ENVIRONMENTAL IMPACT STATEMENT

RED HILL
MINING LEASE

Section 06
Mineral Waste

Section 06 Mineral Waste

6.1 Introduction

The Red Hill Mining Lease is located adjacent to the existing Goonyella, Riverside and Broadmeadow (GRB) mine complex in the Bowen Basin, approximately 20 kilometres north of Moranbah and 135 kilometres south-west of Mackay, Queensland.

BHP Billiton Mitsubishi Alliance (BMA), through its joint venture manager, BM Alliance Coal Operations Pty Ltd, proposes to convert the existing Red Hill Mining Lease Application (MLA) 70421 to enable the continuation of existing mining operations associated with the GRB mine complex. Specifically, the mining lease conversion will allow for:

- An extension of three longwall panels (14, 15 and 16) of the existing Broadmeadow underground mine (BRM).
- A future incremental expansion option of the existing Goonyella Riverside Mine (GRM).
- A future Red Hill Mine (RHM) underground expansion option located to the east of the GRM.

The three project elements described above are collectively referred to as 'the project'.

The objective of the project's geochemical study, in response to the Coordinator-General's (September 2013) Terms of Reference, was to evaluate the following:

- the potential of mineral waste samples generated by the project to produce acid and metalliferous drainage (AMD);
- the approximate quantity and concentrations of trace metals in mineral waste and leachates samples, and the potential for contamination associated with mining, handling and storing of these materials;
- to characterise the mineral waste to determine its suitability as a growth media;
- to identify management requirements (if any) necessary to ensure the erosional stability of the rehabilitated landform; and
- to describe and show the location, design and methods for constructing dumps for waste rock and subsoil. Show the location of the dumps on a map relative to topography and other natural features of the area.

6.2 Description of Environmental Values

Waste generated through mining in the form of overburden (from mine access works) and coarse rejects and tailings (from coal processing) has been defined as mineral waste.

Coal is deposited within environments that may have some potential to produce sulfides within the sediments. The mining or disturbance of overburden materials and coal can expose these sulfides (typically pyrite) to air and water, resulting in oxidation of these materials. This can potentially lead to the generation of typically acidic waters with elevated metal and sulfate concentrations; however, sometimes near-neutral but metalliferous and/or saline drainage can also occur. The resulting drainage is referred to as AMD.

Accordingly, the geochemical assessment undertaken for this environmental impact statement (EIS) includes the analysis of the sulfide content of the mineral wastes and determination as to whether the contained sulfides will potentially form acidic, metalliferous and/or saline conditions if oxidised under normal atmospheric environmental conditions.

The material characterised as part of this EIS is considered to be representative of the projected rejects material and thus provides a guide to its potential for generating AMD. Should the proposed project proceed, the generated rejects material may need to be further analysed to better determine their geochemical characteristics, disposal requirements, and implications for site rehabilitation.

It is planned that the coarse rejects and dewatered tailings will be disposed within the existing GRB mine complex waste storage facilities. New tailings or rejects storage facilities are not required for the project.

6.2.1 Summary of Geology

The proposed EIS study area is situated on the north-western margin of the Bowen Basin on the Collinsville Shelf (refer to **Section 5.3**). The geology of the EIS study area comprises Permian age sandstone, siltstone, mudstone, claystone and coal, which displays little lithological variability throughout the entire site (west to east and north to south). The Permian age sediments dip towards the east at between three and five degrees, and are unconformably overlain by poorly consolidated Tertiary and Quaternary age sediments (minor gravels, clays and sands and basalt), which vary in thickness from 0 to 30 meters. The local stratigraphical sequence is provided in **Section 5.3**.

The existing GRB mine complex targets the Goonyella Upper Seam (GUS), Goonyella Middle Seam (GMS), and Goonyella Lower Seam (GLS) through open-cut mining, and the GMS through underground mining. The RHM will target the GMS to the north of the existing BRM, while the Broadmeadow extension will target the GMS eastward into MLA 70421.

A total 46 overburden samples and 19 coal roof and coal floor (i.e. potential reject) samples were collected from 5 core drill holes for geochemical assessment. The location of each sampled drill hole is shown in **Figure 6-1**. The 46 overburden samples comprised a total of 17 siltstone, 11 sandstone, 6 claystone, 5 carbonaceous claystone, and 2 sandstone/siltstone samples (**Table 6–1**). The remaining 5 samples comprised composite samples of shale, mudstone, conglomerate, carbonaceous siltstone, and a mix of siltstone/claystone/sandstone. The potential rejects consisted of a total of 9 coal roof and 10 coal floor samples for geochemical testing (**Table 6–2**).

In addition to potential rejects, eight surface coarse reject samples were obtained from the reject emplacement facilities at the current GRB mine complex, and 10 tailings samples from the existing Riverside and Goonyella tailings dams. The locations of the coarse reject and tailings samples are shown in **Figure 6-2**.

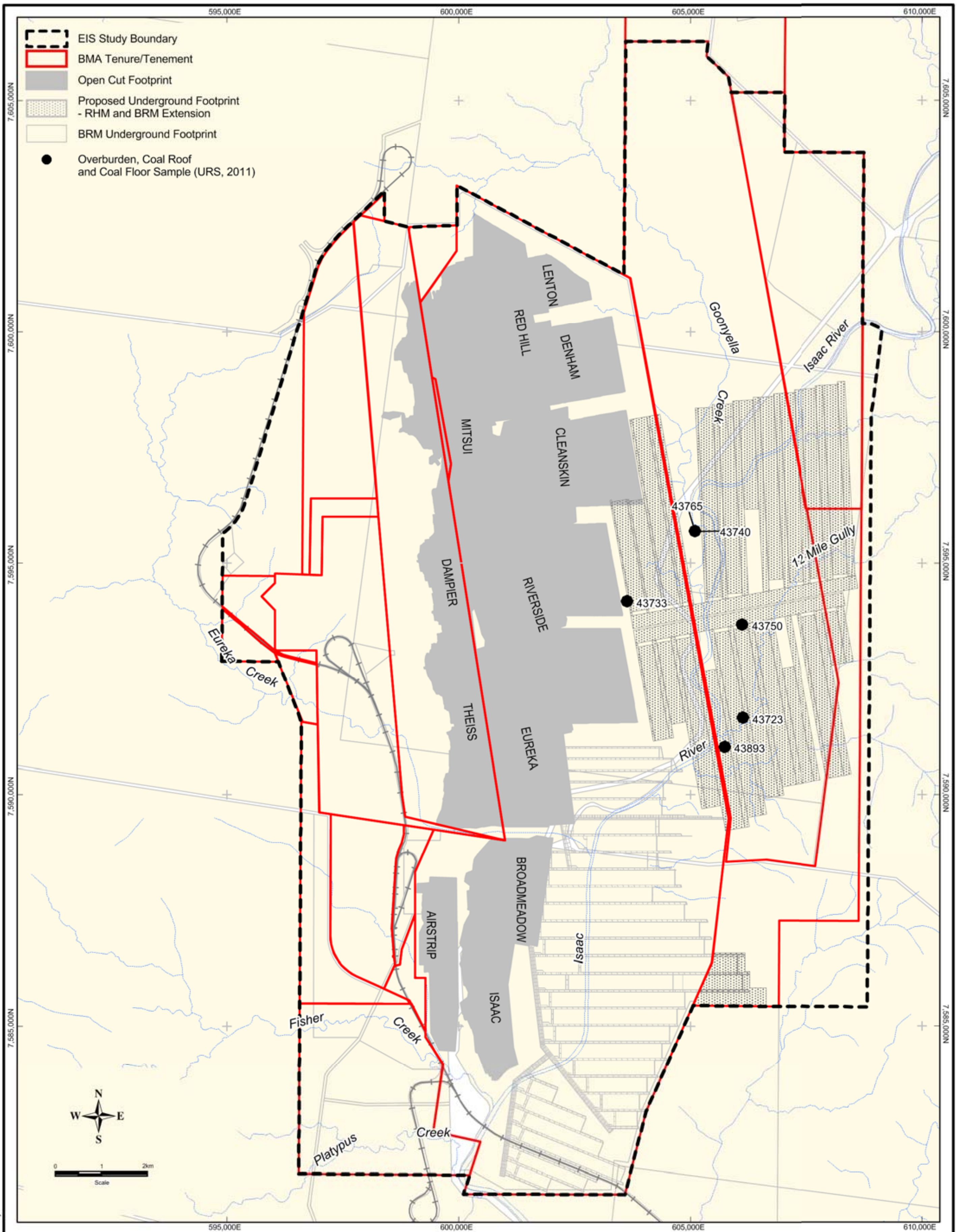
Geochemical testing included; pH (1:5), electrical conductivity (EC) (1:5), acid neutralising capacity (ANC), total sulfur, sulfide-sulfur, and net acid producing potential (NAPP), net acid generation (NAG) test, and exchangeable sodium percentage (ESP) to estimate sodicity of the media.

Table 6-1 Overburden Samples Selected for Geochemical Testing

Drill Hole ID	Total Sample Interval (m)	Lithology	Number of Samples
43723	208.9 to 230.82; 260.11 to 266.45; 372.00 to 417.14	Siltstone	6
		Sandstone - fine to medium grained	2
		Claystone	2
43733	72.36 to 83.97; 113.06 to 138.67; 214.09 to 299.76	Siltstone	6
		Sandstone - fine to medium grained	3
		Claystone	4
		Carbonaceous claystone	4
43765	226.93 to 339.36; 384.88 to 411.07	Siltstone	3
		Carbonaceous siltstone	1
		Sandstone - fine to medium grained	1
		Sandstone - medium grained	1
		Claystone	2
		Carbonaceous claystone	1

Table 6-2 Coal Roof and Coal Floor Samples Selected for Geochemical Testing

Drill Hole ID	Depth (m)		Sample Type	Predominant Lithology
	From	To		
43723	217.92	218.30	Coal roof	Siltstone
43723	264.65	265.15	Coal floor	Claystone
43723	400.20	400.70	Coal floor	Siltstone
43733	128.79	129.29	Coal roof	Carbonaceous claystone
43733	133.50	134.00	Coal floor	Siltstone
43733	222.83	223.38	Coal roof	Siltstone
43733	279.66	280.00	Coal floor	Siltstone
43750	282.20	282.50	Coal floor	Claystone
43750	368.69	369.08	Coal roof	Siltstone
43750	378.50	379.00	Coal floor	Sandstone
43750	417.00	417.34	Coal roof	Sandstone/siltstone
43765	392.30	392.63	Coal roof	Siltstone/claystone
43893	186.96	187.37	Coal roof	Shale
43893	192.12	192.62	Coal floor	Siltstone
43893	299.46	299.94	Coal roof	Shale/siltstone
43893	307.57	308.07	Coal floor	Shale/sandstone
43893	336.00	336.38	Coal floor	Carbonaceous mudstone/siltstone
43893	357.09	357.59	Coal roof	Siltstone
43893	363.61	364.11	Coal floor	Siltstone



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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

DRILL HOLE LOCATIONS FOR OVERBURDEN AND COAL ROOF AND COAL FLOOR SAMPLES

MINERAL WASTE

Figure: **6-1**

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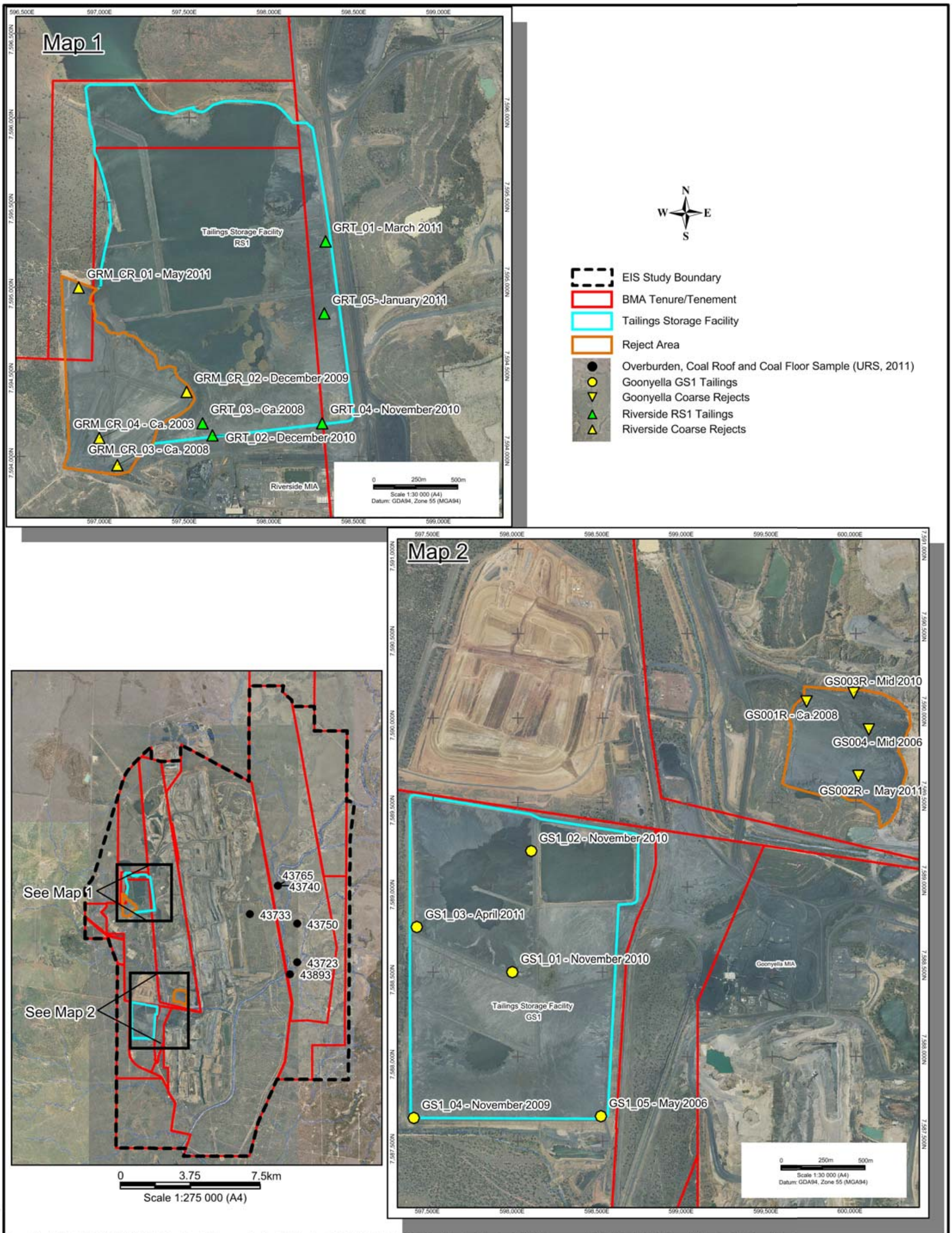

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RED HILL MINING LEASE
ENVIRONMENTAL IMPACT STATEMENT

COARSE REJECT AND TAILINGS SAMPLE LOCATIONS

MINERAL WASTE

Figure: 6-2

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6.2.2 Mineral Waste Quantities

As RHM will be an underground mine, the project will not generate any substantial quantities of overburden. Overburden will only be generated during the construction of drifts for access and services, and main drives for coal longwall access and coal transport.

Over an approximate 25 year life of mine, the project will produce a total of 234 million tonnes of run-of-mine (ROM) coal (i.e. raw coal), 190 million tonnes of product coal and 43 million tonnes of rejects. The Broadmeadow extension (panels 14 and 15) will also produce approximately five million tonnes of ROM coal and one million tonnes of rejects over approximately one year from commencement of mining. These estimates are based on an assumed average density of 1.8 tonnes per cubic metre (t/m^3) for coarse rejects and dry tailings, and the Broadmeadow extension area representing approximately four per cent of the total BRM surface area with an equivalent coal seam thickness being extracted.

The amount of rejects (excluding overburden) produced by the project will represent approximately 29 per cent of the total rejects generated by the GRB mine complex during this period. The rejects from the project are relatively minor compared to the overburden and reject waste produced by the existing GRB mine complex. Approximately 32 million tonnes (1.3 million tonnes per annum (mtpa)) of coarse rejects and 12 million tonnes (0.5 mtpa) of dewatered tailings will be generated by the project based on a coarse reject to total reject ratio of 0.72. It is estimated that for every one tonne of raw coal mined at the project, 0.13 tonnes of coarse rejects and 0.05 tonnes of dewatered tailings will be produced.

The total amount of rejects (coarse rejects and dewatered tailings) produced by the project is shown in **Table 6-3**.

Table 6-3 Estimated Total Mineral Waste Quantities Generated for the Life of Mine

Location	Waste Type[1]	Quantity (mbcm)	Quantity (mt)
Project[2]	Total rejects	24	44
	Coarse rejects[3]	18	32
	Dewatered tailings	7	12

Note 1: Assumed average density of 1.8 t/m^3 for coarse rejects and tailings
Note 2: Based on Broadmeadow extension area representing ~4 per cent of the total BRM surface area, and assuming an equivalent coal seam thickness is extracted
Note 3: Based on coarse reject to total reject ratio of 0.72

Over an approximate 25 year life of mine, the amount of rejects generated by the project will comprise about 1 per cent of the total mineral waste (i.e. overburden and rejects) produced by the GRB mine complex. The proportion of rejects to product coal is 20 per cent for the project. This is substantially less than the yearly average value (from 2010 to 2012) of 40 per cent for other operating underground coal mines located in the northern district (five mines) and central district (eight mines) of the Bowen Basin (NRM 2013). In terms of the GRB mine complex, the percentage of rejects to product coal is comparatively lower (15 per cent) on average when compared to all operating coal mines (underground and open-cut) in Queensland.

6.2.3 Mineral Waste Disposal

Mineral waste disposal includes disposal of spoil and rejects, which will be disposed of into the existing GRB mine complex waste disposal facilities.

6.2.3.1 Spoil Disposal

As the project involves only underground mining, the waste rock material located above (overburden) and between the coal seams (interburden) is removed only during the construction of drifts for access and services, and main drives for coal longwall access and coal transport. For this section, these waste rock materials will be collectively called spoil (or overburden).

The project will not generate any substantial quantities of overburden, with much of the overburden expected to remain largely intact. Spoil material, with suitable geotechnical properties, will be used for engineering and construction purposes such as bulk fill, road sub-base and construction material for laydown areas.

Spoil that is unsuitable for engineering purposes or in excess of requirements will be placed in the GRB mine complex existing waste storage facilities according to the existing approved overburden management practices.

6.2.3.2 Reject Disposal

The rejects materials from the Red Hill coal handling and preparation plant (CHPP) will consist of coarse rejects (>2.5 millimetres) from the dense medium cyclones, fine rejects (<2.5 to 0.25 millimetres) from the desliming cyclones, and flotation tailings (<0.25 millimetres) from the floatation cells. These reject materials from Red Hill CHPP will be managed as follows:

- Dense medium coarse reject material will be dewatered on the rejects drain and rinse screens and transported via the rejects conveyor to the rejects bin. In circumstances where the capacity of the rejects bin is exceeded, overflow will be discharged to a designated rejects bunker. The bunker will provide access for a loader for removal of coarse rejects as required.
- Fine reject material from the reflux classifiers will be transferred to the fine coal reject dewatering screen and dewatered using filter, centrifuge, and de-aeration techniques. Dewatered rejects will be transported via the reject conveyor to the rejects bin.
- Flotation tailings material from the flotation cells will be transferred to a high rate tailings thickener. Solids from the thickener underflow will be pumped to multiple belt press filters. Under normal operating conditions, the solids discharged from the belt press filters (dewatered tailings) will be transferred by a conveyor and discharged onto the coarse rejects conveyor feeding the rejects bin.

Recovered water from dewatering of reject and dewatered tailings materials will be recycled to Red Hill CHPP.

The rejects bin will be designed to ensure an adequate capacity to suit the proposed reject handling fleet. The bin will be emptied on an as-needs basis and will discharge via a pneumatically operated bottom dump gate for loading into haul trucks.

All rejects (dense medium coarse rejects, fine rejects and dewatered tailings) from the rejects bin will be placed within the existing GRB mine complex waste storage facilities. There is no anticipated requirement for an increase to or construction of a new tailings dam as a consequence of the project.

The tailings and rejects management approach will align with the GRB mine complex Tailings Management and Rehabilitation Management Plans including the following measures:

- All reject material will be trucked to designated GRB mine complex site disposal areas.
- Dumps will be developed in line with the GRB mine complex mine plan.
- Reject material will not be placed within 1.5 metres of the final landform surface as per condition F5 and Table 16 of the GRB mine complex environmental authority (EA) EPML00853413 (formerly MIN100921609). This will be managed by survey limit pegs (**Figure 6-3**).
- Survey control will be used to ensure documented evidence of thickness of cover is recorded.

As a contingency, systems will be in place to pump tailings slurry from the thickener underflow from the Red Hill CHPP to the existing Riverside tailings dam (RS1) and Goonyella tailings dam (GS1) in the event that:

- the dewatered tailings are too wet or have inadequate residue moisture content/consistency and thus present a slumping risk when mixed with spoil for disposal −slumping may cause a significant safety hazard or result in significant environmental harm; and
- the proposed belt press filter dewatering system is rendered inoperable due to maintenance, partial or critical failure.

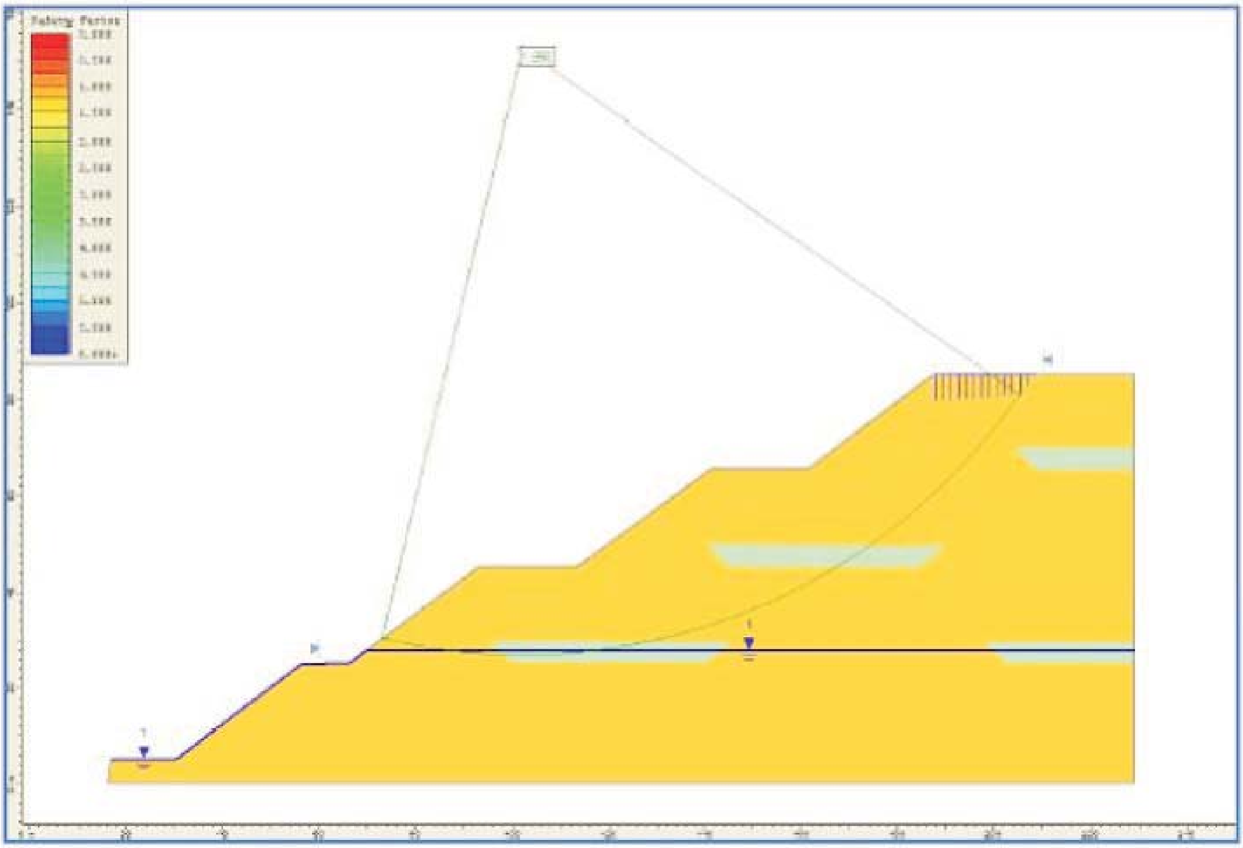
As this is expected to be required only infrequently, the existing GRB mine complex tailings dams have enough capacity to accommodate tailings generated that cannot be dewatered or are too wet for disposal. Currently, tailings from GRM are deposited via perimeter spigots as slurry pumped from the CHPP with a solids content between 20 and 35 per cent (BMA 2010).

The rehabilitation strategy, final landform design and planning for in-pit and out-of-pit spoil dumps at GRB mine complex is covered by an existing rehabilitation plan (BMA 2007a and 2011) prepared to meet requirements of the GRB mine complex EPML00853413 (formerly EA MIN 100921609).

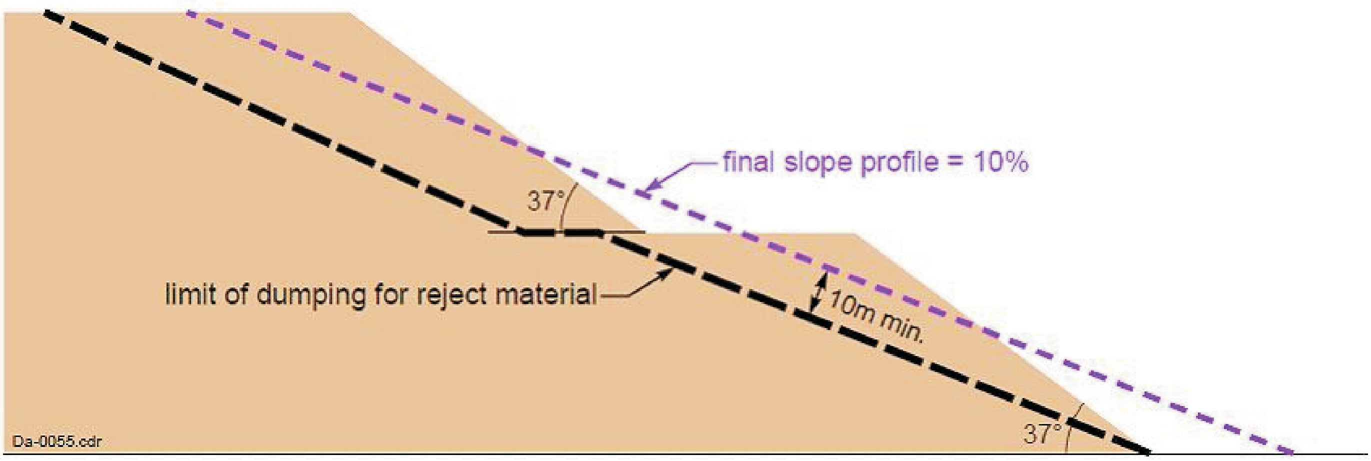
Rejects and spoil dumps will continue to be managed and rehabilitated as per the existing GRB mine complex Mine Rehabilitation Management Plan (BMA 2007a and 2011) and closure plan (BMA 2007b), the commitments in the EPML for the GRM and BRM, and in conformance with the *BMA Sustainable Landform Guideline* (BMA 2009). Rehabilitation of the existing tailings dams will be undertaken as per the existing commitments in the GRB mine complex Mine Closure Plan (BMA 2007b).

The guideline recommends that coal wastes typically require a minimum of two metres of cover, ensuring that these areas are externally draining or in-pit and, where necessary, treating areas with small amount of alkaline material to lower the acidity and increase the pH of any localised acidic near-surface reject areas. This is to ensure the potential for acidity to impact upon the performance of the rehabilitated reject cover system is minimised.

The reject dumps will consist of three covering layers: a barrier layer to minimise moisture inflow and oxygen egress; a protection layer suitable for plant root growth and to provide some protection to the underlying barrier layer from seasonal variations in moisture content; and a topsoil layer suitable as a plant growth medium. The rejects dumps will be revegetated with pasture for a post-mining land use of grazing, as the establishment of bushland on reject dumps is not recommended as tree roots (and tree falls) can affect the integrity of the cover layer (BMA 2011).



Cross Section of Typical Spoil Dump with Reject Placement



Cross section of typical spoil dump showing minimum 10m cover
over coarse rejects and dewatered tailings material

Source: Supplied by BMA

6.3 Geochemical Nature of Mineral Waste Materials

6.3.1 Acid Generating Potential

Static geochemical tests were performed to determine the total acid generating and total acid neutralising potential of mineral waste samples from the EIS study area. The geochemical tests are static in that the tests determine the chemical status of the tailings sample at one point in time, irrespective of how the AMD may develop over time.

The NAPP and net NAG tests (corrected for total organic carbon where appropriate) were used to predict the potential of the mineral waste samples to generate acid. The acid generating potential of a sample is classified based on the geochemical classification criteria adopted by the Department of Resources, Energy and Tourism (formerly Department of Industry, Tourism and Resources) (DITR 2007) as shown in **Table 6-4**.

Table 6-4 Geochemical Classification Criteria based on $NAPP_{CRS}$ and NAGpH Test Data.

Geochemical Classification	$NAPP_{CRS}$ (kg H_2SO_4/t)[1]	NAGpH
Potentially acid forming (PAF)	>10	<4.5
Potentially acid forming – low capacity (PAF-LC)	0 to 10	<4.5
Non-acid forming (NAF)	-100 to <0	≥4.5
Acid consuming (AC)	<-100	≥4.5
Uncertain (UC)[2]	>0	≥4.5
	<0	<4.5

Note 1: $NAPP_{CRS}$ (kg H_2SO_4/t) = [sulfide-sulfur (%) × 30.6] – [acid neutralising capacity (ANC) ((kg H_2SO_4/t)]
Note 2: Further testing required to confirm material classification.

The geochemical test data collected from the five drill holes indicate that overburden and almost all potential reject (i.e. coal roof and coal floor) samples tested are non acid forming (NAF), and have very low sulfide-sulfur concentrations (<0.1 per cent).

The concentration of sulfide-sulfur (as an indicator of pyrite content) for all samples tested is very low with approximately 13.2 per cent of all sulfide concentrations less than 0.01 per cent, and a further 67.5 per cent distributed between 0.01 and 0.1 per cent. The remaining 19.3 per cent (16 samples) of sulfide-sulfur concentrations were >0.1 per cent (maximum 2.3 per cent and median 0.38 per cent). The limited sulfide-sulfur concentration present in the mineral waste materials indicates there is minimal source of potential acidity that can be generated under natural oxidation processes.

Overall, approximately 86 per cent of all mineral wastes samples tested were NAF or AC, with another 6 per cent classified as potentially acid forming (PAF), 2 per cent PAF-LC and 6 per cent UC. All overburden, coarse reject, and coal roof and coal floor samples are NAF, while Riverside and Goonyella tailings samples are typically PAF. Of the five samples classified as UC, two samples (coarse rejects) are PAF but are expected to have a low capacity to generate acid ($NAPP_{CRS}$ 0.3 and 1.8 kg H_2SO_4/t). A further two samples (Goonyella tailings) are expected to be PAF ($NAPP_{CRS}$ 10.3 and 11.2 kg H_2SO_4/t), with the remaining sample (coal floor) expected to be NAF ($NAPP_{CRS}$ -6.9 kg H_2SO_4/t). Therefore, apart from Goonyella tailings samples and to a lesser extent Riverside tailings samples, all other mineral waste samples are considered to be non acid generating.

The high median acid neutralising capacity (ANC) value relative to maximum potential acidity (MPA) indicate that overburden (23) and potential rejects (11) have negligible risk of acid generation and a very high factor of safety in terms of its potential to generate acid. Generally, samples with an ANC/MPA ratio of greater than two are considered to have low or negligible risk of acid generation and a high probability that the material will remain circum-neutral in pH. Therefore, the spoil and rejects produced and disposed at the project are not expected to generate significant acid.

Often, a very small portion of overburden, typically located near coal seams, may have the capacity to generate small quantities of acid. It should be noted that the magnitude of acid generated by coarse rejects is small (i.e. PAF-LC). Given that both the coarse rejects and tailings produced over the project's life of mine are expected to comprise about 0.6 per cent of all mined waste (i.e. overburden and rejects) at the GRB mine complex, their overall contribution to potential environmental harm is expected to be small.

6.3.2 Multi-element Composition and Water Quality

There are no guidelines and/or regulatory criteria specifically related to total metal concentrations in mineral wastes. To provide some context, the total metal concentrations were compared to the National Environment Protection Council (NEPC) health based investigation levels for land used for parklands and recreational open spaces (NEPC 1999). The results shows that the total metal concentrations in all mineral waste samples tested were orders of magnitude less than the guideline values, where such guideline levels exist. Therefore, the mineral waste materials are not expected to present a substantial risk to the environment with respect to beneficial use.

The drainage water quality was assessed by analysing the dissolved metal concentrations in the water extracts (solids to deionised water ratio of 1:5). The results provide an indication of any possible weakly-bound forms of metals that are susceptible to release to solution upon initial contact with meteoric water (i.e. rainfall). The results are compared to the Australian livestock drinking water guidelines (ANZECC and ARMCANZ 2000) because the EIS study area is located in a sparsely populated rural area where surrounding areas have historically, and are currently, used for cattle grazing where mining activity is not currently occurring.

The dissolved metal concentrations in the water extract solutions for overburden, coal roof and coal floor materials, coarse reject and tailings samples are generally orders of magnitude below the Australian livestock drinking water guidelines (ANZECC and ARMCANZ 2000), where guideline values exist. In addition, they are not expected to generate significant salinity. The current EC (1:5) levels are within the salinity range (0 to 7463 microSiemens per centimetre (µS/cm)) recommended for livestock drinking water in Australia (ANZECC and ARMCANZ 2000). The median EC (1:5) for overburden (446 µS/cm), coal roof and floor (382 µS/cm), coarse rejects (250 µS/cm) and tailings (707 µS/cm) samples did not exceed the draft water quality guidelines for EC (835 µS/cm) for the protection of aquatic ecosystems in the Isaac River catchment (DERM 2010).

Therefore, runoff and seepage water quality arising from these mineral waste materials is predicted to contain low dissolved metal and salt concentrations (compared to guideline values). This combined with the predominant NAF nature of the mineral waste samples, suggests the materials represented by the samples tested are not expected to generate acid or mobilise metals and salts to present a substantial risk to downstream water quality.

6.4 Use of Overburden Materials for Revegetation/Rehabilitation

The discussion below focuses on the geochemical characteristics that need to be considered during rehabilitation. Rehabilitation of the proposed EIS study area is discussed in detail in **Section 5.5** of this EIS. In terms of plant growth and erosion hazard, the geochemical characteristics that also need to be considered during revegetation and rehabilitation works include pH (1:5), EC (1:5), effective cation exchange capacity and ESP.

The proposed mining strategy is to dispose all rejects and almost all overburden materials within the existing GRB mine complex waste storage facilities. Suitable overburden materials from mine access construction may be used for engineering and construction purposes.

Generally, it is not acceptable mining practice to allow rejects to report to final surfaces. Typically rejects are buried or mixed well into the spoil material.

Approximately 96 per cent of all mineral waste samples tested are considered sodic with a high risk of dispersion (median ESP value of 30.8 per cent). Materials with a high risk of dispersion generally require management strategies to ensure that slopes are stabilised against erosion. The ESP for all coarse reject and tailings samples was less than 40 per cent, while the proportion of overburden (55 per cent), and coal roof and floor materials (25 per cent) was significantly less.

The majority (78 per cent) of overburden, coal roof and coal floor, coarse reject and tailings samples tested have pH values greater than 9.0, which is regarded as very high and likely to have direct effects on plant growth if not appropriately managed (DERM 1995a and 1995b). The EC (1:5) value for most mineral waste samples (>95 per cent) falls within <150 to 900 µS/cm, which is classed as very low to medium salinity according to the Queensland guidelines for the assessment and management of acid drainage (DERM 1995a).

An assessment of the tolerance of pasture plants to salinity in runoff/seepage water, produced by the contact between meteoric water and mineral waste samples, is made by calculating the average root zone salinity. The salt content of the soil water in the plant's root zone, referred to as the average root zone salinity, is considered the key limitation to plant growth in response to salinity and sodicity levels in irrigation water (ANZECC and ARMCANZ 2000). Apart from three tailings samples from Goonyella and one from Riverside, the average root zone salinity generally did not exceed the average root zone salinity threshold for 13 common pasture species (such as *Pennisetum ciliare*, *Agropyron elongatum* and *Chloris gayana*).

The relatively low salinity and high alkaline pH, combined with the high ESP and predominance of sodium in the soil solution suggest the mineral waste samples tested can be classed as non-saline sodic materials (DERM 1995a). These mineral waste materials are predicted to have structural stability problems related to potential dispersion. Therefore, they would not be suitable for use as a final cover material without prior treatment or overlain with a stable topsoil layer. On this basis, all rejects materials from the RHM will need to be buried below plant root zones.

Treatment of the sodic overburden would be required if these are to be used as revegetation media. Ideally, sodic and dispersive materials should be identified, selectively handled and placed within the core of the overburden dump and away from final surfaces, or returned to voids during mining. Alternatively, treatment of the sodic waste materials would be required if these were to be used as an additional source of revegetation media.

6.5 Potential Impacts and Management Measures

The ongoing management of mineral waste (overburden, coal roof and coal floor, coarse reject and tailings materials) will consider the geochemistry of materials with respect to their potential risk to cause environmental harm, and their suitability for use in revegetation and rehabilitation.

6.5.1 Waste Disposal Methodology

The mineral waste management strategy for the project will focus on:

- evaluating the geochemical characteristics of actual reject materials collected from the Red Hill CHPP and in-fill drilling core samples ahead of mining to confirm the NAF nature or delineate any PAF materials prior to mining; and
- strategic placement of mineral waste materials to minimise runoff and avoid erosion.

As all mineral wastes will be disposed of in the GRB mine complex mineral waste disposal areas, management of these wastes will be in accordance with GRB mine complex site practices. These include the following general strategies:

- The bulk overburden materials, generated during the construction of drifts for access and services, and main drives for coal longwall access and coal transport, are expected to be NAF and from an AMD perspective, no selective handling is required away from coal units.
- Where the overburden materials have properties suitable for engineering purposes, these materials can be used as bulk fill, road sub-base, construction material for laydown areas, and/or foundations and levees, provided suitable surface covering material is applied.
- Excavated spoil (waste rock material) with properties unsuitable for engineering and construction purposes will be placed in designated mineral waste disposal areas at the GRB mine complex according to the existing approved overburden management practices.
- A small amount of overburden typically located near coal seams may be PAF-LC. Any overburden associated with coal units, such as coal ply partings smaller than 30 centimetres in mesh size and some coal roof and floor materials will report with coal to the Red Hill CHPP and will, therefore, report as coarse reject.
- All reject materials (i.e. dense medium, coarse and fine rejects, and dewatered tailings) will be loaded into trucks and dumped onto the in-pit spoil dumps. Mixing and compaction will occur as appropriate to the properties of the materials to achieve a sustainable final landform. If marked amounts of PAF rejects are encountered, lime dosing of compacted coarse reject layers (one to two metres) will be used (as a precautionary measure) to extend the lag period in the unlikely event of acid generation.
- All reject materials will be mixed via alternating disposal of the reject and spoil material into the in-pit spoil dumps at the GRB mine complex.
- Pre-strip weathered spoil materials will be used to cap the reject disposal and dewatered tailings areas. A minimum thickness of two metres of inert cover material will be used, with final thickness to be determined based on the material characteristics. Coarse reject placement will be sequenced such that capping of the rejects will be completed progressively as the working face progresses down the dip. Suitable growth media will be placed onto the re-profiled slopes.

- Given that some coarse reject samples have been classified as PAF-LC in this study, potentially contaminated water from ROM coal and product coal stockpiles will be contained to avoid interaction with clean waters as a precautionary measure.
- Geochemical test results indicate that some rejects may be PAF. BMA will consider lime amendment of PAF rejects materials (dewatered) if they generate leachate pH values less than 5.0.
- Spoil dumps may be re-shaped, and will be covered with a suitable growth media and revegetated with pasture species for a post-mining land use of grazing, or a combination of native grasses supplemented with introduced pasture species in areas where continuous pasture cover is necessary for erosion control.
- No reject material will be placed below the pre-mining groundwater table and all dumps will be designed and constructed to be free draining so as to minimise the potential for geotechnical instability.

6.5.2 On-going Geochemical Sampling and Analysis

BMA will undertake ongoing operational geochemical characterisation of mineral waste materials in planned disturbance areas of the proposed RHM and Broadmeadow extension ahead of mining to confirm the expected geochemical characteristics of these materials.

Characterisation of reject materials (coarse rejects and dewatered tailings) from the project will also be undertaken to verify their expected geochemical nature. These data will be used to re-evaluate and update the management and disposal strategies for reject materials.

BMA will conduct an ongoing geochemical assessment program that is commensurate with the current AMD risk of the mineral wastes:

- Actual coarse rejects and tailings (dewatered) generated from the project will be assessed on an annual basis for the following geochemical parameters:
  - pH (1:5) and EC (1:5);
  - NAPP (including ANC, total S and CRS);
  - NAG;
  - total Al, As, Cd, Cr, Cu, Co, Pb, Mo, Ni, Se, Sb, U and Zn;
  - dissolved Al, As, Cd, Cr, Cu, Co, Pb, Mo, Ni, Se, Sb, U, V and Zn in 1:5 (solid to liquid) extracts; and
  - CEC, sodium absorption ratio (SAR) and ESP.
- Monitoring of potential drainage/seepage water quality from spoil dumps for pH, EC, sulfate, and dissolved Al, As, Cd, Cu, Co, Pb, Ni and Zn.

- Overburden, potential reject (i.e. coal roof and coal floor materials) and GMS coal samples collected from in-fill drill core samples will be assessed on an annual basis for the following geochemical parameters:
  - pH (1:5) and EC (1:5);
  - NAPP (including ANC, Total S and CRS);
  - NAG;
  - total Al, As, Cd, Cr, Cu, Co, Pb, Mo, Ni, Se, Sb, U and Zn;
  - dissolved Al, As, Cd, Cr, Cu, Co, Pb, Mo, Ni, Se, Sb, U and Zn in 1:5 (solid to liquid) extracts; and
  - CEC, SAR and ESP.
- BMA will conduct laboratory scale kinetic leach column tests during the mining phase of the project to improve predictions on seepage quality and release rates of environmentally important metals.

6.5.3 Water Quality Monitoring and Management

Runoff (and seepage water) quality resulting from the contact between meteoric water and mineral waste materials (spoil and rejects) is not expected to be problematic with respect to acidity, salinity and metals concentrations. However, leachate and site water derived from such materials will be monitored to ensure nearby drainages are not receiving acid, salt and metal loads that could impact upon the existing ecosystem.

Water quality monitoring is undertaken by GRB mine complex in accordance with requirements of its EPML00853413 (formerly EA MIN 100921609). In general, water will be managed by retaining or reusing surface seepage and runoff water on site in accordance with existing approved site water management system practices.