Mining Waste Management Plan

Middlemount Coal Mine

Prepared for: **Middlemount Coal Pty Ltd**

LEADERS IN MINING GEOCHEMISTRY

Mining Waste Management Plan

Middlemount Coal Mine

Prepared for: **Middlemount Coal Pty Ltd**

DOCUMENT CONTROL			
Project Title	Mining Waste Management Plan		
Project Name	Middlemount Coal Mine		
Project Number	2019025		

DOCUMENT DISTRIBUTION			
Document File Name	**Document Status**	**Distributed to**	**Date distributed**
2019025_001_RGS DRAFT MCM MWMP Rev 1	**Draft**	**Resource Strategies**	**20 June 2019**
2019025_002_RGS DRAFT MCM MWMP Rev 1	**Final**	**Resource Strategies**	**27 June 2019**

Limitations and disclaimer:

This report documents the work undertaken by RGS Environmental Pty Ltd (RGS).

This report should be read in full. While the findings presented in this report are based on information that RGS considers reliable unless stated otherwise, the accuracy and completeness of source information cannot be guaranteed, although RGS has taken reasonable steps to verify the accuracy of such source data. RGS has made no independent verification of this information beyond the agreed scope of works and RGS assumes no responsibility for any inaccuracies or omissions outside of RGS's direct control. Furthermore, the information compiled in this report addresses the specific needs of the Client, so may not address the needs of third parties using this report for their own purposes. Thus, RGS and their employees accept no liability for any losses or damage for any action taken or not taken on the basis of any part of the contents of this report. Those acting on information provided in this report do so entirely at their own risk.

This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Table of Contents

Figures

Tables

Definitions

Acronym	Definition
Acid and Metalliferous Drainage (AMD)	Any contaminated discharge resulting from mining and associated processing, which is formed through a series of chemical, physical and biological reactions when geological strata is exposed to oxygen and moisture as a result of ground disturbance activities.
ANC	Acid Neutralising Capacity, expressed as kg H_2SO_4 per tonne of sample.
CHPP	Coal Handling and Preparation Plant
Coarse Reject	Coarse coal waste produced through coal processing sourced from the D&R screen and the spirals rejects dewatering screen.
EA	Environmental Authority (EPML00716913)
EDMS	Environmental Database Management System
Hazardous substance	A substance which has the potential to harm the health of persons in the workplace and/or adversely impact the environment.
Mining Waste	Any mining and coal handling and processing related waste, including: overburden, interburden, partings, coarse reject, tailings and miscellaneous waste rock material;
Mining By-Product	Any mining and coal handling and processing related waste, including: overburden, interburden, partings, coarse reject, tailings and miscellaneous waste rock material;
NAF	Non-Acid Forming. Geochemical classification criterion for a sample that will not generate acidic conditions.
NAF (Barren)	Non-Acid Forming. Geochemical classification criterion for a sample that will not generate acidic conditions. Barren of oxidisable sulfur.
NAG	Net Acid Generation
NAPP	Net Acid Producing Potential
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acidic conditions.
ROM	Run of Mine
SSE	Site Senior Executive
Tailings	Fine coal waste produced through coal processing sourced from the Tailings Thickener underflow.
Uncertain	Geochemical classification criterion for a sample where the potential to generate acid conditions remains uncertain and may require further analysis.

1 INTRODUCTION

1.1 Purpose

RGS Environmental Pty Ltd (RGS) has prepared this Mining Waste Management Plan (MWMP) for Middlemount Coal Pty Ltd (MCPL) operations at Middlemount Coal Mine (MCM). This MWMP details how MCPL will manage its mining wastes (ie. overburden, interburden, coarse rejects and tailings) during mining operations. The plan aims to ensure all mining wastes are managed in accordance with Queensland coal mining industry standards and regulatory requirements including the requirements of Environmental Authority (EA) number EPML 00716913[1], to align with relevant technical guidelines[2,3,4,5] and in a manner that minimises the environmental and health risks.

1.2 Background

MCPL owns and operates MCM, an existing open cut coal mine located approximately 90 kilometres (km) north-east of Emerald and approximately 3 km to the south-west of the Middlemount Township, Queensland (Qld) (**Figure 1-1**).

In May 2017, ML 70379 was extended to the north-west of the currently approved operations at the MCM (via a realignment of the ML 70379 boundary) (**Figure 1-2**).

On 21 March 2019, MCPL obtained state approval (via amendment of the EA) to expand its mining activities within the expanded ML 70379 area (ie. the Western Extension Project). MCPL is currently seeking federal approval for the Western Extension Project under the *Environment Protection and Biodiversity Conservation Act, 1999*.

In the past MCPL has not been required to prepare a MWMP, however some elements similar to the requirements to the MWMP have been previously captured within the MCPL's Plan of Operations[6] and other internal site documents (ie. sampling and characterisation of mine waste). Under Condition C30 of the EA (Acid Rock Drainage), MCPL must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid rock drainage. Under Condition E3 of the EA, a MWMP is required to be developed and implemented by 29 June 2019 for review and comment. Under Condition E4, the MWMP must be updated within 20 business days of receiving comments from the administering authority (ie. the Queensland Department of Environment and Science [DES]).

1.3 Summary

This MWMP addresses how mining waste materials will be managed as part of the current and planned mine operations as described in the EA[1] and Plan of Operations[6].

[1] DES (2019). Environmental Authority EPML00716913 – Middlemount Coal Mine. Permit issued by the Queensland Department of Environment and Science (DES). 21 March
[2] COA, 2016. *Leading Practice Sustainable Development Program for the Mining Industry. Managing Acid and Metalliferous Drainage*. September. Commonwealth of Australia, Canberra ACT.
[3] DEHP, 2013. *Application Requirements for Activities with Impacts to Land Guideline.* Queensland Department of Environment and Heritage Protection (DEHP).
[4] DME, 1995. *Draft Technical Guidelines for the Environmental Management of Exploration and Mining in Queensland, Technical Guideline – Assessment and Management of Acid Drainage and Saline/Sodic Wastes*. Queensland Department of Minerals and Energy (DME).
[5] INAP, 2009. *Global Acid Rock Drainage Guide (GARD Guide)*. Document prepared by Golder Associates on behalf of the International Network on Acid Prevention (INAP). June 2009 (http://www.inap.com.au/).
[6] MCPL (2019). Plan of Operations. Middlemount Coal Mine (EPML00716913). Middlemount Coal Pty Ltd. Period 1 January 2019 to 31 December 2020. 29 March.

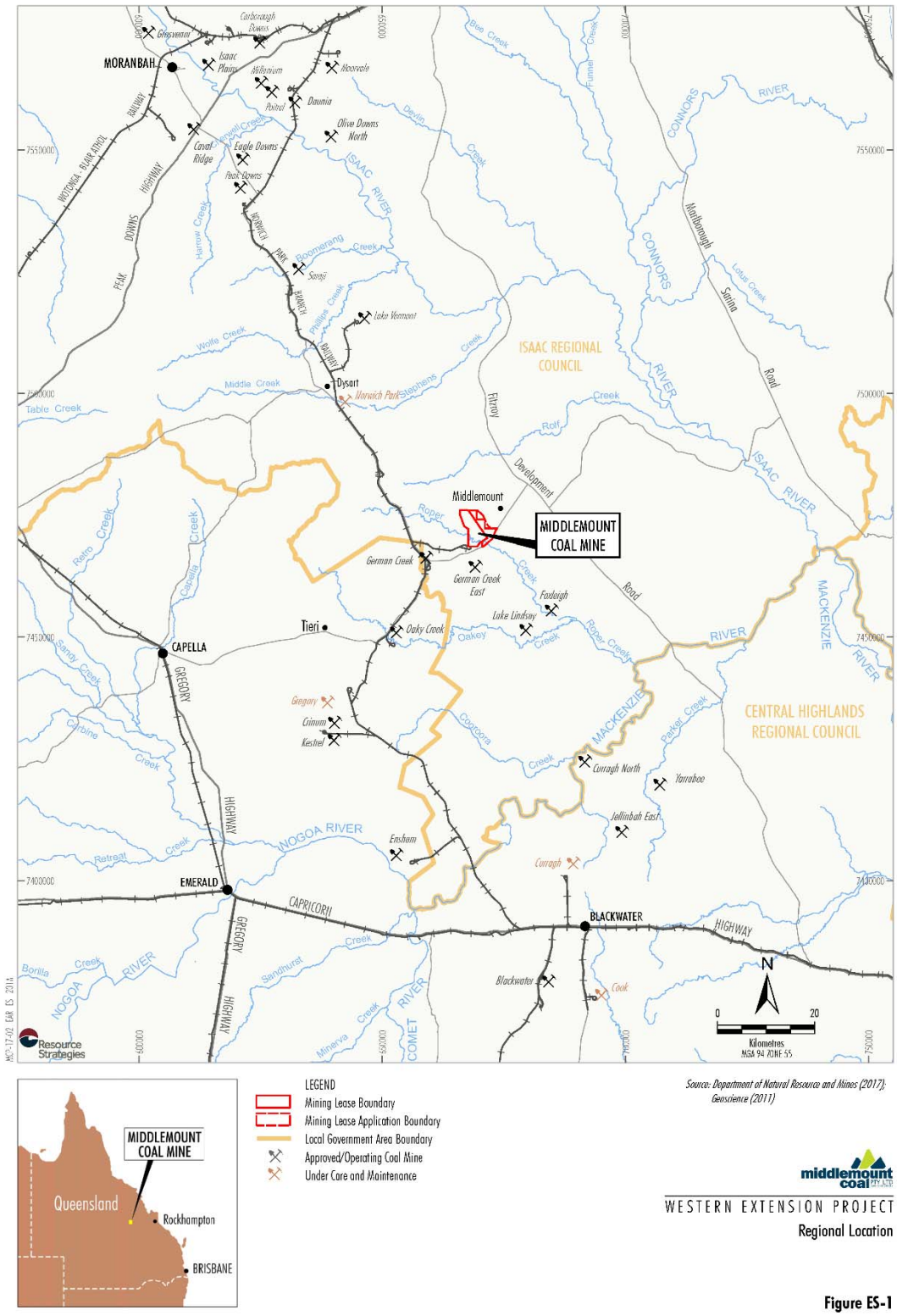

Figure 1-1: MCM Location (figure supplied by Resource Strategies)

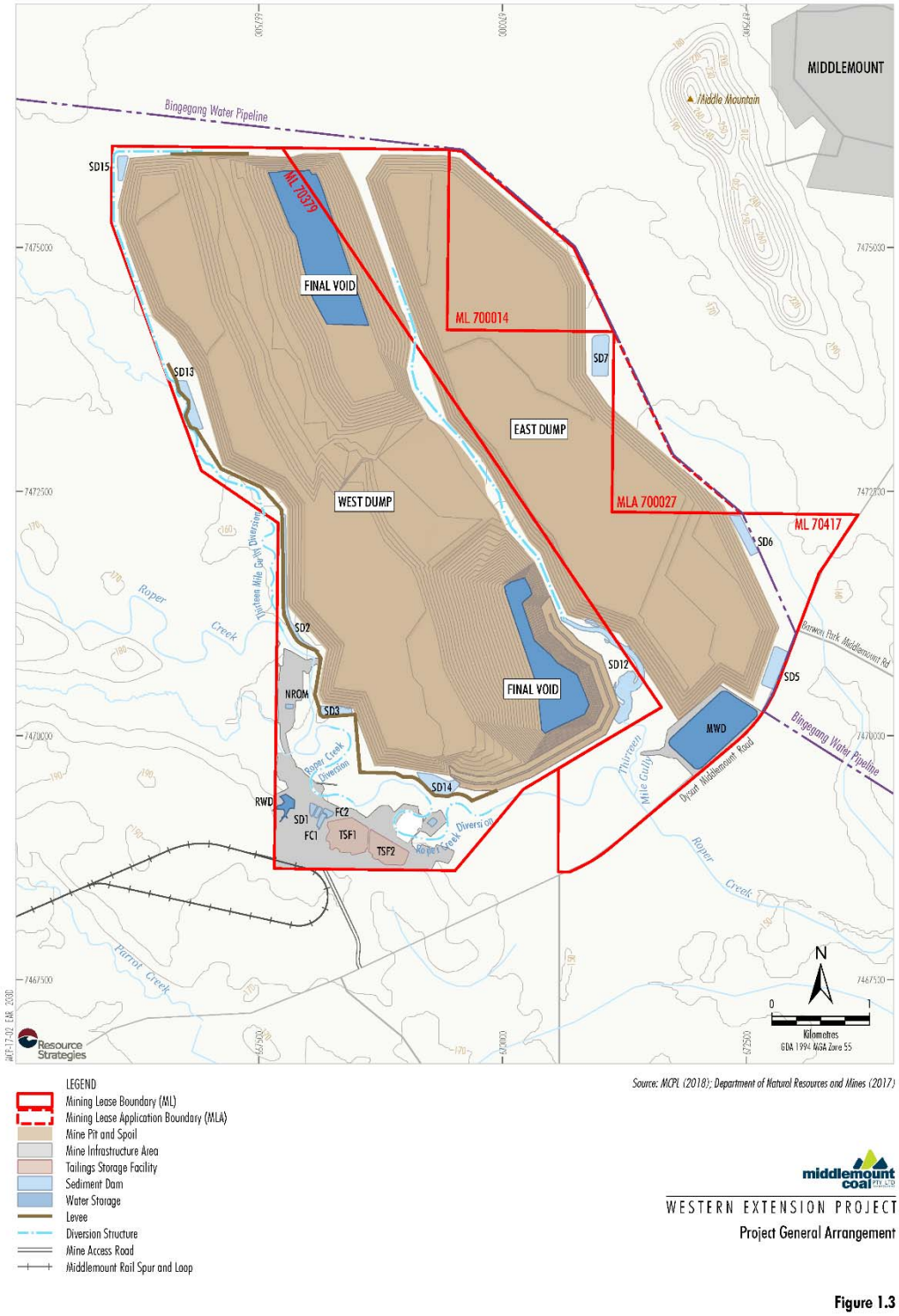

Figure 1-2: Project General Arrangement (figure supplied by Resource Strategies)

1.4 Regulation and license conditions

1.4.1 Environmental Authority EPML00716913 - MCPL

MCPL operates the MCM under EA EPML00716913 and the Plan of Operations and has approval for coal extraction at a rate of up to 5.7 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal.

This MWMP also addresses the conditions of the EA relating to Mining Waste Management: Conditions C30, E3 and E4.

1.4.2 Acid Rock Drainage: Condition C30

Under Condition C30, MCPL must ensure proper and effective measures are taken to avoid or otherwise minimise the generation and/or release of acid rock drainage.

1.4.3 Mining Waste Management: Conditions E3 and E4

Under Condition E3, a MWMP must be developed and implemented by an appropriately qualified person for every stage of the mining activities. The MWMP must be submitted to the administering authority by 29 June 2019 for review and comment. Under Condition E4, the MWMP must be updated within 20 business days of receiving comments from the DES. The MWMP must at a minimum include:

a) characterisation programs to ensure that all mining waste is progressively characterised during disposal for net acid producing potential, salinity and the following contaminants: pH, Electrical Conductivity (EC), Acid Neutralising Capacity (ANC), Net Acid Generation (NAG) (reporting NAG capacity and NAG pH after oxidation), Total Sulfur (S), Chromium Reducible Sulfur (Scr), Boron (B) Cadmium (Cd), Iron (Fe), Aluminium (Al), Copper (Cu), Magnesium (Mg), Manganese (Mn), Calcium (Ca), Sodium (Na), Zinc (Zn) and Sulfate (SO_4);

b) characterisation programs to ensure that the physical properties of the mining waste are progressively characterised during disposal;

c) the availability or leachability of metals from the mining waste;

d) quantification of Potentially Acid Forming (PAF) mining waste from mining waste present;

e) review impacts of the PAF mining waste on the rehabilitation;

f) management actions for mining waste that has been identified as having a high availability or leachability of metals;

g) management actions for mining waste that has been defined as PAF;

h) identification of environmental impacts and potential environmental impacts;

i) control measures for routine operations to minimise likelihood of environmental harm;

j) contingency plans and emergency procedures for non-routine situations;

k) periodic review of environmental performance and continual improvement;

l) containment of tailings;

m) records to indicate locations and characteristics of tailings stored within the tailings storage facility;

n) the management of seepage and leachates from tailings storages both during operation and the foreseeable future;

o) the control of fugitive emissions to air; and

p) a program for progressive sampling and characterisation to identify acid producing potential and metal concentrations of tailings.

1.4.4 Potential Future Requirements: Progressive Rehabilitation and Closure Plan

The Queensland government is seeking better mine rehabilitation, improvement in financial assurance and assessment and action on residual risk. The mining rehabilitation reforms include:

- Financial assurance reform;

- Mining rehabilitation reforms;
- Mineral and Energy Resources (Financial Provisioning) Bill 2018; and
- Financial Assurance under the Environmental Protection Act 1994 Guideline

The reforms are being developed to reduce environmental harm and ensure that there is adequate financial provisioning. The need to develop a robust and defensible life of mine plan is being driven by:

- amendments to the Queensland Government Mineral and Energy Resources (Financial Provisioning) Bill 2018 (the Bill); and
- amendments to the Environmental Protection Act 1994 (EP Act) that will require a Progressive Rehabilitation and Closure Plan (PRC Plan)[7].

A PRC Plan will have mandatory content including:

- A rehabilitation **planning component** which documents the:
  - consultation processes undertaken to develop the plan;
  - the proposed design of the mine;
  - the final landform including encapsulation and cover design requirements;
  - different post-mining land uses or non-use management areas for the site,
  - methodologies and trials for rehabilitation;
  - and any post-closure management requirements for the site.
- A PRC Plan **schedule component** which includes:
  - all mined units (not just mining waste);
  - maps of final rehabilitation outcomes for each area;
  - tables of time-based milestones for achieving each post-mining land use or non-use management areas, and,
  - any conditions imposed on the schedule by the administering authority.

The content in this MWMP (and the current MCPL Rehabilitation Management Plan[8]) will cover some of the planning and scheduling components required within a potential future PRC Plan.

1.5 Document Control and Review Process

This MWMP will be reviewed and updated every two years by a suitably qualified person and the MCPL Environment Department and progressively updated and implemented to align with the Geology Department drilling programs.

Revision 001 of this MWMP is a draft document dated 20 June, 2019 and was approved by Daniel Jones, Environmental Superintendent at MCM. The current revision of the Plan (**Revision 002**) was certified by RGS on the (27 June, 2019). The information in **Table 1-1** documents the version control and sign off by RGS and MCM.

Table 1-1: MWMP Version Control and Approval

Document Control			
Revision	**Signatory**	**Role**	**Company approval (Signed and dated)**
Revision 001	Daniel Jones (MCPL)	Document Owner	
Revision 002	Alan Robertson (RGS)	Document Author	
Revision 003			

[7] DES (2019). Public Consultation Draft. Guideline. Progressive Rehabilitation and Closure Plans (PRCP plans). Department of Environment and Science (DES).

[8] MCPL (2012). Middlemount Coal Project Stage 2 Rehabilitation Management Plan. Document. August.

Table 1-2 allows for future amendments to the MWMP to be progressively tracked, over the life of the mine, and, if any substantive changes have been made or are proposed to be recorded in the Plan.

It is advisable to document how and why changes are made to the Plan to allow subsequent managers to understand the history of the site and follow the progressive management and operation of the mine areas.

Table 1-2: Management Plan Amendments

Document Control			
Revision	**Signatory**	**Requirement for amendment**	**Reference to amendment**
Revision 001			
Revision 002			
Revision 003			

Changes made to the MWMP will be documented to allow subsequent managers to understand the history of the site and follow the progressive management and operation of the mine areas.

RGS certifies that this MWMP is feasible and would meet the intent of the EA conditions (ie. the MWMP will enable MCM to continue to progressively characterise, mine and place the mined materials so that their potential to contribute to (or to mitigate) environmental harm can be determined.

In addition to the geochemical characterisation of materials currently being mined and processed, the MWMP includes information on project based characterisation work required for the management of the future mine materials (eg. the Western Extension Project), which are expected to be based on existing landforms construction techniques to contain future PAF mining wastes that will limit the extent of any adverse impact on the receiving environment.

1.6 Integration of the MWMP with other Departments

Effective management of mining waste materials including materials that will be required to initiate and then maintain sustainable vegetation, requires communication between the environmental, geology, mine planning and technical services departments.

Without effective communication and clear workflow designation the MWMP will not meet its objectives. The information in **Table 1-3** shows the potential workflow and communication within and between MCPL departments.

Table 1-3: MWMP departmental workflow

Department	Role	Tasks and responsibilities	Connections
Environment Department	Document control	Owner of the MWMP	→ Geology,
		Compilation and updating the MWMP and ensuring that the aim and objectives will be met ie. auditing process	
		Ensuring the MWMP is integrated with the Plans being managed by other departments eg. the PRC Plan and Water Management Plan	→ Planning, → Environmental, → Geology, → Tech. Services
		Ensure scheduled mining waste material sampling and analytical programs are planned, ahead of mining, on an as-required basis.	← Planning, ←→ Geology
		Work with the Geology Department to develop the MWMP to obtain necessary samples from in-fill drilling programs and/or blast hole drilling programs.	←→ Geology
		Document how changes to the MWMP will be tracked over time.	
	Life of mine planning	There will be a future regulatory requirement for a PRC Plan that must align with the short, medium, and long-term rehabilitation goals for the site.	← Planning
		The Environment Department must work with other departments and guide them to ensure that the operational mine plans to mine and produce coal align the legislative requirements of the Queensland Government *Mineral and Energy Resources (Financial Provisioning) Bill 2018* and the amendments to the *Environmental Protection Act 1994.*	←→ Planning ←→ Geology
	Material characterisation	Define the material types that will be mined (or processed) and need to be managed and rehabilitated to attain minimal financial liability and relinquishment. In general, all materials from the topsoil to the deepest mined surface should be included in the MWMP.	← Geology
		Document the specific sampling processes and the physical and geochemical analytical methods that will be adopted in consultation with the Geology Department.	←→ Geology
		Define the geochemical and physical criteria that will be used to classify the samples from drilling and sampling programs in consultation with the Geology Department.	←→ Geology
		Manage the interpretation and classification of the analytical data.	← Geology
	Financial Provisioning	Environmental Departments are typically required to manage environmental provisioning for rehabilitation and closure, and this requires reliable outputs from short, medium and long-term mine plans.	← Planning
Geology Department	Drilling and sampling	Utilise the MWMP to develop scheduled exploration and operational drilling and sampling plans.	← Environmental, (←→ Planning)
		Implement the exploration and operation drilling and sampling plans.	
	Update geology models	Compile the material characterisation data into the geology model(s).	← Environmental
		Provide the raw data and interpreted data to the Environmental Department.	→ Environmental
		Develop and report annual material balances and provide these to Environmental Department.	→ Environmental
		Provide the revised geology model to the mine planning team.	→ Planning
	Issue geology model and material balances	Provide updated material balances for all mined units to the Environment team to verify that the overall aim of the rehabilitation and closure plan can continue to be met eg. for the active (current iteration) of the mine plan is there enough topsoil, subsoil and other necessary material to achieve complete rehabilitation over the life of mine.	→ Environmental
Mine Planning Department	Life of mine planning	Development and maintenance of schedule in the Operational Mine Plan and PRC Plan	←→ Geology, ←→ Environmental
	Scheduling	Utilise revised geology models to develop short, medium and long-term mine plans including plans for progressive rehabilitation and closure.	← Geology
		Mine planners will need to align with environmental design criteria associated with constructed landforms to ensure that the landforms are rehabilitated to a safe and stable landform that does not cause environmental harm and will conform to the objectives of the *Mineral and Energy Resources (Financial Provisioning) Bill 2018* (the Bill).	→ Environmental
		Mine planners will provide the numerical basis from the Operational Mine Plan and PRC Plan to the environmental department for annual financial reporting (internally and externally).	→ Environmental
		Mine planners will provide the schedules and plan to technical services to implement on the ground.	→ Tech. Services
Technical Services	Design and construction	Operation of the mine including implementation of rehabilitation plans.	← Planning, ← Environmental, ← Geology

2 SCOPE, AIM AND OBJECTIVES OF THE MWMP

2.1 Scope

The scope of the MWMP is to manage all mined units including overburden/interburden, coal, and coal reject streams. Although not explicitly stated in the EA, the MWMP should also include sub-units for topsoil, subsoil and extremely weathered to weathered regolith that are present above the pre-mining groundwater level and that are potentially critical units required for successful rehabilitation.

Effective management leading to successful rehabilitation that will attain regulatory relinquishment or be considered as fit-for-purpose by a subsequent landowner will integrate the mining, placement and rehabilitation of the mined units.

To achieve effective management of the mining waste materials, this MWMP addresses the following conditions of the EA, and/or will reference where more detailed information is available:

- characterisation of the mined units and coal rejects (EA Condition E3 a, b, c and p) (Section 4);
- geological modelling and volumetric estimations of non-coal materials to develop material balances to satisfy (EA Condition E3 d) (ie. quantification of PAF from mining waste present) (Section 4);
- a defensible disposal plan for PAF materials that identifies potential environmental impacts and includes scheduling of material movement, placement and landform re-shaping, to appropriately and economically place material for maximum benefit and to minimise the likelihood of environmental harm (EA Condition E3 f, g, h, i, l and o) (Sections 5 and 6);
- location records and post placement verification of the mine scheduling to ensure that the placement and landform design criteria have been met (EA Condition E3 d and k) (Sections 6 and 7);
- contingency plans and emergency procedures for non-routine situations (Section 8);
- Management of seepage from mining waste materials (EA Condition E3 n - details contained in the MCM Water Management Plan) (Sections 4 and 5);
- rehabilitation strategy documenting what the overall goal for rehabilitation will be over the life of mine (details contained in the MCM Rehabilitation Management Plan);
- rehabilitation objectives, design criteria, indicators for success and completion criteria (details contained in the MCM Rehabilitation Management Plan);
- review programs to check environmental performance and continuous improvement, and ensure that rehabilitation has achieved the overall aim of the MWMP (EA Condition E3 k) details contained in the MCM Rehabilitation Management Plan); and
- document control defining how the document will be managed and how changes will be tracked over time.

2.2 Aim

The aim of the MWMP is to enable mining, coal processing and rehabilitation to be completed economically with minimal adverse environmental and social impacts on the land and water resources, and to lead to successful post-rehabilitation beneficial reuse. To achieve this aim there will be an integrated planning approach coupling the work programs undertaken by environmental, exploration and operational geology and short, medium and long term mine planning departments.

With an integrated, cross-discipline planning approach at the site, implementation of the management aims will be effective and eliminate any subsequent environmental issues.

The MWMP is the central focal point of a broader set of plans and procedures that will be used to achieve the intent of the Plan. The site procedures for some tasks such as material characterisation would be documented and managed by the custodian of the Plan.

Other tasks such as exploration and operational geological programs, short, medium and long-term mine planning (including landform design), water management (including seepage, sediment and

erosion control), and rehabilitation (ecological) programs are detailed in other MCM management plans and managed by other departments.

2.3 Objectives

The objectives of the MWMP are to document and map out:

- why the Plan is required;
- when the Plan will need to be updated
- how changes to the MWMP will be tracked to enable the reasons for changes to the Plan over the life of mine to be understood;
- who will plan and implement the tasks required to be undertaken by each department;
- how the data collected from departmental tasks such as waste characterisation or developing material balances will be stored and made accessible to other departments who are required to make use of the data;
- how the data are to be used and which other plans the data and the Plan will need to integrate with other Management Plans (eg. Water Management Plan, Mine Plan, Mine Rehabilitation Plan or future PRC Plan); and
- when the tasks in the MWMP are required to be undertaken and what the outputs will be.

2.4 Data Management

The material characterisation program will compile geochemical, physical and nutrient data. Typically, this data is provided by a commercial laboratory in pdf and spreadsheets that are then stored on a server. This can lead to the eventual loss of the data.

All geochemical, physical and any other relevant (eg. nutrient) data associated with the characterisation of coal, coal roof, coal floor, coal partings, rejects, tailings, topsoil, subsoil, regolith units in the overburden and interburden will be stored in the Geology Department geological database or in the environmental database management system (EDMS).

3 GEOLOGY

MCM resources form part of the wider Bowen Basin coalfields. Nearby open-cut coal mines to the south of Middlemount include German Creek East and Foxleigh. The coal deposition in this particular region of the Bowen Basin has both a marine and non-marine geological history. The presence of an oceanic environment in the early to middle Permian age is evident, and this was eventually followed by some volcanic/fault-line (tectonic) activity and a receding shoreline during the late Permian. At this time, and up until the early Triassic, the region was covered by swamps and shallow-lakes which acted like an internal drainage system, and the formation of fluvial floodplains occurred. Continental sedimentation was the primary method of coal deposition in and around the Middlemount area until a period of folding occurred in the stratigraphic profile in the late Triassic. In the following Jurassic age, the Bowen Basin was collectively exposed to a time when natural erosion processes exceeded the rate of deposition, and this resulted in a variety of geological structural formations across the region (eg. dykes, sills).

Permian coal deposits are ideally suited for the manufacture of prime coking coal and the Bowen Basin contains up to 70% of Queensland's state reserves. Extensive research into the geology of the Bowen Basin has occurred in recent years, and the geology is generally predictable and well understood. Coal deposits from this sequence are typically diverse in terms of rank/quality, thickness and associated economic-grade, and are widely distributed across the Bowen Basin. They are also typically characterised by (relatively) low sulfur content and a low propensity for spontaneous combustion.

Three Permian coal-bearing horizons are mined by Middlemount (the Middlemount, Tralee and Pisces seams). The coal seams mined by Middlemount are part of the Rangal Coal Measures and Burngrove Formation and the typical stratigraphy of the Project area is provided in **Figure 3-1**. The Roper, Middlemount Lower and Upper, Tralee and Pisces Upper seams (in descending order) belong to the Rangal Coal Measures, while the Pisces Lower seam belongs to the Burngrove Formation. Seams strike north-northwest and dip to the east generally at 3 to 7 degrees.

Two types of coal are produced for export markets: a semi-hard, low phosphorous coking coal, and a low-volatile Pulverised Coal Injection (PCI) coal. Mining at the open cut uses conventional truck-excavator techniques, and the raw coal is washed at the CHPP facility to render the products suitable for commercial export.

The Middlemount seam is the uppermost seam, which subcrops about 40 m below the natural surface through the middle section of ML70379. The seam thickness ranges from 2 to 7 m (average 4 m) and the upper plies are used as PCI coal and the lower as coking coal. The Pisces seam lies 30 to 50 m below the Middlemount seam and subcrops about 40 m below the natural surface through the western section of ML70379. The seam thickness ranges from 2 to 6 m (average 4.8 m) of coking coal.

The Rangal coal measures are overlain by Permian, and then by Tertiary and Quaternary (Alluvium) materials progressing to surface. The Permian and Tertiary materials consist mostly of weathered and fresh sandstone and siltstone with occasional mudstone and claystone. The Project area is typically covered by unconsolidated tertiary and Quaternary (alluvium) clayey and sandy sediments. Weathering depth is variable but is typically around 35 to 45 m.

The uniform stratigraphy/geology at MCM is typical of coal mines in the Northern Bowen Basin, where the stratigraphic profile in the lateral direction at the open pit is consistent and predictable.

MCM will generate a significant volume of coal and mining waste materials. For spoil, it is expected that approximately 1.171 million bank cubic metres (mbcm) will be produced over the life of mine. For coal rejects, the total mass of coarse reject and tailing materials is 27 Mt with a waste to product coal ratio (m/m) of 0.35:1. The total coarse reject and tailing masses are predicted to be 15 and 12 Mt (dry), respectively.

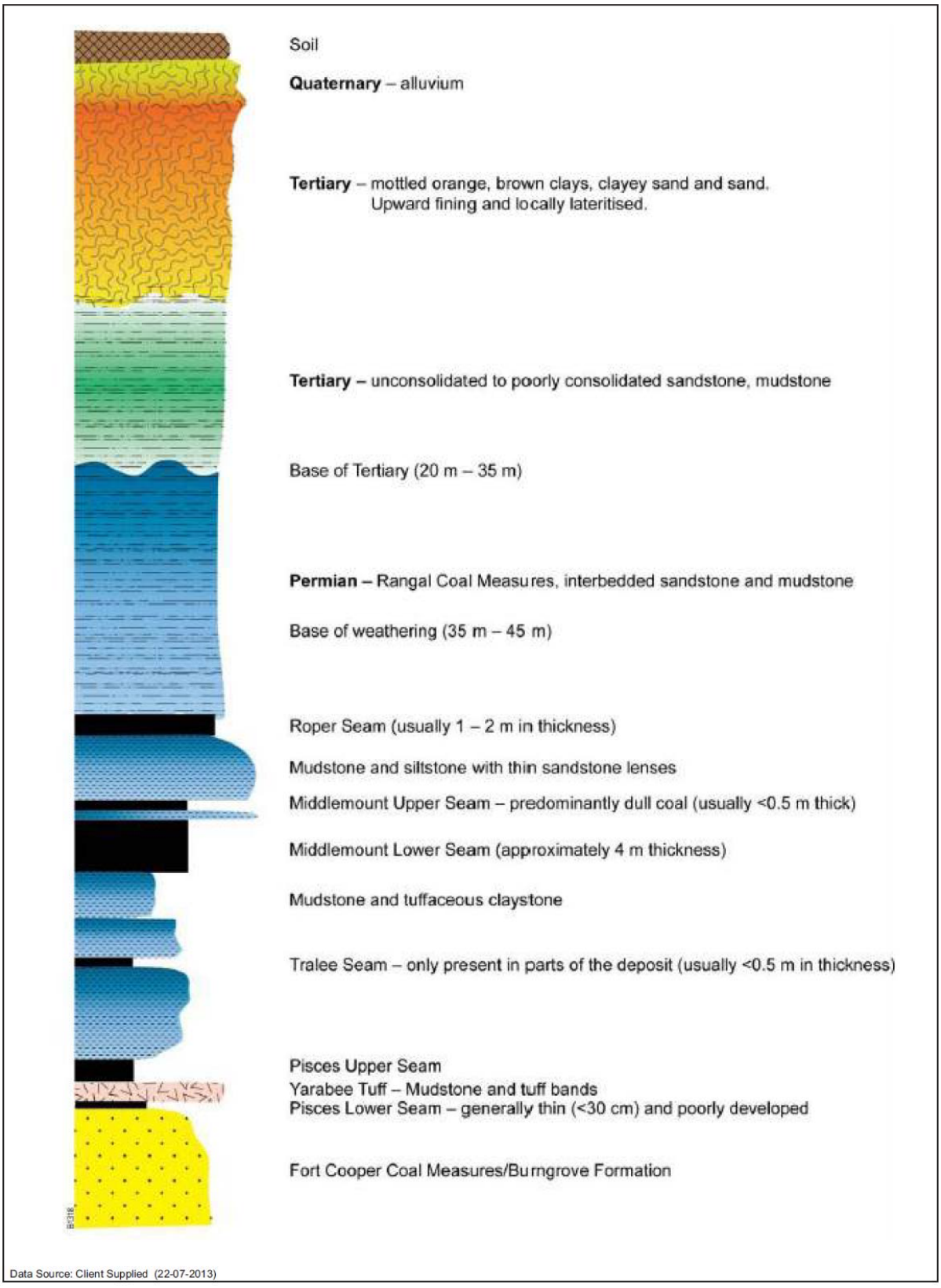

Figure 3-1: Typical Stratigraphic Profile

4 MATERIAL CHARACTERISTICS

A summary of the characteristics of the range of MCM coal and mining waste materials is provided graphically in **Figure 4-1** in accordance with the classification system presented in **Table 4-1**. This information is reproduced from RGS (2013)[9] and is based on the characterisation of 103 samples.

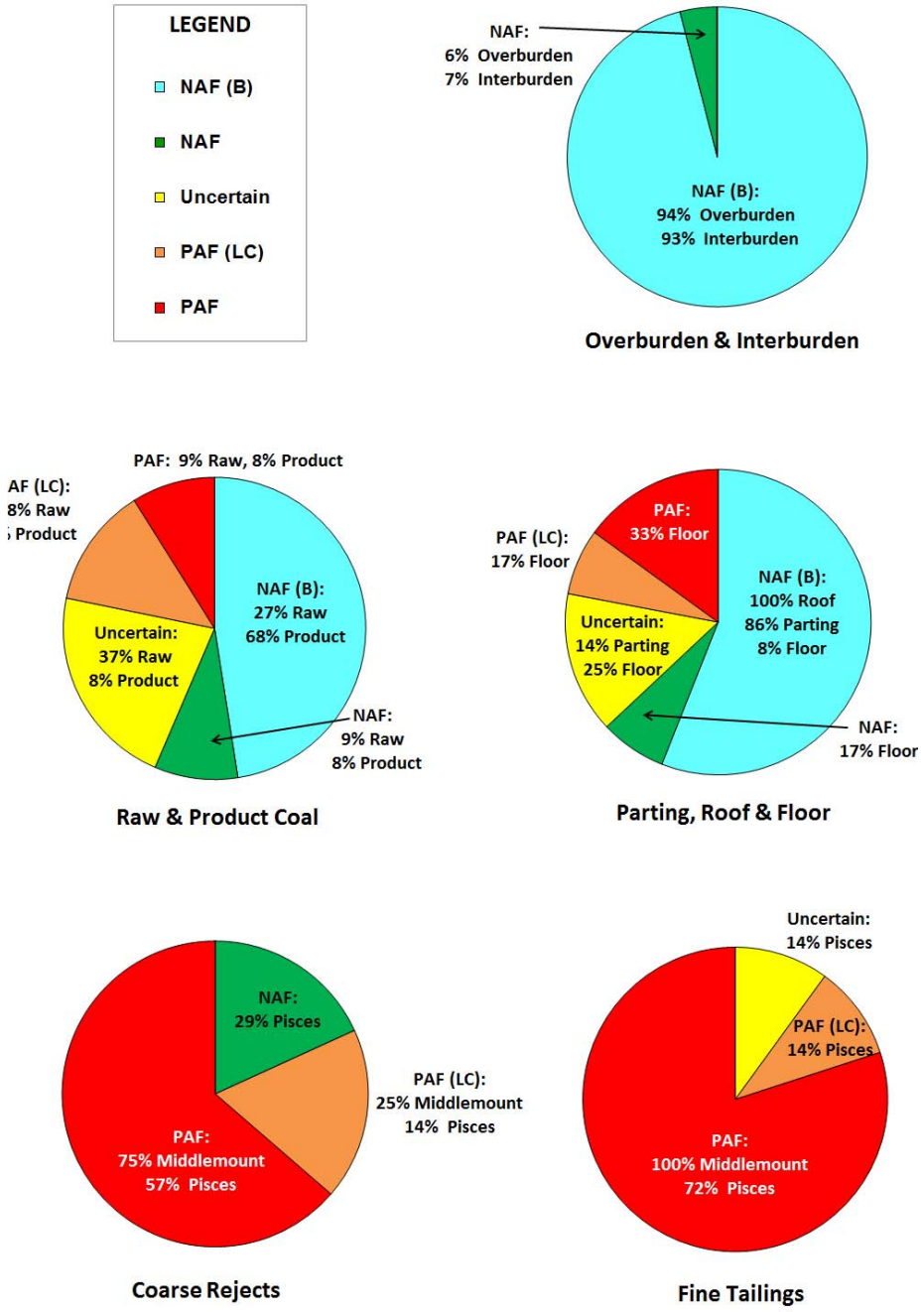

Figure 4-1: Geochemical classification of coal and mining by-product materials (from RGS 2013[9])

[9] RGS (2013). Middlemount Coal Project – Geochemical Assessment of Coal and Mining Waste Materials. Document prepared for Middlemount Coal Pty Ltd by RGS Environmental Pty Ltd (RGS). 16 August.

Table 4-1: Geochemical classification criteria for mine materials (from RGS, 2013[9])

Geochemical Classification	Total or Sulfide Sulfur(%)[1]	NAPP (kg H_2SO_4/t)	ANC: MPA Ratio	NAG_{pH}	NAG Capacity (kg H_2SO_4/t)
Non-Acid Forming (NAF) – Barren[2]	≤ 0.1	-	-	-	-
Non-Acid Forming (NAF)	> 0.1	≤ -5	≥ 2	-	-
Uncertain	> 0.1	> -5 and ≤ 5	< 2	≥ 4.5	≤ 5
Potentially Acid Forming (PAF) - Low Capacity	> 0.1	> 5 and ≤ 10	< 2	< 4.5	≤ 10
Potentially Acid Forming (PAF)	> 0.1	> 10	< 2	< 4.5	> 10

Notes:
1. If total sulfur or sulfide sulfur is less than or equal to 0.1 %, the NAPP and ANC/MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur.
2. A sample classified as NAF can be further described as 'barren' if the total sulfur and/or sulfide sulfur content is less than or equal to 0.1 per cent, as the sample essentially has negligible acid generating capacity.

4.1 Spoil

The available information on overburden and interburden (spoil) material[9, 10, 11] at MCM suggests that spoil is essentially barren of sulfur, is classified as Non-Acid Forming (NAF), and has a high factor of safety with respect to any potential to generate Acid and Metalliferous Drainage (AMD).

The Permian interburden material, in particular, has significant excess acid neutralising capacity (ANC), which is readily available, to more than adequately buffer the negligible amount of acid that could theoretically be produced from this material. This material is classified as NAF but is also be considered to be acid consuming. The Permian interburden material covers a depth interval of some 30 to 50 m in the stratigraphic profile and therefore a large volume of material mined from the open pit has readily available ANC to provide acid buffering. Hence, the Permian spoil materials provide a useful source of acid buffering material that is used as part of the management (encapsulation) strategy for other Potentially Acid Forming PAF materials which occur at the site (eg. coarse reject and tailings).

The concentration of total metals in most spoil is typically well below applied guideline criteria for soils and is unlikely to present any environmental issues associated with rehabilitation and final land use. Surface runoff and seepage from spoil is predicted to be pH neutral to slightly alkaline and show relatively low levels of salinity following surface exposure. The concentration of soluble trace metals and major ions in runoff and seepage from spoil is likely to be low, remain within applied water quality guideline criteria, and is unlikely to present any significant environmental risks for on-site or downstream water quality.

In common with most coal mines in the Northern Bowen Basin, some spoil materials are sodic and have a moderate to high dispersion potential. Spoil materials are used at the MCM for general applications such as rehabilitation, although Permian interburden appears to be less prone to dispersion than Tertiary materials.

4.2 Coal, Roof, Parting, Floor, Coarse Rejects and Tailings

The available information on coal, roof, parting, floor, coarse rejects and tailings materials[9, 10, 11, 12] confirms that most of the coarse reject and tailings materials generated from processing the Middlemount and Pisces seams, and some of the floor material from the Middlemount seam, are likely to be PAF.

The concentration of total metals in PAF materials is typically below applied guideline criteria for soils. Surface runoff and seepage from PAF materials left exposed to oxidising conditions is likely to be acidic, with increased levels of salinity due to soluble sulfate, calcium and magnesium concentrations caused

[10] Parsons Brinkerhoff, 2011. Middlemount Coal Project – Stage 2 EIS.
[11] RGS (2016). Middlemount Coal Mine – Review of Geochemical Monitoring Data. Document prepared for Middlemount Coal Pty Ltd by RGS Environmental Pty Ltd (RGS). 21 April.
[12] RGS (2012). Geochemical Assessment of Coarse Reject and Tailings Materials - Middlemount Coal Mine. RGS Report No. 101116, 18 July.

by sulfide oxidation and neutralisation. The concentration of some soluble trace metals and major ions in runoff and seepage from PAF materials could be elevated if exposed to oxidising conditions.

4.3 Risk Assessment

The results summarised in **Figure 4-1** and discussed in this section demonstrate that the materials which carry the most significant risk of acid generation and poor quality leachate at MCM are the coarse reject and tailings materials generated at the Coal Handling and Processing Plant (CHPP). These findings align well with the MCPL operating experience over the past decade and would be expected given the predictable geology and stratigraphy of the open cut mining area previously described in **Section 3**.

5 ENVIRONMENTAL ISSUES, IMPACTS AND CONTROLS

The environmental issues, impacts and controls associated with mining waste materials at MCM are described in **Table 5-1**. The potential for AMD from coarse reject and tailing materials is considered to be the major risk and the following hierarchical of control strategies in order of priority can be categorised as:

- prevention of impact;
- minimisation of impact and/or likelihood through active or passive treatment impact; and
- interception and control of impact.

The control measures will depend on topography, mining method, material type, soil/rock types, mineralogy, and available neutralisation resources. Control measures are documented in **Table 5-1** and have been integrated into the operational management measures described in **Section 6**.

Table 5-1: Environmental Issues, Impacts and Controls

Potential Issue	Potential Impact	Control Measures
AMD	• Contamination of surface water from spoil emplacement areas and stockpiles. • Contamination of stock, irrigation and domestic groundwater supplies. • Degradation of aquatic ecosystems. • Impact on recreation and aesthetics. • AMD from incorrect placement of PAF material.	• Minimise exposure of PAF materials to wetting and drying cycles by limiting rehandling of PAF mining waste, coarse rejects and tailings material and progressive covering of PAF material. • Selective handling and placement of materials, including neutralisation of PAF materials by mixing of PAF material with spoil with excess acid neutralisation capacity (eg. PAF with Permian spoil). Factor of safety applied to mixing with minimum of 3 Permian to 1 PAF by weight (target of 5 parts Permian to 1 part PAF material), based on geochemical characterisation assessment (RGS, 2013). • Development and communication of PAF disposal areas and methods. • Rehandling of incorrectly placed material (eg. within 10 m of final landform surface). • Diversion of run-on water from PAF disposal locations. • Minimisation of water pondage on dump surfaces and subsequent infiltration. • Placement of PAF material at least 10 m from final landform with NAF/Permian cover to minimise water movement through material and provide neutralising material. • Rapid dewatering of tailings and recycling of decant water to minimise the volume of decant water and the duration of exposure. Possible through mechanical dewatering or in-line flocculant cells. • RPEQ designed and certified tailings decant storages. • Chemical amelioration, eg. lime dosing, where required. • Disposal locations to be within the in-pit spoil and are internally draining to the mine pit. • Containment of mine affected water including leachate from PAF disposal locations and coal stockpiles. • Rehabilitation of spoil dumps to minimise leaching of water through spoil. • Rehabilitation of tailings dams and coal stockpiles. • Progressive characterisation of mining wastes, specifically coarse and tailings. • Tracking of PAF disposal locations. • Monitoring of leachate from in-pit disposal locations and coal stockpiles. • Monitoring of groundwater resources, specifically aquifers suitable for human or stock consumption. • Monitoring of upstream reference and downstream impact points and REMP monitoring. • Adoption of emergency response plans, including consideration of downstream landholders.

Potential Issue	Potential Impact	Control Measures
Dust from PAF materials	• Toxicity to the receiving environment. • Transport of contaminants to the receiving environment.	• Minimise exposure of PAF materials to wetting and drying cycles by limiting rehandling of PAF rejects and waste and progressive covering of PAF material. • Dust suppression of PAF disposal locations. • Neutralisation of PAF materials by mixing of PAF material with spoil with excess acid neutralisation capacity (eg. PAF with Permian spoil). Factor of safety applied to mixing with a minimum of 3 Permian to 1 PAF based on geochemical characterisation assessment (RGS, 2013). • Placement of PAF material at least 10 m from final landform with NAF/Permian cover. • Rapid dewatering of tailings and recycling of decant water to minimise the volume of decant water and the duration of exposure. Possible through mechanical dewatering or in-line flocculant cells. To provide working surfaces for tailings reclamation without wet/boggy sub-stratum. • Rehabilitation of spoil dumps to minimise leaching of water through spoil. • Rehabilitation of tailings dams and coal stockpiles. • Monitoring and analysis of dust emissions. • Dewatering of tailings prior to transport to minimise spills of wet material.
Release of tailings from Tailings Storage Facilities	• Release of tailings and/or tailings decant water to Roper creek. • Sediment load increased in Roper Creek. • Contamination of water from release of water with some or all of the following; low pH, high EC, elevated metal or sulfate concentration • Metal accumulation in plants and animals. • Contamination of stock drinking supplies. • Contamination of soil. • Loss of human and/or animal life.	• Certified design and construction of the Tailings Storage Facilities. • Annual inspection by Registered Professional Engineer of Queensland (RPEQ). • Routine inspections and repairs. • Maintenance of Design Storage Allowance. • Reclamation of tailings and/or alternative dewatering of tailings prior to placement within in-pit spoil with available acid neutralisation capacity.
Interaction of PAF with rehabilitation	• Interaction of PAF with rehabilitation.	• PAF material to be co-disposed with spoil with acid neutralisation potential. • 10 m buffer maintained from PAF disposal locations to the final rehabilitation profile. • Rehabilitation monitoring.
Metals/metalloids leachate	• Leaching of metals/metalloids via AMD.	• Mining waste characterisation and contact testing (RGS 2013). • Progressive characterisation of coal and mining waste and review to determine the potential leachate risk (RGS, 2016). • Disposal of PAF material with spoil with available acid neutralisation capacity.

Potential Issue	Potential Impact	Control Measures
Dust from Overburden	• Toxicity to the receiving environment	• Progressive recontouring and rehabilitation of spoil dumps. • Dust suppression. • Rehabilitation of spoil dumps to minimise leaching of water through spoil. • Rehabilitation of tailings dams and coal stockpiles. • Monitoring and analysis of dust emissions.
Spoil run-off	• Contamination of surface water from spoil run-off	• Progressive recontouring and rehabilitation of spoil dumps. • Rehabilitation of spoil dumps to minimise leaching of water through spoil. • Rehabilitation of tailings dams and coal stockpiles. • Installation and maintenance of drainage and sediment and erosion control structures to control and treat run-off from spoil piles.

6 MATERIAL MANAGEMENT

6.1 Material Definition

At the MCM coarse rejects and tailings are co-disposed in pit at the site along with spoil materials in accordance with the EA[1], Plan of Operations[6], In-Pit Disposal Site Procedure[13] and the Environmental Management Plan (EMP)[14]. It should be noted that historically at MCM mining waste materials have been termed 'mining by-products'.

The previous MCM Mining By-Products Management Plan[15] states that '*Mining waste is generated through the coal excavation process and includes overburden, interburden. It can also contain coal seam partings, roof and floor materials if these do not report with coal to the CHPP. All these mining waste components are disposed of within the mining pit and need to be treated in accordance with the risk of acid generation. Generally, overburden is placed in ex-pit spoil and interburden is placed in in-pit spoil*'.

6.2 Coal Processing

The mining materials flow at the MCM CHPP is presented in **Figure 6-1** below.

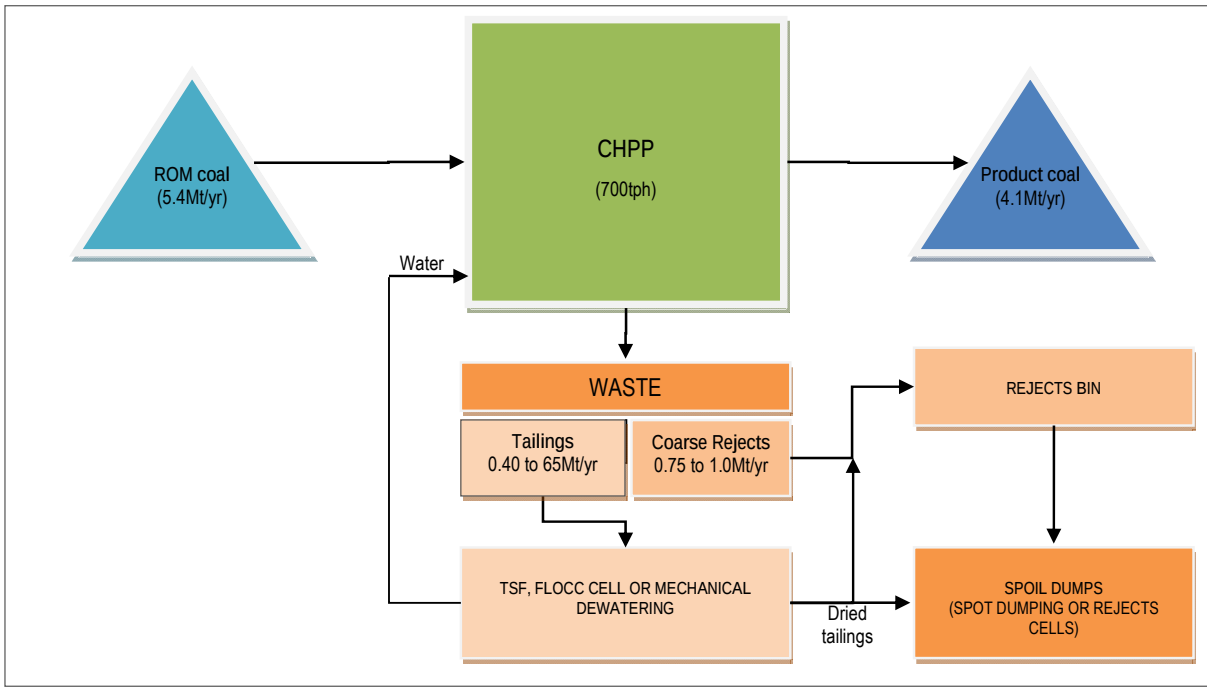

Figure 6-1: Materials process flow (adapted from Stage 2 EIS (PB, 2012[10]))

Coal processing of coal at the CHPP produces two waste products: ie. coarse rejects and tailings.

Coarse rejects: are produced from the spirals/spirals reject dewatering screen and Dense Medium Cyclone via a drain and rinse screen. Coarse rejects report via the rejects conveyor to the 240 t rejects bin prior to trucking to the disposal locations within spoil in-pit.

[13] Middlemount Coal (2018a). Mining By-Product In-Pit Disposal Site Practice. Document SP-212-004 Version 2. 24 April.
[14] Middlemount Coal (2018b). Environmental Management Plan. Management Plan 003. 17 October.
[15] Middlemount Coal (2018c). Mining By-Products Management Plan. Document MP-212-001 Version 7. 24 April

Tailings: (fine rejects) are produced from the CHPP thickener underflow and are then pumped to one of the following locations:

- Tailings Storage Facility (TSF) 2 In Line Flocculation (ILF) Cells consists of four cells within the existing and permitted TSF 2 footprint. The cells are used to hold tailings that have been flocculated in the pipeline prior to deposition, for a short period prior to it being excavated and hauled for disposal within spoil in-pit.
- In-line flocculant cells – consists of two emergency cells located between TSF 1 and Sediment Dam 1. These two cells are yet to be utilised, and if required, tailings will be pumped to in-line flocculant cells with flocculant added prior to discharge to accelerate dewatering of the material.

6.3 Operational Management

All mining waste at the open pit is mined by excavator and truck or dozer push. As previously described in **Section 4**, most mining waste is classified as NAF or acid consuming with the exception of the Middlemount and Pisces seam floor. Coarse rejects and tailings (process wastes) have the potential to form AMD. To mitigate the risk from PAF material, the mining waste, coarse rejects and tailings disposal options are shown in **Table 6-1** . Each option is documented in more detail in this section.

6.3.1 Overburden and interburden

Overburden is classified as NAF and is placed in any in-pit or ex-pit spoil dump. Dispersive material is preferentially placed away from the final landform surface.

Interburden is preferentially placed in-pit to provide the acid neutralisation capacity for spot-dumping of PAF materials and creation of Permian caps and bunds on coal reject cells. Placement in ex-pit spoil can be used to neutralise any PAF material that is placed in the ex-pit spoil.

6.3.2 Coal seam partings and roof

Coal seam partings and roof material is preferentially placed in in-pit spoil at least 10 m from the final landform surface. Where required, this material may be placed in ex-pit spoil at least 10 m from the final landform.

6.3.3 Coal seam floor

Coal seam floor material is placed at least 10 m from the final landform surface and preferentially spot dumped with Permian material within in-pit spoil. In the event it is necessary to place the material in ex-pit spoil the floor material is lime dosed and covered with 10 metres of Permian spoil

6.3.4 Coarse rejects

Coarse rejects are discharged to the 240 t rejects bin via the rejects conveyor. Mine Haul trucks haul the rejects from the bin for disposal within the in-pit spoil dump. Where production of rejects exceeds haulage to in-pit disposal or wet-weather constrains pit access, rejects are temporarily stored on rejects pads. Stockpiled rejects are then loaded into haul trucks using front-end loaders or excavator for haulage to the disposal location in-pit.

To prevent hang-ups of material and minimise temporary stockpiling of rejects, the Coarse Rejects Bin is kept below 75 % capacity and drawn down regularly when operating with coarse rejects only while the CHPP is running. The Coarse Rejects Bin is emptied prior to any planned shut-downs.

In the event that tailings are co-mingled with the coarse rejects on the rejects conveyor, the rejects bin is maintained below 50% capacity and is emptied regularly.

Drainage from coarse rejects storage areas (rejects bin and temporary rejects storage locations) is contained on site (as detailed in the MCM Water Management Plan). Water is returned to the Raw Water Dam for reuse as soon as practicable.

Table 6-1: Mining Waste Disposal Options used at MCM

Material	MCM Mining Waste Disposal Options					
	Ex Pit Spoil	**In-Pit Spoil**	**In-Pit spot dump in Permian** (10 m from final landform surface)	**Ex-Pit spot dump** (10 m from final landform surface)	**In-Pit Cells** (10 m from final landform surface)	**TSF**
Overburden	Preferred	Preferred	N/A	N/A	N/A	N/A
Interburden	Preferred	Preferred	N/A	N/A	N/A	N/A
Coal Seam Partings & Roof (All Seams)	Acceptable (10 m from final landform)	Preferred	Preferred	Acceptable	N/A	N/A
Coal Seam Floor (All Seams)	Avoid (Lime dosing and 1 0m of Permian cover)	Acceptable (10 m from final landform)	Preferred	Avoid (Lime dosing and 10 m of Permian cover)	N/A	N/A
Coarse Rejects	No	No	Preferred (Ideal 5:1, Minimum 3:1 Permian to Rejects)	Avoid (Minimum 10:1 Permian spoil to rejects, lime dosing and 10 m Permian cover required)	Acceptable (Lime dose as required)	N/A
Tailings	No	No	Acceptable (Lime Dose as required) – Caution – Tip head stability	No	Preferred (Dried and Lime dosed as required)	Acceptable
Co-mingled Coarse Rejects & Tailings	No	No	Preferred (Ideal 5:1, Minimum 3:1 Permian to Rejects)	Avoid (10:1 Permian spoil to rejects, lime dosing and 10 m Permian cover required)	Acceptable (Lime dose as required)	N/A

6.3.5 Tailings

At the MCM, MCPL uses earth bunded structures as ILF cells designed to hold flocculated tailings temporarily whilst dewatering takes place and excavation/reclamation of dried tailings can occur. The ILF cells have a minimum capacity of one week of CHPP production with additional allowance (freeboard) for rainfall and water management. Cells are designed with no external catchment to minimise flooding potential, environmental risk and Design Storage Allowance (DSA) requirements and will include sufficient DSA capacity in addition to the operational volumes. All water produced is returned to the CHPP or the Raw Water Dam to supply plant make-up water.

The tailings are dosed with flocculant to accelerate the dewatering process prior to placement in the ILF cells. The dewatered tailings are allowed to dry and are then excavated and trucked to the pit for placement within the in-pit spoil dump. The CHPP is responsible for the operation of the tailings discharge and return water. Mine operations are responsible for tailings reclamation.

6.4 PAF waste placement

PAF waste material (coarse rejects and tailings) is preferentially placed within in-pit spoil via spot dumping with Permian interburden or placed within in-pit cells. In both cases the ANC of the Permian spoil is used to neutralise the potential acid forming capacity of the PAF material. All PAF material is placed at least 10 m from the final landform surface (**Figure 6-2**).

Where placement of in ex-pit spoil is required, PAF material is lime dosed, spot dumped and covered with Permian interburden.

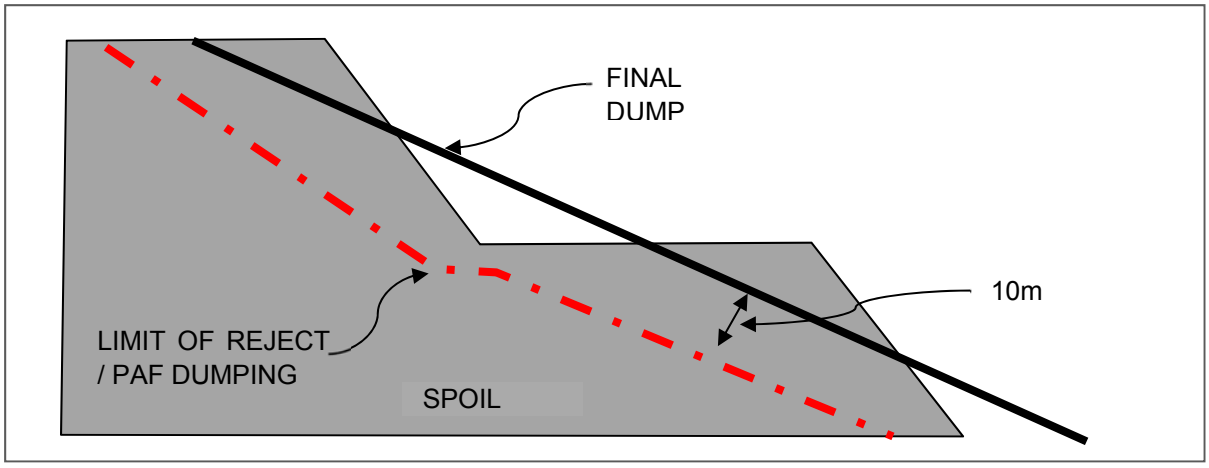

Figure 6-2: Typical Cross-section of spoil dump and 10m minimum cover.

6.4.1 Spot Dumping – In-pit spoil

Spot dumping of PAF coarse rejects/tailings materials and Permian spoil occurs within the boundaries of the open pit area (ie. internally draining bounds of the open pit spoil). The objective of the spot dumping is to enable the ANC of the spoil to neutralise the potential acid formation. To provide a suitable factor of safety, PAF material is mixed with a minimum of 3 parts Permian spoil by weight (Target of 5 parts Permian to 1 part PAF material).

All Spot dumping locations drain internally to the open pit and are at least 10 m from the final landform. No coarse rejects or co-mingled coarse and fine rejects are used as part of a tip head safety bund, haul road or ramp.

In-pit spot dumping is designed in accordance with the Mining By-Product In-Pit Disposal Site Practice[13].

6.4.2 In-pit cell operations

As an alternative to spot dumping, cell based in-pit emplacements are progressively constructed. These emplacements are created within the Permian spoil in progressive in-pit dump designs. Cells include a permeable floor for basal drainage and containing embankments of Permian spoil. PAF material is

tipped over dedicated tip heads and covered with 10m of Permian spoil. Cells are designed in accordance with the Mining By-Product In-Pit Disposal Site Practice[13].

6.4.3 Spot dumping – Ex-pit spoil

In certain unusual circumstances placement of PAF in ex-pit spoil may be required. Under this eventuality, PAF material will be spot dumped with Permian spoil at a ratio of 10:1 (Permian to PAF). The PAF material will be lime dosed and covered with 10 m of Permian spoil. Specific approval from MCM's Environment Department is required prior to placement of PAF in Ex-pit spoil.

No coarse rejects or co-mingled coarse and fine rejects will be used as part of a tip head safety bund, haul road or ramp.

6.5 NAF Waste Placement

NAF coarse rejects and tailings materials are treated the same as PAF coarse and fine rejects; and are preferentially placed within in-pit spoil via spot dumping with Permian interburden. The ANC of the Permian spoil is used to provide a factor of safety to NAF categorised coarse and fine rejects. All NAF coarse and fine rejects and coal seam floor material will be placed at least 10 m from the final landform surface.

NAF overburden, interburden and coal seam partings and floor may be placed in in-pit or ex-pit spoil. Partings and floor are preferentially placed in-pit.

6.6 Coarse Rejects and Tailings Disposal Recording

A record of coarse rejects and tailings properties is maintained by MCPL in the EDMS, including Acid Base Account and monitoring results as described in **Section 2.5**. Additionally, monthly tonnages of coarse rejects and thickened tailings disposed are also recorded in the production database.

7 MONITORING

Monitoring of water and solid materials forms an important part of the on-site management of mining waste materials and is completed in accordance with the EA[1], Plan of Operations[6], EMP[14], Water Management Plan[16], and this MWMP.

The monitoring program is primarily aimed at identifying PAF coarse reject and tailing materials and potential impacts to ensure that management practices are appropriate or are modified accordingly. Monitoring is conducted by trained on site personnel or by specialist consultants as engaged by MCPL.

Ongoing characterisation of coarse rejects and tailings materials is completed in accordance with relevant site plans and procedures. Leachate from coarse rejects and tailings placed at spoil disposal areas and tailings decant water is included in the site water quality monitoring program.

On-going characterisation of the coal and mining waste materials (including overburden, interburden, floor, roof and partings) is completed on a project basis in accordance with relevant site plans and procedures, if new areas of the site are planned to be mined that have not been previously characterised (eg. the Western Extension Project described in **Section 1.2**).

The routine and project-based MCM monitoring program schedules are provided in **Table 7-1**. The monitoring program is revised as part of data and management plan reviews and as more site-specific data becomes available.

On a project basis, drill core/chip samples representing overburden, interburden, coal seam, coal seam roof, parting and floor materials from new areas of the site that are planned to be mined will be taken and subjected to geochemical screening tests according to this MWMP; and selected samples will be subjected to water extract water quality tests and kinetic tests, if required, as described in **Table 7-1**. Some input from an experienced geochemist will be required to assist with the sample selection and testing program and interpretation of results.

Drill core intervals will cover up to 0.5 m whereas drill chip intervals may cover up to 3 m intervals and be limited to a single lithology or material type, where possible, to assist in later interpretation of results. Drill core/chip samples will weigh approximately 1-2 kg and samples will be double bagged and clearly labelled with the sample name and date of collection. A list of all samples collected will be prepared and include the drill hole number, sample depth interval and any visual observations of key minerals (eg. pyrite, calcite). Drill logs will be geophysically corrected and provided to the geochemist interpreting the project based geochemical assessment program.

The drill core/chip samples described above will be stored in a cool dry place prior to being sent to an appropriate commercial laboratory for geochemical characterisation. Each sample batch will be accompanied by a completed laboratory Chain of Custody (COC) form, which identifies the samples and details the analyses required to be completed (**Table 7-1**).

7.1 Monitoring Records

Sampling and characterisation of coal and mining waste from the open pit (overburden, interburden, floor, partings and roof materials) and from coal processing (coarse rejects and tailings) is undertaken periodically as part of the monitoring program to assess the risk of AMD associated with any PAF materials. The aim the program is to quantify the characteristics of materials, assess potential impacts and confirm or modify management strategies associated with the material.

Additional monitoring to that described in **Table 7-1** includes routine ground water, regulated structures (TSF) inspections and rehabilitation monitoring.

[16] Middlemount Coal (2019). Draft Water Management Plan MP 207-001. 23 April.

Table 7-1: Routine and Project-Based MCM Coal, Mining Waste and Water Quality Monitoring Program

Frequency	Sample Source	Sample Point	Analysis	Comments
Quarterly	Middlemount Seam, Tralee Seam Pisces Seam or blend.	1. Tailings thickener underflow 2. Coarse rejects	pH, EC, total sulfur, ANC and Scr. 1:5 water extract water quality (dissolved Ag, Al, As, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, Pb, Hg, K, Ni, Mg, Mn, Mo, Na, Se, U, V, Zn and SO_4).	Source of coal to be recorded to develop spatial understanding of rejects by source. Frequency to be reviewed annually or if materials are consistently NAF.
	TSF and ILF cell decant water	TSF 1, ILF Cell 1 & 2 and TSF 2 if receiving tailings.	pH, EC, dissolved Ag, Al, As, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, Pb, Hg, K, Ni, Mg, Mn, Mo, Na, Se, U, V, Zn and SO_4 as per EA Table C3).	
	Middlemount Seam, Tralee Seam Pisces Seam	ROM Coal	pH, EC, total sulfur, ANC and Scr.	
Opportunistic	Leachate from disposal locations		pH, EC, dissolved Ag, Al, As, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, Pb, Hg, K, Ni, Mg, Mn, Mo, Na, Se, U, V, Zn and SO_4 (as per EA Table C3).	If possible. Locations to include in-pit cells and pit water.
Project Based	Overburden, interburden, floor, partings and roof of all seams	Overburden, interburden, floor, partings and roof from exploration drill core.	pH, EC, total sulfur and Scr, as required. 1:5 water extract water quality (dissolved Ag, Al, As, Ca, Cd, Cl, Co, Cr, Cu, F, Fe, Pb, Hg, K, Ni, Mg, Mn, Mo, Na, Se, U, V, Zn and SO_4). Column leach testing as required.	One-off sampling for new project areas to focus on spatial distribution rather than strict timing.
As Required	All sample sources	Additional sampling will be undertaken on an as-needs basis.		

[#]ICPMS/CV FIMS – analytical methods required to achieve laboratory Limit of Reporting (LOR).

Monitoring records for coal and mining waste materials are maintained by MCPL and stored in the EDMS and include the following:

- Sample date and time;
- Sampler
- Sample location
- Sample source (seam, strip and block)
- In-situ parameters pH, EC and temperature (water only)
- Visual observations. Key indicators of AMD presence include (but are not limited to):
  - Turbidity
  - Colour, (eg. particularly red coloured, unnaturally clear water;
  - Odour, (eg. sulfurous);
  - Precipitate formation (eg. orange-brown iron oxide precipitates);
  - Corrosion of concrete or steel structures.
  - Laboratory results for the range of analyses described in **Table 7-1**.

7.2 Saline and Sodic Potential

EA Condition E3 requires characterisation programs to ensure that both the geochemical and physical properties of the mining waste are progressively characterised. The physical test parameters are typically focussed on rehabilitation and more information on this issue is contained in the Rehabilitation Management Plan[8]. During disposal, spoil material is characterised to identify dispersive and non-dispersive spoil and saline drainage potential. The primary source of salts that can leach from soil, sub-soil, regolith units, transition material and fresh rock can be sodium chloride (brought inland from the ocean in rain and leached through the geological profile over geological timescales) or primary and secondary minerals.

Saline drainage levels in surface runoff and seepage from spoil associated with sodium chloride (NaCl), sodium bi-carbonate ($NaHCO_3$) or sulfate (SO_4^{2-}) can be elevated and may not achieve with water quality targets and limit the ability to release water from site.

Soil and spoil dominated by NaCl or $NaHCO_3$ can be sodic (the clay minerals disperse making them highly erodible-when the clays settle, and they can have very low permeability) and this can reduce the ability to use the soil or spoil for rehabilitation.

MCPL will ensure that a program for sampling and testing of soil and overburden at new mining areas, such as the Western Extension Project, includes methods which allow identification and management of saline drainage potential and/or sodic potential. This will be done as part of rehabilitation field trials.

7.3 Integrated Monitoring and Management

Other monitoring that may interact with mining waste management includes groundwater, regulated structures, rehabilitation monitoring and general inspections. Items considered include:

- Water quality – groundwater;
- Water quality – surface water;
- Seepage/leachate production and quality;
- Visual inspections;
- Soil geochemistry; and,
- Vegetation coverage and establishment.

All monitoring results are used to assist with continuous improvement of the mining waste management strategies.

7.4 MWMP Review

The MCM Environment Department is responsible for communicating the outcomes of an independent review of the risk of AMD, to site personnel and contractors. Reviews will be undertaken by the MCM Environment Department and/or a suitably qualified specialist consultants on a two-yearly basis. If management practices are not effective, changes to the management will be made and implemented.

In addition to the MWMP review process described above, additional reviews will occur on an 'as needs' basis if mining waste management issues arise. Reviews will include consideration of monitoring results. Any changes in operational practices will be incorporated into the documentation and communicated to responsible employees and contractors.

Suitable criteria to establish whether mining waste management practices are effective are as follows:

- no complaints in relation to mining by-products management;
- full compliance with the requirements of this MWMP;
- no uncontrolled release of contaminated leachate; and
- continual improvement in mining waste management practices.

All matters relating to Mining by-products are referred to and managed by the MCM Environment Department.

All relevant personnel employed at MCM will undergo training in relation to mining waste management.

8 CONTINGENCY AND EMERGENCY PLANS

8.1 Operational Contingencies

MCPL has developed operational contingencies for scenarios that may occur throughout the life of the operation. Each scenario may have more than one contingency of which a portion of the contingencies may be enacted in that event based on the site conditions at the time. The scenarios and contingencies are presented in **Table 8-1**.

Table 8-1: Operational Contingencies

Scenario	Possible Contingencies
Insufficient Permian for spot placement of PAF material	• In-pit cell construction and possible lime dosing. • Ex-pit spot dumping with lime dosing. • Tailings diverted to TSF 1 or 2.
Incorrect placement of PAF within 10 m of final landform	• Incident Investigation. • Removal and relocation of PAF material to suitable dump location. • Assessment of potential or real impacts.
Wet-weather preventing access to disposal locations	• Temporary storage of rejects at temporary rejects stockpiles. • Review CHPP production rates.
Mechanical dewatering equipment malfunction	• Temporary placement of tailings in the TSF 1 or 2. • Future reclamation to provide sufficient emergency capacity in TSF 1 or 2.
Abnormal monitoring results	• Investigation into cause of results and mitigation measures required.
AMD indicators found	• Soil and water sampling to be conducted. • AMD source treated (removed, ameliorated, etc). • Interception/mitigation measures installed based on expert advice.

8.2 Emergency Response

If any MCPL personnel suspect the presence of AMD, it is reported to the Site Senior Executive (SSE) and the MCM Environment Department as soon as practicable and within 24 hours. The Emergency Preparedness and Response Management Plan (ERMP) is also consulted. Emergencies relating to regulated dams are managed in accordance with regulated dam guidelines and operational plans.

Any uncontrolled release of contaminants is managed in accordance with the following general principles:

1. **Isolate**
   - Isolate access to the spill and sources of spill (valves, etc), where possible.
2. **Notify**
   - Notify Supervisor and Environment Department or SSE.
   - The MCM Environmental Department, in consultation with the SSE, will consider the need to contact downstream landholders, DES and other stakeholders. The ERMP should also be consulted.
3. **Contain**
   - Prevent spill spreading or entering waterways (eg. by bunding). Amelioration with lime, if required.
4. **Control the release**
   - Control the release source (drain, etc). May be completed in conjunction with Principle 3.
5. **Reclaim**
   - Reclaim released material and/or contaminated material where the impact is justified. Caution is to be applied around watercourses and with potentially acidic water/material and specialist advice may need to be sought.

The MCM Environment Department will commence an investigation into the reported AMD and may include visual inspections, soil and water monitoring and possible test pits. Where AMD is deemed likely, the MCM Environment Department will engage a suitably qualified consultant to advise on appropriate actions that may include sampling programs to determine if AMD is occurring as well as containment, mitigation and

remedial actions to prevent further AMD impacts. The MCM Environment Department will review this MWMP, site procedures and monitoring records. If required, management plans and site procedures will be amended.

Where an incident occurs that results in an emergency or incident which results in, or may result in, environmental harm or the release of contaminants not in accordance with the sites EA, the administering authority will be notified in writing within 24 hours (EA Condition A8).

Written advice will be provided to the administering authority (EA Condition A9 and A10), no more than 10 business days following the initial notification of an emergency, incident or information about circumstances which result or may result in environmental harm or the release of contaminants, or within 24 hours after receiving the results from analysed samples.

9 CERTIFICATION

As described in **Section 1.5**, RGS certifies that this MWMP is feasible and would meet the intent of the EA conditions (ie. the MWMP will enable MCM to continue to progressively characterise, mine and place the mined materials so that their potential to contribute to (or to mitigate) environmental harm can be determined. The Qualifications of the RGS personnel suitably qualified to certify this MWMP are provided below.

9.1 Suitably Qualified Persons – RGS Company Details

The core business of RGS is to undertake static and kinetic chemical and physical material characterisation studies and produce certified mine material, mine rehabilitation and mine closure plans that include sampling, analytical and monitoring programs.

RGS is an owner-operated leading environmental consulting company that has been operating successfully for the past twelve years. We provide timely and cost-effective solutions to complex environmental management issues from exploration through the planning, operational and closure phases of small to large scale mining projects. RGS has gained an international reputation as a leading provider of environmental management services to the mining and mineral processing industry and takes pride in being flexible, practical and innovative. RGS is committed to delivering on time and within budget; technical excellence; consistent quality; and continual improvement of our service delivery and skills.

RGS personnel have provided services to more than 500 mining and mineral processing projects in Algeria, Argentina, Australia, Bangladesh, Brazil, China, Ghana, India, Indonesia, Laos, Malaysia, Mozambique, New Caledonia, New Zealand, Papua New Guinea, Philippines, Romania, Thailand, Turkey and Vietnam. RGS has worked on more than 100 coal mine projects in Queensland, New South Wales, Western Australia, Africa, New Zealand, Indonesia, Laos and Bangladesh. Our clients range from small to large mining companies including Anglo American, BHP Billiton, CS Energy, Evolution Mining, MMG, Rio Tinto, Stanwell Corporation, Vale and Glencore.

9.2 Suitably Qualified Persons – Relevant Experience

RGS Personnel

Alan Robertson has a PhD in Pure and Applied Chemistry and has over 25 years' experience completing geochemical studies for the mining and mineral processing industry. He has worked on projects for major mining companies (*e.g.* Anglo American, BHP Billiton, Glencore and Vale) in Australia, Asia, Africa, Europe and South America for both coal and hard rock mines. Alan has expertise in mine waste characterisation, development of AMD management plans, and design of mine waste storage facilities from conception through to closure. Alan is regularly engaged directly by Regulators to provide independent environmental advice on mine closure and rehabilitation aspects of mining operations.

Greg Maddocks has a PhD in Geochemical Engineering, over 15 years' mining sector experience and has worked on various open pit and underground mining projects in Australia and South-East Asia. Greg has developed Mining Waste and Rehabilitation Management Plans compliant with the requirements of Australian industry guidelines and standards. Mine closure work ranges from evaluating and selecting optimal water and waste management strategies to developing management plans for tailings and overburden storage facilities and open pits.


RGS
LEADERS IN MINING
GEOCHEMISTRY