Central Queensland Coal Project

Chapter 8 – Waste Rock and Rejects

Environmental Impact Statement

CDM Smith

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Central Queensland Coal Project

Chapter 8 – Waste Rock and Rejects

24 October 2017

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8 Waste Rock and Rejects

The purpose of this chapter is to describe the assessment undertaken to identify the potential for the Central Queensland Coal Project (herein referred to as 'the Project') to produce acid and/or metalliferous drainage (AMD), saline and sodic potential of waste rock and rejects and the risks and management measures to be implemented for the Project.

8.1 Project Overview

The Project is located 130 km northwest of Rockhampton in the Styx Coal Basin in Central Queensland. The Project will be located within Mining Lease (ML) 80187 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent.

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high grade thermal coal (HGTC). Development of the Project is expected to commence in 2018 and extend for approximately 20 years until the current reserve is depleted.

The Project consists of three open cut operations that will be mined using a truck and shovel methodology. The run-of-mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (Year 1-4), where coal will be crushed, screened and washed to SSCC grade with an estimate 80% yield. Stage 2 of the Project (Year 4-20) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2 and 4, will be in operation.

A new train loadout facility (TLF) will be developed to connect into the existing Queensland Rail North Coast Rail Line. This connection will allow the product coal to be transported to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT).

The Project is located within the Livingstone Shire Council (LSC) Local Government Area (LGA). The Project is generally located on the "Mamelon" property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on the "Strathmuir" property, described as real property Lot 9 on MC230. A small section of the haul road to the TLF is located on the "Brussels" property described as real property Lot 85 on SP164785.

8.2 Relevant Legislation and Guidelines

There is no specific guidance in Queensland for the number of samples to be collected from each mineral waste type, and the associated laboratory analytical program. In March 2016, the Western Australian Department of Mines and Petroleum (DMP) released draft guidance for characterising mineral wastes (DMPMAR15_3596), which has been considered in this assessment. Current industry best practice and guideline documents referred to in undertaking mine waste geochemical assessments include:

- Department of Minerals and Energy (DME) (1995a), Assessment and Management of Acid Drainage;
- DME (1995b), Guidelines for the Assessment and Management of Saline / Sodic Waste;

- Australian and New Zealand Environment and Conservation Council (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality;
- AMIRA (2002), Acid Rock Drainage (ARD) Test Handbook, Project P387A Prediction and Control of Acid Metalliferous Drainage;
- Department of Industry, Innovation and Science Australia (2016), Tailings Management, Leading Practice Sustainable Development Program for the Mining Industry;
- Department of Industry, Innovation and Science Australia (2016), Managing Acid and Metalliferous Drainage, Leading Practice Sustainable Development Program for the Mining Industry;
- International Network for Acid Prevention (2009), The Global Acid Rock Drainage (GARD) Guide, www.gardguide.com; and
- WA DMP (March 2016) Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals DMPMAR15_3596.

These abovementioned documents have been used as a guide for the development of this waste rock and rejects assessment.

8.2.1 Contaminated Land Guidelines

The primary environmental legislative requirements for the management of contaminated land in Queensland are contained within the *Environmental Protection Act 1994* (EP Act) and subsidiary regulations. The EP Act is administered by the Department of Environment and Heritage Protection (EHP). In Queensland, activities that have been identified as likely to cause land contamination are referred to as notifiable activities by EHP.

Notifiable activities are defined in Schedule 3 of the EP Act. Land parcels that have historically or are currently used for notifiable activities and are reported to the government are recorded on EHP's Environmental Management Register (EMR). Inclusion of a land parcel on the EMR does not necessarily mean that the land is contaminated, as it may or may not pose a risk to human health and/or the environment. Sites that have been demonstrated to pose a risk to human health and/or the environment will be included on EHP's Contaminated Land Register (CLR). Land parcels are recorded on the CLR when an investigation has identified that contaminants are present at concentrations that represent a risk to human health and, as such, action is required to remediate or manage the land to prevent adverse environmental and human health impacts.

Soil investigation thresholds referred to in Queensland to evaluate whether land may be contaminated are based on values presented in the *National Environment Protection (Assessment of Site Contamination) Measure* (NEPC 2013). This document presents investigation and screening levels reflecting the protection of environmental and human health. These investigations and screening levels are not intended for use as default remediation trigger criteria, rather they are intended to prompt an appropriate site-specific assessment when they are exceeded.

8.3 Environmental Objectives and Performance Criteria

The Project goal is that any waste generated, transported, or received as part of carrying out the activity is managed in a way that protects all Environmental Values (EVs). The specific objectives and performance outcomes to achieve this goal are outlined below.

8.3.1 Environmental Objectives

Ensure that potential pollution from waste rock is identified during the design, construction and operation of the Project and is managed in appropriate storages to prevent leachate and acid drainage.

8.3.2 Performance Outcomes

The performance outcomes for the management of mineral wastes generated by the Project are, as determined by the Terms of Reference:

- No unacceptable contamination of surface water and groundwater (refer to Section 8.7.2 on adopted assessment criteria);
- No acid and metal toxicity in the revegetation layers; and
- No post-closure pollution or long term liability.

8.4 Waste Rock Overview

8.4.1 Waste Rock

Waste rock comprises overburden and interburden material extracted as part of mining operations. Overburden is rock that sits above the uppermost target coal seam and is required to be removed to access the coal. Interburden is the rock material between the targeted coal seams. Waste rock generally consists of large sized, blocky material.

Rejects are the processing waste which includes rock and a very small amount of low-grade coal particulates that naturally occur within the deposit and extracted as part of the ROM coal. Rejects are removed during the crushing, screening and washing of the coal at the CHPP. The outputs from the CHPP are product coal, coarse rejects (particles sized between 1 mm and 120 mm) and tailings (particles less than 1 mm in size). All rejects will be dewatered before leaving the CHPP, which minimises risks associated with storage of wet tailings.

Coal deposits often occur in areas of sulfide-bearing rocks. When these rocks are broken, and exposed by mining and processing there is the potential for the sulfide minerals to oxidise (if oxygen is present). When sulfides are exposed to air and water, the sulfides oxidise to produce an acidic solution. The low pH in the acidic solution then dissolves heavy metals and metalloids present in the rock or water. This process is known as acid mine drainage (AMD) (Lottermoser, 2007). Releases or leaching of this acid mine water can adversely affect the surrounding environment, particularly as result of lowering the pH and quality characteristics of surface and groundwaters. This may consequently impact on aquatic vegetation, fauna and drinking water.

The potential for AMD depends on the presence of sulfide bearing materials, the reactivity of the sulfide and the buffering capacity of the waste rock to neutralise the acid release. Where some natural neutralisation occurs, for example at pH levels greater than 6 pH units, saline mine drainage

(SMD) or neutral mine drainage (NMD) can occur. NMD can also occur where the exposed waste materials are sodic (exchangeable sodium percentage (ESP) greater than six) and highly erodible, leading to both saline and sediment-laden mine drainage. The impacts of SMD and NMD are like those of AMD.

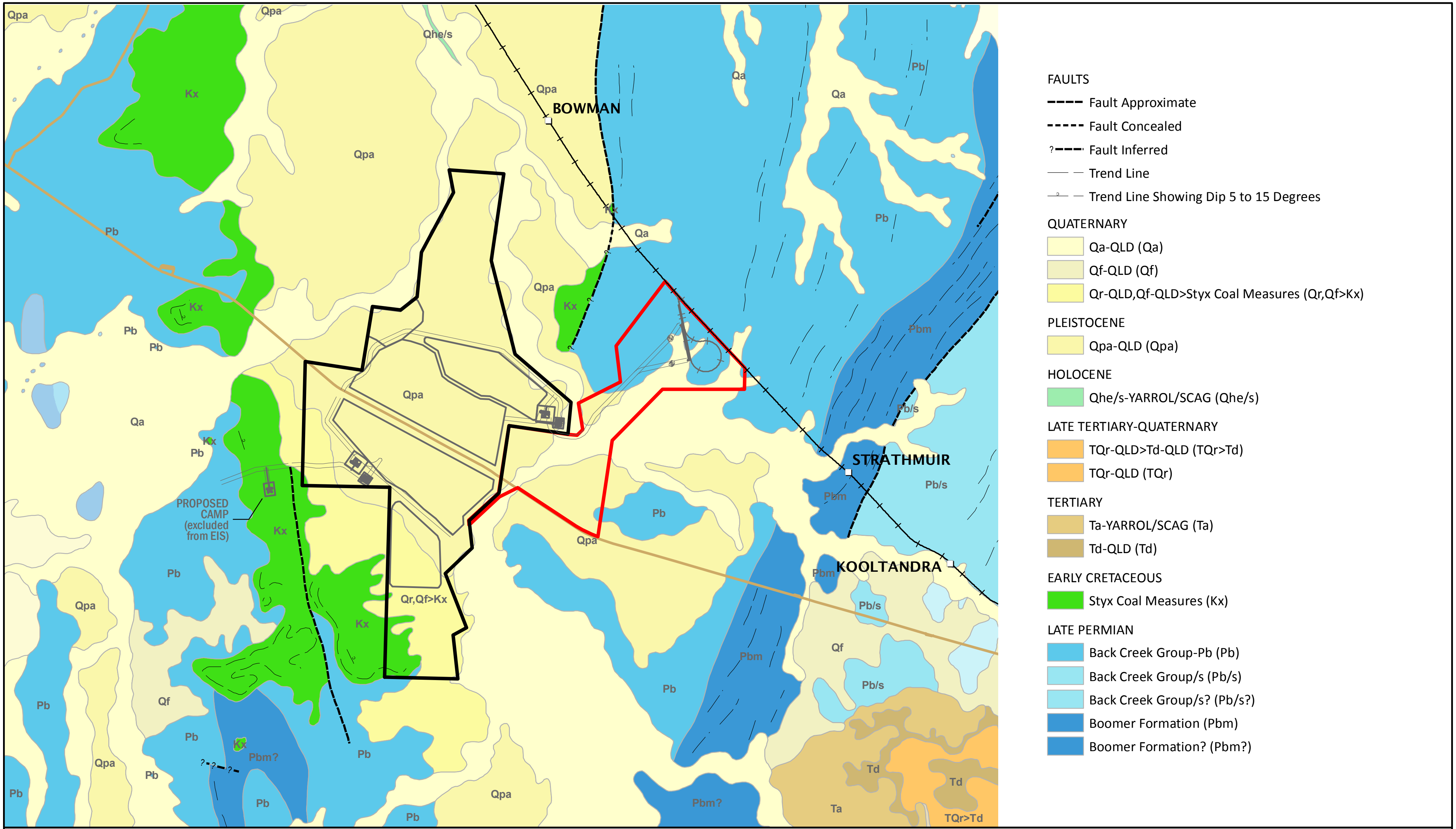
8.4.2 Regional Geology

The Styx Coal reserves lie in the Styx Basin, a small, Early Cretaceous, intracratonic sag basin that covers an area of approximately 300 km^2 onshore and 500 km^2 offshore. The known coal bearing strata of the basin are referred to as the Styx Coal Measures (see Figure 8-1) and consist of quartzose, calcareous, lithic and pebbly sandstones, pebbly conglomerate, siltstone, carbonaceous shale and coal. The environment of deposition was freshwater, deltaic to paludal with occasional marine incursions (Taubert, 2002).

The Styx Coal Measures are preserved as basin infill in a half graben geometry which has an overall plunge to the north. Earlier attempts to understand coal-seam geometry are thought to have been incorrect in assuming that the deposit was basically flat lying, rather than incorporating the north and east dipping components.

The Styx Basin is relatively undeveloped, except for two small scale, government owned mines that were in operation from 1919 to 1963. The Ogmore and Bowman collieries, located close to the north and northeast of ML80187 respectively, produced small qualities of low quality coal for use in steam trains and other boiler requirements (see Chapter 18 - Cultural Heritage).

A more complete description of the geology and stratigraphy of the Project area is provided in Chapter 3 – Description of the Project, at Section 3.3.



N

0 1 2 km

Legend

ML 80187

ML 700022

Proposed mine infrastructure

North Coast Rail Line

Main road

Scale @ A4 1:100,000
Date: 12/07/17
Drawn: Gayle B.

Figure 8-1

Regional geological map

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2016

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8.4.3 Local Stratigraphy

The stratigraphy of the Project area is shown at Figure 8-2 and described in Table 8-1. The coal seams are relatively shallow, and the average cumulative thickness of the full sequence of coal (Grey to V_L2 seams) is approximately 6 m, contained within a sequence of approximately 120 m of coal bearing strata.

The coal seams dip generally to the east in the area west of the Bruce Highway, with the Violet seam, the lowest coal seam in the sequence sub-cropping in the western part of ML80187. The deposit structure is currently interpreted to be a syncline structure, the axis of which runs northwest / southeast through the mine area. This structural interpretation follows the deposit structure originally described by Morten (1955).

Currently no faults have been interpreted, and the apparent undulation seen in the floor contours of the coal seams is interpreted to be the result of variations in interburden thickness, known to be common in the Basin.

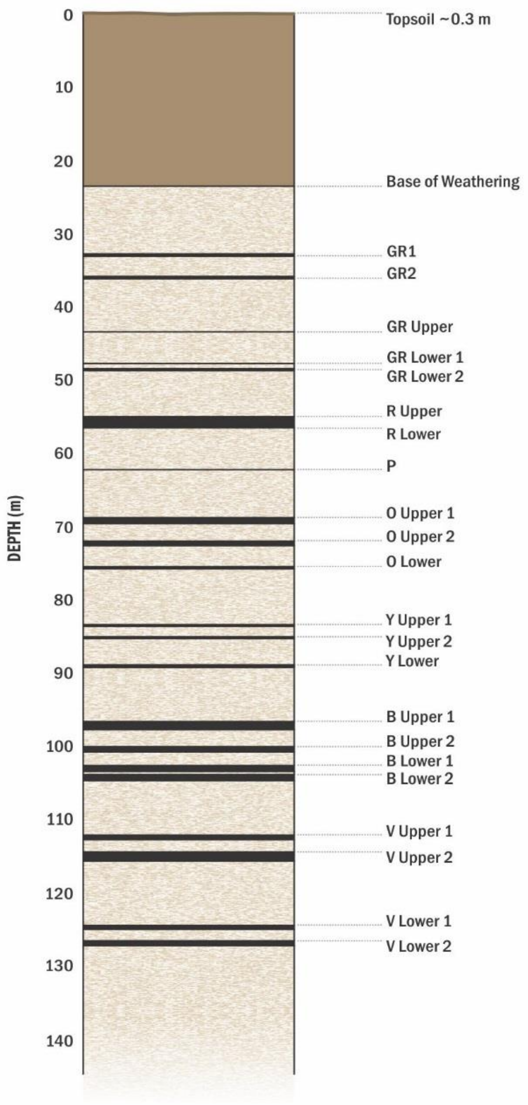


Figure 8-2 Schematic stratigraphic section

Table 8-1 Stratigraphic units of the Project mine

Period	Group	Sub-group/formation	Dominant lithology
Quaternary	Surficial	Quaternary Alluvial	Alluvium, coastal swamp deposits
Cainozoic	Surficial	Undifferentiated sediment	Sand, soil, alluvium, lateritic gravel
Lower Cretaceous	-	Styx Coal Measures	Quartz sandstone, conglomerate, siltstone, carbonaceous shale, coal
Upper Permian	Back Creek Group	Boomer Formation	Volcanolithic sandstone, claystone, siltstone, pebble conglomerate
Permian	Back Creek Group	Back Creek Group	Undifferentiated: fossiliferous volcanolithic sandstone, siltstone, limestone

8.4.4 Waste Rock Generation Rate

Rejects and tailings disposal will be conducted in accordance with the Project's Mineral Waste Management Plan. Over the life of the mine, the total volume of excavated waste rock from open cut activities (i.e. overburden and interburden) is expected to be approximately 558.4 million bank cubic metres (Mbcm). The estimation of tonnage and volumes of waste rock and subsoils to be excavated during each year both annually and cumulative is illustrated in Table 8-2.

The preferred method to dispose of mine waste is to truck rejects initially to ex-pit dump areas and as the open cuts develop and rejects to in-pit disposal cells. These materials will be hauled as back loads to disposal areas using coal haulage trucks after they deliver ROM coal to the ROM stockpile. An estimation of the dump schedule presented in Figure 8-3 to Figure 8-6.

Whilst the initial mining approach is based around truck and shovel operations, Central Queensland Coal will continue to review alternative mining methods to optimise product coal outputs. Other mining methods to improve resource recovery may be considered as the Project progresses. It is; however, unlikely that an alternative method would exceed the waste rock impacts considered here.

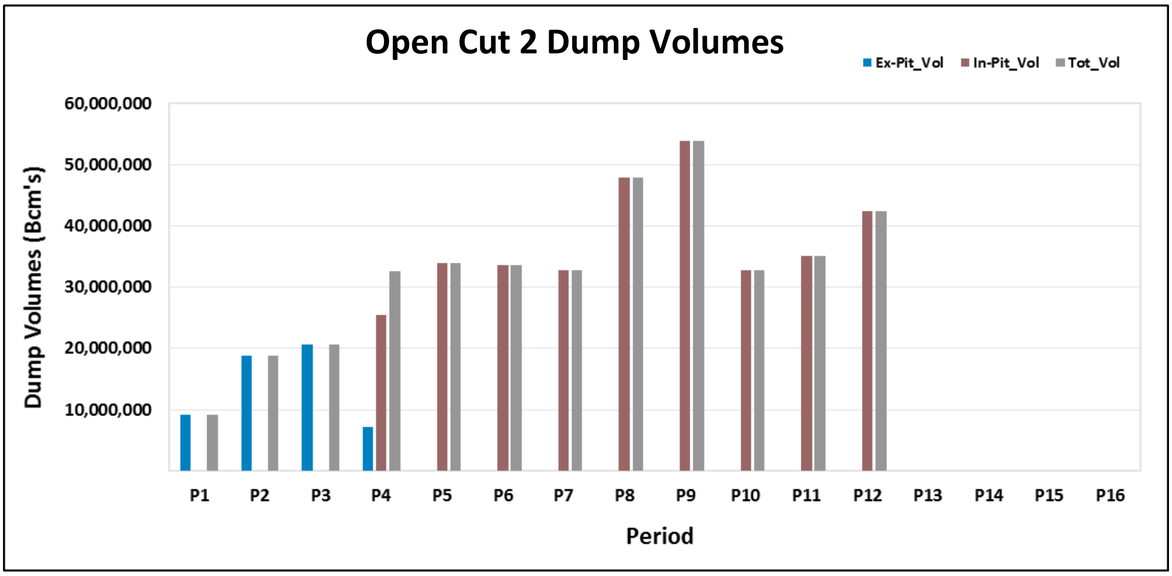


Figure 8-3 Waste material dump schedule – Open Cut 2

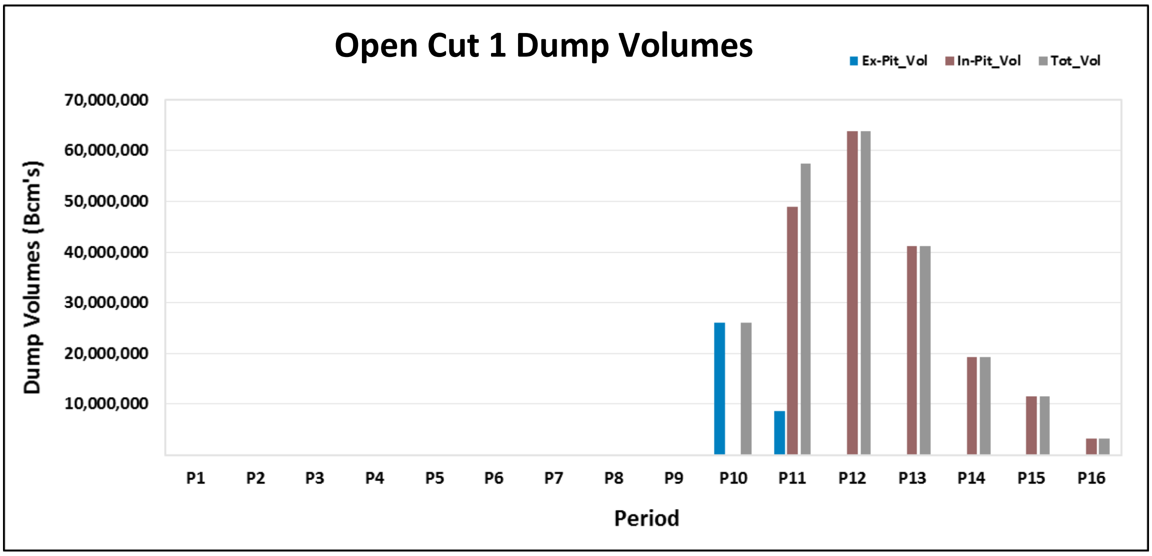


Figure 8-4 Waste material dump schedule – Open Cut 1

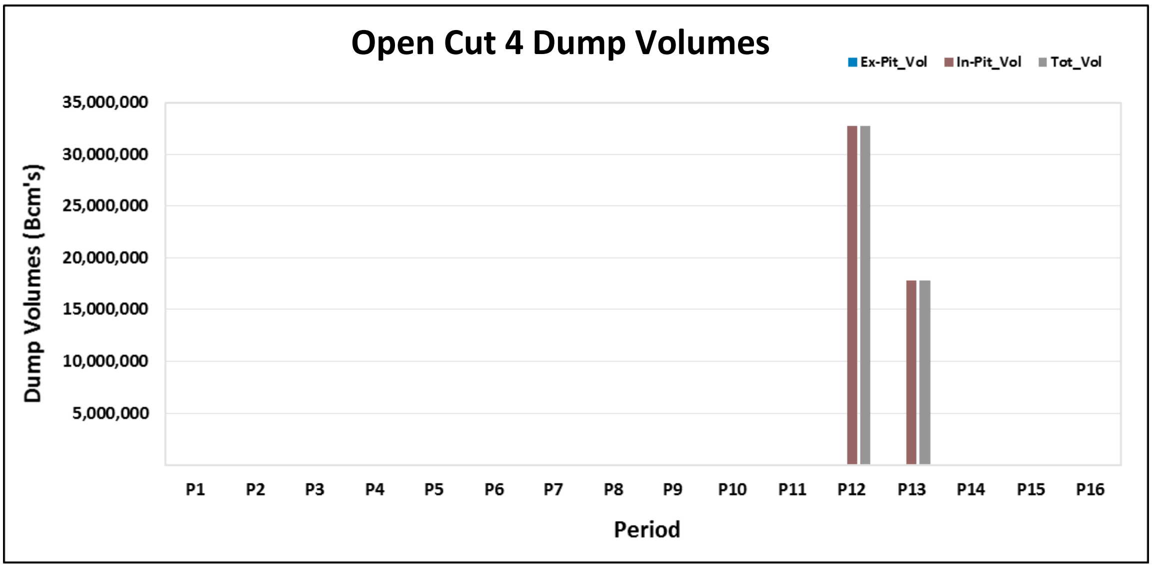


Figure 8-5 Waste material dump schedule – Open Cut 4

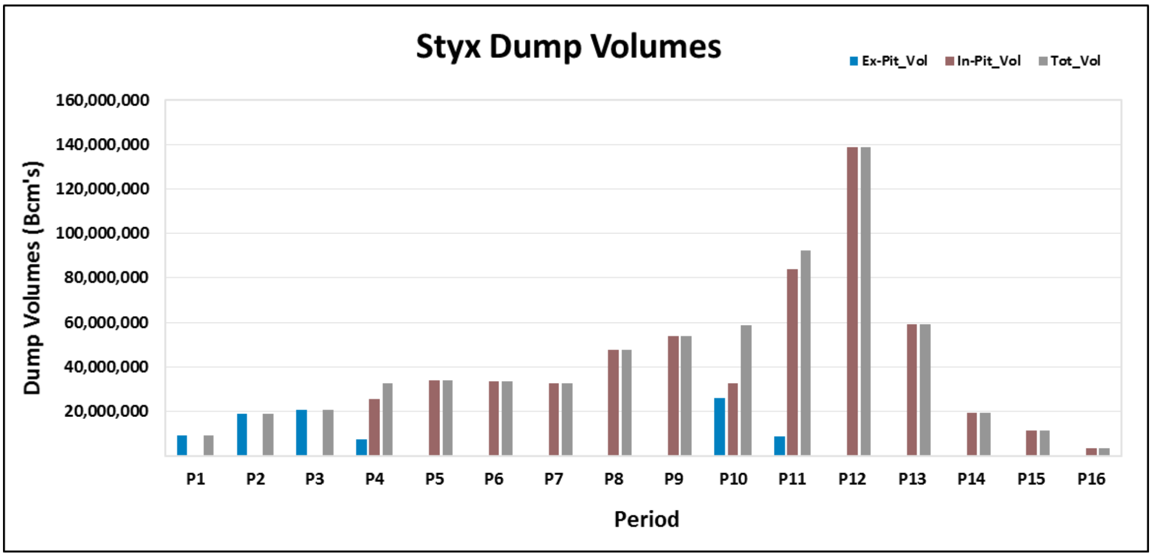


Figure 8-6 Waste material dump schedule – total volume

Table 8-2 Estimated waste material dump schedule

Dump Schedule												
Year	**Volume (bcm)**	**Accumulative Volume (bcm)**	**In-Pit Dump (bcm)**	**Ex-Pit dump (bcm)**	**In-pit Pit 2 (bcm)**	**In-pit Pit 1 (bcm)**	**Ex-pit Pit 2 (bcm)**	**Ex-pit Pit 1 (bcm)**	**In-pit Pit 4* (bcm)**	**CHPP Total Rejects (bcm)**	**CHPP 2 (bcm)**	**CHPP 1 (bcm)**
1	9,216,291	9,216,291	-	9,216,291	-		9,216,291			82,655	82,655	-
2	18,735,164	27,951,455	-	18,735,164	-		18,735,164			150,444	150,444	
3	20,695,724	48,647,179	-	20,695,724	-		20,695,724			150,910	150,910	
4	32,648,831	81,296,010	25,424,564	7,224,267	25,424,564		7,224,267			291,361	291,361	
5	33,850,728	115,146,738	33,850,728	-	33,850,728					281,292	281,292	
6	33,587,960	148,734,698	33,587,960	-	33,587,960					298,384	298,384	
7	32,722,286	181,456,984	32,722,286	-	32,722,286					324,845	324,845	
8	47,825,108	229,282,092	47,825,108	-	47,825,108					486,919	486,919	
9	53,810,048	283,092,140	53,810,048	-	53,810,048					547,301	547,301	
10	58,783,646	341,875,786	32,748,482	26,035,164	32,748,482			26,035,164		845,003	416,565	428,439
11	92,509,126	434,384,913	83,847,299	8,661,827	35,004,920	48,842,379		8,661,827		911,475	259,198	652,277
12	138,889,917	573,274,830	138,889,917	-	42,326,636	63,797,618			32,765,663	1,008,847	513,820	495,027
13	58,974,584	632,249,414	58,974,584	-	-	41,152,653			17,821,932	600,163	136,156	464,007
14	19,275,774	651,525,188	19,275,774	-	-	19,275,774				167,939		167,939
15	11,458,087	662,983,275	11,458,087	-	-	11,458,087				86,345		86,345
16	3,127,489	666,110,764	3,127,489	-	-	3,127,489				28,528		28,528
Total	**666,110,764**	**666,110,764**	**575,542,327**	**90,568,437**	**337,300,732**	**187,654,000**	**55,871,446**	**34,696,991**	**50,587,595**	**6,262,411**	**3,939,851**	**2,322,561**

*Open Cut 4 waste will report to Open Cut 2 for in-pit disposal

8.5 Study Methodology

8.5.1 Acid Generation and Saline Drainage Potential

It is important to understand the characteristics of waste rock, overburden and other materials to determine handling limitations and risks. Depending on the geological properties of the rock improper management may create environmental pollution through acid drainage or saline drainage. The physical and chemical characteristics of overburden and interburden have been determined through geochemical testing and compared with the relevant guidelines. The results are provided in Section 8.7.

8.5.2 Overburden and Waste Rock Assessment

An assessment of overburden and coal (as possible reject material) was undertaken by RGS Environmental Pty Ltd in 2012 to determine the potential environmental issues that may arise from the handling and treatment of these materials as part of the Project. The assessment primarily focused on potential acid-forming (PAF) materials and the potential for AMD to occur. The geochemical testing program used samples collected from coal resource assessment boreholes located in the proposed mine area and considered to be representative of geological conditions across the site.

Although dated, sample density guidelines for the assessment of overburden and interburden are provided in the 'Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland', specifically, the 'Guidelines for Assessment and Management of Acid Drainage' (DME 1995a) and the 'Guidelines for the Assessment and Management of Saline/Sodic Wastes' (DME 1995b). Guidance is also provided in WA DMP (March 2016). The guidelines outline the sampling intensity of overburden material based on a variety of factors, with the minimum number of samples to be determined by the mass of each separate rock/overburden type.

An outline of the drill hole, sample depth and lithology of samples analysed as part of RGS Environmental' s geochemical assessment is provided in Table 8-3, whilst the drill hole locations are presented in Figure 8-7.

Table 8-3 Geochemical sampling strategy

Drill hole	Depth from (m)	Depth to (m)	Lithology	Waste domain
STX083	27.40	27.90	Carbonaceous Mudstone	Overburden
STX083	17.70	18.10	Clay	Overburden
STX083	24.20	24.60	Sandstone	Overburden
STX083	39.20	39.65	Sandstone	Overburden
STX083	67.10	67.60	Sandstone	Overburden
STX083	47.45	48.00	Sandstone and Coal	Overburden
STX083	12.10	12.55	Siltstone	Overburden
STX083	38.50	38.90	Siltstone	Overburden
STX083	53.25	53.70	Siltstone	Overburden
STX083	74.60	75.00	Siltstone	Overburden
STX095	57.75	58.05	Carbonaceous Mudstone	Overburden
STX095	60.35	60.75	Mudstone	Overburden
STX095	69.30	69.75	Mudstone	Overburden
STX095	28.30	28.90	Mudstone and Coal	Overburden
STX095	24.40	24.70	Sandstone	Overburden
STX095	36.50	36.75	Sandstone	Overburden
STX095	42.75	43.15	Sandstone	Overburden

Drill hole	Depth from (m)	Depth to (m)	Lithology	Waste domain
STX095	51.75	52.05	Sandstone	Overburden
STX095	63.75	64.20	Sandstone	Overburden
	78.75	78.95	Sandstone	Overburden
	34.20	34.85	Sandstone and Coal	Overburden
	38.55	39.15	Siltstone and Coal	Overburden
	44.75	45.40	Siltstone and Coal	Overburden
	48.75	49.45	Siltstone and Coal	Overburden
STX099C	35.10	35.60	Coal and Mudstone (Floor)	Potential Reject
	30.47	30.77	Siltstone (Roof)	Potential Reject
	65.60	65.94	Carbonaceous Siltstone	Overburden
	68.60	69.00	Carbonaceous Siltstone	Overburden
	56.10	56.60	Carbonaceous Siltstone	Overburden
	44.20	44.60	Mudstone and Coal	Overburden
	20.50	21.00	Mudstone	Overburden
	26.60	27.00	Sandstone	Overburden
	41.10	41.60	Sandstone	Overburden
	51.20	51.50	Sandstone	Overburden
	62.60	63.00	Sandstone	Overburden
STX101C	60.25	60.65	Mudstone and Coal	Overburden
	67.90	68.18	Mudstone and Coal	Overburden
	43.60	44.00	Siltstone and Coal	Overburden
	19.55	20.05	Mudstone	Overburden
	50.54	50.85	Sandstone	Overburden
	59.85	60.15	Sandstone	Overburden
	35.50	36.01	Siltstone	Overburden
	38.85	39.20	Siltstone	Overburden
	23.13	23.75	Carbonaceous Mudstone (Floor)	Potential Reject
	53.85	54.05	Carbonaceous Mudstone (Floor)	Potential Reject
	28.57	28.97	Carbonaceous Mudstone (Floor)	Potential Reject
	21.59	21.89	Carbonaceous Mudstone (Roof)	Potential Reject
	27.85	28.17	Carbonaceous Mudstone (Roof)	Potential Reject
	52.72	52.92	Carbonaceous Mudstone (Roof)	Potential Reject
	42.36	42.56	Carbonaceous Mudstone (Floor)	Potential Reject
	41.60	42.10	Carbonaceous Mudstone (Roof)	Potential Reject
	70.94	71.34	Carbonaceous Siltstone (Floor:)	Potential Reject
	73.30	73.65	Carbonaceous Siltstone (Floor:)	Potential Reject
	71.85	72.10	Carbonaceous Siltstone (Roof)	Potential Reject
	42.10	42.36	Coal	Potential Reject
STX103C	26.60	27.00	Carbonaceous Mudstone	Overburden
	55.99	56.54	Carbonaceous Mudstone	Overburden
	70.70	71.20	Carbonaceous Mudstone	Overburden
	65.60	66.05	Mudstone	Overburden
	15.40	15.85	Sandstone	Overburden
	20.60	20.90	Sandstone	Overburden
	32.60	33.00	Sandstone	Overburden
	67.00	67.60	Sandstone	Overburden
	38.60	39.05	Siltstone	Overburden
	44.24	44.64	Siltstone	Overburden
	48.80	49.30	Siltstone	Overburden
	53.60	53.97	Siltstone	Overburden
	61.00	61.54	Siltstone	Overburden
	63.00	63.30	Siltstone	Overburden
STX104CR	30.22	30.54	Carbonaceous Mudstone	Overburden

Drill hole	Depth from (m)	Depth to (m)	Lithology	Waste domain
	81.23	81.70	Sandstone	Overburden
	87.00	87.44	Siltstone	Overburden
	97.45	98.10	Siltstone	Overburden
STX105	36.19	36.84	Carbonaceous Mudstone	Overburden
	50.74	51.49	Carbonaceous Mudstone	Overburden
	61.41	61.74	Carbonaceous Mudstone	Overburden
	68.74	69.21	Carbonaceous Mudstone	Overburden
	30.27	31.00	Sandstone	Overburden
	41.74	42.53	Sandstone	Overburden
	53.74	54.39	Sandstone	Overburden
	65.74	66.16	Sandstone	Overburden
	25.97	26.49	Siltstone	Overburden
	45.00	45.67	Siltstone	Overburden
STX122C	28.90	29.30	Carbonaceous Siltstone	Overburden
	36.40	37.00	Carbonaceous Siltstone	Overburden
	44.60	45.20	Carbonaceous Siltstone	Overburden
	67.32	67.58	Carbonaceous Siltstone	Overburden
	74.55	75.05	Carbonaceous Siltstone	Overburden
	39.60	40.00	Carbonaceous Siltstone and Coal	Overburden
	61.74	62.18	Mudstone and Coal	Overburden
	57.25	57.70	Sandstone and Coal	Overburden
	25.20	25.60	Siltstone and Coal	Overburden
	53.60	53.90	Sandstone	Overburden
	22.00	22.50	Siltstone	Overburden
STX124	60.30	60.60	Carbonaceous Mudstone	Overburden
	75.90	76.20	Carbonaceous Mudstone	Overburden
	50.60	51.00	Mudstone and Coal	Overburden
	23.60	24.13	Mudstone	Overburden
	47.60	48.14	Mudstone	Overburden
	38.60	38.96	Sandstone	Overburden
	58.95	59.50	Sandstone	Overburden
	71.60	72.00	Sandstone	Overburden
	29.60	30.08	Siltstone	Overburden
	53.60	54.05	Siltstone	Overburden
	32.08	32.60	Siltstone and Sandstone (Floor)	Potential Reject
STX134C	62.20	62.60	Carbonaceous Mudstone	Overburden
	74.10	74.50	Carbonaceous Mudstone	Overburden
	59.60	60.05	Carbonaceous Mudstone and Clay	Overburden
	74.60	78.10	Carbonaceous Mudstone and Coal	Overburden
	37.30	37.70	Sand/Siltstone	Overburden
	29.60	29.90	Sandstone	Overburden
	33.20	33.60	Sandstone	Overburden
	62.60	64.00	Sandstone	Overburden
	53.60	54.00	Sandstone and Siderite	Overburden
	23.15	23.60	Siltstone	Overburden
	35.00	35.40	Siltstone	Overburden
STX135C	11.60	12.10	Clay	Overburden
	22.00	22.50	Coal	Overburden
	42.00	42.50	Mudstone and Coal	Overburden
	56.60	57.10	Mudstone and Coal	Overburden
	31.25	31.58	Mudstone	Overburden
	50.00	50.60	Sandstone	Overburden
	70.00	70.35	Sandstone	Overburden

Drill hole	Depth from (m)	Depth to (m)	Lithology	Waste domain
	59.60	60.10	Siltstone	Overburden
	37.55	37.95	Mudstone (Floor)	Potential Reject
	35.50	36.15	Mudstone (Roof)	Potential Reject
STX136C	37.60	38.10	Siltstone and Coal	Overburden
	62.70	63.10	Siltstone and Coal	Overburden
	29.20	29.60	Mudstone	Overburden
	17.60	18.00	Sandstone	Overburden
	59.80	60.22	Sandstone	Overburden
	71.60	72.20	Sandstone	Overburden
	20.35	20.60	Sandstone and Carbonaceous Mudstone	Overburden
	74.00	74.60	Siltstone	Overburden
	13.96	14.42	Weathered Clay	Overburden
	51.96	52.30	Mudstone (Floor)	Potential Reject
	50.60	51.02	Mudstone (Roof)	Potential Reject
STX139C	50.60	50.85	Mudstone	Overburden
	43.40	43.90	Sandstone	Overburden
	46.95	47.25	Sandstone	Overburden
	53.50	53.85	Sandstone	Overburden
	59.85	60.15	Sandstone	Overburden
	71.85	72.50	Sandstone	Overburden
	33.85	34.30	Siltstone	Overburden
	48.35	48.65	Siltstone	Overburden
	35.90	36.50	Siltstone and Coal	Overburden
STX145C	95.60	95.95	Carbonaceous Mudstone	Overburden
	13.97	14.60	Carbonaceous Siltstone and Coal	Overburden
	26.80	27.30	Mudstone and Coal	Overburden
	20.30	20.60	Sandstone	Overburden
	35.60	36.10	Sandstone	Overburden
	119.00	119.60	Sandstone	Overburden
	23.60	24.10	Siltstone	Overburden
	44.60	44.94	Siltstone	Overburden
	72.00	72.50	Siltstone	Overburden
	49.50	49.90	Mudstone (Floor)	Potential Reject
	128.10	128.60	Mudstone Parting	Potential Reject
	101.90	102.50	Mudstone Parting	Potential Reject
	64.00	64.50	Mudstone and Siltstone (Floor)	Potential Reject
	61.30	61.80	Mudstone and Siltstone (Roof)	Potential Reject
	76.50	76.85	Siltstone (Floor)	Potential Reject
	83.90	84.25	Siltstone (Floor)	Potential Reject
	82.50	82.85	Siltstone (Roof)	Potential Reject

Source: RGS Environmental, 2012)

Additional geochemical testing was undertaken by RGS Environmental in 2012, using composites of selected samples, which are described in Table 8-4.

Table 8-4 Geochemical composite sample descriptions

Composite Number	Drill hole	Depth from (m)	Depth to (m)	Material Description	Waste domain
1	STX103C	26.60	27.00	Carbonaceous Mudstone	Overburden
	STX083	27.40	27.90		
	STX104CR	30.22	30.54		
	STX105	36.19	36.84		
2	STX105	50.74	51.49	Carbonaceous Mudstone	Overburden
	STX103C	55.99	56.54		
	STX095	57.75	58.05		
	STX124	60.30	60.60		
	STX105	61.41	61.74		
	STX134C	62.20	62.60		
	STX105	68.74	69.21		
	STX103C	70.70	71.20		
	STX134C	74.10	74.50		
	STX124	75.90	76.20		
3	STX101C	23.13	23.75	Carbonaceous Mudstone (Roof and Floor Mix)	Potential Coal Reject
	STX101C	53.85	54.05		
	STX101C	28.57	28.97		
	STX101C	21.59	21.89		
	STX101C	27.85	28.17		
	STX101C	52.72	52.92		
	STX101C	42.36	42.56		
	STX101C	41.60	42.10		
4	STX122C	28.90	29.30	Carbonaceous Siltstone (incl. some roof & floor)	Overburden
	STX122C	36.40	37.00		
	STX122C	44.60	45.20		
	STX099C	56.10	56.60		
	STX122C	67.32	67.58		
	STX122C	74.55	75.05		
	STX101C	70.94	71.34		
	STX101C	73.30	73.65		
	STX101C	71.85	72.10		
5	STX135C	42.00	42.50	Coal Mudstone	Overburden
	STX135C	56.60	57.10		
	STX101C	60.25	60.65		
	STX122C	61.74	62.18		
	STX148C	62.60	63.00		
	STX101C	67.90	68.18		
	STX099C	44.20	44.60		
6	STX101C	19.55	20.05	Mudstone	Overburden
	STX099C	20.50	21.00		
	STX124	23.60	24.13		
	STX136C	29.20	29.60		
	STX135C	31.25	31.58		
7	STX124	47.60	48.14	Mudstone	Overburden
	STX139C	50.60	50.85		
	STX148C	59.60	60.00		
	STX095	60.35	60.75		
	STX148C	64.00	64.47		
	STX103C	65.60	66.05		
	STX095	69.30	69.75		
8	STX135C	37.55	37.95	Mudstone Mix (inc.	Potential Coal Reject
	STX136C	51.96	52.30		

Composite Number	Drill hole	Depth from (m)	Depth to (m)	Material Description	Waste domain
	STX145C	49.50	49.90	parting, roof and floor) + some siltstone (x2 samples in total) + single sample of mud with coal	
	STX136C	50.60	51.02		
	STX135C	35.50	36.15		
	STX145C	128.10	128.60		
	STX145C	101.90	102.50		
	STX095	28.30	28.90		
	STX145C	64.00	64.50		
	STX145C	61.30	61.80		
9	STX103C	15.40	15.85	Sandstone	Overburden
	STX136C	17.60	18.00		
	STX145C	20.30	20.60		
	STX103C	20.60	20.90		
	STX083	24.20	24.60		
	STX095	24.40	24.70		
	STX099C	26.60	27.00		
	STX134C	29.60	29.90		
	STX105	30.27	31.00		
	STX103C	32.60	33.00		
	STX134C	33.20	33.60		
	STX145C	35.60	36.10		
	STX095	36.50	36.75		
	STX124	38.60	38.96		
	STX083	39.20	39.65		
10	STX099C	41.10	41.60	Sandstone	Overburden
	STX105	41.74	42.53		
	STX095	42.75	43.15		
	STX139C	43.40	43.90		
	STX139C	46.95	47.25		
	STX135C	50.00	50.60		
	STX101C	50.54	50.85		
	STX099C	51.20	51.50		
	STX095	51.75	52.05		
	STX139C	53.50	53.85		
	STX122C	53.60	53.90		
	STX105	53.74	54.39		
	STX124	58.95	59.50		
	STX136C	59.80	60.22		
	STX101C	59.85	60.15		
	STX139C	59.85	60.15		
11	STX099C	62.60	63.00	Sandstone	Overburden
	STX134C	62.60	64.00		
	STX095	63.75	64.20		
	STX105	65.74	66.16		
	STX103C	67.00	67.60		
	STX083	67.10	67.60		
	STX135C	70.00	70.35		
	STX148C	71.20	71.60		
	STX124	71.60	72.00		
	STX136C	71.60	72.20		
	STX139C	71.85	72.50		
	STX095	78.75	78.95		
	STX104CR	81.23	81.70		
	STX148C	95.60	96.05		

Composite Number	Drill hole	Depth from (m)	Depth to (m)	Material Description	Waste domain
	STX145C	119.00	119.60		
12	STX083	12.10	12.55	Siltstone	Overburden
	STX122C	22.00	22.50		
	STX134C	23.15	23.60		
	STX145C	23.60	24.10		
	STX105	25.97	26.49		
	STX124	29.60	30.08		
	STX139C	33.85	34.30		
	STX134C	35.00	35.40		
	STX101C	35.50	36.01		
	STX083	38.50	38.90		
	STX103C	38.60	39.05		
13	STX103C	44.24	44.64	Siltstone	Overburden
	STX145C	44.60	44.94		
	STX105	45.00	45.67		
	STX139C	48.35	48.65		
	STX103C	48.80	49.30		
	STX083	53.25	53.70		
	STX103C	53.60	53.97		
	STX124	53.60	54.05		
	STX135C	59.60	60.10		
14	STX136C	74.00	74.60	Siltstone	Overburden
	STX083	74.60	75.00		
	STX148C	78.70	79.00		
	STX104CR	87.00	87.44		
	STX148C	87.80	88.20		
	STX104CR	97.45	98.10		
	STX148C	116.60	117.15		
	STX148C	131.05	131.60		
	STX148C	146.60	147.00		
15	STX145C	76.50	76.85	Siltstone Mix (incl. roof and floor), mixed with coal.	Potential Coal Reject
	STX145C	83.90	84.25		
	STX101C	38.85	39.20		
	STX099C	30.47	30.77		
	STX145C	82.50	82.85		
	STX139C	35.90	36.50		
	STX095	38.55	39.15		
	STX095	44.75	45.40		
	STX095	48.75	49.45		

Source: RGS Environmental, 2012

Kinetic leach column (KLC) testing was initiated by RGS Environmental in May 2012 (until August 2012), using six composites (KLC1 to KLC6) of selected samples, which are described in Table 8-5.

Table 8-5 Geochemical composite sample descriptions for kinetic leach columns

Composite Number	Drill hole	Depth from (m)	Depth to (m)	Average static acid-base account (ABA) values							ANC/MPA	Lithology	Sample Type
				pH	EC	Total S	S_{Cr}	MPA	ANC	NAPP			
				(units)	(µS/cm)	(%)	(%)	(kg H_2SO_4/t)					
KLC1	STX083	27.40	27.90	9.7	644	0.13	0.18	5.5	58.5	-53	10.6	Carbonaceous Mudstone	Overburden
	STX095	57.75	58.05										
	STX103C	26.60	27.00										
	STX103C	55.99	56.54										
	STX103C	70.70	71.20										
	STX104CR	30.22	30.54										
	STX105	61.41	61.74										
	STX105	68.74	69.21										
	STX124	60.30	60.60										
	STX124	75.90	76.20										
	STX134C	62.20	62.60										
KLC2	STX095	60.35	60.75	9.8	570	0.13	0.04	1.2	48.2	-47	39.3	Mudstone and Coal	Overburden
	STX099C	20.50	21.00										
	STX101C	67.90	68.18										
	STX103C	65.60	66.05										
	STX122C	61.74	62.18										
	STX124	23.60	24.13										
	STX124	47.60	48.14										
	STX124	50.60	51.00										
	STX135C	31.25	31.58										
	STX135C	42.00	42.50										
	STX135C	56.60	57.10										
	STX139C	50.60	50.85										
	STX145C	26.80	27.30										
KLC3	STX083	24.20	24.60	9.9	597	0.04	0.04	1.2	72.2	-70.9	58.9	Sandstone	Overburden
	STX083	39.20	39.65										
	STX083	67.10	67.60										
	STX095	24.40	24.70										
	STX095	36.50	36.75										
	STX095	51.75	52.05										
	STX095	78.75	78.95										

Composite Number	Drill hole	Depth from	Depth to	Average static acid-base account (ABA) values							ANC/MPA	Lithology	Sample Type
				pH	EC	Total S	S_{Cr}	MPA	ANC	NAPP			
		(m)	(m)	(units)	(µS/cm)	(%)	(%)	(kg H_2SO_4/t)					
	STX099C	26.60	27.00										
	STX099C	41.10	41.60										
	STX099C	51.20	51.50										
	STX099C	62.60	63.00										
	STX101C	50.54	50.85										
	STX101C	59.85	60.15										
	STX103C	15.40	15.85										
	STX103C	20.60	20.90										
	STX103C	67.00	67.60										
	STX104CR	81.23	81.70										
	STX105	30.27	31.00										
	STX105	41.74	42.53										
	STX105	53.74	54.39										
	STX122C	53.60	53.90										
	STX124	38.60	38.96										
	STX124	58.95	59.50										
	STX124	71.60	72.00										
	STX134C	29.60	29.90										
	STX134C	37.30	37.70										
	STX134C	33.20	33.60										
	STX134C	62.60	64.00										
	STX135C	50.00	50.60										
	STX135C	70.00	70.35										
	STX136C	17.60	18.00										
	STX139C	43.40	43.90										
	STX139C	46.95	47.25										
	STX139C	53.50	53.85										
	STX139C	59.85	60.15										
	STX139C	71.85	72.50										
	STX145C	20.30	20.60										
	STX145C	119.00	119.60										
KLC4	STX095	44.75	45.40	9.8	666	0.16	0.20	6.1	54.6	-48.4	8.9		Overburden

Composite Number	Drill hole	Depth from	Depth to	Average static acid-base account (ABA) values							ANC/MPA	Lithology	Sample Type
				pH	EC	Total S	S_{Cr}	MPA	ANC	NAPP			
		(m)	(m)	(units)	(µS/cm)	(%)	(%)	(kg H_2SO_4/t)					
	STX095	48.75	49.45									Carbonaceous Siltstone and Coal	
	STX099C	56.10	56.60										
	STX099C	65.60	65.94										
	STX099C	68.60	69.00										
	STX101C	43.60	44.00										
	STX122C	25.20	25.60										
	STX122C	28.90	29.30										
	STX122C	36.40	37.00										
	STX122C	39.60	40.00										
	STX122C	44.60	45.20										
	STX122C	74.55	75.05										
	STX136C	13.96	14.42										
	STX136C	37.60	38.10										
	STX136C	62.70	63.10										
	STX139C	35.90	36.50										
KLC5	STX101C	21.59	21.89	9.2	519	0.06	0.11	3.4	22.6	-19.2	6.7	Carbonaceous Mudstone (Roof & Floor) and Siltstone (Floor)	Potential Coal Reject
	STX101C	23.13	23.75										
	STX101C	27.85	28.17										
	STX101C	28.57	28.97										
	STX101C	41.60	42.10										
	STX101C	42.36	42.56										
	STX101C	52.72	52.92										
	STX101C	53.85	54.05										
	STX101C	70.94	71.34										
	STX101C	73.30	73.65										
KLC6	STX099C	35.10	35.60	9.6	536	0.08	0.13	4.0	35.2	-31.2	8.8	Mudstone (Roof & Floor)	Potential Coal Reject
	STX135C	35.50	36.15										
	STX135C	37.55	37.95										
	STX136C	50.60	51.02										
	STX136C	51.96	52.30										
	STX145C	49.50	49.90										
	STX145C	128.10	128.60										

Source: RGS Environmental, 2012

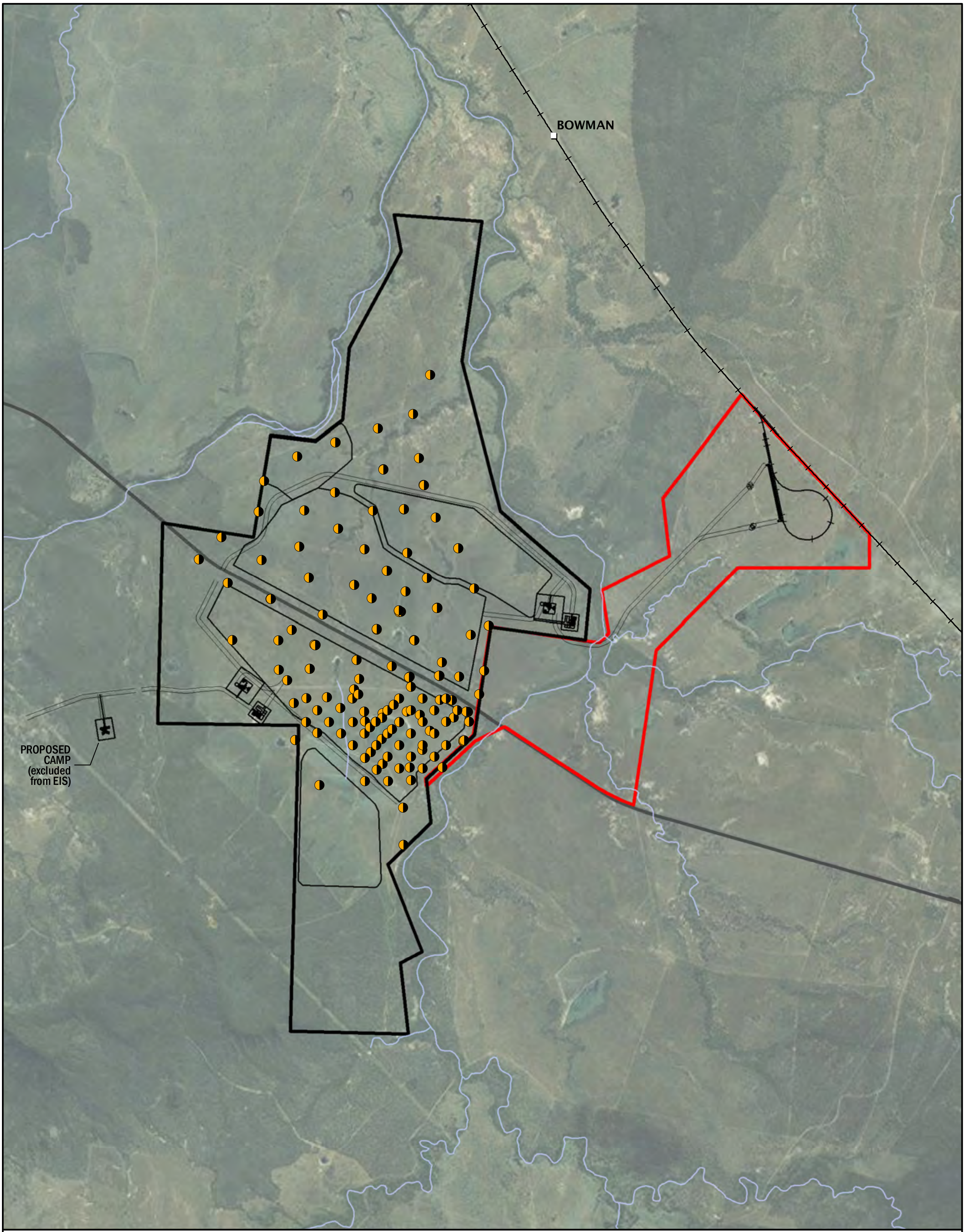


Figure 8-7

Location of exploration drillholes

Legend

- ● Exploration drillholes
- ML 80187
- ML 700022
- Proposed mine infrastructure
- North Coast Rail Line
- Main road
- Watercourse

N

0 0.5 1 km

Scale @ A4 1:60,000
Date: 24/07/17
Drawn: Gayle B.

DATA SOURCE
QLD Spatial Catalogue (QSpatial), 2017
Esri Basemaps, 2017

CDM Smith

8.5.3 Overburden and Coal Reject Analysis

A total of 174 discrete samples were selected for geochemical analysis by RGS Environmental in 2012, which consisted of:

- 147 samples of material defined as overburden;
- 27 samples of material defined as potential coal rejects;
- Preparation of 15 composite samples from selected discrete samples (refer to Table 8-3) for multi-element solid and solution analysis; and
- Preparation of six composite samples from selected discrete samples for KLC test work.

The location of the drill holes and sample depths were from the geotechnical and resource definition drilling programs undertaken by Central Queensland Coal in 2011-2012.

An environmental geochemical assessment of waste rock and potential coal reject material was undertaken by RGS Environmental based on the characterisation of samples using static geochemical test methods. Samples were tested for a range of parameters considered important for characterising the material for management and re-use purposes, including:

- pH and electrolytic conductivity (1:5) – 174 samples;
- Net acid production potential (NAPP, based on calculation from total sulfur (%, converted to Maximum Potential Acidity (MPA) as kg H_2SO_4/T, and Acid Neutralising Capacity (ANC, as kg H_2SO_4/T)) – 174 samples;
- Chromium reducible sulfur– 50 samples;
- Multi-element composition (solids and solutions) – 15 composite samples; and
- Cation exchange capacity (CEC, including Exchangeable Sodium Percentage) – 15 composite samples.

Kinetic leach column (KLC) testing was initiated by RGS Environmental in May 2012 (until August 2012), using six composites (KLC1 to KLC6) of selected samples, which are described in Table 8-5.

The KLC testing undertaken by RGS Environmental included seven leaches fortnightly (22 May 2012 to 14 August 2012), with analysis at each leach including:

- pH and electrolytic conductivity;
- Acidity, alkalinity and net alkalinity (as mg $CaCO_3$/L); and
- Multi-element composition (solutions, mg/L).

The results of the physical and chemical characteristics of overburden and interburden have been determined through geochemical testing and compared with the relevant guidelines. These results are provided in Section 8.7.

8.6 Description of Environmental Values

8.6.1 Surface Water

The Project is wholly contained within the Styx River Basin, comprising of Styx River, Waverley and St Lawrence Creeks. The Styx Basin discharges to the Great Barrier Reef Marine Park (GBRMP), which is listed as a World Heritage Area. The Project is bordered by two watercourses as defined under the Water Act, namely Tooloombah Creek and Deep Creek. These creeks meet at a confluence downstream of the Project area to form the Styx River. The coastal zone, commencing downstream of the North Coast Rail Line, is located approximately 10 km downstream of the ML area. The GBRMP is located approximately 40 km downstream of the ML area.

The Fitzroy Basin Association Natural Resource Management (NRM) body manages waters within the Styx Basin. Fitzroy Basin Association NRM body encompasses eight sub-catchments; Lower-Fitzroy, Isaac-Connors, Comet, Upper and Lower Dawson, Styx-Herbert, Water Park and Boyne-Calliope. Due to the NRM comprising an area over 152,000 km^2, the region has been split into 192 Neighbourhood Catchments. The project is located within the F3 Neighbourhood Catchment which is described as having a high sediment delivery ratio to the Great Barrier Reef with a low number of landholders within the basin (Fitzroy Basin Association 2015). Sediment in the Fitzroy Region is the most significant risk to the Great Barrier Reef, an estimated 1.5 million tonnes of extra sediment deposited each year - 83% of the sediment coming from grazing land. It is estimated that the Styx Basin contributes 97,892 t per year. The load contributions from the Styx Basin are based on limited monitoring results. Cattle grazing is the dominant land use of the area (80%) and the basin contains 14% wetland area. Many the wetlands are Estuarine systems (8.8%) with approximately 187 lacustrine / palustrine wetlands (EHP 2017).

Waste rock storages and dams containing waste rock runoff could impact surface water values through degradation of water quality from contaminant migration through leaching, leaks or from direct mine water discharges.

8.6.2 Groundwater

At the regional scale, the Styx River basin contains usable groundwater supplies in shallow water-table aquifers that are hosted in the unconsolidated Cenozoic surface deposits, particularly within the alluvial infill sediments associated with surface drainage, and within fractured and weathered zones of outcropping Cretaceous rocks (Styx Basin) and older Permian rocks (Back Creek Group, Lizzie Creek Volcanics Group and Connors Volcanic Group). The deeper sediments underlying the Cenozoic surface deposits and below the zone of surface fracturing and weathering have much lower permeability and are not known to yield useable groundwater supplies.

Shallow unconfined groundwater flow in Cenozoic sediments and fractured and weathered rocks within Styx River Basin is driven by diffuse groundwater recharge from rainfall within the basin. The water table slopes generally toward the ocean but locally follows topographic relief, with depth to water table from ground surface typically in the range 2 to 15 m in existing groundwater bores dependent on location. Most groundwater discharge is thought to occur by evapotranspiration from topographic lows, particularly along valleys of the surface drainage network, including evaporation of surface pools and bank seepage, and transpiration by riparian vegetation communities that access groundwater within their root zones. The main processes for interaction between groundwater and surface water are episodic groundwater recharge along flowing watercourses during wet conditions, and groundwater discharge to watercourses that intersect the water table during dry conditions.

Groundwater salinity ranges from fresh to brackish. Groundwater use in the area is generally limited to stock watering, with some domestic use. Stygofauna have been recorded within some groundwater bores constructed within the alluvial aquifer associated with the Styx River and located more than 8 km away from the Project boundary.

8.6.3 Mineral Waste

The largest volume and mass of waste associated with the Project will be waste rock (estimated 558.4 million bank cubic metres over the life of the mine) generated from the removal of the overburden and interburden material in the open cut mining areas to enable the seams to be extracted. It will also be generated from fine and coarse reject material from the two CHPPs.

Waste generated through mining in the form of spoil (from overburden and interburden removal and ex-pit emplacement) and rejects from coal processing (i.e. coarse rejects and dewatered tailings) has been defined as mineral or mine waste.

The Central Queensland Coal waste geochemical assessment includes the analysis of the sulfide content of the mine waste, and determination as to whether the sulfide minerals will potentially form ARD or NMD / SMD if oxidised under normal atmospheric conditions (i.e. in the presence of air, rainfall, fluctuating seasonal weather patterns).

The material characterised as part of this assessment is representative of the mine waste and provides an indication of the wastes' potential to generate ARD or NMD / SMD. In the absence of actual reject samples (coarse reject and dewatered fines), materials located immediately above and below a coal seam were analysed as potential rejects (i.e. interburden) by RGS Environmental.

During production, the reject materials and other overburden and interburden materials may require further analysis to improve the geo-statistical confidence in their ARD / NMD classification, clarify disposal requirements, and understand potential implications for site rehabilitation.

8.7 Assessment Results

The characterisation provided herein is indicative, and the confidence in the geo-statistical classification of the overburden, interburden and CHPP waste streams will be increased through further exploration resource definition drilling, sampling and analyses prior to operation. This information will be gathered in parallel with the Project's operations to inform mine operations and environmental management.

8.7.1 Acid Generation Potential

The characterisation of the waste rock was undertaken by RGS Environmental in accordance with the Assessment and Management of Acid Drainage Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995c) and other applicable best practice guideline. Rock samples underwent Acid Base Accounting (ABA) assessment, allowing sampled geologies to be classified into non-acid forming (NAF), PAF and uncertain categories. The results of this classification process inferred to have been adopted by RGS Environmental (from NAPP data) are summarised in Table 8-6.

Table 8-6 Geochemical classification of materials to be mined

Category	Total S	S_{Cr}	NAPP value	ANC/MPA
Potentially Acid Forming (PAF)	-	-	>10 kg H_2SO_4/T	<2
Potentially Acid Forming – Low Capacity (PAF-LC)	-	> 0.2%	0 to 10 kg H_2SO_4/T	-
Uncertain	-	-	-10 to 10 kg H_2SO_4/T	<2
Non-acid Forming (NAF) (options)	-	≤ 0.2%	-	> 2
		-	< -10 kg H_2SO_4/T	> 3
Non-acid Forming (NAF) (Barren)	≤ 0.1%	-	-	-

Source: inferred based on RGS Environmental, 2012

Classifications of composite samples, based on average NAPP values, are presented in Table 8-4.

Overall, the risk of acid generation from waste rock and coal reject materials is low, with over 98% of samples analysed classified as NAF (from RGS Environmental, 2012). Statistical evaluation of the ABA classification of waste rock and coal reject materials is presented in Table 8-7 and Table 8-8 respectively.

Table 8-7 Statistical evaluation of ABA of waste rock materials tested

Parameter	pH	EC	Total S	S_{Cr}	MPA	ANC	NAPP	ANC/MPA
	units	mS/cm	%		kg H_2SO_4/T			
Minimum	4.8	106.0	0.0	0.0	0.2	5.3	-389.7	0.2
Maximum	10.2	2780.0	8.2	7.6	233.4	390.0	197.2	1273.5
Mean	9.8	612.3	0.2	0.3	3.7	53.7	-50.0	122.5
Median	9.9	612.0	0.0	0.1	0.9	39.8	-38.2	34.0

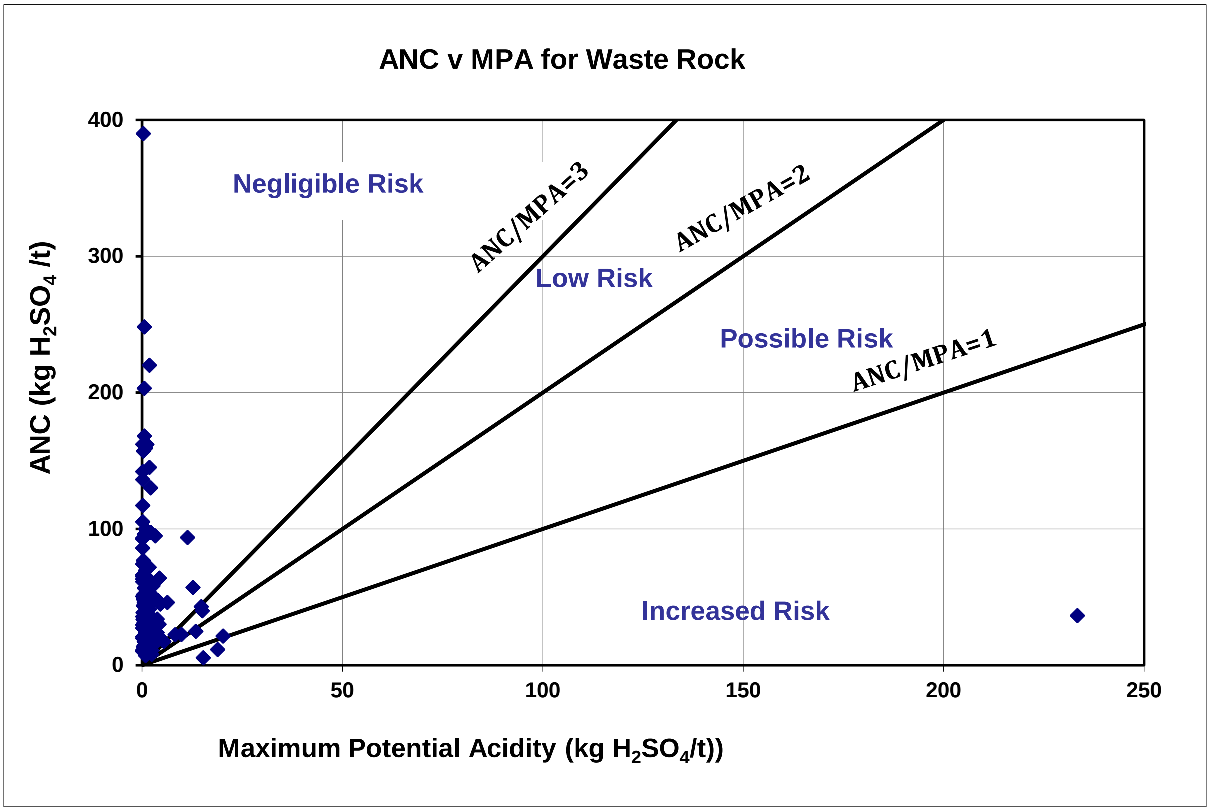
Source: based on RGS Environmental 2012

Table 8-8 Statistical evaluation of ABA of coal reject materials tested

Parameter	pH	EC	Total S	S_{Cr}	MPA	ANC	NAPP	ANC/MPA
	units	mS/cm	%		kg H_2SO_4/T			
Minimum	8.8	326.0	0.0	0.1	0.2	10.0	-319.1	0.9
Maximum	10.1	768.0	0.7	0.6	18.2	320.0	1.4	348.3
Mean	9.5	538.6	0.1	0.2	2.5	40.3	-37.8	40.6
Median	9.6	510.0	0.1	0.1	1.7	20.1	-19.2	15.5

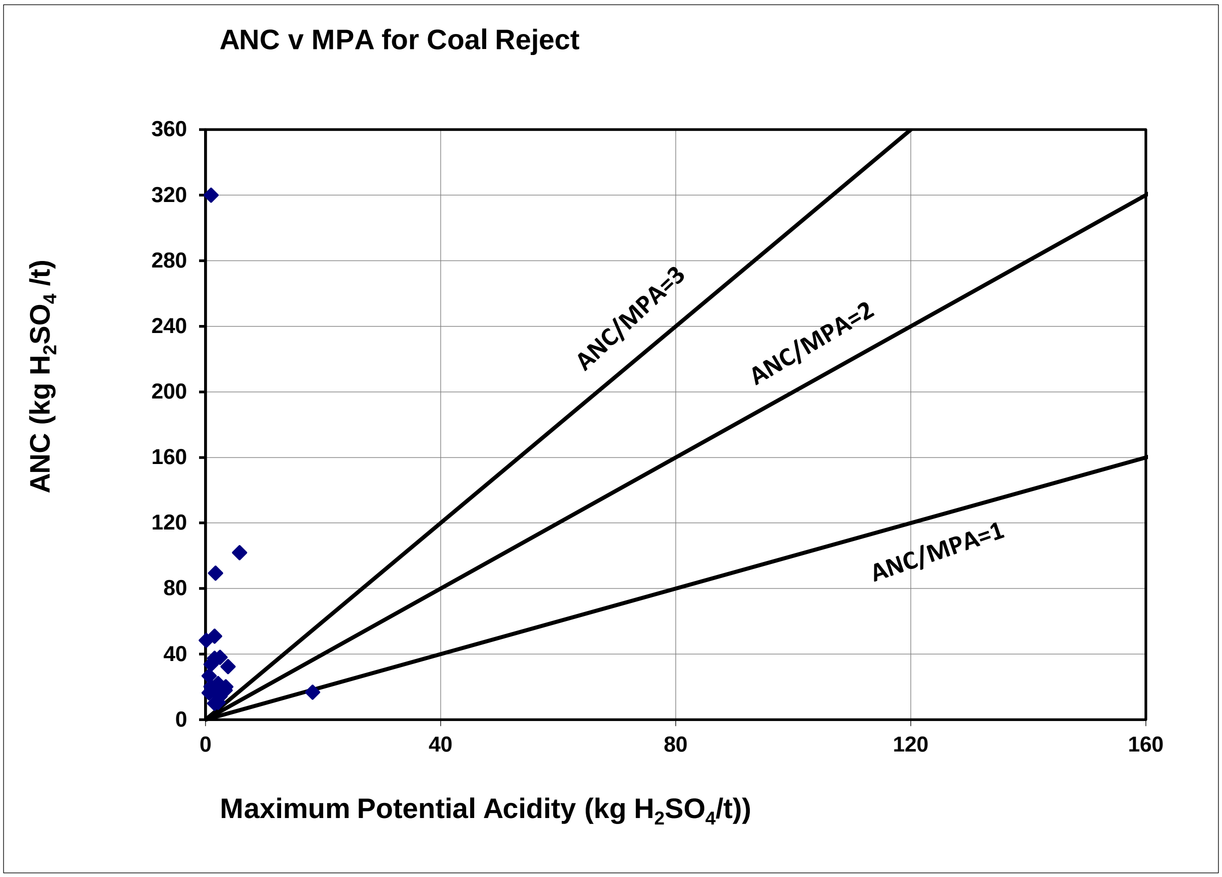
Source: based on RGS Environmental 2012

The mean NAPP values for waste rock and coal reject samples tested were -50.0 and -37.8 kg H_2SO_4/T, respectively, whilst the mean ANC/MPA ratios were 122.5 and 406.6, respectively; indicating NAF and "low risk" (ANC/MPA) acid forming characteristics. The cumulative distribution of total sulfur (%S) in waste rock and coal reject samples containing ≤0.3% S was 93% and 96%, respectively.



Source: RGS Environmental, 2012

Figure 8-8 Acid-base account - waste rock



Source: RGS Environmental, 2012

Figure 8-9 Acid-base account - coal reject samples

8.7.2 Multi-element Solid and Solutions (Leachate Potential)

A total of 15 composite samples were analysed for solid and solution concentrations of multi-elements to determine the level of risk associated with leachate generated from waste rock (12 composite samples) and coal rejects (3 composite samples).

The concentrations of solid multi-element analyses were compared to the Health-based Investigation Levels for parks, recreation, open space and playing fields ("HIL(E)") in the National Environment Protection (Assessment of Site Contamination) Measure (NEPM, 1999) by RGS Environmental in 2012. The NEPM was revised and released in 2013 and as such, the results from RGS Environmental' s work has been compared to the equivalent criteria, HIL-C (Recreational C), and the Ecological Investigation Levels (EILs) from NEPM 2013, where relevant. The soil results have been compared with recreational use criteria as they reflect the likely post mining land use.

The concentration of multi-elements in composite samples was also compared to the average abundance of the element, based on Bowen (1979). The comparison methodology used the Global Abundance Index (GAI), with the following formula:

$$GAI = Int\left(log_2\left(\frac{Measured\ Concentration}{1.5\ x\ Average\ Abundance}\right)\right)$$

A zero or positive GAI value indicates enrichment of the element in the sample when compared to average-crustal abundances. The generally accepted methodology is that if a sample's element has a GAI of 3 or higher, it signifies enrichment that warrants further evaluation. The actual enrichment ranges for the GAI values are as follows (from GARD Guide):

- GAI = 0 represents <3 times median soil content;
- GAI=1 represents 3 to 6 times median soil content;
- GAI=2 represents 6 to 12 times median soil content;
- GAI=3 represents 12 to 24 times median soil content;
- GAI=4 represents 24 to 48 times median soil content;
- GAI=5 represents 48 to 96 times median soil content; and
- GAI=6 represents more than 96 times median soil content.

Of the fifteen composite samples analysed, one sample (2, carbonaceous mudstone) revealed GAI values of 0 (iron, manganese) and 1 (arsenic, zinc). All remaining samples and elements revealed GAI values less than 0, whilst all concentrations of elements analysed were below the HIL-C and EILs (NEPM 2013).

The leachate analysis results of the fifteen composite samples undertaken by RGS Environmental were compared to the following assessment criteria:

- ANZECC / ARMCANZ 2000 Trigger Values for slightly to moderately disturbed aquatic ecosystems (95% level of protection);
- ANZECC / ARMCANZ 2000 Primary Industries (Irrigation) and General Water Use, Long Term Trigger Values; and
- ANZECC / ARMCANZ 2000 Primary Industries Livestock Drinking Water Quality.

Concentrations of major ions, metals and metalloids were either below the analytical limits of reporting (LoR) and / or the assessment criteria in most composite samples, except for those parameters listed in Table 8-9 below.

Table 8-9 Composite waste rock and coal reject solution results greater than criteria

Parameter	95% protection of freshwater	Long-term trigger values for irrigation and general water use	Stock watering
Al	X		
As	X		
Mo		X	
Se	X	X	X
V	X		

These exceedances were generally marginally greater than the laboratory LoR and within the order of magnitude of the LoR.

Concentrations of dissolved aluminium (Al), arsenic (As), molybdenum (Mo), selenium (Se) and vanadium (V) in the six KLC samples were consistent with the multi-element solution concentrations from the 15 composite waste rock and potential coal reject samples. Over the seven leach events, the concentrations of dissolved elements, in addition to parameters such as pH, SO_4, EC and alkalinity, were broadly consistent. Anomalous (elevated) concentrations of most dissolved elements were reported in leach event 5, which is likely due to colloidal matter entrained in the preserved laboratory sample, and is not indicative of the trend in concentrations over the leach events.

Leachate from waste rock and coal reject materials may contain elevated concentrations of dissolved As, Mo, Se and V when compared to potential water quality monitoring criteria. It should be noted that elevated As, Mo, Se and V concentrations in coal mine waste leachates are encountered in other coal deposits and projects in Queensland, and that the leachate results from RGS Environmental in 2012 are a consistent with similar deposits. Concentrations of Mo and Se in the solid composite samples were below the laboratory, whilst the solid concentrations of As and V were below the EILs (NEPM 2013) and had GAI values of 0.

Metal / metalloid concentrations in water extracts were generally consistent across composition samples and therefore likely consistent with existing concentrations within the regional geology and associated aquifer. The concentrations are within the same order of magnitude as the assessment criteria. The leaching of metals / metalloids from rock is likely to have minimal impact on surface and groundwater. The waste rock was classified as acid consuming and likely to remain pH neutral to alkaline following excavation. Therefore, dissolution of heavy metals in an acidic environment is unlikely.

8.7.3 Saline and Sodic Drainage Potential

The characterisation of the waste rock was undertaken in accordance with the Assessment and Management of Saline and Sodic Waste Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995c). Salinity and sodicity affect the erodibility of mining waste, with salinity generally supressing the degree of dispersion and sodicity increasing the likelihood of clay dispersion when wet. Sodic waste can also have extremely low permeability, impeded drainage, hard-set when dry and have potential for tunnel erosion.

Composite waste rock and potential coal reject samples were analysed and classified in accordance with the indicative criteria (Table 8-10) for saline and sodic material summarised in Table 8-11.

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Table 8-10 Indicative saline and sodic material

Parameter	Very low	Low	Medium	High	Very high
pH (1:5)	<4.5	4.5-5.5	5.5-7.0	7.0-9.0	>9.0
Electrical conductivity (EC) (dSm^{-1}) (1:5)	<0.15	0.15-0.45	0.45-0.9	0.9-2.0	>2.0
Electrical conductivity (dSm^{-1}) (saturation extract)	<2	2-4	4-8	8-16	>16
Chloride (ppm)	<100	100-300	300-600	600-2000	>2000
Exchangeable Sodium Percentage ESP (%)	<2	2-6	6-12	12-20	>20
Cation Exchange Capacity (CEC) (meq/100g)	<6*	6-12	12-25	25-40	>40
Calcium /Magnesium Ratio (Ca:Ma ratio)	<1	1-2	2-5	>5	

Source: DME 1995c

Table 8-11 Saline and sodic drainage potential results

Parameter	Composite Sample														
	Overburden												Potential Coal Reject		
	1	2	4	5	6	7	9	10	11	12	13	14	3	8	15
pH (1:5)	9.6	9.8	9.9	9.8	9.6	9.9	9.9	10.0	9.6	8.6	10.0	9.0	9.2	9.5	9.8
EC (dSm^{-1}) (1:5)	0.63	0.65	0.66	0.57	0.64	0.53	0.61	0.61	0.55	0.65	0.56	0.42	0.51	0.59	0.55
ESP (%)	34.6	39.5	41.8	31.7	34.7	42.8	28.9	32.2	33.1	34.2	42.7	34.4	36.3	36.6	39.2
CEC (meq/100g)	69	80.2	78.7	58.4	70	61.8	75.4	72.9	67.4	76.1	65.5	55.2	57.9	74.5	70
Ca:Mg ratio	2.3	10.4	6.7	5.7	1.9	5.3	3.6	4.7	13.6	2.4	5.4	14.5	0.9	4.8	3.4
Salinity Classification	**Medium**														
Sodicity Classification	**Very High**														

Composite waste rock and potential coal reject samples were alkaline (greater than pH 7) displaying a very high pH (8.6 to 10.0 pH). The salinity (measured using EC) (1:5) of the samples was generally moderate (0.42 to 0.66 dS/m).

Sodicity of waste rock and coal reject composite samples, in the form of Exchangeable Sodium Potential (ESP: %), were very high (28.9% to 42.7%). Strongly sodic materials are likely to have structural stability problems related to potential dispersion. In addition to potential dispersion, sodic materials often have unbalanced nutrient ratios that can lead to macro-nutrient deficiencies. Hence, to promote vegetation growth during rehabilitation, the addition of fertilisers is often required.

The existing groundwater environment is provided in Chapter 10 – Groundwater. Details of the groundwater and nominated mitigation measures is provided in Section 8.9.

8.7.4 Kinetic Leach Column Results

Interpretation of the (incomplete) KLC testing program results is based on data provided by RGS Environmental from the 2012 program. Charts of pH, EC, cumulative sulfate release rate, net alkalinity and residual ANC are presented in Figure 8-10 to Figure 8-14.

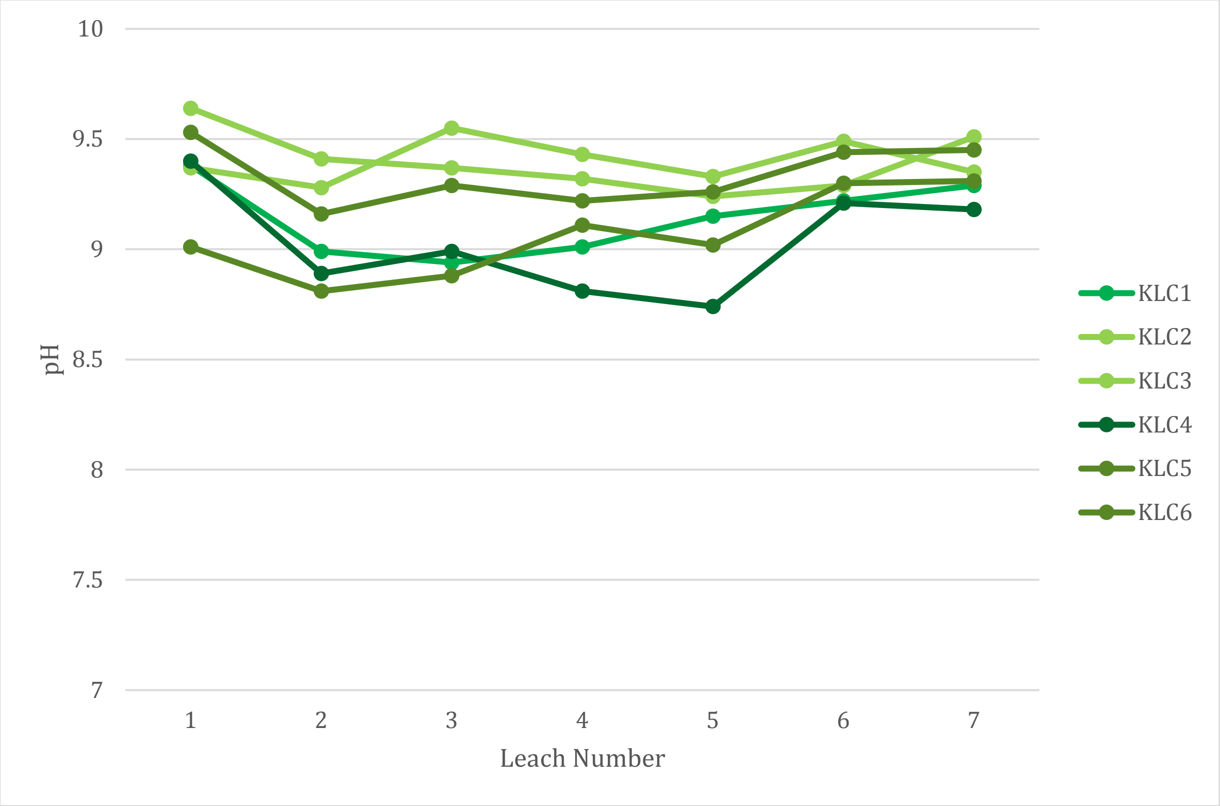


Figure 8-10 Kinetic leach columns - pH

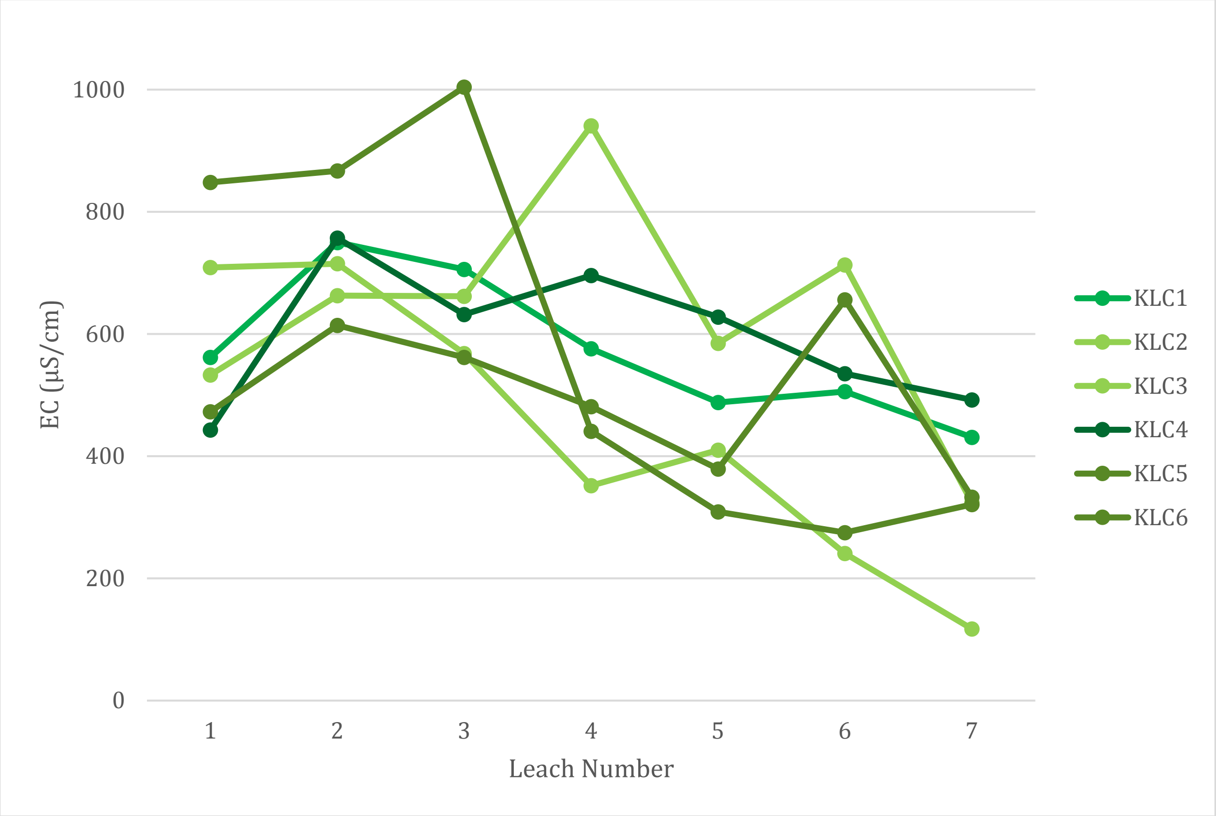


Figure 8-11 Kinetic leach columns - EC

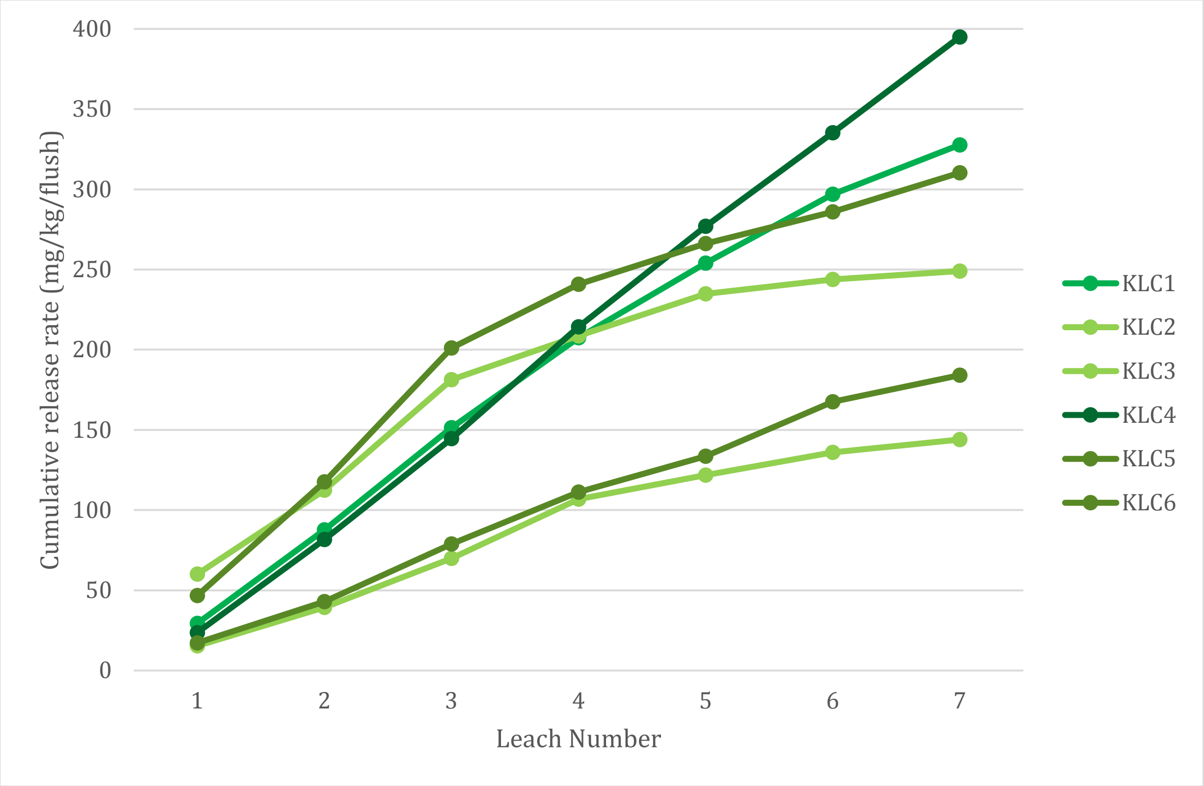


Figure 8-12 Kinetic leach columns - cumulative SO_4 release rate

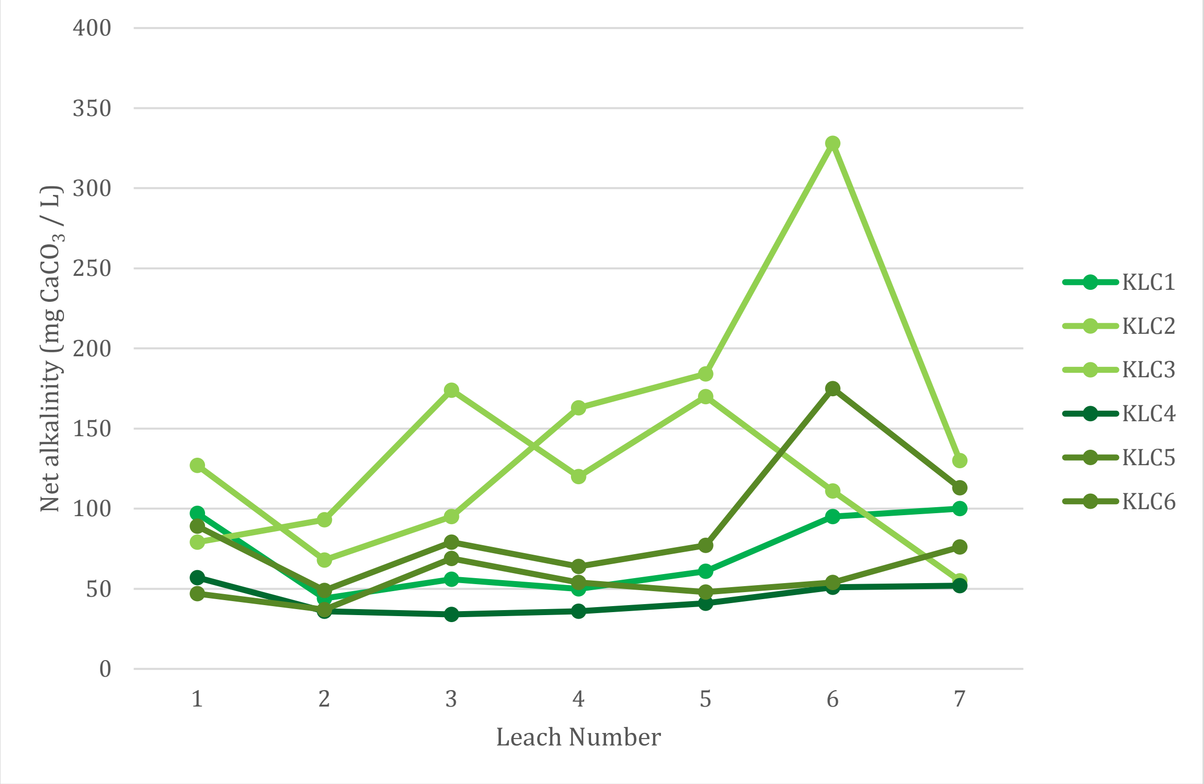


Figure 8-13 Kinetic leach columns - net alkalinity

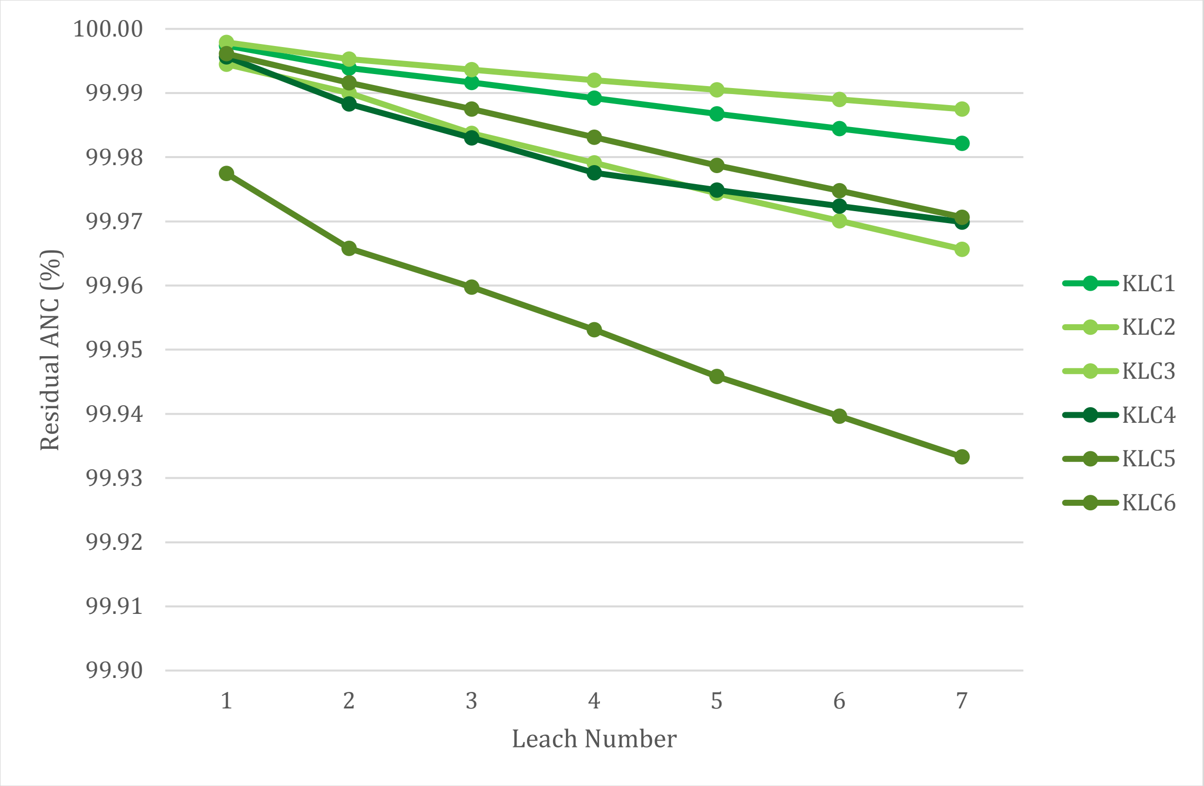


Figure 8-14 Kinetic leach columns - residual ANC

All six composite samples revealed consistent alkaline conditions over the recorded KLC testing period, with pH values at leach number 7 returning to the initial leach (1) pH value after an initial slight reduction.

The salinity (measured as EC) over the leach (flush) events was relatively stable over the testing period, with an overall broad decrease in EC values over time. Column samples KLC3 (overburden sandstone) and KLC6 (potential coal reject) demonstrated minor variation in measured EC values, though the overall trend was of decreasing salinity.

The net alkalinity and residual ANC charts indicate that the composite waste samples continue to produce alkalinity at or greater than the initial leach value; whilst the residual ANC values after the seventh leach event ranged from 99.94% to 99.99%, indicating the materials will continue to produce alkalinity (alkaline leachate) commensurate with the high average ANC of the static solid laboratory results.

The average sulfate generation rate and calculated sulfide oxidation rate (Bennett et al. 2000) for the six KLC composite samples is presented in Table 8-12. The sulfate generation rates of 1.01 to 3.99 mg SO_4 / kg / week (correlating with oxidation rates ranging from 1.09 to 2.69 kg/O_2/m^3/sec) are low, which correlates with the cumulative sulfate release and residual ANC rates, indicating neutral to alkaline leachate production with low acidity (Bennet et al. 2000).

Table 8-12 Average sulfate generation rate and sulfide oxidation rates for KLC composite samples

Sample	Lithology	Sample Type	Sulfate Generation Rate (mg SO_4 / kg /week)	Oxidation Rate (kg/O_2/m^3/s)
KLC1	Carbonaceous Mudstone	Overburden	3.54	2.39×10^{-11}
KLC2	Mudstone and Coal	Overburden	2.90	1.96×10^{-11}
KLC3	Sandstone	Overburden	1.01	1.09×10^{-11}
KLC4	Carbonaceous Siltstone and Coal	Overburden	3.99	2.69×10^{-11}
KLC5	Carbonaceous Mudstone (Roof & Floor) and Siltstone (Floor)	Potential Coal Reject	3.41	2.30×10^{-11}
KLC6	Mudstone (Roof & Floor)	Potential Coal Reject	1.99	1.35×10^{-11}

8.8 Waste Rock and Rejects Potential Impacts

Waste rock and coarse and fine rejects generated during the extraction of the resource have the potential to impact upon the EVs described in Section 8.6 if they are not appropriately managed. Management measures have been determined in response to these potential impacts and best reflect the requirements for land management throughout the construction, operation and rehabilitation phases of the Project.

The information contained in this section has been provided at a level of detail suitable for strategic planning. However, to make decisions about specific construction activities at the detailed planning phase, a higher intensity geochemical investigation will need to be undertaken due to the potential variation in overburden and interburden geology within the proposed open-cut mine areas. The information gathered from a higher intensity geochemical investigation will be used to inform the Project-specific Mineral Waste Management Plan (MWMP), and continue throughout the life of the Project.

A MWMP will be prepared and will include, but not be limited to:

- Effective characterisation of the mining waste to predict, under the proposed placement and disposal strategy, the quality of run-off and seepage generated including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic inorganic substances;
- Mineral waste field and laboratory testing procedure for validation of the acid-forming and potential erodibility characterisations of each phase;
- Classifying waste rock zones (based on acid forming potential, salinity and sodicity), placement and use of waste rock materials and appropriate disposal of PAF waste or waste designated as not suitable for use on final surfaces (including potential PAF material identified during mining);
- Ex-situ spoil dump design criteria, including preferred selective placement of each waste domain, dump heights, dump profiles, conceptual final landform design;
- Monitoring and management of erosion, groundwater and surface water (including run-off and seepage) at ex-situ waste landforms; and
- Progressive rehabilitation strategies.

8.9 Potential Impacts and Mitigation Measures

Waste rock has the potential to impact on the environmental values presented in Section 8.6 depending on the waste rock size and characteristics. The waste rock is expected to have a low capacity to be potentially acid forming and moderate saline drainage potential. The waste rock has potential to be highly sodic. There is some potential for leachate from extracted waste rock and tailings to enter local waterways and degrade water quality. The leaching of mine water into waterways can result in negative impact on aquatic organisms, changes in water quality which can in turn affect water availability for humans, and livestock.

Sodic and highly sodic materials have potential to cause slaking, are dispersive, and tend to be highly erodible. Mine waste (overburden and interburden) materials, particularly those placed ex-pit, need to be appropriately shaped and monitored to create structurally and chemically suitable landforms for successful rehabilitation.

Should AMD/SNMD enter groundwater then the following impacts may occur:

- Changes to the salinity of groundwater within the water table;
- Changes to pH of groundwater and the mobilisation of dissolved metals;
- Effects on stock watering and aquatic ecology dependent on shallow groundwater; and
- The salinity of rejects is expected to be low and the sodicity is variable. Surface salinity contents of exposed reject surfaces can increase by oxidisation, capillary action and surface evaporation. No deleterious metal concentrations have been detected in tested coal samples.

Rainfall on the reject disposal areas is unlikely to cause any significant mobilisation of contaminants within the solid reject material given geochemistry of rejects.

The management measures for the potential impacts are discussed in the following sections.

8.9.1 Waste Rock Dump Design and Disposal Method

The detailed design of the management of waste rock generated by the Project will account for:

- Climate, topography and location of sensitive receptors within the Project area i.e. Tooloombah Creek and Deep Creek;
- The geochemical characteristics of the waste rock and its variations across the mine;
- Expected water balance and water quality controls within the waste rock dumps;
- Measures that provide for safe operations;
- Compliance requirements of the Project’s EA and minimum performance standards for the mining industry;
- Costs (in terms of net present value); and
- Facilitating progressive rehabilitation and optimising for mine closure outcomes.

Waste rock management will occur as part of the overall mine plan (known as the Plan of Operations). Accordingly, any changes to the Plan of Operations will also require review and, if necessary, updates to the MWMP. This will ensure that any staging requirements are adequately financed and timed to occur as part of site operations, rather than as two separate, unintegrated operations.

The proposed disposal method for waste rock is to initially truck rejects to an out-of-pit dump area during the development phase of each open cut. This area would be graded and compacted to ensure no internal pooling of water and to minimise the infiltration into soils within the disposal area. The cells will be bunded around its perimeter to capture and divert and water away from the cells and to contain water within it.

As operations progress through the open cuts, the area behind the working face will receive the waste rock where it will be permanently disposed of to fill the void. Surplus material will remain in the out-of-pit waste dump (see Chapter 11 – Rehabilitation and Decommissioning). This provides an opportunity to minimise land disturbance by the Project and to provide a final landform at the end of the mine life. The siting of the out-of-pit dump areas has accounted for sensitive site receptors, surface and groundwater drainage impacts, proximity to the CHPPs and health and safety risks. These factors will continue to be considered during detailed design of the dumps.

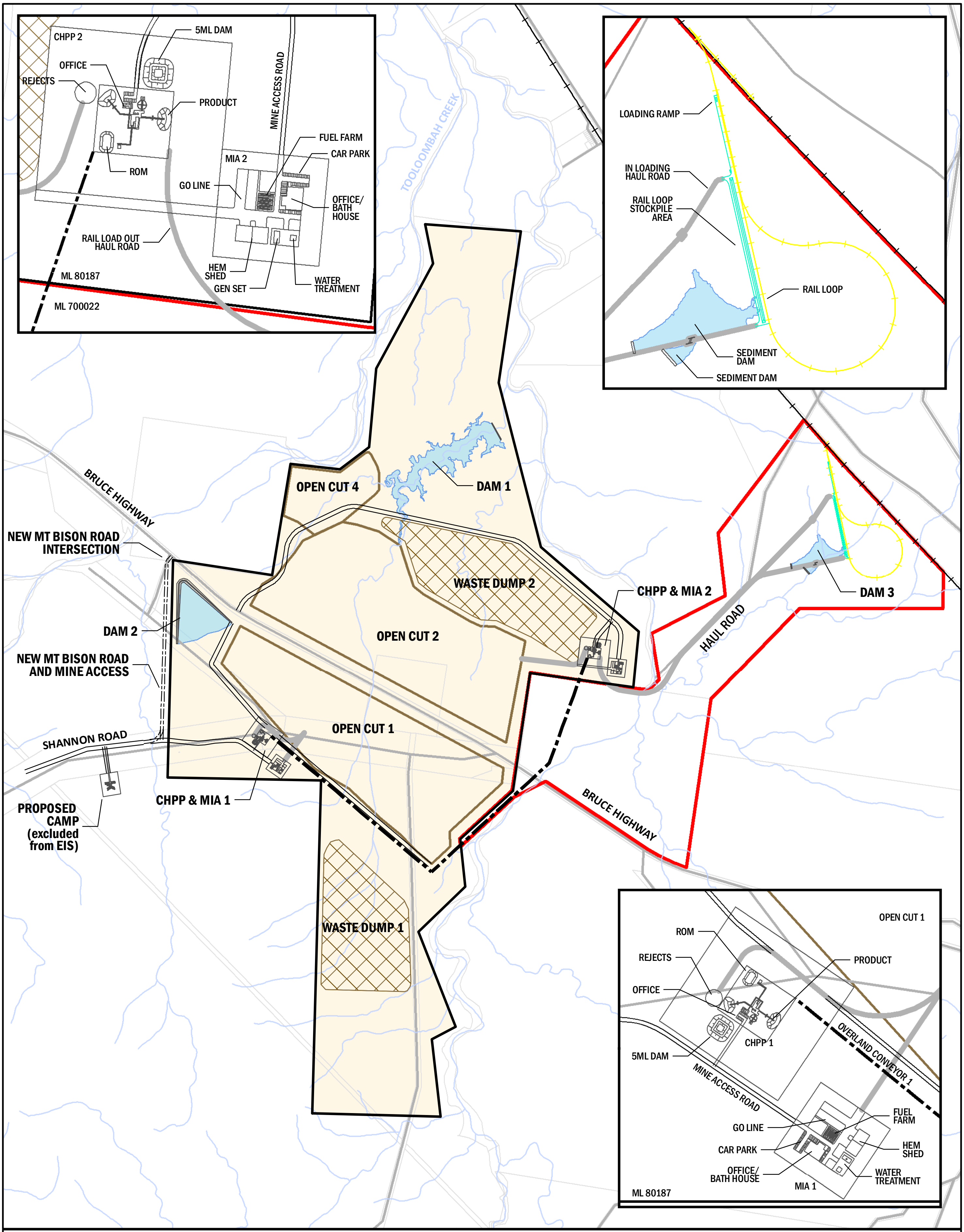
In terms of environmental risk, overburden, interburden and potential coal reject materials tested to date are expected to have a very high potential for dispersion (erosion).

The disposal of waste rock whether out-of-pit or in-pit will be designed in a manner that avoids and minimises the potential for the waste rock to cause environmental harm through erosion. Weathered rock (i.e. oxide zone) will be placed at the base of the waste rock dumps, and capped beneath unweathered materials (i.e. interburden and overburden from transition or primary zones). This measure will cover the rock with most potential to disperse and reduce erosion impacts. Sourcing of material with low sodicity will be important for shaping and rehabilitating the out-of-pit waste rock dumps.

Thus, it is proposed that materials characterised and validated as non-dispersive and non-sodic are used for the outer slopes of waste rock dumps to limit dispersion and erosion, with identified sodic materials disposed of within the central (inner) zones of waste rock dumps. Surface run-off and seepage from waste rock dumps and any rehabilitated areas will be monitored for a standard suite of water monitoring parameters in accordance with the Project-specific MWMP. The locations of the proposed waste rock dumps are shown in Figure 8-15.

In terms of mine closure planning, this approach means that the waste rock used for the final landform covering should comprise material that has a relatively low salinity and low potential for dispersion. All spoil will be placed at angle of repose for geotechnical stability and will be further flattened prior to final rehabilitation. The waste rock is therefore not considered to pose significant management issues to the Project with respect to erosion, subject to the sourcing of suitable material for the outer layers of the dumps.

Where rock from the Project area is used in the construction of roads and hard-standing areas, for example, engineering and geotechnical testing will be undertaken to prior to their use to determine the propensity of the materials to erode given their potential sodicity. More sodic and dispersive materials will be identified and selectively handled.



N

Legend

▬	ML 80187
🟥	ML 700022
▭	Open-cut Mine Pit
🟦	Dam Catchment
▨	Waste Dump Area
-·-	Overland Conveyor
▬	Haul roads
—	Rail Loadout Facility
—+—	Rail Loop
—	Proposed mine infrastructure
—	Watercourse
—+—	North Coast Rail Line
—	Main road
▭	Cadastral boundary

0 0.5 1 km

Scale @ A4 1:55,000
Date: 17/07/17
Drawn: Gayle B.

Figure 8-15
Project area layout

DATA SOURCE
QLD Open Source Data, 2017
Esri Basemaps

CDM Smith

BRUGGEMANNGD B:\BES150160 Styx Coal\GIS\DATA\MXD\FINAL\.03 EIS Preparation\BES150160.03-072 R1 project area layout.mxd 7/17/2017

8.9.2 Tailings and Fine Rejects Disposal Method and Containment

The management of tailings will follow the principles of waste rock management described above. It will also follow the management principles set out in the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland (DME 1995c). It should be noted that the majority of overburden is a valuable resource for rehabilitation of the mine, with only a very small portion of overburden having potential to generate acidic drainage. Rejects management will:

- Produce stable rejects that will be mixed with overburden and buried in-pit;
- Minimise disturbance to the environment by strategically and heavily diluting all rejects with overburden material in a centre location at the base of the out-of-pit dumps in the initial years of operation, prior to Steady State Mining and all rejects in the open cut mine void, after mining operations have reach Steady State; and
- Minimise risks to the environment through appropriate design and construction of rejects management facilities and waste rock dumps.

Dried coarse rejects and filter pressed tailings will be mixed with overburden waste and strategically placed within both the out-of-pit dumps and in the open cut mine void. All overburden will be characterised and the benign material will be preferentially placed in the upper layers and on the surface of the waste dumps, ensuring the surface material contains a percentage of clay, prior to top soiling and seeding. If PAF or saline material is unavoidably placed near the surface of the dumps, this area will be capped with inert material prior to top soiling and seeding. The tailings solids will be monitored to determine pH, EC, sulphur species and acid neutralising capacity (initially monthly) until geochemical trends have been established. Monitoring will then continue annually.

Waste rock pile embankments will be monitored for performance. This will ensure stability of the embankments during operations and embankment raising. Piezometers will be installed to check groundwater levels (see Chapter 10 – Groundwater regarding groundwater monitoring).

Survey monuments would be installed along each embankment of the waste rock dumps. These monuments would be surveyed on a regular basis to detect any embankment movements. The information derived from both piezometers and monuments will be used to assess the overall stability of the embankments.

A meteorological station is installed near at the site to monitor and record rainfall and evaporation data.

In terms of mine closure planning, this approach means that the waste rock used for the final landform covering should comprise material that has a relatively low salinity and low potential for dispersion.

8.9.3 Water Rejects and Tailings

Rejects and tailings will be dewatered prior to their disposal using filter press technology to treat the rejects. The coal fraction of the rejects will be beneficiated using spirals with desliming cyclone overflow being pumped to the tailings thickener where flocculent will be added. The thickened tailings are then passed through a filter press where the moisture content is reduced to approximately 26%. A dry paste like material is produced and these pressed tailings are then discharged onto the rejects conveyor for disposal via the reject bin.

Haul trucks which offload coal at the ROM stockpiles, will be backloaded at the reject bin to transport rejects to the pit. A more detailed description is provided in Chapter 3 – Description of the Project.

Filtering tailings is not new and more mines are choosing the process to reduce water consumption, limit seepage from the tailings and build a stable stack not subject to slope failure or flow (Murphy and Caldwell. 2012). Within Australia, the Dartbrook Coal Mine (Bickert 2004) uses this membrane filter press technology as does Daunia, Bengalla, Maules Creek, Moolarben and Cavil Ridge. Several mines located overseas also use this technology including:

- Alamo Dorado and El Sauzal mines in Mexico;
- Greens Creek and Pogo mines in Alaska;
- La Coipa in Chile;
- Raglan in Canada;
- Coeur Manquiri mine in Boliva; and
- South African coal mines (Murphy and Caldwell 2012).

Central Queensland Coal proposes to manage rejects through design measures that avoid the production of a tailings slurry stream and measures to achieve the reuse of the solids. This approach is consistent with the adopted waste management hierarchy (see Chapter 7 – Waste Management). The proposed management of rejects further meets the objectives of the Tailings Management Guideline of the Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland series (DME 1995c). These objectives being:

- Filter press produces stable tailings which are rehabilitated within the landform;
- The process of creating a solid waste minimises and avoids additional disturbance required for traditional wet slurry disposal cells;
- It minimises the threats to the environment both during mining and after rehabilitation. Dry overburden integration and stacking minimises seepage, removing the risks of groundwater contamination. This waste management option has a higher operational cost; however, lower rehabilitation costs and avoids lengthy ongoing closure monitoring requirements of traditional tailings settlement ponds; and
- Adequate environmental protection is achieved through the minimisation of water consumption, as water is recovered and reused in processing. It also negates the need for storage structures and can provide for concurrent reclamation.

This process has considerable long-term economic, social and environmental benefits.

8.10 Qualitative Risk Assessment

Potential impacts on the land resulting from a combination of construction of the proposed infrastructure and ongoing mining activities within the Project area have been assessed utilising the risk assessment framework outlined in Chapter 1 – Introduction. The risk impact assessment at Table 8-13 is a qualitative risk assessment that outlines the potential impacts, the initial risk, mitigation measures and the residual risk following the implementation of the mitigation measures. Soil management strategies in the form of mitigation measures are also identified.

For the purposes of this risk levels are defined as follows:

- Extreme – Extensive long-term harm with widespread impacts that are irreversible in 5-10 years. Significant non-compliances with the EA and / or other approval conditions that result in significant degradation to EVs;
- High – Major long-term and widespread harm that are reversible in <5 years. Non-compliances with the EA and / or other approval conditions that result in major degradation to EVs;
- Medium – Moderate environmental harm that is contained onsite or minor widespread harm that are reversible in <1 years. Non-compliances with the EA and / or other approval conditions that result in minimal degradation to EVs; and
- Low – Minor unplanned onsite harm that does not extend off-site. No non-compliances with the EA and / or other approval conditions.

Table 8-13 Qualitative risk assessment

Issue and associated Project phase	Potential impacts	Potential risk	Mitigation measures	Residual risk
Waste rock				
Surface water, Acid Mine Drainage from Overburden resulting in contamination of waterways and Land Contamination (Construction Operation and Decommissioning)	The waste rock is expected to have a low capacity to be potentially acid forming and moderate saline drainage potential. The waste rock has potential to be highly sodic. There is some potential for leachate from extracted waste rock and tailings to enter local waterways and degrade water quality. The leaching of mine water into waterways can result in negative impact on aquatic organisms, changes in water quality which can in turn affect water availability for humans, and livestock. Sodic and highly sodic materials have potential to cause slaking, are dispersive, and tend to be highly erodible. Mine waste (overburden and interburden) materials, particularly those placed ex-pit, need to be appropriately shaped and monitored to create structurally and chemically suitable landforms for successful rehabilitation.	Medium	The following measures are provided to specifically manage impacts to local waterways: ▪ Ongoing testing of the overburden and rock material for acid drainage potential; ▪ Minimise up gradient clean water entering mine affected catchments; ▪ Mine dewatering dam 2 is designed as a turkey's nest storage with no external contributing catchment; ▪ All contaminated water on-site will be collected using site environmental dams, preventing the water from entering local waterways. These dams will collect water from the waste rock storage; ▪ Ensure an appropriate quantity of acid neutralising agent (ag and / or hydrated lime) readily available near waste rock and tailings leachate areas; ▪ Water quality monitoring will be undertaken at the environmental dams, mine-affected water dams, discharge locations and locations both upstream and downstream of the Project area; ▪ Characterisation of the mining waste to predict, under the proposed placement and disposal strategy, the quality of run-off and seepage generated including salinity, acidity, alkalinity and dissolved metals, metalloids and non-metallic inorganic substances; ▪ Management of water quality or leaching if impacts detected above trigger levels; ▪ Visual inspections of disposal areas and water quality for seepage and vegetation die back;	Low

			- All containment dams and disposal areas will be designed, constructed and monitored for their structural integrity; and - All water that discharges to a waterway will meet nominated Project-specific water quality criteria.	
Groundwater Contamination (Construction Operation and Decommissioning)	The waste rock is expected to have a low capacity to be potentially acid forming, and has moderate saline drainage potential. However, the waste rock is highly sodic. Should AMD/SNMD enter groundwater then the following impacts may occur: - Changes to the salinity of groundwater within the water table; - Changes to pH of groundwater and the mobilisation of dissolved metals; and - Effects on stock watering and aquatic ecology dependent on shallow groundwater.	Medium	Regular monitoring of groundwater quality will take place during the life of mine, comprising the following: - Quarterly field measurements of EC and pH of groundwater from the monitoring bores and monthly field measurements of the same parameters for water pumped from the mine, with samples sent to a NATA laboratory; - Six monthly sampling of groundwater from monitoring bores and selected landholder bores for laboratory analyses of major ions, total dissolved solids and metals, with samples sent to a NATA laboratory; - Regular sampling of groundwater dependent ecosystems; and - Further monitoring of water quality if impacts detected above trigger levels and implementation of management measures if impacts recorded.	Low
Process Waste				
Salinity from Reject Fines Management (Operation)	The salinity of rejects is expected to be low and the sodicity is variable. Surface salinity contents of exposed reject surfaces can increase by oxidisation, capillary action and surface evaporation. No deleterious metal concentrations have been detected in tested coal samples.	Medium	- Where necessary, surfaces will be progressively capped with benign spoil prior to topsoiling. Co-disposal of dry tailings waste through filter press technology into open cut pits following completion of mining. Filter cake suitable for rehabilitation and low risk of causing water pollution; - The potentially sodic nature of the waste rock material would be managed with appropriate erosion and sediment control measures that will be included in an erosion and sediment control plan, with highly sodic material being covered with benign material prior to rehabilitation activities; - Consistent with current practices and existing EA conditions for nearby mines, highly sodic material would be covered with benign material prior to rehabilitation activities, the depth of which will	Low

			depend on the sodicity of the material and the proposed rehabilitation methods; - Waste rock monitoring will be conducted during construction and operation to test for electrical conductivity, pH, NAPP and ESP to identify potential non-benign material that is required to be managed; and - Sodic and dispersive materials will be identified, selectively handled and placed within the centre of waste rock piles or returned to voids away from the final surface.	
Water infiltrating or seeping from reject disposal cells (Operation)	Rainfall on the reject disposal cells is unlikely to cause any significant mobilisation of contaminants within the solid reject material given geochemistry of rejects.	Medium	Use of thickeners and filter press technology and dry stacking significantly reduces the risk of seepage from the filter press waste storage. Monitoring of surface water and groundwater quality within and adjacent to disposal cells. Management of water quality or leaching if impacts detected above trigger levels.	Low

8.11 Conclusion

Waste rock and coarse and fine rejects generated during the extraction of the resource have the potential to impact upon the EVs described in Section 8.6 if they are not appropriately managed. Management measures have been determined in response to these potential impacts and best reflect the requirements for land management through the construction, operation and rehabilitation phases of the Project.

8.12 Commitments

In relation to managing wastes, Central Queensland Coal's commitments are provided in Table 8-14.

Table 8-14 Commitments - waste rock

Commitment
Prepare and implement a Mineral Waste Management Plan prior to commencing operations, setting out design requirements for waste rock dumps and management of potential acidic, metalliferous, saline and sodic drainage and the design measures to assist with rehabilitation objectives.
Ongoing revision and update of Mineral Waste Management Plan during mining operations and implementation for the life of the mine.
Tailings to be dewatered prior to disposal.
Waste rock and tailings to be co-disposed.
Materials with risk of dispersal or sodicity to be placed at the base of rock dumps and capped beneath unweathered material.
Environmental Manager to ensure surface water and groundwater is monitored according to appropriate guidelines within and adjacent to disposal areas for changes in water quality, in particular salinity and pH, and through visual inspections for seepage.
Disposal area walls to be monitored for movement using survey monuments.

8.13 ToR Cross-reference Table

Table 8-15 ToR cross-reference

Terms of Reference	Section of the EIS
8.12 Waste management	
Conduct impact assessment in accordance with the EHP's *EIS information guidelines – Waste management.*	Noted
Describe all the expected waste streams from the proposed project activities during the construction, operational, rehabilitation and decommissioning phases of the project. Waste streams for resource projects would typically include: waste rock, tailings and coarse rejects from mining and mineral processing; salt from petroleum and gas projects; and brackish, saline or mine affected water from all types of resource projects.	Section 8.4
Describe the quantity, and physical and chemical characteristics; hazard and toxicity of each significant waste, as well as any attributes that may affect its dispersal in the environment, and its associated risk of causing environmental harm.	Sections 8.7 and 8.9
Define and describe the objectives and practical measures for protecting or enhancing environmental values from impacts by wastes.	Section 8.9
Assess the proposed management measures against the preferred waste management hierarchy, namely: avoid waste generation; cleaner production; recycle; reuse; reprocess and reclaim; waste to energy; treatment; disposal. This includes the generation and storage of waste.	Section 8.10.2 and Chapter 7 – Waste Management
Describe how nominated quantitative standards and indicators may be achieved for waste management, and how the achievement of the objectives would be monitored, audited and managed.	Section 8.9
Detail waste management planning for the proposed project especially how measures have been applied to prevent or minimise environmental impacts due to waste at each stage of the project.	Section 8.9
Use a material/energy flow analysis to provide details of natural resource use efficiency (such as energy and water), integrated processing design, and any co-generation of power and by-product reuse.	To be done as part of detailed design.
Identify the quantity, quality and location of all potential discharges of water and contaminants (including treated wastewater/sewage) by the project. Describe whether the discharges would be from point sources (whether controlled and uncontrolled discharges) or diffuse sources (such as irrigation to land of treated wastewater/sewage effluent), and describe the receiving environment (such as land or surface waters).	Chapter 9 – Surface Water
Provide a risk assessment of the potential impacts on surface waters (in the near-field or far-field) due to any controlled or uncontrolled discharges from the site. The EIS should address the following matters with regard to every potential discharge of contaminated water: • Describe the circumstances in which controlled and uncontrolled discharges might occur.	Chapter 9 – Surface Water
• Provide stream flow data and information on discharge water quality (including any potential variation in discharge water quality) that will be used in combination with proposed discharge rates to estimate in-stream dilution and water quality. Chemical and physical properties of any waste water (including concentrations of constituents) at the point of entering natural surface waters should be discussed along with toxicity of effluent constituents to human health, flora and fauna.	Chapter 9 – Surface Water
• Provide an assessment of the available assimilative capacity of the receiving waters given existing background levels and other potential point source discharges in the catchment. Options for controlled discharge at times of natural stream flow should be investigated to ensure that adequate flushing of waste water is achieved.	Chapter 9 – Surface Water
• Provide water quality limits that are appropriate to maintain background water quality and protect water users.	Chapter 9 – Surface Water
• Describe the necessary streamflow conditions in receiving water under which controlled discharges will be allowed.	Chapter 9 – Surface Water

Terms of Reference	**Section of the EIS**
Provide relevant information on existing and proposed sewage infrastructure (related to environmentally relevant activity (ERA) 63) by referring to relevant EHP policies and guidelines[1], depending on the proposed collection (sewer infrastructure), treatment of sewage, and proposed reuse/disposal of treated wastewater and sewage wastes generated. For activities associated with ERA 63, the EIS must include: • the preferred location and capacity of the proposed sewage treatment plant (STP) system(s) with specific reference to the 'daily peak design capacity' of equivalent persons	No STP is proposed as part of the EIS. Section 7.9.2
• inputs the STP would receive from the mine camp(s) (e.g. any infiltration of groundwater into the sewer collection system, trade waste from camp cafeteria), whether the effluent coming from the MIA would be contaminated with other industrial pollutants, and whether these contaminants would have any adverse effects on wastewater treatment	
• the expected effluent quality and quantity, and suitable calculations showing the volume of any wet weather storage(s) and area(s) for sustainable effluent irrigation based on the equivalent persons (EP) of the facility/ies and location of the irrigation area(s)	
• avoidance and mitigation measures associated with the generation, treatment and disposal/reuse of sewage generated	
• identify any risks to the receiving environment including land and water quality.	
Identify beneficial use options under the *Waste Reduction and Recycling Act 2011* as per the relevant guidelines for irrigation, drilling mud, and associated water. The uses might include aquaculture, coal washing, dust suppression, construction, landscaping and revegetation, industrial and manufacturing operations, research and development and domestic, stock, stock intensive and incidental land management. If effluent is to be used for dust suppression or other uses, demonstrate that the water quality is appropriate for that used from an environmental and public health perspective.	Chapter 3 – Project Description Chapter 9 – Surface Water
Provide maps and plans describing composting activities to produce a 'soil conditioner'; identify any risks to the receiving environment, and any potential impacts on water quality or land and how these would be managed. Demonstrate that the composted material (as 'soil conditioner') is suitable for its intended use in any proposed rehabilitation by referring to appropriate guidelines and Australian Standards.	No composting is proposed as part of the EIS

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[1] E.g. https://www.ehp.qld.gov.au/licences-permits/guidelines.html