# SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

**Appendix E-2**

Mine Water Balance Technical Report

BHP

Saraji East Mining Lease Project
BM Alliance Coal Operations Pty Ltd
15-Mar-2021

# Saraji East Mining Lease Project Environmental Impact Statement

## Mine Water Balance Report

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## Mine Water Balance Report

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# Quality Information

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Prepared by Tim Wallis

Reviewed by Dr Mohand Amghar

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| 4 | 15-Mar-2021 | Updated following adequacy review | Elisha Bawden<br>Project Manager | EBawden |

## Table of Contents

**List of Tables**



**List of Figures**

# Acronyms

| | |
|---|---|
| AEP | Annual exceedance probability |
| AWAS | Australian Water Accounting Standard |
| AWBM | Australian water balance model |
| BMA | BM Alliance Coal Operations Pty Ltd |
| BOM | Bureau of Meteorology |
| CHPP | Coal handling and preparation plant |
| DES | Department of Environment and Science |
| DEHP | Department of Environment and Heritage Protection |
| DIIS | Department of Industry, Innovation and Science |
| DNRME | Department of Natural Resources, Mine and Energy |
| DSA | Design storage allowance |
| EC | Electrical conductivity |
| EIS | Environmental Impact Statement |
| EP Act | *Environmental Protection Act 1994* |
| EPC | Exploration Permit for Coal |
| ESS | Extreme storm surge |
| EWPC | Eungella Water Pipeline Company |
| GRI | Global Reporting Initiative |
| ha | Hectare |
| kL | Kilolitre |
| LPSDIP | The Leading Practice Sustainable Development Program |
| MAW | Mine affected water |
| mg/L | Milligrams per litre |
| MIA | Mine infrastructure area |
| µS/cm | Micro Siemens per centimetre |
| ML | Mega litre |
| MLA | Mining lease application |
| mm | Millimetres |
| MRL | Mandatory reporting level |
| PET | Potential Evapotranspiration |
| RE | Regional Ecosystem |
| REMP | Receiving environment monitoring program |
| ROM | Run of mine |
| ROP | Resource operations plans |
| RWD | Raw water dam |
| SILO | Scientific Information for Land Owners |
| SMD | Slightly to moderately disturbed |

| | |
|---|---|
| TDS | Total dissolved solids |
| TLO | Train load out |
| TOR | Terms of Reference |
| tph | Tonnes per hour |
| TSF | Tailings storage facility |
| TSS | Total suspended solids |
| WAF | Water accounting framework |
| WBM | Water balance model |
| WMS | Water management system |
| WP | Water Plan |

# Executive Summary


BM Alliance Coal Operations Pty Ltd (BMA) proposes to develop the Saraji East Mining Lease Project (the Project), a greenfield single-seam underground mine development on Mining Lease Application (MLA) 70383 commencing from within Mining Lease (ML) 1775. The Project also comprises supporting infrastructure, including a Coal Handling Preparation Plant (CHPP), a Mine Infrastructure Area (MIA), a conveyor system, rail spur and balloon loop, water pipelines and dams, powerlines, stockpiles and a construction accommodation village. Infrastructure will be located on the adjacent Saraji Mine MLs as well as on MLA 70383 and MLA 70459. The Project will mine up to 11 million tonnes per annum (Mtpa) and produce up to eight Mtpa of product coal for the export market over a 20-year production schedule (FY 2023 – 2042)This document presents the basis for the conceptual design of the mine Water Management System (WMS) for the Project. It has been prepared to address the Project's Terms of Reference (ToR) (DEHP, 2017).

The conceptual mine WMS has been progressed to a level of detail commensurate with the current Project design and data availability. The WMS is in line with best management practice for mine water management including:

- minimising generation of mine affected water (MAW) by passively diverting clean runoff around the mine WMS wherever practical
- minimising the volumes of MAW stored onsite by preferencing the use of MAW where possible (e.g. for CHPP process and dust suppression)
- minimising the consumption of raw water by preferencing the use of MAW.

## Proposed Mine Water Management System

The conceptual mine WMS consists of the following key components:

- a process water dam
- mine affected runoff collection dams located at each Project process area (MIA, CHPP, ROM and product coal stockpile pads)
- a raw water dam (RWD)
- a sump located in the existing open cut pit where the underground mine portal will be located
- a water transfer network of pumps and pipes.

Mine affected runoff is proposed to be collected from each process area dam and transported to the process water dam. In addition, the process water dam also receives MAW from the underground mine portal sump located in the existing Saraji Mine open cut pit. MAW enters the sump either as runoff, or as a by-product of dewatering of the underground mine. MAW stored in the process water dam is the preferred source of water for the CHPP and dust suppression activities.

Raw water is stored in the raw water dam (RWD), which has been sized to meet all Project water demands for approximately one month. Raw water is used to satisfy potable, underground mine, CHPP and dust suppression water demands when MAW is unavailable.

Preliminary capacity estimates for all mine WMS dams and the water transfer network were determined through water balance assessment using historical climate conditions and conceptual operational rules. For the purpose of this assessment, a conservative approach was adopted to sizing of each conceptual mine WMS storage such that:

- controlled releases of MAW to the receiving environment are not required, and
- capacities are sufficient to prevent the uncontrolled (spillway) discharge of MAW to the receiving environment.

The proposed WMS has been designed with adequate capacity to avoid releases. The preliminary dam capacities presented herein are relevant to the input data, assumptions and adopted operational rules. However, any open system has the potential for uncontrolled discharge of MAW as a result of extreme rainfall events. As such, BMA will be seeking authority and licence conditions to conduct the controlled release of MAW from the Project site during emergency scenarios (e.g. extreme rainfall events). The indicative location for controlled release of MAW is located on Boomerang Creek adjacent to the proposed process water dam (Figure 6). Spillway discharges (uncontrolled) from the process water dam are also proposed to be directed to Boomerang Creek.

Spillway (uncontrolled) discharges from the remaining process area dams will be directed to the receiving environment based on existing topographical constraints. Where dam overflow locations cannot deliver flows directly to Hughes Creek or its tributaries, conveyance channels are proposed to convey the discharge.

A risk-based assessment of hypothetical MAW releases shows that no impacts on the receiving environment are expected from these events.

Preliminary consequence categories have also been determined for all regulated dams. A summary of mine WMS dams is shown in Table 1.

**Table 1 Mine WMS Dams Summary**

| Mine WMS Dam | Configuration | Catchment (Ha) | | Preliminary Consequence Category | Required DSA[*] and ESS AEP[**] | Preliminary Dam Capacity (ML) | Preliminary Hydrological Design Criteria (ML) | | | Preliminary Overflow Destination |
|---|---|---|---|---|---|---|---|---|---|---|
| | | External | Total | | | | ESS[***] | Dam Volume Equivalent to MRL[1] | DSA[****] | |
| **Process water dam** | Turkey's Nest (pumped inflows) | N/A | 17.9 | Significant | 1:20 | 1,050 | 40 | 1,010 | 109 | Hughes Creek via unnamed tributary |
| **CHPP dam** | Partially Excavated (gravity inflows) | 7.3 | 9.7 | Significant | 1:20 | 80 | 21 | 59 | 58 | |
| **Product coal stockpile pad dam** | | 11.0 | 15.1 | Significant | 1:20 | 135 | 33 | 102 | 91 | |
| **ROM pad dam** | | 4.4 | 6.1 | Significant | 1:20 | 45 | 14 | 31 | 37 | |
| **MIA dam** | | 8.8 | 11.4 | Significant | 1:20 | 100 | 25 | 75 | 69 | |

*Design storage allowance
**Extreme storm surge annual exceedance probability
***Extreme storm storage
****Design storage allowance

[1] Due to the preliminary nature of the assessment the level of the MRL (mandatory reporting level) is currently unknown and has been given as the equivalent dam volume

# 1.0 Introduction

BM Alliance Coal Operations Pty Ltd (BMA) has commissioned AECOM Australia Pty Ltd (AECOM) to recommence and finalise the environmental approvals for the Saraji East Mining Lease Project (the Project).

The Project Site (bounded by Exploration Permit for Coal (EPC) 837, EPC 2103, Mining Lease Application (MLA) 70383, MLA 70459, Mining Lease (ML) 1775, ML 70142 and ML 1782) is located to the north of Dysart in Queensland's Bowen Basin and encompasses approximately 11,427 ha hectares (ha) of land (Figure 1).

## 1.1 Project description

The Project is a greenfield, single-seam underground mine development on MLA 70383 commencing from within ML 1775. It has been designed to utilise the existing approved Saraji Mine infrastructure, such as electricity lines, water supply pipelines, coal handling and preparation plant (CHPP), haul roads, workshops and warehouses, wherever practical. The Project will require upgrades to existing mine infrastructure and additional mine infrastructure. As such, the Project also comprises a new CHPP, associated mine infrastructure area (MIA) and a new rail spur and balloon loop, each of which is proposed to be located on the existing adjacent Saraji Mine. A new infrastructure and transport corridor will be constructed on MLA 70383 and MLA 70459 to accommodate the reconfiguration of existing power and water networks and internal access roads. Key attributes of the Project mine water management system (WMS) are shown in Table 2 and the proposed Project layout is shown in Figure 1.

**Table 2 Features of Project Mine Water Management System**

| Aspect of the Project | Details |
|---|---|
| Total production | Approximately 150 million tonnes (Mt) run-of-mine (ROM) coal based on a 20-year production schedule. This equates to approximately 110 Mt of product coal. |
| Average annual production (excluding ramp up and ramp down and potential extensions) | 8.2 Mtpa ROM coal annual average with a maximum of 11 Mtpa<br>6.2 Mtpa product coal annual average with a maximum of eight Mtpa |
| Mine life<br>• Production<br>• Rehabilitation | <br>• Approximately 20 years with potential for extensions<br>• Nominally 10 years |
| Operating hours | 24 hours per day, 7 days per week |
| Mining method | Underground mining |
| Existing mining lease areas | ML 70142, ML1782 and ML 1775 |
| Proposed mining lease area | MLA 70383 and MLA 70459 |
| Water infrastructure | Dams, catchment diversions and drains will be required to support mining operations, minimise generation of mine affected water (MAW) and support protection of downstream environmental values through the minimisation of uncontrolled releases. Key Project water infrastructure to be built consists of:<br>• Process water dam |

| Aspect of the Project | Details |
|---|---|
| | - Runoff from disturbed areas of the Project, including the MIA, CHPP, stockpiles (ROM and product coal), train load out, and portal entry sump (located in existing open cut pit) will be collected at source and transferred to the process water dam. The process water dam will be constructed as a turkey's nest (no external catchment) and located on MLA 70383.<br>• Temporary gas dewatering storage<br>- The pre-drainage of incidental mine gas will result in the production of water. This water will be collected in local facilities near the well head. These facilitates will act as a balancing storage to allow transfer at a constant rate to the process water dam.<br>• Raw Water Dam (RWD)<br>- The RWD will be a turkey's nest design and will receive clean water inflows from BMA's 10,000 mega litres per year (ML/yr) allocation from the Northern Network Pipeline. Water from the RWD will be used to satisfy the Project's potable water and underground mining equipment demands, as well as makeup supply for dust suppression and CHPP process demand when supplies of MAW are unavailable for reuse. The RWD will be located on ML 70142.<br>• Additional Highwall pumps<br>- The access portal to the underground workings will be via the existing open cut highwall. Water collected in the highwall portal pit sumps will be pumped to the process water dam to maintain the flood immunity of the underground workings.<br>• Pipelines<br>- Relocation and re-connection of the existing Eungella Water Pipeline Company (EWPC) Southern Extension Water Pipeline into a new infrastructure and transport corridor to the eastern boundary of MLA 70383 and northern boundary of MLA 70459.<br>- A water pipeline will be constructed connecting the Project's surface infrastructure located on ML 70142 to the process water dam located on MLA 70383.<br>- Water transport associated with the Project will be achieved via the utilisation (and enhancement where necessary), of BMA's existing water pipeline network connecting Saraji Mine to BMA mines to the north and south of Saraji Mine.<br>• Mine affected stormwater drainage infrastructure<br>- Mine affected runoff dams, bunds and drains to capture and treat run-off from disturbed areas including ROM and product stockpile pads, CHPP and MIA. |

## 1.2 Scope of work

This report has been developed to address the relevant requirements of the Project's Terms of Reference (ToR) (DEHP, 2017). Table 3 lists the relevant requirements of the ToR, and summaries how they have been addressed by the MWB.

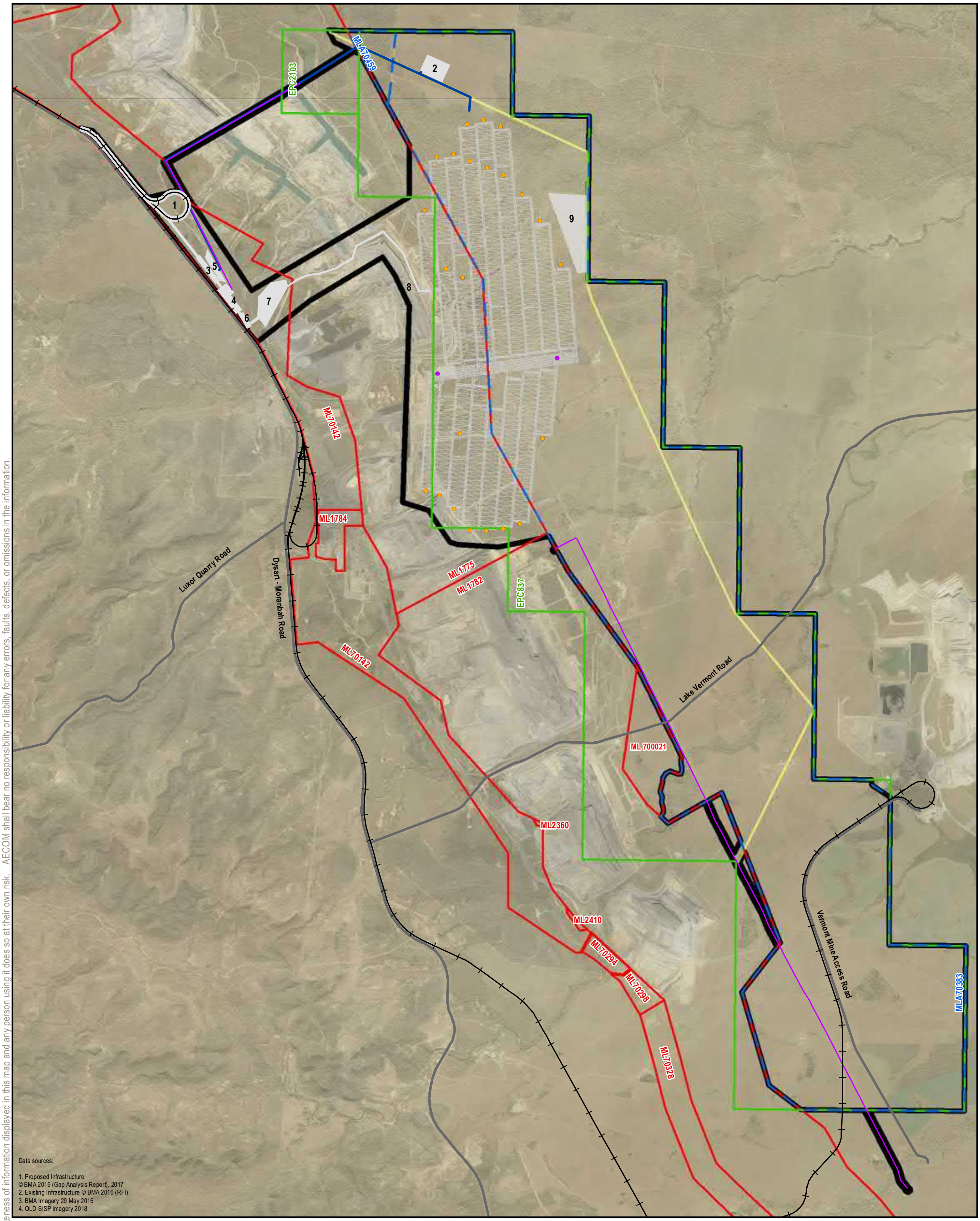
**Table 3 Terms of Reference Addressed by the Mine Water Balance Report**

| ToR Reference | Information Requirement | Comment | Relevant Report Section(s) |
|---|---|---|---|
| 8.3.4 | Identify the quantity, quality, location and timing of all potential and/or proposed releases of contaminants (such as controlled water releases to surface water streams) from water and waste water from the project, whether as point sources (including controlled or uncontrolled discharges, stormwater run-off from regulated structures or other dams and sediment basins) or diffuse sources (such as seepage from waste rock dumps or irrigation to land of treated sewage effluent). | • All mine water management dams have been provisionally sized assuming containment of all potential inflows using historical climate data and under assumed operational rules.<br>• No controlled releases of MAW are currently planned.<br>• All mine water management dams will have the potential to discharge to the receiving environment via spillway (uncontrolled) discharges; however, a risk based approach has shown potential MAW releases will not have noticeable impacts on the receiving environment<br>• Potentially mine affected stormwater runoff from all disturbed sites will be contained at source by collection dams and transferred to the process water dam.<br>• A sewage treatment plant (STP) will be installed to service the MIA, the construction accommodation village, and to treat all sewage generated onsite. Sewage from the stockpile/CHPP area, and from the ablutions facility at the mine portal, will be pumped back to the MIA. Effluent from the STP and the WTP will be captured in the process water dam and used for dust suppression at the Project Site. Therefore, been given no further quantitative consideration as part of the water balance. | 2.1.3, 4.4 and Figure 6 |

| ToR Reference | Information Requirement | Comment | Relevant Report Section(s) |
|---|---|---|---|
| 8.4.1 | Provide details of any proposed impoundment, extraction, discharge, injection, use or loss of surface water or groundwater. Identify any approval or allocation that would be needed under the *Water Act 2000*. | • Groundwater inflow to the mine WMS will be through dewatering of the underground mine as well as from the proposed gas drainage bore field.<br>• Except where originating from disturbed areas, and therefore potentially mine affected and contained, no impoundment, extraction, discharge, injection, use or loss of surface water is expected. | 2.1 and 2.2 |
| 8.4.3 | Describe the options for supplying water to the project and assess any potential consequential impacts in relation to the objectives of any Water Plan and resource operations plan that may apply. | Raw water from BMA's existing surface water allocations will be piped to the Project Site to supply clean water for:<br>• makeup water to the CHPP<br>• supply to underground mining operations<br>• potable demands.<br>Project demand for raw water has been estimated through water balance modelling. | 4.4.3 |
| 8.4.5 | Develop hydrological models as necessary to describe the inputs, movements, exchanges and outputs of all significant quantities and resources of surface water and groundwater that may be affected by the project. The models should address the range of climatic conditions that may be experienced at the site, and adequately assess the potential impacts of the project on water resources. The models should include a site water balance. This should enable a description of the project's impacts at the local scale and in a regional context including proposed: | • A GoldSim water balance model for the Project has been developed.<br>• The water balance model simulates the life of mine under historical climate conditions and assumed operational rules. | 4.0 |

| ToR Reference | Information Requirement | Comment | Relevant Report Section(s) |
|---|---|---|---|
| 8.4.5.1 | Changes in flow regimes from diversions, water take and discharges. | • No new diversions are planned as part of the Project.<br>• Raw water will be sourced from BMA's existing surface water allocations.<br>• Project water storages have been provisionally sized to prevent to the need to conduct controlled releases of MAW under historical climatic conditions and assumed operational rules.<br><br>Refer to Environmental Impact Statement (EIS) Appendix E-1 Surface Water Quality Technical Report. | - |
| 8.4.5.2 | Alterations to riparian vegetation and bank and channel morphology. | Refer to EIS Appendix E-1 Surface Water Quality Technical Report and Appendix E-3 Hydraulics, Hydrology and Geomorphology Technical Report. | - |
| 8.4.5.3 | Direct and indirect impacts arising from the development. | Refer to EIS Appendix E-1 Surface Water Quality Technical Report and EIS Appendix E-3 Hydraulics, Hydrology and Geomorphology Technical Report | - |
| 8.4.5.4 | All of the above information is to be provided in a mine water management plan, for the life of the project, which details management strategies of mine-affected water, sediment-affected water and drainage from areas not disturbed by mining activities. | This report satisfies this requirement. | All |

# Figure 1 Project Location and Proposed Layout




**LEGEND**

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground layout (optimised)
- Transport and Infrastructure Corridor
- Surface Infrastructure
- Flare
- Vent
- Public Road
- Existing Railway
- 66kV Powerline
- Pipeline
- Rail Loop

**Surface Infrastructure**

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

**Figure 1**
**Project Location and Proposed Layout**

**Saraji East Mining Lease Project**

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 10/07/2020 VERSION: 1



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## 1.3 Methodology

The assessment was completed to address relevant requirements of the ToR as outlined in Section 1.2. Key steps undertaken include:

- identification and description the existing environment relevant to the conceptual Project mine water management system (WMS)
- identification of key objectives and considerations for the mine WMS
- development of the proposed mine WMS required to meet the key objectives and considerations
- validation of proposed mine WMS through water balance assessment
    - development of schematic for mine WMS
    - confirmation of mine plan and all model input data
    - development of and confirm water balance model
    - validation of proposed mine WMS meets outline key objectives and considerations.

## 1.4 Relevant legislation

Legislation and guidelines relevant to the proposed WMS are listed below. Additional legislation is listed in other sections of the EIS and should be read in conjunction with the information below.

### 1.4.1 Commonwealth policies

**Australian and New Zealand Guidelines for Fresh and Marine Water Quality**

The Guidelines (ANZECC 2000) provide recommended parameters for:

- water and sediment quality that will sustain the ecological health of aquatic ecosystems
- irrigation and general water use
- livestock drinking water
- aquaculture and human consumers of aquatic food
- waters for recreational activities, such as swimming and boating
- preservation of the aesthetic appeal of these waters.

**Water Stewardship – Leading Practice Sustainable Development Program for the Mining Industry (September 2016)**

The Leading Practice Sustainable Development Program (LPSDP) is managed by a steering committee chaired by the Australian Government Department of Industry, Innovation and Science. The LPSDP aims to provide practical approaches to improving mine water management and reducing water risk. Approaches include practising water stewardship and developing practical, fit-for-purpose mitigation measures.

The LPSDP has been developed for a broad audience, encompassing site and operational staff, and corporate management.

### 1.4.2 Queensland State Legislation and Policies

**Environmental Protection (Water) Policy 2009**

The quality of Queensland waters is protected under the Environmental Protection (Water) Policy 2009 EPP (Water). The EPP (Water) achieves the object of the *Environmental Protection Act 1994* (EP Act) to protect Queensland's waters while supporting ecologically sustainable development. Queensland waters include water in rivers, streams, wetlands, lakes, groundwater aquifers, estuaries and coastal areas.

The EPP (Water) seeks to protect and enhance the suitability of Queensland's waters for various beneficial uses. The Queensland Department of Environment and Science (DES) (previously the Department of Environment and Heritage Protection (DEHP)) hold responsibility for administering the EPP (Water).

**Water Act 2000**

The *Water Act 2000* (Water Act) provides a framework for delivering sustainable water planning, allocation management and supply processes, which will contribute to water security in Queensland. The Water Act and its instruments are administered by the Department of Natural Resources, Mines and Energy (DNRME). Water Plans (WPs) and Resource Operations Plans (ROPs) are governed by the Water Act.

WPs establish a framework for sharing water between human consumptive needs and environmental values. ROPs are developed in parallel with WPs and provide a framework by which objectives from the WPs are implemented, including water allocations and administrative directions.

The Water Act defines a watercourse as a:

- river, creek or stream in which water flows permanently or intermittently in a natural channel, whether artificially improved or not, or
- an artificial channel that has changed the course of the watercourse.

The Water Act lists approvals that are required for activities that interfere with a watercourse. The Water Act also sets out the law with respect to:

- rights to surface and groundwater
- control of works with respect to surface and groundwater conservation and protection
- irrigation, water supply, drainage and flood control.

Under the Water Act, an approval or licence is required for any works that may affect surface or groundwater. BMA will seek an EA with a condition permitting the impacts to surface and groundwater.

**Mineral Resources Act 1989**

The *Mineral Resources Act 1989* provides for the assessment, development and utilisation of mineral resources to the maximum extent practicable, consistent with sound economic and land use management. It provides for the issuing of permits, licences and leases relating to prospecting, exploration, mining and mineral development, and the granting of mining claims. It also provides for landholders affected by these activities to be compensated.

Section 50 (4) of the Act states that:

> *"Where any Act provides that water may be diverted or appropriated only under authority granted under that Act, the holder of a mining claim shall not divert or appropriate water unless the holder holds that authority"*

There are no new diversions planned as part of the Project; water will be managed through a series of existing diversion drains designed to contemporary standards to comply with regulatory requirements.

**Manual for Assessing Consequence Categories and Hydraulic Performance of Structures [ESR/2016/1933, 29/03/16]**

The Manual (March 2016) sets out the requirements of the DES, formerly DEHP (the administering authority), for consequence category assessment and associated design requirements of dams and levee structures, constructed as part of environmentally relevant activities (ERAs) under the EP Act.

**Structures which are Dams or Levees Constructed as Part of Environmentally Relevant Activities [ESR/2016/1934, 05/07/17]**

This guideline provides information about the procedures of the administering authority, for dealings involving dams and related containment structures, constructed as part of ERAs pursuant to the EP Act. This guideline should be read in conjunction with the manual described above. No new watercourse diversions or levees are proposed as part of the Project.

### 1.4.3 Other relevant guidance documents

**Water Accounting Framework for the Minerals Industry**

The water accounting framework (WAF) user guide (published 2014 - Version 1.3) provides an outline for reporting of site water management that allows site water managers to account for, report on and compare site water management practices in a rigorous, consistent and unambiguous manner that can easily be understood by non-experts. It has also been designed to align with frameworks for the Global Reporting Initiative (GRI) and Australian Water Accounting Standard (AWAS).

**Strategic Water Management in the Minerals Industry – A framework**

This framework sets out the strategic issues that mineral operations need to consider for responsible water management at a site, and corporate level in order to manage risks and identify opportunities for continuous improvement. It provides high level guidance in issues that should be addressed in developing water strategies, such as valuing water, strategic planning, implementation, and engaging framework.

## 1.5 Existing environment

### 1.5.1 Climate

Climate at the Project Site is classified as subtropical with a moderately dry winter (as per then Köppen Climate Classification). Climate data for the Project Site has been obtained from SILO Data Drill service (DSITI). The database consists of gridded data covering a 0.05 degree (latitude and longitude) grid. The database commenced on 1 January 1889. The database has been developed by interpolating data from the Bureau of Meteorology (BOM) recording station network.

The Data Drill, which was used to inform the mine water balance model (WBM, refer to Section 4.3.1) has also been used to derive a basic understanding of the existing climate at the Project Site. Table 4 and Figure 2 respectively show annual rainfall totals (based on hydrologic years: 1 October to 30 September) and monthly rainfall totals derived from the SILO Data Drill.

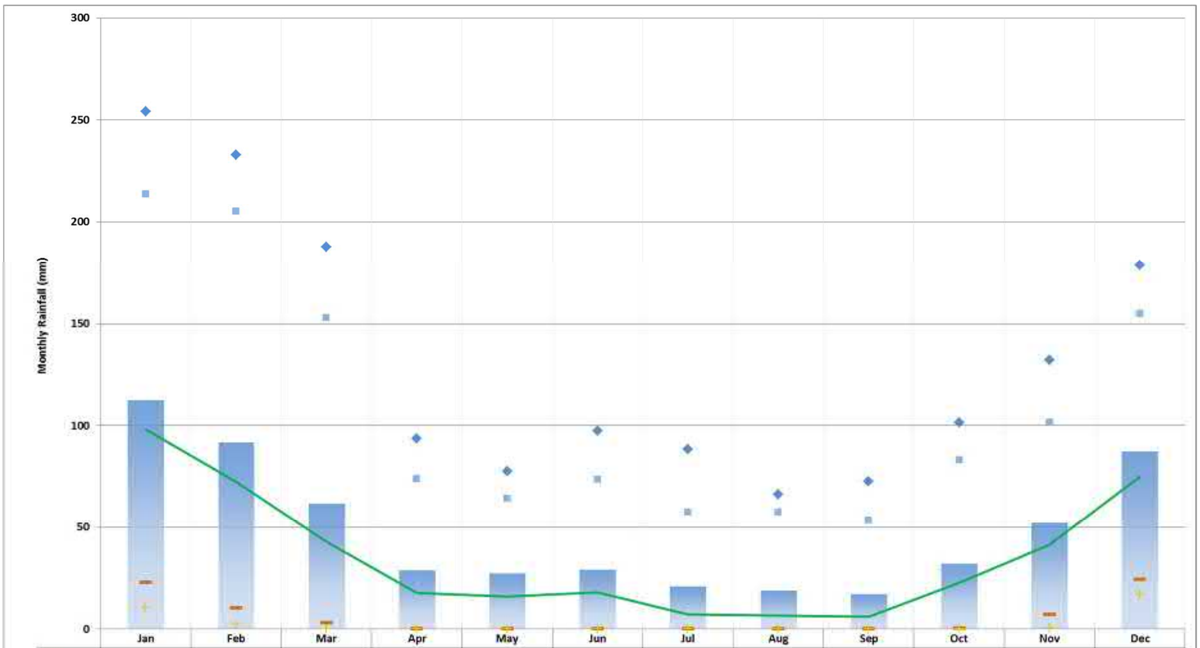
The existing climate at the Project Site can be summarised as follows:

Mean annual rainfall (Table 4) is approximately 580 millimetres (mm); however, total annual rainfall is relatively variable. The 5$^{th}$ and 95$^{th}$ percentile totals of 285 mm and 957 mm indicate that there is a 5% probability that total annual rainfall may be between 50% and 155% of the mean rainfall value.

- Monthly rainfall (Figure 2) shows a distinct seasonal distribution with well-defined wet season occurring from December through March. Approximately 60% (320 mm) of the median annual rainfall falls during this five month period.
- Mean monthly rainfall during the dry season months of April through October ranges from a minimum of around 17 mm per month in August, to a maximum of approximately 29 mm in April. Median rainfall for July, August and September is approximately 7 mm.
- Monthly rainfall variability during the wet season is high with the potential for both flood and drought. Variability is greatest during January where monthly total rainfall ranges from approximately 10.5 mm (5$^{th}$ percentile) to 254 mm (95$^{th}$ percentile).

**Table 4 Annual Rainfall (SILO Data Drill, 1889-2017, Hydrologic Years, 1st October to 30th September)**

| Statistic | Annual Rainfall (mm) | Per cent of Mean |
|---|---|---|
| Mean | 579 | 100% |
| 95th Percentile | 957 | 165% |
| 90th Percentile | 891 | 154% |
| Median | 537 | 93% |
| 10th Percentile | 384 | 66% |
| 5th Percentile | 285 | 49% |
| Standard Deviation | 190 | - |

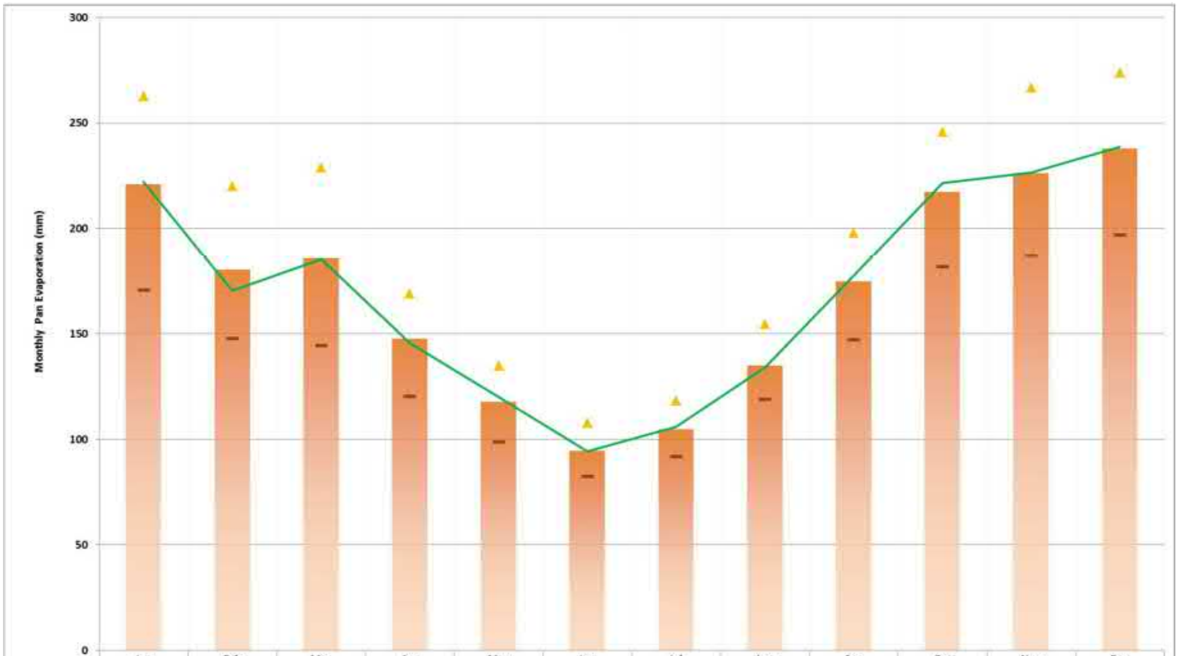



| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 112.2 | 91.7 | 61.8 | 28.6 | 27.2 | 29.1 | 21.0 | 18.8 | 17.0 | 31.9 | 52.0 | 87.4 |
| P95 | 254.1 | 232.8 | 187.8 | 93.6 | 77.6 | 97.3 | 88.5 | 66.2 | 72.7 | 101.6 | 132.1 | 178.8 |
| P90 | 213.7 | 205.2 | 152.9 | 73.8 | 64.3 | 73.5 | 57.5 | 57.6 | 53.4 | 83.2 | 101.5 | 154.7 |
| P50 | 98.1 | 72.6 | 42.8 | 17.6 | 16.1 | 18.1 | 7.3 | 6.8 | 6.0 | 22.8 | 41.2 | 74.9 |
| P10 | 22.7 | 10.3 | 3.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 7.2 | 24.2 |
| P5 | 10.5 | 2.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.6 | 17.1 |

**Figure 2 Monthly Rainfall (SILO Data Drill, 1889-2018)**

Figure 3 shows monthly pan evaporation data derived from the SILO Data Drill for the Project Site. The data can be summarised as follows:

- Monthly evaporation follows a broadly similar seasonal distribution to rainfall, with rates highest from October through March, and lowest from April through September
- The maximum monthly evaporation of 238 mm occurs in December, and the minimum monthly evaporation of 95 mm occurs in June
- By comparing this data with Figure 2, it can be seen that mean evaporation exceeds mean rainfall for all months. This indicates a strongly negative mean annual water balance.




| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | 221.1 | 180.5 | 185.9 | 147.8 | 118.1 | 94.8 | 104.9 | 135.0 | 175.0 | 217.5 | 226.2 | 237.8 |
| P90 | 262.7 | 220.1 | 229.0 | 168.9 | 134.9 | 107.9 | 118.2 | 154.6 | 197.8 | 245.8 | 266.7 | 273.6 |
| P50 | 222.2 | 170.3 | 185.4 | 145.4 | 120.0 | 94.3 | 106.0 | 134.1 | 177.5 | 221.5 | 226.4 | 238.8 |
| P10 | 170.6 | 147.6 | 144.3 | 120.3 | 98.6 | 82.2 | 91.7 | 118.9 | 146.9 | 181.5 | 186.8 | 196.9 |

**Figure 3 Monthly Pan Evaporation (SILO Data Drill, 1970-2017)**

### 1.5.2 Surface water environment

The Project Site is located within the Isaac River catchment, which is a key tributary of the Fitzroy River, the largest river catchment flowing to the eastern coast of Australia. The Fitzroy River discharges to the ocean in Keppel Bay, near Rockhampton, approximately 260 km from the Project Site. Its major tributaries are the Nogoa, Comet, Mackenzie, Isaac, Connors and Dawson Rivers and Callide Creek. The Isaac River, with a catchment area of approximately 22,365 km$^2$ represents 15.7% of the catchment area of the Fitzroy Basin.

A number of watercourses flow through the Project Site, including Boomerang Creek, East Creek, Plumtree Creek, Hughes Creek, Barrett Creek, One Mile Creek, Spring Creek and Phillips Creek (Figure 4). The underground mine footprint intersects only Boomerang Creek, Plumtree Creek and Hughes Creek, which flow easterly and onto the floodplain of the Isaac River.

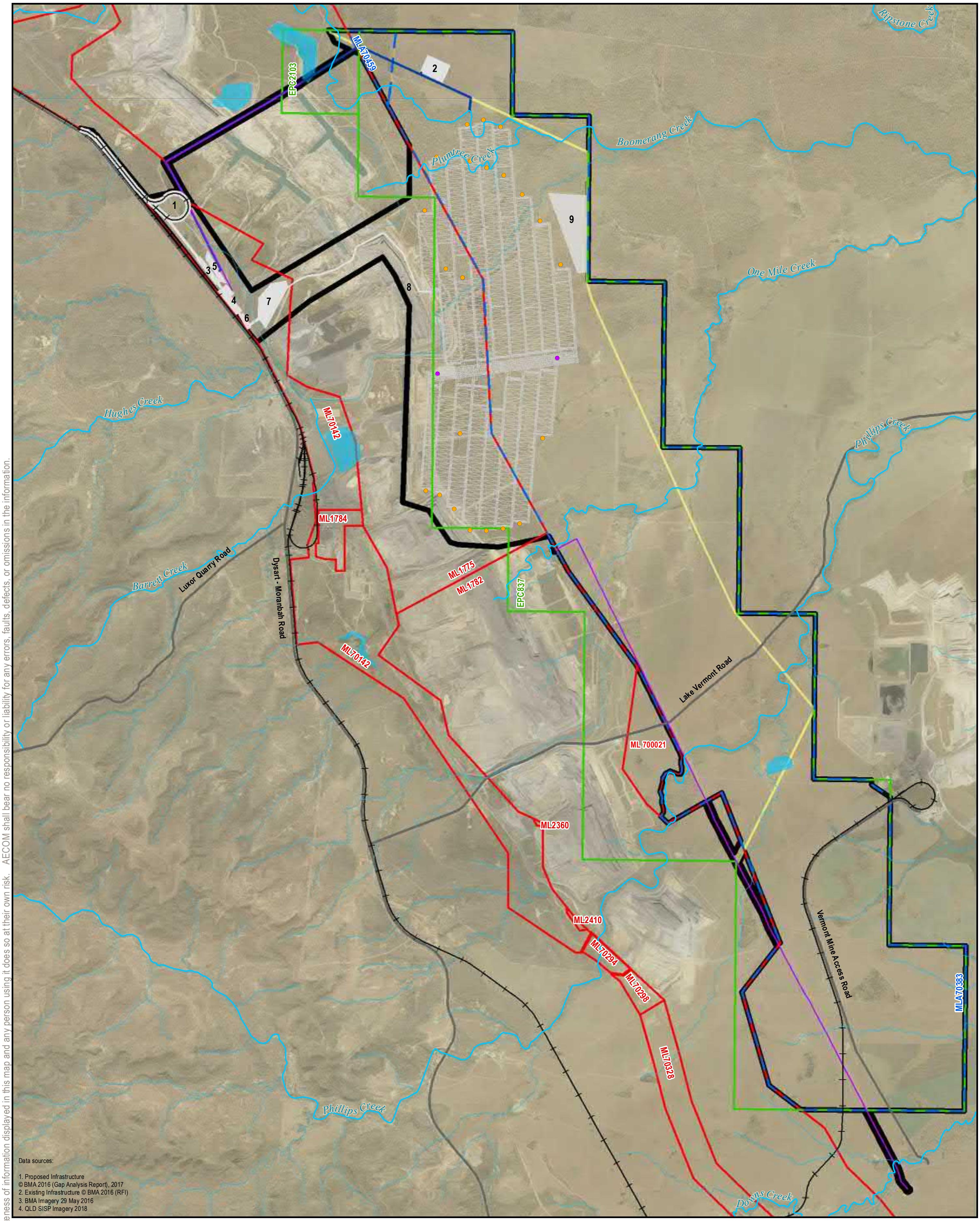
Existing open cut mining operations immediately west of the Project Site have modified the upstream catchment and landscape of the streams. Both Boomerang Creek and Hughes Creek flow through open cut MLs and contain diversion reaches. Plumtree Creek is a tributary of Boomerang Creek, commencing on the eastern edge of the Saraji Mine ML. Boomerang Creek and Hughes Creek converge approximately 1 km downstream of the Project.

Boomerang Creek and Hughes Creek commence in the Harrow Range west of Peak Downs Mine and Saraji Mine, where the upper reaches are relatively confined in narrow valleys. These upper catchments are much steeper, containing occasional scarps. As streams emerge from the range the valley widens and longitudinal slope decreases as they enter a broad, gently undulating floodplain.

Vegetation in the upper catchment is mostly continuous, while many of the flatter areas in the floodplain have been cleared for agriculture and grazing. Through the Project the streams flow within a wedge of woodland in a shallow valley contained by the last of the hillslope of the Harrow Range. Much of Hughes Creek has a very narrow strip of riparian vegetation along its southern bank where it abuts cleared land.

### 1.5.3 Water quality

Local receiving watercourses represent a ‘slightly to moderately disturbed’ (SMD) aquatic habitat. Receiving environment water quality data collected as part of BMA’s receiving environment monitoring program (REMP) indicates that water quality is above the guideline for a number of paramaters. Water quality in the receiving environment is described in more detail in Appendix E-1 Surface Water Quality Technical Report of the EIS (AECOM, 2021).




**LEGEND**

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground layout (optimised)
- Transport and Infrastructure Corridor
- Surface Infrastructure
- Flare
- Vent
- Minor Waterway
- Major Waterway
- Public Road
- Existing Railway
- 66kV Powerline
- Pipeline
- Rail Loop
- Lake / Reservior

**Surface Infrastructure**

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

# Figure 4
## Surface Water Environment

**Saraji East Mining Lease Project**

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 10/07/2020 VERSION: 1

# 2.0 Conceptual water management system objectives and considerations

The purpose of the Project conceptual mine WMS is to examine and address all issues relevant to the importation (of raw water), generation, use, and management of water on the Project Site. The objective of the WMS is to minimise the quantity of water that is contaminated and released by Project activities. This will broadly be achieved by:

- managing the generation, storage, distribution, and reuse of all potentially MAW (including groundwater) captured and generated by the Project
- handling the conveyance of natural runoff originating from undisturbed clean catchments through the Project Site
- managing the storage and distribution of raw water.

The development of the Project conceptual mine WMS has been guided by a set of key objectives based on information provided by BMA, previous studies, best management practice for the management of MAW, and previous experience with coal mines in the Bowen Basin.

## 2.1 Key mine water management system objectives

### 2.1.1 Segregation of waters based on source and assumed quality

Consistent with current practices for mine water management, it is intended, wherever practicable and achievable, to passively divert runoff originating from undisturbed catchments around the mine WMS. The exclusion of clean, uncontaminated runoff will reduce the volume of MAW generated onsite, which requires additional containment and management. Disturbed areas within the mine WMS have been assumed to include all mine process areas as well as the catchment reporting to the underground mine portal developed. This will be located in the highwall of the existing open cut pit.

The use of catchment drains, bunding and other devices will be used wherever feasible and practicable to reduce the risk of clean water flows from entering the mine WMS. Table 5 summarises requirements and assumptions that relate to achieving the stated objective for the segregation of water based on its assumed quality.

**Table 5 Proposed segregation of water**

| Disturbed Mine Area | Aspect | Assumption |
|---|---|---|
| All mine process areas:<br>• Stockpile areas (both product and ROM coal)<br>• CHPP<br>• MIA | Collection and containment of mine affected runoff. | It has been assumed that the design of the mine process areas (by others) will allow for all potentially mine affected runoff to be directed to a common point for collection in the associated collection dams for subsequent transfer to the process water dam. |
| Underground mine portal entrance located in the highwall of the existing open cut pit. | Collection and containment of mine affected runoff originating from the external catchment reporting to the portal entry sump. | Runoff from the catchment area reporting to underground mine portal will be collected in a sump that will also act as a pump stage for underground mine dewatering. It is assumed that the external catchment area currently reporting to the existing open cut pit will be minimised as far as practical by:<br>• re-profiling of the backfilled spoil and overburden material currently occupying the pit<br>• the use of roll-over bunding for all entry roads<br>• high wall check dams and diversion drains. |

### 2.1.2 Minimise volumes of MAW generated and stored onsite

Potential volumes of MAW generated onsite will be minimised wherever possible and stored volumes of MAW will be preferentially sourced to satisfy those Project water demands for which reuse of MAW is suitable. The following assumptions have been made in the development of the Project conceptual mine WMS:

- MAW from the stockpile dams (ROM and product coal), CHPP dam, MIA dam and the portal sump will be transferred to the single process water dam which is the primary storage for MAW
- In order to ensure the containment capacity at each collection is maximised, MAW is assumed to be transferred to the process water dam as soon as it is received. This will reduce the likelihood of an uncontrolled (spillway) discharge of MAW being triggered by additional inflows from subsequent storm events.
- MAW stored onsite (primarily in the process water dam) will be preferentially sourced for site water demands wherever possible. This serves to provide a continual draw on the stored inventory of MAW, thus ensuring that the capacity to receive future inflows is optimised and reliance on an external raw water source is minimised. The process water dam therefore acts as the primary source of water for CHPP process demand, and stockpile and haul/light vehicle (LV) road dust suppression.
- Raw water will be stored onsite in the Raw Water Dam (RWD) and will be used to satisfy those Project water demands for which reuse of MAW is unsuitable (e.g. potable, underground mine and firefighting water) or when the stored inventory of MAW has been exhausted
- Wherever practical and achievable, runoff diversion bunds will be constructed around key mining infrastructure to reduce clean runoff originating from undisturbed catchment runoff entering these areas and potentially becoming mine affected.

### 2.1.3 Containment and release of MAW

A conservative approach has been taken towards controlled and uncontrolled releases of MAW from the Project. Preliminary capacity estimates for all dams and the water transfer network (using the water balance assessment described in Section 4.0) within the Project conceptual mine WMS have been based on the containment of all potential inflows using historical climate data and under a set of assumed operational rules. This conservative approach ensures that:

- Infrastructure capacity and operations capability are sufficient to mitigate the uncontrolled (spillway) discharge of MAW to the receiving environment
- The Project has sufficient storage capacity to cater for maximum mine water volumes that could occur (based on climate extremes evident in available historical data)
- Water allocations of external water sources are sufficient to meet shortfalls in site demands
- Based on the water balance model outcomes, controlled releases of MAW to the receiving environment are not required.

The proposed WMS has been designed with adequate capacity to avoid releases. The preliminary dam capacities presented herein are relevant to the input data, assumptions and adopted operational rules. However, any open system has the potential for uncontrolled discharge of MAW as a result of extreme rainfall events. As such, BMA will seek authority and licence conditions to conduct the controlled release of MAW from the Project site. The indicative location for controlled release of MAW is located on Boomerang Creek adjacent to the proposed process water dam (Figure 6). Spillway discharges (uncontrolled) from the process water dam are also proposed to be directed to Boomerang Creek.

Spillway (uncontrolled) discharges from the remaining process area dams will be directed to the receiving environment based on existing topographical constraints. Where dam overflow locations cannot deliver flows directly to Hughes Creek or its tributaries, conveyance channels are proposed to convey the discharge.

Section 7.2.1 of Appendix E-1 Surface Water Quality Technical Report (AECOM, 2021) includes a risk-based assessment of potential impacts from hypothetical MAW releases into the environment. These impacts are analysed for three climate scenarios (dry, normal and wet conditions), based on:

- Expected MAW water quality characteristics (based on water balance modelling results and data from existing release at Saraji Mine)
- Expected receiving environment water quality characteristics (based on existing REMP data at Boomerang Creek)
- Data from historical MAW release events at Saraji Mine from 2016 to 2017, showing changes to salinity and pH levels in the receiving environment based on grab samples taken during the events

This assessment indicates that impacts from managed MAW release during normal climate conditions will be similar to those from MAW releases from the current Saraji operations, which comply with the regulator requirements set out in Environmental Authority conditions. Additionally, the same assessment shows that impacts from hypothetical releases during dry or wet climate conditions are expected to be negligible.

#### 2.1.4 Water transfer system

The water transfer network provides the ability to move MAW from the various collection dams to the process water dam, as well as the subsequent transfer of MAW to the various consumptive demand points (e.g. CHPP and dust suppression uses). The operating rules for the WMS have been developed in support of the other mine WMS objectives. They are summarised as follows:

- Inflows to the various collection dams will be transferred to the process water dam as soon as practical, provided capacity is available in the process water dam. This will ensure that the containment capacity of each collection dam is maximised.
- Nominal pump capacities will be selected to ensure that pumped transfers from each collection dam to the process water dam are sufficient to support the above objective.

## 2.2 Conceptual mine water management system considerations

#### 2.2.1 Mine progression

The proposed underground mining method employed by the Project, as well as the absence of any surface spoil dumps and out of pit tailings storage facilities (TSFs), allows for a static assessment of the conceptual Project mine WMS. Disturbed catchment areas reporting to the WMS have therefore been assumed as fixed for the operation of the mine. Refer to Section 4.2.2 for details of Project catchment areas.

The estimated rate of mine dewatering is a function of the development and progression of the underground mine workings. Therefore, the estimated dewatering volumes (refer to Section 4.3.3) vary throughout the operation of the mine.

#### 2.2.2 Sources of potentially MAW

Sources of potentially MAW have been assumed as follows:

- Process area runoff –surface runoff associated with the following areas is assumed to be mine affected and will be contained at each respective source and transferred to the process water dam:
  - ROM coal stockpile pad
  - product stockpile pad (including the train load out)
  - CHPP and MIA areas
  - catchment reporting to the underground mine portal located in the existing open cut pit.
- Groundwater – water from both the bore field and underground mine dewatering is assumed to be mine affected and will be transferred to the process water dam as soon as practical. Dewatering

of the underground mine will initially discharge to the portal sump. From there it will be transferred to the process water dam.

- Underground mining operations process return water– water reclaimed from underground mining operations is assumed to be mine affected and will similarly be initially discharged to the portal sump and from there transferred to the process water dam.

### 2.2.3 MAW demands

All mine consumptive water demands for which MAW is suitable (CHPP process demand and dust suppression) will be preferentially supplied with MAW from the process water dam. This is in line with current management practices for reducing reliance on an external water supply. It also provides a continual draw on stored inventories of MAW, thereby increasing storage potential for future inflow events. A detailed breakdown of water demands for the Project Site is provided in Section 4.3.5.

Under normal operating conditions, the Project mine water system will operate independently of the existing Saraji mine water system. However, should sufficient MAW not be available for CHPP process and dust suppression at the Project, this may be imported from the existing Saraji Mine water system, following water quality testing to confirm that water is of an appropriate quality for the intended use. Similarly, where additional water demands at the existing Saraji Mine need to be met, water that satisfies water quality testing may be exported from the Project.

### 2.2.4 Raw water supply

The Project's raw water supply will be linked to the existing Saraji Mine water management system. While it is planned to reuse MAW whenever possible, raw water is still required for those consumptive demands for which MAW is unsuited or for when supplies of MAW are unavailable.

BMA holds contractual rights to approximately 10,000 ML/yr of water from the Burdekin Pipeline (owned by SunWater) as a supply source for BMA operations in the vicinity of Moranbah. In addition, BMA has a water allocation of 6200 ML/yr from the Eungella Dam that is also available for use in BMA operations in the Moranbah vicinity. In securing its water rights, BMA has allowed for the current and potential future use of water from these sources at the Saraji Mine and for growth options associated with MLA 70383.

In relation to the proposed activities on MLA 70383, BMA will prepare, update and maintain a Water Management Plan.

The Plan will recognise that water to be used for Project operations will be sourced via an off-take from the existing water pipelines developed to support BMA's current and future mining operations, along with various other purposes. Further, this Plan will recognise that water will be sourced from the Eungella Dam and/or the Burdekin Pipeline. The Project will have an internal BMA allocation to draw water from as part of the BMA-related water allocations.

These allocations are held by BMA directly or indirectly via contractual arrangements with SunWater in accordance with the Burdekin Water Resource Plan and the Water Act.

The key demands for raw water are:

- all underground mining demands
- potable water for domestic requirements
- makeup CHPP process water and dust suppression when stored supplies of MAW are unavailable.

### 2.2.5 Water treatment within the mine water management system

For the current scope, no quality restrictions have been placed on the reuse of MAW by the CHPP or for dust suppression. Where potential quality restrictions may arise it is expected that the blending of raw and MAW could be conducted to achieve the desired quality.

A small potable water treatment plant (WTP) will be installed at the MIA for the treatment of raw water for potable use. This water will be transported to storage tanks at each demand location as required.

A sewage treatment plant will be installed to service the MIA and the construction accommodation village to treat all site sewage generated. Sewage from the CHPP area and from the washdown facilities at the mine portal will be pumped back to the MIA. The sewage treatment plant will be designed to provide sufficient capacity for the construction and operation workforce. Treated effluent from the sewage treatment plant and the water treatment plant will be captured and stored on site at the process water dam and used for dust suppression.

### 2.2.6 Groundwater inflows

Groundwater inflow to the mine WMS will be through dewatering (groundwater inflows as well as collection of underground mining process return water) of the underground mine, and from the proposed gas drainage bore field. The quality of groundwater is expected to be suitable for re-use by the Project's consumptive demands (CHPP and dust suppression). It will be pumped to the underground mine portal sump prior to transfer to the process water dam. Refer to Section 4.3.3 for estimated rate of groundwater and gas drainage inflow volumes expected during the operation of the mine.

### 2.2.7 Consequence category for dams

A preliminary consequence category assessment has been completed for all proposed Project dams as per guidance provided by the DES (formerly DEHP) *Manual for assessing consequence categories and hydraulic performance of structures* ('the Manual', version March 2016) (refer Table 6).

**Table 6 Preliminary Consequence Category Assessment for the Project WMS MAW Storages**

| Dam | Harm to humans | | | General Environmental Harm | | | General Economic Loss or Property Damage | | | Overall Hazard Category |
|---|---|---|---|---|---|---|---|---|---|---|
| | FC-S | FC-O | DB | FC-S | FC-O | DB | FC-S | FC-O | DB | |
| Process water dam | L | L | L | L | S | S | L | L | L | S |
| Underground Mine Portal Sump | L | L | L | L | L | L | L | L | L | L |
| CHPP Dam | L | L | L | L | S | S | L | L | L | S |
| Product Coal Stockpile Pad Dam | L | L | L | L | S | S | L | L | L | S |
| ROM Coal Stockpile Pad Dam | L | L | L | L | S | S | L | L | L | S |
| MIA Dam | L | L | L | L | S | S | L | L | L | S |

FC-S = Failure to contain – Seepage
FC-O = Failure to contain – Overtopping
DB = Dam Break
L = Low Consequence
S = Significant Consequence
H = High Consequence

The preliminary consequence category classifications reflect the following considerations for the conceptual mine WMS infrastructure:

- 'Significant' consequence category classification has preliminarily been assigned to the process water dam on the basis of:
  - Harm to humans:
    - Under the dam break scenario the consequence category is provisionally considered *low* due to the lack of public infrastructure (roads, rail, waterway crossing, etc.) or private homesteads within a reasonable distance from the proposed process water dam location
    - The consequence category from the failure to contain seepage scenario is provisionally considered *low* as it is assumed that all mine WMS dams will be constructed with a suitable leak prevention system
    - The consequence category resulting from the overflow scenario is provisionally considered *low* as any possible downstream contamination would likely result in less than 10 people being affected

- General environment harm:
  - Under both the overflow and dam break scenarios, the likely quality of water stored in the process water dam could result in environmental harm
  - The consequence category from the failure to contain seepage scenario is provisionally considered *low* as it is assumed that all mine WMS dams will be constructed with a suitable leak prevention system
- General economic loss or property damage:
  - Under both the overflow and dam break scenarios the consequence category is provisionally considered *low.* Estimated economic damage to third party assets (e.g. downstream use for stock watering) would be expected to require less than $1 million in rehabilitation, compensation or rectification costs.
  - The consequence category from the failure to contain seepage scenario is provisionally considered *low* as it is assumed that all mine WMS dams will be constructed with a suitable leak prevention system

• 'Significant' consequence category classification has preliminarily been assigned to all process areas dams on the basis of:
  - General environment harm:
    - Under both the overflow and dam break scenarios, the likely quality of water stored in the process area dams could result in environmental harm
    - The consequence category from the failure to contain seepage scenario is provisionally considered *low* as it is assumed that all mine WMS dams will be constructed with a suitable leak prevention system
  - Harm to humans and general economic loss or property damage:
    - Process area dams are provisionally considered to be *low* consequence category.

As per the *Manual for assessing consequence categories and hydraulic performance of structures*, dams assessed as being in the significant or high consequence category for the failure to contain (overtopping) scenario are required to incorporate a number of hydraulic performance criteria as outlined in Table 7 below. As the Project design progresses a more detailed failure impact assessment (FIA) will be conducted to confirm consequence categories for all Project storages.

**Table 7 Preliminary Hydrological and Hydraulic Design Criteria for Mine WMS Dams**

| **Failure to Contain - Overtopping** | | |
|---|---|---|
| Consequence Category | Wet Season Containment (Design Storage Allowance (DSA)) | Storm Event Containment (Extreme Storm Storage, ESS) |
| Significant | 1:20 wet season volume | 1:10 AEP 72hr duration |
| **Failure to Contain – Dam Break** | | |
| Consequence Category | Flood Passage - Spillway Event Capacity | Flood Level for Embankment Crest Level |
| Significant | 1:100 AEP to 1:1,000 AEP | Spillway design flood peak level + wave run-up allowance for 1:10 AEP wind. |

#### 2.2.7.1 Design storage allowance

Based on the preliminary hydraulic performance criteria shown in Table 7, each significant consequence dam is required to incorporate a nominated storage capacity which includes a Design Storage Allowance (DSA). This is the storage volume to be made available in each dam upon the commencement of the wet season (1 November) each year. The DSA is the sum of all catchment runoff, direct rainfall over the dam and process water inflows over the critical wet period (three month) and assuming no evaporative or runoff losses.

Using the method of deciles as outlined in the Manual, DSA depths for the Project have been estimated (refer to Figure 5) as:

- significant consequence category – 612 mm
- high consequence category – 801 mm.

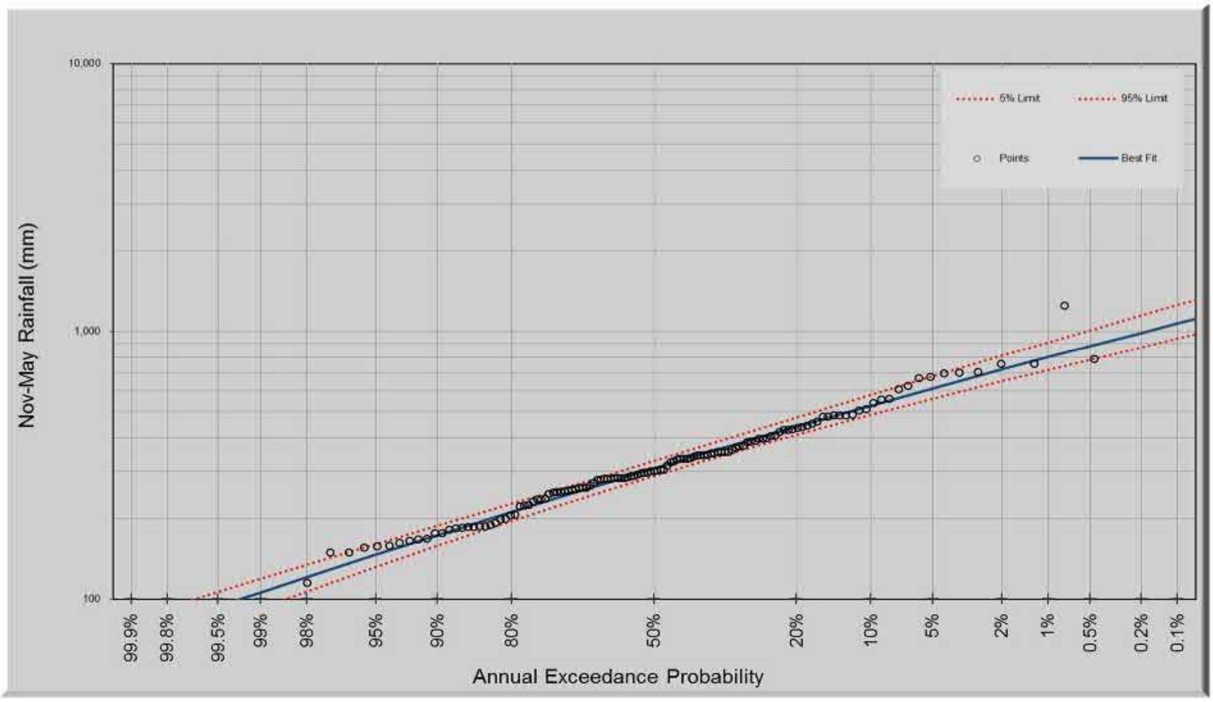



**Figure 5 Design Storage Allowance Estimation – Method of Deciles (Log Pearson Type 3) SILO Data Drill 1889-2018**

### 2.2.7.2 Extreme storm storage mandatory reporting Levels

The extreme storm surge (ESS) provides a nominated containment volume that can be held within the dam prior to spillway discharge. The Mandatory Reporting Level (MRL) is then the maximum volume that the dam can reach and still contain the ESS without a spillway discharge occurring. The volume of the ESS is estimated by determining the total storm event inflow (assuming no runoff losses) for the 72-hour duration storm at the adopted AEP (1:20 or 1:100) relevant to the dam's consequence category. Using Intensity Frequency Duration (IFD 2016) data obtained from the BoM online IFD service, ESS depths for the Project have been estimated as:

- significant consequence category – 224 mm
- high consequence category – 328 mm.

Due to the current level of design progression the ESS wave run-up has not been included; however, this will be a requirement of future stages of the Project design. Table 9 provides a summary of the preliminary hydrological design criteria for relevant Project mine WMS dams.

### 2.2.7.3 Underground mine portal sump immunity

Potential 1,000 year AEP storm event volumes reporting to the underground mine portal sump are shown in Table 8. Rainfall depths were estimated using CRC Forge. The design and configuration of the underground mine portal and sump are subject to ongoing design and therefore the volumes shown (which are based on a reporting catchment area of 56 ha (refer to Figure 6) are provided for reference only.

**Table 8 Estimated 1,000 Year AEP Storm Event Volumes Reporting to Portal Sump**

| 1,000 Year AEP Event Duration (hrs) | Total Rainfall Depth (mm) | Estimated Storm Volume (ML) |
|---|---|---|
| 24 | 339.6 | 190 |
| 48 | 392.8 | 220 |
| 72 | 437 | 245 |

**Table 9** **Mine WMS Dams Preliminary Hydrologic Design Criteria Summary**

| Mine WMS Dam | Configuration | Catchment (Ha) | | Preliminary Consequence Category | Required DSA and ESS AEP | Preliminary Dam Capacity (ML) | Preliminary Hydrological Design Criteria (ML) | | | Preliminary Overflow Destination |
|---|---|---|---|---|---|---|---|---|---|---|
| | | External | Total | | | | ESS | Dam Vol. Equivalent to MRL[2] | DSA | |
| **Process water dam** | Turkey's Nest (pumped inflows) | N/A | 17.9 | Significant | 1:20 | 1,050 | 40 | 1,010 | 109 | Hughes Creek via unnamed tributary |
| **CHPP dam** | Partially Excavated (gravity inflows) | 7.3 | 9.7 | Significant | 1:20 | 80 | 21 | 59 | 58 | |
| **Product coal stockpile pad dam** | | 11.0 | 15.1 | Significant | 1:20 | 135 | 33 | 102 | 91 | |
| **ROM pad dam** | | 4.4 | 6.1 | Significant | 1:20 | 45 | 13 | 32 | 37 | |
| **MIA dam** | | 8.8 | 11.4 | Significant | 1:20 | 100 | 25 | 75 | 69 | |

[2] Due to the preliminary nature of the assessment the level of the MRL is currently unknown and has been given as the equivalent dam volume

# 3.0 Proposed mine water management system components

## 3.1 Process water dam

One large process water dam is proposed for the Project (refer to Figure 6) to provide the storage required to contain the estimated volume of MAW generated over the operation of the mine. The process water dam will be constructed as a turkey's nest storage with minimal external catchment area. However, the exact nature of the dam design will be determined through later dates of the design progression.

The conceptual design and operational rules applied to the process water dam for the assessment are:

- Water will be transferred to the process water dam following localised containment and collection in one of the various process area runoff dams or sumps located around the Project Site
- The process water dam will be used to preferentially supply water to various consumptive water demands for which the reuse of MAW is appropriate (CHPP process supply, dust suppression)
- In the event of a spillway discharge from the process water dam, water will, as far as practical, be directed via existing drainage pathways to the receiving environment (Figure 6).

## 3.2 Process areas runoff collection system

Runoff from several operational areas and facilities is expected to potentially generate MAW. It is proposed that runoff originating from these areas be collected in dams assigned to each location via gravity inflow. Process areas within the Project are the CHPP, the ROM pad and product stockpile.

Conceptual design and operational rules for the process area runoff collection system applied within the assessment are:

- Runoff from each process area will be conveyed by gravity flow to its respective containment dam. Pumping of runoff to the containment dams is not considered practical due to the high degree of variability in rainfall volume and intensities.
- Potentially clean runoff originating outside of the process areas will, as far as practical, be passively diverted around the process areas by way of catch drains as required to reduce the total volume of water requiring containment
- Water will be transferred from each process area dam to the process water dam as soon as possible in order to ensure that capacity to contain additional inflows is maximised
- In the event of a spillway discharge from any of the process area dams, water will, as far as practical, be directed via existing drainage pathways to the receiving environment (Figure 6).

## 3.3 Portal sump

Both groundwater ingress and process return water are considered to be mine affected and will be collected as required within the underground mine and pumped to the Portal Sump located in the existing pit. In addition, incidental water captured via the advanced gas drainage bore field is also considered to be potentially mine affected and will therefore also be transferred to the Portal Sump. Stormwater runoff from the portal entry ramps as well as any additional runoff generated within pit is similarly considered to be mine affected and will also be collected in the Portal Sump

Conceptual design and operational rules for the Portal Sump are as follows:

- Pumped inflows to the portal sump will come from dewatering of the underground mine (groundwater ingress and process effluent) and from the gas drainage bore field
- Runoff from the underground mine portal ramp and pit will enter the Portal Sump via gravity inflow
- Water will be transferred from the Portal Sump to the process water dam as required.

## 3.4 CHPP process and dust suppression water supply

It is proposed that processing and washing of coal will be conducted onsite with the Project CHPP located within ML 70142. The CHPP will be designed to progress ROM coal at a rate of 800 tonnes per hour (tph), equivalent to a yield up to 5 Mtpa of metallurgical product coal (or 7 Mtpa of ROM coal) which will be delivered to the train load out bin at a rate of approximately 4,500 tph. The CHPP will require a raw water supply of approximately 1500 ML/yr to achieve this production rate. Water will be preferentially sourced from the process water dam in line with the objectives stated in Section 2.0.

The use of the existing Saraji Mine CHPP will be used for processing Project coal in years where ROM tonnes exceeds 7 Mtpa.

Water for dust suppression (e.g. haul roads and stockpiles) will also be preferentially sourced from the process water dam in line with objectives stated in Section2.0.

Conceptual design and operational rules for the CHPP process and dust suppression water supply are as follows:

- reuse of MAW to be prioritised over raw water use whenever sufficient supply available in the process water dam
- dust suppression demand reduced to zero when daily rainfall exceeds evaporation
- no quality restrictions have been imposed on reuse of MAW.

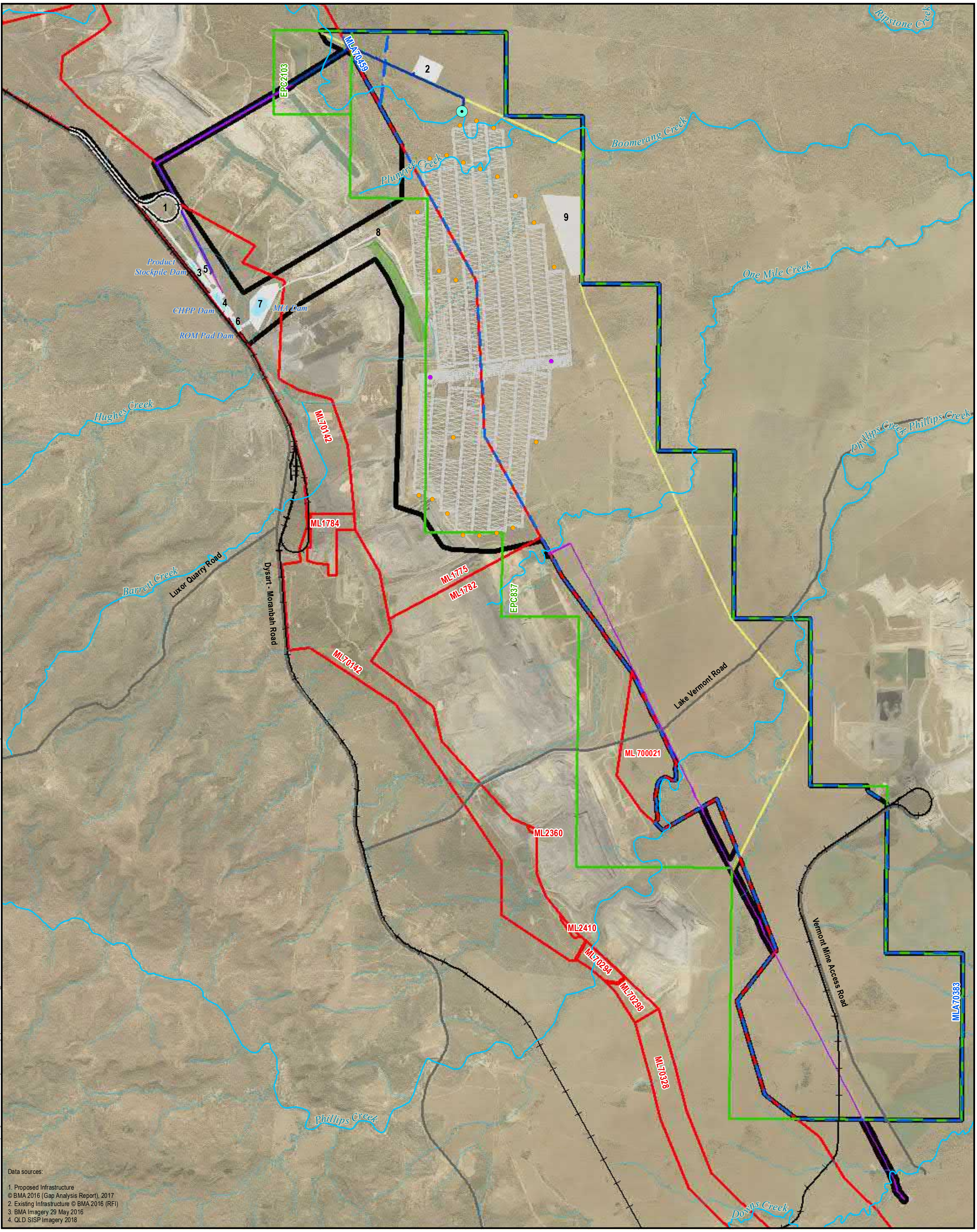
## 3.5 Rejects and tailings management

All reject and tailings material will be disposed of via a dry disposal system and managed via trucking to the existing Saraji Mine’s in-pit spoil dumps. Therefore, reject and tailings material has been not considered in this document.

## 3.6 Raw water system

To supply Project water demands for which reuse of MAW is unsuited (potable, washdown, underground mine process), or for when MAW is unavailable, a raw water dam (RWD) is proposed for the Project Site. The conceptual sizing of the RWD is such that it can provide approximately one month’s supply of water for all Project water demands including potable, processing and operations in the absence of alternative sources such as the re-use of MAW. The provisional location of the RWD is shown on Figure 6.

As described in Section 2.2.5, it is proposed to capture the WTP effluent waste stream (as well as the treated STP effluent) in the process water dam and use it for dust suppression on the Project Site. Therefore, WTP effluent has not been considered in the water balance assessment.




**LEGEND**

- Project Site
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
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- Underground layout (optimised)
- Transport and Infrastructure Corridor
- Surface Infrastructure
- Indicative Proposed Mine Water Release Point
- Flare
- Vent
- Public Road
- Existing Railway
- 66kV Powerline
- Pipeline
- Rail Loop
- Minor Waterway
- Major Waterway
- Indicative Dam Location
- Bauhinia Pit Portal Sump Catchment

**Surface Infrastructure**

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

## Figure 6
## Location of Key Water Management Infrastructure and Portal Sump Catchment

**Saraji East Mining Lease Project**

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 24/07/2020 VERSION: 1



Filename: \\aubne1fp003\Projects\605X\60507031\4. Tech Work Area\4.99 GIS\02_MXDs\06 Environmental Impact Statement\E-2 Mine Water Balance Report\60507031_G173_v1_A4P_F_6_KeyWaterMngtInfrastructurePortalPumpCatch.mxd

# 4.0 Assessment of proposed conceptual mine water management system

## 4.1 Model development

A dynamic water balance model (WBM) was developed for the Project using Goldsim probabilistic modelling software. GoldSim is a Monte Carlo simulation software package that is commonly used in the mining industry for water balance modelling. The purpose of the water balance assessment is to validate the proposed mine WMS under a range of historical climatic conditions, with the aim of:

- estimating the potential quantity and quality of MAW that may be generated by the Project throughout the operation of the mine
- estimating the storage capacity required for each of the WMS dams to meet the stated MAW containment objectives
- confirming that the proposed operational rules are supportive of the proposed MAW containment reuse objectives
- identifying the required transfer capacities to move MAW around the mine WMS so that containment, productivity (CHPP operations) and reuse objectives are met
- estimating the potential volumes of raw water required to satisfy Project consumptive demands that either:
  - cannot be satisfied through the reuse of MAW, or
  - when stored volumes of MAW are unavailable following periods of prolonged drought
- developing an understanding of the potential risk of overflow to the receiving environment.

## 4.2 Model description

The WBM has been developed to dynamically simulate the entire 20 year production schedule (operation of the mine). This allows for key model inputs such as climate data, water demands, groundwater inflow, etc. to vary with each simulated mine year. In this manner, the WBM provides for a more representative simulation of the Project as it allows for ready identification of critical WMS stress points such as maximum containment requirements and peak raw water demand.

### 4.2.1 Modelling approach

In order to validate the performance of the proposed mine WMS under a range of historical climatic conditions, multiple simulations (known as realisations) of the 20-year production schedule were performed. The only difference between each realisation was the input climate data (rainfall and evaporation) which consisted of 128 years (1889 to 2017) of data obtained from the BoM SILO Data Drill (refer to Section 4.3.1).

Running on a daily timestep, the first model realisation simulates the proposed 20 year production schedule utilising climate data from 1889 to 1914. The second realisation then utilises climate data from the period 1890 to 1915, the third from 1891 to 1916, and so on. This process allows for a total of 129 model realisations (known as a Monte Carlo simulation) to be run from the available climate data and has multiple benefits such as:

- each year of the mine is effectively modelled for each year of the available climate data such that all potential stress points are simulated under the full range of historical climatic conditions
- the cyclical nature of consecutive above average wet seasons that are present in the climate data are more readily captured and their impact on the proposed mine WMS assessed.

Key simulation assumptions are summarised in Table 10.

**Table 10 Key Simulation Assumptions**

| Aspect | Assumption |
|---|---|
| Length of simulation | Life of mine, 20 years |
| Simulation type | Probabilistic |
| Number of realisations | 128 |
| Start/end months for year | Simulation based on hydrological year (1 October to 30 September) |
| Dam initial conditions | • Process water dam – 525 ML (50% of capacity)<br>• All Process area dams – 2 ML (nominal dead storage volume)<br>• Pit sump – 150 ML (nominal dead storage volume). |

### 4.2.2 Key assumptions

The WBM has been developed to a level of complexity commensurate with the level of available data and Project design progression. A variety of simplifications and assumptions were made as follows:

- mine plan:
  - the groundwater inputs have been assessed through modelling which assessed a maximised underground layout
  - no additional land disturbances are required beyond those completed to develop the project prior to the start of operations
  - runoff from all process area dams (ROM pad and product stockpile, CHPP, MIA and underground mine portal) dams with an external catchment will enter via gravity inflows
  - to the greatest extent practical it is assumed all runoff from undisturbed areas within the Project Site will be diverted around the mine WMS
- mine operations:
  - pumped transfers occur 'instantly' within each water balance model timestep (i.e. daily) and are based on specific transfer rules
  - no allowance is made for the time taken for water to actually move from one location to the next and pump availability is assumed to be 100% of potential capacity for 100% of the time
  - pump capacity remains fixed irrespective of head differential in dams due to draw down
  - water transfer rules prevent the transfer of water to another dam if the destination dam has insufficient capacity
  - no quality restrictions have been placed on the reuse of MAW for either CHPP or dust suppression use
  - no restrictions have been placed on the availability of raw water and the model is able to draw whatever amount is required
  - model inputs for mine consumptive water demands have been based on rates provided by BMA
- environmental considerations:
  - performance of the mine WMS was assessed on the basis of historical climate data however the potential changes to climatic extremes resulting from climate change have not been considered
  - evaporative water losses from all dams has been estimated to be 70% of Class A Pan evaporation
  - all dams have been assumed to be fully lined and no seepage losses have been considered
  - potential loss of dam storage capacity over time due to sedimentation has not been considered.

### 4.2.3 Rainfall - runoff sub-model

In order to estimate the potential volumes of runoff entering the proposed mine WMS, the WBM utilises the Australian Water Balance Model (Boughton, 1993). The AWBM was selected for this purpose due to its simplicity, widespread usage in many similar applications and ease of parameterisation and calibration. This conceptual rainfall-runoff model uses three independently balanced surface stores to simulate partial areas of rainfall excess. The excess rainfall is then divided into surface and baseflow stores which are then allowed to discharge at rates governed by their respective recession constants.

In order to reflect the differences in land use, potential for contamination and runoff depth within the Project, the WBM utilises a number of different land use types as detailed in Table 11. Each utilises the AWBM to simulate the different volumes of runoff generated by each land use and is managed within the mine WMS according to its assumed quality (refer section 4.3.4).

**Table 11 AWBM Land use Types**

| Land-use | Proposed runoff management |
|---|---|
| Disturbed<br>*(All potential sources of contaminated runoff originating from mine WMS process areas)* | Contained onsite and managed within the mine WMS |
| Spoil<br>*(All spoil and overburden areas)* | Contained onsite and managed within the mine WMS |

Adopted AWBM parameters for each model land use have been taken from the existing Saraji Mine water balance model and are shown in Table 12[3]. Based on the assumptions regarding the passive diversion of clean water catchments around the mine WMS (refer to Section 2.1) no undisturbed (natural) catchments are assumed to report to the mine WMS. In addition, the catchment reporting to the mine portal sump is assumed to consist entirely of spoil and has conservatively been modelled assuming that it remains un-rehabilitated over the operation of the mine.

**Table 12 Adopted AWBM Land use Parameters**

| Parameter | Description | Land use | |
|---|---|---|---|
| | | Disturbed | Spoil |
| A1 | Partial area | 0.134 | 0.134 |
| A2 | Partial area | 0.433 | 0.433 |
| A3 | Partial area | 0.433 | 0.433 |
| C1 | Surface storage capacity | 10 | 20 |
| C2 | Surface storage capacity | 60 | 100 |
| C3 | Surface storage capacity | 120 | 160 |
| BFI | Base Flow Index | 0.35 | 0.8 |
| $K_b$ | Base flow recession constant | 0.7 | 0.7 |
| $K_s$ | Surface flow recession constant | 0.1 | 0.1 |

## 4.3 Model input data

A range of input data was used to inform the WBM. Data has been obtained from a range sources including BMA and BoM and is detailed in Sections 4.3.1 to 4.3.7.

[3] Memo to Shaun Davidge (16/11/16) from Jacobs Australia Pty Ltd - *Saraji Mine – Grevillea Pit EA Amendment – Water Balance Assessment*

### 4.3.1 Climate

Input climate data for the WBM consists of daily rainfall and evaporation records which were sourced from the BOM SILO Data Drill. This fully synthetic data set is derived from the BOMs extensive database of recorded observations taken its network of weather recording stations. The WBM utilises 128 years of data representing the period 1889 to 2017.

Rainfall data is used by the AWBM to estimate runoff depths and consequent runoff volumes entering the mine WMS. Rainfall directly over each dam within the crest is also added to the mine WMS but without any loss.

Potential evapotranspiration (PET) is used to inform the AWBM rainfall-runoff model and pan evaporation is used to estimate dam evaporative water losses. In recognition of the potential for reduced evaporation rates from large bodies of water and water containing elevated salinity levels, the daily pan evaporation rate was reduced to 80% of the input Class A pan rate when estimating evaporation from each dam. Dam evaporative losses are calculated daily with each time step and are a function of each dam's water surface area on that particular day.

**Table 13 Climate Data – Key assumptions**

| Aspect | Assumption |
|---|---|
| Data source | SILO Data Drill obtained for Lat, Long: -22.35, 148.30 (decimal degrees) |
| Length of record | 1 January 1889 to the current year |
| Time increment | Daily |
| Rainfall | Daily total |
| Evaporation (class A pan) | Daily total |
| Evaporation pan factor | 0.8 (applied to evaporation from all dams) |
| Evaporation (potential evapotranspiration) | FAO56[4] (used by AWBM model) |

### 4.3.2 Mine catchment areas

The catchment areas reporting to each mine process area dam were defined on the basis of the mine layout plan and advice provided by BMA. Due to the underground nature of the proposed mining activities, the catchment area reporting to the underground mine portal sump remains fixed for the operation of the mine. Catchment land use has been defined on the basis of the assumed process taking place within each catchment area. Existing highwall check dams, catchment drains and other such strategies have been assumed to remain in place such that incident runoff to the pit is minimised to the greatest extent practical. Table 14 summarises adopted catchment areas and assumptions for the mine WMS. Locations of WMS dams and catchments are shown in Figure 6.

[4] Potential Evapotranspiration calculated using the FAO Penman-Monteith formula as in FAO Irrigation and Drainage paper 56, http://www.fao.org/docrep/X0490E/X0490E00.htm

**Table 14 Mine Water Management System Catchments and Assumptions**

| Catchment | External Catchment Area (ha) | AWBM Land use | Assumptions |
|---|---|---|---|
| Process and Raw Water Dams | 0 | N/A | Turkeys nest dams with no external catchment. |
| Product stockpile and train load out | 11 | Disturbed | Includes approximately 2.5 ha for Train Load Out (TLO) |
| ROM coal stockpile | 4.4 | Disturbed | |
| MIA | 8.8 | Disturbed | • Total area of MIA assumed at approximately 60 ha.<br>• 15% assumed to be mine affected.<br>• Remaining 85% of MIA area not considered to be mine affected and therefore subject to relevant stormwater management controls as required. |
| CHPP | 7.3 | Disturbed | • Total area occupied by CHPP assumed to be approximately 15 ha.<br>• 50% of CHPP area assumed to be mine affected.<br>• Remaining are not considered mine affected and therefore subject to relevant stormwater management controls as required. |
| Underground mine portal sump = | 79 | Spoil | The external catchment area currently reporting to the existing open cut pit will be minimised as far as practical by:<br>• Re-profiling of the backfilled spoil and overburden material currently occupying the pit.<br>• The use of roll-over bunding for all entry roads.<br>• High wall check dams and diversion drains. |

### 4.3.3 Groundwater

Groundwater enters the mine WMS either as dewatering of the underground workings or via the gas drainage bore field. Assumed combined inflows are provided in Table 15. Mine dewatering and gas drainage was modelled as a single, combined input to the WBM.

**Table 15 Assumed Mine Water Management System Groundwater Inflows**

| Financial Year (FY) | Mine Year | Total Mine Dewatering and Gas Drainage (ML/d) | Year | Mine Year | Total Mine Dewatering and Gas Drainage (ML/d) |
|---|---|---|---|---|---|
| FY 2023 | 1 | 0.00 | FY 2033 | 11 | 0.62 |
| FY 2024 | 2 | 0.01 | FY 2034 | 12 | 0.55 |
| FY 2025 | 3 | 0.09 | FY 2035 | 13 | 0.49 |
| FY 2026 | 4 | 0.26 | FY 2036 | 14 | 0.48 |
| FY 2027 | 5 | 0.46 | FY 2037 | 15 | 0.62 |
| FY 2028 | 6 | 0.61 | FY 2038 | 16 | 0.72 |
| FY 2029 | 7 | 0.67 | FY 2039 | 17 | 0.26 |
| FY 2030 | 8 | 0.71 | FY 2040 | 18 | 0.26 |
| FY 2031 | 9 | 0.72 | FY 2041 | 19 | 0.21 |
| FY 2032 | 10 | 0.66 | FY 2042 | 20 | 0.13 |

### 4.3.4 Water quality

Table 16 shows the assumed water quality for the various model land uses and water inputs. Salt mass enters the model each timestep based on the estimated flow rate and assumed total dissolved solids (TDS) from each source. The estimated TDS of water in each modelled dam is calculated daily based on the mass of salt (micro Siemens per centimetre, µS/cm) and volume of water contained in each dam. A solubility limit of 300 grams per litre (g/L) was also assumed.

**Table 16 Assumed Model Water Quality**

| Water Source | Assumed Salinity (µS/cm)[5] | Assumed TDS (mg/L) |
|---|---|---|
| Groundwater inflow (underground mine inflow and gas drainage) | 4,478 | 3,000 (approximate mean of monitoring bores PZ10 and PZ09 which are located within the underground mine footprint) |
| Underground process return water (assumed to be co-mingled with dewatering) | 4,478 | 3,000 (as per groundwater quality) |
| Raw water | 200 (assumption) | 134 |
| AWBM disturbed (runoff) | 3,500 (assumption) | 2,345 |
| AWBM spoil (runoff) | 1,500 (assumption) | 1,005 |

### 4.3.5 Water demand

Mine consumptive water demand sources are shown in Table 17. Potable and underground process water demands are sourced solely from the RWD, whereas CHPP and dust suppression is preferentially sourced from the process water dam with make-up from the RWD.

[5] Based on an assumed conversion of 0.67

**Table 17 Water Demand Sources**

| Water Demand | Quality Restrictions | Proposed Source | |
|---|---|---|---|
| | | 1st Preference | 2nd Preference |
| Potable | Treated raw water | WTP (supplied from RWD) | N/A |
| Underground process | Raw water | RWD | N/A |
| CHPP | None | Process water dam | RWD |
| Surface road dust suppression | None | Process water dam | RWD |
| Stockpile dust suppression | None | Process water dam | RWD |

Assumed water demands were provided by BMA and are shown in Table 18 below. Modelled dust suppression demand has been based on the following assumptions:

- stockpile dust suppression (ROM and product coal) – 3.5 mm/m$^2$/d over 15.4 ha
- six kilometres of access road (light vehicle) from portal entrance to ROM pad – 3.5 mm/m$^2$/d assuming that the road is eight metres wide with one metre shoulders.

Dust suppression demand is assumed to be zero on days where rainfall is in excess of evaporation.

**Table 18 Assumed Mine water Management System Water Demands**

| Mine Year | CHPP Net Demand [6](ML/d) | Underground Mine Process (ML/d) | Stockpile Dust Suppression (ML/d) | Access Road Dust Suppression (ML/d) | Raw Water incl. Potable (ML/d) |
|---|---|---|---|---|---|
| 1 | 0 | 1.5 | 0 | 0.1 | 0.66 |
| 2-21 | 1.5 | 3.36 | 0.462 | 0.1 | 0.66 |

### 4.3.6 Water transfer rules

Basic operating rules suitable for concept level design were incorporated into the WBM. Model water transfers dictate when transfers occur, where water is transferred to and at what rate the transfer should take place. Table 19 summarises the model water transfer rules.

[6] Inclusive of all return water

**Table 19 Model water Transfer Rules**

| From | To | Condition 1 – Source Dam or Sump[7] | | | Criteria | Condition 1 – Destination Dam | | | Rate (L/s) |
|---|---|---|---|---|---|---|---|---|---|
| Prod. Stockpile Dam | Process water dam | Prod. Stockpile Dam | > | 2 ML | AND | Process water dam | < | 970 ML | 30 |
| ROM Coal Stockpile Dam | Process water dam | ROM Coal Stockpile Dam | > | 2 ML | AND | Process water dam | < | 970 ML | 30 |
| MIA Dam | Process water dam | MIA Dam | > | 2 ML | AND | Process water dam | < | 970 ML | 30 |
| CHPP Dam | Process water dam | CHPP Dam | > | 2 ML | AND | Process water dam | < | 970 ML | 30 |
| Pit Sump | Process water dam | Pit Sump | > | 150 ML | AND | Process water dam | < | 800 ML | 50 |

### 4.3.7 Project water storage assumptions

Stage-storage relationships for each dam that relate volume to water surface area (from which evaporative losses are calculated) have been developed using a set of common assumptions as shown below:

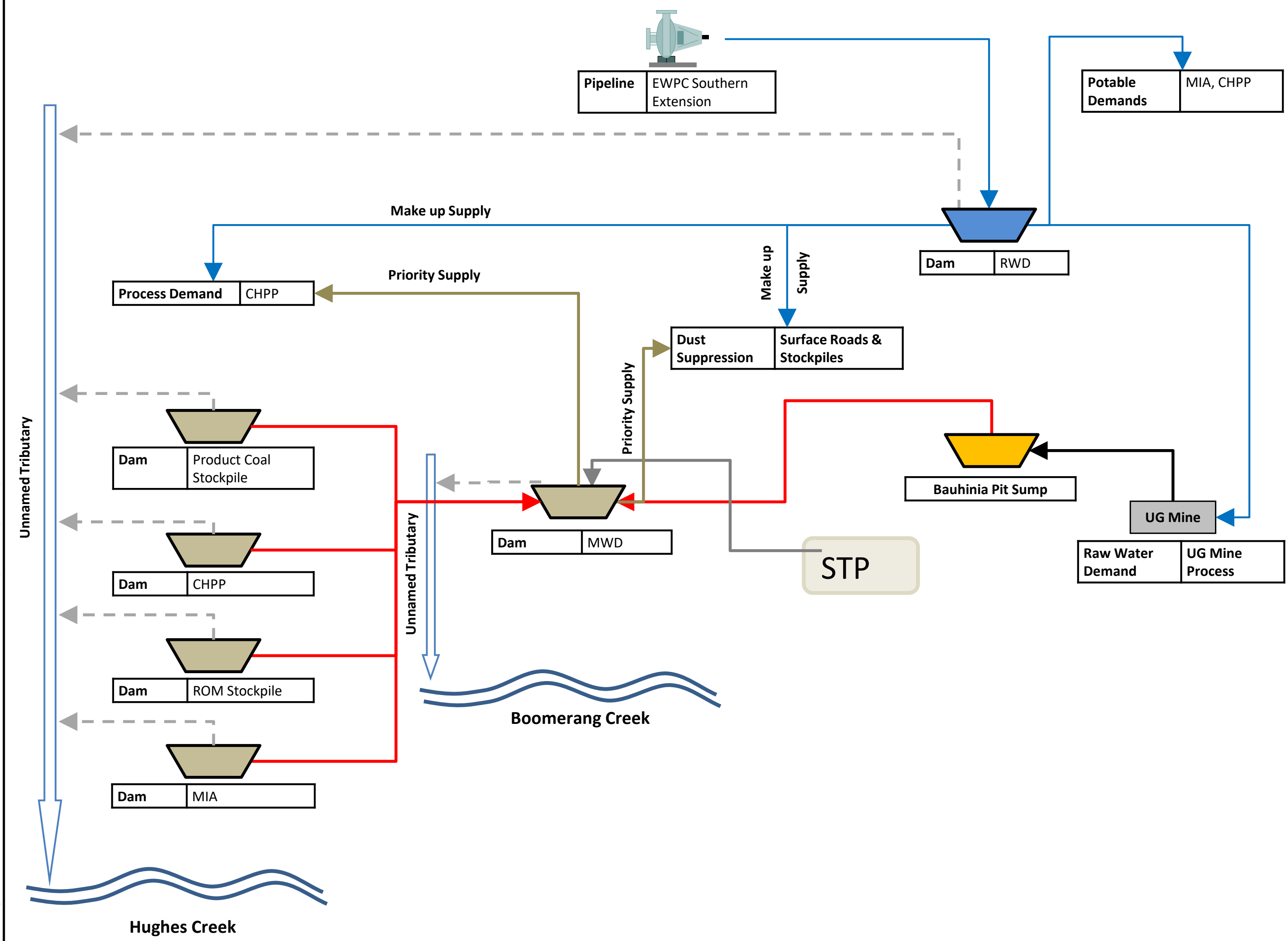
- all dams are based on simple trapezoidal design with a flat, rectangular base
- batter slopes of 3:1 (Horizontal:Vertical)
- 0.5 m freeboard for all process area dams and 1 m freeboard for process water dam and RWD
- 3.5 m wide internally draining crest for all process area dams and 5 m for process water dam and RWD
- dam embankment heights have been limited to approximately 8 m.

Stage storage for the underground mine portal sump has been based on LiDAR survey data provided by BMA.

### 4.3.8 Model schematic

Figure 7 shows the schematic for the conceptual mine WMS as represented by the WBM.

[7] Effectively may be considered as the source dam or sump nominal dead storage volume



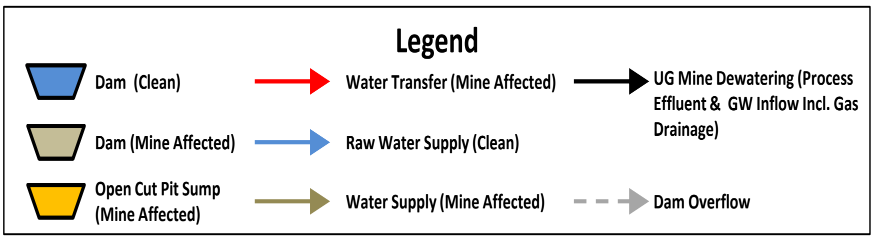




Figure 7
Mine Water Balance Schematic

Environmental Impact Statement
Saraji East Mining Lease Project

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## 4.4 Modelling results

### 4.4.1 Preliminary dam capacities

The Project WMS outlined in Section 3.0 was assessed using water balance simulation to confirm the containment and release design objectives and criteria presented in Section 2.0 can be met. Sufficient system containment and transfer capacity has been provided to prevent the uncontrolled release (i.e. spillway overflow) of water to the receiving environment and without the requirement for controlled release of MAW. The estimated preliminary capacities for all WMS dams are given in Table 20. Based on this, the total MAW capacity in the dam system is 1,410 ML, the majority of which is contained in the Process water dam.

**Table 20 Preliminary Dam Capacities**

| Dam | Preliminary Capacity (ML) |
|---|---|
| Process water dam (MAW) | 1,050 |
| CHPP dam (MAW) | 80 |
| Product coal stockpile pad dam (MAW) | 135 |
| ROM coal stockpile pad dam (MAW) | 45 |
| MIA dam (MAW) | 100 |
| RWD | 200 |

#### 4.4.1.1 Process water dam

Figure 8 and Figure 9 show storage and water quality plots for the process water dam respectively. Results are presented as percentile distributions and represent the distribution of volume of water in the process water dam, or the estimated salinity of the water contained in the process water dam, at each model timestep (i.e. each day). The plots may be read as follows:

- the lightest green areas represent the range of values between:
  - the 95$^{th}$ and 90$^{th}$ percentile
  - the 5$^{th}$ and 10$^{th}$ percentile
- the next darkest green band represents the range of values between:
  - the 90$^{th}$ and 75$^{th}$ percentile
  - the 10$^{th}$ and 25$^{th}$ percentile
- the darkest green band in the middle represents the range of values between:
  - the 25$^{th}$ and 75$^{th}$ percentile
- the solid red and black lines represent the average result and median results respectively.

From Figure 8 and Figure 9 it can be seen that:

- The volume of water stored in the process water dam shows a distinct seasonal fluctuation with volumes increasing during the summer wet season and reducing during the winter dry season. The median volume of water in the process water dam is approximately 350 ML. Operational water balance accounting results are provided in Section 4.4.1.1.1.
- The spread of values around the median is a direct result of the input climate data used (this is the only model input variable to change between each realisation) and represents the estimated range of potential outcomes resulting from the variability associated with rainfall and runoff inflows and evaporative losses.
- Estimated water quality in the process water dam is subjected to seasonal evaporative concentration; however, the median and average electrical conductivity values remain within a range of 4,000 µS/cm to 5,000 µS/cm.

Additional storage plots for WMS dams are shown in Appendix A.

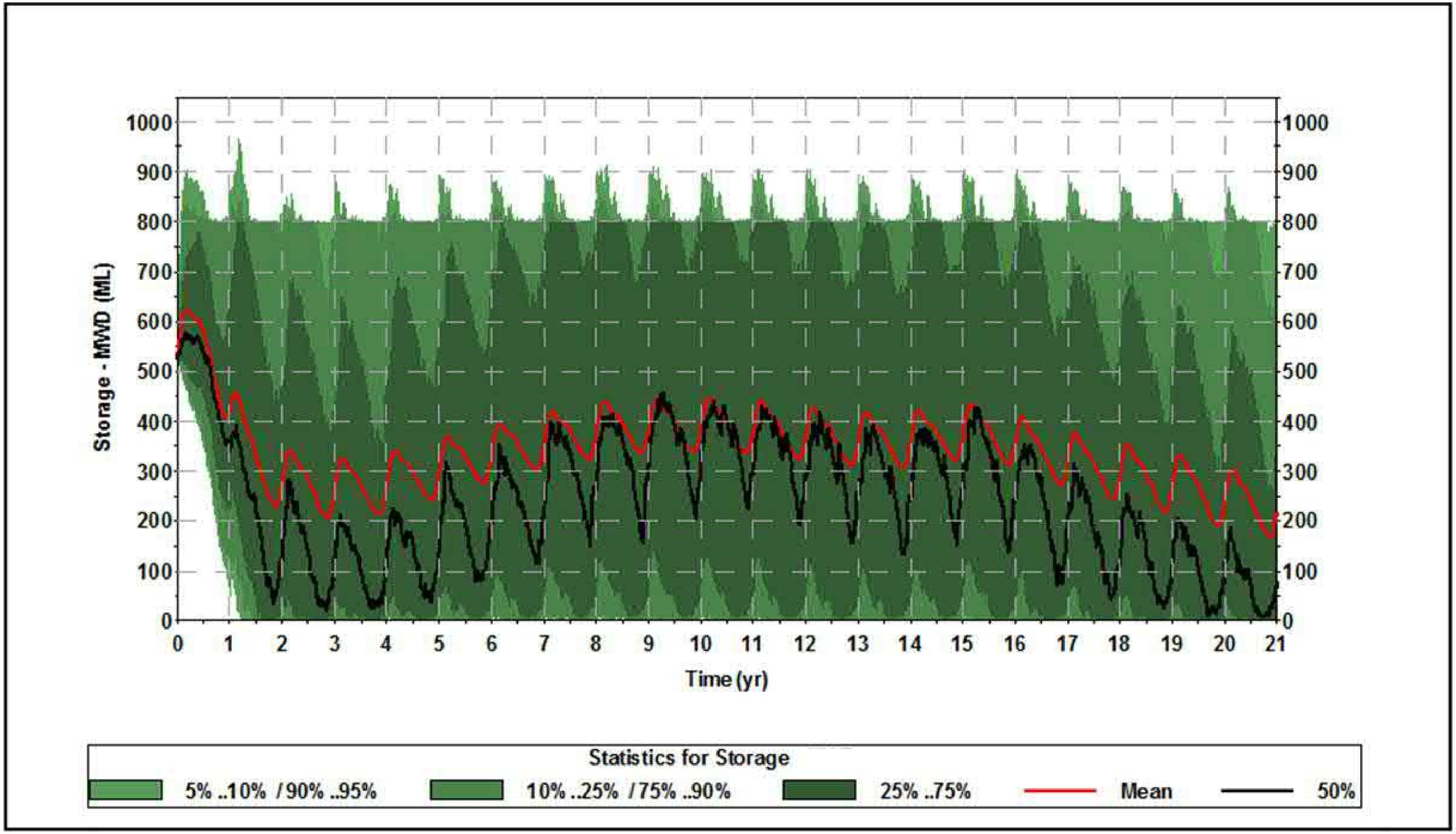



**Figure 8 Process water dam Storage Performance**

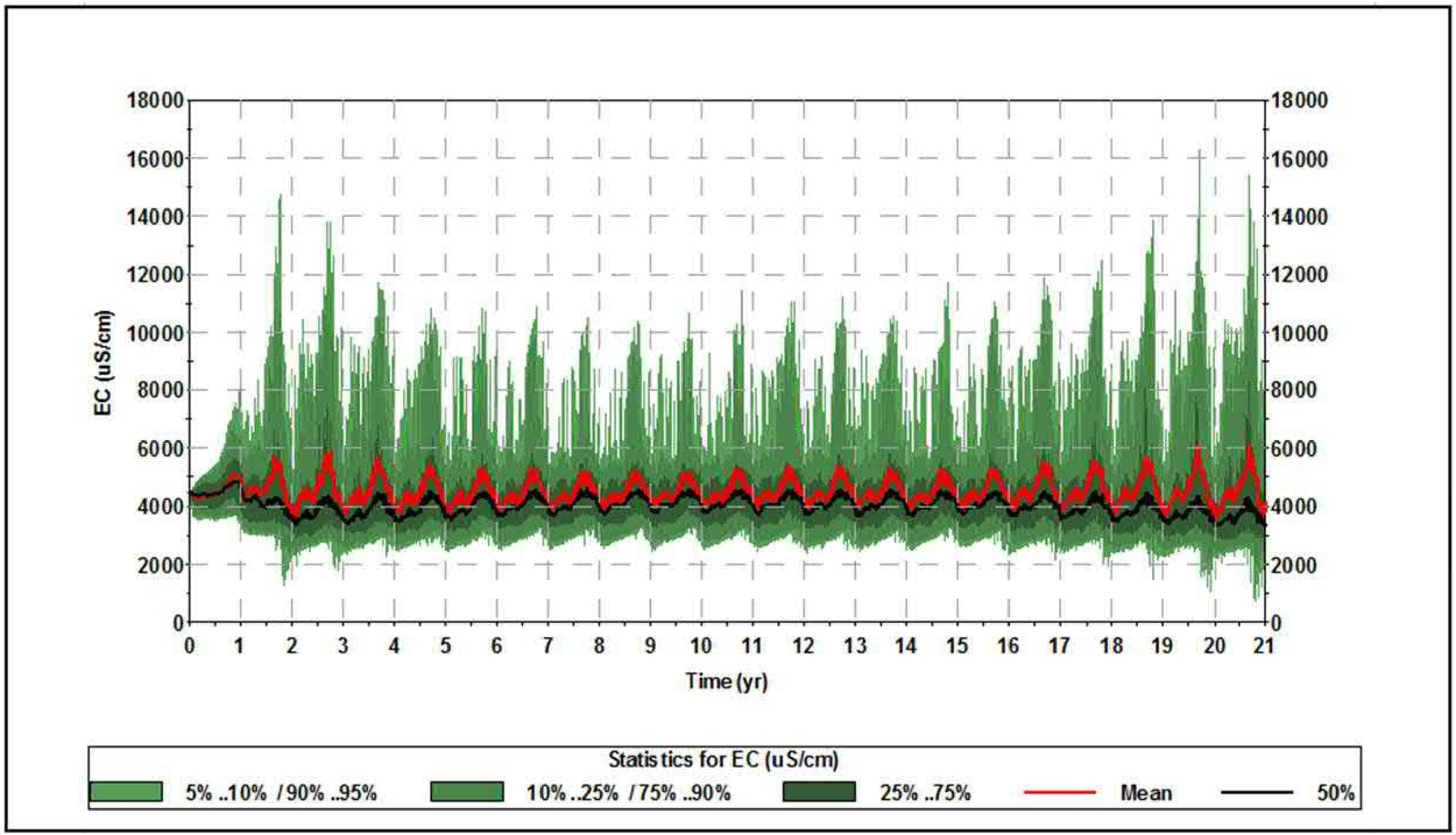



**Figure 9 Process water dam EC concentration**

##### 4.4.1.1.1 Salinity concentrations

Salinity concentration results for the process water dam were broken down based on the relative process water dam volumes, for the following scenarios:

- Process water dam less than 20% full (<210 ML), representative of dry conditions
- Process water dam between 20% and 80% full (between 210 ML and 840 ML), representative of normal operating conditions
- Process water dam more than 80% full (>840 ML), representative of wet conditions

Results for this assessment are included in Appendix A. These show that:

- The upper range ($75^{th}$ percentile to $95^{th}$ percentile results) of salinity concentrations for dry conditions oscillate approximately between 5,000 μS/cm and 14,000 μS/cm. In general, the drier the process water dam, the higher the salinity concentrations.
- The upper range ($75^{th}$ percentile to $95^{th}$ percentile results) of salinity concentrations for normal operating conditions oscillate approximately between 4,000 μS/cm and 6,000 μS/cm.
- The upper range ($75^{th}$ percentile to $95^{th}$ percentile results) of salinity concentrations for wet conditions oscillate approximately between 2,500 μS/cm and 3,500 μS/cm.

### 4.4.2 Mine water and salt balance accounting

Summary water and salt balance fluxes for the WBM are presented in Table 21 and Table 22. All dams within the WBM as well as the entire model have been subjected to water and mass balance checks to confirm model continuity and mass balance.

**Water balance**

Referring to Table 21:

- raw water represents the largest single input to the mine WMS, with median values of 31.9 GL over the operation of the mine (Table 21) or 1,594 ML/y
- runoff input is highly variable with the $10^{th}$ and $90^{th}$ percentile total annual runoff volumes ranging from 203 ML/yr to 373 ML/yr respectively
- raw water demand is relatively consistent at 1,600 ML/y (median result) as the majority of raw water demand originates from underground process use for which MAW is unsuitable (i.e. supply is not subject to climate variability)
- overflows to the receiving environment are predicted to be zero.

**Salt balance**

Referring to Table 22:

- groundwater represents the largest salt input over the operation of the mine at approximately 24,000 tonnes or 1,194 t/yr
- salt input to the receiving environment via overflows is zero.

Note that results presented under each percentile result may not occur within a single realisation and are a function of the total distribution of all results from all model realisations (128 in total).

**Table 21 Mine Water Balance Summary**

| | Life of Mine | | | | | Annual | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Units | Mean | Median | 10th | 90th | Units | Mean | Median | 10th | 90th |
| **WMS Inputs** | | | | | | | | | | |
| Direct rainfall | GL | 6.6 | 6.6 | 6.0 | 7.1 | ML/yr | 328 | 328 | 298 | 354 |
| Total runoff | GL | 6.2 | 6.4 | 4.1 | 7.5 | ML/yr | 310 | 318 | 203 | 373 |
| Raw water input | GL | 32.0 | 31.9 | 31.0 | 33.4 | ML/yr | 1,602 | 1,594 | 1,548 | 1,671 |
| Groundwater input | GL | 3.1 | 3.1 | 3.1 | 3.1 | ML/yr | 156 | 156 | 156 | 156 |
| **Total water Input** | **GL** | **47.9** | **47.9** | **46.6** | **48.9** | **ML/yr** | **2,395** | **2,395** | **2,332** | **2,443** |
| **WMS Outputs** | | | | | | | | | | |
| Total evaporation | GL | 8.5 | 8.5 | 7.3 | 9.2 | ML/yr | 423 | 424 | 366 | 462 |
| Total water demand | GL | 39.7 | 39.7 | 39.7 | 39.7 | ML/yr | 1,985 | 1,985 | 1,985 | 1,985 |
| External overflows | GL | 0.0 | 0.0 | 0.0 | 0.0 | ML/yr | 0 | 0 | 0 | 0 |
| **Total water output** | **GL** | **48.2** | **48.2** | **47.0** | **48.9** | **ML/yr** | **2,408** | **2,409** | **2,350** | **2,446** |

**Table 22 Mine Salt Balance Summary**

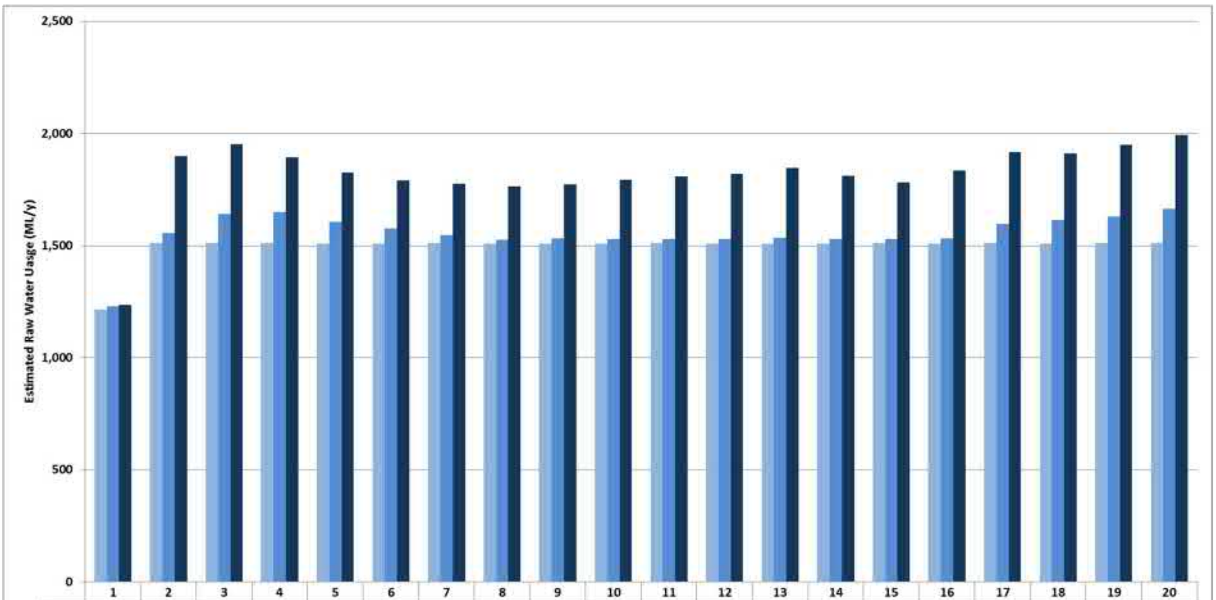
| | Life of Mine | | | | | Annual | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Units | Mean | Median | 10th | 90th | Units | Mean | Median | 10th | 90th |
| WMS Inputs | | | | | | | | | | |
| Total runoff | Tonne | 10,919 | 11,228 | 7,423 | 13,163 | Tonne/yr | 546 | 561 | 371 | 658 |
| Raw water input | Tonne | 4,293 | 4,273 | 4,148 | 4,478 | Tonne/yr | 215 | 214 | 207 | 224 |
| Groundwater input | Tonne | 23,873 | 23,873 | 23,873 | 23,873 | Tonne/yr | 1,194 | 1,194 | 1,194 | 1,194 |
| **Total salt input** | **Tonne** | **39,085** | **39,370** | **35,788** | **41,200** | **Tonne/yr** | **1,954** | **1,969** | **1,789** | **2,060** |
| **WMS Outputs** | | | | | | | | | | |
| CHPP | Tonne | 12,737 | 12,579 | 10,680 | 13,847 | Tonne/yr | 637 | 629 | 534 | 692 |
| Total water demand | Tonne | 40,052 | 40,354 | 37,004 | 41,944 | Tonne/yr | 2,003 | 2,018 | 1,850 | 2,097 |
| External overflows | Tonne | 0 | 0 | 0 | 0 | Tonne/yr | 0 | 0 | 0 | 0 |
| **Total salt output** | **Tonne** | **40,052** | **40,354** | **37,004** | **41,944** | **Tonne/yr** | **2,003** | **2,018** | **1,850** | **2,097** |

### 4.4.3 Estimated raw water consumption

Figure 10 shows the estimated raw water demand for each mine year.

As some Project water demands (underground mine process and potable) cannot use MAW, there will always be an annual demand for raw water which, based on the assumed demands given in Table 18 is 1,467 ML/yr from year two onwards. Other results to note include:

- Median total annual demand is approximately 1,500 ML/yr to 1,650 ML/y depending on the mine year
- The intra-annual variability in additional raw water required between each mine year is a function of the availability of MAW to satisfy the remaining Project water demands for CHPP process demand and dust suppression. This is a result of variability in the estimated inflow of runoff and rainfall whereas the inter-annual variability is a function of the rate of estimated groundwater inflow such.




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5% | 1,216 | 1,511 | 1,513 | 1,511 | 1,509 | 1,509 | 1,513 | 1,509 | 1,510 | 1,509 | 1,511 | 1,510 | 1,509 | 1,510 | 1,513 | 1,509 | 1,511 | 1,508 | 1,511 | 1,511 |
| 50% | 1,230 | 1,557 | 1,642 | 1,649 | 1,605 | 1,577 | 1,547 | 1,528 | 1,533 | 1,529 | 1,530 | 1,530 | 1,537 | 1,531 | 1,531 | 1,532 | 1,596 | 1,615 | 1,629 | 1,666 |
| 95% | 1,237 | 1,899 | 1,953 | 1,892 | 1,827 | 1,792 | 1,776 | 1,765 | 1,772 | 1,795 | 1,809 | 1,821 | 1,847 | 1,811 | 1,782 | 1,835 | 1,918 | 1,910 | 1,949 | 1,992 |

**Figure 10 Estimated Project Annual Raw Water Demand**

### 4.4.4 Potential reduction in flows to receiving environment

The development of the conceptual mine WMS does not include any significant loss of catchment area reporting to Hughes Creek or its tributaries. The combined disturbed catchment areas of the process area dams is 31.7 ha (0.317 km$^2$) which represents just 0.3% of the Hughes Creek (including Plumtree Creek) catchment and any potential loss in flow would likely be immaterial.

## 4.5 Conclusions

The conceptual design of the Project WMS was developed in line with current management practice for mine water management. Assessment of the Project indicates that the proposed mine WMS meets the objectives and considerations outlined within Sections 2.1 and 2.2. The key findings and conclusions of the report are:

- Clean stormwater runoff originating from non-mine affected catchments will, wherever practical and achievable, be passively diverted around mine-affected areas through the use of clean runoff conveyance channels and bunds
- Potentially mine affected stormwater runoff will be collected at source and conveyed as soon as practical to the process water dam
- Volumes of MAW stored onsite are minimised through their preferential re-use wherever possible
- Collection and containment of MAW has been optimised to reduce the risk of overflows to the environment
- Estimated dam storage capacities are sufficient to meet the hydrologic design criteria requirements of the preliminary DES Consequence Category assessment
- Reliance on an external raw water source has been minimised through the preferential re-use of MAW for Project water demands for which it is suitable (CHPP process demand and dust suppression)
- Security of water supply (in the absence of all other sources including groundwater) has been provided by the RWD which, at 200 ML is capable of supplying all site water demands for approximately one month
- A preliminary consequence category assessment has been conducted for all Project dams containing MAW.

Mine dam structures have been designed to have sufficient capacity to contain all MAW. Uncontrolled releases are only likely to occur if the rain event is beyond the design capacity of the dam, or if there has been mismanagement in the operation of the dams. Therefore, the basis of the proposed mine WMS is that there will be no controlled or uncontrolled releases of MAW under normal operating conditions, based on historical climate data. A risk-based assessment of hypothetical MAW releases shows that no impacts on the receiving environment are expected from these events.

# 5.0 References

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# 6.0 Standard limitations

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

# Appendix A

## Additional Water Balance Plots

# Appendix A Additional Water Balance Plots

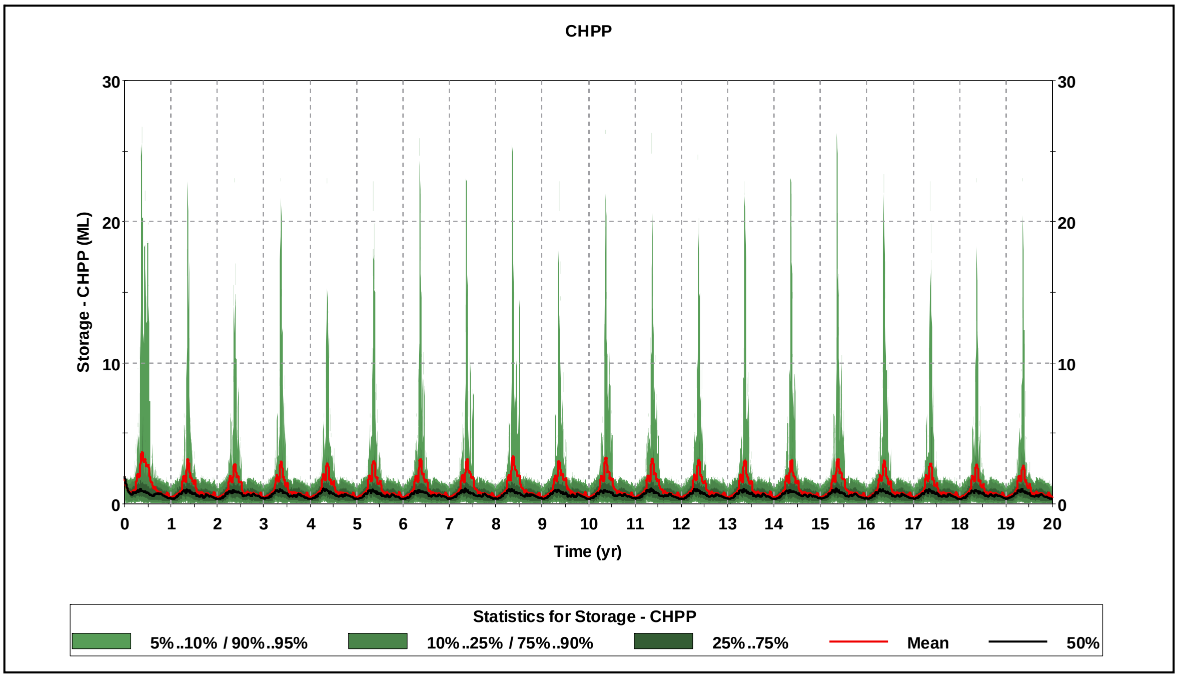


**Figure 11 CHPP Dam Storage Performance**

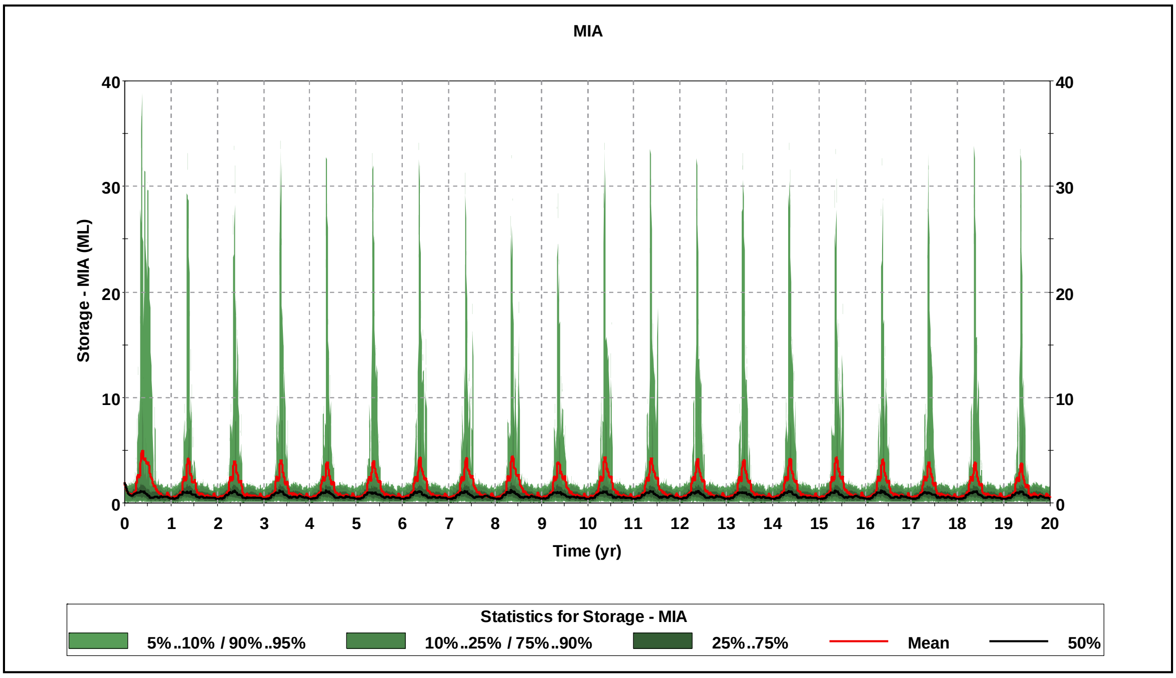


**Figure 12 MIA Dam Storage Performance**

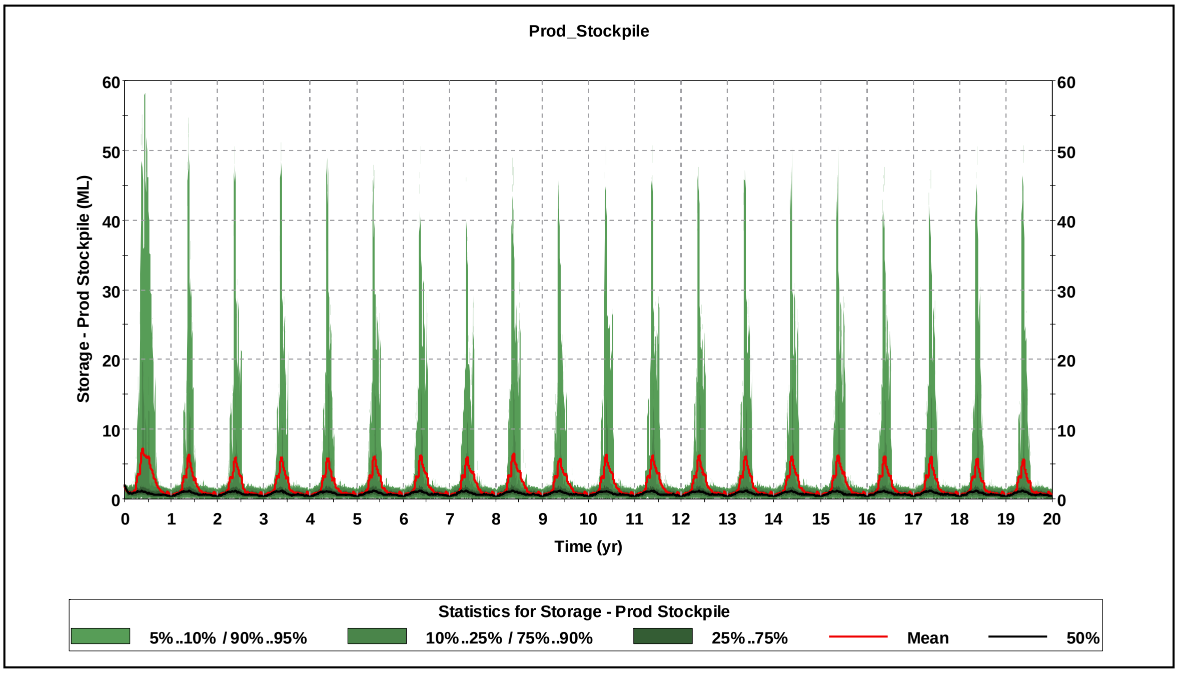


**Figure 13 Product Stockpile Dam Storage Performance**

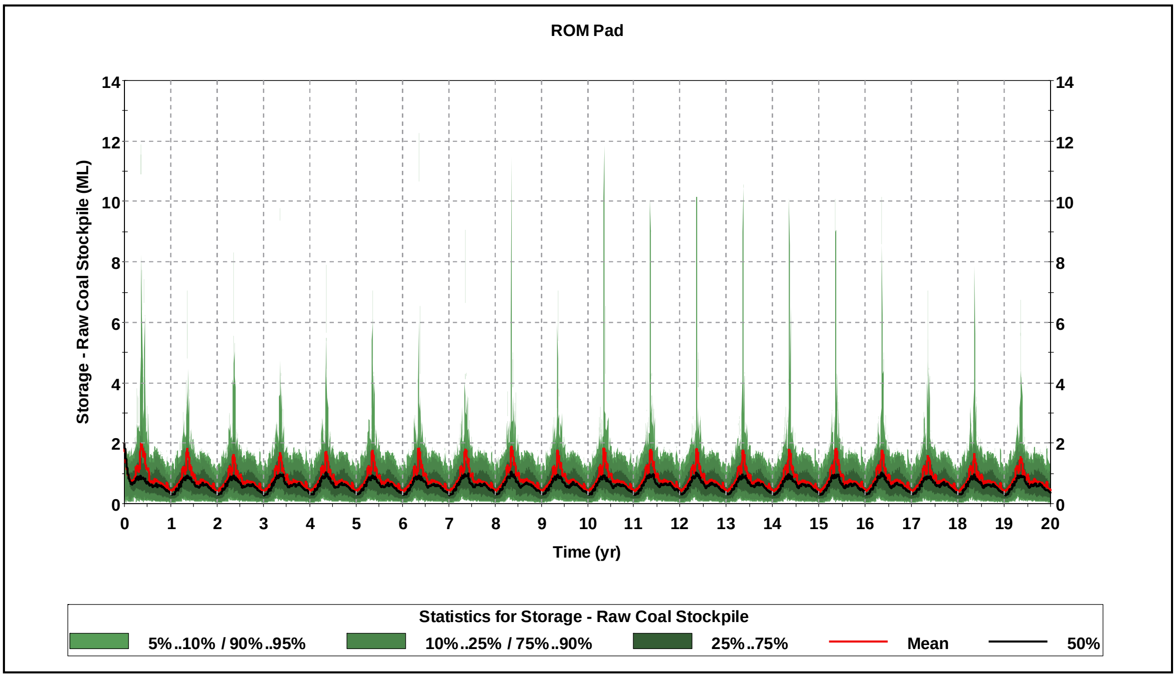


**Figure 14 ROM Pad Dam Storage Performance**

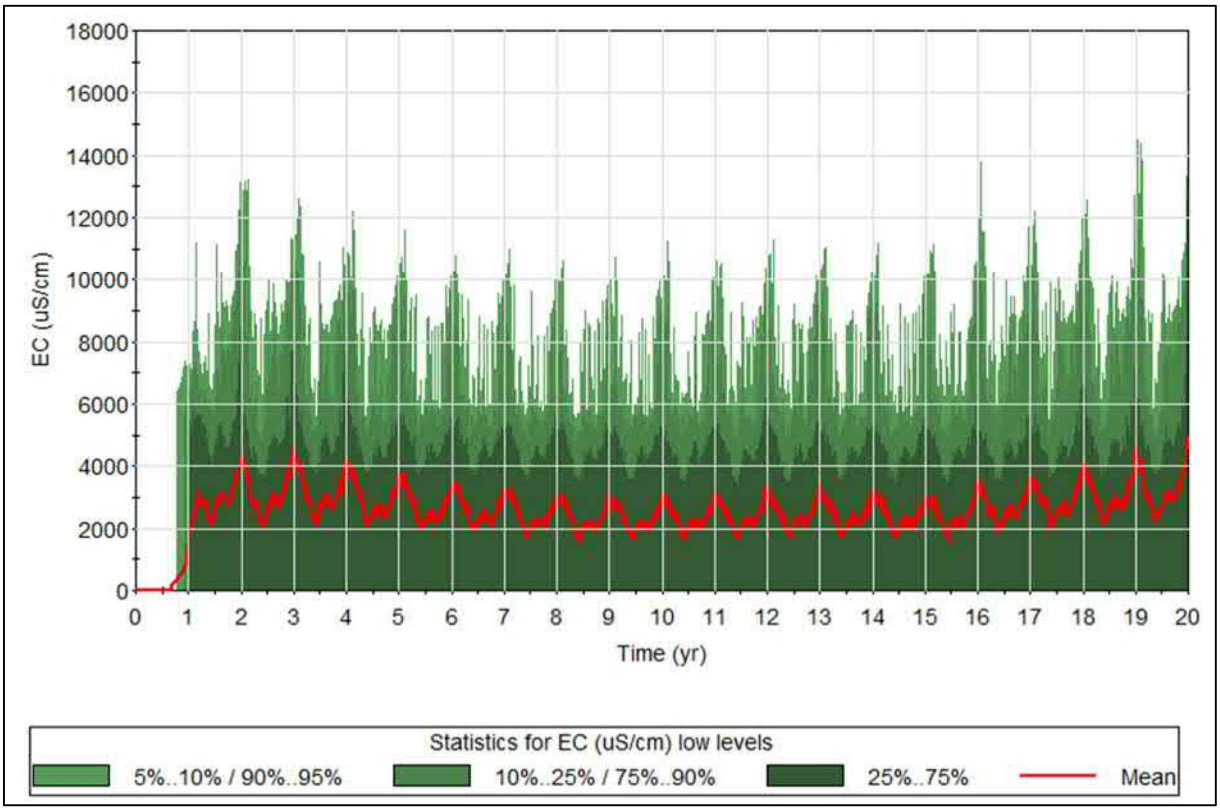


**Figure 15 Process water dam – Salinity concentrations for dam levels below 20% full**

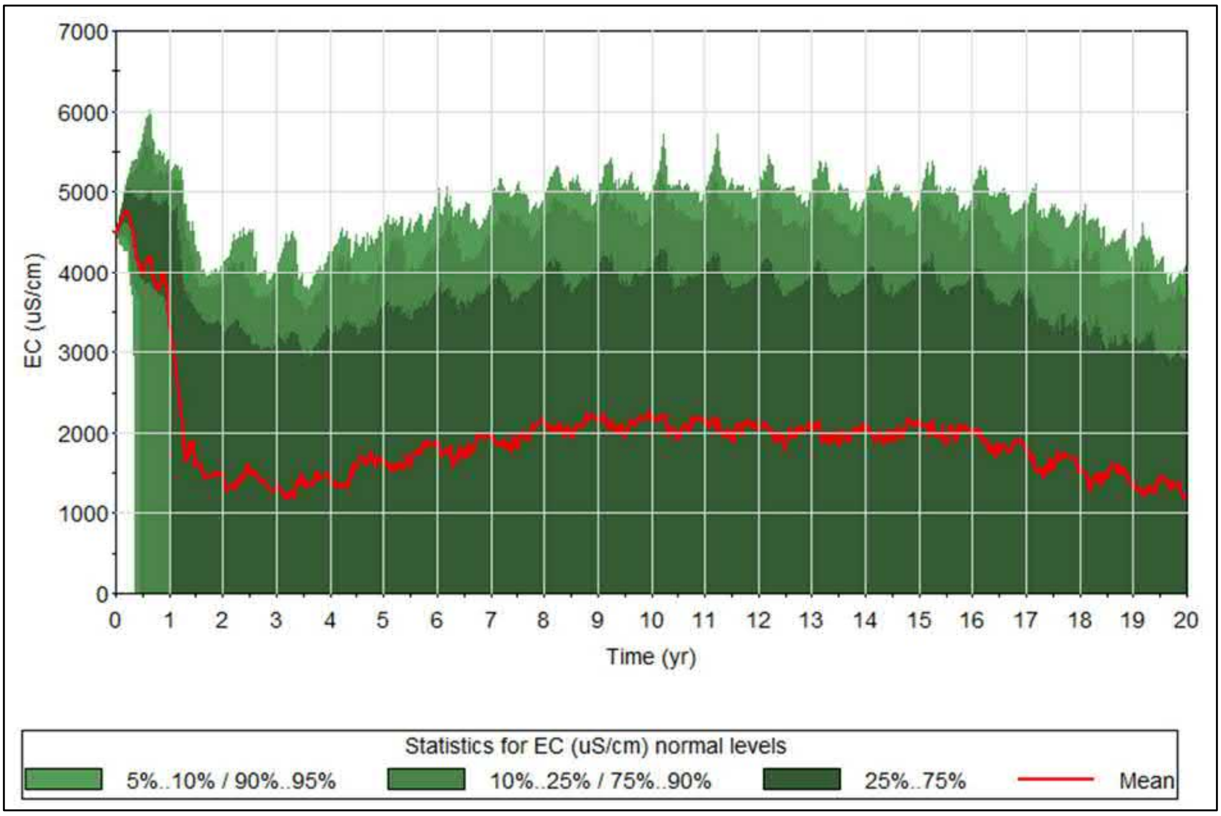


**Figure 16 Process water dam – Salinity concentrations for dam levels between 20% and 80% full**

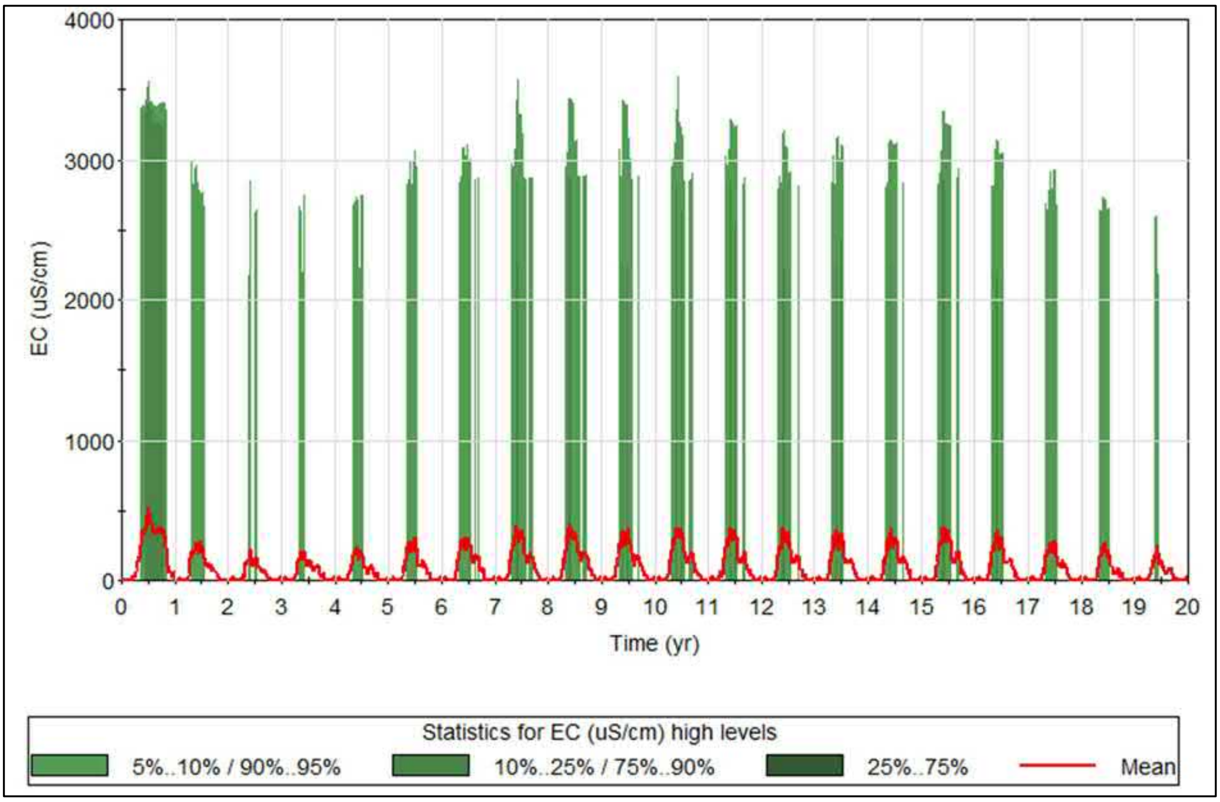


**Figure 17 Process water dam – Salinity concentrations for dam levels higher than 80% full**