Appendix O

Geochemical Assessment of Interburden and Potential Coal Reject

TECHNICAL REPORT

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Boggabri Coal Mine

***Prepared for*: Hansen Bailey Pty Ltd, on behalf of Boggabri Coal Operations Pty Ltd**

MINE WASTE AND
WATER MANAGEMENT

TECHNICAL REPORT

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Prepared for: **Hansen Bailey Pty Ltd, on behalf of Boggabri Coal Operations Pty Ltd**

DOCUMENT CONTROL	
Report Name	**Geochemical Assessment of Interburden and Potential Coal Reject**
Project Number	**2018028**
File Location	**2018028 (Boggabri)/Reporting**
Date	**27/04/2021**

DOCUMENT DISTRIBUTION			
Document Name	**Document Status**	**Distributed to**	**Date distributed**
Geochemical Assessment of Interburden and Potential Coal Reject	Revision A	Hansen Bailey	24 June 2020
Geochemical Assessment of Interburden and Potential Coal Reject	Revision B	Hansen Bailey and Boggabri Coal Operations Pty Ltd	8 September 2020
Geochemical Assessment of Interburden and Potential Coal Reject	Revision C	Hansen Bailey and Boggabri Coal Operations Pty Ltd	17 October 2020
Geochemical Assessment of Interburden and Potential Coal Reject	Revision D	Hansen Bailey and Boggabri Coal Operations Pty Ltd	30 October 2020
Geochemical Assessment of Interburden and Potential Coal Reject	Revision E	Hansen Bailey and Boggabri Coal Operations Pty Ltd	27 April 2021

Limitations and disclaimer:

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1 Introduction

1.1 Background

Boggabri Coal Mine (BCM) is located approximately 15 km north-east of the Boggabri township in NSW (**Figure A1**, **Attachment A**). Mining activity commenced in 2006, and the current approval for mining extends until the end of 2033. The mine operates as an open cut, using a truck and shovel mining method.

Overburden and interburden material is placed within the pit void (when possible) or within an overburden emplacement area (OEA). Reject material (both coarse and fine) from the Coal Preparation Plant (CPP) is placed within the pit void and co-disposed with a much larger volume of overburden and interburden material. In a maximum worst case year, the Modification anticipates the production of approximately 1.3 million tonnes (Mt) of coal reject (coarse and fine reject) materials (in 2022), compared with 69.8 million bank cubic metres (Mbcm) of overburden/interburden production in the same year. Over the Mine life from (2022 to 2039), the average annual coal reject production is of 0.8 Mt compared to an annual average of 66.6 Mbcm of overburden/interburden.

1.2 Modification Description

Boggabri Coal Operations Pty Ltd (BCOPL) intends to seek a Modification (MOD8) to the current State Significant Development Approval (SSD 09_0182) for BCM under Section 4.55 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to increase the depth of approved mining operations within the currently approved Mine Disturbance Boundary and to facilitate the establishment of a fauna movement crossing of the existing haul road at BCM (the Modification (MOD8)). A conceptual layout of the Modification (MOD8) is shown on **Figure A2** (**Attachment A**) and generally comprises the following:

- Increasing the approved maximum depth of mining down to the Templemore Coal Seam (and associated mine plan amendments) to recover an additional 61.6 Million tonnes (Mt) of Run of Mine (ROM) coal resource within the currently approved Mine Disturbance Boundary, resulting in a six year extension to mine life (i.e. from 31 December 2033 to 31 December 2039); and
- Construction of a specifically designed fauna movement crossing of the existing haul road between the mining area and the Mine Infrastructure Area (MIA) to encourage the movement of fauna from the Leard State Forest to the Southern Rehabilitation Area (SRA).

The increase in the depth of mining operations will occur on a staged basis as is justified by customer demands and other economic drivers.

The proposed mining will remain within the currently approved Mine Disturbance Boundary. However, a minor increase in disturbance footprint (less than 1.21 hectares of disturbance within a 3.31 hectare footprint) will be required to facilitate the construction of landforms associated with the fauna movement crossing.

The key components of the Modification (MOD8) are conceptually illustrated in **Figure A2 (Attachment A)**.

1.3 Geochemical Assessment Program

RGS Environmental Pty Ltd (RGS) was commissioned by Hansen Bailey on behalf of BCOPL to complete a geochemical assessment of interburden and potential coal reject material that would be encountered during mining operations associated with the Modification (MOD8). MOD8 seeks approval to increase the depth of coal mined from the current Merriown Seam to the Templemore Seam. The objective of the assessment is to determine the geochemical nature of the interburden and potential coal reject materials as part of the technical studies being completed to support an application for a Modification (MOD8) to SSD 09_0182.

1.4 Previous Work

Several geochemical assessment studies have previously been completed on overburden, interburden and potential coal reject materials at BCM. These include the studies completed as part of the initial Environmental Impact Statement (EIS) for BCM (Boggabri EIS, 1987), as well as geochemical assessments completed in

2006 (EGi, 2006), 2009 (RGS, 2009) and the most recent study completed in 2019/2020 (RGS, 2020a). In addition, geochemistry studies at neighbouring operations mining the same stratigraphic units below the Merriown seam e.g., Maules Creek (RGS, 2011; 2012, 2018 and 2019c) and Tarrawonga (URS, 2005; GEM, 2010;2011; RGS 2017; 2019a,b and 2020b) have been completed.

1.4.1 Boggabri Environmental Impact Statement (1987)

As part of the EIS for the BCM (Boggabri EIS, 1987), a geochemical assessment was completed on 32 soil samples and 31 rock samples from two drill holes. The assessment found that most overburden (and interburden) materials were likely to be non-saline, non-sodic and slightly alkaline to slightly acidic. In addition, potential sodic, saline and acid producing strata relative to the four main coal seams made up a relatively small proportion of the material that was planned to be mined. The assessment also identified that the roof and floor material associated with the Braymont Seam was potentially acid forming (PAF). The sandy conglomerate associated with the Braymont and Jeralong seams was also identified as sodic.

The EIS recommended that all potentially sodic, saline or acidic overburden (and interburden) materials were to be buried during the mining process in order to significantly reduce the risk of environmental impacts from the proposed mining activities.

1.4.2 ARD Assessment of Overburden and Interburden (2006)

A geochemical (Acid Rock Drainage) assessment study was complete in 2006 (EGi, 2006) using 49 composite drill core samples (prepared from 106 individual drill core samples) from a single drill hole (IBC2115) at BCM. The study found that while the bulk of the overburden and interburden materials were non-acid forming (NAF), material close to the Braymont and Jeralong seams (both roof and floor material) may be PAF. There was no significant elemental enrichment in the overburden and interburden materials and no significant risk of leaching of metals or metalloids from NAF materials at neutral pH.

The EGi report found that segregation and selective handling of PAF materials would be required and would involve the deep burial of PAF material under NAF material.

1.4.3 Continuation of Boggabri Coal Mine - Geochemical Assessment (2009)

RGS completed a geochemical assessment of overburden, interburden and potential coal reject materials at BCM as part of an application for the continuation of the BCM (RGS, 2009; Hansen Bailey, 2009). The assessment found that most of the overburden, interburden and potential coal reject material had a low total sulfur content (<0.1 %S) with excess acid neutralising capacity (ANC) and was therefore classified as NAF (barren). A small proportion of the potential coal reject materials located near the Braymont Seam (roof samples) had elevated total sulfur content and negligible buffering capacity (and hence a reduced factor of safety) and were classified as PAF.

The concentration of total metals in the NAF overburden, interburden and potential coal reject material was low and considered unlikely to present any environmental issues associated with revegetation and rehabilitation. Surface runoff and seepage from the overburden, interburden and potential coal reject material was predicted to be slightly alkaline and to have relatively low salinity. However, this was not the case for any potential coal reject material from the Braymont seam (and potentially the Jeralong seam) where PAF materials were considered likely to generate acidic and more saline runoff and seepage. The assessment concluded that the major ion chemistry of any initial surface runoff and seepage from the overburden, interburden and potential coal reject materials was likely to be dominated by sodium, bicarbonate, chloride and sulfate, although for PAF materials, calcium and sulfate was expected to be more dominant. For PAF materials, the initial concentration of soluble sulfate in surface runoff and seepage was expected to remain within the applied water quality guideline criterion (1,000 mg/L; ANZECC & ARMCANZ, 2000), although further exposure to oxidising conditions could lead to increased soluble sulfate concentrations.

The assessment also concluded that some of the overburden, interburden and potential coal reject materials were sodic and could have structural stability problems related to potential material dispersion.

Notwithstanding, some of the near surface and conglomerate overburden materials were less sodic (and more suitable for use (along with salvaged topsoil and subsoil) in revegetation and rehabilitation activities).

1.4.4 Geochemical and Physical Characterisation of Mine Waste Materials (2020)

RGS completed a geochemical assessment of overburden, interburden and potential coal reject materials at BCM in 2019/2020 (RGS, 2020). The assessment focussed on the geochemistry of the overburden, interburden and potential coal reject materials likely to be generated from the currently approved mining operations within the upper part of the stratigraphic profile (namely, from the surface to the base of the Merriown Seam). The work program was completed in order to provide suitable input into a planned hydrochemical modelling program for long-term water quality as required by SSD 09_0182 for BCM (expected to be completed in the second half of 2020).

The assessment found that most overburden, interburden and potential coal reject materials were classified as NAF, with an excess of ANC. Overall, the majority of the material tested was expected to have a relatively low risk of acid generation. A small number of PAF samples were identified, mainly associated with the immediate roof of the Braymont and Thornfield seams (but not the Jeralong seam), and it was recommended that materials represented by these samples be selectively handled and buried deep in the open-pit profile under NAF material.

The concentration of total metals in the overburden, interburden and potential coal reject material was low and considered unlikely to present any environmental issues associated with revegetation and rehabilitation. Surface runoff and seepage from NAF overburden, interburden and potential coal reject material generally ranged from pH neutral to slightly alkaline, with a low to moderate level of salinity. The surface runoff and seepage from any PAF materials was considered to have the potential to become acidic, saline and contain elevated concentrations of some metals/metalloids if left exposed to oxidising conditions.

At the neutral to slightly alkaline pH of any leachate expected from the bulk NAF overburden and interburden material, metals/metalloids were found to be sparingly soluble. Dissolved metal/metalloid concentrations in surface runoff and seepage from NAF materials were therefore predicted to be low and unlikely to pose any environmental issues with respect to the quality of surface and groundwater resources at the site.

The RGS assessment concluded that the NAF overburden, interburden and potential coal reject materials should be amenable to revegetation as part of any rehabilitation activities, however sodic material may require the addition of gypsum and fertiliser to limit the potential for dispersion and erosion and provide a reasonable growth medium for revegetation and rehabilitation.

1.5 Local Geology

BCM is located within the Gunnedah Basin, one of the main coal basins in NSW. The deposit is located with the Permian-aged Maules Creek sub-basin and is underlain by the Boggabri Volcanics unit (which also separates the Maules Creek sub-basin from the Mulalley sub-basin to the west). Within topographical valleys, Quaternary alluvial deposits overlie the stratigraphy.

The Maules Creek sub-basin is comprised of a sedimentary sequence (the Maules Creek Formation) that consists of predominantly conglomerate and sandstone, with minor siltstone, claystone and coal seams present. At the top of the Maules Creek Formation conglomerate beds dominate, but the finer sandstone and siltstone beds become more common towards the base of the formation. The underlying Boggabri Volcanics consist of rhyolite and pyroclastics, with minor sediments, basalt, andesite and tuffs also present.

There are two coal-bearing sequences contained within the Gunnedah Basin – the early Permian aged Bellata Group, and the late Permian Black Jack Group. The majority of the Bellata Group coal seams are within the Maules Creek Formation. Currently, BCM mines coal from eight coal seams within the Bellata Group, including the Herndale, Onavale, Teston, Thornfield, Braymont, Bollol Creek, Jeralong and Merriown seams. The mine plan changes being considered as part of the Modification (MOD8) will expand the number of coal seams mined to include the Velyama, Nagero, Northam, Therribri, Flixton, Tarrawonga and Templemore seams. A stratigraphic column of the BCM deposit is shown in **Figure A3** (**Attachment A**).

1.6 Scope of Work

The objective of the work program described herein was to complete a geochemical assessment of the interburden and potential coal reject materials present below the Merriown Seam (i.e., down to the KAZ seam). This work has been completed as part of the proposed Modification (MOD8) to SSD 09_0182 for BCM. The scope of work included:

- Selection of drill holes from the 2019 resource drilling program to be used in the geochemical assessment;
- Coordination of the geochemical analysis programs;
- Geochemical characterisation of interburden proposed open pit extent and potential coal reject (roof and floor material) from the target coal seams; and
- Preparation of a Geochemical Assessment Report based on existing information, sample analyses and discussion regarding any acid and metalliferous drainage (AMD) potential or other salinity, erosion or dispersion issues related to the Modification (MOD8) (this report).

The geochemical test program was designed to assess the degree of risk from AMD, oxidation of pyrite, leachability of metals/metalloids, and characterisation of standard soil parameters including salinity, cation exchange capacity (CEC) and major metal/metalloid compositions. The work program was completed in accordance with relevant industry guidelines (COA, 2016a,b,c; and INAP, 2009).

1.7 Report Structure

Background information on the sources of potential impacts on water quality from coal mines is presented in **Section 2**. The detailed methodology used for the geochemical sampling and testing program is described in **Section 3**. The geochemical results obtained from the testing program on the samples are presented in **Section 4**.

A summary of findings regarding the geochemical characteristics of the tested materials, and any potential contact water impact is presented in **Section 5**. The main conclusions and recommendations generated from the assessment for the Modification (MOD8) are presented in **Section 6**. A complete list of references relied upon to complete this report are presented in **Section 7**.

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, 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 for 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 reject and tailings) 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 NAF or PAF. In some cases, reactive pyrite/marcasite can preferentially report to either the coarse reject or tailings stream 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 (30.6), 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 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 (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-} and SO_4^{2-}), metals (e.g., Al, Fe, Mn and Zn) and metalloids (e.g., Mo and Se). This type of drainage is referred to AMD, although it will also contain elevated concentrations of salts (COA, 2016c).

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 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 elevated organic carbon content can cause interference with the standard NAG test 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 a sufficient level of 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 sulfur isopachs and ultimately a sulfur grid layer model can be used to delineate the likely location of any PAF materials) and assist in the refinement 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 Methodology

RGS personnel worked closely with BCOPL geology personnel to facilitate the development of an appropriate sampling and geochemical testing plan for obtaining representative samples of interburden and potential coal reject (roof and floor) materials associated with the Modification (MOD8).

Three drill holes (BC2463, BC2464 and BC2466) were sampled by BCOPL personnel and drill core from the 2019 resource drilling program was provided to RGS for geochemical assessment. The location of the drill holes with respect to the mine area is shown in **Figure A4** (**Attachment A**).

3.1 Sample Selection and Preparation

The sampling methodology used to obtain geochemical samples from the Modification (MOD8) was undertaken in accordance with relevant guidelines documents. While there are no specific regulatory requirements regarding the total number of samples required, existing risk-based technical guidelines for the geochemical assessment of mine rock in Australia (AMIRA, 2002; COA, 2016c) and worldwide (INAP, 2009) were used by RGS as a framework for the sampling program.

A total of 92 samples were collected from the three drill holes provided (35 samples from BC2463, 27 samples from BC2464 and 30 samples from BC2466). The location of these drill holes with respect to the operational mine area is shown in **Figure A4** (**Attachment A**).

The samples represented the interburden and potential coal reject materials expected to be encountered during future mining activities at BCM, from approximately 75 m to 450 m below surface. This covers the stratigraphic profile from directly below the Merriown Seam to the basement. **Table 3.1** details 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 encountered at the project, considering the risk profile indicated from the geology and previous geochemical testing programs at BCM. Samples were collected by BCOPL personnel and dispatched to ALS Environmental Laboratory (ALS) in Stafford, QLD for geochemical testing.

Table 3.1: Sample Materials Used for Geochemical Testing

Representative sample material	Lithology	Number of samples
Interburden	Conglomerate	17
	Sandstone	17
	Siltstone	10
Roof, floor and parting	Conglomerate	2
	Sandstone	16
	Siltstone	30
	Total	**92 samples**

Once received, samples were prepared by crushing to pass 10 mm and a subsample pulverised to less than 75 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. A list of all of the 92 interburden and potential coal reject samples included in this study is provided at **Table C.1** (**Attachment C**).

3.2 Geochemical Test Program

A series of static and kinetic geochemical tests were completed on the collected BCM 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, CEC, 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 B**.

3.2.1 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) was used as a screening procedure whereby the acid-neutralising and acid-generating characteristics of a material were assessed. All 92 samples were screened using ABA by geochemical testing for the following parameters:

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

The results of the ABA screening assessment are discussed in **Section 4.1**. After the results of the ABA screening test were received and interpreted, four 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 and NAPP values were calculated. Scr data was preferentially used, as it provides a more accurate representation of the potential MPA and NAPP, 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 92 samples were used to create 10 composite samples. The composites were determined based on the lithology, stratigraphy and geochemistry of the original samples.

All 10 composite samples were sent for whole rock multi-element testing at ALS and were tested for:

- Paste pH and EC [1:5 w:v, sample:deionised water];
- Total and soluble major cations (Ca, Mg, K, Na) [HCl and HNO_3 acid digest followed by ICP-AES/MS];
- Soluble major anions (Cl, SO_4, F) [ICP-AES/MS and PC Titrator (1:5 w:v water extracts)];
- Acidity and alkalinity as $CaCO_3$ mg/L [PC Titrator (1:5 w:v water extracts)];
- Total metals (Al, As, B, Cd, Co, Cr, Cu, Fe, Mn, Ni, P, Pb, Sb, Se, Th, U, V and Zn) [HCl and HNO_3 acid digest followed by FIMS and/or ICP-AES/MS];
- Total and soluble total organic carbon (TOC) [ICP-AES/MS]; and
- Soluble metals (Al, As, B, Cd, Co, Cr, Cu, Fe, Mn, Ni, P, Pb, Sb, Se, Th, U, V and Zn) [ICP-AES/MS and FIMS (1:5 w:v water extracts)].

The 10 composite samples were also tested for exchangeable cations (Ca, Mg, Na and K) [ICP-AES], which was used to calculate the CEC and ESP; and TOC.

The ALS test results for the static geochemical test program are provided in **Attachment E**. Summary results tables are provided in **Attachment C** and discussed in **Section 4**.

3.2.2 Kinetic Tests

Following the receipt and interpretation of the static geochemical test results, six kinetic leach column (KLC) tests were set up at the RGS laboratory. The KLC tests comprised composite samples of conglomerate, combined sandstone and siltstone, and potential coal reject (including carbonaceous) materials completed under both saturated (anoxic) and unsaturated (oxic) laboratory-controlled conditions. These materials represent the bulk of the interburden sandstone and siltstone materials were combined for the kinetic testing due to the limited amount of siltstone sample material available for testing. The KLC tests were completed over a period of six months, from February to August 2020, using a monthly watering and leaching cycle.

The KLCs were set up at the RGS laboratory following standard mining industry guidelines (AMIRA, 2002). RGS utilised large (20 L) KLC columns for laboratory-based reaction leach testing. The bigger size, compared to more traditional 2 L columns routinely used for laboratory testing, allowed for a wider sample particle size distribution to be used in the columns.

The saturated columns (KLC 1, KLC 3, and KLC 5) were fully saturated to the top of the column and simulate material under anoxic conditions, where mined materials are permanently saturated. The unsaturated columns (KLC 2, KLC 4 and KLC 6) simulate weathering of materials under free draining oxic conditions that may be present above the final groundwater level.

Further details of the KLC test arrangement are provided in **Attachment B**.

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

- pH and EC;
- Acidity and alkalinity [PC Titrator];
- Dissolved metals/metalloids (Al, As, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sb, Se, Sr, V and Zn) [ICP-AES/MS];
- Dissolved major cations (Ca, Mg, Na and K) [ICP-AES/MS]; and
- Dissolved major anions (Cl, SO_4) and F [ICP-AES/MS].

The kinetic geochemical test program results and trends are summarised in **Attachment D** and discussed in **Section 4.6**. The raw ALS laboratory results are provided in **Attachment E**.

4 Geochemical Test Results

4.1 Acid-base Account Results

Acid-Base Account results for the 92 interburden and potential coal reject samples from the Modification (MOD8) are presented in **Table C2 (Attachment C)** and summarised below. Results are shown by lithology and material type to facilitate interpretation.

4.1.1 pH and EC

The natural pH of deionised water typically ranges from 5.0 to 6.5. The $pH_{(1:5)}$ of the 92 samples ranges from 7.2 to 10.1 (median 8.9) (**Figure 4.1**). The pH results indicate that initial leachate from materials represented by these samples is likely to be pH neutral to slightly alkaline. There appears to be no distinct correlation between the sample pH and sample location, depth, lithology or type.

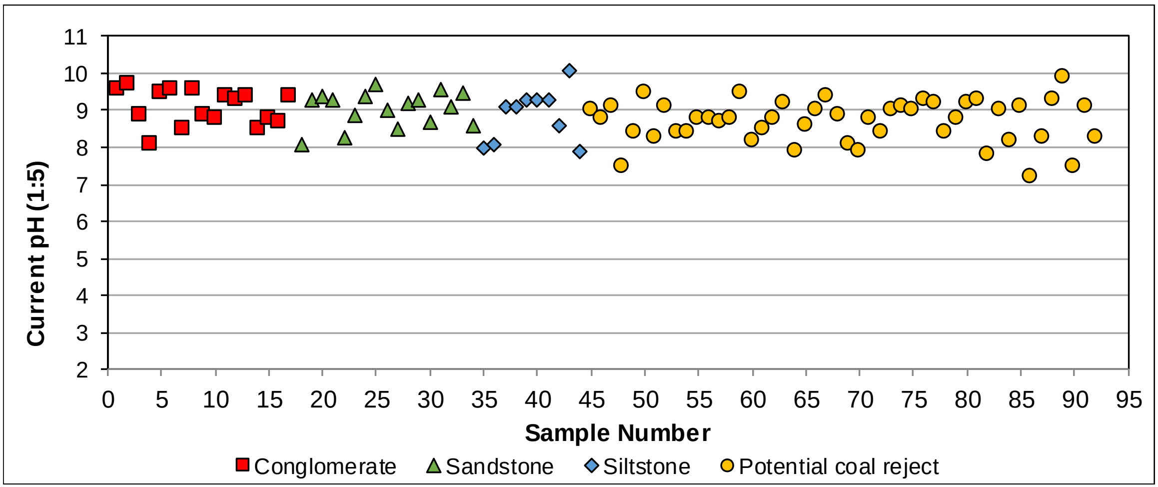

Figure 4.1: pH results for interburden and potential coal reject

The current $EC_{(1:5)}$ of the samples ranges from 30 to 539 µS/cm (median 120 µS/cm) (**Figure 4.2**). The EC results indicate that initial leachate from materials represented by these samples is likely have a relatively low salinity value. There appears to be no distinct correlation between the sample EC and sample location, depth, lithology or type.

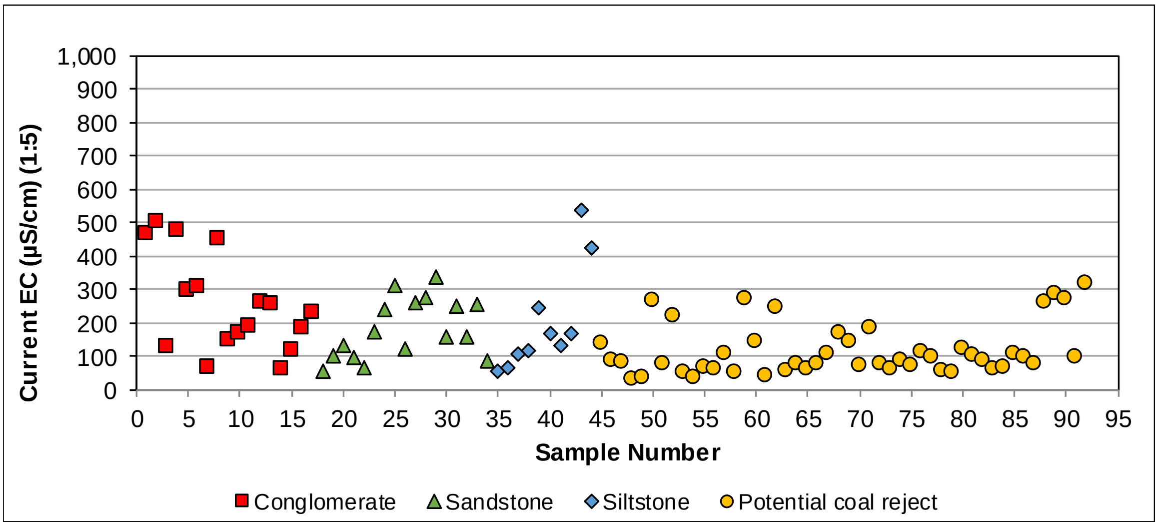

Figure 4.2: Electrical conductivity results for interburden and potential coal reject

As previously discussed, the pH and EC tests were completed on pulverised samples with a particle size of ≤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.

It is also expected that the salinity of leachate (as represented by EC) from low sulfur interburden and potential coal reject 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. The salinity of leachate from any higher sulfur potential coal reject materials may increase if these materials oxidise over time.

4.1.2 Sulfur

The total sulfur content of the interburden samples ranges from below the laboratory limit of reporting (LoR) (0.01 %S) to a maximum of 0.84 %S and is considered to be low. The median total sulfur value is 0.02 %S, compared with the median crustal abundance value of 0.07 %S (INAP, 2009; Bowen, 1979). Materials containing less than 0.1 %S are generally considered to be barren of sulfur, represent background concentrations and have a negligible capacity to generate acidity.

Figure 4.3 shows the total sulfur content of the sample materials and illustrates that most of the samples have a very low sulfur content. Only four out of 92 samples have a sulfur content greater than 0.1 %S, and these samples represent a few of the potential coal reject materials. Only two samples (a roof sample from above the TAK seam and a floor sample from below the KAZ seam) have a total sulfur content greater than 0.2 % S. Material represented by these samples will not now be mined as the Modification (MOD8) will only target seams down to the Templemore seam (as previously shown in **Figure A3**).

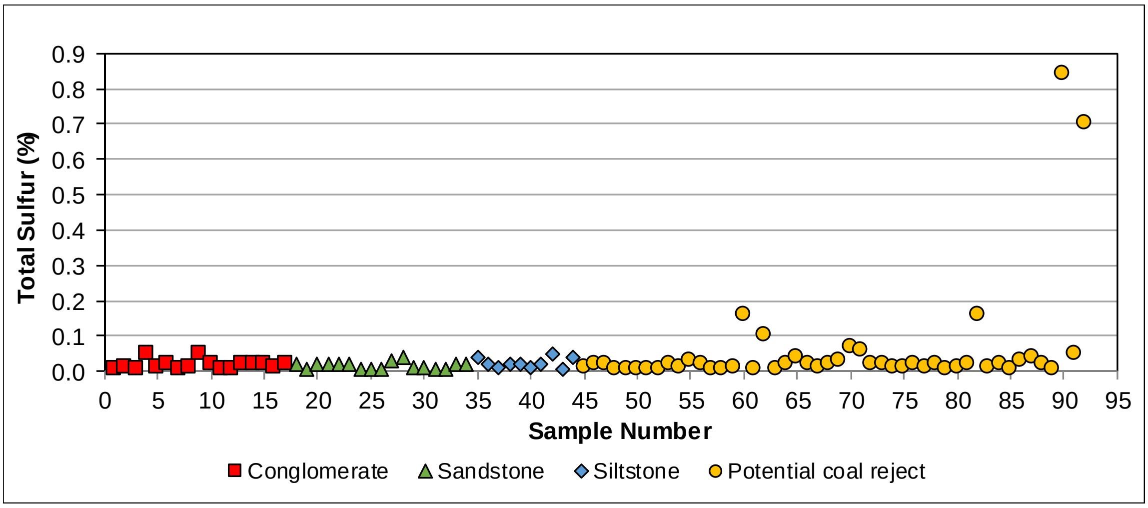

Figure 4.3: Total sulfur results for interburden and potential coal reject

4.1.3 Sulfide Sulfur

Figure 4.4 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 four samples was tested using the Scr method.

The test results show a sulfide sulfur content ranging from 0.02 to 0.59 %Scr and indicate that, on average, only about half of the total sulfur content is present as sulfide sulfur (most likely pyrite/marcasite) and may have some potential to generate acidity. The remainder of the total sulfur is likely to be present as organic sulfur or sulfate, which have negligible capacity to generate acidity. As discussed in Section 4.1.2, the only two samples with appreciable sulfide sulfur content (> 0.2 %S) represent roof materials from the TAK seam and floor materials from below the KAZ seam) which will not be mined as part of Modification (MOD8).

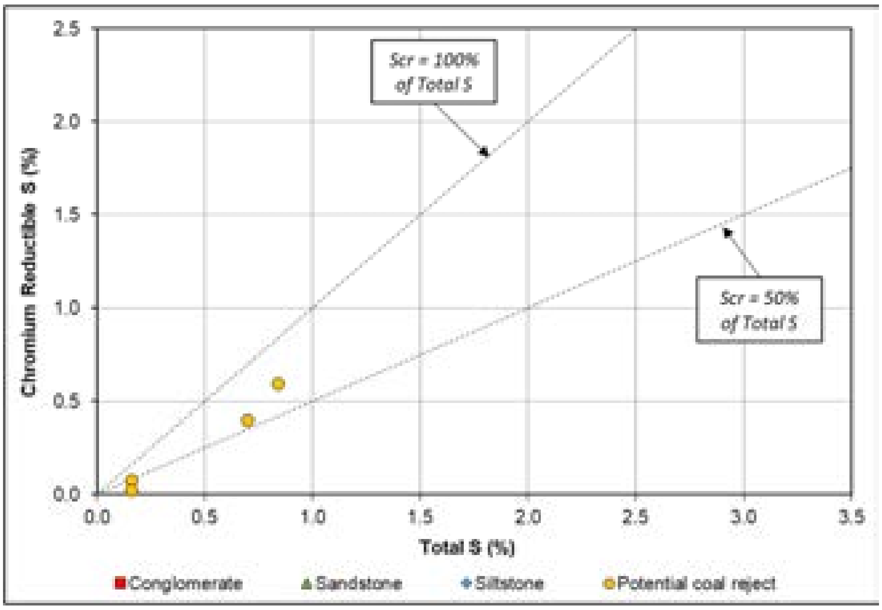

Figure 4.4: Total sulfur versus sulfide sulfur for selected samples

4.1.4 Maximum Potential Acidity

The MPA results for the samples ranges from 0.2 to 18.2 kg H_2SO_4/t, and has a median value of 0.6 kg H_2SO_4/t. Hence, as a bulk material, the amount of acidity that could potentially be produced from the samples is low.

4.1.5 Acid Neutralising Capacity

The acid neutralising capacity (ANC) for the samples ranges from 6.0 to 406.0 kg H_2SO_4/t (median 20.5 kg H_2SO_4/t) and is more than an order of magnitude greater than the median MPA. The interburden samples generally exhibited higher ANC values than the potential coal reject samples. The median ANC value was 35.4 kg H_2SO_4/t for conglomerate and 24.9 kg H_2SO_4/t for sandstone, 18.8 kg H_2SO_4/t for siltstone and 14.3 kg H_2SO_4/t for potential coal reject samples.

4.1.6 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 value for the 92 interburden and potential coal reject samples ranges from -393.9 to 1.0 kg H_2SO_4/t, and has a negative median value of -19.7 kg H_2SO_4/t.

The NAPP data is presented in **Figure 4.5** and illustrates that all of the interburden and potential coal reject samples have a NAPP value that is negative or close to zero.

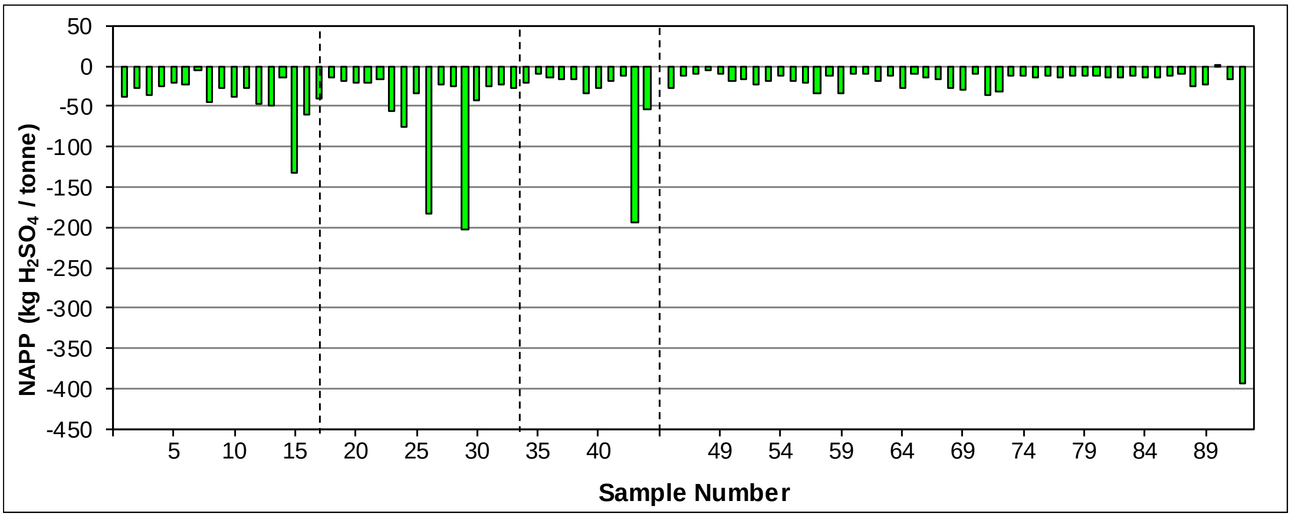

Figure 4.5: NAPP results for interburden and potential coal reject

4.1.7 ANC:MPA ratio

The ANC:MPA ratio of the samples ranges from 0.95 to 1,260.4, with a median value of 43.7. **Figure 4.6** shows a plot of the ANC versus MPA values for the samples. ANC:MPA ratio lines have been plotted on the graph to illustrate the factor of safety associated with the samples in terms of the potential for the generation of AMD. Generally, samples with an ANC:MPA ratio of greater than 2 and 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 the potential for AMD (COA, 2016c; INAP, 2009).

A total of 91 samples fall into the low to negligible risk categories, while one potential coal reject sample falls into the possible risk category.

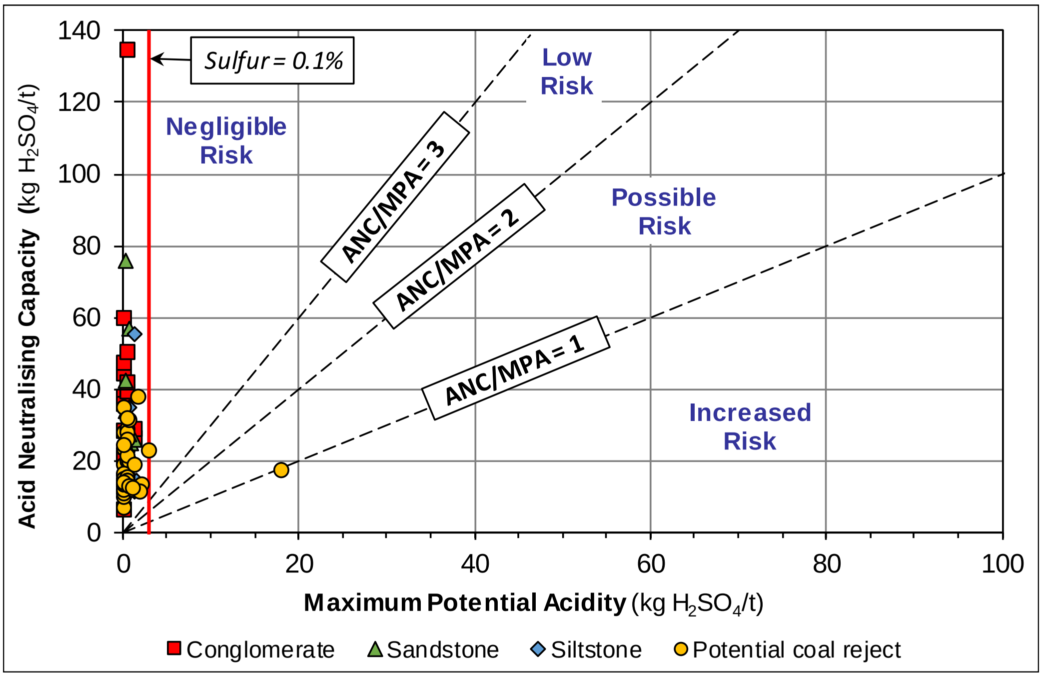

Figure 4.6: ANC vs MPA for interburden and potential coal reject

4.1.8 Geochemical Classification

The Acid Base Account test data presented in **Attachment C** and discussed in this section have been used to classify the acid forming nature of the interburden and potential coal reject samples. These classification criteria reflect Australian (COA, 2016c) and international (INAP, 2009) guidelines for the classification of mine waste materials. **Table 4.1** summarises the criteria used by RGS to classify the acid forming nature of the 92 samples from BCM, and a breakdown of the number of samples in each classification category.

Table 4.1: Geochemical classification criteria

Geochemical Classification	Total Sulfur[1] (%)	NAPP (kg H_2SO_4/t)	ANC:MPA Ratio	No. Samples (n = 92)
Non-Acid Forming (Barren)[2]	≤ 0.1	-	-	90
Non-Acid Forming	≤ 0.1	≤ -5	≥ 2	1
Uncertain	≤ 0.1	> -5 and ≤ +5	≥ 2	1
Potentially Acid Forming	> 0.1	> +5	< 2	0

Notes:
1. If total sulfur is less than or equal to 0.1% S, 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% S, as the sample essentially has negligible acid generating capacity.

The data presented in **Table 4.1** illustrate that 91 of the 92 samples tested (99 %) are classified as NAF as a result of the low levels of total sulfur and excess ANC present in these samples. One sample is classified as uncertain and has a low NAPP value that is close to zero.

It is expected that blending of the potential coal reject materials during co-disposal at the Modification (MOD8) will result in a bulk material that is classified as NAF. The majority of the materials represented by the samples tested have excess ANC and are likely to provide a significant source of buffering to any unexpected acidity generated from specific mine materials.

Notwithstanding, it is recommended that sampling and testing of materials encountered by the Modification (MOD8) (i.e. strata underlying the Merriown coal seam) focus on the geochemical characterisation of actual coal reject materials from the CPP, whilst specific coal seam blends are being processed, to determine whether coal reject materials are likely to be PAF and require any special management measures.

4.2 Multi-element Concentration in Solids

Multi-element assays were carried out on the 10 composite samples described in **Section 3.2.1** 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 total metals/metalloids) are shown in **Table C3** (**Attachment C**). For comparison, guideline values from the National Environmental Protection Measure (NEPM) (NEPC, 2013) are shown for some elements. Where no guideline values are listed, none are specified in the NEPM. 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.

4.3 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, 2016c and 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 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 (see **Table 4.2**).

Table 4.2: 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		

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 arsenic, chromium, cadmium, copper, lead, selenium and zinc, more so than with major rock-forming elements, such as aluminium, calcium, iron, manganese and sodium.

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 shown to be 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 a coal deposit means that some 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 aluminium, copper, cadmium, iron and zinc increase significantly.

Table C3 (**Attachment C**) provides total metal/metalloid concentrations for the 10 composite interburden and potential coal reject samples described in **Section 3.2.1**. The relative enrichment of metals/metalloids in these samples compared to median crustal abundance (GAI) is presented in **Table C4** (**Attachment C**).

The GAI results indicate that of the metals/metalloids tested, none of the 10 selected composite samples are enriched compared to median crustal abundance (i.e., all samples have a GAI < 3). The potential solubility of any metals/metalloids in the materials was investigated further through water extract tests and KLC tests as presented in **Sections 4.5** and **4.6**, respectively.

4.4 Soil Properties

To investigate the potential for the interburden and potential coal reject materials to be used as part of site rehabilitation/revegetation activities, a series of chemical tests were conducted on the composite samples. The tests included CEC, calculated ESP and total organic carbon. The results of these tests are shown in **Table C3** (**Attachment C**) and summarised below.

4.4.1 Sodicity

The ESP results for the 10 composite samples are presented in **Table C3** (**Attachment C**).

Sodicity occurs when exchangeable sodium on the cation-exchange complex leads to clay dispersion in the soil (Hazelton and Murphy, 2016). 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 22.5 to 38.4 %, with a mean value of 28.6 %. Under the rating for Australian soils established by Isbell (2002) and Northcote and Skene (1972) shown in **Table 4.3**, the samples are considered to be strongly sodic, and may be prone to dispersion.

Table 4.3: Ratings for Exchangeable Sodium Percentage

ESP Rating[1]	ESP Percentage
Non-sodic	< 6
Moderate	6 – 14
Strong	> 14%

[1] Ratings are based on Isbell (2002) and Northcote and Skene (1972).

4.4.2 Cation Exchange Capacity

The total CEC and individual exchangeable cation values for the 10 composite samples are presented in **Table C3** (**Attachment C**).

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, 2016). The results show that the CEC of the samples is generally very low, ranging from 2.9 to 6.8 meq/100g, with an mean CEC of value 4.6 meq/100g (**Table 4.4**).

Table 4.4: Ratings for Cation Exchange Capacity

CEC Rating[1]	CEC (meq/100g)
Very low	<6
Low	6 – 12
Moderate	12 – 25
High	25 – 40
Very high	>40

[1] Ratings are taken from Hazelton and Murphy (2007)

The individual exchangeable cation values are summarised in **Table 4.5**. The Ca:Mg ratio ranges from 1.6 to 5.0, and materials represented by the samples are considered to have a low to balanced Ca:Mg ratio (Hazelton and Murphy, 2016). This supports the finding in **Section 4.4.1** that some of the waste material represented by the composite samples may be prone to dispersion.

For materials with a low CEC value and low calcium concentration, some soil and fertiliser addition may be required to provide a reasonable growth medium for vegetation roots as part of planned rehabilitation and revegetation activities.

Table 4.5: Summary of Exchangeable Cation Levels

Cation	Minimum (meq/100g)	Maximum (meq/100g)	Average (meq/100g)
Na^{+}	0.6	1.8	1.3
K^{+}	0.2	0.4	0.3
Ca^{2+}	1.5	3.8	2.3
Mg^{2+}	0.4	1.0	0.7

[1] Ratings are based on Hazelton and Murphy (2007)

4.4.3 Total Organic Carbon

Organic matter is a general term used to describe the organic components in a soil. These organic compounds originate from plants and animals and are largely responsible for much of the physical and chemical fertility of a soil (Hazelton and Murphy, 2016). The total organic carbon (TOC) levels in the samples range from 0.1 to 6.4 %, with a median value of 2.1 %. Hazelton and Murphy (2016) classify this as ranging from low to high.

The composite sample representing interburden siltstone had a higher TOC content (2.2 %) than composite samples representing conglomerate (0.2 %) and sandstone (0.7 %) interburden material. Interburden siltstone material can be rated as a moderate TOC concentration, compared with a low rating for the conglomerate and sandstone composite samples. The low TOC level of the conglomerate and sandstone composite samples indicate that the material represented by these samples is likely to exhibit poor to average structural conditions and structural stability.

Composite 6 represents potential coal reject (conglomerate and sandstone roof and floor samples) material from the upper portion of the target stratigraphy. This sample returned a much lower TOC value (0.5 %) than the other potential coal reject samples (Composite 7 to 10), which range from 2.4 to 6.4 %, and generally represents carbonaceous sandstone and siltstone material from the lower portion of the target stratigraphy.

Samples that returned higher TOC results (composite samples 5, 7, 8, 9 and 10) equate to moderate to high TOC ratings, indicating that the material represented by the samples are likely to have moderate to good structural condition and structural stability. However, Composites 9 and 10 (representing carbonaceous siltstone) have sufficiently high TOC values, to indicate that these materials may be water repellent (Hazelton and Murphy, 2016).

4.5 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 10 composite interburden and potential coal reject samples (as described in **Sections 4.1** to **4.3**) with Australian guideline values for livestock drinking water and aquatic freshwater ecosystems (ANZECC & 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 10 composite samples are presented in **Table C5** (**Attachment C**). The pH of the water extracts ranges from 8.1 to 8.6, and all of the samples are therefore considered to be slightly alkaline and have pH values within the pH range (6 to 9) for 95 % species protection in freshwater ecosystems (ANZECC & ARMCANZ, 2000).

The acidity value in the water extract samples is below the laboratory Limit of Reporting (LoR) of 1 mg/L (as $CaCO_3$). The total alkalinity value is elevated and ranges from 450 to 4,333 mg/L (as $CaCO_3$) and has a median value of 1,207 mg/L. The alkalinity is predominantly present in the bicarbonate form, leading to a positive net alkalinity value in all samples. The results confirm that the bulk materials represented by the samples tested have excess inherent alkalinity and should provide a significant source of buffering to any acidity generated.

The EC in the water extracts ranges from 457 to 701 µS/cm (median 556 µS/cm) and is typically low. The results confirm that these materials exhibit relatively low salinity and low concentrations of dissolved solids when in contact with water.

The range in concentrations for the major ions in solution in the water extracts are provided in **Table 4.6**. The water extract solutions are generally dominated by potassium, sodium, chloride and sulfate ions. The concentrations for the major ions were well below the water quality guideline criteria for livestock drinking water, where these exist.

Table 4.6: Major Ion Concentrations in Solution

Ion	Minimum (mg/L)	Maximum (mg/L)	Median (mg/L)
Calcium (Ca)	0.7	3.0	0.8
Magnesium (Mg)	0.3	0.7	0.3
Potassium (K)	2.0	4.7	3.0
Sodium (Na)	11.7	50.7	33.7
Chloride (Cl)	3.3	6.7	4.2
Fluoride (F)	<0.03	<0.03	<0.03
Sulfate (SO_4)	3.7	25.0	9.2

The concentration of the dissolved trace metals/metalloids tested in the water extracts is generally low and in some cases below the laboratory LoR. The main exceptions are aluminium and zinc, which are greater than the applied water quality guideline for 95 % species protection in freshwater aquatic ecosystems (ANZECC & ARMCANZ, 2000) in all of the composite samples tested. However, the aluminium and zinc results are below the applied guideline values for livestock drinking water (ANZECC & ARMCANZ, 2000). Given that the pH values in the relevant water extracts are pH neutral to slightly alkaline, the elevated aluminium and zinc concentrations in these water extracts may in some part be due to the formation of colloidal materials in the water extracts, which can pass through the (0.45 µm filter) filtration stage used in the standard laboratory preparation procedure. This can occur due to the physical preparation of the sample at the laboratory to pass a 75 µm particle size. This conclusion is strengthened by the presence of elevated concentrations of iron in the water extracts compared to typical background concentrations.

Two of the five interburden samples have slightly elevated concentrations of arsenic in water extracts compared to the applied water quality guidelines criteria for freshwater aquatic ecosystems (95 % species protection) described above. In addition, two of the five potential coal reject samples have slightly elevated concentrations of copper and lead compared to the applied water quality guidelines criteria for freshwater aquatic ecosystems (95 % species protection). Again, the dissolved concentrations of these metals/metalloids are well below the applied guideline values for livestock drinking water (ANZECC & ARMCANZ, 2000).

Overall, the results indicate that dissolved metal/metalloid concentrations in initial surface runoff and seepage from the sample materials are unlikely to significantly impact upon the quality of surface and groundwater resources at the Modification (MOD8).

The dynamic quality of mine waste contact water (if these materials are left exposed to atmospheric i.e., oxidising conditions) and any potential risk to water resources at the site is investigated further using KLC tests in **Section 4.6.**

4.6 Water Quality Kinetic Tests

As described in **Section 3.2.2** and **Attachment B**, a KLC test program was completed for three representative composite samples of interburden material under both saturated (anoxic) and unsaturated free leach (oxic) conditions for a period of six months using a monthly watering and leaching cycle. The six KLC tests cover the range of interburden (conglomerate and sandstone/siltstone) and potential coal reject (roof and floor) materials likely to be generated by the Modification (MOD8).

Due to the limited amount of siltstone material available for KLC testing, siltstone and sandstone samples were combined to generate the material for KLC 3 and KLC 4. A description of the materials represented by each KLC test is summarised in **Table 4.7** and detailed in **Table C6** (**Attachment C**).

The KLC tests commenced in February 2020 and were operated under a monthly watering and leaching regime until August 2020. The KLC tests were operated following mining industry guidelines for such tests (AMIRA, 2002; COA, 2016c).

Table 4.7: KLC Material Description

KLC Sample #	Description
KLC1	Conglomerate (saturated)
KLC2	Conglomerate (free leach)
KLC3	Sandstone/Siltstone (saturated)
KLC4	Sandstone/Siltstone (free leach)
KLC5	Potential coal reject (saturated)
KLC6	Potential coal reject (free leach)

The leachate results from the KLC test program are presented alongside 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 levels” for site water storage or discharge.

It should be noted that the KLC samples were crushed to pass a 10 mm sieve size, where required, and therefore have a high surface area for potential geochemical reaction. The ratio of sample to water in the KLC tests was approximately 20:1 (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 two orders 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 Modification (MOD8).

The monthly KLC test results for the composite interburden and potential coal reject samples are presented in **Attachment D**. Tables **KLC 1** to **KLC 6** provide the KLC test data for the seven leach events (over a period of six months), selected components of which are also shown graphically.

The KLC test results indicate that:

- Leachate from the six KLC tests has a pH value that remains within a relatively narrow range of 8.24 to 8.94 over the test period. The lowest pH value in leachate from the KLC tests is generally more than two pH units greater than the deionised water used in the test program. Therefore, it is likely that the mine waste materials add some alkalinity to contact/leaching water. These results suggest that pH values in any surface runoff and seepage from bulk mine waste materials exposed to oxidising conditions will be in the range pH 8 to 9.
- Leachate from the six KLC tests has an EC value in the range of 347 to 1,360 µS/cm over the test period. The EC value is generally highest for leachate collected from the conglomerate interburden material under

saturated conditions (KLC 1) and lowest for leachate collected from the potential coal reject material under free leaching conditions. Most EC values in leachate show a relatively consistent steady trend over time Given that the ratio of sample to water in the KLC tests is concentrated (i.e., approximately 20:1 (w/v)) these results indicate that EC values from most bulk mine waste materials exposed to oxidising conditions will be relatively low.

- The acidity value in leachate from the six KLC tests is typically below the laboratory LoR (<1 mg/L, as $CaCO_3$) throughout the test period. The alkalinity values in leachate from the KLC tests are elevated, and more than sufficient to create positive net alkalinity values (i.e., the alkalinity is greater than the acidity) over the test period. The magnitude of the net alkalinity is higher under saturated (i.e., anoxic) conditions.
- The concentration of major ions in leachate from the six KLC tests is typically dominated by variable concentrations of sodium, chloride and sulfate. Lower concentrations of other major ions are also likely to be present in leachate from these materials. The concentration of fluoride is elevated in leachate from the sandstone/siltstone interburden under both saturated and free-leaching conditions compared to the applied water quality low risk trigger guideline value for livestock drinking water (2 mg/L) (ANZECC & ARMCANZ, 2000).
- The sulfate release rate from the six KLC samples is generally quite low and stable over the test period with most values less than 20 mg/L. The highest sulfate release rate was observed for the conglomerate interburden under saturated conditions (KLC 1).
- The sulfate concentration in leachate from all of the KLC tests is generally an order of magnitude less than the applied livestock drinking water quality guideline value of 1,000 mg/L (ANZECC & ARMCANZ, 2000).
- The interburden and potential coal reject materials used in the KLC tests retain at least ~82.2 % of their inherent total sulfur content after six months of exposure to idealised oxidising conditions, which reflects low inherent sulfide concentration in the sample materials, slow rate of sulfide oxidation (and low potential for acid generation) for these materials.
- The interburden and potential coal reject samples retain at least ~99.95 % of their inherent ANC value after six months of exposure to idealised oxidising conditions, which reflects the slow release of alkalinity from these materials.
- The concentration of trace metals/metalloids in the leachate from the six KLC tests is generally low and typically below the laboratory LoR. Most trace metals/metalloids are therefore sparingly soluble at the slightly alkaline pH of the KLC leachate. The concentrations of all metals/metalloids are typically below the applied water quality guideline criteria for livestock drinking water (ANZECC & ARMCANZ, 2000). The main exceptions are molybdenum and selenium in some of the leachate collected from the KLC samples. The molybdenum concentration can be greater than the applied water quality low risk trigger guideline value for livestock drinking water (0.15 mg/L) and is generally higher under saturated conditions. However, the molybdenum concentration trend in leachate appears to be downwards from the second leach event. In contrast, the selenium concentration is higher under free leaching conditions and, under these conditions, is consistently greater than the applied water quality low risk trigger guideline value for livestock drinking water (0.02 mg/L) in leachate from the sandstone/siltstone interburden and potential coal reject tests (KLC 4 and KLC 6). Notwithstanding, the highly concentrated nature of the KLC test regime (sample to water ratio of approximately 20:1 (w/v)) indicates that dissolved metal/metalloid concentrations in leachate from bulk mine waste materials will be relatively low.
- The sulfate generation rate results obtained for the six KLC test samples 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 sulfate (and calcium) concentrations in most of the KLC leachate are typically much less than the solubility limit of gypsum ($CaSO_4$), for example, which indicates that sulfate generation is not controlled by gypsum dissolution in the KLC test materials. Therefore, the sulfate 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 sulfate generation rate and associated sulfide oxidation rate for the KLC tests are shown in **Table 4.8**.

- The sulfate generation rate from the KLC samples ranges from 1.10 to 3.08 mg/kg/week which is equivalent to a sulfide oxidation rate ranging from 4.58 x 10^{-10} to 1.27 x 10^{-9} kg $O_2/m^3/s$. Mining waste materials with an oxidation rate less than 5 x 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 or slightly alkaline and/or has a low level of acidity (AMIRA, 1995; Bennett *et al*., 2000). Hence, all of the mine waste materials tested fall into this category. Overall, the KLC results reflect the range of material characteristics predicted from the static geochemical test results shown in **Section 4.1**.

Table 4.8: Sulfate Generation and Sulfide Oxidation Rates for KLC tests

KLC Sample Number	Sample Description	Sulfate Generation Rate (mg/kg/week)	Oxidation Rate (kg $O_2/m^3/s$)
KLC1	Conglomerate (saturated)	3.08	1.27 x 10^{-9}
KLC2	Conglomerate (free leach)	2.43	9.95 x 10^{-10}
KLC3	Sandstone/Siltstone (saturated)	1.29	5.34 x 10^{-10}
KLC4	Sandstone/Siltstone (free leach)	1.88	7.67 x 10^{-10}
KLC5	Potential coal reject (saturated)	1.10	4.58 x 10^{-10}
KLC6	Potential coal reject (free leach)	2.07	8.43 x 10^{-10}

Potential implications of these results with respect to the management of the interburden and potential coal reject materials generated by the Modification (MOD8) are discussed further in **Section 5**.

5 Summary of Findings

5.1 AMD Potential and Management

The results of the static geochemical tests demonstrate that the overwhelming majority of the interburden and potential coal reject materials contain negligible sulfur, have excess ANC, and are classified as NAF. These samples represent materials with a very low risk of acid generation and a high factor of safety with respect to generating acidic drainage.

It is expected that blending of the potential coal reject materials during co-disposal at the Modification (MOD8) will result in a bulk material that is classified as NAF. The majority of the materials represented by the samples tested have excess ANC and are likely to provide a significant source of buffering to any unexpected acidity generated from specific mine materials.

The ANC results presented in this geochemical assessment are higher than those seen in work completed by RGS on overburden, interburden and potential coal reject materials from higher in the stratigraphic profile (RGS, 2020) (i.e., from surface down to the Merriown seam). This indicates an even higher factor of safety with respect to any potential for AMD as BCOPL mines deeper into the stratigraphic profile.

Notwithstanding, it is recommended that future sampling and testing at the BCM focus on the geochemical characterisation of actual coal reject materials from the CPP, whilst specific coal seams are being processed, to determine whether coal reject materials are likely to be PAF and require any special management measures. It is understood that a geochemical sampling and assessment program for actual coal reject materials will commence once a coal reject sampling equipment has been installed at the CPP in September 2020.

5.2 Soil Characteristics

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 geochemical tests described in this report indicate that the deeper interburden materials are strongly sodic and low in exchangeable calcium and consequently, may be susceptible to dispersion and erosion and should be managed appropriately. This supports the observation made in previous work completed by RGS (RGS, 2020), which concluded that strongly sodic materials are present at depth in the stratigraphic profile.

In addition, the low TOC level of the conglomerate and sandstone interburden characterised in this report indicates that material represented by the samples tested may exhibit poor to average structural conditions and structural stability.

The dispersive and structural characteristics of the interburden material may be improved to some extent with the addition of gypsum to the material or use of a vegetated subsoil/topsoil cover. BCOPL currently successfully manages overburden and interburden materials with similar characteristics at BCM in accordance with the Mining Operations Plan (BCOPL, 2020) and the current rehabilitation methodology should therefore continue for materials generated by the proposed Modification (MOD8).

5.3 Multi-Element Composition and Enrichment

The multi-element concentrations of interburden and potential coal reject materials are presented in **Section 4.2** and **4.3**, along with a comparison against applied guideline values and median crustal abundance in soils. The results indicate that these materials are not significantly enriched with metals/metalloids compared to applied guideline values and median crustal abundance in unmineralised soils. As such, the interburden and potential coal reject materials are not expected to present any environmental issues associated with metal/metalloid concentrations for revegetation and rehabilitation.

5.4 Water Quality

The static and kinetic geochemical test results presented in this report indicate that surface runoff and seepage from NAF interburden and potential coal reject materials are likely to be slightly alkaline and have a low EC value indicating low salinity levels (and low concentrations of dissolved solids). Surface runoff and seepage from these 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 and ARMCANZ (2000).

The major ion concentrations in leachate from interburden and potential coal reject materials are relatively low and dominated by sodium, chloride, sulfate and bicarbonate. Lower concentrations of other major ions are also likely to be present in leachate from the materials. The calcium and sulfate concentration in leachate from the interburden and potential coal reject materials is well below the applied ANZECC and ARMCANZ stock water quality guideline criterion (1,000 mg/L).

Water extract and KLC test results for interburden and potential coal reject materials indicate that most trace metals/metalloids are sparingly soluble in contact water, and that the concentration of dissolved metals/ metalloids in surface runoff and seepage from these materials is likely to be low and below applied water quality guideline criteria. It is therefore expected that the potential risk on the quality of surface water and groundwater resources from water in contact with mining waste materials at the Modification (MOD8) will be relatively low.

It is recommended that BCOPL consider periodically including several metals/metalloids in the existing site water quality monitoring program (including aluminium, arsenic, copper, lead, molybdenum, selenium and zinc) to verify that the dissolved concentration of these elements remains low.

6 Conclusions and Recommendations

6.1 Conclusions

RGS has completed a geochemistry assessment of interburden and potential coal reject materials at BCM associated with MOD8 to the current SSD approval. The main findings of the geochemistry assessment are:

- The overwhelming majority of the interburden and potential coal reject samples tested have a low sulfur content, excess ANC and are classified as NAF. These materials have a very low risk of acid generation and mining deeper into the stratigraphic profile at the BCM will provide an even higher factor of safety with respect to potential for the generation of acidity.
- The initial and ongoing surface runoff and seepage from the interburden and potential coal reject material is expected to be slightly alkaline and have a low level of salinity.
- There is no significant metal/metalloid enrichment in interburden and potential coal reject materials compared to applied guideline values and median crustal abundance in unmineralised soils.
- Most metals/metalloids are sparingly soluble at the slightly alkaline pH of leachate expected from bulk NAF mining waste materials. Dissolved metal/metalloid concentrations in surface runoff and leachate from bulk NAF mining waste materials are expected to be low and unlikely to pose a significant risk to the quality of surface and groundwater resources at the relevant storage facilities.
- The interburden (and potential coal reject) materials are sodic and may be prone to dispersion and erosion. BCOPL currently successfully manages overburden and interburden materials with similar characteristics at BCM in accordance with the Mining Operations Plan (BCOPL, 2020) and the current rehabilitation methodology should therefore continue for materials generated by the proposed Modification (MOD8).

6.2 Recommendations

As a result of the geochemistry assessment work completed on interburden and potential coal reject materials generated by the Modification (MOD8), several recommendations are provided to minimise the risk of any significant environmental harm to the immediate and downstream environment.

- In line with industry best practice, operational sampling and geochemical testing of mining waste material should continue to be used throughout the mine life to verify the veracity and performance of the adopted mining waste management strategy. This strategy should include geochemical characterisation of coal reject materials from the CPP, whilst specific coal seams are being processed, as there is currently a paucity of geochemical information on these materials. Coal reject materials are currently stored deep in the open pit profile under spoil materials and make up a small proportion of the waste materials handled at BCM.
- It is recommended that BCOPL consider periodically including several metals/metalloids in the existing site water quality monitoring program (including aluminium, arsenic, copper, lead, molybdenum, selenium and zinc) to verify that the dissolved concentration of these elements remains low.

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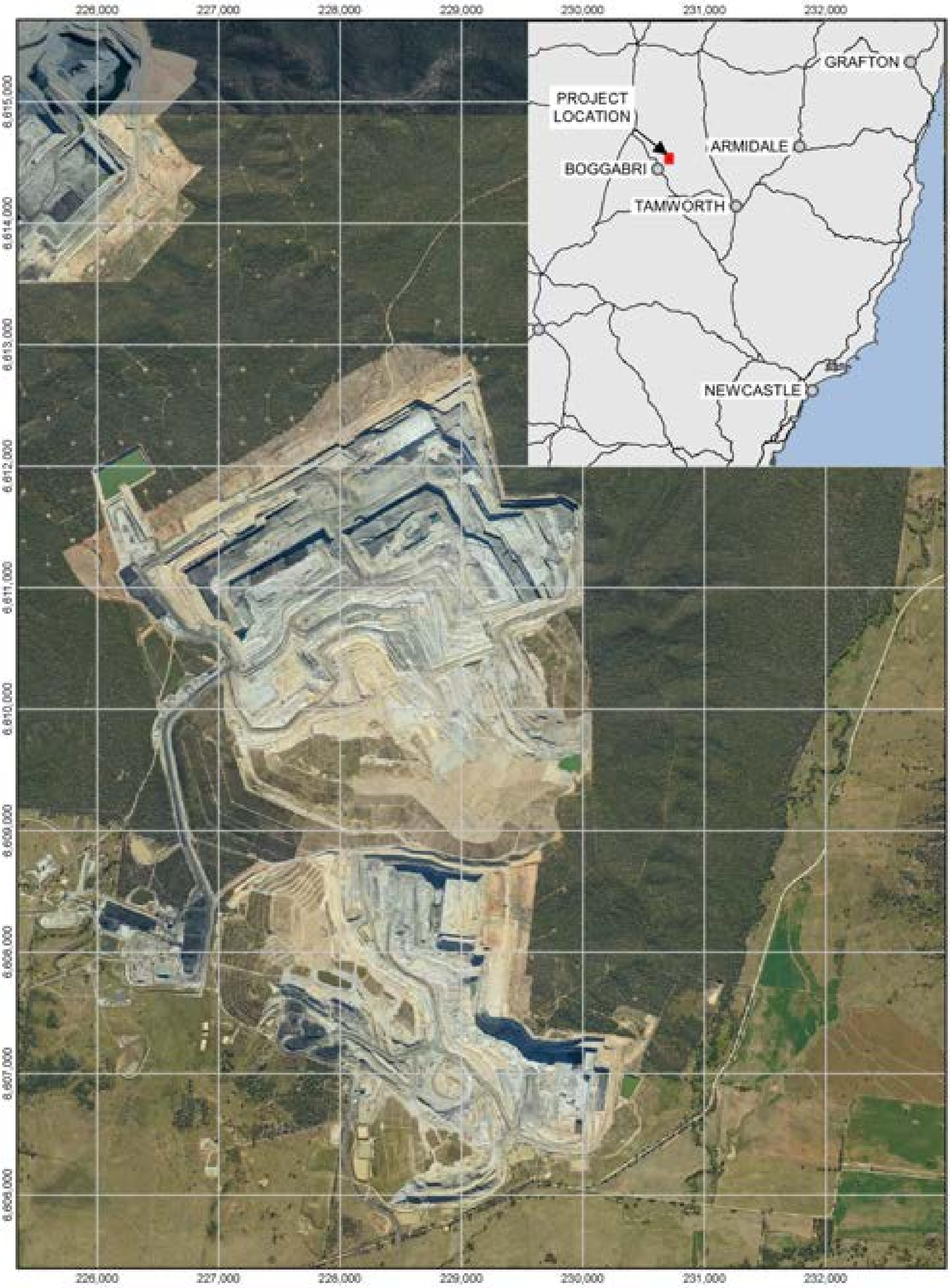
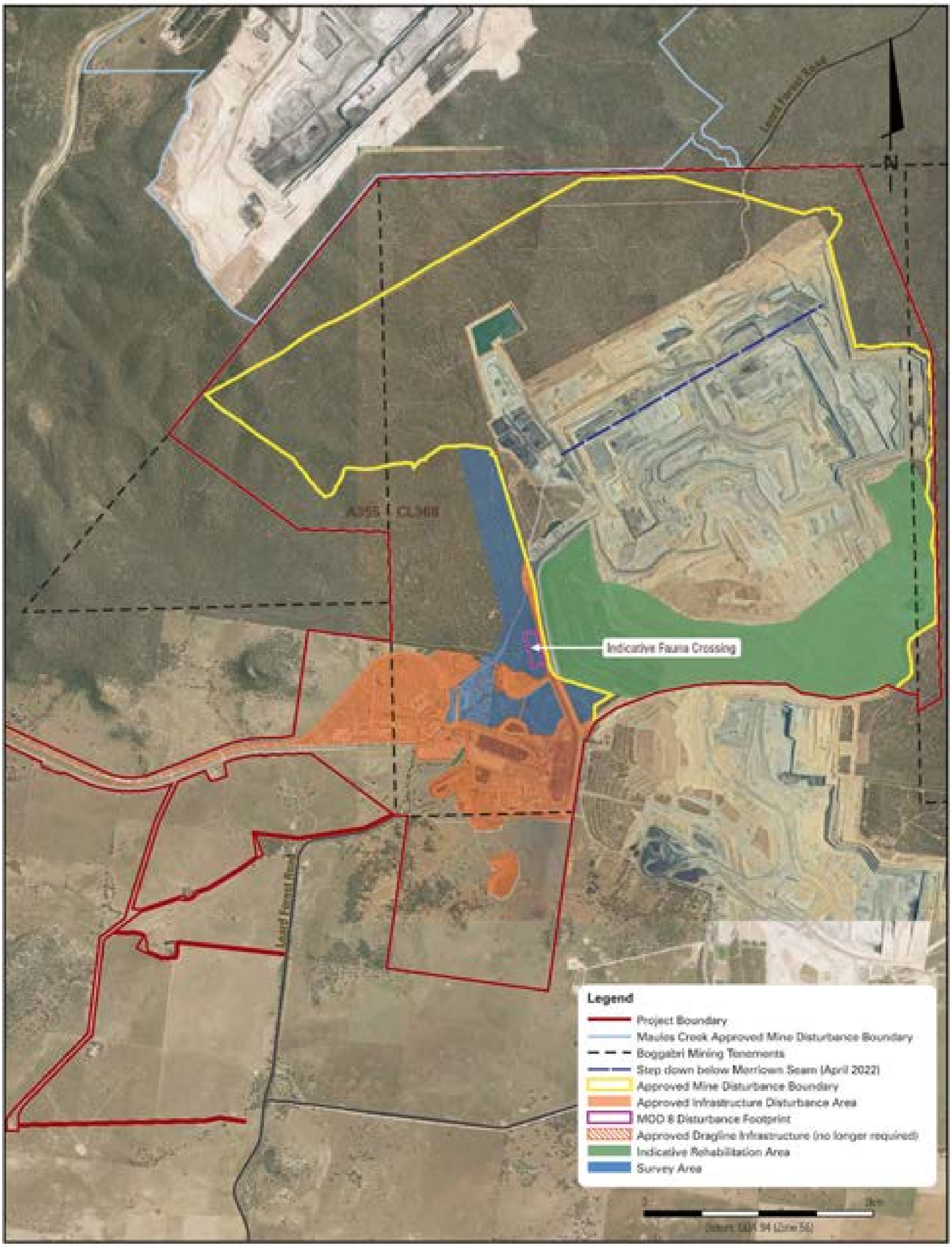
Attachment A Figures



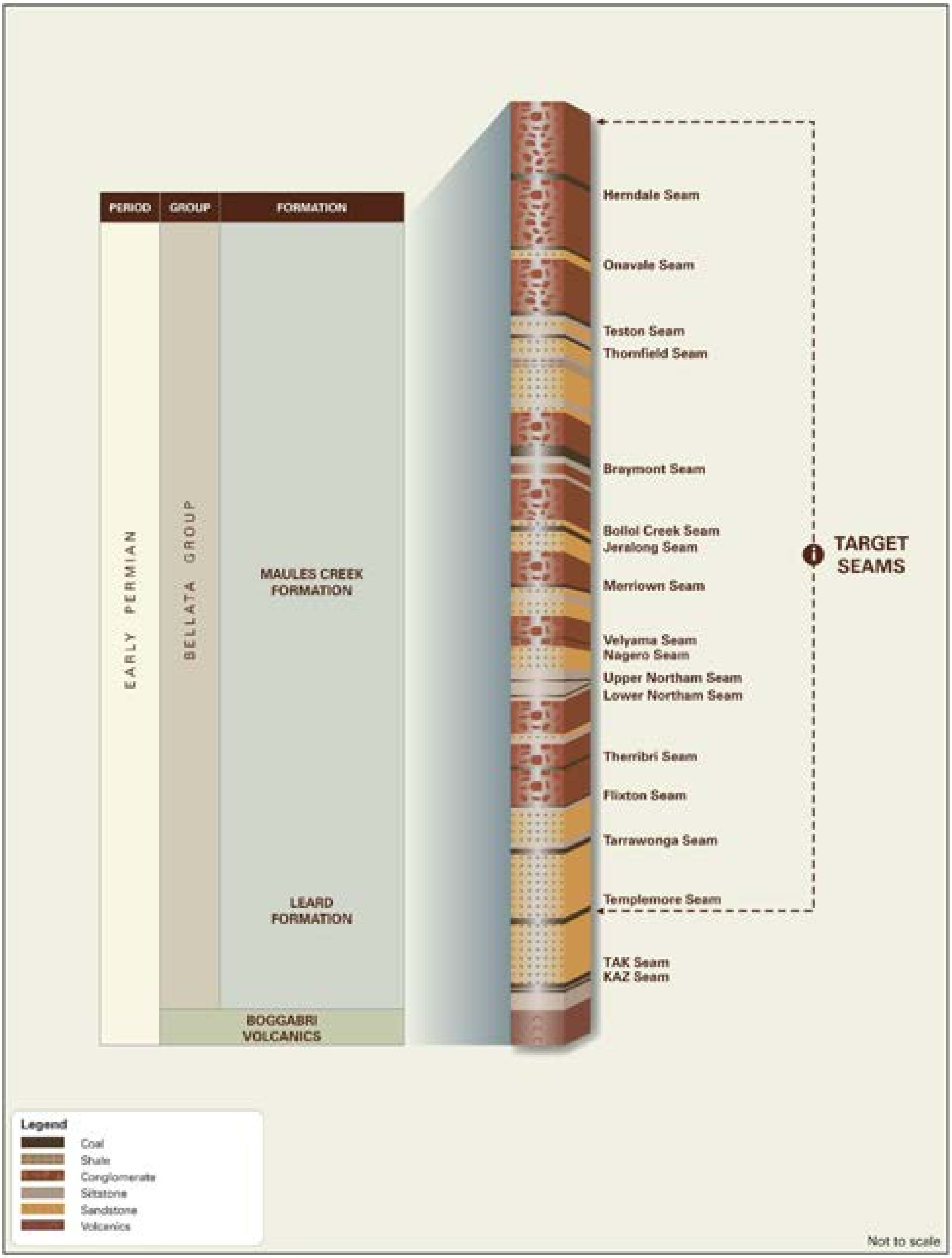
Source: Hansen Bailey; Google Satellite Maps

RGS	Scale 1:45,000 Datum: GDA 94 Zone 56	Geochemical Assessment of Interburden and Potential Coal Rejects	500 0 500 1000 1500 m	
	Boggabri Expansion Spatial Data.qgz; Project Location	**Boggabri Mine Location**	Figure: A1 Job Number: 2018028 27/04/2021	N



Source: Hansen Bailey

RGS		Geochemical Assessment of Interburden and Potential Coal Rejects		
	Boggabri Expansion Spatial Data.qgz; Project Layout	**Conceptual MOD 8 Project Layout**	Figure: A2	N
			Job Number: 2018028 27/04/2021	



Source: Hansen Bailey

Boggabri Expansion Spatial Data.qgz; Stratigraphic Column	Geochemical Assessment of Interburden and Potential Coal Rejects	
	Typical Stratigraphic Column	Figure: A3 Job Number: 2018028 27/04/2021

N

Source: GoogleMaps

RGS	Scale 1:4,000 Datum: AMG:56	Geochemical Assessment of Interburden and Potential Coal Reject	0 0.5 1 1.5 km	
	Drill hole locations.qgz; 2018028	**Boggabri Drill Hole Locations**	Figure: A4 Job Number: 2018028 27/04/2021	N

Attachment B 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 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:

$$FeS_2 + 15/4\ O_2 + 7/2\ H_2O \text{ ---> } Fe(OH)_3 + 2\ H_2SO_4$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing 1%S as pyrite would be 30.6 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 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 EC measured on 1:5 w/w water extract. This gives an indication of the inherent acidity and salinity of the waste material when initially exposed in a waste emplacement area.

Total sulfur content 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 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	Al, Ca, Fe, K, Mg, Na and S.
Minor elements	As, B, Cd, Co, Cr, Cu, F, Hg, Mn, Mo, Ni, Pb, Sb, Se and 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 (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-mass spectroscopy (ICP-MS), ICP-optical emission spectroscopy (OES), and atomic absorption spectrometry (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.

The KLC set up used by RGS was adapted (i.e., was larger than) from *AMIRA, 2002*. A 20 L column size was used and 20 kg of crushed sample (passing 10 mm) was accurately weighed and used in the leach columns. The sample in the column was leached with deionised water at a rate of approximately 1 L per cycle and the leachate from the columns collected and analysed.

Attachment C Static Geochemical Test Results

Table C1: List of Interburden and Potential Coal Reject Samples

RGS Sample No.	ALS Sample ID	Drill Hole ID	Sample Lithology	Sample Type	From	To	Interval
					(m)		
AMD000	EB2000277001	BC2463	Sandstone, siltstone, carbonaceous mudstone	Floor (Merriown)	208.84	209.74	0.90
AMD001	EB2000277002	BC2463	Conglomerate	Interburden	221.92	223.24	1.32
AMD002	EB2000277003	BC2463	Conglomerate	Interburden	235.02	236.91	1.89
AMD003	EB2000277004	BC2463	Sandstone, siltstone	Roof (Velyama)	267.09	267.65	0.56
AMD005	EB2000277005	BC2463	Carbonaceous siltstone, coal	Floor (Nagero)	272.36	272.62	0.26
AMD007	EB2000277006	BC2463	Siltstone, sandstone, coal	Floor (Northam)	275.75	276.32	0.57
AMD008	EB2000277007	BC2463	Sandstone	Interburden	277.49	278.30	0.81
AMD009	EB2000277008	BC2463	Sandstone	Interburden	287.95	289.33	1.38
AMD010	EB2000277009	BC2463	Siltstone, carbonaceous siltstone, coal, sandstone	Floor (Northam)	292.48	292.86	0.38
AMD011	EB2000277010	BC2463	Conglomerate	Interburden	299.89	300.70	0.81
AMD012	EB2000277011	BC2463	Conglomerate	Interburden	315.67	316.22	0.55
AMD013	EB2000277012	BC2463	Sandstone	Interburden	331.50	331.97	0.47
AMD014	EB2000277013	BC2463	Siltstone	Roof (Therribri)	335.05	335.50	0.45
AMD015	EB2000277014	BC2463	Carbonaceous siltstone, sandstone	Floor (Therribri)	339.44	339.49	0.05
AMD016	EB2000277015	BC2463	Siltstone, coal, carbonaceous mudstone	Interburden	340.83	341.18	0.35
AMD017	EB2000277016	BC2463	Siltstone	Interburden	347.91	348.56	0.65
AMD018	EB2000277017	BC2463	Siltstone	Roof (Flixton)	348.57	349.05	0.48
AMD019	EB2000277018	BC2463	Siltstone, carbonaceous mudstone	Floor (Flixton)	350.39	350.53	0.14
AMD020	EB2000277019	BC2463	Conglomerate	Interburden	355.21	355.97	0.76
AMD021	EB2000277020	BC2463	Sandstone	Interburden	358.38	358.96	0.58
AMD022	EB2000277021	BC2463	Siltstone	Interburden	366.42	366.83	0.41
AMD023	EB2000277022	BC2463	Sandstone	Interburden	367.84	368.52	0.68
AMD024	EB2000277023	BC2463	Siltstone	Interburden	370.88	371.16	0.28
AMD026	EB2000277024	BC2463	Siltstone, sandstone	Floor (Tarrawonga)	379.98	380.19	0.21
AMD027	EB2000277025	BC2463	Conglomerate	Interburden	385.54	386.86	1.32
AMD028	EB2000277026	BC2463	Siltstone	Interburden	391.66	392.10	0.44
AMD029	EB2000277027	BC2463	Sandstone	Interburden	395.89	396.54	0.65
AMD030	EB2000277028	BC2463	Sandstone, siderite	Roof (Templemore)	408.25	408.89	0.64
AMD031	EB2000277029	BC2463	Carbonaceous siltstone, mudstone, coal	Floor (Templemore)	412.29	412.55	0.26
AMD032	EB2000277030	BC2463	Sandstone	Interburden	423.09	424.27	1.18
AMD033	EB2000277031	BC2463	Siltstone	Interburden	437.43	437.84	0.41
AMD034	EB2000277032	BC2463	Siltstone, coal, carbonaceous siltstone	Roof (Tak)	440.65	441.04	0.39
AMD035	EB2000277033	BC2463	Carbonaceous siltstone, coal	Roof (Tak)	443.54	444.29	0.75
AMD036	EB2000277034	BC2463	Carbonaceous sandstone/mudstone, carbonate	Floor (Kaz)	445.59	446.16	0.57
AMD037	EB2000277035	BC2463	Conglomerate	Interburden	451.08	451.81	0.73
AMD038	EB2000277036	BC2464	Sandstone	Floor (Merriown)	75.92	76.37	0.45
AMD039	EB2000277037	BC2464	Conglomerate	Interburden	84.28	85.94	1.66
AMD040	EB2000277038	BC2464	Carbonaceous siltstone/sandstone, coal	Interburden	93.45	94.15	0.70
AMD041	EB2000277039	BC2464	Siltstone, carbonaceous mudstone, coal	Roof (Nagero)	116.59	116.95	0.36
AMD042	EB2000277040	BC2464	Sandstone, siltstone	Floor (Nagero)	118.24	119.23	0.99
AMD043	EB2000277041	BC2464	Sandstone	Interburden	119.97	120.27	0.30
AMD044	EB2000277042	BC2464	Siltstone	Interburden	121.40	121.91	0.51
AMD045	EB2000277043	BC2464	Siltstone, carbonaceous mudstone	Roof (Northam)	122.69	122.82	0.13
AMD046	EB2000277044	BC2464	Siltstone, carbonaceous mudstone	Floor (Northam)	124.13	124.32	0.19
AMD047	EB2000277045	BC2464	Sandstone	Interburden	126.06	127.20	1.14
AMD048	EB2000277046	BC2464	Siltstone, siderite, sandstone	Roof (Northam)	129.38	130.57	1.19
AMD050	EB2000277047	BC2464	Conglomerate	Interburden	141.02	141.74	0.72
AMD051	EB2000277048	BC2464	Sandstone	Interburden	143.68	144.25	0.57
AMD052	EB2000277049	BC2464	Conglomerate	Roof (Therribri)	156.01	157.47	1.46
AMD053	EB2000277050	BC2464	Sandstone, siltstone, carbonaceous siltstone	Floor (Therribri)	157.95	158.69	0.74
AMD054	EB2000277051	BC2464	Carbonaceous siltstone, siltstone	Roof (Therribri)	158.99	159.43	0.44
AMD055	EB2000277052	BC2464	Sandstone, siltstone	Floor (Therribri)	160.72	161.12	0.40
AMD056	EB2000277053	BC2464	Conglomerate	Interburden	170.00	171.03	1.03
AMD057	EB2000277054	BC2464	Sandstone	Interburden	178.30	179.02	0.72
AMD058	EB2000277055	BC2464	Sandstone	Interburden	187.37	188.12	0.75
AMD059	EB2000277056	BC2464	Conglomerate, coal	Interburden	190.93	191.98	1.05
AMD061	EB2000277057	BC2464	Siltstone, sandstone, carbonaceous siltstone	Roof (Flixton)	198.26	199.39	1.13
AMD062	EB2000277058	BC2464	Sandstone	Floor (Tarrawonga)	202.48	203.26	0.78
AMD063	EB2000277059	BC2464	Conglomerate	Interburden	219.01	221.90	2.89
AMD065	EB2000277060	BC2464	Carbonaceous siltstone/mudstone	Floor (Tarrawonga)	225.22	225.90	0.68
AMD066	EB2000277061	BC2464	Carbonaceous siltstone	Interburden	237.19	237.57	0.38
AMD067	EB2000277062	BC2464	Conglomerate	Interburden	241.97	242.17	0.20
AMD068	EB2000277063	BC2466	Sandstone, siltstone, carbonaceous siltstone	Floor (Merriown)	144.26	144.94	0.68
AMD069	EB2000277064	BC2466	Conglomerate	Interburden	157.30	158.80	1.50
AMD070	EB2000277065	BC2466	Siltstone	Roof (Velyama)	185.17	185.43	0.26
AMD071	EB2000277066	BC2466	Carbonaceous siltstone, coal	Floor (Nagero)	189.09	189.27	0.18
AMD072	EB2000277067	BC2466	Sandstone	Roof (Northam)	192.21	192.65	0.44
AMD073	EB2000277068	BC2466	Siltstone	Roof (Northam)	192.85	193.19	0.34
AMD074	EB2000277069	BC2466	Carbonaceous siltstone	Floor (Northam)	194.57	195.09	0.52
AMD075	EB2000277070	BC2466	Sandstone	Interburden	200.17	200.91	0.74
AMD076	EB2000277071	BC2466	Carbonaceous siltstone, siltstone	Roof (Northam)	204.89	205.09	0.20
AMD077	EB2000277072	BC2466	Siltstone, sandstone, carbonaceous siltstone	Floor (Northam)	206.11	206.59	0.48
AMD078	EB2000277073	BC2466	Conglomerate	Interburden	224.29	224.86	0.57
AMD079	EB2000277074	BC2466	Sandstone	Interburden	241.07	242.34	1.27
AMD080	EB2000277075	BC2466	Conglomerate, sandstone	Roof (Therribri)	248.84	250.09	1.25
AMD081	EB2000277076	BC2466	Sandstone, siltstone	Roof (Therribri)	250.95	251.70	0.75

Table C1: List of Interburden and Potential Coal Reject Samples

RGS Sample No.	ALS Sample ID	Drill Hole ID	Sample Lithology	Sample Type	From	To	Interval
					(m)		
AMD082	EB2000277077	BC2466	Sandstone, siltstone, carbonaceous siltstone	Floor (Therribri)	252.00	252.70	0.70
AMD083	EB2000277078	BC2466	Siltstone	Floor (Therribri)	254.06	254.22	0.16
AMD084	EB2000277079	BC2466	Conglomerate	Interburden	260.89	261.99	1.10
AMD085	EB2000277080	BC2466	Siltstone, coal, carbonaceous siltstone	Roof (Flixton)	265.40	265.73	0.33
AMD086	EB2000277081	BC2466	Siltstone, carbonaceous siltstone	Floor (Flixton)	267.96	268.15	0.19
AMD087	EB2000277082	BC2466	Sandstone	Interburden	280.33	281.70	1.37
AMD088	EB2000277083	BC2466	Carbonaceous siltstone, siltstone, sandstone	Roof (Tarrawonga)	290.86	291.36	0.50
AMD089	EB2000277084	BC2466	Sandstone	Floor (Tarrawonga)	294.66	294.99	0.33
AMD090	EB2000277085	BC2466	Sandstone	Interburden	308.93	310.48	1.55
AMD091	EB2000277086	BC2466	Sandstone	Roof (Templemore)	322.33	322.56	0.23
AMD092	EB2000277087	BC2466	Sandstone, carbonaceous mudstone	Floor (Templemore)	325.51	325.73	0.22
AMD093	EB2000277088	BC2466	Sandstone	Interburden	329.95	330.57	0.62
AMD094	EB2000277089	BC2466	Conglomerate	Interburden	333.63	334.15	0.52
AMD095	EB2000277090	BC2466	Siltstone	Roof (Tak)	349.12	349.85	0.73
AMD096	EB2000277091	BC2466	Calcrete, carbonaceous mudstone	Floor (Kaz)	353.59	353.82	0.23
AMD097	EB2000277092	BC2466	Carbonaceous mudstone	Interburden	359.87	360.28	0.41

Table C2: Acid Base Account Test Results for Boggabri Interburden and Potential Coal Reject

Sample No.	RGS Sample ID	Drill Hole ID	ALS Sample ID	Material Type	Seam	Lithology	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)	(%)	(%)	kg H_2SO_4/t				
									Interburden										
1	AMD001	BC2463	EB2000277002	Interburden		Conglomerate	MN - VY	221.92	223.24	1.32	9.6	466	0.005		0.2	37.5	-37.3	244.9	Non-Acid Forming (Barren)
2	AMD002	BC2463	EB2000277003	Interburden		Conglomerate	MN - VY	235.02	236.91	1.89	9.7	502	0.01		0.3	27.8	-27.5	90.8	Non-Acid Forming (Barren)
3	AMD039	BC2464	EB2000277037	Interburden		Conglomerate	MN - NG	84.28	85.94	1.66	8.9	130	0.005		0.2	35.4	-35.2	231.2	Non-Acid Forming (Barren)
4	AMD069	BC2466	EB2000277064	Interburden		Conglomerate	MN - VY	157.30	158.80	1.50	8.1	478	0.05		1.5	25.9	-24.4	16.9	Non-Acid Forming (Barren)
5	AMD011	BC2463	EB2000277010	Interburden		Conglomerate	NT2 - TH	299.89	300.70	0.81	9.5	294	0.01		0.3	20.3	-20.0	66.3	Non-Acid Forming (Barren)
6	AMD012	BC2463	EB2000277011	Interburden		Conglomerate	NT2 - TH	315.67	316.22	0.55	9.6	306	0.02		0.6	24.2	-23.6	39.5	Non-Acid Forming (Barren)
7	AMD050	BC2464	EB2000277047	Interburden		Conglomerate	NT2 - TH1	141.02	141.74	0.72	8.5	64	0.005		0.2	6.0	-5.8	39.2	Non-Acid Forming (Barren)
8	AMD078	BC2466	EB2000277073	Interburden		Conglomerate	NT2 - TH1	224.29	224.86	0.57	9.6	449	0.01		0.3	44.1	-43.8	144.0	Non-Acid Forming (Barren)
9	AMD056	BC2464	EB2000277053	Interburden		Conglomerate	TH3 - FX	170.00	171.03	1.03	8.9	149	0.05		1.5	28.3	-26.8	18.5	Non-Acid Forming (Barren)
10	AMD059	BC2464	EB2000277056	Interburden		Conglomerate	TH3 - FX	190.93	191.98	1.05	8.8	167	0.02		0.6	39.1	-38.5	63.8	Non-Acid Forming (Barren)
11	AMD084	BC2466	EB2000277079	Interburden		Conglomerate	TH3 - FX	260.89	261.99	1.10	9.4	191	0.005		0.2	28	-27.8	182.9	Non-Acid Forming (Barren)
12	AMD020	BC2463	EB2000277019	Interburden		Conglomerate	FX - TA	355.21	355.97	0.76	9.3	260	0.005		0.2	46.8	-46.6	305.6	Non-Acid Forming (Barren)
13	AMD027	BC2463	EB2000277025	Interburden		Conglomerate	TA - TP	385.54	386.86	1.32	9.4	257	0.02		0.6	49.9	-49.3	81.5	Non-Acid Forming (Barren)
14	AMD063	BC2464	EB2000277059	Interburden		Conglomerate	TA1 - TA2	219.01	221.90	2.89	8.5	62	0.02		0.6	14.0	-13.4	22.9	Non-Acid Forming (Barren)
15	AMD067	BC2464	EB2000277062	Interburden		Conglomerate	TA2 - BASE	241.97	242.17	0.20	8.8	116	0.02		0.6	134	-133.4	218.8	Non-Acid Forming (Barren)
16	AMD094	BC2466	EB2000277089	Interburden		Conglomerate	TP - TAK	333.63	334.15	0.52	8.7	185	0.01		0.3	59.4	-59.1	194.0	Non-Acid Forming (Barren)
17	AMD037	BC2463	EB2000277035	Interburden		Conglomerate	KA - BASE	451.08	451.81	0.73	9.4	232	0.02		0.6	41.2	-40.6	67.3	Non-Acid Forming (Barren)
18	AMD043	BC2464	EB2000277041	Interburden		Sandstone	NG - NT1	119.97	120.27	0.30	8.1	57	0.02		0.6	14.9	-14.3	24.3	Non-Acid Forming (Barren)
19	AMD008	BC2463	EB2000277007	Interburden		Sandstone	NT1 - NT2	277.49	278.30	0.81	9.3	100	0.005		0.2	18.1	-17.9	118.2	Non-Acid Forming (Barren)
20	AMD009	BC2463	EB2000277008	Interburden		Sandstone	NT1 - NT2	287.95	289.33	1.38	9.4	135	0.02		0.6	20.7	-20.1	33.8	Non-Acid Forming (Barren)
21	AMD013	BC2463	EB2000277012	Interburden		Sandstone	NT2 - TH	331.50	331.97	0.47	9.3	99	0.02		0.6	20.9	-20.3	34.1	Non-Acid Forming (Barren)
22	AMD047	BC2464	EB2000277045	Interburden		Sandstone	NT1 - NT2	126.06	127.20	1.14	8.3	64	0.02		0.6	16.8	-16.2	27.4	Non-Acid Forming (Barren)
23	AMD051	BC2464	EB2000277048	Interburden		Sandstone	NT2 - TH1	143.68	144.25	0.57	8.9	172	0.02		0.6	57.0	-56.4	93.1	Non-Acid Forming (Barren)
24	AMD075	BC2466	EB2000277070	Interburden		Sandstone	NT1 - NT2	200.17	200.91	0.74	9.4	242	0.005		0.2	75.9	-75.7	495.7	Non-Acid Forming (Barren)
25	AMD079	BC2466	EB2000277074	Interburden		Sandstone	NT2 - TH1	241.07	242.34	1.27	9.7	314	0.005		0.2	33.8	-33.6	220.7	Non-Acid Forming (Barren)
26	AMD057	BC2464	EB2000277054	Interburden		Sandstone	TH3 - FX	178.30	179.02	0.72	9.0	125	0.005		0.2	184	-183.8	1201.6	Non-Acid Forming (Barren)
27	AMD058	BC2464	EB2000277055	Interburden		Sandstone	TH3 - FX	187.37	188.12	0.75	8.5	263	0.03		0.9	24.8	-23.9	27.0	Non-Acid Forming (Barren)
28	AMD021	BC2463	EB2000277020	Interburden		Sandstone	FX - TA	358.38	358.96	0.58	9.2	276	0.04		1.2	26.1	-24.9	21.3	Non-Acid Forming (Barren)
29	AMD023	BC2463	EB2000277022	Interburden		Sandstone	FX - TA	367.84	368.52	0.68	9.3	340	0.01		0.3	203	-202.7	662.9	Non-Acid Forming (Barren)
30	AMD087	BC2466	EB2000277082	Interburden		Sandstone	FX - TA	280.33	281.70	1.37	8.7	158	0.01		0.3	42.4	-42.1	138.4	Non-Acid Forming (Barren)
31	AMD029	BC2463	EB2000277027	Interburden		Sandstone	TA - TP	395.89	396.54	0.65	9.6	252	0.005		0.2	24.9	-24.7	162.6	Non-Acid Forming (Barren)
32	AMD090	BC2466	EB2000277085	Interburden		Sandstone	TA - TP	308.93	310.48	1.55	9.1	160	0.005		0.2	23.8	-23.6	155.4	Non-Acid Forming (Barren)
33	AMD032	BC2463	EB2000277030	Interburden		Sandstone	TP - TAK	423.09	424.27	1.18	9.5	258	0.02		0.6	27.3	-26.7	44.6	Non-Acid Forming (Barren)
34	AMD093	BC2466	EB2000277088	Interburden		Sandstone	TP - TAK	329.95	330.57	0.62	8.6	86	0.02		0.6	20.9	-20.3	34.1	Non-Acid Forming (Barren)
35	AMD040	BC2464	EB2000277038	Interburden		Siltstone	MN - NG	93.45	94.15	0.70	8.0	54	0.04		1.2	11.4	-10.2	9.3	Non-Acid Forming (Barren)
36	AMD044	BC2464	EB2000277042	Interburden		Siltstone	NG - NT1	121.40	121.91	0.51	8.1	64	0.02		0.6	15.7	-15.1	25.6	Non-Acid Forming (Barren)
37	AMD016	BC2463	EB2000277015	Interburden		Siltstone	TH - FX	340.83	341.18	0.35	9.1	106	0.01		0.3	16.8	-16.5	54.9	Non-Acid Forming (Barren)
38	AMD017	BC2463	EB2000277016	Interburden		Siltstone	TH - FX	347.91	348.56	0.65	9.1	117	0.02		0.6	17.8	-17.2	29.1	Non-Acid Forming (Barren)
39	AMD022	BC2463	EB2000277021	Interburden		Siltstone	FX - TA	366.42	366.83	0.41	9.3	244	0.02		0.6	35.0	-34.4	57.1	Non-Acid Forming (Barren)
40	AMD024	BC2463	EB2000277023	Interburden		Siltstone	FX - TA	370.88	371.16	0.28	9.3	168	0.01		0.3	26.6	-26.3	86.9	Non-Acid Forming (Barren)
41	AMD028	BC2463	EB2000277026	Interburden		Siltstone	TA - TP	391.66	392.10	0.44	9.3	134	0.02		0.6	19.8	-19.2	32.3	Non-Acid Forming (Barren)
42	AMD066	BC2464	EB2000277061	Interburden		Siltstone	TA2 - BASE	237.19	237.57	0.38	8.6	170	0.05		1.5	14.4	-12.9	9.4	Non-Acid Forming (Barren)
43	AMD033	BC2463	EB2000277031	Interburden		Siltstone	TP - TAK	437.43	437.84	0.41	10.1	539	0.005		0.2	193	-192.8	1260.4	Non-Acid Forming (Barren)
44	AMD097	BC2466	EB2000277092	Interburden		Siltstone	KA - BASE	359.87	360.28	0.41	7.9	425	0.04		1.2	55.6	-54.4	45.4	Non-Acid Forming (Barren)

Table C2: Acid Base Account Test Results for Boggabri Interburden and Potential Coal Reject

Sample No.	RGS Sample ID	Drill Hole ID	ALS Sample ID	Material Type	Seam	Lithology	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]
Potential Coal Reject																			
45	AMD052	BC2464	EB2000277049	Roof	TH	Conglomerate	NT2 - TH1	156.01	157.47	1.46	9.0	138	0.01		0.3	27.5	-27.2	89.8	Non-Acid Forming (Barren)
46	AMD080	BC2466	EB2000277075	Roof	TH	Conglomerate	NT2 - TH1	248.84	250.09	1.25	8.8	85	0.02		0.6	11.8	-11.2	19.3	Non-Acid Forming (Barren)
47	AMD000	BC2463	EB2000277001	Floor	MN	Sandstone	MN - VY	208.84	209.74	0.90	9.1	80	0.02		0.6	11.0	-10.4	18.0	Non-Acid Forming (Barren)
48	AMD038	BC2464	EB2000277036	Floor	MN	Sandstone	MN - NG	75.92	76.37	0.45	7.5	30	0.005		0.2	6.5	-6.3	42.4	Non-Acid Forming (Barren)
49	AMD068	BC2466	EB2000277063	Floor	MN	Sandstone	MN - VY	144.26	144.94	0.68	8.4	37	0.005		0.2	9.5	-9.3	62.0	Non-Acid Forming (Barren)
50	AMD003	BC2463	EB2000277004	Roof	VY	Sandstone	MN - VY	267.09	267.65	0.56	9.5	268	0.005		0.2	18.7	-18.5	122.1	Non-Acid Forming (Barren)
51	AMD042	BC2464	EB2000277040	Floor	NG	Sandstone	NG - NT1	118.24	119.23	0.99	8.3	76	0.005		0.2	15.6	-15.4	101.9	Non-Acid Forming (Barren)
52	AMD072	BC2466	EB2000277067	Roof	NT	Sandstone	NG - NTR	192.21	192.65	0.44	9.1	219	0.005		0.2	23.1	-22.9	150.9	Non-Acid Forming (Barren)
53	AMD053	BC2464	EB2000277050	Floor	TH	Sandstone	TH1 - TH2	157.95	158.69	0.74	8.4	49	0.02		0.6	19.4	-18.8	31.7	Non-Acid Forming (Barren)
54	AMD055	BC2464	EB2000277052	Roof	TH	Sandstone	TH3 - FX	160.72	161.12	0.40	8.4	38	0.01		0.3	11.2	-10.9	36.6	Non-Acid Forming (Barren)
55	AMD081	BC2466	EB2000277076	Roof	TH	Sandstone	TH1 - TH2	250.95	251.70	0.75	8.8	64	0.03		0.9	19.7	-18.8	21.4	Non-Acid Forming (Barren)
56	AMD082	BC2466	EB2000277077	Floor	TH	Sandstone	TH2 - TH3	252.00	252.70	0.70	8.8	60	0.02		0.6	21.2	-20.6	34.6	Non-Acid Forming (Barren)
57	AMD062	BC2464	EB2000277058	Floor	TA	Sandstone	TA1 - TA2	202.48	203.26	0.78	8.7	105	0.005		0.2	34.4	-34.2	224.7	Non-Acid Forming (Barren)
58	AMD089	BC2466	EB2000277084	Floor	TA	Sandstone	TA - TP	294.66	294.99	0.33	8.8	52	0.005		0.2	11.6	-11.4	75.8	Non-Acid Forming (Barren)
59	AMD030	BC2463	EB2000277028	Roof	TP	Sandstone	TA - TP	408.25	408.89	0.64	9.5	270	0.01		0.3	34.5	-34.2	112.7	Non-Acid Forming (Barren)
60	AMD091	BC2466	EB2000277086	Roof	TP	Sandstone	TA - TP	322.33	322.56	0.23	8.2	142	0.16	0.076	2.3	12.8	-10.5	5.5	Non-Acid Forming (Barren)
61	AMD092	BC2466	EB2000277087	Floor	TP	Sandstone	TP - TAK	325.51	325.73	0.22	8.5	41	0.005		0.2	10.4	-10.2	67.9	Non-Acid Forming (Barren)
62	AMD036	BC2463	EB2000277034	Floor	KAZ	Sandstone	KA - BASE	445.59	446.16	0.57	8.8	244	0.10		3.1	22.4	-19.3	7.3	Non-Acid Forming (Barren)
63	AMD070	BC2466	EB2000277065	Roof	VY	Siltstone	MN - VY	185.17	185.43	0.26	9.2	58	0.005		0.2	12.4	-12.2	81.0	Non-Acid Forming (Barren)
64	AMD041	BC2464	EB2000277039	Roof	NG	Siltstone	MN - NG	116.59	116.95	0.36	7.9	75	0.02		0.6	28.6	-28.0	46.7	Non-Acid Forming (Barren)
65	AMD071	BC2466	EB2000277066	Floor	NG	Siltstone	NG - NTR	189.09	189.27	0.18	8.6	60	0.04		1.2	11.4	-10.2	9.3	Non-Acid Forming (Barren)
66	AMD005	BC2463	EB2000277005	Floor	NG	Siltstone	NG - NT1	272.36	272.62	0.26	9.0	76	0.02		0.6	14.7	-14.1	24.0	Non-Acid Forming (Barren)
67	AMD007	BC2463	EB2000277006	Floor	NT	Siltstone	NT1 - NT2	275.75	276.32	0.57	9.4	107	0.01		0.3	16.1	-15.8	52.6	Non-Acid Forming (Barren)
68	AMD010	BC2463	EB2000277009	Floor	NT	Siltstone	NT2 - TH	292.48	292.86	0.38	8.9	166	0.02		0.6	27.5	-26.9	44.9	Non-Acid Forming (Barren)
69	AMD045	BC2464	EB2000277043	Roof	NT	Siltstone	NG - NT1	122.69	122.82	0.13	8.1	143	0.03		0.9	30.7	-29.8	33.4	Non-Acid Forming (Barren)
70	AMD046	BC2464	EB2000277044	Floor	NT	Siltstone	NT1 - NT2	124.13	124.32	0.19	7.9	70	0.07		2.1	11.0	-8.9	5.1	Non-Acid Forming (Barren)
71	AMD048	BC2464	EB2000277046	Roof	NT	Siltstone	NT1 - NT2	129.38	130.57	1.19	8.8	184	0.06		1.8	37.5	-35.7	20.4	Non-Acid Forming (Barren)
72	AMD073	BC2466	EB2000277068	Roof	NT	Siltstone	NTR - NT1	192.85	193.19	0.34	8.4	77	0.02		0.6	31.4	-30.8	51.3	Non-Acid Forming (Barren)
73	AMD074	BC2466	EB2000277069	Floor	NT	Siltstone	NT1 - NT2	194.57	195.09	0.52	9.0	61	0.02		0.6	12.7	-12.1	20.7	Non-Acid Forming (Barren)
74	AMD076	BC2466	EB2000277071	Roof	NT	Siltstone	NT1 - NT2	204.89	205.09	0.20	9.1	85	0.01		0.3	11.7	-11.4	38.2	Non-Acid Forming (Barren)
75	AMD077	BC2466	EB2000277072	Floor	NT	Siltstone	NT2 - TH1	206.11	206.59	0.48	9.0	71	0.01		0.3	13.9	-13.6	45.4	Non-Acid Forming (Barren)
76	AMD014	BC2463	EB2000277013	Roof	TH	Siltstone	NT2 - TH	335.05	335.50	0.45	9.3	110	0.02		0.6	13.5	-12.9	22.0	Non-Acid Forming (Barren)
77	AMD015	BC2463	EB2000277014	Floor	TH	Siltstone	TH - FX	339.44	339.49	0.05	9.2	99	0.01		0.3	14.6	-14.3	47.7	Non-Acid Forming (Barren)
78	AMD054	BC2464	EB2000277051	Roof	TH	Siltstone	TH2 - TH3	158.99	159.43	0.44	8.4	54	0.02		0.6	13.5	-12.9	22.0	Non-Acid Forming (Barren)
79	AMD083	BC2466	EB2000277078	Floor	TH	Siltstone	TH3 - FX	254.06	254.22	0.16	8.8	49	0.005		0.2	12.9	-12.7	84.2	Non-Acid Forming (Barren)
80	AMD018	BC2463	EB2000277017	Roof	FX	Siltstone	TH - FX	348.57	349.05	0.48	9.2	124	0.01		0.3	12.9	-12.6	42.1	Non-Acid Forming (Barren)
81	AMD019	BC2463	EB2000277018	Floor	FX	Siltstone	FX - TA	350.39	350.53	0.14	9.3	101	0.02		0.6	15.2	-14.6	24.8	Non-Acid Forming (Barren)
82	AMD085	BC2466	EB2000277080	Roof	FX	Siltstone	TH3 - FX	265.40	265.73	0.33	7.8	89	0.16	0.021	0.6	13.9	-13.3	21.6	Non-Acid Forming (Barren)
83	AMD086	BC2466	EB2000277081	Floor	FX	Siltstone	FX - TA	267.96	268.15	0.19	9.0	60	0.01		0.3	13.1	-12.8	42.8	Non-Acid Forming (Barren)
84	AMD061	BC2464	EB2000277057	Roof	FX	Siltstone	FX - TA1	198.26	199.39	1.13	8.2	65	0.02		0.6	14.0	-13.4	22.9	Non-Acid Forming (Barren)
85	AMD026	BC2463	EB2000277024	Floor	TA	Siltstone	TA - TP	379.98	380.19	0.21	9.1	108	0.005		0.2	13.6	-13.4	88.8	Non-Acid Forming (Barren)
86	AMD065	BC2464	EB2000277060	Floor	TA	Siltstone	TA2 - BASE	225.22	225.90	0.68	7.2	99	0.03		0.9	12.4	-11.5	13.5	Non-Acid Forming (Barren)
87	AMD088	BC2466	EB2000277083	Roof	TA	Siltstone	FX - TA	290.86	291.36	0.50	8.3	74	0.04		1.2	11.9	-10.7	9.7	Non-Acid Forming (Barren)
88	AMD031	BC2463	EB2000277029	Floor	TP	Siltstone	TP - TAK	412.29	412.55	0.26	9.3	260	0.02		0.6	25.4	-24.8	41.5	Non-Acid Forming (Barren)
89	AMD034	BC2463	EB2000277032	Roof	TAK	Siltstone	TP - TAK	440.65	441.04	0.39	9.9	286	0.005		0.2	24.1	-23.9	157.4	Non-Acid Forming (Barren)
90	AMD095	BC2466	EB2000277090	Roof	TAK	Siltstone	TP - TAK	349.12	349.85	0.73	7.5	272	0.84	0.593	18.2	17.2	1.0	0.9	Uncertain
91	AMD035	BC2463	EB2000277033	Roof	TAK	Siltstone	TAK - KAZ	443.54	444.29	0.75	9.1	95	0.05		1.5	18.3	-16.8	12.0	Non-Acid Forming (Barren)
92	AMD096	BC2466	EB2000277091	Floor	KAZ	Siltstone	KAZ - BASE	353.59	353.82	0.23	8.3	319	0.70	0.396	12.1	406.0	-393.9	33.5	Non-Acid Forming

Notes

1. Current pH, EC, Alkalinity and Acidity provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; 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 .

Table C3: Multi-Element Test Results for Interburden and Potential Coal Reject

	RGS Sample Number →		Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6	Composite 7	Composite 8	Composite 9	Composite 10
	ALS Laboratory ID →		EB2002443005	EB2002443006	EB2002443007	EB2002443008	EB2002443009	EB2002443010	EB2002443011	EB2002443012	EB2002443013	EB2002443014
Parameters	Limit of Reporting	NEPC[1] Health-Based Investigation Level (HILs)-C	Interburden Conglomerate	Interburden Conglomerate	Interburden Sandstone	Interburden Sandstone	Interburden Siltstone	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject
Major Cations			All units mg/kg									
Calcium (Ca)	50	-	5,210	13,500	8,320	14,500	8,040	2,270	2,930	2,310	1,200	11,300
Magnesium (Mg)	50	-	1,420	2,890	2,790	5,110	2,910	1,110	1,330	3,300	730	3,350
Potassium (K)	50	-	1,190	940	1,150	1,280	920	890	980	1,020	1,110	1,010
Sodium (Na)	50	-	2,060	560	670	830	820	500	670	610	770	850
Fluoride (F)	40	-	130	150	210	180	250	150	180	260	280	260
Major, Minor and Trace Elements			All units mg/kg (except Total Organic Carbon (%))									
Aluminium (Al)	50	-	720	600	970	1,010	1,120	800	1,070	1,010	1,080	1,010
Antimony (Sb)	0.1	-	<0.1	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic (As)	0.1	300	5.5	6.0	5.3	6.5	6.4	2.2	2.2	3.2	2.8	4.4
Boron (B)	50	20,000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (Cd)	0.1	90	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chromium (Cr) - hexavalent	0.1	300 **	2	9.1	9.5	8.7	6.6	6.9	5.1	3.4	1.8	5.2
Cobalt (Co)	0.1	300	3.8	3.4	3.9	7.1	7.3	3.6	5.1	3.0	3.8	10.0
Copper (Cu)	0.1	17,000	4.2	3.7	7.8	5.8	17.9	8.6	22.8	21.9	23.4	23.8
Iron (Fe)	50	-	5,060	20,800	14,800	28,200	17,300	5,100	4,860	17,700	12,700	35,100
Lead (Pb)	0.1	600	6.9	4.6	10.3	8.1	12.3	9.6	12.0	14.5	14.2	15.0
Manganese (Mn)	0.1	19,000	88.4	395.0	174.0	507.0	252.0	61.7	46.2	80.9	36.6	207.0
Molybdenum (Mo)	2	2	0.4	0.2	0.4	0.4	0.2	0.4	0.2	0.1	0.2	1.0
Nickel (Ni)	0.1	1,200	9.1	18.9	11.7	18.1	19.3	8.7	13.7	8.0	7.8	21.8
Phosphorus (P)	50	-	<50	<50	<50	100	110	<50	<50	<50	<50	70
Selenium (Se)	1	700	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Thorium (Th)	0.1	-	1.3	2.1	1.7	2.4	2.8	1.1	1.5	0.7	0.5	1.2
Vanadium (V)	1	-	6.0	12.0	16.0	20.0	21.0	11.0	12.0	12.0	8.0	30.0
Uranium (U)	0.1	-	0.3	0.4	0.3	1	0.3	0.4	0.3	0.4	0.3	0.4
Zinc (Zn)	0.5	30,000	34.6	7.7	38	31.6	57.9	36	41.4	44.7	61.9	67
Total Organic Carbon	0.02%		0.1	0.3	0.7	0.8	2.2	0.5	2.4	3.0	6.4	5.1
Exchangable Cations			All units meq/100g (except Exchangable Sodium (%))									
Exch. Calcium	0.2	-	1.6	1.8	2.7	3.8	2.7	1.5	2.4	1.7	2.4	2.2
Exch. Magnesium	0.2	-	1	0.4	0.9	1	0.8	0.6	0.6	0.6	0.9	0.4
Exch. Potassium	0.2	-	0.3	<0.2	0.3	0.3	0.3	<0.2	0.2	0.2	0.4	0.3
Exch. Sodium	0.2	-	1.7	0.9	1.5	1.6	1.6	0.6	1	0.9	1.4	1.8
Cation Exchange Capacity	0.2	-	4.6	3.3	5.4	6.8	5.5	2.9	4.3	3.5	5.1	4.6
Calcium:Magnesium Ratio	0.2	-	1.6	4.3	3	3.7	3.2	2.5	4.2	2.8	2.6	5
Magnesium:Potassium Ratio	0.2	-	3.3	-	2.8	3.7	2.7	-	2.3	2.8	2.6	1.6
Exchangable Sodium Percentage	0.2%	-	38	27.5	28.1	24.1	29.3	22.5	23.9	25.7	28	38.4

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 C4: Geochemical Abundance Index Results for Interburden and Potential Coal Reject

	RGS Sample Number →		Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6	Composite 7	Composite 8	Composite 9	Composite 10
	ALS Laboratory ID →		EB2002443005	EB2002443006	EB2002443007	EB2002443008	EB2002443009	EB2002443010	EB2002443011	EB2002443012	EB2002443013	EB2002443014
Parameters	Limit of Reporting	Median Crustal Abundance[1]	Interburden Conglomerate	Interburden Conglomerate	Interburden Sandstone	Interburden Sandstone	Interburden Siltstone	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject
Major Elements	all units in mg/kg		Geochemical Abundance Index									
Calcium (Ca)	50	15,000	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
Potassium (K)	50	14,000	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
Fluoride (F)	50	200	0	0	0	0	0	0	0	0	0	0
Major, Minor and Trace Elements	all units in mg/kg		Geochemical Abundance Index									
Aluminium (Al)	50	71,000	0	0	0	0	0	0	0	0	0	0
Antimony (Sb)	0.1	1	0	0	0	0	0	0	0	0	0	0
Arsenic (As)	0.1	6	0	0	0	0	0	0	0	0	0	0
Boron (B)	50	20	0	0	0	0	0	0	0	0	0	0
Cadmium (Cd)	0.1	0.35	0	0	0	0	0	0	0	0	0	0
Chromium (Cr) - hexavalent	0.1	70	0	0	0	0	0	0	0	0	0	0
Cobalt (Co)	0.1	8	0	0	0	0	0	0	0	0	0	0
Copper (Cu)	0.1	30	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
Lead (Pb)	0.1	35	0	0	0	0	0	0	0	0	0	0
Manganese (Mn)	0.1	1,000	0	0	0	0	0	0	0	0	0	0
Molybdenum (Mo)	2	2	0	0	0	0	0	0	0	0	0	0
Nickel (Ni)	0.1	50	0	0	0	0	0	0	0	0	0	0
Phosphorus (P)	50	800	0	0	0	0	0	0	0	0	0	0
Selenium (Se)	1	0.4	0	0	0	0	0	0	0	0	0	0
Thallium	0.1	9	0	0	0	0	0	0	0	0	0	0
Vanadium	1	90	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)	0.5	90	0	0	0	0	0	0	0	0	0	0

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

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.

Table C5: Multi-Element Test Results for Water Extracts from Interburden and Potential Coal Reject

			RGS Sample Number →	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6	Composite 7	Composite 8	Composite 9	Composite 10
			ALS Laboratory ID →	EB2002443005	EB2002443006	EB2002443007	EB2002443008	EB2002443009	EB2002443010	EB2002443011	EB2002443012	EB2002443013	EB2002443014
		Water Quality Guidelines:											
Parameters	Limit of Reporting	Aquatic Ecosystems (freshwater)[1]	Livestock Drinking Water[2]	Interburden Conglomerate	Interburden Conglomerate	Interburden Sandstone	Interburden Sandstone	Interburden Siltstone	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject	Potential Coal Reject
pH	0.01 pH unit	6 to 9	-	8.3	8.5	8.6	8.3	8.1	8.3	8.1	8.1	8.4	8.3
Electrical Conductivity	1 µS/cm	<1,000[#]	3,580[^]	648	480	522	598	701	457	534	578	490	690
Carbonate Alkalinity (mg$CaCO_3$/L)	1 mg/L	-	-	112	84	112	84	56	56	56	28	28	56
Bicarbonate Alkalinity (mg$CaCO_3$/L)	1 mg/L	-	-	1,093	2,933	997	4,167	2,077	1,150	603	490	420	4,000
Total Alkalinity (mg$CaCO_3$/L)	1 mg/L	-	-	1,207	3,020	1,110	4,233	2,133	1,207	660	520	450	4,067
Acidity (mg$CaCO_3$/L)	1 mg/L	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Net Alkalinity (mg$CaCO_3$/L)	1 mg/L	-	-	1,206	3,020	1,110	4,233	2,133	1,206	660	520	450	4,066
Major Ions		All units mg/L						All units mg/L					
Calcium (Ca)	0.3	-	1,000	1.0	3.0	1.3	1.7	0.7	0.7	0.7	0.7	1.0	0.7
Magnesium (Mg)	0.3	-	-	0.3	0.7	0.3	0.3	<0.3	<0.3	<0.3	0.3	0.3	<0.3
Potassium (K)	0.3	-	-	4.7	4.7	4.7	4.0	2.7	3.3	2.0	2.7	2.7	2.7
Sodium (Na)	0.3	-	-	50.7	31.7	35.7	36.7	36.0	28.0	28.3	21.3	11.7	40.3
Chloride (Cl)	0.3	-	-	6.0	4.0	4.3	4.7	4.7	3.3	3.7	3.7	4.0	6.7
Fluoride (F)	0.03	-	2	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Sulfate (SO_4)	0.3	-	1,000	25.0	11.0	10.0	13.7	6.7	6.3	8.3	7.3	3.7	14.7
Total Organic Carbon (TOC)	0.3	-	-	2.3	0.7	1.0	1.3	1.7	1.3	1.7	1.7	1.7	2.0
Trace Metals/Metalloids		All units mg/L						All units mg/L					
Aluminium (Al)	0.003	0.055	5	1.160	0.247	1.413	0.697	2.317	0.747	1.320	2.670	4.133	1.407
Antimony (Sb)	0.0003	-	-	0.0023	0.0020	0.0020	0.0027	0.0033	0.0017	0.0013	0.0010	0.0020	0.0023
Arsenic (As) (III)	0.0003	0.024 **	0.5	0.011	0.007	0.038	0.012	0.125	0.024	0.038	0.023	0.109	0.076
Boron (B)	0.017	0.37	5	0.123	0.153	0.123	0.153	0.197	0.127	0.193	0.223	0.180	0.167
Cadmium (Cd)	0.00003	0.0002	0.01	0.00010	0.00010	0.00013	0.00010	0.00013	0.00010	0.00013	0.00017	0.00017	0.00017
Chromium (Cr) - total	0.0003	-	1 (total)	0.0003	<0.0003	0.0007	<0.0003	0.0017	0.0007	0.0013	0.0017	0.0040	0.0010
Cobalt (Co)	0.0003	-	1	0.0007	<0.0003	0.0007	0.0010	0.0017	0.0003	0.0007	0.0007	0.0017	0.0010
Copper (Cu)	0.0003	0.0014	1	0.0010	0.0003	0.0007	0.0003	0.0013	0.0003	0.0010	0.0023	0.0040	0.0013
Iron (Fe)	0.017	-	-	0.180	0.053	0.247	0.280	0.280	0.093	0.153	1.030	0.593	0.230
Lead (Pb)	0.0003	0.0034	0.1	0.0017	<0.0003	0.0017	0.0010	0.0027	0.0007	0.0020	0.0053	0.0073	0.0023
Manganese (Mn)	0.0003	1.90	-	0.0030	0.0023	0.0033	0.0057	0.0033	0.0013	0.0017	0.0063	0.0027	0.0030
Molybdenum (Mo)	0.0003	-	0.15	0.0177	0.0203	0.0283	0.0353	0.0443	0.0333	0.0317	0.0137	0.0250	0.1273
Nickel (Ni)	0.0003	0.011	1	0.0017	0.0007	0.0017	0.0017	0.0043	0.0007	0.0020	0.0030	0.0040	0.0023
Phosphorus (P)	0.333	-	-	<0.333	<0.333	<0.333	<0.333	<0.333	<0.333	<0.333	<0.333	<0.333	<0.333
Selenium (Se)	0.003	0.011	0.02	<0.003	<0.003	<0.003	<0.003	0.007	<0.003	0.003	0.007	0.007	0.010
Thorium (Th)	0.0003	-	-	0.0007	0.0003	0.0003	0.0003	0.0007	0.0007	0.0007	0.0010	0.0010	0.0007
Uranium (U)	0.0003	-	0.2	0.0003	<0.0003	<0.0003	0.0003	<0.0003	<0.0003	<0.0003	0.0003	0.0003	<0.0003
Vanadium (V)	0.003	-	-	<0.003	<0.003	0.007	<0.003	0.017	0.023	0.027	0.013	0.067	0.030
Zinc (Zn)	0.0017	0.008	20	0.0497	0.0340	0.0480	0.0383	0.0610	0.0343	0.0643	0.1150	0.1237	0.0580

* Cr (VI) = hexavalent. ** 0.013 mg/Lfor pentavalent Arsenic (V).

for still water bodies only, moving rivers at low flow rates should not exceed 2,200µS/cm

^ 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.

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

1. ANZECC & ARMCANZ (2000). Trigger values for aquatic ecosystems (95% species protection level)

2. ANZECC & ARMCANZ (2000). Recommended guideline limits for Livestock Drinking Water.

1 + 2. both taken from the "Australian and New Zealand Guidelines for Fresh and Marine Water Quality", National Water Quality Management Strategy, 2000, compilation by ANZECC and ARMCANZ.

Table C6: Interburden and Potential Coal Reject Samples Selected for KLC Testing

Sample No.	RGS Sample ID	Drill Hole ID	ALS Sample ID	Sample Lithology	Material Type	Seam	Lithology	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]	KLC
									(m)				(µS/cm)	(%)		kg H_2SO_4/t					
								Interburden													
1	AMD001	BC2463	EB2000277002	Conglomerate	Interburden		Conglomerate	MN - VY	221.92	223.24	1.32	9.6	466	0.005		0.2	37.5	-37.3	244.9	Non-Acid Forming (Barren)	
2	AMD002	BC2463	EB2000277003	Conglomerate	Interburden		Conglomerate	MN - VY	235.02	236.91	1.89	9.7	502	0.01		0.3	27.8	-27.5	90.8	Non-Acid Forming (Barren)	
3	AMD039	BC2464	EB2000277037	Conglomerate	Interburden		Conglomerate	MN - NG	84.28	85.94	1.66	8.9	130	0.005		0.2	35.4	-35.2	231.2	Non-Acid Forming (Barren)	
4	AMD069	BC2466	EB2000277064	Conglomerate	Interburden		Conglomerate	MN - VY	157.30	158.80	1.50	8.1	478	0.05		1.5	25.9	-24.4	16.9	Non-Acid Forming (Barren)	
5	AMD011	BC2463	EB2000277010	Conglomerate	Interburden		Conglomerate	NT2 - TH	299.89	300.70	0.81	9.5	294	0.01		0.3	20.3	-20.0	66.3	Non-Acid Forming (Barren)	
6	AMD012	BC2463	EB2000277011	Conglomerate	Interburden		Conglomerate	NT2 - TH	315.67	316.22	0.55	9.6	306	0.02		0.6	24.2	-23.6	39.5	Non-Acid Forming (Barren)	
7	AMD050	BC2464	EB2000277047	Conglomerate	Interburden		Conglomerate	NT2 - TH1	141.02	141.74	0.72	8.5	64	0.005		0.2	6	-5.8	39.2	Non-Acid Forming (Barren)	
8	AMD078	BC2466	EB2000277073	Conglomerate	Interburden		Conglomerate	NT2 - TH1	224.29	224.86	0.57	9.6	449	0.01		0.3	44.1	-43.8	144.0	Non-Acid Forming (Barren)	
9	AMD056	BC2464	EB2000277053	Conglomerate	Interburden		Conglomerate	TH3 - FX	170.00	171.03	1.03	8.9	149	0.05		1.5	28.3	-26.8	18.5	Non-Acid Forming (Barren)	1 & 2
10	AMD059	BC2464	EB2000277056	Conglomerate, coal	Interburden		Conglomerate	TH3 - FX	190.93	191.98	1.05	8.8	167	0.02		0.6	39.1	-38.5	63.8	Non-Acid Forming (Barren)	
11	AMD084	BC2466	EB2000277079	Conglomerate	Interburden		Conglomerate	TH3 - FX	260.89	261.99	1.10	9.4	191	0.005		0.2	28	-27.8	182.9	Non-Acid Forming (Barren)	
12	AMD020	BC2463	EB2000277019	Conglomerate	Interburden		Conglomerate	FX - TA	355.21	355.97	0.76	9.3	260	0.005		0.2	46.8	-46.6	305.6	Non-Acid Forming (Barren)	
13	AMD027	BC2463	EB2000277025	Conglomerate	Interburden		Conglomerate	TA - TP	385.54	386.86	1.32	9.4	257	0.02		0.6	49.9	-49.3	81.5	Non-Acid Forming (Barren)	
14	AMD063	BC2464	EB2000277059	Conglomerate	Interburden		Conglomerate	TA1 - TA2	219.01	221.90	2.89	8.5	62	0.02		0.6	14	-13.4	22.9	Non-Acid Forming (Barren)	
15	AMD067	BC2464	EB2000277062	Conglomerate	Interburden		Conglomerate	TA2 - BASE	241.97	242.17	0.20	8.8	116	0.02		0.6	134	-133.4	218.8	Non-Acid Forming (Barren)	
16	AMD094	BC2466	EB2000277089	Conglomerate	Interburden		Conglomerate	TP - TAK	333.63	334.15	0.52	8.7	185	0.01		0.3	59.4	-59.1	194.0	Non-Acid Forming (Barren)	
17	AMD037	BC2463	EB2000277035	Conglomerate	Interburden		Conglomerate	KA - BASE	451.08	451.81	0.73	9.4	232	0.02		0.6	41.2	-40.6	67.3	Non-Acid Forming (Barren)	
18	AMD043	BC2464	EB2000277041	Sandstone	Interburden		Sandstone	NG - NT1	119.97	120.27	0.30	8.1	57	0.02		0.6	14.9	-14.3	24.3	Non-Acid Forming (Barren)	
19	AMD008	BC2463	EB2000277007	Sandstone	Interburden		Sandstone	NT1 - NT2	277.49	278.30	0.81	9.3	100	0.005		0.2	18.1	-17.9	118.2	Non-Acid Forming (Barren)	
20	AMD009	BC2463	EB2000277008	Sandstone	Interburden		Sandstone	NT1 - NT2	287.95	289.33	1.38	9.4	135	0.02		0.6	20.7	-20.1	33.8	Non-Acid Forming (Barren)	
21	AMD013	BC2463	EB2000277012	Sandstone	Interburden		Sandstone	NT2 - TH	331.50	331.97	0.47	9.3	99	0.02		0.6	20.9	-20.3	34.1	Non-Acid Forming (Barren)	
22	AMD047	BC2464	EB2000277045	Sandstone	Interburden		Sandstone	NT1 - NT2	126.06	127.20	1.14	8.3	64	0.02		0.6	16.8	-16.2	27.4	Non-Acid Forming (Barren)	
23	AMD051	BC2464	EB2000277048	Sandstone	Interburden		Sandstone	NT2 - TH1	143.68	144.25	0.57	8.9	172	0.02		0.6	57	-56.4	93.1	Non-Acid Forming (Barren)	
24	AMD075	BC2466	EB2000277070	Sandstone	Interburden		Sandstone	NT1 - NT2	200.17	200.91	0.74	9.4	242	0.005		0.2	75.9	-75.7	495.7	Non-Acid Forming (Barren)	
25	AMD079	BC2466	EB2000277074	Sandstone	Interburden		Sandstone	NT2 - TH1	241.07	242.34	1.27	9.7	314	0.005		0.2	33.8	-33.6	220.7	Non-Acid Forming (Barren)	
26	AMD057	BC2464	EB2000277054	Sandstone	Interburden		Sandstone	TH3 - FX	178.30	179.02	0.72	9.0	125	0.005		0.2	184	-183.8	1201.6	Non-Acid Forming (Barren)	
27	AMD058	BC2464	EB2000277055	Sandstone	Interburden		Sandstone	TH3 - FX	187.37	188.12	0.75	8.5	263	0.03		0.9	24.8	-23.9	27.0	Non-Acid Forming (Barren)	
28	AMD021	BC2463	EB2000277020	Sandstone	Interburden		Sandstone	FX - TA	358.38	358.96	0.58	9.2	276	0.04		1.2	26.1	-24.9	21.3	Non-Acid Forming (Barren)	
29	AMD023	BC2463	EB2000277022	Sandstone	Interburden		Sandstone	FX - TA	367.84	368.52	0.68	9.3	340	0.01		0.3	203	-202.7	662.9	Non-Acid Forming (Barren)	
30	AMD087	BC2466	EB2000277082	Sandstone	Interburden		Sandstone	FX - TA	280.33	281.70	1.37	8.7	158	0.01		0.3	42.4	-42.1	138.4	Non-Acid Forming (Barren)	
31	AMD029	BC2463	EB2000277027	Sandstone	Interburden		Sandstone	TA - TP	395.89	396.54	0.65	9.6	252	0.005		0.2	24.9	-24.7	162.6	Non-Acid Forming (Barren)	3 & 4
32	AMD090	BC2466	EB2000277085	Sandstone	Interburden		Sandstone	TA - TP	308.93	310.48	1.55	9.1	160	0.005		0.2	23.8	-23.6	155.4	Non-Acid Forming (Barren)	
33	AMD032	BC2463	EB2000277030	Sandstone	Interburden		Sandstone	TP - TAK	423.09	424.27	1.18	9.5	258	0.02		0.6	27.3	-26.7	44.6	Non-Acid Forming (Barren)	
34	AMD093	BC2466	EB2000277088	Sandstone	Interburden		Sandstone	TP - TAK	329.95	330.57	0.62	8.6	86	0.02		0.6	20.9	-20.3	34.1	Non-Acid Forming (Barren)	
35	AMD040	BC2464	EB2000277038	Carbonaceous siltstone/sandstone, coal	Interburden		Siltstone	MN - NG	93.45	94.15	0.70	8.0	54	0.04		1.2	11.4	-10.2	9.3	Non-Acid Forming (Barren)	
36	AMD044	BC2464	EB2000277042	Siltstone	Interburden		Siltstone	NG - NT1	121.40	121.91	0.51	8.1	64	0.02		0.6	15.7	-15.1	25.6	Non-Acid Forming (Barren)	
37	AMD016	BC2463	EB2000277015	Siltstone, coal, carbonaceous mudstone	Interburden		Siltstone	TH - FX	340.83	341.18	0.35	9.1	106	0.01		0.3	16.8	-16.5	54.9	Non-Acid Forming (Barren)	
38	AMD017	BC2463	EB2000277016	Siltstone	Interburden		Siltstone	TH - FX	347.91	348.56	0.65	9.1	117	0.02		0.6	17.8	-17.2	29.1	Non-Acid Forming (Barren)	
39	AMD022	BC2463	EB2000277021	Siltstone	Interburden		Siltstone	FX - TA	366.42	366.83	0.41	9.3	244	0.02		0.6	35	-34.4	57.1	Non-Acid Forming (Barren)	
40	AMD024	BC2463	EB2000277023	Siltstone	Interburden		Siltstone	FX - TA	370.88	371.16	0.28	9.3	168	0.01		0.3	26.6	-26.3	86.9	Non-Acid Forming (Barren)	
41	AMD028	BC2463	EB2000277026	Siltstone	Interburden		Siltstone	TA - TP	391.66	392.10	0.44	9.3	134	0.02		0.6	19.8	-19.2	32.3	Non-Acid Forming (Barren)	
42	AMD066	BC2464	EB2000277061	Carbonaceous siltstone	Interburden		siltstone	TA2 - BASE	237.19	237.57	0.38	8.6	170	0.05		1.5	14.4	-12.9	9.4	Non-Acid Forming (Barren)	
43	AMD033	BC2463	EB2000277031	Siltstone	Interburden		Siltstone	TP - TAK	437.43	437.84	0.41	10.1	539	0.005		0.2	193	-192.8	1260.4	Non-Acid Forming (Barren)	
44	AMD097	BC2466	EB2000277092	Carbonaceous mudstone	Interburden		Siltstone	KA - BASE	359.87	360.28	0.41	7.9	425	0.04		1.2	55.6	-54.4	45.4	Non-Acid Forming (Barren)	

Table C6: Interburden and Potential Coal Reject Samples Selected for KLC Testing

Sample No.	RGS Sample ID	Drill Hole ID	ALS Sample ID	Sample Lithology	Material Type	Seam	Lithology	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]	KLC
								Potential Coal Reject													
45	AMD052	BC2464	EB2000277049	Conglomerate	Roof	TH	Conglomerate	NT2 - TH1	156.01	157.47	1.46	9.0	138	0.01		0.3	27.5	-27.2	89.8	Non-Acid Forming (Barren)	
46	AMD080	BC2466	EB2000277075	Conglomerate, sandstone	Roof	TH	Conglomerate	NT2 - TH1	248.84	250.09	1.25	8.8	85	0.02		0.6	11.8	-11.2	19.3	Non-Acid Forming (Barren)	
47	AMD000	BC2463	EB2000277001	Sandstone, siltstone, carbonaceous mudstone	Floor	MN	Sandstone	MN - VY	208.84	209.74	0.90	9.1	80	0.02		0.6	11	-10.4	18.0	Non-Acid Forming (Barren)	
48	AMD038	BC2464	EB2000277036	Sandstone	Floor	MN	Sandstone	MN - NG	75.92	76.37	0.45	7.5	30	0.005		0.2	6.5	-6.3	42.4	Non-Acid Forming (Barren)	
49	AMD068	BC2466	EB2000277063	Sandstone, siltstone, carbonaceous siltstone	Floor	MN	Sandstone	MN - VY	144.26	144.94	0.68	8.4	37	0.005		0.2	9.5	-9.3	62.0	Non-Acid Forming (Barren)	
50	AMD003	BC2463	EB2000277004	Sandstone, siltstone	Roof	VY	Sandstone	MN - VY	267.09	267.65	0.56	9.5	268	0.005		0.2	18.7	-18.5	122.1	Non-Acid Forming (Barren)	
51	AMD042	BC2464	EB2000277040	Sandstone, siltstone	Floor	NG	Sandstone	NG - NT1	118.24	119.23	0.99	8.3	76	0.005		0.2	15.6	-15.4	101.9	Non-Acid Forming (Barren)	
52	AMD072	BC2466	EB2000277067	Sandstone	Roof	NT	Sandstone	NG - NTR	192.21	192.65	0.44	9.1	219	0.005		0.2	23.1	-22.9	150.9	Non-Acid Forming (Barren)	
53	AMD053	BC2464	EB2000277050	Sandstone, siltstone, carbonaceous siltstone	Floor	TH	Sandstone	TH1 - TH2	157.95	158.69	0.74	8.4	49	0.02		0.6	19.4	-18.8	31.7	Non-Acid Forming (Barren)	
54	AMD055	BC2464	EB2000277052	Sandstone, siltstone	Roof	TH	Sandstone	TH3 - FX	160.72	161.12	0.40	8.4	38	0.01		0.3	11.2	-10.9	36.6	Non-Acid Forming (Barren)	
55	AMD081	BC2466	EB2000277076	Sandstone, siltstone	Floor	TH	Sandstone	TH1 - TH2	250.95	251.70	0.75	8.8	64	0.03		0.9	19.7	-18.8	21.4	Non-Acid Forming (Barren)	
56	AMD082	BC2466	EB2000277077	Sandstone, siltstone, carbonaceous siltstone	Floor	TH	Sandstone	TH2 - TH3	252.00	252.70	0.70	8.8	60	0.02		0.6	21.2	-20.6	34.6	Non-Acid Forming (Barren)	
57	AMD062	BC2464	EB2000277058	Sandstone	Floor	TA	Sandstone	TA1 - TA2	202.48	203.26	0.78	8.7	105	0.005		0.2	34.4	-34.2	224.7	Non-Acid Forming (Barren)	
58	AMD089	BC2466	EB2000277084	Sandstone	Floor	TA	Sandstone	TA - TP	294.66	294.99	0.33	8.8	52	0.005		0.2	11.6	-11.4	75.8	Non-Acid Forming (Barren)	
59	AMD030	BC2463	EB2000277028	Sandstone, siderite	Roof	TP	Sandstone	TA - TP	408.25	408.89	0.64	9.5	270	0.01		0.3	34.5	-34.2	112.7	Non-Acid Forming (Barren)	
60	AMD091	BC2466	EB2000277086	Sandstone	Roof	TP	Sandstone	TA - TP	322.33	322.56	0.23	8.2	142	0.16	0.076	2.3	12.8	-10.5	5.5	Non-Acid Forming (Barren)	
61	AMD092	BC2466	EB2000277087	Sandstone, carbonaceous mudstone	Floor	TP	Sandstone	TP - TAK	325.51	325.73	0.22	8.5	41	0.005		0.2	10.4	-10.2	67.9	Non-Acid Forming (Barren)	
62	AMD036	BC2463	EB2000277034	Carbonaceous sandstone/mudstone, carbonate	Floor	KAZ	Sandstone	KA - BASE	445.59	446.16	0.57	8.8	244	0.1		3.1	22.4	-19.3	7.3	Non-Acid Forming (Barren)	
63	AMD070	BC2466	EB2000277065	Siltstone	Roof	VY	Siltstone	MN - VY	185.17	185.43	0.26	9.2	58	0.005		0.2	12.4	-12.2	81.0	Non-Acid Forming (Barren)	
64	AMD041	BC2464	EB2000277039	Siltstone, carbonaceous mudstone, coal	Roof	NG	Siltstone	MN - NG	116.59	116.95	0.36	7.9	75	0.02		0.6	28.6	-28.0	46.7	Non-Acid Forming (Barren)	
65	AMD071	BC2466	EB2000277066	Carbonaceous siltstone, coal	Floor	NG	Siltstone	NG - NTR	189.09	189.27	0.18	8.6	60	0.04		1.2	11.4	-10.2	9.3	Non-Acid Forming (Barren)	
66	AMD005	BC2463	EB2000277005	Carbonaceous siltstone, coal	Floor	NG	Siltstone	NG - NT1	272.36	272.62	0.26	9.0	76	0.02		0.6	14.7	-14.1	24.0	Non-Acid Forming (Barren)	
67	AMD007	BC2463	EB2000277006	Siltstone, sandstone, coal	Roof	NT	Siltstone	NT1 - NT2	275.75	276.32	0.57	9.4	107	0.01		0.3	16.1	-15.8	52.6	Non-Acid Forming (Barren)	
68	AMD010	BC2463	EB2000277009	Carbonaceous siltstone, coal, sandstone	Floor	NT	Siltstone	NT2 - TH	292.48	292.86	0.38	8.9	166	0.02		0.6	27.5	-26.9	44.9	Non-Acid Forming (Barren)	
69	AMD045	BC2464	EB2000277043	Siltstone, carbonaceous mudstone	Roof	NT	Siltstone	NG - NT1	122.69	122.82	0.13	8.1	143	0.03		0.9	30.7	-29.8	33.4	Non-Acid Forming (Barren)	5 & 6
70	AMD046	BC2464	EB2000277044	Siltstone, carbonaceous mudstone	Floor	NT	Siltstone	NT1 - NT2	124.13	124.32	0.19	7.9	70	0.07		2.1	11	-8.9	5.1	Non-Acid Forming (Barren)	
71	AMD048	BC2464	EB2000277046	Siltstone, siderite, sandstone	Roof	NT	Siltstone	NT1 - NT2	129.38	130.57	1.19	8.8	184	0.06		1.8	37.5	-35.7	20.4	Non-Acid Forming (Barren)	
72	AMD073	BC2466	EB2000277068	Siltstone	Roof	NT	Siltstone	NTR - NT1	192.85	193.19	0.34	8.4	77	0.02		0.6	31.4	-30.8	51.3	Non-Acid Forming (Barren)	
73	AMD074	BC2466	EB2000277069	Carbonaceous siltstone	Floor	NT	Siltstone	NT1 - NT2	194.57	195.09	0.52	9.0	61	0.02		0.6	12.7	-12.1	20.7	Non-Acid Forming (Barren)	
74	AMD076	BC2466	EB2000277071	Carbonaceous siltstone, siltstone	Roof	NT	Siltstone	NT1 - NT2	204.89	205.09	0.20	9.1	85	0.01		0.3	11.7	-11.4	38.2	Non-Acid Forming (Barren)	
75	AMD077	BC2466	EB2000277072	Siltstone, sandstone, carbonaceous siltstone	Floor	NT	Siltstone	NT2 - TH1	206.11	206.59	0.48	9.0	71	0.01		0.3	13.9	-13.6	45.4	Non-Acid Forming (Barren)	
76	AMD014	BC2463	EB2000277013	Siltstone	Roof	TH	Siltstone	NT2 - TH	335.05	335.50	0.45	9.3	110	0.02		0.6	13.5	-12.9	22.0	Non-Acid Forming (Barren)	
77	AMD015	BC2463	EB2000277014	Carbonaceous siltstone, sandstone	Floor	TH	Siltstone	TH - FX	339.44	339.49	0.05	9.2	99	0.01		0.3	14.6	-14.3	47.7	Non-Acid Forming (Barren)	
78	AMD054	BC2464	EB2000277051	Carbonaceous siltstone, siltstone	Roof	TH	Siltstone	TH2 - TH3	158.99	159.43	0.44	8.4	54	0.02		0.6	13.5	-12.9	22.0	Non-Acid Forming (Barren)	
79	AMD083	BC2466	EB2000277078	Siltstone	Floor	TH	Siltstone	TH3 - FX	254.06	254.22	0.16	8.8	49	0.005		0.2	12.9	-12.7	84.2	Non-Acid Forming (Barren)	
80	AMD018	BC2463	EB2000277017	Siltstone	Roof	FX	Siltstone	TH - FX	348.57	349.05	0.48	9.2	124	0.01		0.3	12.9	-12.6	42.1	Non-Acid Forming (Barren)	
81	AMD019	BC2463	EB2000277018	Siltstone, carbonaceous mudstone	Floor	FX	Siltstone	FX - TA	350.39	350.53	0.14	9.3	101	0.02		0.6	15.2	-14.6	24.8	Non-Acid Forming (Barren)	
82	AMD085	BC2466	EB2000277080	Siltstone, coal, carbonaceous siltstone	Roof	FX	Siltstone	TH3 - FX	265.40	265.73	0.33	7.8	89	0.16	0.021	0.6	13.9	-13.3	21.6	Non-Acid Forming (Barren)	
83	AMD086	BC2466	EB2000277081	Siltstone, carbonaceous siltstone	Floor	FX	Siltstone	FX - TA	267.96	268.15	0.19	9.0	60	0.01		0.3	13.1	-12.8	42.8	Non-Acid Forming (Barren)	
84	AMD061	BC2464	EB2000277057	Siltstone, sandstone, carbonaceous siltstone	Roof	FX	Siltstone	FX - TA1	198.26	199.39	1.13	8.2	65	0.02		0.6	14	-13.4	22.9	Non-Acid Forming (Barren)	
85	AMD026	BC2463	EB2000277024	Siltstone, sandstone	Floor	TA	Siltstone	TA - TP	379.98	380.19	0.21	9.1	108	0.005		0.2	13.6	-13.4	88.8	Non-Acid Forming (Barren)	
86	AMD065	BC2464	EB2000277060	Carbonaceous siltstone/mudstone	Floor	TA	siltstone	TA2 - BASE	225.22	225.90	0.68	7.2	99	0.03		0.9	12.4	-11.5	13.5	Non-Acid Forming (Barren)	
87	AMD088	BC2466	EB2000277083	Carbonaceous siltstone, siltstone, sandstone	Roof	TA	Siltstone	FX - TA	290.86	291.36	0.50	8.3	74	0.04		1.2	11.9	-10.7	9.7	Non-Acid Forming (Barren)	
88	AMD031	BC2463	EB2000277029	Carbonaceous siltstone, mudstone, coal	Floor	TP	Siltstone	TP - TAK	412.29	412.55	0.26	9.3	260	0.02		0.6	25.4	-24.8	41.5	Non-Acid Forming (Barren)	
89	AMD034	BC2463	EB2000277032	Siltstone, coal, carbonaceous siltstone	Roof	TAK	Siltstone	TP - TAK	440.65	441.04	0.39	9.9	286	0.005		0.2	24.1	-23.9	157.4	Non-Acid Forming (Barren)	
90	AMD095	BC2466	EB2000277090	Siltstone	Roof	TAK	Siltstone	TP - TAK	349.12	349.85	0.73	7.5	272	0.84	0.593	18.2	17.2	1.0	0.9	Uncertain	
91	AMD035	BC2463	EB2000277033	Carbonaceous siltstone, coal	Roof	TAK	Siltstone	TAK - KA	443.54	444.29	0.75	9.1	95	0.05		1.5	18.3	-16.8	12.0	Non-Acid Forming (Barren)	
92	AMD096	BC2466	EB2000277091	Calcrete, carbonaceous mudstone	Floor	KAZ	Siltstone	KA - BASE	353.59	353.82	0.23	8.3	319	0.7	0.396	12.1	406	-393.9	33.5	Non-Acid Forming	

Notes
1. Current pH, EC, Alkalinity and Acidity provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; 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 .

Attachment D Kinetic Geochemical Test Results

KLC 1 - Conglomerate - Saturated

Weight (kg)	12.00	Total S (%)	0.017	ANC	38.9
pH (1:5)	9.30	Scr (%)	0.017	NAPP	-38.4
EC (µS/cm)	253	MPA	0.5	ANC:MPA	74.7

Date			27-Feb-20	26-Mar-20	30-Apr-20	28-May-20	25-Jun-20	30-Jul-20	28-Aug-20
Number of Weeks			0	4	9	13	17	22	26
Leach Number			1	2	3	4	5	6	7
ALS Laboratory Number			EB2005519001	EB2008519001	EB2011635002	EB2014216001	EB2016805001	EB2020005001	EB2022571001
Volume On (L)			13.2	1.0	1.0	1.0	1.1	1.2	1.2
Volume Off (L)			0.888	0.987	0.998	0.989	1.070	1.080	1.050
Cumulative Volume Off (L)			0.89	1.9	2.9	3.9	4.9	6.0	7.1
Pore Volumes			0.7	1.4	2.1	2.9	3.7	4.5	5.2
pH (RGS Measurement)			8.88	8.85	8.76	8.84	8.70	8.69	8.83
pH (ALS Measurement)			8.70	8.67	8.61	8.73	8.69	8.70	8.66
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			1,009	1,350	1,418	1,257	1,020	810	977
EC (ALS Measurement) (µS/cm)			1,020	1,360	1,360	1,240	1,080	1,000	921
Acidity (mg/L)*			<1	<1	<1	<1	2	<1	<1
Alkalinity (mg/L)*			190	386	466	485	447	446	435
Net Alkalinity (mg/L)*			190	386	466	485	445	446	435
Major Ions (mg/L)	**LoR**	**WQ Guidelines[#] (mg/L)**	(mg/L)						
Calcium (Ca)	1	1,000	4	4	4	4	3	3	3
Potassium (K)	1	-	6	6	6	4	3	3	4
Magnesium (Mg)	1	-	2	2	2	2	1	1	1
Sodium (Na)	1	-	223	315	316	294	260	262	222
Chloride (Cl)	1	-	15	12	12	11	9	8	7
Fluoride (F)	0.1	2	1.9	2.0	1.9	1.6	1.6	1.7	1.8
Sulfate (SO_4)	1	1,000	228	278	190	154	108	79	68
Trace metals/ metalloids	**LoR**	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	1.04	0.11	0.07	0.04	0.06	0.09	0.11
Arsenic (As)	0.001	0.5	0.17	0.15	0.144	0.12	0.106	0.106	0.107
Cadmium (Cd)	0.0001	0.01	0.0002	0.0005	0.0004	0.0004	0.0003	<0.0001	0.0001
Cobalt (Co)	0.001	1	0.004	0.004	0.003	0.002	0.001	0.001	<0.001
Chromium (Cr)	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	0.001	1	0.002	<0.001	0.006	<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
Lithium (Li)	0.001	-	0.007	0.010	0.010	0.009	0.008	0.007	0.007
Manganese (Mn)	0.001	2	0.001	0.002	0.003	0.002	0.002	0.002	0.002
Molybdenum (Mo)	0.001	0.15	0.680	0.975	0.850	0.648	0.413	0.273	0.180
Nickel (Ni)	0.001	1	0.01	0.008	0.006	0.005	0.003	0.003	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	-	0.03	0.011	0.004	0.003	0.002	0.002	0.002
Selenium (Se)	0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium (Sr)	0.01	-	0.100	0.130	0.112	0.108	0.098	0.087	0.077
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			17	23	16	13	10	7	6
Cumulative SO_4 Release			17	40	56	68	78	85	91
Ca Release Rate			0.30	0.33	0.33	0.33	0.27	0.27	0.26
Cumulative Ca Release			0.30	0.63	0.96	1.29	1.55	1.82	2.09
Mg Release Rate			0.15	0.16	0.17	0.16	0.09	0.09	0.09
Cumulative Mg Release			0.15	0.31	0.48	0.64	0.73	0.82	0.91
Residual ANC (%)			100.00	99.99	99.99	99.99	99.98	99.98	99.98
Residual Sulfur (%)			96.7	92.2	89.1	86.6	84.7	83.3	82.2
SO_4/(Ca+Mg) molar ratio			13.0	15.9	10.9	8.8	9.7	7.1	6.1

< 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).

KLC 2 - Conglomerate - Free Leach

Weight (kg)	12.00	Total S (%)	0.017	ANC	38.9
pH (1:5)	9.30	Scr (%)	0.017	NAPP	-38.4
EC (µS/cm)	253	MPA	0.5	ANC:MPA	74.7

Date			27-Feb-20	26-Mar-20	30-Apr-20	28-May-20	25-Jun-20	30-Jul-20	28-Aug-20
Number of Weeks			0	4	9	13	17	22	26
Leach Number			1	2	3	4	5	6	7
ALS Laboratory Number			EB2005519002	EB2008519002	EB2011635002	EB2014216002	EB2016805002	EB2020005002	EB2022571002
Volume On (L)			2.4	1.4	1.4	1.4	1.4	1.4	1.4
Volume Off (L)			0.336	0.599	0.477	0.410	0.816	0.882	0.914
Cumulative Volume Off (L)			0.34	0.9	1.4	1.8	2.6	3.5	4.4
Pore Volumes			0.2	0.7	1.0	1.3	2.0	2.6	3.3
pH (RGS Measurement)			9.26	9.05	8.99	8.88	8.93	8.98	8.59
pH (ALS Measurement)			8.76	8.76	8.69	8.67	8.80	8.78	8.53
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			797	1,017	1,051	841	798	657	967
EC (ALS Measurement) (µS/cm)			818	1,050	1,040	828	883	818	918
Acidity (mg/L)*			<1	<1	<1	<1	<1	<1	<1
Alkalinity (mg/L)*			165	184	188	178	212	207	221
Net Alkalinity (mg/L)*			165	184	188	178	212	207	221
Major Ions (mg/L)	**LoR**	**WQ Guidelines# (mg/L)**	(mg/L)						
Calcium (Ca)	1	1,000	4	4	4	4	4	3	5
Potassium (K)	1	-	6	4	3	3	3	4	4
Magnesium (Mg)	1	-	2	2	2	1	2	1	2
Sodium (Na)	1	-	170	228	215	174	188	192	205
Chloride (Cl)	1	-	15	10	8	5	4	3	4
Fluoride (F)	0.1	2	1.7	1.9	1.7	1.2	1.2	1.2	1.4
Sulfate (SO_4)	1	1,000	173	287	238	180	174	154	194
Trace metals/ metalloids	**LoR**	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	1.14	0.78	0.2	0.76	0.77	1.28	0.87
Arsenic (As)	0.001	0.5	0.104	0.103	0.075	0.046	0.039	0.039	0.034
Cadmium (Cd)	0.0001	0.01	0.0001	0.0002	0.0001	<0.0001	<0.0001	0.0002	0.0001
Cobalt (Co)	0.001	1	0.002	0.003	0.002	0.002	0.002	0.002	0.002
Chromium (Cr)	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	0.004
Iron (Fe)	0.05	1	<0.05	<0.05	<0.05	<0.05	0.05	0.09	0.06
Lithium (Li)	0.001	-	0.006	0.009	0.009	0.007	0.007	0.007	0.008
Manganese (Mn)	0.001	2	<0.001	0.002	0.002	0.002	0.001	0.001	<0.001
Molybdenum (Mo)	0.001	0.15	0.434	0.460	0.308	0.140	0.100	0.090	0.103
Nickel (Ni)	0.001	1	0.007	0.009	0.006	0.004	0.004	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	-	0.019	0.058	0.038	0.026	0.014	0.013	0.013
Selenium (Se)	0.01	0.02	0.02	0.03	0.02	0.02	0.02	0.01	0.02
Strontium (Sr)	0.01	-	0.084	0.085	0.084	0.074	0.088	0.079	0.098
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	0.006	<0.005	0.006	0.009
Calculations**									
SO_4 Release Rate			5	14	9	6	12	11	15
Cumulative SO_4 Release			5	19	29	35	47	58	73
Ca Release Rate			0.11	0.20	0.16	0.14	0.27	0.22	0.38
Cumulative Ca Release			0.11	0.31	0.47	0.61	0.88	1.10	1.48
Mg Release Rate			0.06	0.10	0.08	0.03	0.14	0.07	0.15
Cumulative Mg Release			0.06	0.16	0.24	0.27	0.41	0.48	0.63
Residual ANC (%)			100.00	100.00	99.99	99.99	99.99	99.99	99.98
Residual Sulfur (%)			99.0	96.2	94.4	93.2	90.8	88.6	85.7
SO_4/(Ca+Mg) molar ratio			9.9	16.4	13.6	13.3	9.9	13.8	9.8

< 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).

KLC 3 - Sandstone/Siltstone - Saturated

Weight (kg)	12.00	**Total S (%)**	0.015	**ANC**	49.1
pH (1:5)	9.10	**Scr (%)**	0.015	**NAPP**	-48.6
EC (µS/cm)	182	**MPA**	0.5	**ANC:MPA**	106.9

Date			**27-Feb-20**	**26-Mar-20**	**30-Apr-20**	**28-May-20**	**25-Jun-20**	**30-Jul-20**	**28-Aug-20**
Number of Weeks			**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number			**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number			EB2005519003	EB2008519003	EB2011635003	EB2014216003	EB2016805003	EB2020005003	EB2022571003
Volume On (L)			13.2	1.0	1.0	1.0	1.1	1.2	1.4
Volume Off (L)			1.078	0.946	1.085	0.986	1.081	1.080	1.041
Cumulative Volume Off (L)			1.08	2.0	3.1	4.1	5.2	6.3	7.3
Pore Volumes			0.8	1.5	2.3	3.0	3.8	4.6	5.4
pH (RGS Measurement)			9.00	8.80	8.46	8.66	8.53	8.42	8.51
pH (ALS Measurement)			8.94	8.58	8.39	8.68	8.42	8.56	8.58
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			707	900	1,044	992	870	735	912
EC (ALS Measurement) (µS/cm)			741	963	1,020	994	937	927	884
Acidity (mg/L)*			<1	<1	<1	<1	<1	<1	<1
Alkalinity (mg/L)*			216	353	439	472	465	499	450
Net Alkalinity (mg/L)*			216	353	439	472	465	499	450
Major Ions (mg/L)	**LoR**	**WQ Guidelines# (mg/L)**	(mg/L)						
Calcium (Ca)	1	1,000	4	5	6	5	5	6	6
Potassium (K)	1	-	5	5	4	4	4	4	4
Magnesium (Mg)	1	-	1	2	2	2	2	2	2
Sodium (Na)	1	-	157	221	241	233	226	244	211
Chloride (Cl)	1	-	18	13	11	10	8	6	5
Fluoride (F)	0.1	2	3.7	4.4	3.2	2.7	3.0	3.0	3.0
Sulfate (SO_4)	1	1,000	108	110	74	55	39	29	26
Trace metals/ metalloids	**LoR**	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	0.92	0.46	0.07	0.03	0.02	0.02	0.04
Arsenic (As)	0.001	0.5	0.563	0.158	0.102	0.08	0.067	0.066	0.068
Cadmium (Cd)	0.0001	0.01	0.0001	0.0003	0.0003	0.0002	0.0002	<0.0001	0.0001
Cobalt (Co)	0.001	1	0.002	0.002	0.002	0.001	0.001	<0.001	<0.001
Chromium (Cr)	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
Lithium (Li)	0.001	-	0.019	0.044	0.061	0.063	0.056	0.070	0.063
Manganese (Mn)	0.001	2	<0.001	0.002	0.004	0.004	0.004	0.005	0.005
Molybdenum (Mo)	0.001	0.15	0.453	0.641	0.552	0.416	0.275	0.240	0.173
Nickel (Ni)	0.001	1	0.009	0.007	0.006	0.005	0.005	0.004	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	-	0.033	0.018	0.005	0.003	0.001	0.002	0.002
Selenium (Se)	0.01	0.02	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium (Sr)	0.01	-	0.097	0.145	0.156	0.160	0.176	0.180	0.170
Vanadium	0.01	-	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	0.005	20	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**									
SO_4 Release Rate			10	9	7	5	4	3	2
Cumulative SO_4 Release			10	18	25	30	33	36	38
Ca Release Rate			0.36	0.39	0.54	0.41	0.45	0.54	0.52
Cumulative Ca Release			0.36	0.75	1.30	1.71	2.16	2.70	3.22
Mg Release Rate			0.09	0.16	0.18	0.16	0.18	0.18	0.17
Cumulative Mg Release			0.09	0.25	0.43	0.59	0.77	0.95	1.13
Residual ANC (%)			100.00	99.99	99.99	99.99	99.98	99.98	99.97
Residual Sulfur (%)			97.8	95.9	94.4	93.4	92.6	92.1	91.6
SO_4/(Ca+Mg) molar ratio			8.0	5.5	3.3	2.8	2.0	1.3	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.

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KLC 4 - Sandstone/Siltstone - Free Leach

Weight (kg)	12.00	**Total S (%)**	0.015	**ANC**	49.1
pH (1:5)	9.10	**Scr (%)**	0.015	**NAPP**	-48.6
EC (µS/cm)	182	**MPA**	0.5	**ANC:MPA**	106.9

Date			**27-Feb-20**	**26-Mar-20**	**30-Apr-20**	**28-May-20**	**25-Jun-20**	**30-Jul-20**	**28-Aug-20**
Number of Weeks			**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number			**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number			EB2005519004	EB2008519004	EB2011635004	EB2014216004	EB2016805004	EB2020005004	EB2022571004
Volume On (L)			2.4	1.4	1.4	1.4	1.4	1.4	1.4
Volume Off (L)			0.383	0.963	0.995	0.895	1.036	0.982	0.960
Cumulative Volume Off (L)			0.38	1.3	2.3	3.2	4.3	5.3	6.2
Pore Volumes			0.3	1.0	1.7	2.4	3.2	3.9	4.6
pH (RGS Measurement)			9.38	8.93	8.83	8.82	8.92	8.86	8.85
pH (ALS Measurement)			8.74	8.67	8.61	8.66	8.72	8.66	8.59
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			466	859	895	793	584	463	577
EC (ALS Measurement) (µS/cm)			508	891	875	795	638	579	554
Acidity (mg/L)*			<1	<1	<1	<1	<1	<1	<1
Alkalinity (mg/L)*			168	234	224	211	173	180	187
Net Alkalinity (mg/L)*			168	234	224	211	173	180	187
Major Ions (mg/L)	**LoR**	**WQ Guidelines# (mg/L)**	(mg/L)						
Calcium (Ca)	1	1,000	4	4	5	5	4	4	4
Potassium (K)	1	-	4	5	4	4	3	3	4
Magnesium (Mg)	1	-	0.5	1	2	2	1	1	1
Sodium (Na)	1	-	106	192	185	168	138	137	123
Chloride (Cl)	1	-	11	16	10	5	3	2	2
Fluoride (F)	0.1	2	1.9	4.3	3.8	3.1	2.2	1.8	2.1
Sulfate (SO_4)	1	1,000	62	162	141	125	92	78	76
Trace metals/ metalloids	**LoR**	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	1.09	1.15	1.06	0.52	0.81	0.71	0.46
Arsenic (As)	0.001	0.5	0.27	0.185	0.099	0.056	0.036	0.03	0.028
Cadmium (Cd)	0.0001	0.01	<0.0001	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt (Co)	0.001	1	0.001	0.002	0.002	0.001	0.001	0.001	<0.001
Chromium (Cr)	0.001	1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	0.001	1	<0.001	0.002	0.002	0.001	0.002	0.002	0.001
Iron (Fe)	0.05	1	0.06	0.08	0.09	0.05	0.08	0.07	0.05
Lithium (Li)	0.001	-	0.012	0.035	0.042	0.042	0.035	0.035	0.034
Manganese (Mn)	0.001	2	0.001	0.002	0.003	0.003	0.001	<0.001	<0.001
Molybdenum (Mo)	0.001	0.15	0.188	0.446	0.219	0.091	0.043	0.032	0.025
Nickel (Ni)	0.001	1	0.006	0.011	0.007	0.004	0.004	0.004	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	-	0.014	0.044	0.033	0.025	0.012	0.013	0.012
Selenium (Se)	0.01	0.02	0.03	0.09	0.07	0.06	0.04	0.03	0.03
Strontium (Sr)	0.01	-	0.070	0.122	0.123	0.125	0.113	0.107	0.108
Vanadium	0.01	-	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	0.005	20	<0.005	0.007	0.008	0.006	0.006	0.006	0.010
Calculations**									
SO_4 Release Rate			2.0	13.0	11.7	9.3	7.9	6.4	6.1
Cumulative SO_4 Release			2.0	15.0	26.7	36.0	43.9	50.3	56.4
Ca Release Rate			0.13	0.32	0.41	0.37	0.35	0.33	0.32
Cumulative Ca Release			0.13	0.45	0.86	1.24	1.58	1.91	2.23
Mg Release Rate			0.02	0.08	0.17	0.15	0.09	0.08	0.08
Cumulative Mg Release			0.02	0.10	0.26	0.41	0.50	0.58	0.66
Residual ANC (%)			100.00	99.99	99.99	99.98	99.98	99.97	99.97
Residual Sulfur (%)			99.9	99.1	98.4	97.9	97.4	97.1	96.7
SO_4/(Ca+Mg) molar ratio			5.4	12.0	7.1	6.3	6.8	5.8	5.6

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

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

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KLC 5 - Potential Rejects - Saturated

Weight (kg)	12.00	Total S (%)	0.057	ANC	25.7
pH (1:5)	8.80	Scr (%)	0.057	NAPP	-24.0
EC (µS/cm)	115	MPA	1.7	ANC:MPA	14.7

Date			27-Feb-20	26-Mar-20	30-Apr-20	28-May-20	25-Jun-20	30-Jul-20	28-Aug-20
Number of Weeks			0	4	9	13	17	22	26
Leach Number			1	2	3	4	5	6	7
ALS Laboratory Number			EB2005519005	EB2008519005	EB2011635005	EB2014216005	EB2016805005	EB2020005005	EB2022571005
Volume On (L)			12.4	1.0	1.0	1.0	1.0	1.2	1.1
Volume Off (L)			0.964	0.915	1.005	0.992	1.031	1.029	1.049
Cumulative Volume Off (L)			0.96	1.9	2.9	3.9	4.9	5.9	7.0
Pore Volumes			0.7	1.4	2.1	2.9	3.6	4.4	5.2
pH (RGS Measurement)			8.73	8.69	8.57	8.57	8.61	8.51	8.49
pH (ALS Measurement)			8.24	8.51	8.45	8.65	8.46	8.57	8.59
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			698	1,022	1,094	1,014	884	718	870
EC (ALS Measurement) (µS/cm)			726	1,050	1,070	1,020	960	918	876
Acidity (mg/L)*			<1	<1	<1	<1	<1	<1	<1
Alkalinity (mg/L)*			209	415	483	504	484	506	438
Net Alkalinity (mg/L)*			209	415	483	504	484	506	438
Major Ions (mg/L)	LoR	WQ Guidelines# (mg/L)	(mg/L)						
Calcium (Ca)	1	1,000	5	6	7	6	6	7	6
Potassium (K)	1	-	6	6	6	6	5	5	5
Magnesium (Mg)	1	-	2	2	2	2	2	2	2
Sodium (Na)	1	-	157	243	251	238	233	240	205
Chloride (Cl)	1	-	14	16	13	12	8	6	5
Fluoride (F)	0.1	2	2.4	1.8	1.5	1.4	1.3	1.3	1.5
Sulfate (SO_4)	1	1,000	100	108	65	47	34	25	20
Trace metals/ metalloids	LoR	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	1.03	0.07	0.03	0.01	0.01	0.02	0.02
Arsenic (As)	0.001	0.5	0.367	0.116	0.096	0.079	0.069	0.065	0.066
Cadmium (Cd)	0.0001	0.01	0.0002	0.0005	0.0004	0.0003	0.0003	<0.0001	0.0001
Cobalt (Co)	0.001	1	0.002	0.002	0.001	0.001	<0.001	<0.001	<0.001
Chromium (Cr)	0.001	1	0.002	<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	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium (Li)	0.001	-	0.010	0.024	0.029	0.030	0.028	0.029	0.026
Manganese (Mn)	0.001	2	0.001	0.001	0.002	0.002	0.002	0.003	0.003
Molybdenum (Mo)	0.001	0.15	0.725	0.984	0.791	0.623	0.416	0.319	0.238
Nickel (Ni)	0.001	1	0.01	0.008	0.007	0.006	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	-	0.027	0.004	0.002	0.001	<0.001	0.001	<0.001
Selenium (Se)	0.01	0.02	0.11	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium (Sr)	0.01	-	0.102	0.153	0.158	0.160	0.168	0.159	0.147
Vanadium	0.01	-	0.08	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	0.005	20	0.005	0.006	<0.005	0.007	0.007	0.007	0.007
Calculations**									
SO_4 Release Rate			8.0	8.2	5.4	3.9	2.9	2.1	1.7
Cumulative SO_4 Release			8.0	16.3	21.7	25.6	28.5	30.7	32.4
Ca Release Rate			0.40	0.46	0.59	0.50	0.52	0.60	0.52
Cumulative Ca Release			0.40	0.86	1.45	1.94	2.46	3.06	3.58
Mg Release Rate			0.16	0.15	0.17	0.17	0.17	0.17	0.17
Cumulative Mg Release			0.16	0.31	0.48	0.65	0.82	0.99	1.16
Residual ANC (%)			99.99	99.99	99.98	99.97	99.96	99.96	99.95
Residual Sulfur (%)			99.5	99.0	98.7	98.5	98.3	98.2	98.1
SO_4/(Ca+Mg) molar ratio			5.0	4.8	2.6	2.1	1.5	1.0	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).

KLC 6 - Potential Rejects - Free Leach

Weight (kg)	12.00	**Total S (%)**	0.057	**ANC**	25.7
pH (1:5)	8.80	**Scr (%)**	0.057	**NAPP**	-24.0
EC (µS/cm)	115	**MPA**	1.7	**ANC:MPA**	14.7

Date			**27-Feb-20**	**26-Mar-20**	**30-Apr-20**	**28-May-20**	**25-Jun-20**	**30-Jul-20**	**28-Aug-20**
Number of Weeks			**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number			**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number			EB2005519006	EB2008519006	EB2011635006	EB2014216006	EB2016805006	EB2020005006	EB2022571006
Volume On (L)			2.4	1.4	1.4	1.4	1.4	1.4	1.4
Volume Off (L)			0.792	0.952	1.023	1.071	1.058	1.052	1.059
Cumulative Volume Off (L)			0.79	1.7	2.8	3.8	4.9	5.9	7.0
Pore Volumes			0.6	1.3	2.0	2.8	3.6	4.4	5.2
pH (RGS Measurement)			9.11	8.81	8.76	8.66	8.80	8.82	8.72
pH (ALS Measurement)			8.33	8.51	8.43	8.45	8.54	8.43	8.39
pH (deionised water used in test)			6.45	6.15	5.98	6.69	6.19	6.14	6.46
EC (RGS Measurement) (µS/cm)			334	464	593	601	475	406	533
EC (ALS Measurement) (µS/cm)			347	475	586	607	549	521	523
Acidity (mg/L)*			<1	<1	<1	<1	<1	<1	<1
Alkalinity (mg/L)*			101	115	128	123	111	122	125
Net Alkalinity (mg/L)*			101	115	128	123	111	122	125
Major Ions (mg/L)	**LoR**	**WQ Guidelines[#] (mg/L)**	(mg/L)						
Calcium (Ca)	1	1,000	3	3	3	4	3	3	4
Potassium (K)	1	-	4	3	3	3	3	3	3
Magnesium (Mg)	1	-	1	0.5	1	1	1	1	1
Sodium (Na)	1	-	76	104	118	123	107	106	108
Chloride (Cl)	1	-	8	7	6	5	4	3	2
Fluoride (F)	0.1	2	1.3	1.5	1.3	1.2	1.1	1.1	1.2
Sulfate (SO_4)	1	1,000	47	101	116	128	115	108	114
Trace metals/ metalloids	**LoR**	(mg/L)	(mg/L)						
Aluminium (Al)	0.01	5	1.34	0.73	0.14	0.27	0.38	0.56	0.12
Arsenic (As)	0.001	0.5	0.143	0.098	0.062	0.045	0.034	0.032	0.033
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
Chromium (Cr)	0.001	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	0.001	1	<0.001	0.002	0.002	0.002	0.002	0.002	0.001
Iron (Fe)	0.05	1	0.07	0.06	0.05	<0.05	<0.05	0.06	<0.05
Lithium (Li)	0.001	-	0.005	0.009	0.012	0.013	0.012	0.012	0.013
Manganese (Mn)	0.001	2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.001	0.15	0.281	0.274	0.181	0.106	0.056	0.037	0.031
Nickel (Ni)	0.001	1	0.003	0.004	0.004	0.003	0.002	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	-	0.013	0.035	0.018	0.012	0.007	0.007	0.009
Selenium (Se)	0.01	0.02	0.04	0.10	0.10	0.10	0.08	0.07	0.07
Strontium (Sr)	0.01	-	0.057	0.055	0.066	0.080	0.074	0.070	0.087
Vanadium	0.01	-	0.05	0.04	0.02	0.02	0.01	0.02	0.02
Zinc (Zn)	0.005	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**									
SO_4 Release Rate			3.1	8.0	9.9	11.4	10.1	9.5	10.1
Cumulative SO_4 Release			3.1	11.1	21.0	32.4	42.6	52.0	62.1
Ca Release Rate			0.20	0.24	0.26	0.36	0.26	0.26	0.35
Cumulative Ca Release			0.20	0.44	0.69	1.05	1.31	1.58	1.93
Mg Release Rate			0.07	0.04	0.09	0.09	0.09	0.09	0.09
Cumulative Mg Release			0.1	0.11	0.19	0.28	0.37	0.46	0.54
Residual ANC (%)			100.00	99.99	99.99	99.99	99.98	99.98	99.97
Residual Sulfur (%)			99.8	99.3	98.8	98.1	97.5	97.0	96.4
SO_4/(Ca+Mg) molar ratio			4.2	11.0	10.4	9.5	10.3	9.7	8.4

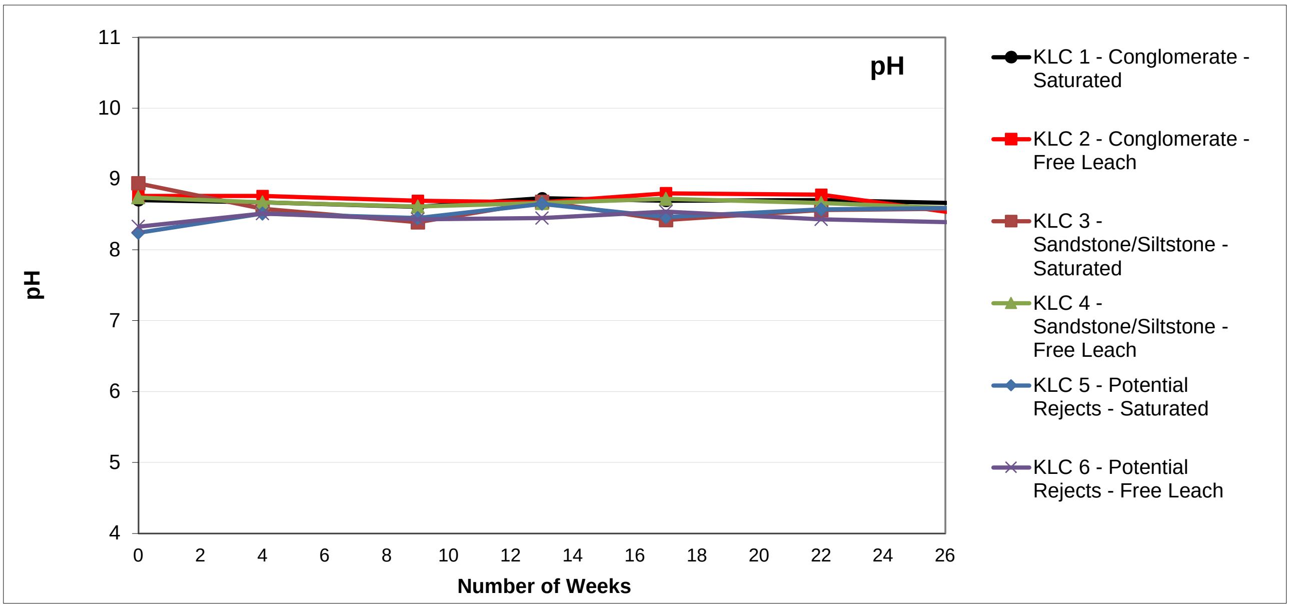
< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

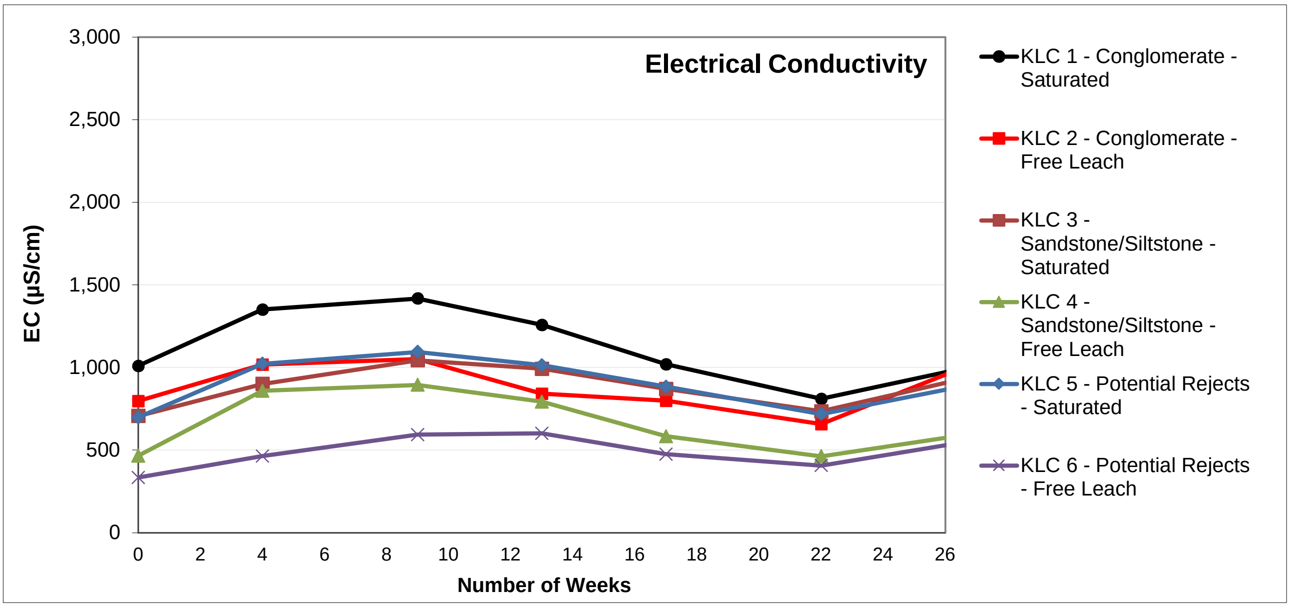
** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

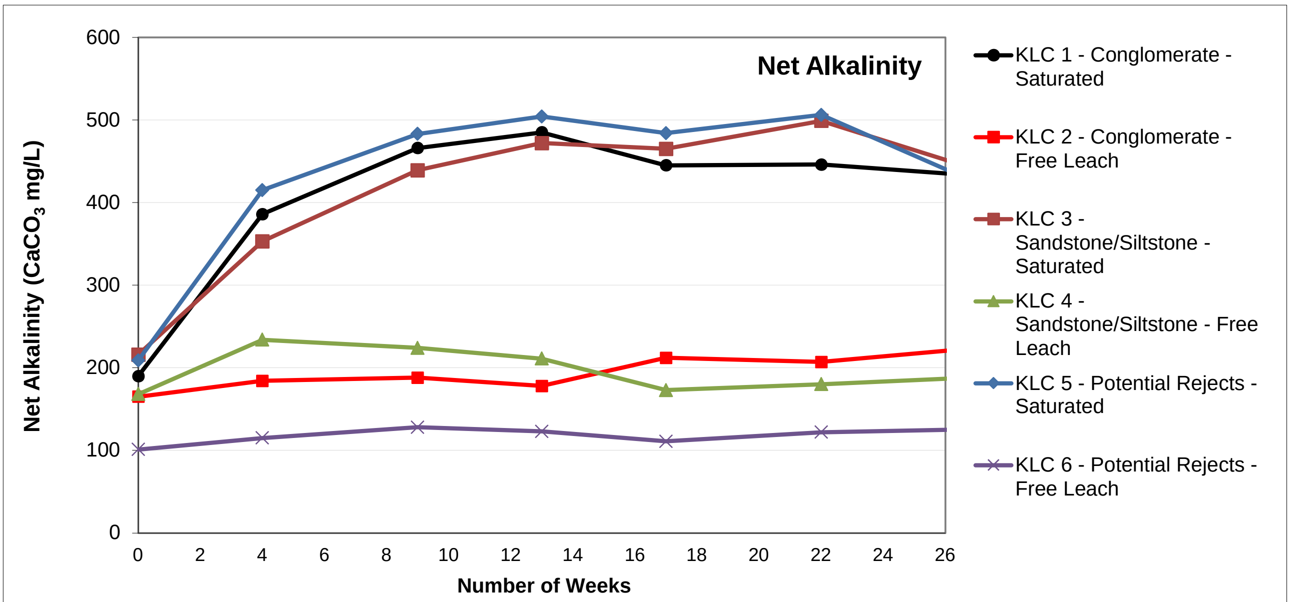
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity.

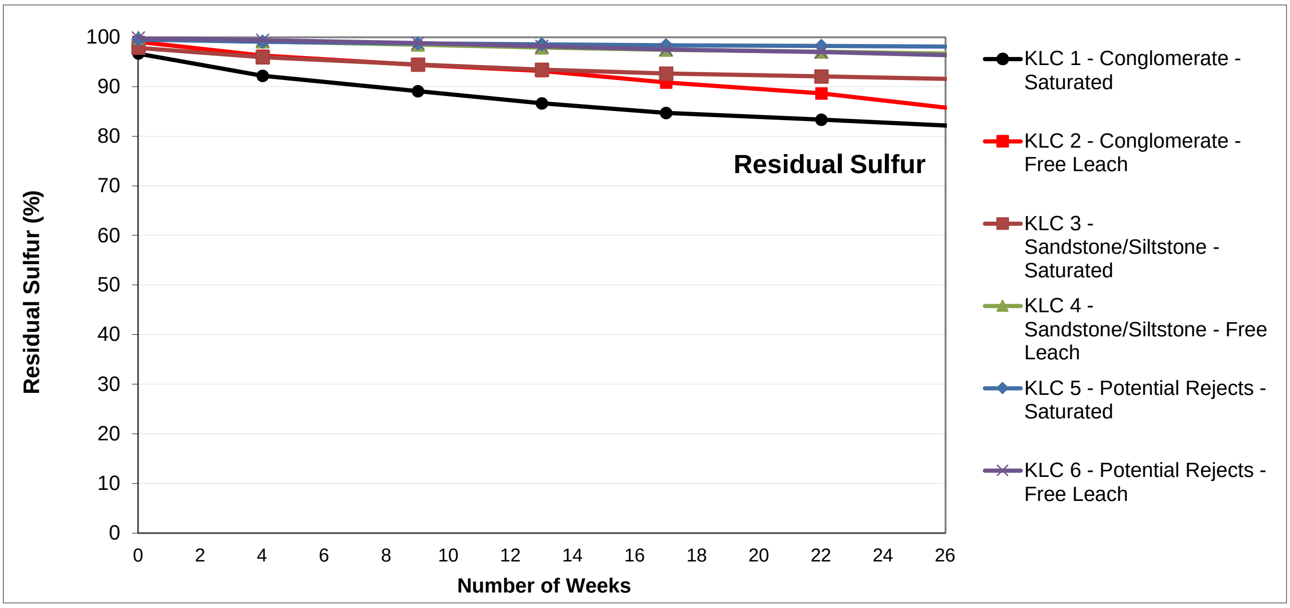
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential.

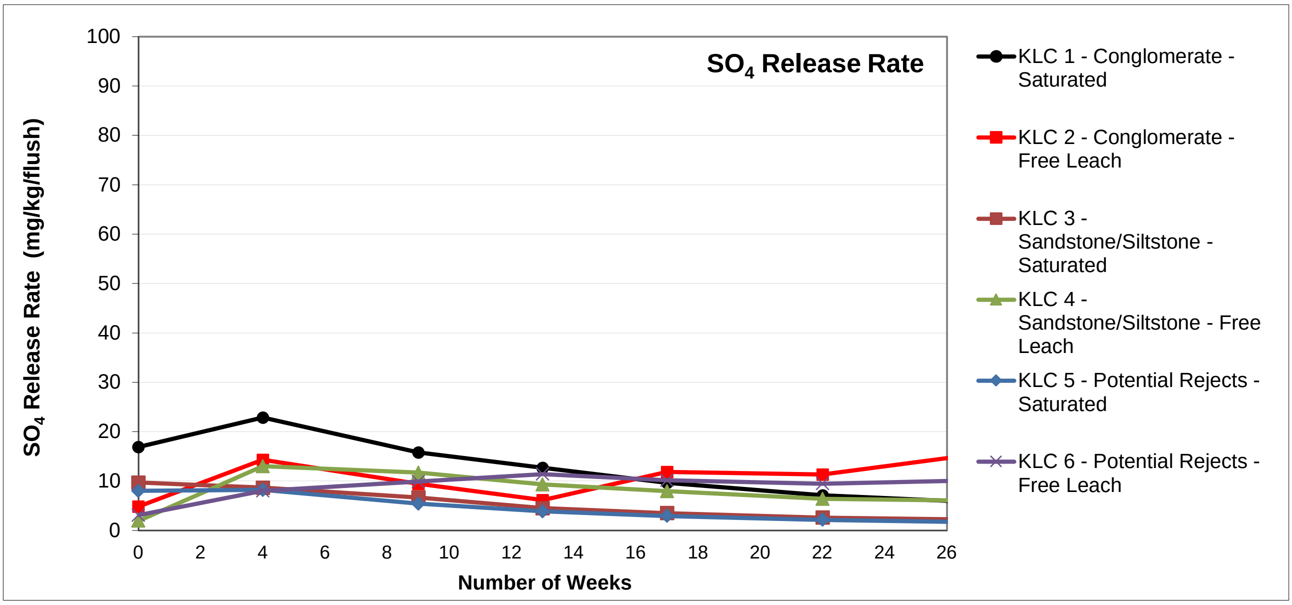
ANZECC & ARMCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, 2000, ANZECC (Australian and New Zealand Environment Conservation Council) and ARMCANZ (Agriculture and Resource Management Council of Australia and New Zealand).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

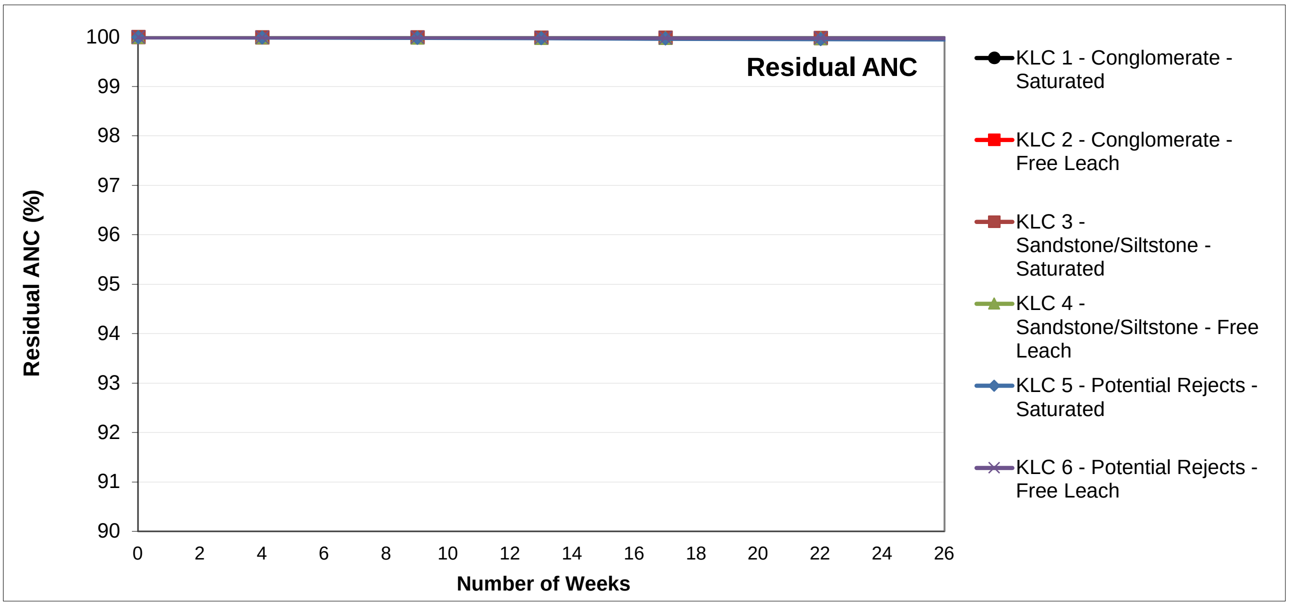

pH
11
10
9
8
7
6
5
4
pH
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

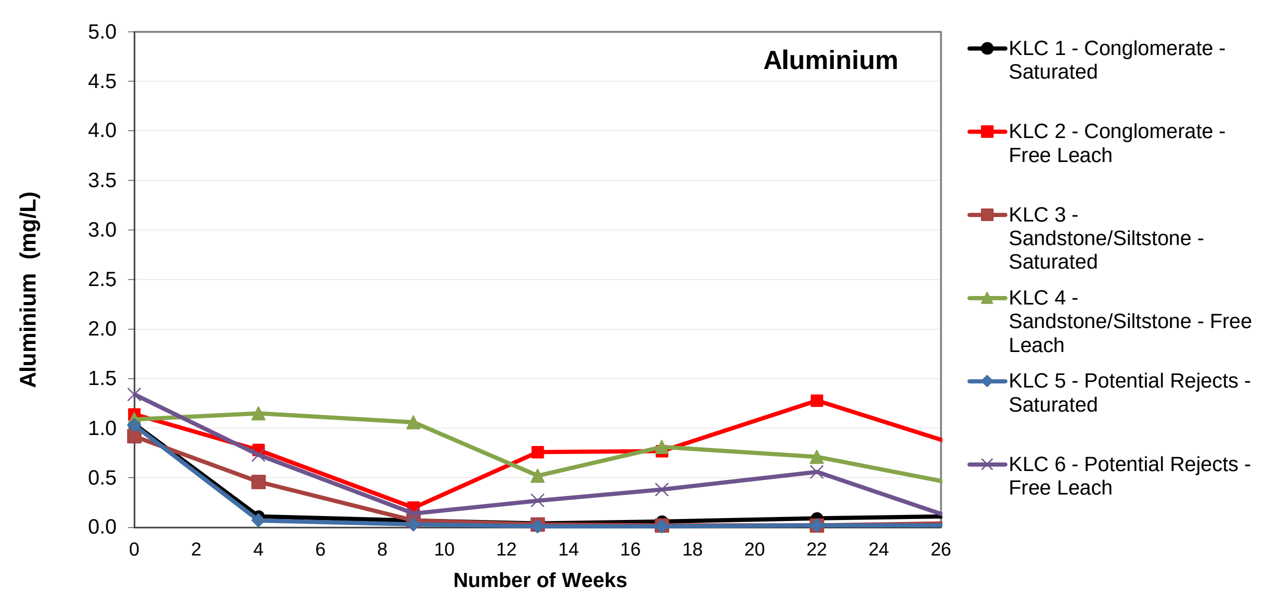

Electrical Conductivity
3,000
2,500
2,000
1,500
1,000
500
0
EC (µS/cm)
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

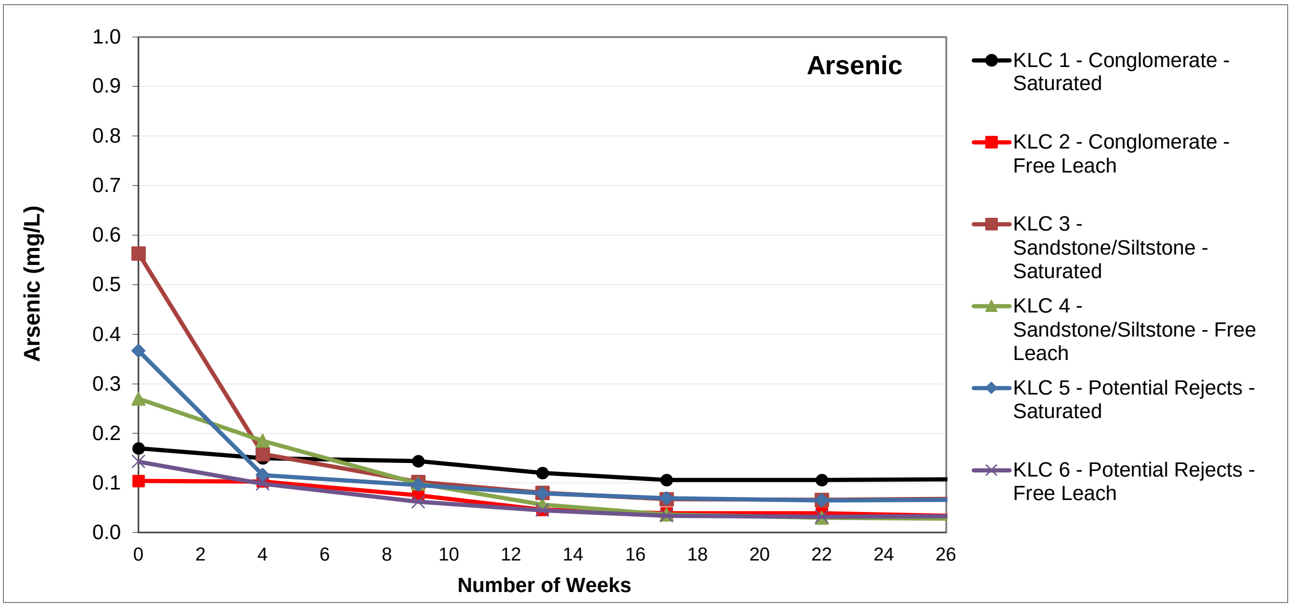

Net Alkalinity
600
500
400
300
200
100
0
Net Alkalinity ($CaCO_3$ mg/L)
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

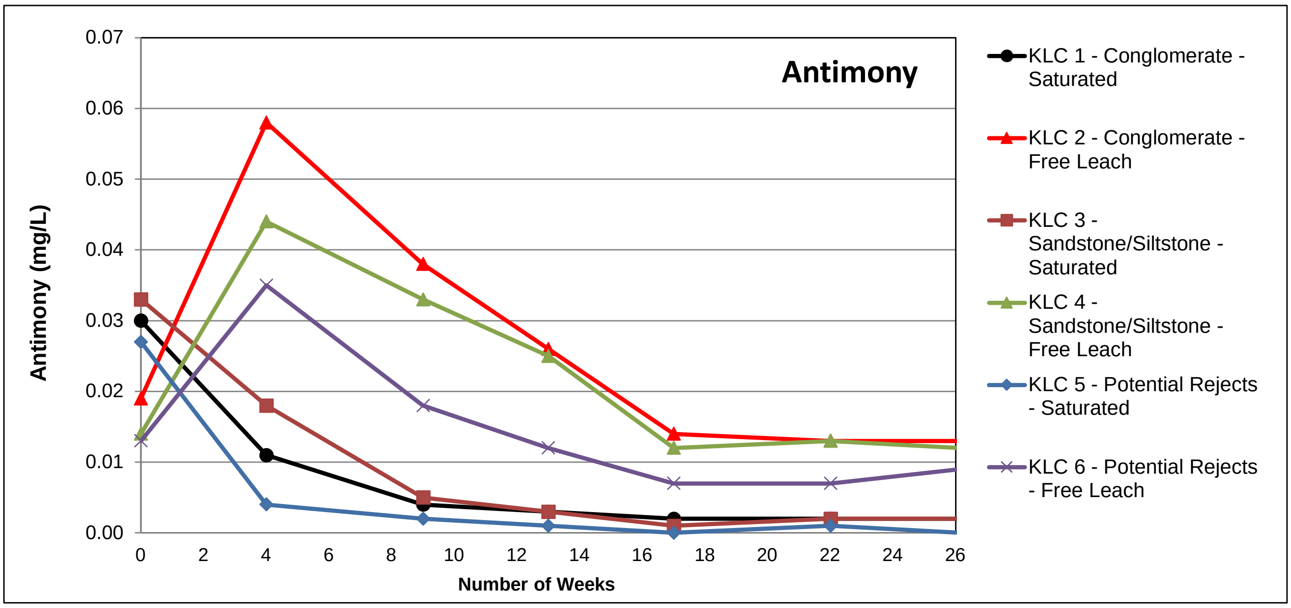

Residual Sulfur
Residual Sulfur (%)
100
90
80
70
60
50
40
30
20
10
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

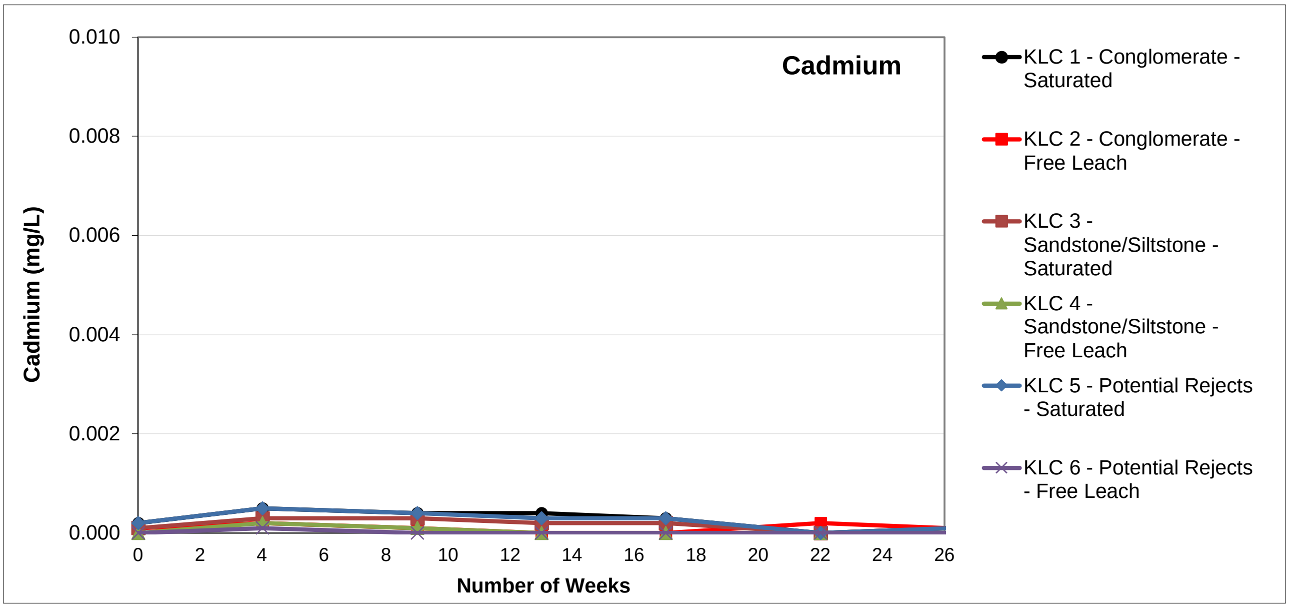

SO_4 Release Rate
SO_4 Release Rate (mg/kg/flush)
100
90
80
70
60
50
40
30
20
10
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

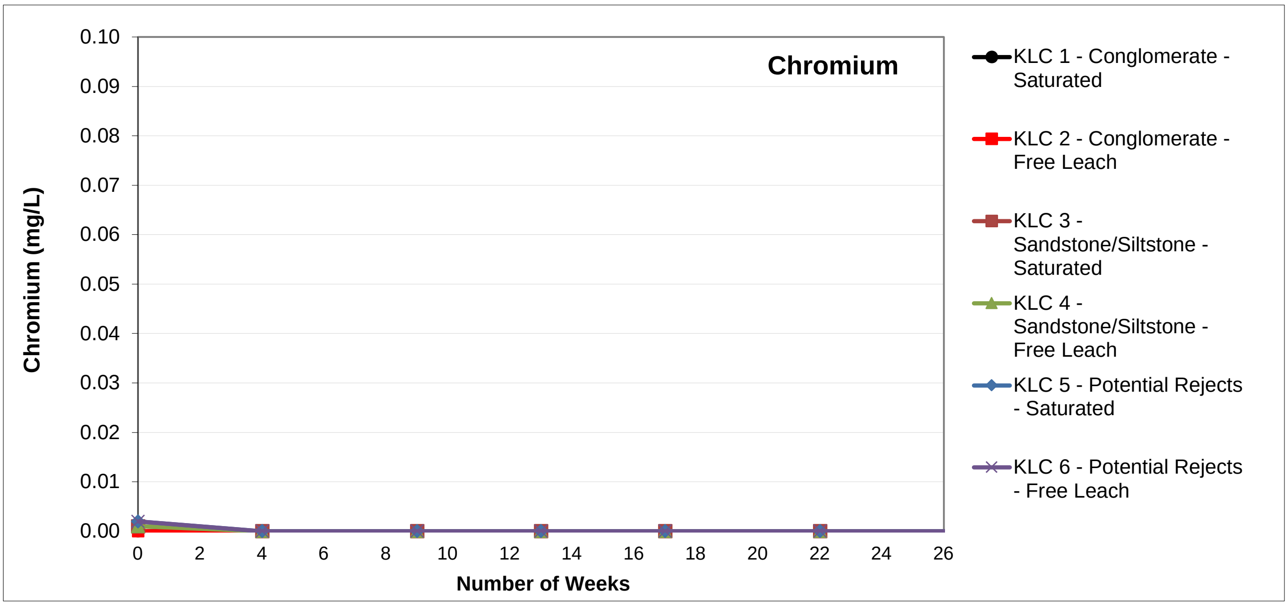

Residual ANC
Residual ANC (%)
100
99
98
97
96
95
94
93
92
91
90
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

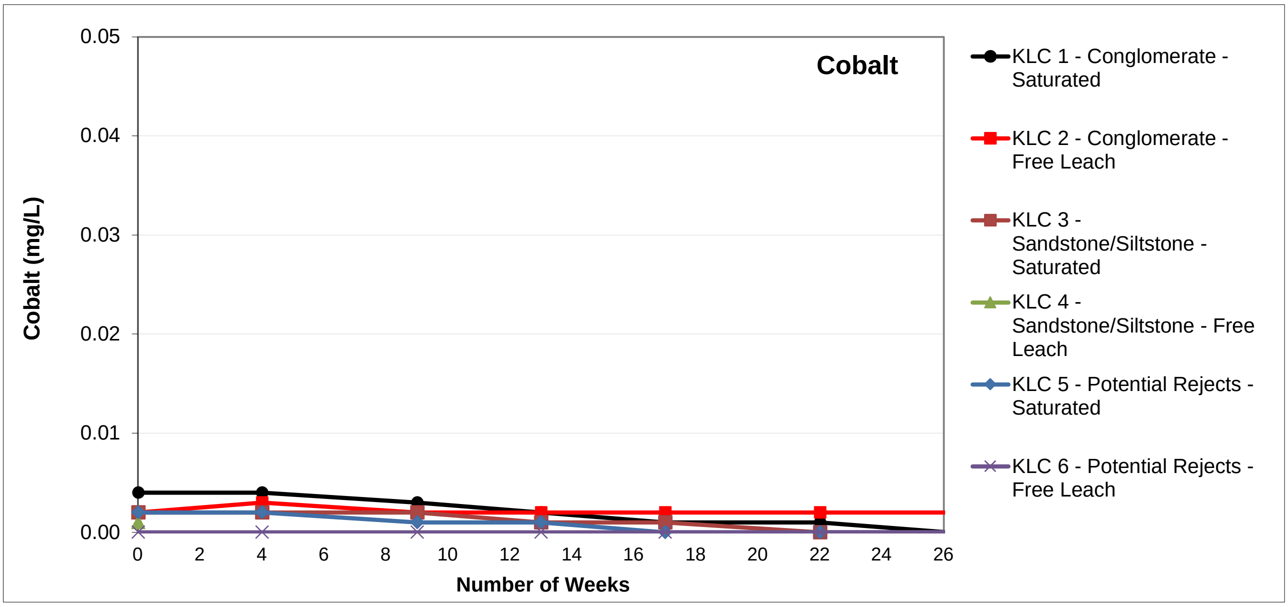

Aluminium
Aluminium (mg/L)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

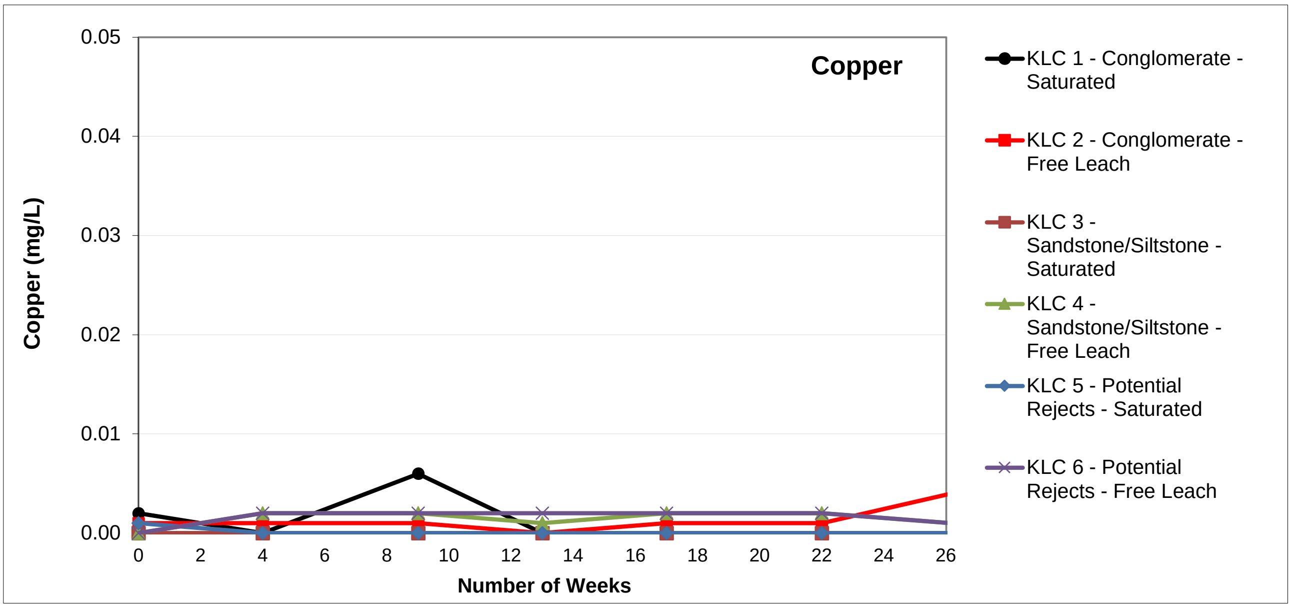

Arsenic
Arsenic (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

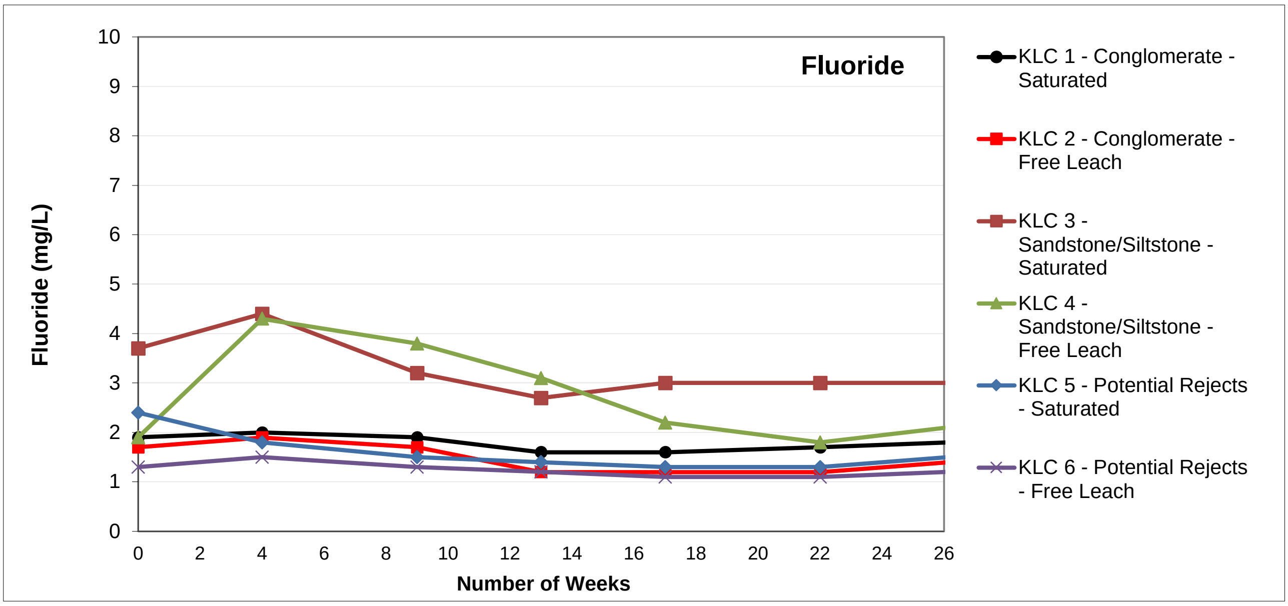

Antimony
Antimony (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

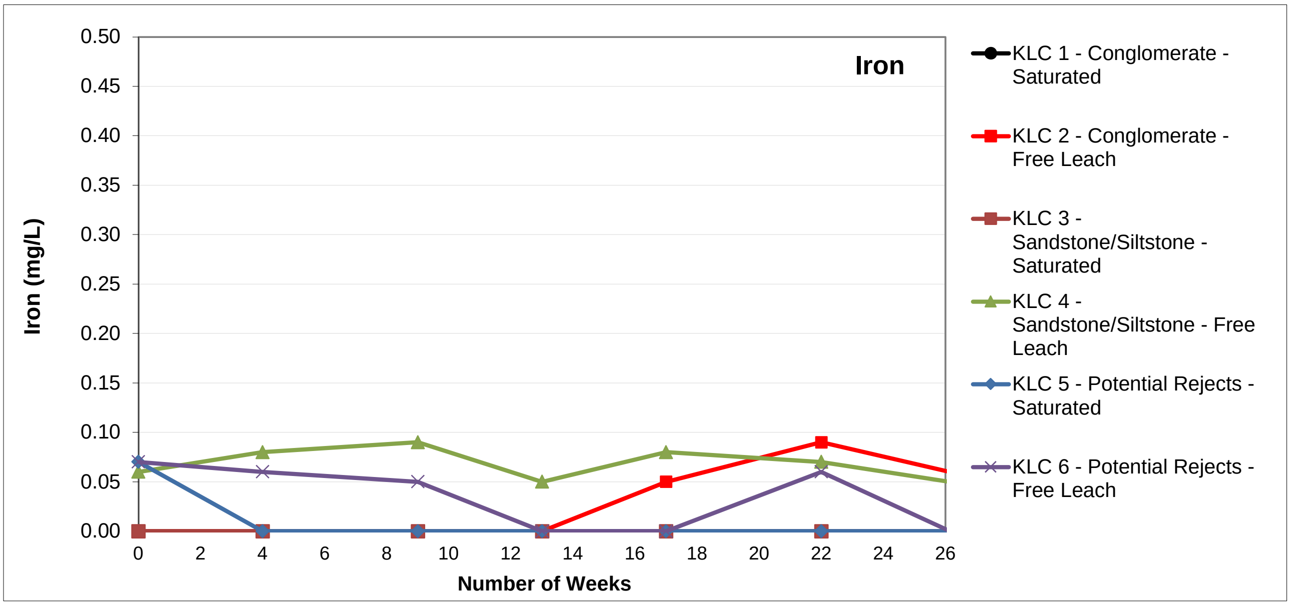

Cadmium
Cadmium (mg/L)
0.010
0.008
0.006
0.004
0.002
0.000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Chromium
Chromium (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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Cobalt
Cobalt (mg/L)
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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Copper
Copper (mg/L)
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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Fluoride
Fluoride (mg/L)
10
9
8
7
6
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Iron
Iron (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
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
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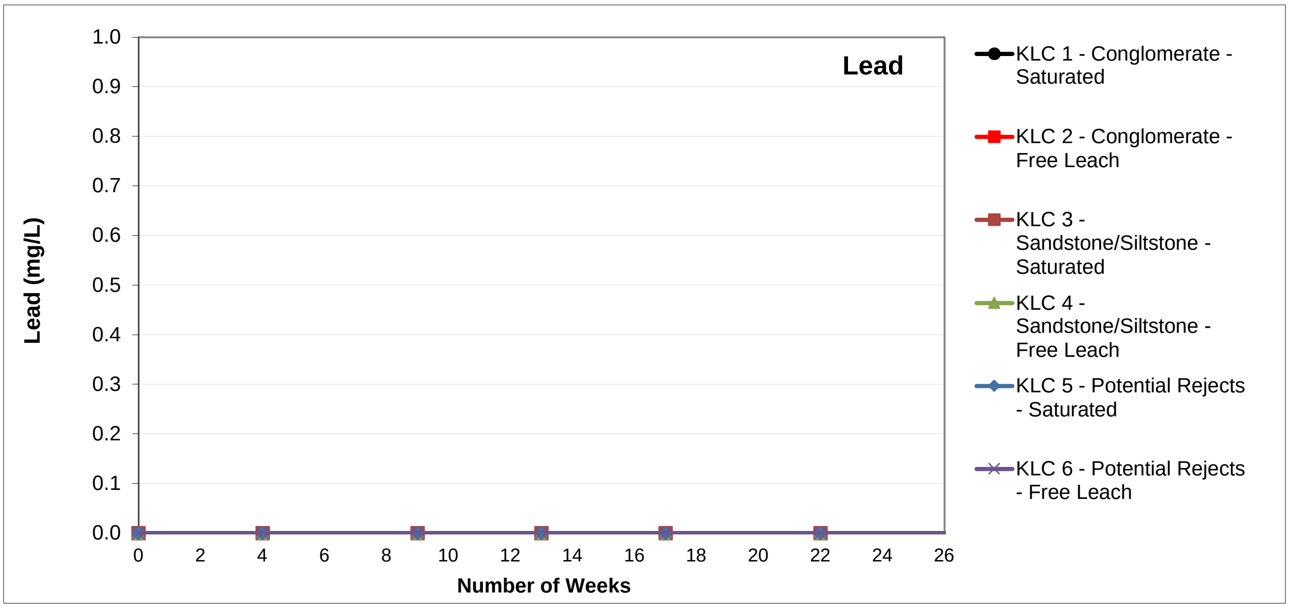
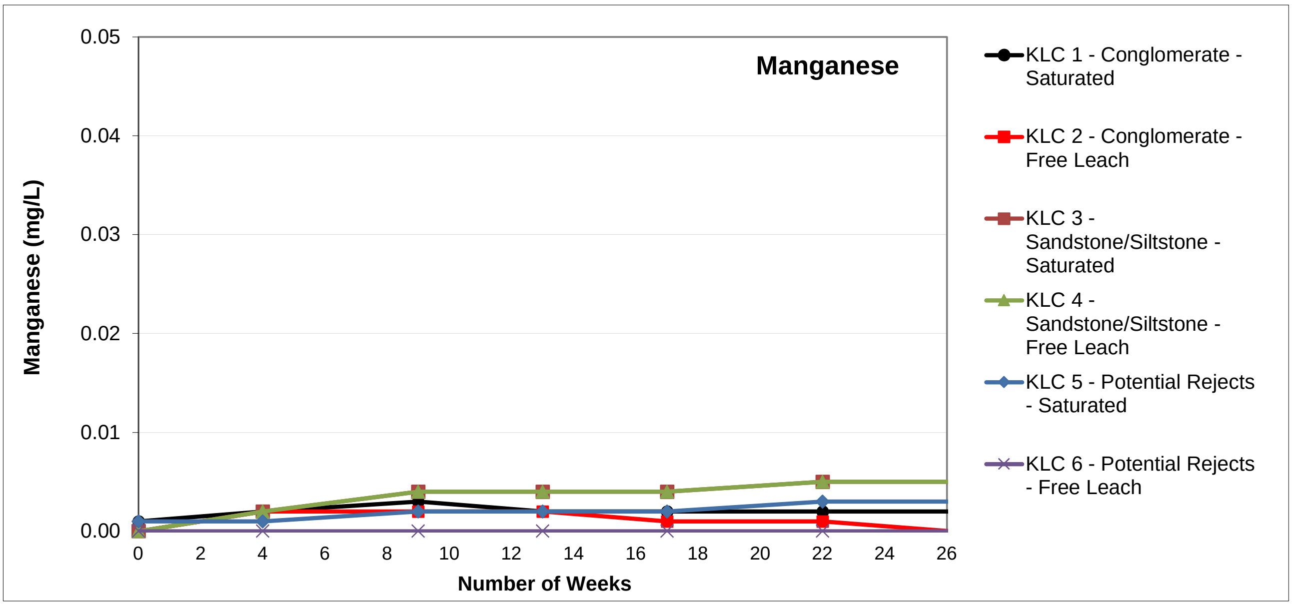
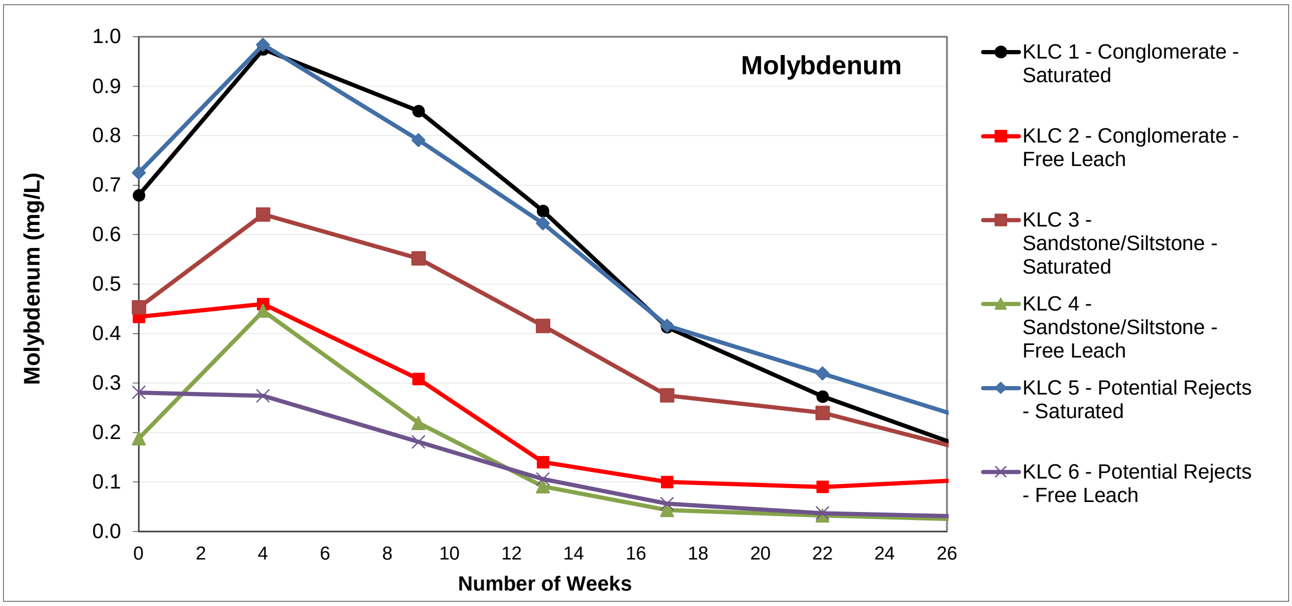
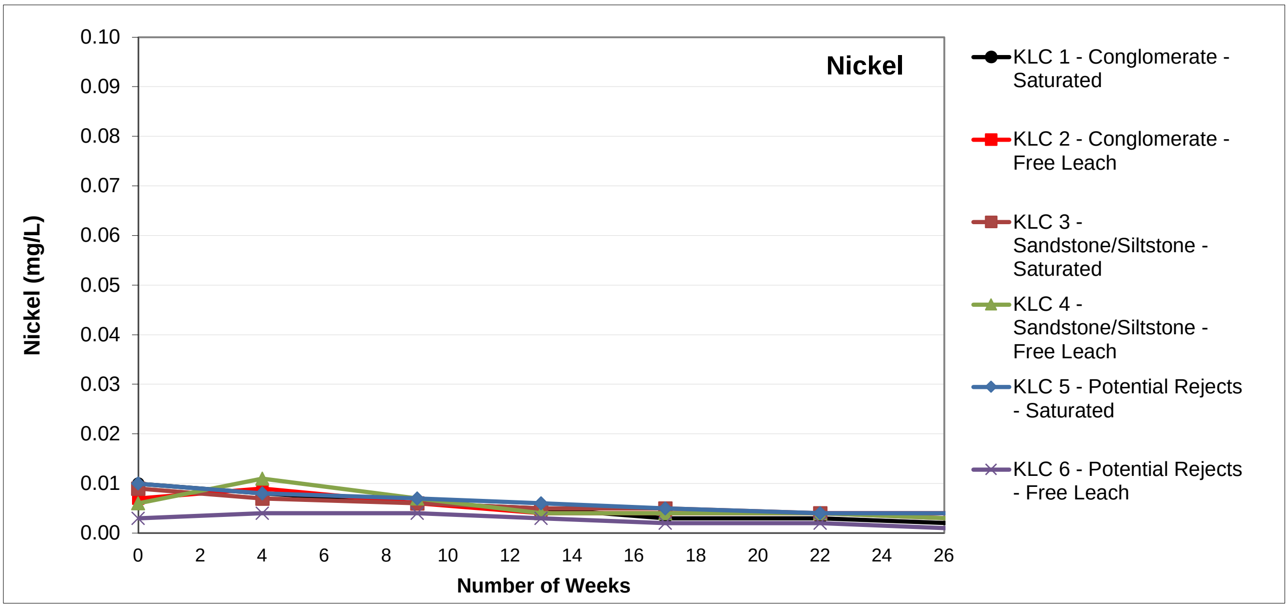
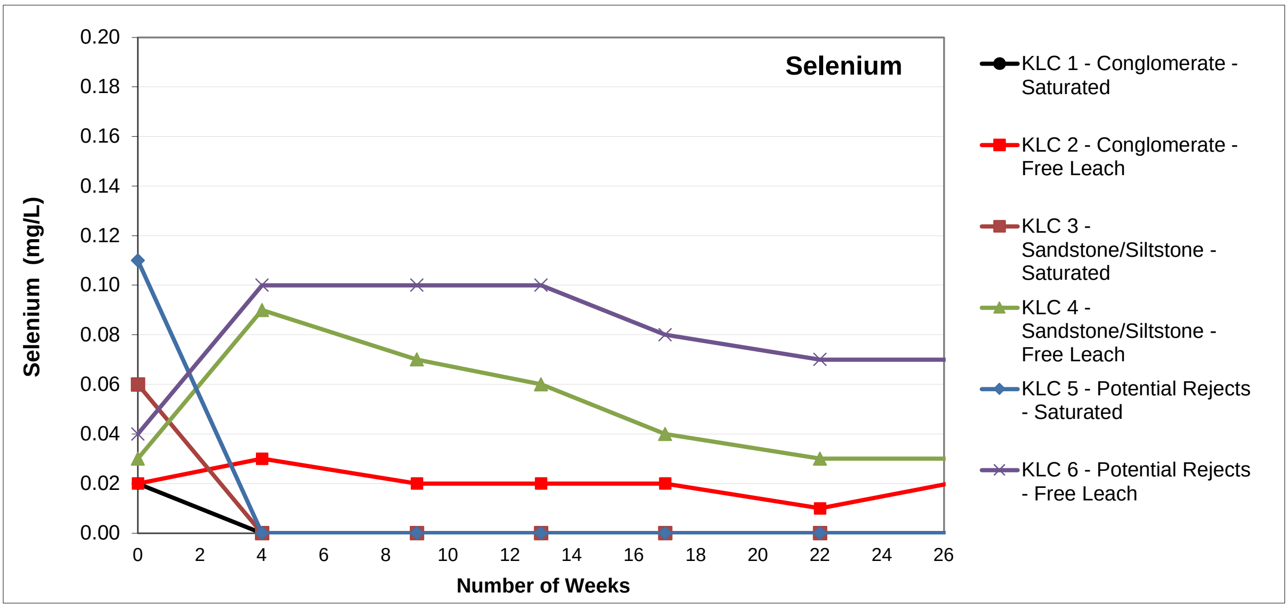
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

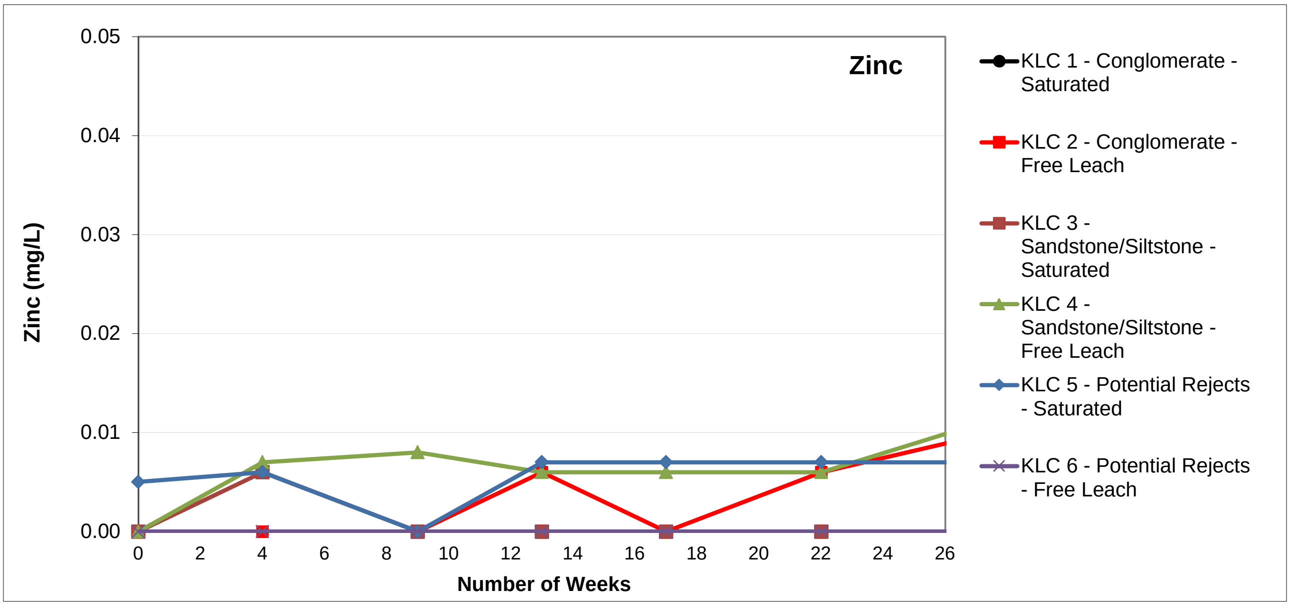

Lead
Lead (mg/L)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Manganese
Manganese (mg/L)
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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Molybdenum
Molybdenum (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
Number of Weeks
KLC 1 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Nickel
Nickel (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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Selenium
Selenium (mg/L)
0.20
0.18
0.16
0.14
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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach


Zinc
Zinc (mg/L)
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 - Conglomerate - Saturated
KLC 2 - Conglomerate - Free Leach
KLC 3 - Sandstone/Siltstone - Saturated
KLC 4 - Sandstone/Siltstone - Free Leach
KLC 5 - Potential Rejects - Saturated
KLC 6 - Potential Rejects - Free Leach

Attachment E ALS Laboratory Results

(Certificates of analysis)

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2000277**	Page	: 1 of 21
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028 Boggabri Project	Date Samples Received	: 07-Jan-2020 11:20
Order number	: ----	Date Analysis Commenced	: 21-Jan-2020
C-O-C number	: ----	Issue Date	: 24-Jan-2020 15:47
Sampler	: ----		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 92		
No. of samples analysed	: 92		

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
Kim McCabe	Senior Inorganic 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: ROCK
(Matrix: SOIL)

			Client sample ID	AMD000	AMD001	AMD002	AMD003	AMD005
			Client sampling date / time	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-001	EB2000277-002	EB2000277-003	EB2000277-004	EB2000277-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.1	9.6	9.7	9.5	9.0
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-10.4	-37.5	-27.5	-18.7	-14.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	80	466	502	268	76
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	11.0	37.5	27.8	18.7	14.7
ANC as CaCO3	----	0.1	% CaCO3	1.1	3.8	2.8	1.9	1.5
Fizz Rating	----	0	Fizz Unit	1	2	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	<0.01	0.01	<0.01	0.02

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD007	AMD008	AMD009	AMD010	AMD011
			Client sampling date / time	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-006	EB2000277-007	EB2000277-008	EB2000277-009	EB2000277-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.3**	**9.4**	**8.9**	**9.5**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-15.8**	**-18.1**	**-20.1**	**-26.9**	**-20.0**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**107**	**100**	**135**	**166**	**294**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**16.1**	**18.1**	**20.7**	**27.5**	**20.3**
ANC as CaCO3	----	0.1	% CaCO3	**1.6**	**1.8**	**2.1**	**2.8**	**2.1**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**1**	**1**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.01**	<0.01	**0.02**	**0.02**	**0.01**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD012	AMD013	AMD014	AMD015	AMD016
			Client sampling date / time	20-Dec-2019 00:00	20-Dec-2019 00:00	20-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-011	EB2000277-012	EB2000277-013	EB2000277-014	EB2000277-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.3	9.3	9.2	9.1
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-23.6	-20.3	-12.9	-14.3	-16.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	306	99	110	99	106
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	24.2	20.9	13.5	14.6	16.8
ANC as CaCO3	----	0.1	% CaCO3	2.5	2.1	1.4	1.5	1.7
Fizz Rating	----	0	Fizz Unit	1	1	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	0.02	0.01	0.01

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD017	AMD018	AMD019	AMD020	AMD021
			Client sampling date / time	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00
Compound	*CAS Number*	*LOR*	*Unit*	EB2000277-016	EB2000277-017	EB2000277-018	EB2000277-019	EB2000277-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.1	9.2	9.3	9.3	9.2
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-17.2	-12.6	-14.6	-46.8	-24.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	117	124	101	260	276
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	17.8	12.9	15.2	46.8	26.1
ANC as CaCO3	----	0.1	% CaCO3	1.8	1.3	1.5	4.8	2.7
Fizz Rating	----	0	Fizz Unit	1	1	1	2	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.01	0.02	<0.01	0.04

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	AMD022	AMD023	AMD024	AMD026	AMD027
Client sampling date / time				23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00
				EB2000277-021	EB2000277-022	EB2000277-023	EB2000277-024	EB2000277-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.3	9.3	9.1	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-34.4	-203	-26.3	-13.6	-49.3
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	244	340	168	108	257
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	35.0	203	26.6	13.6	49.9
ANC as CaCO3	----	0.1	% CaCO3	3.6	20.7	2.7	1.4	5.1
Fizz Rating	----	0	Fizz Unit	2	3	1	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.01	0.01	<0.01	0.02

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	AMD028	AMD029	AMD030	AMD031	AMD032
Client sampling date / time				23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00
				EB2000277-026	EB2000277-027	EB2000277-028	EB2000277-029	EB2000277-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.6	9.5	9.3	9.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-19.2	-24.9	-34.2	-24.8	-26.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	134	252	270	260	258
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	19.8	24.9	34.5	25.4	27.3
ANC as CaCO3	----	0.1	% CaCO3	2.0	2.5	3.5	2.6	2.8
Fizz Rating	----	0	Fizz Unit	1	1	2	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	<0.01	0.01	0.02	0.02

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD033	AMD034	AMD035	AMD036	AMD037
			Client sampling date / time	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00	23-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-031	EB2000277-032	EB2000277-033	EB2000277-034	EB2000277-035
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**10.1**	**9.9**	**9.1**	**8.8**	**9.4**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-193**	**-24.1**	**-16.8**	**-19.3**	**-40.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**539**	**286**	**95**	**244**	**232**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**193**	**24.1**	**18.3**	**22.4**	**41.2**
ANC as CaCO3	----	0.1	% CaCO3	**19.7**	**2.5**	**1.9**	**2.3**	**4.2**
Fizz Rating	----	0	Fizz Unit	**3**	**1**	**1**	**1**	**2**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	**0.05**	**0.10**	**0.02**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD038	AMD039	AMD040	AMD041	AMD042
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-036	EB2000277-037	EB2000277-038	EB2000277-039	EB2000277-040
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.5	8.9	8.0	7.9	8.3
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-6.5	-35.4	-10.2	-28.0	-15.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	30	130	54	75	76
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.5	35.4	11.4	28.6	15.6
ANC as CaCO3	----	0.1	% CaCO3	0.7	3.6	1.2	2.9	1.6
Fizz Rating	----	0	Fizz Unit	1	1	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	0.04	0.02	<0.01

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

			Client sample ID	AMD043	AMD044	AMD045	AMD046	AMD047
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-041	EB2000277-042	EB2000277-043	EB2000277-044	EB2000277-045
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.1**	**8.1**	**8.1**	**7.9**	**8.3**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-14.3**	**-15.1**	**-29.8**	**-8.8**	**-16.2**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**57**	**64**	**143**	**70**	**64**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**14.9**	**15.7**	**30.7**	**11.0**	**16.8**
ANC as CaCO3	----	0.1	% CaCO3	**1.5**	**1.6**	**3.1**	**1.1**	**1.7**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**1**	**1**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	**0.03**	**0.07**	**0.02**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD048	AMD050	AMD051	AMD052	AMD053
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-046	EB2000277-047	EB2000277-048	EB2000277-049	EB2000277-050
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.8	8.5	8.9	9.0	8.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-35.7	-6.0	-56.4	-27.2	-18.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	184	64	172	138	49
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	37.5	6.0	57.0	27.5	19.4
ANC as CaCO3	----	0.1	% CaCO3	3.8	0.6	5.8	2.8	2.0
Fizz Rating	----	0	Fizz Unit	2	1	2	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	<0.01	0.02	0.01	0.02

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD054	AMD055	AMD056	AMD057	AMD058
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-051	EB2000277-052	EB2000277-053	EB2000277-054	EB2000277-055
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.4	8.9	9.0	8.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-12.9	-10.9	-26.8	-184	-23.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	54	38	149	125	263
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	13.5	11.2	28.3	184	24.8
ANC as CaCO3	----	0.1	% CaCO3	1.4	1.1	2.9	18.8	2.5
Fizz Rating	----	0	Fizz Unit	1	1	1	3	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.01	0.05	<0.01	0.03

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD059	AMD061	AMD062	AMD063	AMD065
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-056	EB2000277-057	EB2000277-058	EB2000277-059	EB2000277-060
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.8	8.2	8.7	8.5	7.2
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-38.5	-13.4	-34.4	-13.4	-11.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	167	65	105	62	99
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	39.1	14.0	34.4	14.0	12.4
ANC as CaCO3	----	0.1	% CaCO3	4.0	1.4	3.5	1.4	1.3
Fizz Rating	----	0	Fizz Unit	2	1	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.02	<0.01	0.02	0.03

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD066	AMD067	AMD068	AMD069	AMD070
			Client sampling date / time	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00	30-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-061	EB2000277-062	EB2000277-063	EB2000277-064	EB2000277-065
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	8.8	8.4	8.1	9.2
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-12.9	-133	-9.5	-24.4	-12.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	170	116	37	478	58
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	14.4	134	9.5	25.9	12.4
ANC as CaCO3	----	0.1	% CaCO3	1.5	13.7	1.0	2.6	1.3
Fizz Rating	----	0	Fizz Unit	1	2	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.02	<0.01	0.05	<0.01

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD071	AMD072	AMD073	AMD074	AMD075
			Client sampling date / time	30-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-066	EB2000277-067	EB2000277-068	EB2000277-069	EB2000277-070
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.6	9.1	8.4	9.0	9.4
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-10.2	-23.1	-30.8	-12.1	-75.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	60	219	77	61	242
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	11.4	23.1	31.4	12.7	75.9
ANC as CaCO3	----	0.1	% CaCO3	1.2	2.4	3.2	1.3	7.7
Fizz Rating	----	0	Fizz Unit	1	1	1	1	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	<0.01	0.02	0.02	<0.01

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD076	AMD077	AMD078	AMD079	AMD080
			Client sampling date / time	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-071	EB2000277-072	EB2000277-073	EB2000277-074	EB2000277-075
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.1**	**9.0**	**9.6**	**9.7**	**8.8**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-11.4**	**-13.6**	**-43.8**	**-33.8**	**-11.2**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**85**	**71**	**449**	**314**	**85**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**11.7**	**13.9**	**44.1**	**33.8**	**11.8**
ANC as CaCO3	----	0.1	% CaCO3	**1.2**	**1.4**	**4.5**	**3.4**	**1.2**
Fizz Rating	----	0	Fizz Unit	**1**	**1**	**2**	**2**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.01**	**0.01**	**0.01**	<0.01	**0.02**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD081	AMD082	AMD083	AMD084	AMD085
			Client sampling date / time	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-076	EB2000277-077	EB2000277-078	EB2000277-079	EB2000277-080
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.8	8.8	8.8	9.4	7.8
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-18.8	-20.6	-12.9	-28.0	-9.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	64	60	49	191	89
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	19.7	21.2	12.9	28.0	13.9
ANC as CaCO3	----	0.1	% CaCO3	2.0	2.2	1.3	2.8	1.4
Fizz Rating	----	0	Fizz Unit	1	1	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	<0.01	<0.01	0.16

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD086	AMD087	AMD088	AMD089	AMD090
			Client sampling date / time	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-081	EB2000277-082	EB2000277-083	EB2000277-084	EB2000277-085
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.0**	**8.7**	**8.3**	**8.8**	**9.1**
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-12.8**	**-42.1**	**-10.7**	**-11.6**	**-23.8**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**60**	**158**	**74**	**52**	**160**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**13.1**	**42.4**	**11.9**	**11.6**	**23.8**
ANC as CaCO3	----	0.1	% CaCO3	**1.3**	**4.3**	**1.2**	**1.2**	**2.4**
Fizz Rating	----	0	Fizz Unit	**1**	**2**	**1**	**1**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.01**	**0.01**	**0.04**	<0.01	<0.01

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD091	AMD092	AMD093	AMD094	AMD095
			Client sampling date / time	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00	31-Dec-2019 00:00
Compound	CAS Number	LOR	Unit	EB2000277-086	EB2000277-087	EB2000277-088	EB2000277-089	EB2000277-090
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.2	8.5	8.6	8.7	7.5
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-7.9	-10.4	-20.3	-59.1	8.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	142	41	86	185	272
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	12.8	10.4	20.9	59.4	17.2
ANC as CaCO3	----	0.1	% CaCO3	1.3	1.0	2.1	6.0	1.8
Fizz Rating	----	0	Fizz Unit	1	1	1	2	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.16	<0.01	0.02	0.01	0.84

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	AMD096	AMD097	----	----	----
			Client sampling date / time	31-Dec-2019 00:00	31-Dec-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB2000277-091	EB2000277-092	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.3	7.9	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-384	-54.4	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	319	425	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	406	55.6	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	41.4	5.7	----	----	----
Fizz Rating	----	0	Fizz Unit	5	2	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.70	0.04	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2002443**	Page	: 1 of 10
Amendment	: **2**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028 Boggabri Project	Date Samples Received	: 29-Jan-2020 13:24
Order number	: ----	Date Analysis Commenced	: 04-Feb-2020
C-O-C number	: ----	Issue Date	: 27-Feb-2020 16:13
Sampler	: ALAN ROBERTSON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 14		
No. of samples analysed	: 14		

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
Diana Mesa	2IC Organic Chemist	Brisbane Organics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Merrin Avery	Supervisor - Inorganic	Newcastle - Inorganics, Mayfield West, NSW
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.

- 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.
- EK040-P (Fluoride): Unable to analyse fluoride on sample 5 (Composite 1) due to insufficient sample volume
- Amendment (17/02/2020): This report has been amended and re-released to allow the reporting of additional analytical data.
- Amendment (27/02/20): This report has been amended and re-released to allow the reporting of additional analytical data. Mo was missed on the original COC and has been added for Total and Leachable metals
- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio for some samples as the required results for Magnesium/Potassium are below LOR.
- EG005T (Total Metals by ICP-AES): Sample EB2004114-021 shows poor duplicate results due to sample heterogeneity. Confirmed by visual inspection.
- 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: LEACHATE (Matrix: WATER)			Client sample ID	Composite 1	Composite 2	Composite 3	Composite 4	Composite 5
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
Compound	CAS Number	LOR	Unit	EB2002443-005	EB2002443-006	EB2002443-007	EB2002443-008	EB2002443-009
				Result	Result	Result	Result	Result
ED040W: Water Leachable Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	1	mg/L	75	33	30	41	20
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	18	12	13	14	14
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	3	9	4	5	2
Magnesium	7439-95-4	1	mg/L	1	2	1	1	<1
Sodium	7440-23-5	1	mg/L	152	95	107	110	108
Potassium	7440-09-7	1	mg/L	14	14	14	12	8
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	3.48	0.74	4.24	2.09	6.95
Antimony	7440-36-0	0.001	mg/L	0.007	0.006	0.006	0.008	0.010
Arsenic	7440-38-2	0.001	mg/L	0.032	0.021	0.115	0.037	0.375
Cadmium	7440-43-9	0.0001	mg/L	0.0003	0.0003	0.0004	0.0003	0.0004
Chromium	7440-47-3	0.001	mg/L	0.001	<0.001	0.002	<0.001	0.005
Cobalt	7440-48-4	0.001	mg/L	0.002	<0.001	0.002	0.003	0.005
Copper	7440-50-8	0.001	mg/L	0.003	0.001	0.002	0.001	0.004
Lead	7439-92-1	0.001	mg/L	0.005	<0.001	0.005	0.003	0.008
Manganese	7439-96-5	0.001	mg/L	0.009	0.007	0.010	0.017	0.010
Molybdenum	7439-98-7	0.001	mg/L	0.053	0.061	0.085	0.106	0.133
Nickel	7440-02-0	0.001	mg/L	0.005	0.002	0.005	0.005	0.013
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.02
Thorium	7440-29-1	0.001	mg/L	0.002	0.001	0.001	0.001	0.002
Uranium	7440-61-1	0.001	mg/L	0.001	<0.001	<0.001	0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.02	<0.01	0.05
Zinc	7440-66-6	0.005	mg/L	0.149	0.102	0.144	0.115	0.183
Boron	7440-42-8	0.05	mg/L	0.37	0.46	0.37	0.46	0.59
Iron	7439-89-6	0.05	mg/L	0.54	0.16	0.74	0.84	0.84
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	0.8	1.2	1.2	1.1	4.7
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	7	2	3	4	5
EG005(ED093)W: Water Leachable Metals by ICPAES								
Phosphorus	7723-14-0	1	mg/L	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Composite 6	Composite 7	Composite 8	Composite 9	Composite 10
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
Compound	CAS Number	LOR	Unit	EB2002443-010	EB2002443-011	EB2002443-012	EB2002443-013	EB2002443-014
				Result	Result	Result	Result	Result
ED040W: Water Leachable Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	1	mg/L	19	25	22	11	44
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	10	11	11	12	20
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	2	2	2	3	2
Magnesium	7439-95-4	1	mg/L	<1	<1	1	1	<1
Sodium	7440-23-5	1	mg/L	84	85	64	35	121
Potassium	7440-09-7	1	mg/L	10	6	8	8	8
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	2.24	3.96	8.01	12.4	4.22
Antimony	7440-36-0	0.001	mg/L	0.005	0.004	0.003	0.006	0.007
Arsenic	7440-38-2	0.001	mg/L	0.073	0.114	0.068	0.328	0.229
Cadmium	7440-43-9	0.0001	mg/L	0.0003	0.0004	0.0005	0.0005	0.0005
Chromium	7440-47-3	0.001	mg/L	0.002	0.004	0.005	0.012	0.003
Cobalt	7440-48-4	0.001	mg/L	0.001	0.002	0.002	0.005	0.003
Copper	7440-50-8	0.001	mg/L	0.001	0.003	0.007	0.012	0.004
Lead	7439-92-1	0.001	mg/L	0.002	0.006	0.016	0.022	0.007
Manganese	7439-96-5	0.001	mg/L	0.004	0.005	0.019	0.008	0.009
Molybdenum	7439-98-7	0.001	mg/L	0.100	0.095	0.041	0.075	0.382
Nickel	7440-02-0	0.001	mg/L	0.002	0.006	0.009	0.012	0.007
Selenium	7782-49-2	0.01	mg/L	<0.01	0.01	0.02	0.02	0.03
Thorium	7440-29-1	0.001	mg/L	0.002	0.002	0.003	0.003	0.002
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	0.001	0.001	<0.001
Vanadium	7440-62-2	0.01	mg/L	0.07	0.08	0.04	0.20	0.09
Zinc	7440-66-6	0.005	mg/L	0.103	0.193	0.345	0.371	0.174
Boron	7440-42-8	0.05	mg/L	0.38	0.58	0.67	0.54	0.50
Iron	7439-89-6	0.05	mg/L	0.28	0.46	3.09	1.78	0.69
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	1.4	1.8	1.3	1.4	3.0
EP005: Total Organic Carbon (TOC)								
Total Organic Carbon	----	1	mg/L	4	5	5	5	6
EG005(ED093)W: Water Leachable Metals by ICPAES								
Phosphorus	7723-14-0	1	mg/L	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	AMD001	AMD002	AMD003	AMD004	Composite 1
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
Compound	CAS Number	LOR	Unit	EB2002443-001	EB2002443-002	EB2002443-003	EB2002443-004	EB2002443-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	----	----	----	----	9.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	----	----	376
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.076	0.021	0.593	0.396	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	----	----	----	----	8.3
EA032: Electrical Conductivity (saturated paste)								
ø Electrical Conductivity (Saturated Paste)	----	1	µS/cm	----	----	----	----	648
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	----	----	1.6
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	----	1.0
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	----	----	0.3
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	----	----	1.7
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	----	4.6
ø Exchangeable Sodium Percent	----	0.2	%	----	----	----	----	38.0
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	----	----	1.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	----	----	3.3
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	----	----	----	----	3620
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	----	----	----	3280
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	----	----	----	337
ED038A: Acidity								
Acidity	----	1	mg/kg	----	----	----	----	<5
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	----	----	----	----	2060
Potassium	7440-09-7	50	mg/kg	----	----	----	----	1190
Calcium	7440-70-2	50	mg/kg	----	----	----	----	5210
Magnesium	7439-95-4	50	mg/kg	----	----	----	----	1420
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	----	----	720
Boron	7440-42-8	50	mg/kg	----	----	----	----	<50
Iron	7439-89-6	50	mg/kg	----	----	----	----	5060
Phosphorus	7723-14-0	50	mg/kg	----	----	----	----	<50

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	AMD001	AMD002	AMD003	AMD004	Composite 1
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
Compound	CAS Number	LOR	Unit	EB2002443-001	EB2002443-002	EB2002443-003	EB2002443-004	EB2002443-005
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	----	----	----	----	5.5
Selenium	7782-49-2	1	mg/kg	----	----	----	----	<1
Cadmium	7440-43-9	0.1	mg/kg	----	----	----	----	<0.1
Cobalt	7440-48-4	0.1	mg/kg	----	----	----	----	3.8
Chromium	7440-47-3	0.1	mg/kg	----	----	----	----	2.0
Copper	7440-50-8	0.1	mg/kg	----	----	----	----	4.2
Thorium	7440-29-1	0.1	mg/kg	----	----	----	----	1.3
Manganese	7439-96-5	0.1	mg/kg	----	----	----	----	88.4
Molybdenum	7439-98-7	0.1	mg/kg	----	----	----	----	0.4
Nickel	7440-02-0	0.1	mg/kg	----	----	----	----	9.1
Lead	7439-92-1	0.1	mg/kg	----	----	----	----	6.9
Antimony	7440-36-0	0.1	mg/kg	----	----	----	----	<0.1
Uranium	7440-61-1	0.1	mg/kg	----	----	----	----	0.3
Zinc	7440-66-6	0.5	mg/kg	----	----	----	----	34.6
Vanadium	7440-62-2	1	mg/kg	----	----	----	----	6
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	----	----	----	----	130
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	----	----	----	----	0.09

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6
Client sampling date / time				20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
				EB2002443-006	EB2002443-007	EB2002443-008	EB2002443-009	EB2002443-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.6	9.6	9.5	9.1	9.2
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	236	263	285	301	177
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	8.5	8.6	8.3	8.1	8.3
EA032: Electrical Conductivity (saturated paste)								
ø Electrical Conductivity (Saturated Paste)	----	1	µS/cm	480	522	598	701	457
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	1.8	2.7	3.8	2.7	1.5
ø Exchangeable Magnesium	----	0.2	meq/100g	0.4	0.9	1.0	0.8	0.6
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	0.3	0.3	0.3	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	0.9	1.5	1.6	1.6	0.6
ø Cation Exchange Capacity	----	0.2	meq/100g	3.3	5.4	6.8	5.5	2.9
ø Exchangeable Sodium Percent	----	0.2	%	27.5	28.1	24.1	29.3	22.5
ø Calcium/Magnesium Ratio	----	0.2	-	4.3	3.0	3.7	3.2	2.5
ø Magnesium/Potassium Ratio	----	0.2	-	----	2.8	3.7	2.7	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	9060	3330	12700	6400	3620
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	8800	2990	12500	6230	3450
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	253	337	253	168	168
ED038A: Acidity								
Acidity	----	1	mg/kg	<5	<5	<5	<5	<5
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	560	670	830	820	500
Potassium	7440-09-7	50	mg/kg	940	1150	1280	920	890
Calcium	7440-70-2	50	mg/kg	13500	8320	14500	8040	2270
Magnesium	7439-95-4	50	mg/kg	2890	2790	5110	2910	1110
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	600	970	1010	1120	800
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Iron	7439-89-6	50	mg/kg	20800	14800	28200	17300	5100
Phosphorus	7723-14-0	50	mg/kg	<50	<50	100	110	<50
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	6.0	5.3	6.5	6.4	2.2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Composite 2	Composite 3	Composite 4	Composite 5	Composite 6
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00
Compound	CAS Number	LOR	Unit	EB2002443-006	EB2002443-007	EB2002443-008	EB2002443-009	EB2002443-010
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Selenium	7782-49-2	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
Cobalt	7440-48-4	0.1	mg/kg	3.4	3.9	7.1	7.3	3.6
Chromium	7440-47-3	0.1	mg/kg	9.1	9.5	8.7	6.6	6.9
Copper	7440-50-8	0.1	mg/kg	3.7	7.8	5.8	17.9	8.6
Thorium	7440-29-1	0.1	mg/kg	2.1	1.7	2.4	2.8	1.1
Manganese	7439-96-5	0.1	mg/kg	395	174	507	252	61.7
Molybdenum	7439-98-7	0.1	mg/kg	0.2	0.4	0.4	0.2	0.4
Nickel	7440-02-0	0.1	mg/kg	18.9	11.7	18.1	19.3	8.7
Lead	7439-92-1	0.1	mg/kg	4.6	10.3	8.1	12.3	9.6
Antimony	7440-36-0	0.1	mg/kg	0.4	<0.1	<0.1	<0.1	<0.1
Uranium	7440-61-1	0.1	mg/kg	0.4	0.3	1.0	0.3	0.4
Zinc	7440-66-6	0.5	mg/kg	7.7	38.0	31.6	57.9	36.0
Vanadium	7440-62-2	1	mg/kg	12	16	20	21	11
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	150	210	180	250	150
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	0.29	0.65	0.84	2.23	0.49

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Composite 7	Composite 8	Composite 9	Composite 10	----
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	----
Compound	CAS Number	LOR	Unit	EB2002443-011	EB2002443-012	EB2002443-013	EB2002443-014	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.0	9.3	9.3	9.4	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	188	233	88	347	----
EA031: pH (saturated paste)								
ø pH (Saturated Paste)	----	0.1	pH Unit	8.1	8.1	8.4	8.3	----
EA032: Electrical Conductivity (saturated paste)								
ø Electrical Conductivity (Saturated Paste)	----	1	µS/cm	534	578	490	690	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	2.4	1.7	2.4	2.2	----
ø Exchangeable Magnesium	----	0.2	meq/100g	0.6	0.6	0.9	0.4	----
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	0.2	0.4	0.3	----
ø Exchangeable Sodium	----	0.2	meq/100g	1.0	0.9	1.4	1.8	----
ø Cation Exchange Capacity	----	0.2	meq/100g	4.3	3.5	5.1	4.6	----
ø Exchangeable Sodium Percent	----	0.2	%	23.9	25.7	28.0	38.4	----
ø Calcium/Magnesium Ratio	----	0.2	-	4.2	2.8	2.6	5.0	----
ø Magnesium/Potassium Ratio	----	0.2	-	2.3	2.8	2.6	1.6	----
ED037: Alkalinity								
ø Total Alkalinity as CaCO3	----	1	mg/kg	1980	1560	1350	12200	----
ø Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	1810	1470	1260	12000	----
ø Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	168	84	84	168	----
ED038A: Acidity								
Acidity	----	1	mg/kg	<5	<5	<5	<5	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	670	610	770	850	----
Potassium	7440-09-7	50	mg/kg	980	1020	1110	1010	----
Calcium	7440-70-2	50	mg/kg	2930	2310	1200	11300	----
Magnesium	7439-95-4	50	mg/kg	1330	3300	730	3350	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1070	1010	1080	1010	----
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	----
Iron	7439-89-6	50	mg/kg	4860	17700	12700	35100	----
Phosphorus	7723-14-0	50	mg/kg	<50	<50	<50	70	----
EG020T: Total Metals by ICP-MS								
Arsenic	7440-38-2	0.1	mg/kg	2.2	3.2	2.8	4.4	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Composite 7	Composite 8	Composite 9	Composite 10	----
			Client sampling date / time	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	20-Jan-2020 00:00	----
Compound	CAS Number	LOR	Unit	EB2002443-011	EB2002443-012	EB2002443-013	EB2002443-014	--------
				Result	Result	Result	Result	----
EG020T: Total Metals by ICP-MS - Continued								
Selenium	7782-49-2	1	mg/kg	<1	<1	<1	<1	----
Cadmium	7440-43-9	0.1	mg/kg	<0.1	<0.1	<0.1	0.1	----
Cobalt	7440-48-4	0.1	mg/kg	5.1	3.0	3.8	10.0	----
Chromium	7440-47-3	0.1	mg/kg	5.1	3.4	1.8	5.2	----
Copper	7440-50-8	0.1	mg/kg	22.8	21.9	23.4	23.8	----
Thorium	7440-29-1	0.1	mg/kg	1.5	0.7	0.5	1.2	----
Manganese	7439-96-5	0.1	mg/kg	46.2	80.9	36.6	207	----
Molybdenum	7439-98-7	0.1	mg/kg	0.2	0.1	0.2	1.0	----
Nickel	7440-02-0	0.1	mg/kg	13.7	8.0	7.8	21.8	----
Lead	7439-92-1	0.1	mg/kg	12.0	14.5	14.2	15.0	----
Antimony	7440-36-0	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----
Uranium	7440-61-1	0.1	mg/kg	0.3	0.4	0.3	0.4	----
Zinc	7440-66-6	0.5	mg/kg	41.4	44.7	61.9	67.0	----
Vanadium	7440-62-2	1	mg/kg	12	12	8	30	----
EK040T: Fluoride Total								
Fluoride	16984-48-8	40	mg/kg	180	260	280	260	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	2.42	2.96	6.38	5.05	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2005519**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 27-Feb-2020 15:50
Order number	: -	Date Analysis Commenced	: 28-Feb-2020
C-O-C number	: 8679	Issue Date	: 05-Mar-2020 17:18
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri_L1		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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*
Dave Gitsham	Metals Instrument Chemist	Brisbane Inorganics, Stafford, QLD
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.

- 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-1	KLC-2	KLC-3	KLC-4	KLC-5
Client sampling date / time				27-Feb-2020 10:22	27-Feb-2020 14:28	27-Feb-2020 11:11	27-Feb-2020 14:28	27-Feb-2020 11:08
Compound	CAS Number	LOR	Unit	EB2005519-001	EB2005519-002	EB2005519-003	EB2005519-004	EB2005519-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.68	8.76	8.94	8.74	8.24
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1020	818	741	508	726
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	25	23	35	24	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	166	142	181	144	209
Total Alkalinity as CaCO3	----	1	mg/L	190	165	216	168	209
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	86	64	41	23	36
Silicon as SiO2	14464-46-1	0.1	mg/L	9.3	8.9	10.6	8.8	10.6
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	228	173	108	62	100
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	15	15	18	11	14
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	4	4	4	5
Magnesium	7439-95-4	1	mg/L	2	2	1	<1	2
Sodium	7440-23-5	1	mg/L	223	170	157	106	157
Potassium	7440-09-7	1	mg/L	6	6	5	4	6
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.04	1.14	0.92	1.09	1.03
Antimony	7440-36-0	0.001	mg/L	0.030	0.019	0.033	0.014	0.027
Arsenic	7440-38-2	0.001	mg/L	0.170	0.104	0.563	0.270	0.367
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.087	0.059	0.087	0.052	0.097
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	0.0001	0.0001	<0.0001	0.0002
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-1	KLC-2	KLC-3	KLC-4	KLC-5
			Client sampling date / time	27-Feb-2020 10:22	27-Feb-2020 14:28	27-Feb-2020 11:11	27-Feb-2020 14:28	27-Feb-2020 11:08
Compound	CAS Number	LOR	Unit	EB2005519-001	EB2005519-002	EB2005519-003	EB2005519-004	EB2005519-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.001**	**0.001**	**0.002**
Cobalt	7440-48-4	0.001	mg/L	**0.004**	**0.002**	**0.002**	**0.001**	**0.002**
Copper	7440-50-8	0.001	mg/L	**0.002**	**0.001**	<0.001	<0.001	**0.001**
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.007**	**0.006**	**0.019**	**0.012**	**0.010**
Manganese	7439-96-5	0.001	mg/L	**0.001**	<0.001	<0.001	**0.001**	**0.001**
Molybdenum	7439-98-7	0.001	mg/L	**0.680**	**0.434**	**0.453**	**0.188**	**0.725**
Nickel	7440-02-0	0.001	mg/L	**0.010**	**0.007**	**0.009**	**0.006**	**0.010**
Rubidium	7440-17-7	0.001	mg/L	**0.011**	**0.009**	**0.009**	**0.006**	**0.012**
Selenium	7782-49-2	0.01	mg/L	**0.02**	**0.02**	**0.06**	**0.03**	**0.11**
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.100**	**0.084**	**0.097**	**0.070**	**0.102**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	**0.01**
Uranium	7440-61-1	0.001	mg/L	**0.004**	**0.002**	**0.006**	**0.003**	**0.006**
Vanadium	7440-62-2	0.01	mg/L	**0.01**	<0.01	**0.02**	**0.02**	**0.08**
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	**0.005**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.06**	**0.07**
Tungsten	7440-33-7	0.001	mg/L	**0.004**	**0.002**	**0.005**	**0.002**	**0.002**
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.9**	**1.7**	**3.7**	**1.9**	**2.4**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**9.21**	----	----	----	**6.93**
ø Total Anions	----	0.01	meq/L	----	**7.32**	**7.07**	**4.96**	----
ø Total Cations	----	0.01	meq/L	**10.2**	**7.91**	**7.24**	**4.91**	**7.40**
ø Ionic Balance	----	0.01	%	**5.18**	----	----	----	**3.25**
ø Ionic Balance	----	0.01	%	----	**3.88**	**1.16**	**0.46**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	27-Feb-2020 10:21	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2005519-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.33	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	347	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	3	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	98	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	101	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	17	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	7.0	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	47	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	8	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	----	----	----	----
Magnesium	7439-95-4	1	mg/L	1	----	----	----	----
Sodium	7440-23-5	1	mg/L	76	----	----	----	----
Potassium	7440-09-7	1	mg/L	4	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.34	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	0.013	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.143	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	0.042	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	27-Feb-2020 10:21	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2005519-006	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	**0.002**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.005**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.281**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.008**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.04**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.057**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	**0.04**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.05**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.07**	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.3**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**3.41**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**3.64**	----	----	----	----
ø Ionic Balance	----	0.01	%	**3.32**	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2008519**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 26-Mar-2020 15:15
Order number	: -	Date Analysis Commenced	: 27-Mar-2020
C-O-C number	: 9693	Issue Date	: 02-Apr-2020 09:28
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri_L2		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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	26-Mar-2020 10:50	26-Mar-2020 10:50	26-Mar-2020 10:51	26-Mar-2020 10:52	26-Mar-2020 10:53
Compound	CAS Number	LOR	Unit	EB2008519-001	EB2008519-002	EB2008519-003	EB2008519-004	EB2008519-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.67	8.76	8.58	8.67	8.51
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1360	1050	963	891	1050
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	49	32	34	36	32
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	337	152	319	198	383
Total Alkalinity as CaCO3	----	1	mg/L	386	184	353	234	415
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	92	96	36	54	34
Silicon as SiO2	14464-46-1	0.1	mg/L	11.4	14.5	13.8	13.5	12.8
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	278	287	110	162	108
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	12	10	13	16	16
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	4	5	4	6
Magnesium	7439-95-4	1	mg/L	2	2	2	1	2
Sodium	7440-23-5	1	mg/L	315	228	221	192	243
Potassium	7440-09-7	1	mg/L	6	4	5	5	6
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.11	0.78	0.46	1.15	0.07
Antimony	7440-36-0	0.001	mg/L	0.011	0.058	0.018	0.044	0.004
Arsenic	7440-38-2	0.001	mg/L	0.150	0.103	0.158	0.185	0.116
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.079	0.038	0.129	0.090	0.158
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0005	0.0002	0.0003	0.0002	0.0005
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

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-Mar-2020 10:50	26-Mar-2020 10:50	26-Mar-2020 10:51	26-Mar-2020 10:52	26-Mar-2020 10:53
Compound	CAS Number	LOR	Unit	EB2008519-001	EB2008519-002	EB2008519-003	EB2008519-004	EB2008519-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.004**	**0.003**	**0.002**	**0.002**	**0.002**
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	<0.001	**0.002**	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.010**	**0.009**	**0.044**	**0.035**	**0.024**
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.002**	**0.002**	**0.002**	**0.001**
Molybdenum	7439-98-7	0.001	mg/L	**0.975**	**0.460**	**0.641**	**0.446**	**0.984**
Nickel	7440-02-0	0.001	mg/L	**0.008**	**0.009**	**0.007**	**0.011**	**0.008**
Rubidium	7440-17-7	0.001	mg/L	**0.011**	**0.009**	**0.011**	**0.011**	**0.015**
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.03**	<0.01	**0.09**	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.130**	**0.085**	**0.145**	**0.122**	**0.153**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.007**	**0.005**	**0.013**	**0.011**	**0.019**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	**0.006**	**0.007**	**0.006**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.08**	<0.05
Tungsten	7440-33-7	0.001	mg/L	**0.002**	<0.001	**0.001**	**0.001**	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**2.0**	**1.9**	**4.4**	**4.3**	**1.8**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**13.8**	**9.93**	**9.71**	**8.50**	**11.0**
ø Total Cations	----	0.01	meq/L	**14.2**	**10.4**	**10.2**	**8.76**	**11.2**
ø Ionic Balance	----	0.01	%	**1.36**	**2.21**	**2.24**	**1.52**	**0.88**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	26-Mar-2020 10:53	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2008519-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.51**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**475**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**14**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**101**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**115**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**32**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**10.0**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**101**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**7**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
Sodium	7440-23-5	1	mg/L	**104**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.73**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.035**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.098**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.059**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**KLC-6**	----	----	----	----
			Client sampling date / time	26-Mar-2020 10:53	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2008519-006**	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.009**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.274**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.004**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.008**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.10**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.055**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	**0.01**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.005**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.04**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.06**	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.5**	----	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**4.60**	----	----	----	----
ø **Total Cations**	----	0.01	meq/L	**4.75**	----	----	----	----
ø **Ionic Balance**	----	0.01	%	**1.63**	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2011635**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 30-Apr-2020 14:50
Order number	: -	Date Analysis Commenced	: 01-May-2020
C-O-C number	: 10689	Issue Date	: 07-May-2020 09:19
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri_L3		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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
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.

- 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	KLC-1	KLC-2	KLC-3	KLC-4	KLC-5
Client sampling date / time				30-Apr-2020 11:26	30-Apr-2020 11:27	30-Apr-2020 11:28	30-Apr-2020 11:28	30-Apr-2020 11:29
				EB2011635-001	EB2011635-002	EB2011635-003	EB2011635-004	EB2011635-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.61	8.69	8.39	8.61	8.45
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1360	1040	1020	875	1070
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	41	23	20	23	22
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	425	166	419	201	461
Total Alkalinity as CaCO3	----	1	mg/L	466	188	439	224	483
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	71	89	25	50	22
Silicon as SiO2	14464-46-1	0.1	mg/L	12.1	14.4	12.9	14.0	13.6
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	190	238	74	141	65
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	12	8	11	10	13
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	4	6	5	7
Magnesium	7439-95-4	1	mg/L	2	2	2	2	2
Sodium	7440-23-5	1	mg/L	316	215	241	185	251
Potassium	7440-09-7	1	mg/L	6	3	4	4	6
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.07	0.20	0.07	1.06	0.03
Antimony	7440-36-0	0.001	mg/L	0.004	0.038	0.005	0.033	0.002
Arsenic	7440-38-2	0.001	mg/L	0.144	0.075	0.102	0.099	0.096
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.063	0.030	0.137	0.072	0.160
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0004	0.0001	0.0003	0.0001	0.0004
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

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-2020 11:26	30-Apr-2020 11:27	30-Apr-2020 11:28	30-Apr-2020 11:28	30-Apr-2020 11:29
Compound	CAS Number	LOR	Unit	EB2011635-001	EB2011635-002	EB2011635-003	EB2011635-004	EB2011635-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.003**	**0.002**	**0.002**	**0.002**	**0.001**
Copper	7440-50-8	0.001	mg/L	**0.006**	**0.001**	<0.001	**0.002**	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.010**	**0.009**	**0.061**	**0.042**	**0.029**
Manganese	7439-96-5	0.001	mg/L	**0.003**	**0.002**	**0.004**	**0.003**	**0.002**
Molybdenum	7439-98-7	0.001	mg/L	**0.850**	**0.308**	**0.552**	**0.219**	**0.791**
Nickel	7440-02-0	0.001	mg/L	**0.006**	**0.006**	**0.006**	**0.007**	**0.007**
Rubidium	7440-17-7	0.001	mg/L	**0.010**	**0.006**	**0.010**	**0.009**	**0.014**
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.02**	<0.01	**0.07**	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.112**	**0.084**	**0.156**	**0.123**	**0.158**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.006**	**0.005**	**0.015**	**0.010**	**0.024**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	**0.008**	<0.005
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.09**	<0.05
Tungsten	7440-33-7	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.9**	**1.7**	**3.2**	**3.8**	**1.5**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	----	----	----	**7.89**	----
ø Total Anions	----	0.01	meq/L	**13.6**	**8.94**	**10.6**	----	**11.4**
ø Total Cations	----	0.01	meq/L	**14.3**	**9.79**	**11.0**	**8.56**	**11.6**
ø Ionic Balance	----	0.01	%	----	----	----	**4.09**	----
ø Ionic Balance	----	0.01	%	**2.36**	**4.57**	**1.97**	----	**0.94**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	30-Apr-2020 11:29	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2011635-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.43**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**586**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**6**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**122**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**128**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**39**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**9.9**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**116**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**6**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**118**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.14**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.018**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.062**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.046**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	30-Apr-2020 11:29	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2011635-006	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.012**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.181**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.004**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.006**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.10**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.066**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.006**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.02**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.05**	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.3**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**5.14**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**5.44**	----	----	----	----
ø Ionic Balance	----	0.01	%	**2.83**	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2014216**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 28-May-2020 16:20
Order number	: -	Date Analysis Commenced	: 01-Jun-2020
C-O-C number	: 11472	Issue Date	: 04-Jun-2020 09:00
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri_L4		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

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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.

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.
~ = 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	28-May-2020 12:55	28-May-2020 12:55	28-May-2020 12:56	28-May-2020 12:56	28-May-2020 12:56
Compound	CAS Number	LOR	Unit	EB2014216-001	EB2014216-002	EB2014216-003	EB2014216-004	EB2014216-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.73	8.67	8.68	8.66	8.65
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1240	828	994	795	1020
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	50	20	44	24	44
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	435	158	428	187	460
Total Alkalinity as CaCO3	----	1	mg/L	485	178	472	211	504
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	53	61	19	41	16
Silicon as SiO2	14464-46-1	0.1	mg/L	10.5	10.2	12.3	10.6	12.3
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	154	180	55	125	47
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	11	5	10	5	12
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	4	4	5	5	6
Magnesium	7439-95-4	1	mg/L	2	1	2	2	2
Sodium	7440-23-5	1	mg/L	294	174	233	168	238
Potassium	7440-09-7	1	mg/L	4	3	4	4	6
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.04	0.76	0.03	0.52	0.01
Antimony	7440-36-0	0.001	mg/L	0.003	0.026	0.003	0.025	0.001
Arsenic	7440-38-2	0.001	mg/L	0.120	0.046	0.080	0.056	0.079
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.060	0.028	0.140	0.063	0.162
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0004	<0.0001	0.0002	<0.0001	0.0003
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

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-2020 12:55	28-May-2020 12:55	28-May-2020 12:56	28-May-2020 12:56	28-May-2020 12:56
Compound	CAS Number	LOR	Unit	EB2014216-001	EB2014216-002	EB2014216-003	EB2014216-004	EB2014216-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.002**	**0.002**	**0.001**	**0.001**	**0.001**
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	**0.001**	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.009**	**0.007**	**0.063**	**0.042**	**0.030**
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.002**	**0.004**	**0.003**	**0.002**
Molybdenum	7439-98-7	0.001	mg/L	**0.648**	**0.140**	**0.416**	**0.091**	**0.623**
Nickel	7440-02-0	0.001	mg/L	**0.005**	**0.004**	**0.005**	**0.004**	**0.006**
Rubidium	7440-17-7	0.001	mg/L	**0.008**	**0.006**	**0.009**	**0.007**	**0.013**
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.02**	<0.01	**0.06**	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.108**	**0.074**	**0.160**	**0.125**	**0.160**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.005**	**0.004**	**0.012**	**0.008**	**0.024**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.006**	<0.005	**0.006**	**0.007**
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	**0.05**	<0.05
Tungsten	7440-33-7	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.6**	**1.2**	**2.7**	**3.1**	**1.4**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	----	----	----	**7.24**	----
ø Total Anions	----	0.01	meq/L	**13.2**	**7.44**	**10.8**	----	**11.4**
ø Total Cations	----	0.01	meq/L	**13.2**	**7.93**	**10.6**	**7.82**	**11.0**
ø Ionic Balance	----	0.01	%	----	----	----	**3.89**	----
ø Ionic Balance	----	0.01	%	**0.18**	**3.14**	**0.96**	----	**1.87**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**KLC-6**	----	----	----	----
			Client sampling date / time	28-May-2020 12:57	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2014216-006**	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.45**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**607**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**8**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**115**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**123**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**42**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**7.5**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**128**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**5**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**123**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.27**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.012**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.045**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.041**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	28-May-2020 12:57	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2014216-006	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.013**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.106**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.006**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.10**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.080**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.006**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.02**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.2**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**5.26**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**5.71**	----	----	----	----
ø Ionic Balance	----	0.01	%	**4.06**	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2016805**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 25-Jun-2020 15:30
Order number	: -	Date Analysis Commenced	: 29-Jun-2020
C-O-C number	: 12109	Issue Date	: 02-Jul-2020 13:34
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri_L5		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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 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-1	KLC-2	KLC-3	KLC-4	KLC-5
			Client sampling date / time	25-Jun-2020 11:14	25-Jun-2020 11:14	25-Jun-2020 11:14	25-Jun-2020 11:15	25-Jun-2020 11:15
Compound	CAS Number	LOR	Unit	EB2016805-001	EB2016805-002	EB2016805-003	EB2016805-004	EB2016805-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.69	8.80	8.42	8.72	8.46
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1080	883	937	638	960
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	43	30	19	23	24
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	404	181	446	149	460
Total Alkalinity as CaCO3	----	1	mg/L	447	212	465	173	484
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	2	<1	6	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	36	63	13	29	11
Silicon as SiO2	14464-46-1	0.1	mg/L	8.9	7.1	10.6	6.8	11.0
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	174	39	92	34
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	9	4	8	3	8
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	4	5	4	6
Magnesium	7439-95-4	1	mg/L	1	2	2	1	2
Sodium	7440-23-5	1	mg/L	260	188	226	138	233
Potassium	7440-09-7	1	mg/L	3	3	4	3	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.06	0.77	0.02	0.81	0.01
Antimony	7440-36-0	0.001	mg/L	0.002	0.014	0.001	0.012	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.106	0.039	0.067	0.036	0.069
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.054	0.030	0.144	0.051	0.160
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0003	<0.0001	0.0002	<0.0001	0.0003
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

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-2020 11:14	25-Jun-2020 11:14	25-Jun-2020 11:14	25-Jun-2020 11:15	25-Jun-2020 11:15
Compound	CAS Number	LOR	Unit	EB2016805-001	EB2016805-002	EB2016805-003	EB2016805-004	EB2016805-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	**0.001**	**0.002**	**0.001**	**0.001**	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	<0.001	**0.002**	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.008**	**0.007**	**0.056**	**0.035**	**0.028**
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.001**	**0.004**	**0.001**	**0.002**
Molybdenum	7439-98-7	0.001	mg/L	**0.413**	**0.100**	**0.275**	**0.043**	**0.416**
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.004**	**0.005**	**0.004**	**0.005**
Rubidium	7440-17-7	0.001	mg/L	**0.007**	**0.006**	**0.008**	**0.006**	**0.011**
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.02**	<0.01	**0.04**	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.098**	**0.088**	**0.176**	**0.113**	**0.168**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	**0.01**	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.004**	**0.004**	**0.010**	**0.006**	**0.021**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	**0.006**	**0.007**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.05**	<0.05	**0.08**	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.6**	**1.2**	**3.0**	**2.2**	**1.3**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	----	----	----	**5.57**	----
ø Total Anions	----	0.01	meq/L	**11.4**	**7.97**	**10.3**	----	**10.6**
ø Total Cations	----	0.01	meq/L	**11.6**	**8.62**	**10.3**	**6.36**	**10.7**
ø Ionic Balance	----	0.01	%	----	----	----	**6.63**	----
ø Ionic Balance	----	0.01	%	**0.80**	**3.90**	**0.09**	----	**0.58**

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	25-Jun-2020 11:16	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2016805-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.54**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**549**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**10**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**101**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**111**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**38**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**5.8**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**115**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**4**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**107**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.38**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.007**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.034**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.036**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	25-Jun-2020 11:16	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2016805-006	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.012**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.056**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.005**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.08**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.074**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.006**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.01**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.1**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**4.72**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**4.96**	----	----	----	----
ø Ionic Balance	----	0.01	%	**2.46**	----	----	----	----

Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2020005**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 30-Jul-2020 16:40
Order number	:	Date Analysis Commenced	: 31-Jul-2020
C-O-C number	: 12958	Issue Date	: 05-Aug-2020 08:01
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri L6		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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.
- 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-Jul-2020 08:49	30-Jul-2020 08:50	30-Jul-2020 08:51	30-Jul-2020 08:51	30-Jul-2020 08:52
Compound	CAS Number	LOR	Unit	EB2020005-001	EB2020005-002	EB2020005-003	EB2020005-004	EB2020005-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.70	8.78	8.56	8.66	8.57
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1000	818	927	579	918
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	44	27	34	17	37
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	403	180	465	163	469
Total Alkalinity as CaCO3	----	1	mg/L	446	207	499	180	506
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	26	54	9	24	8
Silicon as SiO2	14464-46-1	0.1	mg/L	8.4	6.1	10.2	6.4	10.5
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	79	154	29	78	25
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	8	3	6	2	6
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	3	3	6	4	7
Magnesium	7439-95-4	1	mg/L	1	1	2	1	2
Sodium	7440-23-5	1	mg/L	262	192	244	137	240
Potassium	7440-09-7	1	mg/L	3	4	4	3	5
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.09	1.28	0.02	0.71	0.02
Antimony	7440-36-0	0.001	mg/L	0.002	0.013	0.002	0.013	0.001
Arsenic	7440-38-2	0.001	mg/L	0.106	0.039	0.066	0.030	0.065
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.053	0.033	0.155	0.051	0.162
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0002	<0.0001	<0.0001	<0.0001
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

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-Jul-2020 08:49	30-Jul-2020 08:50	30-Jul-2020 08:51	30-Jul-2020 08:51	30-Jul-2020 08:52
Compound	CAS Number	LOR	Unit	EB2020005-001	EB2020005-002	EB2020005-003	EB2020005-004	EB2020005-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	0.001	0.002	<0.001	0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	0.001	<0.001	0.002	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	0.007	0.007	0.070	0.035	0.029
Manganese	7439-96-5	0.001	mg/L	0.002	0.001	0.005	<0.001	0.003
Molybdenum	7439-98-7	0.001	mg/L	0.273	0.090	0.240	0.032	0.319
Nickel	7440-02-0	0.001	mg/L	0.003	0.004	0.004	0.004	0.004
Rubidium	7440-17-7	0.001	mg/L	0.007	0.007	0.009	0.006	0.011
Selenium	7782-49-2	0.01	mg/L	<0.01	0.01	<0.01	0.03	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	0.087	0.079	0.180	0.107	0.159
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	0.01	<0.01	0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	0.003	0.004	0.010	0.006	0.019
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	0.006	<0.005	0.006	0.007
Iron	7439-89-6	0.05	mg/L	<0.05	0.09	<0.05	0.07	<0.05
Tungsten	7440-33-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	1.7	1.2	3.0	1.8	1.3
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	10.8	7.43	10.7	5.28	10.8
ø Total Cations	----	0.01	meq/L	11.7	8.68	11.2	6.32	11.1
ø Ionic Balance	----	0.01	%	4.11	7.81	1.99	8.98	1.29

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	30-Jul-2020 08:53	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2020005-006	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.43**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**521**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**12**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**110**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**122**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**34**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**5.6**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**108**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**106**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.56**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.007**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.032**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.034**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-6	----	----	----	----
			Client sampling date / time	30-Jul-2020 08:53	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2020005-006	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.002**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.012**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.037**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.006**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.07**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.070**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	**0.01**	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.005**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.02**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	**0.06**	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.1**	----	----	----	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**4.77**	----	----	----	----
ø Total Cations	----	0.01	meq/L	**4.92**	----	----	----	----
ø Ionic Balance	----	0.01	%	**1.53**	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2022571**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Carsten Emrich
Address	: PO BOX 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3552 8616
Project	: 2018028_Boggabri	Date Samples Received	: 27-Aug-2020 16:56
Order number	:	Date Analysis Commenced	: 30-Aug-2020
C-O-C number	: 13595	Issue Date	: 04-Sep-2020 13:09
Sampler	: ALAN ROBERTSON		
Site	: 2018028_Boggabri-L7		
Quote number	: BN/1234/19		
No. of samples received	: 6		
No. of samples analysed	: 6		

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 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-1	KLC-2	KLC-3	KLC-4	KLC-5
			Client sampling date / time	27-Aug-2020 13:11	27-Aug-2020 13:11	27-Aug-2020 13:12	27-Aug-2020 13:12	27-Aug-2020 13:13
Compound	CAS Number	LOR	Unit	EB2022571-001	EB2022571-002	EB2022571-003	EB2022571-004	EB2022571-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.66**	**8.53**	**8.58**	**8.59**	**8.59**
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**921**	**918**	**884**	**554**	**876**
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	**37**	**18**	**33**	**19**	**33**
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**398**	**203**	**417**	**168**	**405**
Total Alkalinity as CaCO3	----	1	mg/L	**435**	**221**	**450**	**187**	**438**
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	<1
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**23**	**69**	**9**	**25**	**7**
Silicon as SiO2	14464-46-1	0.1	mg/L	**9.4**	**7.2**	**12.2**	**7.2**	**12.3**
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**68**	**194**	**26**	**76**	**20**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**7**	**4**	**5**	**2**	**5**
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**3**	**5**	**6**	**4**	**6**
Magnesium	7439-95-4	1	mg/L	**1**	**2**	**2**	**1**	**2**
Sodium	7440-23-5	1	mg/L	**222**	**205**	**211**	**123**	**205**
Potassium	7440-09-7	1	mg/L	**4**	**4**	**4**	**4**	**5**
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.11**	**0.87**	**0.04**	**0.46**	**0.02**
Antimony	7440-36-0	0.001	mg/L	**0.002**	**0.013**	**0.002**	**0.012**	<0.001
Arsenic	7440-38-2	0.001	mg/L	**0.107**	**0.034**	**0.068**	**0.028**	**0.066**
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	**0.053**	**0.034**	**0.154**	**0.054**	**0.152**
Bismuth	7440-69-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	**0.0001**	**0.0001**	<0.0001	**0.0001**
Indium	7440-74-6	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cerium	7440-45-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lanthanum	7439-91-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Caesium	7440-46-2	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	KLC-1	KLC-2	KLC-3	KLC-4	KLC-5
			Client sampling date / time	27-Aug-2020 13:11	27-Aug-2020 13:11	27-Aug-2020 13:12	27-Aug-2020 13:12	27-Aug-2020 13:13
Compound	CAS Number	LOR	Unit	EB2022571-001	EB2022571-002	EB2022571-003	EB2022571-004	EB2022571-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.002**	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	**0.004**	<0.001	**0.001**	<0.001
Ytterbium	7440-64-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Yttrium	7440-65-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Zirconium	7440-67-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
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	**0.007**	**0.008**	**0.063**	**0.034**	**0.026**
Manganese	7439-96-5	0.001	mg/L	**0.002**	<0.001	**0.005**	<0.001	**0.003**
Molybdenum	7439-98-7	0.001	mg/L	**0.180**	**0.103**	**0.173**	**0.025**	**0.238**
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.004**	**0.003**	**0.003**	**0.004**
Rubidium	7440-17-7	0.001	mg/L	**0.007**	**0.007**	**0.009**	**0.006**	**0.012**
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.02**	<0.01	**0.03**	<0.01
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Strontium	7440-24-6	0.001	mg/L	**0.077**	**0.098**	**0.170**	**0.108**	**0.147**
Tellurium	22541-49-7	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	7440-31-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium	7440-32-6	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium	7440-61-1	0.001	mg/L	**0.002**	**0.004**	**0.009**	**0.005**	**0.015**
Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	**0.009**	<0.005	**0.010**	**0.007**
Iron	7439-89-6	0.05	mg/L	<0.05	**0.06**	<0.05	**0.05**	<0.05
Tungsten	7440-33-7	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.8**	**1.4**	**3.0**	**2.1**	**1.5**
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**10.3**	**8.57**	**9.67**	**5.38**	**9.31**
ø Total Cations	----	0.01	meq/L	**9.99**	**9.43**	**9.74**	**5.73**	**9.51**
ø Ionic Balance	----	0.01	%	**1.55**	**4.81**	**0.36**	**3.23**	**1.06**

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			Client sample ID	**KLC-6**	----	----	----	----
			Client sampling date / time	27-Aug-2020 13:13	----	----	----	----
Compound	CAS Number	LOR	Unit	**EB2022571-006**	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.39**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**523**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**6**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**119**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**125**	----	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	----	----	----	----
ED040F: Dissolved Major Anions								
Sulfur as S	63705-05-5	1	mg/L	**38**	----	----	----	----
Silicon as SiO2	14464-46-1	0.1	mg/L	**6.8**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**114**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**4**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**108**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.12**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	**0.009**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	**0.033**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.038**	----	----	----	----
Bismuth	7440-69-9	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Indium	7440-74-6	0.001	mg/L	<0.001	----	----	----	----
Cerium	7440-45-1	0.001	mg/L	<0.001	----	----	----	----
Lanthanum	7439-91-0	0.001	mg/L	<0.001	----	----	----	----
Caesium	7440-46-2	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)			*Client sample ID*	**KLC-6**	----	----	----	----
			Client sampling date / time	27-Aug-2020 13:13	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	**EB2022571-006**	--------	--------	--------	--------
				Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	----	----	----	----
Ytterbium	7440-64-4	0.001	mg/L	<0.001	----	----	----	----
Yttrium	7440-65-5	0.001	mg/L	<0.001	----	----	----	----
Zirconium	7440-67-7	0.005	mg/L	<0.005	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Lithium	7439-93-2	0.001	mg/L	**0.013**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.031**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	----	----	----	----
Rubidium	7440-17-7	0.001	mg/L	**0.005**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	**0.07**	----	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**0.087**	----	----	----	----
Tellurium	22541-49-7	0.005	mg/L	<0.005	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	----	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	----	----	----	----
Tin	7440-31-5	0.001	mg/L	<0.001	----	----	----	----
Titanium	7440-32-6	0.01	mg/L	<0.01	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	**0.006**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.02**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.005	----	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	----	----	----	----
Tungsten	7440-33-7	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.2**	----	----	----	----
EN055: Ionic Balance								
ø **Total Anions**	----	0.01	meq/L	**4.93**	----	----	----	----
ø **Total Cations**	----	0.01	meq/L	**5.06**	----	----	----	----
ø **Ionic Balance**	----	0.01	%	**1.29**	----	----	----	----

RGS

MINE WASTE AND
WATER MANAGEMENT