BMA
BHP Billiton Mitsubishi Alliance

Red Hill Mining Lease | ENVIRONMENTAL IMPACT STATEMENT

RED HILL
MINING LEASE

Mine Water Management Overview Report

Appendix I2

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Abbreviations and Units

Abbreviation	Definition
AEP	Annual Exceedence Probability (or probability of occurrence in a one year period)
ARI	Average Recurrence Interval
AWBM	Australian Water Balance Model
BMA	BHP Billiton Mitsubishi Alliance
BRM	Broadmeadow underground mine
BSO	Broadmeadow Sustaining Operations
CHPP	Coal Handling and Preparation Plant
EA	Environmental Authority
EC	Electrical Conductivity
EHP	Department of Environment and Heritage Protection
EIS	Environmental Impact Statement
EPP (Water)	Environmental Protection (Water) Policy 2009
EVs	Environmental Values
GMS	Goonyella Middle Seam
GED	General Environmental Duty
GRB	Goonyella Riverside and Broadmeadow
IQQM	Integrated Quality Quantity Model
MIA	Mine Infrastructure Area
MLA	Mine Lease Application
RHM	Red Hill Mining Lease
TDS	Total Dissolved Solids
TOR	Terms of Reference

Unit	Definition
km	kilometre
km^2	square kilometre
m	metre
L/s	litres per second
L/t	litres per tonne
m^3/s	cubic metres per second
mg/L	milligrams per litre
ML	megalitre
ML/year	megalitres per year
mtpa	million tonnes per annum
µS/cm	microSiemens per centimetre

Section 01 Introduction

1.1 Context

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

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

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

The three project elements described above are collectively referred to as 'the project'. The project elements include the following components:

- The extension of BRM longwall panels 14, 15, and 16 into MLA70421. Key elements include:
  - No new mining infrastructure is proposed other than infrastructure required for drainage of incidental mine gas (IMG) to enable safe and efficient mining.
  - Management of waste and water produced from drainage of IMG will be integrated with the existing BRM waste and water management systems.
  - The mining of the Broadmeadow extension is to sustain existing production rates of the BRM mine and will extend the life of mine by approximately one year.
  - The existing BRM workforce will complete all work associated with the extensions.
- The incremental expansion of the GRM including:
  - Underground mining associated with the RHM underground expansion option to target the Goonyella Middle Seam (GMS) on ML 1763;
  - a new mine industrial area (MIA);
  - a coal handling and preparation plant (CHPP) adjacent to the Riverside MIA on MLA1764 and ML1900 − the Red Hill CHPP will consist of up to three 1,200 tonne per hour (tph) modules;
  - construction of a drift for mine access;
  - a conveyor system linking RHM to the Red Hill CHPP;
  - associated coal handling infrastructure and stockpiles;
  - a new conveyor linking product coal stockpiles to a new rail load-out facility located on ML 1900; and

- means for providing flood protection to the mine access and MIA, potentially requiring a levee along the west bank of the Isaac River.

- A potential new Red Hill underground mine expansion option to the east of the GRB mine complex, to target the GMS on MLA 70421. The proposed mine layout consists of:
  - a main drive extending approximately west to east with longwall panels ranging to the north and south;
  - a network of bores and associated surface infrastructure over the underground mine footprint for mine gas pre-drainage (IMG) and management of goaf methane drainage to enable the safe extraction of coal;
  - a ventilation system for the underground workings;
  - a bridge across the Isaac River for all-weather access. This will be located above the main headings, and will also provide a crossing point for other mine related infrastructure including water pipelines and power supply;
  - a new accommodation village (Red Hill accommodation village) for the up to 100 per cent remote construction and operational workforces with capacity for up to 3,000 workers; and
  - potential production capacity of 14 million tonnes per annum (mtpa) of high quality hard coking coal over a life of 20 to 25 years.

A range of technical studies for surface water management were commissioned to support the EIS for the project. This report prepared by BMA presents an overview of the mine water management assessments that were undertaken for the project by SKM and URS.

1.2 Purpose of Technical Report

This technical report presents an overview of mine water management aspects of the existing GRB mine complex operations, the project, and the outcomes of technical water balance modelling assessments undertaken for the project. The water balance modelling assessments are presented in a separate technical report (Red Hill Mining Lease EIS **Appendix I3**).

A key aspect of the project water management system is that it will interface with the GRB mine complex. This interface will provide greater efficiency, maximise reuse, ensure mine water releases are managed holistically and reduce water related risks. The Broadmeadow extension is not expected to generate significant additional mine water and water from BRM underground operations will continue to be managed through the existing BRM infrastructure.

To evaluate the interface with GRB mine complex, the baseline performance of the GRB mine water management system without the project (described as the 'baseline' scenario) was assessed using a water balance model. The baseline scenario represents the GRB mine complex in 2015. The impacts on the GRB mine water management network arising from the interface with RHM were evaluated using this model.

Section 02 Assessment Context

2.1 Project Context

The proposed project includes the development of a new greenfield mine adjacent to the existing GRB mine complex, and it is intended to operate under a separate environmental authority (EA). Although the coal extraction activities of the proposed RHM will operate separately from the existing GRB mine complex, it is proposed that the RHM water management system will include an interface with the GRB mine complex. Specifically, it is intended that surplus mine waters generated at the project will be transferred to the GRB mine water management network and that water demands (reuse of mine water) for the proposed Red Hill CHPP and other mine-related uses will be supplemented from the GRB mine water inventory. This type of mine water exchange arrangement also occurs between other coal mining operations in Queensland. There are provisions in the Model Water Conditions for Coal Mines in the Fitzroy Basin (EHP 2013) that allow for exchange of mine waters between separate coal mine operations including requirements for proper management and responsibility for general environmental duty (GED) as defined in the *Environmental Protection Act 1994* (EP Act). This context is important as it has guided how water management assessments have been undertaken for the EIS.

2.2 Mine Water Balance

For assessment of proposed mine water management, a mine water balance assessment is relevant to address the following requirements of the terms of reference (TOR) for the EIS:

- Section 3.4 (water resources);
- Section 4.8 (water management);
- Section 5.3 (surface water); and
- Section 5.11 (waste).

A detailed 'whole of operation' mine water balance model assessment was undertaken to support the EIS and to assess impacts on mine water management performance. A baseline scenario was set up in the model to represent the GRB mine water management system (without the project), and another scenario set up to represent the inclusion of the project activities. A technical report accompanying the EIS has been prepared (SKM 2013) which details the water balance model (refer to Red Hill Mining Lease EIS **Appendix I3**). For the EIS phase of the project, the overall purpose of the mine water balance assessments was to assess and demonstrate that the GRB mine water management system when operated with the project interface will perform adequately and maintain capability to comply with release criteria defined in the EA.

Adequate mine water management system performance is important in order to protect surface water environmental values. The mine water management system performance needs to be able to cater for extreme climatic conditions ranging from very high rainfall wet season conditions when management of excess waters is necessary, to the opposite extreme, of prolonged dry periods which places greater demand on the requirement for reliable off-site water supply.

Adequate mine water management system performance is also equally important for sustainable business operations of the project (and existing GRB mine complex operations). Mine water needs to be managed so that there is a low risk of interruption to mining operations. During dry periods operations need to be maintained and the requirement for external water supply needs to be kept to a minimum. It is important that the underground mine and open cut pits are able to be effectively dewatered and any mine water be made available for re-use on the mine site.

2.3 Mine Water Definition

Mine water is a generalised term adopted to describe water from a range of sources generated from the mining and processing activities. It should be noted that terminology for 'mine water' has varied considerably in recent years and among different literature and also different geographic regions. For the purpose of this report, the term 'mine' water is adopted from the contemporary definition of 'mine affected water' as documented in the EHP (2013) Model Water Conditions for Coal Mines in the Fitzroy Basin. This adopted definition of mine water is:

- Pit water, tailings dam water, processing plant water.
- Water contaminated by a mining activity which would have been an environmentally relevant activity under Schedule 2 of the *Environmental Protection Regulation 2008* if it had not formed part of the mining activity.
- Rainfall runoff which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated. This excludes rainfall runoff discharging through release points associated with erosion and sediment control structures that have been installed to manage runoff containing sediment only, provided that this water has not been mixed with pit water, tailings dam water, processing plant water or workshop water.
- Groundwater which has been in contact with any areas disturbed by mining activities which have not yet been rehabilitated.
- Groundwater from the mine's dewatering activities.
- A mix of mine affected water and other water.

With this definition, descriptions of mine water in this report address the project's EIS TOR requirements to describe 'stormwater' and 'liquid waste'. Sewage effluent is not considered to be mine water and is described separately in the project EIS.

For reference to descriptions of the water balance and water management herein, the mine water management system is defined as the combined influence and operation of:

- catchments and drainage that collect mine waters (and exclude clean waters);
- dams that capture and store mine water; and
- the pumping or transfer infrastructure used to distribute mine water through the network for reuse in operations, or to make controlled compliant releases of mine water to downstream waterways.

The mine water management system performance is an assessment of the mine water management system's capability to adequately contain and manage excess mine water in very wet periods, supply mine water for reuse (particularly in dry periods), and ensure that controlled releases of mine water comply with the EA conditions.

Section 03 Red Hill Mining Lease Water Balance

3.1 Overview

It is expected that coal production from the overall complex will increase to 32.5 mtpa when the RHM becomes operational as coal from the proposed RHM will be processed in the proposed new Red Hill CHPP.

As RHM is an underground mine, the collection of mine water from disturbed catchment runoff is limited and as a result groundwater dewatering will be the main source of mine water generated. In general, if groundwater was constantly being dewatered from an underground mine, it may result in a surplus of water. However, when connecting the RHM into the GRB mine water management network, the assessment of the potential impact should consider both the amount of groundwater being removed from the RHM and the amount of water that is then re-used to process coal product within the Red Hill CHPP. Analysing the expected groundwater dewatering rates and rates of coal production over time will provide an insight into whether the RHM will produce a net surplus or deficit of mine water and the potential impacts on the GRB mine complex.

3.1.1 Groundwater Dewatering

Interception of groundwater within the RHM is predicted to be the largest generated water source. The interception of groundwater was assessed through modelling (Red Hill Mining Lease EIS **Appendix J**) and is predicted to be approximately 35,000 ML over a 23 year mine life. This includes groundwater generated from gas drainage, underground dewatering and ground water incidental to the raw coal. The average rate of groundwater generation is predicted to be approximately 1,200 ML/annum with a predicted peak at just under 2,000 ML/annum in 2032, approximately 15 years after the commencement of operations.

Groundwater modelling was undertaken in order to predict the potential groundwater level draw down and recoveries that are likely to occur for the Broadmeadow extension and the RHM underground expansion option. It is considered that the assumptions of the groundwater model are conservative when using the predictions as inputs into water balance modelling.

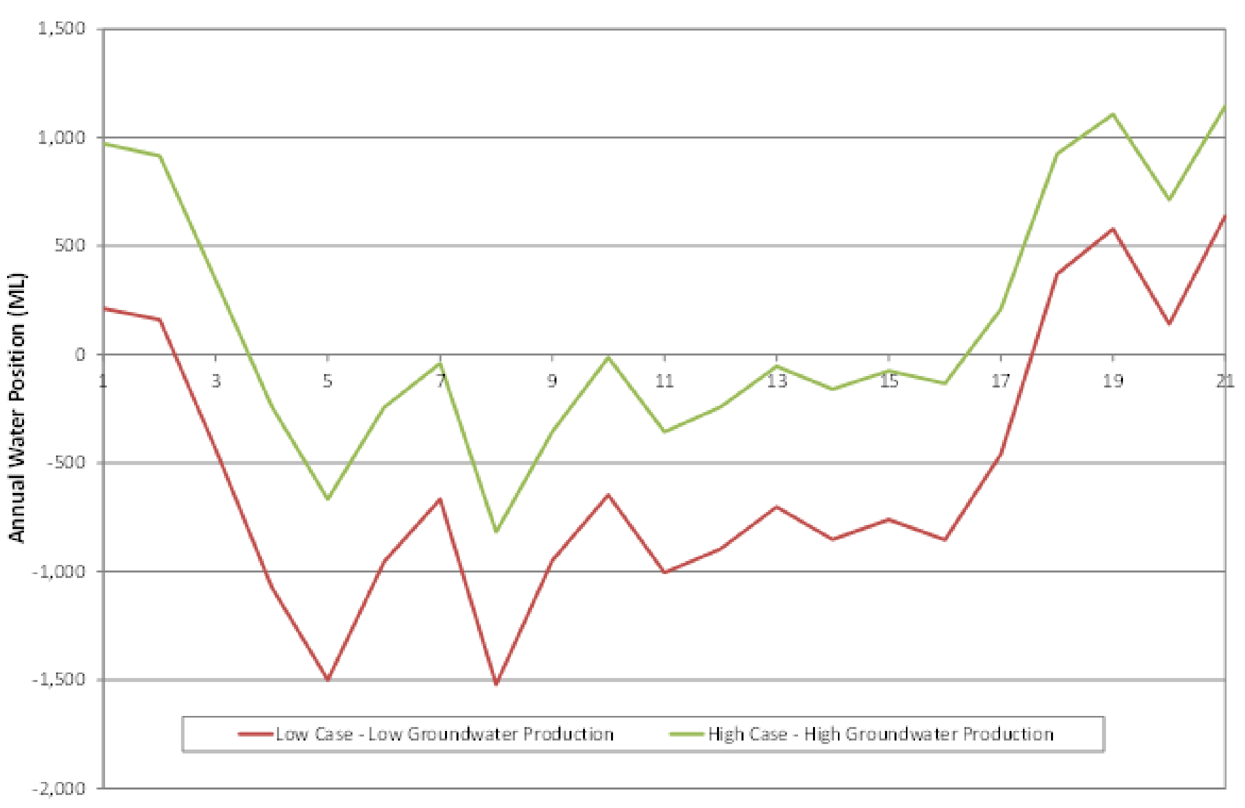
3.1.2 CHPP Mine Water Demand

The coal production profile highlights that the RHM is scheduled to extract 234 million tonnes of run of mine coal over 23 years. Based on this production profile, the average annual water usage through the CHPP is predicted to be approximately 1,300 ML/year, while the peak requirement of 2,300 ML/year is predicted to occur eight years after commencement of operations (based on an assumed development and production scenario).

3.1.3 Water Position

Figure 1 shows the water position estimated as the balance between water make through groundwater dewatering and the mine water demand from the proposed Red Hill CHPP. It can be seen that later in the life of the project the demand for mine water re-use within the RHM is exceeded by the water make achieved through groundwater dewatering. It is estimated that this results in an average surplus of 640 ML/yr, which is made up of approximately 500 ML/yr from groundwater dewatering and 140 ML/yr from recovery of water used in the underground mining operation.

Figure 1 Red Hill Scenario Groundwater Dewatering and Raw Water Demands



The water position for the RHM is predicted to vary between surplus and deficit over the life of the mine. This is due to the balance between the pre-mining drainage of groundwater and the production schedule. There are three phases of water positions in the project life:

- Year 1 to 3 – initial surplus – this is a result of the pre-mining drainage of groundwater coupled with lower production at project start up.
- Year 4 to Year 17 – deficit – this is due to the production demand being in excess of the projected groundwater generation.
- After year 17 – surplus – projected groundwater generation peaks after the peak in production demand.

3.2 Management of Potential Surplus

As detailed in **Section 3.1.3**, there is the potential for RHM underground operations to have a surplus of water both in the early and latter stages of the in the mine life. Whilst there is still uncertainty in the predictions, it is anticipated that when in surplus conditions, RHM may generate an average annual surplus of approximately 640 ML/year.

Groundwater from RHM will be dewatered to a 50 ML transfer dam. There is opportunity for re-use of small quantities on site; however any surplus water will be transferred to the GRB mine complex. Under normal conditions any water surplus produced by RHM would be used by the GRB mine complex operation, which includes the processing of RHM coal, and has water requirements exceeding its external supply. However, the occurrence of any potential RHM surpluses during periods of high rainfall may require additional management actions at GRB mine complex (e.g. additional storage, reduce minimum inventory).

The initial surplus between Year 1 and 3 is a result of pre-mining drainage of groundwater. This potential surplus may vary between 200 and 1,000 ML in the initial stages. The range in the potential surplus is due to the schedule of the pre-mining drainage of groundwater not being finalised. The short term surplus would be integrated into the GRB mine complex operations for use. This storage is temporary because if not consumed by the GRB mine complex, the surplus will be consumed in processing RHM coal after year 3 as the RHM annual water position is predicted to become a deficit.

The potential average surplus of the project in the latter stages of the project is potentially up to 640 ML/yr. The potential surplus is expected to be less than 640 ML/yr as a schedule of pre-mining drainage of groundwater will be developed and integrated into the production schedule to optimise the water management at RHM. A 640 ML/yr surplus is considered to be the worst case for assessing the potential impacts of a RHM surplus on the GRB mine water management system. The water balance assessment has been undertaken on this basis to determine any management actions required for the RHM.

3.3 Compliance

Water generated by the RHM will be directed to a transfer dam from which it can be pumped to the GRB mine complex for re-use or release (in accordance with the existing EA for GRM).

Section 04 Overview Description of the Baseline Water Balance Model

The design of upgrades, performance assessment and planning of the water management system, as well as assessment of risks to compliance and mine operations, is guided by a dynamic integrated water and salt balance model of the entire mine water management system. Herein, the model is simply referred to as the 'water balance model'.

Through the history of the mine's development, water balance models have been developed and utilised for the mine operations. The current model (Engeny 2013) utilised by the site operations is developed using Goldsim software which is widely accepted for this type of application. Mine water balance assessment for the project has been undertaken by SKM (Red Hill Mining Lease EIS **Appendix I3**) and the modelling undertaken has built upon the existing site operations GoldSim model of the GRB mine water management system developed by Engeny (2013).

4.1 Climate

Climate data (rainfall and evaporation) are the primary inputs for the mine water balance model. The climate data used for the water balance modelling was sourced from the EHP SILO data drill service which provides a processed form of data recorded by the Bureau of Meteorology. The climate data period used extended from 1900 to 2007 (108 years). Two sets of climate data have been used in the model, one to represent the site and surrounding catchments and the other to represent the upper Isaac River catchment.

4.2 Water Quality and Quantity Balance

The water balance model operates on a daily time-step and converts rainfall over catchments to runoff using the Australian Water Balance Model (AWBM) runoff model. The AWBM also represents different runoff characteristics from natural catchments and classifications of mine disturbed catchments across the site (includes natural, spoil, hardstand, rehabilitation and tailings).

The water balance model simulates water volumes and salt mass (in salinity of waters) from all sources. This allows estimates of water quality (salinity as EC) to be determined and assess the capability to comply with the EA conditions.

For surface runoff sources of mine water, variable rates of salinity are simulated in the water balance model, which is related to either runoff rate, or a function of rainfall rate. The variable salinity rates were derived from detailed analysis of available site specific water quality and flow data, and tested in model validation as part of the environmental evaluation undertaken in 2007.

The water balance model represents daily estimates of flow (or volume) and salinity of mine waters for all connected components of the GRB mine water management network, as well as natural flows (rates and salinity) in the surrounding creeks and rivers upstream and immediately downstream of the mine.

4.3 External Catchments

The water balance model includes the representation of external catchments to simulate passing flows at the GRB mine complex. This includes a number of creeks and rivers as well as the Burton Gorge Dam. The Water Resource Plan for the Fitzroy Basin includes an Integrated Quantity Quality Model (IQQM) of Isaac and Connors Rivers sub-catchments. Investigation of the IQQM results for the Burton Gorge Dam showed that when overtopping of the dam occurred, significant flow volumes were conveyed downstream. Representing these high flow volumes within the upper Isaac River, increases the release opportunity at the GRB mine complex.

4.4 Model Limitations and Exclusions

Several important limitations of the water balance model are important to note for evaluation of the model results.

The water balance model does not include any allowance for seepage or transmission losses in dams and open channel drains. This assumption will tend to overestimate mine water volumes in the mine water management network. This is conservative from the perspective of assessing containment performance and release compliance and also risks of prolonged water accumulation in the open cut mine pits. This assumption is not conservative for assessing the availability of mine water to be reused in mine operations.

The model does not include representation of any other mines discharging waters into the Isaac River or other creeks represented in the model catchments. The potential releases from the existing North Goonyella Mine (Peabody operation north of the GRB mine complex) cannot be represented because details of their releases are not known to BMA.

The mine water balance model simulations are undertaken for a static configuration of the mine representative of a given point in time, which for the project baseline is nominally 2015. The simulation periods are performed with the complete 108 years of climate data (to test extremes of climate influence) and time series results are produced for water volumes (or flows in waterways) and salinity for every part of the model.

Detailed information regarding the representation of the baseline scenario is presented in the Red Hill Mining Lease EIS **Appendix I3**.

Section 05 Baseline Scenario

5.1 Adopted Baseline Representation

For the purpose of defining an EIS baseline scenario (excluding the proposed project), a configuration of the mine water management system nominally representing GRB mine complex in the year 2015 was adopted. More information on the components of the baseline scenario mine water management system is provided in the Red Hill Mining Lease EIS **Appendix I3**.

5.2 Overview of the Baseline GRB Mine Water Management System

A catchment plan showing the layout of baseline GRB mine water management network is presented in **Figure 2**. A schematic diagram of the connectivity of the GRB mine water management network (and representation of the GRB mine water balance model) is presented in **Figure 3**.

The key licensed release point for the GRB mine water management network is the GS4A dam located on the Eureka Creek diversion. Overflows from GS4A release into the Isaac River. The GS4A dam also has a low level gate outlet which can be used to control the flow rate and timing of releases, when the water quality is suitable.

GS4A has a number of mine water and clean water catchments which contribute to it. Potential inflow water sources to GS4A include: Upstream Eureka Creek, Ramp 21/22, high dump sediment dams and the overflows from GS3 / RS10. The dewatering of Ramps 6, 8 and 10 also occurs to GS4A.

A key strategy of the GRB mine water system to ensure controlled releases are compliant, is to reduce the volume of water flowing directly into GS4A. This is done by dewatering excess inventory from storages within the GS4A catchment to Ramp 21/22.

The baseline mine water management network storage capacity, excluding contingency storage in low priority mine pits and tailing storage facilities, is approximately 24,000 ML. This is currently maintained at up to 14,000 ML to maintain freeboard as required by the regulated dam requirements. When insufficient volume is available in the key storages, pumping transfers commence to use contingency backup storage in low priority mine pits. The available capacity, including contingency storage provisions in mine pits (Ramps 21, 22/23, 31 and 32), for exceptionally wet weather is approximately 60,000 ML in the baseline scenario.

 BNE

RED HILL MINING LEASE
SURFACE WATER MINE WATER
MANAGEMENT TECHNICAL REPORT

CATCHMENTS AND LAYOUT OF THE BASE CASE GRB MINE WATER MANAGEMENT SYSTEM (2015)

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SURFACE WATER Figure: **2**

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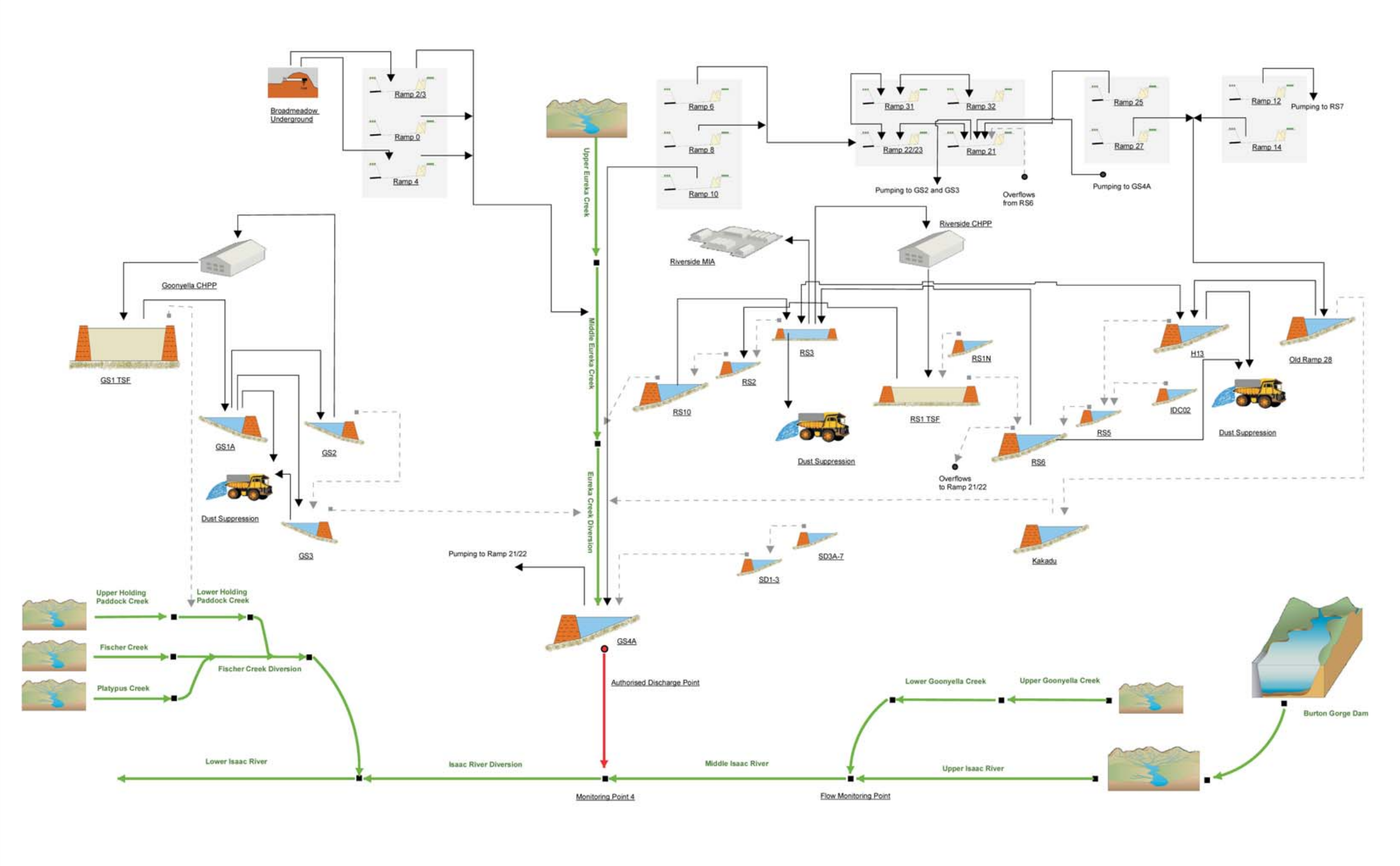

Legend			
Creek / River	Spillway Overflow	Water Storage	
Authorised Release	Natural Catchment	Tailings Storage Facility	
Pump / Pipeline Transfer	Mining Pit	Coal Handling and Preparation Plant	
Two-way Pump / Pipeline Transfer	Underground Mine	Mining Industrial Area	

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RED HILL MINING LEASE
EIS Water Balance Modelling
Baseline Water Balance Model Schematic

Job No: QE06596
Last Modified: 26 August 2013
By: Sarah Buckley

SINCLAIR KNIGHT MERZ SKM

URS file:42627136-g-2255b.cdr

5.3 Existing GRB Mine Complex Environmental Authority Release Criteria

The current GRB mine complex EA No. EPML00853413 dated 6th September (formerly EA No. MIN100921609) permits release of water from the GS4A dam into the Isaac River, conditional upon satisfaction of the following criteria for flow conditions and salinity of releases:

- Natural flow rate measured at the upstream Isaac River gauging station (upstream of confluence with Goonyella Creek) > 3 m^3/s.
- Release criteria under flow conditions:
  - the salinity of mine affected water released from GS4A must not exceed an EC of 10,000 µS/cm; and
  - the salinity in the Isaac River at the downstream release point must not exceed an EC of 2,000 µS/cm.

Subsequent to this, there is also provision to release should there be flow in Eureka Creek and no flow in the Isaac River. Water release from GS4A may occur during times of no flow in the Isaac River, provided surface flows have been recorded in (Upper) Eureka Creek within the previous 24 hours. This condition allows for total release of all natural Eureka Creek inflows.

Other water quality criteria limits (parameters) including pH, turbidity, and sulphate are also specified in the existing EA. It is known from site experience and previous assessments (URS 2007) that salinity is the most significant parameter for water quality management and compliance for the GRB mine water management system. The modelling assessments of mine water management performance primarily focus on salinity and flow criteria compliance.

5.4 Mine Water Reuse and Baseline Water Demands

An important aspect of the operational strategy for the GRB mine water management system is to reuse mine water in the operations wherever possible as a priority over use of external pipeline raw water supply. This has sustainability benefits of being as self-sufficient as possible and to minimise reliance on external water supply to the mine. It is also critically important to manage the storage inventory (total mine water volumes) in the mine water management network. This is important to ensure adequate storage can be made available for containment of wet and very wet seasonal conditions.

Not all of the mine operational water requirements can be supplied with mine water. Some of the water requirements for the operations require high quality water sourced from external pipeline raw water supply. These raw water demands form a very small portion of the overall site water use and are summarised in **Table 1**.

Table 1 Baseline GRB Mine Complex Raw Water Demands

Item	Demand (ML/yr)
BRM	365
Goonyella and Riverside CHPP	180
Water Treatment Plant	180
Total	**725**

The major component of the mine operational water demands that can be supplied with mine water and are summarised below in **Table 2**.

Table 2 Baseline GRB Mine Water Demands

Item	Demand (ML/yr)
Goonyella CHPP	1,600
Riverside CHPP	1,600
Riverside MIA	500
Dust Suppression	1,760
Total	**5,460**

5.5 Dominant Mine Water Sources, Catchments, and Typical Salinity

The majority of mine water generated within the GRB mine complex is via runoff from catchments which are largely defined as disturbed. In representing the GRB mine complex, each catchment is broken into a number of sub-catchments based on the land-use. To represent the catchments under the baseline scenario the following land-uses were assigned to each catchment were: natural, spoil, hardstand, rehabilitation and tailings.

Mine water can also be generated through the dewatering of groundwater. Mining pits within the GRB mine complex do not accumulate groundwater inflows. Therefore, the BRM is the only source that is represented as a groundwater generator. Approximately 870 ML/yr of groundwater is dewatered from the BRM.

With the generation of mine water, be it from surface runoff or groundwater, comes an impact to its water quality. For mines such as the GRB mine complex, salinity is generally the dominant contaminant of mine water which needs to be managed. Rates of salinity generation differ depending on the extent of disturbance, be it natural, spoil, hardstand, rehabilitation, tailings or simply dewatering of groundwater. More information on how salinity is calculated within the baseline scenario is provided in the Red Hill Mining Lease EIS **Appendix I3**.

Section 06 Baseline Scenario System Performance

6.1 Water Management Performance Characterisation

The mine water balance model has been used to assess the performance of the baseline GRB mine water management system prior to the implementation / operation of the proposed project. There are a number of performance indicators used to characterise the expected baseline water management performance which include:

- compliance of releases (overflows and gate releases) at GS4A with the EA criteria;
- regulatory requirements for regulated storages;
- statistics of the total mine water volume (inventory) in the mine water management network which provides an indication of whether the total storage capacity is sufficient, and how often low priority mine pits will be required for use as contingency mine water storage;
- utilisation of the release opportunity for consideration of external factors to the operation for example upstream mine releases; and
- external water requirements for mining operations.

6.2 Compliance of Releases at GS4A with Environmental Authority Criteria

For compliance with the current EA release conditions, a number of flow and water quality criteria must be met. The following figures are presented to demonstrate capacity to comply with the respective water quality (salinity) and flow criteria including:

- salinity level of releases for the end of pipe limit (**Figure 4**);
- salinity level at the downstream compliance point of the Isaac River(**Figure 5**);
- flow rate of releases in relation to the flow conditions of the Isaac River (**Figure 6**).

The EA conditions require that releases from GS4A meet prescribed water quality limits for EC of 10,000 µS/cm as the end of pipe limit. The ability of GRB mine complex, under the Baseline scenario, to comply with this criterion is presented in **Figure 4**, which shows the modelled flow release of GS4A against the release salinity (EC). This figure shows there are no exceedences, in the 108 year modelling period, of the end of pipe limit.

Figure 4 Baseline Scenario Modelled Compliance with End of Pipe Limit at GS4A

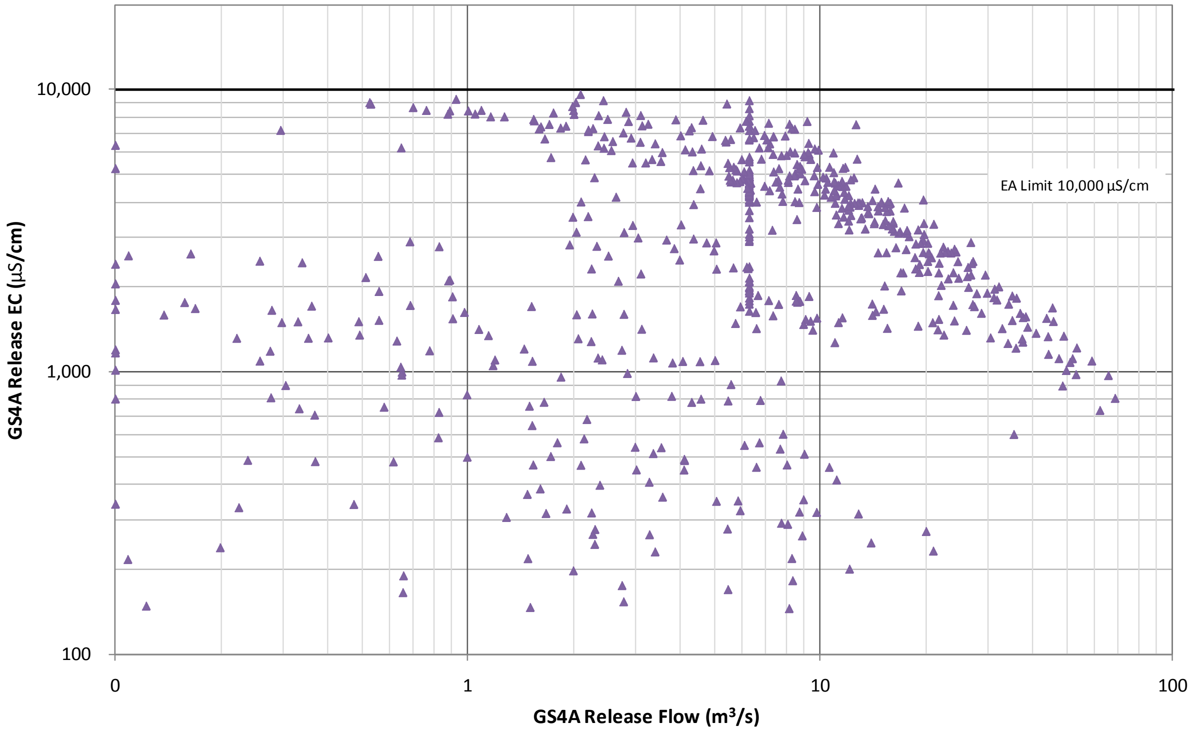
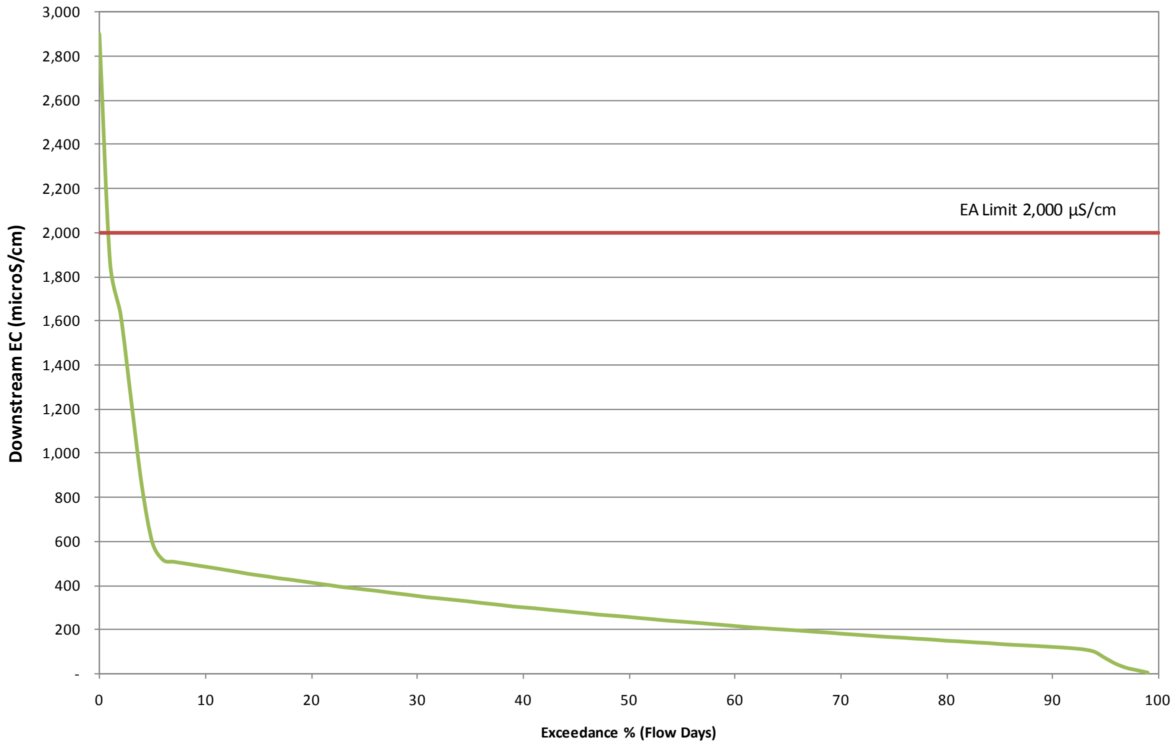
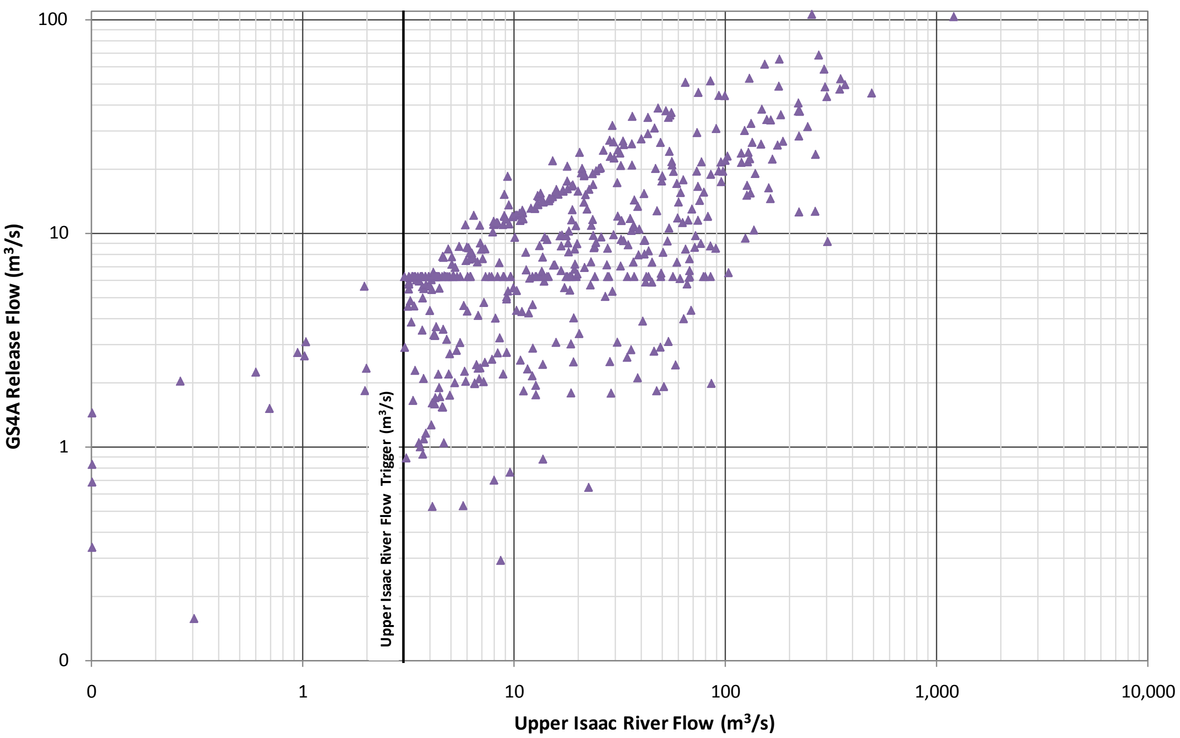


Figure 5 Baseline Scenario Modelled Downstream Isaac Salinity Compliance



The model identified three one-day occurrences, during the 108 year modelling period, that the EC of releases from GS4A causes the downstream EA receiving water trigger level of 2,000 µS/cm to be exceeded. These exceedences are a result of flows entering GS4A, from both natural and site catchments, that are in excess of the 2 m^3/s pumping capacity from GS4A, while there is no flow in the Isaac River.

Figure 6 Baseline Scenario Modelled Compliance with Flow Trigger



The existing GRB mine complex EA conditions require that the flow rate of releases from GS4A must only occur when the flow in the upper Isaac River is greater than 3 m^3/s or there is a natural flow measured at Eureka Creek at monitoring point 2. **Figure 6** shows the modelled GS4A release flow against the modelled upper Isaac River flow. This figure demonstrates that releases under the Baseline scenario are managed appropriately to ensure compliance with the relative flow criteria.

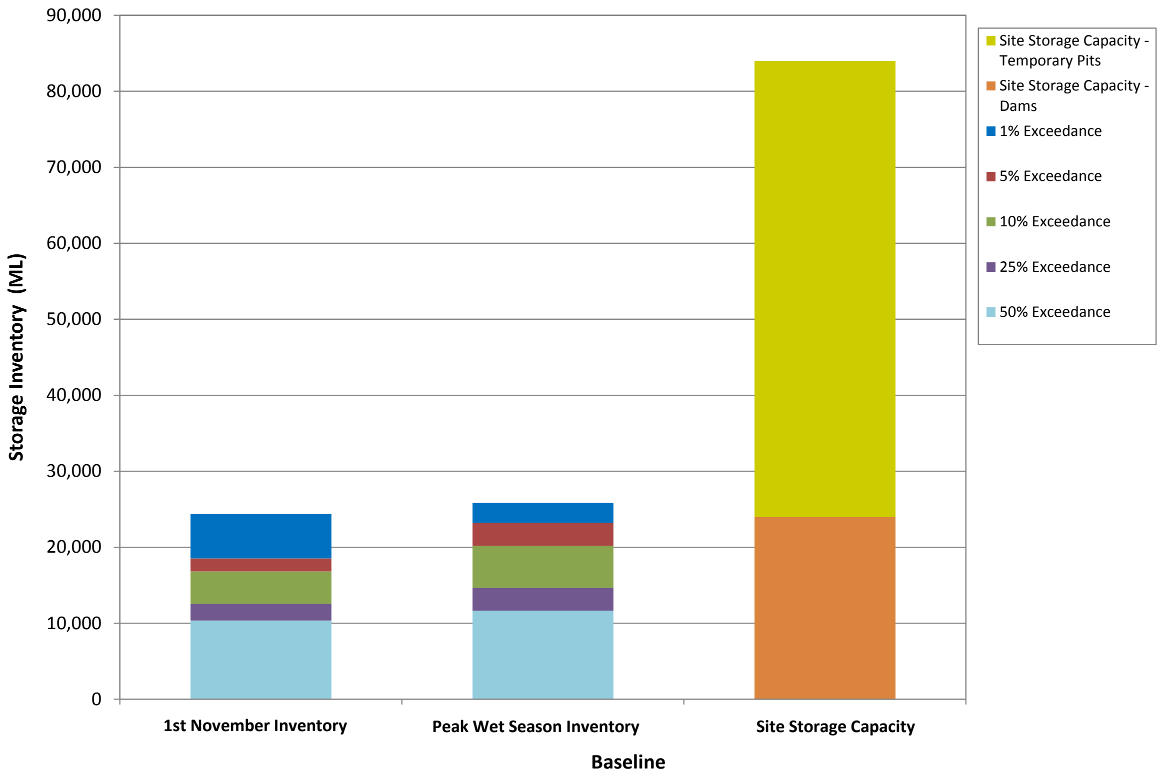
The model identified 14 occurrences, during the 108 year modelling period, of the flow release from GS4A when the flow in the upper Isaac River is less than 3 m^3/s and the release volume is greater that the natural flow recorded at monitoring point 2 on Eureka Creek. There are no active releases made from storages on the site in these events. The exceedences of the flow criteria can occur as a result of variable rainfall in the area with more rainfall has falling in the Eureka Creek catchment than in the upper Isaac River catchment, the rainfall in the Eureka Creek and site catchments has caused the pumps of GS4A to be overwhelmed and overflow has occurred from GS4A. Although there are 14 modelled occurrences of overflows from GS4A only three of these modelled overflows result in non-compliance with the receiving water quality limit.

6.3 Regulatory Requirements for Regulated Structures

Under the EA, a number of structures are regulated and require specific management including management of levels prior to the 1st of November each year. The EA conditions require that the mine water system has sufficient capability to have no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year average recurrence interval (ARI) wet season.

Figure 7 shows a comparison between the site storage capacity for regulated dams, the percentage exceedence for the 1st of November volumes and the percentage exceedence for the peak wet season inventory. It should be noted that the tailings facilities and Ramp 0 are classified as regulated structures and have been included in the site storage capacity. This figure shows that the predicted peak wet season volumes on site are accommodated with site storage capacity. However there may be the requirement to store water in temporarily in mine pits. The storage inventory may be distributed around site, meaning that releases may occur from a particular section of the mine water network. However, as discussed in **Section 6.2**, there are only three exceedence events over the 108 year simulation. This demonstrates that the GRB mine complex system has sufficient capability to manage wet seasons up to the 1 in 10 year ARI.

Figure 7 Baseline Scenario Regulatory Requirements for Regulated Structures



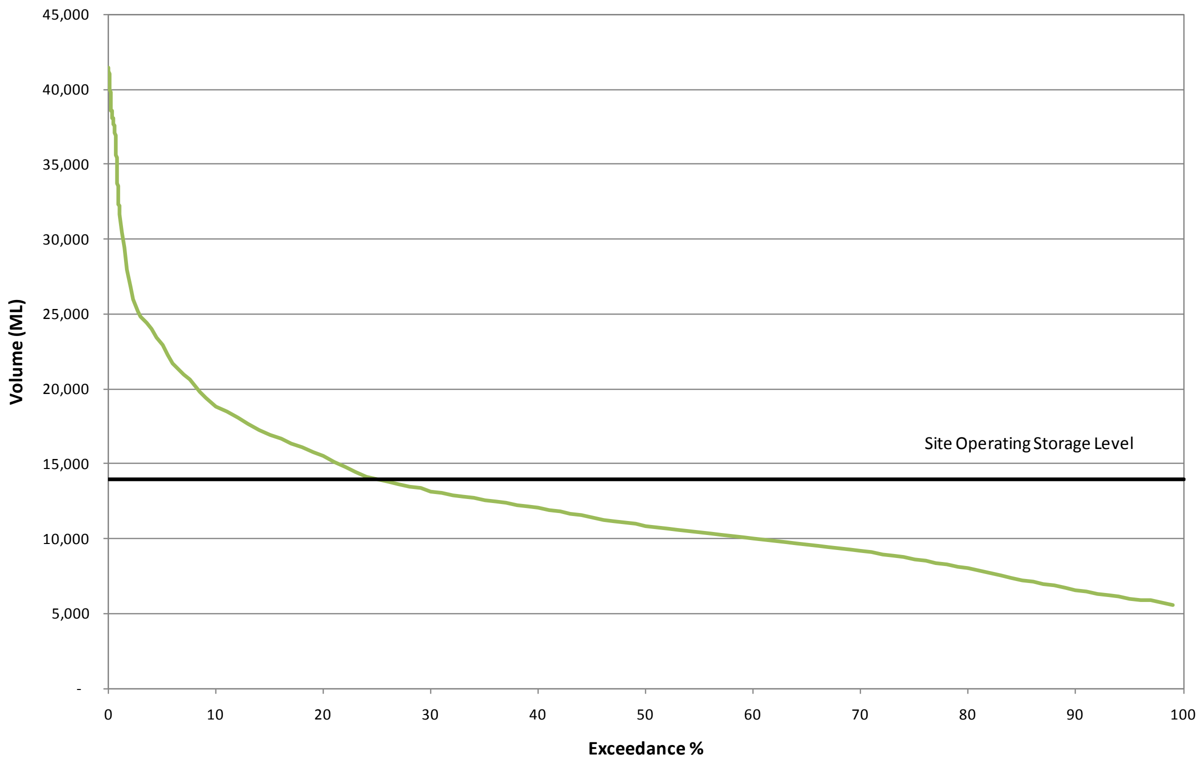
6.4 Storage Inventory

The total mine water volume in the mine water management network and frequency of needing to manage large quantities of mine water are valuable indicators of whether the baseline scenario has sufficient total storage capacity to manage extreme wet periods and how often low priority mine pits will be required for use as contingency storage.

In order to demonstrate the variability of mine water inventory over time, the baseline scenario results are presented as an exceedence probability of the total mine water inventory (**Figure 8**). The site combined storage capacity for dams is 24,000 ML. However this is maintained at 14,000 ML.

Whilst the **Figure 8** shows that the on-site storage has the capacity to manage the site inventory for the majority of the time, there is the requirement for use of the low priority pits as an emergency contingency storage. The percentage exceedence greater than the site operating storage level is a result of the starting water inventory of 40,000 ML on site and the management capacity of infrastructure.

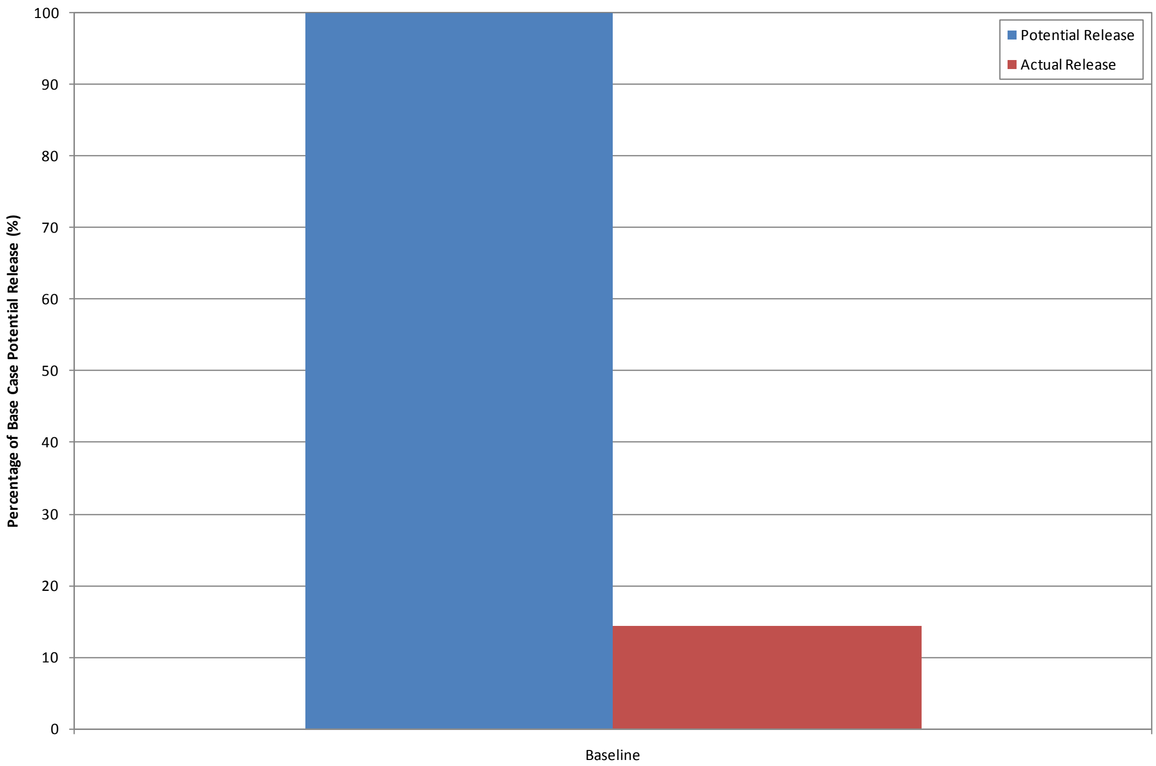
Figure 8 Baseline Scenario Modelled Exceedence of Site Water Volumes



6.5 Release Opportunity Utilisation

An exclusion of the water balance modelling, as identified in **Section 4.4**, is the ability to represent the releases of other mining operations upstream of the GRB mine complex. **Figure 9** presents the modelled release opportunity and the release utilisation for the baseline scenario. This figure shows that in the baseline scenario approximately 14 per cent of the release opportunity is being utilised. This shows that should other mining operations impact on the release opportunities of the GRB mine complex, there are still significant release opportunities that could be further utilised by the GRB mine complex.

Figure 9 Baseline Scenario Modelled Release Utilisation



6.6 External Mine Water Supply

The GRB mine complex has a number of allocations for external water sources for the supply of water to the site to meet a shortfall in mine water requirements. The allocations that are held by BMA in the region are sufficient to supply the potential water requirements for the GRB mine complex.

6.7 Summary

The baseline scenario water balance modelling assessments of the GRB mine water management prior to implementation and operation of the proposed project indicates that:

- infrastructure capacity and operations capability is sufficient to comply with the EA criteria with a high level of confidence for releases from GS4A including respective salinity criteria and flow criteria;
- infrastructure capacity and operations capability is sufficient to comply with the EA criteria for salinity compliance limits applicable in the Isaac River downstream of the mine releases;
- allocations are sufficient to external water sources to meet shortfalls in site demands;
- the utilisation of release opportunities is approximately 14 per cent, which allows for potential reduction of release opportunities by external operations without significant impact on the GRB mine complex; and
- the Baseline scenario has sufficient storage capacity (including use of low priority pits for contingency storage) to cater for maximum mine water volumes that could occur (based on climate extremes evident in available historical data).

Section 07 Red Hill Scenario System Performance

7.1 Overview and Organisational Responsibilities

The water management system for the project includes an interface with the GRB mine water management network. For the purpose of environmental management responsibilities, this will involve the RHM collecting its mine waters and transferring mine water and the associated general environmental duty of care to the GRB mine complex operations. Waters will then be managed and released in accordance with the existing EA in place for the GRB mine complex.

The RHM will be responsible for the design, construction, maintenance, surveillance, operation, management, and risks of the mine water management infrastructure with the RHM project area. This will include responsibility for potential overflow releases from RHM mine water facilities in the event of extreme rainfall that exceeds the design storage allowance criteria for the relevant dams. The project does not envisage any controlled mine water release facilities for the RHM mine water network. RHM mine waters will be contained to achieve prescribed containment performance criteria and transferred to the GRB mine water management network.

The GRB mine water management network will not require new license release points, and the releases of mine water will be undertaken via the GS4A dam as described for the baseline scenario.

The Red Hill CHPP will be located within the GRB mine complex and water supply to the Red Hill CHPP will be drawn from the GRB mine water inventory.

7.2 Project Water Requirements

The majority of water required for the operation of the RHM will require high quality water sourced from external pipeline raw water supply. The estimated Red Hill raw water demands are provided in **Table 3**.

Table 3 Red Hill GRB Mine Complex Raw Water Demands

Item	Demand (ML/yr)
BRM	*365*
Goonyella and Riverside CHPP	*180*
Water Treatment Plant	*180*
Red Hill Potable	145
Red Hill Underground	730
Red Hill CHPP	30
Total	**1,630**

Note: demands in italics indicates baseline scenario demands

The majority of the Red Hill CHPP water requirement can be supplied with mine water which, when available, will be drawn from the GRB mine water inventory. The average Red Hill CHPP operational mine water demand is approximately 1,300 ML/year. This water requirement is substantially less than the existing water use rates in the existing Goonyella and Riverside CHPP operations, in terms of litres per tonne of production, as the Red Hill CHPP will utilise a more modern design and incorporate belt press filters to recover water from waste products. The estimated mine water demands for the project case scenario are provided in **Table 4**.

Table 4 Red Hill GRB Mine Complex Water Demands

Item	Demand (ML/yr)
Goonyella CHPP	*1,600*
Riverside CHPP	*1,600*
Riverside MIA	*500*
Dust Suppression	*1,760*
Red Hill CHPP	1,300
Total	**9,070**

Note: demands in italics indicates baseline scenario demands

7.3 Project Case Scenario Representation

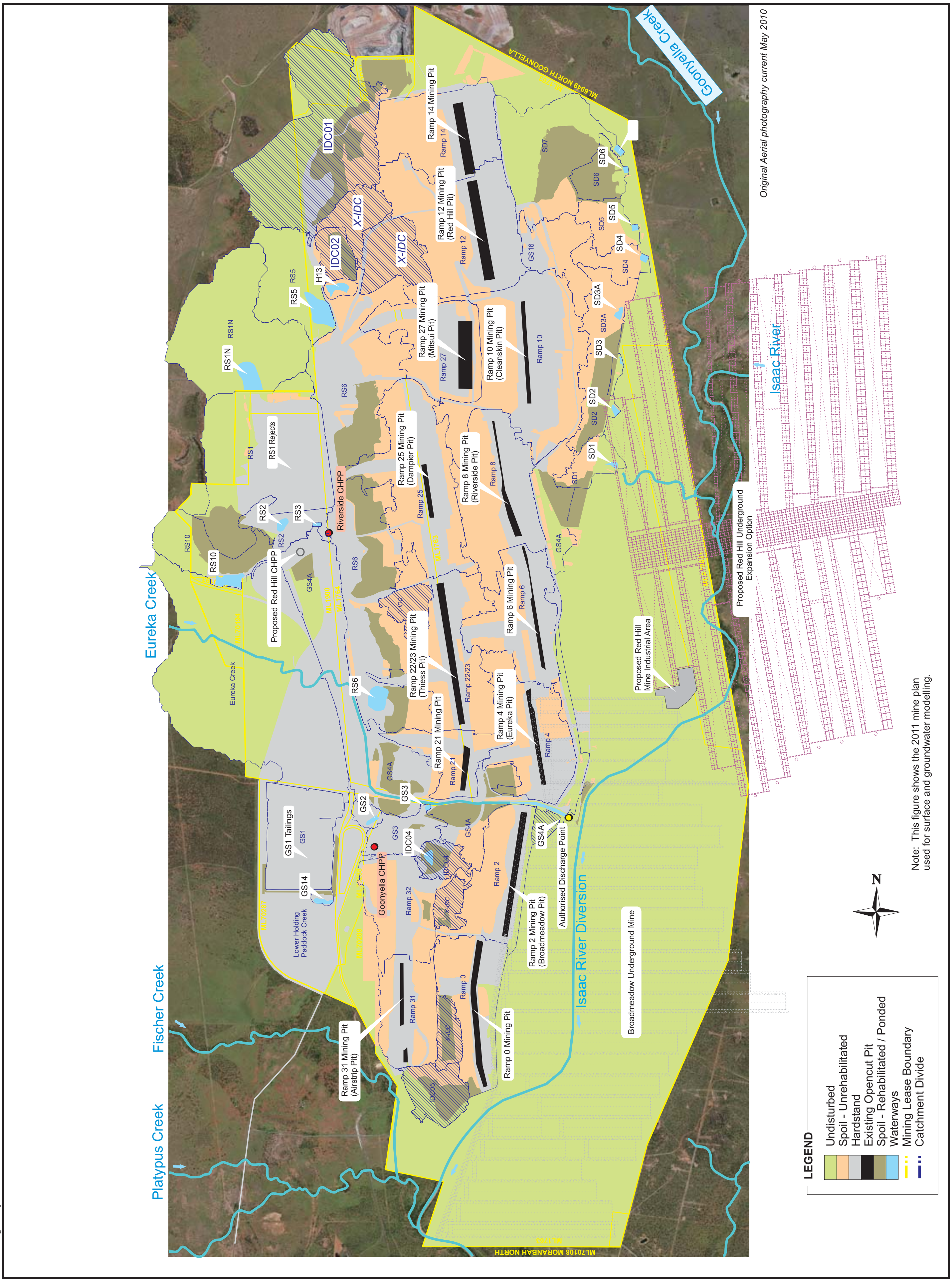
The project case scenario has been developed to assess any potential impacts that may result from the interface between RHM and the GRB mine water management network under the worst case scenario of RHM surplus water. Comparison of the performance of the GRB mine water management system under the baseline scenario and the project case scenario has formed the basis for this assessment. To represent the project case scenario, the following modifications have been made to the baseline scenario model:

- Red Hill underground mine;
- Red Hill CHPP;
- Red Hill MIA;
- Red Hill 50 ML dam.
- Excess water from RHM is dewatered to the GRB mine complex via the Red Hill 50 ML dam.

As discussed in **Section 3.2**, there is a potential for RHM to generate an average water surplus of 640 ML/yr during the latter stages of operations. The results provided below were used to identify whether compliance with EA conditions would be affected by any such water surplus and if any further works would be required in order for the GRB mine water system to manage the potential water surplus generated from RHM.

The operating rules for the project case GRB mine water management system were also modified to reflect the upgraded configuration of the system. Complete details of all of the modelling inputs and assumptions are presented in the Red Hill Mining Lease EIS **Appendix I3**.

For the project case scenario, the EA conditions for releases from the GRB mine water management network were assumed to be the same as the baseline conditions.



 BNE

RED HILL MINING LEASE
SURFACE WATER MINE WATER
MANAGEMENT TECHNICAL REPORT

CATCHMENT PLAN OF THE PROJECT CASE GRB MINE WATER MANAGEMENT SYSTEM (2015)

BMA
BHP Billiton Mitsubishi Alliance

SURFACE WATER

Figure: 10

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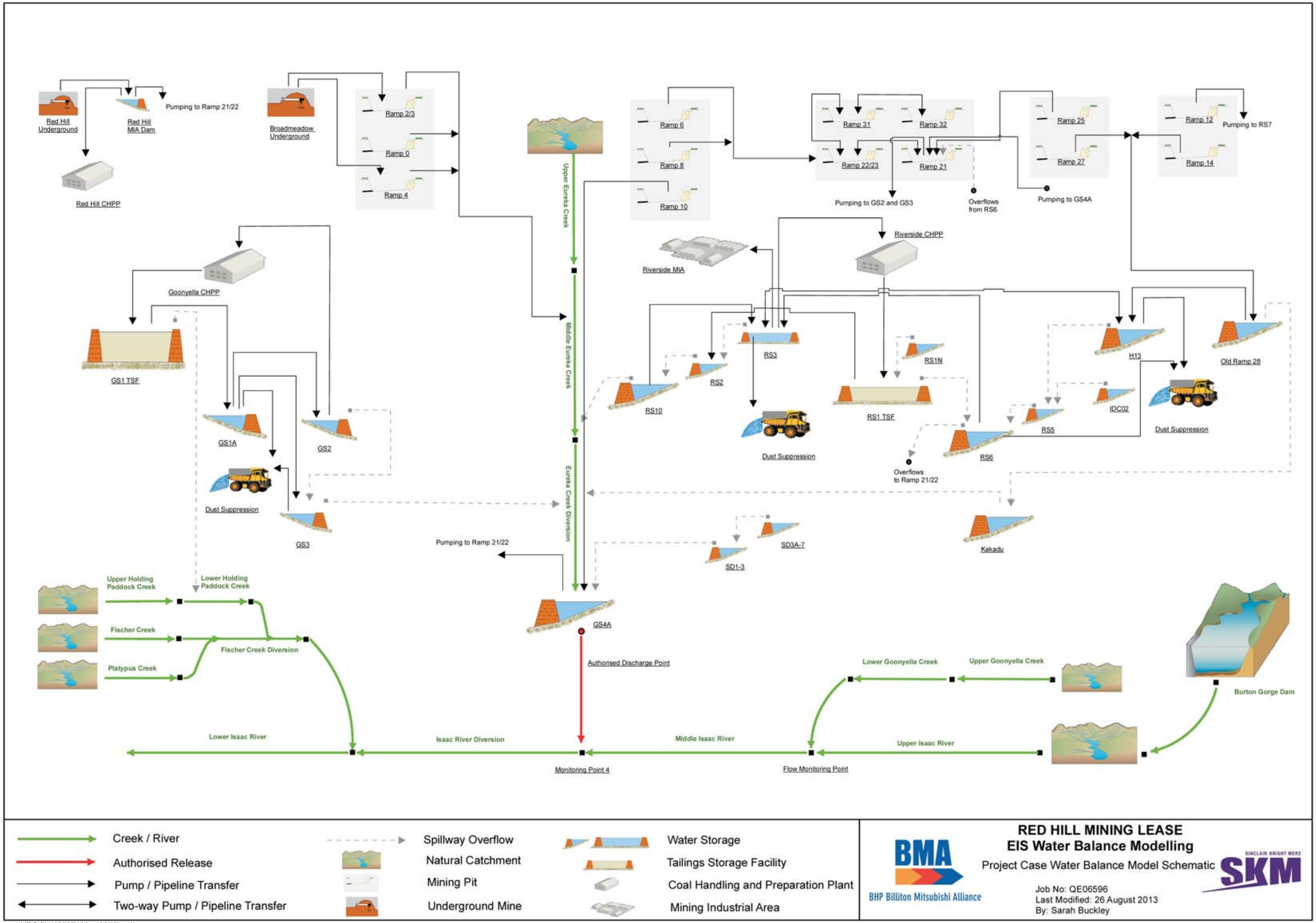

RED HILL MINING LEASE
EIS Water Balance Modelling
Project Case Water Balance Model Schematic

BMA
BHP Billiton Mitsubishi Alliance

SINCLAIR KNIGHT MERZ SKM

Job No: QE06596
Last Modified: 26 August 2013
By: Sarah Buckley

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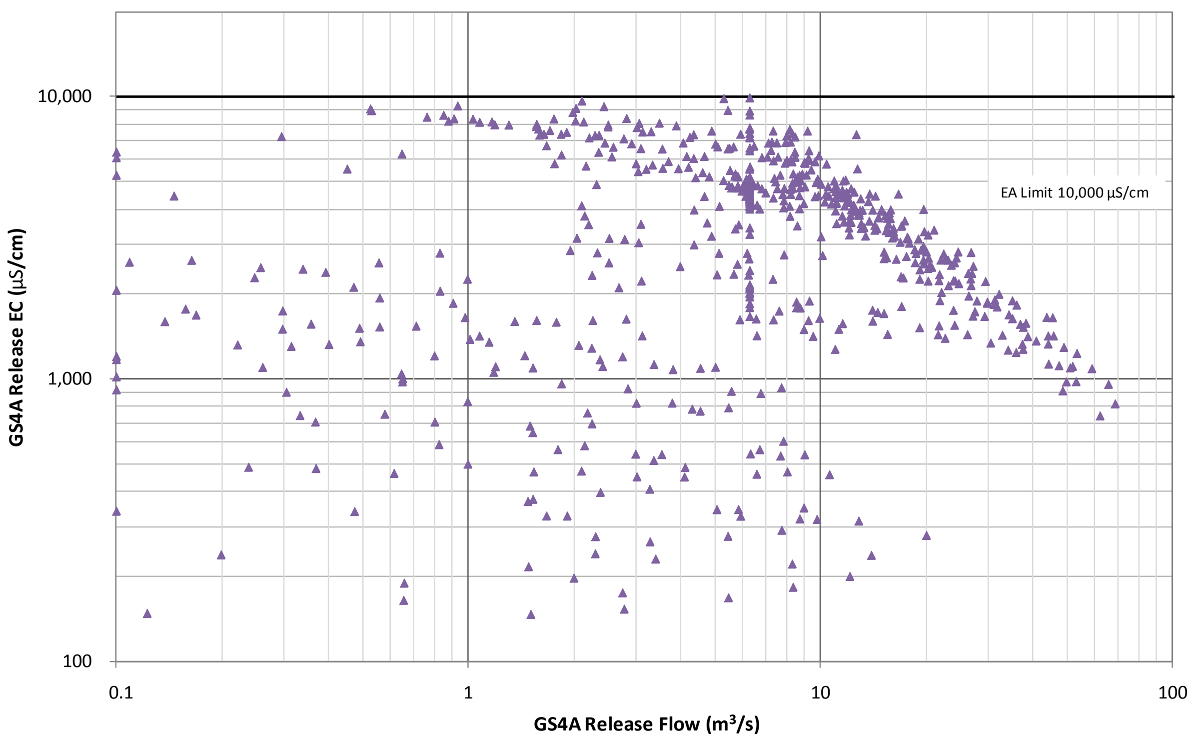
7.4 Compliance of Releases at GS4A with Environmental Authority Criteria

For compliance with the current EA release conditions, a number of flow and water quality criteria must be met. The following figures presented to demonstrate capacity to comply with the respective water quality (salinity) and flow criteria including:

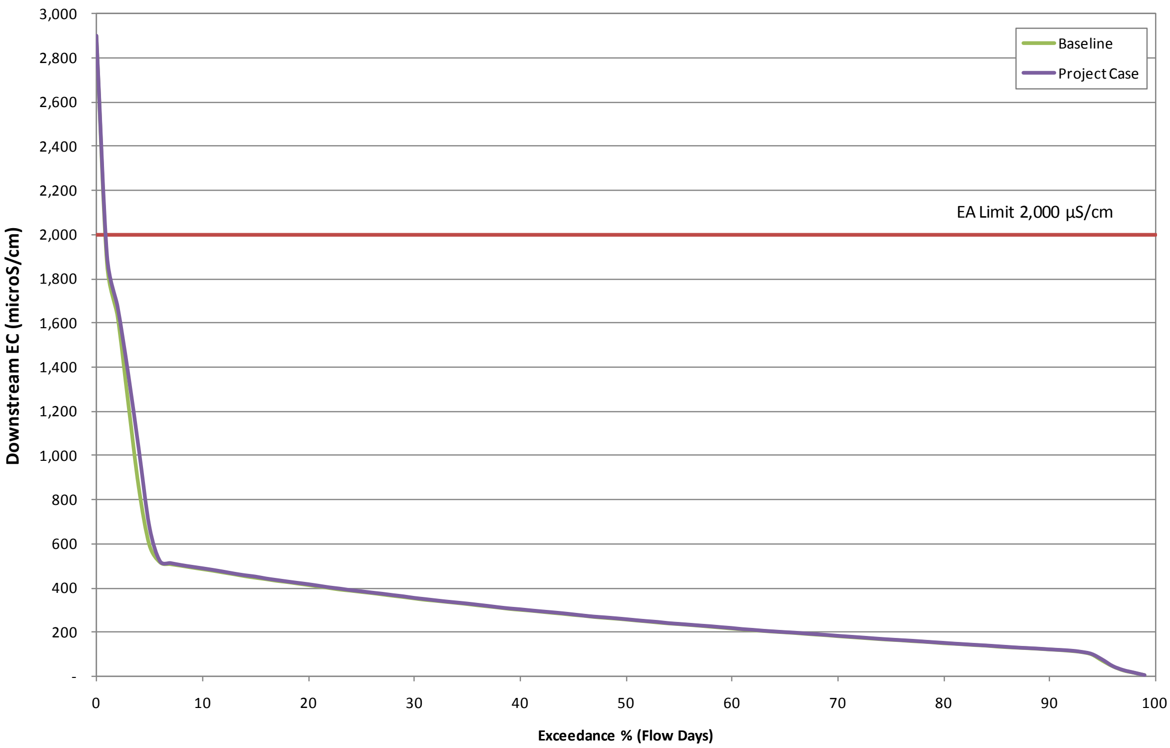
- salinity level of releases for the end of pipe limit River (**Figure 12**);
- salinity level at the downstream compliance point of the Isaac River (**Figure 13**); and
- flow rate of releases in relation to the flow conditions of the Isaac (**Figure 15**).

Figure 12 Project Case Scenario Modelled Compliance with End of Pipe Limit at GS4A



The existing GRB mine complex EA conditions require that releases from GS4A meet prescribed water quality limits for EC of 10,000 µS/cm as the end of pipe limit. The ability of the GRB mine complex, under the Project Case scenario, to comply with this criterion is presented in **Figure 12**, which shows the modelled flow release of GS4A against the release salinity (EC). This figure shows there are no exceedences, in the 108 year modelling period, of the end of pipe limit for the Project Case scenario which is no change from the Baseline scenario.

Figure 13 Project Case Scenario Modelled Downstream Isaac Salinity Compliance at GS4A

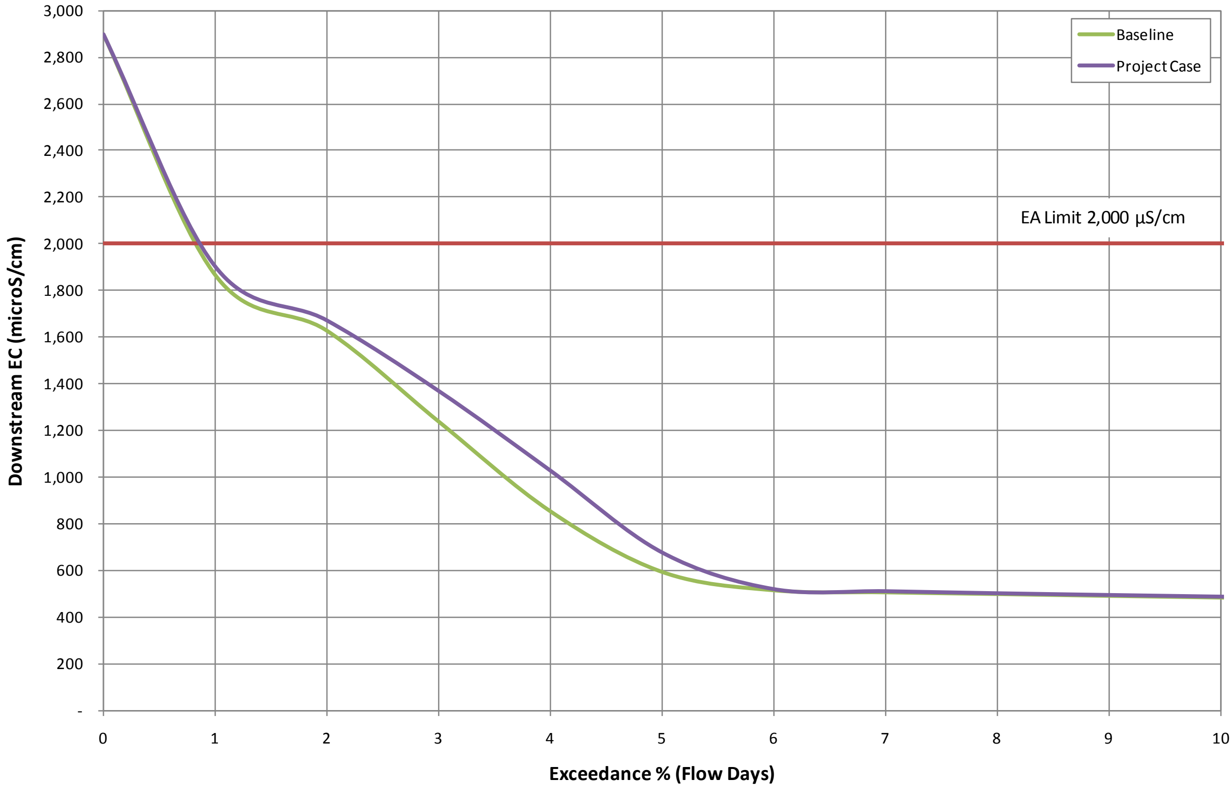


The EA conditions require that in addition to releases from GS4A meeting prescribed water quality limits, that salinity thresholds also apply to the downstream Isaac River Diversion; after mixing of the GS4A releases and Isaac River flows. The ability of the GRB mine complex, under the Project Case scenario, to comply with this criterion is presented in **Figure 13**, which shows the modelled flow days (expressed as an exceedence) against downstream Isaac River salinity (EC).

Figure 13 shows the EA receiving water trigger level of 2,000 µS/cm is met of the majority of the flow days and demonstrates that releases under the Project Case scenario are managed appropriately to ensure compliance with the applicable salinity limits in the Isaac River downstream of the mine's release point.

The impact on the downstream water quality between the Project Case and Baseline scenario is shown in **Figure 14**. This figure shows there is a very minor increase in the downstream water quality levels between the 1 to 6 per cent flow exceedence; however, this is below the 2,000 µS/cm receiving waters trigger level.

Figure 14 Project Case Scenario Modelled Downstream Isaac Salinity Compliance – Zoom

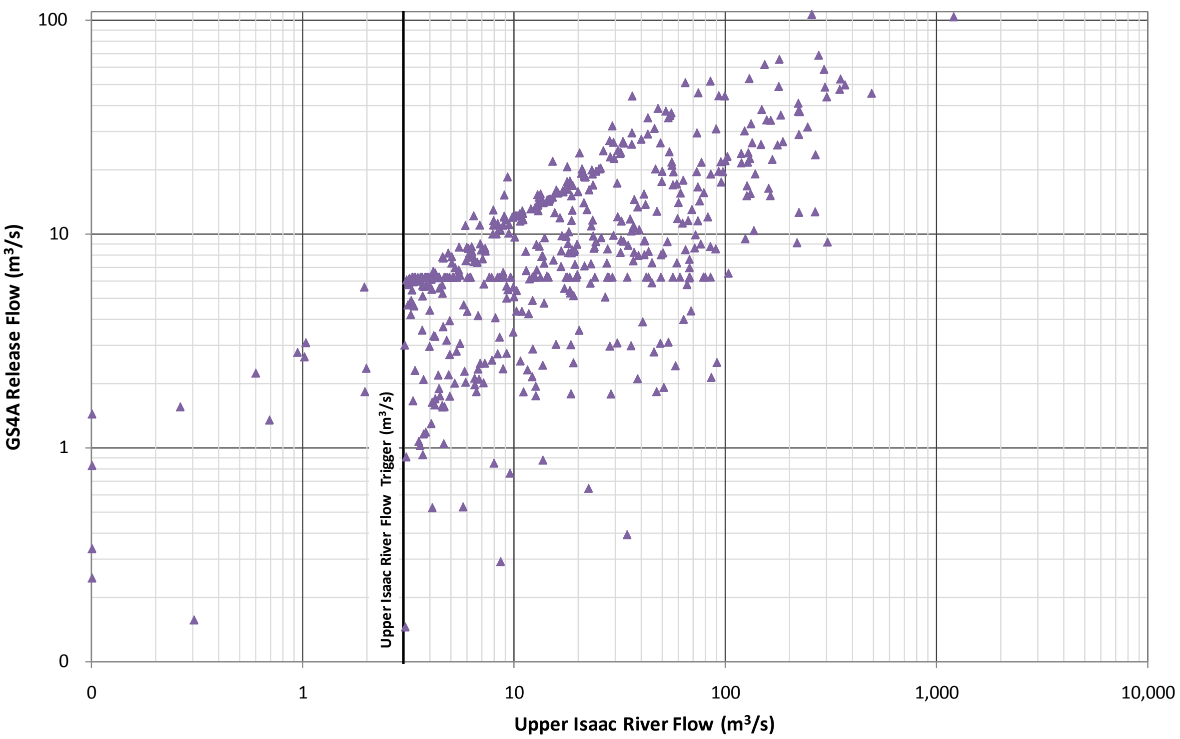


As in the baseline scenario (**Section 6.2**), the model identified three one-day occurrences, during the 108 years modelling period, that EC of releases from GS4A causes the downstream EA receiving water trigger level of 2,000 µS/cm to be exceeded in the Project Case scenario. These exceedences are a result of flows entering GS4A, from both natural and site catchments, that are in excess of the 2 m^3/s pumping capacity from GS4A, while there is no flow in the Isaac River. There is no change in compliance in the Project Case scenario for this condition from the Baseline scenario.

The existing GRB mine complex EA conditions require that the flow rate of releases from GS4A must only occur when the flow in the upper Isaac River is greater than the 3 m^3/s or there is a natural flow measured at Eureka Creek at monitoring point 2. **Figure 15** shows the modelled GS4A release flow against the modelled upper Isaac River flow. This figure demonstrates that releases under the Baseline scenario are managed appropriately to ensure compliance with the relative flow criteria.

As in the Baseline scenario (**Section 6.2**), the model identified 14 occurrences, during the 108 year modelling period, of the flow release from GS4A when the flow in the upper Isaac River is less than 3 m^3/s and the release volume is greater that the natural flow recorded at monitoring point 2 on Eureka Creek. There are no active releases made from storages on the site in these events. The exceedences of the flow criteria are a result of variable rainfall in the area with more rainfall falling in the Eureka Creek Catchment than in the upper Isaac River catchment. The rainfall in the Eureka Creek and site catchments has caused the pumps of GS4A to be overwhelmed and overflow has occurred from GS4A. Although there are 14 modelled occurrences of overflows from GS4A, only three of these modelled overflows result in non-compliance with the receiving water quality limit. There is no change in compliance in the Project Case scenario for this condition from the Baseline scenario.

Figure 15 Baseline Scenario Modelled Compliance with Flow Trigger

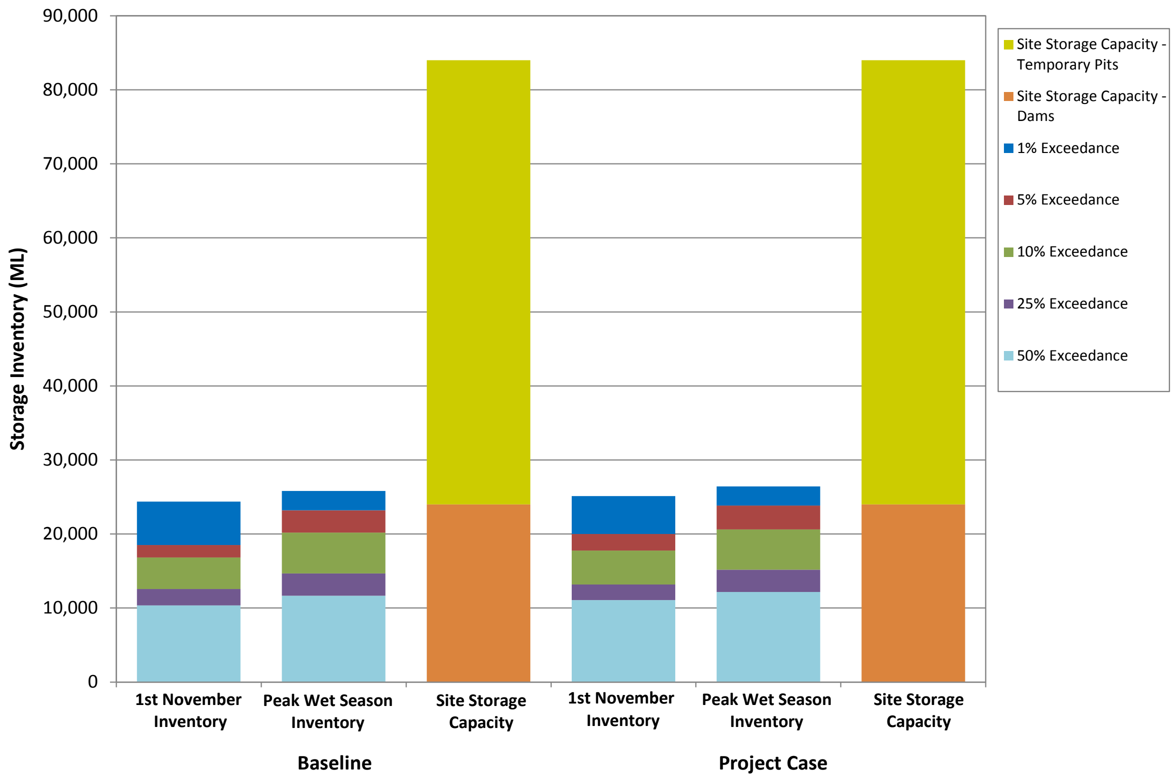


7.5 Regulatory Requirements for Regulated Structures

Under the EA, a number of structures are regulated and require specific management including management of levels prior to the 1st of November each year. The EA conditions require that the mine water system has sufficient capability to ensure that there are no unauthorised discharges of mine water for wet season rainfall events up to a 1 in 10 year ARI wet season.

Figure 16 shows a comparison between the site storage capacity for regulated dams, the percentage exceedence for the 1st of November volumes and the percentage exceedence for the peak wet season inventory for the project case and baseline scenarios. It should be noted that the tailings facilities and Ramp 0 are classified as regulated structures and have been included in the site storage capacity. This figure shows in the project case scenario there is predicted to be a small increase in volumes on site at 1st of November. However, the predicted volumes are accommodated within the site storage capacity.

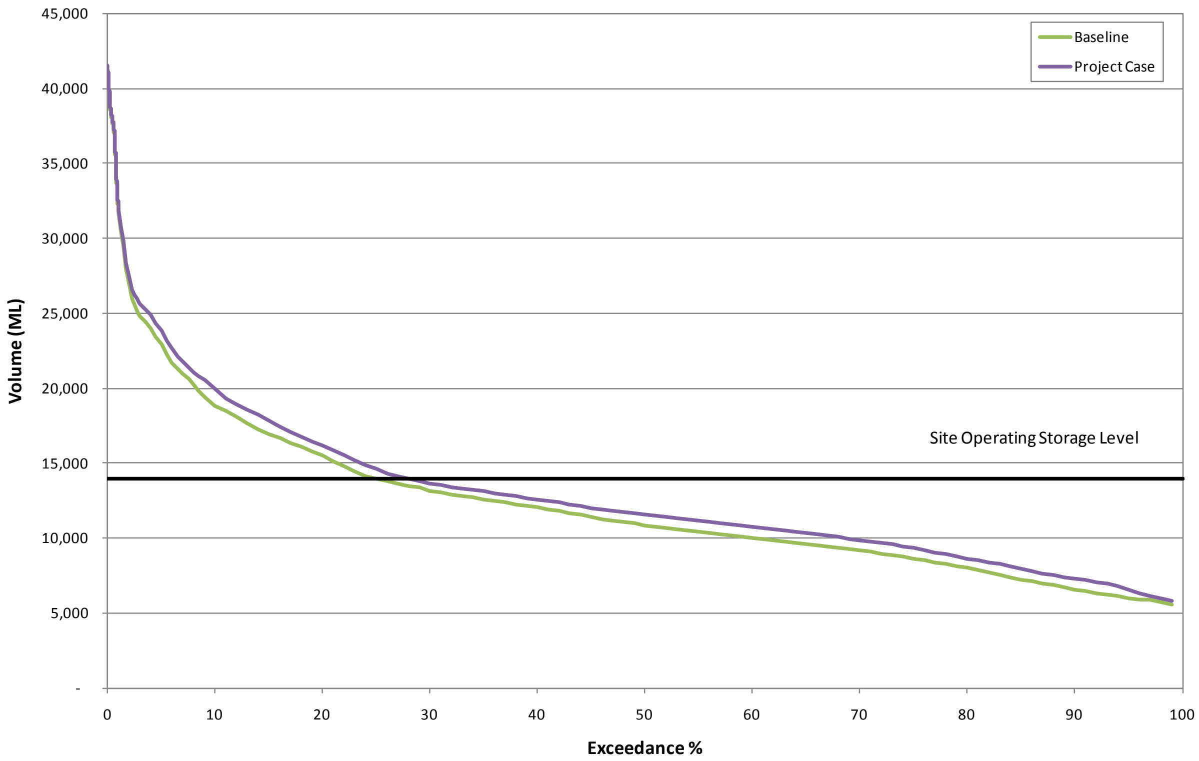
Figure 16 Project Case Scenario Regulatory Requirements for Regulated Structures



7.6 Storage Inventory

Figure 17 demonstrates the variability of mine water inventory over time for the project case and baseline scenarios presented as an exceedence probability of the total mine water inventory. The site storage inventory is 24,000 ML; however, this is maintained at 14,000 ML. This result shows that the storage site inventory is increased in the project case scenario. This increase is accommodated in the GRB mine complex storage operating volume.

Figure 17 Project Case Scenario Modelled Exceedence of Site Water Volumes

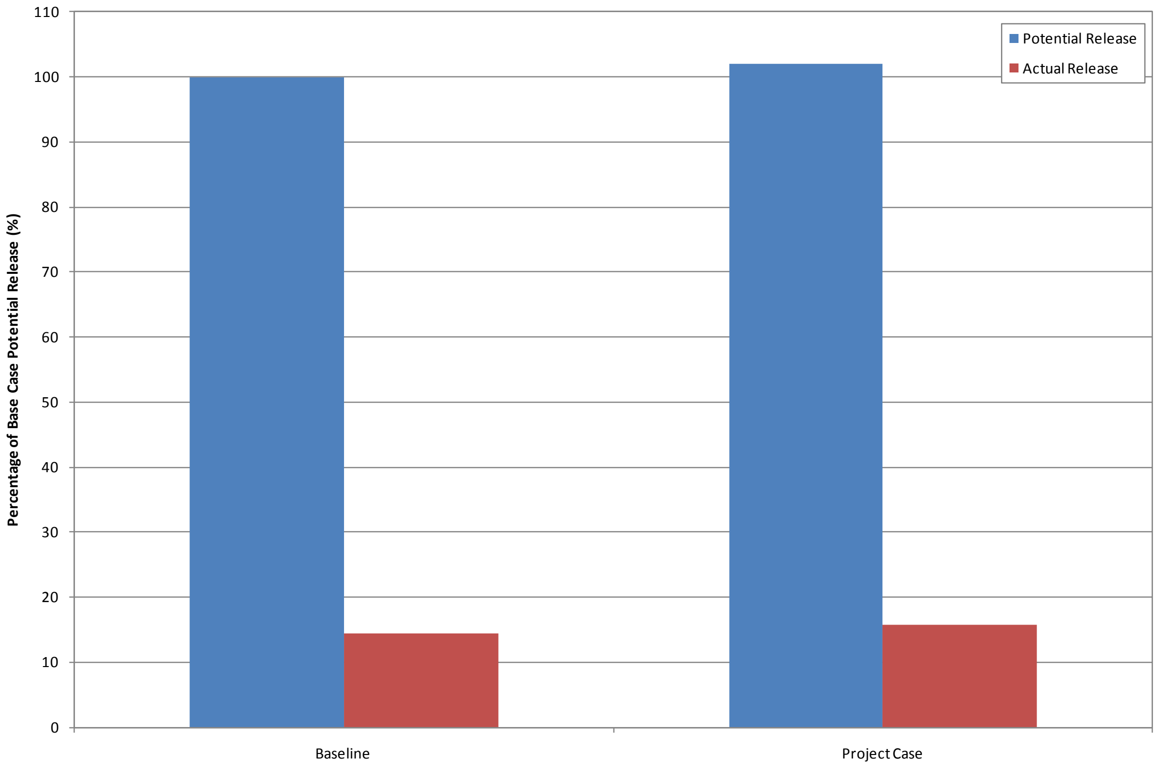


7.7 Release Opportunity Utilisation

An exclusion from the water balance modelling, as identified in **Section 4.4**, is the ability to represent the releases of other mining operations upstream of the GRB mine complex. **Figure 18** presents the modelled release opportunity and the release utilisation for the project case and the baseline scenario. This figure shows that the release opportunity is slightly increased (by approximately two per cent) due to the small predicted increase in the site water inventory as a result of the surplus of groundwater.

There is still significant release opportunity to be utilised in the Project Case scenario with a release utilisation of 16 per cent.

Figure 18 Project Case Scenario Modelled Release Utilisation



7.8 External Mine Water Supply

As discussed in **Section 3.1.3**, the water position for the RHM is predicted to vary between surplus and deficit over the mine life. It is predicted that in the periods of surplus there could be an average surplus of up to 640 ML/yr of mine water. This additional water would be used in the GRB mine complex to meet the 8,000 ML/yr demand, reducing the raw water requirement for the GRB mine complex.

During periods of potential deficit, water for the operations could be sourced from mine water on the GRB mine complex or from external sources. This water demand would be sourced with BMA's current water allocations.

The RHM will require the use of good quality, water equivalent to raw water, in the underground operations. This demand is predicted to be approximately 730 ML/yr over the mine life. This water demand would be sourced with BMA's current water allocations.

7.9 Summary

The project case scenario water balance modelling assessment of the GRB mine water management system indicates that:

- infrastructure capacity and operations capability is sufficient to comply with the existing GRB mine complex EA criteria with a high level of confidence for releases from GS4A including respective salinity criteria and flow criteria;

- infrastructure capacity and operations capability is sufficient to comply with the EA criteria for salinity compliance limits applicable in the Isaac River downstream of the mine releases;
- allocations of external water sources are sufficient to meet shortfalls in site demands;
- the utilisation of release opportunities is approximately 16 per cent, which allows for potential reduction of release opportunities by external operations without significant impact on the GRB mine complex; and
- the Project Case scenario has sufficient storage capacity (including use of low priority pits for contingency storage) to cater for maximum mine water volumes that could occur (based on climate extremes evident in available historical data).

Section 08 Mine Water Management Impact Summary

The project case water balance modelling assessment of the integrated GRB mine complex and Red Hill scenario mine water management and comparisons to the baseline scenario indicate that:

- The project will not adversely impact on the capability of the GRB mine water management system to comply with EA conditions for release of mine water from GS4A for respective salinity criteria and flow criteria.
- The project will not adversely impact on the capability of the GRB mine water management system to comply with the EA criteria for salinity compliance limits applicable in the Isaac River downstream of the mine releases.
- There will not be a significant impact on the requirements for external water supply.
- There is negligible change to the water quality in the Isaac River downstream of the GRB mine complex.
- The GRB mine water management network has sufficient storage capacity (including use of low priority pits for contingency storage) to cater for maximum mine water volumes from the combined GRB mine complex and proposed project operations that could occur (based on climate extremes evident in available historical data).

Section 09 References

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Hart, B. 2008. *Review of the Fitzroy River Water Quality Issues - Report to Queensland Premier*, Water Science Pty Ltd and Water Studies Centre, Monash University In collaboration with Professor Paul Greenfield, University of Queensland Mark Pascoe, International Water Centre

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Legislation

Environmental Protection Act 1994

Environmental Protection Regulation 2008

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