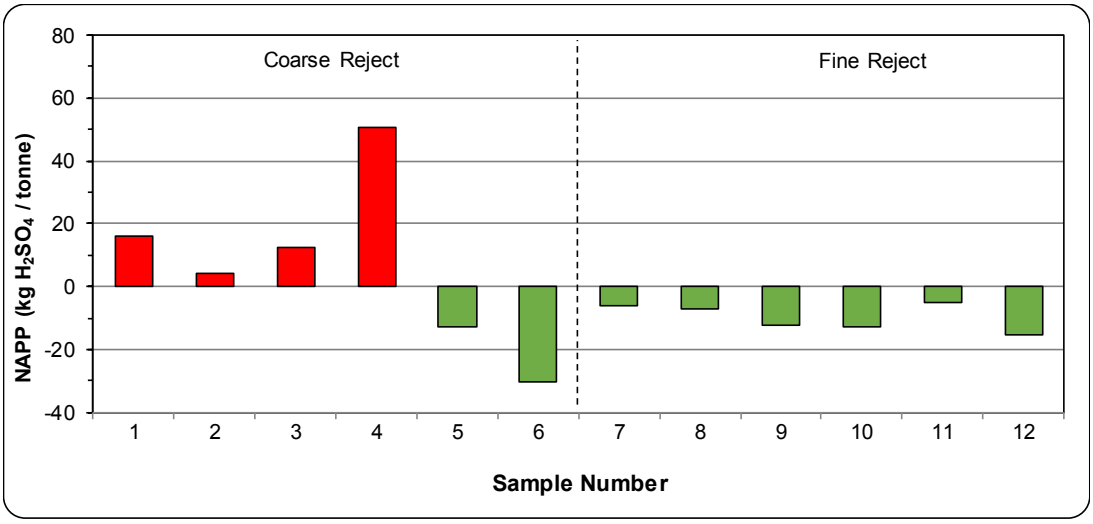


**Figure 5.11: NAPP values for coal reject samples**

### *5.2.8* ANC:MPA ratio

The ANC:MPA ratio of the six coarse reject samples ranges from 0.2 to 11.6 (median 0.7) and of the six fine reject samples ranges from 1.2 to 4.2 (median 2.8).

**Figure 5.12** shows a plot of the ANC versus MPA values for the 12 coal reject samples. ANC:MPA ratio lines have been plotted on the figure to illustrate the factor of safety associated with the samples in terms of potential for generation of AMD. Generally, samples with an ANC:MPA ratio of greater than 2 or a sulfide content of ≤0.1 %S are considered to represent material with a low to negligible risk of acid generation and a high factor of safety in terms of potential for AMD (COA, 2016; INAP, 2009).

Based on the ANC:MPA results, the four coarse reject samples associated with the WN and ED have a reduced factor of safety and increased risk of acid generation compared to the remainder of the coarse and fine reject samples tested.

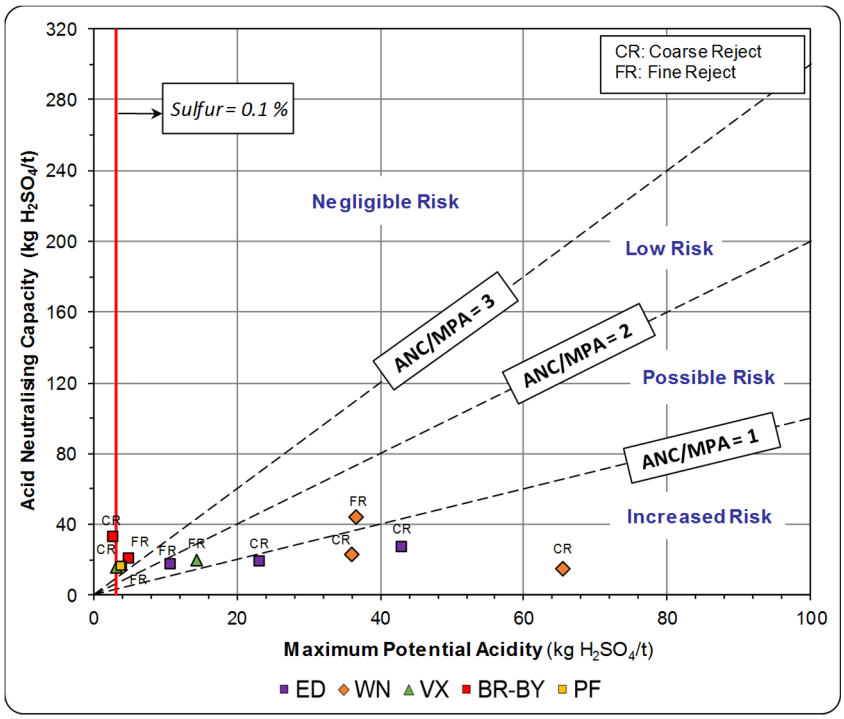


**Figure 5.12: ANC vs MPA for coal reject**

### 5.2.9 Geochemical classification

The ABA test data presented in **Attachment B** and discussed in this section has been used to classify the acid forming nature of the coal reject samples. These classification criteria generally reflect Australian (COA, 2016) and international (INAP, 2009) guideline criteria for classification of mine waste materials. **Table 5.4** provides a summary of the geochemical classification criteria used by RGS to classify the acid forming nature of the 12 samples from the Project, and a breakdown of the number of samples in each classification category.

**Table 5.4: Geochemistry classification criteria for coal reject material**

| Geochemical Classification | Total Sulfur[1] (%) | ANC:MPA Ratio | NAPP (kg $H_2SO_4$/t) | Samples (n=12) |
|---|---|---|---|---|
| NAF-Barren[2] | ≤ 0.1 | - | - | 1 |
| NAF | > 0.1 | > 2 | ≤ -5 | 7 |
| Uncertain[3] | > 0.1 | < 2 | > -5 and ≤ +5 | 1 |
| PAF | > 0.1 | < 2 | > 5 | 3 |

1. If total sulfur is less than or equal to 0.1 %, the NAPP and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur.
2. A sample classified as NAF can be further described as 'barren' if the total sulfur and/or sulfide sulfur content is less than or equal to 0.1 %, as the sample essentially has negligible acid generating capacity.
3. Samples that fall outside the stated NAF/PAF classification categories based on the criteria provided are classified as Uncertain.

The criteria presented in **Table 5.4** illustrate that all of the fine rejects samples and two of the coarse rejects samples are classified as NAF, despite some of these samples having an elevated sulfide sulfur content. One of the coarse rejects samples from the ED is classified as Uncertain, and the remaining three coarse rejects samples from the WN and ED seams are classified as PAF.

## 5.3 Multi-element concentration in solids

Multi-element assays were carried out on 19 composite samples described in **Section 4.2.1** to identify any elements (metals/metalloids) present in these materials at concentrations that may be of environmental concern with respect to revegetation and surface water/groundwater quality. The total metals/metalloids concentration for individual elements in these materials can be relevant for revegetation activities and/or where the potential exists for human contact (e.g. if the material was to be used off-site).

The results from the multi-element testing (for metals/metalloids in whole rock) are shown in **Table B3** (**Attachment B**) for overburden and interburden and **Table B4** (**Attachment B**) for coarse and fine rejects. For comparison, guideline values from the National Environmental Protection Measure (NEPM) (NEPC, 2013) are shown for some elements. Where no NEPM guideline values are listed, none are specified in the tables. All major, minor and trace elements tested returned values below those listed in the NEPM for Health-Based Investigation Level - HIL(C); public open spaces - recreational land use.

## 5.4 Geochemical abundance index

Total metal/metalloid concentrations in mining waste materials can be compared to the median crustal abundance for un-mineralised soils (Bowen, 1979; COA, 2016;INAP, 2009). The extent of enrichment is reported as the Geochemical Abundance Index (GAI), which relates the actual concentration in a sample with the median (or average) crustal abundance on a $\log_{10}$ scale. The GAI is expressed in integer increments from 0 to 6, where a GAI value of 0 indicates that the element is present at a concentration less than, or similar to, the median crustal abundance; and a GAI value of 6 indicates approximately a 100-fold enrichment above median crustal abundance (**Table 5.5**).

**Table 5.5: Geochemical abundance index values and enrichment factors**

| GAI | Enrichment Factor | GAI | Enrichment Factor |
|---|---|---|---|
| **0** | Less than 3-fold enrichment | **4** | 24 – 48 fold enrichment |
| **1** | 3 – 6 fold enrichment | **5** | 48 – 96 fold enrichment |
| **2** | 6 – 12 fold enrichment | **6** | Greater than 96 fold enrichment |
| **3** | 12 – 24 fold enrichment | | |

Generally, a GAI of 3 or greater signifies enrichment that may warrant further examination. This is particularly the case with some environmentally important 'trace' elements, such as As, Cr, Cd, Cu, Pb, Se and Zn, more so than with major rock-forming elements, such as Al, Ca, Fe, Mn and Na.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality or public health, but their significance should still be evaluated. While the GAI provides an indication of metals/metalloids that may be enriched relative to the global average crustal abundance, the following points should also be considered:

- The median crustal abundance varies between different literature sources, therefore affecting the calculated GAI values.
- If a sample is enriched relative to the median crustal abundance, there is no direct correlation that that sample will also leach metals/metalloids at elevated concentrations. The mobility of metals/metalloids is dependent on mineralogy, adsorption/desorption and the environment in which it occurs.
- Whilst some element concentrations can be elevated relative to the median crustal abundance, the nature of an ore deposit means the background levels are generally expected to be elevated.

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

**Tables B3** and **B4** (**Attachment B**) provide total metal/metalloid concentrations for the ten overburden and interburden composite samples and nine individual/composite coal reject samples described in **Sections 4.2.1** and **4.2.2** respectively. The relative enrichment of metals/metalloids in these samples compared to median crustal abundance (GAI) is presented in **Tables B5** and **B6** (**Attachment B**), respectively.

The GAI results indicate that of the metals/metalloids tested, none of the ten composite overburden and interburden samples or nine composite coal rejects samples are enriched compared to median crustal abundance in un-mineralised soils (i.e. all samples have a GAI < 3). While the concentration of Se appears slightly elevated relative to median crustal abundance (GAI = 2) this is simply an artefact of the concentrations used in the GAI calculation (i.e. half the laboratory limit of reporting [LoR] of 5 milligrams per kilogram [mg/kg]). Notwithstanding, the nature of a coal deposit means that the concentration of some metals/metalloids are expected to be slightly elevated compared to background soil levels in some materials.

The potential solubility of metals/metalloids was investigated further through the use of water extract and KLC tests as presented in **Sections 5.6** and **5.7**.

## 5.5 Physical characterisation

To investigate the potential for the overburden/interburden materials to be dispersive, a series of physical tests were conducted on seven of the ten composite samples. Composites 4, 5 and 10 were excluded from this testing as they contained material that was classified as PAF and would therefore not be placed on the outer face of the waste emplacement. The tests included particle size distribution (PSD), dispersion percentage, EA testing, cation exchange capacity (CEC) and ESP. The results of these tests are shown in **Table B3** and **B7** (**Attachment B**) and are summarised here.

### *5.5.1* Particle size distribution

PSD describes the relative amounts of gravel, sand, silt and clay within a sample (Hazelton and Murphy, 2007). Samples with higher proportions of finer material (such as clay and silt) have higher surface areas and can have higher levels of chemical and physical activity. Coarser particles (such as sand) have smaller surface areas and are generally less chemically and physically active (Hazelton and Murphy, 2007).

PSD tests were performed on crushed material from the seven composite samples. Whilst the sample materials have therefore altered from their in-situ state (crushed), their inherent cohesive characteristics are recorded and can be used to infer the material performance in a 'real-life' setting.

The composite samples can all be described as silty gravel based on the PSD results presented in **Table B7** (**Attachment B**). The collective PSD results are shown below in **Figure 5.13**.

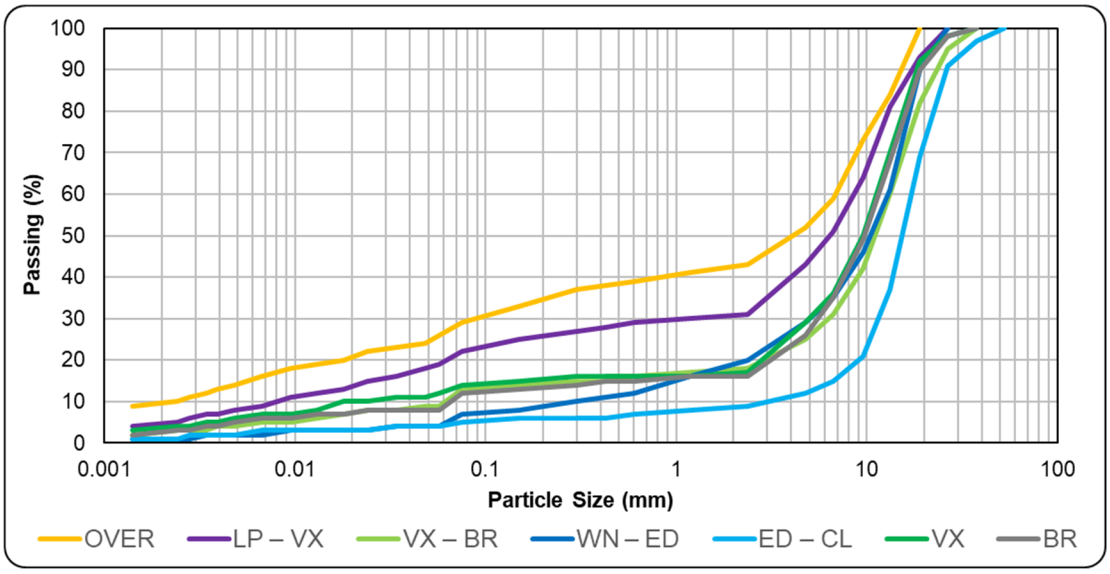


**Figure 5.13: Particle size distribution for composite samples**

The interburden material from between the ED to CL seams, which would form the base of the pit in areas where the ED seam is mined, has the highest proportion of coarse material, with approximately 90 % greater than 1 millimetre (mm) in grain size, and therefore this material is harder, and fractions into coarser grains when broken. In comparison, overburden materials are softer and have higher proportions of fines with approximately 40 % being less than 1 mm. Intermediate hardness is shown in the other interburden materials such as interburden material from between the LP to VA seams, which has a PSD with approximately 30 % fines (<1 mm) and 70 % coarse material (> 1 mm).

### *5.5.2* Sodicity

The ESP results for the seven composite samples are presented in **Table B3 (Attachment B).**

Sodicity occurs when exchangeable sodium on the cation-exchange complex leads to clay dispersion in the soil (Hazelton and Murphy, 2007). Sodicity is of interest as it can result in surface crusting and low infiltration and hydraulic conductivity within affected soils.

The ESP results for the samples range from 0.5 to 18.1 %, with a mean value of 8.4 %. Under the rating for Australian soils established by Isbell (2002) and Northcote and Skene (1972) shown in **Table 5.6** the samples are generally considered to be moderately sodic.

**Table 5.6: Ratings for exchangeable sodium percentage**

| ESP Rating | ESP Percentage |
|---|---|
| Non-sodic | < 6 |
| Moderate | 6 – 14 |
| Strong | > 14 |

Overall, the results of the ESP tests indicate that most of the overburden/interburden materials represented by the samples tested are likely to be moderately sodic; and consequently, may be susceptible to dispersion and erosion and should be managed appropriately.

### *5.5.3* Dispersion

The dispersion percentage and EA results for the seven selected samples are presented in **Attachment D** and summarised in **Table B7** (**Attachment B**).

The dispersion percentage estimates the percentage of clay content in the material that is dispersed in the sample. The dispersion percentage values for the seven composite samples ranges from 4 % to 30 % (with a median value of 12 %) indicating that the samples represent materials may be prone to dispersion without management.

The EA test results for the seven composite samples returned Class 2 EA results for all of the samples. Class 2 EA materials are considered to have moderate dispersibility after rainfall, irrigation or tillage. Class 2 materials are also susceptible to some degree of tunnelling, and readily form surficial crusts (Hazelton and Murphy, 2007).

The EA test results for the overburden/interburden materials align well with those described for sodicity (ESP) in **Section 5.5.2** and suggest that some of the overburden/interburden materials may be prone to dispersion and erosion. Material dispersion and erosion characteristics may be improved to some extent by the addition of gypsum and a vegetated subsoil/topsoil cover. Notwithstanding, overburden/interburden materials indicated as prone to dispersion should be managed appropriately.

### *5.5.4* Cation exchange capacity

The total CEC and individual exchangeable cation results for the seven composite overburden and interburden samples are presented in **Table B3** (**Attachment B**).

CEC measures the capacity of a soil to hold and exchange cations, which provides a buffering effect to changes in pH and available nutrient levels (Hazelton and Murphy, 2007). According to the rating established by Hazelton and Murphy (2007) shown in **Table 5.7**, the results presented in **Table B3** (**Attachment B**) show that the CEC of the composite samples is generally low to moderate, ranging from 8.1 to 15.1 milli-equivalents [meq]/100g, with a mean CEC value of 10.1 meq/100g).

**Table 5.7: Ratings for cation exchange capacity**

| CEC Rating | CEC (meq/100g) |
|---|---|
| Very low | <6 |
| Low | 6 – 12 |
| Moderate | 12 – 25 |
| High | 25 – 40 |
| Very high | >40 |

Additionally, the individual exchangeable cation results show that the composite samples can be considered to be low in $Ca^{2+}$, but high in $Mg^{2+}$, $K^{+}$ and $Na^{+}$. The exchangeable cation values in the overburden and interburden samples are summarised in **Table 5.8**. The $Na^{+}$ and $Mg^{2+}$ values are considered high. The $Ca^{2+}/Mg^{2+}$ ratio ranges from 0.5 to 2.3, and the samples are considered to have a relatively low $Ca^{2+}$ concentration (Hazelton and Murphy, 2007). This supports the finding in **Section 5.5.2** that some of the overburden and interburden materials may be prone to dispersion.

**Table 5.8: Summary of exchangeable cation levels**

| Cation | Minimum (meq/100g) | Maximum (meq/100g) | Average (meq/100g) | Rating[1] |
|---|---|---|---|---|
| $Na^{+}$ | <0.2 | 1.5 | 0.9 | High |
| $K^{+}$ | <0.2 | 1.8 | 1.1 | High |
| $Ca^{2+}$ | <0.2 | 8.6 | 4.3 | Low |
| $Mg^{2+}$ | <0.2 | 5.9 | 4.0 | High |

Notes: Ratings based on Hazelton and Murphy (2007).

For overburden and interburden materials with a low CEC value and low $Ca^{2+}$ concentration, some soil, gypsum and fertiliser addition may be required to provide a reasonable growth medium for vegetation as part of planned rehabilitation/revegetation activities.

## 5.6 Water quality static tests

There are no specific regulatory criteria for metal/metalloid concentrations in leachate from mining waste materials on mine sites in NSW. As such, RGS has compared the multi-element results in water extracts from the ten composite overburden and interburden samples and nine individual or composite coal reject samples (as described in **Sections 5.1** to **5.4**) with the Australian guideline values for livestock drinking water and aquatic freshwater eco-systems (ANZECC and ARMCANZ, 2000). These guidelines are provided for context only and are not intended to be interpreted as "maximum permissible levels" for site water storage or discharge.

It should also be recognized that direct comparison of geochemical data with guideline values can be misleading. For the purpose of this study, guideline values are only provided for broad context and should not be interpreted as arbitrary "maximum" or "trigger" values. Using sample pulps (ground to passing 75 µm) provides a high surface area to solution ratio, which encourages mineral reaction and dissolution of the solid phase. The results on screening tests on water extract solutions is assumed to represent a "worst case" scenario for initial surface runoff and seepage from mining waste materials.

The results from multi-element testing of water extracts (using a 1:5 sample to water ratio) from the ten composite overburden and interburden samples and nine composite coal reject samples are presented in **Table B8** and **Table B9** (**Attachment B**), respectively. The pH of the water extracts from overburden and interburden samples ranges from 5.9 to 7.9 (median 7.2) and from the coarse and fine reject samples ranges from 6.0 to 8.8 (median 7.7). All but one of the samples therefore currently have a pH value that is within the pH range (pH 6 to 9) for 95 % species protection in freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000).

The total alkalinity in the water extracts from overburden and interburden ranges from low to moderate (524 to 4,460 mg calcium carbonate per litre [$CaCO_3$/L]) and has a median value of 1,921 mg $CaCO_3$/L. The majority of the alkalinity is in the form of bicarbonate ($HCO_3$). Most of the water extracts from overburden and interburden have a relatively low acidity value (ranging from below detection to 168 mg $CaCO_3$/L) and excess alkalinity, leading to a positive net alkalinity value.

The total alkalinity in the water extracts from coal reject is low (<1 to 14 mg $CaCO_3$/L, with a median value of 4 mg $CaCO_3$/L). The majority of the alkalinity is again in the form of $HCO_3$. Most of the water extracts have a relatively low acidity value (ranging from <1 to 12 mg $CaCO_3$/L) and excess alkalinity, leading to a positive net alkalinity value. The exceptions are the water extracts from WN seam coarse reject and VX seam fine reject, which both have negative net alkalinity values.

The water extracts from the overburden and interburden samples have moderate EC values (ranging from 720 to 3,100 µS/cm; median 1,565 µS/cm), indicating moderate salinity and concentrations of dissolved solids. Water extracts from the coal reject samples have slightly lower EC values (ranging from 696 to 1,810 µS/cm; median 1,070 µS/cm).

The concentration of major ions in water extracts from the overburden and interburden samples is dominated by $HCO_3^-$ and $SO_4^{2-}$ with lower concentrations of other major ions. The range in concentrations for the major ions are listed in **Table 5.9**. Whilst most of the major ion concentrations are well below the water quality guideline parameters for livestock drinking water where these exist (ANZECC & ARMCANZ, 2000), the Fluoride ($F^-$) and sulfate ($SO_4^{2-}$) concentrations in one of the ten samples is greater than the applied livestock drinking water guideline of 2 mg/L and 1,000 mg/L for these anions, respectively.

**Table 5.9: Major ion concentrations in water extracts from overburden and interburden**

| Major Ion | Minimum (mg/L) | Maximum (mg/L) | Median (mg/L) |
|---|---|---|---|
| $Ca^{2+}$ | 2 | 292 | 27 |
| $Mg^{2+}$ | 4 | 186 | 24 |
| $K^+$ | 4 | 28 | 15 |
| $Na^+$ | 10 | 68 | 46 |
| $Cl^-$ | 8 | 46 | 12 |
| $F^-$ | <0.2 | 2.6 | 0.6 |
| $SO_4^{2-}$ | 20 | 1,418 | 178 |
| $HCO_3^-$ | 524 | 4,460 | 1,921 |

The concentration of major ions in water extracts from the coal reject samples is dominated by $Ca^{2+}$, $Mg^{2+}$, $Na^+$, $Cl^-$ and $SO_4^{2-}$ with lower concentrations of other major ions. The range in concentrations for the major ions are listed in **Table 5.10**. Whilst most of the major ion concentrations are well below the water quality guideline parameters for livestock drinking water where these exist (ANZECC & ARMCANZ, 2000), the $F^-$ and $SO_4^{2-}$ concentrations in two and one of the ten samples, is greater than the applied livestock drinking water guideline of 2 mg/L and 1,000 mg/L for these anions, respectively.

**Table 5.10: Major ion concentrations in water extracts from coal reject**

| Major Ion | Minimum (mg/L) | Maximum (mg/L) | Median (mg/L) |
|---|---|---|---|
| $Ca^{2+}$ | 4 | 124 | 12 |
| $Mg^{2+}$ | 6 | 40 | 16 |
| $K^+$ | <2 | 4 | 4 |
| $Na^+$ | 8 | 48 | 24 |
| Cl- | <2 | 24 | 9 |
| $F^-$ | <0.2 | 3.0 | 0.8 |
| $SO_4^{2-}$ | 80 | 1,338 | 138 |

The concentration of trace metals/metalloids in the water extracts from the overburden and interburden materials is typically low and predominantly below the laboratory limit of reporting (LoR). Most of the metal/metalloid concentrations tested in the water extracts are below the applied water quality guideline criteria (ANZECC & ARMCANZ, 2000), where these exist. The only exception is one of the composite samples representing BY-WN interburden material, which has elevated concentrations of Mn (24.2 mg/L), Ni (0.36 mg/L) and Zn (0.12 mg/L), compared to the applied freshwater aquatic ecosystem trigger values for these metals.

The concentration of trace metals/metalloids in the water extracts is also typically low, predominantly below the laboratory LoR and below the applied water quality guideline criteria. Exceptions include the WN coarse reject which has slightly elevated concentrations of Ni (0.05 mg/L) and Zn (0.03 mg/L) and the VX coarse reject, which has slightly elevated concentrations of Cu (0.006 mg/L), Ni (0.034 mg/L) and Zn (0.08 mg/L) compared to the applied freshwater aquatic ecosystem trigger values for these metals.

Overall, the water extract results indicate that dissolved metal/metalloid concentrations in initial surface runoff and seepage from NAF overburden/interburden and coal reject materials are unlikely to present a significant risk to the quality of surface and groundwater resources.

## 5.7 Water quality kinetic tests

### *5.7.1* Overburden and interburden

KLC tests were completed on five composite samples of overburden and interburden using the methodology described in **Section 4.2.2**. The composition of the five composite samples used in the KLC tests is summarised in **Table 5.11** and detailed in **Table B10** (**Attachment B**). The KLC tests on overburden and interburden materials were operated for a period of six months from 31 January to 1 August 2019 under a monthly watering and leaching regime, following mining industry guidelines for such tests (AMIRA, 2002; COA, 2016).

The leachate results from the KLC test program are presented alongside Australian water quality guideline values for livestock drinking water quality (ANZECC & ARCANZ, 2000). These guidelines are provided for context only and are not intended to be interpreted as “maximum permissible levels” for site water storage or discharge. It should be noted that the KLC samples were crushed to pass a 10 mm sieve size and therefore have a high surface area for potential geochemical reaction. The ratio of sample to water in the KLC tests was approximately 3:1 (w:v) (i.e. concentrated), whereas the ratio of sample to water generally used in tests where results can (arbitrarily) be compared against guideline concentrations to provide relevant context is over an order of magnitude more dilute at 1:5 (w:v). Whilst arbitrary comparisons against guideline concentrations can be helpful in some situations to provide relevant context, such comparisons cannot be directly extrapolated to the field situation at the Project.

**Table 5.11: KLC material description**

| KLC Sample # | Description |
|---|---|
| KLC1 | Weathered overburden (NAF) |
| KLC2 | BY-WN interburden (PAF) |
| KLC3 | ED-CL (NAF/Uncertain) |
| KLC4 | VA interburden (NAF) |
| KLC5 | WN interburden (PAF) |

### *5.7.1.1 Leachate chemistry*

The monthly leach test results for the five KLC tests are presented in **Attachment C. Figures 5.14** to **5.17** provide the KLC test data for the six months of leaching, selected components of which are also shown graphically (the first leach event is essentially month zero). The KLC test results indicate that:

- Leachate from the five KLC tests has a pH value in the range 2.0 to 8.9. The lowest pH values are displayed by the BY-WN (KLC2) and WN (roof, floor and parting) (KLC 5) interburden strata. The pH of leachate from weathered overburden (KLC 1) is slightly alkaline and the pH of leachate from the VA seam interburden (roof, floor and parting strata) is typically pH neutral (KLC4). The pH of leachate from the Foybrook interburden varies from pH neutral to slightly acidic (KLC3). These KLC pH trends are illustrated in **Figure 5.14**.

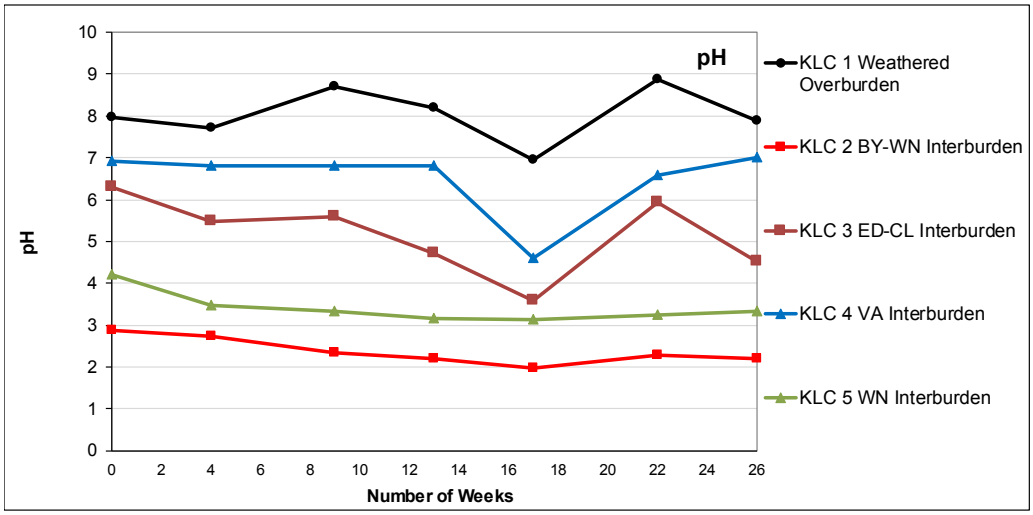


**Figure 5.14: KLC pH results for overburden/interburden**

- The amount of acidity and alkalinity released from the KLC tests is variable and for PAF BY-WN interburden (KLC2) results in a strongly negative net alkalinity (i.e. alkalinity minus acidity) value compared to the rest of the KLC test materials, as illustrated in **Figure 5.15**. The WN interburden material (KLC 5) also has a negative net alkalinity value and the remaining KLC test materials have net alkalinity values that are either positive or close to zero.

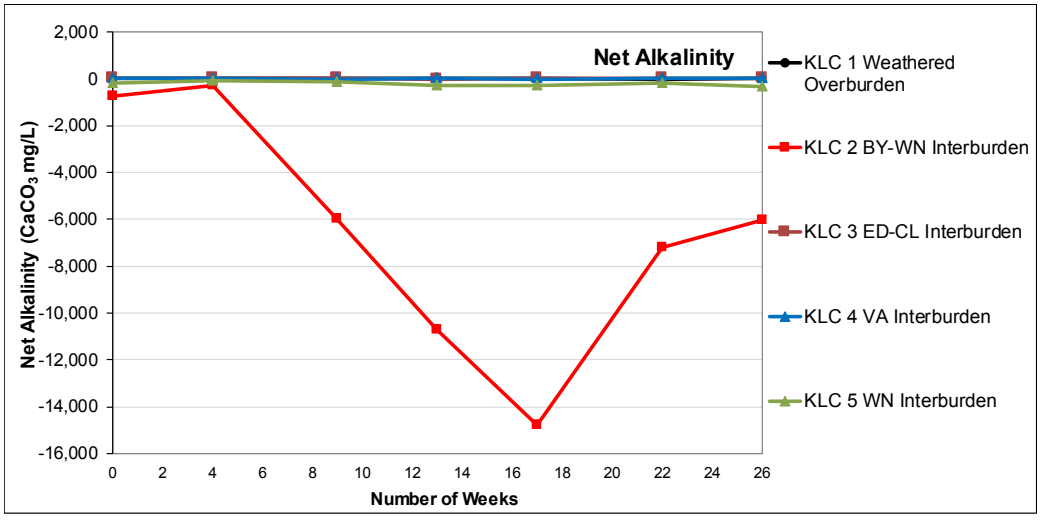


**Figure 5.15: KLC Net Alkalinity results for overburden/interburden**

- The EC values for KLC leachate are variable and range from 94 to 12,560 µS/cm. The highest EC values are shown for the PAF BY-WN interburden (KLC2) and the WN interburden material (KLC5). The remainder of the KLC test materials (KLC1, KLC3 and KLC4) have lower EC results (**Figure 5.16**).
- The major ion concentration in the leachate collected from KLC1, KLC3 and KLC4 is dominated by $Na^+$, $Cl^-$ and $SO_4^{2-}$, whereas the leachate from KLC2 and KLC5 is dominated by $Ca^{2+}$, $Mg^{2+}$ and $SO_4^{2-}$.
- The $SO_4^{2-}$ concentration in the KLC leachate for KLC1, KLC3 and KLC4 is well below the applied guideline value of 1,000 mg/L (ANZECC & ARMCANZ, 2000). The leachate for KLC2 exceeds the guideline value in every leach event, while KLC5 exceeds the guideline value after three months (i.e. after four leach events).

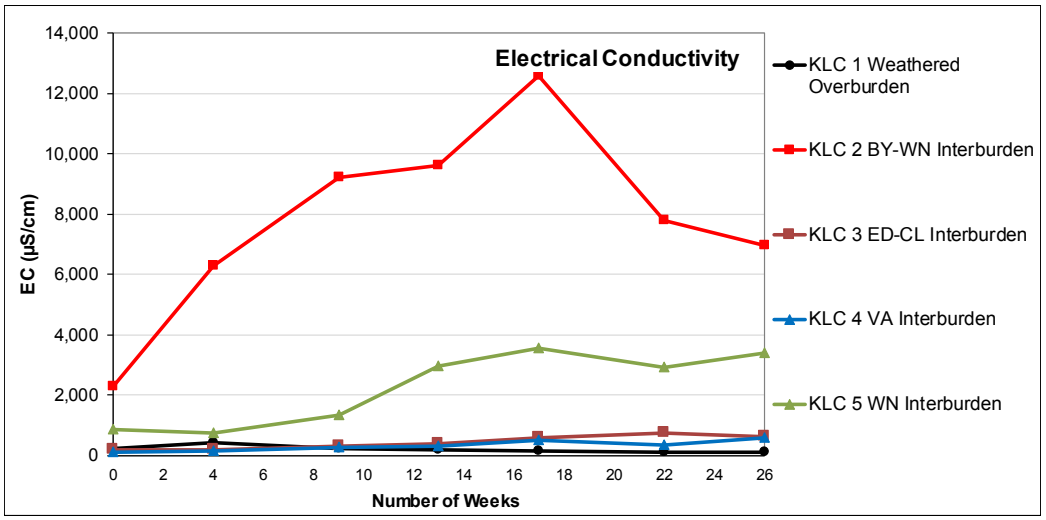


**Figure 5.16: KLC EC results for overburden/interburden**

- The concentrations of dissolved $Ca^{2+}$ and $Mg^{2+}$ in leachate from the KLC tests have been used to calculate the residual ANC remaining in the sample materials. The results indicate that for most of the KLCs, greater than 90 % of the measured ANC remains at the end of the six-month test period. The exception is the PAF BY-WN interburden (KLC2), which has only 30 % of the measured ANC remaining at the end of the test period. Note that KLC2 also contains the lowest amount of inherent ANC, with an average value of 7.7 kg $H_2SO_4$/t, compared to the range of average ANC values for the other KLCs (26.5 to 54.5 kg $H_2SO_4$/t).
- The $SO_4^{2-}$ generation/release rate results have been used to calculate the rate of sulfide oxidation in the material represented by each KLC. Most $SO_4^{2-}$ salts generated from sulfide reactions involving materials with a relatively low sulfide sulfur concentration are highly soluble, and therefore will be collected in column leachate. The $SO_4^{2-}$ concentration (and hence generation/release rate) in leachate from the KLC tests is highly variable between the KLCs, however the value tends to increase for the PAF materials (KLC2 and KLC5) over the six-month test period as illustrated in **Figure 5.17**.

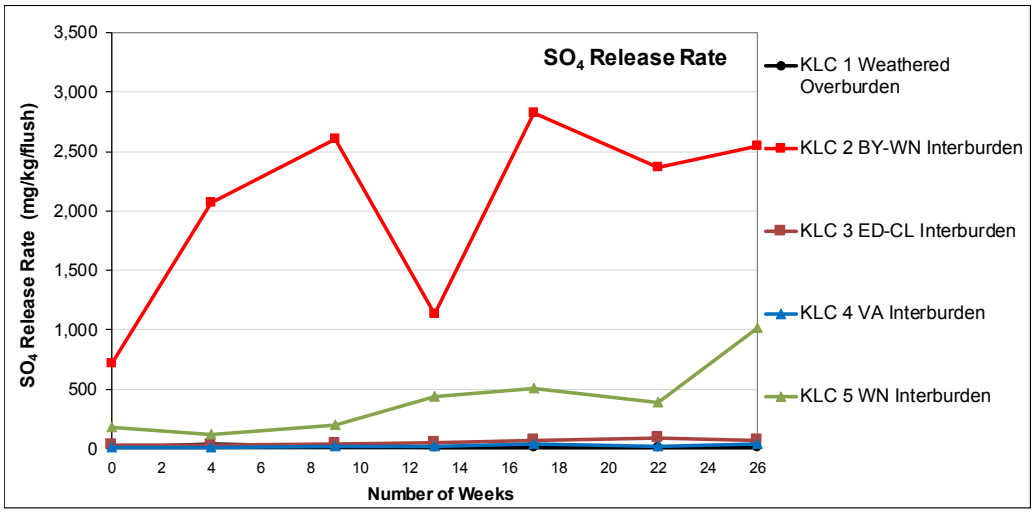


**Figure 5.17: KLC sulfate generation/release rates for overburden/interburden**

Mining waste materials with low rates of sulfate generation/release and low to moderate ANC levels generally have an increased factor of safety with respect to potential acid generation; and are likely to generate leachate that is pH neutral and/or has low levels of acidity (AMIRA, 1995; Bennett et al., 2000). The materials represented by KLC tests 1, 3 and 4 fall into this category, and the KLC results reflect the NAF material classification predicted from the static geochemical test results in **Section 5.1**. For these materials, the concentration of dissolved trace metals/metalloids in KLC leachate is typically very low, often below the laboratory LoR and within the applied water quality guidelines. The only exception is Se, which can exceed the applied guideline value of 0.02 mg/L in some KLC leachate samples. Slightly elevated concentrations of this metalloid are often found in (concentrated) KLC leachate from coal mine samples in Australia but are not commonly detected in water quality monitoring programs in the field. Overall, ongoing surface runoff and seepage from materials represented by the three NAF KLC materials are unlikely to present a significant risk to the quality of surface water and groundwater resources at the Project.

In comparison, PAF KLC2 and KLC5 materials exhibit higher rates of sulfide oxidation and have a lower factor of safety with respect to potential acid generation (i.e. these materials are likely to generate acidic pH leachate if left exposed to oxidising/weathering conditions). The KLC results reflect the PAF material classification predicted from the static geochemical test results in **Section 5.1**. The concentrations of Al, As, Cd, Co, Cu, Fe, Mn, Ni, Se and Zn in KLC leachate are elevated compared to applied livestock drinking water guidelines (ANZECC & ARMCANZ, 2000) for KLC2. In comparison, elevated concentrations of metals/metalloids in leachate from KLC5 is limited to Al, Fe, Mn and Ni compared to the applied livestock drinking water guidelines. These results demonstrate that if left unmanaged, dissolved metal/metalloid concentrations are likely to be elevated in surface runoff and seepage from PAF materials.

#### *5.7.1.2 Sulfide oxidation and sulfate generation rates*

The $SO_4^{2-}$ generation/release rates obtained for the sample materials used in the KLC tests have been used to determine the rate of sulfide oxidation in these materials. Most sulfate salts generated from sulfide reaction involving materials with a relatively low sulfide sulfur concentration are highly soluble, and therefore will be collected in column leachate. The dissolved $SO_4^{2-}$ (and $Ca^{2+}$) concentrations in most of the KLC leachate are typically less than the solubility limit of gypsum ($CaSO_4$), for example, which indicates that $SO_4^{2-}$ generation is not controlled by gypsum dissolution in the KLC test materials. Therefore, the $SO_4^{2-}$ concentrations and oxidation rate calculations provide reasonable estimates of these parameters and the results align well with existing static and dynamic geochemical data derived from a wide range of mine waste materials (AMIRA, 1995). The $SO_4^{2-}$ generation rate and sulfide oxidation rate for the KLC tests are shown in Table 5.12.

**Table 5.12: Sulfate generation and sulfide oxidation rates for KLC tests on overburden/interburden**

| KLC Sample Number | Sample Description | $SO_4^{2-}$ Generation Rate (mg/kg/week) | Oxidation Rate (kg $O_2/m^3/s$) |
|---|---|---|---|
| KLC1 | Weathered overburden | 3.6 | $1.49 \times 10^{-9}$ |
| KLC2 | BY-WN interburden | 473.4 | $1.93 \times 10^{-7}$ |
| KLC3 | Foybrook interburden | 12.1 | $4.91 \times 10^{-9}$ |
| KLC4 | VA interburden | 5.6 | $2.31 \times 10^{-9}$ |
| KLC5 | WN interburden | 97.3 | $4.08 \times 10^{-8}$ |

Notes: The $SO_4^{2-}$ generation rate is measured in units of milligrams of $SO_4^{2-}$ generated per kilogram of sample material per week (mg/kg/week). The sulfide oxidation rate is measured in units of kilograms of Oxygen ($O_2$) per cubic metre per second (kg $O_2/m^3/s$).

The sulfate generation rate from the KLC samples ranges from 3.6 to 473.4 mg/kg/week which is equivalent to a sulfide oxidation rate ranging from $1.49 \times 10^{-9}$ to $1.93 \times 10^{-7}$ kg $O_2/m^3/s$. Mining waste materials with an oxidation rate less than $1 \times 10^{-8}$ kg $O_2/m^3/s$ and a moderate ANC level have an increased factor of safety and are likely to generate leachate that is pH neutral and/or has a low level of acidity (AMIRA, 1995; Bennett et al., 2000). Hence, all of the NAF sample materials used in the KLC test program fall into this category. In comparison, the PAF sample materials have a reduced factor of safety and are likely to generate leachate that has an acidic pH and elevated levels of acidity.

Overall, the KLC results for overburden and interburden reflect the range of material characteristics predicted from the static geochemical test results presented in **Section 5.1**. Potential implications of these results with respect to the management of these materials at the Project are discussed further in **Section 6.**

### *5.7.2* Coal rejects

KLC tests were completed on nine composite samples of coal reject materials (four coarse reject and five fine reject samples) using the methodology described in **Section 4.2.2**. The composition of the nine coal reject samples used in the KLC tests is summarised in **Table 5.13** and detailed in **Table B11** (**Attachment B**). The KLC tests on the coal reject materials were operated for a period of six months from 8 April to 9 October 2020 under a monthly watering and leaching cycle, following mining industry guidelines for such tests (AMIRA, 2002; COA, 2016).

The leachate results from the KLC program are presented alongside the Australian water quality guideline values for livestock drinking water quality (ANZECC & ARMCANZ, 2000). These guidelines are provided for context only and are not intended to be interpreted as “maximum permissible values” for site water quality. Additionally, the KLC samples were crushed to pass a 10 mm sieve size, and therefore have a high surface area for potential geochemical reactions. The ratio of sample to water in the KLC leach tests was generally between 2:1 and 3:1 (w:v), which is an order of magnitude more concentrated than that used in the static tests (at 1:5 [w:v]), where results have been (arbitrarily) compared against guideline concentrations to provide relevant context. This difference in concentration should be considered when comparing results with the applied water quality guidelines. Whilst arbitrary comparisons against guideline concentrations are useful in some situations to provide relevant context, such comparisons cannot be directly extrapolated to the field situation at the Project.

**Table 5.13: KLC material description**

| KLC Sample # | Description |
|---|---|
| KLC6 | ED Coarse Reject (PAF/ Uncertain) |
| KLC7 | ED Fine Reject (NAF) |
| KLC8 | WN1 Coarse Reject (PAF) |
| KLC9 | WN1 Fine Reject (NAF) |
| KLC10 | PF2 Fine Reject (NAF) |
| KLC11 | VX1 Coarse Reject (NAF) |
| KLC12 | VX1 Fine Reject (NAF) |
| KLC13 | BRBY Fine Reject (NAF) |
| KLC14 | BRBY Coarse Reject (NAF Barren) |

### *5.7.2.1 Leachate chemistry*

KLC test results for the coal reject materials are present in **Attachment C** and **Figures 5.18** to **5.20** provide data for the monthly leach events over a total period of six months from 8 April to 9 October 2020 (the first leach event is essentially month zero). The KLC test results to date indicate that:

- Leachate from the nine KLC tests has a pH value in the range 2.39 to 8.21. The lowest pH values (<3) are associated with the PAF WN1 coarse reject material and to a lesser extent, the NAF VX1 coarse reject material (<5). Most coal reject samples have pH values similar to or greater than the pH of the deionised water used in the KLC tests. The KLC pH trends for coal rejects are illustrated in **Figure 5.18**.

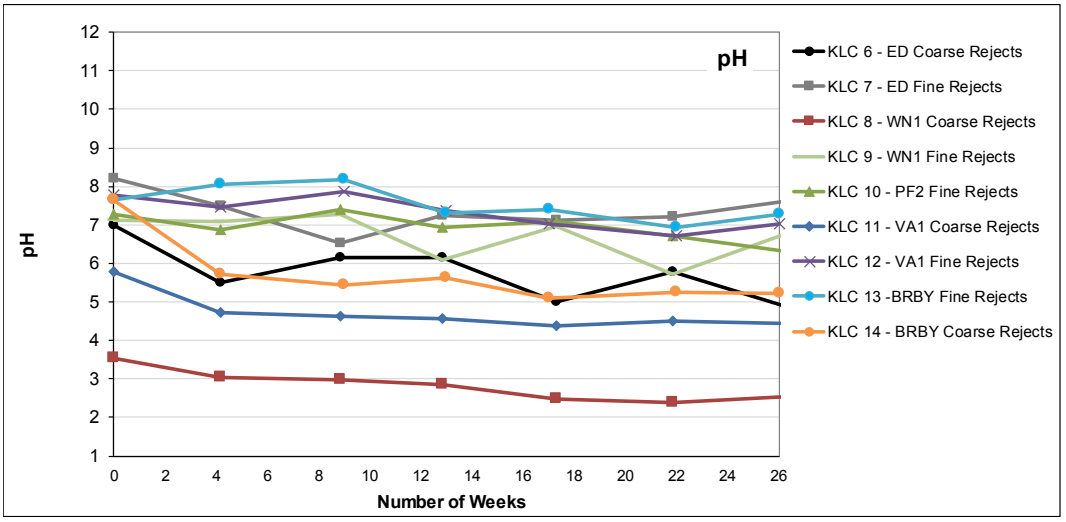


**Figure 5.18: KLC pH results for coal reject**

- Leachate from the KLC tests have EC values in the range 40 to 5,760 µS/cm. The highest EC values are associated with WN coarse reject material (>3,000 µS/cm) and ED coarse rejects (>1,000 µS/cm). The KLC EC trends for coal rejects are illustrated in **Figure 5.19**.

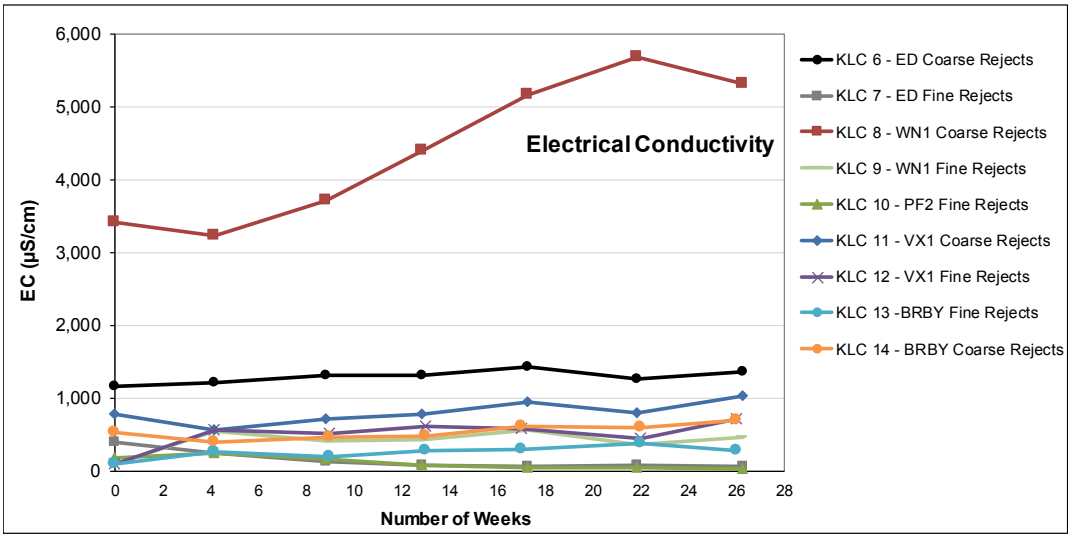


**Figure 5.19: KLC EC results for coal reject**

- The acidity values in leachate from the KLC tests are typically low (<30 mg/L, as $CaCO_3$) and in some cases, less than the laboratory LoR (<1 mg/L, as $CaCO_3$). The exception is the WN coarse reject (KLC8) material that has an increasing acidity level, which is greater than 5,000 mg/L (as $CaCO_3$), towards the end of the six month test period. The alkalinity value in KLC leachate ranges from less than the laboratory LoR (<1 mg/L, as $CaCO_3$) to 70 mg/L, as $CaCO_3$, resulting in a net alkalinity value that is either positive or relatively close to zero for all but the WN coarse reject material.
- The major ion concentration in the KLC leachate collected from the coal reject materials is generally dominated by $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $Cl^{-}$ and $SO_4^{2-}$.
- The $SO_4^{2-}$ concentration in KLC leachate from most of the coal reject samples is below the applied ANZECC & ARMCANZ stock water quality guideline criterion (1,000 mg/L) over the test period. The $SO_4^{2-}$ concentration is higher than this criterion in leachate from the WN coarse reject material (KLC8) and shows an increasing concentration trend.
- The concentrations of dissolved $Ca^{2+}$ and $Mg^{2+}$ in leachate from the KLC tests have been used to calculate the residual ANC remaining in the sample materials. The results indicate that the majority of coarse reject samples retain at least 93.8 % of their inherent ANC value after six months of exposure to oxidising conditions, which reflects the slow release of alkalinity from these materials. In contrast, the WN coal reject (KLC8) retains less (79.5 %) of the sample's inherent ANC.
- The $SO_4^{2-}$ generation/release rate results have been used to calculate the rate of sulfide oxidation in the material represented by each KLC. Most $SO_4^{2-}$ salts generated from sulfide reaction involving materials with a relatively low sulfide sulfur concentration are highly soluble, and therefore will be collected in column leachate. The $SO_4^{2-}$ concentration (and hence generation/release rate) in leachate from most of the KLC tests is relatively low and shows a steady trend, however the $SO_4^{2-}$ concentration is notably higher for leachate from the PAF WN coarse reject material (KLC8) as illustrated in **Figure 5.20**.

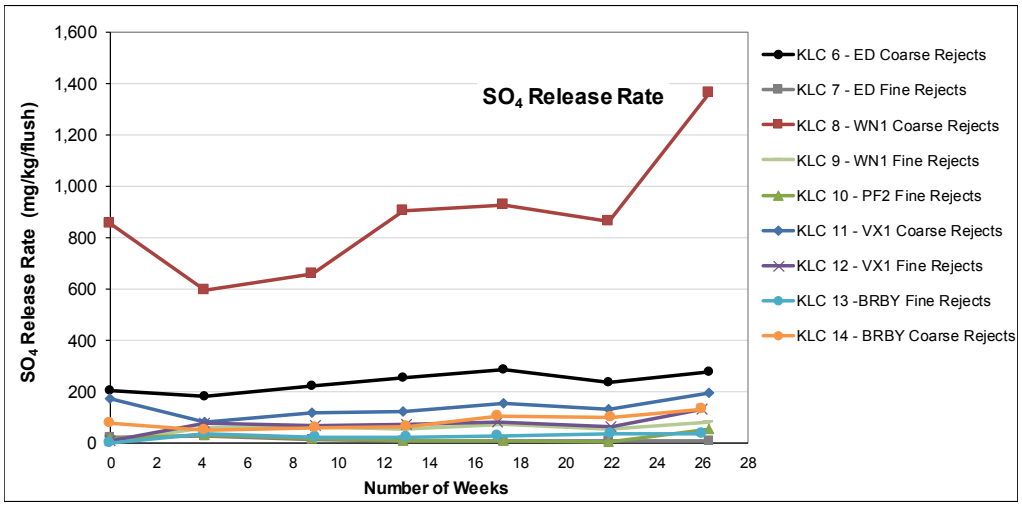


**Figure 5.20: KLC sulfate generation/release rates for coal reject**

Mining waste materials with low sulfate generation/release rates and low to moderate ANC levels generally have an increased factor of safety with respect to potential acid generation; and are likely to generate leachate that is pH neutral and/or has relatively low levels of acidity (AMIRA, 1995; Bennett et al., 2000). The materials represented by KLC tests 7, 9, 10, 11, 12, 13 and 14 generally fall into this category, and the KLC results reflect the NAF material classification predicted from the static geochemical test results in **Section 5.2** (although KLC leachate from the VX coarse reject has a slightly lower pH value than expected, which is probably due to the inherent ANC being unavailable to provide buffering until lower pH values are reached). For these materials, the concentration of dissolved trace metals/metalloids in KLC leachate is typically very low, often below the laboratory LoR and within the applied water quality guidelines. Overall, ongoing surface runoff and seepage from materials represented by the NAF KLC materials are unlikely to present a significant risk to the quality of surface water and groundwater resources at the Project.

In comparison, KLC8 (and to a lesser extent KLC6) materials exhibit higher rates of sulfide oxidation and have a lower factor of safety with respect to potential acid generation (i.e. materials represented by KLC8 are likely to generate acidic pH leachate if left exposed to oxidising/weathering conditions). The KLC results reflect the PAF and PAF/Uncertain material classifications for these materials, respectively, as predicted from the static geochemical test results in **Section 5.2**. The concentrations of Al, As, Cd, Co, Cu, Fe, Mn, Ni and Se in KLC leachate are elevated compared to applied livestock drinking water guidelines (ANZECC & ARMCANZ, 2000) for KLC8. These results demonstrate that if left unmanaged, some dissolved metal/metalloid concentrations are likely to be elevated in surface runoff and seepage from PAF materials.

### *5.7.2.2 Sulfide oxidation and sulfate generation rates*

The $SO_4^{2-}$ generation/release rate results obtained for the nine KLC tests on the coal reject samples have been used to determine the rate of sulfide oxidation in these materials. Most $SO_4^{2-}$ salts generated from sulfide reaction involving materials with a relatively low sulfide sulfur concentration are highly soluble, and therefore will be collected in column leachate. Therefore, the $SO_4^{2-}$ concentrations and oxidation rate calculations provide reasonable estimates of these parameters and the results align well with existing static and dynamic geochemical data derived from a wide range of mine waste materials (AMIRA, 1995). The initial $SO_4^{2-}$ generation rate and associated sulfide oxidation rate for the nine KLC tests are shown in **Table 5.14**.

**Table 5.14: Sulfate generation and sulfide oxidation rates for KLC tests on coal reject**

| KLC Sample Number | Sample Description | Sulfate Generation Rate (mg/kg/week) | Oxidation Rate (kg $O_2/m^3/s$) |
|---|---|---|---|
| KLC6 | ED coarse reject (PAF/Uncertain) | 55.3 | $2.2 \times 10^{-8}$ |
| KLC7 | ED fine reject (NAF) | 3.9 | $1.6 \times 10^{-9}$ |
| KLC8 | WN1 coarse reject (PAF) | 204.6 | $8.3 \times 10^{-8}$ |
| KLC9 | WN1 fine reject (NAF) | 13.3 | $5.3 \times 10^{-9}$ |
| KLC10 | PF2 fine reject (NAF) | 3.6 | $1.5 \times 10^{-9}$ |
| KLC11 | VX1 coarse reject (NAF) | 32.9 | $1.3 \times 10^{-8}$ |
| KLC12 | VX1 fine reject (NAF) | 17.6 | $7.3 \times 10^{-9}$ |
| KLC13 | BRBY fine reject (NAF) | 6.5 | $2.7 \times 10^{-9}$ |
| KLC14 | BRBY coarse reject (NAF Barren) | 20.1 | $8.3 \times 10^{-9}$ |

The $SO_4^{2-}$ generation rate from the KLC samples ranges from 3.6 to 204.6 mg/kg/week which is equivalent to a sulfide oxidation rate ranging from $1.5 \times 10^{-9}$ to $8.3 \times 10^{-8}$ kg $O_2/m^3/s$. Mining waste materials with an oxidation rate less than $1 \times 10^{-8}$ kg $O_2/m^3/s$ and a moderate ANC level have an increased factor of safety and are likely to generate leachate that is pH neutral and/or has a low level of acidity (AMIRA, 1995; Bennett et al., 2000). While most coal reject materials used in the KLC test program generally fall into this category, the WN1 coarse reject material (KLC8) is likely to have a reduced factor of safety and generate leachate that has an acidic pH and elevated level of acidity.

Overall, the KLC results generally reflect the range of material characteristics predicted from the static geochemical test results presented in **Section 5.2**. Potential implications of these results with respect to the management of these materials at the Project are discussed further in **Section 6**.

# 6 Discussion

## 6.1 Acid forming potential

### *6.1.1* Overburden and interburden

The results of the ABA tests presented in **Section 5.1** and the water extract and KLC test results discussed in **Sections 5.7.1** and **5.7.2**, respectively, demonstrate that the AMD potential of the materials represented by the samples tested is closely linked to stratigraphy. The overburden and most of the interburden materials are classified as NAF, with excess ANC and generally low oxidisable sulfur content. Material represented by the samples has a low risk of acid generation and a high factor of safety with respect to potential AMD.

In contrast, BY-WN interburden in the Bulga formation (commonly known as Archerfield Sandstone) has an elevated oxidisable sulfur content, minimal ANC, and is classified as PAF. Coal seam roof, floor and parting materials (collectively called interburden) associated with the WN seam can also be classified as PAF, although based on the samples tested, may be less reactive than the BY-WN interburden.

Based on the currently available information, PAF materials appear to be confined to the BY-WN interburden materials and interburden materials (roof, floor and parting) associated with the WN seam. PAF interburden materials are generally recognizable by lithology, which can be predicted and modelled in advance of mining, so that these materials can be managed appropriately. It is recommended that PAF interburden materials be selectively handled and encapsulated within NAF materials in the overburden emplacement area as part of pit backfill. Operational sampling and geochemical testing of selected interburden materials and surface and groundwater quality monitoring should also be used throughout the mine life to verify that the adopted waste management strategy is appropriate and performing according to the design and expected outcomes.

These findings and recommended management strategy align well with the known geochemical characteristics of, and management practices for, mine waste materials generated at nearby coal mines, including the adjacent Bengalla Mine, which were reviewed by RGS as part of the development of the sampling strategy for the current Project. The RGS review findings have been summarised in **Section 3** and **Attachment E**.

### *6.1.2* Coal reject

The results of the ABA tests presented in **Section 5.2** and the water extract and KLC test results discussed in **Sections 5.7.1** and **5.7.2** demonstrate that the AMD potential of the coal reject materials represented by the samples tested is closely linked to the specific coal seam processed to generate these materials. Whilst the fine reject materials tested are classified as NAF and have excess ANC, those derived from the WN seam contain an elevated concentration of oxidisable sulfur which could oxidise under unsaturated conditions to produce elevated sulfate concentrations in contact water. It is recommended that the geochemical characteristics of fine reject materials are considered with respect to the management of the surface Fines Emplacement Area at the Project. In particular fine reject materials generated from processing different seams should be well mixed and exposure to prolonged unsaturated conditions for WN seam fine reject should be avoided.

On the basis of the samples tested, the oxidisable sulfur content of coarse reject materials generated from processing the WN seam and ED seam is elevated and some of these materials are classified as PAF. In particular the WN seam coarse reject rapidly generates low pH conditions (pH 3-4) and contact water (leachate) shows elevated concentrations of $SO_4^{2-}$, and some metals/metalloids. Material represented by these coarse reject samples has an increased risk of acid generation and a lower factor of safety with respect to potential AMD.

Based on the geochemical test results to date, PAF materials appear to be confined to coarse reject generated from processing the WN seam (and potentially the ED seam). It is recommended that any identified PAF coal reject materials be selectively handled and encapsulated within NAF materials in the overburden emplacement area as part of pit backfill. Operational sampling and geochemical testing of coal reject and surface and groundwater quality monitoring should also be used throughout the mine life to verify that the adopted waste management strategy is appropriate and performing according to the design and expected outcomes.

These findings and recommended management strategy align well with the known geochemical characteristics of, and management practices for, mine waste materials generated at nearby coal mines, including the adjacent Bengalla Mine, which were reviewed by RGS as part of the development of the sampling strategy for the current Project. The RGS review findings are summarised in **Section 3** and **Attachment E**.

## 6.2 Physical characteristics

### *6.2.1* Overburden and interburden

The interburden material appears to have a higher proportion of harder material, which fractions into coarser grains when broken, compared to softer overburden materials which have higher proportions of fines. These material characteristics may be beneficial in terms of selecting appropriate materials for landform construction and rehabilitation/revegetation activities.

Dispersive materials can impact surface water environments through increasing the sediment load present in surface waters, increasing the turbidity of surface waters. Overall, the results of the physical and exchangeable cation characterisation tests described in this report indicate that the overburden and interburden materials are moderately sodic and consequently, may be susceptible to dispersion and erosion and should be managed appropriately. At Bengalla Mine, no selective handling of moderately sodic overburden and interburden is applied and these materials are successfully managed by placement of a revegetated subsoil/topsoil layer over final landforms as part of rehabilitation.

If required, the dispersive characteristics of the overburden and interburden materials can also be improved further with the addition of gypsum to surface material below the revegetated subsoil/topsoil cover. In addition, fertiliser addition could be considered for overburden and interburden materials used in rehabilitation to provide a reasonable growth medium for revegetation and rehabilitation purposes.

## 6.3 Multi-element composition and enrichment

### *6.3.1* Overburden and interburden

The concentration of trace metals/metalloids in solid overburden and interburden materials is expected to be low compared to applied guideline criteria for soils median crustal abundance in un-mineralised soils and is not expected to present any environmental issues associated with revegetation and rehabilitation.

### *6.3.2* Coal reject

The concentration of trace metals/metalloids in solid coal reject materials (coarse and fine reject) is expected to be low compared to applied guideline criteria for soils and median crustal abundance in un-mineralised soils.

## 6.4 Water quality

### *6.4.1* Overburden and interburden

The static and kinetic geochemical test results presented in this report demonstrate that initial surface runoff and seepage from NAF materials is likely to be pH neutral to slightly alkaline and have a low to moderate salinity value. Whilst some PAF interburden materials, particularly those associated with the BY-WN and WN, are likely to generate acidic pH values, surface runoff and seepage from bulk NAF materials is likely to fall within the range for 95 % species protection in freshwater aquatic ecosystems (pH 6 to 9) as set out in ANZECC & ARMCANZ (2000).

The total concentrations of major ions in initial leachate from NAF materials are relatively low and are dominated by $HCO^{3-}$ and $SO_4^{2-}$, although $Ca^{2+}$ and $Mg^{2+}$ concentrations do tend to increase over time in leachate from PAF materials. Whilst most of the major ion concentrations in leachate from NAF overburden and interburden waste materials are within the applied water quality guidelines for livestock drinking water (ANZECC & ARMCANZ, 2000), sulfate concentrations can be elevated for PAF materials.

The initial concentration of most trace metals/metalloids tested for water in contact with most NAF overburden and interburden materials is low, predominantly below the laboratory LoR, and below the applied water quality guideline criteria. However, KLC test results show that if PAF materials are left unmanaged and exposed to prolonged oxidising conditions, these materials have the potential to generate elevated concentrations of a some metals/metalloids in contact water compared to the applied livestock drinking water guideline values including Al, As, Cd, Co, Cu, Fe, Mn, Ni, Se and Zn.

It is expected that the potential risk of any impact on the quality of surface water and groundwater water from water in contact with NAF mining waste materials at the Project will be low. For material classified as PAF, namely BY-WN interburden and WN interburden (roof, floor and parting), future weathering and oxidation of these materials may lead to acidic conditions and can significantly increase the solubility and mobility of some metals/metalloids. It is therefore important that PAF materials are managed according to the methodology in the current Mining Operation Plan and Rehabilitation Management Plan (MOP) (MACH Energy, 2020) to avoid prolonged exposure to oxidising/weathering conditions, especially as PAF materials have a short lag period preceding acid generation (most likely up to a week). It is noted that the adjacent Bengalla Mine ensures that PAF materials are covered with NAF materials within one week of exposure to oxidising/weathering conditions. Traffic compaction and application of agricultural lime (fine limestone) dosing to the surface of PAF materials could be considered to potentially extend the lag period preceding acid generation in the field prior to encapsulation with NAF materials.

Overall, dissolved metal/metalloid concentrations in surface runoff and seepage from most NAF overburden and interburden materials at the Project are unlikely to present a significant risk to surface and groundwater resources. However, if left exposed, PAF materials may have the potential to generate poor quality leachate which could present some risk to water resources.

Encapsulation of PAF materials with NAF materials either in an emplacement facility or preferably as part of pit backfill activities is recommended to prevent exposure to long-term weathering conditions and control the potential for acid generation, sulfate salt release, and mobility of trace metals/metalloids from these materials.

### *6.4.2* Coal reject

The static and kinetic geochemical test results presented in this report indicate that initial surface runoff and seepage from most NAF coal reject materials is likely to be pH neutral to slightly alkaline and have a low to moderate salinity value. Seepage from bulk NAF reject materials is likely to fall within the range for 95 % species protection in freshwater aquatic ecosystems (pH 6 to 9) as set out in ANZECC & ARMCANZ (2000). In contrast, some PAF coal reject materials, particularly those associated with the WN seam (and potentially the ED seam), have the potential to generate acidic pH values in surface runoff and seepage.

The total concentrations of major ions in leachate from NAF coal reject materials are relatively low and are dominated by $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$ and $SO_4^{2-}$. Whilst most of the major ion concentrations in leachate from NAF coal reject materials are below the applied water quality guidelines for livestock drinking water (ANZECC & ARMCANZ, 2000) the sulfate concentrations can be elevated for PAF materials.

The concentration of most trace metals/metalloids tested for water in contact with most NAF coal reject materials is initially relatively low, predominantly below the laboratory LoR, and below the applied water quality guideline criteria. Exceptions include the WN1 and VX1 coarse reject materials, which can have slightly elevated concentrations of Cu, Ni and Zn in initial contact water compared to the applied freshwater aquatic ecosystem trigger values for these metals. In comparison, KLC test results show that PAF materials have the potential to generate elevated concentrations of a number of metals/metalloids in leachate over time compared to the applied livestock drinking water guideline values including Al, As, Cd, Co, Cu, Fe, Mn, Ni and Se.

It is expected that the potential risk of any impact on the quality of surface water and groundwater water from water in contact with NAF coal reject materials at the Project is relatively low. For PAF coarse reject materials, associated with the WN and potentially the ED seam, weathering and oxidation of these materials may lead to acidic conditions and can significantly increase the solubility and mobility of metals/metalloids. It is therefore important that PAF coarse reject materials are managed to avoid prolonged exposure to oxidising/weathering conditions, especially as PAF coarse reject materials are likely to have a short lag period preceding acid generation (most likely up to a week). It is noted that the adjacent Bengalla Mine ensure that PAF materials are covered with NAF materials within one week of exposure to oxidising/weathering conditions. Again, traffic compaction and application of agricultural lime (fine limestone) dosing to the surface of PAF materials could be considered to potentially extend the lag period preceding acid generation in the field prior to encapsulation with NAF materials. As stated in **Section 6.1.2**, for fine reject, it is recommended that materials generated from processing different seams be well mixed at the Fines Emplacement Area and exposure to prolonged unsaturated conditions for WN seam fine reject should be avoided.

Overall, dissolved metal/metalloid concentrations in surface runoff and seepage from most NAF coal reject materials at the Project are unlikely to present a significant risk to surface and groundwater resources. However, if left exposed, PAF materials may have the potential to generate poor quality leachate which may present some risk to water resources.

Encapsulation of any PAF coarse reject materials by NAF materials either in an emplacement facility or preferably as part of pit backfill activities is recommended to prevent exposure to long-term weathering conditions and control the potential for acid generation and mobility of trace metals/metalloids from these materials.

# 7 Conclusions and recommendations

## 7.1 Conclusions

RGS has completed a geochemistry assessment of overburden, interburden and coal reject materials at the Project. The main findings of the geochemistry assessment are:

- Most overburden and interburden materials are classified as NAF, have excess ANC and have low oxidisable sulfur content. These materials have a very low risk of acid generation and a high factor of safety with respect to potential for AMD.
- PAF material occurrence is limited to BY-WN interburden, WN interburden (roof, floor and parting) and coarse rejects derived from processing the WN seam (and possibly the ED seam).
- While fine reject materials are generally classified as NAF, those associated with the WN seam can have elevated oxidisable sulfur content, which has the potential to oxidise under unsaturated conditions and produce elevated sulfate concentrations in contact water.
- PAF interburden and coarse reject materials are reactive when exposed to air and moisture and have a relatively short lag period preceding acid generation (up to a week). PAF interburden materials are recognisable by lithology, which can be predicted prior to mining and an appropriate destination planned for these materials.
- Initial and ongoing surface runoff and seepage from NAF overburden, interburden and coal reject material is expected to be pH neutral to slightly alkaline and, have a low to moderate level of salinity. Surface runoff and seepage from PAF interburden and coal reject material has the potential to become progressively more acidic and saline, if left unmanaged and exposed to oxidising conditions.
- The concentration of trace metals/metalloids in solid overburden, interburden and coal reject materials is expected to be low compared to applied guideline criteria for soils and median crustal abundance in un-mineralised soils and is not expected to present any environmental issues associated with revegetation and rehabilitation.
- Metals/metalloids are sparingly soluble at the neutral to slightly alkaline pH of the leachate expected from NAF overburden, interburden and coal reject materials. Dissolved metal/metalloid concentrations in surface runoff and seepage from bulk NAF waste rock materials are expected to be low and unlikely to pose a significant risk to the quality of surface and groundwater resources at relevant storage facilities.
- PAF interburden and coarse reject materials have the potential to become acidic and mobilise some metals/metalloids over time if not managed appropriately. If left unmanaged, this characteristic could pose a risk to the quality of surface and groundwater resources at relevant storage facilities.
- NAF overburden and interburden materials should be amenable to revegetation as part of rehabilitation activities, although gypsum and fertiliser addition may need to be considered for sodic materials to limit dispersion and erosion and to provide a reasonable growth medium if these materials are used for revegetation and rehabilitation.
- At the adjacent Bengalla Mine, no selective handling of moderately sodic overburden and interburden is applied and these materials are successfully managed by placement of a revegetated subsoil/topsoil layer over final landforms as part of rehabilitation.

## 7.2 Recommendations

As a result of the geochemistry assessment work completed on at the Project, several recommendations are provided to minimise the risk of any significant environmental harm to the immediate and downstream environment.

- PAF interburden and coal reject materials should continue to be managed at the Project in accordance with Section 3.2.3 of the current MOP (MACH Energy, 2020).

- Selective handling and encapsulation of PAF interburden and coal reject materials at an emplacement or preferably as part of an open pit backfilling within one week of placement should be considered as this process has been successfully applied at the adjacent Bengalla Mine over many years.
- If swift encapsulation of PAF materials is not practical at the Project, some consideration of material management practices such as traffic compaction and dosing with agricultural lime (fine limestone) should be considered to extend the lag period preceding acid generation prior to encapsulation.
- PAF materials should not be placed at overburden emplacement areas or pit backfill areas that overlay or have potential connectivity with alluvial soils and/or creeks, to avoid any potential water quality impacts.
- Additional testing (e.g. pH, EC, exchangeable cations, nutrients, PSD and EA tests) and rehabilitation field trials should be considered when bulk materials become available. Such tests would help to validate the most appropriate management option for rehabilitation of these materials in final landforms progressively and at mine closure.
- Operational sampling and geochemical testing of mining waste material and water quality monitoring should be used throughout the mine life to verify the veracity and performance of the adopted mining waste management strategy.
- Surface water and seepage from the mining and mining waste storage areas should be monitored to ensure that key water quality parameters remain within appropriate licence criteria. Water quality monitoring parameters should be integrated into the current water quality monitoring program and include pH, EC and total suspended solids (TSS) on a quarterly basis and the suite of water quality analyses described in **Tables B8** and **B9** (**Attachment B**) of this report opportunistically and at least on an annual basis.

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# Attachment A Geochemical assessment of mining waste materials

# GEOCHEMICAL ASSESSMENT OF MINING WASTE MATERIALS

## ACID GENERATION AND PREDICTION

Acid generation is caused by the exposure of sulfide minerals, most commonly pyrite ($FeS_2$), to atmospheric oxygen and water. Sulfur (S) assay results are used to calculate the maximum acid that could be generated by the sample by either directly determining the pyritic S content or assuming that all sulfur not present as sulfate occurs as pyrite. Pyrite reacts under oxidising conditions to generate acid according to the following overall reaction:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \rightarrow Fe(OH)_3 + 2\ H_2SO_4$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing 1 per cent (%) total sulfur content (%S) as pyrite would be 30.6 kilograms sulfuric acid per tonne (kg $H_2SO_4$/t). The chemical components of the acid generation process consist of the above sulfide oxidation reaction and acid neutralization, which is mainly provided by inherent carbonates and to a lesser extent silicate materials. The amount and rate of acid generation is determined by the interaction and overall balance of the acid generation and neutralisation components.

### *Net Acid Producing Potential*

The net acid producing potential (NAPP) is used as an indicator of materials that may be of concern with respect to acid generation. The NAPP calculation represents the balance between the maximum potential acidity (MPA) of a sample, which is derived from the sulfide sulfur content, and the acid neutralising capacity (ANC) of the material, which is determined experimentally. By convention, the NAPP result is expressed in units of kg $H_2SO_4$/t sample. If the capacity of the solids to neutralise acid (ANC) exceeds their capacity to generate acid (MPA), then the NAPP of the material is negative. Conversely, if the MPA exceeds the ANC, the NAPP of the material is positive. A NAPP assessment involves a series of analytical tests that include:

### *Determination of pH and EC*

pH and electrical conductivity (EC) measured on 1:5 weight/water (w/w) water extract. This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

### *Total sulfur content and Maximum Potential Acidity*

Total sulfur content is determined by the LECO high temperature combustion method. The total sulfur content is then used to calculate the MPA, which assumes that the entire sulfur content is present as reactive pyrite. Direct determination of the pyritic sulfur content can provide a more accurate estimate of the MPA.

### *Acid neutralising capacity*

By addition of acid to a known weight of sample, then titration with Sodium hydroxide (NaOH) to determine the amount of residual acid. The ANC measures the capacity of a sample to react with and neutralise acid. The ANC can be further evaluated by slow acid titration to a set end-point in the Acid Buffering Characteristic Curve (ABCC) test through calculation of the amount of acid consumed and evaluation of the resultant titration curve.

### *Net Acid Generation*

The Net Acid Generation (NAG) test involves the addition of hydrogen peroxide to a sample of mine rock or process residue to oxidise reactive sulfide, then measurement of pH and titration of any net acidity produced by the acid generation and neutralisation reactions occurring in the sample. A significant NAG result (i.e. final $NAG_{pH} < 4.5$) indicates that the sample is potentially acid forming (PAF) and the test provides a direct measure of the net amount of acid remaining in the sample after all acid generating and acid neutralising reactions have taken place. A $NAG_{pH} > 4.5$ indicates that the sample is non-acid forming (NAF). The NAG test can provide a direct assessment of the potential for a material to produce acid after a period of exposure and weathering and is used to refine the results of the theoretical NAPP predictions. The NAG test can be used as a stand-alone test but is recommended that this only be considered after site specific calibration work is carried out.

The standard NAG test is unsuitable for coal mining projects as the high organic content of some materials can cause erroneous results (Stewart et al., 2003; ACARP, 2008).

## ASSESSMENT OF ELEMENT ENRICHMENT AND SOLUBILITY

In mineralised areas it is common to find a suite of enriched elements that have resulted from natural geological processes. Multi-element scans are carried out to identify any elements that are present in a material (or readily leachable from a material) at concentrations that may be of environmental concern with respect to surface water quality, revegetation and public health. The samples are generally analysed for the following elements:

| | |
|---|---|
| Major elements | Aluminium (Al), Calcium (Ca), Iron (Fe), Potassium (K), Magnesium (Mg), Sodium (Na) and S. |
| Minor elements | Arsenic (As), Boron (B), Cadmium (Cd), Cobalt (Co), Chromium (Cr), Copper (Cu), Fluorine (F), Mercury (Hg), Manganese (Mn), Molybdenum (Mo), Nickle (Ni), Lead (Pb), Antimony (Sb), Selenium (Se) and Zinc (Zn). |

The concentration of these elements in samples can be directly compared with relevant state or national environmental and health-based concentration guideline criteria to determine the level of significance. Water extracts are used to determine the immediate element solubilities under the existing sample pH conditions of the sample. The following tests are normally carried out:

### *Multi-element composition of solids.*

Multi-element composition of solid samples determined using a combination of ICP-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (ICP-OES), and atomic absorption spectrometry (AAS).

### *Multi-element composition of water extracts (1:5 sample:deionised water).*

Multi-element composition of water extracts from solid samples determined using a combination of ICP-MS, ICP-OES, and AAS.

Under some conditions (e.g. low pH) the solubility and mobility of common environmentally important elements can increase significantly. If element mobility under initial pH conditions is deemed likely and/or subsequent low pH conditions may occur, kinetic leach column test work may be completed on representative samples.

## KINETIC LEACH COLUMN TESTS

Kinetic leach column (KLC) tests can be used to provide information on the reaction kinetics of mine waste materials. The major objectives of kinetics tests are to:

- Provide time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions);
- Investigate metal release and drainage/seepage quality; and
- Assess treatment options such as addition of alkaline materials.

The KLC tests simulate the weathering process that leads to acid and base generation and reaction under laboratory controlled or site conditions. The kinetic tests allow an assessment of the acid forming characteristics and indicate the rate of acid generation, over what period it will occur, and what management controls may be required.

In KLC tests, water is added to a sample and the mixture allowed to leach products and by-products of acid producing and consuming reactions. Samples of leachate are then collected and analysed. Intermittent water application is applied to simulate rainfall and heat lamps are used to simulate sunshine. These tests provide real-time information and may have to continue for months or years. Monitoring includes trends in pH, sulfate, acidity or alkalinity, and metals, for example. The pH of the collected leachate simulates the acid drainage process, acidity or alkalinity levels indicate the rate of acid production and acid neutralisation, and sulfate production can be related to the rate of sulfide oxidation. Metal concentration data provides an assessment of metal solubility and leaching behaviour.

**Figure A1** shows the kinetic leach column set up typically used by RGS Environmental Pty Ltd (RGS) adapted from *AMIRA, 2002*. The columns are placed under heat lamps to allow the sample to dry between water additions to ensure adequate oxygen ingress into the sample material.

Approximately 2 kilograms (kg) of sample is accurately weighed and used in the leach columns and depending on the physical nature of the material and particle size can be used on an as-received basis (i.e. no crushing as with process residues) or crushed to nominal 5-10 millimetres (mm) particle size (as with waste rock). The sample in the column is initially leached with deionised water at a rate of about 400 millilitres per kilogram (mL/kg) of sample and the initial leachate from the columns collected and analysed. Subsequent column leaching is carried out at a rate of about 400 ml/kg per month and again collected and analysed. The leaching rate can be varied to better simulate expected site conditions or satisfy test program data requirements. The column must be exposed to drying conditions in between watering events. The residual water content and air void content in the column can be determined by comparing the wet and dry column weights. A heat lamp is generally used above the sample during daylight hours to maintain the leach column surface temperature at about 30°C.

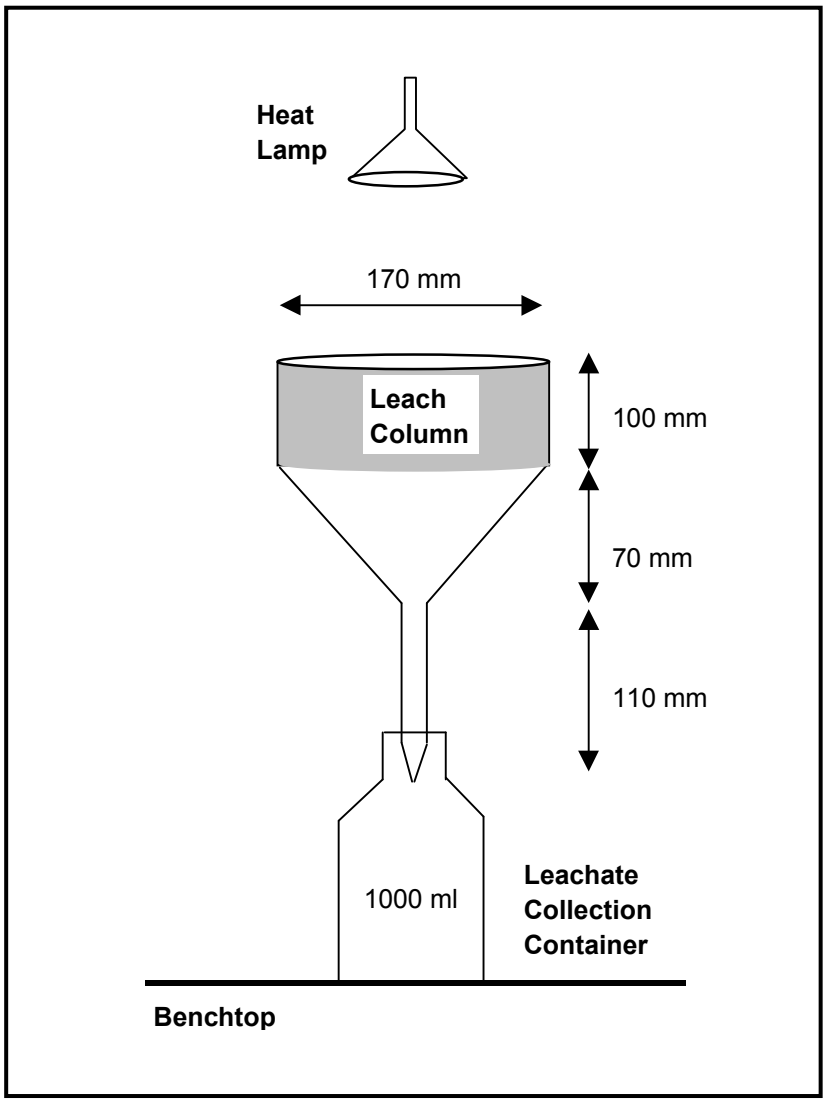


**Figure A1: Kinetic leach column setup**

# Attachment B Static geochemical results

## Table B1: Acid Base Account Results for Overburden and Interburden

| Sample No. | Drill Hole ID | Sample ID | Sample Lithology | Stratigraphy | Bounding coal seams | From | To | Interval | pH[1] | EC[1] | Total S* | Scr | MPA[2] | ANC[2] | NAPP[2] | ANC: MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (m) | | | | (µS/cm) | (%) | (%) | ($kgH_2SO_4/t$) | | | | |
| **Overburden** | | | | | | | | | | | | | | | | | |
| 1 | 2103LA | AMD001 | Weathered Claystone | Overburden | OVER | 1.00 | 7.00 | 6.00 | 8.6 | 478 | 0.03 | - | 0.9 | 44.7 | -43.8 | 48.7 | Non-Acid Forming (Barren) |
| 2 | 2103LA | AMD002 | Weathered Sandstone | Overburden | OVER | 7.00 | 12.00 | 5.00 | 9.0 | 255 | 0.02 | - | 0.6 | 52.8 | -52.2 | 86.2 | Non-Acid Forming (Barren) |
| 3 | 2123L | AMD013 | Weathered Claystone | Overburden | OVER | 0.00 | 8.00 | 8.00 | 8.7 | 484 | 0.02 | - | 0.6 | 13.9 | -13.3 | 22.7 | Non-Acid Forming (Barren) |
| 4 | 2123L | AMD014 | Weathered Sandstone | Overburden | OVER | 8.00 | 14.00 | 6.00 | 8.8 | 430 | 0.02 | - | 0.6 | 49.2 | -48.6 | 80.3 | Non-Acid Forming (Barren) |
| 5 | 2123L | AMD015 | Weathered Siltstone | Overburden | OVER | 14.00 | 17.70 | 3.70 | 8.3 | 444 | 0.05 | - | 1.5 | 44.5 | -43.0 | 29.1 | Non-Acid Forming (Barren) |
| 6 | 2133L | AMD026 | Weathered Claystone | Overburden | OVER | 0.00 | 4.00 | 4.00 | 8.7 | 447 | 0.02 | - | 0.6 | 29.8 | -29.2 | 48.7 | Non-Acid Forming (Barren) |
| 7 | 2133L | AMD027 | Weathered Claystone | Overburden | OVER | 4.00 | 10.00 | 6.00 | 8.4 | 366 | 0.02 | - | 0.6 | 20.0 | -19.4 | 32.7 | Non-Acid Forming (Barren) |
| 8 | 2133L | AMD028 | Weathered Carbonaceous Siltstone | Overburden | OVER | 10.00 | 15.00 | 5.00 | 8.6 | 321 | 0.02 | - | 0.6 | 48.6 | -48.0 | 79.3 | Non-Acid Forming (Barren) |
| 9 | 2133L | AMD029 | Weathered Siltstone | Overburden | OVER | 15.00 | 21.00 | 6.00 | 8.9 | 283 | 0.02 | - | 0.6 | 48.3 | -47.7 | 78.9 | Non-Acid Forming (Barren) |
| 10 | 2133L | AMD030 | Weathered Siltstone | Overburden | OVER | 21.00 | 29.00 | 8.00 | 8.9 | 255 | 0.02 | - | 0.6 | 61.6 | -61.0 | 100.6 | Non-Acid Forming (Barren) |
| 11 | 2167L | AMD063 | Clay | Overburden | OVER | 0.00 | 2.00 | 2.00 | 8.4 | 634 | 0.03 | - | 0.9 | 50.4 | -49.5 | 54.9 | Non-Acid Forming (Barren) |
| **Interburden** | | | | | | | | | | | | | | | | | |
| 12 | 2133L | AMD035 | Sandstone/Siltstone | Birnamwood | LP - VA | 28.75 | 29.44 | 0.69 | 8.4 | 174 | 0.01 | - | 0.2 | 20.4 | -20.2 | 133.2 | Non-Acid Forming (Barren) |
| 13 | 2133L | AMD036 | Claystone | Birnamwood | LP - VA | 29.67 | 30.10 | 0.43 | 8.1 | 155 | 0.04 | - | 1.2 | 12.5 | -11.3 | 10.2 | Non-Acid Forming (Barren) |
| 14 | 2167L | AMD064 | Carbonaceous Claystone | Birnamwood | LP - VA | 2.00 | 8.00 | 6.00 | 8.8 | 567 | 0.02 | - | 0.6 | 80.5 | -79.9 | 131.4 | Non-Acid Forming (Barren) |
| 15 | 2167L | AMD065 | Claystone | Birnamwood | LP - VA | 8.00 | 15.00 | 7.00 | 7.9 | 590 | 0.03 | - | 0.9 | 37.6 | -36.7 | 40.9 | Non-Acid Forming (Barren) |
| 16 | 2167L | AMD068 | Sandstone | Birnamwood | LP - VA | 15.97 | 16.21 | 0.24 | 8.9 | 247 | 0.05 | - | 1.5 | 171.0 | -169.5 | 111.7 | Non-Acid Forming (Barren) |
| 17 | 2167L | AMD069 | Claystone | Birnamwood | LP - VA | 18.11 | 18.20 | 0.09 | 7.9 | 164 | 0.03 | - | 0.9 | 19.2 | -18.3 | 20.9 | Non-Acid Forming (Barren) |
| 18 | 2103LA | AMD003 | Claystone/Carbonaceous Claystone | Birnamwood | VA - BR | 15.01 | 15.24 | 0.23 | 7.2 | 349 | 0.20 | 0.07 | 2.2 | 6.5 | -4.3 | 2.9 | Non-Acid Forming (Barren) |
| 19 | 2123L | AMD016 | Siltstone/Claystone | Birnamwood | VA - BR | 17.70 | 17.97 | 0.27 | 7.7 | 337 | 0.04 | - | 1.2 | 105.0 | -103.8 | 85.7 | Non-Acid Forming (Barren) |
| 20 | 2133L | AMD049 | Siltstone | Birnamwood | VA - BR | 69.77 | 70.70 | 0.93 | 8.6 | 148 | 0.04 | - | 1.2 | 21.7 | -20.5 | 17.7 | Non-Acid Forming (Barren) |
| 21 | 2133L | AMD050 | Sandstone | Birnamwood | VA - BR | 70.70 | 81.50 | 10.80 | 9.0 | 322 | 0.03 | - | 0.9 | 51.6 | -50.7 | 56.2 | Non-Acid Forming (Barren) |
| 22 | 2133L | AMD052 | Claystone | Birnamwood | VA - BR | 82.12 | 82.52 | 0.40 | 7.9 | 138 | 0.08 | - | 2.5 | 8.6 | -6.2 | 3.5 | Non-Acid Forming (Barren) |
| 23 | 2103LA | AMD004 | Sandstone | Bulga | BY - WN | 25.87 | 28.02 | 2.15 | 8.3 | 597 | 0.10 | - | 3.1 | 48.4 | -45.3 | 15.8 | Non-Acid Forming (Barren) |
| 24 | 2103LA | AMD005 | Sandstone | Bulga | BY - WN | 28.61 | 29.25 | 0.64 | 4.3 | 3490 | 2.10 | 0.90 | 27.4 | 0.3 | 27.2 | 0.01 | Potentially Acid Forming |
| 25 | 2103LA | AMD006 | Sandstone/Siltstone | Bulga | BY - WN | 29.33 | 29.46 | 0.13 | 5.8 | 2630 | 1.62 | 0.88 | 26.9 | 4.7 | 22.2 | 0.17 | Potentially Acid Forming |
| 26 | 2103LA | AMD007 | Sandstone | Bulga | BY - WN | 31.19 | 31.39 | 0.20 | 3.9 | 2230 | 3.27 | 1.71 | 52.4 | 0.3 | 52.1 | 0.005 | Potentially Acid Forming |
| 27 | 2123L | AMD017 | Sandstone | Bulga | BY - WN | 30.46 | 31.15 | 0.69 | 7.6 | 156 | 0.02 | - | 0.6 | 6.9 | -6.3 | 11.3 | Non-Acid Forming (Barren) |
| 28 | 2123L | AMD018 | Sandstone | Bulga | BY - WN | 33.77 | 34.95 | 1.18 | 4.1 | 3970 | 3.13 | 1.50 | 45.9 | 0.3 | 45.7 | 0.01 | Potentially Acid Forming |
| 29 | 2123L | AMD019 | Sandstone | Bulga | BY - WN | 35.17 | 35.47 | 0.30 | 3.9 | 2760 | 2.10 | 1.07 | 32.8 | 0.3 | 32.5 | 0.01 | Potentially Acid Forming |
| 30 | 2123L | AMD020 | Sandstone | Bulga | BY - WN | 35.64 | 36.52 | 0.88 | 4.5 | 3630 | 2.43 | 1.17 | 35.8 | 0.3 | 35.6 | 0.01 | Potentially Acid Forming |
| 31 | 2133L | AMD053 | Conglomerate | Bulga | BY - WN | 93.99 | 94.06 | 0.07 | 6.1 | 484 | 0.07 | - | 2.1 | 2.5 | -0.4 | 1.2 | Non-Acid Forming (Barren) |
| 32 | 2133L | AMD054 | Conglomerate | Bulga | BY - WN | 98.20 | 100.50 | 2.30 | 7.8 | 2810 | 0.84 | 0.36 | 11.0 | 43.2 | -32.2 | 3.9 | Non-Acid Forming |
| 33 | 2133L | AMD056 | Sandstone/Siltstone | Bulga | BY - WN | 100.50 | 100.84 | 0.34 | 4.7 | 2060 | 1.64 | 0.87 | 26.5 | 0.3 | 26.3 | 0.01 | Potentially Acid Forming |
| 34 | 2167L | AMD084 | Sandstone | Bulga | BY - WN | 61.48 | 62.87 | 1.39 | 8.2 | 94 | 0.02 | - | 0.6 | 10.0 | -9.4 | 16.3 | Non-Acid Forming (Barren) |
| 35 | 2167L | AMD085 | Sandstone | Bulga | BY - WN | 62.87 | 68.00 | 5.13 | 8.5 | 663 | 0.14 | 0.10 | 3.1 | 68.8 | -65.7 | 22.5 | Non-Acid Forming (Barren) |
| 36 | 2167L | AMD086 | Sandstone | Bulga | BY - WN | 68.92 | 69.07 | 0.15 | 5.9 | 2350 | 1.49 | 0.81 | 24.7 | 6.0 | 18.7 | 0.2 | Potentially Acid Forming |
| 37 | 2167L | AMD087 | Sandstone | Bulga | BY - WN | 69.20 | 69.30 | 0.10 | 4.5 | 2480 | 3.18 | 1.57 | 48.1 | 5.4 | 42.7 | 0.1 | Potentially Acid Forming |
| 38 | 2103LA | AMD008 | Claystone | Foybrook | WN - ED | 37.10 | 37.48 | 0.38 | 9.0 | 251 | 0.06 | - | 1.8 | 289.0 | -287.2 | 157.3 | Non-Acid Forming (Barren) |
| 39 | 2103LA | AMD009 | Claystone | Foybrook | WN - ED | 38.10 | 38.36 | 0.26 | 8.0 | 228 | 0.05 | - | 1.5 | 20.8 | -19.3 | 13.6 | Non-Acid Forming (Barren) |
| 40 | 2133L | AMD061 | Claystone | Foybrook | WN - ED | 113.86 | 114.51 | 0.65 | 8.5 | 405 | 0.22 | 0.13 | 3.9 | 49.2 | -45.3 | 12.6 | Non-Acid Forming |
| 41 | 2167L | AMD089 | Sandstone | Foybrook | WN - ED | 76.29 | 76.45 | 0.16 | 7.4 | 331 | 0.11 | 0.05 | 1.5 | 16.1 | -14.6 | 11.0 | Non-Acid Forming (Barren) |
| 42 | 2167L | AMD090 | Sandstone | Foybrook | WN - ED | 78.44 | 79.04 | 0.60 | 8.6 | 294 | 0.05 | - | 1.5 | 13.5 | -12.0 | 8.8 | Non-Acid Forming (Barren) |

## Table B1: Acid Base Account Results for Overburden and Interburden

| Sample No. | Drill Hole ID | Sample ID | Sample Lithology | Stratigraphy | Bounding coal seams | From | To | Interval | pH[1] | EC[1] | Total S* | Scr | MPA[2] | ANC[2] | NAPP[2] | ANC:MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (m) | | | | (µS/cm) | (%) | (%) | ($kgH_2SO_4/t$) | | | | |
| 43 | 2167L | AMD091 | Stony Coal/Carbonaceous Claystone | Foybrook | WN - ED | 79.88 | 80.00 | 0.12 | 7.9 | 109 | 0.12 | 0.02 | 0.7 | 4.5 | -3.8 | 6.4 | Non-Acid Forming (Barren) |
| 44 | 2167L | AMD096 | Coal | Foybrook | WN - ED | 76.04 | 76.29 | 0.25 | 7.1 | 170 | 0.70 | 0.06 | 1.7 | 12.0 | -10.3 | 6.9 | Non-Acid Forming (Barren) |
| 45 | 2103LA | AMD010 | Claystone | Foybrook | ED - CL | 42.90 | 43.00 | 0.10 | 6.9 | 751 | 0.24 | 0.15 | 4.5 | 5.4 | -0.9 | 1.2 | Uncertain |
| 46 | 2103LA | AMD011 | Sandstone | Foybrook | ED - CL | 43.35 | 43.81 | 0.46 | 7.7 | 204 | 0.04 | - | 1.2 | 4.9 | -3.7 | 4.0 | Non-Acid Forming (Barren) |
| 47 | 2103LA | AMD012 | Siltstone/Claystone | Foybrook | ED - CL | 47.28 | 48.18 | 0.90 | 8.8 | 208 | 0.02 | - | 0.6 | 15.3 | -14.7 | 25.0 | Non-Acid Forming (Barren) |
| 48 | 2123L | AMD023 | Sandstone | Foybrook | ED - CL | 48.61 | 48.68 | 0.07 | 8.7 | 317 | 0.06 | - | 1.8 | 108.0 | -106.2 | 58.8 | Non-Acid Forming (Barren) |
| 49 | 2123L | AMD024 | Claystone | Foybrook | ED - CL | 51.72 | 51.99 | 0.27 | 8.7 | 330 | 0.04 | - | 1.2 | 19.4 | -18.2 | 15.8 | Non-Acid Forming (Barren) |
| 50 | 2123L | AMD025 | Sandstone/Siltstone | Foybrook | ED - CL | 52.36 | 52.79 | 0.43 | 8.9 | 237 | 0.04 | - | 1.2 | 308.0 | -306.8 | 251.4 | Non-Acid Forming (Barren) |
| 51 | 2133L | AMD062 | Sandstone | Foybrook | ED - CL | 118.92 | 120.14 | 1.22 | 7.1 | 487 | 0.29 | - | 8.9 | 21.7 | -12.8 | 2.4 | Non-Acid Forming |
| 52 | 2167L | AMD092 | Claystone | Foybrook | ED - CL | 84.19 | 84.37 | 0.18 | 6.8 | 506 | 0.51 | 0.39 | 11.8 | 7.4 | 4.4 | 0.6 | Uncertain |
| 53 | 2167L | AMD093 | Tuff | Foybrook | ED - CL | 84.37 | 84.85 | 0.48 | 8.0 | 184 | 0.12 | 0.07 | 2.2 | 5.9 | -3.7 | 2.6 | Non-Acid Forming (Barren) |
| 54 | 2167L | AMD094 | Sandstone | Foybrook | ED - CL | 85.07 | 85.28 | 0.21 | 8.4 | 133 | 0.05 | - | 1.5 | 23.2 | -21.7 | 15.2 | Non-Acid Forming (Barren) |
| 55 | 2167L | AMD095 | Sandstone | Foybrook | ED - CL | 85.80 | 90.00 | 4.20 | 9.0 | 305 | 0.03 | - | 0.9 | 80.8 | -79.9 | 87.9 | Non-Acid Forming (Barren) |
| **Roof, Floor and Parting** | | | | | | | | | | | | | | | | | |
| 56 | 2133L | AMD037 | Claystone | Vaux | VA | 39.33 | 39.74 | 0.41 | 8.1 | 174 | 0.03 | - | 0.9 | 22.6 | -21.7 | 24.6 | Non-Acid Forming (Barren) |
| 57 | 2133L | AMD038 | Claystone | Vaux | VA | 40.18 | 40.84 | 0.66 | 7.7 | 206 | 0.14 | 0.08 | 2.4 | 12.4 | -10.0 | 5.3 | Non-Acid Forming (Barren) |
| 58 | 2133L | AMD039 | Siltstone | Vaux | VA | 42.00 | 48.00 | 6.00 | 8.6 | 279 | 0.03 | - | 0.9 | 79.0 | -78.1 | 86.0 | Non-Acid Forming (Barren) |
| 59 | 2133L | AMD040 | Siltstone | Vaux | VA | 48.00 | 51.50 | 3.50 | 8.8 | 295 | 0.02 | - | 0.6 | 69.5 | -68.9 | 113.5 | Non-Acid Forming (Barren) |
| 60 | 2133L | AMD042 | Sandstone | Vaux | VA | 51.97 | 52.32 | 0.35 | 8.4 | 110 | 0.05 | - | 1.5 | 15.2 | -13.7 | 9.9 | Non-Acid Forming (Barren) |
| 61 | 2133L | AMD043 | Sandstone/Siltstone | Vaux | VA | 54.69 | 55.00 | 0.31 | 8.5 | 106 | 0.03 | - | 0.9 | 12.8 | -11.9 | 13.9 | Non-Acid Forming (Barren) |
| 62 | 2133L | AMD044 | Siltstone | Vaux | VA | 55.00 | 61.50 | 6.50 | 9.0 | 302 | 0.02 | - | 0.6 | 86.1 | -85.5 | 140.6 | Non-Acid Forming (Barren) |
| 63 | 2133L | AMD046 | Claystone | Vaux | VA | 62.29 | 62.37 | 0.08 | 8.6 | 87 | 0.02 | - | 0.6 | 13.4 | -12.8 | 21.9 | Non-Acid Forming (Barren) |
| 64 | 2133L | AMD047 | Siderite/Sandstone | Vaux | VA | 63.11 | 63.24 | 0.13 | 8.4 | 92 | 0.01 | - | 0.2 | 10.8 | -10.6 | 70.5 | Non-Acid Forming (Barren) |
| 65 | 2133L | AMD048 | Claystone | Vaux | VA | 67.72 | 68.29 | 0.57 | 8.4 | 134 | 0.03 | - | 0.9 | 17.2 | -16.3 | 18.7 | Non-Acid Forming (Barren) |
| 66 | 2167L | AMD070 | Sandstone | Vaux | VA | 19.35 | 19.40 | 0.05 | 7.9 | 121 | 0.03 | - | 0.9 | 6.2 | -5.3 | 6.7 | Non-Acid Forming (Barren) |
| 67 | 2167L | AMD071 | Claystone | Vaux | VA | 19.79 | 20.00 | 0.21 | 7.7 | 171 | 0.10 | - | 3.1 | 18.1 | -15.0 | 5.9 | Non-Acid Forming (Barren) |
| 68 | 2167L | AMD072 | Sandstone | Vaux | VA | 23.65 | 23.96 | 0.31 | 8.8 | 205 | 0.02 | - | 0.6 | 33.2 | -32.6 | 54.2 | Non-Acid Forming (Barren) |
| 69 | 2167L | AMD073 | Claystone | Vaux | VA | 25.19 | 25.35 | 0.16 | 8.2 | 124 | 0.03 | - | 0.9 | 23.9 | -23.0 | 26.0 | Non-Acid Forming (Barren) |
| 70 | 2167L | AMD074 | Claystone/Carbonaceous Claystone | Vaux | VA | 25.88 | 25.96 | 0.08 | 7.8 | 144 | 0.04 | - | 1.2 | 9.1 | -7.9 | 7.4 | Non-Acid Forming (Barren) |
| 71 | 2167L | AMD075 | Sandstone | Vaux | VA | 26.65 | 26.83 | 0.18 | 8.4 | 218 | 0.04 | - | 1.2 | 28.2 | -27.0 | 23.0 | Non-Acid Forming (Barren) |
| 72 | 2167L | AMD076 | Claystone | Vaux | VA | 27.48 | 27.68 | 0.20 | 7.6 | 184 | 0.06 | - | 1.8 | 12.0 | -10.2 | 6.5 | Non-Acid Forming (Barren) |
| 73 | 2167L | AMD077 | Claystone | Vaux | VA | 27.94 | 28.06 | 0.12 | 7.6 | 123 | 0.14 | 0.06 | 2.0 | 8.1 | -6.1 | 4.1 | Non-Acid Forming (Barren) |
| 74 | 2167L | AMD079 | Claystone/Carbonaceous Claystone | Broonie | BR | 30.22 | 30.38 | 0.16 | 8.0 | 173 | 0.11 | 0.06 | 1.9 | 20.9 | -19.0 | 10.8 | Non-Acid Forming (Barren) |
| 75 | 2167L | AMD080 | Sandstone/Siltstone | Broonie | BR | 30.81 | 31.08 | 0.27 | 8.5 | 236 | 0.06 | - | 1.8 | 11.2 | -9.4 | 6.1 | Non-Acid Forming (Barren) |
| 76 | 2167L | AMD081 | Sandstone | Broonie | BR | 34.00 | 40.00 | 6.00 | 8.7 | 346 | 0.03 | - | 0.9 | 93.4 | -92.5 | 101.7 | Non-Acid Forming (Barren) |
| 77 | 2167L | AMD082 | Sandstone | Broonie | BR | 40.00 | 47.00 | 7.00 | 8.9 | 350 | 0.03 | - | 0.9 | 78.1 | -77.2 | 85.0 | Non-Acid Forming (Barren) |
| 78 | 2167L | AMD083 | Claystone | Broonie | BR | 48.95 | 49.09 | 0.14 | 7.5 | 167 | 0.14 | 0.11 | 3.4 | 11.5 | -8.1 | 3.4 | Non-Acid Forming |
| 79 | 2133L | AMD057 | Claystone | Wynn | WN | 103.24 | 103.38 | 0.14 | 3.4 | 2540 | 3.34 | 1.58 | 48.4 | 0.3 | 48.1 | 0.01 | Potentially Acid Forming |
| 80 | 2133L | AMD058 | Sandstone | Wynn | WN | 103.93 | 104.29 | 0.36 | 6.9 | 2130 | 3.59 | 2.57 | 78.7 | 24.5 | 54.2 | 0.3 | Potentially Acid Forming |
| 81 | 2133L | AMD059 | Sandstone/Siltstone | Wynn | WN | 106.14 | 107.50 | 1.36 | 8.7 | 482 | 0.63 | 0.49 | 15.1 | 102.0 | -86.9 | 6.8 | Non-Acid Forming |
| 82 | 2133L | AMD060 | Siltstone | Wynn | WN | 109.56 | 109.78 | 0.22 | 8.6 | 352 | 0.20 | 0.14 | 4.3 | 14.2 | -9.9 | 3.3 | Non-Acid Forming |
| 83 | 2167L | AMD088 | Sandstone | Wynn (floor) | WN | 74.72 | 75.00 | 0.28 | 5.5 | 501 | 0.52 | 0.25 | 15.9 | 2.3 | 13.6 | 0.1 | Potentially Acid Forming |

1. Current pH, EC provided for 1:5 sample:water slurry.
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification criteria detail provided in report text.

## Table B2: Acid Base Account Results for Coal Reject

| Sample No. | Sample ID | Sample Lithology | Sample Type | Coal Seam Source | pH[1] | EC[1] | Total Sulfur | Scr | MPA[2] | ANC[2] | NAPP[2] | ANC: MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (µS/cm) | (%) | | (kg $H_2SO_4$/t) | | | | |
| **Coarse Reject** | | | | | | | | | | | | | |
| 1 | REJ001 | ED Reject 1 of 2 | Coarse Reject | ED | 7.40 | 316 | 1.90 | 1.410 | 43.2 | 27.2 | 16.0 | 0.6 | Potentially Acid Forming |
| 2 | REJ002 | ED Reject 2 of 2 | Coarse Reject | ED | 7.10 | 323 | 1.17 | 0.762 | 23.3 | 19.0 | 4.3 | 0.8 | Uncertain |
| 3 | REJ004 | WN1 Reject 1 of 2 | Coarse Reject | WN | 6.40 | 1,200 | 1.99 | 1.180 | 36.1 | 23.4 | 12.7 | 0.6 | Potentially Acid Forming |
| 4 | REJ005 | WN1 Reject 2 of 2 | Coarse Reject | WN | 5.60 | 1,590 | 2.80 | 2.140 | 65.5 | 15.2 | 50.4 | 0.2 | Potentially Acid Forming |
| 5 | REJ009 | VA1 Reject | Coarse Reject | VX | 5.90 | 326 | 0.24 | 0.109 | 3.3 | 16.0 | -12.6 | 4.8 | Non-Acid Forming |
| 6 | REJ012 | BRBY Reject | Coarse Reject | BRBY | 7.80 | 98 | 0.24 | 0.093 | 2.8 | 33.2 | -30.3 | 11.6 | Non-Acid Forming (Barren) |
| **Fine Reject** | | | | | | | | | | | | | |
| 7 | REJ003 | ED Tailing | Fine Reject | ED | 8.40 | 125 | 0.60 | 0.352 | 10.8 | 17.0 | -6.2 | 1.6 | Non-Acid Forming |
| 8 | REJ006 | WN1 Tailing | Fine Reject | WN | 8.60 | 141 | 1.58 | 1.200 | 36.8 | 44.1 | -7.3 | 1.2 | Non-Acid Forming |
| 9 | REJ007 | PF2 Tailing 1 of 2 | Fine Reject | PF | 7.70 | 186 | 0.29 | 0.130 | 4.0 | 16.2 | -12.2 | 4.1 | Non-Acid Forming |
| 10 | REJ008 | PF2 Tailing 2 of 2 | Fine Reject | PF | 7.60 | 185 | 0.29 | 0.129 | 4.0 | 16.7 | -12.7 | 4.2 | Non-Acid Forming |
| 11 | REJ010 | VA1 Tailing | Fine Reject | VX | 8.60 | 149 | 0.77 | 0.471 | 14.4 | 19.7 | -5.3 | 1.4 | Non-Acid Forming |
| 12 | REJ011 | BRBY Tailing | Fine Reject | BRBY | 8.30 | 141 | 0.42 | 0.165 | 5.1 | 20.4 | -15.3 | 4.0 | Non-Acid Forming |

Notes
1. Current pH, EC provided for 1:5 sample:water slurry.
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification criteria detail provided in report text.

## Table B3: Multi-Element Composition for Overburden and Interburden

| | Composite Sample Number → | | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALS Laboratory ID → | | EB1905293029 | EB1905293030 | EB1905293031 | EB1905293032 | EB1905293033 | EB1905293034 | EB1905293035 | EB1905293036 | EB1905293037 | EB1905293038 |
| | Sample Description → | | Overburden | LP to VA seam | VA to BR seam | BY to WN seam | BY to WN seam | WN to ED seam | ED to CL seams | Within VA seam | Within BR seam | Within WN seam |
| **Parameters** | Limit of Reporting | NEPC[1] Health-Based Investigation Level (HILs)-C | | | | | | | | | | |
| **Major Elements** | All units mg/kg | | | | | | | | | | | |
| Aluminium (Al) | 50 | - | 5,100 | 6,880 | 4,710 | 7,840 | 6,970 | 5,530 | 7,000 | 4,800 | 5,120 | 4,930 |
| Calcium (Ca) | 50 | - | 10,200 | 5,240 | 7,250 | 16,100 | 9,270 | 4,930 | 8,880 | 5,000 | 1,570 | 12,900 |
| Iron (Fe) | 50 | - | 18,100 | 28,000 | 24,900 | 29,800 | 34,500 | 19,200 | 30,900 | 21,300 | 12,600 | 32,600 |
| Potassium (K) | 50 | - | 1,380 | 1,600 | 1,680 | 1,680 | 1,620 | 1,610 | 1,550 | 1,450 | 1,570 | 1,250 |
| Magnesium (Mg) | 50 | - | 4,640 | 2,960 | 3,300 | 7,470 | 6,200 | 2,930 | 4,660 | 3,450 | 2,290 | 7,110 |
| Sodium (Na) | 50 | - | 380 | 470 | 270 | 630 | 610 | 590 | 530 | 390 | 520 | 460 |
| **Minor Elements** | All units mg/kg | | | | | | | | | | | |
| Arsenic (As) | 5 | 300 | 7 | 7 | 15 | 7 | 6 | 6 | 8 | 6 | <5 | 8 |
| Boron (B) | 50 | 20,000 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |
| Cadmium (Cd) | 1 | 90 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Cobalt (Co) | 2 | 300 | 10 | 10 | 10 | 9 | 12 | 9 | 11 | 10 | 13 | 7 |
| Chromium (Cr) | 2 | 300 ** | 6 | 7 | 6 | 8 | 8 | 5 | 6 | 5 | 3 | 6 |
| Copper (Cu) | 5 | 17,000 | 16 | 23 | 17 | 21 | 30 | 25 | 23 | 25 | 43 | 26 |
| Fluoride (F) | 40 | - | 170 | 210 | 190 | 220 | 230 | 190 | 200 | 180 | 190 | 190 |
| Manganese (Mn) | 5 | 19,000 | 230 | 416 | 356 | 432 | 543 | 285 | 276 | 266 | 91 | 527 |
| Molybdenum (Mo) | 2 | - | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Nickel (Ni) | 2 | 1,200 | 15 | 13 | 12 | 11 | 14 | 11 | 20 | 12 | 15 | 11 |
| Lead (Pb) | 2 | 600 | 17 | 12 | 13 | 13 | 12 | 12 | 13 | 13 | 14 | 10 |
| Antimony (Sb) | 5 | - | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Selenium (Se) | 5 | 700 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Thorium (Th) | 0.1 | - | 4.8 | 3.4 | 3.9 | 6.0 | 5.7 | 5.2 | 5.5 | 5.1 | 6.4 | 4.8 |
| Uranium (U) | 0.1 | - | 0.6 | 0.8 | 0.6 | 1.1 | 0.7 | 0.7 | 0.9 | 0.6 | 0.8 | 0.7 |
| Zinc (Zn) | 5 | 30,000 | 90 | 81 | 76 | 86 | 87 | 80 | 87 | 88 | 105 | 78 |
| **Exchangable Cations** | All units meq/100g (except Exchangable Sodium (%)) | | | | | | | | | | | |
| Exch. Calcium | 0.2 | - | 5.4 | 3.7 | 8.6 | - | - | <0.2 | 6.6 | 3.7 | 1.8 | - |
| Exch. Magnesium | 0.2 | - | 5.9 | 3.3 | 3.8 | - | - | <0.2 | 5.9 | 5.3 | 3.4 | - |
| Exch. Potassium | 0.2 | - | 1.1 | 1.8 | 0.4 | - | - | <0.2 | 1.4 | 1.2 | 1.5 | - |
| Exch. Sodium | 0.2 | - | 0.8 | 1.0 | <0.1 | - | - | <0.2 | 1.1 | 0.9 | 1.5 | - |
| Cation Exchange Capacity | 0.2 | - | 13.2 | 9.8 | 13.2 | - | - | <0.2 | 15.1 | 11.1 | 8.1 | - |
| Calcium:Magnesium Ratio | 0.2 | - | 0.9 | 1.1 | 2.3 | - | - | - | 1.1 | 0.7 | 0.5 | - |
| Magnesium:Potassium Ratio | 0.2 | - | 5.5 | 1.9 | 10.6 | - | - | - | 4.2 | 4.4 | 2.2 | - |
| Exchangable Sodium Percentage | 0.2% | - | 6.0 | 10.1 | <0.8 | - | - | - | 7.5 | 8.0 | 18.1 | - |

Notes: < indicates less than the laboratory limit of reporting. Shaded cells exceed applied guideline limit.

** Guideline level for Cr(VI) = 300 mg/kg. Guideline level for Cr(III) = 24% of total Cr.

1. NEPC (2013). National Environmental Protection Council (NEPC). *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)* , Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

## Table B4: Multi-Element Composition for Coal Reject

| | Composite Sample Number → | | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALS Laboratory ID → | | EB2010009013 | EB2010009014 | EB2010009015 | EB2010009016 | EB2010009017 | EB2010009018 | EB2010009019 | EB2010009020 | EB2010009021 |
| | Sample Description → | | ED Coarse Reject | ED Fine Reject | WN1 Coarse Reject | WN1 Fine Reject | PF2 Fine Reject | VA1 Coarse Reject | VA1 Fine Reject | BRBY Fine Reject | BRBY Coarse Reject |
| **Parameters** | Limit of Reporting | NEPC[1] Health-Based Investigation Level (HILs)-C | | | | | | | | | |
| **Major Elements** | All units mg/kg | | | | | | | | | | |
| Aluminium (Al) | 50 | - | 1,550 | 2,040 | 1,240 | 2,560 | 1,890 | 1,590 | 1,750 | 1,870 | 1,260 |
| Calcium (Ca) | 50 | - | 3,620 | 3,000 | 6,170 | 11,100 | 4,580 | 5,620 | 4,390 | 4,710 | 6,640 |
| Iron (Fe) | 50 | - | 38,700 | 17,300 | 39,200 | 63,200 | 12,900 | 64,300 | 18,900 | 16,900 | 13,800 |
| Potassium (K) | 50 | - | 430 | 820 | 400 | 950 | 870 | 600 | 610 | 560 | 230 |
| Magnesium (Mg) | 50 | - | 2,660 | 2,410 | 2,310 | 5,530 | 2,200 | 5,570 | 3,170 | 2,320 | 2,840 |
| Sodium (Na) | 50 | - | 320 | 270 | 260 | 230 | 500 | 220 | 270 | 300 | 260 |
| **Minor Elements** | All units mg/kg | | | | | | | | | | |
| Arsenic (As) | 5 | 300 | 7 | <5 | 23 | 12 | <5 | <5 | 6 | <5 | <5 |
| Boron (B) | 50 | 20,000 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 | <50 |
| Cadmium (Cd) | 1 | 90 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Cobalt (Co) | 2 | 300 | 6 | 6 | 5 | 8 | 4 | <2 | 4 | 6 | <2 |
| Chromium (Cr) | 2 | 300 ** | <2 | <2 | <2 | 4 | <2 | <2 | 3 | 4 | <2 |
| Copper (Cu) | 5 | 17,000 | 12 | 18 | 32 | 26 | 23 | 24 | 21 | 23 | 11 |
| Fluoride (F) | 40 | - | 160 | 240 | 120 | 190 | 230 | 250 | 200 | 200 | 150 |
| Manganese (Mn) | 5 | 19,000 | 658 | 222 | 531 | 881 | 140 | 875 | 194 | 205 | 260 |
| Molybdenum (Mo) | 2 | - | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Nickel (Ni) | 2 | 1,200 | 9 | 9 | 8 | 13 | 6 | 6 | 8 | 12 | <2 |
| Antimony (Sb) | 5 | - | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Selenium (Se) | 5 | 700 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 | <5 |
| Thorium (Th) | 0.1 | - | 5.6 | 7.7 | 6.8 | 6.5 | 4.2 | 6.5 | 5.8 | 6.5 | 6.7 |
| Uranium (U) | 0.1 | - | 2.5 | 2.8 | 1.8 | 1.5 | 2.6 | 1 | 1.8 | 1.2 | 1 |
| Zinc (Zn) | 5 | 30,000 | 37 | 47 | 38 | 70 | 51 | 42 | 40 | 38 | 14 |

Notes: < indicates less than the laboratory limit of reporting. Shaded cells exceed applied guideline limit.

** Guideline level for Cr(VI) = 300 mg/kg. Guideline level for Cr(III) = 24% of total Cr.

1. NEPC (2013). National Environmental Protection Council (NEPC). *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)*, Amendment of Schedule B1-B7 of 1999 version. Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use.

## Table B5: Geochemical Abundance Index Results for Overburden and Interburden

| | RGS Sample Number → | | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALS Laboratory ID → | | EB1905293029 | EB1905293030 | EB1905293031 | EB1905293032 | EB1905293033 | EB1905293034 | EB1905293035 | EB1905293036 | EB1905293037 | EB1905293038 |
| Parameters | Limit of Reporting | Median Crustal Abundance[1] | Overburden | LP to VA seam | VA to BR seam | BY to WN seam | BY to WN seam | WN to ED seam | ED to CL seams | Within VA seam | Within BR seam | Within WN seam |
| **Major Elements** | all units in mg/kg | | Geochemical Abundance Index | | | | | | | | | |
| Aluminium (Al) | 50 | 71,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calcium (Ca) | 50 | 15,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron (Fe) | 50 | 40,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potassium (K) | 50 | 14,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Magnesium (Mg) | 50 | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sodium (Na) | 50 | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Major, Minor and Trace Elements** | all units in mg/kg | | Geochemical Abundance Index | | | | | | | | | |
| Arsenic (As) | 5 | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Boron (B) | 50 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cadmium (Cd) | 1 | 0.35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cobalt (Co) | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chromium (Cr) | 2 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Copper (Cu) | 5 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fluoride (F) | 40 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Manganese (Mn) | 5 | 1,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molybdenum (Mo) | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nickel (Ni) | 2 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lead (Pb) | 0.2 | 35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Antimony (Sb) | 5 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Selenium (Se) | 5 | 0.4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Thorium (Th) | 0.1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Uranium (U) | 0.1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zinc (Zn) | 5 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes: GAI's greater than or equal to 3 are highlighted.

1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009). When no GARD Guide value is available for a particular element, then values are taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, pages 60-61.

## Table B6: Geochemical Abundance Index Results for Coal Reject

| | RGS Sample Number → | | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ALS Laboratory ID → | | EB2010009013 | EB2010009014 | EB2010009015 | EB2010009016 | EB2010009017 | EB2010009018 | EB2010009019 | EB2010009020 | EB2010009021 |
| Parameters | Limit of Reporting | Median Crustal Abundance[1] | ED Coarse Reject | ED Fine Reject | WN1 Coarse Reject | WN1 Fine Reject | PF2 Fine Reject | VX1 Coarse Reject | VX1 Fine Reject | BRBY Fine Reject | BRBY Coarse Reject |
| **Major Elements** | all units in mg/kg | | Geochemical Abundance Index | | | | | | | | |
| Aluminium (Al) | 50 | 71,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Calcium (Ca) | 50 | 15,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Iron (Fe) | 50 | 40,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Potassium (K) | 50 | 14,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Magnesium (Mg) | 50 | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sodium (Na) | 50 | 5,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Major, Minor and Trace Elements** | all units in mg/kg | | Geochemical Abundance Index | | | | | | | | |
| Arsenic (As) | 5 | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Boron (B) | 50 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cadmium (Cd) | 1 | 0.35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cobalt (Co) | 2 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chromium (Cr) | 2 | 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Copper (Cu) | 5 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fluorine (F) | 40 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Manganese (Mn) | 5 | 1,000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molybdenum (Mo) | 2 | 1.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nickel (Ni) | 2 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Antimony (Sb) | 5 | 1.0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Selenium (Se) | 5 | 0.4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Thorium (Th) | 0.1 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Uranium (U) | 0.1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Zinc (Zn) | 5 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Notes: GAI's greater than or equal to 3 are highlighted.

1. Median Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009). When no GARD Guide value is available for a particular element, then values are taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, pages 60-61.

**Table B7: Particle Size Distribution, Emerson Class and Soil Classification Results for Overburden and Interburden**

| RGS Sample Number → | | | C1 | C2 | C3 | C6 | C7 | C8 | C9 |
|---|---|---|---|---|---|---|---|---|---|
| Trilab Laboratory ID → | | | 19020143 | 19020144 | 19020145 | 19020146 | 19020147 | 19020148 | 19020149 |
| Sample ID → | | | Overburden | Between LP and VA seams | Between VA and BR seams | Between WN and ED seams | Between ED to CL seams | Within VA seam | Within BR seam |
| **Emerson Aggregate** | Units | LOR | | | | | | | |
| Color (Munsell) | - | - | Grey | Grey | Grey | Grey | Grey | Grey | Grey |
| Texture | - | - | Silty gravel | Silty gravel | Silty gravel | Silty gravel | Silty gravel | Silty gravel | Silty gravel |
| Emerson Class Number | - | - | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **Particle Sizing** | Units | LOR | | | | | | | |
| +1.4 µm | % | 1 | 9 | 4 | 2 | 1 | 1 | 3 | 2 |
| +2.4 µm | % | 1 | 10 | 5 | 3 | 1 | 1 | 4 | 3 |
| +2.8 µm | % | 1 | 11 | 6 | 3 | 1 | 2 | 4 | 3 |
| +3.4 µm | % | 1 | 12 | 7 | 3 | 2 | 2 | 5 | 4 |
| +3.9 µm | % | 1 | 13 | 7 | 4 | 2 | 2 | 5 | 4 |
| +4.8 µm | % | 1 | 14 | 8 | 4 | 2 | 2 | 6 | 5 |
| +6.7 µm | % | 1 | 16 | 9 | 5 | 2 | 3 | 7 | 6 |
| +9.5 µm | % | 1 | 18 | 11 | 5 | 3 | 3 | 7 | 6 |
| +13 µm | % | 1 | 19 | 12 | 6 | 3 | 3 | 8 | 7 |
| +18 µm | % | 1 | 20 | 13 | 7 | 3 | 3 | 10 | 7 |
| +24 µm | % | 1 | 22 | 15 | 8 | 3 | 3 | 10 | 8 |
| +34 µm | % | 1 | 23 | 16 | 8 | 4 | 4 | 11 | 8 |
| +48 µm | % | 1 | 24 | 18 | 9 | 4 | 4 | 11 | 8 |
| +57 µm | % | 1 | 26 | 19 | 9 | 4 | 4 | 12 | 8 |
| +75 µm | % | 1 | 29 | 22 | 13 | 7 | 5 | 14 | 12 |
| +150 µm | % | 1 | 33 | 25 | 14 | 8 | 6 | 15 | 13 |
| +300 µm | % | 1 | 37 | 27 | 15 | 10 | 6 | 16 | 14 |
| +425 µm | % | 1 | 38 | 28 | 15 | 11 | 6 | 16 | 15 |
| +600 µm | % | 1 | 39 | 29 | 16 | 12 | 7 | 16 | 15 |
| +1180 µm | % | 1 | 41 | 30 | 17 | 16 | 8 | 16 | 16 |
| +2.36 mm | % | 1 | 43 | 31 | 18 | 20 | 9 | 17 | 16 |
| +4.75 mm | % | 1 | 52 | 43 | 25 | 29 | 12 | 29 | 26 |
| +6.7 mm | % | 1 | 59 | 51 | 31 | 35 | 15 | 36 | 35 |
| +9.5 mm | % | 1 | 73 | 64 | 42 | 46 | 21 | 50 | 49 |
| +13.2 mm | % | 1 | 84 | 81 | 60 | 61 | 37 | 70 | 68 |
| +19 mm | % | 1 | 100 | 93 | 82 | 90 | 69 | 92 | 90 |
| +26.5 mm | % | 1 | | 100 | 95 | 100 | 91 | 98 | 98 |
| +37.5 mm | % | 1 | | | 100 | | 97 | 100 | 100 |
| +53 mm | % | 1 | | | | | 100 | | |
| **Physical Tests** | Units | LOR | | | | | | | |
| Dispersion (%) | % | 1 | 9 | 10 | 30 | 25 | 12 | 4 | 15 |
| Soil Particle Density | $g/cm^3$ | 0.01 | 2.54 | 2.63 | 2.42 | 2.25 | 2.46 | 2.47 | 2.27 |

Notes: LOR - Laboratory Limit of Reporting
Hydrometer used to measure down to percentage passing 2µm (ALS code EA150-H). Hydrometer type ASTM E100. Test Method AS1289.3.6.3.

## Table B8: Multi-Element Test Results for Water Extracts from Overburden and Interburden

| | | RGS Sample Number → | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ALS Laboratory ID → | EB1905293029 | EB1905293030 | EB1905293031 | EB1905293032 | EB1905293033 | EB1905293034 | EB1905293035 | EB1905293036 | EB1905293037 | EB1905293038 |
| | | Client Sample ID → | Overburden | LP to VA seam | VA to BR seam | BY to WN seam | BY to WN seam | WN to ED seam | ED to CL seams | Within VA seam | Within BR seam | Within WN seam |
| | | Water Quality Guidelines: | | | | | | | | | | |
| Parameters | Limit of Reporting | Aquatic Ecosystems (freshwater)[1] | Livestock Drinking Water[2] | | | | | | | | | |
| pH | 0.01 pH unit | 6 to 9 | - | 6.9 | 7.8 | 7.7 | 5.9 | 7.8 | 6.8 | 7.0 | 7.1 | 7.2 | 7.9 |
| Electrical Conductivity | 1 µS/cm | <1,000# | 3,580^ | 2,660 | 1,140 | 720 | 3,100 | 803 | 2,810 | 2,660 | 1,990 | 967 | 756 |
| Carbonate Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2,880 | 1,822 | 4,460 | 968 | 2,020 | 958 | 2,440 | 1,568 | 524 | 2,880 |
| Total Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2,880 | 1,822 | 4,460 | 968 | 2,020 | 958 | 2,440 | 1,568 | 524 | 2,880 |
| Acidity ($mgCaCO_3/L$) | 1 mg/L | - | - | 95 | 4 | <1 | 168 | <1 | 64 | 40 | 23 | 13 | <1 |
| Net Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2,785 | 1,818 | 4,460 | 800 | 2,020 | 894 | 2,400 | 1,545 | 511 | 2,880 |
| **Major Ions** | All units mg/L | | | All units mg/L | | | | | | | | | |
| Calcium (Ca) | 2 | - | 1,000 | 138 | 10 | 8 | 292 | 4 | 132 | 90 | 44 | 2 | 6 |
| Magnesium (Mg) | 2 | - | - | 94 | 6 | 8 | 186 | 6 | 72 | 54 | 40 | 4 | 6 |
| Potassium (K) | 2 | - | - | 18 | 16 | 14 | 4 | 10 | 28 | 22 | 22 | 14 | 14 |
| Sodium (Na) | 2 | - | - | 40 | 46 | 50 | 10 | 48 | 68 | 56 | 40 | 46 | 42 |
| Chloride (Cl) | 2 | - | - | 24 | 46 | 22 | 8 | 8 | 10 | 42 | 14 | 8 | 10 |
| Fluoride (F) | 0.2 | - | 2 | 0.4 | 1.4 | 2.6 | <0.2 | 1.6 | 0.4 | 0.6 | 0.6 | 0.6 | 1.0 |
| Sulfate ($SO_4$) | 2 | - | 1,000 | 730 | 32 | 20 | 1,418 | 32 | 706 | 426 | 278 | 78 | 24 |
| **Trace Metals/Metalloids** | All units mg/L | | | All units mg/L | | | | | | | | | |
| Aluminium (Al) | 0.2 | 0.055 | 5 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Antimony (Sb) | 0.02 | - | - | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Arsenic (As) - trivalent | 0.02 | 0.024 ** | 0.5 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Boron (B) | 0.2 | 0.37 | 5 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Cadmium (Cd) | 0.02 | 0.0002 | 0.01 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Chromium (Cr) - total | 0.02 | 0.001 (hex)* | 1 (total) | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Cobalt (Co) | 0.02 | - | 1 | <0.02 | <0.02 | <0.02 | 0.24 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Copper (Cu) | 0.02 | 0.0014 | 1 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Iron (Fe) | 0.2 | - | - | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Manganese (Mn) | 0.02 | 1.90 | - | 1.36 | <0.02 | <0.02 | 24.20 | <0.02 | 0.68 | 0.10 | 0.12 | <0.02 | <0.02 |
| Molybdenum (Mo) | 0.02 | - | 0.15 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.04 | <0.02 |
| Nickel (Ni) | 0.02 | 0.011 | 1 | <0.02 | <0.02 | <0.02 | 0.36 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Selenium (Se) | 0.02 | 0.011 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 | 0.02 | <0.02 | <0.02 | <0.02 |
| Thorium (Th) | 0.002 | - | - | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Uranium (U) | 0.002 | - | 0.2 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.00 | <0.002 | <0.002 | <0.002 |
| Zinc (Zn) | 0.02 | 0.008 | 20 | <0.02 | <0.02 | <0.02 | 0.12 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |

Notes: < indicates concentration less than the detection limit. Shaded cells exceed applied guideline values.

# for still water bodies only, moving rivers at low flow rates should not exceed 2,200µS/cm. * Cr (VI) = hexavalent. ** 0.013 mg/L for pentavalent Arsenic (V).

^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400mg/L for livestock drinking water.

ANZECC & ARMCANZ (2000). 1. Trigger values for aquatic ecosystems (95% species protection level). 2. Recommended guideline limits for Livestock Drinking Water.

## Table B9: Multi-Element Test Results for Water Extracts from Coal Reject

| | | RGS Sample Number → | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ALS Laboratory ID → | EB2010009013 | EB2010009014 | EB2010009015 | EB2010009016 | EB2010009017 | EB2010009018 | EB2010009019 | EB2010009020 | EB2010009021 |
| | | Client Sample ID → | ED Coarse Reject | ED Fine Reject | WN1 Coarse Reject | WN1 Fine Reject | PF2 Fine Reject | VX1 Coarse Reject | VX1 Fine Reject | BRBY Fine Reject | BRBY Coarse Reject |
| | | Water Quality Guidelines: | | | | | | | | | |
| Parameters | Limit of Reporting | Aquatic Ecosystems (freshwater)[1] | Livestock Drinking Water[2] | | | | | | | | |
| pH | 0.01 pH unit | 6 to 9 | - | 7.4 | 8.0 | 6.0 | 7.7 | 7.3 | 6.5 | 8.8 | 7.9 | 7.8 |
| Electrical Conductivity | 1 µS/cm | <1,000# | 3,580^ | 1,810 | 737 | 1,400 | 1,020 | 1,180 | 1,300 | 1,000 | 1,070 | 696 |
| Carbonate Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2 | 14 | <1 | 3 | 6 | 1 | 2 | 4 | 6 |
| Total Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2 | 14 | <1 | 3 | 6 | 1 | 2 | 4 | 6 |
| Acidity ($mgCaCO_3/L$) | 1 mg/L | - | - | 1 | 0 | 12 | 1 | 6 | 1 | 4 | 1 | 1 |
| Net Alkalinity ($mgCaCO_3/L$) | 1 mg/L | - | - | 2 | 14 | -12 | 3 | 6 | 0 | -2 | 4 | 5 |
| **Major Ions** | | All units mg/L | | All units mg/L | | | | | | | | |
| Calcium (Ca) | 2 | - | 1,000 | 16 | 12 | 124 | 8 | 12 | 18 | 10 | 18 | 4 |
| Magnesium (Mg) | 2 | - | - | 20 | 16 | 40 | 8 | 14 | 20 | 22 | 16 | 6 |
| Potassium (K) | 2 | - | - | 4 | 4 | <2 | 2 | 4 | 4 | 4 | 4 | <2 |
| Sodium (Na) | 2 | - | - | 34 | 28 | 12 | 8 | 48 | 10 | 24 | 32 | 20 |
| Chloride (Cl) | 2 | - | - | 8 | 10 | 2 | 24 | 22 | <2 | 8 | 12 | 6 |
| Fluoride (F) | 0.2 | - | 2 | 0.6 | 1.2 | <0.2 | 0.4 | 1.8 | <0.2 | 3.0 | 2.4 | 0.8 |
| Sulfate ($SO_4$) | 2 | - | 1,000 | 240 | 96 | 1,338 | 114 | 138 | 264 | 170 | 128 | 80 |
| **Trace Metals/Metalloids** | | All units mg/L | | All units mg/L | | | | | | | | |
| Aluminium (Al) | 0.02 | 0.055 | 5 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.020 | <0.02 | <0.02 | <0.02 |
| Antimony (Sb) | 0.002 | - | - | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Arsenic (As) - trivalent | 0.002 | 0.024 ** | 0.5 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Boron (B) | 0.2 | 0.37 | 5 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Cadmium (Cd) | 0.002 | 0.0002 | 0.01 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium (Cr) - total | 0.002 | 0.001 (hex)* | 1 (total) | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Cobalt (Co) | 0.002 | - | 1 | 0.004 | 0.004 | 0.04 | <0.002 | <0.002 | 0.008 | <0.002 | <0.002 | <0.002 |
| Copper (Cu) | 0.002 | 0.0014 | 1 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.006 | <0.002 | <0.002 | <0.002 |
| Iron (Fe) | 0.2 | - | - | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| Manganese (Mn) | 0.002 | 1.90 | - | 0.02 | 0.058 | 1.72 | 0.020 | 0.026 | 0.19 | 0.01 | 0.04 | 0.02 |
| Molybdenum (Mo) | 0.002 | - | 0.15 | 0.004 | 0.028 | <0.002 | 0.004 | 0.002 | <0.002 | 0.020 | 0.030 | 0.004 |
| Nickel (Ni) | 0.002 | 0.011 | 1 | 0.008 | 0.004 | 0.05 | <0.002 | <0.002 | 0.034 | <0.002 | 0.002 | <0.002 |
| Selenium (Se) | 0.02 | 0.011 | 0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Thorium (Th) | 0.002 | - | - | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Uranium (U) | 0.002 | - | 0.2 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Zinc (Zn) | 0.01 | 0.008 | 20 | <0.01 | <0.01 | 0.03 | <0.01 | <0.01 | 0.08 | <0.01 | <0.01 | <0.01 |

Notes: < indicates concentration less than the detection limit. Shaded cells exceed applied guideline values.

# for still water bodies only, moving rivers at low flow rates should not exceed 2,200µS/cm. * Cr (VI) = hexavalent. ** 0.013 mg/L for pentavalent Arsenic (V).

^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400mg/L for livestock drinking water.

ANZECC & ARMCANZ (2000). 1. Trigger values for aquatic ecosystems (95% species protection level). 2. Recommended guideline limits for Livestock Drinking Water.

## Table B10: Makeup of Composite Overburden and Interburden Samples Selected for KLC Test Program

| RGS Sample No. | RGS KLC No. | Drill Hole ID | Sample ID | Sample Lithology | Sample Stratigraphy | From | To | Interval | pH[1] | EC[1] | Total S | Scr | MPA[2] | ANC[2] | NAPP[2] | ANC:MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (m) | | | | (µS/cm) | (%) | | kg $H_2SO_4$/t | | | | |
| 1 | KLC1 | 2103LA | AMD001 | Weathered Claystone | Overburden | 1 | 7 | 6 | 8.6 | 478 | 0.03 | - | 0.9 | 44.7 | -43.8 | 48.7 | Non-Acid Forming (Barren) |
| 2 | | 2103LA | AMD002 | Weathered Sandstone | Overburden | 7 | 12 | 5 | 9 | 255 | 0.02 | | 0.6 | 52.8 | -52.2 | 86.2 | Non-Acid Forming (Barren) |
| 3 | | 2123L | AMD013 | Weathered Claystone | Overburden | 0 | 8 | 8 | 8.7 | 484 | 0.02 | | 0.6 | 13.9 | -13.3 | 22.7 | Non-Acid Forming (Barren) |
| 4 | | 2123L | AMD014 | Weathered Sandstone | Overburden | 8 | 14 | 6 | 8.8 | 430 | 0.02 | | 0.6 | 49.2 | -48.6 | 80.3 | Non-Acid Forming (Barren) |
| 5 | | 2123L | AMD015 | Weathered Siltstone | Overburden | 14 | 17.7 | 3.7 | 8.3 | 444 | 0.05 | | 1.5 | 44.5 | -43.0 | 29.1 | Non-Acid Forming (Barren) |
| 6 | | 2133L | AMD026 | Weathered Claystone | Overburden | 0 | 4 | 4 | 8.7 | 447 | 0.02 | | 0.6 | 29.8 | -29.2 | 48.7 | Non-Acid Forming (Barren) |
| 7 | | 2133L | AMD027 | Weathered Claystone | Overburden | 4 | 10 | 6 | 8.4 | 366 | 0.02 | | 0.6 | 20.0 | -19.4 | 32.7 | Non-Acid Forming (Barren) |
| 8 | | 2133L | AMD028 | Weathered Carbonaceous Siltstone | Overburden | 10 | 15 | 5 | 8.6 | 321 | 0.02 | | 0.6 | 48.6 | -48.0 | 79.3 | Non-Acid Forming (Barren) |
| 9 | | 2133L | AMD029 | Weathered Siltstone | Overburden | 15 | 21 | 6 | 8.9 | 283 | 0.02 | | 0.6 | 48.3 | -47.7 | 78.9 | Non-Acid Forming (Barren) |
| 10 | | 2133L | AMD030 | Weathered Siltstone | Overburden | 21 | 29 | 8 | 8.9 | 255 | 0.02 | | 0.6 | 61.6 | -61.0 | 100.6 | Non-Acid Forming (Barren) |
| 11 | | 2167L | AMD063 | Clay | Overburden | 0 | 2 | 2 | 8.4 | 634 | 0.03 | | 0.9 | 50.4 | -49.5 | 54.9 | Non-Acid Forming (Barren) |
| 23 | KLC2 | 2103LA | AMD004 | Sandstone | BY - WN | 25.87 | 28.02 | 2.15 | 8.3 | 597 | 0.10 | | 3.1 | 48.4 | -45.3 | 15.8 | Non-Acid Forming (Barren) |
| 24 | | 2103LA | AMD005 | Sandstone | BY - WN | 28.61 | 29.25 | 0.64 | 4.3 | 3490 | 2.10 | 0.90 | 27.4 | 0.3 | 27.2 | 0.0 | Potentially Acid Forming |
| 25 | | 2103LA | AMD006 | Sandstone/Siltstone | BY - WN | 29.33 | 29.46 | 0.13 | 5.8 | 2630 | 1.62 | 0.88 | 26.9 | 4.7 | 22.2 | 0.2 | Potentially Acid Forming |
| 26 | | 2103LA | AMD007 | Sandstone | BY - WN | 31.19 | 31.39 | 0.2 | 3.9 | 2230 | 3.27 | 1.71 | 52.4 | 0.3 | 52.1 | 0.0 | Potentially Acid Forming |
| 27 | | 2123L | AMD017 | Sandstone | BY - WN | 30.46 | 31.15 | 0.69 | 7.6 | 156 | 0.02 | | 0.6 | 6.9 | -6.3 | 11.3 | Non-Acid Forming (Barren) |
| 28 | | 2123L | AMD018 | Sandstone | BY - WN | 33.77 | 34.95 | 1.18 | 4.1 | 3970 | 3.13 | 1.50 | 45.9 | 0.3 | 45.7 | 0.01 | Potentially Acid Forming |
| 29 | | 2123L | AMD019 | Sandstone | BY - WN | 35.17 | 35.47 | 0.3 | 3.9 | 2760 | 2.10 | 1.07 | 32.8 | 0.3 | 32.5 | 0.01 | Potentially Acid Forming |
| 30 | | 2123L | AMD020 | Sandstone | BY - WN | 35.64 | 36.52 | 0.88 | 4.5 | 3630 | 2.43 | 1.17 | 35.8 | 0.3 | 35.6 | 0.01 | Potentially Acid Forming |
| 45 | KLC3 | 2103LA | AMD010 | Claystone | ED - CL | 42.90 | 43.00 | 0.10 | 6.9 | 751 | 0.24 | 0.15 | 4.5 | 5.4 | -0.9 | 1.2 | Uncertain |
| 46 | | 2103LA | AMD011 | Sandstone | ED - CL | 43.35 | 43.81 | 0.46 | 7.7 | 204 | 0.04 | | 1.2 | 4.9 | -3.7 | 4.0 | Non-Acid Forming (Barren) |
| 47 | | 2103LA | AMD012 | Siltstone/Claystone | ED - CL | 47.28 | 48.18 | 0.90 | 8.8 | 208 | 0.02 | | 0.6 | 15.3 | -14.7 | 25.0 | Non-Acid Forming (Barren) |
| 48 | | 2123L | AMD023 | Sandstone | ED - CL | 48.61 | 48.68 | 0.07 | 8.7 | 317 | 0.06 | | 1.8 | 108.0 | -106.2 | 58.8 | Non-Acid Forming (Barren) |
| 49 | | 2123L | AMD024 | Claystone | ED - CL | 51.72 | 51.99 | 0.27 | 8.7 | 330 | 0.04 | | 1.2 | 19.4 | -18.2 | 15.8 | Non-Acid Forming (Barren) |
| 50 | | 2123L | AMD025 | Sandstone/Siltstone | ED - CL | 52.36 | 52.79 | 0.43 | 8.9 | 237 | 0.04 | | 1.2 | 308.0 | -306.8 | 251.4 | Non-Acid Forming (Barren) |
| 51 | | 2133L | AMD062 | Sandstone | ED - CL | 118.92 | 120.14 | 1.22 | 7.1 | 487 | 0.29 | | 8.9 | 21.7 | -12.8 | 2.4 | Non-Acid Forming |
| 52 | | 2167L | AMD092 | Claystone | ED - CL | 84.19 | 84.37 | 0.18 | 6.8 | 506 | 0.51 | 0.39 | 11.8 | 7.4 | 4.4 | 0.6 | Uncertain |
| 53 | | 2167L | AMD093 | Tuff | ED - CL | 84.37 | 84.85 | 0.48 | 8 | 184 | 0.12 | 0.07 | 2.1 | 5.9 | -3.7 | 2.8 | Non-Acid Forming (Barren) |
| 54 | | 2167L | AMD094 | Sandstone | ED - CL | 85.07 | 85.28 | 0.21 | 8.4 | 133 | 0.05 | | 1.5 | 23.2 | -21.7 | 15.2 | Non-Acid Forming (Barren) |
| 55 | | 2167L | AMD095 | Sandstone | ED - CL | 85.80 | 90.00 | 4.20 | 9 | 305 | 0.03 | | 0.9 | 80.8 | -79.9 | 87.9 | Non-Acid Forming (Barren) |
| 56 | KLC4 | 2133L | AMD037 | Claystone | VA | 39.33 | 39.74 | 0.41 | 8.1 | 174 | 0.03 | | 0.9 | 22.6 | -21.7 | 24.6 | Non-Acid Forming (Barren) |
| 57 | | 2133L | AMD038 | Claystone | VA | 40.18 | 40.84 | 0.66 | 7.7 | 206 | 0.14 | 0.08 | 2.4 | 12.4 | -10.0 | 5.2 | Non-Acid Forming (Barren) |
| 58 | | 2133L | AMD039 | Siltstone | VA | 42.00 | 48.00 | 6.00 | 8.6 | 279 | 0.03 | | 0.9 | 79.0 | -78.1 | 86.0 | Non-Acid Forming (Barren) |
| 59 | | 2133L | AMD040 | Siltstone | VA | 48.00 | 51.50 | 3.50 | 8.8 | 295 | 0.02 | | 0.6 | 69.5 | -68.9 | 113.5 | Non-Acid Forming (Barren) |
| 60 | | 2133L | AMD042 | Sandstone | VA | 51.97 | 52.32 | 0.35 | 8.4 | 110 | 0.05 | | 1.5 | 15.2 | -13.7 | 9.9 | Non-Acid Forming (Barren) |
| 61 | | 2133L | AMD043 | Sandstone/Siltstone | VA | 54.69 | 55.00 | 0.31 | 8.5 | 106 | 0.03 | | 0.9 | 12.8 | -11.9 | 13.9 | Non-Acid Forming (Barren) |
| 62 | | 2133L | AMD044 | Siltstone | VA | 55.00 | 61.50 | 6.50 | 9 | 302 | 0.02 | | 0.6 | 86.1 | -85.5 | 140.6 | Non-Acid Forming (Barren) |
| 63 | | 2133L | AMD046 | Claystone | VA | 62.29 | 62.37 | 0.08 | 8.6 | 87 | 0.02 | | 0.6 | 13.4 | -12.8 | 21.9 | Non-Acid Forming (Barren) |
| 64 | | 2133L | AMD047 | Siderite/Sandstone | VA | 63.11 | 63.24 | 0.13 | 8.4 | 92 | 0.01 | | 0.2 | 10.8 | -10.6 | 70.5 | Non-Acid Forming (Barren) |
| 65 | | 2133L | AMD048 | Claystone | VA | 67.72 | 68.29 | 0.57 | 8.4 | 134 | 0.03 | | 0.9 | 17.2 | -16.3 | 18.7 | Non-Acid Forming (Barren) |
| 66 | | 2167L | AMD070 | Sandstone | VA | 19.35 | 19.40 | 0.05 | 7.9 | 121 | 0.03 | | 0.9 | 6.2 | -5.3 | 6.7 | Non-Acid Forming (Barren) |
| 67 | | 2167L | AMD071 | Claystone | VA | 19.79 | 20.00 | 0.21 | 7.7 | 171 | 0.10 | | 3.1 | 18.1 | -15.0 | 5.9 | Non-Acid Forming (Barren) |
| 68 | | 2167L | AMD072 | Sandstone | VA | 23.65 | 23.96 | 0.31 | 8.8 | 205 | 0.02 | | 0.6 | 33.2 | -32.6 | 54.2 | Non-Acid Forming (Barren) |
| 69 | | 2167L | AMD073 | Claystone | VA | 25.19 | 25.35 | 0.16 | 8.2 | 124 | 0.03 | | 0.9 | 23.9 | -23.0 | 26.0 | Non-Acid Forming (Barren) |
| 70 | | 2167L | AMD074 | Claystone/Carbonaceous Claystone | VA | 25.88 | 25.96 | 0.08 | 7.8 | 144 | 0.04 | | 1.2 | 9.1 | -7.9 | 7.4 | Non-Acid Forming (Barren) |
| 71 | | 2167L | AMD075 | Sandstone | VA | 26.65 | 26.83 | 0.18 | 8.4 | 218 | 0.04 | | 1.2 | 28.2 | -27.0 | 23.0 | Non-Acid Forming (Barren) |
| 72 | | 2167L | AMD076 | Claystone | VA | 27.48 | 27.68 | 0.20 | 7.6 | 184 | 0.06 | | 1.8 | 12.0 | -10.2 | 6.5 | Non-Acid Forming (Barren) |
| 73 | | 2167L | AMD077 | Claystone | VA | 27.94 | 28.06 | 0.12 | 7.6 | 123 | 0.14 | 0.06 | 2.0 | 8.1 | -6.1 | 4.1 | Non-Acid Forming (Barren) |
| 79 | KLC5 | 2133L | AMD057 | Claystone | WN | 103.24 | 103.38 | 0.14 | 3.4 | 2540 | 3.34 | 1.58 | 48.4 | 0.3 | 48.1 | 0.0 | Potentially Acid Forming |
| 80 | | 2133L | AMD058 | Sandstone | WN | 103.93 | 104.29 | 0.36 | 6.9 | 2130 | 3.59 | 2.57 | 78.7 | 24.5 | 54.2 | 0.3 | Potentially Acid Forming |
| 81 | | 2133L | AMD059 | Sandstone/Siltstone | WN | 106.14 | 107.50 | 1.36 | 8.7 | 482 | 0.63 | 0.49 | 15.1 | 102.0 | -86.9 | 6.8 | Non-Acid Forming |
| 82 | | 2133L | AMD060 | Siltstone | WN | 109.56 | 109.78 | 0.22 | 8.6 | 352 | 0.20 | 0.14 | 4.3 | 14.2 | -9.9 | 3.3 | Non-Acid Forming |
| 83 | | 2167L | AMD088 | Sandstone | WN | 74.72 | 75.00 | 0.28 | 5.5 | 501 | 0.52 | 0.25 | 7.7 | 2.3 | 5.5 | 0.3 | Potentially Acid Forming |

Notes
1. Current pH and EC provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential
3. Sample classification criteria detail provided in report text.

## Table B11: Makeup of Composite and Individual Coal Reject Samples Selected for KLC Test Program

| RGS Sample No. | RGS KLC No. | Drill Hole ID | Sample ID | Sample Lithology | Sample Stratigraphy | pH[1] | EC[1] | Total S | Scr | MPA[2] | ANC[2] | NAPP[2] | ANC: MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (µS/cm) | (%) | | kg $H_2SO_4$/t | | | | |
| 1 | KLC6 | - | REJ001 | ED Reject 1 of 2 | Coarse Reject | 7.4 | 316 | 1.90 | 1.410 | 43.2 | 27.1 | 16.1 | 0.6 | Potentially Acid Forming |
| 2 | | - | REJ002 | ED Reject 2 of 2 | Coarse Reject | 7.1 | 323 | 1.17 | 0.762 | 23.3 | 19.0 | 4.3 | 0.8 | Uncertain |
| 23 | KLC7 | - | REJ003 | ED Tailing | Fine Reject | 8.4 | 125 | 0.60 | 0.352 | 10.8 | 17.0 | -6.2 | 1.6 | Non-Acid Forming |
| 45 | KLC8 | - | REJ004 | WN1 Reject 1 of 2 | Coarse Reject | 6.4 | 1200 | 1.99 | 1.180 | 36.1 | 23.4 | 12.7 | 0.6 | Potentially Acid Forming |
| 46 | | - | REJ005 | WN1 Rejects 2 of 2 | Coarse Reject | 5.6 | 1590 | 2.80 | 2.140 | 65.5 | 15.1 | 50.4 | 0.2 | Potentially Acid Forming |
| 56 | KLC9 | - | REJ006 | WN1 Tailing | Fine Reject | 8.6 | 141 | 1.58 | 1.200 | 36.8 | 44.0 | -7.3 | 1.2 | Non-Acid Forming |
| 79 | KLC10 | - | REJ007 | PF2 Tailing 1 of 2 | Fine Reject | 7.7 | 186 | 0.29 | 0.130 | 4.0 | 16.2 | -12.2 | 4.1 | Non-Acid Forming |
| 80 | | - | REJ008 | PF2 Tailing 2 of 2 | Fine Reject | 7.6 | 185 | 0.29 | 0.129 | 4.0 | 16.7 | -12.7 | 4.2 | Non-Acid Forming |
| 79 | KLC11 | - | REJ009 | VA1 Reject | Coarse Reject | 5.9 | 326 | 0.24 | 0.109 | 3.3 | 16.0 | -12.7 | 4.8 | Non-Acid Forming |
| 79 | KLC12 | - | REJ010 | VA1 Tailing | Fine Reject | 8.6 | 149 | 0.77 | 0.471 | 14.4 | 19.7 | -5.3 | 1.4 | Non-Acid Forming |
| 79 | KLC13 | - | REJ011 | BRBY Tailing | Fine Reject | 8.3 | 141 | 0.42 | 0.165 | 5.1 | 20.4 | -15.3 | 4.0 | Non-Acid Forming |
| 79 | KLC14 | - | REJ012 | BRBY Reject | Coarse Reject | 7.8 | 98 | 0.24 | 0.093 | 2.8 | 33.1 | -30.3 | 11.6 | Non-Acid Forming (Barren) |

Notes

1. Current pH and EC provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential
3. Sample classification criteria detail provided in report text.

# Attachment C Kinetic geochemical results

**KLC 1 Weathered Overburden**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 1.30 | **Total S (%)** | 0.02 | **ANC** | 42.2 |
| **pH (1:5)** | 8.70 | **Scr (%)** | 0.02 | **NAPP** | -41.6 |
| **EC (µS/cm)** | 400 | **MPA** | 0.6 | **ANC:MPA** | 68.9 |

| **Date** | | | **31-Jan-19** | **26-Feb-19** | **26-Mar-19** | **30/04/2019** | **28/05/2019** | **25-Jun-19** | **31-Jul-19** |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Weeks** | | | **0** | **4** | **9** | **13** | **17** | **22** | **26** |
| **Leach Number** | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **ALS Laboratory Number** | | | EB1902439001 | EB1904857001 | EB1907715001 | EB1910914001 | EB1913624001 | EB1916406001 | EB1919939001 |
| **Volume On (L)** | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Volume Off (L)** | | | 0.622 | 0.942 | 0.609 | 0.509 | 0.606 | 0.666 | 0.642 |
| **Cum. Volume (L)** | | | 0.62 | 1.56 | 2.17 | 2.68 | 3.29 | 3.95 | 4.60 |
| **Pore Volumes** | | | 0.5 | 1.2 | 1.6 | 2.0 | 2.4 | 2.9 | 3.4 |
| **pH (RGS Measurement)** | | | 7.98 | 7.72 | 8.71 | 8.20 | 6.94 | 8.88 | 7.89 |
| **pH (ALS Measurement)** | | | 7.06 | 7.42 | 7.92 | 7.50 | 7.12 | 6.85 | 7.66 |
| **pH (deionised water used in test)** | | | 5.98 | 6.45 | 5.53 | 5.53 | 6.31 | 5.45 | 5.47 |
| **EC (RGS Measurement) (µS/cm)** | | | 215 | 414 | 247 | 179 | 133 | 105 | 94 |
| **EC (ALS Measurement) (µS/cm)** | | | 229 | 454 | 261 | 185 | 152 | 114 | 99 |
| **Acidity (mg/L)*** | | | 1 | 1 | <1 | 2 | <1 | 1 | <1 |
| **Alkalinity (mg/L)*** | | | 20 | 23 | 17 | 14 | 9 | 9 | 13 |
| **Net Alkalinity (mg/L)*** | | | 19 | 22 | 17 | 12 | 9 | 8 | 13 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | All units mg/L | | | | | | |
| **Calcium (Ca)** | 1 | 1,000 | 4 | 5 | 3 | 2 | 1 | 0.5 | 0.5 |
| **Potassium (K)** | 1 | - | 2 | 4 | 3 | 2 | 2 | 2 | 2 |
| **Magnesium (Mg)** | 1 | - | 3 | 6 | 4 | 2 | 2 | 1 | 0.5 |
| **Sodium (Na)** | 1 | - | 35 | 69 | 40 | 32 | 24 | 20 | 17 |
| **Chloride (Cl)** | 1 | - | 39 | 82 | 43 | 25 | 18 | 11 | 10 |
| **Fluoride (F)** | 0.1 | 2 | 0.7 | 1.3 | 0.9 | 0.6 | 0.5 | 0.5 | 0.4 |
| **Sulfate ($SO_4$)** | 1 | 1,000 | 20 | 55 | 35 | 27 | 24 | 19 | 17 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | mg/L | All units mg/L | | | | | | |
| **Aluminium (Al)** | 0.01 | 5 | 0.67 | 0.10 | 0.18 | 0.72 | 0.65 | 1.28 | 0.48 |
| **Arsenic (As)** | 0.001 | 0.5 | 0.002 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 | 0.003 |
| **Boron (B)** | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Cadmium (Cd)** | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Cobalt (Co)** | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Copper (Cu)** | 0.001 | 1 | 0.006 | 0.006 | 0.003 | 0.002 | 0.002 | 0.003 | 0.0005 |
| **Iron (Fe)** | 0.05 | 1 | 0.15 | <0.05 | <0.05 | 0.13 | 0.13 | 0.16 | 0.07 |
| **Lithium (Li)** | 0.002 | - | - | - | - | 0.002 | 0.002 | 0.002 | 0.0005 |
| **Mercury (Hg)** | 0.0001 | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Manganese (Mn)** | 0.001 | 2 | 0.006 | 0.007 | 0.005 | 0.003 | 0.003 | 0.002 | 0.001 |
| **Molybdenum (Mo)** | 0.001 | 0.15 | 0.002 | 0.014 | 0.010 | 0.008 | 0.006 | 0.006 | 0.002 |
| **Nickel (Ni)** | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Lead (Pb)** | 0.001 | 0.1 | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Antimony (Sb)** | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Selenium (Se)** | 0.01 | 0.02 | <0.01 | 0.04 | 0.02 | 0.02 | 0.01 | <0.01 | <0.01 |
| **Strontium (Sr)** | 0.001 | - | - | - | - | 0.058 | 0.045 | 0.020 | 0.008 |
| **Vanadium (V)** | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Zinc (Zn)** | 0.005 | 20 | <0.005 | <0.005 | 0.011 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| **$SO_4$ Release Rate** | | | 10 | 40 | 16 | 11 | 11 | 10 | 8 |
| **Cumulative $SO_4$ Release** | | | 10 | 49 | 66 | 76 | 88 | 97 | 106 |
| **Ca Release Rate** | | | 1.9 | 3.6 | 1.4 | 0.8 | 0.5 | 0.3 | 0.2 |
| **Cumulative Ca Release** | | | 1.9 | 5.5 | 6.9 | 7.7 | 8.2 | 8.4 | 8.7 |
| **Mg Release Rate** | | | 1.4 | 4.3 | 1.9 | 0.8 | 0.9 | 0.5 | 0.2 |
| **Cumulative Mg Release** | | | 1.4 | 5.8 | 7.7 | 8.4 | 9.4 | 9.9 | 10.1 |
| **Residual ANC (%)** | | | 100.0 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 | 99.9 |
| **Residual Sulfur (%)** | | | 98.4 | 91.8 | 89.0 | 87.3 | 85.4 | 83.8 | 82.4 |
| **$SO_4$/(Ca+Mg) molar ratio** | | | 0.9 | 1.5 | 1.5 | 2.1 | 2.3 | 3.7 | 5.4 |

< indicates less than the limit of reporting (LoR). * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush. Low Ca and Mg concentrations recorded as half the LoR.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

**KLC 2 Bulga Sandstone Interburden**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 1.30 | **Total S (%)** | 1.85 | **ANC** | 7.7 |
| **pH (1:5)** | 5.30 | **Scr (%)** | 0.92 | **NAPP** | 20.5 |
| **EC (µS/cm)** | 2,433 | **MPA** | 28.2 | **ANC:MPA** | 0.3 |

| **Date** | | | **31-Jan-19** | **26-Feb-19** | **26-Mar-19** | **30/04/419** | **28-May-19** | **25-Jun-19** | **31-Jul-19** |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Weeks** | | | **0** | **4** | **9** | **13** | **17** | **22** | **26** |
| **Leach Number** | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **ALS Laboratory Number** | | | EB1902439002 | EB1904857002 | EB1907715002 | EB1910914002 | EB1913624002 | EB1916406002 | EB1919939002 |
| **Volume On (L)** | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Volume Off (L)** | | | 0.665 | 0.445 | 0.412 | 0.352 | 0.457 | 0.423 | 0.428 |
| **Cum. Volume (L)** | | | 0.67 | 1.11 | 1.52 | 1.87 | 2.33 | 2.75 | 3.18 |
| **Pore Volumes** | | | 0.5 | 0.8 | 1.1 | 1.4 | 1.7 | 2.0 | 2.4 |
| **pH (RGS Measurement)** | | | 2.88 | 2.74 | 2.33 | 2.20 | 1.96 | 2.28 | 2.19 |
| **pH (ALS Measurement)** | | | 2.78 | 2.76 | 2.37 | 2.22 | 2.02 | 2.19 | 2.31 |
| **pH (deionised water used in test)** | | | 5.98 | 6.45 | 5.53 | 5.53 | 6.31 | 5.45 | 5.47 |
| **EC (RGS Measurement) (µS/cm)** | | | 2,291 | 6,270 | 9210 | 9,630 | 12,560 | 7,800 | 6,950 |
| **EC (ALS Measurement) (µS/cm)** | | | 2,320 | 6,940 | 9480 | 9,730 | 13,300 | 8,220 | 7,170 |
| **Acidity (mg/L)*** | | | 748 | 306 | 6,000 | 10,700 | 14,800 | 7,200 | 6,060 |
| **Alkalinity (mg/L)*** | | | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Net Alkalinity (mg/L)*** | | | -748 | -306 | -6,000 | -10,700 | -14,800 | -7,200 | -6,060 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| **Calcium (Ca)** | 1 | 1,000 | 61 | 81 | 118 | 118 | 160 | 144 | 189 |
| **Potassium (K)** | 1 | - | 3 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Magnesium (Mg)** | 1 | - | 114 | 474 | 693 | 750 | 629 | 482 | 411 |
| **Sodium (Na)** | 1 | - | 6 | 0.5 | 0.5 | 0.5 | 0.5 | 1 | 0.5 |
| **Chloride (Cl)** | 1 | - | 9 | 4 | 17 | 12 | 1 | 5 | 5 |
| **Fluoride (F)** | 0.1 | 2 | 0.5 | <0.1 | 4.4 | 3.0 | 2.5 | <0.1 | <0.1 |
| **Sulfate ($SO_4$)** | 1 | 1,000 | 1,400 | 6,030 | 8,230 | 4,170 | 8,020 | 7,290 | 7,730 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | mg/L | All units mg/L | | | | | | |
| **Aluminium (Al)** | 0.01 | 5 | 18.8 | 70.4 | 167 | 177 | 381 | 214 | 161 |
| **Arsenic (As)** | 0.001 | 0.5 | 0.008 | 0.069 | 0.378 | 1.57 | 1.64 | 1.17 | 0.66 |
| **Boron (B)** | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Cadmium (Cd)** | 0.0001 | 0.01 | 0.0033 | 0.0151 | 0.0283 | 0.0253 | 0.0384 | 0.0176 | 0.0102 |
| **Cobalt (Co)** | 0.001 | 1 | 0.421 | 2.25 | 3.13 | 2.53 | 3.26 | 1.73 | 0.874 |
| **Copper (Cu)** | 0.001 | 1 | 0.205 | 0.209 | 1.15 | 1.61 | 2.88 | 1.36 | 0.726 |
| **Iron (Fe)** | 0.05 | 1 | 247 | 1,360 | 1,780 | 2,500 | 4,030 | 2,150 | 1,470 |
| **Lithium (Li)** | 0.002 | - | - | - | - | 0.096 | 0.212 | 0.084 | 0.046 |
| **Mercury (Hg)** | 0.0001 | - | - | - | - | 0.0001 | 0.0003 | <0.0001 | <0.0001 |
| **Manganese (Mn)** | 0.001 | 2 | 16.7 | 85.5 | 165.0 | 122.0 | 172.0 | 85.3 | 42.4 |
| **Molybdenum (Mo)** | 0.001 | 0.15 | <0.001 | 0.001 | 0.002 | 0.010 | 0.022 | 0.015 | 0.009 |
| **Nickel (Ni)** | 0.001 | 1 | 0.676 | 2.800 | 4.560 | 3.630 | 5.310 | 2.650 | 1.420 |
| **Lead (Pb)** | 0.001 | 0.1 | 0.056 | 0.004 | <0.001 | 0.003 | 0.002 | 0.0025 | <0.001 |
| **Antimony (Sb)** | 0.001 | - | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 |
| **Selenium (Se)** | 0.01 | 0.02 | <0.01 | 0.01 | 0.03 | 0.03 | 0.05 | 0.03 | 0.02 |
| **Strontium (Sr)** | 0.001 | - | - | - | - | 0.279 | 0.441 | 0.357 | 0.235 |
| **Vanadium (V)** | 0.01 | - | 0.01 | 0.5 | 1.06 | 0.75 | 0.42 | 0.35 | 0.12 |
| **Zinc (Zn)** | 0.005 | 20 | 2.11 | 11.40 | 28.30 | 22.00 | 31.20 | 15.30 | 7.78 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| **$SO_4$ Release Rate** | | | 716 | 2064 | 2608 | 1129 | 2819 | 2370 | 2545 |
| **Cumulative $SO_4$ Release** | | | 716 | 2780 | 5389 | 6518 | 9337 | 11707 | 14252 |
| **Ca Release Rate** | | | 31.2 | 27.7 | 37.4 | 32.0 | 56.2 | 46.8 | 62.2 |
| **Cumulative Ca Release** | | | 31.2 | 58.9 | 96.3 | 128.3 | 184.5 | 231.3 | 293.6 |
| **Mg Release Rate** | | | 58.3 | 162.3 | 219.6 | 203.1 | 221.1 | 156.7 | 135.3 |
| **Cumulative Mg Release** | | | 58.3 | 220.6 | 440.2 | 643.3 | 864.4 | 1021.1 | 1156.4 |
| **Residual ANC (%)** | | | 96.0 | 86.6 | 73.9 | 62.2 | 48.9 | 39.2 | 30.1 |
| **Residual Sulfur (%)** | | | 98.7 | 95.0 | 90.3 | 88.2 | 83.2 | 78.9 | 74.3 |
| **$SO_4$/(Ca+Mg) molar ratio** | | | 2.3 | 2.9 | 2.7 | 1.3 | 2.8 | 3.2 | 3.7 |

< indicates less than the limit of reporting (LoR). * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush. Low Ca and Mg concentrations recorded as half the LoR.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

**KLC 3 Foybrook Interburden**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 2.00 | **Total S (%)** | 0.13 | **ANC** | 54.5 |
| **pH (1:5)** | 8.10 | **Scr (%)** | 0.11 | **NAPP** | -51.1 |
| **EC (µS/cm)** | 333 | **MPA** | 3.4 | **ANC:MPA** | 16.2 |

| **Date** | | | **31-Jan-19** | **26-Feb-19** | **26-Mar-19** | **30-Apr-19** | **28-May-19** | **25-Jun-19** | **31-Jul-19** |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Weeks** | | | **0** | **4** | **9** | **13** | **17** | **22** | **26** |
| **Leach Number** | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **ALS Laboratory Number** | | | EB1902439003 | EB1904857003 | EB1907715003 | EB1910914003 | EB1913624003 | EB1916406003 | EB1919939003 |
| **Volume On (L)** | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Volume Off (L)** | | | 0.744 | 0.610 | 0.680 | 0.593 | 0.582 | 0.579 | 0.559 |
| **Cum. Volume (L)** | | | 0.74 | 1.35 | 2.03 | 2.63 | 3.21 | 3.79 | 4.35 |
| **Pore Volumes** | | | 0.6 | 1.0 | 1.5 | 1.9 | 2.4 | 2.8 | 3.2 |
| **pH (RGS Measurement)** | | | 6.29 | 5.49 | 5.60 | 4.71 | 3.59 | 5.94 | 4.52 |
| **pH (ALS Measurement)** | | | 6.28 | 6.19 | 5.96 | 4.31 | 6.08 | 5.64 | 5.70 |
| **pH (deionised water used in test)** | | | 5.98 | 6.45 | 5.53 | 5.53 | 6.31 | 5.45 | 5.47 |
| **EC (RGS Measurement) (µS/cm)** | | | 196 | 197 | 309 | 396 | 600 | 728 | 633 |
| **EC (ALS Measurement) (µS/cm)** | | | 194 | 210 | 298 | 415 | 589 | 769 | 622 |
| **Acidity (mg/L)*** | | | 1 | 1 | 4 | 7 | 3 | 2 | <1 |
| **Alkalinity (mg/L)*** | | | 10 | 3 | 2 | <1 | 3 | 2 | 1 |
| **Net Alkalinity (mg/L)*** | | | 9 | 2 | -2 | -7 | 0 | 0 | 1 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| **Calcium (Ca)** | 1 | 1,000 | 8 | 6 | 7 | 10 | 15 | 22 | 22 |
| **Potassium (K)** | 1 | - | 2 | 2 | 3 | 3 | 5 | 5 | 5 |
| **Magnesium (Mg)** | 1 | - | 3 | 5 | 6 | 9 | 19 | 24 | 18 |
| **Sodium (Na)** | 1 | - | 22 | 27 | 38 | 59 | 74 | 100 | 77 |
| **Chloride (Cl)** | 1 | - | 6 | 6 | 10 | 11 | 16 | 12 | 14 |
| **Fluoride (F)** | 0.1 | 2 | 0.2 | 0.2 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 |
| **Sulfate ($SO_4$)** | 1 | 1,000 | 71 | 92 | 109 | 159 | 228 | 314 | 240 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | mg/L | All units mg/L | | | | | | |
| **Aluminium (Al)** | 0.01 | 5 | 0.02 | 0.01 | 0.06 | 0.01 | 0.03 | 0.03 | 0.005 |
| **Arsenic (As)** | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | 0.001 | 0.002 | <0.001 | 0.001 |
| **Boron (B)** | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Cadmium (Cd)** | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | 0.0001 | 0.0001 | <0.0001 | 0.0001 |
| **Cobalt (Co)** | 0.001 | 1 | 0.015 | 0.006 | 0.006 | 0.013 | 0.010 | 0.010 | 0.004 |
| **Copper (Cu)** | 0.001 | 1 | <0.001 | <0.001 | 0.002 | 0.002 | 0.003 | 0.002 | 0.001 |
| **Iron (Fe)** | 0.05 | 1 | 0.03 | 0.12 | 0.07 | 0.11 | 0.10 | 0.03 | 0.03 |
| **Lithium (Li)** | 0.002 | - | - | - | - | 0.011 | 0.015 | 0.015 | 0.009 |
| **Mercury (Hg)** | 0.0001 | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Manganese (Mn)** | 0.001 | 2 | 0.023 | 0.020 | 0.022 | 0.021 | 0.030 | 0.027 | 0.006 |
| **Molybdenum (Mo)** | 0.001 | 0.15 | 0.002 | 0.002 | 0.003 | 0.003 | 0.003 | 0.004 | 0.003 |
| **Nickel (Ni)** | 0.001 | 1 | 0.016 | 0.006 | 0.008 | 0.016 | 0.011 | 0.011 | 0.005 |
| **Lead (Pb)** | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Antimony (Sb)** | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Selenium (Se)** | 0.01 | 0.02 | <0.01 | <0.01 | 0.01 | 0.02 | 0.03 | 0.03 | 0.02 |
| **Strontium (Sr)** | 0.001 | - | - | - | - | 0.706 | 1.020 | 1.230 | 0.834 |
| **Vanadium (V)** | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Zinc (Zn)** | 0.005 | 20 | 0.019 | 0.023 | 0.028 | 0.052 | 0.055 | 0.057 | 0.040 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| **$SO_4$ Release Rate** | | | 26 | 28 | 37 | 47 | 66 | 91 | 67 |
| **Cumulative $SO_4$ Release** | | | 14279 | 14307 | 14344 | 14391 | 14457 | 14548 | 14615 |
| **Ca Release Rate** | | | 3.0 | 1.8 | 2.4 | 3.0 | 4.4 | 6.4 | 6.1 |
| **Cumulative Ca Release** | | | 296.5 | 298.4 | 300.8 | 303.7 | 308.1 | 314.5 | 320.6 |
| **Mg Release Rate** | | | 1.1 | 1.5 | 2.0 | 2.7 | 5.5 | 7.0 | 5.0 |
| **Cumulative Mg Release** | | | 1157.5 | 1159.1 | 1161.1 | 1163.8 | 1169.3 | 1176.3 | 1181.3 |
| **Residual ANC (%)** | | | 100.0 | 100.0 | 99.9 | 99.9 | 99.8 | 99.8 | 99.7 |
| **Residual Sulfur (%)** | | | 99.3 | 98.6 | 97.7 | 96.4 | 94.7 | 92.4 | 90.7 |
| **$SO_4$/(Ca+Mg) molar ratio** | | | 2.3 | 2.7 | 2.7 | 2.7 | 2.1 | 2.1 | 1.9 |

< indicates less than the limit of reporting (LoR). * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush. Low Ca and Mg concentrations recorded as half the LoR.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

**KLC 4 Vaux Interburden**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 2.00 | **Total S (%)** | 0.05 | **ANC** | 26.5 |
| **pH (1:5)** | 8.30 | **Scr (%)** | 0.05 | **NAPP** | -25.0 |
| **EC (µS/cm)** | 171 | **MPA** | 1.5 | **ANC:MPA** | 17.3 |

| **Date** | | | **31-Jan-19** | **26-Feb-19** | **26-Mar-19** | **30-Apr-19** | **28-May-19** | **25-Jun-19** | **01-Aug-19** |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Weeks** | | | **0** | **4** | **9** | **13** | **17** | **22** | **26** |
| **Leach Number** | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **ALS Laboratory Number** | | | EB1902439004 | EB1904857004 | EB1907715004 | EB1910914004 | EB1913624004 | EB1916406004 | EB1919939004 |
| **Volume On (L)** | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Volume Off (L)** | | | 0.654 | 0.510 | 0.483 | 0.474 | 0.437 | 0.419 | 0.351 |
| **Cum. Volume (L)** | | | 0.65 | 1.16 | 1.65 | 2.12 | 2.56 | 2.98 | 3.33 |
| **Pore Volumes** | | | 0.5 | 0.9 | 1.2 | 1.6 | 1.9 | 2.2 | 2.5 |
| **pH (RGS Measurement)** | | | 6.92 | 6.81 | 6.81 | 6.81 | 4.59 | 6.57 | 7.01 |
| **pH (ALS Measurement)** | | | 6.60 | 6.73 | 6.73 | 6.71 | 6.49 | 6.53 | 7.03 |
| **pH (deionised water used in test)** | | | 5.98 | 6.45 | 5.53 | 5.53 | 6.31 | 5.45 | 6.11 |
| **EC (RGS Measurement) (µS/cm)** | | | 98 | 165 | 271 | 304 | 511 | 349 | 568 |
| **EC (ALS Measurement) (µS/cm)** | | | 104 | 180 | 280 | 310 | 530 | 393 | 596 |
| **Acidity (mg/L)*** | | | 2 | 1 | 2 | 1 | 2 | 1 | <1 |
| **Alkalinity (mg/L)*** | | | 11 | 6 | 6 | 6 | 6 | 7 | 14 |
| **Net Alkalinity (mg/L)*** | | | 9 | 5 | 4 | 5 | 4 | 6 | 14 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| **Calcium (Ca)** | 1 | 1,000 | 0.5 | 1 | 2 | 3 | 6 | 4 | 14 |
| **Potassium (K)** | 1 | - | 2 | 2 | 4 | 4 | 6 | 4 | 8 |
| **Magnesium (Mg)** | 1 | - | 0.5 | 2 | 3 | 5 | 10 | 7 | 15 |
| **Sodium (Na)** | 1 | - | 17 | 27 | 46 | 56 | 91 | 57 | 83 |
| **Chloride (Cl)** | 1 | - | 7 | 12 | 21 | 21 | 32 | 17 | 20 |
| **Fluoride (F)** | 0.1 | 2 | 0.4 | 0.6 | 1.2 | 0.9 | 1.1 | 0.8 | 1.4 |
| **Sulfate ($SO_4$)** | 1 | 1,000 | 26 | 46 | 91 | 98 | 182 | 121 | 204 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | mg/L | All units mg/L | | | | | | |
| **Aluminium (Al)** | 0.01 | 5 | 0.63 | 0.05 | 0.20 | 0.74 | 0.04 | 0.19 | 0.005 |
| **Arsenic (As)** | 0.001 | 0.5 | 0.007 | 0.005 | 0.007 | 0.006 | 0.006 | 0.004 | 0.009 |
| **Boron (B)** | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Cadmium (Cd)** | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Cobalt (Co)** | 0.001 | 1 | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 | 0.001 | 0.002 |
| **Copper (Cu)** | 0.001 | 1 | 0.002 | 0.001 | 0.002 | 0.003 | 0.003 | 0.002 | 0.004 |
| **Iron (Fe)** | 0.05 | 1 | 0.08 | 0.03 | 0.03 | 0.03 | 0.15 | 0.03 | 0.03 |
| **Lithium (Li)** | 0.002 | - | - | - | - | 0.012 | 0.02 | 0.014 | 0.028 |
| **Mercury (Hg)** | 0.0001 | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Manganese (Mn)** | 0.001 | 2 | 0.002 | 0.002 | 0.003 | 0.004 | 0.008 | 0.004 | 0.008 |
| **Molybdenum (Mo)** | 0.001 | 0.15 | 0.007 | 0.007 | 0.012 | 0.011 | 0.017 | 0.016 | 0.042 |
| **Nickel (Ni)** | 0.001 | 1 | 0.0005 | 0.001 | 0.001 | 0.002 | 0.002 | <0.001 | 0.003 |
| **Lead (Pb)** | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Antimony (Sb)** | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 |
| **Selenium (Se)** | 0.01 | 0.02 | 0.01 | 0.03 | 0.05 | 0.06 | 0.10 | 0.06 | 0.08 |
| **Strontium (Sr)** | 0.001 | - | - | - | - | 0.269 | 0.641 | 0.388 | 1.07 |
| **Vanadium (V)** | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Zinc (Zn)** | 0.005 | 20 | <0.005 | <0.005 | 0.013 | <0.005 | <0.005 | <0.005 | 0.009 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| **$SO_4$ Release Rate** | | | 8.5 | 11.7 | 22.0 | 23.2 | 40 | 25 | 36 |
| **Cumulative $SO_4$ Release** | | | 8.5 | 20.2 | 42.2 | 65.4 | 105 | 131 | 166 |
| **Ca Release Rate** | | | 0.2 | 0.3 | 0.5 | 0.7 | 1.3 | 0.8 | 2.5 |
| **Cumulative Ca Release** | | | 0.2 | 0.4 | 0.9 | 1.6 | 2.9 | 3.8 | 6.2 |
| **Mg Release Rate** | | | 0.2 | 0.5 | 0.7 | 1.2 | 2.2 | 1.5 | 2.6 |
| **Cumulative Mg Release** | | | 0.2 | 0.7 | 1.4 | 2.6 | 4.8 | 6.2 | 8.9 |
| **Residual ANC (%)** | | | 100.0 | 100.0 | 100.0 | 99.9 | 99.9 | 99.9 | 99.8 |
| **Residual Sulfur (%)** | | | 99.4 | 98.6 | 97.2 | 95.6 | 93.0 | 91.3 | 88.9 |
| **$SO_4$/(Ca+Mg) molar ratio** | | | 8.2 | 4.5 | 5.5 | 3.6 | 3.4 | 3.2 | 2.2 |

< indicates less than the limit of reporting (LoR). * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush. Low Ca and Mg concentrations recorded as half the LoR.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

**KLC 5 Wynne Interburden**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 2.00 | **Total S (%)** | 1.66 | **ANC** | 28.7 |
| **pH (1:5)** | 6.60 | **Scr (%)** | 1.01 | **NAPP** | 2.2 |
| **EC (µS/cm)** | 1,201 | **MPA** | 30.9 | **ANC:MPA** | 0.9 |

| **Date** | | | **31-Jan-19** | **26-Feb-19** | **26-Mar-19** | **30-Apr-19** | **28-May-19** | **25-Jun-19** | **01-Aug-19** |
|---|---|---|---|---|---|---|---|---|---|
| **Number of Weeks** | | | **0** | **4** | **9** | **13** | **17** | **22** | **26** |
| **Leach Number** | | | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **ALS Laboratory Number** | | | EB1902439005 | EB1904857005 | EB1907715005 | EB1910914005 | EB1913624005 | EB1916406005 | EB1919939005 |
| **Volume On (L)** | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| **Volume Off (L)** | | | 0.740 | 0.586 | 0.523 | 0.435 | 0.399 | 0.369 | 0.781 |
| **Cum. Volume (L)** | | | 0.74 | 1.33 | 1.85 | 2.28 | 2.68 | 3.05 | 3.83 |
| **Pore Volumes** | | | 0.5 | 1.0 | 1.4 | 1.7 | 2.0 | 2.3 | 2.8 |
| **pH (RGS Measurement)** | | | 4.20 | 3.48 | 3.33 | 3.15 | 3.13 | 3.26 | 3.33 |
| **pH (ALS Measurement)** | | | 4.37 | 3.47 | 3.3 | 3.15 | 3.18 | 3.24 | 3.28 |
| **pH (deionised water used in test)** | | | 5.98 | 6.45 | 5.53 | 5.53 | 6.31 | 5.45 | 6.11 |
| **EC (RGS Measurement) (µS/cm)** | | | 856 | 728 | 1331 | 2,960 | 3,550 | 2,930 | 3,410 |
| **EC (ALS Measurement) (µS/cm)** | | | 846 | 821 | 1430 | 3,070 | 3,820 | 3,130 | 3,540 |
| **Acidity (mg/L)*** | | | 178 | 84 | 155 | 281 | 286 | 181 | 321 |
| **Alkalinity (mg/L)*** | | | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Net Alkalinity (mg/L)*** | | | -178 | -84 | -155 | -281 | -286 | -181 | -321 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| **Calcium (Ca)** | 1 | 1,000 | 53 | 28 | 67 | 123 | 206 | 153 | 229 |
| **Potassium (K)** | 1 | - | 4 | 2 | 3 | 3 | 3 | 3 | 2 |
| **Magnesium (Mg)** | 1 | - | 31 | 46 | 106 | 306 | 457 | 335 | 417 |
| **Sodium (Na)** | 1 | - | 24 | 26 | 39 | 84 | 81 | 50 | 50 |
| **Chloride (Cl)** | 1 | - | 3 | 5 | 4 | 7 | 6 | 4 | 6 |
| **Fluoride (F)** | 0.1 | 2 | <0.1 | 0.1 | <0.1 | 0.25 | 0.1 | 0.2 | 0.1 |
| **Sulfate ($SO_4$)** | 1 | 1,000 | 478 | 396 | 755 | 2,030 | 2,550 | 2,090 | 2,600 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | mg/L | All units mg/L | | | | | | |
| **Aluminium (Al)** | 0.01 | 5 | 2.12 | 2.00 | 2.92 | 9.36 | 9.46 | 6.66 | 10.6 |
| **Arsenic (As)** | 0.001 | 0.5 | 0.009 | <0.001 | 0.003 | 0.002 | 0.003 | 0.002 | 0.002 |
| **Boron (B)** | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Cadmium (Cd)** | 0.0001 | 0.01 | 0.0007 | 0.001 | 0.0014 | 0.0034 | 0.0035 | 0.0023 | 0.0036 |
| **Cobalt (Co)** | 0.001 | 1 | 0.345 | 0.292 | 0.267 | 0.522 | 0.525 | 0.33 | 0.484 |
| **Copper (Cu)** | 0.001 | 1 | 0.11 | 0.062 | 0.071 | 0.155 | 0.108 | 0.111 | 0.101 |
| **Iron (Fe)** | 0.05 | 1 | 65.3 | 26.4 | 22.0 | 41.2 | 29.8 | 24.3 | 12.1 |
| **Lithium (Li)** | 0.002 | - | - | - | - | 0.03 | 0.027 | 0.02 | 0.034 |
| **Mercury (Hg)** | 0.0001 | - | - | - | - | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **Manganese (Mn)** | 0.001 | 2 | 0.556 | 0.697 | 1.420 | 3.610 | 6.660 | 4.400 | 7.130 |
| **Molybdenum (Mo)** | 0.001 | 0.15 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| **Nickel (Ni)** | 0.001 | 1 | 0.903 | 0.682 | 0.718 | 1.350 | 1.200 | 0.870 | 1.260 |
| **Lead (Pb)** | 0.001 | 0.1 | 0.003 | 0.002 | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 |
| **Antimony (Sb)** | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Selenium (Se)** | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.02 | 0.02 | 0.01 | 0.01 |
| **Strontium (Sr)** | 0.001 | - | - | - | - | 1.660 | 2.840 | 1.730 | 3.630 |
| **Vanadium (V)** | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **Zinc (Zn)** | 0.005 | 20 | 0.832 | 0.739 | 1.09 | 2.48 | 2.31 | 1.51 | 1.94 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| **$SO_4$ Release Rate** | | | 176.9 | 116.0 | 197.4 | 441.5 | 509 | 386 | 1015 |
| **Cumulative $SO_4$ Release** | | | 176.9 | 292.9 | 490.3 | 931.8 | 1441 | 1827 | 2842 |
| **Ca Release Rate** | | | 19.6 | 8.2 | 17.5 | 26.8 | 41.1 | 28.3 | 89.4 |
| **Cumulative Ca Release** | | | 19.6 | 27.8 | 45.3 | 72.1 | 113.2 | 141.4 | 230.9 |
| **Mg Release Rate** | | | 11.5 | 13.5 | 27.7 | 66.6 | 91.2 | 61.9 | 162.8 |
| **Cumulative Mg Release** | | | 11.5 | 24.9 | 52.7 | 119.2 | 210.4 | 272.3 | 435.1 |
| **Residual ANC (%)** | | | 99.7 | 99.4 | 98.9 | 97.7 | 96.1 | 95.0 | 91.9 |
| **Residual Sulfur (%)** | | | 99.6 | 99.4 | 99.0 | 98.1 | 97.1 | 96.3 | 94.3 |
| **$SO_4$/(Ca+Mg) molar ratio** | | | 1.9 | 1.6 | 1.3 | 1.3 | 1.1 | 1.2 | 1.2 |

< indicates less than the limit of reporting (LoR). * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush. Low Ca and Mg concentrations recorded as half the LoR.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

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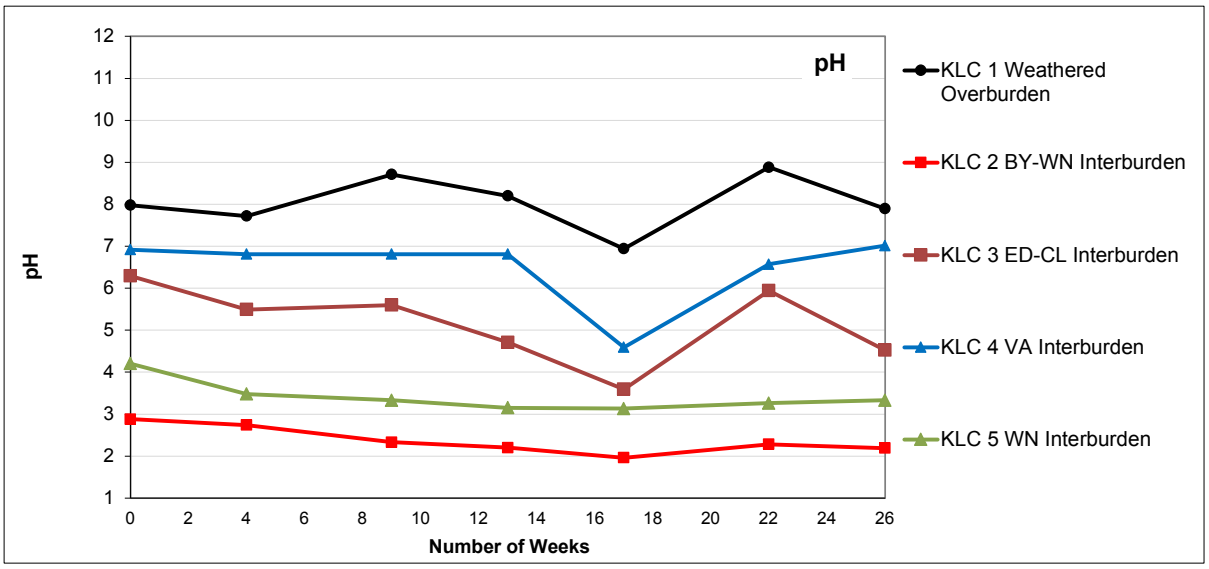
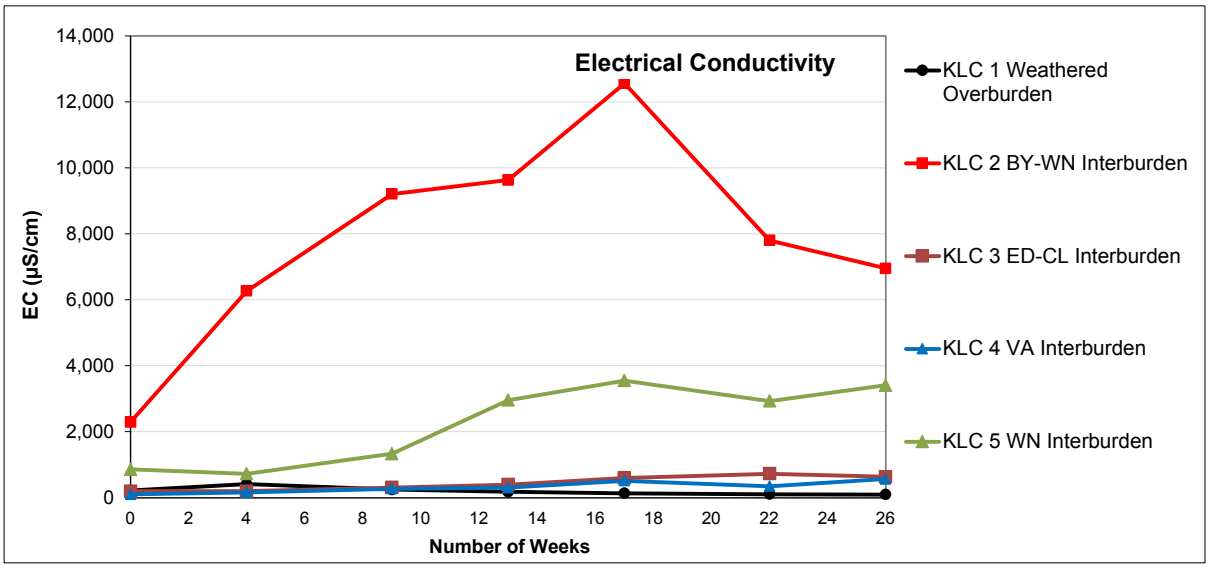
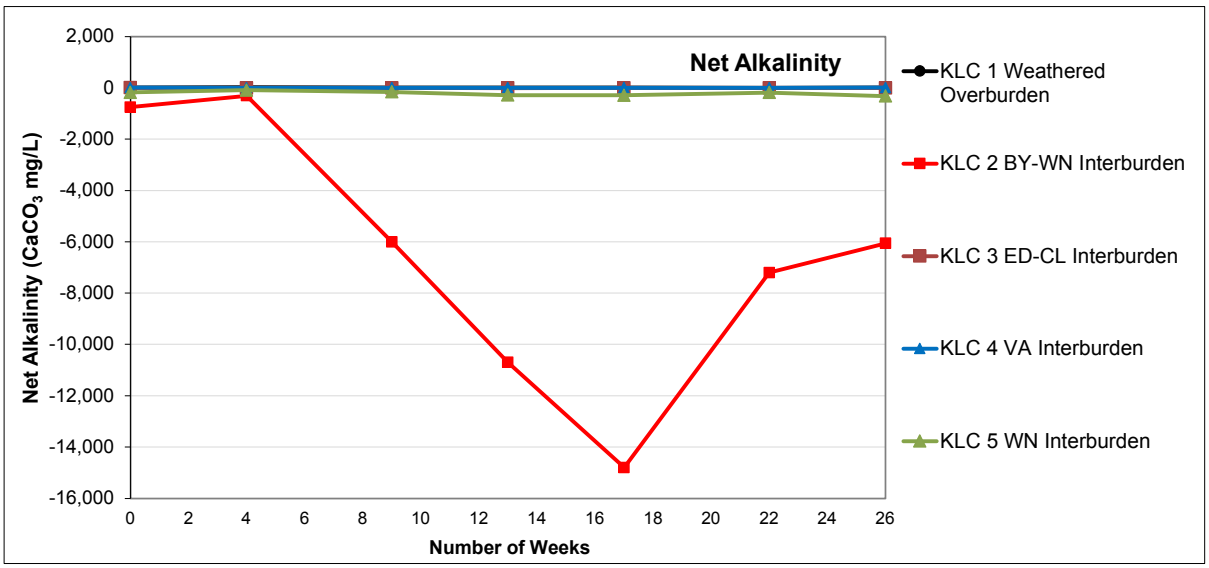
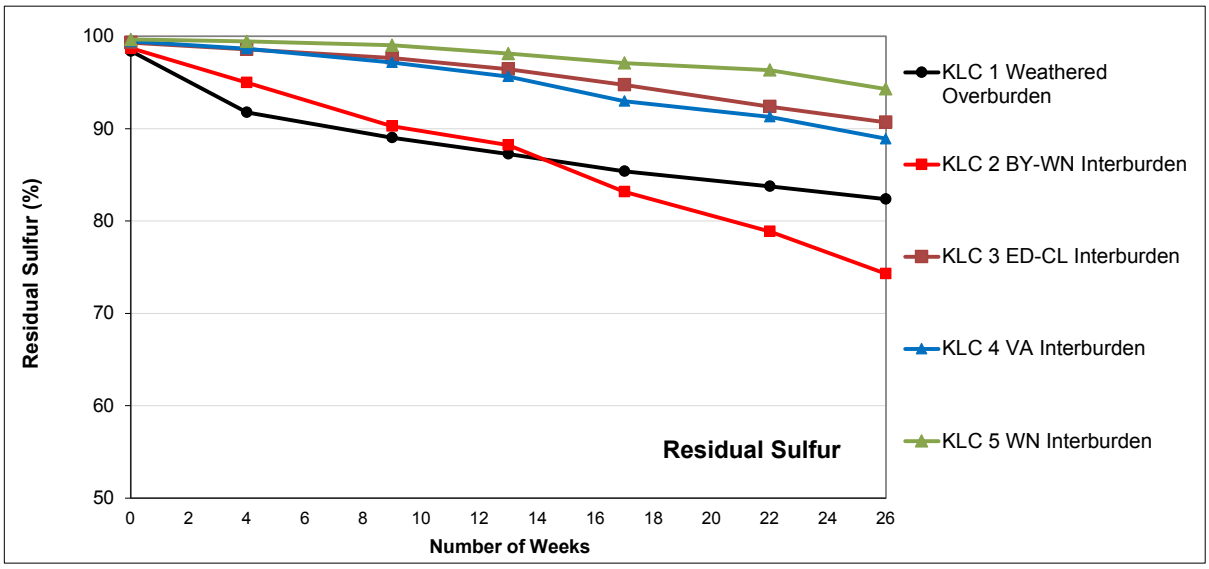
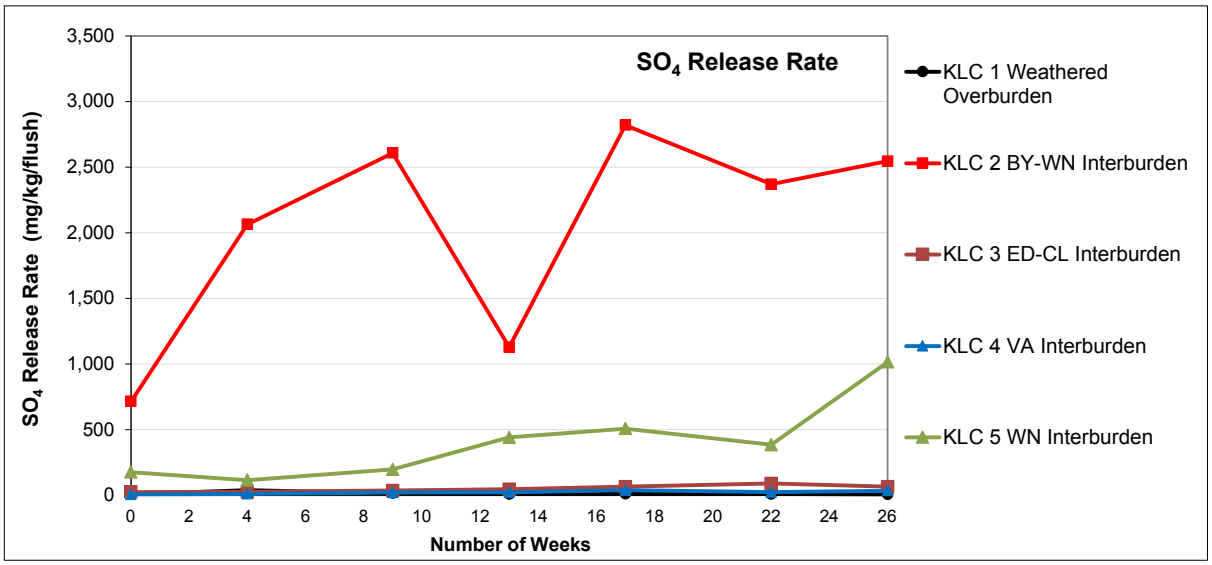
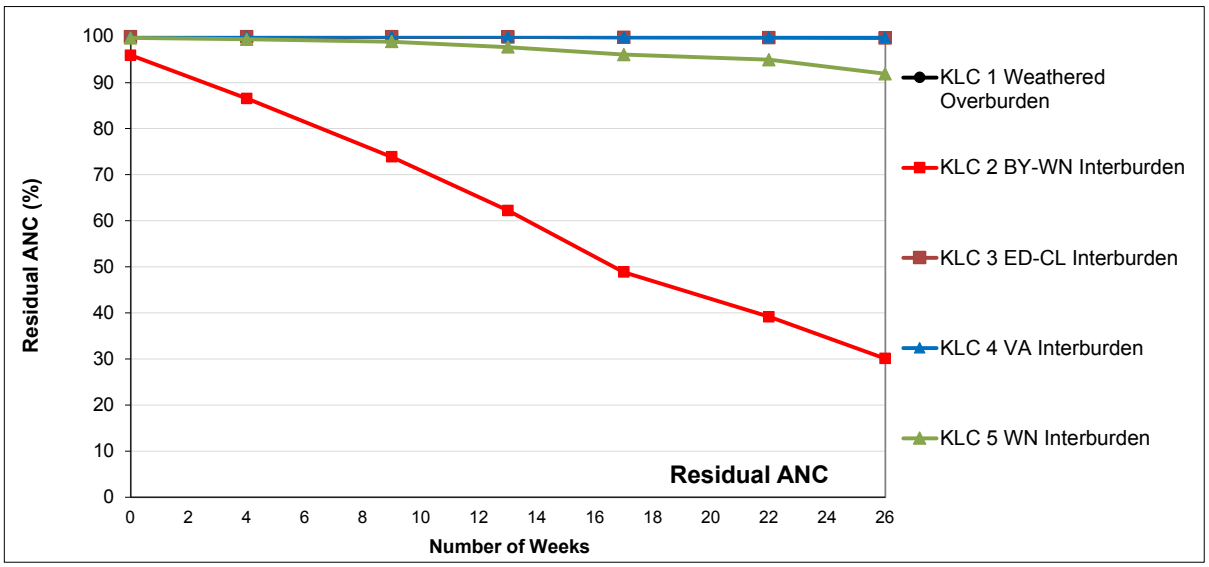

pH
pH
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

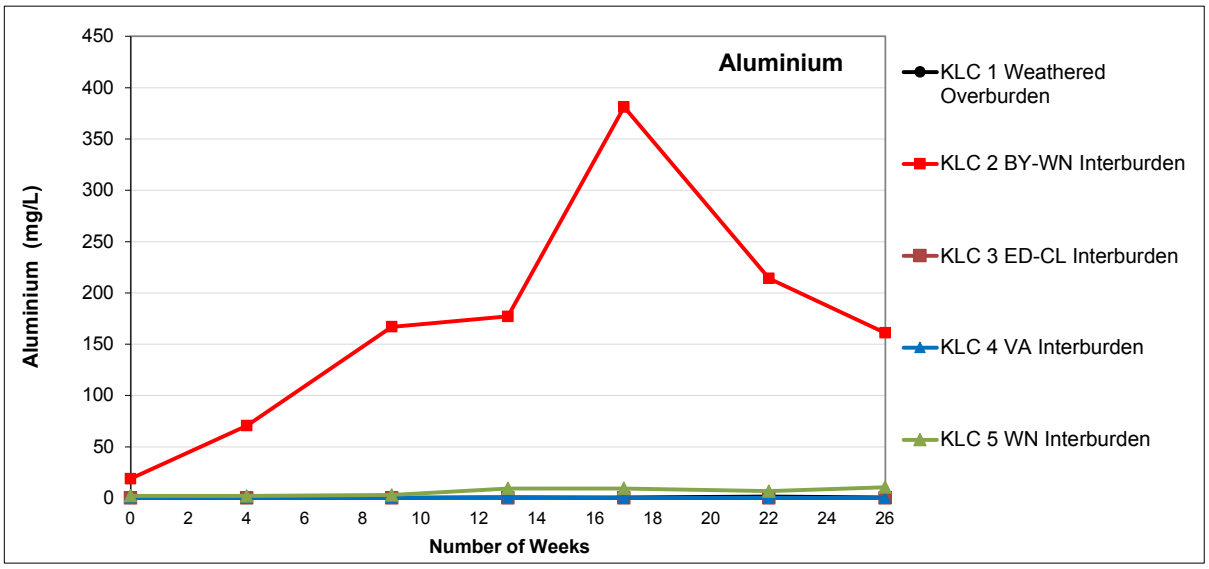

Electrical Conductivity
EC (µS/cm)
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

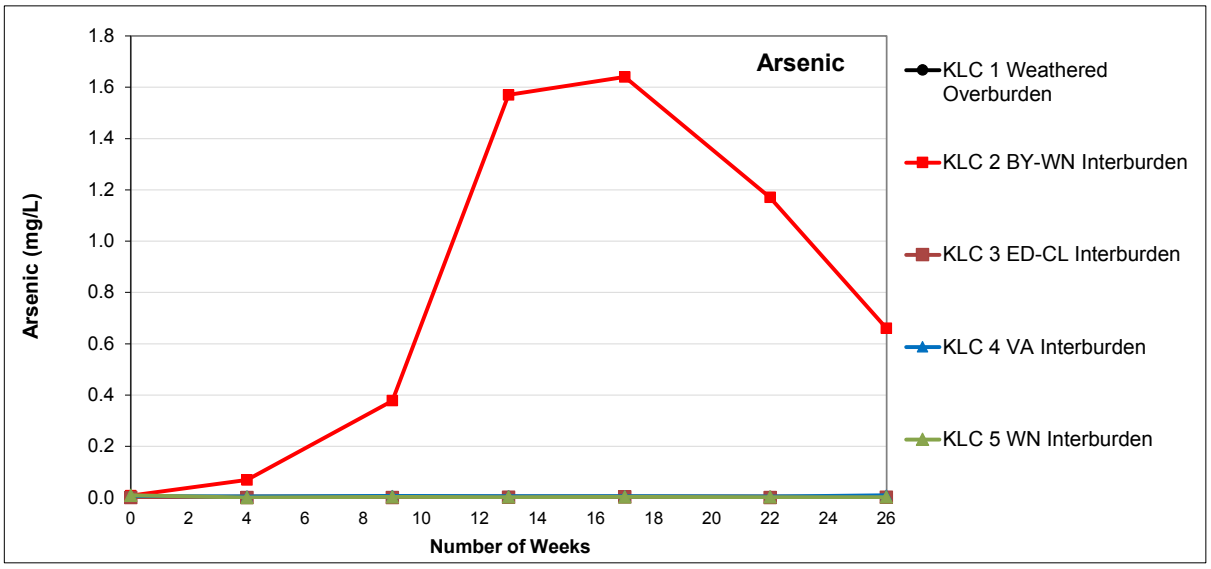

Net Alkalinity
Net Alkalinity (CaCO3 mg/L)
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

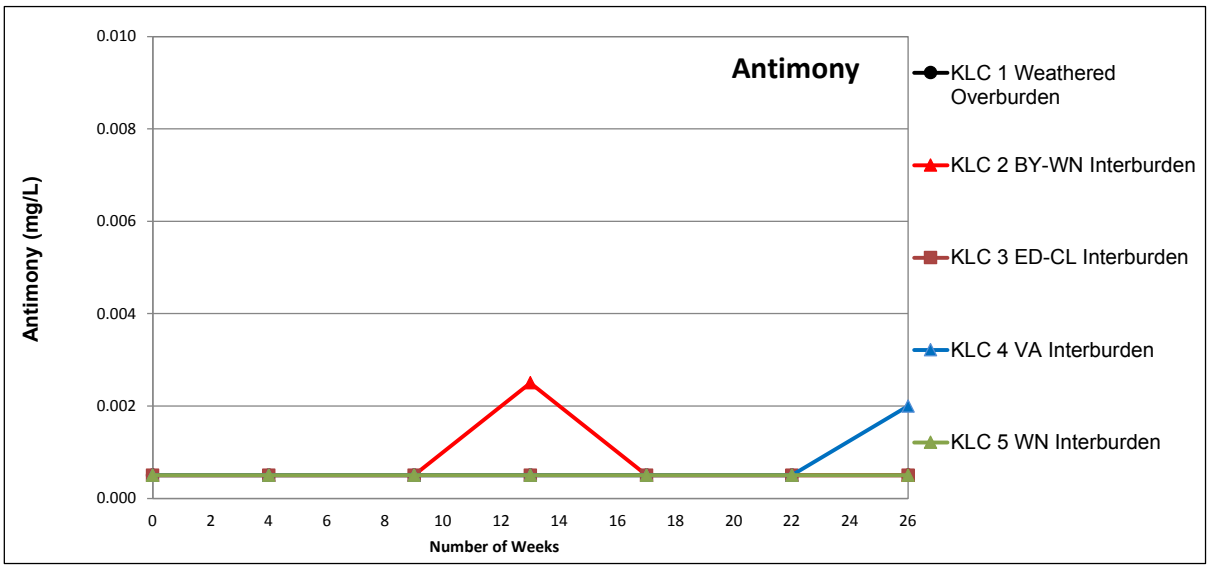

Residual Sulfur (%)
100
90
80
70
60
50
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
Residual Sulfur
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

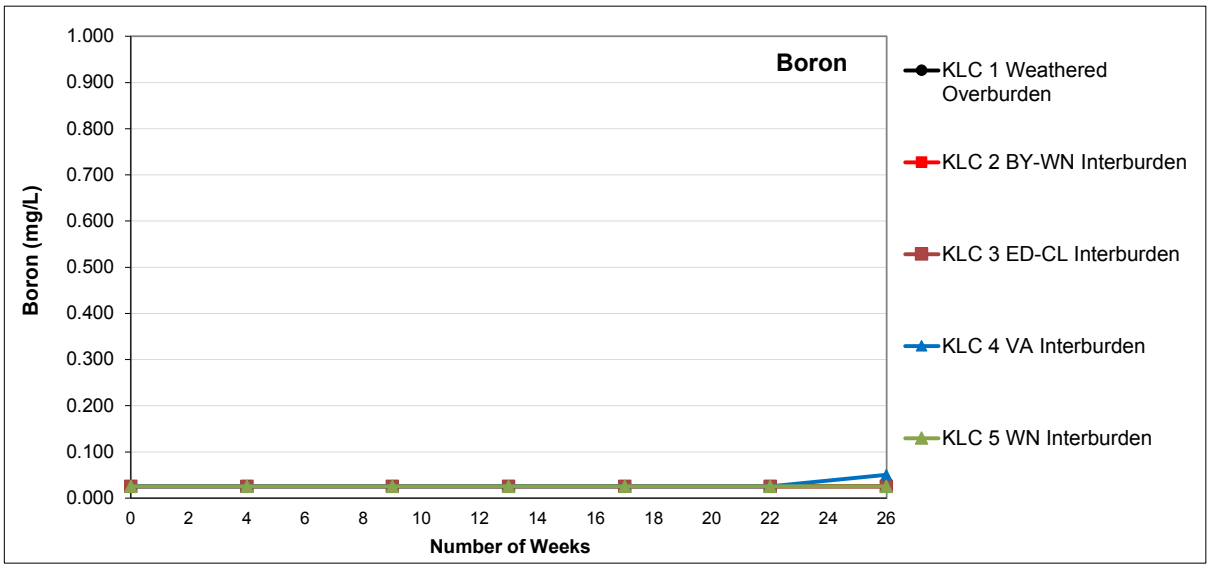

SO4 Release Rate (mg/kg/flush)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
SO4 Release Rate
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

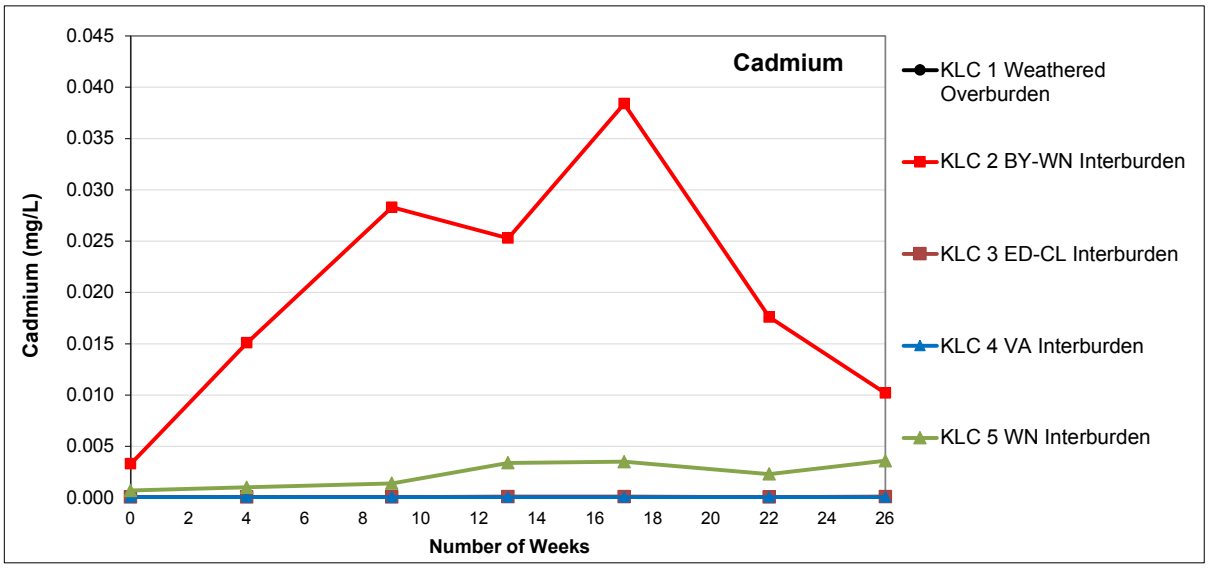

Residual ANC (%)
100
90
80
70
60
50
40
30
20
10
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
Residual ANC
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

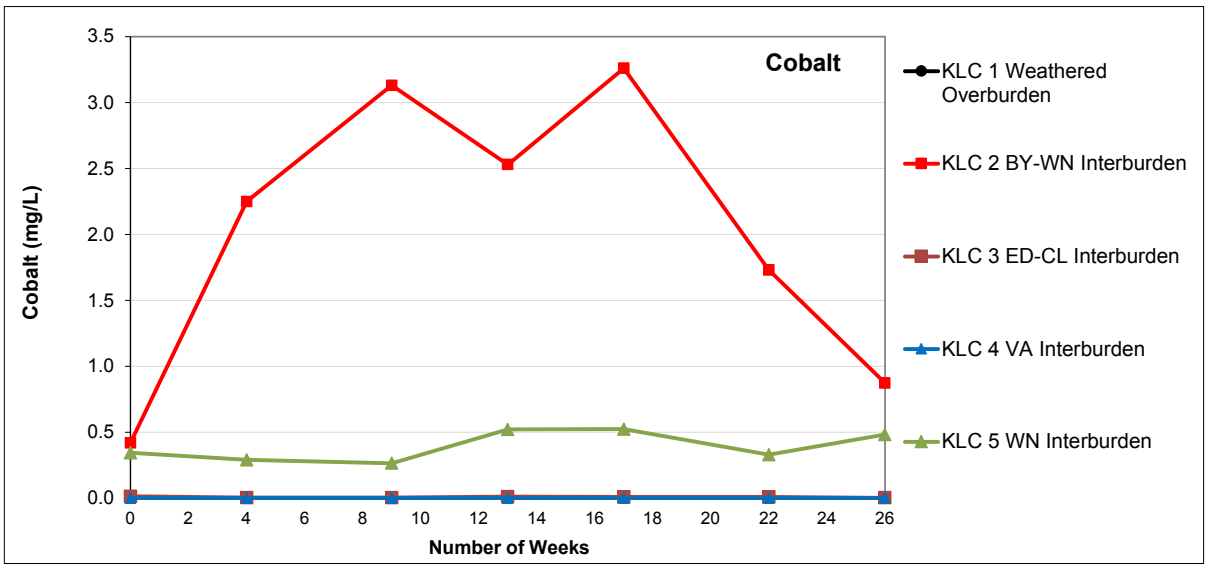

Aluminium
Aluminium (mg/L)
450
400
350
300
250
200
150
100
50
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

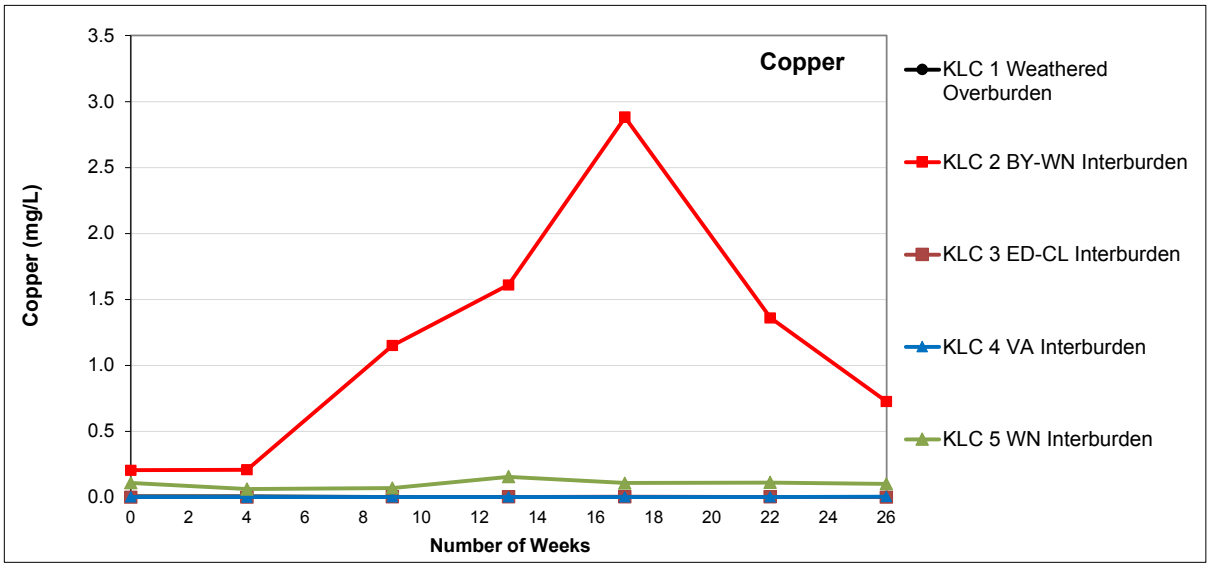

Arsenic
Arsenic (mg/L)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

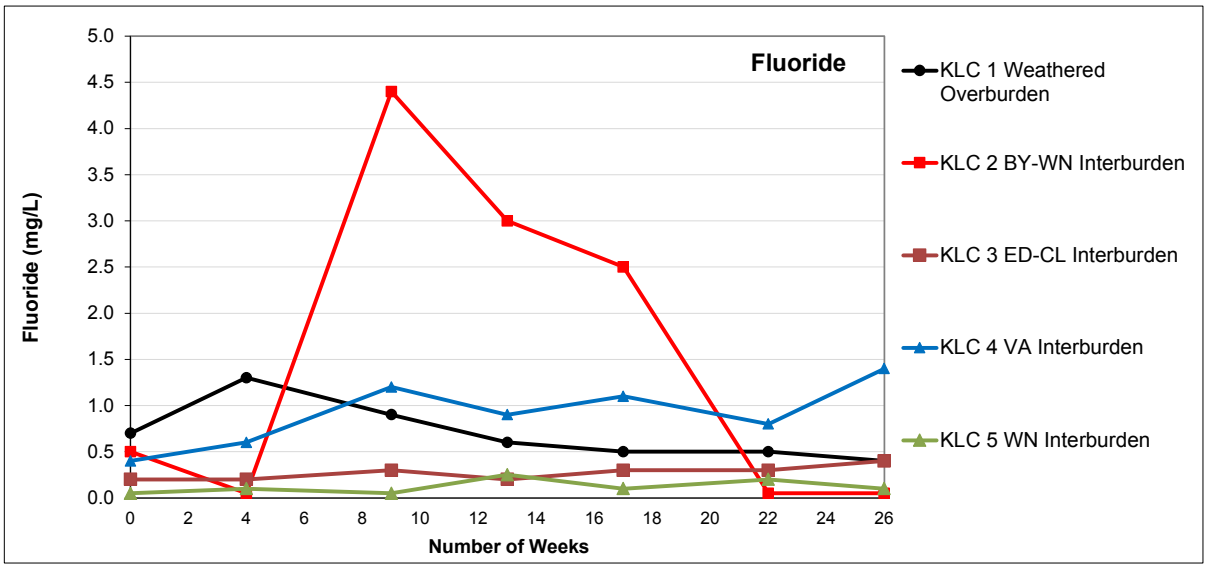

Antimony
Antimony (mg/L)
0.010
0.008
0.006
0.004
0.002
0.000
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

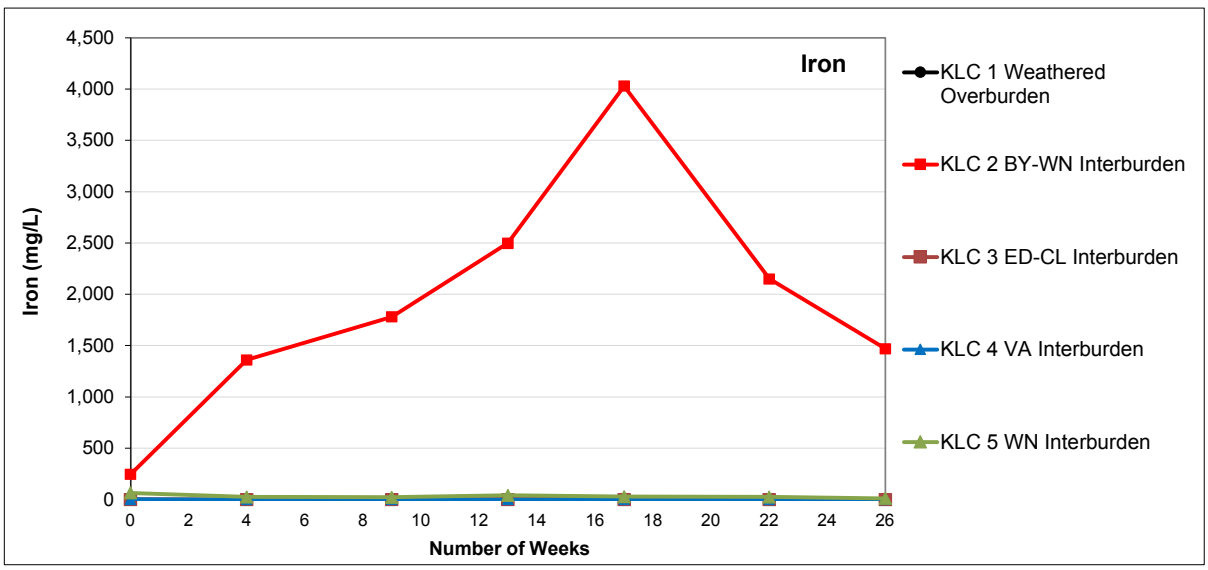

Boron
Boron (mg/L)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

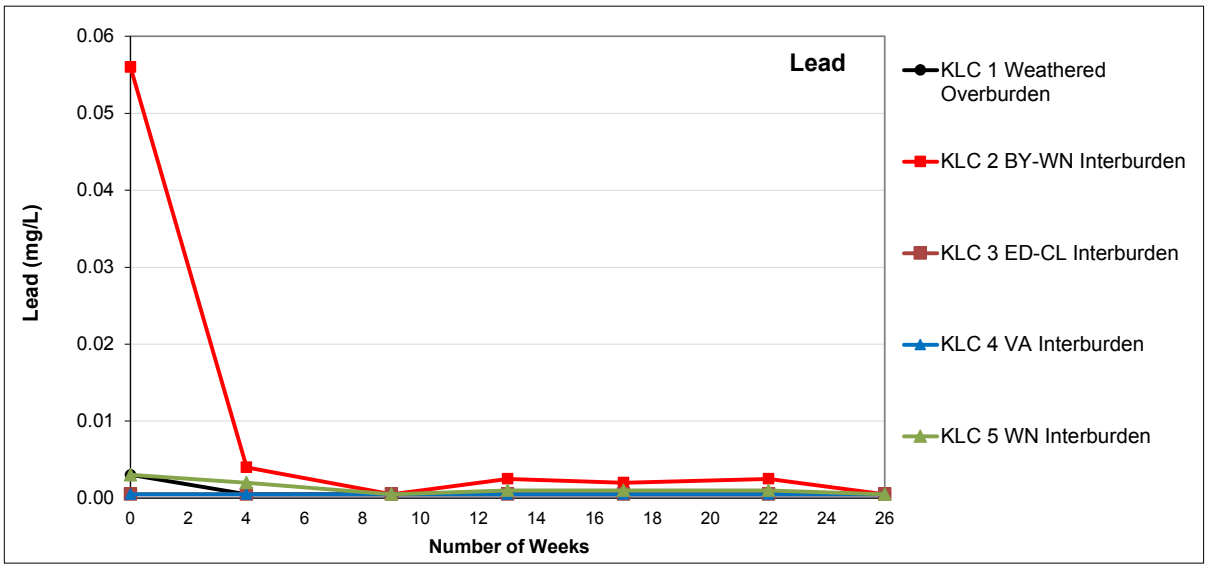

Cadmium
Cadmium (mg/L)
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

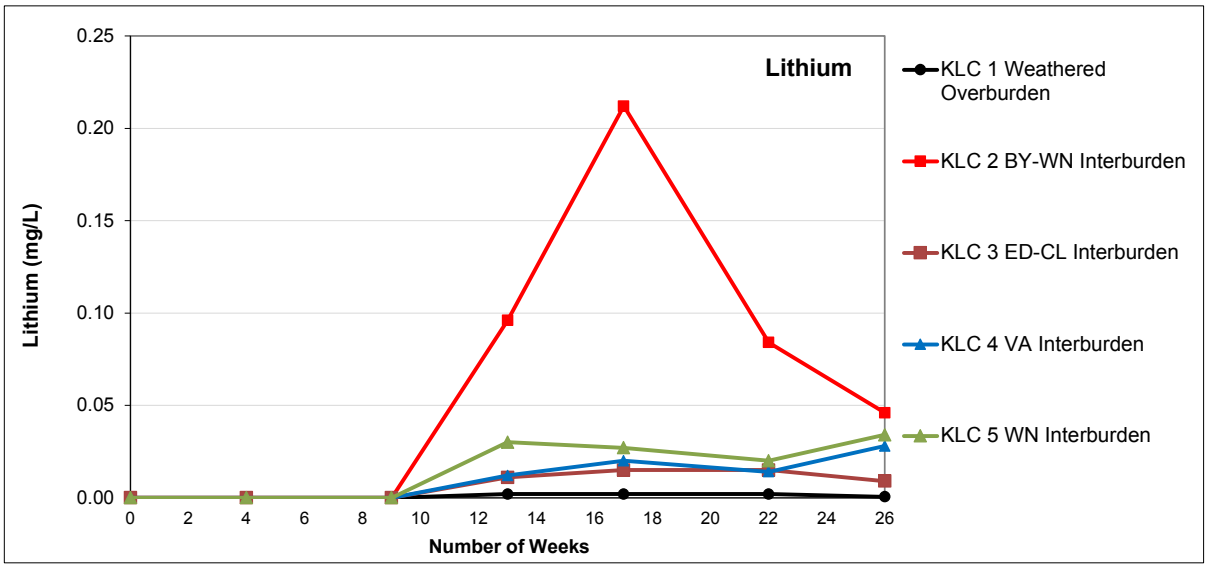

Cobalt
Cobalt (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

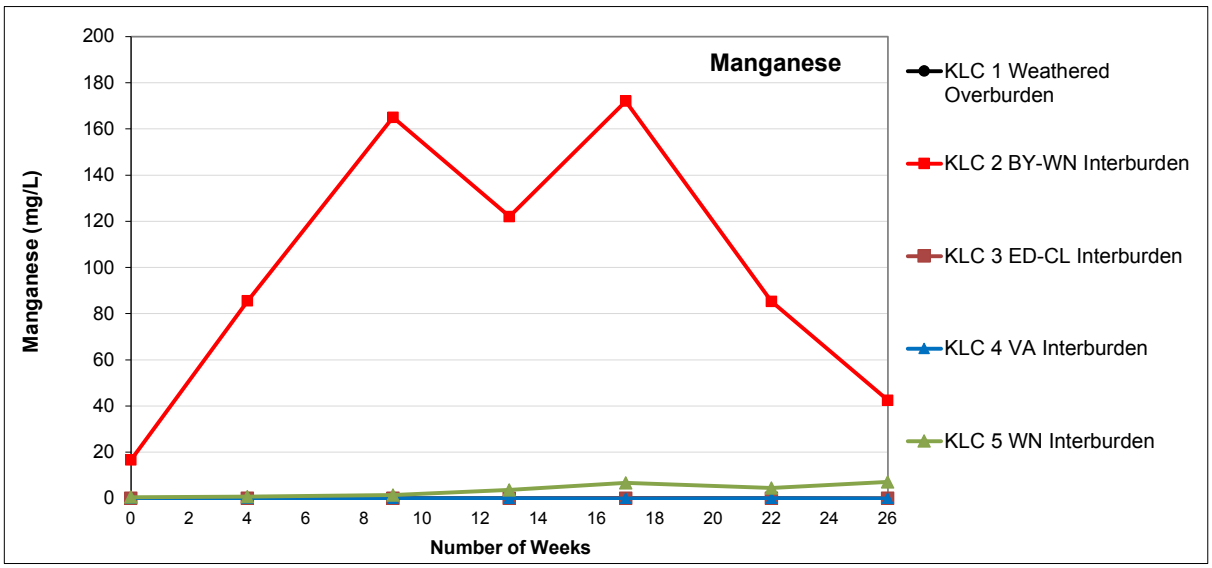

Copper
Copper (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

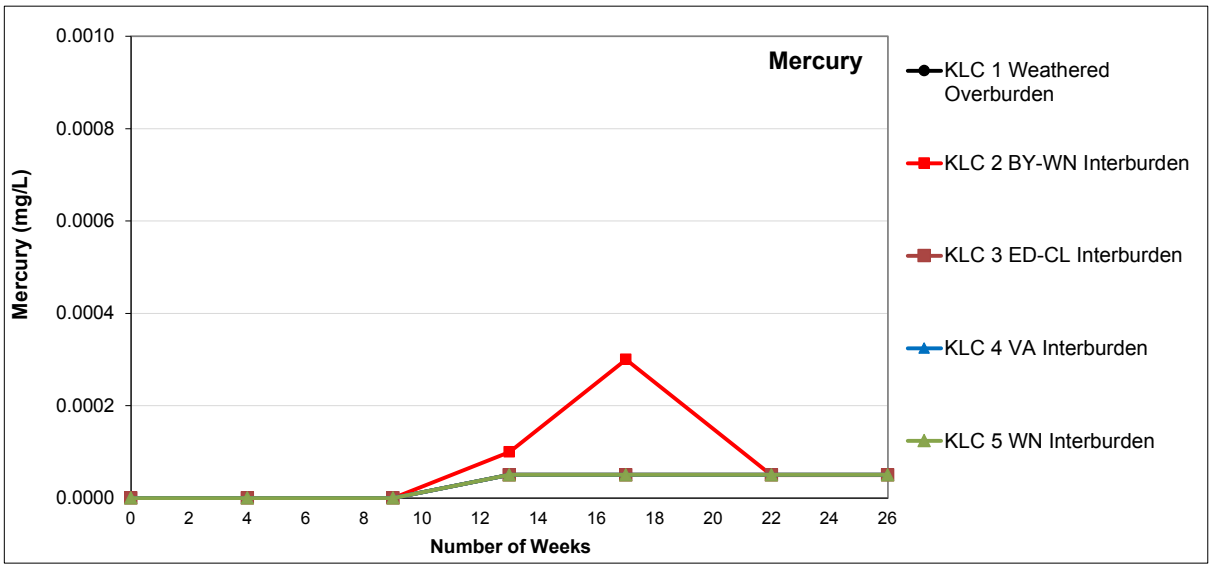

Fluoride
Fluoride (mg/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

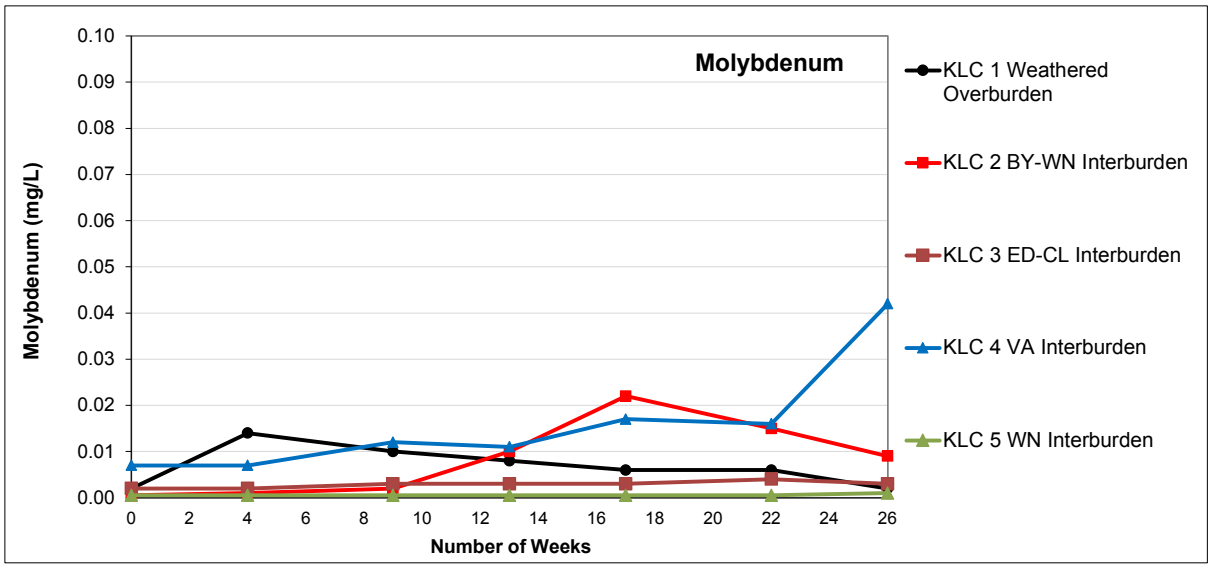

Iron
Iron (mg/L)
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

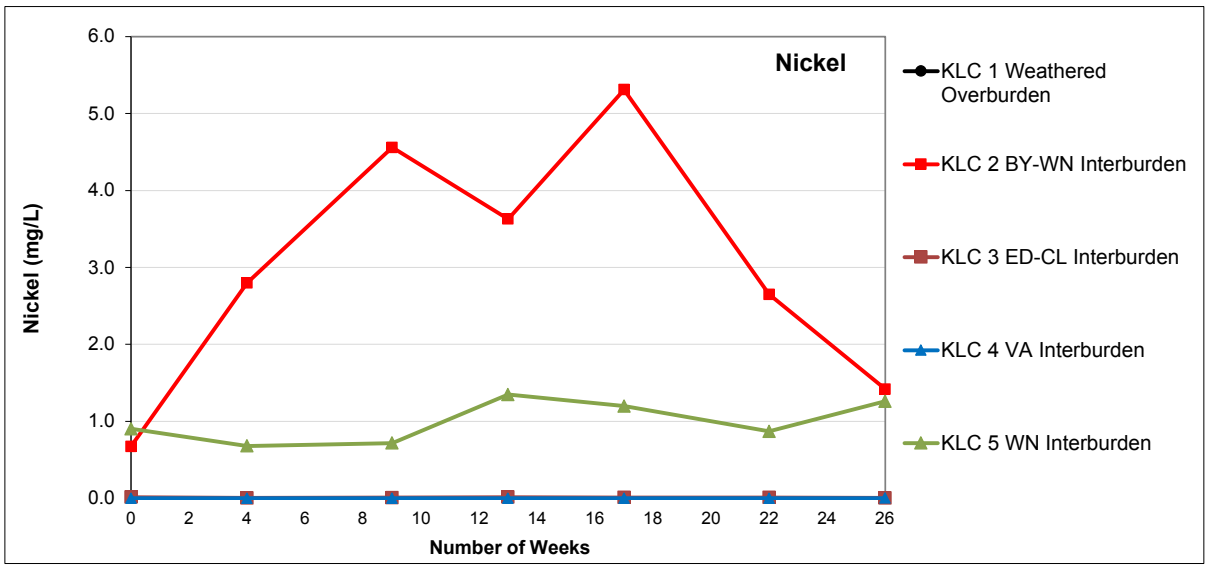

Lead
Lead (mg/L)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

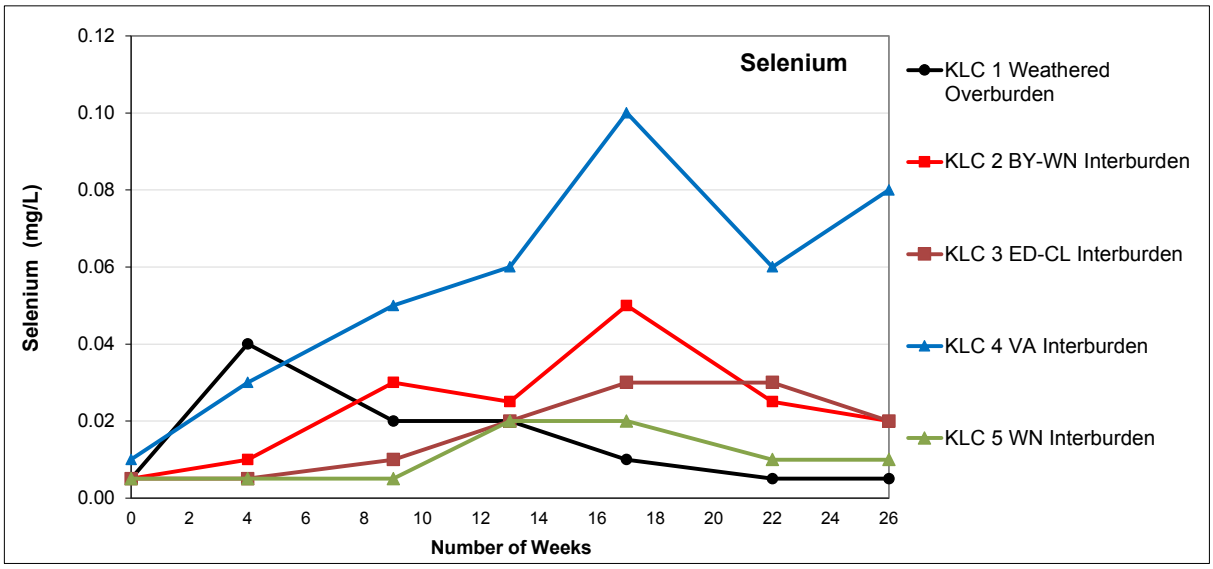

Lithium
Lithium (mg/L)
0.25
0.20
0.15
0.10
0.05
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

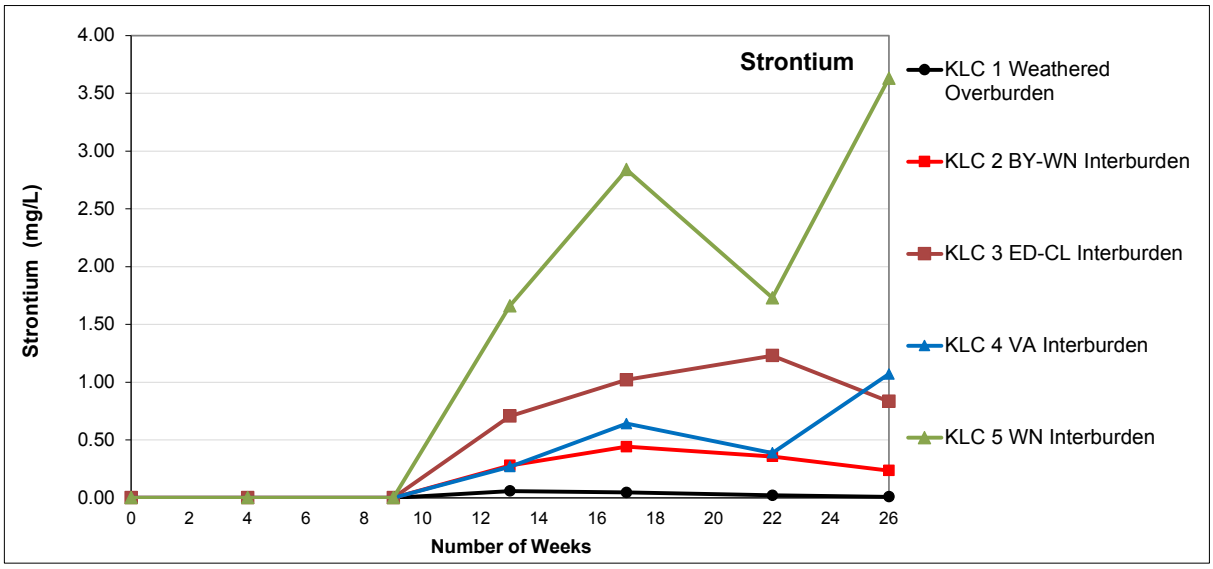

Manganese
Manganese (mg/L)
200
180
160
140
120
100
80
60
40
20
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

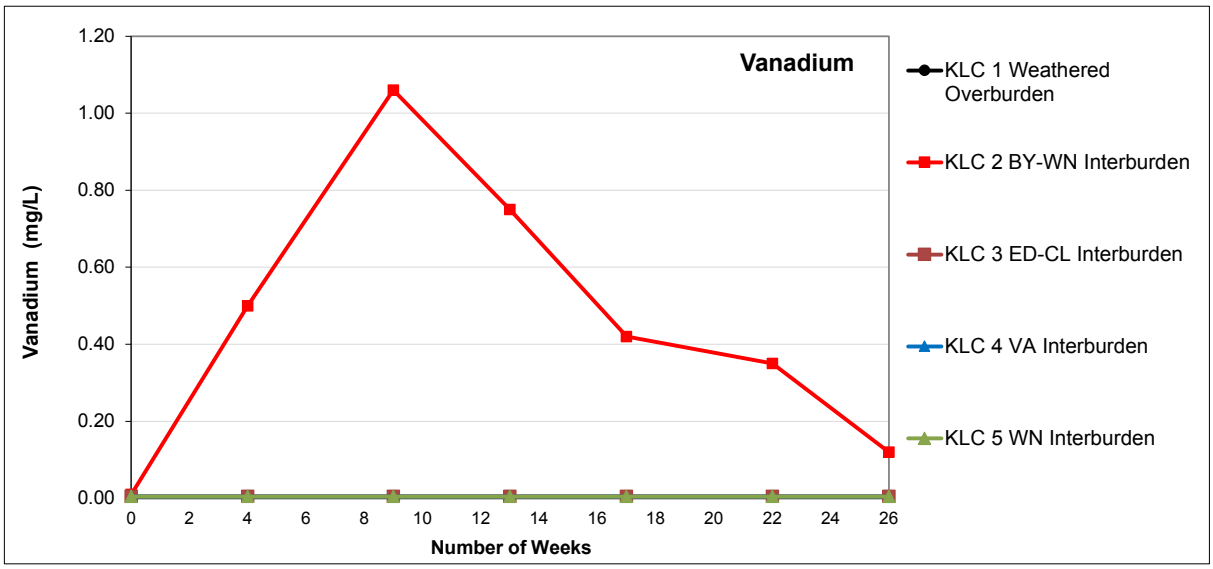

Mercury
Mercury (mg/L)
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

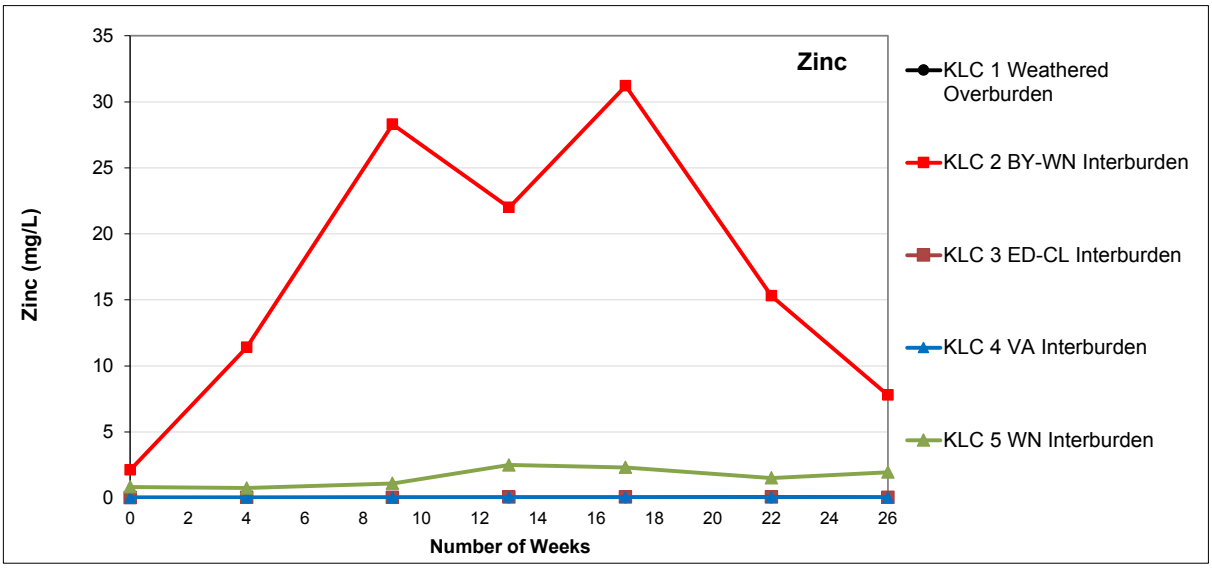

Molybdenum
Molybdenum (mg/L)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden


Nickel
Nickel (mg/L)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden


Selenium
Selenium (mg/L)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden


Strontium
Strontium (mg/L)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden


Vanadium
Vanadium (mg/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden


Zinc
Zinc (mg/L)
Number of Weeks
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12
14
16
18
20
22
24
26
KLC 1 Weathered Overburden
KLC 2 BY-WN Interburden
KLC 3 ED-CL Interburden
KLC 4 VA Interburden
KLC 5 WN Interburden

## KLC 6 - ED Coarse Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 1.50 | ANC | 24 |
| pH (1:5) | 7.20 | Scr (%) | 1.08 | NAPP | 23.0 |
| EC (µS/cm) | 320 | MPA | 45.9 | ANC:MPA | 0.5 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898001 | EB2009898002 | EB2015249001 | EB2017807001 | EB2020923001 | EB2023744001 | EB2026635001 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.732 | 0.558 | 0.558 | 0.615 | 0.682 | 0.643 | 0.626 |
| Cum. Volume (L) | | | 0.73 | 1.29 | 1.85 | 2.46 | 3.15 | 3.79 | 4.41 |
| Pore Volumes | | | 0.5 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.00 | 5.51 | 6.17 | 6.15 | 5.01 | 5.79 | 4.89 |
| pH (ALS Measurement) | | | 7.03 | 5.38 | 5.12 | 5.21 | 4.78 | 5.49 | 5.30 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 1,173 | 1,218 | 1,314 | 1,321 | 1,429 | 1,273 | 1,366 |
| EC (ALS Measurement) (µS/cm) | | | 1,240 | 1,250 | 1,470 | 1,420 | 1,550 | 1,300 | 1,600 |
| Acidity (mg/L)* | | | 4 | 15 | 22 | 10 | 14 | 19 | 16 |
| Alkalinity (mg/L)* | | | 12 | 4 | 3 | 9 | <1 | <1 | <1 |
| Net Alkalinity (mg/L)* | | | 8 | -11 | -19 | -1 | -14 | -19 | -16 |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 53 | 72 | 100 | 108 | 132 | 105 | 125 |
| Potassium (K) | 1 | - | 6 | 9 | 8 | 6 | 7 | 6 | 7 |
| Magnesium (Mg) | 1 | - | 62 | 85 | 109 | 121 | 133 | 110 | 130 |
| Sodium (Na) | 1 | - | 108 | 80 | 72 | 53 | 42 | 31 | 26 |
| Chloride (Cl) | 1 | - | 39 | 8 | 7 | 5 | 5 | 6 | 4 |
| Fluoride (F) | 0.1 | 2 | 1.1 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Sulfate ($SO_4$) | 1 | 1,000 | 564 | 652 | 805 | 836 | 840 | 741 | 892 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | <0.01 | 0.04 | 0.08 | 0.06 | 0.08 | 0.07 | 0.1 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.1 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.001 | 0.0007 | 0.0007 | 0.0008 | 0.0007 | 0.0008 |
| Cobalt (Co) | 0.001 | 1 | 0.012 | 0.091 | 0.12 | 0.087 | 0.07 | 0.045 | 0.039 |
| Copper (Cu) | 0.001 | 1 | <0.001 | 0.006 | 0.011 | 0.007 | 0.012 | 0.008 | 0.01 |
| Iron (Fe) | 0.05 | 1 | <0.05 | 2.52 | 5.67 | 5.71 | 5.23 | 4.16 | 4.06 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.015 | 0.014 | 0.02 | 0.015 | 0.018 | 0.018 | 0.02 |
| Manganese (Mn) | 0.001 | 2 | 0.112 | 1.07 | 1.97 | 2.31 | 2.07 | 1.61 | 2.14 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.008 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | 0.011 | 0.093 | 0.118 | 0.089 | 0.073 | 0.050 | 0.044 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | 0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| Strontium (Sr) | 0.01 | - | 1.48 | 1.46 | 1.95 | 2.27 | 2.08 | 1.75 | 2.14 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.01 | 0.092 | 0.157 | 0.122 | 0.126 | 0.097 | 0.106 |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 206.4 | 181.9 | 224.6 | 257.1 | 286.4 | 238.2 | 279.2 |
| Cumulative $SO_4$ Release | | | 206.4 | 388.3 | 612.9 | 870.0 | 1,156.4 | 1,394.7 | 1,673.9 |
| Ca Release Rate | | | 19.4 | 20.1 | 27.9 | 33.2 | 45.0 | 33.8 | 39.1 |
| Cumulative Ca Release | | | 19.4 | 39.5 | 67.4 | 100.6 | 145.6 | 179.4 | 218.5 |
| Mg Release Rate | | | 22.7 | 23.7 | 30.4 | 37.2 | 45.4 | 35.4 | 40.7 |
| Cumulative Mg Release | | | 22.7 | 46.4 | 76.8 | 114.0 | 159.4 | 194.7 | 235.4 |
| Residual ANC (%) | | | 99.4 | 98.8 | 98.0 | 97.1 | 95.8 | 94.9 | 93.8 |
| Residual Sulfur (%) | | | 99.5 | 99.1 | 98.6 | 98.1 | 97.4 | 96.9 | 96.3 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.5 | 1.3 | 1.2 | 1.1 | 1.0 | 1.1 | 1.1 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 7 - ED Fine Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.60 | ANC | 17 |
| pH (1:5) | 8.40 | Scr (%) | 0.35 | NAPP | 1.4 |
| EC (µS/cm) | 125 | MPA | 18.4 | ANC:MPA | 0.9 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898002 | EB2012205002 | EB2015249002 | EB2017807002 | EB2020923002 | EB2023744002 | EB2026635002 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.863 | 0.845 | 0.860 | 0.885 | 0.879 | 0.872 | 0.904 |
| Cum. Volume (L) | | | 0.86 | 1.71 | 2.57 | 3.45 | 4.33 | 5.20 | 6.11 |
| Pore Volumes | | | 0.6 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 8.21 | 7.48 | 6.54 | 7.23 | 7.11 | 7.20 | 7.62 |
| pH (ALS Measurement) | | | 8.04 | 6.77 | 6.58 | 6.41 | 6.87 | 6.95 | 6.91 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 399 | 257 | 128 | 86 | 68.0 | 86 | 74 |
| EC (ALS Measurement) (µS/cm) | | | 373 | 180 | 107 | 80 | 72 | 87 | 81 |
| Acidity (mg/L)* | | | 1 | <1 | <1 | 2 | 2 | 1 | 3 |
| Alkalinity (mg/L)* | | | 70 | 4 | 5 | 10 | 5 | 6 | 7 |
| Net Alkalinity (mg/L)* | | | 69 | 4 | 5 | 8 | 3 | 3 | 4 |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 11 | 14 | 5 | 3 | 4 | 4 | 4 |
| Potassium (K) | 1 | - | 4 | 1 | 1 | 1 | 1 | 2 | 2 |
| Magnesium (Mg) | 1 | - | 13 | 8 | 5 | 4 | 4 | 5 | 4 |
| Sodium (Na) | 1 | - | 38 | 4 | 4 | 3 | 2 | 4 | 2 |
| Chloride (Cl) | 1 | - | 32 | 3 | 1 | 2 | 1 | 2 | 2 |
| Fluoride (F) | 0.1 | 2 | 0.9 | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| Sulfate ($SO_4$) | 1 | 1,000 | 54 | 74 | 39 | 30 | 23 | 27 | 24 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | <0.01 | 0.02 | 0.17 | 0.17 | 0.14 | 0.06 | 0.13 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cobalt (Co) | 0.001 | 1 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Copper (Cu) | 0.001 | 1 | <0.001 | <0.001 | 0.002 | <0.001 | 0.001 | 0.001 | 0.002 |
| Iron (Fe) | 0.05 | 1 | <0.05 | <0.05 | 0.07 | <0.05 | <0.05 | <0.05 | <0.05 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.008 | <0.001 | 0.001 | <0.001 | <0.001 | 0.001 | 0.001 |
| Manganese (Mn) | 0.001 | 2 | 0.044 | 0.010 | 0.020 | 0.007 | 0.006 | 0.010 | 0.011 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.022 | <0.01 | 0.004 | 0.004 | 0.004 | 0.004 | 0.004 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | 0.001 | 0.002 | 0.001 | 0.001 | 0.002 | 0.001 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Strontium (Sr) | 0.01 | - | 0.278 | 0.325 | 0.128 | 0.088 | 0.081 | 0.097 | 0.086 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 23.3 | 31.3 | 16.8 | 13.3 | 10.1 | 11.8 | 10.8 |
| Cumulative $SO_4$ Release | | | 23.3 | 54.6 | 71.3 | 84.6 | 94.7 | 106.5 | 117.3 |
| Ca Release Rate | | | 4.7 | 5.9 | 2.2 | 1.3 | 1.8 | 1.7 | 1.8 |
| Cumulative Ca Release | | | 4.7 | 10.7 | 12.8 | 14.1 | 15.9 | 17.6 | 19.4 |
| Mg Release Rate | | | 5.6 | 3.4 | 2.2 | 1.8 | 1.8 | 2.2 | 1.8 |
| Cumulative Mg Release | | | 5.6 | 9.0 | 11.1 | 12.9 | 14.7 | 16.8 | 18.7 |
| Residual ANC (%) | | | 99.8 | 99.6 | 99.6 | 99.5 | 99.4 | 99.3 | 99.3 |
| Residual Sulfur (%) | | | 99.9 | 99.7 | 99.6 | 99.5 | 99.5 | 99.4 | 99.3 |
| $SO_4$/(Ca+Mg) molar ratio | | | 0.7 | 1.1 | 1.2 | 1.3 | 0.9 | 0.9 | 0.9 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 8 - WN1 Coarse Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 2.40 | ANC | 19.0 |
| pH (1:5) | 6.00 | Scr (%) | 1.66 | NAPP | 55.0 |
| EC (µS/cm) | 1,400 | MPA | 73.5 | ANC:MPA | 0.3 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898003 | EB2012205003 | EB2015249003 | EB2017807003 | EB2020923003 | EB2023744003 | EB2026635003 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.686 | 0.514 | 0.494 | 0.531 | 0.545 | 0.535 | 0.554 |
| Cum. Volume (L) | | | 0.69 | 1.20 | 1.69 | 2.23 | 2.77 | 3.31 | 3.86 |
| Pore Volumes | | | 0.5 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 3.55 | 3.03 | 2.97 | 2.85 | 2.48 | 2.39 | 2.54 |
| pH (ALS Measurement) | | | 3.57 | 2.96 | 2.83 | 2.73 | 2.53 | 2.47 | 2.44 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 3,410 | 3,230 | 3,710 | 4,400 | 5,160 | 5,670 | 5,310 |
| EC (ALS Measurement) (µS/cm) | | | 3650 | 3,430 | 4,050 | 4,590 | 5,600 | 5,870 | 6,090 |
| Acidity (mg/L)* | | | 62 | 538 | 1,060 | 1,250 | 1,760 | 2,220 | 5,500 |
| Alkalinity (mg/L)* | | | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Net Alkalinity (mg/L)* | | | -62 | -538 | -1,060 | -1250 | -1760 | -2220 | -5500 |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 318 | 157 | 196 | 234 | 248 | 134 | 261 |
| Potassium (K) | 1 | - | 4 | 3 | 2 | <1 | <1 | 1 | <1 |
| Magnesium (Mg) | 1 | - | 304 | 210 | 312 | 449 | 474 | 258 | 531 |
| Sodium (Na) | 1 | - | 120 | 42 | 37 | 23 | 11 | 5 | <1 |
| Chloride (Cl) | 1 | - | 3 | 1 | <1 | <1 | <1 | <1 | <1 |
| Fluoride (F) | 0.1 | 2 | 0.4 | 0.3 | 1.2 | <0.1 | <0.1 | 0.1 | <0.1 |
| Sulfate ($SO_4$) | 1 | 1,000 | 2,500 | 2,330 | 2,680 | 3,410 | 3,410 | 3,230 | 4920 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | 2.39 | 3.18 | 10.8 | 24.9 | 38.1 | 27.6 | 94.8 |
| Arsenic (As) | 0.001 | 0.5 | 0.002 | 0.121 | 0.52 | 0.86 | 1.10 | 0.54 | 1.35 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | 0.0177 | 0.0201 | 0.0200 | 0.0297 | 0.0394 | 0.0260 | 0.055 |
| Cobalt (Co) | 0.001 | 1 | 0.599 | 0.583 | 0.730 | 0.959 | 1.050 | 0.49 | 1.08 |
| Copper (Cu) | 0.001 | 1 | 0.375 | 0.834 | 1.20 | 1.52 | 2.00 | 1.14 | 3.62 |
| Iron (Fe) | 0.05 | 1 | 0.8 | 93 | 250 | 380 | 515 | 310 | 945 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | 0.0002 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.061 | 0.031 | 0.07 | 0.073 | 0.106 | 0.058 | 0.126 |
| Manganese (Mn) | 0.001 | 2 | 19.6 | 13.1 | 33.6 | 56.3 | 66.6 | 40.3 | 103 |
| Molybdenum (Mo) | 0.001 | 0.15 | <0.001 | 0.001 | 0.002 | 0.003 | 0.003 | 0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | 0.698 | 0.734 | 0.954 | 1.240 | 1.500 | 0.752 | 1.580 |
| Lead (Pb) | 0.001 | 0.1 | 0.009 | 0.022 | 0.010 | 0.003 | 0.002 | 0.001 | <0.005 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.005 |
| Selenium (Se) | 0.01 | 0.02 | 0.02 | 0.03 | 0.04 | 0.02 | 0.04 | 0.03 | <0.01 |
| Strontium (Sr) | 0.01 | - | 4.31 | 2.32 | 2.08 | 1.62 | 1.32 | 0.639 | 0.804 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | 0.02 | 0.02 | 0.03 | 0.02 | <0.05 |
| Zinc (Zn) | 0.005 | 20 | 1.86 | 1.68 | 2.27 | 3.43 | 4.81 | 3.18 | 7.65 |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 858 | 599 | 662 | 905 | 929 | 864 | 1,363 |
| Cumulative $SO_4$ Release | | | 858 | 1,456 | 2,118 | 3,024 | 3,953 | 4,817 | 6,180 |
| Ca Release Rate | | | 109 | 40 | 48 | 62 | 68 | 36 | 72 |
| Cumulative Ca Release | | | 109 | 149 | 198 | 260 | 328 | 363 | 436 |
| Mg Release Rate | | | 104 | 54 | 77 | 119 | 129 | 69 | 147 |
| Cumulative Mg Release | | | 104 | 158 | 235 | 355 | 484 | 553 | 700 |
| Residual ANC (%) | | | 96.4 | 94.7 | 92.5 | 89.1 | 85.5 | 83.6 | 79.5 |
| Residual Sulfur (%) | | | 98.8 | 98.0 | 97.1 | 95.8 | 94.5 | 93.3 | 91.4 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.3 | 1.9 | 1.6 | 1.5 | 1.4 | 2.4 | 1.8 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 9 - WN1 Fine Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 1.58 | ANC | 44 |
| pH (1:5) | 8.60 | Scr (%) | 1.2 | NAPP | 4.3 |
| EC (µS/cm) | 141 | MPA | 48.4 | ANC:MPA | 0.9 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898004 | EB2012205004 | EB2015249004 | EB2017807004 | EB2020923004 | EB2023744004 | EB2026635004 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.945 | 0.737 | 0.709 | 0.635 | 0.715 | 0.775 | 0.782 |
| Cum. Volume (L) | | | 0.95 | 1.68 | 2.39 | 3.03 | 3.74 | 4.52 | 5.30 |
| Pore Volumes | | | 0.7 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.12 | 7.09 | 7.27 | 6.10 | 6.95 | 5.71 | 6.79 |
| pH (ALS Measurement) | | | 6.91 | 6.85 | 6.66 | 6.29 | 6.74 | 6.46 | 6.35 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 97 | 550 | 421 | 436 | 573 | 361 | 464 |
| EC (ALS Measurement) (µS/cm) | | | 98 | 392 | 415 | 373 | 501 | 325 | 459 |
| Acidity (mg/L)* | | | 6 | 2 | <1 | 4 | 3 | 2 | 10 |
| Alkalinity (mg/L)* | | | 13 | 6 | 6 | 6 | 7 | 4 | 4 |
| Net Alkalinity (mg/L)* | | | 7 | 4 | 6 | 2 | 4 | 2 | -6 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 4 | 24 | 22 | 24 | 17 | 14 | 18 |
| Potassium (K) | 1 | - | <1 | 4 | 3 | 3 | 3 | 2 | 3 |
| Magnesium (Mg) | 1 | - | 4 | 25 | 26 | 30 | 35 | 18 | 36 |
| Sodium (Na) | 1 | - | 7 | 12 | 12 | 11 | 11 | 6 | 7 |
| Chloride (Cl) | 1 | - | 6 | 6 | 6 | 5 | 5 | 3 | 4 |
| Fluoride (F) | 0.1 | 2 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | <0.1 | <0.1 |
| Sulfate ($SO_4$) | 1 | 1,000 | 22 | 164 | 187 | 176 | 203 | 144 | 216 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cobalt (Co) | 0.001 | 1 | <0.001 | 0.001 | 0.0020 | 0.002 | 0.002 | 0.001 | 0.002 |
| Copper (Cu) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Iron (Fe) | 0.05 | 1 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.002 | 0.003 | 0.003 | 0.002 | 0.003 | 0.003 | 0.002 |
| Manganese (Mn) | 0.001 | 2 | 0.016 | 0.03 | 0.05 | 0.041 | 0.048 | 0.042 | 0.066 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.002 | 0.002 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 | 0.01 |
| Strontium (Sr) | 0.01 | - | 0.088 | 0.561 | 0.526 | 0.384 | 0.418 | 0.36 | 0.443 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 10.4 | 60.4 | 66.3 | 55.9 | 72.6 | 55.8 | 84.5 |
| Cumulative $SO_4$ Release | | | 10.4 | 70.8 | 137.1 | 193.0 | 265.6 | 321.4 | 405.8 |
| Ca Release Rate | | | 1.9 | 8.8 | 7.8 | 7.6 | 6.1 | 5.4 | 7.0 |
| Cumulative Ca Release | | | 1.9 | 10.7 | 18.5 | 26.2 | 32.2 | 37.7 | 44.7 |
| Mg Release Rate | | | 1.9 | 9.2 | 9.2 | 9.5 | 12.5 | 7.0 | 14.1 |
| Cumulative Mg Release | | | 1.9 | 11.1 | 20.3 | 29.8 | 42.4 | 49.3 | 63.4 |
| Residual ANC (%) | | | 99.9 | 99.6 | 99.4 | 99.1 | 98.7 | 98.5 | 98.1 |
| Residual Sulfur (%) | | | 100.0 | 99.7 | 99.4 | 99.2 | 98.8 | 98.6 | 98.2 |
| $SO_4$/(Ca+Mg) molar ratio | | | 0.9 | 1.0 | 1.2 | 1.0 | 1.1 | 1.4 | 1.2 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 10 - PF2 Fine Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.29 | ANC | 16.2 |
| pH (1:5) | 7.70 | Scr (%) | 0.129 | NAPP | -7.5 |
| EC (µS/cm) | 185 | MPA | 8.9 | ANC:MPA | 1.8 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898005 | EB2012205005 | EB2015249005 | EB2017807005 | EB2020923005 | EB2023744005 | EB2026635004 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.984 | 0.878 | 0.899 | 0.878 | 0.880 | 0.892 | 0.919 |
| Cum. Volume (L) | | | 0.98 | 1.86 | 2.76 | 3.64 | 4.52 | 5.41 | 6.33 |
| Pore Volumes | | | 0.7 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.27 | 6.87 | 7.39 | 6.94 | 7.10 | 6.72 | 6.30 |
| pH (ALS Measurement) | | | 7.28 | 6.73 | 6.58 | 6.56 | 6.79 | 6.81 | 6.65 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 191 | 250 | 170 | 86 | 60 | 56 | 40 |
| EC (ALS Measurement) (µS/cm) | | | 199 | 214 | 153 | 76 | 59 | 55 | 40 |
| Acidity (mg/L)* | | | 29 | 1 | <1 | 2 | 2 | 2 | 4 |
| Alkalinity (mg/L)* | | | 31 | 4 | 3 | 9 | 5 | 5 | 6 |
| Net Alkalinity (mg/L)* | | | 2 | 3 | 3 | 7 | 3 | 3 | 2 |
| | | | | | | | | | |
| Major Ions (mg/L) | LoR | WQ Guidelines# | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 6 | 13 | 4 | 2 | 2 | 2 | 1 |
| Potassium (K) | 1 | - | 1 | 1 | 1 | <1 | <1 | <1 | <1 |
| Magnesium (Mg) | 1 | - | 6 | 12 | 7 | 3 | 3 | 2 | 2 |
| Sodium (Na) | 1 | - | 22 | 8 | 11 | 5 | 4 | 3 | 3 |
| Chloride (Cl) | 1 | - | 16 | 6 | 5 | 2 | 1 | 1 | <1 |
| Fluoride (F) | 0.1 | 2 | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 |
| Sulfate ($SO_4$) | 1 | 1,000 | 40 | 81 | 48 | 26 | 20 | 15 | 10 |
| Trace metals/ metalloids (mg/L) | LoR | WQ Guidelines# | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | <0.01 | 0.03 | 0.26 | 0.35 | 0.34 | 0.10 | 0.35 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cobalt (Co) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Copper (Cu) | 0.001 | 1 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Iron (Fe) | 0.05 | 1 | <0.05 | <0.05 | 0.08 | 0.08 | 0.10 | <0.05 | 0.08 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.003 | 0.001 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| Manganese (Mn) | 0.001 | 2 | 0.023 | 0.011 | 0.006 | 0.006 | 0.004 | 0.006 | 0.005 |
| Molybdenum (Mo) | 0.001 | 0.15 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Strontium (Sr) | 0.01 | - | 0.11 | 0.238 | 0.077 | 0.043 | 0.041 | 0.036 | 0.023 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | | | | | | | | |
| Calculations** | | | | | | | | | |
| $SO_4$ Release Rate | | | 19.7 | 35.6 | 21.6 | 11.4 | 8.8 | 6.7 | 4.6 |
| Cumulative $SO_4$ Release | | | 19.7 | 55.2 | 76.8 | 88.2 | 97.0 | 103.7 | 108.3 |
| Ca Release Rate | | | 3.0 | 5.7 | 1.8 | 0.9 | 0.9 | 0.9 | 0.5 |
| Cumulative Ca Release | | | 3.0 | 8.7 | 10.5 | 11.3 | 12.2 | 13.1 | 13.6 |
| Mg Release Rate | | | 3.0 | 5.3 | 3.1 | 1.3 | 1.3 | 0.9 | 0.9 |
| Cumulative Mg Release | | | 3.0 | 8.2 | 11.4 | 12.7 | 14.0 | 14.9 | 15.8 |
| Residual ANC (%) | | | 99.9 | 99.7 | 99.6 | 99.6 | 99.6 | 99.5 | 99.5 |
| Residual Sulfur (%) | | | 99.9 | 99.8 | 99.7 | 99.6 | 99.6 | 99.6 | 99.5 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.1 | 1.0 | 1.3 | 1.6 | 1.2 | 1.2 | 1.0 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 11 - VX1 Coarse Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.24 | ANC | 16 |
| pH (1:5) | 5.90 | Scr (%) | 0.109 | NAPP | -8.6 |
| EC (µS/cm) | 326 | MPA | 7.4 | ANC:MPA | 2.2 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898006 | EB2012205006 | EB2015249006 | EB2017807006 | EB2020923006 | EB2023744006 | EB2026635005 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.827 | 0.643 | 0.629 | 0.593 | 0.599 | 0.620 | 0.643 |
| Cum. Volume (L) | | | 0.83 | 1.47 | 2.10 | 2.69 | 3.29 | 3.91 | 4.55 |
| Pore Volumes | | | 0.6 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 5.77 | 4.72 | 4.64 | 4.56 | 4.37 | 4.50 | 4.44 |
| pH (ALS Measurement) | | | 5.80 | 4.81 | 4.51 | 4.57 | 4.30 | 4.66 | 4.55 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 788 | 560 | 715 | 782 | 954 | 803 | 1,030 |
| EC (ALS Measurement) (µS/cm) | | | 850 | 559 | 753 | 797 | 995 | 811 | 1,150 |
| Acidity (mg/L)* | | | 4 | 15 | 5 | 12 | 22 | 14 | 14 |
| Alkalinity (mg/L)* | | | 4 | 1 | <1 | <1 | <1 | <1 | <1 |
| Net Alkalinity (mg/L)* | | | 0 | -14 | -5 | -12 | -22 | -14 | -14 |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 59 | 37 | 48 | 48 | 59 | 48 | 62 |
| Potassium (K) | 1 | - | 5 | 7 | 6 | 6 | 7 | 6 | 7 |
| Magnesium (Mg) | 1 | - | 53 | 38 | 55 | 70 | 91 | 65 | 109 |
| Sodium (Na) | 1 | - | 25 | 12 | 14 | 15 | 18 | 14 | 21 |
| Chloride (Cl) | 1 | - | 5 | 1 | 2 | 2 | 2 | 2 | 3 |
| Fluoride (F) | 0.1 | 2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Sulfate ($SO_4$) | 1 | 1,000 | 425 | 261 | 388 | 423 | 522 | 434 | 611 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | 0.02 | 0.06 | 0.09 | 0.11 | 0.11 | 0.10 | 0.16 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | 0.0003 | 0.0002 | 0.0003 | 0.0004 | 0.0004 | 0.0004 | 0.0007 |
| Cobalt (Co) | 0.001 | 1 | 0.011 | 0.015 | 0.013 | 0.013 | 0.014 | 0.010 | 0.016 |
| Copper (Cu) | 0.001 | 1 | 0.003 | 0.012 | 0.027 | 0.032 | 0.047 | 0.038 | 0.063 |
| Iron (Fe) | 0.05 | 1 | <0.05 | 3.79 | 4.62 | 3.68 | 2.59 | 1.76 | 1.72 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.013 | 0.007 | 0.011 | 0.012 | 0.015 | 0.016 | 0.018 |
| Manganese (Mn) | 0.001 | 2 | 0.404 | 0.399 | 0.558 | 0.643 | 0.786 | 0.572 | 0.939 |
| Molybdenum (Mo) | 0.001 | 0.15 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | 0.02 | 0.019 | 0.024 | 0.023 | 0.028 | 0.022 | 0.033 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| Strontium (Sr) | 0.01 | - | 0.642 | 0.425 | 0.534 | 0.58 | 0.679 | 0.581 | 0.802 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | 0.063 | 0.043 | 0.061 | 0.072 | 0.091 | 0.077 | 0.113 |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 175.7 | 83.9 | 122.0 | 125.4 | 156.3 | 134.5 | 196.4 |
| Cumulative $SO_4$ Release | | | 175.7 | 259.6 | 381.7 | 507.1 | 663.4 | 798.0 | 994.4 |
| Ca Release Rate | | | 24.4 | 11.9 | 15.1 | 14.2 | 17.7 | 14.9 | 19.9 |
| Cumulative Ca Release | | | 24.4 | 36.3 | 51.4 | 65.6 | 83.3 | 98.2 | 118.1 |
| Mg Release Rate | | | 21.9 | 12.2 | 17.3 | 20.8 | 27.3 | 20.2 | 35.0 |
| Cumulative Mg Release | | | 21.9 | 34.1 | 51.4 | 72.2 | 99.4 | 119.6 | 154.6 |
| Residual ANC (%) | | | 99.2 | 98.9 | 98.3 | 97.7 | 96.9 | 96.3 | 95.4 |
| Residual Sulfur (%) | | | 99.2 | 98.9 | 98.3 | 97.8 | 97.1 | 96.5 | 95.7 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.2 | 1.1 | 1.2 | 1.1 | 1.0 | 1.2 | 1.1 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 12 - VX1 Fine Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.77 | ANC | 19.7 |
| pH (1:5) | 8.60 | Scr (%) | 0.471 | NAPP | 3.9 |
| EC (µS/cm) | 149 | MPA | 23.6 | ANC:MPA | 0.8 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898007 | EB2012205007 | EB2015249007 | EB2017807007 | EB2020923007 | EB2023744007 | EB2026635005 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.897 | 0.648 | 0.678 | 0.707 | 0.725 | 0.725 | 0.782 |
| Cum. Volume (L) | | | 0.90 | 1.55 | 2.22 | 2.93 | 3.66 | 4.38 | 5.16 |
| Pore Volumes | | | 0.7 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.76 | 7.46 | 7.86 | 7.37 | 7.04 | 6.73 | 7.03 |
| pH (ALS Measurement) | | | 7.05 | 7.19 | 7.04 | 6.53 | 6.98 | 6.92 | 6.85 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 97 | 576 | 521 | 615 | 581 | 449 | 713 |
| EC (ALS Measurement) (µS/cm) | | | 101 | 576 | 487 | 508 | 556 | 432 | 710 |
| Acidity (mg/L)* | | | 21 | 2 | 1 | 2 | 1 | 2 | 6 |
| Alkalinity (mg/L)* | | | 11 | 11 | 11 | 12 | 7 | 8 | 9 |
| Net Alkalinity (mg/L)* | | | -10 | 9 | 10 | 10 | 6 | 6 | 3 |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 3 | 29 | 15 | 21 | 16 | 14 | 16 |
| Potassium (K) | 1 | - | <1 | 3 | 3 | 3 | 2 | 2 | 2 |
| Magnesium (Mg) | 1 | - | 4 | 46 | 35 | 47 | 46 | 33 | 64 |
| Sodium (Na) | 1 | - | 7 | 22 | 19 | 16 | 15 | 10 | 14 |
| Chloride (Cl) | 1 | - | 6 | 10 | 9 | 7 | 7 | 4 | 6 |
| Fluoride (F) | 0.1 | 2 | 0.4 | 1 | 0.7 | 0.5 | 0.4 | 0.3 | 0.3 |
| Sulfate ($SO_4$) | 1 | 1,000 | 25 | 246 | 204 | 216 | 236 | 180 | 342 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | 0.02 | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| Cobalt (Co) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Copper (Cu) | 0.001 | 1 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Iron (Fe) | 0.05 | 1 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | <0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 | 0.002 |
| Manganese (Mn) | 0.001 | 2 | 0.004 | 0.017 | 0.017 | 0.018 | 0.024 | 0.023 | 0.038 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.007 | 0.015 | 0.006 | 0.003 | 0.002 | 0.001 | 0.001 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | <0.01 | 0.01 |
| Strontium (Sr) | 0.01 | - | 0.07 | 0.72 | 0.374 | 0.358 | 0.41 | 0.38 | 0.455 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 11.2 | 79.7 | 69.2 | 76.4 | 85.6 | 65.3 | 133.7 |
| Cumulative $SO_4$ Release | | | 11.2 | 90.9 | 160.1 | 236.4 | 322.0 | 387.2 | 521.0 |
| Ca Release Rate | | | 1.3 | 9.4 | 5.1 | 7.4 | 5.8 | 5.1 | 6.3 |
| Cumulative Ca Release | | | 1.3 | 10.7 | 15.8 | 23.3 | 29.1 | 34.1 | 40.4 |
| Mg Release Rate | | | 1.8 | 14.9 | 11.9 | 16.6 | 16.7 | 12.0 | 25.0 |
| Cumulative Mg Release | | | 1.8 | 16.7 | 28.6 | 45.2 | 61.9 | 73.8 | 98.8 |
| Residual ANC (%) | | | 99.9 | 99.5 | 99.2 | 98.8 | 98.4 | 98.1 | 97.5 |
| Residual Sulfur (%) | | | 100.0 | 99.6 | 99.3 | 99.0 | 98.6 | 98.3 | 97.7 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.1 | 1.0 | 1.2 | 0.9 | 1.1 | 1.1 | 1.2 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 13 - BRBY Fine Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.42 | ANC | 20.4 |
| pH (1:5) | 8.30 | Scr (%) | 0.165 | NAPP | -7.5 |
| EC (µS/cm) | 141 | MPA | 12.9 | ANC:MPA | 1.6 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898008 | EB2012205008 | EB2015249008 | EB2017807008 | EB2020923008 | EB2023744008 | EB2026635006 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.673 | 0.803 | 0.725 | 0.661 | 0.580 | 0.604 | 0.763 |
| Cum. Volume (L) | | | 0.67 | 1.48 | 2.20 | 2.86 | 3.44 | 4.05 | 4.81 |
| Pore Volumes | | | 0.5 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.64 | 8.06 | 8.17 | 7.31 | 7.41 | 6.93 | 7.27 |
| pH (ALS Measurement) | | | 7.30 | 7.34 | 7.26 | 6.52 | 7.22 | 7.11 | 7.02 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 94 | 265 | 195 | 289 | 305 | 381 | 285 |
| EC (ALS Measurement) (µS/cm) | | | 98 | 248 | 198 | 216 | 310 | 324 | 295 |
| Acidity (mg/L)* | | | 4 | 1 | <1 | 1 | 1 | 2 | 3 |
| Alkalinity (mg/L)* | | | 22 | 9 | 15 | 11 | 8 | 9 | 10 |
| Net Alkalinity (mg/L)* | | | 18 | 8 | 15 | 10 | 7 | 7 | 7 |
| | | | | | | | | | |
| **Major Ions (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 3 | 16 | 8 | 13 | 15 | 15 | 8 |
| Potassium (K) | 1 | - | <1 | 2 | 2 | 2 | 2 | 2 | 2 |
| Magnesium (Mg) | 1 | - | 3 | 12 | 8 | 12 | 16 | 16 | 16 |
| Sodium (Na) | 1 | - | 10 | 13 | 14 | 12 | 19 | 13 | 13 |
| Chloride (Cl) | 1 | - | 9 | 8 | 9 | 9 | 16 | 11 | 10 |
| Fluoride (F) | 0.1 | 2 | 0.2 | 0.4 | 0.4 | 0.3 | 0.4 | 0.4 | 0.3 |
| Sulfate ($SO_4$) | 1 | 1,000 | 11 | 94 | 64 | 81 | 102 | 120 | 100 |
| **Trace metals/ metalloids (mg/L)** | **LoR** | **WQ Guidelines#** | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | 0.01 | 0.02 | 0.12 | 0.06 | 0.02 | 0.01 | 0.01 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0003 | <0.0001 |
| Cobalt (Co) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Copper (Cu) | 0.001 | 1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 |
| Iron (Fe) | 0.05 | 1 | 0.06 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.002 | 0.002 | 0.002 | <0.001 | 0.002 | 0.002 | 0.002 |
| Manganese (Mn) | 0.001 | 2 | 0.015 | 0.009 | 0.012 | 0.014 | 0.013 | 0.014 | 0.012 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.004 | 0.014 | 0.012 | 0.007 | 0.013 | 0.010 | 0.011 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | <0.001 | 0.001 | <0.001 | 0.001 | 0.001 | 0.001 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | 0.01 | 0.03 | 0.02 | 0.02 |
| Strontium (Sr) | 0.01 | - | 0.063 | 0.314 | 0.156 | 0.179 | 0.26 | 0.269 | 0.179 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| | | | | | | | | | |
| **Calculations**** | | | | | | | | | |
| $SO_4$ Release Rate | | | 3.7 | 37.7 | 23.2 | 26.8 | 29.6 | 36.2 | 38.2 |
| Cumulative $SO_4$ Release | | | 3.7 | 41.4 | 64.6 | 91.4 | 121.0 | 157.2 | 195.4 |
| Ca Release Rate | | | 1.0 | 6.4 | 2.9 | 4.3 | 4.4 | 4.5 | 3.1 |
| Cumulative Ca Release | | | 1.0 | 7.4 | 10.3 | 14.6 | 19.0 | 23.5 | 26.6 |
| Mg Release Rate | | | 1.0 | 4.8 | 2.9 | 4.0 | 4.6 | 4.8 | 6.1 |
| Cumulative Mg Release | | | 1.0 | 5.8 | 8.7 | 12.7 | 17.3 | 22.2 | 28.3 |
| Residual ANC (%) | | | 100.0 | 99.8 | 99.7 | 99.6 | 99.4 | 99.3 | 99.1 |
| Residual Sulfur (%) | | | 100.0 | 99.8 | 99.7 | 99.6 | 99.5 | 99.3 | 99.2 |
| $SO_4$/(Ca+Mg) molar ratio | | | 0.6 | 1.1 | 1.3 | 1.0 | 1.0 | 1.2 | 1.2 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

Shaded cells exceed applied water quality guideline values.

## KLC 14 - BRBY Coarse Rejects

| | | | | | |
|---|---|---|---|---|---|
| Weight (kg) | 2.00 | Total S (%) | 0.24 | ANC | 33.1 |
| pH (1:5) | 7.80 | Scr (%) | 0.093 | NAPP | 25.8 |
| EC (µS/cm) | 98 | MPA | 7.4 | ANC:MPA | 4.5 |

| Date | | | 08-Apr-20 | 07-May-20 | 09-Jun-20 | 07-Jul-20 | 07-Aug-20 | 08-Sep-20 | 09-Oct-20 |
|---|---|---|---|---|---|---|---|---|---|
| Number of Weeks | | | 0 | 4 | 9 | 13 | 17 | 22 | 26 |
| Leach Number | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| ALS Laboratory Number | | | EB2009898009 | EB2012205009 | EB2015249009 | EB2017807009 | EB2020923009 | EB2023744009 | EB2026635007 |
| Volume On (L) | | | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Volume Off (L) | | | 0.934 | 0.557 | 0.595 | 0.620 | 0.671 | 0.681 | 0.663 |
| Cum. Volume (L) | | | 0.93 | 1.49 | 2.09 | 2.71 | 3.38 | 4.06 | 4.72 |
| Pore Volumes | | | 0.7 | 1.4 | 2.4 | 3.4 | 4.4 | 5.4 | 6.4 |
| pH (RGS Measurement) | | | 7.66 | 5.73 | 5.44 | 5.63 | 5.11 | 5.24 | 5.22 |
| pH (ALS Measurement) | | | 7.39 | 5.71 | 5.98 | 5.05 | 4.90 | 5.33 | 5.37 |
| pH (deionised water used in test) | | | 6.01 | 6.10 | 6.75 | 6.73 | 6.68 | 5.98 | 6.43 |
| EC (RGS Measurement) (µS/cm) | | | 538 | 406 | 462 | 491 | 619 | 595 | 699 |
| EC (ALS Measurement) (µS/cm) | | | 560 | 408 | 494 | 495 | 650 | 596 | 786 |
| Acidity (mg/L)* | | | 4 | 8 | 22 | 12 | 21 | 2 | 12 |
| Alkalinity (mg/L)* | | | 29 | 4 | 5 | 3 | 2 | <1 | 1 |
| Net Alkalinity (mg/L)* | | | 25 | -4 | -17 | -9 | -19 | -1 | -11 |
| | | | | | | | | | |
| Major Ions (mg/L) | LoR | WQ Guidelines# | | | | | | | |
| Calcium (Ca) | 1 | 1,000 | 14 | 20 | 29 | 33 | 47 | 43 | 50 |
| Potassium (K) | 1 | - | 3 | 4 | 3 | 3 | 3 | 3 | 3 |
| Magnesium (Mg) | 1 | - | 17 | 22 | 29 | 36 | 49 | 42 | 66 |
| Sodium (Na) | 1 | - | 64 | 23 | 15 | 10 | 10 | 7 | 9 |
| Chloride (Cl) | 1 | - | 35 | 4 | 3 | 2 | 2 | 2 | 2 |
| Fluoride (F) | 0.1 | 2 | 1.8 | 0.5 | 0.3 | 0.3 | 0.3 | 0.2 | 0.3 |
| Sulfate ($SO_4$) | 1 | 1,000 | 170 | 179 | 207 | 209 | 315 | 293 | 404 |
| Trace metals/ metalloids (mg/L) | LoR | WQ Guidelines# | | | | | | | |
| Aluminium (Al) | 0.01 | 5 | <0.01 | 0.01 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| Arsenic (As) | 0.001 | 0.5 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron (B) | 0.05 | 5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Cadmium (Cd) | 0.0001 | 0.01 | <0.0001 | 0.0002 | 0.0003 | 0.0002 | 0.0003 | 0.0002 | 0.0002 |
| Cobalt (Co) | 0.001 | 1 | <0.001 | 0.006 | 0.005 | 0.003 | 0.003 | 0.002 | 0.002 |
| Copper (Cu) | 0.001 | 1 | <0.001 | 0.001 | 0.005 | 0.004 | 0.005 | 0.004 | 0.003 |
| Iron (Fe) | 0.05 | 1 | <0.05 | 2.46 | 5.80 | 5.98 | 6.08 | 4.13 | 3.4 |
| Mercury (Hg) | 0.0001 | 0.02 | <0.0001 | <0.0001 | <0.0001 | - | - | - | - |
| Lithium (Li) | 0.001 | - | 0.01 | <0.01 | 0.007 | 0.005 | 0.007 | 0.007 | 0.007 |
| Manganese (Mn) | 0.001 | 2 | 0.018 | 0.382 | 0.548 | 0.497 | 0.582 | 0.432 | 0.46 |
| Molybdenum (Mo) | 0.001 | 0.15 | 0.037 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nickel (Ni) | 0.001 | 1 | <0.001 | 0.006 | 0.006 | 0.005 | 0.005 | 0.004 | 0.004 |
| Lead (Pb) | 0.001 | 0.1 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Antimony (Sb) | 0.001 | - | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Selenium (Se) | 0.01 | 0.02 | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 | 0.01 | 0.02 |
| Strontium (Sr) | 0.01 | - | 0.339 | 0.384 | 0.503 | 0.541 | 0.66 | 0.614 | 0.721 |
| Vanadium | 0.01 | - | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc (Zn) | 0.005 | 20 | <0.005 | 0.013 | 0.022 | 0.02 | 0.023 | 0.019 | 0.017 |
| | | | | | | | | | |
| Calculations** | | | | | | | | | |
| $SO_4$ Release Rate | | | 79.4 | 49.9 | 61.6 | 64.8 | 105.7 | 99.8 | 133.9 |
| Cumulative $SO_4$ Release | | | 79.4 | 129.2 | 190.8 | 255.6 | 361.3 | 461.1 | 595.0 |
| Ca Release Rate | | | 6.5 | 5.6 | 8.6 | 10.2 | 15.8 | 14.6 | 16.6 |
| Cumulative Ca Release | | | 6.5 | 12.1 | 20.7 | 31.0 | 46.7 | 61.4 | 78.0 |
| Mg Release Rate | | | 7.9 | 6.1 | 8.6 | 11.2 | 16.4 | 14.3 | 21.9 |
| Cumulative Mg Release | | | 7.9 | 14.1 | 22.7 | 33.9 | 50.3 | 64.6 | 86.5 |
| Residual ANC (%) | | | 99.8 | 99.6 | 99.3 | 98.9 | 98.4 | 97.9 | 97.3 |
| Residual Sulfur (%) | | | 99.7 | 99.4 | 99.2 | 98.9 | 98.4 | 98.0 | 97.4 |
| $SO_4$/(Ca+Mg) molar ratio | | | 1.7 | 1.3 | 1.1 | 0.9 | 1.0 | 1.1 | 1.1 |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

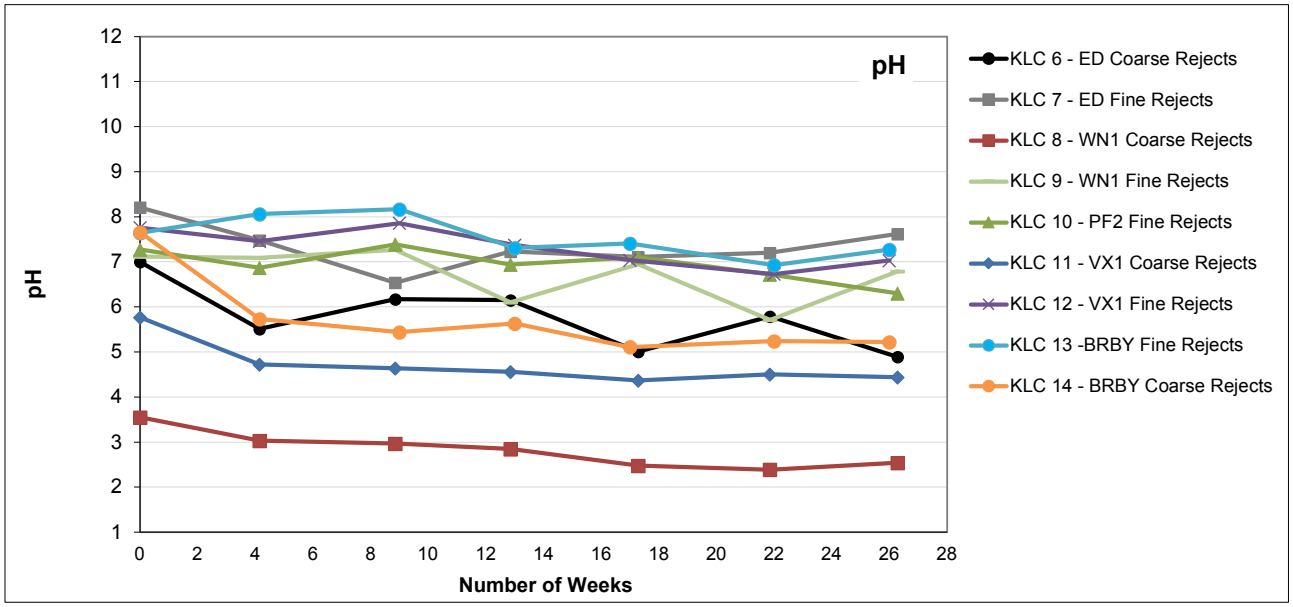
** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

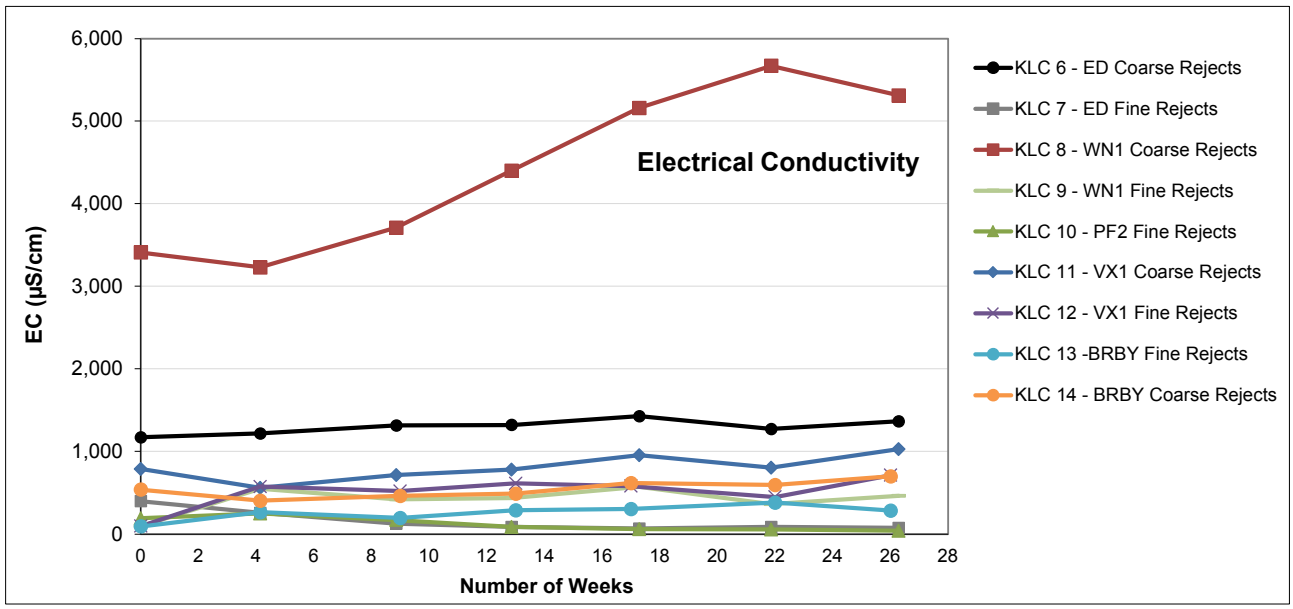
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

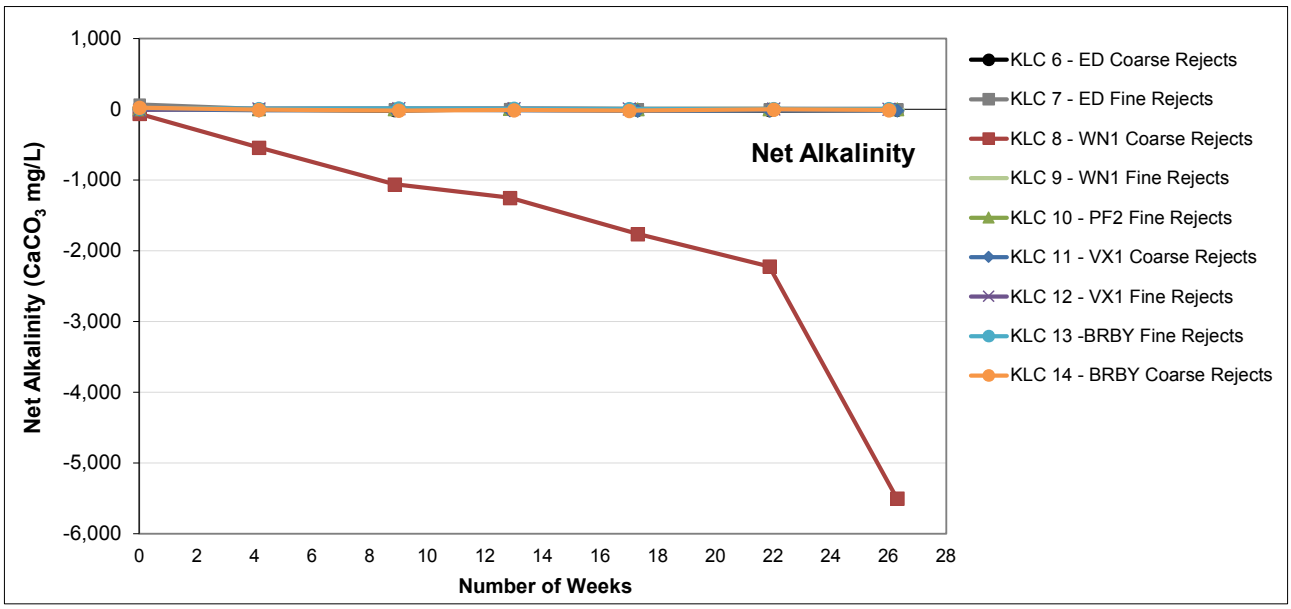
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

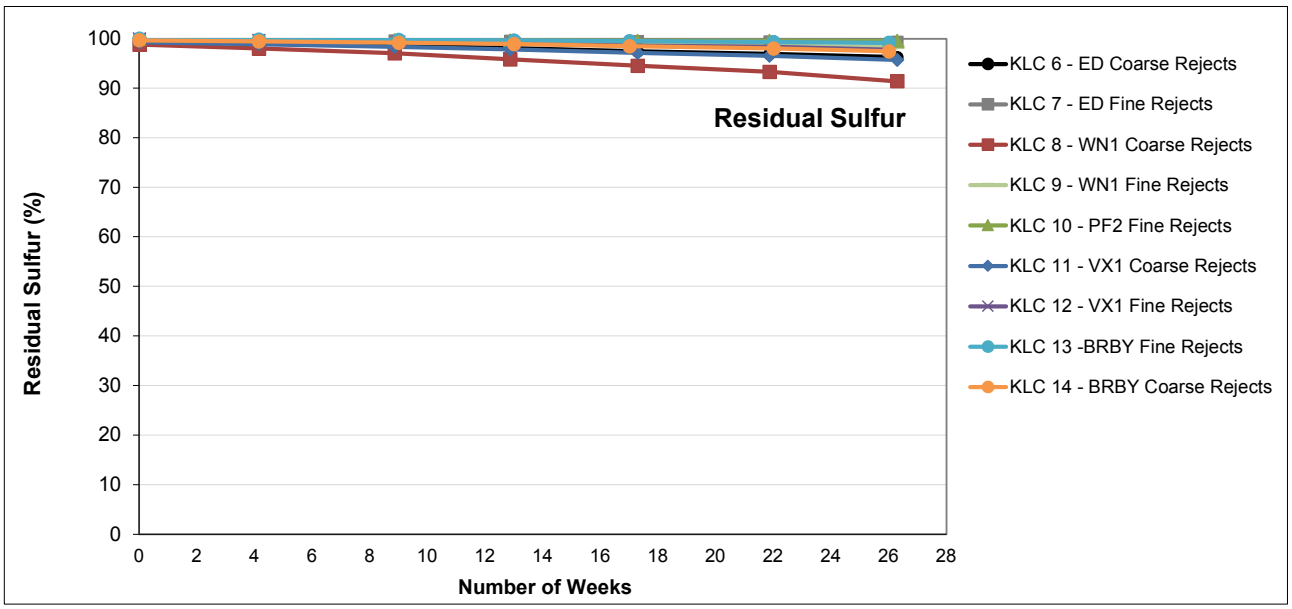
# ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand). Livestock Drinking Water Levels (Irrigation Levels used for Fe and Mn).

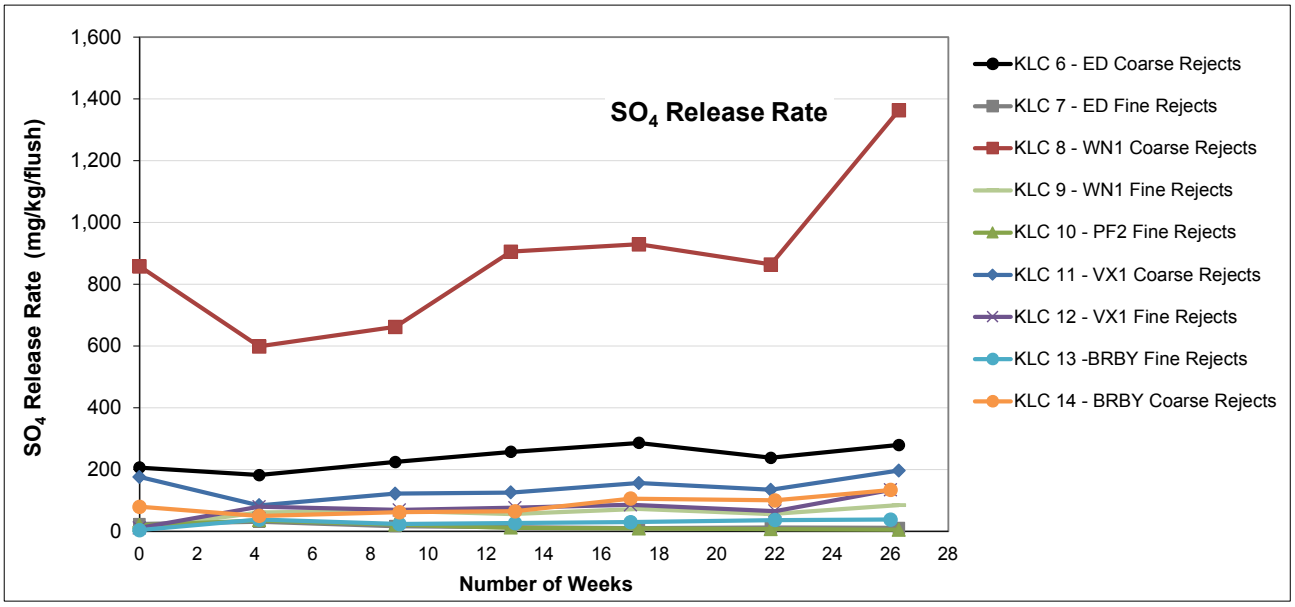
Shaded cells exceed applied water quality guideline values.

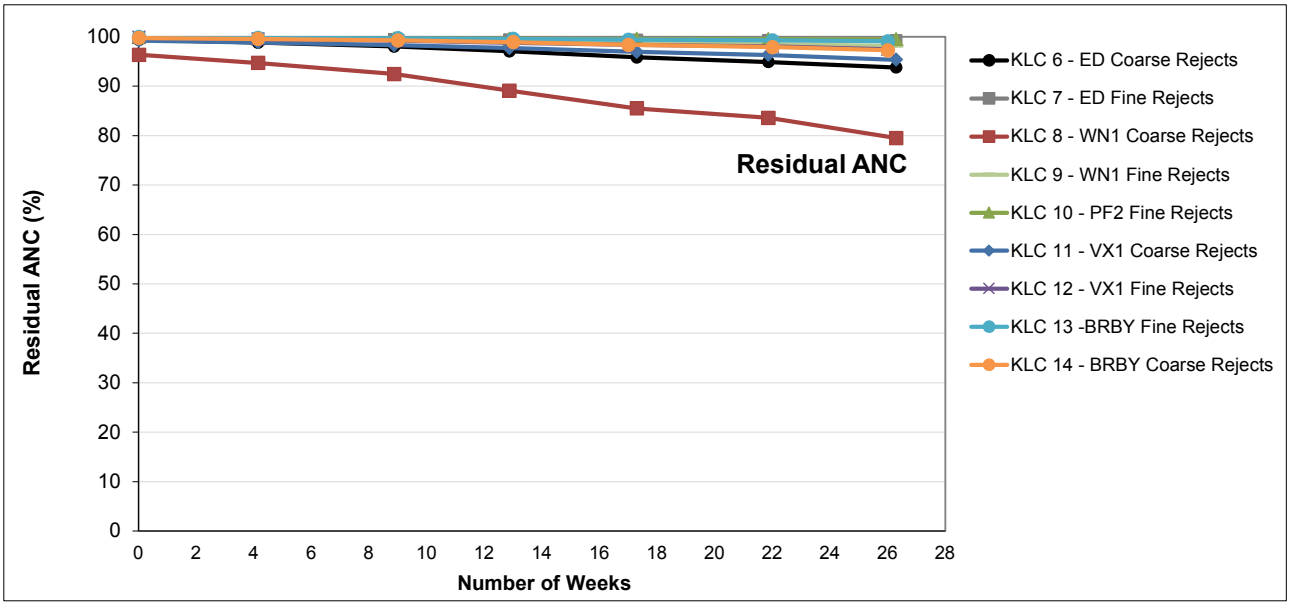

pH
pH
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

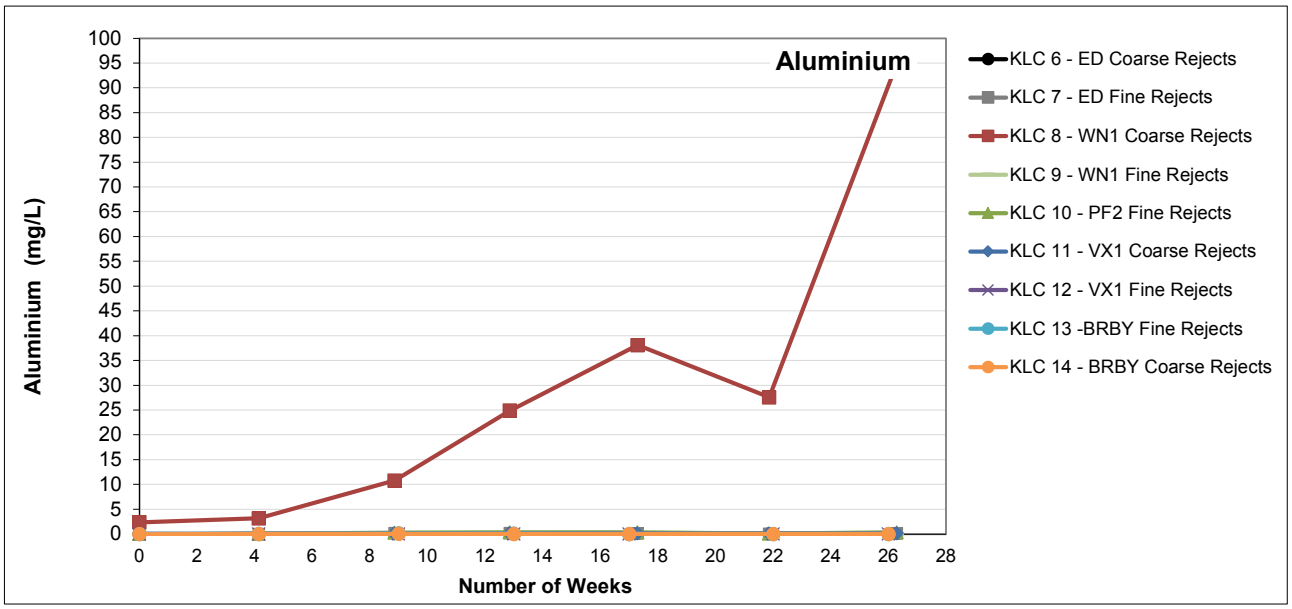

Electrical Conductivity
EC (µS/cm)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

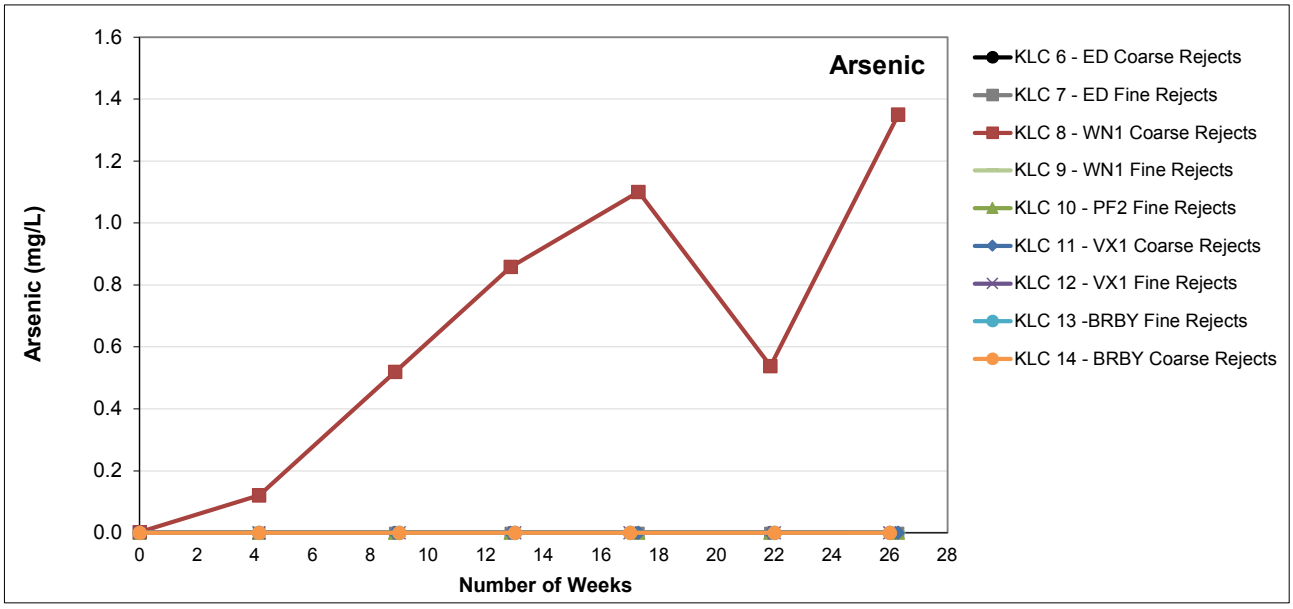

Net Alkalinity
Net Alkalinity (CaCO3 mg/L)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

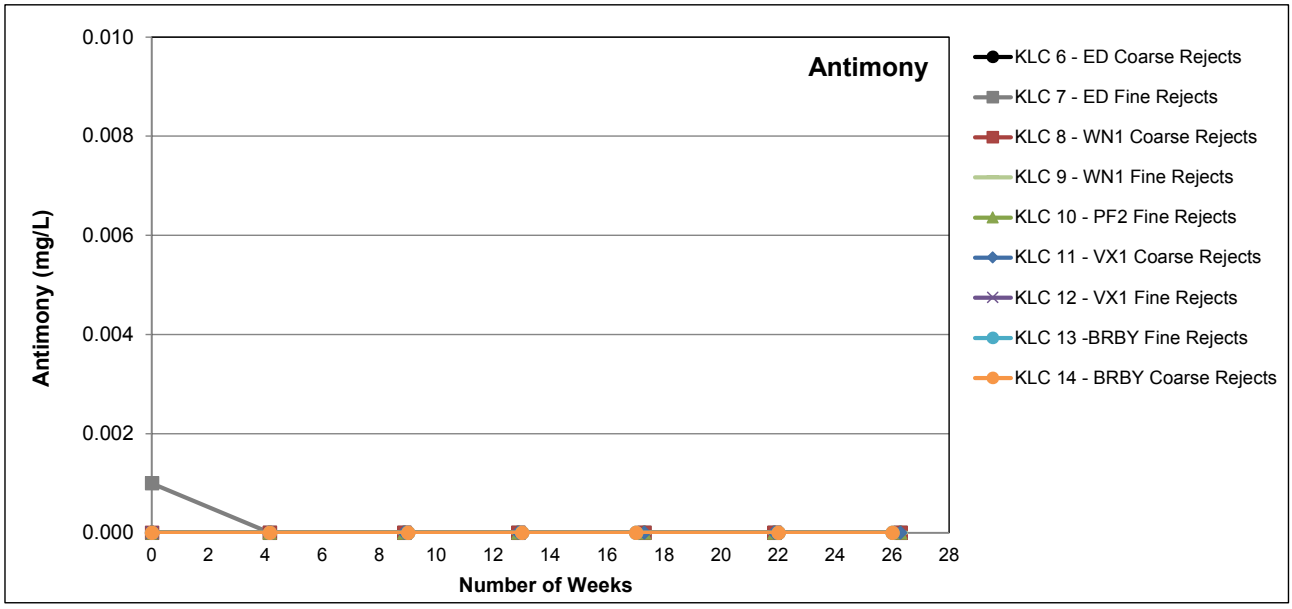

Residual Sulfur
Residual Sulfur (%)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

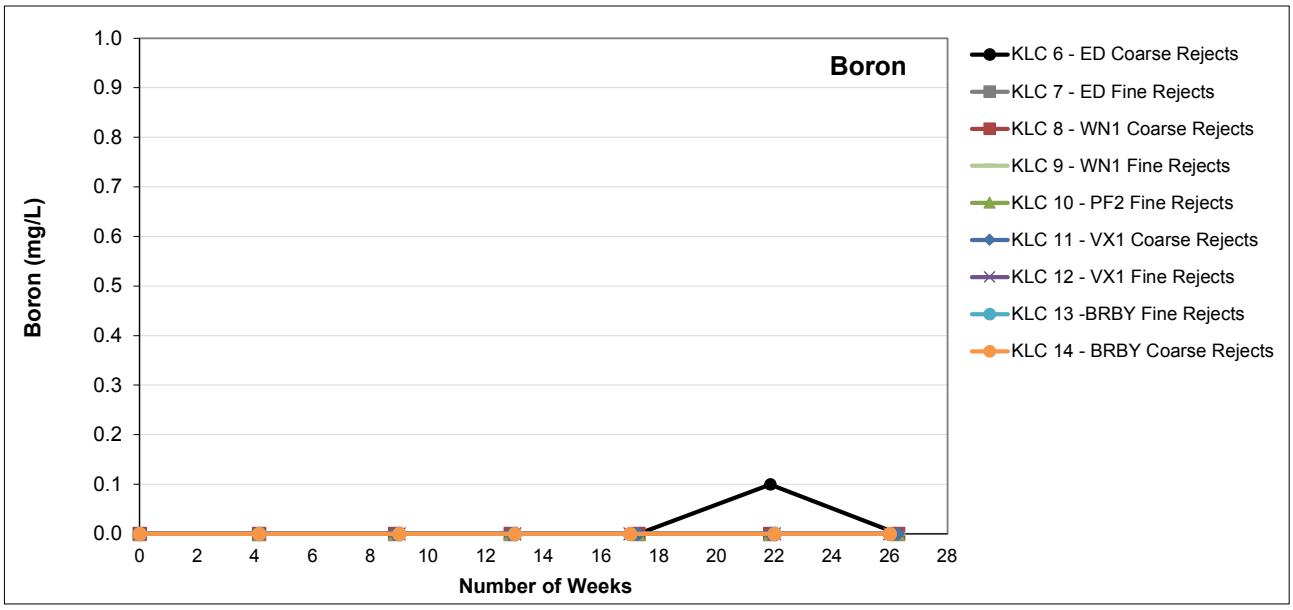

SO4 Release Rate
SO4 Release Rate (mg/kg/flush)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

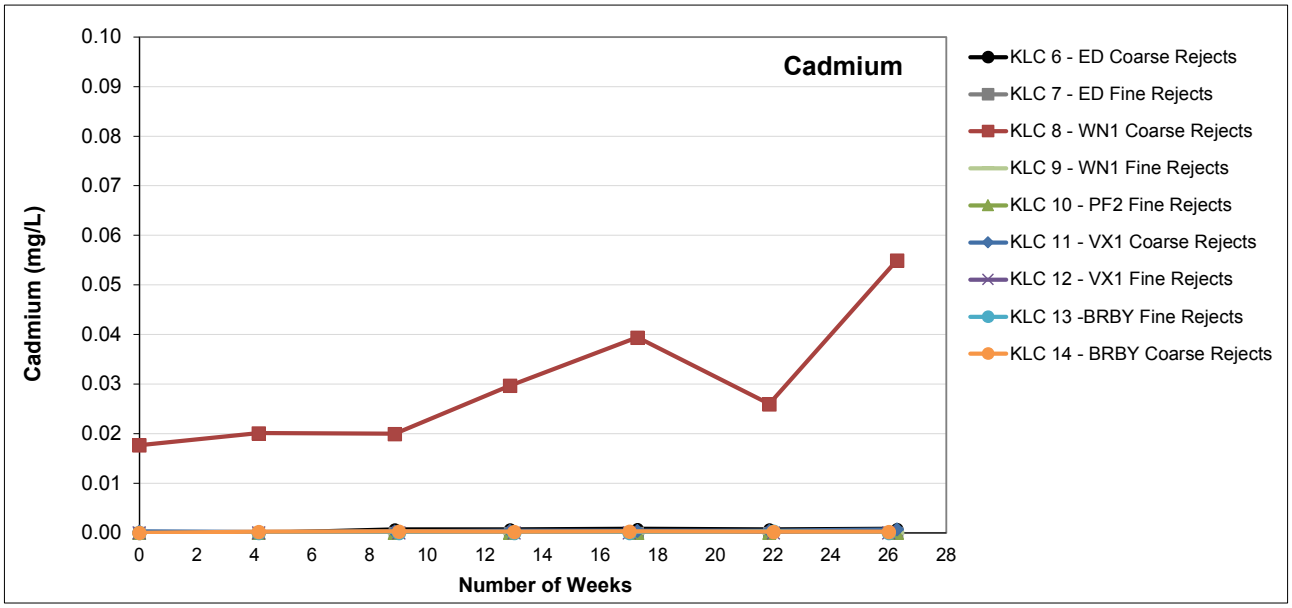

Residual ANC
Residual ANC (%)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

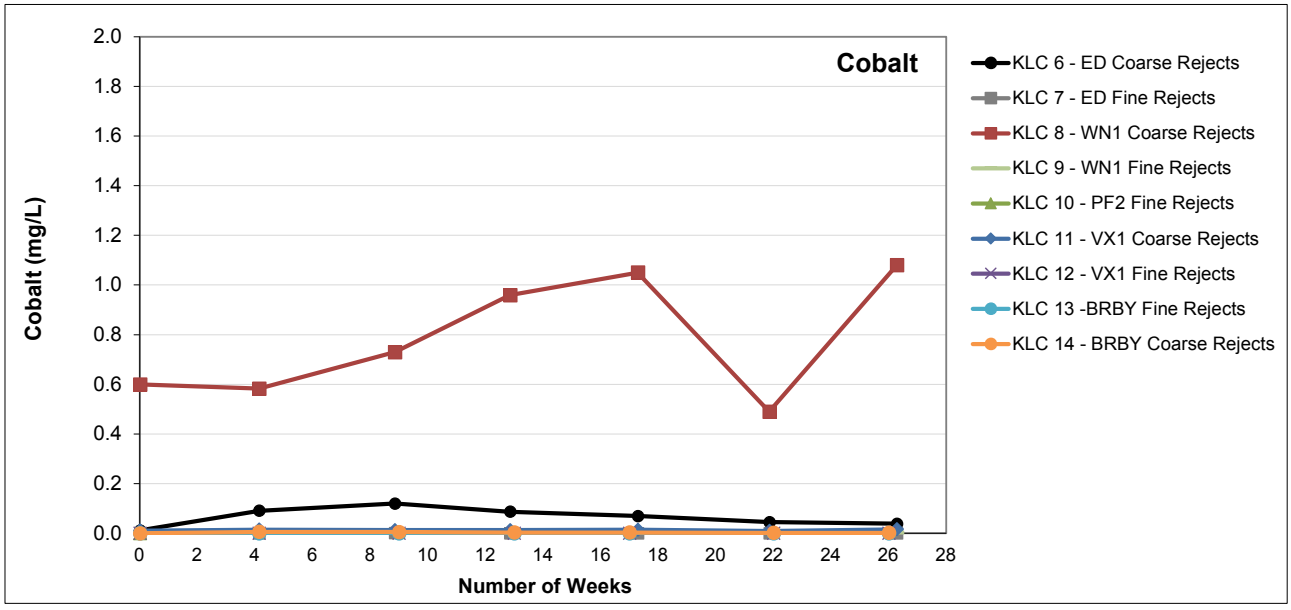

Aluminium
Aluminium (mg/L)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

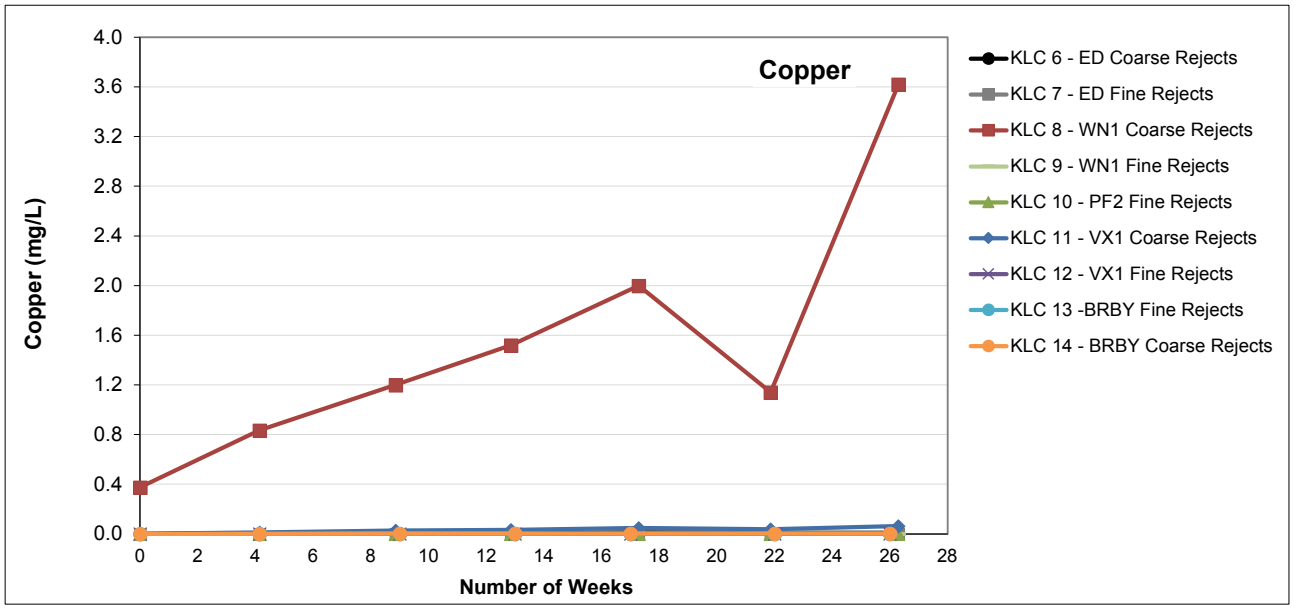

Arsenic
Arsenic (mg/L)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

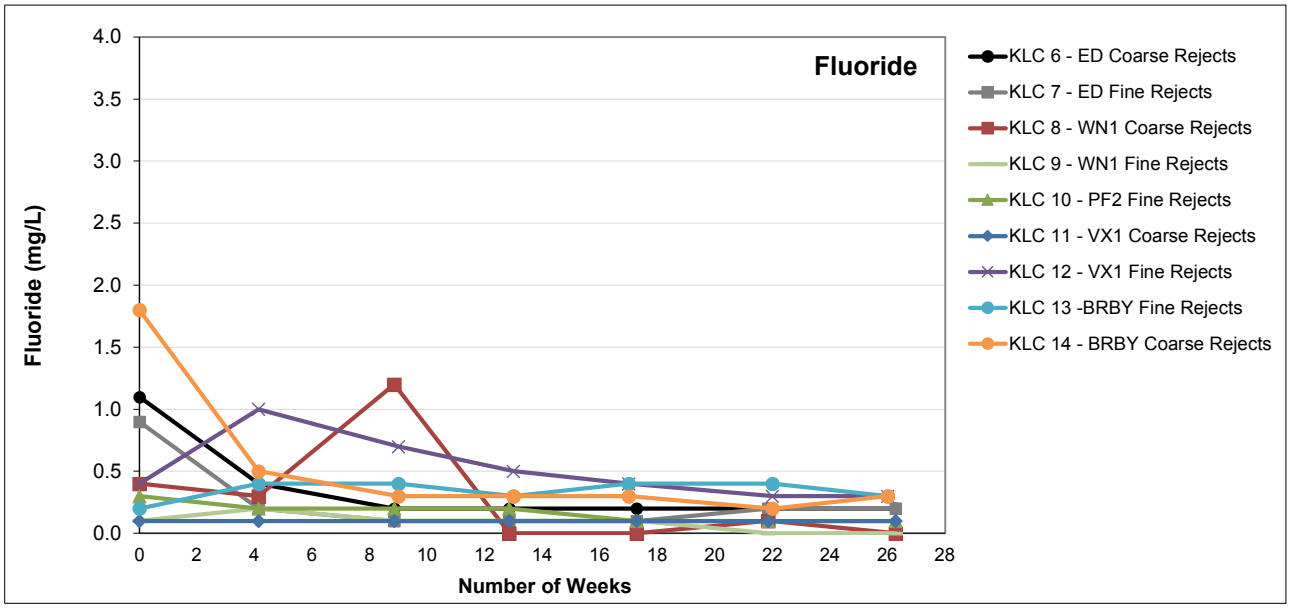

Antimony
Antimony (mg/L)
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

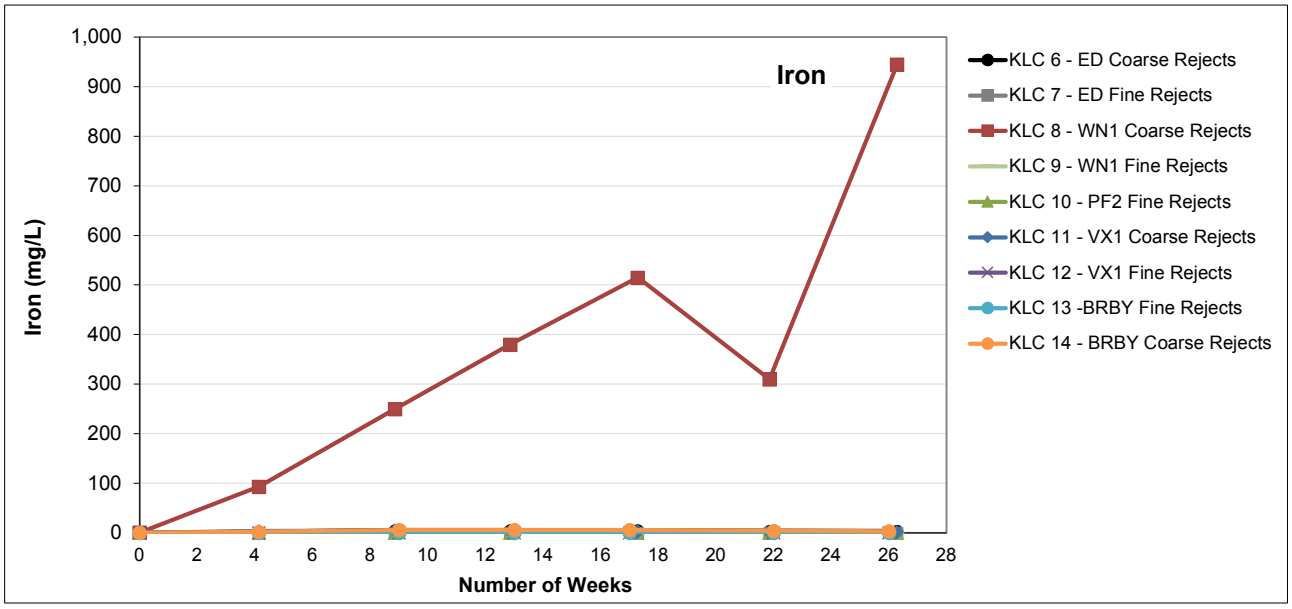

Boron
Boron (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

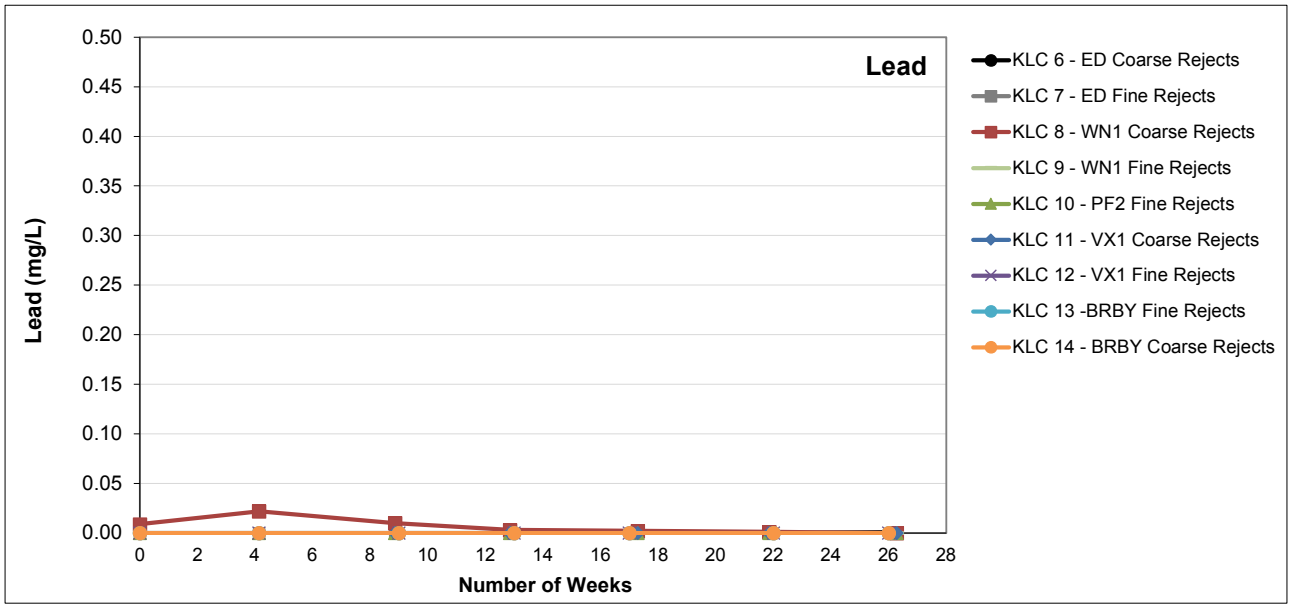

Cadmium
Cadmium (mg/L)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

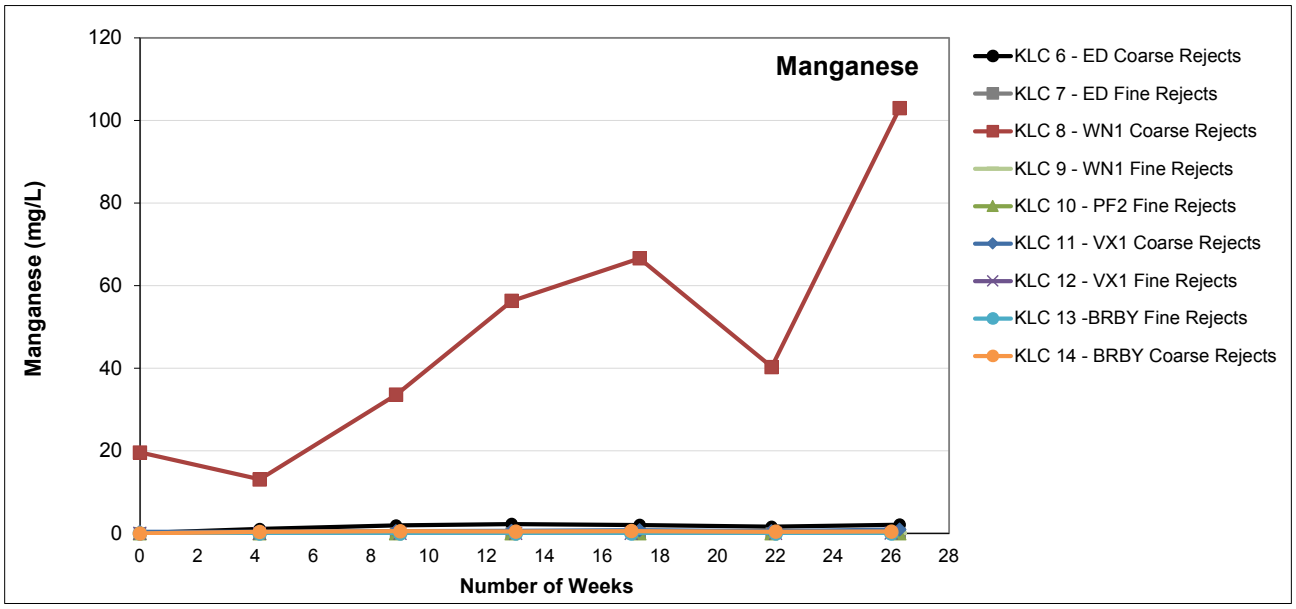

Cobalt
Cobalt (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

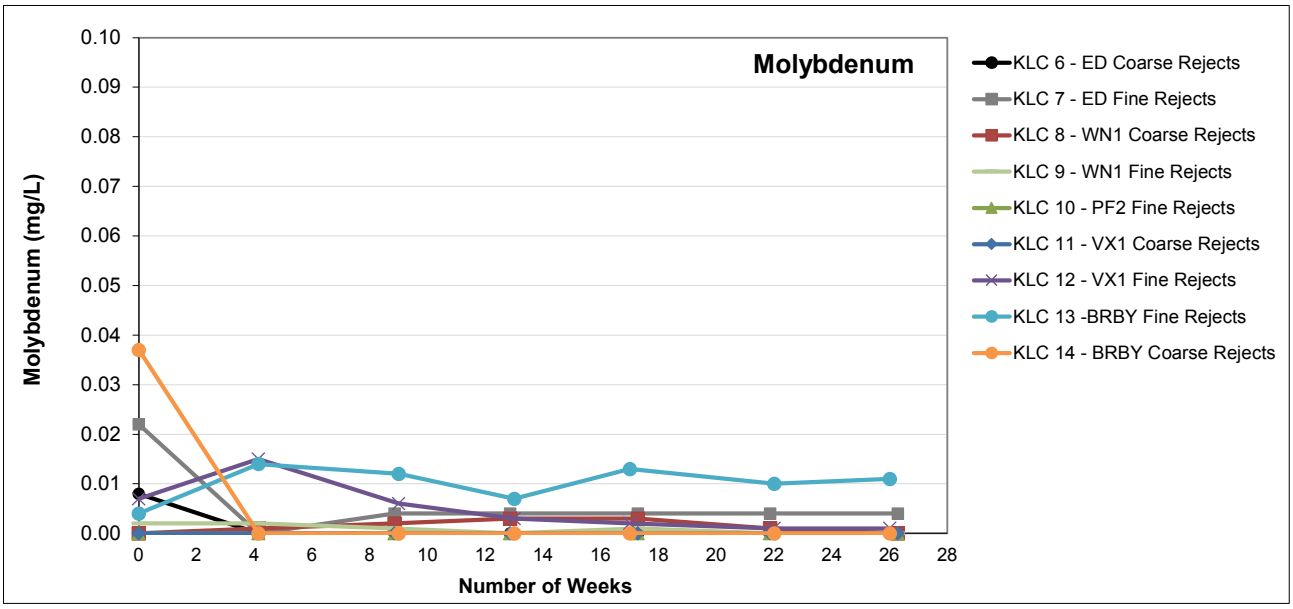

Copper
Copper (mg/L)
4.0
3.6
3.2
2.8
2.4
2.0
1.6
1.2
0.8
0.4
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

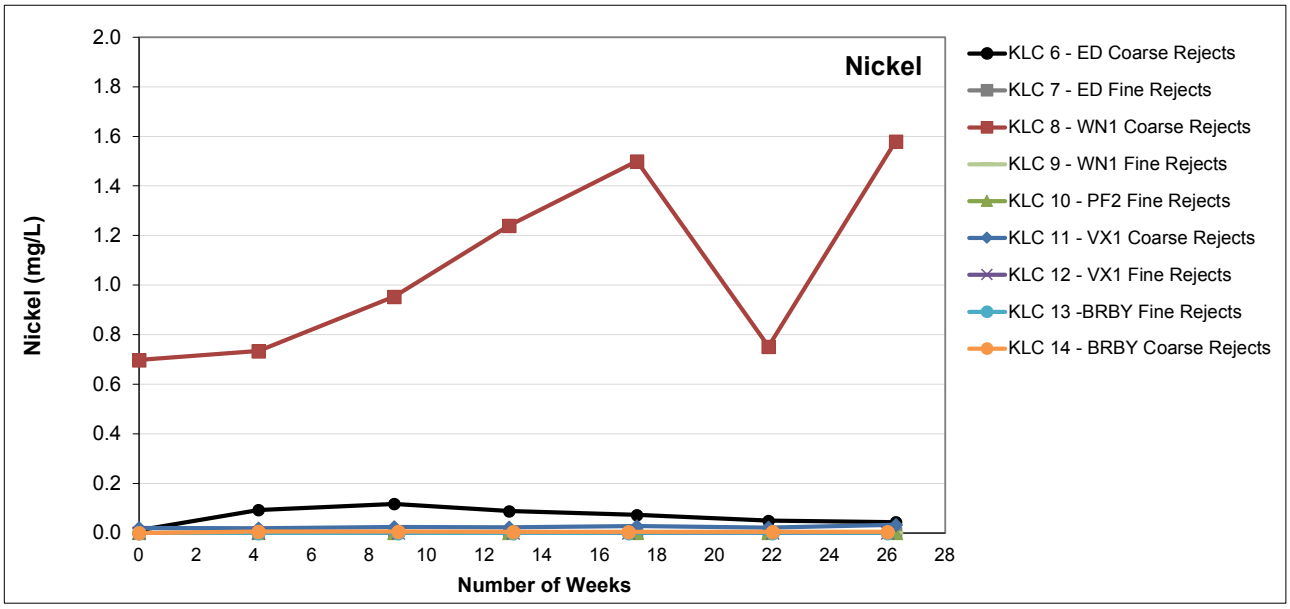

Fluoride
Fluoride (mg/L)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

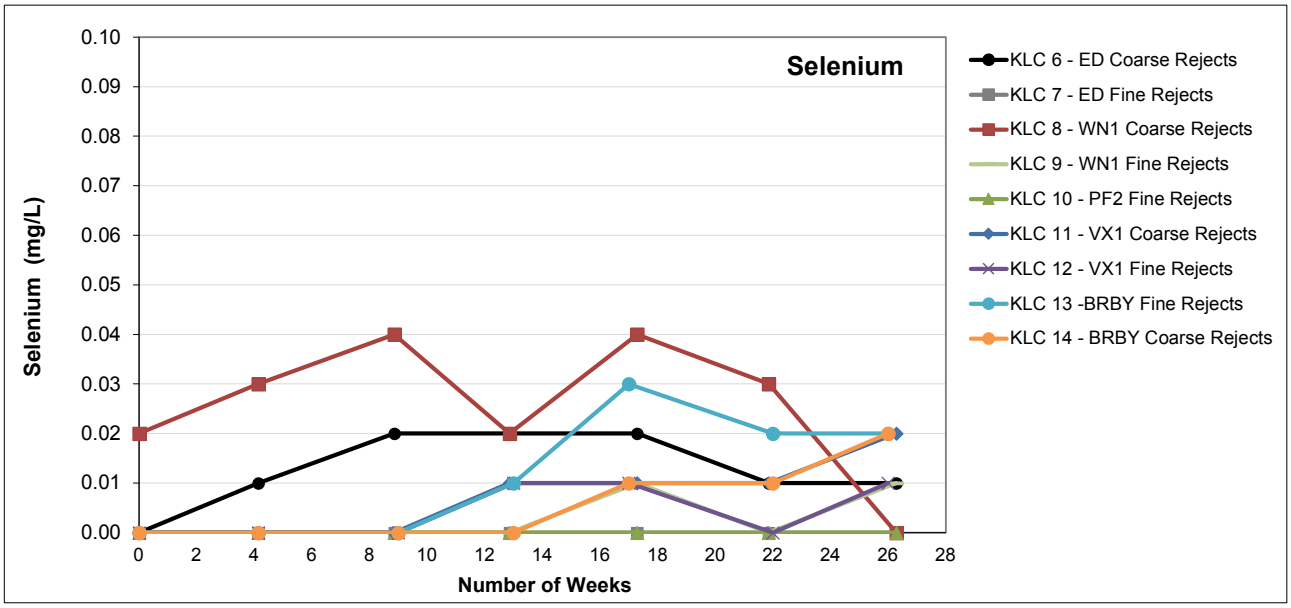

Iron
Iron (mg/L)
1,000
900
800
700
600
500
400
300
200
100
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

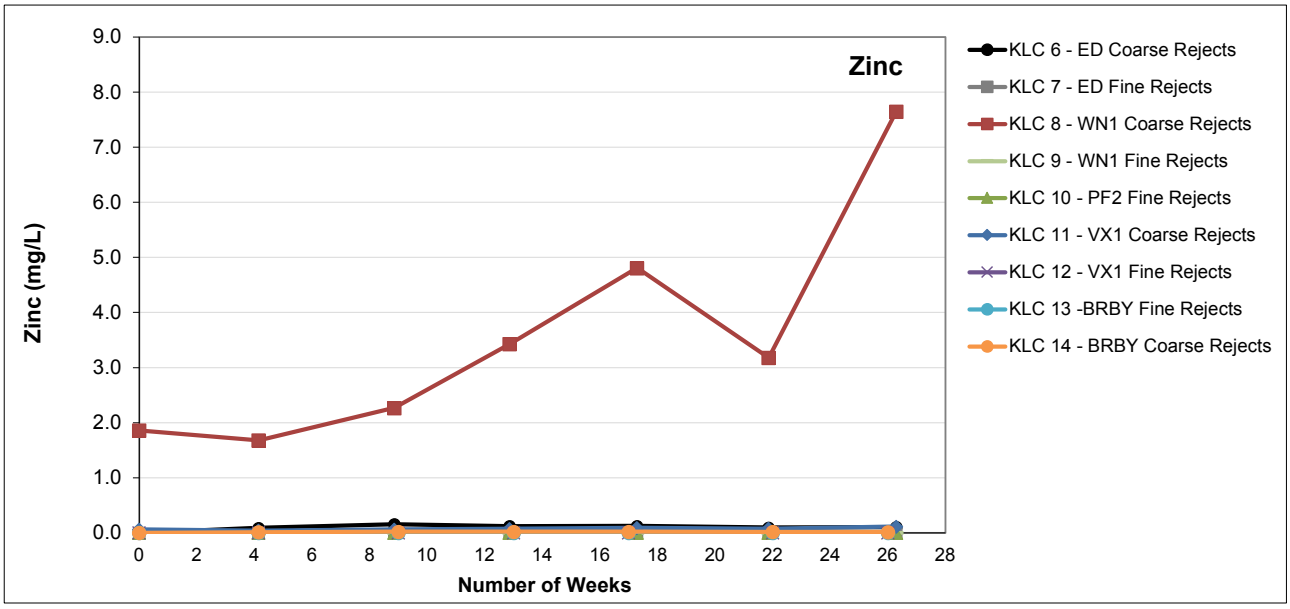

Lead
Lead (mg/L)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects


Manganese
Manganese (mg/L)
120
100
80
60
40
20
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects


Molybdenum
Molybdenum (mg/L)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects


Nickel
Nickel (mg/L)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects


Selenium
Selenium (mg/L)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects


Zinc
Zinc (mg/L)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Number of Weeks
KLC 6 - ED Coarse Rejects
KLC 7 - ED Fine Rejects
KLC 8 - WN1 Coarse Rejects
KLC 9 - WN1 Fine Rejects
KLC 10 - PF2 Fine Rejects
KLC 11 - VX1 Coarse Rejects
KLC 12 - VX1 Fine Rejects
KLC 13 -BRBY Fine Rejects
KLC 14 - BRBY Coarse Rejects

# Attachment D ALS and Trilab laboratory results (certificates of analysis)

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1831663** | Page | : 1 of 19 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 20-Dec-2018 11:30 |
| Order number | : | Date Analysis Commenced | : 15-Jan-2019 |
| C-O-C number | : ---- | Issue Date | : 22-Jan-2019 17:59 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 83 | | |
| No. of samples analysed | : 83 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Satishkumar Trivedi | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD001 | AMD002 | AMD003 | AMD004 | AMD005 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-001 | EB1831663-002 | EB1831663-003 | EB1831663-004 | EB1831663-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.6 | 9.0 | 7.2 | 8.3 | 4.3 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -43.8 | -52.2 | -0.4 | -45.3 | 64.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 478 | 255 | 349 | 597 | 3490 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 44.7 | 52.8 | 6.5 | 48.4 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 4.6 | 5.4 | 0.7 | 4.9 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 2 | 2 | 0 | 2 | 0 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.02 | 0.20 | 0.10 | 2.10 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD006 | AMD007 | AMD008 | AMD009 | AMD010 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-006 | EB1831663-007 | EB1831663-008 | EB1831663-009 | EB1831663-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **5.8** | **3.9** | **9.0** | **8.0** | **6.9** |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **44.9** | **100** | **-287** | **-19.3** | **1.9** |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **2630** | **2230** | **251** | **228** | **751** |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **4.7** | <0.5 | **289** | **20.8** | **5.4** |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **0.5** | <0.1 | **29.5** | **2.1** | **0.6** |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **0** | **0** | **3** | **1** | **1** |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | **1.62** | **3.27** | **0.06** | **0.05** | **0.24** |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD011 | AMD012 | AMD013 | AMD014 | AMD015 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-011 | EB1831663-012 | EB1831663-013 | EB1831663-014 | EB1831663-015 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.7 | 8.8 | 8.7 | 8.8 | 8.3 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -3.7 | -14.7 | -13.3 | -48.6 | -43.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 204 | 208 | 484 | 430 | 444 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 4.9 | 15.3 | 13.9 | 49.2 | 44.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.5 | 1.6 | 1.4 | 5.0 | 4.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 1 | 1 | 2 | 2 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.04 | 0.02 | 0.02 | 0.02 | 0.05 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD016 | AMD017 | AMD018 | AMD019 | AMD020 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-016 | EB1831663-017 | EB1831663-018 | EB1831663-019 | EB1831663-020 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.7 | 7.6 | 4.1 | 3.9 | 4.5 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -104 | -6.3 | 95.8 | 64.3 | 74.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 337 | 156 | 3970 | 2760 | 3630 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 105 | 6.9 | <0.5 | <0.5 | <0.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 10.7 | 0.7 | <0.1 | <0.1 | <0.1 |
| Fizz Rating | ---- | 0 | Fizz Unit | 2 | 1 | 0 | 0 | 0 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.04 | 0.02 | 3.13 | 2.10 | 2.43 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD023 | AMD024 | AMD025 | AMD026 | AMD027 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-021 | EB1831663-022 | EB1831663-023 | EB1831663-024 | EB1831663-025 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.7 | 8.7 | 8.9 | 8.7 | 8.4 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -106 | -18.2 | -307 | -29.2 | -19.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 317 | 330 | 237 | 447 | 366 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 108 | 19.4 | 308 | 29.8 | 20.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 11.1 | 2.0 | 31.4 | 3.0 | 2.0 |
| Fizz Rating | ---- | 0 | Fizz Unit | 3 | 1 | 4 | 1 | 1 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.06 | 0.04 | 0.04 | 0.02 | 0.02 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD028 | AMD029 | AMD030 | AMD035 | AMD036 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-026 | EB1831663-027 | EB1831663-028 | EB1831663-029 | EB1831663-030 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **8.6** | **8.9** | **8.9** | **8.4** | **8.1** |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **-48.0** | **-47.7** | **-61.0** | **-20.4** | **-11.3** |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **321** | **283** | **255** | **174** | **155** |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **48.6** | **48.3** | **61.6** | **20.4** | **12.5** |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **5.0** | **4.9** | **6.3** | **2.1** | **1.3** |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **2** | **2** | **2** | **1** | **1** |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | **0.02** | **0.02** | **0.02** | <0.01 | **0.04** |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD037 | AMD038 | AMD039 | AMD040 | AMD043 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-031 | EB1831663-032 | EB1831663-033 | EB1831663-034 | EB1831663-035 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.1 | 7.7 | 8.6 | 8.8 | 8.5 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -21.7 | -8.1 | -78.1 | -68.9 | -11.9 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 174 | 206 | 279 | 295 | 106 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 22.6 | 12.4 | 79.0 | 69.5 | 12.8 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 2.3 | 1.3 | 8.1 | 7.1 | 1.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 1 | 2 | 2 | 1 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.14 | 0.03 | 0.02 | 0.03 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD044 | AMD046 | AMD047 | AMD048 | AMD050 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-036 | EB1831663-037 | EB1831663-038 | EB1831663-039 | EB1831663-040 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 9.0 | 8.6 | 8.4 | 8.4 | 9.0 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -85.5 | -12.8 | -10.8 | -16.3 | -50.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 302 | 87 | 92 | 134 | 322 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 86.1 | 13.4 | 10.8 | 17.2 | 51.6 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 8.8 | 1.4 | 1.1 | 1.8 | 5.3 |
| Fizz Rating | ---- | 0 | Fizz Unit | 2 | 1 | 1 | 1 | 2 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.02 | 0.02 | <0.01 | 0.03 | 0.03 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD052 | AMD053 | AMD054 | AMD056 | AMD057 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-041 | EB1831663-042 | EB1831663-043 | EB1831663-044 | EB1831663-045 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **7.9** | **6.1** | **7.8** | **4.7** | **3.4** |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **-6.2** | **-0.4** | **-17.5** | **50.2** | **102** |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **138** | **484** | **2810** | **2060** | **2540** |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **8.6** | **2.5** | **43.2** | <0.5 | <0.5 |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **0.9** | **0.2** | **4.4** | <0.1 | <0.1 |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **0** | **0** | **2** | **0** | **0** |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | **0.08** | **0.07** | **0.84** | **1.64** | **3.34** |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD058 | AMD059 | AMD060 | AMD061 | AMD062 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-046 | EB1831663-047 | EB1831663-048 | EB1831663-049 | EB1831663-050 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.9 | 8.7 | 8.6 | 8.5 | 7.1 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | 85.4 | -82.7 | -8.1 | -42.5 | -12.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 2130 | 482 | 352 | 405 | 487 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 24.5 | 102 | 14.2 | 49.2 | 21.7 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 2.5 | 10.4 | 1.4 | 5.0 | 2.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 3 | 1 | 2 | 1 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 3.59 | 0.63 | 0.20 | 0.22 | 0.29 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD063 | AMD064 | AMD065 | AMD069 | AMD070 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-051 | EB1831663-052 | EB1831663-053 | EB1831663-054 | EB1831663-055 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.4 | 8.8 | 7.9 | 7.9 | 7.9 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -49.5 | -79.9 | -36.7 | -18.3 | -5.3 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 634 | 567 | 590 | 164 | 121 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 50.4 | 80.5 | 37.6 | 19.2 | 6.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 5.1 | 8.2 | 3.8 | 2.0 | 0.6 |
| Fizz Rating | ---- | 0 | Fizz Unit | 2 | 2 | 2 | 1 | 0 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD071 | AMD072 | AMD073 | AMD074 | AMD075 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-056 | EB1831663-057 | EB1831663-058 | EB1831663-059 | EB1831663-060 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.7 | 8.8 | 8.2 | 7.8 | 8.4 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -15.0 | -32.6 | -23.0 | -7.9 | -27.0 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 171 | 205 | 124 | 144 | 218 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 18.1 | 33.2 | 23.9 | 9.1 | 28.2 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 1.8 | 3.4 | 2.4 | 0.9 | 2.9 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 2 | 1 | 0 | 1 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.10 | 0.02 | 0.03 | 0.04 | 0.04 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD076 | AMD077 | AMD079 | AMD080 | AMD081 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-061 | EB1831663-062 | EB1831663-063 | EB1831663-064 | EB1831663-065 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.6 | 7.6 | 8.0 | 8.5 | 8.7 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -10.2 | -3.8 | -17.5 | -9.4 | -92.5 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 184 | 123 | 173 | 236 | 346 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 12.0 | 8.1 | 20.9 | 11.2 | 93.4 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 1.2 | 0.8 | 2.1 | 1.1 | 9.5 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 0 | 1 | 1 | 2 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.06 | 0.14 | 0.11 | 0.06 | 0.03 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD082 | AMD083 | AMD084 | AMD085 | AMD086 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-066 | EB1831663-067 | EB1831663-068 | EB1831663-069 | EB1831663-070 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 8.9 | 7.5 | 8.2 | 8.5 | 5.9 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | -77.2 | -7.2 | -9.4 | -64.5 | 39.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 350 | 167 | 94 | 663 | 2350 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 78.1 | 11.5 | 10.0 | 68.8 | 6.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 8.0 | 1.2 | 1.0 | 7.0 | 0.6 |
| Fizz Rating | ---- | 0 | Fizz Unit | 2 | 1 | 1 | 2 | 0 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.03 | 0.14 | 0.02 | 0.14 | 1.49 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD087 | AMD088 | AMD089 | AMD090 | AMD091 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-071 | EB1831663-072 | EB1831663-073 | EB1831663-074 | EB1831663-075 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 4.5 | 5.5 | 7.4 | 8.6 | 7.9 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | 91.9 | 13.6 | -12.7 | -12.0 | -0.8 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 2480 | 501 | 331 | 294 | 109 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 5.4 | 2.3 | 16.1 | 13.5 | 4.5 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.6 | 0.2 | 1.6 | 1.4 | 0.4 |
| Fizz Rating | ---- | 0 | Fizz Unit | 0 | 0 | 1 | 1 | 0 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 3.18 | 0.52 | 0.11 | 0.05 | 0.12 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD092 | AMD093 | AMD094 | AMD095 | AMD096 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1831663-076 | EB1831663-077 | EB1831663-078 | EB1831663-079 | EB1831663-080 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 6.8 | 8.0 | 8.4 | 9.0 | 7.1 |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| Net Acid Production Potential | ---- | 0.5 | kg H2SO4/t | 8.2 | -2.2 | -21.7 | -79.9 | 9.4 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 506 | 184 | 133 | 305 | 170 |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| ANC as H2SO4 | ---- | 0.5 | kg H2SO4 equiv./t | 7.4 | 5.9 | 23.2 | 80.8 | 12.0 |
| ANC as CaCO3 | ---- | 0.1 | % CaCO3 | 0.8 | 0.6 | 2.4 | 8.2 | 1.2 |
| Fizz Rating | ---- | 0 | Fizz Unit | 1 | 0 | 1 | 2 | 1 |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| Sulfur - Total as S (LECO) | ---- | 0.01 | % | 0.51 | 0.12 | 0.05 | 0.03 | 0.70 |

## Analytical Results

| Sub-Matrix: SOLID (Matrix: SOIL) | | | Client sample ID | AMD042 | AMD049 | AMD068 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB1831663-081 | EB1831663-082 | EB1831663-083 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **8.4** | **8.6** | **8.9** | **----** | **----** |
| **EA009: Nett Acid Production Potential** | | | | | | | | |
| **Net Acid Production Potential** | ---- | 0.5 | kg H2SO4/t | **-13.7** | **-20.5** | **-169** | **----** | **----** |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **110** | **148** | **247** | **----** | **----** |
| **EA013: Acid Neutralising Capacity** | | | | | | | | |
| **ANC as H2SO4** | ---- | 0.5 | kg H2SO4 equiv./t | **15.2** | **21.7** | **171** | **----** | **----** |
| **ANC as CaCO3** | ---- | 0.1 | % CaCO3 | **1.6** | **2.2** | **17.4** | **----** | **----** |
| **Fizz Rating** | ---- | 0 | Fizz Unit | **1** | **1** | **3** | **----** | **----** |
| **ED042T: Total Sulfur by LECO** | | | | | | | | |
| **Sulfur - Total as S (LECO)** | ---- | 0.01 | % | **0.05** | **0.04** | **0.05** | **----** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1905293** | Page | : 1 of 17 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MS AMANDA CLEMENTS | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : ---- | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 28-Feb-2019 17:14 |
| Order number | : | Date Analysis Commenced | : 04-Mar-2019 |
| C-O-C number | : ---- | Issue Date | : 18-Mar-2019 08:51 |
| Sampler | : LAURA JACKSON | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 38 | | |
| No. of samples analysed | : 38 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Merrin Avery | Supervisor - Inorganic | Newcastle - Inorganics, Mayfield West, NSW |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Calcium/Magnesium Ratio for sample EB1905293-034 (Composite 6 as the required results for Calcium/Magnesium are below LOR.
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio for sample EB1905293-034 (Composite 6) as the required results for Magnesium/Potassium are below LOR.
- ED037 (Alkalinity): NATA accreditation does not cover the performance of this service.
- ED038 (Acidity): NATA accreditation does not cover the performance of this service.
- EA031 (Saturated Paste pH): NATA accreditation does not cover the performance of this service.
- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | AMD003 | AMD005 | AMD006 | AMD007 | AMD018 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1905293-001 | EB1905293-002 | EB1905293-003 | EB1905293-004 | EB1905293-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | **0.072** | **0.896** | **0.879** | **1.71** | **1.50** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | AMD019 | AMD020 | AMD054 | AMD056 | AMD085 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1905293-006 | EB1905293-007 | EB1905293-008 | EB1905293-009 | EB1905293-010 |
| | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | **1.07** | **1.17** | **0.360** | **0.866** | **0.106** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | AMD086 | AMD087 | AMD061 | AMD089 | AMD091 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-011 | EB1905293-012 | EB1905293-013 | EB1905293-014 | EB1905293-015 |
| | | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | | **0.807** | **1.57** | **0.128** | **0.048** | **0.023** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | AMD096 | AMD010 | AMD092 | AMD093 | AMD038 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-016 | EB1905293-017 | EB1905293-018 | EB1905293-019 | EB1905293-020 |
| | | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | | **0.057** | **0.146** | **0.385** | **0.073** | **0.077** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | AMD077 | AMD079 | AMD083 | AMD057 | AMD058 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1905293-021 | EB1905293-022 | EB1905293-023 | EB1905293-024 | EB1905293-025 |
| | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | **0.064** | **0.063** | **0.110** | **1.58** | **2.57** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | AMD059 | AMD060 | AMD088 | Composite 1 | Composite 2 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1905293-026 | EB1905293-027 | EB1905293-028 | EB1905293-029 | EB1905293-030 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | ---- | ---- | ---- | 7.4 | 8.7 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | ---- | ---- | ---- | 1270 | 379 |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | |
| Chromium Reducible Sulphur | ---- | 0.005 | % | 0.493 | 0.140 | 0.254 | ---- | ---- |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | ---- | ---- | ---- | 6.9 | 7.8 |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | ---- | ---- | ---- | 2660 | 1140 |
| **EA033-A: Actual Acidity** | | | | | | | | |
| pH KCl (23A) | ---- | 0.1 | pH Unit | ---- | ---- | ---- | 8.1 | 9.0 |
| Titratable Actual Acidity (23F) | ---- | 2 | mole H+ / t | ---- | ---- | ---- | <2 | <2 |
| sulfidic - Titratable Actual Acidity (s-23F) | ---- | 0.02 | % pyrite S | ---- | ---- | ---- | <0.02 | <0.02 |
| **EA033-B: Potential Acidity** | | | | | | | | |
| Chromium Reducible Sulfur (22B) | ---- | 0.005 | % S | ---- | ---- | ---- | 0.365 | 0.016 |
| acidity - Chromium Reducible Sulfur (a-22B) | ---- | 10 | mole H+ / t | ---- | ---- | ---- | 228 | <10 |
| **EA033-C: Acid Neutralising Capacity** | | | | | | | | |
| Acid Neutralising Capacity (19A2) | ---- | 0.01 | % CaCO3 | ---- | ---- | ---- | 3.85 | 3.26 |
| acidity - Acid Neutralising Capacity (a-19A2) | ---- | 10 | mole H+ / t | ---- | ---- | ---- | 770 | 651 |
| sulfidic - Acid Neutralising Capacity (s-19A2) | ---- | 0.01 | % pyrite S | ---- | ---- | ---- | 1.23 | 1.04 |
| **EA033-E: Acid Base Accounting** | | | | | | | | |
| ANC Fineness Factor | ---- | 0.5 | - | ---- | ---- | ---- | 1.5 | 1.5 |
| Net Acidity (sulfur units) | ---- | 0.02 | % S | ---- | ---- | ---- | <0.02 | <0.02 |
| Net Acidity (acidity units) | ---- | 10 | mole H+ / t | ---- | ---- | ---- | <10 | <10 |
| Liming Rate | ---- | 1 | kg CaCO3/t | ---- | ---- | ---- | <1 | <1 |
| Net Acidity excluding ANC (sulfur units) | ---- | 0.02 | % S | ---- | ---- | ---- | 0.36 | <0.02 |
| Net Acidity excluding ANC (acidity units) | ---- | 10 | mole H+ / t | ---- | ---- | ---- | 228 | <10 |
| Liming Rate excluding ANC | ---- | 1 | kg CaCO3/t | ---- | ---- | ---- | 17 | <1 |
| **ED006: Exchangeable Cations on Alkaline Soils** | | | | | | | | |
| ø Exchangeable Calcium | ---- | 0.2 | meq/100g | ---- | ---- | ---- | 5.4 | 3.7 |
| ø Exchangeable Magnesium | ---- | 0.2 | meq/100g | ---- | ---- | ---- | 5.9 | 3.3 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | AMD059 | AMD060 | AMD088 | Composite 1 | Composite 2 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-026 | EB1905293-027 | EB1905293-028 | EB1905293-029 | EB1905293-030 |
| | | | | | Result | Result | Result | Result | Result |
| **ED006: Exchangeable Cations on Alkaline Soils - Continued** | | | | | | | | | |
| ø Exchangeable Potassium | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | 1.1 | 1.8 |
| ø Exchangeable Sodium | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | 0.8 | 1.0 |
| ø Cation Exchange Capacity | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | 13.2 | 9.8 |
| ø Exchangeable Sodium Percent | ---- | 0.2 | % | | ---- | ---- | ---- | 6.0 | 10.1 |
| ø Calcium/Magnesium Ratio | ---- | 0.2 | - | | ---- | ---- | ---- | 0.9 | 1.1 |
| ø Magnesium/Potassium Ratio | ---- | 0.2 | - | | ---- | ---- | ---- | 5.5 | 1.9 |
| **ED037: Alkalinity** | | | | | | | | | |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/kg | | ---- | ---- | ---- | 14400 | 9110 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/kg | | ---- | ---- | ---- | 14400 | 9110 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/kg | | ---- | ---- | ---- | <5 | <5 |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity | ---- | 1 | mg/kg | | ---- | ---- | ---- | 474 | 20 |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | | ---- | ---- | ---- | 3650 | 160 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | | ---- | ---- | ---- | 120 | 230 |
| **ED093S: Soluble Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | | ---- | ---- | ---- | 690 | 50 |
| Magnesium | 7439-95-4 | 10 | mg/kg | | ---- | ---- | ---- | 470 | 30 |
| Sodium | 7440-23-5 | 10 | mg/kg | | ---- | ---- | ---- | 200 | 230 |
| Potassium | 7440-09-7 | 10 | mg/kg | | ---- | ---- | ---- | 90 | 80 |
| **ED093T: Total Major Cations** | | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | | ---- | ---- | ---- | 380 | 470 |
| Potassium | 7440-09-7 | 50 | mg/kg | | ---- | ---- | ---- | 1380 | 1600 |
| Calcium | 7440-70-2 | 50 | mg/kg | | ---- | ---- | ---- | 10200 | 5240 |
| Magnesium | 7439-95-4 | 50 | mg/kg | | ---- | ---- | ---- | 4640 | 2960 |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | | |
| Aluminium | 7429-90-5 | 1 | mg/kg | | ---- | ---- | ---- | <1 | <1 |
| Antimony | 7440-36-0 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| Arsenic | 7440-38-2 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| Boron | 7440-42-8 | 1 | mg/kg | | ---- | ---- | ---- | <1 | <1 |
| Cadmium | 7440-43-9 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| Chromium | 7440-47-3 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| Cobalt | 7440-48-4 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | AMD059 | AMD060 | AMD088 | Composite 1 | Composite 2 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-026 | EB1905293-027 | EB1905293-028 | EB1905293-029 | EB1905293-030 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)S : Soluble Metals by ICPAES - Continued** | | | | | | | | | |
| **Copper** | 7440-50-8 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| **Iron** | 7439-89-6 | 1 | mg/kg | | ---- | ---- | ---- | <1 | <1 |
| **Manganese** | 7439-96-5 | 0.1 | mg/kg | | ---- | ---- | ---- | **6.8** | <0.1 |
| **Molybdenum** | 7439-98-7 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| **Nickel** | 7440-02-0 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| **Selenium** | 7782-49-2 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| **Zinc** | 7440-66-6 | 0.1 | mg/kg | | ---- | ---- | ---- | <0.1 | <0.1 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 50 | mg/kg | | ---- | ---- | ---- | **5100** | **6880** |
| **Antimony** | 7440-36-0 | 5 | mg/kg | | ---- | ---- | ---- | <5 | <5 |
| **Arsenic** | 7440-38-2 | 5 | mg/kg | | ---- | ---- | ---- | **7** | **7** |
| **Boron** | 7440-42-8 | 50 | mg/kg | | ---- | ---- | ---- | <50 | <50 |
| **Cadmium** | 7440-43-9 | 1 | mg/kg | | ---- | ---- | ---- | <1 | <1 |
| **Chromium** | 7440-47-3 | 2 | mg/kg | | ---- | ---- | ---- | **6** | **7** |
| **Cobalt** | 7440-48-4 | 2 | mg/kg | | ---- | ---- | ---- | **10** | **10** |
| **Copper** | 7440-50-8 | 5 | mg/kg | | ---- | ---- | ---- | **16** | **23** |
| **Iron** | 7439-89-6 | 50 | mg/kg | | ---- | ---- | ---- | **18100** | **28000** |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | ---- | ---- | ---- | **230** | **416** |
| **Molybdenum** | 7439-98-7 | 2 | mg/kg | | ---- | ---- | ---- | <2 | <2 |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | ---- | ---- | ---- | **15** | **13** |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | ---- | ---- | ---- | <5 | <5 |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | ---- | ---- | ---- | **90** | **81** |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | | |
| **Uranium** | 7440-61-1 | 0.01 | mg/kg | | ---- | ---- | ---- | <0.01 | <0.01 |
| **Thorium** | 7440-29-1 | 0.01 | mg/kg | | ---- | ---- | ---- | <0.01 | <0.01 |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | | ---- | ---- | ---- | **4.8** | **3.4** |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | | ---- | ---- | ---- | **0.6** | **0.8** |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | ---- | ---- | ---- | **2** | **7** |
| **EK040T: Fluoride Total** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 40 | mg/kg | | ---- | ---- | ---- | **170** | **210** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | Composite 3 | Composite 4 | Composite 5 | Composite 6 | Composite 7 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | EB1905293-031 | EB1905293-032 | EB1905293-033 | EB1905293-034 | EB1905293-035 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 5.9 | ---- | ---- | 7.5 | 7.6 |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 2060 | ---- | ---- | 1230 | 1030 |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | 6.0 | 7.7 | 7.8 | 6.8 | 7.0 |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | 3100 | 720 | 803 | 2810 | 2660 |
| **EA033-A: Actual Acidity** | | | | | | | | |
| pH KCl (23A) | ---- | 0.1 | pH Unit | 7.0 | 8.9 | 8.7 | 7.9 | 8.4 |
| Titratable Actual Acidity (23F) | ---- | 2 | mole H+ / t | <2 | <2 | <2 | <2 | <2 |
| sulfidic - Titratable Actual Acidity (s-23F) | ---- | 0.02 | % pyrite S | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| **EA033-B: Potential Acidity** | | | | | | | | |
| Chromium Reducible Sulfur (22B) | ---- | 0.005 | % S | 0.713 | 0.012 | 0.021 | 0.194 | 0.459 |
| acidity - Chromium Reducible Sulfur (a-22B) | ---- | 10 | mole H+ / t | 444 | <10 | 13 | 121 | 286 |
| **EA033-C: Acid Neutralising Capacity** | | | | | | | | |
| Acid Neutralising Capacity (19A2) | ---- | 0.01 | % CaCO3 | 1.72 | 6.68 | 5.62 | 1.87 | 3.88 |
| acidity - Acid Neutralising Capacity (a-19A2) | ---- | 10 | mole H+ / t | 344 | 1330 | 1120 | 374 | 774 |
| sulfidic - Acid Neutralising Capacity (s-19A2) | ---- | 0.01 | % pyrite S | 0.55 | 2.14 | 1.80 | 0.60 | 1.24 |
| **EA033-E: Acid Base Accounting** | | | | | | | | |
| ANC Fineness Factor | ---- | 0.5 | - | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Net Acidity (sulfur units) | ---- | 0.02 | % S | 0.34 | <0.02 | <0.02 | <0.02 | <0.02 |
| Net Acidity (acidity units) | ---- | 10 | mole H+ / t | 215 | <10 | <10 | <10 | <10 |
| Liming Rate | ---- | 1 | kg CaCO3/t | 16 | <1 | <1 | <1 | <1 |
| Net Acidity excluding ANC (sulfur units) | ---- | 0.02 | % S | 0.71 | <0.02 | 0.02 | 0.19 | 0.46 |
| Net Acidity excluding ANC (acidity units) | ---- | 10 | mole H+ / t | 444 | <10 | 13 | 121 | 286 |
| Liming Rate excluding ANC | ---- | 1 | kg CaCO3/t | 33 | <1 | 1 | 9 | 21 |
| **ED005: Exchange Acidity** | | | | | | | | |
| ø Exchange Acidity | ---- | 0.1 | meq/100g | 0.4 | ---- | ---- | ---- | ---- |
| ø Exchangeable Aluminium | ---- | 0.1 | meq/100g | <0.1 | ---- | ---- | ---- | ---- |
| **ED006: Exchangeable Cations on Alkaline Soils** | | | | | | | | |
| ø Exchangeable Calcium | ---- | 0.2 | meq/100g | ---- | ---- | ---- | <0.2 | 6.6 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | Composite 3 | Composite 4 | Composite 5 | Composite 6 | Composite 7 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-031 | EB1905293-032 | EB1905293-033 | EB1905293-034 | EB1905293-035 |
| | | | | | Result | Result | Result | Result | Result |
| **ED006: Exchangeable Cations on Alkaline Soils - Continued** | | | | | | | | | |
| ø Exchangeable Magnesium | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | <0.2 | **5.9** |
| ø Exchangeable Potassium | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | <0.2 | **1.4** |
| ø Exchangeable Sodium | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | <0.2 | **1.1** |
| ø Cation Exchange Capacity | ---- | 0.2 | meq/100g | | ---- | ---- | ---- | <0.2 | **15.1** |
| ø Exchangeable Sodium Percent | ---- | 0.2 | % | | ---- | ---- | ---- | ---- | **7.5** |
| ø Calcium/Magnesium Ratio | ---- | 0.2 | - | | ---- | ---- | ---- | ---- | **1.1** |
| ø Magnesium/Potassium Ratio | ---- | 0.2 | - | | ---- | ---- | ---- | ---- | **4.2** |
| **ED008: Exchangeable Cations** | | | | | | | | | |
| Exchangeable Calcium | ---- | 0.1 | meq/100g | | **8.6** | ---- | ---- | ---- | ---- |
| Exchangeable Magnesium | ---- | 0.1 | meq/100g | | **3.8** | ---- | ---- | ---- | ---- |
| Exchangeable Potassium | ---- | 0.1 | meq/100g | | **0.4** | ---- | ---- | ---- | ---- |
| Exchangeable Sodium | ---- | 0.1 | meq/100g | | <0.1 | ---- | ---- | ---- | ---- |
| Cation Exchange Capacity | ---- | 0.1 | meq/100g | | **13.2** | ---- | ---- | ---- | ---- |
| Exchangeable Sodium Percent | ---- | 0.1 | % | | **0.5** | ---- | ---- | ---- | ---- |
| Calcium/Magnesium Ratio | ---- | 0.1 | - | | **2.3** | ---- | ---- | ---- | ---- |
| Magnesium/Potassium Ratio | ---- | 0.1 | - | | **10.6** | ---- | ---- | ---- | ---- |
| **ED037: Alkalinity** | | | | | | | | | |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/kg | | **4840** | **22300** | **10100** | **4790** | **12200** |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/kg | | **4840** | **22300** | **10100** | **4790** | **12200** |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity | ---- | 1 | mg/kg | | **838** | <5 | <5 | **318** | **202** |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | | **7090** | **100** | **160** | **3530** | **2130** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | | **40** | **110** | **40** | **50** | **210** |
| **ED093S: Soluble Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | | **1460** | **40** | **20** | **660** | **450** |
| Magnesium | 7439-95-4 | 10 | mg/kg | | **930** | **40** | **30** | **360** | **270** |
| Sodium | 7440-23-5 | 10 | mg/kg | | **50** | **250** | **240** | **340** | **280** |
| Potassium | 7440-09-7 | 10 | mg/kg | | **20** | **70** | **50** | **140** | **110** |
| **ED093T: Total Major Cations** | | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | | **270** | **630** | **610** | **590** | **530** |
| Potassium | 7440-09-7 | 50 | mg/kg | | **1680** | **1680** | **1620** | **1610** | **1550** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | Composite 3 | Composite 4 | Composite 5 | Composite 6 | Composite 7 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-031 | EB1905293-032 | EB1905293-033 | EB1905293-034 | EB1905293-035 |
| | | | | | Result | Result | Result | Result | Result |
| **ED093T: Total Major Cations - Continued** | | | | | | | | | |
| Calcium | 7440-70-2 | 50 | mg/kg | | 7250 | 16100 | 9270 | 4930 | 8880 |
| Magnesium | 7439-95-4 | 50 | mg/kg | | 3300 | 7470 | 6200 | 2930 | 4660 |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | | |
| Aluminium | 7429-90-5 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |
| Antimony | 7440-36-0 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Arsenic | 7440-38-2 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Boron | 7440-42-8 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |
| Cadmium | 7440-43-9 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium | 7440-47-3 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cobalt | 7440-48-4 | 0.1 | mg/kg | | 1.2 | <0.1 | <0.1 | <0.1 | <0.1 |
| Copper | 7440-50-8 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Iron | 7439-89-6 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |
| Manganese | 7439-96-5 | 0.1 | mg/kg | | 121 | <0.1 | <0.1 | 3.4 | 0.5 |
| Molybdenum | 7439-98-7 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Nickel | 7440-02-0 | 0.1 | mg/kg | | 1.8 | <0.1 | <0.1 | <0.1 | <0.1 |
| Selenium | 7782-49-2 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | 0.1 | 0.1 |
| Zinc | 7440-66-6 | 0.1 | mg/kg | | 0.6 | <0.1 | <0.1 | <0.1 | <0.1 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | | 4710 | 7840 | 6970 | 5530 | 7000 |
| Antimony | 7440-36-0 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| Arsenic | 7440-38-2 | 5 | mg/kg | | 15 | 7 | 6 | 6 | 8 |
| Boron | 7440-42-8 | 50 | mg/kg | | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | | 6 | 8 | 8 | 5 | 6 |
| Cobalt | 7440-48-4 | 2 | mg/kg | | 10 | 9 | 12 | 9 | 11 |
| Copper | 7440-50-8 | 5 | mg/kg | | 17 | 21 | 30 | 25 | 23 |
| Iron | 7439-89-6 | 50 | mg/kg | | 24900 | 29800 | 34500 | 19200 | 30900 |
| Manganese | 7439-96-5 | 5 | mg/kg | | 356 | 432 | 543 | 285 | 276 |
| Molybdenum | 7439-98-7 | 2 | mg/kg | | <2 | <2 | <2 | <2 | <2 |
| Nickel | 7440-02-0 | 2 | mg/kg | | 12 | 11 | 14 | 11 | 20 |
| Selenium | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | <5 | <5 |
| Zinc | 7440-66-6 | 5 | mg/kg | | 76 | 86 | 87 | 80 | 87 |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | | |
| Uranium | 7440-61-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | 0.01 |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | Composite 3 | Composite 4 | Composite 5 | Composite 6 | Composite 7 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1905293-031 | EB1905293-032 | EB1905293-033 | EB1905293-034 | EB1905293-035 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020S: Soluble Metals by ICPMS - Continued** | | | | | | | | | |
| Thorium | 7440-29-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| Thorium | 7440-29-1 | 0.1 | mg/kg | | **3.9** | **6.0** | **5.7** | **5.2** | **5.5** |
| Uranium | 7440-61-1 | 0.1 | mg/kg | | **0.6** | **1.1** | **0.7** | **0.7** | **0.9** |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| Fluoride | 16984-48-8 | 1 | mg/kg | | <1 | **13** | **8** | **2** | **3** |
| **EK040T: Fluoride Total** | | | | | | | | | |
| Fluoride | 16984-48-8 | 40 | mg/kg | | **190** | **220** | **230** | **190** | **200** |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | Client sample ID | Composite 8 | Composite 9 | Composite 10 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB1905293-036 | EB1905293-037 | EB1905293-038 | -------- | -------- |
| | | | | Result | Result | Result | ---- | ---- |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| pH Value | ---- | 0.1 | pH Unit | 7.8 | 8.0 | ---- | ---- | ---- |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 768 | 286 | ---- | ---- | ---- |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | 7.1 | 7.2 | 7.9 | ---- | ---- |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | 1990 | 967 | 756 | ---- | ---- |
| **EA033-A: Actual Acidity** | | | | | | | | |
| pH KCl (23A) | ---- | 0.1 | pH Unit | 8.2 | 6.8 | 8.7 | ---- | ---- |
| Titratable Actual Acidity (23F) | ---- | 2 | mole H+ / t | <2 | <2 | <2 | ---- | ---- |
| sulfidic - Titratable Actual Acidity (s-23F) | ---- | 0.02 | % pyrite S | <0.02 | <0.02 | <0.02 | ---- | ---- |
| **EA033-B: Potential Acidity** | | | | | | | | |
| Chromium Reducible Sulfur (22B) | ---- | 0.005 | % S | 0.233 | 0.118 | 0.033 | ---- | ---- |
| acidity - Chromium Reducible Sulfur (a-22B) | ---- | 10 | mole H+ / t | 145 | 74 | 20 | ---- | ---- |
| **EA033-C: Acid Neutralising Capacity** | | | | | | | | |
| Acid Neutralising Capacity (19A2) | ---- | 0.01 | % CaCO3 | 2.98 | 1.31 | 6.54 | ---- | ---- |
| acidity - Acid Neutralising Capacity (a-19A2) | ---- | 10 | mole H+ / t | 595 | 262 | 1310 | ---- | ---- |
| sulfidic - Acid Neutralising Capacity (s-19A2) | ---- | 0.01 | % pyrite S | 0.95 | 0.42 | 2.10 | ---- | ---- |
| **EA033-E: Acid Base Accounting** | | | | | | | | |
| ANC Fineness Factor | ---- | 0.5 | - | 1.5 | 1.5 | 1.5 | ---- | ---- |
| Net Acidity (sulfur units) | ---- | 0.02 | % S | <0.02 | <0.02 | <0.02 | ---- | ---- |
| Net Acidity (acidity units) | ---- | 10 | mole H+ / t | <10 | <10 | <10 | ---- | ---- |
| Liming Rate | ---- | 1 | kg CaCO3/t | <1 | <1 | <1 | ---- | ---- |
| Net Acidity excluding ANC (sulfur units) | ---- | 0.02 | % S | 0.23 | 0.12 | 0.03 | ---- | ---- |
| Net Acidity excluding ANC (acidity units) | ---- | 10 | mole H+ / t | 145 | 74 | 20 | ---- | ---- |
| Liming Rate excluding ANC | ---- | 1 | kg CaCO3/t | 11 | 6 | 2 | ---- | ---- |
| **ED006: Exchangeable Cations on Alkaline Soils** | | | | | | | | |
| ø Exchangeable Calcium | ---- | 0.2 | meq/100g | 3.7 | 1.8 | ---- | ---- | ---- |
| ø Exchangeable Magnesium | ---- | 0.2 | meq/100g | 5.3 | 3.4 | ---- | ---- | ---- |
| ø Exchangeable Potassium | ---- | 0.2 | meq/100g | 1.2 | 1.5 | ---- | ---- | ---- |
| ø Exchangeable Sodium | ---- | 0.2 | meq/100g | 0.9 | 1.5 | ---- | ---- | ---- |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | Composite 8 | Composite 9 | Composite 10 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB1905293-036 | EB1905293-037 | EB1905293-038 | -------- | -------- |
| | | | | | Result | Result | Result | ---- | ---- |
| **ED006: Exchangeable Cations on Alkaline Soils - Continued** | | | | | | | | | |
| ø Cation Exchange Capacity | ---- | 0.2 | meq/100g | | 11.1 | 8.1 | ---- | ---- | ---- |
| ø Exchangeable Sodium Percent | ---- | 0.2 | % | | 8.0 | 18.1 | ---- | ---- | ---- |
| ø Calcium/Magnesium Ratio | ---- | 0.2 | - | | 0.7 | 0.5 | ---- | ---- | ---- |
| ø Magnesium/Potassium Ratio | ---- | 0.2 | - | | 4.4 | 2.2 | ---- | ---- | ---- |
| **ED037: Alkalinity** | | | | | | | | | |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/kg | | 7840 | 2620 | 14400 | ---- | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/kg | | 7840 | 2620 | 14400 | ---- | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/kg | | <5 | <5 | <5 | ---- | ---- |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity | ---- | 1 | mg/kg | | 116 | 66 | <5 | ---- | ---- |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | | |
| Sulfate as SO4 2- | 14808-79-8 | 10 | mg/kg | | 1390 | 390 | 120 | ---- | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 10 | mg/kg | | 70 | 40 | 50 | ---- | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | | 220 | 10 | 30 | ---- | ---- |
| Magnesium | 7439-95-4 | 10 | mg/kg | | 200 | 20 | 30 | ---- | ---- |
| Sodium | 7440-23-5 | 10 | mg/kg | | 200 | 230 | 210 | ---- | ---- |
| Potassium | 7440-09-7 | 10 | mg/kg | | 110 | 70 | 70 | ---- | ---- |
| **ED093T: Total Major Cations** | | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | | 390 | 520 | 460 | ---- | ---- |
| Potassium | 7440-09-7 | 50 | mg/kg | | 1450 | 1570 | 1250 | ---- | ---- |
| Calcium | 7440-70-2 | 50 | mg/kg | | 5000 | 1570 | 12900 | ---- | ---- |
| Magnesium | 7439-95-4 | 50 | mg/kg | | 3450 | 2290 | 7110 | ---- | ---- |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | | |
| Aluminium | 7429-90-5 | 1 | mg/kg | | <1 | <1 | <1 | ---- | ---- |
| Antimony | 7440-36-0 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Arsenic | 7440-38-2 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Boron | 7440-42-8 | 1 | mg/kg | | <1 | <1 | <1 | ---- | ---- |
| Cadmium | 7440-43-9 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Chromium | 7440-47-3 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Cobalt | 7440-48-4 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Copper | 7440-50-8 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| Iron | 7439-89-6 | 1 | mg/kg | | <1 | <1 | <1 | ---- | ---- |

## Analytical Results

| Sub-Matrix: PULP (Matrix: SOIL) | | | | Client sample ID | Composite 8 | Composite 9 | Composite 10 | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | 12-Dec-2018 00:00 | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB1905293-036 | EB1905293-037 | EB1905293-038 | -------- | -------- |
| | | | | | Result | Result | Result | ---- | ---- |
| **EG005(ED093)S : Soluble Metals by ICPAES - Continued** | | | | | | | | | |
| **Manganese** | 7439-96-5 | 0.1 | mg/kg | | **0.6** | <0.1 | <0.1 | ---- | ---- |
| **Molybdenum** | 7439-98-7 | 0.1 | mg/kg | | <0.1 | **0.2** | <0.1 | ---- | ---- |
| **Nickel** | 7440-02-0 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| **Selenium** | 7782-49-2 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| **Zinc** | 7440-66-6 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 50 | mg/kg | | **4800** | **5120** | **4930** | ---- | ---- |
| **Antimony** | 7440-36-0 | 5 | mg/kg | | <5 | <5 | <5 | ---- | ---- |
| **Arsenic** | 7440-38-2 | 5 | mg/kg | | **6** | <5 | **8** | ---- | ---- |
| **Boron** | 7440-42-8 | 50 | mg/kg | | <50 | <50 | <50 | ---- | ---- |
| **Cadmium** | 7440-43-9 | 1 | mg/kg | | <1 | <1 | <1 | ---- | ---- |
| **Chromium** | 7440-47-3 | 2 | mg/kg | | **5** | **3** | **6** | ---- | ---- |
| **Cobalt** | 7440-48-4 | 2 | mg/kg | | **10** | **13** | **7** | ---- | ---- |
| **Copper** | 7440-50-8 | 5 | mg/kg | | **25** | **43** | **26** | ---- | ---- |
| **Iron** | 7439-89-6 | 50 | mg/kg | | **21300** | **12600** | **32600** | ---- | ---- |
| **Manganese** | 7439-96-5 | 5 | mg/kg | | **266** | **91** | **527** | ---- | ---- |
| **Molybdenum** | 7439-98-7 | 2 | mg/kg | | <2 | <2 | <2 | ---- | ---- |
| **Nickel** | 7440-02-0 | 2 | mg/kg | | **12** | **15** | **11** | ---- | ---- |
| **Selenium** | 7782-49-2 | 5 | mg/kg | | <5 | <5 | <5 | ---- | ---- |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | **88** | **105** | **78** | ---- | ---- |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | | |
| **Uranium** | 7440-61-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | ---- | ---- |
| **Thorium** | 7440-29-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | ---- | ---- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | | **5.1** | **6.4** | **4.8** | ---- | ---- |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | | **0.6** | **0.8** | **0.7** | ---- | ---- |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **3** | **3** | **5** | ---- | ---- |
| **EK040T: Fluoride Total** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 40 | mg/kg | | **180** | **190** | **190** | ---- | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2010009** | Page | : 1 of 10 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MS VERONICA CANALES | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH-Mt Pleasant | Date Samples Received | : 08-Apr-2020 14:44 |
| Order number | : ---- | Date Analysis Commenced | : 15-Apr-2020 |
| C-O-C number | : ---- | Issue Date | : 30-Apr-2020 14:13 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 21 | | |
| No. of samples analysed | : 21 | | |

ilac-MRA NATA

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ben Felgendrejeris | Senior Acid Sulfate Soil Chemist | Brisbane Acid Sulphate Soils, Stafford, QLD |
| Joel Mullarvey | Laboratory Technician | Newcastle - Inorganics, Mayfield West, NSW |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Mark Hallas | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

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

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

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

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

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

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

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

- Samples 18 & 21 were required to go for crushing before fluoride analysis (EK040T) could be done
- EA031 (Saturated Paste pH): NATA accreditation does not cover the performance of this service.
- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ED093T (Major Cations - Total): Sample BRBY Rejects-KLC 14 (EB2010009-021) shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Client sample ID | ED Rejects 1 of 2 | ED Rejects 2 of 2 | ED Tailings | WN1 Rejects 1 of 2 | WN1 Rejects 2 of 2 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2010009-001 | EB2010009-002 | EB2010009-003 | EB2010009-004 | EB2010009-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | | **1.41** | **0.762** | **0.352** | **1.18** | **2.14** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Client sample ID | WN1 Tailings | PF2 Tailings 1 of 2 | PF2 Tailings 2 of 2 | VA1 Rejects | VA1 Tailings |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2010009-006 | EB2010009-007 | EB2010009-008 | EB2010009-009 | EB2010009-010 |
| | | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | | |
| **Chromium Reducible Sulphur** | ---- | 0.005 | % | | **1.20** | **0.130** | **0.129** | **0.109** | **0.471** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Client sample ID | BRBY Tailings | BRBY Rejects | ED Rejects - KLC 6 | ED tailings - KLC 7 | WN1 Rejects - KLC 8 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | EB2010009-011 | EB2010009-012 | EB2010009-013 | EB2010009-014 | EB2010009-015 |
| | | | | Result | Result | Result | Result | Result |
| **EA026 : Chromium Reducible Sulfur** | | | | | | | | |
| Chromium Reducible Sulphur | ---- | 0.005 | % | 0.165 | 0.093 | ---- | ---- | ---- |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | ---- | ---- | 7.4 | 8.0 | 7.1 |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | ---- | ---- | 1810 | 737 | 1400 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | ---- | ---- | 16.6 | 44.7 | 12.7 |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | ---- | ---- | 80 | 60 | 620 |
| Magnesium | 7439-95-4 | 10 | mg/kg | ---- | ---- | 100 | 80 | 200 |
| Sodium | 7440-23-5 | 10 | mg/kg | ---- | ---- | 170 | 140 | 60 |
| Potassium | 7440-09-7 | 10 | mg/kg | ---- | ---- | 20 | 20 | <10 |
| **ED093T: Total Major Cations** | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | ---- | ---- | 320 | 270 | 260 |
| Potassium | 7440-09-7 | 50 | mg/kg | ---- | ---- | 430 | 820 | 400 |
| Calcium | 7440-70-2 | 50 | mg/kg | ---- | ---- | 3620 | 3000 | 6170 |
| Magnesium | 7439-95-4 | 50 | mg/kg | ---- | ---- | 2660 | 2410 | 2310 |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | |
| Boron | 7440-42-8 | 1 | mg/kg | ---- | ---- | <1 | <1 | <1 |
| Iron | 7439-89-6 | 1 | mg/kg | ---- | ---- | <1 | <1 | <1 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | ---- | ---- | 1550 | 2040 | 1240 |
| Antimony | 7440-36-0 | 5 | mg/kg | ---- | ---- | <5 | <5 | <5 |
| Arsenic | 7440-38-2 | 5 | mg/kg | ---- | ---- | 7 | <5 | 23 |
| Boron | 7440-42-8 | 50 | mg/kg | ---- | ---- | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | ---- | ---- | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | ---- | ---- | <2 | <2 | <2 |
| Cobalt | 7440-48-4 | 2 | mg/kg | ---- | ---- | 6 | 6 | 5 |
| Copper | 7440-50-8 | 5 | mg/kg | ---- | ---- | 12 | 18 | 32 |
| Iron | 7439-89-6 | 50 | mg/kg | ---- | ---- | 38700 | 17300 | 39200 |
| Manganese | 7439-96-5 | 5 | mg/kg | ---- | ---- | 658 | 222 | 531 |
| Molybdenum | 7439-98-7 | 2 | mg/kg | ---- | ---- | <2 | <2 | <2 |
| Nickel | 7440-02-0 | 2 | mg/kg | ---- | ---- | 9 | 9 | 8 |
| Selenium | 7782-49-2 | 5 | mg/kg | ---- | ---- | <5 | <5 | <5 |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Client sample ID | BRBY Tailings | BRBY Rejects | ED Rejects - KLC 6 | ED tailings - KLC 7 | WN1 Rejects - KLC 8 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2010009-011 | EB2010009-012 | EB2010009-013 | EB2010009-014 | EB2010009-015 |
| | | | | | Result | Result | Result | Result | Result |
| **EG005(ED093)T: Total Metals by ICP-AES - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 5 | mg/kg | | ---- | ---- | **37** | **47** | **38** |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | | |
| **Arsenic** | 7440-38-2 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Selenium** | 7782-49-2 | 0.1 | mg/kg | | ---- | ---- | <0.1 | <0.1 | <0.1 |
| **Cadmium** | 7440-43-9 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Cobalt** | 7440-48-4 | 0.01 | mg/kg | | ---- | ---- | **0.02** | **0.02** | **0.19** |
| **Chromium** | 7440-47-3 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Thorium** | 7440-29-1 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Copper** | 7440-50-8 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Manganese** | 7439-96-5 | 0.01 | mg/kg | | ---- | ---- | **0.09** | **0.29** | **8.61** |
| **Molybdenum** | 7439-98-7 | 0.01 | mg/kg | | ---- | ---- | **0.02** | **0.14** | <0.01 |
| **Nickel** | 7440-02-0 | 0.01 | mg/kg | | ---- | ---- | **0.04** | **0.02** | **0.26** |
| **Antimony** | 7440-36-0 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Uranium** | 7440-61-1 | 0.01 | mg/kg | | ---- | ---- | <0.01 | <0.01 | <0.01 |
| **Zinc** | 7440-66-6 | 0.05 | mg/kg | | ---- | ---- | <0.05 | <0.05 | **0.16** |
| **Aluminium** | 7429-90-5 | 0.1 | mg/kg | | ---- | ---- | <0.1 | <0.1 | <0.1 |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | | ---- | ---- | **5.6** | **7.7** | **6.8** |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | | ---- | ---- | **2.5** | **2.8** | **1.8** |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | ---- | ---- | **3** | **6** | <1 |
| **EK040T: Fluoride Total** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 40 | mg/kg | | ---- | ---- | **160** | **240** | **120** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Client sample ID | WN1 Tailings-KLC 9 | PF2 Tailings-KLC 10 | VA1 Rejects-KLC 11 | VA1 Tailings-KLC 12 | BRBY Tailings-KLC 13 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | EB2010009-016 | EB2010009-017 | EB2010009-018 | EB2010009-019 | EB2010009-020 |
| | | | | Result | Result | Result | Result | Result |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | 7.7 | 7.3 | 6.5 | 8.8 | 7.9 |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | 1020 | 1180 | 1300 | 1000 | 1070 |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 39.6 | 51.4 | 7.9 | 47.8 | 53.5 |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | 40 | 60 | 90 | 50 | 90 |
| Magnesium | 7439-95-4 | 10 | mg/kg | 40 | 70 | 100 | 110 | 80 |
| Sodium | 7440-23-5 | 10 | mg/kg | 40 | 240 | 50 | 120 | 160 |
| Potassium | 7440-09-7 | 10 | mg/kg | 10 | 20 | 20 | 20 | 20 |
| **ED093T: Total Major Cations** | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | 230 | 500 | 220 | 270 | 300 |
| Potassium | 7440-09-7 | 50 | mg/kg | 950 | 870 | 600 | 610 | 560 |
| Calcium | 7440-70-2 | 50 | mg/kg | 11100 | 4580 | 5620 | 4390 | 4710 |
| Magnesium | 7439-95-4 | 50 | mg/kg | 5530 | 2200 | 5570 | 3170 | 2320 |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | |
| Boron | 7440-42-8 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Iron | 7439-89-6 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 2560 | 1890 | 1590 | 1750 | 1870 |
| Antimony | 7440-36-0 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Arsenic | 7440-38-2 | 5 | mg/kg | 12 | <5 | <5 | 6 | <5 |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | <50 | <50 | <50 | <50 |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | <1 | <1 | <1 | <1 |
| Chromium | 7440-47-3 | 2 | mg/kg | 4 | <2 | <2 | 3 | 4 |
| Cobalt | 7440-48-4 | 2 | mg/kg | 8 | 4 | <2 | 4 | 6 |
| Copper | 7440-50-8 | 5 | mg/kg | 26 | 23 | 24 | 21 | 23 |
| Iron | 7439-89-6 | 50 | mg/kg | 63200 | 12900 | 64300 | 18900 | 16900 |
| Manganese | 7439-96-5 | 5 | mg/kg | 881 | 140 | 875 | 194 | 205 |
| Molybdenum | 7439-98-7 | 2 | mg/kg | <2 | <2 | <2 | <2 | <2 |
| Nickel | 7440-02-0 | 2 | mg/kg | 13 | 6 | 6 | 8 | 12 |
| Selenium | 7782-49-2 | 5 | mg/kg | <5 | <5 | <5 | <5 | <5 |
| Zinc | 7440-66-6 | 5 | mg/kg | 70 | 51 | 42 | 40 | 38 |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Client sample ID | WN1 Tailings-KLC 9 | PF2 Tailings-KLC 10 | VA1 Rejects-KLC 11 | VA1 Tailings-KLC 12 | BRBY Tailings-KLC 13 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 | 31-Mar-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2010009-016 | EB2010009-017 | EB2010009-018 | EB2010009-019 | EB2010009-020 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020S: Soluble Metals by ICPMS - Continued** | | | | | | | | | |
| Arsenic | 7440-38-2 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Selenium | 7782-49-2 | 0.1 | mg/kg | | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Cadmium | 7440-43-9 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Cobalt | 7440-48-4 | 0.01 | mg/kg | | <0.01 | <0.01 | **0.04** | <0.01 | <0.01 |
| Chromium | 7440-47-3 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Thorium | 7440-29-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Copper | 7440-50-8 | 0.01 | mg/kg | | <0.01 | <0.01 | **0.03** | <0.01 | <0.01 |
| Manganese | 7439-96-5 | 0.01 | mg/kg | | **0.10** | **0.13** | **0.96** | **0.07** | **0.19** |
| Molybdenum | 7439-98-7 | 0.01 | mg/kg | | **0.02** | **0.01** | <0.01 | **0.10** | **0.15** |
| Nickel | 7440-02-0 | 0.01 | mg/kg | | <0.01 | <0.01 | **0.17** | <0.01 | **0.01** |
| Antimony | 7440-36-0 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Uranium | 7440-61-1 | 0.01 | mg/kg | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Zinc | 7440-66-6 | 0.05 | mg/kg | | <0.05 | <0.05 | **0.40** | <0.05 | <0.05 |
| Aluminium | 7429-90-5 | 0.1 | mg/kg | | <0.1 | <0.1 | **0.1** | <0.1 | <0.1 |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| Thorium | 7440-29-1 | 0.1 | mg/kg | | **6.5** | **4.2** | **6.5** | **5.8** | **6.5** |
| Uranium | 7440-61-1 | 0.1 | mg/kg | | **1.5** | **2.6** | **1.0** | **1.8** | **1.2** |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| Fluoride | 16984-48-8 | 1 | mg/kg | | **2** | **9** | <1 | **15** | **12** |
| **EK040T: Fluoride Total** | | | | | | | | | |
| Fluoride | 16984-48-8 | 40 | mg/kg | | **190** | **230** | **250** | **200** | **200** |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | Client sample ID | BRBY Rejects-KLC 14 | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-Mar-2020 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | EB2010009-021 | -------- | -------- | -------- | -------- |
| | | | | Result | ---- | ---- | ---- | ---- |
| **EA031: pH (saturated paste)** | | | | | | | | |
| ø pH (Saturated Paste) | ---- | 0.1 | pH Unit | 7.8 | ---- | ---- | ---- | ---- |
| **EA032: Electrical Conductivity (saturated paste)** | | | | | | | | |
| ø Electrical Conductivity (Saturated Paste) | ---- | 1 | µS/cm | 696 | ---- | ---- | ---- | ---- |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| Moisture Content | ---- | 1.0 | % | 8.2 | ---- | ---- | ---- | ---- |
| **ED093S: Soluble Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 10 | mg/kg | 20 | ---- | ---- | ---- | ---- |
| Magnesium | 7439-95-4 | 10 | mg/kg | 30 | ---- | ---- | ---- | ---- |
| Sodium | 7440-23-5 | 10 | mg/kg | 100 | ---- | ---- | ---- | ---- |
| Potassium | 7440-09-7 | 10 | mg/kg | <10 | ---- | ---- | ---- | ---- |
| **ED093T: Total Major Cations** | | | | | | | | |
| Sodium | 7440-23-5 | 50 | mg/kg | 260 | ---- | ---- | ---- | ---- |
| Potassium | 7440-09-7 | 50 | mg/kg | 230 | ---- | ---- | ---- | ---- |
| Calcium | 7440-70-2 | 50 | mg/kg | 6640 | ---- | ---- | ---- | ---- |
| Magnesium | 7439-95-4 | 50 | mg/kg | 2840 | ---- | ---- | ---- | ---- |
| **EG005(ED093)S : Soluble Metals by ICPAES** | | | | | | | | |
| Boron | 7440-42-8 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| Iron | 7439-89-6 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| **EG005(ED093)T: Total Metals by ICP-AES** | | | | | | | | |
| Aluminium | 7429-90-5 | 50 | mg/kg | 1260 | ---- | ---- | ---- | ---- |
| Antimony | 7440-36-0 | 5 | mg/kg | <5 | ---- | ---- | ---- | ---- |
| Arsenic | 7440-38-2 | 5 | mg/kg | <5 | ---- | ---- | ---- | ---- |
| Boron | 7440-42-8 | 50 | mg/kg | <50 | ---- | ---- | ---- | ---- |
| Cadmium | 7440-43-9 | 1 | mg/kg | <1 | ---- | ---- | ---- | ---- |
| Chromium | 7440-47-3 | 2 | mg/kg | <2 | ---- | ---- | ---- | ---- |
| Cobalt | 7440-48-4 | 2 | mg/kg | <2 | ---- | ---- | ---- | ---- |
| Copper | 7440-50-8 | 5 | mg/kg | 11 | ---- | ---- | ---- | ---- |
| Iron | 7439-89-6 | 50 | mg/kg | 13800 | ---- | ---- | ---- | ---- |
| Manganese | 7439-96-5 | 5 | mg/kg | 260 | ---- | ---- | ---- | ---- |
| Molybdenum | 7439-98-7 | 2 | mg/kg | <2 | ---- | ---- | ---- | ---- |
| Nickel | 7440-02-0 | 2 | mg/kg | <2 | ---- | ---- | ---- | ---- |
| Selenium | 7782-49-2 | 5 | mg/kg | <5 | ---- | ---- | ---- | ---- |
| Zinc | 7440-66-6 | 5 | mg/kg | 14 | ---- | ---- | ---- | ---- |
| **EG020S: Soluble Metals by ICPMS** | | | | | | | | |

## Analytical Results

| Sub-Matrix: SOIL (Matrix: SOIL) | | | | Client sample ID | BRBY Rejects-KLC 14 | ---- | ---- | ---- | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Mar-2020 00:00 | ---- | ---- | ---- | ---- |
| Compound | CAS Number | LOR | Unit | | EB2010009-021 | -------- | -------- | -------- | -------- |
| | | | | | Result | ---- | ---- | ---- | ---- |
| **EG020S: Soluble Metals by ICPMS - Continued** | | | | | | | | | |
| **Arsenic** | 7440-38-2 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Selenium** | 7782-49-2 | 0.1 | mg/kg | | <0.1 | ---- | ---- | ---- | ---- |
| **Cadmium** | 7440-43-9 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Cobalt** | 7440-48-4 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Chromium** | 7440-47-3 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Thorium** | 7440-29-1 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Copper** | 7440-50-8 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Manganese** | 7439-96-5 | 0.01 | mg/kg | | **0.09** | ---- | ---- | ---- | ---- |
| **Molybdenum** | 7439-98-7 | 0.01 | mg/kg | | **0.02** | ---- | ---- | ---- | ---- |
| **Nickel** | 7440-02-0 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Antimony** | 7440-36-0 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Uranium** | 7440-61-1 | 0.01 | mg/kg | | <0.01 | ---- | ---- | ---- | ---- |
| **Zinc** | 7440-66-6 | 0.05 | mg/kg | | <0.05 | ---- | ---- | ---- | ---- |
| **Aluminium** | 7429-90-5 | 0.1 | mg/kg | | <0.1 | ---- | ---- | ---- | ---- |
| **EG020T: Total Metals by ICP-MS** | | | | | | | | | |
| **Thorium** | 7440-29-1 | 0.1 | mg/kg | | **6.7** | ---- | ---- | ---- | ---- |
| **Uranium** | 7440-61-1 | 0.1 | mg/kg | | **1.0** | ---- | ---- | ---- | ---- |
| **EK040S: Fluoride Soluble** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 1 | mg/kg | | **4** | ---- | ---- | ---- | ---- |
| **EK040T: Fluoride Total** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 40 | mg/kg | | **150** | ---- | ---- | ---- | ---- |

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# EMERSON CLASS NUMBER TEST REPORT

**Test Method: AS 1289 3.8.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020143-EM |
| | | **Workorder No.** | 5513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 11/02/2019 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |

| **Sample No.** | 19020143 | 19020144 | 19020145 | 19020146 | 19020147 | 19020148 | 19020149 |
|---|---|---|---|---|---|---|---|
| **Client ID** | Composite 1 | Composite 2 | Composite 3 | Composite 6 | Composite 7 | Composite 8 | Composite 9 |
| **Depth (m)** | Not Supplied | Not Supplied | Not Supplied | Not Supplied | Not Supplied | Not Supplied | Not Supplied |
| **Description** | Silty GRAVEL - grey | Silty GRAVEL - grey | Silty GRAVEL - grey | Silty GRAVEL - grey | Silty GRAVEL - grey | Silty GRAVEL - grey | Silty GRAVEL - grey |
| **Emerson Class Number** | **2** | **2** | **2** | **2** | **2** | **2** | **2** |

| **Sample No.** | - | - | - | - | - | - | - |
|---|---|---|---|---|---|---|---|
| **Client ID** | - | - | - | - | - | - | - |
| **Depth (m)** | - | - | - | - | - | - | - |
| **Description** | - | - | - | - | - | - | - |
| **Emerson Class Number** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

| **Sample No.** | - | - | - | - | - | - | - |
|---|---|---|---|---|---|---|---|
| **Client ID** | - | - | - | - | - | - | - |
| **Depth (m)** | - | - | - | - | - | - | - |
| **Description** | - | - | - | - | - | - | - |
| **Emerson Class Number** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 22°C



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Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Park

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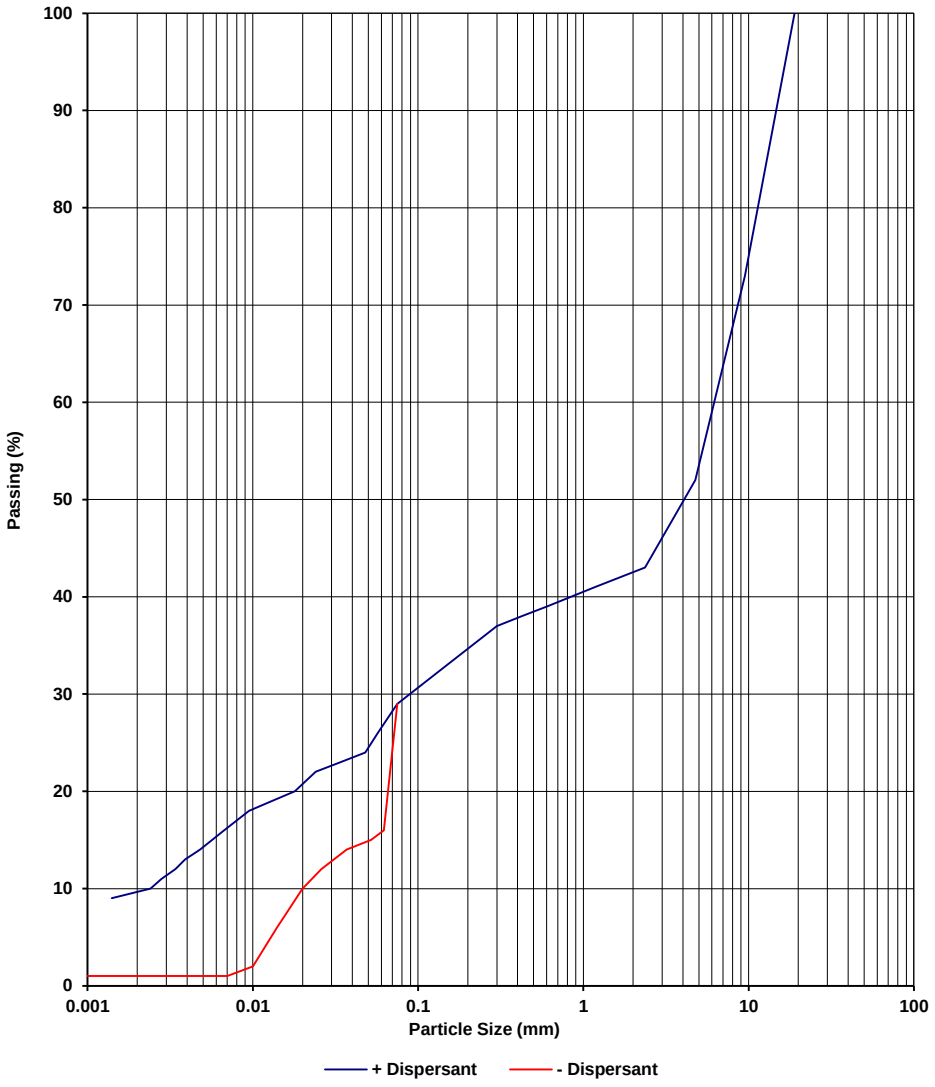
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020143-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 7/2/19-12/2/19 |
| | | **Report Date** | 12/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 1 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | |
| 26.5 | |
| 19.0 | 100 |
| 13.2 | 84 |
| 9.5 | 73 |
| 6.7 | 59 |
| 4.75 | 52 |
| 2.36 | 43 |
| 1.18 | 41 |
| 0.600 | 39 |
| 0.425 | 38 |
| 0.300 | 37 |
| 0.150 | 33 |
| 0.075 | 29 |
| 0.057 | 26 |
| 0.048 | 24 |
| 0.034 | 23 |
| 0.024 | 22 |
| 0.018 | 20 |
| 0.013 | 19 |
| 0.0095 | 18 |
| 0.0067 | 16 |
| 0.0048 | 14 |
| 0.0039 | 13 |
| 0.0034 | 12 |
| 0.0028 | 11 |
| 0.0024 | 10 |
| 0.0014 | 9 |




**DISPERSION (%) : 9.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.54
Sample/s supplied by the client



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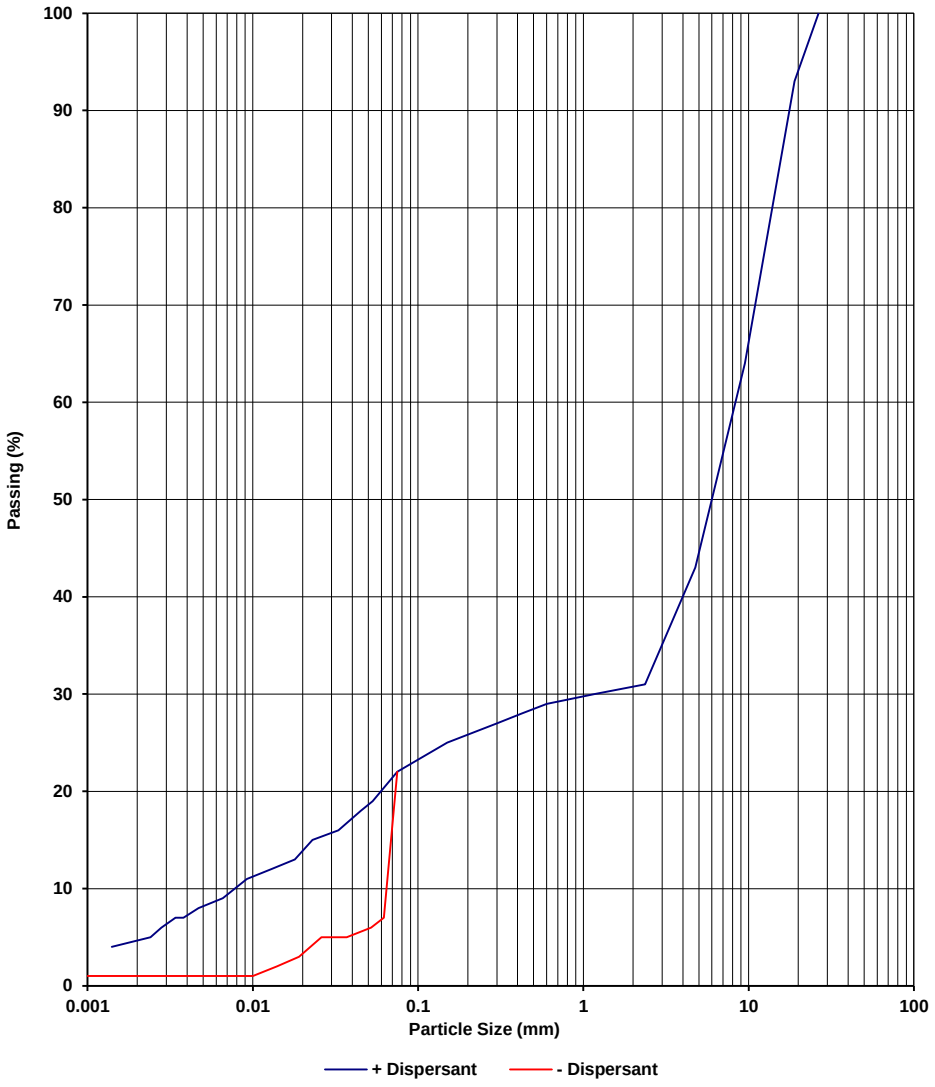
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020144-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 2 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | |
| 26.5 | 100 |
| 19.0 | 93 |
| 13.2 | 81 |
| 9.5 | 64 |
| 6.7 | 51 |
| 4.75 | 43 |
| 2.36 | 31 |
| 1.18 | 30 |
| 0.600 | 29 |
| 0.425 | 28 |
| 0.300 | 27 |
| 0.150 | 25 |
| 0.075 | 22 |
| 0.053 | 19 |
| 0.045 | 18 |
| 0.033 | 16 |
| 0.023 | 15 |
| 0.018 | 13 |
| 0.013 | 12 |
| 0.0092 | 11 |
| 0.0066 | 9 |
| 0.0047 | 8 |
| 0.0038 | 7 |
| 0.0034 | 7 |
| 0.0028 | 6 |
| 0.0024 | 5 |
| 0.0014 | 4 |




**DISPERSION (%) : 10.0**

NOTES/REMARKS:

Moisture Content 0.1%

-2.36mm Soil Particle Density (t/m$^3$) 2.63

Sample/s supplied by the client



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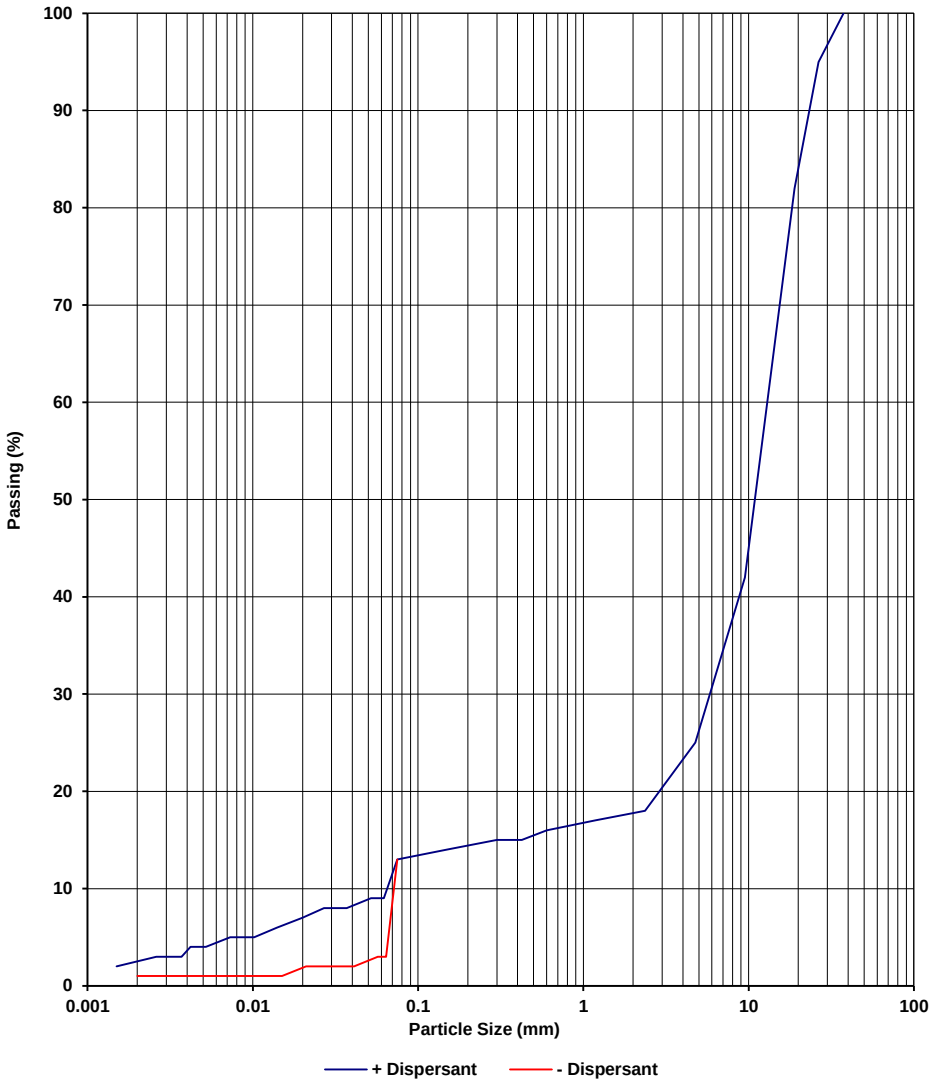
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020145-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 3 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | 100 |
| 26.5 | 95 |
| 19.0 | 82 |
| 13.2 | 60 |
| 9.5 | 42 |
| 6.7 | 31 |
| 4.75 | 25 |
| 2.36 | 18 |
| 1.18 | 17 |
| 0.600 | 16 |
| 0.425 | 15 |
| 0.300 | 15 |
| 0.150 | 14 |
| 0.075 | 13 |
| 0.062 | 9 |
| 0.052 | 9 |
| 0.037 | 8 |
| 0.027 | 8 |
| 0.02 | 7 |
| 0.014 | 6 |
| 0.0102 | 5 |
| 0.0073 | 5 |
| 0.0052 | 4 |
| 0.0042 | 4 |
| 0.0037 | 3 |
| 0.003 | 3 |
| 0.0026 | 3 |
| 0.0015 | 2 |




**DISPERSION (%) : 30.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.42
Sample/s supplied by the client



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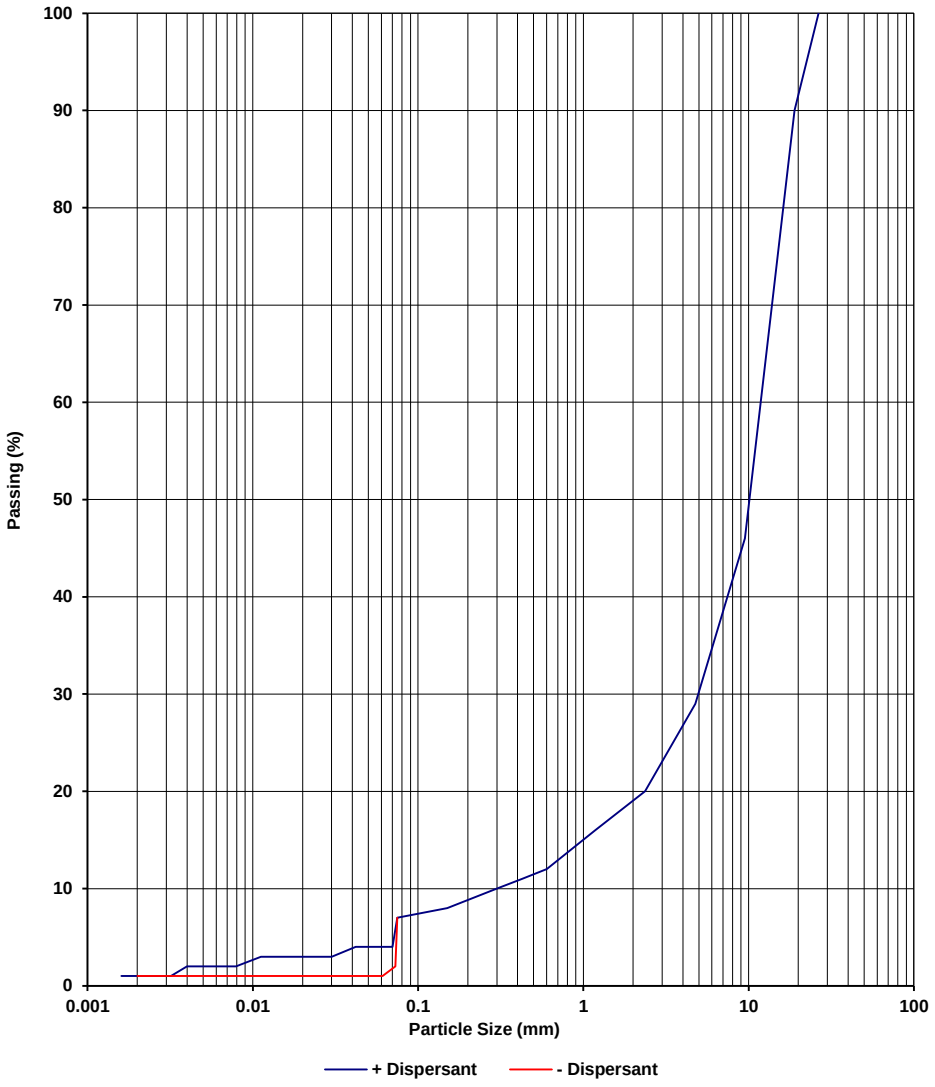
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020146-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 6 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | |
| 26.5 | 100 |
| 19.0 | 90 |
| 13.2 | 61 |
| 9.5 | 46 |
| 6.7 | 35 |
| 4.75 | 29 |
| 2.36 | 20 |
| 1.18 | 16 |
| 0.600 | 12 |
| 0.425 | 11 |
| 0.300 | 10 |
| 0.150 | 8 |
| 0.075 | 7 |
| 0.07 | 4 |
| 0.059 | 4 |
| 0.042 | 4 |
| 0.03 | 3 |
| 0.022 | 3 |
| 0.016 | 3 |
| 0.0112 | 3 |
| 0.0079 | 2 |
| 0.0056 | 2 |
| 0.0046 | 2 |
| 0.004 | 2 |
| 0.0032 | 1 |
| 0.0028 | 1 |
| 0.0016 | 1 |




**DISPERSION (%) : 25.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.25
Sample/s supplied by the client



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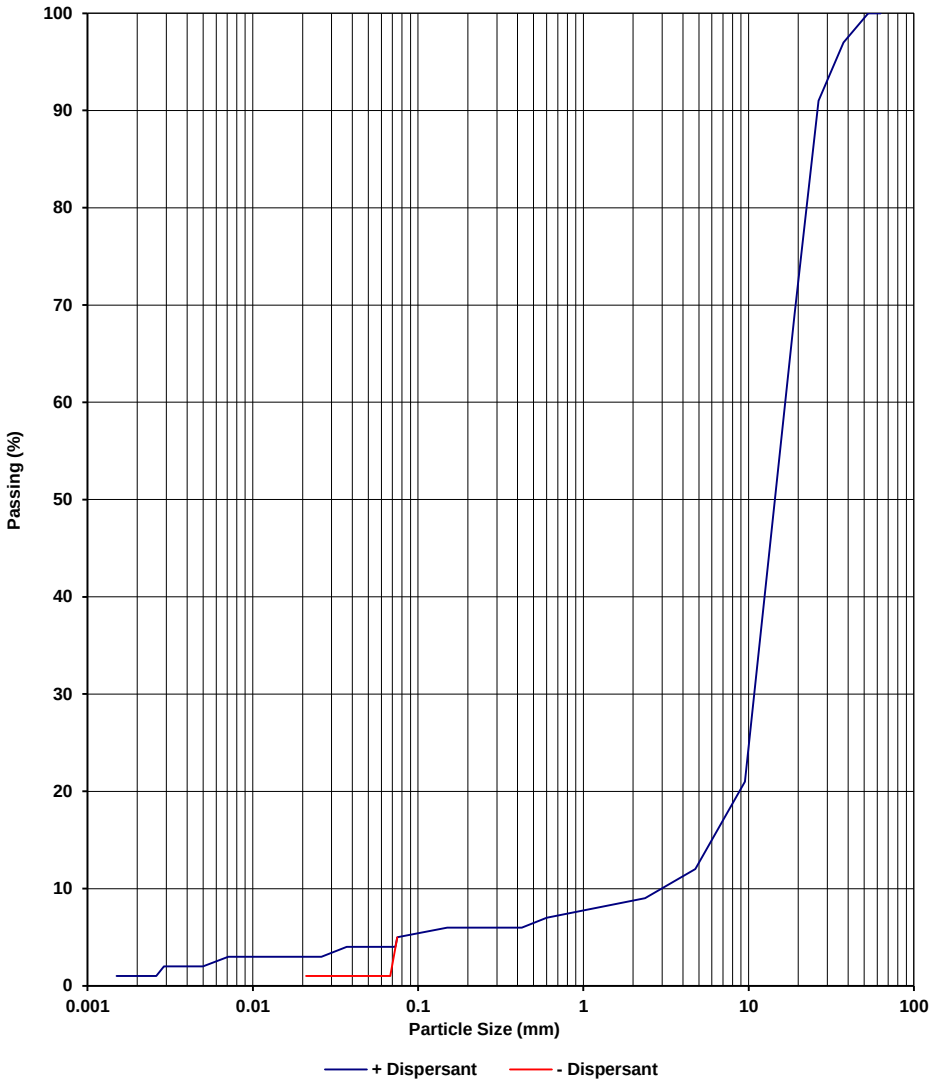
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020147-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 7 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | 100 |
| 37.5 | 97 |
| 26.5 | 91 |
| 19.0 | 69 |
| 13.2 | 37 |
| 9.5 | 21 |
| 6.7 | 15 |
| 4.75 | 12 |
| 2.36 | 9 |
| 1.18 | 8 |
| 0.600 | 7 |
| 0.425 | 6 |
| 0.300 | 6 |
| 0.150 | 6 |
| 0.075 | 5 |
| 0.073 | 4 |
| 0.052 | 4 |
| 0.037 | 4 |
| 0.026 | 3 |
| 0.019 | 3 |
| 0.014 | 3 |
| 0.01 | 3 |
| 0.0071 | 3 |
| 0.005 | 2 |
| 0.0041 | 2 |
| 0.0036 | 2 |
| 0.0029 | 2 |
| 0.0026 | 1 |
| 0.0015 | 1 |




**DISPERSION (%) : 12.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.46
Sample/s supplied by the client



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Tested at Trilab Brisbane Laboratory

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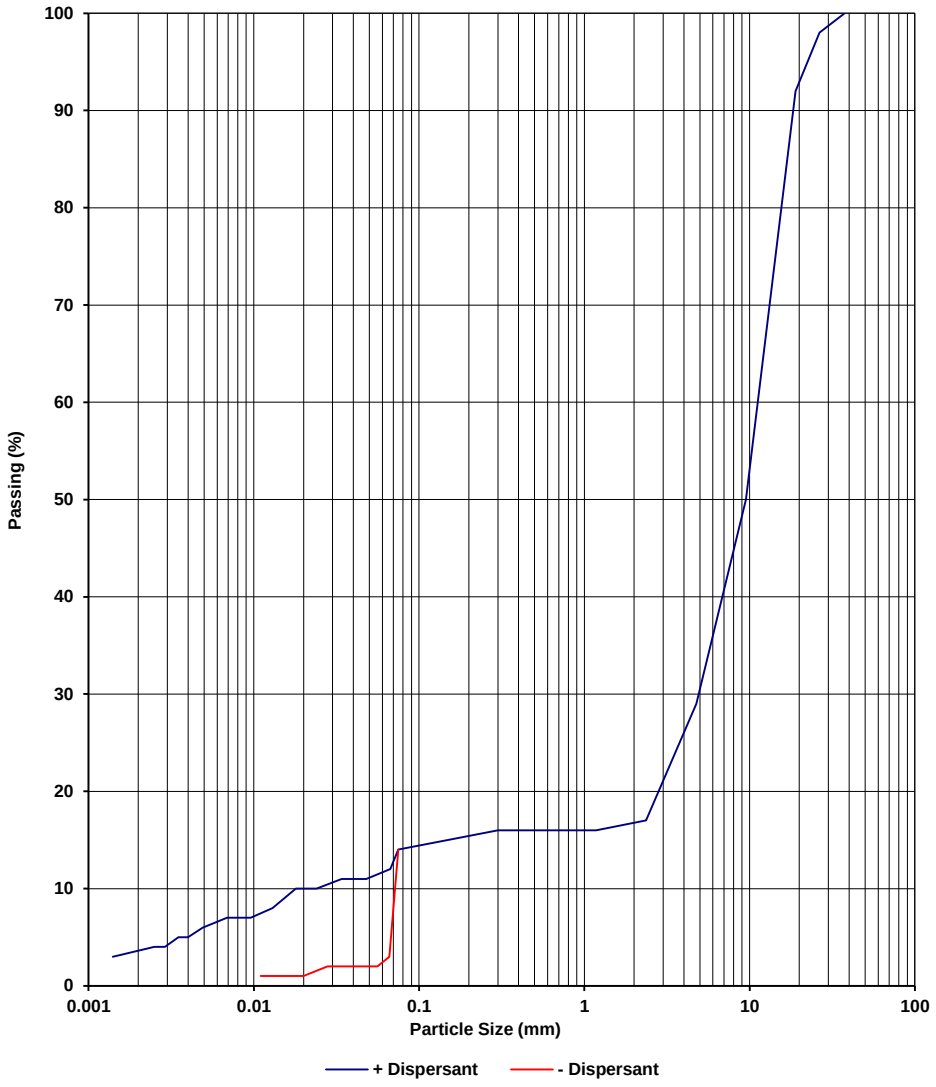
# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020148-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 8 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | 100 |
| 26.5 | 98 |
| 19.0 | 92 |
| 13.2 | 70 |
| 9.5 | 50 |
| 6.7 | 36 |
| 4.75 | 29 |
| 2.36 | 17 |
| 1.18 | 16 |
| 0.600 | 16 |
| 0.425 | 16 |
| 0.300 | 16 |
| 0.150 | 15 |
| 0.075 | 14 |
| 0.067 | 12 |
| 0.048 | 11 |
| 0.034 | 11 |
| 0.024 | 10 |
| 0.018 | 10 |
| 0.013 | 8 |
| 0.0096 | 7 |
| 0.0069 | 7 |
| 0.0049 | 6 |
| 0.004 | 5 |
| 0.0035 | 5 |
| 0.0029 | 4 |
| 0.0025 | 4 |
| 0.0014 | 3 |




**DISPERSION (%) : 4.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.47
Sample/s supplied by the client



Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

**Laboratory No. 9926**

Trilab
Soil Rock Calibration

**Brisbane**
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

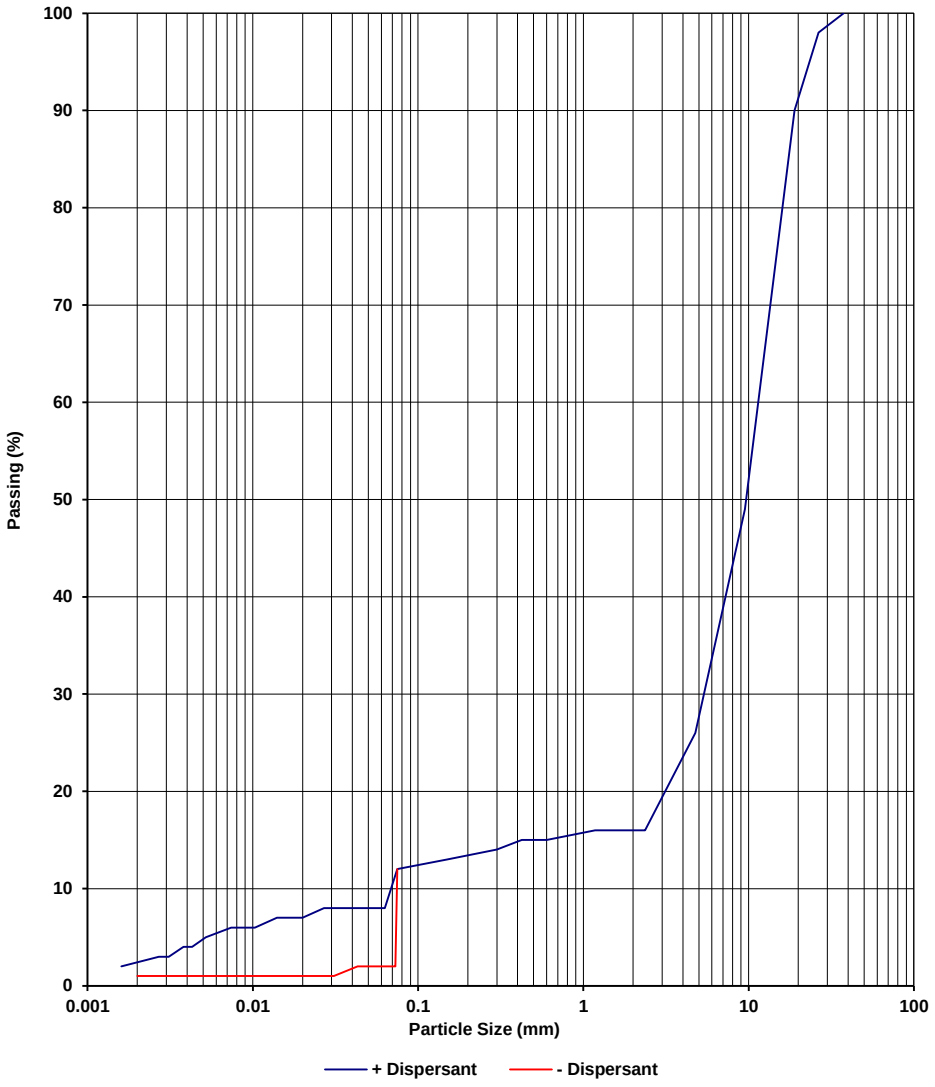
**Perth**
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

# PARTICLE SIZE DISTRIBUTION
with
# PERCENTAGE DISPERSION TEST REPORT

**Test Method: AS 1289 3.8.2 & AS 1289.2.1.1**

| | | | |
|---|---|---|---|
| **Client** | RGS Environmental Pty Ltd | **Report No.** | 19020149-%D |
| | | **Workorder No.** | 0005513 |
| **Address** | PO Box 3091, Sunnybank South QLD 4109 | **Test Date** | 6/2/19-11/2/19 |
| | | **Report Date** | 13/02/2019 |
| **Project** | 2018030 - MACH Energy | | |
| **Client ID** | Composite 9 | **Depth (m)** | Not Supplied |

| Sieve Size (mm) | Passing % |
|---|---|
| 150.0 | |
| 75.0 | |
| 63.0 | |
| 53.0 | |
| 37.5 | 100 |
| 26.5 | 98 |
| 19.0 | 90 |
| 13.2 | 68 |
| 9.5 | 49 |
| 6.7 | 35 |
| 4.75 | 26 |
| 2.36 | 16 |
| 1.18 | 16 |
| 0.600 | 15 |
| 0.425 | 15 |
| 0.300 | 14 |
| 0.150 | 13 |
| 0.075 | 12 |
| 0.063 | 8 |
| 0.053 | 8 |
| 0.037 | 8 |
| 0.027 | 8 |
| 0.02 | 7 |
| 0.014 | 7 |
| 0.0103 | 6 |
| 0.0074 | 6 |
| 0.0052 | 5 |
| 0.0043 | 4 |
| 0.0038 | 4 |
| 0.0031 | 3 |
| 0.0027 | 3 |
| 0.0016 | 2 |




**DISPERSION (%) : 15.0**

NOTES/REMARKS: Moisture Content 0.1% -2.36mm Soil Particle Density (t/m$^3$) 2.27
Sample/s supplied by the client



Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

**Laboratory No. 9926**

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1902439** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 31-Jan-2019 16:45 |
| Order number | : | Date Analysis Commenced | : 31-Jan-2019 |
| C-O-C number | : ---- | Issue Date | : 08-Feb-2019 09:34 |
| Sampler | : MARY MACELROY | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 |
| Compound | CAS Number | LOR | Unit | EB1902439-001 | EB1902439-002 | EB1902439-003 | EB1902439-004 | EB1902439-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 7.06 | 2.78 | 6.28 | 6.60 | 4.37 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 229 | 2320 | 194 | 104 | 846 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | 20 | <1 | 10 | 11 | <1 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | 20 | <1 | 10 | 11 | <1 |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 1 | 748 | 1 | 2 | 178 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | 20 | 1400 | 71 | 26 | 478 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 39 | 9 | 6 | 7 | 3 |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | 4 | 61 | 8 | <1 | 53 |
| Magnesium | 7439-95-4 | 1 | mg/L | 3 | 114 | 3 | <1 | 31 |
| Sodium | 7440-23-5 | 1 | mg/L | 35 | 6 | 22 | 17 | 24 |
| Potassium | 7440-09-7 | 1 | mg/L | 2 | 3 | 2 | 2 | 4 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | 0.67 | 18.8 | 0.02 | 0.63 | 2.12 |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | 0.002 | 0.008 | <0.001 | 0.007 | 0.009 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | 0.0033 | <0.0001 | <0.0001 | 0.0007 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | 0.421 | 0.015 | <0.001 | 0.345 |
| Copper | 7440-50-8 | 0.001 | mg/L | 0.006 | 0.205 | <0.001 | 0.002 | 0.110 |
| Lead | 7439-92-1 | 0.001 | mg/L | 0.003 | 0.056 | <0.001 | <0.001 | 0.003 |
| Lithium | 7439-93-2 | 0.001 | mg/L | 0.002 | 0.021 | 0.002 | 0.002 | 0.013 |
| Manganese | 7439-96-5 | 0.001 | mg/L | 0.006 | 16.7 | 0.023 | 0.002 | 0.556 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | 0.002 | <0.001 | 0.002 | 0.007 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | 0.001 | 0.676 | 0.016 | <0.001 | 0.903 |
| Selenium | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | 0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | 0.080 | 0.546 | 0.378 | 0.091 | 0.994 |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | 0.01 | <0.01 | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 4 |
| Work Order | : | EB1902439 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2018030 Mach Energy |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 | 31-Jan-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1902439-001 | EB1902439-002 | EB1902439-003 | EB1902439-004 | EB1902439-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **2.11** | **0.019** | <0.005 | **0.832** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **0.15** | **247** | <0.05 | **0.08** | **65.3** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.7** | **0.5** | **0.2** | **0.4** | <0.1 |
| **EN055: Ionic Balance** | | | | | | | | | |
| **Total Anions** | ---- | 0.01 | meq/L | | **1.92** | **29.4** | **1.85** | **0.96** | **10.0** |
| **Total Cations** | ---- | 0.01 | meq/L | | **----** | **24.4** | **----** | **----** | **8.99** |
| **Total Cations** | ---- | 0.01 | meq/L | | **2.02** | **----** | **1.65** | **0.79** | **----** |
| **Ionic Balance** | ---- | 0.01 | % | | **----** | **9.29** | **----** | **----** | **5.46** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1904857** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 26-Feb-2019 16:10 |
| Order number | : ---- | Date Analysis Commenced | : 26-Feb-2019 |
| C-O-C number | : ---- | Issue Date | : 05-Mar-2019 10:33 |
| Sampler | : MARY MACELROY | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- EG020-F (Dissolved Metals by ICP-MS): Limit of reporting raised for some samples due to matrix interference.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1904857-001 | EB1904857-002 | EB1904857-003 | EB1904857-004 | EB1904857-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | | 7.42 | 2.76 | 6.19 | 6.73 | 3.47 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | | 454 | 6940 | 210 | 180 | 821 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | | 23 | <1 | 3 | 6 | <1 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | | 23 | <1 | 3 | 6 | <1 |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | | 1 | 306 | 1 | 1 | 84 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | | 55 | 6030 | 92 | 46 | 396 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | | 82 | 4 | 6 | 12 | 5 |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | | 5 | 81 | 6 | 1 | 28 |
| Magnesium | 7439-95-4 | 1 | mg/L | | 6 | 474 | 5 | 2 | 46 |
| Sodium | 7440-23-5 | 1 | mg/L | | 69 | <1 | 27 | 27 | 26 |
| Potassium | 7440-09-7 | 1 | mg/L | | 4 | <1 | 2 | 2 | 2 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | | 0.10 | 70.4 | 0.01 | 0.05 | 2.00 |
| Antimony | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | | 0.004 | 0.069 | <0.001 | 0.005 | <0.001 |
| Barium | 7440-39-3 | 0.001 | mg/L | | 0.008 | 0.004 | 0.015 | 0.031 | 0.006 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | 0.0151 | <0.0001 | <0.0001 | 0.0010 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | | <0.001 | 2.25 | 0.006 | <0.001 | 0.292 |
| Copper | 7440-50-8 | 0.001 | mg/L | | 0.006 | 0.209 | <0.001 | 0.001 | 0.062 |
| Lead | 7439-92-1 | 0.001 | mg/L | | <0.001 | 0.004 | <0.001 | <0.001 | 0.002 |
| Lithium | 7439-93-2 | 0.001 | mg/L | | 0.005 | 0.054 | 0.005 | 0.006 | 0.017 |
| Manganese | 7439-96-5 | 0.001 | mg/L | | 0.007 | 85.5 | 0.020 | 0.002 | 0.697 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | | 0.014 | 0.001 | 0.002 | 0.007 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | | <0.001 | 2.80 | 0.006 | 0.001 | 0.682 |
| Selenium | 7782-49-2 | 0.01 | mg/L | | 0.04 | 0.01 | <0.01 | 0.03 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | | 0.158 | 0.353 | 0.544 | 0.182 | 0.566 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 | 26-Feb-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1904857-001 | EB1904857-002 | EB1904857-003 | EB1904857-004 | EB1904857-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | **0.50** | <0.01 | <0.01 | <0.01 |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **11.4** | **0.023** | <0.005 | **0.739** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | **1360** | **0.12** | <0.05 | **26.4** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **1.3** | <0.1 | **0.2** | **0.6** | **0.1** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **Total Anions** | ---- | 0.01 | meq/L | | **3.92** | **126** | **2.14** | **1.42** | **8.38** |
| **Total Cations** | ---- | 0.01 | meq/L | | **----** | **103** | **----** | **----** | **7.60** |
| **Total Cations** | ---- | 0.01 | meq/L | | **3.85** | **----** | **1.94** | **1.44** | **----** |
| **Ionic Balance** | ---- | 0.01 | % | | **----** | **9.83** | **----** | **----** | **4.87** |
| **Ionic Balance** | ---- | 0.01 | % | | **0.91** | **----** | **----** | **----** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1907715** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 26-Mar-2019 16:51 |
| Order number | : 2018030 | Date Analysis Commenced | : 27-Mar-2019 |
| C-O-C number | : ---- | Issue Date | : 02-Apr-2019 11:53 |
| Sampler | : VERONICA CANALES | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

ilac-MRA NATA

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

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- Analytical Results

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## *Signatories*

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

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

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- EG035F (Dissolved Mercury): Positive mercury results have been confirmed by re-extraction and re-analysis.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Page : 3 of 4
Work Order : EB1907715
Client : RGS ENVIRONMENTAL PTY LTD
Project : 2018030 Mach Energy

## Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Client sample ID | KLC 1 Leachate | KLC 2 Leachate | KLC 3 Leachate | KLC 4 Leachate | KLC 5 Leachate |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 |
| | | | | | EB1907715-001 | EB1907715-002 | EB1907715-003 | EB1907715-004 | EB1907715-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| **pH Value** | ---- | 0.01 | pH Unit | | **7.92** | **2.37** | **5.96** | **6.73** | **3.30** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | | **261** | **9480** | **298** | **280** | **1430** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | | **17** | <1 | **2** | **6** | <1 |
| **Total Alkalinity as CaCO3** | ---- | 1 | mg/L | | **17** | <1 | **2** | **6** | <1 |
| **ED038A: Acidity** | | | | | | | | | |
| **Acidity as CaCO3** | ---- | 1 | mg/L | | <1 | **6000** | **4** | **2** | **155** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | **35** | **8230** | **109** | **91** | **755** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | **43** | **17** | **10** | **21** | **4** |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | | **3** | **118** | **7** | **2** | **67** |
| **Magnesium** | 7439-95-4 | 1 | mg/L | | **4** | **693** | **6** | **3** | **106** |
| **Sodium** | 7440-23-5 | 1 | mg/L | | **40** | <1 | **38** | **46** | **39** |
| **Potassium** | 7440-09-7 | 1 | mg/L | | **3** | <1 | **3** | **4** | **3** |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 0.01 | mg/L | | **0.18** | **167** | **0.06** | **0.20** | **2.92** |
| **Antimony** | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Arsenic** | 7440-38-2 | 0.001 | mg/L | | **0.004** | **0.378** | <0.001 | **0.007** | **0.003** |
| **Cadmium** | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | **0.0283** | <0.0001 | <0.0001 | **0.0014** |
| **Cobalt** | 7440-48-4 | 0.001 | mg/L | | <0.001 | **3.13** | **0.006** | <0.001 | **0.267** |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | **0.003** | **1.15** | **0.002** | **0.002** | **0.071** |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Lithium** | 7439-93-2 | 0.001 | mg/L | | **0.003** | **0.117** | **0.008** | **0.012** | **0.019** |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.005** | **165** | **0.022** | **0.003** | **1.42** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | **0.010** | **0.002** | **0.003** | **0.012** | <0.001 |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | **4.56** | **0.008** | **0.001** | **0.718** |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | **0.02** | **0.03** | **0.01** | **0.05** | <0.01 |
| **Strontium** | 7440-24-6 | 0.001 | mg/L | | **0.101** | **0.414** | **0.528** | **0.216** | **0.946** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | **1.06** | <0.01 | <0.01 | <0.01 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 Leachate | KLC 2 Leachate | KLC 3 Leachate | KLC 4 Leachate | KLC 5 Leachate |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 | 26-Mar-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1907715-001 | EB1907715-002 | EB1907715-003 | EB1907715-004 | EB1907715-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| Zinc | 7440-66-6 | 0.005 | mg/L | | **0.011** | **28.3** | **0.028** | **0.013** | **1.09** |
| Boron | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| Iron | 7439-89-6 | 0.05 | mg/L | | <0.05 | **1780** | **0.07** | <0.05 | **22.0** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| Mercury | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | **0.0003** | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| Fluoride | 16984-48-8 | 0.1 | mg/L | | **0.9** | **4.4** | **0.3** | **1.2** | <0.1 |
| **EN055: Ionic Balance** | | | | | | | | | |
| Total Anions | ---- | 0.01 | meq/L | | **2.28** | **172** | **2.59** | **2.61** | **15.8** |
| Total Cations | ---- | 0.01 | meq/L | | **----** | **152** | **----** | **----** | **----** |
| Total Cations | ---- | 0.01 | meq/L | | **2.30** | **----** | **2.57** | **2.45** | **13.8** |
| Ionic Balance | ---- | 0.01 | % | | **----** | **6.02** | **----** | **----** | **----** |
| Ionic Balance | ---- | 0.01 | % | | **----** | **----** | **----** | **----** | **6.71** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1910914** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 30-Apr-2019 15:40 |
| Order number | : 2018039 | Date Analysis Commenced | : 01-May-2019 |
| C-O-C number | : ---- | Issue Date | : 09-May-2019 11:57 |
| Sampler | : VERONICA CANALES | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Mark Hallas | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- EG020F (Dissolved Metals by ICP-MS): Limit of reporting raised due to matrix interference.
- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EK040P (Fluoride) - Particular samples required dilution due to matrix interferences. LOR values have been adjusted accordingly.
- EG035F (Dissolved Mercury): Positive mercury result has been confirmed by re-extraction and re-analysis.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 |
| Compound | CAS Number | LOR | Unit | EB1910914-001 | EB1910914-002 | EB1910914-003 | EB1910914-004 | EB1910914-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 7.50 | 2.22 | 4.31 | 6.71 | 3.15 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 185 | 9730 | 415 | 310 | 3070 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | 14 | <1 | <1 | 6 | <1 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | 14 | <1 | <1 | 6 | <1 |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 2 | 10700 | 7 | 1 | 281 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | 27 | 4170 | 159 | 98 | 2030 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 25 | 12 | 11 | 21 | 7 |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | 2 | 118 | 10 | 3 | 123 |
| Magnesium | 7439-95-4 | 1 | mg/L | 2 | 750 | 9 | 5 | 306 |
| Sodium | 7440-23-5 | 1 | mg/L | 32 | <1 | 59 | 56 | 84 |
| Potassium | 7440-09-7 | 1 | mg/L | 2 | <1 | 3 | 4 | 3 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | 0.72 | 177 | 0.01 | 0.74 | 9.36 |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.005 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | 0.004 | 1.57 | 0.001 | 0.006 | 0.002 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | 0.0253 | 0.0001 | <0.0001 | 0.0034 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | 2.53 | 0.013 | 0.001 | 0.522 |
| Copper | 7440-50-8 | 0.001 | mg/L | 0.002 | 1.61 | 0.002 | 0.003 | 0.155 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.005 | <0.001 | <0.001 | 0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | 0.002 | 0.096 | 0.011 | 0.012 | 0.030 |
| Manganese | 7439-96-5 | 0.001 | mg/L | 0.003 | 122 | 0.021 | 0.004 | 3.61 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | 0.008 | 0.010 | 0.003 | 0.011 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | <0.001 | 3.63 | 0.016 | 0.002 | 1.35 |
| Selenium | 7782-49-2 | 0.01 | mg/L | 0.02 | <0.05 | 0.02 | 0.06 | 0.02 |
| Strontium | 7440-24-6 | 0.001 | mg/L | 0.058 | 0.279 | 0.706 | 0.269 | 1.66 |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | 0.75 | <0.01 | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 4 |
| Work Order | : | EB1910914 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2018030 Mach Energy |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 | 30-Apr-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1910914-001 | EB1910914-002 | EB1910914-003 | EB1910914-004 | EB1910914-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **22.0** | **0.052** | <0.005 | **2.48** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **0.13** | **2500** | **0.11** | <0.05 | **41.2** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | **0.0001** | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.6** | **3.0** | **0.2** | **0.9** | <0.5 |
| **EN055: Ionic Balance** | | | | | | | | | |
| **Total Anions** | ---- | 0.01 | meq/L | | **1.55** | **87.2** | **3.62** | **2.75** | **42.5** |
| **Total Cations** | ---- | 0.01 | meq/L | | **----** | **92.6** | **----** | **----** | **----** |
| **Total Cations** | ---- | 0.01 | meq/L | | **1.71** | **----** | **3.88** | **3.10** | **35.0** |
| **Ionic Balance** | ---- | 0.01 | % | | **----** | **3.01** | **----** | **----** | **----** |
| **Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **3.49** | **5.92** | **9.56** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1913624** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 28-May-2019 17:05 |
| Order number | : 2018030 | Date Analysis Commenced | : 28-May-2019 |
| C-O-C number | : ---- | Issue Date | : 07-Jun-2019 14:02 |
| Sampler | : VERONICA CANALES | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Mark Hallas | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Tom Maloney | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

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

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG035F (Dissolved Mercury): Positive mercury results have been confirmed by re-extraction and re-analysis.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 |
| | | | | | EB1913624-001 | EB1913624-002 | EB1913624-003 | EB1913624-004 | EB1913624-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| **pH Value** | ---- | 0.01 | pH Unit | | **7.12** | **2.02** | **6.08** | **6.49** | **3.18** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | | **152** | **13300** | **589** | **530** | **3820** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | | **9** | <1 | **3** | **6** | <1 |
| **Total Alkalinity as CaCO3** | ---- | 1 | mg/L | | **9** | <1 | **3** | **6** | <1 |
| **ED038A: Acidity** | | | | | | | | | |
| **Acidity as CaCO3** | ---- | 1 | mg/L | | <1 | **14800** | **3** | **2** | **286** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | **24** | **8020** | **228** | **182** | **2550** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | **18** | **1** | **16** | **32** | **6** |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | | **1** | **160** | **15** | **6** | **206** |
| **Magnesium** | 7439-95-4 | 1 | mg/L | | **2** | **629** | **19** | **10** | **457** |
| **Sodium** | 7440-23-5 | 1 | mg/L | | **24** | <1 | **74** | **91** | **81** |
| **Potassium** | 7440-09-7 | 1 | mg/L | | **2** | <1 | **5** | **6** | **3** |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 0.01 | mg/L | | **0.65** | **381** | **0.03** | **0.04** | **9.46** |
| **Antimony** | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Arsenic** | 7440-38-2 | 0.001 | mg/L | | **0.004** | **1.64** | **0.002** | **0.006** | **0.003** |
| **Cadmium** | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | **0.0384** | **0.0001** | <0.0001 | **0.0035** |
| **Cobalt** | 7440-48-4 | 0.001 | mg/L | | <0.001 | **3.26** | **0.010** | **0.001** | **0.525** |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | **0.002** | **2.88** | **0.003** | **0.003** | **0.108** |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | <0.001 | **0.002** | <0.001 | <0.001 | **0.001** |
| **Lithium** | 7439-93-2 | 0.001 | mg/L | | **0.002** | **0.212** | **0.015** | **0.020** | **0.027** |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **0.003** | **172** | **0.030** | **0.008** | **6.66** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | **0.006** | **0.022** | **0.003** | **0.017** | <0.001 |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | <0.001 | **5.31** | **0.011** | **0.002** | **1.20** |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | **0.01** | **0.05** | **0.03** | **0.10** | **0.02** |
| **Strontium** | 7440-24-6 | 0.001 | mg/L | | **0.045** | **0.441** | **1.02** | **0.641** | **2.84** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | **0.42** | <0.01 | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 4 |
| Work Order | : | EB1913624 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2018030 Mach Energy |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 | 28-May-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1913624-001 | EB1913624-002 | EB1913624-003 | EB1913624-004 | EB1913624-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **31.2** | **0.055** | <0.005 | **2.31** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **0.13** | **4030** | **0.10** | **0.15** | **29.8** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | **0.0003** | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.5** | <5.0 | **0.3** | **1.1** | **0.1** |
| **EN055: Ionic Balance** | | | | | | | | | |
| ø **Total Anions** | ---- | 0.01 | meq/L | | **1.19** | **167** | **5.26** | **4.81** | **53.3** |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **----** | **391** | **----** | **----** | **----** |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **1.31** | **----** | **5.66** | **5.23** | **51.5** |
| ø **Ionic Balance** | ---- | 0.01 | % | | **----** | **40.1** | **----** | **----** | **----** |
| ø **Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **3.67** | **4.20** | **1.69** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1916406** | Page | : 1 of 4 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 25-Jun-2019 14:50 |
| Order number | : 2018030 | Date Analysis Commenced | : 26-Jun-2019 |
| C-O-C number | : ---- | Issue Date | : 02-Jul-2019 14:52 |
| Sampler | : MARY MACILROY | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- EG020F (Dissolved Metals by ICP-MS): Limit of reporting raised due to matrix interference.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 |
| Compound | CAS Number | LOR | Unit | EB1916406-001 | EB1916406-002 | EB1916406-003 | EB1916406-004 | EB1916406-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 6.85 | 2.19 | 5.64 | 6.53 | 3.24 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 114 | 8220 | 769 | 393 | 3130 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | 9 | <1 | 2 | 7 | <1 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | 9 | <1 | 2 | 7 | <1 |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 1 | 7200 | 2 | 1 | 181 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | 19 | 7290 | 314 | 121 | 2090 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 11 | <10 | 12 | 17 | 4 |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | <1 | 144 | 22 | 4 | 153 |
| Magnesium | 7439-95-4 | 1 | mg/L | 1 | 482 | 24 | 7 | 335 |
| Sodium | 7440-23-5 | 1 | mg/L | 20 | 1 | 100 | 57 | 50 |
| Potassium | 7440-09-7 | 1 | mg/L | 2 | <1 | 5 | 4 | 3 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | 1.28 | 214 | 0.03 | 0.19 | 6.66 |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.005 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | 0.004 | 1.17 | <0.001 | 0.004 | 0.002 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | <0.0001 | 0.0176 | <0.0001 | <0.0001 | 0.0023 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | <0.001 | 1.73 | 0.010 | 0.001 | 0.330 |
| Copper | 7440-50-8 | 0.001 | mg/L | 0.003 | 1.36 | 0.002 | 0.002 | 0.111 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.005 | <0.001 | <0.001 | 0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | 0.002 | 0.084 | 0.015 | 0.014 | 0.020 |
| Manganese | 7439-96-5 | 0.001 | mg/L | 0.002 | 85.3 | 0.027 | 0.004 | 4.40 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | 0.006 | 0.015 | 0.004 | 0.016 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | <0.001 | 2.65 | 0.011 | <0.001 | 0.870 |
| Selenium | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.05 | 0.03 | 0.06 | 0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | 0.020 | 0.357 | 1.23 | 0.388 | 1.73 |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | 0.35 | <0.01 | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 4 |
| Work Order | : | EB1916406 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2018030 Mach Energy |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 1 | KLC 2 | KLC 3 | KLC 4 | KLC 5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 | 25-Jun-2019 00:00 |
| Compound | CAS Number | LOR | Unit | | EB1916406-001 | EB1916406-002 | EB1916406-003 | EB1916406-004 | EB1916406-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | <0.005 | **15.3** | **0.057** | <0.005 | **1.51** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **0.16** | **2150** | <0.05 | <0.05 | **24.3** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.5** | <0.1 | **0.3** | **0.8** | **0.2** |
| **EN055: Ionic Balance** | | | | | | | | | |
| ø **Total Anions** | ---- | 0.01 | meq/L | | **0.88** | **152** | **6.92** | **3.14** | **43.6** |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **----** | **154** | **----** | **----** | **----** |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **1.00** | **----** | **7.55** | **3.36** | **37.4** |
| ø **Ionic Balance** | ---- | 0.01 | % | | **----** | **0.65** | **----** | **----** | **----** |
| ø **Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **4.39** | **3.37** | **7.61** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB1919939** | Page | : 1 of 3 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Customer Services EB |
| Address | : PO Box 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61-7-3243 7222 |
| Project | : 2018030 Mach Energy | Date Samples Received | : 01-Aug-2019 15:39 |
| Order number | : - | Date Analysis Commenced | : 02-Aug-2019 |
| C-O-C number | : 2897 | Issue Date | : 07-Aug-2019 11:59 |
| Sampler | : MARY MACELROY | | |
| Site | : Mach Energy | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

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Accreditation No. 825
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This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

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

- ED045G (Chloride): Sample EB1919939_002 (KLC-2) was diluted due to matrix interference. LOR adjusted accordingly.
- Ionic Balance out of acceptable limits for sample EB1919939-002 (KLC-2) due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Page : 3 of 3
Work Order : EB1919939
Client : RGS ENVIRONMENTAL PTY LTD
Project : 2018030 Mach Energy

## Analytical Results

Sub-Matrix: **WASTEWATER** (Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Client sample ID | KLC-1 | KLC-2 | KLC-3 | KLC-4 | KLC-5 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 01-Aug-2019 10:37 | 01-Aug-2019 10:37 | 01-Aug-2019 10:38 | 01-Aug-2019 10:39 | 01-Aug-2019 10:39 |
| | | | | | EB1919939-001 | EB1919939-002 | EB1919939-003 | EB1919939-004 | EB1919939-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| **pH Value** | ---- | 0.01 | pH Unit | | **7.66** | **2.31** | **5.70** | **7.03** | **3.28** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | | **99** | **7170** | **622** | **596** | **3540** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | | **13** | <1 | **1** | **14** | <1 |
| **Total Alkalinity as CaCO3** | ---- | 1 | mg/L | | **13** | <1 | **1** | **14** | <1 |
| **ED038A: Acidity** | | | | | | | | | |
| **Acidity as CaCO3** | ---- | 1 | mg/L | | <1 | **6060** | <1 | <1 | **321** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | **17** | **7730** | **240** | **204** | **2600** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | **10** | <10 | **14** | **20** | **6** |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | | <1 | **189** | **22** | **14** | **229** |
| **Magnesium** | 7439-95-4 | 1 | mg/L | | <1 | **411** | **18** | **15** | **417** |
| **Sodium** | 7440-23-5 | 1 | mg/L | | **17** | <1 | **77** | **83** | **50** |
| **Potassium** | 7440-09-7 | 1 | mg/L | | **2** | <1 | **5** | **8** | **2** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.4** | <0.1 | **0.4** | **1.4** | **0.1** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **0.90** | **161** | **5.41** | **5.09** | **54.3** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **0.79** | **43.2** | **6.06** | **5.75** | **48.0** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **57.6** | **5.62** | **6.06** | **6.19** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2009898** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH-Mt Pleasant | Date Samples Received | : 08-Apr-2020 16:03 |
| Order number | : ---- | Date Analysis Commenced | : 14-Apr-2020 |
| C-O-C number | : ---- | Issue Date | : 20-Apr-2020 17:43 |
| Sampler | : LEXI K NG | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

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- General Comments
- Analytical Results

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## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Santusha Pandra | Senior Chemist | Brisbane Inorganics, Stafford, QLD |

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

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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 6 | KLC 7 | KLC 8 | KLC 9 | KLC 10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2009898-001 | EB2009898-002 | EB2009898-003 | EB2009898-004 | EB2009898-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | | 7.03 | 8.04 | 3.57 | 6.91 | 7.28 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | | 1240 | 373 | 3650 | 98 | 199 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | | 12 | 70 | <1 | 13 | 31 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | | 12 | 70 | <1 | 13 | 31 |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | | 4 | 1 | 62 | 6 | 29 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | | 564 | 54 | 2500 | 22 | 40 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | | 39 | 32 | 3 | 6 | 16 |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | | 53 | 11 | 318 | 4 | 6 |
| Magnesium | 7439-95-4 | 1 | mg/L | | 62 | 13 | 304 | 4 | 6 |
| Sodium | 7440-23-5 | 1 | mg/L | | 108 | 38 | 120 | 7 | 22 |
| Potassium | 7440-09-7 | 1 | mg/L | | 6 | 4 | 4 | <1 | 1 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | | <0.01 | <0.01 | 2.39 | 0.01 | <0.01 |
| Antimony | 7440-36-0 | 0.001 | mg/L | | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | | <0.0001 | <0.0001 | 0.0177 | <0.0001 | <0.0001 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | | 0.012 | 0.001 | 0.599 | <0.001 | <0.001 |
| Copper | 7440-50-8 | 0.001 | mg/L | | <0.001 | <0.001 | 0.375 | <0.001 | 0.001 |
| Lead | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | 0.009 | <0.001 | <0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | | 0.015 | 0.008 | 0.061 | 0.002 | 0.003 |
| Manganese | 7439-96-5 | 0.001 | mg/L | | 0.112 | 0.044 | 19.6 | 0.016 | 0.023 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | | 0.008 | 0.022 | <0.001 | 0.002 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | | 0.011 | <0.001 | 0.698 | <0.001 | <0.001 |
| Selenium | 7782-49-2 | 0.01 | mg/L | | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | | 1.48 | 0.278 | 4.31 | 0.088 | 0.110 |
| Vanadium | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 6 |
| Work Order | : | EB2009898 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 - MACH-Mt Pleasant |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 6 | KLC 7 | KLC 8 | KLC 9 | KLC 10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 |
| Compound | CAS Number | LOR | Unit | | EB2009898-001 | EB2009898-002 | EB2009898-003 | EB2009898-004 | EB2009898-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.005** | <0.005 | **1.86** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | **0.80** | <0.05 | <0.05 |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **1.1** | **0.9** | **0.4** | **0.1** | **0.3** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **13.1** | **3.42** | **52.1** | **0.89** | **1.90** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **12.6** | **3.37** | **46.2** | **0.83** | **1.78** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **1.88** | **0.76** | **6.02** | **----** | **----** |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC 11 | KLC 12 | KLC 13 | KLC 14 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | EB2009898-006 | EB2009898-007 | EB2009898-008 | EB2009898-009 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **5.80** | **7.05** | **7.30** | **7.39** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **850** | **101** | **98** | **560** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **4** | **11** | **22** | **29** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **4** | **11** | **22** | **29** | ---- |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **4** | **21** | **4** | **4** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **425** | **25** | **11** | **170** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **5** | **6** | **9** | **35** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **59** | **3** | **3** | **14** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | **53** | **4** | **3** | **17** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **25** | **7** | **10** | **64** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | **5** | <1 | <1 | **3** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.02** | **0.02** | **0.01** | <0.01 | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0003** | <0.0001 | <0.0001 | <0.0001 | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.011** | <0.001 | <0.001 | <0.001 | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.003** | <0.001 | <0.001 | <0.001 | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.013** | <0.001 | **0.002** | **0.010** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | **0.404** | **0.004** | **0.015** | **0.018** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.007** | **0.004** | **0.037** | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.020** | <0.001 | <0.001 | <0.001 | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | **0.642** | **0.069** | **0.063** | **0.339** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

| | | |
|---|---|---|
| Page | : | 6 of 6 |
| Work Order | : | EB2009898 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 - MACH-Mt Pleasant |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC 11 | KLC 12 | KLC 13 | KLC 14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | 08-Apr-2020 00:00 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2009898-006 | EB2009898-007 | EB2009898-008 | EB2009898-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.063** | <0.005 | <0.005 | <0.005 | ---- |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | <0.05 | <0.05 | **0.06** | <0.05 | ---- |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **0.4** | **0.2** | **1.8** | ---- |
| **EN055: Ionic Balance** | | | | | | | | | |
| ø **Total Anions** | ---- | 0.01 | meq/L | | **9.07** | **0.91** | **0.92** | **5.11** | ---- |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **8.52** | **0.78** | **0.83** | **4.96** | ---- |
| ø **Ionic Balance** | ---- | 0.01 | % | | **3.12** | **----** | **----** | **1.47** | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2012205** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 | Date Samples Received | : 07-May-2020 16:20 |
| Order number | : - | Date Analysis Commenced | : 08-May-2020 |
| C-O-C number | : 10854 | Issue Date | : 12-May-2020 10:56 |
| Sampler | : ALAN ROBERTSON, VERONICA CANALES | | |
| Site | : 2019086- MACH Mt Pleasant_L2 | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

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

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

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

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

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

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

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

- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- EG035F (Dissolved Mercury): Positive mercury result has been confirmed by re-extraction and re-analysis.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 07-May-2020 12:23 | 07-May-2020 13:10 | 07-May-2020 13:10 | 07-May-2020 13:11 | 07-May-2020 13:11 |
| Compound | CAS Number | LOR | Unit | EB2012205-001 | EB2012205-002 | EB2012205-003 | EB2012205-004 | EB2012205-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **5.38** | **6.77** | **2.96** | **6.85** | **6.73** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **1250** | **180** | **3430** | **392** | **214** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **4** | **4** | <1 | **6** | **4** |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **4** | **4** | <1 | **6** | **4** |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **15** | <1 | **538** | **2** | **1** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **652** | **74** | **2330** | **164** | **81** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **8** | **3** | **1** | **6** | **6** |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **72** | **14** | **157** | **24** | **13** |
| Magnesium | 7439-95-4 | 1 | mg/L | **85** | **8** | **210** | **25** | **12** |
| Sodium | 7440-23-5 | 1 | mg/L | **80** | **4** | **42** | **12** | **8** |
| Potassium | 7440-09-7 | 1 | mg/L | **9** | **1** | **3** | **4** | **1** |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.04** | **0.02** | **3.18** | <0.01 | **0.03** |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | **0.121** | <0.001 | <0.001 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0005** | <0.0001 | **0.0201** | <0.0001 | <0.0001 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.091** | <0.001 | **0.583** | **0.001** | <0.001 |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.006** | <0.001 | **0.834** | <0.001 | <0.001 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | **0.022** | <0.001 | <0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.014** | <0.001 | **0.031** | **0.003** | **0.001** |
| Manganese | 7439-96-5 | 0.001 | mg/L | **1.07** | **0.010** | **13.1** | **0.030** | **0.011** |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.005** | **0.001** | **0.002** | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.093** | **0.001** | **0.734** | **0.002** | <0.001 |
| Selenium | 7782-49-2 | 0.01 | mg/L | **0.01** | <0.01 | **0.03** | <0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | **1.46** | **0.325** | **2.32** | **0.561** | **0.238** |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-May-2020 12:23 | 07-May-2020 13:10 | 07-May-2020 13:10 | 07-May-2020 13:11 | 07-May-2020 13:11 |
| Compound | CAS Number | LOR | Unit | | EB2012205-001 | EB2012205-002 | EB2012205-003 | EB2012205-004 | EB2012205-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.092** | <0.005 | **1.68** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **2.52** | <0.05 | **93.4** | <0.05 | <0.05 |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | **0.0002** | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.4** | **0.2** | **0.3** | **0.2** | **0.2** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **13.9** | **1.70** | **48.5** | **3.70** | **1.94** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **----** | **----** | **31.2** | **----** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **14.3** | **1.56** | **----** | **3.88** | **2.01** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **21.7** | **----** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **1.48** | **----** | **----** | **2.32** | **----** |

| | |
|---|---|
| Page | : 5 of 6 |
| Work Order | : EB2012205 |
| Client | : RGS ENVIRONMENTAL PTY LTD |
| Project | : 2019086 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 07-May-2020 13:12 | 07-May-2020 13:12 | 07-May-2020 13:13 | 07-May-2020 13:13 | ---- |
| Compound | CAS Number | LOR | Unit | EB2012205-006 | EB2012205-007 | EB2012205-008 | EB2012205-009 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **4.81** | **7.19** | **7.34** | **5.71** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **559** | **576** | **248** | **408** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **1** | **11** | **9** | **4** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **1** | **11** | **9** | **4** | ---- |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **15** | **2** | **1** | **8** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **261** | **246** | **94** | **179** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **1** | **10** | **8** | **4** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **37** | **29** | **16** | **20** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | **38** | **46** | **12** | **22** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **12** | **22** | **13** | **23** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | **7** | **3** | **2** | **4** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.06** | <0.01 | **0.02** | **0.01** | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0002** | <0.0001 | <0.0001 | **0.0002** | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.015** | <0.001 | <0.001 | **0.006** | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.012** | **0.001** | <0.001 | **0.001** | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.007** | **0.002** | **0.002** | **0.005** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | **0.399** | **0.017** | **0.009** | **0.382** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.015** | **0.014** | <0.001 | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.019** | **0.001** | <0.001 | **0.006** | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | **0.425** | **0.720** | **0.314** | **0.384** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

| | | |
|---|---|---|
| Page | : | 6 of 6 |
| Work Order | : | EB2012205 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-May-2020 13:12 | 07-May-2020 13:12 | 07-May-2020 13:13 | 07-May-2020 13:13 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2012205-006 | EB2012205-007 | EB2012205-008 | EB2012205-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.043** | <0.005 | <0.005 | **0.013** | ---- |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | ---- |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **3.79** | <0.05 | <0.05 | **2.46** | ---- |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | ---- |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **1.0** | **0.4** | **0.5** | ---- |
| **EN055: Ionic Balance** | | | | | | | | | |
| ø **Total Anions** | ---- | 0.01 | meq/L | | **5.48** | **5.62** | **2.36** | **3.92** | ---- |
| ø **Total Cations** | ---- | 0.01 | meq/L | | **5.67** | **6.27** | **2.40** | **3.91** | ---- |
| ø **Ionic Balance** | ---- | 0.01 | % | | **1.73** | **5.41** | **----** | **0.10** | ---- |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2015249** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH Mt Pleasant | Date Samples Received | : 09-Jun-2020 17:30 |
| Order number | : - | Date Analysis Commenced | : 10-Jun-2020 |
| C-O-C number | : 11691 | Issue Date | : 15-Jun-2020 10:39 |
| Sampler | : ALAN ROBERTSON, VERONICA CANALES | | |
| Site | : 2019086- MACH Mt Pleasant_L3 | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

ilac-MRA NATA

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

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

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

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

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

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

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

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

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 09-Jun-2020 11:01 | 09-Jun-2020 11:01 | 09-Jun-2020 11:03 | 09-Jun-2020 11:03 | 09-Jun-2020 11:04 |
| Compound | CAS Number | LOR | Unit | EB2015249-001 | EB2015249-002 | EB2015249-003 | EB2015249-004 | EB2015249-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **5.12** | **6.58** | **2.83** | **6.66** | **6.58** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **1470** | **107** | **4050** | **415** | **153** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **3** | **5** | <1 | **6** | **3** |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **3** | **5** | <1 | **6** | **3** |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **22** | <1 | **1060** | <1 | <1 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **805** | **39** | **2680** | **187** | **48** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **7** | **1** | <1 | **6** | **5** |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **100** | **5** | **196** | **22** | **4** |
| Magnesium | 7439-95-4 | 1 | mg/L | **109** | **5** | **312** | **26** | **7** |
| Sodium | 7440-23-5 | 1 | mg/L | **72** | **4** | **37** | **12** | **11** |
| Potassium | 7440-09-7 | 1 | mg/L | **8** | **1** | **2** | **3** | **1** |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.08** | **0.17** | **10.8** | <0.01 | **0.26** |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | **0.518** | <0.001 | <0.001 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0007** | <0.0001 | **0.0221** | <0.0001 | <0.0001 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.121** | **0.001** | **0.726** | **0.002** | <0.001 |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.011** | **0.002** | **1.20** | <0.001 | <0.001 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | **0.009** | <0.001 | <0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.017** | **0.001** | **0.066** | **0.003** | **0.001** |
| Manganese | 7439-96-5 | 0.001 | mg/L | **1.97** | **0.024** | **33.6** | **0.045** | **0.006** |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.004** | **0.002** | **0.001** | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.118** | **0.002** | **0.954** | **0.002** | <0.001 |
| Selenium | 7782-49-2 | 0.01 | mg/L | **0.02** | <0.01 | **0.04** | <0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | **1.95** | **0.128** | **2.08** | **0.526** | **0.077** |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | **0.02** | <0.01 | <0.01 |

| | | |
|---|---|---|
| Page | : | 4 of 6 |
| Work Order | : | EB2015249 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 - MACH Mt Pleasant |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 09-Jun-2020 11:01 | 09-Jun-2020 11:01 | 09-Jun-2020 11:03 | 09-Jun-2020 11:03 | 09-Jun-2020 11:04 |
| Compound | CAS Number | LOR | Unit | | EB2015249-001 | EB2015249-002 | EB2015249-003 | EB2015249-004 | EB2015249-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.157** | <0.005 | **2.27** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **5.67** | **0.07** | **250** | <0.05 | **0.08** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.2** | **0.1** | **1.2** | **0.1** | **0.2** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **17.0** | **0.94** | **55.8** | **4.18** | **1.20** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **----** | **----** | **48.6** | **----** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **17.3** | **0.86** | **----** | **3.84** | **1.28** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **7.10** | **----** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **0.82** | **----** | **----** | **4.32** | **----** |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 09-Jun-2020 11:04 | 09-Jun-2020 11:05 | 09-Jun-2020 11:05 | 09-Jun-2020 11:05 | ---- |
| Compound | CAS Number | LOR | Unit | EB2015249-006 | EB2015249-007 | EB2015249-008 | EB2015249-009 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **4.51** | **7.04** | **7.26** | **5.98** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **753** | **487** | **198** | **494** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | <1 | **11** | **15** | **5** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | <1 | **11** | **15** | **5** | ---- |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **5** | **1** | <1 | **22** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **388** | **204** | **64** | **207** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **2** | **9** | **9** | **3** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **48** | **15** | **8** | **29** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | **55** | **35** | **8** | **29** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **14** | **19** | **14** | **15** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | **6** | **3** | **2** | **3** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.09** | **0.01** | **0.12** | **0.04** | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0003** | <0.0001 | <0.0001 | **0.0003** | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.013** | <0.001 | <0.001 | **0.005** | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.027** | <0.001 | <0.001 | **0.005** | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.011** | **0.002** | **0.002** | **0.007** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | **0.558** | **0.017** | **0.012** | **0.548** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.006** | **0.012** | <0.001 | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.024** | **0.001** | **0.001** | **0.006** | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | **0.534** | **0.374** | **0.156** | **0.503** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

| | | |
|---|---|---|
| Page | : | 6 of 6 |
| Work Order | : | EB2015249 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 - MACH Mt Pleasant |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 09-Jun-2020 11:04 | 09-Jun-2020 11:05 | 09-Jun-2020 11:05 | 09-Jun-2020 11:05 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2015249-006 | EB2015249-007 | EB2015249-008 | EB2015249-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.061** | <0.005 | <0.005 | **0.022** | **----** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **4.62** | <0.05 | <0.05 | **5.80** | **----** |
| **EG035F: Dissolved Mercury by FIMS** | | | | | | | | | |
| **Mercury** | 7439-97-6 | 0.0001 | mg/L | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **0.7** | **0.4** | **0.3** | **----** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **8.13** | **4.72** | **1.89** | **4.49** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **7.68** | **4.53** | **1.72** | **4.56** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **2.85** | **2.04** | **----** | **0.76** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2017807** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH Mt Pleasant | Date Samples Received | : 07-Jul-2020 16:09 |
| Order number | : - | Date Analysis Commenced | : 08-Jul-2020 |
| C-O-C number | : 12389 | Issue Date | : 13-Jul-2020 15:30 |
| Sampler | : ALAN ROBERTSON, VERONICA CANALES | | |
| Site | : 2019086- MACH Mt Pleasant L4 | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Dave Gitsham | Metals Instrument Chemist | Brisbane Inorganics, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |

## General Comments

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

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

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

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

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

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

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

- Ionic Balance out of acceptable limits due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 07-Jul-2020 10:23 | 07-Jul-2020 10:24 | 07-Jul-2020 10:25 | 07-Jul-2020 10:26 | 07-Jul-2020 10:26 |
| Compound | CAS Number | LOR | Unit | EB2017807-001 | EB2017807-002 | EB2017807-003 | EB2017807-004 | EB2017807-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **5.21** | **6.41** | **2.73** | **6.29** | **6.56** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **1420** | **80** | **4590** | **373** | **76** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | **9** | **10** | <1 | **6** | **9** |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | **9** | **10** | <1 | **6** | **9** |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **10** | **2** | **1250** | **4** | **2** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **836** | **30** | **3410** | **176** | **26** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **5** | **2** | <1 | **5** | **2** |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **108** | **3** | **234** | **24** | **2** |
| Magnesium | 7439-95-4 | 1 | mg/L | **121** | **4** | **449** | **30** | **3** |
| Sodium | 7440-23-5 | 1 | mg/L | **53** | **3** | **23** | **11** | **5** |
| Potassium | 7440-09-7 | 1 | mg/L | **6** | **1** | <1 | **3** | <1 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.06** | **0.17** | **24.9** | <0.01 | **0.35** |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | **0.858** | <0.001 | <0.001 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0007** | <0.0001 | **0.0297** | <0.0001 | <0.0001 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.087** | <0.001 | **0.959** | **0.002** | <0.001 |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.007** | <0.001 | **1.52** | <0.001 | <0.001 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | **0.003** | <0.001 | <0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.015** | <0.001 | **0.073** | **0.002** | <0.001 |
| Manganese | 7439-96-5 | 0.001 | mg/L | **2.31** | **0.007** | **56.3** | **0.041** | **0.006** |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.004** | **0.003** | <0.001 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.089** | **0.001** | **1.24** | **0.002** | <0.001 |
| Selenium | 7782-49-2 | 0.01 | mg/L | **0.02** | <0.01 | **0.02** | <0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | **2.27** | **0.088** | **1.62** | **0.384** | **0.043** |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | **0.02** | <0.01 | <0.01 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Jul-2020 10:23 | 07-Jul-2020 10:24 | 07-Jul-2020 10:25 | 07-Jul-2020 10:26 | 07-Jul-2020 10:26 |
| Compound | CAS Number | LOR | Unit | | EB2017807-001 | EB2017807-002 | EB2017807-003 | EB2017807-004 | EB2017807-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.122** | <0.005 | **3.43** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **5.71** | <0.05 | **380** | <0.05 | **0.08** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.2** | **0.1** | <0.1 | **0.1** | **0.2** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **17.7** | **0.88** | **71.0** | **3.92** | **0.78** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **----** | **0.68** | **68.2** | **----** | **0.60** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **17.8** | **----** | **----** | **4.22** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **1.96** | **----** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **0.22** | **----** | **----** | **3.64** | **----** |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Jul-2020 10:27 | 07-Jul-2020 10:27 | 07-Jul-2020 10:28 | 07-Jul-2020 10:28 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2017807-006 | EB2017807-007 | EB2017807-008 | EB2017807-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | | **4.57** | **6.53** | **6.52** | **5.05** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | | **797** | **508** | **216** | **495** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | | <1 | **12** | **11** | **3** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | | <1 | **12** | **11** | **3** | ---- |
| **ED038A: Acidity** | | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | | **12** | **2** | **1** | **12** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | | **423** | **216** | **81** | **209** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | | **2** | **7** | **9** | **2** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | | **48** | **21** | **13** | **33** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | | **70** | **47** | **12** | **36** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | | **15** | **16** | **12** | **10** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | | **6** | **3** | **2** | **3** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | | **0.11** | <0.01 | **0.06** | **0.02** | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | | **0.0004** | <0.0001 | <0.0001 | **0.0002** | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | | **0.013** | <0.001 | <0.001 | **0.003** | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | | **0.032** | <0.001 | <0.001 | **0.004** | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | | **0.012** | **0.001** | <0.001 | **0.005** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | | **0.643** | **0.018** | **0.014** | **0.497** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.003** | **0.007** | <0.001 | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | | **0.023** | <0.001 | <0.001 | **0.005** | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | | **0.01** | **0.01** | **0.01** | <0.01 | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | | **0.580** | **0.358** | **0.179** | **0.541** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

| | | |
|---|---|---|
| Page | : | 6 of 6 |
| Work Order | : | EB2017807 |
| Client | : | RGS ENVIRONMENTAL PTY LTD |
| Project | : | 2019086 - MACH Mt Pleasant |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Jul-2020 10:27 | 07-Jul-2020 10:27 | 07-Jul-2020 10:28 | 07-Jul-2020 10:28 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2017807-006 | EB2017807-007 | EB2017807-008 | EB2017807-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.072** | <0.005 | <0.005 | **0.020** | **----** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **3.68** | <0.05 | <0.05 | **5.98** | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **0.5** | **0.3** | **0.3** | **----** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **8.86** | **4.93** | **2.16** | **4.47** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **8.96** | **5.69** | **2.21** | **5.12** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **0.56** | **7.10** | **----** | **6.82** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2020923** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH Mt Pleasant | Date Samples Received | : 07-Aug-2020 17:10 |
| Order number | : | Date Analysis Commenced | : 12-Aug-2020 |
| C-O-C number | : 13193 | Issue Date | : 18-Aug-2020 08:44 |
| Sampler | : ALAN ROBERTSON, VERONICA CANALES | | |
| Site | : 2019086_MACH Mt Pleasant-L5 | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

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| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Dave Gitsham | Metals Instrument Chemist | Brisbane Inorganics, Stafford, QLD |
| Kim McCabe | Senior Inorganic Chemist | Brisbane Inorganics, Stafford, QLD |
| Santusha Pandra | Senior Chemist | Brisbane Inorganics, Stafford, QLD |

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

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

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

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

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

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
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- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

Sub-Matrix: **WATER**
(Matrix: **WATER**)

| Compound | CAS Number | LOR | Unit | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Aug-2020 12:21 | 07-Aug-2020 12:21 | 07-Aug-2020 12:22 | 07-Aug-2020 12:22 | 07-Aug-2020 12:22 |
| | | | | | EB2020923-001 | EB2020923-002 | EB2020923-003 | EB2020923-004 | EB2020923-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | | |
| **pH Value** | ---- | 0.01 | pH Unit | | **4.78** | **6.87** | **2.53** | **6.74** | **6.79** |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | | **1550** | **72** | **5600** | **501** | **59** |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | | |
| **Hydroxide Alkalinity as CaCO3** | DMO-210-001 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Carbonate Alkalinity as CaCO3** | 3812-32-6 | 1 | mg/L | | <1 | <1 | <1 | <1 | <1 |
| **Bicarbonate Alkalinity as CaCO3** | 71-52-3 | 1 | mg/L | | <1 | **5** | <1 | **7** | **5** |
| **Total Alkalinity as CaCO3** | ---- | 1 | mg/L | | <1 | **5** | <1 | **7** | **5** |
| **ED038A: Acidity** | | | | | | | | | |
| **Acidity as CaCO3** | ---- | 1 | mg/L | | **14** | **2** | **1760** | **3** | **2** |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | | |
| **Sulfate as SO4 - Turbidimetric** | 14808-79-8 | 1 | mg/L | | **840** | **23** | **3410** | **203** | **20** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | | |
| **Chloride** | 16887-00-6 | 1 | mg/L | | **5** | **1** | <1 | **5** | **1** |
| **ED093F: Dissolved Major Cations** | | | | | | | | | |
| **Calcium** | 7440-70-2 | 1 | mg/L | | **132** | **4** | **248** | **17** | **2** |
| **Magnesium** | 7439-95-4 | 1 | mg/L | | **133** | **4** | **474** | **35** | **3** |
| **Sodium** | 7440-23-5 | 1 | mg/L | | **42** | **2** | **11** | **11** | **4** |
| **Potassium** | 7440-09-7 | 1 | mg/L | | **7** | **1** | <1 | **3** | <1 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | | |
| **Aluminium** | 7429-90-5 | 0.01 | mg/L | | **0.08** | **0.14** | **38.1** | <0.01 | **0.34** |
| **Antimony** | 7440-36-0 | 0.001 | mg/L | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Arsenic** | 7440-38-2 | 0.001 | mg/L | | <0.001 | <0.001 | **1.10** | <0.001 | <0.001 |
| **Cadmium** | 7440-43-9 | 0.0001 | mg/L | | **0.0008** | <0.0001 | **0.0394** | <0.0001 | <0.0001 |
| **Cobalt** | 7440-48-4 | 0.001 | mg/L | | **0.070** | <0.001 | **1.05** | **0.002** | <0.001 |
| **Copper** | 7440-50-8 | 0.001 | mg/L | | **0.012** | **0.001** | **2.00** | <0.001 | <0.001 |
| **Lead** | 7439-92-1 | 0.001 | mg/L | | **0.001** | <0.001 | **0.002** | <0.001 | <0.001 |
| **Lithium** | 7439-93-2 | 0.001 | mg/L | | **0.018** | <0.001 | **0.106** | **0.003** | <0.001 |
| **Manganese** | 7439-96-5 | 0.001 | mg/L | | **2.07** | **0.006** | **66.6** | **0.048** | **0.004** |
| **Molybdenum** | 7439-98-7 | 0.001 | mg/L | | <0.001 | **0.004** | **0.003** | **0.001** | <0.001 |
| **Nickel** | 7440-02-0 | 0.001 | mg/L | | **0.073** | **0.001** | **1.50** | **0.002** | <0.001 |
| **Selenium** | 7782-49-2 | 0.01 | mg/L | | **0.02** | <0.01 | **0.04** | **0.01** | <0.01 |
| **Strontium** | 7440-24-6 | 0.001 | mg/L | | **2.08** | **0.081** | **1.32** | **0.418** | **0.041** |
| **Vanadium** | 7440-62-2 | 0.01 | mg/L | | <0.01 | <0.01 | **0.03** | <0.01 | <0.01 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Aug-2020 12:21 | 07-Aug-2020 12:21 | 07-Aug-2020 12:22 | 07-Aug-2020 12:22 | 07-Aug-2020 12:22 |
| Compound | CAS Number | LOR | Unit | | EB2020923-001 | EB2020923-002 | EB2020923-003 | EB2020923-004 | EB2020923-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.126** | <0.005 | **4.81** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **5.23** | <0.05 | **515** | <0.05 | **0.10** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.2** | **0.1** | <0.1 | **0.1** | **0.1** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **17.6** | **0.61** | **71.0** | **4.51** | **0.54** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **----** | **----** | **82.0** | **----** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **19.5** | **0.64** | **----** | **4.28** | **0.52** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **7.20** | **----** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **5.14** | **----** | **----** | **2.54** | **----** |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 07-Aug-2020 12:23 | 07-Aug-2020 12:23 | 07-Aug-2020 12:23 | 07-Aug-2020 12:24 | ---- |
| Compound | CAS Number | LOR | Unit | EB2020923-006 | EB2020923-007 | EB2020923-008 | EB2020923-009 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **4.30** | **6.98** | **7.22** | **4.90** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **995** | **556** | **310** | **650** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | <1 | **7** | **8** | **2** | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | <1 | **7** | **8** | **2** | ---- |
| **ED038A: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **22** | **1** | **1** | **21** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **522** | **236** | **102** | **315** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **2** | **7** | **16** | **2** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **59** | **16** | **15** | **47** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | **91** | **46** | **16** | **49** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **18** | **15** | **19** | **10** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | **7** | **2** | **2** | **3** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.11** | <0.01 | **0.02** | **0.03** | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0004** | <0.0001 | <0.0001 | **0.0003** | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.014** | <0.001 | <0.001 | **0.003** | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.047** | <0.001 | <0.001 | **0.005** | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.015** | **0.001** | **0.002** | **0.007** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | **0.786** | **0.024** | **0.013** | **0.582** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.002** | **0.013** | <0.001 | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.028** | <0.001 | **0.001** | **0.005** | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | **0.01** | **0.01** | **0.03** | **0.01** | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | **0.679** | **0.410** | **0.260** | **0.660** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 07-Aug-2020 12:23 | 07-Aug-2020 12:23 | 07-Aug-2020 12:23 | 07-Aug-2020 12:24 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2020923-006 | EB2020923-007 | EB2020923-008 | EB2020923-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.091** | <0.005 | <0.005 | **0.023** | **----** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **2.59** | <0.05 | <0.05 | **6.08** | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **0.4** | **0.4** | **0.3** | **----** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **10.9** | **5.25** | **2.73** | **6.65** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **11.4** | **5.29** | **2.94** | **6.89** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **2.11** | **0.35** | **----** | **1.74** | **----** |

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **EB2023744** | Page | : 1 of 6 |
| Client | : **RGS ENVIRONMENTAL PTY LTD** | Laboratory | : Environmental Division Brisbane |
| Contact | : MR ALAN ROBERTSON | Contact | : Carsten Emrich |
| Address | : PO BOX 3091<br>SUNNYBANK SOUTH QLD, AUSTRALIA 4109 | Address | : 2 Byth Street Stafford QLD Australia 4053 |
| Telephone | : +61 07 3344 1222 | Telephone | : +61 7 3552 8616 |
| Project | : 2019086 - MACH Mt Pleasant | Date Samples Received | : 08-Sep-2020 17:30 |
| Order number | : - | Date Analysis Commenced | : 11-Sep-2020 |
| C-O-C number | : 13839 | Issue Date | : 16-Sep-2020 15:56 |
| Sampler | : ALAN ROBERTSON, VERONICA CANALES | | |
| Site | : 2019086_MACH Mt Pleasant L6 | | |
| Quote number | : BN/1234/19 | | |
| No. of samples received | : 9 | | |
| No. of samples analysed | : 9 | | |

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

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

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

## *Signatories*

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

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

## General Comments

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

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

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

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

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

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

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

- Ionic Balance out of acceptable limits for some samples due to analytes not quantified in this report.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 08-Sep-2020 10:12 | 08-Sep-2020 10:12 | 08-Sep-2020 10:13 | 08-Sep-2020 10:14 | 08-Sep-2020 10:14 |
| Compound | CAS Number | LOR | Unit | EB2023744-001 | EB2023744-002 | EB2023744-003 | EB2023744-004 | EB2023744-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | 5.49 | 6.95 | 2.47 | 6.46 | 6.81 |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | 1300 | 87 | 5870 | 325 | 55 |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | <1 |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | <1 | 6 | <1 | 4 | 5 |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | <1 | 6 | <1 | 4 | 5 |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | 19 | 1 | 2220 | 2 | 2 |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | 741 | 27 | 3230 | 144 | 15 |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | 6 | 2 | <1 | 3 | 1 |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | 105 | 4 | 134 | 14 | 2 |
| Magnesium | 7439-95-4 | 1 | mg/L | 110 | 5 | 258 | 18 | 2 |
| Sodium | 7440-23-5 | 1 | mg/L | 31 | 4 | 5 | 6 | 3 |
| Potassium | 7440-09-7 | 1 | mg/L | 6 | 2 | 1 | 2 | <1 |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | 0.07 | 0.06 | 27.6 | <0.01 | 0.10 |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | 0.538 | <0.001 | <0.001 |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | 0.0007 | <0.0001 | 0.0260 | <0.0001 | <0.0001 |
| Cobalt | 7440-48-4 | 0.001 | mg/L | 0.045 | <0.001 | 0.490 | 0.001 | <0.001 |
| Copper | 7440-50-8 | 0.001 | mg/L | 0.008 | 0.001 | 1.14 | <0.001 | <0.001 |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Lithium | 7439-93-2 | 0.001 | mg/L | 0.018 | 0.001 | 0.058 | 0.003 | 0.001 |
| Manganese | 7439-96-5 | 0.001 | mg/L | 1.61 | 0.010 | 40.3 | 0.042 | 0.006 |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | 0.004 | 0.001 | <0.001 | <0.001 |
| Nickel | 7440-02-0 | 0.001 | mg/L | 0.050 | 0.002 | 0.752 | 0.002 | <0.001 |
| Selenium | 7782-49-2 | 0.01 | mg/L | 0.01 | <0.01 | 0.03 | <0.01 | <0.01 |
| Strontium | 7440-24-6 | 0.001 | mg/L | 1.75 | 0.097 | 0.639 | 0.360 | 0.036 |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | 0.02 | <0.01 | <0.01 |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-6 | KLC-7 | KLC-8 | KLC-9 | KLC-10 |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 08-Sep-2020 10:12 | 08-Sep-2020 10:12 | 08-Sep-2020 10:13 | 08-Sep-2020 10:14 | 08-Sep-2020 10:14 |
| Compound | CAS Number | LOR | Unit | | EB2023744-001 | EB2023744-002 | EB2023744-003 | EB2023744-004 | EB2023744-005 |
| | | | | | Result | Result | Result | Result | Result |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.097** | <0.005 | **3.18** | <0.005 | <0.005 |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | **0.10** | <0.05 | <0.05 | <0.05 | <0.05 |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **4.16** | <0.05 | **310** | <0.05 | <0.05 |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.2** | **0.2** | **0.1** | <0.1 | **0.1** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **15.6** | **0.74** | **67.2** | **3.16** | **0.44** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **----** | **----** | **50.9** | **----** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **15.8** | **0.84** | **----** | **2.49** | **0.39** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **----** | **----** | **13.8** | **----** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **0.63** | **----** | **----** | **----** | **----** |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|
| | | | Client sampling date / time | 08-Sep-2020 10:15 | 08-Sep-2020 10:15 | 08-Sep-2020 10:15 | 08-Sep-2020 10:16 | ---- |
| Compound | CAS Number | LOR | Unit | EB2023744-006 | EB2023744-007 | EB2023744-008 | EB2023744-009 | -------- |
| | | | | Result | Result | Result | Result | ---- |
| **EA005P: pH by PC Titrator** | | | | | | | | |
| pH Value | ---- | 0.01 | pH Unit | **4.66** | **6.92** | **7.11** | **5.33** | ---- |
| **EA010P: Conductivity by PC Titrator** | | | | | | | | |
| Electrical Conductivity @ 25°C | ---- | 1 | µS/cm | **811** | **432** | **324** | **596** | ---- |
| **ED037P: Alkalinity by PC Titrator** | | | | | | | | |
| Hydroxide Alkalinity as CaCO3 | DMO-210-001 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Carbonate Alkalinity as CaCO3 | 3812-32-6 | 1 | mg/L | <1 | <1 | <1 | <1 | ---- |
| Bicarbonate Alkalinity as CaCO3 | 71-52-3 | 1 | mg/L | <1 | **8** | **9** | <1 | ---- |
| Total Alkalinity as CaCO3 | ---- | 1 | mg/L | <1 | **8** | **9** | <1 | ---- |
| **ED038: Acidity** | | | | | | | | |
| Acidity as CaCO3 | ---- | 1 | mg/L | **14** | **2** | **2** | **2** | ---- |
| **ED041G: Sulfate (Turbidimetric) as SO4 2- by DA** | | | | | | | | |
| Sulfate as SO4 - Turbidimetric | 14808-79-8 | 1 | mg/L | **434** | **180** | **120** | **293** | ---- |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| Chloride | 16887-00-6 | 1 | mg/L | **2** | **4** | **11** | **2** | ---- |
| **ED093F: Dissolved Major Cations** | | | | | | | | |
| Calcium | 7440-70-2 | 1 | mg/L | **48** | **14** | **15** | **43** | ---- |
| Magnesium | 7439-95-4 | 1 | mg/L | **65** | **33** | **16** | **42** | ---- |
| Sodium | 7440-23-5 | 1 | mg/L | **14** | **10** | **13** | **7** | ---- |
| Potassium | 7440-09-7 | 1 | mg/L | **6** | **2** | **2** | **3** | ---- |
| **EG020F: Dissolved Metals by ICP-MS** | | | | | | | | |
| Aluminium | 7429-90-5 | 0.01 | mg/L | **0.10** | <0.01 | **0.01** | **0.03** | ---- |
| Antimony | 7440-36-0 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Arsenic | 7440-38-2 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Cadmium | 7440-43-9 | 0.0001 | mg/L | **0.0004** | <0.0001 | **0.0003** | **0.0002** | ---- |
| Cobalt | 7440-48-4 | 0.001 | mg/L | **0.010** | <0.001 | <0.001 | **0.002** | ---- |
| Copper | 7440-50-8 | 0.001 | mg/L | **0.038** | <0.001 | **0.002** | **0.004** | ---- |
| Lead | 7439-92-1 | 0.001 | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | ---- |
| Lithium | 7439-93-2 | 0.001 | mg/L | **0.016** | **0.002** | **0.002** | **0.007** | ---- |
| Manganese | 7439-96-5 | 0.001 | mg/L | **0.572** | **0.023** | **0.014** | **0.432** | ---- |
| Molybdenum | 7439-98-7 | 0.001 | mg/L | <0.001 | **0.001** | **0.010** | <0.001 | ---- |
| Nickel | 7440-02-0 | 0.001 | mg/L | **0.022** | <0.001 | **0.001** | **0.004** | ---- |
| Selenium | 7782-49-2 | 0.01 | mg/L | **0.01** | <0.01 | **0.02** | **0.01** | ---- |
| Strontium | 7440-24-6 | 0.001 | mg/L | **0.581** | **0.380** | **0.269** | **0.614** | ---- |
| Vanadium | 7440-62-2 | 0.01 | mg/L | <0.01 | <0.01 | <0.01 | <0.01 | ---- |

## Analytical Results

| Sub-Matrix: WATER (Matrix: WATER) | | | | Client sample ID | KLC-11 | KLC-12 | KLC-13 | KLC-14 | ---- |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Client sampling date / time | 08-Sep-2020 10:15 | 08-Sep-2020 10:15 | 08-Sep-2020 10:15 | 08-Sep-2020 10:16 | ---- |
| Compound | CAS Number | LOR | Unit | | EB2023744-006 | EB2023744-007 | EB2023744-008 | EB2023744-009 | -------- |
| | | | | | Result | Result | Result | Result | ---- |
| **EG020F: Dissolved Metals by ICP-MS - Continued** | | | | | | | | | |
| **Zinc** | 7440-66-6 | 0.005 | mg/L | | **0.077** | <0.005 | <0.005 | **0.019** | **----** |
| **Boron** | 7440-42-8 | 0.05 | mg/L | | <0.05 | <0.05 | <0.05 | <0.05 | **----** |
| **Iron** | 7439-89-6 | 0.05 | mg/L | | **1.76** | <0.05 | <0.05 | **4.13** | **----** |
| **EK040P: Fluoride by PC Titrator** | | | | | | | | | |
| **Fluoride** | 16984-48-8 | 0.1 | mg/L | | **0.1** | **0.3** | **0.4** | **0.2** | **----** |
| **EN055: Ionic Balance** | | | | | | | | | |
| **ø Total Anions** | ---- | 0.01 | meq/L | | **9.09** | **4.02** | **2.99** | **6.16** | **----** |
| **ø Total Cations** | ---- | 0.01 | meq/L | | **8.51** | **3.90** | **2.68** | **5.98** | **----** |
| **ø Ionic Balance** | ---- | 0.01 | % | | **3.32** | **1.51** | **----** | **1.42** | **----** |

# Attachment E Review of existing geochemistry information at the MPO, Bengalla and Mt Arthur Coal Mines

# E1 Department of Mineral Resources (1995)

Preliminary geochemical characterisation of overburden and interburden materials from the Project was completed by the Department of Mineral Resources Mineral Resources (DMR) Development Laboratory in 1995 (DMR, 1995). A total of 62 drill core samples from eight bore holes were prepared and subjected to a range of geochemical tests including pH, electrical conductivity (EC), total sulfur, total carbon, calculated net acid producing potential (NAPP), short term weathering/leach tests (bicarbonate, alkalinity, major ions). The sodicity/dispersivity of the samples was determined from the major cation results (Calcium ions [$Ca^{2+}$], Potassium ions [$K^{+}$], Magnesium ions [$Mg^{2+}$] and Sodium ions [$Na^{+}$]) and used to calculate the Sodium Adsorption Ration (SAR) and Exchangeable Sodium Percentage (ESP), respectively. The EC test results were used to indicate the salinity of the samples.

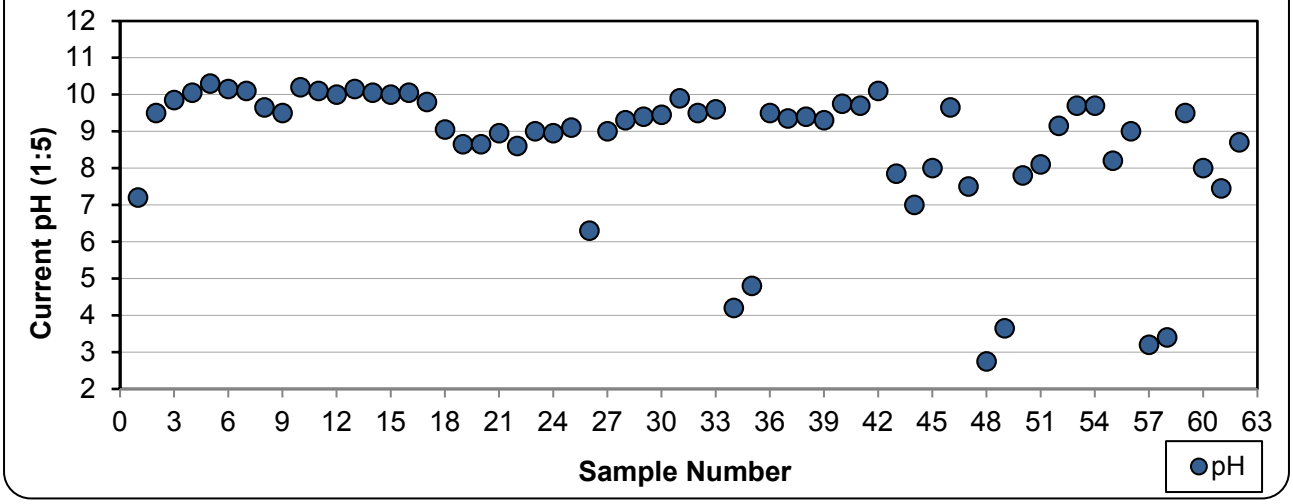
The report identified a few samples that have the potential to produce leachate that is acidic, saline or sodic/dispersive on weathering. The authors suggested that for material represented by the specific samples under a 'worst case scenario', these chemical conditions could have an adverse effect on vegetation growth and water quality draining from spoil at an overburden/interburden emplacement.

## E1.1 Acid Base Account

The Acid Base Account (ABA) data for the 62 overburden/interburden samples from the Project contained in the 1995 DMR report has been reviewed by RGS Environmental Pty Ltd (RGS) and an overview is presented in **Table E1 (Appendix 1)** and summarised below.

- **pH**: The pH of the 62 samples ranges from 2.75 to 10.30 and has a median value of 9.33 (**Figure E1.1**). The pH range of the deionised water used in these tests is typically pH 5 to 6.5 therefore only those samples with a pH value less than 5 are considered acidic. Six samples have a pH value less than pH 5 and these all represent interburden materials associated with the Wynn (WN) seam. A total of 14 interburden samples are associated with the WN seam and the remaining eight samples have pH values in the range 6.3 to 9.6 (median 9.2). Three of the four drill holes where interburden associated with the WN seam has been sampled, contain samples that would be considered acidic.

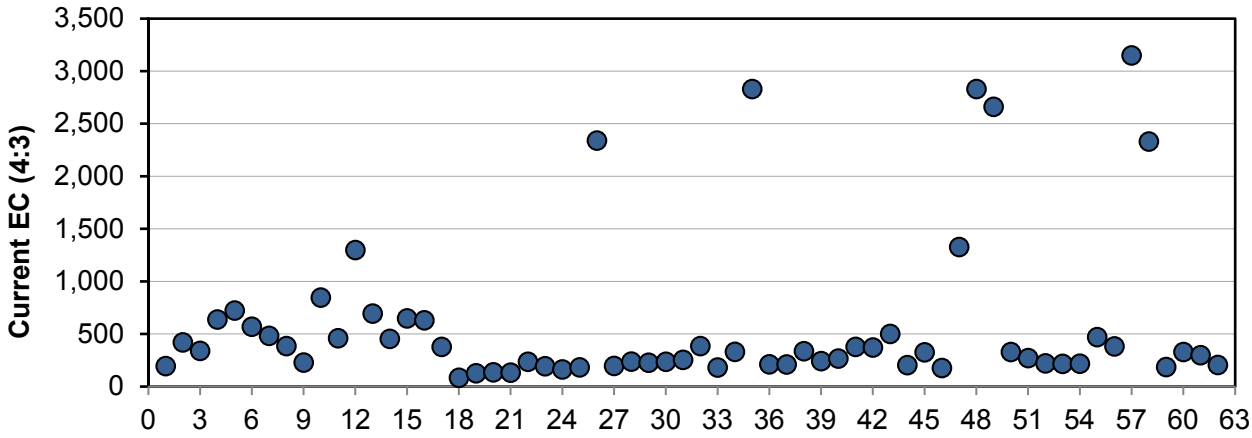
**Figure E1.1: pH values for overburden and interburden**




*There is no indication in the 1995 DMR report as to how old the drill core was before sampling and how long the samples had been stored in the laboratory prior to testing. This information is key to understanding the potential lag period preceding acid generation for materials represented by selected WN seam interburden. RGS completed additional static and kinetic testing on fresh drill core samples in the current report to address this issue and better understand the lag period preceding acid generation in potentially acid forming (PAF) materials.*

- **EC**: The current EC for the 62 samples ranges from 84 to 3,150 microsiemens per centimetre (µS/cm) (**Figure E1.2**) and is typically low (median 329 µS/cm). Six samples with EC values greater than 1,500 µS/cm have been classified as saline and again these samples mostly represent acidic interburden materials associated with the WN seam. The elevated salinity in these samples is mainly due to increased sulfate concentrations, most likely generated through sulfide oxidation (e.g. pyrite or marcasite).

**Figure E1.2: EC values for overburden and interburden**




*It should be noted that the pH and EC values provided in the 1995 DMR report were for a sample particle size less than 2 millimetres (mm); and therefore, samples have a large surface area in contact with the test water. This situation provides a greater potential for dissolution and reaction than may occur in the field, and therefore represents an assumed 'worst case' scenario.*

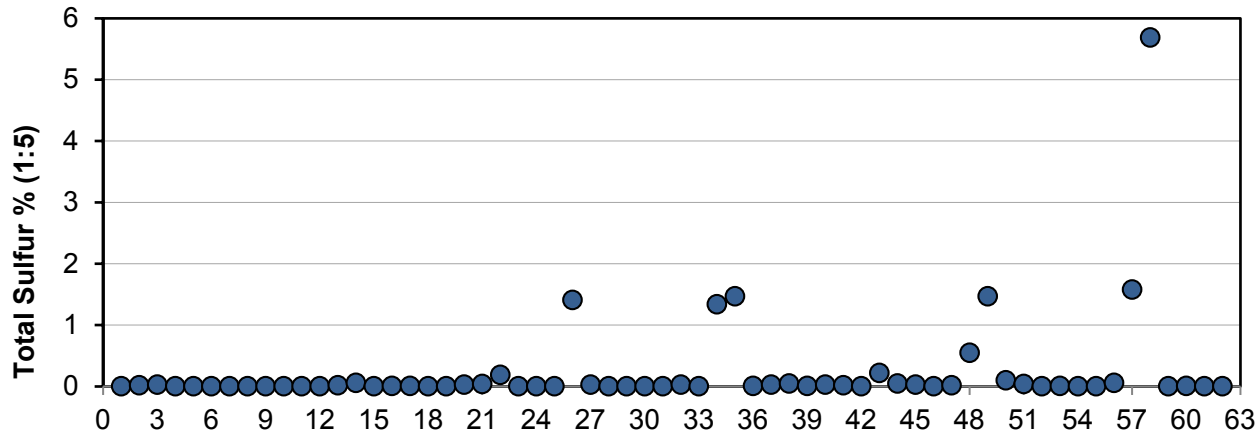
*In addition, the ratio of sample to contact water was 4 to 3 (i.e. 20 grams [g] to 15 millilitres [mL]), which is concentrated and is essentially similar to a saturated paste. However, the ratio of sample to water generally used in tests where results are (arbitrarily) compared against guideline concentrations only to provide relevant context, is typically almost an order of magnitude more dilute at 1:5 (weight/volume [w/v]). Whilst arbitrary comparisons against guideline concentrations can be helpful in some situations to provide relevant context, such comparisons cannot be directly extrapolated to the field situation at the Project.*

*It is also expected that the salinity of leachate from most low sulfur mining waste materials (i.e. overburden/interburden not associated with the WN seam) will diminish with time as salts are flushed from the rock matrix and a state of equilibrium develops. At that point, the salinity of seepage/runoff should stabilise at a lower asymptotic concentration relative to the weathering/erosion of the materials.*

*RGS completed additional EC testing on relatively fresh drill core samples at a ratio of 1:5 w/v in the current study to allow comparison with EC results for nearby mines (e.g. Bengalla Mine and Mt Arthur Coal Mine).*

- **Total sulfur**: The total sulfur content (%S) of the samples ranges from <0.01 %S to 5.69 %S (median 0.01 %S) (**Figure E1.3**). Compared to the median crustal abundance of sulfur (0.07 per cent [%]) (INAP, 2009) the median values of the overburden and interburden materials is generally quite low. Materials with a total sulfur content less than or equal to 0.1 %S are essentially barren of sulfur, generally represent background concentrations, and have negligible capacity to generate acidity[2]. The sulfur content of seven of the 14 samples representing interburden materials associated with the WN seam is greater than 0.22 %S and six of these seven samples have been indicated as having the potential to generate acidic pH values through sulfide oxidation.

**Figure E1.3: Total sulfur values for overburden and interburden**




- **Sulfide Sulfur:** The reactive sulfide sulfur content of the seven samples with elevated total sulfur content was not determined by DMR. However, given RGS' experience of interburden associated with the WN seam at the adjacent Bengalla Mine (where these strata are generally called Archerfield Sandstone), it is expected that most of the total sulfur content in these materials will be present as reactive pyrite, which have the potential to react and become acidic upon exposure to oxidising conditions.

  It should be noted that in general, some coal seam materials (including roof and floor materials) can also have elevated total sulfur content at coal mines. This can be related to the presence of sulfide sulfur but may also be associated with non-acid generating forms of sulfur, such as organic sulfur or secondary mineral sulfates e.g. gypsum.

  *RGS completed sulfur speciation testing (Chromium Reducible Sulfur test (AS 4969.7, 2008)) on fresh drill core samples in the current study to facilitate a more accurate assessment of the acid generating capacity and risk associated with the Mount Pleasant Operation (MPO) mine materials which have elevated total sulfur content.*

- **Maximum Potential Activity (MPA)**: Based on the total sulfur content, the MPA that could be generated by the overburden and interburden samples ranges from < 0.15 (below laboratory limit of reporting - LoR) to 174.3 kilogram of Sulfuric Acid per tonne (kg $H_2SO_4$/t) and has a low median value of 0.3 kg $H_2SO_4$/t.
- **Acid Neutralising Capacity (ANC)**: The ANC for the overburden and interburden samples ranges from 0.18 to 302 kg $H_2SO_4$/t and has an elevated median value of 66 kg $H_2SO_4$/t. The fresh samples typically have higher ANC values compared to the weathered material. The ANC is relatively low in some of the acidic interburden materials associated with the WN seam (i.e. five of the six samples had ANC values less than 10 kg $H_2SO_4$/t).

[2] The median crustal abundance of sulfur (0.07 %S) has been rounded up to 0.1 %S (INAP, 2009).

*The ANC value used by DMR in 1995 was calculated using sample pre-treatment and total carbonate and carbonate carbon assay with a LECO analyser to allow a 'crude' NAPP value to be calculated (see below). RGS completed additional ANC tests on fresh drill core samples in the current study to validate the veracity of the 1995 ANC results.*

- **ANC:MPA ratio**: The ANC:MPA ratio for the samples ranges from 0.01 to 1,972 and has a high median value of 106.6. In simplistic terms, this means that most samples have significant excess ANC over MPA. (i.e. only the six acidic overburden/interburden samples associated with the WN seam have low ANC:MPA ratios less than 2.9).
- **NAPP**: The calculated NAPP value for the overburden and interburden samples is calculated by subtracting the ANC from the MPA and ranges from -301.8 to +40.2 kg $H_2SO_4$/t and has a median value of -64.2 kg $H_2SO_4$/t. **Figure E1.4** illustrates that all samples have a negative NAPP value, except for the six acidic interburden samples associated with the WN seam.

**Figure E1.4: NAPP values for overburden/interburden samples**

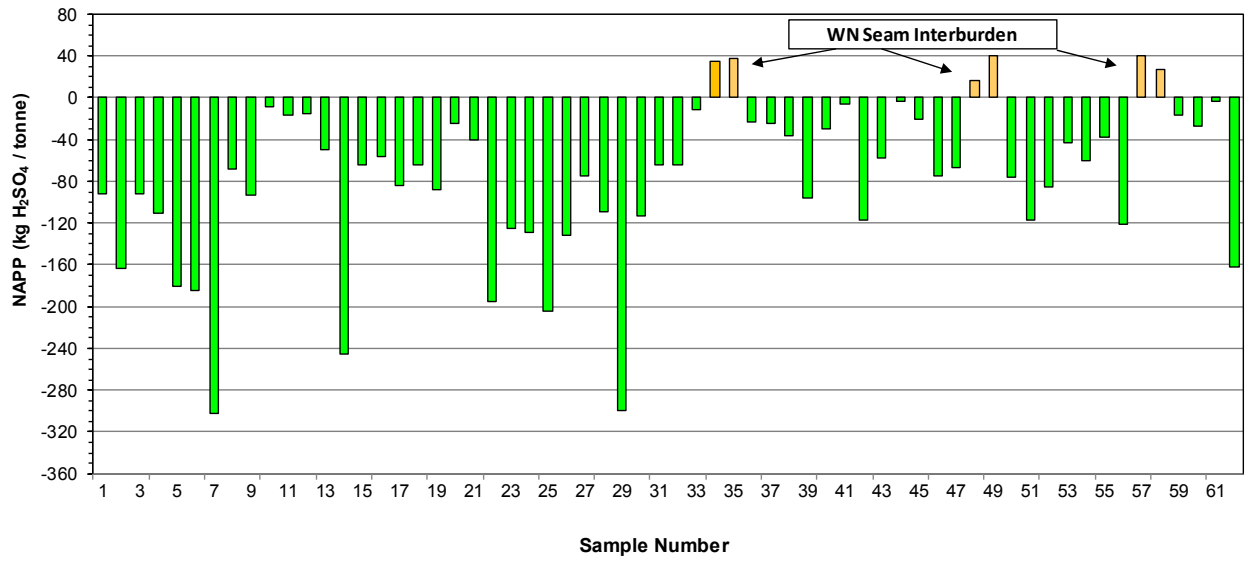
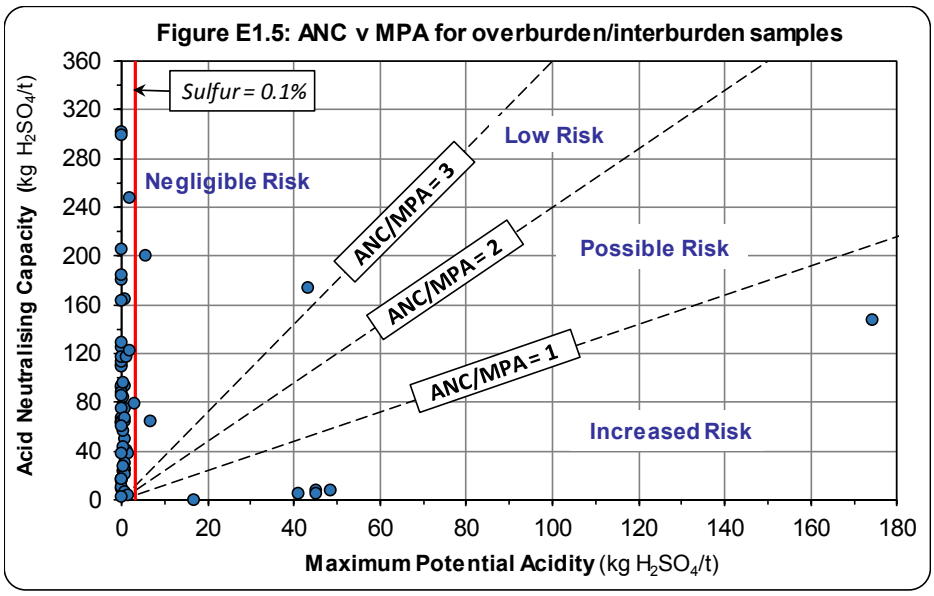



**Figure E1.5** shows a plot of ANC versus MPA for the 62 overburden and interburden samples). ANC:MPA ratio lines have been plotted on the graph to illustrate the factor of safety associated with the samples. Generally, those samples with an ANC:MPA ratio greater than 2 (or with a total or sulfide sulfur content ≤0.1 %S) are considered to have a low to negligible risk of acid generation and a high factor of safety in terms of potential for acid and metalliferous drainage (AMD) (INAP, 2009[3]; COA, 2016).

[3] INAP considers that mine materials with an ANC/MPA ratio greater than 2 are likely to be NAF unless significant preferential exposure of sulfides along fracture planes occurs in combination with insufficiently reactive ANC.




The results indicate that all of the overburden and interburden samples tested, not associated with the WN seam, plot in the low to negligible risk domains shown in the figure and represent materials with a very low risk of acid generation and a high factor of safety with respect to potential AMD. In contrast, the six acidic interburden sample associated with the WN seam plot in the increased risk domain and represent materials with an increased risk of acid generation and a low factor of safety with respect to potential AMD.

**Table E1.1** provides a summary of the geochemical classification criteria used by RGS to classify the acid forming nature of the 62 overburden and interburden samples, and a breakdown of the number of samples in each classification category.

**Table E1.1: Geochemical classification criteria for overburden and interburden**

| Geochemical Classification | Total Sulfur[1] (%) | ANC: MPA Ratio | NAPP (kg $H_2SO_4$/t) | Number of Samples (n=62) | Percentage of Samples (%) |
|---|---|---|---|---|---|
| Acid Consuming (AC) | ≤ 0.1 | - | ≤ -50 | 37 | 59.7 |
| Non-Acid Forming (NAF) | < 0.1 | ≥ 2 | ≤ 0 | 19 | 30.6 |
| Potentially Acid Forming (PAF) | > 0.1 | < 2 | > 5 | 6 | 9.7 |

Notes: 1. Sulfide sulfur data (obtained using the Chromium Reducible Sulfur [Scr] test) can also be used in place of total sulfur to calculate MPA and as part of sample classification.

The Acid Base Account (ABA) test data presented in **Table E1 (Appendix 1)** and discussed in this section have been used to classify the acid forming nature of the 62 overburden and interburden samples from the Project. The results indicate that of the 62 samples tested, 90.3 % are classified as either AC or NAF; and 9.7 % are classified as PAF. All of the PAF samples are from interburden associated with the WN seam.

Overall, the ABA results confirm that most of the overburden and interburden materials have low sulfur content, excess ANC, a high factor of safety and a low risk of generating AMD. Approximately half of the 14 samples representing interburden associated with the WN seam have elevated sulfur content, low ANC, an increased risk of acid generation, and a low factor of safety with respect to potential AMD.

## E1.2 Sodicity and dispersion

The 62 samples described in **Section E1.1** were tested for exchangeable cations and the (SAR) and (ESP) values calculated to provide information on the likelihood of the overburden and interburden materials to be sodic and/or prone to dispersion.

Seven of the 62 samples were classified as highly sodic and six samples were classified as moderately sodic based on SAR results being initially greater than 15 and 9, respectively as shown in **Table E1.2**. Most of the remaining (49) overburden and interburden samples had relatively low SAR values and low sodicity values.

Determination of ESP provides a measure of the proportion of sodium adsorbed on the sample material and is one of the most widely used tests to assist in the assessment of dispersibility. Generally, samples with ESP values less than 6 are considered non-sodic, whereas greater than 6 are considered moderately sodic and may be prone to dispersion, and greater than 14 are considered strongly sodic and may be susceptible to dispersion and can have adverse effects on plants (Isbell, 2002; and Northcote and Skene, 1972), although these characteristics may be improved to some extent by the addition of gypsum.

ESP is a function of SAR and therefore the ESP values for the overburden and interburden samples provided in **Table E1.2** support and parallel the SAR values. Essentially, the samples listed in the table can be considered moderately to strongly sodic and prone to dispersion, whereas the remaining (49) samples have lower ESP values and can be considered less sodic and less prone to dispersion.

**Table E1.2: SAR and ESP results for selected overburden/Interburden samples**

| Sample ID | Drill Hole ID | From | To | Sample Description | Sodium (meq/L) | Sodium Adsorption Ratio (SAR) | | | Exchangeable Sodium Percentage (ESP) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 16 hour | 10 day | 20 day | 16 hour |
| **Highly Sodic Samples** | | | | | | | | | |
| E94/1405 | 4000C000 | 60.59 | 60.89 | MTA A Interburden | 9.4 | 23.5 | 7.9 | 2.7 | 25.1 |
| E94/1412 | 4000F000 | 60.50 | 60.80 | MTA Midburden | 35.8 | 23.1 | 8.0 | 2.5 | 24.7 |
| E94/1414 | 4000F000 | 74.10 | 74.40 | MTA Midburden | 62.7 | 42.1 | 6.3 | 5.2 | 37.8 |
| E94/1415 | 4000F000 | 90.53 | 90.83 | MTA A Midburden | 23.7 | 22.3 | 26.2 | 6.3 | 24.0 |
| E94/1417 | 4000F000 | 110.10 | 110.40 | MTA A Midburden | 25.7 | 20.5 | - | 7.7 | 22.5 |
| E94/1418 | 4000F000 | 134.20 | 134.50 | MTA C Midburden | 18.7 | 15.6 | 18.5 | 4.7 | 17.8 |
| E94/1433 | 5000C000 | 90.20 | 90.50 | BRN A Midburden | 9.8 | 19.1 | 8.5 | 2.7 | 21.2 |
| **Moderately Sodic Samples** | | | | | | | | | |
| E94/1404 | 4000C000 | 52.20 | 52.50 | MTA A Interburden | 10.9 | 9.2 | 12.5 | 3.8 | 11.0 |
| E94/1407 | 4000C000 | 88.20 | 88.50 | PFD A Interburden | 13.4 | 12.1 | 13.3 | 6.5 | 14.2 |
| E94/1408 | 4000C000 | 104.20 | 104.50 | VAUX A Interburden | 7.5 | 9.2 | 5.5 | 1.6 | 11.0 |
| E94/1413 | 4000F000 | 68.5 | 68.80 | MTA Midburden | 17.4 | 14.6 | 7.6 | 2.2 | 16.8 |
| E94/1416 | 4000F000 | 99.10 | 99.40 | PFD A Midburden | 12.2 | 11.7 | 18.5 | 6.9 | 13.8 |
| E94/1419 | 4000F000 | 162.20 | 162.50 | PFD C Midburden | 9.6 | 9.4 | 8.9 | 3.4 | 11.2 |

# E2 EGi (1998)

The geochemistry work completed in 1998 for simulated MPO coal reject materials was based on a proposed multi-seam operation comprising of eight main coal seams with a total reject production schedule (coarse and fine rejects) of about 48 million tonnes over 20 years (EGi, 1998). The contribution of each of the coal seams to the proposed total reject production in 1998 is shown in **Table E2.1**.

**Table E2.1: Total Reject Production for the 20-year MPO proposed in 1998**

| Coal Seam | Total Reject (tonnes) | Percentage of Total (%) |
|---|---|---|
| Warkworth | 7,432,303 | 15.5 |
| Mt Arthur | 5,242,362 | 10.9 |
| Piercefield | 11,029,320 | 23.0 |
| Vaux | 7,317,784 | 15.3 |
| Broonie | 2,486,709 | 5.2 |
| Bayswater | 4,745,866 | 9.9 |
| Wynn | 4,827,088 | 10.1 |
| Edderton | 4,812,694 | 10.0 |
| **TOTAL** | **47,894,126** | **100.0** |

## E2.1 Acid Base Account

The 1998 ABA results for representative rejects samples from washing the eight main coal seams are presented in **Table E2** (**Appendix 1**). The results were interpreted to indicate that coal rejects derived from processing the WN and Broonie seams was PAF (due to elevated total sulfur concentrations), whilst coal reject from the Warkworth, Mt Arthur, Piercefield, Vaux, Bayswater and Edderton seams was indicated to be NAF, although most reject samples contained elevated total sulfur content.

*It is noted that no sulfur speciation tests were completed on the reject samples in 1998 and therefore some of the total sulfur content may have been present as low risk organic sulfur. Similarly, the availability of the ANC was not confirmed. RGS has addressed this in the current study by completing static and kinetic tests on representative coal reject samples*.

Two composite reject samples were prepared in 1998 to represent washery reject from Years 2 to 3 and Years 10 to 14 of the planned 20-year MPO operation, at that time. The two composite reject samples were classified as NAF based on NAPP and Net Acid Generation (NAG) test data (**Table E2**, **Appendix 1**) even though both samples were estimated to contain more than 1 % total sulfur (%S). The two composite reject samples were subjected to (KLC) tests and results are presented in **Table E3(i)** and **E3(ii)** (**Appendix 1**). The KLC test results were interpreted to indicate that that Run-of-mine (ROM) coal rejects from the multi-seam operation was likely to be NAF but would contain reactive sulfides and would generate elevated levels of sulfate in pore water. The results were also interpreted to suggest that oxidation of sulfides could potentially result in the release of elevated concentrations of arsenic (As) within pore water.

The initial leachate Total Dissolved Solids (TDS) concentration in KLC leachate was saline, and was expected to decrease in the longer term and be dominated by sulfate salts of calcium (Ca) and magnesium (Mg).

*It is noted that the concentration of As in KLC leachate reduced significantly from Week 1 to Week 6. In addition, the sample:water ratio in column leachate was in the order of 5:1 to 10:1 in weeks 1 and 6 respectively (i.e. concentrated). However, the ratio of sample to water generally used in tests where results are (arbitrarily) compared against guideline concentrations to provide relevant context is typically more than an order of magnitude more dilute at 1:5 (w/v). Whilst arbitrary comparisons against guideline concentrations can be helpful in some situations to provide relevant context, such comparisons cannot be directly extrapolated to the field situation at the MPO.*

*The KLC test were operated for three months and two water quality measurements were made for soluble metals/metalloids (Week 1 and Week 6). KLC tests on coal rejects are being completed by RGS over a period of six months in the current study with monthly leaching in line with Australian (COA, 2016) and international (INAP, 2009) technical guidelines.*

### E2.2 Multi-Element Concentrations in Solids

Multi-element scans were carried out on the two composite reject samples described in **Section E2.1** to identify any elements (particularly metals/metalloids) present in the reject materials at concentrations that may be of environmental concern with respect to reject disposal (e.g. for revegetation, surface water/groundwater quality and/or where the potential exists for human contact). The results from multi-element testing (total metals/metalloids) of the two composite reject samples are presented in **Table E3 (Appendix 1)**.

### E2.3 Geochemical Abundance Index

Total metal/metalloid concentrations in mining waste materials can be compared to the median crustal abundance for unmineralised soils (Bowen, 1979, INAP, 2009). The extent of enrichment is reported as the Geochemical Abundance Index (GAI), which relates the actual concentration in a sample with the median (or average) crustal abundance on a $\log_{10}$ scale. The GAI is expressed in integer increments from 0 to 6, where a GAI value of 0 indicates that the element is present at a concentration less than, or similar to, the median crustal abundance; and a GAI value of 6 indicates approximately a 100-fold enrichment above median crustal abundance **(Table E2.2)**.

The main purpose of the GAI is to identify any elements (particularly metals/metalloids) that are present at concentrations well above normal background values and which may warrant further examination to assess their environmental significance (EGi, 1998). As a general rule, a GAI of 3 or greater signifies enrichment that may warrant further examination. This is particularly the case with some environmentally important 'trace' elements, such as As, Chromium (Cr), Cadmium (Cd), Copper (Cu), Lead (Pb), Selenium (Se) and Zinc (Zn), more so than with major rock-forming elements, such as Aluminium (Al), Ca, Iron (Fe), Mg and Sodium (Na).

**Table E2.2: Geochemical Abundance Index (GAI) values and Enrichment Factors**

| GAI | Enrichment Factor | GAI | Enrichment Factor |
|---|---|---|---|
| **0** | Less than 3-fold enrichment | **4** | 24 – 48 fold enrichment |
| **1** | 3 – 6 fold enrichment | **5** | 48 – 96 fold enrichment |
| **2** | 6 – 12 fold enrichment | **6** | Greater than 96 fold enrichment |
| **3** | 12 – 24 fold enrichment | | |

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality or public health, but their significance should still be evaluated. The GAI provides an indication of metals/metalloids that may be enriched relative to the global average crustal abundance, however the following points should also be considered:

- The median crustal abundance varies between different literature sources, therefore affecting the calculated GAI values.
- If a sample is enriched relative to median crustal abundance, there is no direct correlation that the sample will also leach metals/metalloids at elevated concentrations. The mobility of metals/metalloids is dependent on mineralogy, adsorption/desorption and the environment in which it occurs.
- Whilst some element concentrations can be elevated relative to the median crustal abundance, the nature of an ore deposit means the background levels are generally expected to be elevated.
- Because an element is not enriched does not mean it will never be a concern, because under some conditions (e.g. low pH) the solubility of common environmentally important elements such as Al, Cu, Cd, Fe and Zn increases significantly.

The relative enrichment of metals/metalloids in the two composite reject samples from the Project described in **Section E2.2** has been compared to median crustal abundance (GAI) in **Table E4 (Appendix 1)**.

The GAI results were interpreted by EGi in 1998 to indicate that the two composite reject samples were relatively free of enrichment by metals/metalloids, although Bismuth (Bi) and Se were indicated as being enriched compared to average crustal abundance in igneous rocks. The non-metal element S was indicated as being enriched, although the significance of S enrichment has already been discussed in **Section E2.1**. In 1998, the elevated concentrations of Bi and Se were compared to typical concentrations in Australian steaming black coal and shale by EGi and unlikely to be of environmental concern.

*A reinterpretation of the 1998 data by RGS in the current study and comparison against median crustal abundance in soils (Bowen, 1979) confirms that two composite reject samples were relatively free of enrichment by metals/metalloids however, the GAI values suggest that no metals/metalloids are significantly enriched (S was indicated as being enriched and is discussed above). Hence, for reject materials, it is unlikely that the concentration of metals/metalloids will be of environmental concern.*

*It is noted that total metal/metalloid and leachable metal/metalloid testing (i.e. in KLC tests) was completed on two composite samples of coal reject materials prepared to address the mine plan in 1998. This has been addressed in the current RGS study for representative samples of coal reject materials.*

# E3 Rio Tinto (2011)

## E3.1 Sulfur Distribution in Coal

A Feasibility Study for the MPO was completed in 2011 (Rio Tinto, 2011) and RGS was supplied with the Geology section (Section 6) of the Feasibility Study Report and associated appendices (Appendix 6.1, Geology and Coal Resources; and Appendix 6.2, Coal Quality) as part of the geochemistry assessment process. Appendix 6.2 of the Feasibility Study Report provided the weighted average total sulfur concentration for coal seams identified at the MPO; and the proportion of total sulfur present as organic sulfur.

The weighted average total sulfur in raw coal from the Bowfield to the Edderton seams (refer to the stratigraphic profile provided earlier in **Section 1.4** of this report) ranges from 0.33 % in the Bayswater seam to 1.43 % in the WN seam (**Table E3.1**). The elevated total sulfur concentration in the WN seam is expected given the historical geochemistry work completed on simulated coal reject materials described in **Section E2** (EGi, 1998). However, it is noted that the total sulfur concentrations in coal reject materials were generally higher than for raw coal, suggesting that the coal washing process may concentrate sulfur to some extent in the coal reject materials.

**Table E3.1: Total Sulfur by Coal Seam for Raw Coal**

| Coal Seam | Total Sulfur (%) |
|---|---|
| Bowfield | 0.48 |
| Warkworth | 0.44 |
| Mt Arthur | 0.39 |
| Piercefield | 0.42 |
| Vaux | 0.43 |
| Broonie | 0.42 |
| Bayswater | 0.33 |
| Wynn | 1.43 |
| Edderton | 0.59 |
| Clanricard | 0.66 |
| Bengalla | - |
| Edinglassie | 0.52 |
| Ramrod Creek | - |

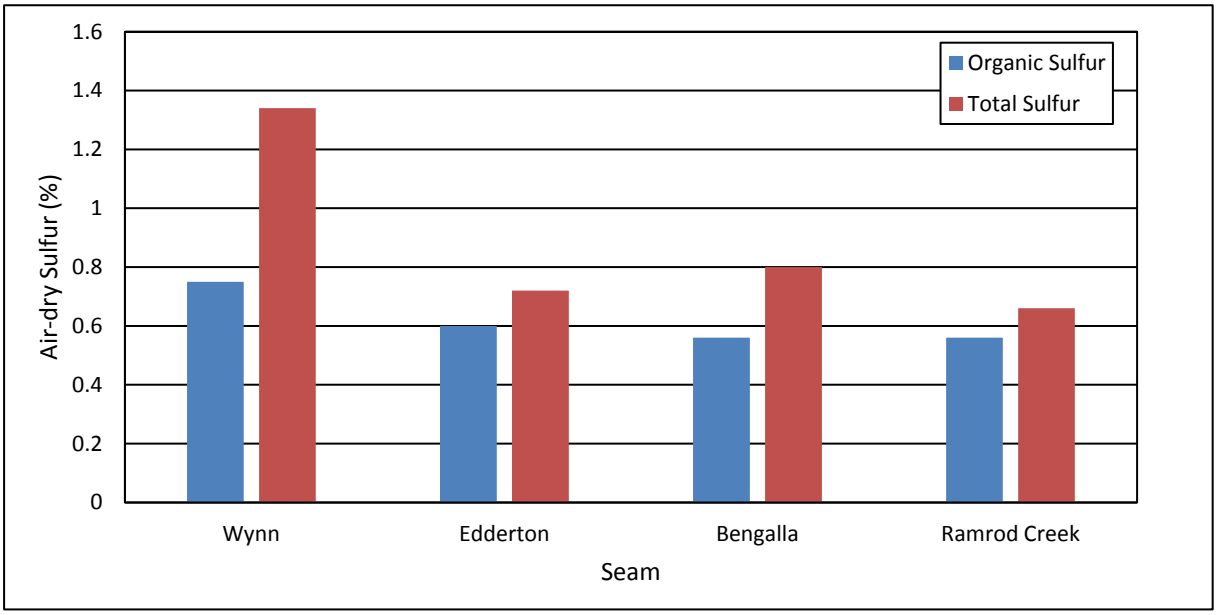
Data on the forms of sulfur present in each of the coal seams is available in the Feasibility Study Report, however the forms of sulfur data is sparse and is generally only widely available and statistically valid for washed coal samples taken from the WN, Edderton and Bengalla seams (**Table E3.2**).

**Table E3.2: Washed Coal Samples Subjected to Forms of Sulfur Testing**

| Seam | Number of samples collected | Number of samples used to determine forms of sulfur | % of samples tested |
|---|---|---|---|
| WN | 335 | 136 | 41% |
| Edderton | 285 | 36 | 13% |
| Bengalla | 114 | 44 | 39% |

**Figure E3.1** illustrates the weighted average concentrations of total sulfur and organic sulfur present in the four seams. The results indicate that just over half of the total sulfur in the (elevated sulfur) WN seam is present as low risk organic sulfur, whereas most of the total sulfur in the (lower sulfur) Edderton and Bengalla seams is present as low risk organic sulfur. This means that the WN seam not only contains higher total sulfur concentrations than most of the other lower sulfur coal seams, but has a higher proportion of potentially reactive sulfur (most likely present as pyrite or marcasite).

**Figure E3.1: Total and Organic Sulfur Content of Washed Coal from Individual Coal Seams**




## E4 GEM (2012)

### E4.1 Study Overview

A Geochemistry Study for a Modification to Mt Arthur Coal Mine was completed in 2012 (GEM, 2012) and the study report was supplied to RGS to include in the MPO geochemistry assessment process. Mt Arthur Coal Mine is located in close proximity to the MPO (south of Bengalla Mine) and targets similar seams from the Wittingham Coal Measures. The local and regional geological features of the Mt Arthur Coal Mine are also very similar to those described for the MPO.

The 2012 study focussed on confirmation testing (137 samples from 2 drill holes within the proposed pit extension area at that time as well as 60 drill core sample from 2 drill holes located in an already approved area to the west of the pit at that time) of the geochemical characteristics of overburden and interburden materials. The intent was to confirm that the geochemical characteristics of these materials were consistent with those from a previous geochemical assessment conducted for the Mt Arthur North EIS (Dames and Moore, 2000). The 2000 study was completed on 99 drill hole samples of overburden and interburden from the proposed open cut pit and 10 bulk samples representing coal rejects from individual coal seams. The 2012 report presented the results and findings of the geochemical assessment and the identified geochemical implications for the Modification and provided recommendations for environmental management and any required additional or future geochemical testing.

### E4.2 Study Findings

The 2012 assessment confirmed that the bulk of the overburden and interburden materials were likely to be NAF with a low salinity risk and no specific constraints were required for the handling and storage of these materials. However, due to the sporadic occurrence of reactive PAF materials associated with some of the coal seams, it was recommended that the uneconomic coal seams, partings, roof and floor strata be selectively mined and buried at a depth greater than 5 metre (m) within the overburden emplacement to reduce the risk of AMD. The materials earmarked for selective mining and burial represented approximately 5 % of the total annual overburden produced and coal-associated overburden was readily identifiable in the field. In addition, moderate to highly sodic overburden and interburden materials were identified and were to be managed using gypsum amendment prior to topdressing, if exposed within the final surfaces of the emplacements. This process was expected to minimise the risk of potential issues associated with dispersion, emplacement stability, increased erosion potential and increased Total Suspended Solids (TSS) in surface drainage water.

In 2012, some of the overburden and interburden materials from the Modification area was indicated as being likely to contain significantly enriched concentrations of As, Sb and Se with more sporadic (and slight) enrichment of Mercury (Hg) compared to average crustal abundance. Whilst Hg and Sb were expected to be sparingly soluble, As, Molybdenum (Mo) and Se were expected to be more soluble at the prevailing near-neutral pH of these materials.

Due to these findings, it was recommended that pH, EC, TSS, total alkalinity/Acidity, sulfate, As, Hg, Mo, Se and Sb be included in the surface water quality monitoring program for emplacement areas, with periodic data review. It was also recommended that additional geochemical investigations be completed for overburden and interburden in future if the mining operations were to expand or move into new areas not covered by data from existing investigations.

### E4.3 RGS Comment

*RGS generally agrees with the overall findings and recommendations in the 2012 Mt Arthur Coal Mine geochemical assessment. However, it is noted that only six of the 137 overburden and interburden samples were classified as PAF and most of the overburden and interburden samples contain significant excess ANC. Based on the data presented in Table 3 and B1/B2 of the report, RGS concludes that only three of the six samples are actually PAF and represent Archerfield Sandstone (termed 'Bayswater (lower) floor' in the report even although it covers a 5.25 m depth interval of strata) and the WN seam (Upper) roof and (Lower) floor.*

*The 2012 classification of the three remaining samples associated with the Bowfield (parting), Warkworth (roof) and Ramrod Creek (floor) seams appears to have been influenced by potentially erroneous standard NAG test data, which contradicts the NAPP data. As stated in* ***Attachment A****, the standard single addition NAG test should be used with caution at coal mines for carbonaceous materials, coal or coal reject, as samples with elevated organic carbon contents can cause interference with standard NAG tests due to partial oxidation of carbonaceous materials. This can lead to (false positive) low* $NAG_{pH}$ *values and high acidities in NAG solutions unrelated to acid generation from sulfides (Stewart et al., 2003; ACARP, 2008). Based on the more reliable NAPP data, the three samples should be reclassified as Uncertain or NAF.*

*Similarly, the 2012 assessment relied upon comparisons against average crustal abundance in igneous rocks to indicate that whilst most overburden and interburden materials were relatively free of enrichment by metals/metalloids, some materials could contain enriched concentrations of As, Sb and Se with more sporadic (and slight) enrichment of Hg (Table 4). Coal is hosted in sedimentary rocks, potentially with minor igneous intrusions in the forms of dykes or sills. A comparison against median crustal abundances of sedimentary rocks or soils is therefore more appropriate.*

*A reinterpretation of the 2012 metal/metalloid concentration data by RGS and comparison against median crustal abundance in soils (Bowen, 1979) confirms that the selected samples are relatively free of enrichment by metals/metalloids, i.e. the GAI values suggest that no metals/metalloids are significantly enriched. The highest metal/metalloid concentration values presented in Table 4 are generally within the range of elemental compositions in soils (Bowen, 1979)*

*Hence, for reject materials, it is unlikely that the concentration of metals/metalloids will be of environmental concern. However, if acid conditions occur in rejects, elevated concentrations of metals/metalloids such as Al, Fe, Mn and Ni may occur. As part of the current RGS study, KLC tests are being completed on coal reject materials which represent those likely to be generated by the current mine plan.*

## E5 RGS (2013)

A Geochemistry Study for a Modification to Bengalla Mine was completed in 2013 (RGS, 2013) and is included in the current MPO geochemistry assessment process. Bengalla Mine is located immediately south of the MPO and targets similar seams from the Wittingham Coal Measures. The local and regional geological features of Bengalla Mine are also very similar to those described for the MPO.

The 2013 study focussed on confirmation testing (105 samples from eight drill holes within an area to the west of the existing operations at that time) as well as nine coal reject samples with varying geochemical characteristics generated from processing the Vaux, Bayswater and WN coal seams. The intent was to confirm that the geochemical characteristics of these materials were consistent with those from several previous geochemistry studies (HLA Envirosciences, 1992; Eastwood and Carras, 1998; Matrix Plus, 2005; BMC, 2009; and RGS, 2010) and suitable for use in the development of an additional overburden emplacement area to the west of Dry Creek. The RGS report reviewed the previous geochemical studies and presented the results and findings of the 2013 geochemistry study and the identified geochemical implications for the Modification; and provided recommendations for environmental management and monitoring.

The 2013 geochemistry study confirmed that all overburden and interburden materials (apart from the Archerfield Sandstone (ASS) located above the WN seam) had negligible total sulfur (<0.1 %S), excess ANC and was classified as NAF. Bulk overburden and interburden materials reporting to the emplacement areas therefore had a high factor of safety with respect to potential acid generation. The ASS interburden (equivalent to the Bayswater-Wynn [BY-WN] interburden at MPO) was generally classified as PAF, although test results indicated that the ASS was not uniformly PAF and could also be NAF. Geochemical kinetic testing of ASS indicated a short lag time preceding acid generation of several weeks to months and confirmed that this material is likely to be reactive when exposed to air and moisture.

Coal reject materials were found to contain elevated total sulfur content however, the only coal reject material that was classified as PAF was derived from processing the WN seam. Some overburden and interburden materials were found to be sodic and could have structural stability issues related to potential dispersion and erosion.

The concentration of trace metals/metalloids in solid overburden/interburden and coal reject materials was found to be low compared to applied guideline criteria for soils and was unlikely to present any environmental issues associated with revegetation and rehabilitation.

Water extract and KLC test results from NAF overburden, interburden and coal reject materials indicated low levels of salinity and low concentrations of trace metals and major ions (including sulfate) in surface runoff and seepage from these materials (within applied water quality guideline criteria). However, PAF ASS interburden and PAF coal rejects (derived from processing the WN seam) if left unmanaged, were expected to generate acidic leachate, with elevated salinity and elevated concentrations of some metals (Al, As, Cd, Co, Cu, Ni, Se and Zn) if exposed to oxidising conditions.

The 2013 report indicated that the ASS material at Bengalla Mine was dumped in the open pit by dragline and then covered with acid neutralising and inert overburden to a depth of at least 60 m. Drainage from the ASS was contained within the mine water management system and local groundwater flows were directed into the pit. Coal reject materials were co-disposed with overburden (and interburden) at the overburden emplacement area and make up approximately 5 % of the total overburden mass. The combined overburden and coal reject in the mine spoils was estimated to be NAF with a high factor of safety and excess ANC and it was concluded that these measures would result in a very low risk of AMD at the site.

The RGS report recommended that the management methods implemented for ASS overburden and coal reject materials of deep burial under NAF overburden in the backfilled open cut pit continue as described in the Acid Rock Drainage Management Plan (BMC, 2009). However, it was recommended that the proponent not dispose of ASS or coal reject materials within overburden emplacement areas that overlay or had potential connectivity with alluvial soils and/or Dry Creek, to avoid any potential water quality impacts.

The practice of pre-stripping topsoil from areas to be disturbed for use in final rehabilitation activities (surface cover or growth medium) was recommended to continue along with successful site rehabilitation practices for potentially sodic overburden by ensuring that a topsoil cover was utilised as part of final rehabilitation. These practices were expected to continue to limit the risk of dispersion and erosion of surface materials at the site.

Water quality monitoring for surface water and collected water in the pit was recommended to continue to ensure that key water quality parameters remained within licence limit criteria.

## E6 RGS (2017) and RGS (2018)

In recent years, RGS has completed several additional geochemistry studies at various existing and proposed open cut coal mines in the Hunter Valley (e.g. Dartbrook Mine and Bulga Coal), which target similar seams from the Wittingham Coal Measures as those being targeted at the MPO. The local and regional geological features of these coal mines are also similar to those described for the MPO (RGS, 2017; RGS 2018).

The general findings are similar to the findings of the MPO, Mt Arthur Coal Mine and Bengalla Mine reports described earlier in this section in that:

- Overburden and interburden materials are expected to be NAF with a low salinity risk and no specific constraints are required for the handling and storage of these materials.
- The ASS interburden and coal rejects derived from processing the WN seam are generally expected to be PAF, reactive when exposed to air and moisture, and have a relatively short lag time preceding acid generation of several weeks to months.
- Some overburden and interburden materials are expected to be sodic and could have structural stability issues related to potential dispersion and erosion.
- The concentration of trace metals/metalloids in solid overburden/interburden and coal reject materials is expected to be low compared to median crustal abundance in soils and applied guideline criteria for soils and is not expected to present any environmental issues associated with revegetation and rehabilitation.
- NAF overburden, interburden and coal reject materials are typically expected to generate low salinity values and relatively low concentrations of trace metals/metalloids and major ions in surface runoff and seepage. However, PAF ASS interburden and PAF coal rejects (derived from processing the WN seam) are expected to have the potential to generate acidic leachate, with elevated salinity and elevated concentrations of some metals/metalloids, if exposed to oxidising conditions.

# E7 Surface water and groundwater quality

## E7.1 MPO surface water and groundwater quality

### *E7.1.1 Surface water monitoring*

Surface water quality monitoring data for the Hunter River and various creeks in the vicinity of the MPO (MACH Energy, 2018), over a 12-month period from July 2017 to June 2018, is provided in **Figures E7.1** and **E7.2** for pH, **Figures E7.3** and **E7.4** for EC; and **Figures E7.5** and **E-7.6** for Total Suspended Solids (TSS), respectively. Surface water quality monitoring locations are provided in **Figure E1** (**Appendix 2**). The pH data confirm that surface water has naturally fluctuated within the neutral to slightly alkaline pH range over the test period. Despite an initial fluctuation in July 2017, the EC data indicate that the salinity of surface waters monitored at the Hunter River is relatively low (and has generally remained at a value of less than 500 µS/cm over the remainder of the test period). The EC of surface water measured at various creeks (Sandy, Muscle and Rosebrook) at the MPO is naturally more saline. The TSS data indicate that the TSS values in the Hunter River and various creeks under normal climatic conditions is typically less than 25 mg/L.

These more recent findings align well with the findings of the 2017 Annual Review for the MPO (MACH Energy,2017) which was completed before coal extraction commenced and surface disturbance was limited to construction activities primarily restricted to works in the catchment of the unnamed tributary, commonly referred to as Dry Creek.

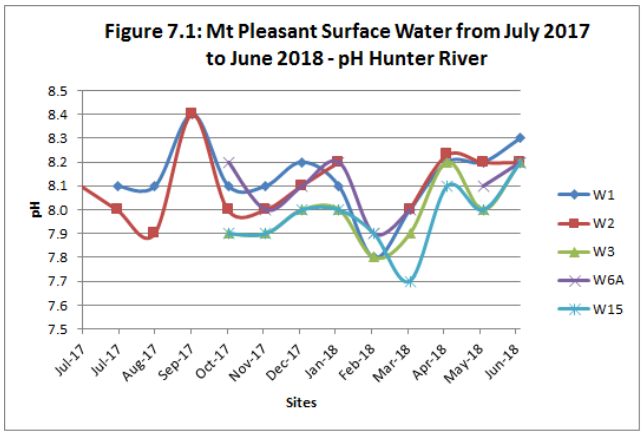



**Figure 7.1: Mt Pleasant Surface Water from July 2017 to June 2018 - pH Hunter River**

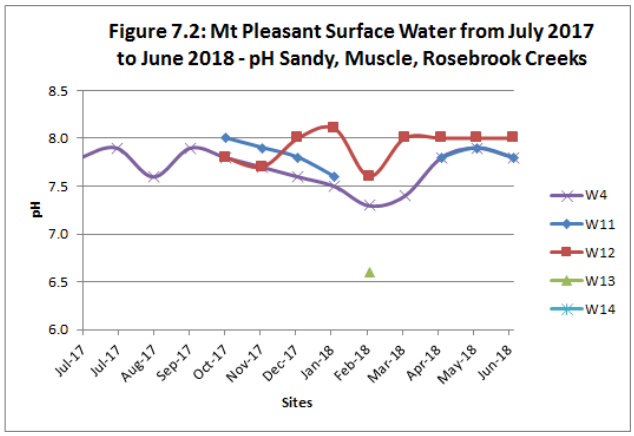



**Figure 7.2: Mt Pleasant Surface Water from July 2017 to June 2018 - pH Sandy, Muscle, Rosebrook Creeks**

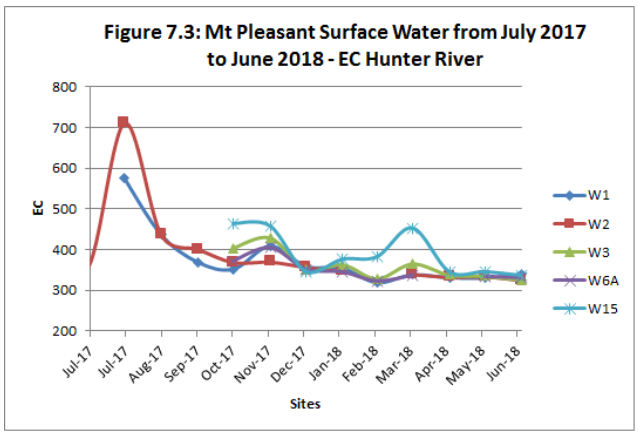



**Figure 7.3: Mt Pleasant Surface Water from July 2017 to June 2018 - EC Hunter River**

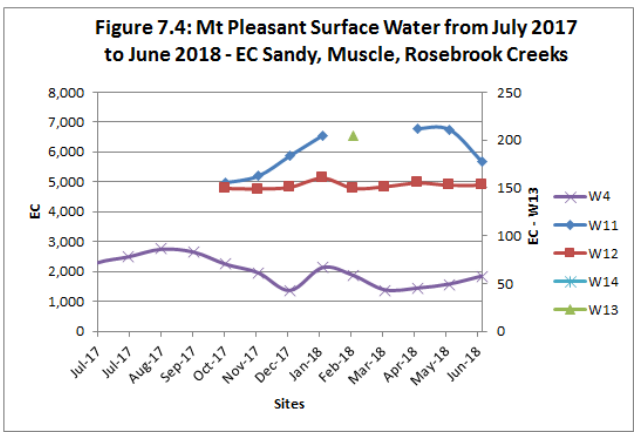



**Figure 7.4: Mt Pleasant Surface Water from July 2017 to June 2018 - EC Sandy, Muscle, Rosebrook Creeks**

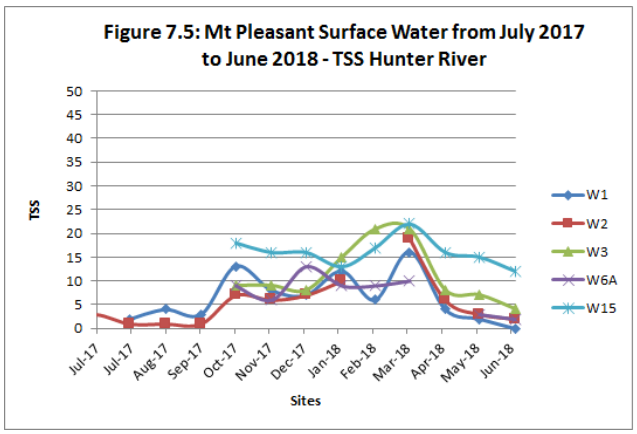



**Figure 7.5: Mt Pleasant Surface Water from July 2017 to June 2018 - TSS Hunter River**

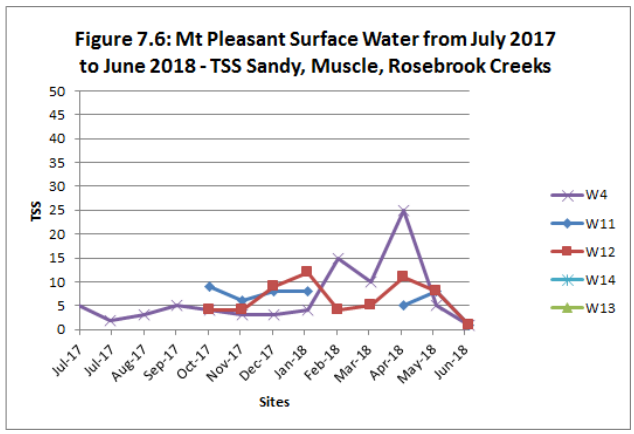



**Figure 7.6: Mt Pleasant Surface Water from July 2017 to June 2018 - TSS Sandy, Muscle, Rosebrook Creeks**

If any mine water is discharged from the MPO in the future, it will be undertaken in accordance with Development Consent DA 92/97 (Condition 26, Schedule 3), Development Consent SSD-5170 (i.e. Bengalla Mine's Development Consent) and Environmental Protection Licence (EPL) 20850.

Site specific water quality trigger values for pH, EC and TSS have been developed for various downstream monitoring sites. Default water quality trigger levels have been adopted for other sites based on ANZECC guideline values (ANZECC & ARMCANZ, 2000) as an interim measure until sufficient data is available to develop site specific values. The majority of monitoring sites are located on ephemeral drainage lines and therefore do not regularly experience flow for sampling.

### *E7.1.2 Groundwater monitoring*

The most recent Annual Review for the MPO (MACH Energy, 2018) indicates that groundwater monitoring is undertaken at a network of bores which are broadly distributed across the MPO area and which cover all major hydrological units (**Figure E2**, **Appendix 2**). Groundwater quality monitoring includes quarterly sampling of pH and EC and annual sampling and analysis of a broader suite of analytical parameters.

Groundwater trigger levels for pH and EC have been developed for the MPO based on the NSW Aquifer Interference Policy and ANZECC water quality guidelines (ANZECC & ARMCANZ, 2000). At any bore where a monitored pH is outside the applicable baseline range (20$^{th}$ to 80$^{th}$ percentile), at three successive monitoring rounds, a groundwater investigation protocol would be initiated. Beneficial use categories have been assigned to each monitoring bore based on its 80$^{th}$ percentile baseline EC and the EC ranges specified in the Water Management Plan (WMP). Should a measured EC value exceed the beneficial use quality range EC for a particular bore at three successive monitoring rounds (as defined in the WMP), the groundwater investigation protocol, as detailed in the Surface and Ground Water Response Plan, would be initiated.

The groundwater monitoring bores are split into three categories; i.e.:

- Groundwater Central Bores – representative of the hard rock aquifer
- Groundwater Eastern Bores – representative of the alluvial aquifer; and
- Groundwater Western Bores – representative of the hard rock aquifer in, or in the vicinity of, the Fines Emplacement Area.

Groundwater results for samples collected from these monitoring bores from March 2014 to December 2017 are indicative of baseline conditions as no coal extraction was undertaken at the MPO during this period.

The majority of EC values for the Central bores trended slightly upwards (range 500 to almost 10,000 µS/cm) but generally remained relatively stable for the Eastern (range 500 to almost 50,000 µS/cm) and Western bore (range 2,000 to over 16,000 µS/cm) sites. pH values for most of the monitoring sites remained within the range 6.5 to 8.0 during the reporting period.

## E7.2 Bengalla Mine surface and groundwater quality

The latest publicly available information on surface and groundwater quality at the Bengalla Mine adjacent to the MPO is contained in the 2017 Annual Review report for the site (Hansen Bailey, 2018). The Annual Review indicates that Bengalla Mining Company (BMC) has developed and implemented a WMP in accordance with the requirements of its modified Development Consent. The surface water monitoring data indicates that during 2017, pH, EC and TSS results at sites potentially impacted by surface operations were within applied water quality guideline criteria (ANZECC and ARMCANZ, 2000). BMC did not discharge under the Hunter River Salinity Trading Scheme (HRSTS) from its licensed discharge site during the reporting period

Groundwater monitoring data from the alluvium and Permian aquifer systems at Bengalla Mine indicated that most monitoring bores recorded groundwater pH values within triggers and shared similar pH trends. Isolated outlying pH values at specific bores were generally slightly more alkaline than expected. EC values in alluvium bores were typically less than 1,500 µS/cm and any exceedances were attributed to a natural phenomenon associated with proximity to coal seam outcrop and their influence on the water quality locally. Permian bores showed higher EC values and the EC data within the coal measures and interburden typically ranged from 2,500 to 9,000 µS/cm. Groundwater quality in the bores to the northwest of the active mining area showed little change in pH (6.9 – 7.8) and EC (5,460 to 8,640 µS/cm) over the reporting period.

Bengalla Mine co-disposes overburden and coal reject materials within the main overburden emplacement area in accordance with the Mining Operations Plan and Rehabilitation Management Plan (MOP) and the Acid Rock Drainage (ARD) and Mineral Waste Management Plan. These documents consider the geochemistry of the materials with respect to their potential to cause environmental harm and its suitability in construction and rehabilitation. BMC maintains a mineral waste inventory of the volumes of NAF and PAF waste disposed on site and disposal locations. Sampling locations for ARD monitoring purposes include:

- Water sampling form Endwall Dam; and
- Analysis of water quality from groundwater bores.

The results from Bengalla Mine's surface water and groundwater monitoring programs are used to determine if mineral waste at Bengalla Mine is being managed appropriately.

In 2017, approximately 5.5 % of the total material volume reporting to the main overburden emplacement area comprised WN interburden (ASS) and coal rejects. Hence the pH and EC monitoring results described above indicate that mineral waste at Bengalla Mine is being managed appropriately with no recorded impacts on surface or groundwater quality at the site. No monitoring data for dissolved metal/metalloid concentrations in surface waters at Bengalla Mine was reported by BMC in 2017. However, previous investigations (RGS, 2013) has demonstrated that the risk of elevated concentrations of dissolved metals/metalloids in surface water and groundwater at Bengalla Mine (from contact with managed overburden, interburden and coal reject materials) is very low.

### E7.3 Mt Arthur Coal Mine surface and ground water quality

The latest publicly available information on surface and groundwater quality at the Mt Arthur Coal Mine adjacent to the MPO is contained in the 2017 Annual Review report for the site (BHP, 2017). The Annual Review indicates that surface water is managed in accordance with various documents including the Site Water Management Plan and, Surface Water Monitoring Program. These documents outline measures for managing water on site and establishes impact assessment criteria (trigger values) against which monitoring results are compared. Downstream water quality is monitored by an independent consultant at five statutory monitoring sites as well as a licenced discharge point.

Water quality parameters in natural watercourses surrounding the mine were subject to normal variations in response to the ephemeral nature of the creeks, local geology and weather conditions. Water quality parameters are only recorded at the HRSTS discharge point and no HRSTS discharge occurred during the reporting period. Surface water pH measured at the statutory monitoring sites remained relatively constant during the reporting period, and within the impact assessment trigger levels of 6.5 – 9.0 at all times. Surface water EC and TSS measured at statutory sites remained below impact assessment trigger levels during the reporting period.

Groundwater at the site is also managed in accordance with various documents including the Site Water Management Plan and Site Water Monitoring Plan. These documents aim to minimise any adverse impacts on aquifers in proximity to the operation, including the two major aquifer areas, the hard rock coal measures and the shallow alluvial deposits associated with the Hunter River; and outline program requirements for monitoring of potential groundwater impacts from mining operations. Assessment criteria for groundwater monitoring results consist of a two-stage trigger process for EC, and pH results outside the trigger criteria range of 6.5 to 9.0 over three consecutive months.

Groundwater pH results were within the impact assessment criteria of 6.5 to 9.0 for the reporting period. There was one anomalous exceedance of the EC trigger value during the reporting period, which was not representative of the overall groundwater quality trends for the reporting year.

Mt Arthur Coal Mine co-disposes overburden and coal reject materials (and any readily identifiable PAF uneconomic coal seams, partings, roof and floor strata) within overburden emplacement areas in accordance with the MOP (i.e. burial at a depth greater than 5 m within the overburden emplacement to reduce the risk of AMD). The materials selectively mined and buried represent approximately 5 % of the total annual overburden produced.

The results from Mt Arthur Coal Mine's surface water and groundwater monitoring programs indicate that overburden, interburden and coal reject materials are being managed appropriately with no recorded impacts on surface or groundwater quality at the site. No monitoring data for dissolved metal/metalloid concentrations in surface waters at Mt Arthur Coal Mine was reported by BHP in 2017. However, previous investigations (GEM, 2012) have demonstrated that the risk of elevated concentrations of dissolved metals/metalloids in surface water and groundwater at Mt Arthur Coal Mine (from contact with managed overburden, interburden and coal reject materials) is low. However, GEM recommended that BHP include the analysis of pH, EC, TSS, total alkalinity/acidity, sulfate, As, Hg, Mo, Se and Sb in the surface water quality monitoring program for emplacement areas, with periodic data review.

# E8 Geological mapping and drill hole data for the MPO

## E8.1 Geological mapping

The geology of the MPO is described in some detail in **Section 1.3** and **Section 1.4** and in the Feasibility Study (Rio Tinto, 2011). According to the Geology Section of the Feasibility Study, 64 coal plies have been identified in the Wittingham Coal Measures at the MPO. These plies are commonly separated by partings less than 0.3 m thick to form working sections suitable for bulk mining. The seams are recognised by a combination of their stratigraphic location relative to each other and key marker horizons, and certain brightness characteristics.

The key marker horizons include the Fairford Formation, which consists of light-coloured tuffaceous claystone at the top of the Mt Arthur Coal Seam, and the Archerfield Sandstone, which is a bronze-coloured sandstone, immediately below the Bayswater seam. The latter unit is a thick dull coal, with characteristically lower volatile matter content, and non-caking properties. **Table E8.1** presents summarises the make-up of the seams, their average ply thickness and geometry.

Sandstone is the predominant lithology in the non-coal strata occurring at the MPO. Mudstone and claystone mainly occur in the immediate roof and floor strata of the coal seams.

The geological database and model for the MPO is largely based on borehole data collected during various campaigns. The resource knowledge is also supported by knowledge of the adjacent Bengalla Mine and from airborne geophysical survey data.

**Table E8.1: Summary of MPO seams, plies, thickness and geometry**

| Seam | Number of Plies | Ply Thickness (m) | Geometry |
|---|---|---|---|
| Bowfield | 2 | 0.6 – 0.8 | Occurs in 2 main seams |
| Warkworth | 10 | 0.3 – 2.3 | Splits southwards into multiple plies |
| Mt Arthur | 4 | 0.4 – 1.7 | Consistent seam |
| Piercefield | 7 | 0.3 – 1.1 | Consists of upper and lower seams, subject to complex splitting |
| Vaux | 10 | 0.4 – 1.5 | Consists of upper and lower seams, split in central part of deposit |
| Broonie | 7 | 0.3 – 1.2 | Consists of upper and lower seams, with splitting and coalescing |
| Bayswater | 6 | 0.8 – 1.3 | Splits northwards and coalesced in south with lower Broonie split |
| Archerfield Sandstone | | | |
| Wynn | 7 | 0.5 – 1.3 | Consists of upper and lower seams |
| Edderton | 4 | 0.5 – 1.4 | Consistent seam, top plies split in the north |
| Clanricard | 2 | 0.3 – 1.2 | - |
| Bengalla | 4 | 0.5 – 1.1 | - |
| Edinglassie | 5 | 0.7 – 2.3 | Structurally consistent |
| Ramrod Creek | 3 | 0.6 – 1.3 | - |

## E8.2 Drill hole data

There has been a significant amount of drilling and testing of drill core and drill chips at the MPO since the 1970s. In the 1970s and 1980s 40 drill holes were completed and resulted in the direct allocation of the MPO to Coal & Allied, which completed progressive drilling on a 1,000 m to 250 m spacing. The drilling on the 1990s resulted in approximately 400 drill holes; 113 of which were cored holes with coal quality information. In 2006, 21 core and 41 open holes were drilled for a feasibility study and in 2010, 7 drill additional holes were drilled. Hence, a total of approximately 508 drill holes have been drilled at the MPO and this information was used in the Feasibility Study to develop the geological model for the site (Rio Tinto, 2011).

In 2018, a further four cored holes were drilled at the MPO by MACH Energy and the drill core from some of these holes was viewed by RGS during the site visit on 26 July 2018. Given that the most recent (pre-2018) drill holes were drilled in 2010, this drill core would be too old for sampling and geochemical testing.

*RGS has coordinated the sampling and geochemical testing of drill core from four holes drilled in 2019. This has been augmented by geochemical sampling and testing of representative samples of MPO coal reject materials of the target coal seams from the Coal Handling and Preparation Plant (CHPP) in 2020.*

# E9 Environmental management of MPO mine waste materials

## E9.1 Current strategy

The current strategy for managing overburden, interburden and coal reject materials at the MPO is described in the MOP (MACH Energy, 2020), Mineral Waste Management Plan (Coal & Allied, 2012), Fines Emplacement Plan (ATC Williams, 2017) and the MPO Mine Optimisation Modification (MOD 3) Environmental Assessment (MACH Energy, 2017).

The 2012 Mineral Waste Management Plan indicates that overburden/interburden and coal reject materials with PAF properties are located well below the first coal and will not be an issue in the construction phase. The plan indicates that a detailed mining plan would be developed prior to mining overburden/interburden horizons identified as PAF, highly saline or highly sodic to ensure that these materials are adequately managed. All coal reject materials identified as having high sulfide content or as PAF would be disposed of in the mined pit whilst fine reject would be placed in a purpose-built storage facility.

The MOP (MACH Energy, 2020) states that overburden will initially be placed in an Overburden Emplacement to the east of the open cuts. As part of the planned routine mining operations, overburden will then also be placed behind the advancing mining operation to permit the extraction of coal using truck and shovel methods. The MOP states that course reject materials will consist predominantly of sedimentary rock types with minimal quantities of carbonaceous material and a low propensity for spontaneous combustion.

Fine rejects are thickened to a solids density of approximately 20 % to 30 % by weight and will predominantly be fine rock and clay with some coal and flocculent. The fine reject storage facility has been constructed according to a detailed design and is clay lined with an underdrainage system and lower sediment/seepage collection pond (ATC Williams, 2017).

Coarse reject materials are conveyed from the CHPP to a 550 tonne (t) bin located northwest of this facility (MACH Energy, 2020). The coarse rejects are then hauled by truck to the waste emplacements for disposal as a component of the general ROM waste emplacement operations. Coarse rejects are placed beneath at least 10 m of NAF waste material to reduce oxygen movement through the rehabilitated profile and manage its geochemical characteristics (i.e. acid generation potential). This also assists to minimise any potential for spontaneous combustion within the rehabilitated waste emplacements.

# Appendix 1

# Tables of Historic Results

# Tables E1 to E4

## Table E1: Acid Base Account Test Results for 1995 overburden and interburden samples

| Sample No. | Drill Hole ID | Sample ID | Sample Lithology | From (m) | To (m) | Interval (m) | Original Sample Description | pH[1] | EC[1] (µS/cm) | Total S* (%) | MPA[2] ($kgH_2SO_4/t$) | Total Carbon ($\%CO_2$) | Carbonate Carbon ($\%CO_2$) | ANC[2] ($kgH_2SO_4/t$) | Crude NAPP (Equiv. $\%CaCO_3$) | NAPP[2] ($kgH_2SO_4/t$) | ANC: MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4000C000 | E94/1403 | Sandstone/Siltstone 90:10 | 36.70 | 37.00 | 0.30 | WKH A Overburden | 7.20 | 195 | 0.005 | 0.2 | 7.0 | 4.1 | 92.3 | -9.4 | -92.1 | 92.1 | Acid Consuming |
| 2 | 4000C000 | E94/1404 | Siltstone | 52.20 | 52.50 | 0.30 | MTA A Interburden | 9.50 | 420 | 0.020 | 0.6 | 11.6 | 7.4 | 164.3 | -16.7 | -163.7 | 268.2 | Acid Consuming |
| 3 | 4000C000 | E94/1405 | Siltstone | 60.59 | 60.89 | 0.30 | MTA A Interburden | 9.85 | 340 | 0.030 | 0.9 | 22.6 | 4.2 | 93.0 | -9.4 | -92.1 | 101.3 | Acid Consuming |
| 4 | 4000C000 | E94/1406 | Sandstone/Siltstone 60:40 | 73.57 | 73.87 | 0.30 | PFD A Interburden | 10.05 | 637 | 0.005 | 0.2 | 8.4 | 5.0 | 110.9 | -11.3 | -110.7 | 724.2 | Acid Consuming |
| 5 | 4000C000 | E94/1407 | Sandstone/Siltstone 80:20 | 88.20 | 88.50 | 0.30 | PFD A Interburden | 10.30 | 723 | 0.005 | 0.2 | 10.1 | 8.1 | 180.5 | -18.4 | -180.3 | 1178.6 | Acid Consuming |
| 6 | 4000C000 | E94/1408 | Sandstone/Siltstone 90:10 | 104.20 | 104.50 | 0.30 | Vaux A Interburden | 10.15 | 569 | 0.005 | 0.2 | 10.0 | 8.3 | 184.4 | -18.8 | -184.2 | 1204.2 | Acid Consuming |
| 7 | 4000C000 | E94/1409 | Sandstone | 122.30 | 122.50 | 0.20 | Vaux A Interburden | 10.10 | 482 | 0.005 | 0.2 | 19.2 | 13.6 | 302.0 | -30.8 | -301.8 | 1972.2 | Acid Consuming |
| 8 | 4000F000 | E94/1410 | Siltstone | 17.20 | 17.50 | 0.30 | WKH A Overburden | 9.65 | 385 | 0.005 | 0.2 | 4.2 | 3.0 | 67.8 | -6.9 | -67.6 | 442.6 | Acid Consuming |
| 9 | 4000F000 | E94/1411 | Sandstone/Siltstone 70:30 | 33.20 | 33.50 | 0.30 | WKH Overburden | 9.50 | 229 | 0.005 | 0.2 | 7.5 | 4.2 | 93.3 | -9.5 | -93.1 | 609.0 | Acid Consuming |
| 10 | 4000F000 | E94/1412 | Tuff | 60.50 | 60.80 | 0.30 | MTA Midburden | 10.20 | 846 | 0.005 | 0.2 | 0.5 | 0.4 | 9.0 | -0.9 | -8.8 | 58.6 | Non-Acid Forming |
| 11 | 4000F000 | E94/1413 | Sandstone | 68.50 | 68.80 | 0.30 | MTA Midburden | 10.10 | 460 | 0.005 | 0.2 | 2.2 | 0.7 | 16.8 | -1.7 | -16.7 | 109.8 | Non-Acid Forming |
| 12 | 4000F000 | E94/1414 | Tuff (Fairford Claystone) | 74.10 | 74.40 | 0.30 | MTA Midburden | 10.00 | 1299 | 0.005 | 0.2 | 1.1 | 0.7 | 15.8 | -1.6 | -15.7 | 103.4 | Non-Acid Forming |
| 13 | 4000F000 | E94/1415 | Sandstone (Silty) | 90.53 | 90.83 | 0.30 | PFD A Midburden | 10.15 | 694 | 0.020 | 0.6 | 6.1 | 2.3 | 50.6 | -5.1 | -50.0 | 82.6 | Acid Consuming |
| 14 | 4000F000 | E94/1416 | Siltstone (Muddy, laminated) | 99.10 | 99.40 | 0.30 | PFD A Midburden | 10.05 | 454 | 0.060 | 1.8 | 42.8 | 11.1 | 247.8 | -25.1 | -246.0 | 134.9 | Acid Consuming |
| 15 | 4000F000 | E94/1417 | Sandstone/Siltstone | 110.10 | 110.40 | 0.30 | PFD A Midburden | 10.00 | 648 | 0.005 | 0.2 | 7.4 | 2.9 | 63.9 | -6.5 | -63.7 | 417.0 | Acid Consuming |
| 16 | 4000F000 | E94/1418 | Sandstone/Siltstone 70:30 | 134.20 | 134.50 | 0.30 | PFD C Midburden | 10.05 | 630 | 0.010 | 0.3 | 5.3 | 2.5 | 56.2 | -5.7 | -55.9 | 183.4 | Acid Consuming |
| 17 | 4000F000 | E94/1419 | Sandstone/Siltstone 50:50 | 162.20 | 162.50 | 0.30 | PFD C Midburden | 9.80 | 377 | 0.010 | 0.3 | 6.0 | 3.8 | 84.6 | -8.6 | -84.3 | 276.2 | Acid Consuming |
| 18 | 5000A500 | E94/1420 | SandstoneWeathered | 24.89 | 25.19 | 0.30 | PFD B Overburden | 9.05 | 84 | 0.005 | 0.2 | 3.2 | 2.9 | 64.8 | -6.6 | -64.7 | 423.4 | Acid Consuming |
| 19 | 5000A500 | E94/1421 | Sandstone | 40.20 | 40.50 | 0.30 | PFD B Overburden | 8.65 | 126 | 0.005 | 0.2 | 4.6 | 4.0 | 88.4 | -9.0 | -88.2 | 577.0 | Acid Consuming |
| 20 | 5000A500 | E94/1422 | Siltstone | 51.10 | 51.40 | 0.30 | PFD B Overburden | 8.65 | 136 | 0.030 | 0.9 | 4.8 | 1.2 | 25.4 | -2.5 | -24.5 | 27.7 | Non-Acid Forming |
| 21 | 5000A500 | E94/1423 | Siltstone | 67.56 | 67.86 | 0.30 | VAUX E Midburden | 8.95 | 132 | 0.040 | 1.2 | 6.0 | 1.8 | 41.4 | -4.1 | -40.2 | 33.8 | Non-Acid Forming |
| 22 | 5000A500 | E94/1424 | Siltstone/Sandstone 60:40 | 77.52 | 77.82 | 0.30 | VAUX E Midburden | 8.60 | 236 | 0.190 | 5.8 | 11.9 | 9.0 | 200.8 | -19.9 | -195.0 | 34.5 | Acid Consuming |
| 23 | 5000A500 | E94/1425 | Sandstone/Siltstone 70:30 | 83.07 | 83.37 | 0.30 | BRN B Midburden | 9.00 | 194 | 0.005 | 0.2 | 8.2 | 5.6 | 124.6 | -12.7 | -124.5 | 813.8 | Acid Consuming |
| 24 | 5000A500 | E94/1426 | Siltstone/Sandstone 60:40 | 86.97 | 87.27 | 0.30 | BRN B Midburden | 8.95 | 163 | 0.005 | 0.2 | 10.6 | 5.8 | 128.5 | -13.1 | -128.4 | 839.4 | Acid Consuming |
| 25 | 5000A500 | E94/1427 | Sandstone | 105.70 | 106.00 | 0.30 | WYNN EF Midburden | 9.10 | 183 | 0.005 | 0.2 | 9.5 | 9.2 | 205.0 | -20.9 | -204.8 | 1338.6 | Acid Consuming |
| 26 | 5000A500 | E94/1428 | Conglomerate | 110.20 | 110.50 | 0.30 | WYNN EF Midburden | 6.30 | 2340 | 1.410 | 43.2 | 8.8 | 7.8 | 174.5 | -13.4 | -131.3 | 4.0 | Non-Acid Forming# |
| 27 | 5000C000 | E94/1429 | Sandstone | 19.46 | 19.76 | 0.30 | PFD A Midburden | 9.00 | 196 | 0.030 | 0.9 | 7.2 | 3.4 | 75.4 | -7.6 | -74.5 | 82.1 | Acid Consuming |
| 28 | 5000C000 | E94/1430 | Sandstone/Siltstone 70:30 | 24.70 | 25.00 | 0.30 | PFD A Midburden | 9.30 | 238 | 0.005 | 0.2 | 8.0 | 4.9 | 108.9 | -11.1 | -108.8 | 711.4 | Acid Consuming |
| 29 | 5000C000 | E94/1431 | Sandstone | 34.70 | 35.00 | 0.30 | PFD A Midburden | 9.40 | 227 | 0.005 | 0.2 | 16.7 | 13.4 | 299.1 | -30.5 | -298.9 | 1953.0 | Acid Consuming |
| 30 | 5000C000 | E94/1432 | Sandstone/Siltstone 70:30 | 56.20 | 56.50 | 0.30 | VAUX A Midburden | 9.45 | 236 | 0.005 | 0.2 | 9.6 | 5.1 | 112.9 | -11.5 | -112.7 | 737.0 | Acid Consuming |
| 31 | 5000C000 | E94/1433 | Sandstone/Siltstone 90:10 | 90.20 | 90.50 | 0.30 | BRN A Midburden | 9.90 | 254 | 0.005 | 0.2 | 6.6 | 2.9 | 63.9 | -6.5 | -63.7 | 417.0 | Acid Consuming |
| 32 | 5000C000 | E94/1434 | Siltstone | 105.95 | 106.25 | 0.30 | BRN B Midburden | 9.50 | 385 | 0.030 | 0.9 | 11.6 | 2.9 | 64.6 | -6.5 | -63.7 | 70.3 | Acid Consuming |
| 33 | 5000C000 | E94/1435 | Sandstone | 128.50 | 128.80 | 0.30 | WYNN EF Midburden | 9.60 | 181 | 0.005 | 0.2 | 1.0 | 0.5 | 10.9 | -1.1 | -10.8 | 71.4 | Non-Acid Forming |
| 34 | 5000C000 | E94/1436 | Sandstone | 133.40 | 133.70 | 0.30 | WYNN EF Midburden | 4.20 | 330 | 1.340 | 41.0 | 1.0 | 0.3 | 5.8 | 3.6 | 35.3 | 0.1 | Potentially Acid Forming |
| 35 | 5000C000 | E94/1437 | Sandstone | 134.90 | 135.20 | 0.30 | WYNN EF Interburden | 4.80 | 2830 | 1.470 | 45.0 | 1.7 | 0.4 | 7.8 | 3.8 | 37.2 | 0.2 | Potentially Acid Forming |
| 36 | 5000C000 | E94/1438 | Sandstone/Siltstone 70:30 | 140.20 | 140.50 | 0.30 | WYNN I Midburden | 9.50 | 211 | 0.010 | 0.3 | 5.4 | 1.1 | 23.8 | -2.4 | -23.5 | 77.8 | Non-Acid Forming |
| 37 | 5000C000 | E94/1439 | Sandstone/Siltstone 60:40 | 152.00 | 152.30 | 0.30 | WYNN I Interburden | 9.35 | 210 | 0.030 | 0.9 | 6.7 | 1.2 | 25.4 | -2.5 | -24.5 | 27.7 | Non-Acid Forming |
| 38 | 5000C000 | E94/1440 | Sandstone | 157.10 | 157.40 | 0.30 | EDDERTON B Midburden | 9.40 | 337 | 0.050 | 1.5 | 8.4 | 1.7 | 37.8 | -3.7 | -36.3 | 24.7 | Non-Acid Forming |

## Table E1: Acid Base Account Test Results for 1995 overburden and interburden samples

| Sample No. | Drill Hole ID | Sample ID | Sample Lithology | From (m) | To (m) | Interval (m) | Original Sample Description | pH[1] | EC[1] (µS/cm) | Total S* (%) | MPA[2] ($kgH_2SO_4/t$) | Total Carbon ($\%CO_2$) | Carbonate Carbon ($\%CO_2$) | ANC[2] ($kgH_2SO_4/t$) | Crude NAPP (Equiv. $\%CaCO_3$) | NAPP[2] ($kgH_2SO_4/t$) | ANC: MPA Ratio | Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39 | 5000F000 | E94/1441 | Conglomerate /sandstone 80:20 | 16.70 | 17.00 | 0.30 | MTA Overburden | 9.30 | 242 | 0.010 | 0.3 | 5.50 | 4.3 | 96.3 | -9.8 | -96.0 | 314.6 | Acid Consuming |
| 40 | 5000F000 | E94/1442 | Siltstone | 34.20 | 34.50 | 0.30 | MTA Overburden | 9.75 | 267 | 0.030 | 0.9 | 7.70 | 1.4 | 30.3 | -3.0 | -29.4 | 33.0 | Non-Acid Forming |
| 41 | 5000F000 | E94/1443 | Mudstone | 42.20 | 42.50 | 0.30 | PFD C Midburden | 9.70 | 377 | 0.020 | 0.6 | 4.00 | 0.3 | 6.5 | -0.6 | -5.9 | 10.6 | Non-Acid Forming |
| 42 | 5000F000 | E94/1444 | Sandstone | 60.20 | 60.50 | 0.30 | PFD C Midburden | 10.10 | 371 | 0.005 | 0.2 | 8.30 | 5.3 | 116.8 | -11.9 | -116.6 | 762.6 | Acid Consuming |
| 43 | 5000F000 | E94/1445 | Siltstone | 83.45 | 83.75 | 0.30 | PFD C Midburden | 7.85 | 500 | 0.220 | 6.7 | 52.50 | 2.9 | 64.6 | -5.9 | -57.8 | 9.6 | Acid Consuming |
| 44 | 6000C000 | E94/1446 | Sandstone Course weathered | 17.20 | 19.59 | 2.39 | BRN B Overburden | 7.00 | 204 | 0.050 | 1.5 | 0.80 | 0.2 | 4.5 | -0.3 | -2.9 | 2.9 | Non-Acid Forming |
| 45 | 6000C000 | E94/1447 | Mudstone- Grey, soft Fissile | 20.45 | 20.75 | 0.30 | BRN B Overburden | 8.00 | 325 | 0.030 | 0.9 | 6.80 | 1.0 | 21.5 | -2.1 | -20.6 | 23.4 | Non-Acid Forming |
| 46 | 6000C000 | E94/1448 | Sandstone | 24.79 | 25.09 | 0.30 | BRN B Overburden | 9.65 | 176 | 0.005 | 0.2 | 5.60 | 3.3 | 74.6 | -7.6 | -74.5 | 487.4 | Acid Consuming |
| 47 | 6000C000 | E94/1449 | Sandstone Conglomerate 80:20 | 41.37 | 41.67 | 0.30 | WYNN EF Midburden | 7.50 | 1328 | 0.020 | 0.6 | 4.30 | 3.0 | 67.3 | -6.8 | -66.6 | 109.8 | Acid Consuming |
| 48 | 6000C000 | E94/1450 | Sandstone Conglomerate | 45.00 | 45.30 | 0.30 | WYNN EF Midburden | 2.75 | 2830 | 0.550 | 16.8 | 0.40 | 0.1 | 0.2 | 1.7 | 16.7 | 0.01 | Potentially Acid Forming |
| 49 | 6000C000 | E94/1451 | Sandstone Conglomerate | 48.00 | 48.30 | 0.30 | WYNN EF Midburden | 3.65 | 2660 | 1.470 | 45.0 | 1.30 | 0.2 | 4.8 | 4.1 | 40.2 | 0.1 | Potentially Acid Forming |
| 50 | 6000C000 | E94/1452 | Mudstone | 55.21 | 55.41 | 0.20 | EDDERTON Midburden | 7.80 | 328 | 0.100 | 3.1 | 22.40 | 3.6 | 79.5 | -7.8 | -76.4 | 26.0 | Acid Consuming |
| 51 | 6000C000 | E94/1453 | Sandstone/siltstone 50:50 | 56.05 | 56.34 | 0.29 | EDDERTON Midburden | 8.10 | 271 | 0.040 | 1.2 | 11.10 | 5.3 | 117.8 | -11.9 | -116.6 | 96.2 | Acid Consuming |
| 52 | 6000D000 | E94/1454 | Sandstone weathered | 16.90 | 17.20 | 0.30 | Vaux Overburden | 9.15 | 221 | 0.005 | 0.2 | 4.90 | 3.8 | 85.4 | -8.7 | -85.3 | 557.8 | Acid Consuming |
| 53 | 6000D000 | E94/1455 | Siltstone/Sandstone 80:20 | 40.14 | 40.44 | 0.30 | BRN A Midburden | 9.70 | 216 | 0.010 | 0.3 | 5.80 | 2.0 | 43.4 | -4.4 | -43.1 | 141.8 | Non-Acid Forming |
| 54 | 6000D000 | E94/1456 | Sandstone/Siltstone 80:20 | 59.84 | 60.14 | 0.30 | BRN B Midburden | 9.70 | 218 | 0.005 | 0.2 | 7.30 | 2.7 | 60.9 | -6.2 | -60.8 | 397.8 | Acid Consuming |
| 55 | 6000D000 | E94/1457 | Conglomerate/Sandstone 70:30 | 68.70 | 69.00 | 0.30 | BAY midburden | 8.20 | 470 | 0.005 | 0.2 | 9.10 | 1.7 | 38.4 | -3.9 | -38.2 | 250.6 | Non-Acid Forming |
| 56 | 6000D000 | E94/1458 | Sandstone | 87.53 | 87.83 | 0.30 | WYNN EF Midburden | 9.00 | 382 | 0.060 | 1.8 | 8.70 | 5.5 | 122.4 | -12.3 | -120.5 | 66.6 | Acid Consuming |
| 57 | 6000D000 | E94/1459 | Sandstone/Conglomerate 80:20 | 90.20 | 90.50 | 0.30 | WYNN EF Midburden | 3.20 | 3150 | 1.580 | 48.4 | 2.90 | 0.3 | 8.2 | 4.1 | 40.2 | 0.2 | Potentially Acid Forming |
| 58 | 6000D000 | E94/1460 | Siltstone | 92.90 | 93.20 | 0.30 | WYNN I Midburden | 3.40 | 2330 | 5.690 | 174.3 | 24.80 | 3.6 | 147.8 | 2.7 | 26.5 | 0.8 | Potentially Acid Forming |
| 59 | 6000D000 | E94/1461 | Sandstone | 100.82 | 101.12 | 0.30 | WYNN I Midburden | 9.50 | 185 | 0.005 | 0.2 | 3.00 | 0.8 | 16.8 | -1.7 | -16.7 | 109.8 | Non-Acid Forming |
| 60 | 6000D000 | E94/1462 | Siltstone | 114.69 | 114.99 | 0.30 | EDDERTON B Midburden | 8.00 | 329 | 0.010 | 0.3 | 8.10 | 1.4 | 27.7 | -2.8 | -27.4 | 90.6 | Non-Acid Forming |
| 61 | 6000G000 | E94/1463 | Sandstone/ Weathered | 10.50 | 10.80 | 0.30 | PFD C Overburden | 7.45 | 298 | 0.005 | 0.2 | 0.60 | 0.1 | 3.1 | -0.3 | -2.9 | 20.2 | Non-Acid Forming |
| 62 | 6000G000 | E94/1464 | Siltstone/Siltstone 60:40 | 25.85 | 26.15 | 0.30 | PFD C Overburden | 8.70 | 205 | 0.005 | 0.2 | 11.60 | 7.3 | 162.8 | -16.6 | -162.7 | 1063.4 | Acid Consuming |

1. Current pH, EC provided for 4:3 sample:water slurry (essentially a saturated paste).
2. MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification criteria detail provided in report text.

* Where total sulfur or ANC results are less than the laboratory LoR a value of half of the LoR is used in this table. # This interburden sample associated with the Wynn seam has an elevated total sulfur content and has the potential to generate neutral mine drainage with elevated concentrations of major ions .

## Table E2: Acid Base Account Test Results for 1998 coal reject samples

| Sample ID | Sample Description | Sample Description | pH[1] | EC[1] | Total S | MPA[2] | ANC[2] | NAPP[2] | $NAG_{pH}$ | EGi Sample Classification[3] | RGS Sample Classification[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (µS/cm) | (%) | (kg H2SO4/t) | | | | | |
| MTP/11699 | WKHR1 + WKHR2 | Warkworth Seam Composite | 7.8 | 870 | 0.37 | 11 | 44 | -33 | nd | Non-Acid Forming | Non-Acid Forming |
| 11700 | MTAR1 + MTAR2 | Mt Arthur Seam Composite | 7.0 | 1210 | 1.20 | 38 | 92 | -54 | nd | Non-Acid Forming | Acid Consuming |
| 11701 | PFDR1 + PFDR2 | Piercefield Seam Composite | 6.8 | 1290 | 1.70 | 53 | 51 | 2 | nd | Non-Acid Forming | Uncertain |
| 11702 | WYNNR1 + WYNNR2 | Wynn Seam Composite | 5.1 | 1560 | 1.80 | 54 | 17 | 37 | nd | Potentially Acid Forming | Potentially Acid Forming |
| 11703 | EDDR1 + EDDT2 | Edderton Seam Composite | 6.8 | 1080 | 0.64 | 20 | 21 | -1 | nd | Non-Acid Forming | Uncertain |
| 11704 | BRNR1 + BRNR2 | Broonie Seam Composite | 6.6 | 950 | 0.61 | 19 | 12 | 7 | nd | Potentially Acid Forming | Potentially Acid Forming (low capacity) |
| 11705 | BAYR1 + BAYR2 | Bayswater Seam Composite | 6.6 | 930 | 0.66 | 20 | 41 | -21 | nd | Non-Acid Forming | Non-Acid Forming |
| 11706 | VAUR1 +VAUR2 | Vaux Seam Composite | 6.7 | 1090 | 1.30 | 39 | 72 | -33 | nd | Non-Acid Forming | Non-Acid Forming |
| 11707 | Leach Column | Column representing bulk tailings for years 2 to 3 | - | - | #1.15 | #35 | #45 | -10 | 5.2 | Non-Acid Forming | Non-Acid Forming |
| 11708 | Leach Column | Column representing bulk tailingsfor years 10 to 14 | - | - | #1.08 | #33 | #51 | -18 | 7.0 | Non-Acid Forming | Non-Acid Forming |

1. Current pH, EC provided for 1:2 sample:deionised water mix.
2. MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; NAPP = Net Acid Producing Potential and NAG = Net Acid Generation
   nd = Not determined; # = Calculated

**TABLE E3(i): COAL REJECT SAMPLE KLC 1 - 11707**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 2.50 | **TS (%)** | 1.15 | **ANC** | 45 |
| **pH (1:5)** | 5.20 | **Scr (%)** | - | **NAPP** | -9.8 |
| **EC (µS/cm)** | 9,600 | **MPA** | 35.2 | **ANC:MPA** | 1.3 |

| **Week Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volume Leached (L)** | 0.458 | 0.451 | 0.386 | 0.210 | 0.217 | 0.221 | 0.221 | 0.224 | 0.224 | 0.226 | 0.225 | 0.221 | 0.220 |
| **Cum. Volume (L)** | 0.46 | 0.91 | 1.30 | 1.51 | 1.72 | 1.94 | 2.16 | 0.22 | 0.45 | 0.67 | 0.90 | 1.12 | 1.34 |
| **Pore Volumes** | 0.3 | 0.7 | 1.0 | 1.1 | 1.3 | 1.4 | 1.6 | 0.2 | 0.3 | 0.5 | 0.7 | 0.8 | 1.0 |
| **pH** | 7.50 | 7.30 | 8.00 | 7.80 | 7.30 | 7.60 | 7.30 | 7.50 | 7.50 | 7.20 | 7.50 | 7.50 | 7.60 |
| **EC** | 9,600 | 2,300 | 4,800 | 2,900 | 3,700 | 2900 | 2,500 | 2,600 | 1900 | 1,400 | 1,300 | 1200 | 1,200 |
| **Alkalinity (mgCaCO3/L)*** | 202 | 28 | 69 | 46 | 45 | 54 | 49 | 60 | 47 | 43 | 55 | 56 | 61 |
| **Major Elements (mg/L)** | All units mg/L | | | | | | | | | | | | |
| **Calcium (Ca)** | 800 | 290 | 500 | 460 | 440 | 450 | - | - | - | - | - | - | - |
| **Chloride (Cl)** | 1770 | 270 | 600 | 880 | 330 | 370 | - | - | - | - | - | - | - |
| **Fluoride (F)** | 0.4 | - | - | - | - | 0.6 | - | - | - | - | - | - | - |
| **Iron (Fe)** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Potassium (K)** | 36 | 11.8 | 21 | 17 | 15.5 | 15 | - | - | - | - | - | - | - |
| **Magnesium (Mg)** | 800 | 180 | 370 | 310 | 275 | 275 | - | - | - | - | - | - | - |
| **Manganese (Mn)** | 12.5 | - | - | - | - | 2.7 | - | - | - | - | - | - | - |
| **Sodium (Na)** | 380 | 27 | 80 | 58 | 46 | 41 | - | - | - | - | - | - | - |
| **Sulfate ($SO_4$)** | 3,176 | 1,108 | 1,917 | 1,797 | 1,678 | 1,618 | - | - | - | - | - | - | - |
| **Minor Elements (mg/L)** | All units mg/L | | | | | | | | | | | | |
| **Aluminium (Al)** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Arsenic (As)** | 5.6 | - | - | - | - | 1.3 | - | - | - | - | - | - | - |
| **Boron (B)** | 0.18 | - | - | - | - | 0.03 | - | - | - | - | - | - | - |
| **Barium (Ba)** | 0.1 | - | - | - | - | 0.04 | - | - | - | - | - | - | - |
| **Cobalt (Co)** | 2.5 | - | - | - | - | 0.034 | - | - | - | - | - | - | - |
| **Chromium (Cr)** | 0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Copper (Cu)** | 0.01 | - | - | - | - | <0.005 | - | - | - | - | - | - | - |
| **Nickel (Ni)** | 1.5 | - | - | - | - | 0.07 | - | - | - | - | - | - | - |
| **Phosphorus (P)** | <0.1 | - | - | - | - | 0.1 | - | - | - | - | - | - | - |
| **Selenium (Se)** | <0.2 | - | - | - | - | <0.02 | - | - | - | - | - | - | - |
| **Silicon (Si)** | 4.7 | - | - | - | - | 1.4 | - | - | - | - | - | - | - |
| **Strontium (Sr)** | 19 | - | - | - | - | 8.8 | - | - | - | - | - | - | - |
| **Vanadium** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Zinc (Zn)** | 1.1 | - | - | - | - | 0.04 | - | - | - | - | - | - | - |
| **Trace Elements (µg/L)** | All units µg/L | | | | | | | | | | | | |
| **Silver (Ag)** | 0.44 | | | | | <0.01 | | | | | | | |
| **Beryllium (Be)** | <0.1 | | | | | <0.1 | | | | | | | |
| **Bismuth (Bi)** | 0.12 | | | | | 0.055 | | | | | | | |
| **Cadmium (Cd)** | 27 | | | | | 1.4 | | | | | | | |
| **Cerium (Ce)** | 0.13 | | | | | 0.088 | | | | | | | |
| **Mercury (Hg)** | <0.1 | | | | | <0.1 | | | | | | | |
| **Lead (Pb)** | 0.5 | | | | | 12 | | | | | | | |
| **Molybdenum (Mo)** | 9 | | | | | 13.5 | | | | | | | |
| **Antimony (Sb)** | 0.41 | | | | | 0.6 | | | | | | | |
| **Tin (Sn)** | 0.4 | | | | | 0.2 | | | | | | | |
| **Thorium (Th)** | 0.03 | | | | | <0.005 | | | | | | | |
| **Titanium (Tl)** | 1.5 | | | | | 0.12 | | | | | | | |
| **Uranium (U)** | 26.5 | | | | | 4.5 | | | | | | | |
| **Tungsten (W)** | 0.04 | | | | | <0.02 | | | | | | | |
| **Calculations**** | | | | | | | | | | | | | |
| **$SO_4$ Release Rate** | 582 | 200 | 296 | 151 | 146 | 143 | - | - | - | - | - | - | - |
| **Cumulative $SO_4$ Release** | 582 | 782 | 1078 | 1229 | 1374 | 1517 | - | - | - | - | - | - | - |
| **Ca Release Rate** | 147 | 52 | 77 | 39 | 38 | 40 | - | - | - | - | - | - | - |
| **Cumulative Ca Release** | 147 | 199 | 276 | 315 | 353 | 393 | - | - | - | - | - | - | - |
| **Mg Release Rate** | 6.6 | 2.1 | 3.2 | 1.4 | 1.3 | 1.3 | - | - | - | - | - | - | - |
| **Cumulative Mg Release** | 6.6 | 8.7 | 12.0 | 13.4 | 14.7 | 16.1 | - | - | - | - | - | - | - |
| **Residual ANC (%)** | 99.1 | 98.8 | 98.4 | 98.2 | 97.9 | 97.7 | - | - | - | - | - | - | - |
| **Residual Sulfur (%)** | 98.3 | 97.7 | 96.9 | 96.4 | 96.0 | 95.6 | - | - | - | - | - | - | - |
| **$SO_4$/(Ca+Mg) molar ratio** | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.4 | - | - | - | - | - | - | - |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; ANC = Acid Neutralising Capacity; MPA = Maximum Potential Acidity; and NAPP = Net Acid Producing Potential.

**TABLE E3(ii): COAL REJECT SAMPLE KLC 2 - 11708**

| | | | | | |
|---|---|---|---|---|---|
| **Weight (kg)** | 2.50 | **Total S (%)** | 1.08 | **ANC** | 51 |
| **pH (1:5)** | 7.00 | **Scr (%)** | - | **NAPP** | -17.9 |
| **EC (µS/cm)** | 8,700 | **MPA** | 33.1 | **ANC:MPA** | 1.5 |

| **Week Number** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Volume Leached (L)** | 0.463 | 0.431 | 0.382 | 0.204 | 0.221 | 0.224 | 0.221 | 0.229 | 0.231 | 0.240 | 0.246 | 0.254 | 0.256 |
| **Cum. Volume (L)** | 0.46 | 0.89 | 1.28 | 1.48 | 1.70 | 1.93 | 2.15 | 0.23 | 0.46 | 0.70 | 0.95 | 1.20 | 1.46 |
| **Pore Volumes** | 0.3 | 0.7 | 0.9 | 1.1 | 1.3 | 1.4 | 1.6 | 0.2 | 0.3 | 0.5 | 0.7 | 0.9 | 1.1 |
| **pH** | 7.70 | 7.10 | 7.70 | 7.80 | 7.50 | 7.80 | 7.50 | 7.70 | 7.70 | 7.60 | 7.80 | 7.80 | 7.80 |
| **EC** | 8,700 | 2,900 | 4,400 | 2,800 | 3,600 | 2,800 | 2,400 | 2,200 | 1,900 | 1,300 | 1,200 | 1,200 | 1,300 |
| **Alkalinity (mgCaCO3/L)*** | 194 | 7 | 38 | 42 | 40 | 39 | 38 | 49 | 43 | 44 | 47 | 51 | 47 |
| **Major Elements (mg/L)** | All units mg/L | | | | | | | | | | | | |
| **Calcium (Ca)** | 780 | 380 | 470 | 420 | 500 | 460 | - | - | - | - | - | - | - |
| **Chloride (Cl)** | 1750 | 450 | 600 | 390 | 410 | 260 | - | - | - | - | - | - | - |
| **Fluoride (F)** | 0.5 | - | - | - | - | 1 | - | - | - | - | - | - | - |
| **Iron (Fe)** | <0.01 | - | - | - | - | 0.02 | - | - | - | - | - | - | - |
| **Potassium (K)** | 35 | 16 | 19 | 15 | 15 | 13 | - | - | - | - | - | - | - |
| **Magnesium (Mg)** | 740 | 260 | 330 | 270 | 295 | 265 | - | - | - | - | - | - | - |
| **Manganese (Mn)** | 9.2 | - | - | - | - | 1.3 | - | - | - | - | - | - | - |
| **Sodium (Na)** | 400 | 90 | 80 | 56 | 52 | 42 | - | - | - | - | - | - | - |
| **Sulfate ($SO_4$)** | 2,936 | 1,158 | 1,738 | 1,618 | 1,857 | 1,797 | - | - | - | - | - | - | - |
| **Minor Elements (mg/L)** | All units mg/L | | | | | | | | | | | | |
| **Aluminium (Al)** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Arsenic (As)** | 5.2 | - | - | - | - | 0.76 | - | - | - | - | - | - | - |
| **Boron (B)** | 0.13 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Barium (Ba)** | 0.09 | - | - | - | - | 0.05 | - | - | - | - | - | - | - |
| **Cobalt (Co)** | 1 | - | - | - | - | 0.023 | - | - | - | - | - | - | - |
| **Chromium (Cr)** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Copper (Cu)** | <0.01 | - | - | - | - | <0.005 | - | - | - | - | - | - | - |
| **Nickel (Ni)** | 0.72 | - | - | - | - | 0.02 | - | - | - | - | - | - | - |
| **Phosphorus (P)** | <0.1 | - | - | - | - | <0.1 | - | - | - | - | - | - | - |
| **Selenium (Se)** | <0.2 | - | - | - | - | <0.02 | - | - | - | - | - | - | - |
| **Silicon (Si)** | 4.5 | - | - | - | - | 1.1 | - | - | - | - | - | - | - |
| **Strontium (Sr)** | 19 | - | - | - | - | 7.6 | - | - | - | - | - | - | - |
| **Vanadium** | <0.01 | - | - | - | - | <0.01 | - | - | - | - | - | - | - |
| **Zinc (Zn)** | 0.52 | - | - | - | - | 0.03 | - | - | - | - | - | - | - |
| **Trace Elements (µg/L)** | All units µg/L | | | | | | | | | | | | |
| **Silver (Ag)** | 0.32 | | | | | <0.01 | | | | | | | |
| **Beryllium (Be)** | 0.1 | | | | | <0.1 | | | | | | | |
| **Bismuth (Bi)** | 0.14 | | | | | 0.035 | | | | | | | |
| **Cadmium (Cd)** | 16 | | | | | 0.62 | | | | | | | |
| **Cerium (Ce)** | 0.54 | | | | | 0.04 | | | | | | | |
| **Mercury (Hg)** | <0.1 | | | | | <0.1 | | | | | | | |
| **Lead (Pb)** | 11 | | | | | 15 | | | | | | | |
| **Molybdenum (Mo)** | <0.5 | | | | | 2 | | | | | | | |
| **Antimony (Sb)** | 0.4 | | | | | 0.46 | | | | | | | |
| **Tin (Sn)** | 0.5 | | | | | <0.1 | | | | | | | |
| **Thorium (Th)** | 0.06 | | | | | <0.005 | | | | | | | |
| **Titanium (TI)** | 0.76 | | | | | 0.1 | | | | | | | |
| **Uranium (U)** | 43 | | | | | 0.5 | | | | | | | |
| **Tungsten (W)** | 0.04 | | | | | <0.02 | | | | | | | |
| **Calculations**** | | | | | | | | | | | | | |
| **$SO_4$ Release Rate** | 544 | 200 | 266 | 132 | 164 | 161 | - | - | - | - | - | - | - |
| **Cumulative $SO_4$ Release** | 544 | 744 | 1009 | 1141 | 1306 | 1467 | - | - | - | - | - | - | - |
| **Ca Release Rate** | 145 | 66 | 72 | 34 | 44 | 41 | - | - | - | - | - | - | - |
| **Cumulative Ca Release** | 145 | 210 | 282 | 316 | 360 | 402 | - | - | - | - | - | - | - |
| **Mg Release Rate** | 6.5 | 2.8 | 2.9 | 1.2 | 1.3 | 1.2 | - | - | - | - | - | - | - |
| **Cumulative Mg Release** | 6.5 | 9.2 | 12.1 | 13.4 | 14.7 | 15.9 | - | - | - | - | - | - | - |
| **Residual ANC (%)** | 99.3 | 98.9 | 98.6 | 98.4 | 98.2 | 97.9 | - | - | - | - | - | - | - |
| **Residual Sulfur (%)** | 98.3 | 97.7 | 96.9 | 96.5 | 96.0 | 95.5 | - | - | - | - | - | - | - |
| **$SO_4$/(Ca+Mg) molar ratio** | 1.5 | 1.2 | 1.4 | 1.5 | 1.5 | 1.6 | - | - | - | - | - | - | - |

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** $SO_4$, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; ANC = Acid Neutralising Capacity; MPA = Maximum Potential Acidity; and NAPP = Net Acid Producing Potential.

## Table E4: Multi-Element Composition and Geochemical Abundance Index for Reject Samples

| | Reject Sample Number → | 1 | 2 | Median Crustal Abundance | 1 | 2 | 1 | 2 |
|---|---|---|---|---|---|---|---|---|
| | ALS Laboratory ID → | Coal Reject | Coal Reject | | Coal Reject | Coal Reject | Coal Reject | Coal Reject |
| | Sample ID → | MTP/11707 | MTP/11708 | | MTP/11707 | MTP/11708 | MTP/11707 | MTP/11708 |
| **Parameters** | **Detection Limit** | | | | **RGS Calculated Value** | | **EGi Calculated Value** | |
| **Major Elements** | All units (%) | | | | Geochemical Abundance Index | | | |
| Aluminium (Al) | 0.002 | 9.4 | 8.8 | 7.1 | 0 | 0 | 0 | 0 |
| Calcium (Ca) | 0.001 | 1.14 | 1.18 | 1.5 | 0 | 0 | 0 | 0 |
| Iron (Fe) | 0.01 | 3.9 | 3.8 | 4.0 | 0 | 0 | 0 | 0 |
| Potassium (K) | 0.002 | 0.98 | 0.9 | 1.4 | 0 | 0 | 0 | 0 |
| Magnesium (Mg) | 0.002 | 0.78 | 0.8 | 0.5 | 0 | 0 | 0 | 0 |
| Sodium (Na) | 0.002 | 0.094 | 0.1 | 0.5 | 0 | 0 | 0 | 0 |
| Sulfur (S) | 0.005 | 1.15 | 1.08 | 0.07 | **3** | **3** | **3** | **3** |
| Silicon (Si) | 0.1 | 19 | 19 | 33 | 0 | 0 | 0 | 0 |
| **Minor Elements** | All units mg/kg | | | | Geochemical Abundance Index | | | |
| Silver (Ag) | 0.1 | 0.4 | 0.1 | 0.05 | 2 | 0 | 2 | 0 |
| Arsenic (As) | 1 | 9 | 6 | 6 | 0 | 0 | 2 | 1 |
| Boron (B) | 50 | <50 | <50 | 20 | <1 | <1 | <2 | <2 |
| Barium (Ba) | 0.1 | 430 | 380 | 500 | 0 | 0 | 0 | 0 |
| Beryllium (Be) | 0.1 | 1.3 | 1.4 | 0.3 | 2 | 2 | 0 | 0 |
| Bismuth (Bi) | 0.01 | 0.52 | 0.49 | 0.2 | 1 | 1 | **3** | **3** |
| Cadmium (Cd) | 0.1 | 0.3 | 0.3 | 0.35 | 0 | 0 | 1 | 1 |
| Cerium (Ce) | 0.01 | 68 | 62 | 50 | 0 | 0 | 0 | 0 |
| Cobalt (Co) | 0.1 | 10 | 8.4 | 8 | 0 | 0 | 0 | 0 |
| Chromium (Cr) | 2 | 16 | 16 | 70 | 0 | 0 | 0 | 0 |
| Copper (Cu) | 1 | 31 | 28 | 30 | 0 | 0 | 0 | 0 |
| Fluorine (F) | 50 | 450 | 450 | 200 | 1 | 1 | 0 | 0 |
| Mercury (Hg) | 0.01 | 0.08 | 0.02 | 0.06 | 0 | 0 | 0 | 0 |
| Manganese (Mn) | 1 | 640 | 540 | 1000 | 0 | 0 | 0 | 0 |
| Molybdenum (Mo) | 0.01 | 2.1 | 1.8 | 1.2 | 0 | 0 | 0 | 0 |
| Nickel (Ni) | 1 | 15 | 14 | 50 | 0 | 0 | 0 | 0 |
| Phosphorus (P) | 20 | 580 | 540 | 800 | 0 | 0 | 0 | 0 |
| Lead (Pb) | 2 | 26 | 28 | 35 | 0 | 0 | 0 | 0 |
| Antimony (Sb) | 0.1 | 0.70 | 0.65 | 1.0 | 0 | 0 | 1 | 1 |
| Selenium (Se) | 0.01 | 0.82 | 0.64 | 0.4 | 0 | 0 | **3** | **3** |
| Tin (Sn) | 0.1 | 8.2 | 6.8 | 4.0 | 0 | 0 | 1 | 1 |
| Strontium (Sr) | 0.1 | 270 | 285 | 250 | 0 | 0 | 0 | 0 |
| Titanium (TI) | 0.02 | 0.84 | 0.8 | 0.2 | 1 | 1 | 0 | 0 |
| Vanadium (V) | 0.01 | 4.2 | 4.1 | 90 | 0 | 0 | 0 | 0 |
| Tungsten (W) | 0.1 | 1.4 | 1.2 | 1.5 | 0 | 0 | 0 | 0 |
| Zinc (Zn) | 1.0 | 76 | 72 | 90 | 0 | 0 | 0 | 0 |

Notes: GAI's greater than or equal to 3 are highlighted. 0 = not enriched; 6 = highly enriched,

1. Average Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).

1. When no GARD Guide value is available for particular element, then values are taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, pages 60-61.

# Appendix 2

# Surface Water and Groundwater Monitoring Locations

# Figures E1 and E2

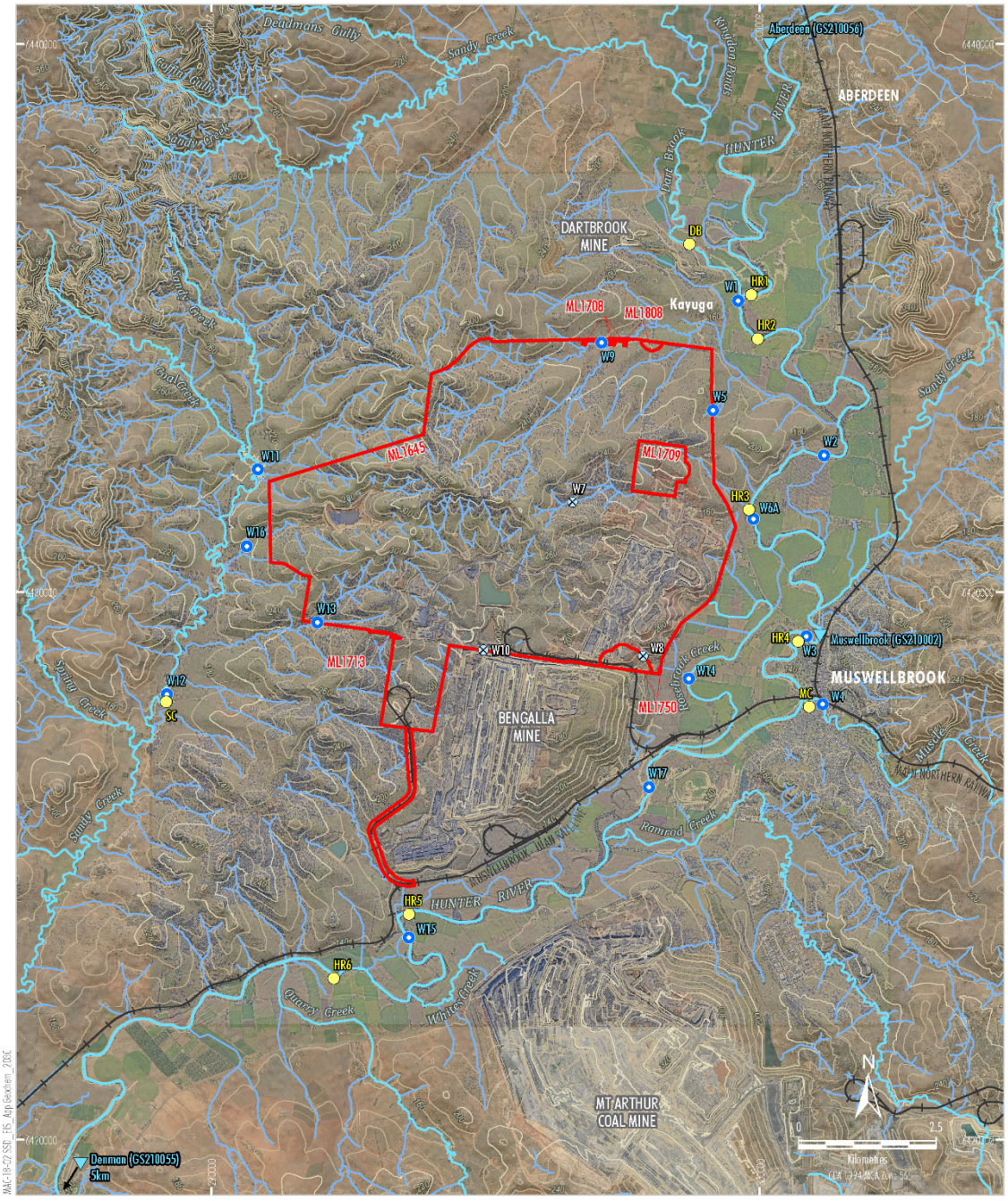
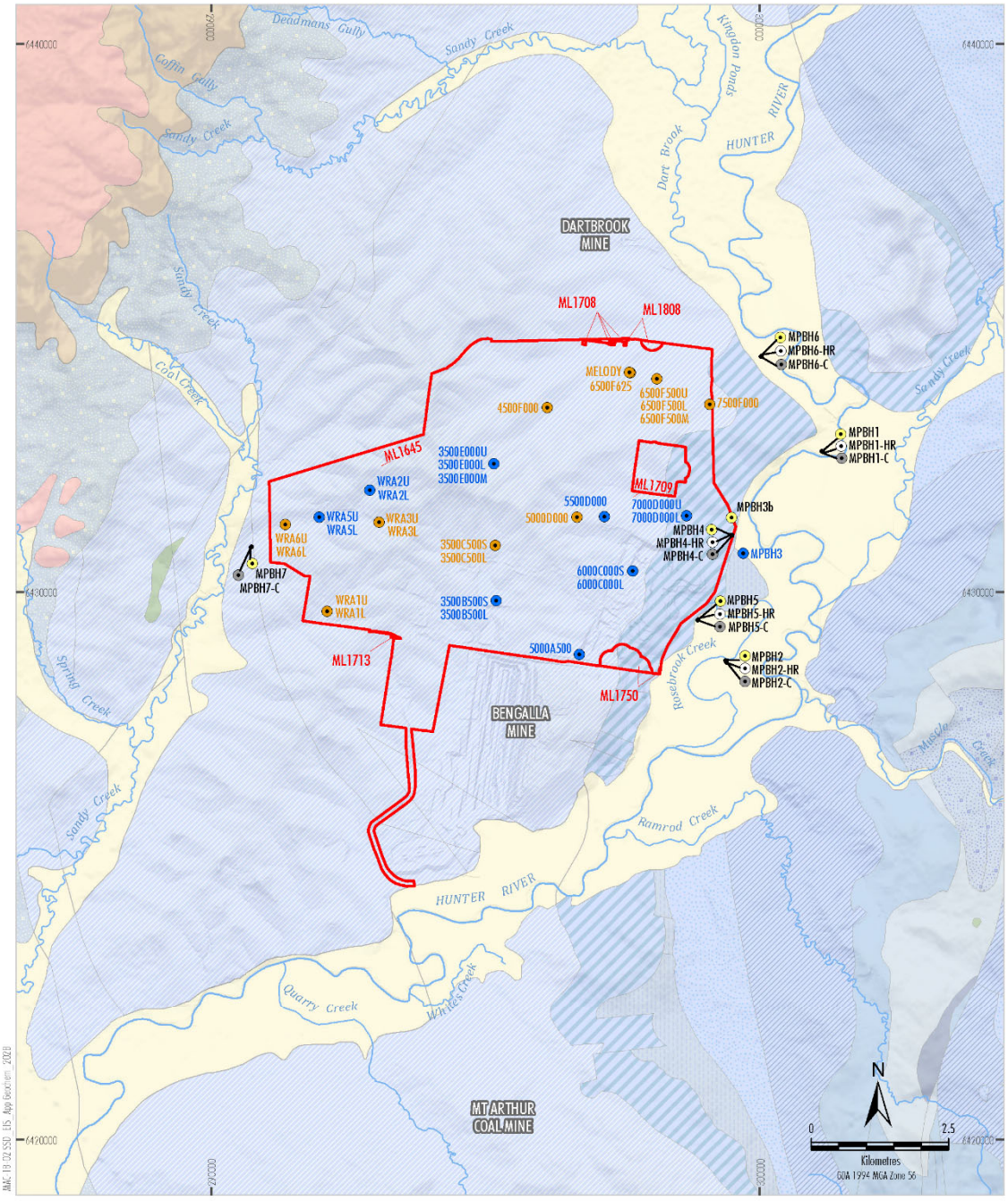

Aberdeen (GS210056)
ABERDEEN
HUNTER RIVER
DARTBROOK MINE
DB
W1
HR1
HR2
ML1708
ML1808
Kayuga
W9
W5
W2
ML1645
ML1709
W7
HR3
W6A
W11
W16
W13
ML1713
W10
W8
HR4
W3
Muswellbrook (GS210002)
MUSWELLBROOK
W12
SC
W14
MC
W4
ML1750
BENGALLA MINE
W17
HR5
W15
HR6
MT ARTHUR COAL MINE
Denman (GS210055)
5km
N
0
2.5
Kilometres
LEGEND
Mining Lease Boundary (Mount Pleasant Operation)
DPI Water Gauging Station
Mt Pleasant Monitoring
Surface Water Monitoring Site
Historical Surface Water Monitoring Site
Stream Health Monitoring Site
Source: MACH (2020); BoM Atlas (2019); NSW Spatial Services (2020)
Orthophoto: MACH (July 2020)
MACHEnergy
MOUNT PLEASANT OPTIMISATION PROJECT
Surface Water and Stream Health Monitoring Locations

**Figure E1**




LEGEND
- Mining Lease Boundary (Mount Pleasant Operation)
- Mount Pleasant Monitoring
- Standpipe
- Standpipe - Alluvium
- Standpipe - Interburden
- Standpipe - Coal Seam
- Standpipe - Historical

*Source: MACH (2020); NSW Spatial Services (2020)*

**MACHEnergy**

MOUNT PLEASANT OPTIMISATION PROJECT

**Groundwater Monitoring Locations**

**Figure E2**


MINE WASTE AND
WATER MANAGEMENT