Appendix J: Water Management Plan

Colton Mine

Water Management Plan

Document Control

Revision	Date	Description	Approved By	Position	Signature
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Contents

Key Terms and Abbreviations

AGE	Australasian Groundwater and Environmental Consultants
AHD	Australian Height Datum
AMD	Acid and metalliferous drainage
ANC	Acid neutralising capacity
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
bGL	Below ground level
BoM	Bureau of Meteorology
CHPP	Coal handling and preparation plant
DERM	Department of Environment and Resource Management
DNRW	Department of Natural Resources and Water
EA	Environmental Authority
EMP	Environmental Management Plan
EP Act	Environmental Protection Act 1994
EPA	Environmental Protection Agency
EPC	Exploration Permit for Coal
EPP Water	Environmental Protection (Water) Policy 2007
EV's	Environmental values
GWDB	Groundwater database
LWBC	Land and Water Biodiversity Committee
ML	Mine lease
MLA	Mine lease application
NAF	Non-acid forming
NAG	Net acid generation
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
PAF	Potentially acid forming
WERD	Water Entitlements Registration Database
WQO's	Water quality objectives

1. Introduction

The Mine Water Management Plan details the manner in which water will be managed for the Colton Mine project in order to:

- Satisfy regulatory requirements
- Maximise the efficiency of site water use
- Minimise the adverse effects of the abstraction and release of water on environmental, social and cultural values

The scope of the Water Management Plan includes all water diversion, capture, storage, use and discharge during the development, operation and post closure phases of the Colton Mine project.

1.1 Project Description

The Project consists of the development of a ~5.0 Mt coking coal Probable Reserve of the Burrum Coal Measures in the Maryborough Basin, South East Queensland. The Project is planned to mine approximately 1.0 Mt of ROM coal per annum by open cut methods to produce on average 0.5 Mtpa of product coal for export. Project production life is anticipated to be 8 - 10 years based on current economic assessment of the resource.

The Project will involve open cut mining using truck and excavator methods. A Coal Handling and Preparation Plant (CHPP) and associated mine infrastructure will be required on site. Product coal will be transported by rail from the Project to Gladstone Port along Queensland Rail Network’s North Coast Line where it will initially be exported through the Barney Point Coal Terminal and later through the Wiggins Island Coal Terminal once capacity at that terminal becomes available to the Project.

1.2 Relevant Legislation

In Queensland, water resource management, use and protection are primarily governed by the following legislation:

- Water Act 2000
- Environmental Protection Act 1994 (EP Act)

In addition to these principal legislative instruments, there is also a range of subordinate legislation used to achieve the outcomes of these Acts including:

- Water Regulation 2002;
- Water resource plans;
- Resource operations plans; and

- Environmental Protection (Water) Policy 2007 (EPP Water).

1.2.1 Water Act 2000

The taking and interfering with water is not controlled in all areas of the State. The areas which are controlled have been prescribed so by either water resource plans or under the Water Regulation 2002. In each case the Water Regulation 2002 or the relevant water resource plan details the management and use of the water to which the plan applies.

The following can be concluded with regard to the Project location:

- The Project is not located within any currently declared artesian or subartesian areas (under the Water Act 2000); and
- The Project is located within the Water Resource (Mary Basin) Plan 2006 area.

Section 9 of the Water Resource (Mary Basin) Plan 2006 specifies water to which the plan applies:

9 Water to which plan applies

(1) This plan applies to the following water in the plan area—

(a) surface water;

(b) subartesian water in the Cooloola Sandmass subartesian area.

(2) In subsection (1)—

surface water means the following—

(a) water in a watercourse or lake;

(b) water in springs not connected to—

(i) artesian water; or

(ii) subartesian water connected to artesian water.

As the Project is not located within the Cooloola Sandmass subartesian area, the Water Resource (Mary Basin) Plan 2006 has no bearing on groundwater (artesian or subartesian) within the Project area. Hence there is no development permit required for the construction of a water bore and no permit or licence required to take groundwater.

Rain water that falls on the mine area will be captured and managed as per this plan. Rainfall that falls outside the mine area that would otherwise flow through the mine area will be diverted around.

In December 2007, amendments to the Water Resource (Mary Basin) Plan 2006 were made under sections 50 and 56 (4) of the Water Act 2000. These amendments do not affect the water to which the Plan applies as set out in Section 9 of the Plan.

A draft resource operations plan for the Mary Basin is yet to be released.

1.2.2 Environmental Protection Act 1994

The Environmental Protection (Water) Policy 1997, subordinate legislation to the EP Act, has the purpose of protecting Queensland's waters (including groundwater) principally through:

- Identifying environmental values for these waters; and
- Deciding and stating water quality guidelines and water quality objectives (WQO's) to enhance or protect the environmental values (EV's).

The Policy also stipulates obligations for the chief executive (water resources) in relation to the development and implementation of environmental plans about environmental water provisions for Queensland waters and protecting ground waters.

Schedule 1 of the EPP Water lists the waters for which environmental values are to be enhanced or protected and specifies the document that details the environmental values and water quality objectives in each instance.

Following review of Schedule 1 and associated plans available from DERM, it was determined that the Project lies within the Mary River catchment as represented in plan WQ1381 (refer Appendix 1). The relevant document is therefore the Mary River Environmental Values and Water Quality Objectives (EPA, 2007). Section 1.1 of this document describes the waters to which it applies as:

- *all freshwaters and tributaries of the Mary River;*
- *the upper, mid and lower estuary/enclosed coastal water of the Mary River and Susan River and tidal tributaries including Tinana Creek;*
- *tidal canals, constructed estuaries, marinas and boat harbours and entrance buffers;*
- *wetlands, and*
- *ground waters.*

1.3 Objectives

1.3.1 General Objectives

The general objectives of the Water Management Plan are:

1. To systematically identify water management issues and risks of harm to the local water resources at all stages of the project (development, operation and post closure)
2. To define the management actions which are in place to prevent or effectively minimise the risk of environmental harm to local water resources
3. To provide quantitative water objectives against which performance can be assessed

4. To identify responsibilities for implementation, monitoring, reporting and review

1.3.2 Site Water Management Objectives

The site water management objectives are detailed in Table 1-1.

Table 1-1 Site water management objectives

No.	Management Objective	Annual Performance Measure
1	To comply with all statutory obligations and community expectations	Number of non-compliances and complaints brought by regulators, employees and the community
2	No uncontrolled discharge of water off-site	Number of uncontrolled off-site water discharges
3	No exceedance of Colton Mine Environmental Authority off-site water quality discharge criteria	Number of discharge water quality exceedances
4	Minimise potential for contamination and maintenance of groundwater quality within specified background limits	Maintenance of groundwater quality within specified background limits (assessed from monitoring data obtained from licensed monitoring bores).
5	Source all site water requirements (excluding potable supply) from within the site	Percentage of water supply sourced from off-site
6	To achieve optimal reliability of water for site operational requirements	Percentage of lost time due to restricted water availability
7	To achieve maximum operability of the mine pit(s) by minimising flooding of the pit(s)	Percentage of lost time due to pit flooding

1.4 Principles

The management of surface water and groundwater for the Colton Mine Project is based on the principles in Table 1-2.

Table 1-2 Water management principles

No.	Management Principle
1	Existing surface water drainage patterns will be maintained where practical to do so
2	Water from different sources will be managed separately: • Unaffected surface water will be diverted around site wherever possible • Intermediate water (including bore water) will be captured and retained in the Mine Water Management Dam for use on site and/or controlled off site discharge • Worked mine water will be captured and retained for use on site
3	Water will be selected for use based on water quality and end of cycle considerations
4	Water for mine operating purposes will be sourced from dedicated on-site mine water storages. Water in these storages will be from on-site runoff, groundwater seepage and dewatering bores
5	Water within the CHPP and facilities area will be a closed area protected by its own catchment dam
6	Overburden dumps will be rehabilitated as soon as practical to minimise potential for release of contaminated surface runoff. Surface runoff will be directed to the Mine Water Management Dam where it will mix with other site waters.
7	Infrastructure to manage mine water will be designed and operated to achieve zero uncontrolled discharge
8	Discharge of excess water off site will be in accordance with Colton Mine Environmental Authority (EA) conditions
9	The site will be left in a safe and environmentally stable condition. The final voids will be bunded, and in-pit dumps above the final voids will be shaped to send runoff away from the voids.

1.5 Site Description

1.5.1 Topography and Drainage

The topography of the Project area is relatively flat, consisting of a low remnant surface controlled by the Elliott Formation, typically ranging in elevation from 5 m AHD to 25 m AHD.

Drainage within and north-northeast of the Project is to the east via non-perennial tributaries of the Susan River which meet the Mary River near its mouth. The area to the south and west of the Project is drained by Saltwater Creek and its non-perennial tributaries which also flow to the Mary River.

Further to the north within EPC923, drainage is to the west via non-perennial tributaries of the Burrum River and to the north via Beelbi Creek and its non-perennial tributaries.

1.5.2 Climate

Maryborough experiences a subtropical climate with significant variation in annual rainfall. Mean daily temperatures range from 9-23 ^{o}C in winter and 20-31^{o}C in summer.

The closest Bureau of Meteorology (BoM) stations to the Project site with long-term rainfall records are listed in Table 1-3. As can be seen from Table 1-3, station 40050 closed in 1980 while both stations 40126 and 40098 are currently in operation.

Table 1-3 BoM long-term rainfall stations in proximity to the Project

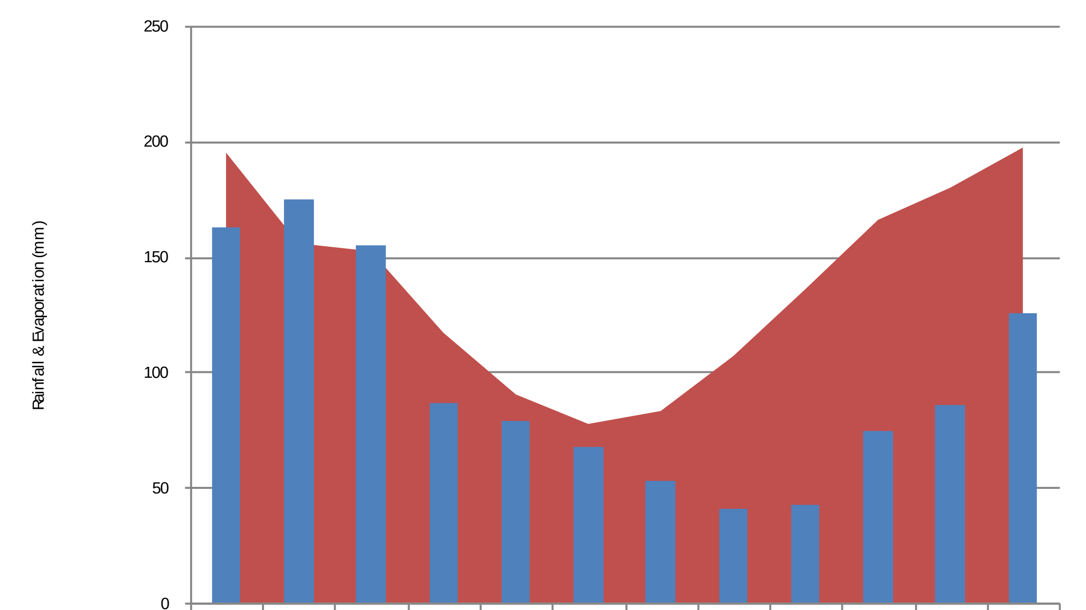
Station Number	Station Name	Distance from Project Site (km)	Latitude (Degrees)	Longitude (Degrees)	Station Height (m above MSL)	Start of Record	Closed	Length of Record (Years)	Completeness of Record (%)
40050	Colton Railway Station	2.5	-25.433	152.650	35.0	Jan-1899	Aug-1980	81.5	78
40098	Howard Post Office	16	-25.318	152.563	26.0	Jan-1899	Open	110.5	98
40126	Maryborough	10	-25.516	152.716	10.3	Feb-1870	Open	139.5	88

There is no BoM pan evaporation station in close proximity to the project site with the nearest stations being:

- 39174 Bundaberg Sugar Research Station January 1966 – present
- 39128 Bundaberg Aero December 1997 – present

Figure 1-1 provides a summary of monthly rainfall and evaporation for Maryborough. The rainfall data presented is for station 40126 from 139 years of records while the evaporation data is from the SILO Patched Point Data set for station 40126. The evaporation data provided from SILO has been generated from long term average data from surrounding stations.

It can be seen from Figure 1-1 that mean monthly evaporation exceeds rainfall for all months except February and March and that the wet season occurs from December through March while the driest months are June through September. The mean annual rainfall and evaporation for Maryborough is 1151 mm and 1660 mm respectively while the lowest recorded annual rainfall for Maryborough is 325 mm in 1902 and the highest is 2248 mm occurring in 1956.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Evaporation	195.4	156	152.6	117.2	90.4	77.6	83.2	107	136.2	166.2	180.2	197.6
Mean Rainfall	162.8	175.1	155.1	87	78.9	67.8	52.9	40.5	42.9	75	86.3	126.2

Figure 1-1 Monthly rainfall and evaporation for Maryborough (BoM station 40126)

2. Environmental Value of Waters

2.1 Overview

The mining leases (ML50273 and ML50274, when granted) and receiving waters lie within the Mary River catchment. The Susan River flows into the Mary River at its mouth which flows into the Great Sandy Straight.

The environmental values for waters within the Mary River catchment are described in the Mary River Environmental Values and Water Quality Objectives (EPA, 2007), which applies to fresh and estuarine surface waters and groundwaters draining the Mary River catchment as represented in plan WQ1381 (refer EPA, 2007).

Of those waters included in the Mary River Environmental Values and Water Quality Objectives (EPA, 2007), the following are of specific relevance to the Colton Mine project:

- Mary River
- Susan River
- all other rivers and creeks of the Mary River catchment (e.g. Saltwater Creek)
- wetlands
- groundwaters

Downstream of the project site are:

- The Great Sandy Marine Park
- The Great Sandy Straight Ramsar Wetland

Figure 2-1 shows the locations of these features. The Great Sandy Straight Marine Park extends upstream in the Mary River to the limit of the mean high water spring tides, while the Great Sandy Straight Ramsar Wetland extends upstream in the Susan River to the Maryborough-Hervey Bay Road.

Table 2-1 summarises the environmental values for waters of the Mary River catchment that are relevant to the Colton Mine project. Explanation of each environmental value can be found in Mary River Environmental Values and Water Quality Objectives (EPA, 2007). In relation to the Mary River, the applicable water type classification is “middle estuary”.

Figure 2-1 Downstream Environmental Values

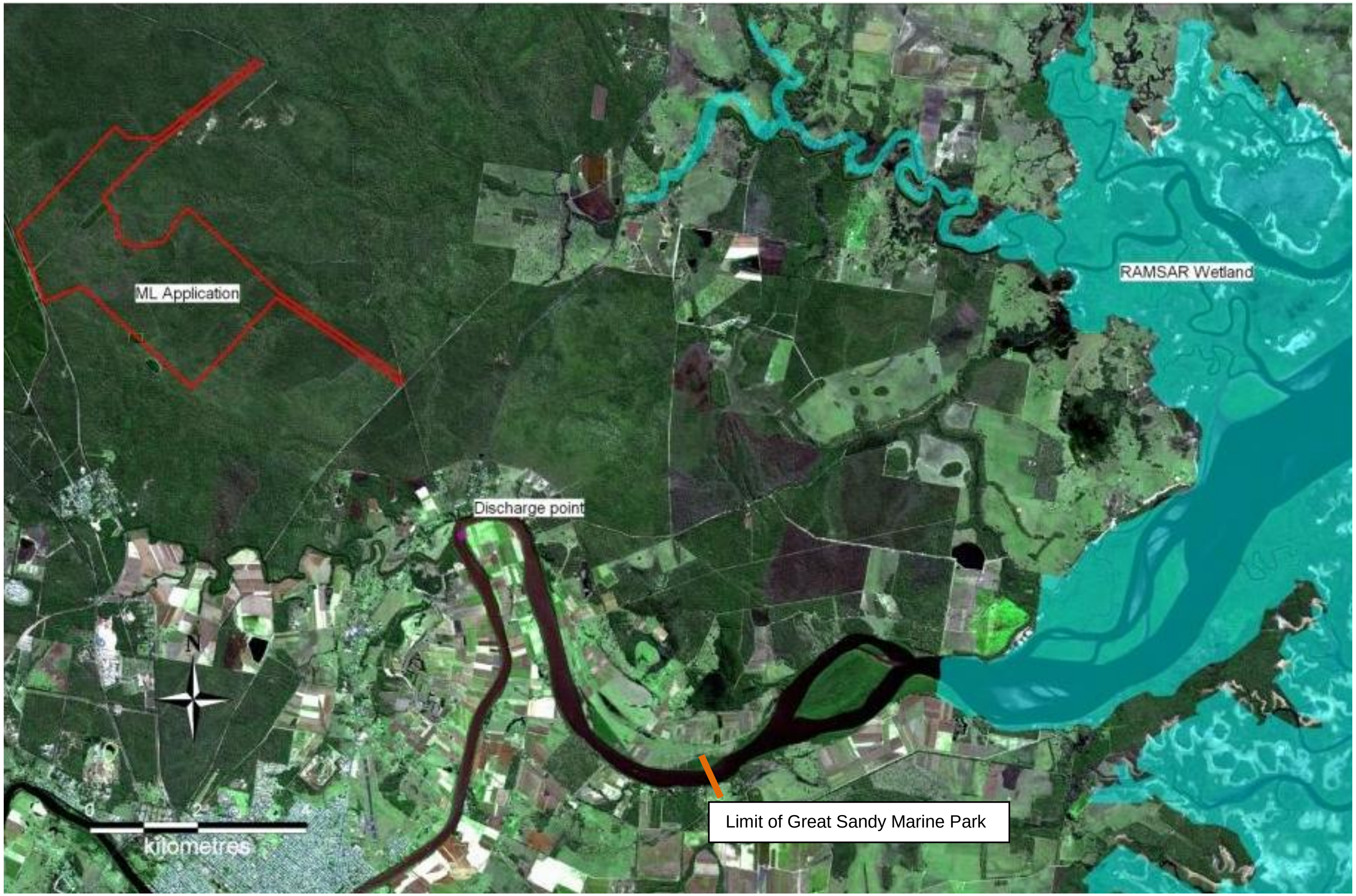


Table 2-1 Environmental values relevant to the Colton Mine project

Environmental Values	Mary River – middle estuary	Susan River – estuarine & freshwater	Other estuarine tributaries	Other freshwater tributaries	Wetlands, lakes and reservoirs	Ground waters
Aquatic ecosystems	✓	✓	✓	✓	✓	✓
Human consumer	✓	✓	✓	✓	✓	
Primary recreation	✓		✓	✓	✓	
Secondary recreation	✓	✓	✓	✓	✓	
Visual recreation	✓	✓	✓	✓	✓	
Cultural heritage	✓	✓	✓	✓	✓	
Industrial use	✓					
Aquaculture	✓					
Drinking water						✓
Irrigation				✓		✓
Stock water				✓		✓
Farm supply				✓		✓
Oystering						
Seagrass						

Source: Mary River Environmental Values and Water Quality Objectives (EPA, 2007)

Notes:

1. ✓ means the EV is selected for protection
2. Blank indicates the EV is not chosen for protection

2.2 Baseline Surface Water and Groundwater Conditions

Baseline surface water conditions are described in the Colton Mine Surface Water Management report (PSM, 2010) and Colton Coal Project Stream Sediment and Morphology Report (AARC, 2010).

Baseline groundwater conditions are described in the Colton Mine Hydrogeological Study (Streamline Hydro, 2010) and Report on Colton Coal Project Groundwater Modelling (AGE, 2010).

3. Contaminant Source Assessment

Several studies have been undertaken as part of the broader environmental study for the Colton Mine project to aid in identification and management of potential contaminant sources during and after the projects life. These studies include:

- ARD Assessment of the Colton Mine Project (EGI, 2009)
- Colton Coal Project Stream Sediment and Morphology Report (AARC, 2010)
- Colton Mine Groundwater Study (Streamline Hydro, 2010)
- Colton Mine Surface Water Study (PSM Australia, 2010)

As a result of these studies, it has been possible to identify potential contamination sources and hence water involved with the project has been classified into three categories as per Table 3-1.

All water sources within the project have been identified and assigned a water quality classification and end use based on their known chemical and physicochemical properties, as summarised in Table 3-2.

Table 3-1 Site water classification

Water Quality Classification	Description
Unaffected	Water which has not been impacted by mining operations
Intermediate	Water which has had low level contact with mining operations which has had negligible or minor change in chemical and physicochemical properties
Worked	Water which has had significant contact with mining operations which has had notable change in chemical and physicochemical properties

Table 3-2 Summary of site water sources and uses

Water Source	Potential Contaminants of Concern	Water Quality Classification	Suitable End Uses
Groundwater seepage into mine pit	Low pH High salinity Metals	Worked	• Site use only (retain with the operational facilities water circuit)
Groundwater supply/ dewatering bores	Low pH High salinity Metals	Intermediate	• Use on site • Release offsite (subject to discharge criteria)
Surface runoff from unaffected mine areas	Nil	Unaffected	• Diversion around operational areas
Runoff & seepage from out of pit overburden dumps	Low pH High salinity Metals Turbidity	Intermediate	• Use on site • Release offsite (subject to discharge criteria)
In-pit rainfall/runoff	Low pH High salinity Metals Turbidity Hydrocarbons (from spills)	Worked	• Site use only (retain with the operational facilities water circuit)
Runoff from site roads & disturbed/operational areas	Low pH High salinity	Worked	• Use on site • Transfer to Mine Water Management Dam for potential release offsite (subject to discharge

Water Source	Potential Contaminants of Concern	Water Quality Classification	Suitable End Uses
	Metals Turbidity Hydrocarbons (from spills)		criteria)
CHPP, washdown bay, facilities runoff & discharge	Low pH High salinity Metals Turbidity Hydrocarbons (from spills)	Worked	• Site use only (retain with the operational facilities water circuit)
Rejects decant	Low pH High salinity Metals Hydrocarbons (from spills)	Worked	• Site use only (retain with the operational facilities water circuit)
Stockpile runoff & seepage	Low pH High salinity Metals Turbidity	Worked	• Site use only (retain with the operational facilities water circuit)

4. Potential Impacts

Potential impacts on water flow, quality and environmental values identified from each of the technical studies are discussed below.

4.1 Hazardous Dam Assessment

The following definitions exist within the Code of Environmental Compliance for Environmental Authorities for High Hazard Dams Containing Hazardous Waste (EPA, n.d.):

'dam' means:

a) *a containment or proposed containment whether permanent or temporary; and*

b) *which does, would or could contain, divert or control flowable substances; and*

c) *but does not include a fabricated or manufactured tank or container designed to a recognised standard.*

'hazardous waste' means:

any substance, whether liquid, solid or gaseous, derived by or resulting from, the processing of minerals that tends to destroy life or impair or endanger health.

The first step in determining if a dam contains hazardous waste is to determine if the dam's contents (either actual contents or predicted contents) exceeds any of the criteria in Table 4-1 (and similarly Table 4-3), or in the case of pH, does not comply with the limits stated in Table 4-1 (and similarly Table 4-3). This includes waste produced by gravity separation or washing processes (EPA, 2003a).

The two proposed on-site dams requiring assessment are the Worked Water Dam and the Mine Water Management Dam.

4.1.1 Worked Water Dam

The Worked Water Dam will receive local area runoff, plant recycled water and washdown coal, rejects and silt from the CHPP facilities area. Processing water for the CHPP will be drawn from recycling from the Worked Water Dam with make up from groundwater and the Mine Water Management Dam. Plant rejects from the CHPP will be dewatered sufficient to allow transportation back into spoil dumps where it will be buried. Water obtained from dewatering rejects will be recycled through the Worked Water Dam for plant use. Work undertaken by EGI (2009) included chemical composition analysis of selected solids and water extracts which provides an indication of the composition and concentrations of solids and liquor in the Worked Water Dam. In conducting the hazardous dams assessment, consideration was given to the results of the EGI (2009) report along with groundwater quality analysis.

There are a wide variety of factors which can influence the concentration of solids and liquor within the Worked Water Dam, including evaporation, the residence time of water and solids in the dam, the source of water and the exposure of contents to the atmosphere (i.e. oxidation).

As the Worked Water Dam is deemed to contain hazardous waste due to exceedances of the assessment criteria in Table 4-1, the next step is to determine if the dam is a high hazard dam. Determining whether a dam is a high hazard dam is undertaken by addressing the assessment criteria in Table 4-2 as provided in EPA (2003a). From Table 4-2 it is concluded that the Worked Water Dam is a high hazard dam as it is located within the Mary River Catchment. The Worked Water Dam must therefore be managed in accordance with the Environmental Protection Act 1994, the process outlined in information sheet *"Managing dams containing hazardous waste"* (EPA, 2003b) and the Code of Environmental Compliance for Environmental Authorities for High Hazard Dams Containing Hazardous Waste (EPA, n.d.).

Table 4-1 Hazardous Dam Assessment for Worked Water Dam

Parameter[1]	Assessment Criteria[2]		Tailings Dam		Comments	
	Liquor[3]	Total Solids[4,5]	Liquor	Total Solids	Liquor	Total Solids
Arsenic	1.0 mg/L	500 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 0.047 mg/L. Maximum concentration in groundwater was 0.007 mg/L.	Maximum concentration in solids from EGI (2009) was 74.0 mg/kg.
Boron	5.0 mg/L	15 000 mg/kg	✓	ND	Maximum concentration in liquor from EGI (2009) was <0.05 mg/L. Maximum concentration in groundwater was 0.3 mg/L.	No data for solids.
Cadmium	10 µg/L	100 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 3.6 µg/L. Maximum concentration in groundwater was 2.4 µg/L.	Maximum concentration in solids from EGI (2009) was 0.11 mg/kg.
Cobalt	1.0 mg/L	500 mg/kg	?	✓	Maximum concentration in liquor from EGI (2009) was 1.73 mg/L. Maximum concentration in groundwater was 0.07 mg/L.	Maximum concentration in solids from EGI (2009) was 24.1 mg/kg.
Copper	1.0 mg/L	5 000 mg/kg	?	✓	Maximum concentration in liquor from EGI (2009) was 0.26 mg/L. Maximum concentration in groundwater was 0.844 mg/L.	Maximum concentration in solids from EGI (2009) was 29.9 mg/kg.
Mercury	2 µg/L	75 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was <0.1 µg/L. Maximum concentration in groundwater was <0.0001 mg/L.	Maximum concentration in solids from EGI (2009) was 0.33 mg/kg.
Nickel	1.0 mg/L	3 000 mg/kg	?	✓	Maximum concentration in liquor from EGI (2009) was 0.78 mg/L. Maximum concentration in groundwater was 0.16 mg/L.	Maximum concentration in solids from EGI (2009) was 18.0 mg/kg.
Zinc	20 mg/L	35 000 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 1.54 mg/L. Maximum concentration in groundwater was 0.596 mg/L.	Maximum concentration in solids from EGI (2009) was 100 mg/kg.
Chloride	2 500 mg/L	-	✗	-	Maximum concentration in liquor from EGI (2009) was only 79 mg/L. The primary source of Chloride will be from wash plant water which can be expected to be above 2,500 mg/L depending on the GW-SW balance in the water supply at any given time.	
Fluoride	2.0 mg/L	-	✓	-	Maximum concentration in liquor from EGI (2009) was 1.1 mg/L. Maximum concentration in groundwater was 0.3 mg/L. Fluoride was not identified by EGI as likely to be associated with ARD.	
Sulphate	1 000 mg/L	-	?	-	Maximum concentration in liquor from EGI (2009) was 828 mg/L. Maximum concentration in groundwater was 622 mg/L.	
Cyanide	10 mg/L	2 500 mg/kg	✓	ND	Maximum concentration in groundwater was 0.042 mg/L.	No data for solids.
PH	Between 4 and 8	Net acid generation of pH<4	?	✗		EGI (2009) indicates solids with NAG pH<4 is expected.

Notes:

[1]Metals should be analysed in accordance with recognised test methods by a NATA certified laboratory.

[2]Source: EPA (2003a).

[3]Applies to the liquid contents in a dam generally available to the environment (for example, water available to birds and animals).

[4]Total solids include suspended and colloidal solids.

[5]Applies to the solids in a dam.

✓ = Within asessment criteria

✗ = Exceeds assessment criteria

? = Potential to exceed assessment criteria

Table 4-2 High Hazard Dam Assessment for Worked Water Dam

Assessment Criteria	Result
The dam is a high hazard dam only if the dam contains hazardous waste and one or more of the following situations occur:	
1. In the event of dam failure or overflow, the dam's content would have one of the more of the following actions:	
a. flow to a sensitive or commercial place;	No
b. flow to a riverine area containing permanent water;	No
c. contaminate a water supply for human consumption; or	No
d. contaminate a water supply for stock.	No
2. The dam is located within a:	
a. declared catchment or sub artesian area; or	Yes
b. watercourse and the dam's surface area exceeds 1ha.	No
3. The dam has a surface area greater than 2ha.	No

4.1.2 Mine Water Management Dam

The Mine Water Management Dam receives surface runoff from within the mine site, including runoff from spoil. It also receives water collected from in-pit sumps and de-watering bores.

The solids that will enter the Mine Water Management Dam will be by way of sediment transport from surface runoff. PSM (2010) have estimated a total sediment production of 18,000 tonnes for the first 3 years of operations when spoil dump areas are bare. After this time it is expected minimal sediment would report to the dam. PSM (2010) equated this quantity to approximately 3% of the storage capacity of the Mine Water Management Dam.

The liquid content of the Mine Water Management Dam will be dominated by surface water runoff and groundwater from de-watering bores and in-pit seepage. Significant fluctuations in concentrations may occur due to variables including the source and proportions of water from each source at any one time, rainfall, evaporation and the residence time of water in the dam.

When considering liquor concentrations in the Mine Water Management Dam, consideration was given to groundwater, water extracts from all lithologies and natural runoff. Most weight was given to surface water and groundwater, as this will form the bulk of the liquor rather than other minor sources such as seepage from spoil. It is noted that data from AARC (2010) is for total and not dissolved constituents and hence is considered to be higher than might be expected for dissolved constituents.

As the Mine Water Management Dam is deemed to contain hazardous waste due to exceedances of the assessment criteria in Table 4-3, the next step is to determine if the dam is a high hazard dam. From Table 4-4 it is concluded that the Mine Water Management Dam is a high hazard dam. The Mine Water Management Dam must therefore be managed in accordance with the Environmental Protection Act 1994, the process outlined in information sheet *"Managing dams containing hazardous waste"* (EPA, 2003b) and the Code of Environmental Compliance for Environmental Authorities for High Hazard Dams Containing Hazardous Waste (EPA, n.d.).

Table 4-3 Hazardous Dam Assessment for Mine Water Management Dam

Parameter[1]	Assessment Criteria[2]		Mine Water Management Dam		Comments	
	Liquor[3]	Total Solids[4,5]	Liquor	Total Solids	Liquor	Total Solids
Arsenic	1.0 mg/L	500 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 0.047 mg/L. Maximum concentration in groundwater was 0.007 mg/L. Maximum concentration in surface water from AARC (2010) was 0.0015 mg/L.	Maximum concentration in solids from EGI (2009) was 20 mg/kg. Maximum concentration in solids from AARC (2010) was <5 mg/kg.
Boron	5.0 mg/L	15 000 mg/kg	✓	ND	Maximum concentration in liquor from EGI (2009) was <0.05 mg/L. Maximum concentration in groundwater was 0.3 mg/L. Maximum concentration in surface water from AARC (2010) was <0.05 mg/L.	No data for solids.
Cadmium	10 µg/L	100 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 3.6 µg/L. Maximum concentration in groundwater was 2.4 µg/L. Maximum concentration in surface water from AARC (2010) was 0.3 µg/L.	Maximum concentration in solids from EGI (2009) was 0.16 mg/kg. Maximum concentration in solids from AARC (2010) was <1 mg/kg.
Cobalt	1.0 mg/L	500 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 1.73 mg/L while the average was 0.3 mg/L. Maximum concentration in groundwater was 0.07 mg/L. Maximum concentration in surface water from AARC (2010) was 0.003 mg/L.	Maximum concentration in solids from EGI (2009) was 18.9 mg/kg. Maximum concentration in solids from AARC (2010) was <2 mg/kg.
Copper	1.0 mg/L	5 000 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 0.26 mg/L while the average was 0.058 mg/L. Maximum concentration in groundwater was 0.844 mg/L while the average was 0.07 mg/L. Maximum concentration in surface water from AARC (2010) was 0.0015 mg/L.	Maximum concentration in solids from EGI (2009) was 54.4 mg/kg. Maximum concentration in solids from AARC (2010) was <5 mg/kg.
Mercury	2 µg/L	75 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was <0.1 µg/L. Maximum concentration in groundwater was <0.0001 mg/L.	Maximum concentration in solids from EGI (2009) was 0.08 mg/kg. Maximum concentration in solids from AARC (2010) was <0.1 mg/kg.
Nickel	1.0 mg/L	3 000 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 0.78 mg/L while the average was 0.16 mg/L. Maximum concentration in groundwater was 0.16 mg/L while the average was 0.034 mg/L. Maximum concentration in surface water from AARC (2010) was 0.002 mg/L.	Maximum concentration in solids from EGI (2009) was 15.6 mg/kg. Maximum concentration in solids from AARC (2010) was 2 mg/kg.
Zinc	20 mg/L	35 000 mg/kg	✓	✓	Maximum concentration in liquor from EGI (2009) was 1.54 mg/L while the average was 0.45 mg/L. Maximum concentration in groundwater was 0.596 mg/L while the average was 0.14 mg/L. Maximum concentration in surface water from AARC (2010) was 0.019 mg/L.	Maximum concentration in solids from EGI (2009) was 103 mg/kg. Maximum concentration in solids from AARC (2010) was <5 mg/kg.
Chloride	2 500 mg/L	-	×	-	Maximum concentration in liquor from EGI (2009) was only 79 mg/L. The primary source of Chloride will be from groundwater which can be expected to be above 2,500 mg/L depending on the GW-SW balance at any given time. Maximum concentration in groundwater was 6,410 mg/L while the average was 3,954 mg/L. Maximum concentration in surface water from AARC (2010) was 45 mg/L. Chloride will also report to the dam due to surface runoff from spoil and roads.	
Fluoride	2.0 mg/L	-	✓	-	Maximum concentration in liquor from EGI (2009) was 1.1 mg/L while the average was 0.83 mg/L. Maximum concentration in groundwater was 0.30 mg/L while the average was 0.19 mg/L.	
Sulphate	1 000 mg/L	-	✓	-	Maximum concentration in liquor from EGI (2009) was 828 mg/L while the average was 349 mg/L. Maximum concentration in groundwater was 622 mg/L while the average was 352 mg/L. Maximum concentration in surface water from AARC (2010) was 2 mg/L.	
Cyanide	10 mg/L	2 500 mg/kg	✓	ND	Maximum concentration in groundwater was 0.042 mg/L.	No data for solids.
PH	Between 4 and 8	Net acid generation of pH<4	✓	?	pH range in groundwater was 5.30 to 7.10. pH rage in surface water from AARC (2010) was 5.65 to 6.20. pH range fin liquor from EGI (2009) was 4.4 to 8.3.	EGI (2009) indicates solids with NAG pH<4 is expected, however the proportional contribution (compared to rainfall, groundwater etc) will vary.

Notes:

[1]Metals should be analysed in accordance with recognised test methods by a NATA certified laboratory.
[2]Source: EPA (2003a).
[3]Applies to the liquid contents in a dam generally available to the environment (for example, water available to birds and animals).
[4]Total solids include suspended and colloidal solids.
[5]Applies to the solids in a dam.
✓ = Within asessment criteria
× = Exceeds assessment criteria
? = Potential to exceed assessment criteria

Table 4-4 High Hazard Dam Assessment for Mine Water Management Dam

Assessment Criteria	**Result**
The dam is a high hazard dam only if the dam contains hazardous waste and one or more of the following situations occur:	
1. In the event of dam failure or overflow, the dam's content would have one of the more of the following actions:	
a. flow to a sensitive or commercial place;	Yes
b. flow to a riverine area containing permanent water;	Yes
c. contaminate a water supply for human consumption; or	No
d. contaminate a water supply for stock.	Yes
2. The dam is located within a:	
a. declared catchment or sub artesian area; or	Yes
b. watercourse and the dam's surface area exceeds 1ha.	Yes
3. The dam has a surface area greater than 2ha.	Yes

4.2 Changes to Waterway Flows

4.2.1 Un-named Watercourse

Construction of the Mine Water Management Dam across the un-named tributary of the Susan River intercepts an existing natural catchment with an area of 7 km^2 (PSM, 2010).

Flows are ephemeral and PSM (2010) have predicted that construction of the Mine Water Management Dam will result in an estimated mean annual reduction in flow downstream of the dam of 216 mm/a or 48 L/s. The frequency of flow is not expected to be changed, only the magnitude reduced.

The Susan River at the Maryborough-Hervey Bay Road has a catchment area of 87 km^2 of which approximately 81 km^2 is natural forest and the remainder is agriculture (PSM, 2010). The mean annual flow at this location is 0.65 m^3/s. As a result of the construction of the Mine Water Management Dam and water diversions around the mine site, it is estimated that flows will be reduced by a maximum of 4% at the Maryborough-Hervey Bay Road Maryborough-Hervey Bay Road crossing (PSM, 2010). The frequency of flow is not expected to be changed, only the magnitude reduced.

4.2.2 Mary River

No water is being sourced from the Mary River for the Colton Mine project. The proposed discharge to the Mary River (average of 946 ML/yr) is considered to account for less than 0.1 % of the total annual flow of the Mary River at the discharge location. The project will therefore have no identifiable impact on the flow regime or water quality of the Mary River.

4.3 Accumulation of Salts, Metals and their Sediments in Waterways

4.3.1 Un-named Watercourse

Section 5 details the water management operating strategy, including the involvement of the un-named watercourse in the site water management strategy. In summary, water captured on-site will be used on site wherever possible, while excess water will be discharged to the Mary River via pipeline. While the Mine Water Management Dam will have a structure allowing release of water to the un-named watercourse, water is only intended to be released to the un-named watercourse in an extreme weather event (e.g. cyclone). Under such circumstances, water being released from site would be diluted with the large quantity of natural runoff occurring off-site water.

As water is not intended to be released to the un-named watercourse on a regular basis, and significant natural flushing would be occurring during any extreme weather event, it is not anticipated that there will be any significant accumulation of salts, metals and their sediments.

Design of the Mine Water Management Dam should give consideration to maximising sediment retention in order to minimise any deposition sediments off-site during any extreme weather event.

During the mine life, assessment of the physico-chemical properties of the sediments of the Mine Water Management Dam should be undertaken on a routine basis. The collection of this information will assist in determining how to manage these sediments at mine closure, so as to prevent any post-closure accumulation of salts, metals or their sediments, should any contents of the dam be allowed to remain and become exposed at some later time.

4.3.2 Mary River

The accumulation of salts, metals and their sediments is not expected to be a significant issue due to the stringent discharge conditions of this Plan and required by the Colton Mine EA.

4.4 Cumulative Effects

4.4.1 Groundwater

There are no known users of groundwater from the Burrum Coal Measures in the area surrounding the Colton Mine. Northern Energy holds exploration tenure over the surrounding area and would therefore be the most likely candidate for any future use or cumulative impacts on groundwater in the area, however no mining beyond the Colton Mine has been identified. This is also supported by the fact that the water is generally not of a quality suitable for other uses (e.g. agriculture) and much of the tenure is State land.

4.4.2 Surface Water

There are no other mining operations within the same portion of the catchment as the project and no other dams on the same watercourse that underlie the project.

A variety of discharges and releases to the Mary River currently exist including:

- Treated sewerage effluent at Maryborough
- Treated sewerage effluent at Gympie
- Cooling water from various industries
- Runoff from agriculture
- Runoff from industrial effluent irrigation

Sand and gravel extraction activities also occur within the Mary River.

Cumulative effects resulting from the Colton Mine discharge to the Mary River are not expected to be significant for the following reasons:

- The discharge will be low in nutrients
- The volume of the discharge is low compared to the Mary River flow
- The location of the discharge is not in immediate proximity to existing discharges

4.5 Acid, Metalliferous & Saline Drainage

Results of work undertaken by EGI (2009) has identified the existence of acid forming material within the deposit. Testing to date indicates that the bulk of the overburden and interburden is likely to be non-acid forming (NAF) while coal seams, seam roof, seam floor, rejects and tailings are likely to be mainly potentially acid forming (PAF) (EGI, 2009).

While EGI (2009) identified an excess of NAF material compared to PAF material, it was also noted that the readily available portion of the acid neutralising capacity (ANC) was lower than that measured.

Kinetic net acid generation (NAG) testing by EGI indicated that PAF materials are likely to be fast reacting, producing acid within weeks of exposure to atmospheric oxidation conditions. The constituents likely to be associated with acid rock drainage include (EGI, 2009):

- Aluminium
- Cobalt
- Copper,
- Iron
- Nickel
- Sulfate
- Zinc
- Arsenic (some slight enrichment indicated)

Uncontrolled, acid, metalliferous and saline drainage can present serious risks to environmental values including aquatic ecosystems, vegetation and water resources, if not appropriately managed.

5. Water Management System

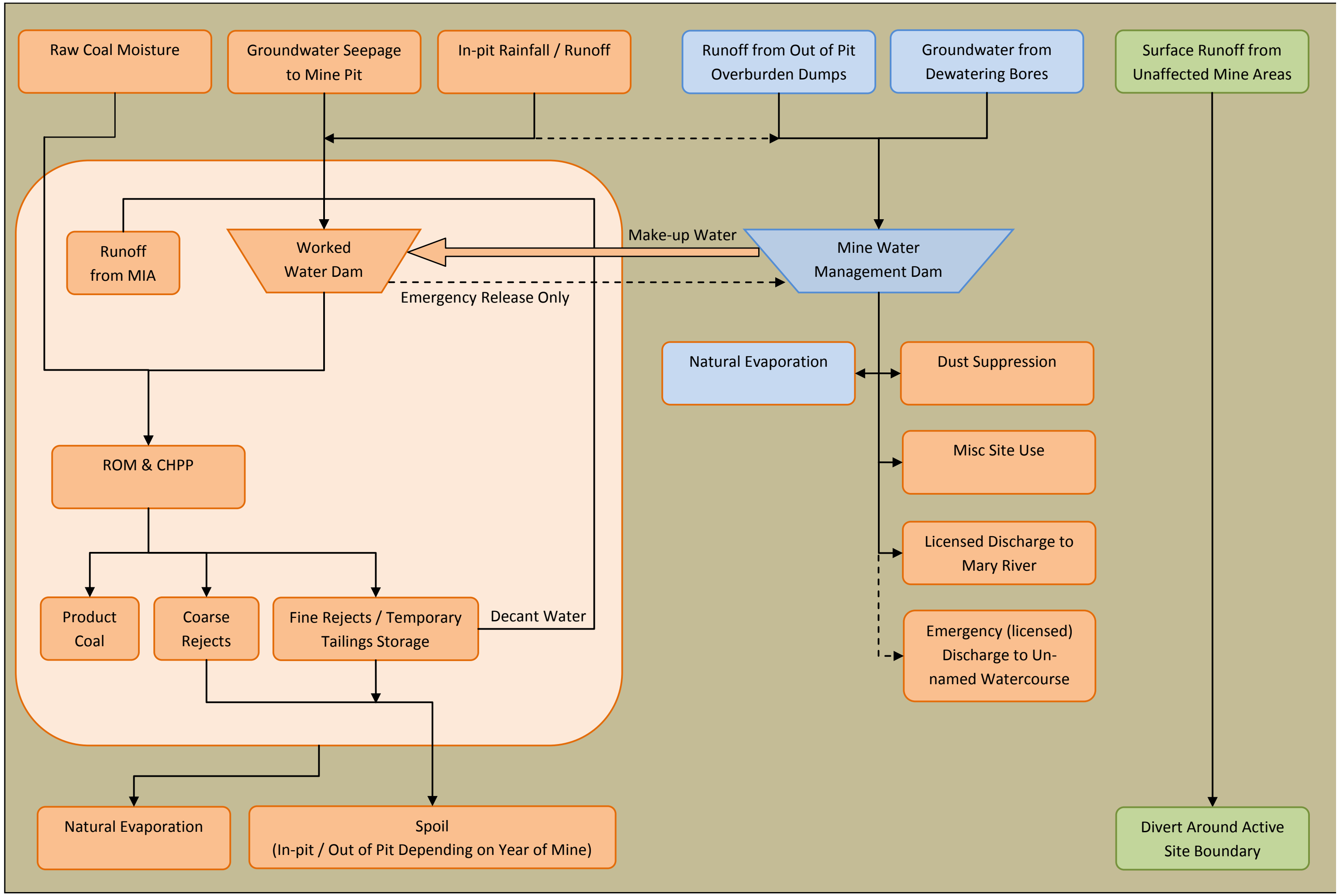
5.1 Site Water Balance and Model

The site Water Management System is illustrated schematically in Figure 5-1 with the mean annual water balance presented in Table 5-1. Table 5-1 highlights that the primary contribution to the site water supply is surface water runoff. It also highlights that a substantial mine water excess will exist for the life of mine, despite there being no importation or extraction of groundwater (other than to provide dry pit working conditions). Full details of the surface water and groundwater modelling to support the water balance are provided in PSM (2010) and AGE (2010).

Table 5-1 Mean annual site water balance

	Annual Volume (ML)
Water Supplies / Inputs	
Raw Coal Moisture	60
Surafce Water Runoff (in and X-pit)	1194
Groundwater Seepage to Mine Pit	438
Subtotal	**1692**
Water Demands / Outputs	
Natural Evaporation	140
Dust Suppression	90
Other Site Use	50
Coarse Rejects Moisture	66
Fine Rejects Moisture	345
Product Coal Moisture	55
Subtotal	**746**
Mine Water Excess	**946**

Figure 5-1 Colton Mine Water Management System Schematic



5.2 Acid Rock & Saline Drainage Prevention & Management Measures

Prior to commencement of operations, the Colton Mine will have in place a plan for the management of acid, metalliferous and saline drainage. At a minimum, this plan will include:

- Additional materials characterisation
- Mitigation strategy (incorporating materials management)
- Monitoring program

Further specific requirements and recommendations to be considered for inclusion in this plan are provided in EGI (2009).

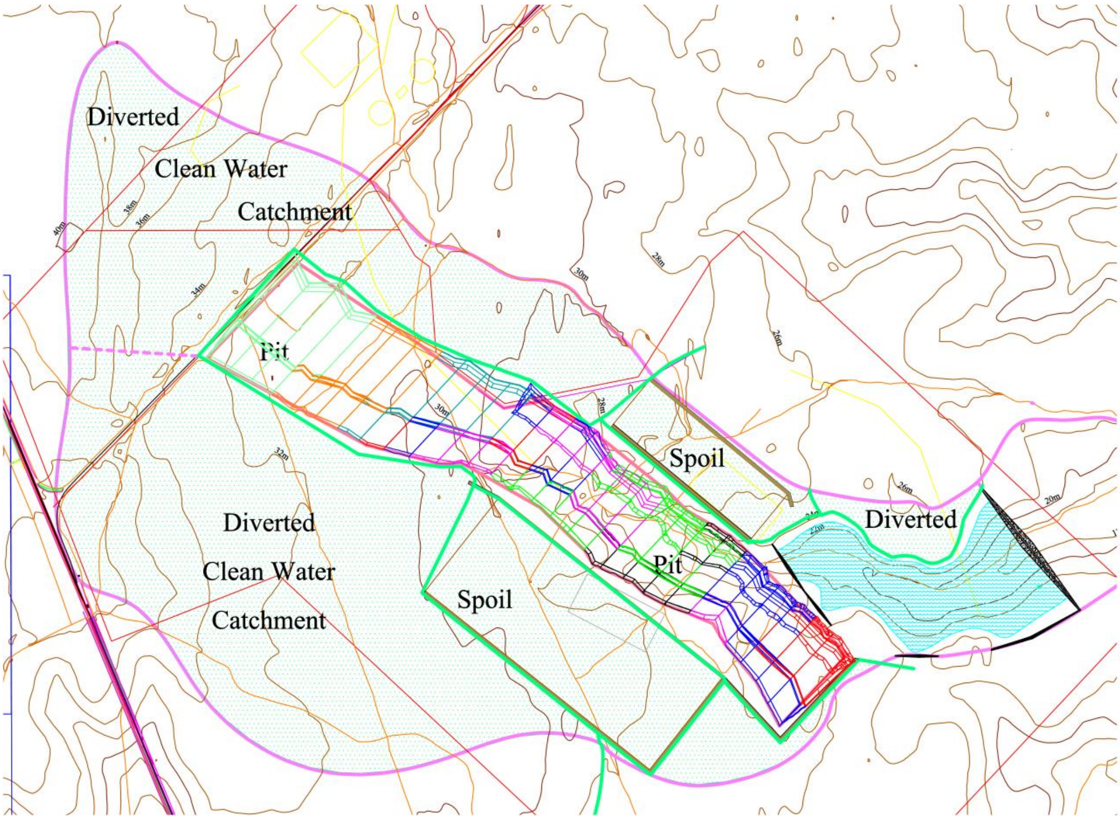
5.3 Water Management Infrastructure

The key water management infrastructure on site will comprise:

- Mine Water Management Dam
- Mary River discharge system (pipeline & pump(s))
- Worked Water Dam
- Water transfer network (pumps & pipes)
- Diversion structures
- Drains

Figure 5-2 shows the locations of the major infrastructure components.

Figure 5-2 Water Management Infrastructure



5.3.1 Operating Strategy

At the commencement of the construction phase, diversion structures will be put in place to divert surface runoff around the active mine site area. These structures will be placed so as to maintain existing topography and drainage patterns wherever possible.

Due to the existence of groundwater, there is a need to commence de-watering prior to mining. The Mine Water Management Dam will therefore need to be constructed to allow for discharge and storage of this water for on-site use. Water from de-watering bores will be stored in the Mine Water Management Dam for topping up supply to the Worked Water Dam, which will be used as the primary water source for coal processing and dust suppression. The Worked Water Dam will be located within the facilities area.

Runoff from out of pit overburden dumps will be collected in a series of small holding and de-silting dams located at the base of the dumps. Water in these small sediment dams will be allowed to settle before the decant water is either used in water trucks for dust control purposes, or pumped to the Mine Water Management Dam for further use on-site, and potential discharge off-site.

In-pit sumps will be developed as mining progresses to collect groundwater seepage and surface runoff. Water from each sump will either be used in water trucks for in-pit dust suppression activities or transferred to the Worked Water Dam. In the extreme event that leads to this dam nearing capacity, water will be retained within the mine pit for as long as practical then transferred to the Mine Water Management Dam, if the Worked Water Dam is still too full to receive more water.

Coarse reject material will be trucked back from the CHPP area and disposed of with spoil. Fine rejects will be held within the facilities area until the moisture content has been reduced sufficiently to allow relocation of this material for disposal with spoil. The condition and subsequent handling of this material will be assessed in accordance with the site plan for the management of acid, metalliferous and saline drainage.

The mine facilities area, comprising CHPP, stockpiles, rejects, workshops and the Worked Water Dam will be a contained area with all water reporting internally to the Worked Water Dam. High contamination risk areas such as workshops and refuelling areas will be bunded where appropriate to ensure containment and allow appropriate management.

Water for dust suppression activities on site such as haul road watering will be drawn from various sources, including (in order of preference) the sediment dams located at the base of the spoil dumps, in-pit sumps, the Mine Water Management Dam or the Worked Water Dam.

The Worked Water Dam will provide all of the water needs within the mine facilities area, with supplementary water provided from the Mine Water Management Dam as required. The primary uses of water within the mine facilities area will be coal washing and dust suppression.

The level of the Mine Water Management Dam will be maintained to ensure adequate site water supply during the dry season, but otherwise will be kept as low as possible by discharge off-site. Water quality within the Mine Water Management Dam will be monitored in accordance with the requirements outlined in Section 6 of this report.

In the event that excess water must be removed from the Worked Water Dam to avoid it exceeding capacity, water will be transferred to the Mine Water Management Dam. The discharge point for water from the Worked Water Dam into the Mine Water Management Dam is to be located as far as practical from the intake point for the Mary River Discharge Pipeline and discharge outlets to the un-named watercourse.

5.3.2 Proposed Maintenance Actions

A water management system maintenance program is to be implemented prior to commencement of operations. The proposed actions to maintain the mine water management infrastructure are provided in Table 5-2.

Table 5-2 Proposed Infrastructure Inspection and Maintenance Actions

Infrastructure	Proposed Maintenance Actions	Proposed Frequency
Mine Water Management Dam	Bathymetric survey	Annual (or as specified by the design engineer)
	Removal of excess sediment	As required following annual bathymetric survey
	Assessment of structure by competent person	Bi-annually
Mary River discharge system	Pipeline integrity assessment (e.g. pressure test / NDT)	Annually
	Instrumentation inspection, maintenance and calibration	As per manufacturers specifications
	Pump and valve inspection and maintenance	As per manufacturers specifications
	System test (run pump and confirm operation of instrumentation control and valves)	Monthly and a week in advance of threat of extreme weather events
Worked Water Dam	Visual inspection / survey & documentation of sediment level	Monthly (frequency may need to be weekly depending on the final size and operational requirements)
	Removal of excess sediment	As required following inspection
	Assessment of structure by competent person	Bi-annually
Water transfer network	Visual inspection for leaks, equipment damage or failure	Daily
	Instrumentation inspection, maintenance and calibration	As per manufacturers specifications

Infrastructure	Proposed Maintenance Actions	Proposed Frequency
	Pump and valve inspection and maintenance	As per manufacturers specifications
	Component / system test (run pump(s) and confirm operation of instrumentation control and valves)	Monthly and a week in advance of threat of extreme weather events
Diversion structures	Inspect for breaches, blockages, excess sedimentation, or signs of overflow	Prior to forecast rainfall in excess of 20 mm in 24 hours Immediately following rainfall in excess of 20 mm in 24 hours A week in advance of threat of extreme weather events
Drains	Inspect for blockages, excess sedimentation, or signs of overflow	Prior to forecast rainfall in excess of 20 mm in 24 hours Immediately following rainfall in excess of 20 mm in 24 hours A week in advance of threat of extreme weather events

5.3.3 Water Treatment Options

Should unforeseen circumstances arise leading to the presence of highly contaminated water existing on site, and this water would otherwise be likely to be discharged, appropriate treatment methods will be identified. Treatment methods may include blending water sources or reverse osmosis. Approval from the relevant government agencies will be sought where necessary.

6. Monitoring

The principal objectives of the water monitoring program are to:

- optimise operational performance
- provide early notice of changes in monitored parameters
- minimise environmental impacts

Monitoring is to be undertaken in accordance with legislative and licence requirements and will use the most current guidelines available which may include:

- Monitoring and Sampling Manual 2009 (DERM, 2009)
- EPA Guidelines: Regulatory Monitoring and Testing – Groundwater Sampling (South Australia EPA, 2007)
- Groundwater Sampling and Analysis – A Field Guide (Sundaram et al., 2009)
- Water Monitoring Data Collection Standards (NRW, 2007)
- Australian Guidelines for Water Quality Monitoring and Reporting (ANZECC & ARMCANZ, 2000a)
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000b)
- AS/NZS 3778:2001 Measurement of water flow in open channels (Standards Australia 2001)
- AS/NZS 5667.12:1999 Water quality - Sampling - Guidance on sampling of bottom sediments (Standards Australia & Standards New Zealand, 1999)

The South Australian and Geoscience Australia guidelines referenced above are the most recent and comprehensive groundwater monitoring guidelines available in Australia and were written with reference to previous state and national standards including:

- Murray-Darling Basin groundwater quality sampling guidelines (MDBC, 1997)
- Groundwater sampling guidelines (Victorian EPA, 2000)
- AS/NZS 5667.11: Water quality—sampling—guidance on sampling of groundwater (Standards Australia & Standards New Zealand, 1998b).

Documented monitoring protocols are to be produced and implemented for all components of the monitoring program (i.e. surface water, groundwater etc) prior to commencement of operations to ensure consistency in monitoring practices.

If over time monitoring parameters or monitoring points are consistently showing no signs of being impacted and there is no potential for future adverse impacts, then such parameters or monitoring points may be removed from the monitoring program, subject to acceptance of their removal by DERM.

6.1 Climate

Due to localised and highly variable nature rainfall, climatic data is to be collected via the following automated logging devices:

- site weather station (including rain gauge)
- at least one other rain gauge within the immediate vicinity of the project.

6.2 Water Use and Discharge Monitoring

The capture and analysis of water use and discharge data is essential to optimise operational water use, minimise environmental impacts and ensure compliance with license conditions. Table 6-1 sets out the site water use monitoring requirements and Table 6-2 sets out the discharge water monitoring requirements. Addition surface water and groundwater monitoring requirements are discussed elsewhere in this section.

Table 6-3 sets out the proposed Mary River discharge contaminant release limits and Table 6-4 the proposed Mary River discharge contaminant trigger investigation levels. As further baseline data for the Mary River is gathered, review of the discharge contaminant trigger investigation levels is proposed.

Table 6-1 Water Source and Storage Monitoring

Water Source / Storage	**Parameters**	**Frequency**
Groundwater supply / dewatering bores	Hours run Flow rate (L/s) Total flow (ML/day) Depth to water Electrical conductivity pH	Weekly
	Full analyte suite (Table 6-8)	Quarterly
In-pit sump pumps	Hours run Flow rate (L/s) Total flow (ML/day) Electrical conductivity pH	Weekly
	Full analyte suite (Table 6-8)	Quarterly
Site dams & all other water sources / storages	Water level Electrical conductivity pH If pump installed: • Hours run • Flow rate (L/s) • Total flow (ML/day) Sediment level	Weekly
	Full analyte suite (Table 6-8)	Quarterly

Table 6-2 Discharge Monitoring Requirements

Monitoring Point ID	Latitude	Longitude	Description	Parameters	Frequency
RP 1	TBC	TBC	Mine Water Management Dam Culvert (upstream / dam side)	Electrical conductivity Suspended solids Temperature Turbidity pH Stage (depth of water) Flow rate(L/s) Total flow (ML/day)	Continuous during discharge
				Full analyte suite (Table 6-6)	Commencement of the release and daily during release
RP 2	TBC	TBC	Sampling tap on pipe where the pipe enters the Mary River	Electrical conductivity Suspended solids Dissolved oxygen Temperature Turbidity pH Flow rate(L/s) Total flow (ML/day)	Continuous during discharge
				Full analyte suite (Table 6-6)	Commencement of the release and thereafter weekly during release

Table 6-3 Mary River Discharge Contaminant Release Limits

Quality Characteristic	Unit	Trigger Level	Comment on Trigger Level
Electrical conductivity (at 25°C)	µS/cm	28,800	80th percentile of >30 years data from monitoring point in Mary River, 100 m upstream of Saltwater Creek).
pH	pH Unit	6.5 (minimum) 9.0 (maximum)	This range is based on Mary River WQO's and long term (>30 year data from monitoring point in Mary River, 100 m upstream of Saltwater Creek).
Turbidity	NTU	8	Mary River WQO (mid estuary, slightly to moderately disturbed)
Suspended solids	mg/L	20	Mary River WQO (mid estuary, slightly to moderately disturbed)
Dissolved oxygen	mg/L	4	Mary River WQO (marine aquaculture)

Table 6-4 Mary River Discharge Contaminant Trigger Investigation Levels

Quality Characteristic	Unit	Trigger Level	Comment on Trigger Level
Sulphate (SO_4^{2-})	mg/L	400	ANZECC & ARMCANZ (2000b) for primary contact recreation
Aluminium	µg/L	200	ANZECC & ARMCANZ (2000b) for primary contact recreation
Arsenic	µg/L	50	ANZECC & ARMCANZ (2000b) for primary contact recreation and Mary River WQO (marine aquaculture)
Barium	µg/L	1,000	ANZECC & ARMCANZ (2000b) for primary contact recreation
Boron	µg/L	1,000	ANZECC & ARMCANZ (2000b) for primary contact recreation
Iron	µg/L	300	ANZECC & ARMCANZ (2000b) for primary contact recreation
Lead	µg/L	4.4	Mary River WQO (mid estuary, slightly to moderately disturbed)
Manganese	µg/L	<10	Mary River WQO (marine aquaculture)

Quality Characteristic	Unit	Trigger Level	Comment on Trigger Level
Mercury	µg/L	<0.05	Mary River WQO (marine aquaculture)
Nickel	µg/L	7	Mary River WQO (mid estuary, slightly to moderately disturbed)
Selenium	µg/L	<10	ANZECC & ARMCANZ (2000b) for primary contact recreation and saltwater aquaculture
Zinc	µg/L	15	Mary River WQO (mid estuary, slightly to moderately disturbed)
Ammonia	µg/L	<10	Mary River WQO (mid estuary, slightly to moderately disturbed) and ANZECC & ARMCANZ (2000b) for primary contact recreation
Nitrite	µg/L	<1,000	ANZECC & ARMCANZ (2000b) for primary contact recreation and Mary River WQO (marine aquaculture)
Nitrate	µg/L	10,000	ANZECC & ARMCANZ (2000b) for primary contact recreation
Nitrite + nitrate as N	µg/L	<10	Mary River WQO (mid estuary, slightly to moderately disturbed)
Total nitrogen as N	µg/L	<300	Mary River WQO (mid estuary, slightly to moderately disturbed)
Organic N	µg/L	<280	Mary River WQO (mid estuary, slightly to moderately disturbed)
Total phosphorus as P	µg/L	<25	Mary River WQO (mid estuary, slightly to moderately disturbed)
Filterable reactive phosphorous	µg/L	<6	Mary River WQO (mid estuary, slightly to moderately disturbed)
Faecal coliforms		The median faecal coliform bacterial concentration should not exceed 14 MPN/100 mL, with no more than 10% of the samples exceeding 43 MPN/100 mL	Mary River WQO for protection of the human consumer

6.3 Surface Water Monitoring

The purpose of surface water monitoring is to:

- ensure compliance with EA conditions
- characterise water quality for off-site waterways thus enabling any potential impacts from the project to be identified
- characterise site water quality for different water sources, supplies and/or storages thus enabling appropriate management measures to be implemented
- to check for acid rock drainage generation and assess the performance of management strategies
- provide data for review/verification of final void water quality predictions

Table 6-5 sets out the project surface water monitoring requirements, with the monitoring locations shown in Figure 6-1.

Table 6-5 Surface water monitoring

Monitoring Point ID	Latitude	Longitude	Description	Parameters	Frequency
MP 1	TBC	TBC	Mine Water Management Dam Culvert (50 m downstream of dam)	Electrical conductivity Suspended solids Temperature Turbidity pH Stage (depth of water)	Daily during discharge
				Full analyte suite (Table 6-6)	Event based
MP 2	TBC	TBC	Mary River at discharge location	Electrical conductivity Suspended solids Dissolved oxygen Temperature Turbidity pH	Continuous during discharge
				Full analyte suite (Table 6-6)	Quarterly Event based
MP 3	TBC	TBC	Upstream tributary of Saltwater Creek at Aldershot	Full analyte suite (Table 6-6)	Quarterly Event based
MP 4	TBC	TBC	Saltwater Creek at Maryborough-Hervey Bay Road (old bridge, approx 1,100 m	Full analyte suite	Quarterly

Monitoring Point ID	Latitude	Longitude	Description	Parameters	Frequency
			upstream from mouth)	(Table 6-6)	Event based
MP 5	TBC	TBC	Mary River, upstream discharge monitoring point (MARY RIVER 27.5km FROM MOUTH 100m U/S OF SALTWATER CREEK	Full analyte suite (Table 6-6)	Quarterly Event based
MP 6	TBC	TBC	Mary River 500 m downstream of discharge point	Full analyte suite (Table 6-6)	Quarterly Event based
MP 7	TBC	TBC	Downstream of Mine Water Management Dam on un-named watercourse being upstream tributary of Susan River	Full analyte suite (Table 6-6)	Event based
MP 8	TBC	TBC	Upstream tributary of Susan River	Full analyte suite (Table 6-6)	Event based
MP 9	TBC	TBC	Upstream tributary of Susan River	Full analyte suite (Table 6-6)	Event based

Figure 6-1 Surface Water Monitoring Points

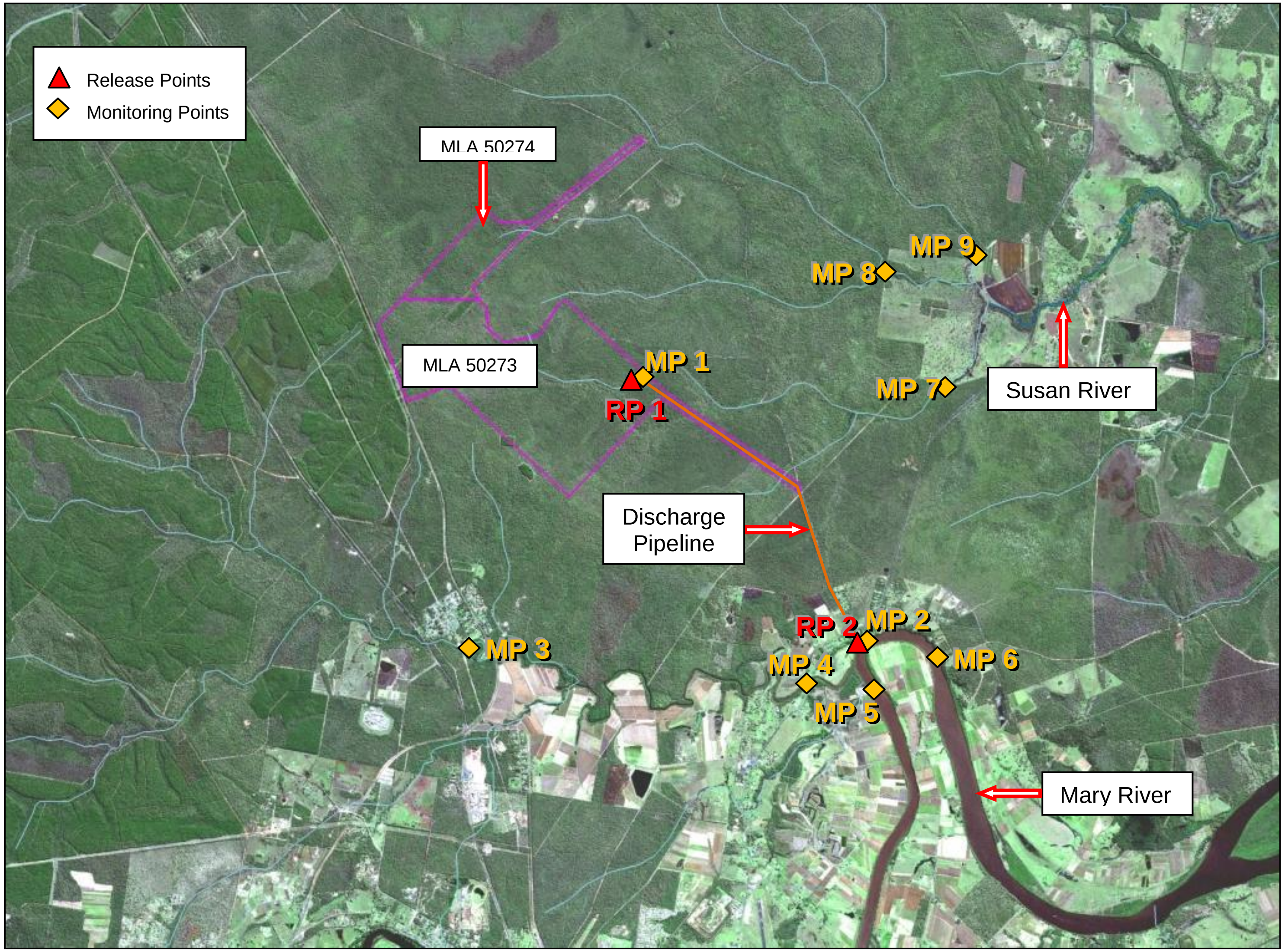


Table 6-6 Suite of analytes for surface water quality analysis

Category	Parameters
Physical properties	Electrical conductivity, pH, temperature, total dissolved solids, turbidity, suspended solids
Acidity & alkalinity	Acidity as $CaCO_3$, alkalinity (bicarbonate, carbonate, hydroxide and total as $CaCO_3$)
Major ions	Calcium, magnesium, sodium, potassium, chloride, sulfate, silicon
Metals (dissolved & total)	Aluminium, arsenic, barium, boron, cadmium, chromium, cobalt, copper, iron, lead, lithium, manganese, mercury, nickel, selenium, zinc
Nutrients	Ammonia, nitrate, total nitrogen, total phosphorus
Bacteria	Faecal coliforms
Biota	Chlorophyll a
Hydrocarbons	Petroleum hydrocarbons C6-C9 and C10-C36

6.4 Groundwater Monitoring

The purpose of groundwater monitoring is to:

- assess the progress of de-watering due to bores and seepage into the mine pit thus aiding in water supply/storage management
- identify any seepage from dams, spoil and stockpile areas
- identify any changes in groundwater quality as a result of de-watering or seepage from dam, spoil and stockpile areas
- to check for acid rock drainage generation and assess the performance of management strategies
- provide data for review of the groundwater model

Groundwater monitoring will be undertaken using the existing network of monitoring bores, with further monitoring bores to be installed prior to commencement and during mining in areas where potential adverse impacts may occur. In some instances the use of alternative monitoring methods such as vibrating wire piezometers may provide more appropriate than monitoring bores.

Replacement monitoring bores will also be required at some time during the project to replace monitoring bores which are within the mine footprint and will be lost from the monitoring network.

The groundwater monitoring network will monitor groundwater and potential seepage within:

- The Burrum Coal Measures
- The overlying / surface Elliot Formation

It was noted by Streamline Hydro (2010) that within the overlying Elliot Formation, groundwater may occur within:

- Shallow, localised lensoidal zones associated with sandy or ferugenous gravels
- Fractured zones in the weathered overburden material

The above zones should therefore be targeted for monitoring seepage from dams, spoil and stockpiles.

Minimum requirements for groundwater monitoring include:

- Compliance with applicable guidelines and standards
- Measurement of water levels using a combination of manual and automated data logging methods to provide redundancy ad ensure different time scales can be captured
- Measurement of water level to an accuracy of not less than 1 cm
- Calibration of water quality instrumentation immediately prior to each sampling event (and not less than weekly)
- Analysis of water quality samples by a NATA accredited laboratory

Table 6-7 sets out the project groundwater monitoring requirements, with the current monitoring bore locations shown in Figure 6-2. Additional monitoring bores will be added prior to and over the project life to replace existing bores which may be lost by mining and to monitor for seepage from dams or spoil.

Table 6-7 Groundwater monitoring

Location	Parameters	Frequency
All monitoring bores	Depth to water	Weekly Continuous (data loggers to be installed in select bores)
	Full analyte suite (Table 6-8)	Quarterly

Figure 6-2 Existing Groundwater Monitoring Points

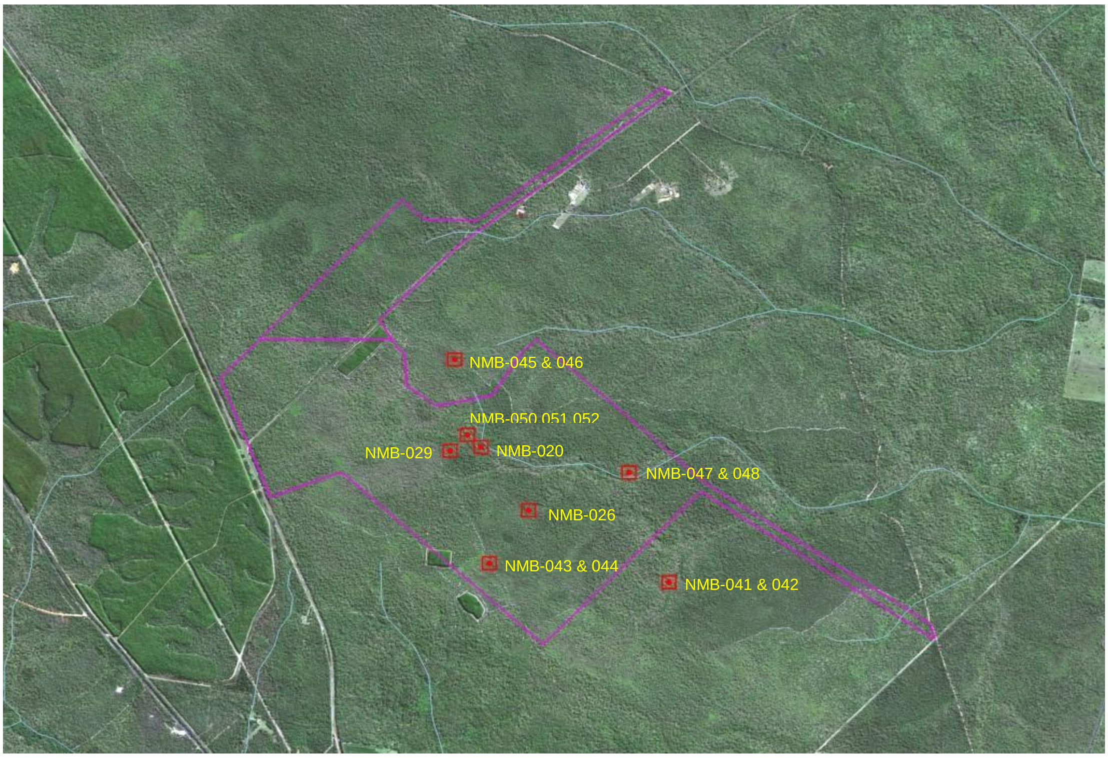


Table 6-8 Suite of analytes for groundwater quality analysis

Category	**Parameters**
Physical properties	Electrical conductivity, pH, temperature, total dissolved solids
Acidity & alkalinity	Acidity as $CaCO_3$, alkalinity (bicarbonate, carbonate, hydroxide and total as $CaCO_3$)
Major ions	Calcium, magnesium, sodium, potassium, chloride, sulfate, silicon
Metals (dissolved & total)	Aluminium, arsenic, barium, boron, cobalt, copper, iron, lithium, manganese, nickel, selenium, zinc
Nutrients	Ammonia, nitrate, total nitrogen, total phosphorus

6.5 Post Closure Monitoring

A post closure monitoring program will be developed in accordance with the Colton Mine EA and any other relevant legislative requirements including EPA Guideline 18: Rehabilitation requirements for mining projects (EPA, 2008).

This monitoring program is to be incorporated within the Colton Mine Water Management Plan as part of an annual review (i.e. no later than 12 months prior to closure) or within an all encompassing mine post closure monitoring plan (no later than 12 months prior to closure).

7. Emergency and Contingency Planning

In the event of an emergency time is critical. Therefore advance and early warning mechanisms are essential, as is preparedness of personnel and equipment. Table 7-1 identifies a number of potential emergency scenarios along with appropriate response measures.

Table 7-1 Emergency and Contingency Response Summary

Scenario	Potential Risks	Response Measures
Inadvertent overtopping of Mine Water Management Dam	• Uncontrolled release of contaminated water off site/lease • Failure of dam	• Immediately cease discharge of water into the Mine Water Management Dam • Assess water quality in the Mine Water Dam, and if within the acceptable limits, commence discharge from the dam via the off-site pipeline. • Assess option to discharge water to mine pit
Loss of power supply to water management pump(s) or valves	• Uncontrolled release of contaminated water off site/lease • Release of contaminated water within site • Flooding of mine pit • Flooding of equipment and infrastructure • Equipment damage	• Redundancy in design • Appropriate valve failure selection where feasible (i.e. fail open, fail closed) • Assess requirement to cease/increase discharge from discharge/receiving points • Standby pumps and generators on-site • Change-over pipework/fittings in place
Loss of power supply to online water quality monitoring instruments for Mary River Discharge	• Release of contaminated water off site/lease • Inadvertent transfer of contaminated water within site • Flooding of mine pit • Flooding of equipment and infrastructure • Equipment damage	• Immediately cease discharge of water from the Mine Water Management Dam to Mary River • Assess available capacity of Mine Water Management Dam and determine duration till 60 % and 80% capacity reached • If essential and time critical to continue discharge, use portable instrument to monitor discharge water quality.

Scenario	Potential Risks	Response Measures
Inability to access critical control and access points in all weather conditions	• Uncontrolled release of contaminated water off lease • Release of contaminated water within site • Flooding of mine pit • Flooding of equipment and infrastructure • Equipment damage	• Access remotely via telemetry link • Redundancy in planning of critical control and access points • Appropriate all-weather transportation • Appropriate valve failure selection where feasible (i.e. fail open, fail closed)
Failure of Mine Water Management Dam	• Uncontrolled release of contaminated water off site/lease • Flooding of downstream properties	• Advise downstream property owners • Implement site emergency response plan
Failure of Worked Water Dam	• Uncontrolled release of contaminated water and solids and and/or off lease • Flooding/damage to equipment/infrastructure	• Implement site emergency response plan • Immediately cease discharge of into the Worked Water Dam
Inability to obtain critical equipment and spare parts for the water management system	• Uncontrolled release of contaminated water off site/lease • Release of contaminated water within site • Flooding of mine pit • Flooding of equipment and infrastructure • Equipment damage	• Implement site emergency response plan • Identify appropriate water discharge location (e.g. Mine Water Management Dam, in-pit sumps) • Discharge water to selected location(s) until equipment is repaired or backup equipment is operational. • Install / start-up backup pumps or valves • Reconnect/change over pipeline connections/routes
Potential exceedence of the rainfall characteristics (intensity and duration) used in the design	• Uncontrolled release of contaminated water off site/lease • Release of contaminated water within site	• Monitor weather as regularly as appropriate • Maximise storage capacity in Mine Water Management Dam and Worked Water Dam by

Scenario	Potential Risks	Response Measures
of water management structures	• Flooding of mine pit • Flooding of equipment and infrastructure • Equipment damage • Flooding of downstream properties	discharging from these dams if possible • Setup and test standby pumps and generators • Bring in additional pumps/generators to site as required • Advise downstream property owners of any risk

8. Responsibilities, Reporting and Review

Table 8-1 assigns the responsibilities required by this Water Management Plan and is to be read in conjunction with this Plan. Responsibilities may be delegated to competent personnel as required.

Table 8-1 Water Management Plan Responsibilities

No.	Task	Responsibility	Timing
1	Review and update this WMP	Environmental Manager	Prior to commencement of Colton Mine
2	Coordinate and certify the design and construction of the proposed water management structures described in this Plan	NEC appointed & appropriately experienced RPEQ	Prior to & during construction phase & prior to mining works
3	Review and update this WMP	Environmental Manager	Annually - prior to 1 November - again prior to 1 May
4	Review and update this WMP after any event involving the uncontrolled release of water to the environment	Environmental Manager	As required
5	Ensure relevant personnel are trained and familiar with the requirements of this Plan	Environmental Manager	Commencement of employment and following all updates.
6	Inspection, monitoring and maintenance of water management structures (dams, drains diversions and bunds)	Mine Manager	Monthly and following high rainfall events (>20 mm in 24 hours)
7	Inspection, monitoring and maintenance of water management infrastructure (pipelines, pumps etc)	Mine Manager	In accordance with manufacturers guidelines and not less than monthly
8	Collection, management, storage and reporting of data: • Water use and discharge monitoring • Surface water monitoring • Groundwater monitoring	Environmental Manager	As specified in this Plan

No.	Task	Responsibility	Timing
9	Ensure that controlled discharges are undertaken in accordance with the Colton Mine EA discharge conditions	Environmental Manager	As required
10	Report and investigate exceedances of EA conditions and trigger values within the regulatory timeframe	Environmental Manager	As required
11	Identification of appropriate responses in emergency	Environmental Manager	As required
12	Review and report site water balance	Environmental Manager	Annually

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