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# Updated Surface Water and Flooding Impact Assessment

**BYLONG** COAL PROJECT
Supplementary Information

Hansen Bailey
ENVIRONMENTAL CONSULTANTS

# Bylong Coal Project

## Updated Surface Water Impact Assessment

Hansen Bailey Pty Ltd

0887-08-C4, 10 July 2018

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|---|---|
| **Report Title** | Bylong Coal Project, Updated Surface Water Impact Assessment |
| **Client** | Hansen Bailey Pty Ltd<br>PO Box 473<br>Singleton NSW 2330<br>Australia |
| **Report Number** | 0887-08-C4 |

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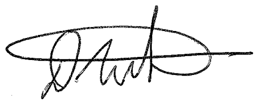

David Newton
**Director / Principal Engineer**

# Executive Summary

In 2015, KEPCO Bylong Australia Pty Ltd (KEPCO) submitted an Environmental Impact Statement (EIS) for the Bylong Coal Project (the Project). The Planning Assessment Commission (PAC) (now Independent Planning Commission (IPC)) finalised its Review Report (the PAC Report) of the Project on 25 July 2017. KEPCO prepared and lodged a detailed response to the PAC Report on 17 January 2018 for consideration by the NSW Department of Planning and Environment (DPE).

Subsequent to the PAC Report, DPE requested advice from the Heritage Council of NSW in relation to the appropriateness of the mitigation and management measures proposed to manage the potential impacts of the Project on the identified heritage values. This advice was sought to address the concern raised within the PAC Report. The key concerns raised by both the PAC and the Heritage Council of NSW include:

- Direct impacts of the Eastern Open Cut and Overburden Emplacement Area (OEA) on the Tarwyn Park property.
- Landscape and visual impacts on the Tarwyn Park homestead across the valley towards the Growee Range.

On 28 May 2018, the DPE responded to KEPCO regarding the concerns raised within the PAC Report and recent advice from the Heritage Council of NSW. The DPE letter stated that in light of the advice received from the PAC and Heritage Council of NSW, the DPE has requested revisions to the proposed mine plan to adequately avoid and minimise the potential impacts on the heritage values of Tarwyn Park and the surrounding landscape. As such, DPE has sought information from KEPCO concerning the potential impacts of contracting the mine footprint with the Eastern Open Cut to remain off Tarwyn Park and other considerations.

In response to the DPE letter, KEPCO has revised the proposed open cut mine plans for the Revised Project Layout to address the concerns outlined by the DPE and Heritage Council of NSW.

The Revised Project Layout entails the following changes to the Project:

- Reduced the footprint of the Eastern Open Cut Mining Area and Eastern OEA to remain outside of the Tarwyn Park property.
- Reduced the footprint of the Western Open Cut Mining Area and Western OEA to retain the wooded ridgeline between the Western OEA and South-Western OEA.
- Minor changes to the production schedule.
- Changes to the proposed sediment dams around the Eastern OEA.

The overall Project disturbance footprint will reduce and remain within the Project Disturbance Boundary previously assessed within the EIS (with the exception of Tarwyn Park).

The surface water impact assessment for the Project has been updated to assess the impacts of the Revised Project Layout mine plans on surface water quality and quantity, and the key findings are summarised as follows:

- The estimated maximum runoff capture volume from undisturbed areas is 149 ML, which is consistent with the volume calculated as part of the EIS investigations. This value still remains well below the available harvestable rights volume of 266 ML.
- There is a 1% probability that the annual volume requirement from the borefield water supply could equal or exceed 1,340 ML/a during the Project. This is consistent with the predictions in the Response to PAC Review Report. The existing water licence allocation from the bores of 3,045 units (currently equivalent to 3,045 ML/year) significantly exceeds the requirement for external water supply to satisfy all site demands for all years of operation, even in the driest climatic sequence experienced over the past 125 years.

- Prior to the commencement of underground operations, there is a low risk of significant volumes of water accumulating in the open cut mining areas. Once underground operations commence, groundwater inflows increase significantly which increases the risk of water accumulating within the water management system. However, the water balance modelling for the Revised Project Layout mine plan indicates that the mine water management system will be capable of achieving nil discharge from the mine-affected water system, consistent with the previous assessment. Simulated overflows from sediment dams during rainfall periods that exceed the design criteria are slightly reduced from previous assessments. On this basis, the risk of surface water quality impacts from the updated Project configuration is slightly less than the previous assessments.
- The predicted impact through loss of catchment for the Revised Project Layout mine plans is less than the impact predicted as part of the EIS investigations due to the reduced mine footprint.
- The flooding impacts of the Revised Project Layout mine plan are similar (and in some cases less than) the previous assessments. Flood impacts will not encroach upon the Tarwyn Park property.

In summary, the surface water impacts of the Revised Project Layout mine configuration are essentially similar to the previous assessments undertaken for the EIS, RTS, Supplementary RTS and PAC Response.

# Contents

# List of figures

# List of tables

# 1 Introduction

## 1.1 BACKGROUND

In 2015, KEPCO Bylong Australia Pty Ltd (KEPCO) submitted an Environmental Impact Statement (EIS) for the Bylong Coal Project (the Project). The Planning Assessment Commission (PAC) (now Independent Planning Commission (IPC)) finalised its Review Report (the PAC Report) of the Project on 25 July 2017. KEPCO prepared and lodged a detailed response to the PAC Report on 17 January 2018 for consideration by the NSW Department of Planning and Environment (DPE).

Subsequent to the PAC Report, DPE requested advice from the Heritage Council of NSW in relation to the appropriateness of the mitigation and management measures proposed to manage the potential impacts of the Project on the identified heritage values. This advice was sought to address the concern raised within the PAC Report. The key concerns raised by both the PAC and the Heritage Council of NSW include:

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- Landscape and visual impacts on the Tarwyn Park homestead across the valley towards the Growee Range.

On 28 May 2018, the DPE responded to KEPCO regarding the concerns raised within the PAC Report and recent advice from the Heritage Council of NSW. The DPE letter stated that in light of the advice received from the PAC and Heritage Council of NSW, the DPE has requested revisions to the proposed mine plan to adequately avoid and minimise the potential impacts on the heritage values of Tarwyn Park and the surrounding landscape. As such, DPE has sought information from KEPCO concerning the potential impacts of contracting the mine footprint with the Eastern Open Cut to remain off Tarwyn Park and other minor considerations.

In response to the DPE letter, KEPCO has revised the proposed open cut mine plans for the Revised Project Layout to address the concerns outlined by the DPE and Heritage Council of NSW. Details of the Revised Project Layout are provided in Section 1.2.

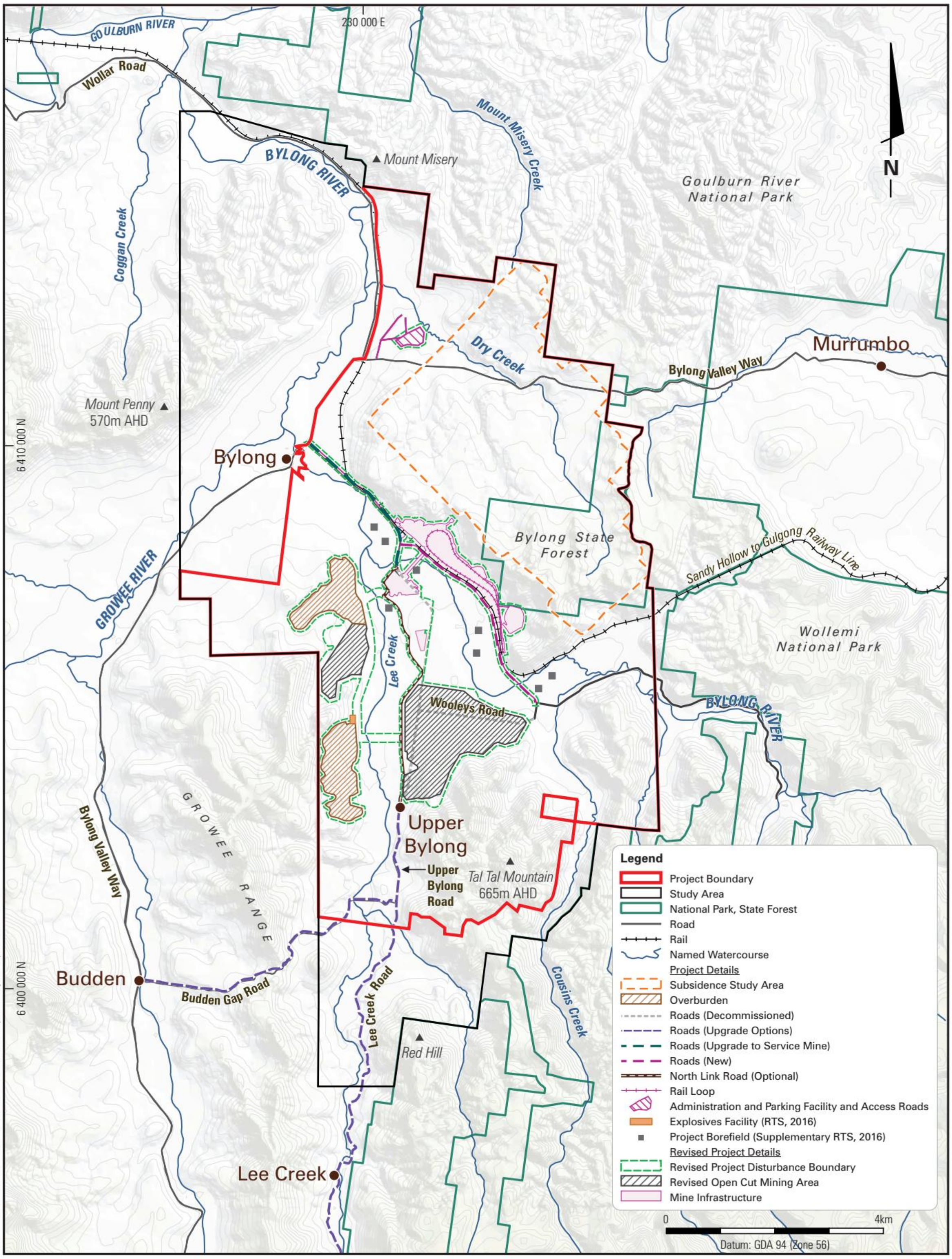
This report presents the outcomes from an updated surface water impact assessment incorporating the Revised Project Layout. This includes a full update of the Project water balance model and a review of the predicted surface water impacts in comparison to previous predictions.

## 1.2 REVISIONS TO THE BYLONG WATER MANAGEMENT SYSTEM

The Revised Project Layout entails the following changes to the Project:

- Reduced the footprint of the Eastern Open Cut Mining Area and Eastern OEA to remain outside of the Tarwyn Park property.
- Reduced the footprint of the Western Open Cut Mining Area and Western OEA to retain the wooded ridgeline between the Western OEA and South-western OEA.
- Minor changes to the production schedule.
- Changes to the proposed sediment dams around the Eastern OEA.

The overall Project disturbance footprint will reduce and remain within the Project Disturbance Boundary previously assessed within the EIS (with the exception of Tarwyn Park). The Revised Project layout is shown in Figure 1.1.

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Revised Conceptual Project Layout

**Figure 1.1 – Revised Conceptual Project Layout**

# 2 Revised Project Layout water management strategy and infrastructure

Figure 2.1 to Figure 2.4 show the indicative location of the key features of the open cut mine for the Revised Project Layout, including infrastructure related to the management of water on the Project site for four different phases of mining (Project Year (PY) 3, PY7, PY9 and PY10+). The main components of water-related infrastructure include:

- Sediment dams to collect and treat runoff from OEAs.
- Dirty water drains to divert sediment-laden runoff from OEAs to sediment dams.
- Clean water drains to divert runoff from undisturbed catchments around areas disturbed by mining.
- A mine-affected water system to store water pumped out of the open cut mining areas and to collect runoff from the Coal Handling and Preparation Plan (CHPP) and coal stockpile area.

Details of proposed mine site storages, including indicative storage sizes and pumping rules for the water balance model are provided in Section 3.

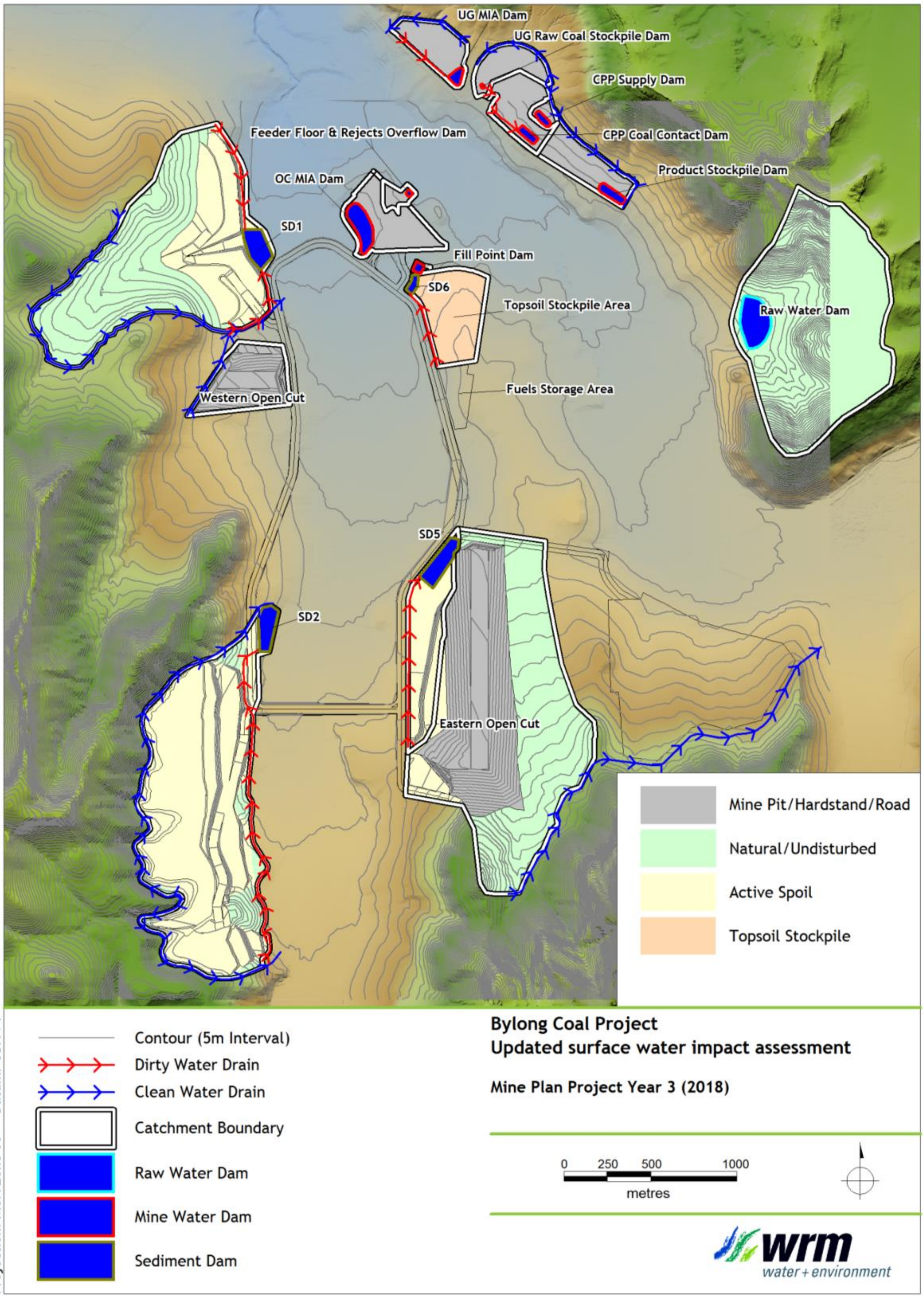


**Figure 2.1 – Project Year 3 Mine Plan**

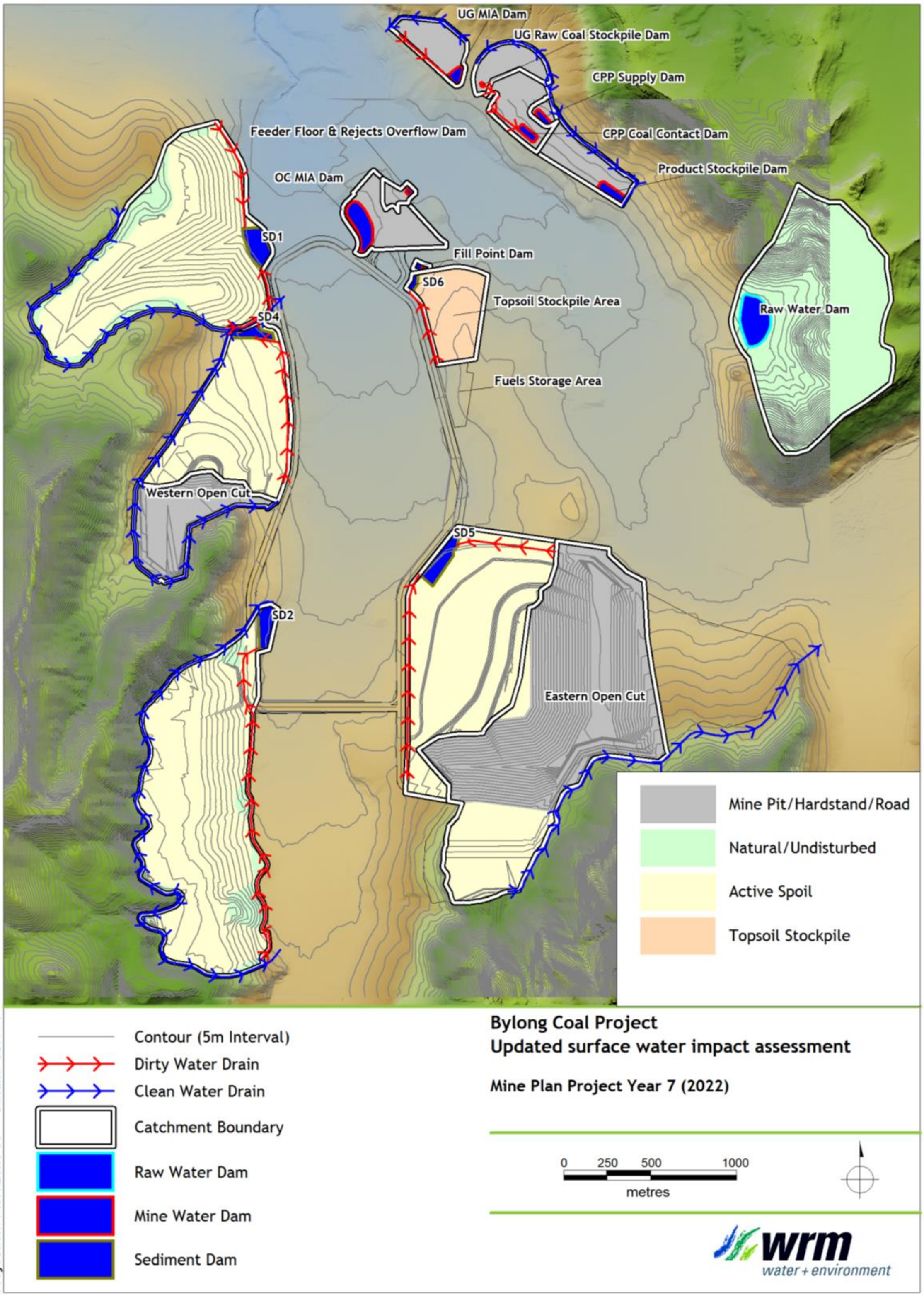


**Figure 2.2 – Project Year 7 Mine Plan**

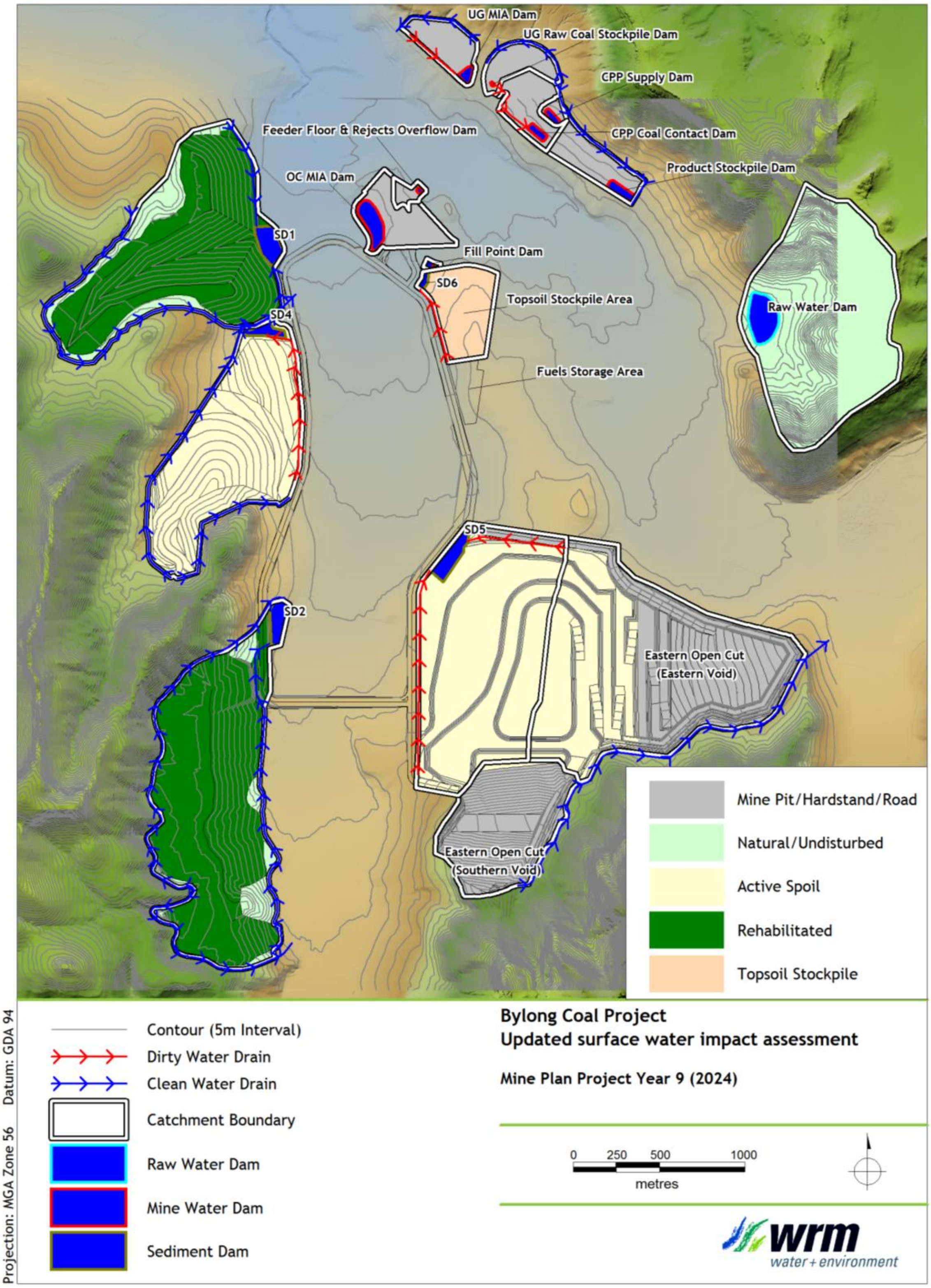


**Figure 2.3 – Project Year 9 Mine Plan**

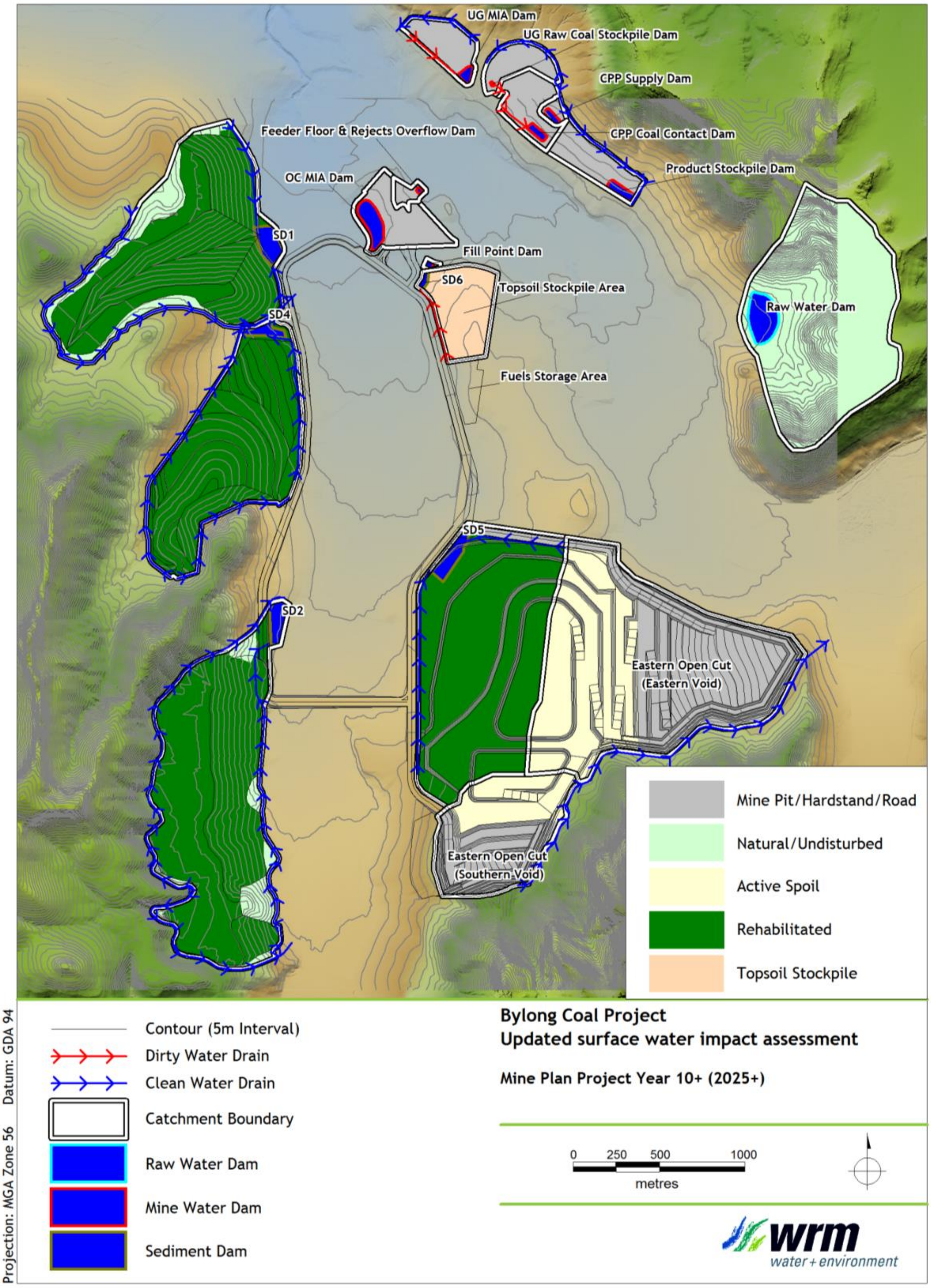


**Figure 2.4 – Project Year 10+ Mine Plan**

# 3 Mine water balance model configuration

## 3.1 OVERVIEW

The previously developed Bylong operational simulation model (OPSIM) has been updated to reflect the Revised Project Layout, as shown in Figure 2.1 to Figure 2.4. This model was used to assess the dynamics of the mine water balance under conditions of varying rainfall and catchment conditions throughout the development of the Project. The OPSIM model dynamically simulates the operation of the water management system and keeps complete account of all site water volumes and representative water quality on a daily time step.

The model has been configured to simulate the operations of all major components of the water management system. The simulated inflows and outflows included in the model are given in Table 3.1. The revised water balance has been developed based on assumptions consistent with the EIS, Response to Submissions (RTS), Supplementary RTS and Response to PAC Review Report work.

**Table 3.1 - Simulated inflows and outflows to the mine water management system**

| Inflows | Outflows |
|---|---|
| Direct rainfall on water surface of storages | Evaporation from water surface of storages |
| Catchment runoff | CHPP demand |
| Groundwater inflows to open cut pit/underground operations | Dust suppression demand |
| Raw (bore) water supply | Underground water supply |
| | Mine infrastructure area (MIA) demands |
| | 'Off-site spills from storages' |

## 3.2 SIMULATION METHODOLOGY

The Revised Project Layout water management system will change over the 23-year operational mine life, including changes in catchment areas, production profile and site water demands. To represent the evolution of the mine layout over time, the Project was modelled in 4 discrete phases. Four representative years have been selected to reflect the average conditions over the mine phase.

The modelled mining phases are summarised in Table 3.2. Construction activities are proposed during PY1 and PY2, and these two years have not been included in the water balance modelling assessment. Open cut mining (including initial box cut development) will be undertaken between PY2 and PY9, with underground mining undertaken between PY6 and PY25.

**Table 3.2 – Project phasing**

| Phase | Representative disturbance year | Modelled period | Number of model years |
|---|---|---|---|
| 1 | PY3 (2018) | PY3 to PY5 (2018 to 2020) | 3 |
| 2 | PY7 (2022) | PY6 to PY7 (2021 to 2022) | 2 |
| 3 | PY9 (2024) | PY8 to PY9 (2023 to 2024) | 2 |
| 4 (Post-open cut mining) | PY10+ (2025) | PY10 to PY25 (2025– 2040) | 16 |

The model was run for 102 climate sequences, each referred to as a "realisation". Each realisation is based on a 23-year sequence extracted from the historical rainfall data. The first realisation is based on rainfall data from 1889 to 1911. The second has used data from 1890 to 1912 and so on. This approach provides the widest possible range of climate scenarios covering the full range of climatic conditions represented in the historical rainfall record. Statistical analysis of the results from all realisations provides a probability distribution of key hydrologic parameters, such as storage inventories and pit inundation.

## 3.3 SIMULATION OF RAINFALL RUNOFF

### 3.3.1 Catchment yield parameters

The OPSIM model uses the Australian Water Balance Model (AWBM) to estimate runoff from rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff. The AWBM uses a group of connected conceptual storages (three surface water storages and one groundwater storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evaporation (surface stores only). Simulated surface runoff occurs when the storages fill and overflow.

The model uses daily rainfall and estimates of catchment evapotranspiration to calculate daily values of runoff using a daily water balance of soil moisture. The model has a baseflow component which simulates the recharge and discharge of a shallow subsurface store. Runoff depth calculated by the AWBM model is converted into runoff volume by multiplying by the contributing catchment area.

The model parameters define the storage depths (C1, C2 and C3), the proportion of the catchment draining to each of the storages (A1, A2 and A3), and the rate of flux between them (Kb, Ks and BFI) (Boughton & Chiew, 2003). Catchments across the site have been characterised into the following land use types:

- natural/undisturbed;
- roads/hardstand/pits;
- active spoil;
- rehabilitated spoil; and
- topsoil stockpile.

For this assessment, the AWBM model parameters used for EIS, RTS, Supplementary RTS and PAC Response assessment have been adopted, as shown in Table 3.3.

**Table 3.3 – Adopted AWBM parameters**

| Parameter | Natural/ undisturbed | Roads/ hardstand/pits | Active spoil | Rehabilitated spoil | Topsoil stockpile |
|---|---|---|---|---|---|
| A1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 |
| A2 | 0.2 | 0.9 | 0.3 | 0.2 | 0.2 |
| C1 | 45 | 4 | 15 | 45 | 45 |
| C2 | 95 | 16 | 50 | 95 | 95 |
| C3 | 150 | - | 110 | 150 | 150 |
| BFI | 0.55 | - | 0.2 | 0.55 | 0.55 |
| kb | 0.7 | - | - | 0.7 | 0.7 |
| Ks | - | - | - | - | - |
| Long-term $C_v$* | 4% | 32% | 8% | 4% | 4% |

** Long term volumetric runoff coefficient*

As part of the PAC Response, in response to a peer review of the water balance modelling completed within the EIS process, an alternate set of AWBM parameters were assessed using the Bylong water balance model (using the EIS mine plan).

The impact of the alternative AWBM parameters on the performance of the Bylong water management system has been assessed as a sensitivity run. The outcomes of this sensitivity assessment are provided in Appendix A.

### 3.3.2 Catchment areas and land disturbance types

Catchment areas and land disturbance types for each of the site storages and mining areas have been estimated from the available topographic information and Revised Project Layout, as shown in Figure 2.1 to Figure 2.4. The catchment for the Eastern Open Cut at PY10+ is assumed to remain at the completion of open cut mining, while the remaining mining void is used for the disposal of coarse and fine reject materials and storage of excess mine water from the underground operations. A summary of catchment areas for the Revised Project Layout mine configuration is provided in Table 3.4.

Table 3.4 - Storage and pit catchment areas

| Project modelling phase | Storage/pit | Contributing catchment (ha) | | | | |
|---|---|---|---|---|---|---|
| | | Active spoil | Mine pit/ hardstand/roads | Natural/ undisturbed | Rehabilitated spoil | Total |
| PY3 | CPP Coal Contact Dam | - | 10.3 | - | - | 10.3 |
| | CPP Supply Dam | - | 1.7 | - | - | 1.7 |
| | Eastern Open Cut | 8.3 | 59.5 | 67.9 | - | 135.8 |
| | Feeder Floor and Rejects Overflow Dam | - | 2.1 | - | - | 2.1 |
| | Fill Point Dam | - | 0.4 | - | - | 0.4 |
| | OC MIA Dam | - | 14.3 | - | - | 14.3 |
| | Product Stockpile Dam | - | 10.8 | - | - | 10.8 |
| | Raw Water Dam | - | 4.1 | 92.5 | - | 96.6 |
| | Sed Dam 1 | 39.4 | - | 63.5 | - | 102.9 |
| | Sed Dam 2 | 101.4 | - | 12.8 | - | 114.2 |
| | Sed Dam 5 | 20.6 | - | - | - | 20.6 |
| | Sed Dam 6 | - | - | - | 18.0 | 18.0 |
| | UG MIA Dam | - | 9.3 | - | - | 9.3 |
| | UG Raw Coal Stockpile Dam | - | 7.6 | - | - | 7.6 |
| | Western Open Cut | - | 16.5 | - | - | 16.5 |
| PY7 | CPP Coal Contact Dam | - | 10.3 | - | - | 10.3 |
| | CPP Supply Dam | - | 1.7 | - | - | 1.7 |
| | Eastern Open Cut | 30.7 | 111.5 | - | - | 142.2 |
| | Feeder Floor and Rejects Overflow Dam | - | 2.1 | - | - | 2.1 |
| | Fill Point Dam | - | 0.4 | - | - | 0.4 |
| | OC MIA Dam | - | 14.3 | - | - | 14.3 |
| | Product Stockpile Dam | - | 10.8 | - | - | 10.8 |
| | Raw Water Dam | - | 4.1 | 92.5 | - | 96.6 |
| | Sed Dam 1 | 82.2 | - | 20.7 | - | 102.9 |
| | Sed Dam 2 | 101.4 | - | 12.8 | - | 114.2 |

| Project modelling phase | Storage/pit | Contributing catchment (ha) Active spoil | Mine pit/ hardstand/roads | Natural/ undisturbed | Rehabilitated spoil | Total |
|---|---|---|---|---|---|---|
| | Sed Dam 4 | 50.7 | - | - | - | 50.7 |
| | Sed Dam 5 | 82.6 | - | - | - | 82.6 |
| | Sed Dam 6 | - | - | - | 18.0 | 18.0 |
| | UG MIA Dam | - | 9.3 | - | - | 9.3 |
| | UG Raw Coal Stockpile Dam | - | 7.6 | - | - | 7.6 |
| | Western Open Cut | - | 24.4 | 9.1 | - | 33.5 |
| PY9 | CPP Coal Contact Dam | - | 10.3 | - | - | 10.3 |
| | CPP Supply Dam | - | 1.7 | - | - | 1.7 |
| | Eastern Open Cut (East Void) | 62.4 | 67.1 | - | - | 129.5 |
| | Eastern Open Cut (South Void) | 1.6 | 42.7 | - | - | 44.2 |
| | Feeder Floor and Rejects Overflow Dam | - | 2.1 | - | - | 2.1 |
| | Fill Point Dam | - | 0.4 | - | - | 0.4 |
| | OC MIA Dam | - | 14.3 | - | - | 14.3 |
| | Product Stockpile Dam | - | 10.8 | - | - | 10.8 |
| | Raw Water Dam | - | 4.1 | 92.5 | - | 96.6 |
| | Sed Dam 1 | - | - | 20.7 | 82.2 | 102.9 |
| | Sed Dam 2 | - | - | 12.8 | 101.4 | 114.2 |
| | Sed Dam 4 | 75.1 | - | 9.1 | - | 84.2 |
| | Sed Dam 5 | 98.8 | 3.4 | - | - | 102.2 |
| | Sed Dam 6 | - | - | - | 18.0 | 18.0 |
| | UG MIA Dam | - | 9.3 | - | - | 9.3 |
| | UG Raw Coal Stockpile Dam | - | 7.6 | - | - | 7.6 |
| PY10+ | CPP Coal Contact Dam | - | 10.3 | - | - | 10.3 |
| | CPP Supply Dam | - | 1.7 | - | - | 1.7 |
| | Eastern Open Cut (East Void) | 64.0 | 67.1 | - | - | 131.1 |
| | Eastern Open Cut (South Void)* | 18.2 | 25.1 | - | - | 43.4 |
| | Feeder Floor and Rejects Overflow Dam | - | 2.1 | - | - | 2.1 |

| Project modelling phase | Storage/pit | Contributing catchment (ha) | | | | |
|---|---|---|---|---|---|---|
| | | Active spoil | Mine pit/ hardstand/roads | Natural/ undisturbed | Rehabilitated spoil | Total |
| | Fill Point Dam | - | 0.4 | - | - | 0.4 |
| | OC MIA Dam | - | 14.3 | - | - | 14.3 |
| | Product Stockpile Dam | - | 10.8 | - | - | 10.8 |
| | Raw Water Dam | - | 4.1 | 92.5 | - | 96.6 |
| | Sed Dam 1 | - | - | 20.7 | 82.2 | 102.9 |
| | Sed Dam 2 | - | - | 12.8 | 101.4 | 114.2 |
| | Sed Dam 4 | - | - | 9.1 | 75.1 | 84.2 |
| | Sed Dam 5 | - | 3.4 | - | 102.4 | 105.8 |
| | Sed Dam 6 | - | - | - | 18.0 | 18.0 |
| | UG MIA Dam | - | 9.3 | - | - | 9.3 |
| | UG Raw Coal Stockpile Dam | - | 7.6 | - | - | 7.6 |

*Note: * Note that South Void at the Eastern OC Area will be backfilled and rehabilitated within a few years of underground only operations commencing.*

## 3.4 CONCEPTUAL WATER MANAGEMENT SYSTEM CONFIGURATION AND SCHEMATIC

A conceptual water management system layout for the Revised Project Layout has been developed based on the water management principles described in Section 4 and is presented in Figure 2.1 to Figure 2.4. Note that the Year 10+ configuration as shown in Figure 2.4 represents conditions in the final years of open cut mining and has been assumed to represent conditions post-open cut mining. However, all OEA's draining to sediment dams will be fully rehabilitated and runoff from these areas are expected to be suitable for release to the downstream environment.

The Eastern Void within the Eastern Open Cut and its associated catchment will remain at the completion of open cut mining for the emplacement of coarse and fine reject materials and storage of excess mine water generated during the longer term underground operations.

The water management system includes indicative locations of proposed water management infrastructure, including clean and dirty water drains. Proposed water storages include:

- a raw water dam;
- mine water dams; and
- sediment dams.

The proposed period of operation for each water storage is presented in Figure 3.1. A schematised plan for the modelled Project's water management system configuration is shown in Figure 3.2 and operating rules are provided in Table 3.5.

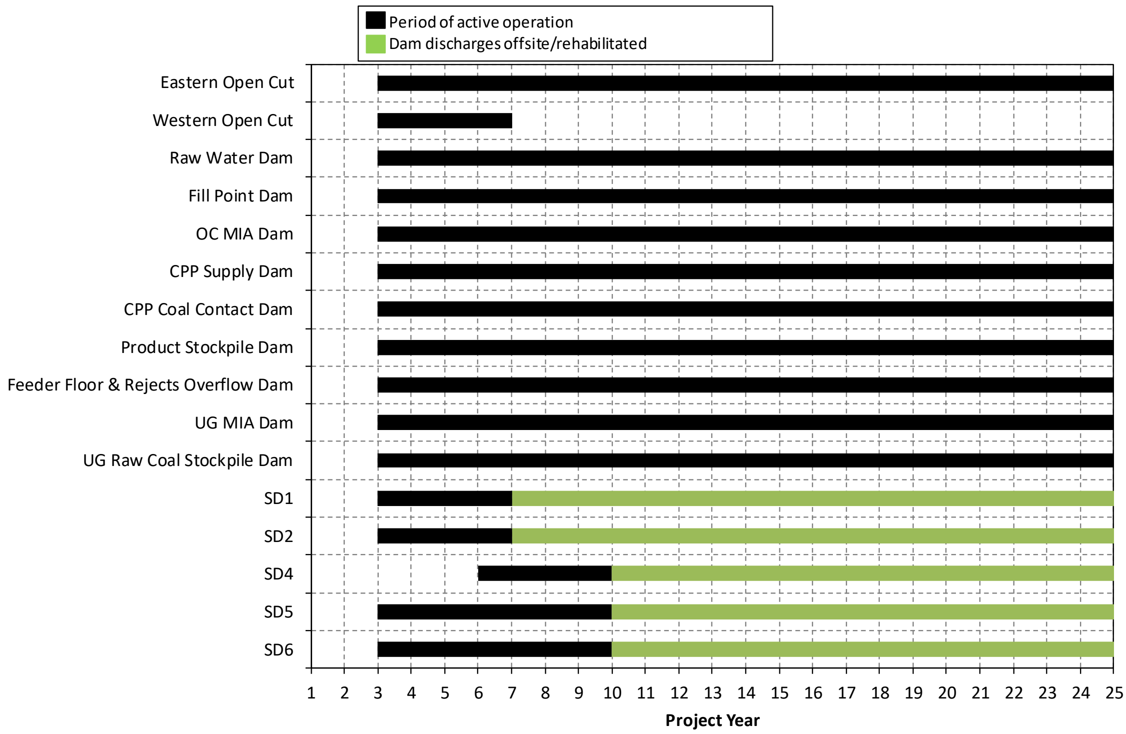


**Figure 3.1 – Project storages periods of operation**

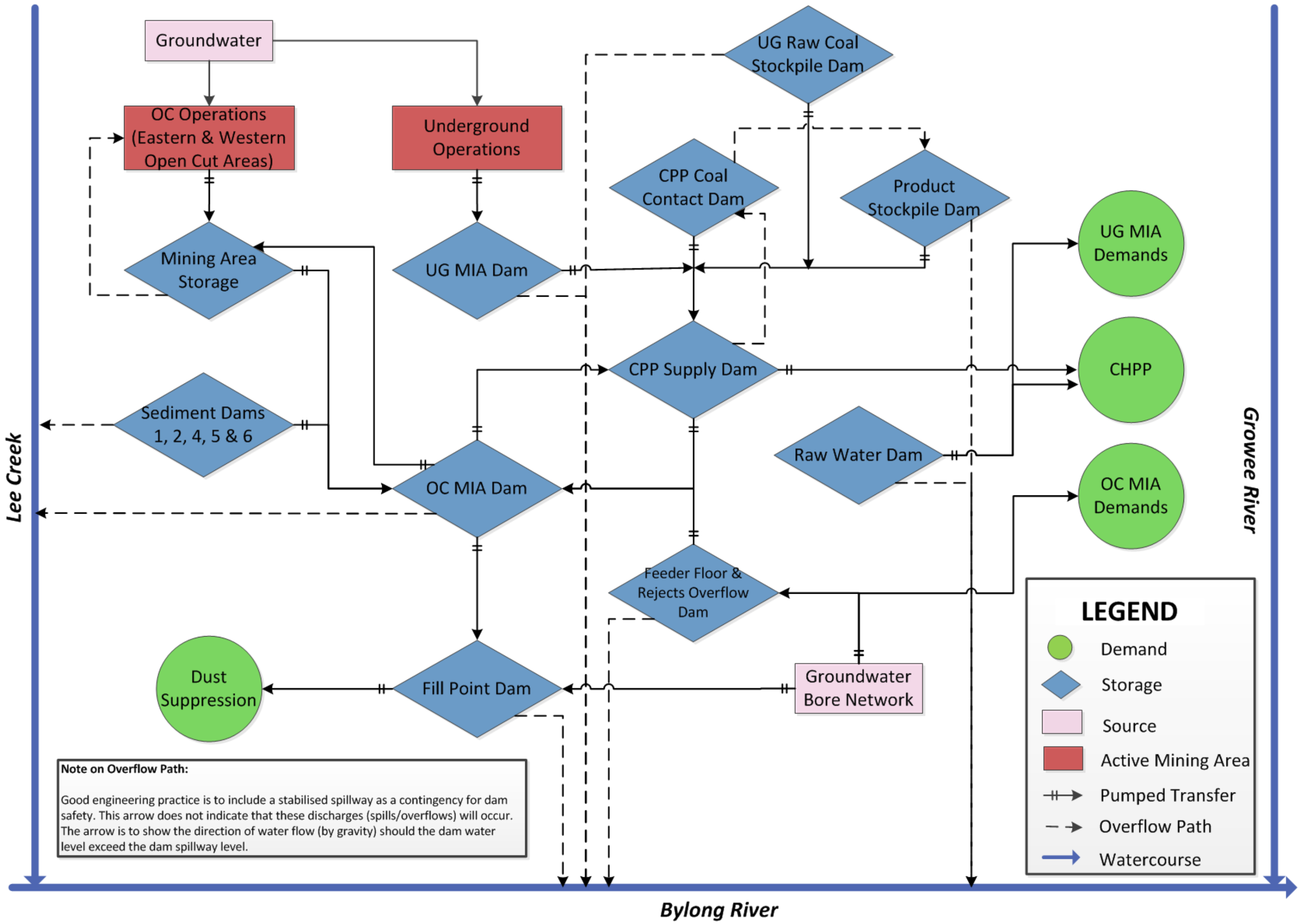


**Figure 3.2 – Water management system schematic**

Table 3.5 – Project water management system operating rules

| Item | Name | Operating Rules |
|---|---|---|
| **1** | **External water supply** | |
| 1.1 | Groundwater bores network | • Primary supply to Open Cut Mine Infrastructure Area (OC MIA)<br>• Secondary supply to Fill Point Dam<br>• Supplies to Feeder Floor & Rejects Overflow Dam to maintain operating levels |
| **2** | **Water demands** | |
| 2.1 | CHPP | • Receives supply from CPP Supply Dam (100 L/s)<br>• Secondary supply from Raw Water Dam (100 L/s) and Groundwater Bores Network (via Feeder Floor & Rejects Overflow Dam) (100 L/s) |
| 2.2 | Haul road dust suppression | • Receives primary supply from Fill Point Dam (140 L/s)<br>• Secondary supply from Groundwater Bores Network |
| 2.3 | Underground mine area infrastructure | • Supply from Raw Water Dam |
| 2.3 | Open cut mine area infrastructure | • Supply from Groundwater Bores Network |
| **3** | **Active mining areas** | |
| 3.1 | Open cut mining areas (Eastern & Western open cut mining areas) | • Continuous dewatering to Mining Area Storage (200 L/s total)<br>• Receives groundwater inflows |
| 3.2 | Underground mine | • Continuous dewatering to UG MIA Dam (200 L/s total)<br>• Receives groundwater inflows |
| **4** | **Water Storages** | |
| 4.1 | Raw Water Dam | • Receives runoff from local catchment<br>• Supplementary water source for CHPP (100 L/s)<br>• Supplementary water source for haul road dust suppression and mine infrastructure demands including underground operations<br>• Overflows to Bylong River |
| 4.2 | CPP Supply Dam | • Receives runoff from a small local catchment<br>• Supplies water to CHPP, haul road dust suppression and mine infrastructure demands including underground operations<br>• Transfers back to the OC MIA Dam to prevent uncontrolled discharges<br>• Receives pumped transfers from the following storages:<br>  ○ OC MIA Dam (100 L/s)<br>  ○ UG MIA Dam (100 L/s)<br>  ○ Product Stockpile Dam (100 L/s)<br>  ○ UG Raw Coal Stockpile Dam (100 L/s)<br>  ○ CPP Coal Contact Dam (100 L/s)<br>• Overflows to CPP Coal Contact Dam |
| 4.3 | OC MIA Dam | • Receives runoff from open cut MIAs<br>• Receives transfers from the following storages:<br>  ○ CHPP Supply Dam (100 L/s)<br>  ○ Water Storage within Mining Areas (200 L/s) |

| Item | Name | Operating Rules |
|---|---|---|
| | | ○ Sediment dams<br>• Transfers back to Mining Area Storage when high alarm level is reached (80%), to prevent uncontrolled spills<br>• Supplies water to CPP Supply Dam to maintain operating levels<br>• Overflows to Lee Creek |
| 4.4 | UG MIA Dam | • Receives runoff from the underground MIAs<br>• Transfers back to CPP Supply Dam to prevent uncontrolled spills<br>• Overflows to Bylong River |
| 4.5 | UG Raw Coal Stockpile Dam | • Receives runoff from the Raw Coal stockpile area<br>• Transfers back to CPP Supply Dam to prevent uncontrolled spills<br>• Overflows to Bylong River |
| 4.6 | CPP Coal Contact Dam | • Receives runoff from the CPP area<br>• Transfers to CPP Supply Dam to prevent uncontrolled spills<br>• Overflows to Product Stockpile Dam |
| 4.7 | Product Stockpile Dam | • Receives runoff from the product stockpile area<br>• Transfers back to CPP Supply Dam to prevent uncontrolled spills<br>• Overflows to Bylong River |
| 4.8 | Fill Point Dam | • Supplies water to haul road dust suppression<br>• Supplies from the following sources:<br>○ OC MIA Dam<br>○ Groundwater Bores Network<br>• Overflows to Bylong River |
| 4.9 | Feeder Floor and Rejects Overflow Dam | • Secondary supply to the CHPP<br>• Supplied from Groundwater Bores Network<br>• Overflows to Bylong River |
| 4.10 | Mining Area Storage | • Dedicated section of Eastern Mining Area void which is used to store excess mine water<br>• Supplies water to OC MIA Dam to meet demands (200 L/s)<br>• Receives dewatering from mining areas (open cut and underground) |
| 4.11 | Sediment Dams 1, 2, 4, 5 & 6 | • Dewatered to OC MIA Dam following rainfall events<br>• Overflows to Lee Creek |
| **5** | **Receiving Waters** | |
| 5.1 | Bylong River | • Receives storage overflows from Raw Water Dam, UG MIA Dam, UG Raw Coal Stockpile Dam, Product Stockpile Dam, Feeder Floor and Rejects Overflow Dam and Fill Point Dam |
| 5.2 | Lee Creek | • Receives storage overflows from OC MIA Dam and Sediment Dams 1, 2, 4, 5 & 6 |
| **6** | **General** | |
| 6.1 | Climate | • All storages and pits receive direct rainfall, local catchment runoff and lose water through evaporation |

## 3.5 MINE WATER STORAGE CAPACITIES

A summary of the proposed mine water storages within the Project water management system is provided in Table 3.6.

**Table 3.6 -Proposed mine water storage details**

| Storage Name | Storage Capacity (ML) | Overflows to |
|---|---|---|
| Raw Water Dam | 300 | Bylong River |
| CPP Supply Dam | 22.2 | CPP Coal Contact Dam |
| CPP Coal Contact Dam | 23.3 | Product Stockpile Dam |
| OC MIA Dam | 106.1 | Lee Creek |
| UG MIA Dam | 15.7 | Bylong River |
| UG Raw Coal Stockpile Dam | 3.4 | Bylong River |
| Product Stockpile Dam | 18.0 | Bylong River |
| Feeder Floor and Rejects Overflow Dam | 6.0 | Bylong River |
| Fill Point Dam | 2.0 | Bylong River |

Capacities of the mining areas have been estimated from the contour information supplied with the mine plans for the Revised Project Layout, and are as follows:

- Eastern OC Area:
  - PY3 - 3,015 ML
  - PY7 - 9,267 ML
  - PY9 - 5,523 ML (South Void) & 17,671 ML (East Void)
  - PY10+ (post-open cut) - 497 ML (South Void) & 18,831 ML (East Void)
- Western OC Area:
  - PY3 - 1,287 ML
  - PY7 - 610 ML
  - PY9 - backfilled
  - PY10+ (post-open cut) - backfilled

Note that South Void at the Eastern OC Area will be backfilled and rehabilitated within a few years of underground only operations commencing. The void remaining at the Eastern OC Area (East Void) at the completion of mining operations for the Revised Project Layout is consistent with the void remaining for the EIS mine plan.

## 3.6 SEDIMENT DAMS

### 3.6.1 Sizing

Conceptual sediment dam locations have been proposed based on the Revised Project Layout mine plans and are shown in in Figure 2.1 to Figure 2.4. There is a total of 5 sediment dams proposed over the life of the Project. The sediment dams will be sized in accordance with current recommended design standards in the following guidelines:

- Managing Urban Stormwater, Soils and Construction (Landcom, 2004).
- Managing Urban Stormwater, Soils and Construction, Mines and Quarries (DECC, 2008).

The sediment dam volumes will be based on the following design standards and methodology which has been updated from the EIS in response to comments from the EPA:

- "Type F" sediment basins consistent with SD 6-4 (page 6-19, Landcom 2004).
- Total sediment basin volume = settling zone volume + sediment storage volume. The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the basin is de-silted. The settling zone is the minimum required free storage capacity that must be restored within 5 days after a runoff event.
- Sediment basin settling zone volume based on 95$^{th}$ percentile 5-day duration rainfall at Scone (51.39 mm) with an adopted volumetric event runoff coefficient for disturbed catchments of 0.74.
- Solids storage volume = 50% of settling zone volume.

The adopted design standard does not provide 100% containment for runoff from disturbed areas. Hence, it is possible that overflows will occur from sediment dams if rainfall exceeds the design standard.

Table 3.7 provides the adopted sediment dam volumes and the associated pump requirements to restore the settling zone capacity within 5 days. Note that current design guidelines (DECC, 2008) allow for the adoption of larger dam sizes to allow for dewatering over a longer period to reduce the required pumping rate.

**Table 3.7 - Proposed sediment dam sizing**

| Sediment Dam | Maximum Catchment Area (ha) | Total Volume Required (ML) | 5-day Pump Requirement (L/s) |
|---|---|---|---|
| SD 1 | 99.9 | 56.9 | 130 |
| SD 2 | 112.9 | 64.3 | 150 |
| SD 4 | 75.2 | 42.8 | 100 |
| SD 5 | 105.8 | 60.2 | 140 |
| SD 6 | 18.0 | 10.2 | 25 |

### 3.6.2 Sediment dam collection system - operating rules

The operating rules for the sediment dam collection system are based on the recommendations in the guideline Managing Urban Stormwater Soils and Construction Guideline: Mines and Quarries (DECC 2008). The operating rules are as follows:

- Runoff from disturbed areas will be captured in a sediment dam and pumped to OC MIA Dam.
- Pump capacities will be sized to empty sediment dams in 5 days.
- Runoff from rehabilitated areas established for more than two years will be directed to a sediment dam and released off-site.
- Sediment dams will overflow when rainfall exceeds the design criteria (95$^{th}$ percentile 5-day rainfall).

In practice, water may be released from sediment dams if it meets water quality criteria and water is not required for use in the water management system.

## 3.7 WATER DEMANDS

A summary of the estimated water demands for the Project is provided below.

### 3.7.1 CHPP

The annual production schedule for the Revised Project Layout has been used to estimate the CHPP demands over the life of the Project. To maintain consistency with the EIS assessment, we have adopted the previous net consumption rate for each year of the Project. The net CHPP consumption rate applies to the washed ROM coal only (not the bypass ROM coal).

A summary of the annual production data and net CHPP water usage is provided in Table 3.8 and Figure 3.3.

**Table 3.8 - Adopted CHPP water demands**

| Project Year | ROM coal (washed) (Mtpa) (wet) | ROM coal (bypass) (Mtpa) (wet) | ROM coal (total) (Mtpa) (wet) | Net consumption rate (L/Rom tonne) | Net CHPP water usage (ML/a) |
|---|---|---|---|---|---|
| PY3 | 2.21 | 1.49 | 3.70 | 95 | 209 |
| PY4 | 2.89 | 1.71 | 4.60 | 101 | 292 |
| PY5 | 2.99 | 1.61 | 4.60 | 97 | 290 |
| PY6 | 3.03 | 1.63 | 4.67 | 98 | 297 |
| PY7 | 3.22 | 1.91 | 5.12 | 91 | 292 |
| PY8 | 3.03 | 1.59 | 4.62 | 88 | 268 |
| PY9 | 4.81 | 0.85 | 5.66 | 78 | 376 |
| PY10 | 3.60 | - | 3.60 | 78 | 282 |
| PY11 | 5.65 | - | 5.65 | 72 | 404 |
| PY12 | 6.04 | - | 6.04 | 72 | 432 |
| PY13 | 5.93 | - | 5.93 | 72 | 424 |
| PY14 | 5.02 | - | 5.02 | 73 | 368 |
| PY15 | 5.65 | - | 5.65 | 74 | 418 |
| PY16 | 5.62 | - | 5.62 | 77 | 435 |
| PY17 | 4.57 | - | 4.57 | 75 | 342 |
| PY18 | 6.30 | - | 6.30 | 72 | 455 |
| PY19 | 5.44 | - | 5.44 | 73 | 395 |
| PY20 | 5.49 | - | 5.49 | 73 | 398 |
| PY21 | 5.32 | - | 5.32 | 72 | 385 |
| PY22 | 5.58 | - | 5.58 | 73 | 405 |
| PY23 | 5.90 | - | 5.90 | 73 | 430 |
| PY24 | 4.73 | - | 4.73 | 72 | 339 |
| PY25 | 5.98 | - | 5.98 | 72 | 433 |

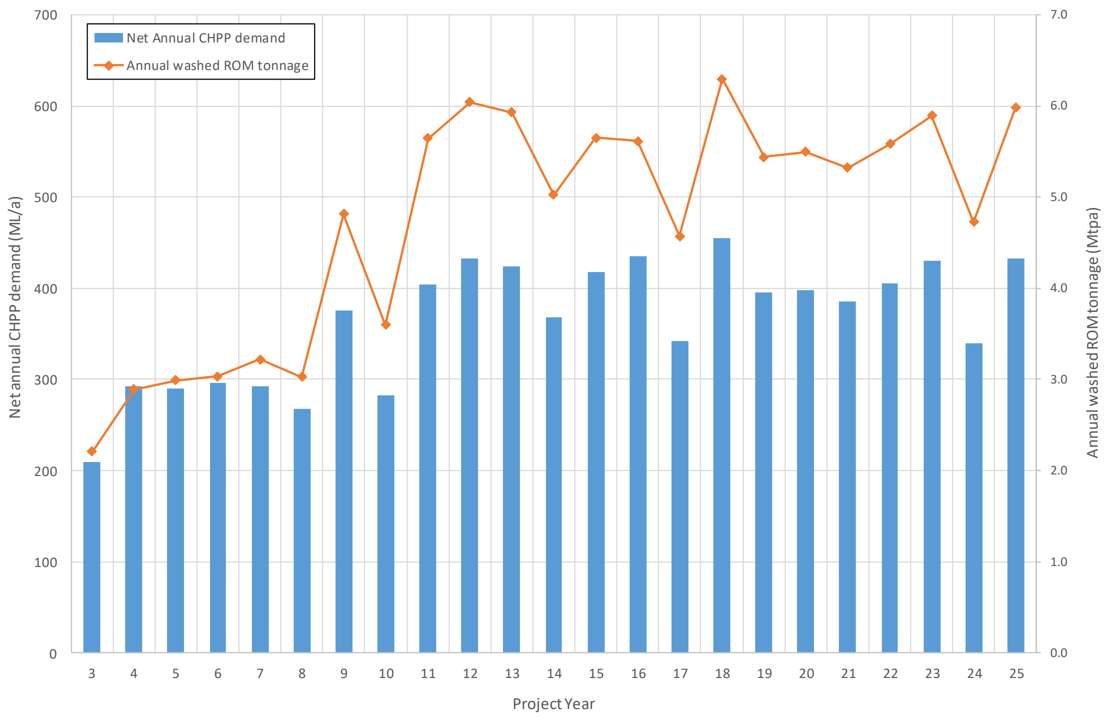


**Figure 3.3 - Adopted average CHPP demands**

### 3.7.2 Haul road dust suppression

The estimated daily average dust suppression demand for the open cut operations is predicted to be 2.85 ML/d (1,041 ML/a). This includes dust suppression on haul roads, dumps, stockpiles and mine facility and hardstand areas (PB, 2014).

The dust suppression demand will reduce once open cut operations cease. The adopted daily average dust-suppression demand during underground operations is 1.37 ML/d (500 ML/a).

### 3.7.3 Underground operations

The total daily underground operations demand for the Project has been estimated at 500 ML/a at full underground production. This demand only applies from PY9 onwards, however a demand of 50 ML/a has been applied during the ramp-up phase (PY6 - PY8) of the underground operations.

### 3.7.4 Mine infrastructure area

Estimates of OC MIA demand (administration buildings, bathhouse and workshops) vary as follows:

- construction and ramp-up - 5.2 ML/a (PY3)
- steady state operations - 6.5 ML/a (PY5 -PY7)
- open cut wind-down - 1.6 ML/a (PY9)

Estimates of underground MIA demands vary as follows:

- construction and ramp-up - 5.2 ML/a (PY6 to PY8)
- steady state operations - 6.5 ML/a (PY9 to PY25)

### 3.7.5 Water demand summary

A summary of the Project demands is presented in Table 3.9.

**Table 3.9 – Site water demand summary**

| Project year | Dust suppression (ML/a) | CHPP net demand (ML/a) | UG operations (ML/a) | MIA demand (OC & UG) (ML/a) | Total site demand (ML/a) |
|---|---|---|---|---|---|
| PY3 | 1,041 | 209 | - | 5.2 | 1,255 |
| PY4 - PY5 | 1,041 | 290 - 297 | - | 6.5 | 1,338 – 1,345 |
| PY6 – PY8 | 1,041 | 268 – 297 | 50 | 11.7 | 1,371 – 1,400 |
| PY9 | 1,041 | 376 | 500 | 8.1 | 1,925 |
| PY10+ (post-open cut) | 500 | 282 - 455 | 500 | 6.5 | 1,289 – 1,462 |

## 3.8 WATER SOURCES

### 3.8.1 Open cut and underground mining area groundwater inflows

Groundwater inflows to the open cut and underground mining areas over the life of the Project were adopted based on estimates provided by AGE (2018), which are based on the updated Supplementary RTS groundwater model for the Revised Project Layout. The updated groundwater inflows are consistent with those adopted in the Response to PAC Review Report, with the exception of a reduction in open cut groundwater inflows between PY3 and PY8 (around 90 ML in total).

The adopted groundwater inflow rates for water balance modelling for the open cut and underground mine are summarised in Table 3.10 and Figure 3.4.

**Table 3.10 – Adopted groundwater inflows**

| Project Year | Open cut groundwater inflow (ML/a) | Underground groundwater inflows (ML/a) | Total groundwater inflow (ML/a) |
|---|---|---|---|
| PY3 | 31 | - | 31 |
| PY4 | 38 | - | 38 |
| PY5 | 37 | - | 37 |
| PY6 | 34 | - | 34 |
| PY7 | 53 | - | 53 |
| PY8 | 43 | 6 | 49 |
| PY9 | 29 | 463 | 492 |
| PY10 | - | 1,173 | 1,173 |
| PY11 | - | 1,446 | 1,446 |
| PY12 | - | 1,268 | 1,268 |
| PY13 | - | 1,049 | 1,049 |
| PY14 | - | 804 | 804 |
| PY15 | - | 704 | 704 |
| PY16 | - | 508 | 508 |

| | | | |
|---|---|---|---|
| PY17 | - | 526 | 526 |
| PY18 | - | 1,030 | 1,030 |
| PY19 | - | 1,744 | 1,744 |
| PY20 | - | 1,943 | 1,943 |
| PY21 | - | 2,371 | 2,371 |
| PY22 | - | 2,099 | 2,099 |
| PY23 | - | 2,869 | 2,869 |
| PY24 | - | 2,241 | 2,241 |
| PY25 | - | 2,766 | 2,766 |

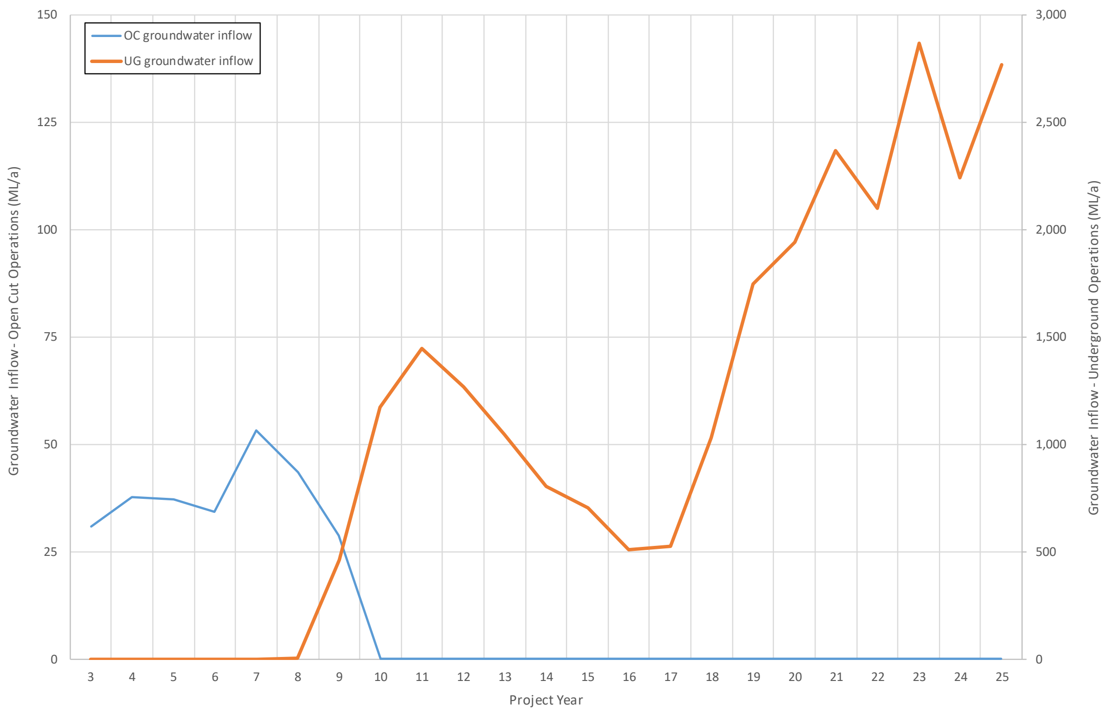


**Figure 3.4 - Adopted groundwater inflows**

### 3.8.2 Groundwater bores

KEPCO has licences to extract approximately 3,045 units from the Bylong River water source as managed under the Hunter Unregulated and Alluvial Water Sources Sharing Plan (HUAWSP). The HUAWSP allows for some extraction of water from the river and groundwater without a Water Access Licence to provide basic landholder rights, which include domestic and stock rights as well as Native Title rights. All water extraction that is not covered by basic landholder rights must be authorised by a Water Access Licence.

This borefield water will be used to meet site water demands in excess of what is captured and stored on site.

## 3.9 SALINITY PARAMETERS

The Project OPSIM model has been configured to use salinity as an indicator of water quality. This has been achieved by assigning representative total dissolved solids (TDS) levels to runoff from catchments and other sources of water.

The salinity concentrations for runoff from spoil, stockpiles and mining pit catchments was determined based on information provided in the EIS Geochemical Impact Assessment (RGS, 2015).

Salinity of natural catchment runoff was based on the median of the recorded EC data at the Bylong River and Lee Creek receiving water monitoring sites. It has been assumed that runoff salinity from rehabilitated catchments will be similar to the natural catchments.

Salinity of the mining area groundwater and borefield water inflows was based on the groundwater sampling data (DP, 2014).

The adopted salinity concentrations applied to the model are given in Table 3.11.

**Table 3.11 - Adopted salinity concentrations**

| Water Source / Land use | EC (μs/cm) | Comment |
|---|---|---|
| Natural/undisturbed/rehab | 700 | Based on median EC data at SW2 & SW8 |
| Roads/hardstand | 1,200 | Adopt same as spoil |
| Spoil | 1,200 | Combined surface runoff (80% @ 500 μS/cm) & baseflow (20% @ 4000 μS/cm). Based on RGS Geochem. Report (S4.1.1 Graph 2, approx. 80th percentile, S5.3.2 p.41) |
| Mining pit | 500 | Based on RGS Geochem. Report (S4.1.2 Graph 8, approx. 80th percentile) |
| Stockpile | 500 | Based on RGS Geochem. Report (S4.1.2 Graph 8, approx. 80th percentile) |
| Pit groundwater inflows | 1,200 | Based on median sample data from DP Report, Table 8 |
| Raw (bore) water | 1,200 | Based on median sample data from DP Report, Table 8 |

Notes: a/ Bylong Coal Project – Geochemical Impact Assessment, RGS, January 2015.
b/ Addendum Report of Hydrogeological Investigations and Monitoring – January to May 2014 Proposed Coal Mine, Bylong, Douglas Partners, June 2014.

## 3.10 LIMITATIONS OF THE WATER BALANCE MODEL

The water balance model developed for the Project is based on the best information currently available and is expected to provide a reasonable representation of the performance of the mine water management system. The performance of the actual system may differ from the model predictions for a variety of reasons, including different climatic sequences and hydrologic behaviour of catchments, as well as variations in operating procedures due to potential equipment failure or operation system error.

The model will be updated in accordance with that described within the Draft Water Management Plan (KEPCO, 2017) (to be updated for DPE approval prior to operations) and validated in the future when more suitable site-specific data becomes available. Model validation will require at least one year of monitoring data following commencement of mining operations and will be undertaken on an annual basis in the early years of the Project to provide early feedback on the likely performance of the system. Once the performance of the model has been confirmed, the frequency of validation reviews could be reduced to once every three years. A key parameter for validation will be the groundwater inflows to the open cut operations, and later, to the underground mine.

# 4 Water management system assessment

## 4.1 OVERVIEW

The potential implications of the site water balance include:

- Potential to run out of water for the production of coal.
- Potential for uncontrolled spills from the mine water dams.
- Potential to impact on production as a result of water inundation to the mining areas.

An assessment of the Project's mine water management system has been undertaken using the water balance model, using the following key performance indicators:

- Mine water inventory – the risk of accumulation (or reduction) of the overall mine water inventory at the Project, and the associated water volumes.
- External raw water requirements – the risk of requiring imported external water to supplement on-site mine water supplies.
- Uncontrolled spillway discharges – the risk of uncontrolled discharges from the site storages to receiving waters.
- Overall site water balance.

A schematic layout of the water balance model is presented in Figure 3.2. Operational guidelines and controls applied to the model are described in Section 3.4.

It is important to note that investigation outcomes are dependent on the accuracy of input assumptions. There are limitations associated with estimating some key site characteristics (e.g. catchment yield/rainfall runoff, mining area groundwater inflows) which cannot be accurately determined prior to the commencement of operations. The use of a large number of climate sequences reflecting the full range of historical climatic conditions provides an indication of the system performance under very wet, very dry and average climatic conditions. This approach is typical and appropriate for modelling both greenfield and brownfield open cut and underground mining operations.

## 4.2 INTERPRETATION OF RESULTS

The modelling methodology of a forecast simulation is described in Section 3.2. In interpreting the results of the water balance assessment, it should be noted that the results provide a statistical analysis of the water management system's performance over the 23 years of mine life, based on 102 different climatic sequences (realisations).

The 50$^{th}$ percentile probability envelope represents the median results, the 10$^{th}$ percentile represents 10% exceedance (i.e. wet conditions) and the 90$^{th}$ percentile results represent 90% exceedance (i.e. dry conditions). There is an 80% chance that the result will fall within the 10$^{th}$ and 90$^{th}$ percentiles and a 98% chance the result will fall between the 1$^{st}$ and 99$^{th}$ percentiles. Importantly, note that a percentile trace shows the percentile chance of a particular value on any particular day, and does not represent continuous results from a single model realisation (e.g. the 90$^{th}$ percentile trace does not represent a single continuous 90$^{th}$ percentile climate scenario, rather it shows the volume/rate exceed by 90% of the 102 realisations on each day of the simulation.

## 4.3 WATER BALANCE MODEL RESULTS

### 4.3.1 Overall water balance

Water balance results for one of the 102 modelled realisations is presented in Table 4.1, averaged over each phase of modelled mine life (model phases are defined in Section 3.2). The water balance results provided are those for the single realisation with median inflows (including direct rainfall, catchment runoff and groundwater) over the life of the Project. The results for this single realisation show inflows, outflows and overall water balance for each of the mine phases for a representative climate sequence. It should be recognised that the following items are subject to climatic variability:

- rainfall runoff;
- evaporation;
- borefield water requirements; and
- site releases/spills.

The results for a single realisation with median inflows show that over the life of the Project:

- Borefield water supply is required in all phases, with the greatest amount required in PY9 (dual operations phase).
- The largest demand from the water management system is dust suppression.
- Total mine water demand (including CHPP make-up, dust suppression, OC/UG MIA usage, underground operations) supplied from the water management system ranges between approximately 1,311 ML/yr and 1,643 ML/yr, with the highest demand in PY9 (dual operations phase).
- No overflows from the mine water system occurred for this simulation.
- The combined spill volume from the sediment dams is highest in PY10+ (22 ML/a) when the sediment dams are rehabilitated and passively managed.

Note that the results presented in Table 4.1 are for a single realisation and will include wet and dry periods distributed throughout the mine life. Rainfall yield for each phase is affected by the variation in climatic conditions within the adopted climate sequence. For example, the high runoff yield indicated for PY 7 likely reflects a wet period (up to 810 mm/year rainfall) during this part of the selected realisation.

Table 4.1 - Average annual water balance - Realisation 72 (1960 to 1982)

| | PY3 | PY7 | PY9 | PY10+ |
|---|---|---|---|---|
| **Water inputs (ML/a)** | | | | |
| Rainfall/runoff yield | 363 | 881 | 429 | 654 |
| Groundwater inflows | 35 | 44 | 271 | 1,533 |
| Raw (bore) water intake | 906 | 578 | 993 | 64 |
| **GROSS WATER INPUTS** | **1,304** | **1,503** | **1,693** | **2,251** |
| **Water outputs (ML/a)** | | | | |
| Evaporation from storages | 62 | 81 | 67 | 339 |
| Dam overflows (offsite) | | | | |
| *Mine water system* | *0* | *0* | *0* | *0* |
| *Sedimentation system* | *0* | *0* | *0* | *21* |
| *Raw Water Dam* | *0* | *0* | *0* | *0* |
| Total | 0 | 0 | 0 | 21 |
| CHPP demand (loss) | 264 | 294 | 322 | 396 |
| Dust suppression | 1,041 | 1,041 | 1,041 | 500 |
| OC & UG MIA Dam usage | 6 | 12 | 5 | 5 |
| Underground operations usage | 0 | 50 | 275 | 500 |
| **GROSS WATER OUTPUTS** | **1,373** | **1,478** | **1,710** | **1,761** |
| **Water balance (ML/a)** | | | | |
| Change in storage volumes | -69 | 25 | -17 | 490 |

### 4.3.2 Borefield water supply requirements

In addition to the water captured within the water management system from surface runoff and groundwater inflows, water will also need to be sourced from a borefield to be constructed within the Bylong River alluvium in order to meet operational demands.

A key objective of the mine site water management system is to maximise the reuse of on-site surface water runoff and groundwater inflows. Recycling mine water will minimise the volume of water from external sources (groundwater bores) that is required to satisfy site demands. However, the volume of water captured on site is highly variable and dependent upon climatic conditions. Hence, the required makeup water volume from the groundwater bores is likely to vary significantly from year to year.

Figure 4.1 shows the total annual modelled demand for water from groundwater bores over the Project period. The results indicate that the annual borefield water requirements are generally highest during the period of open cut operations (PY3 to PY9). The bore water requirements significantly reduce once underground operations commence due to the increase in groundwater inflows to the mine workings and reduction in site water demands. A summary of borefield water requirements for different periods of operation is shown in Table 4.2.

Table 4.2 - Summary of annual borefield water requirements

| Operational period | Borefield water supply | | |
|---|---|---|---|
| | 1% chance of requiring | 10% chance of requiring | 50% chance of requiring |
| Open cut only operations (PY3 to PY5) | 995 to 1,255 ML/a | 950 to 1,180 ML/a | 800 to 935 ML/a |
| Combined mining operations (PY6 to PY9) | 1,250 to 1,345 ML/a | 1,170 to 1,275 ML/a | 855 to 940 ML/a |
| Underground only operations (PY10 to PY25) | 5 to 795 ML/a | 0 to 755 ML/a | 0 to 525 ML/a |

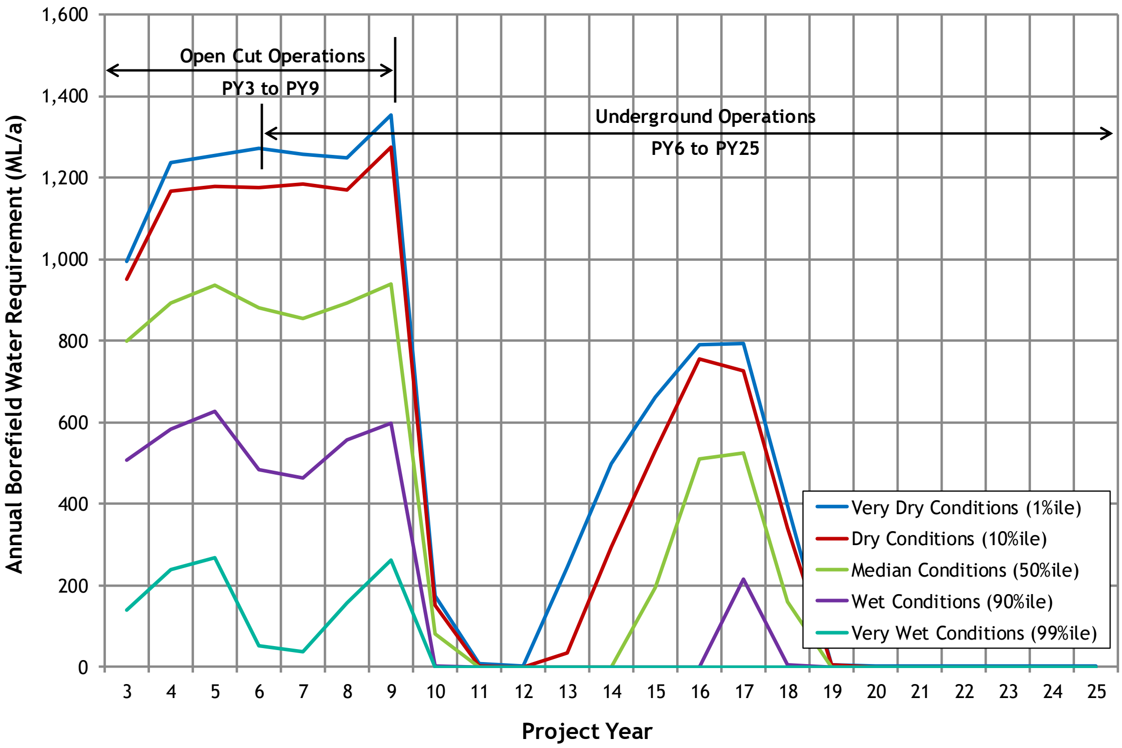


Figure 4.1 - Annual borefield water requirements

### 4.3.3 Mining pit inundation characteristics

As described in Section 3.4, the water management system is configured to pump excess water to the mining areas when the capacity of the mine water dams is exceeded. The stored water is available for re-use as required.

Figure 4.2 shows the percentile plots of stored inventory in the combined mining areas over the Project life. The results indicate the following:

- Prior to the commencement of underground only mining, there is a low risk of significant volumes of water accumulating in the open cut mining areas. Once underground only operations commence, groundwater inflows increase significantly. This results in the potential for water accumulating within the mining voids if wet climatic conditions occur.
- During open cut only operations (PY3 to PY5), there is a:
  - 1% chance of storing up to 430 ML in the open cut mining areas;
  - 10% chance of storing up to 105 ML in the open cut mining areas; and
  - 50% chance that the mining area will not be required to store significant volumes of water.
- During combined and mid Project underground only operations (PY6 to PY16), there is a:
  - 1% chance of storing up to 1,850 ML in the Eastern Open Cut;
  - 10% chance of storing up to 1,290 ML in the Eastern Open Cut; and
  - 50% chance of storing up to 630 ML in the Eastern Open Cut.
- During late Project underground only operations (PY17 to PY25), there is a:
  - 1% chance of storing up to 9,615 ML in the Eastern Open Cut (and the underground goaf areas);
  - 10% chance of storing up to 8,620 ML in the Eastern Open Cut (and the underground goaf areas); and
  - 50% chance of storing up to 7,750 ML in the Eastern Open Cut (and the underground goaf areas).

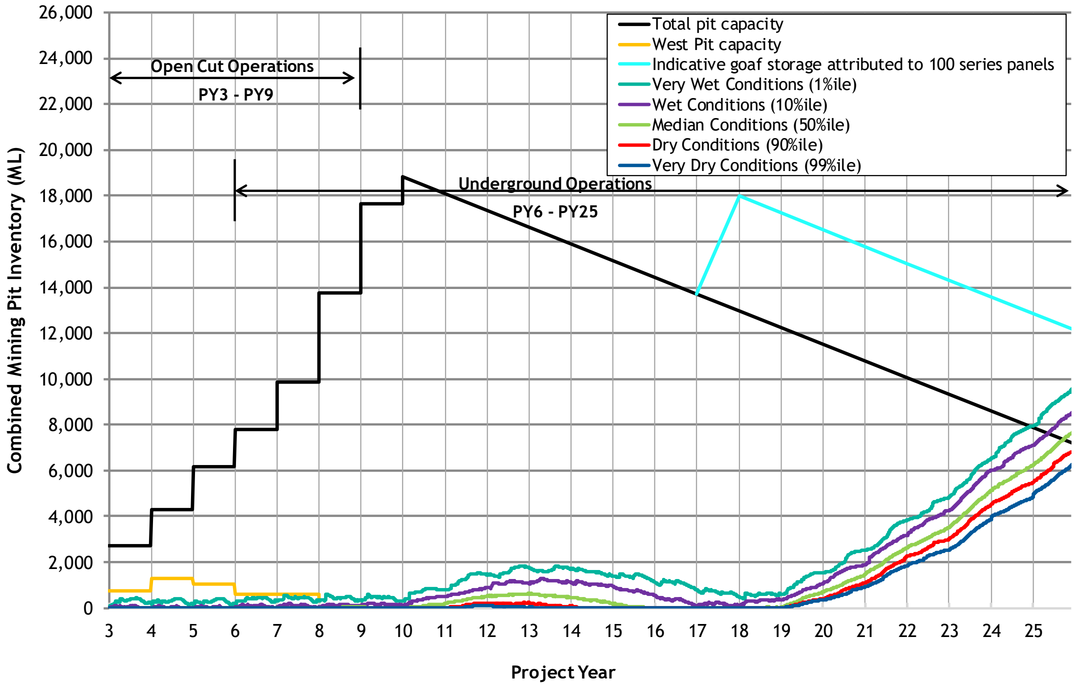


**Figure 4.2 - Combined open cut mining area stored inventory**

The model results show that during open cut only operations, the accumulation of water with the open cut mining operations is manageable. However once underground operations commence, the additional groundwater inflows and reduction in site water demands increase the risk of water accumulation. This water will need to be managed within the water management system, most likely within the void area remaining with the Eastern Open Cut.

After open cut operations cease in around PY9, the capacity of the Eastern Void will be around 18,800 ML, providing significant capacity to store any excess water if climatic conditions are very wet. In addition, some capacity will be available within the underground goaf (attributed to the 100 series longwall panels) from PY18 at the latest.

The reduced water storage capacity within the open cut void over time from PY10 is due to the placement of coal reject material, such that at the end of underground mining it can be capped and rehabilitated. This will enable the remaining areas of the Eastern Open Cut to be rehabilitated and, unlike most open cut mines, will not comprise a final void.

The total bulk volume of rejects during underground operations is estimated to be around 11,700 ML. This would indicate approximately 7,100 ML of remaining capacity available within the Eastern Void to store excess mine water captured through surface runoff and groundwater inflows.

Figure 4.2 shows that over most of the Project life, the available storage capacity within the open cut mining areas is significantly higher than the 1st percentile prediction (very wet conditions) of the required water storage volume. Even if very wet climatic conditions occur, the available storage volume at the very end of Project life (within the open cut void and underground goaf) exceeds the required storage volume by more than 2,500 ML. Once the 200 series longwall panels are extracted, the entire underground mine will become available for storage which will further increase the available storage volume.

Depending on climatic conditions over the Project life, there may be water contained within the Eastern Void at the completion of mining. The proposed management strategy for contained water at the end of mine life is to return this water to the underground mine workings. The impacts of returning this water underground are assessed in the groundwater impact assessment report (AGE, 2015) for the Project.

### 4.3.4 Uncontrolled offsite releases

The results of the site water balance modelling show that the site water management system can be operated to ensure with at least 99% probability that no uncontrolled release of mine water over the Project life.

As explained in Section 3.6.1, the only uncontrolled offsite releases will be from sediment dams during periods of rainfall above the relevant design criteria.

## 4.4 SALT BALANCE

To assess the impact of the Project on the receiving water salt balance, the OPSIM model was run as a forecast simulation. Figure 4.3 shows a schematic of the salt inputs and outputs from the Project.

Salt inputs to the Project include salts in the groundwater inflows, catchment runoff, direct rainfall, and bore water. Salt outputs from the Project include salts which are lost through the CHPP in the rejects and product coal, site demands (including dust suppression, MIA usage and underground operations) and offsite discharges from the sediment water system (there are no predicted offsite discharges from the mine water system). The CHPP is a net user of water, as during the washing and sizing process the moisture content of the rejects material is increased. This process traps water (and salt) in the rejects material. The material is then disposed of in dedicated zones within the open cut mining areas.

Table 4.3 shows the average annual salt balance for the Project, for each phase. The results indicate the following:

- The largest contributor to the Project salt load varies between phases. In PY3, PY7 and PY9, the borefield water inflows contribute the most. In the underground only phase (PY10+), the largest contributor is groundwater inflows.
- Net loss from dust suppression contributes the greatest salt loss for all phases, with CHPP demand and underground operations demand the next largest contributors.

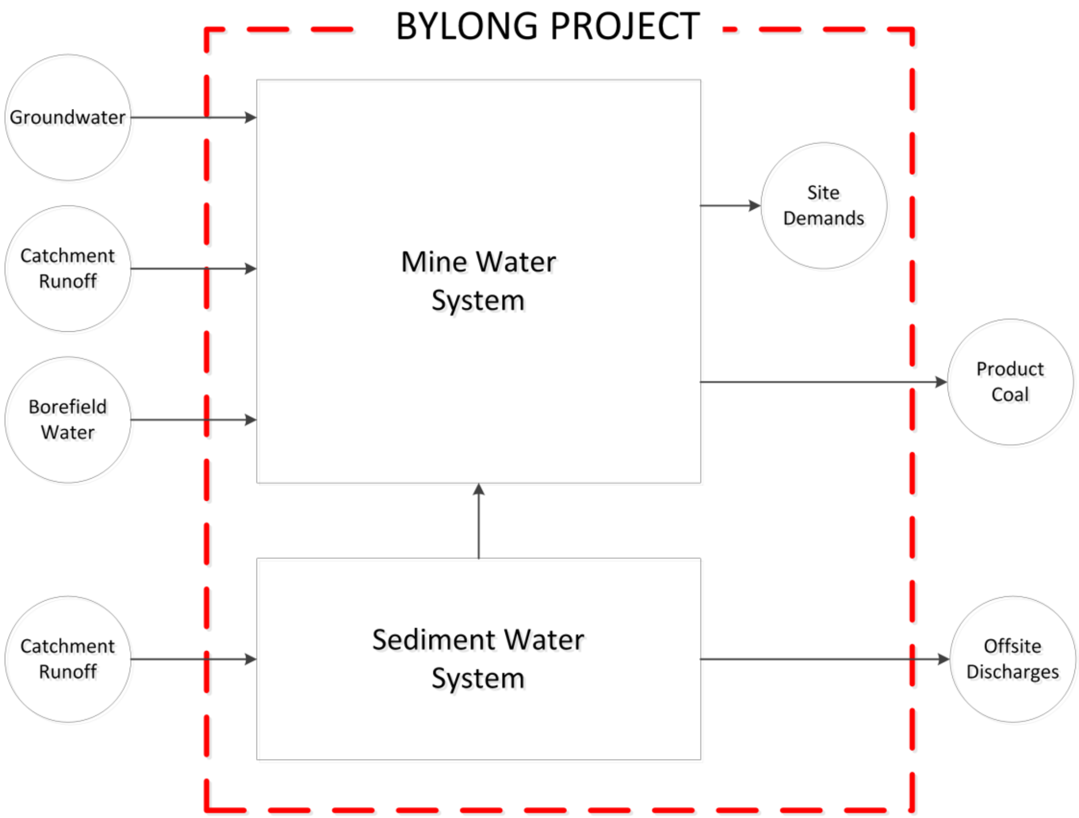


**Figure 4.3 – Project – surface water salt load schematic**

Table 4.3 – Project average annual salt balance

| | PY3 | PY7 | PY9 | PY10+ |
|---|---|---|---|---|
| Salt inputs (tonnes/year) | | | | |
| Rainfall/runoff yield | 331 | 458 | 399 | 311 |
| Groundwater inflows | 31 | 38 | 236 | 1,338 |
| Raw (bore) water intake | 737 | 669 | 723 | 78 |
| **GROSS SALT INPUTS** | **1,099** | **1,165** | **1,358** | **1,727** |
| Salt outputs (tonnes/year) | | | | |
| Evaporation from storages | 0 | 0 | 0 | 0 |
| Dam overflows (offsite) | | | | |
| *Mine water system* | 0 | 0 | 0 | 0 |
| *Sedimentation system* | 6 | 13 | 12 | 25 |
| *Raw Water Dam* | 0 | 0 | 0 | 0 |
| *Total* | 6 | 13 | 12 | 25 |
| CHPP demand (loss) | 195 | 238 | 263 | 351 |
| Dust suppression | 883 | 856 | 858 | 442 |
| OC & UG MIA Dam usage | 2 | 8 | 4 | 7 |
| Underground operations usage | 0 | 40 | 221 | 442 |
| **GROSS SALT OUTPUTS** | **1,086** | **1,155** | **1,358** | **1,267** |
| Salt retained on site (tonnes/year) | | | | |
| Change in storage salt load | 13 | 10 | 0 | 460 |

## 4.5 ADAPTIVE MANAGEMENT OF MINE WATER BALANCE

The model results presented above represent the application of the adopted mine water management system rules over the mine life, regardless of climatic conditions. In reality, there are numerous options for adaptive management of the mine water system to respond to climatic conditions and the current site water inventory in a way that will reduce the risks of impacts to surface water resources.

# 5 Surface water impact assessment

## 5.1 OVERVIEW

This impact assessment has been undertaken as a comparison of water management system performance and potential impacts between previous and the Revised Project Layout mine plans requested by DPE.

To allow for a direct comparison of impacts due to the revisions in the mine plan, the modelling results for the Revised Project Layout have been compared against the model results presented in the EIS (HB, 2015), RTS (HB, 2016), Supplementary RTS (HB, 2016b) and the Response to PAC Review Report (HB, 2017) as appropriate.

## 5.2 POTENTIAL IMPACTS

The potential impacts of the Project on surface water resources include:

- Impacts on regional water availability due to the need to extract borefield water to meet the operational water requirements of mining operations.
- Adverse impacts on the quality of surface runoff draining from the disturbance areas to the various receiving waters surrounding the Project, during both construction and operation of the Project.
- Loss of catchment area draining to local drainage paths due to capture of runoff within onsite storages and the open cut mining areas.
- Potential impacts on flood levels and flood velocities in the Bylong River and its tributaries.

An assessment of each of these potential impacts of the Project is provided in the following sections. This assessment has focused on whether the surface water impacts predicted for the Revised Project Layout mine plan will be equal to or less than those predicted in the EIS documentation provided to date.

The assessment of surface water impacts has been undertaken based on commonly applied methodologies for the simulation of hydrologic and hydraulic processes using currently available data. The adopted approach is considered suitable for quantifying impacts to a level of accuracy consistent with current industry practice. Certain aspects of the project, such as changes to landforms due to construction of overburden emplacements or mine subsidence, will create impacts that are irreversible, although this does not mean that any such impacts are necessarily detrimental to the environmental values of receiving waters.

## 5.3 REGIONAL WATER AVAILABILITY

### 5.3.1 Bylong River Water Source

Water taken from the Bylong River Water Source by the Project is required to be licensed by way of a Water Access Licence under the HUAWSP. Schedule 5 of the *Water Management (General) Regulation 2011* provides a number of exemptions for requiring a Water Access Licence for taking water from a water source.

### 5.3.2 Harvestable rights

Under the *Water Management Act*, landholders in most rural areas are permitted to collect a proportion of the rainfall runoff on their property and store it in one or more dams up to a certain size. This is known as a 'harvestable right'. A dam can capture up to 10 percent of the average regional rainfall runoff for their landholding without requiring a licence.

Since the EIS, the Project's landholdings within and external to the Project Boundary have increased significantly. For consistency with the EIS (and to remain conservative), we have calculated the harvestable rights on the Projects total landholdings within the Study Area as per the EIS, which was 5,467 ha. Using a harvestable rights multiplier value of 0.065 ML/ha, the total harvestable right for the Project is 355 ML.

The previously adopted Project's landholding includes 63 existing farm dams with a combined total surface area of 5.9 ha. Based on an average depth of 1.5 m, the total capacity of existing farm dams is estimated at 89 ML. Subtracting the capacity of existing farm dams (89 ML) from the harvestable right (355 ML) leaves an available harvestable rights volume of 266 ML.

As discussed above, we have adopted the previously calculated harvestable right of 266 ML to maintain consistency with the EIS investigations. This value does not take into account the significant increase in KEPCO landholdings both within and external to the Project Boundary.

### 5.3.3 Excluded works

The water management system for the Project has been designed to minimise the capture of clean runoff wherever possible. Schedule 5, clause 12 of the *Water Management (General) Regulation 2011* provides that a Water Access Licence is not required for water take that is caused by an "excluded work" as outlined in Schedule 1. Schedule 1, clause 3 of the *Water Management (General) Regulation 2011* provides that dams solely for the capture, containment and recirculation of mine affected water consistent with best management practice to prevent the contamination of a water source are "excluded works".

On this basis, water captured in the site water management structures with the exception of rainfall runoff from undisturbed natural catchments, is not subject to licencing requirements.

### 5.3.4 Natural catchments

The capture of runoff from undisturbed natural catchment draining to any of the site water management dams may require a Water Access Licence. Figure 5.1 shows the undisturbed catchment areas draining to the site water management dams.

For the Bylong River Water Source, the maximum undisturbed catchment that is proposed to be captured by the Project is approximately 123 ha, which is consistent with the area calculated as part of the EIS investigations.

The estimated maximum annual runoff capture from the undisturbed area of 123 ha is 149 ML. This volume has been estimated using a runoff depth of 121 mm, based on the maximum annual rainfall at Kerrabee (Murrumbo) (BoM Station No. 62046) of 1,208 mm and a volumetric runoff coefficient of 0.10 (10%) which is the runoff coefficient used for harvestable rights calculations (10% of runoff = 0.065 ML/ha = 6.5 mm runoff. 100% of runoff = 65 mm. 65mm/657 mm average annual rainfall = 10%).

*Comparison with previous assessment*

The estimated maximum runoff capture volume from undisturbed areas is consistent for the Revised Project Layout and is still significantly less than the available harvestable rights volume of 266 ML (excluding existing farm dams and not taking into account additional Project landholdings). Hence, the capture of runoff within the mine water management system does not require licensing.

### 5.3.5 Mine site water requirements

A large proportion of mine site water requirements will be sourced from water collected on the site, including rainfall runoff and groundwater inflows to the open cut mining area which will be stored in the Mining Area Storage for re-use.

The results of the water balance modelling (see Section 4.3.2) indicate that there is a 1% probability that the annual volume requirement from the borefield water supply could equal or exceed 1,345 ML/a during the Project. This is consistent with the most recent predictions in the Response to PAC Review Report.

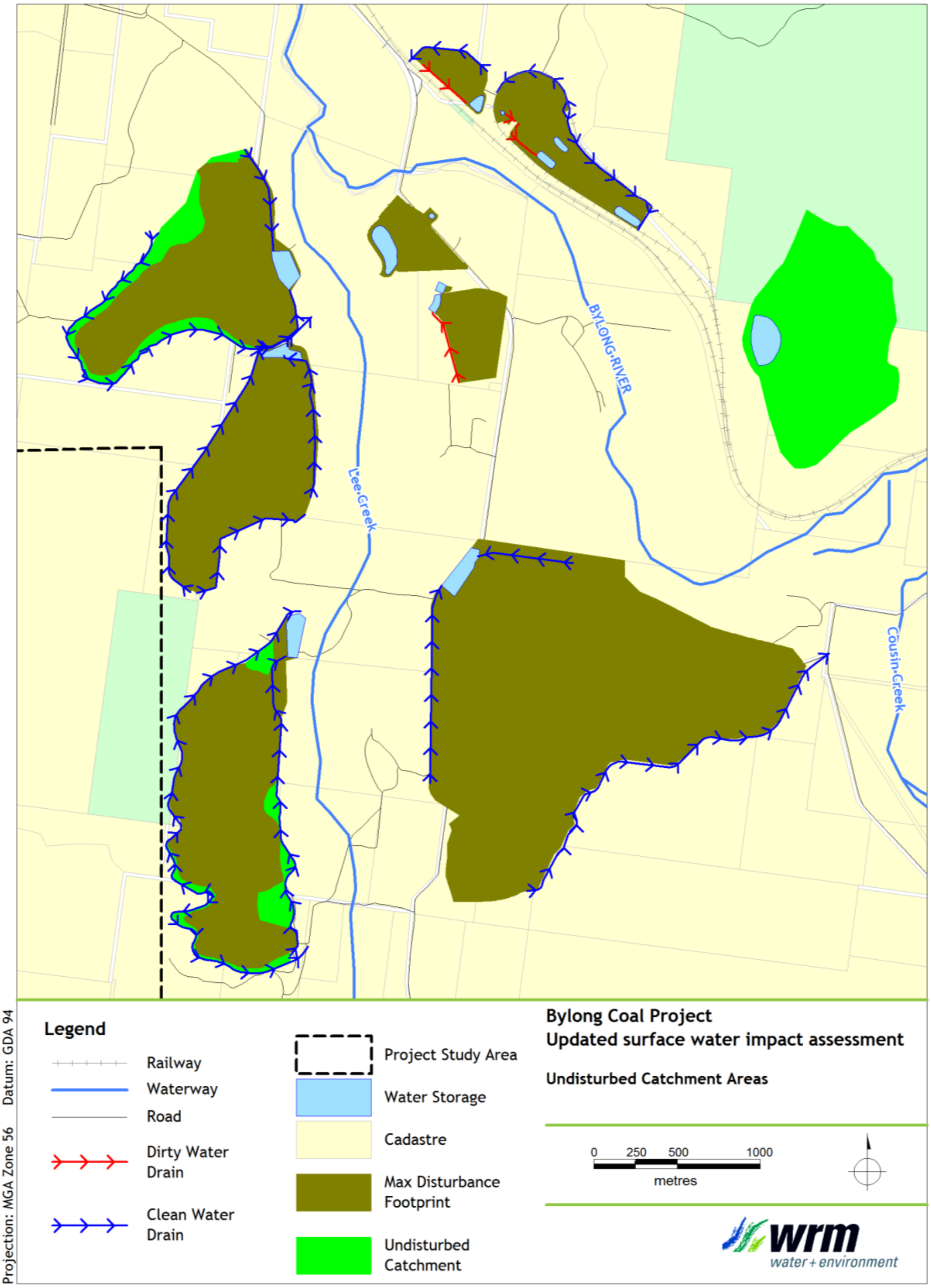


**Figure 5.1 – Natural catchment areas draining to the mine water management system**

However, the existing water licence allocation from the bores of 3,045 units (currently equivalent to 3,045 ML/year) significantly exceeds the requirement for external water supply to satisfy all site demands for all years of operation, even in the driest climatic sequence experienced over the past 125 years. Further water allocations under the HUAWSP may also be secured by KEPCO into the future and any future land acquisitions required for the Project.

The impact of the groundwater extraction and interception on regional water availability is given in EIS (AGE, 2015), RTS (AGE, 2016), Supplementary RTS (AGE, 2016b), the Response to PAC Review Report (AGE, 2017) and the revised Groundwater Impact Assessment Report (AGE, 2018). As all makeup water supplies for the Project would be obtained from the alluvial borefield under existing Water Access Licences held by KEPCO, it is not anticipated that there will be any adverse impact on other licensed groundwater users within the water source who will still have access to their entitlement (subject to climatic conditions and the operation of the water supply scheme).

## 5.4 WATER QUALITY IMPACTS

### 5.4.1 Construction phase impacts

Key activities during the construction phase will include land clearing and earthworks associated with construction of the rail loop, CHPP and MIAs , as well as road upgrades and construction of water management structures. The potential impacts during the construction phase of the Project primarily relate to the potential for release of sediment in surface runoff due to land disturbance from construction activities.

The management of surface runoff during the construction phase of the Project will be in accordance with a Construction Water Management Plan (CWMP). The CWMP will identify the erosion and sediment control measures to be implemented on the site, taking into account the staging of construction works. All management measures will be designed in accordance with relevant standards and best practice guidelines, including *'Managing Urban Stormwater: Soils and Construction, Volume 1'* (Landcom, 2004). The CWMP will also identify requirements for storage of fuels and other potential contaminants to minimise the risk of release of other pollutants.

Water use during the construction phase (estimated at approximately 5.2 ML/a - see Section 3.7.4) will be very small compared to the operational water requirements. All water required for construction will be obtained from appropriately licensed groundwater bores.

*Comparison with previous assessment*

There are no proposed changes to the construction phase as part of the Revised Project Layout.

### 5.4.2 Operational phase impacts

The results of the water balance modelling indicate that under the current model assumptions and configuration, there are no uncontrolled spills of mine-affected water from the Product Stockpile Dam, Fill Point Dam, CHPP Coal Contact Dam, Feeder Floor and Reject Overflow Dam, OC MIA Dam, UG MIA Dam or the open cut mining areas. Therefore, the mine water management system is sufficient to protect the environmental values of the receiving waters.

Some overflow of water from sediment dams may occur during wet periods that exceed the design standard of the sediment control system (see Section 3.6.1). Available geochemical information indicates that the runoff draining to most of the sediment dams should have salinity consistent with receiving waterways. Overflows would only occur during significant rainfall events which will also generate runoff from surrounding undisturbed catchments. Hence, it is unlikely that sediment dam overflows will have a measurable impact on receiving water quality.

*Comparison with previous assessment*

The water balance modelling indicates that there is no impact on the ability of the Bylong water management system to achieve nil discharge from the mine affected water system as a result of the Revised Project Layout mine plans.

### 5.4.3 Surface water salt load impacts on receiving catchments

The surface water salt load on the receiving environment in Bylong River is potentially impacted in two ways:

- A reduction in catchment area results in an effective reduction in salt load to the receiving environment.
- An increase in salt load from sediment dam overflows.

The net impact on the Bylong River at a location immediately downstream of the Bylong River/Lee Creek confluence has been assessed. Table 5.1 provides a summary of the salt balance for the pre-mine catchments and each phase of the mine life.

The model results show that the total average salt load released offsite in surface runoff is reduced by the Project, when compared with the pre-mine case. The average annual salt load released to Bylong River is reduced by around 0.9% to 5.4%, depending on the mine phase. Note that this represents a likely upper limit of the salt load impact since the quality of surface runoff from rehabilitated areas is likely to improve over time.

Under normal operation, runoff from OEAs collected in sediment dams is pumped back for use in the mine water management system or released to the receiving environment if the water quality is suitable for release. Sediment dams would only spill following extended periods of significant rainfall that exceed the design criteria. Under these conditions, it is likely that the quality of water collected in sediment dams would be improved by fresh surface runoff inflows.

**Table 5.1 - Long Term Average Surface Water Salt Balance**

| | Pre-mine | PY3 | PY7 | PY9 | PY10+ |
|---|---|---|---|---|---|
| **Average Annual Salt Balance (tonnes/year)** | | | | | |
| **Bylong River Salt Load** | | | | | |
| Catchment Runoff | 3,637 | 3,546 | 3,435 | 3,430 | 3,577 |
| Dam Overflows | - | 6 | 13 | 12 | 26 |
| **Total** | **3,637** | **3,552** | **3,448** | **3,442** | **3,603** |

The estimation of salt load from catchment runoff and dam overflows has been updated as part of this assessment. Rather than assessing each phase individually using a static long-term rainfall data set, the average loads have been extracted directly from the forecast model results. This makes the results more consistent with other results presented in this report. In addition, the previous assessment modelled the spillway for the sediment dams at a level 0.5 m below the full supply volume, which is conservative in terms of overflow risk. The latest model has been updated to fully provide the available proposed storage volume in each sediment dam. This has resulted in less modelled overflows and less salt load in the overflows.

### 5.4.4 Post-Mining impacts

Once the post-mining landform is established and rehabilitated, it is expected that long-term water quality from surface runoff should be similar to pre-mining conditions. However, there is the potential for seepage through the backfilled overburden and coarse and fine reject materials to have some impact on the salinity of water in the alluvial aquifer in the vicinity of the Project.

An assessment of the potential impact on the salinity of post-mining alluvial groundwater (AGE, 2018) indicates that salinity may rise from about 585 to 684 mg/L. This could potentially result in an increase in baseflow salinity in the Bylong River by a similar amount. The results of the groundwater modelling completed by AGE indicate an average annual baseflow volume of the order of 291 ML/a. Hence, the change in baseflow salinity could potentially increase the baseflow salt load from about 170 tonnes per year to 200 tonnes per year. Assuming no change in the salinity of surface runoff compared to pre-mining (see Table 5.1), the total salt load (surface runoff plus baseflow) could increase from 3,807 to 3,837 tonnes per year, an increase of less than 1%.

When considered in the context of variability of background salinity, a change in average salt load of less than 1% would be virtually undetectable. Such a change would be unlikely to affect stream health as indicated by the River Condition Index which considers stream geomorphology, riparian vegetation, hydrology and biodiversity. Ongoing monitoring will be undertaken to confirm the magnitude of any impact on baseflow quality. The results of background water quality monitoring to date show that vegetated areas of the catchment have lower salinity runoff. Hence, any observable impact could be mitigated through catchment revegetation, which could be applied to the immediate vicinity of the Project, as well as the extensive biodiversity offset areas (> 30 $km^2$) to be acquired under the Project. Further information on the water quality of vegetated catchment areas will be gathered over the Project life to inform revegetation strategies.

*Comparison with previous assessment*

The predicted impact on background salinity of around 1% is consistent with the outcomes from the EIS investigations.

## 5.5 LOSS OF CATCHMENT

### 5.5.1 During active mining operations

During active mining operations, the mine water management system will capture runoff from areas that would have previously flowed to the receiving waters of Bylong River, Lee Creek and Growee River. The mine phase plans are shown in Figure 2.1 to Figure 2.4 for PY3, PY7, PY9 and PY10+ respectively. A breakdown of the catchment areas reporting to the mine site storages are provided in Table 5.2.

Table 5.2 shows the maximum catchment area captured within the mine water management system during active mining operations assuming that no water overflows or is released from sediment dams following treatment. The maximum captured catchment areas represent:

- Less than 1.1% of the Bylong River catchment to a point downstream of the Project Boundary (this includes Lee Creek and Growee River catchments).
- Approximately 4.2% of the Lee Creek catchment to the confluence with the Bylong River.
- Less than 0.1% of the Growee River catchment to the confluence with the Bylong River.

These reductions in catchment area indicate that the likely reduction in surface flow would represent a small proportion of total catchment runoff. The loss of flow in the Goulburn River catchment, which has an area of more than 3,300 $km^2$, would be immeasurably small.

**Table 5.2 – Catchment area captured within the mine water management system**

| Catchment | Total catchment area (km²) | Mine captured catchment area (km²) | | | |
|---|---|---|---|---|---|
| | | PY3 | PY7 | PY9 | PY10+ |
| Bylong River (to d/s of Project Boundary) | 702 | 5.5 | 6.8 | 7.3 | 7.4 |
| Lee Creek | 120 | 4.0 | 4.9 | 5.0 | 5.0 |
| Growee River | 344 | 0.1 | 0.1 | 0.1 | 0.1 |

*Comparison with previous assessment*

The predicted impact through loss of catchment for the Revised Project Layout mine plans is around 1.3 $km^2$ (at maximum development) less than the impact predicted as part of the EIS investigations due to the reduced mine footprint.

### 5.5.2 Final landform

The final landform at the completion of the Project will consist generally of the following:

- Rehabilitated OEAs which are shaped into the surrounding natural landform.
- Rehabilitated open cut mining areas and associated OEAs to blend into the surrounding natural topography, including no final void.
- Removal and rehabilitation of all infrastructure related disturbed areas including haul roads and MIAs.

At the completion of mining, surface runoff from rehabilitated OEAs will be released from the site. No final void is proposed to remain at the completion of the Project. As such, there is not anticipated to be any significant changes in catchment areas between pre- and post-mining, and therefore no measurable impact on the receiving water volumes.

This does not change as a result of the Revised Project Layout mine plans.

## 5.6 FLOODING IMPACTS

Hydrological and hydraulic models of the Bylong River were prepared for the EIS to assess the flood risks and impacts of the Project. In the Response to Submissions, the developed conditions hydraulic model was updated to include the revised haul roads and proposed North Link Road. The updated model configuration was run for a range of design flood events, up to the 1,000 year Average Recurrence Interval (ARI) events to assess the flood risks and impacts of the Project.

The Revised Project Layout mine plan configuration was compared to the developed conditions configuration in the RTS to qualitatively assess the flood impacts. The Revised Project Layout mine plan is generally similar to the previous SWIA and RTS configuration, with the exception of reduced disturbed area in the vicinity of Tarwyn Park and the south eastern portion of the Western Open Cut.

The haul road on the eastern overbank of Lee Creek has also been relocated further to the east (to optimise haul distances). Figure 5.3 shows the 100 year ARI flood extent and flood depth impacts from the RTS model configuration, overlain with the previous and Revised Project Layout mine plan configurations. The following is of note:

- In the vicinity of Tarwyn Park, there will be no open cut mining activity and therefore there will be no flood impacts. The Iron Tank, Tarwyn Park Homestead and Tarwyn Park Stables are located outside the 100-year ARI flood extent and will not be impacted by the Revised Project Layout mine plan.

- The flood impacts near the OC MIA in the Bylong River are primarily due to the overland conveyor embankment (OLC Embankment). There are no proposed changes to the OLC Embankment and therefore the flood impacts will be unchanged from what have been provided in the previous EIS and RTS.
- As there are no proposed changes to the haul road configuration, the flood impacts associated with the proposed haul road crossings at Lee Creek will remain unchanged from the EIS and RTS.
- The currently proposed haul road on the right (east) overbank of Lee Creek has been relocated further east to higher ground outside the 100-year ARI flood extent. The flood impacts shown to the west of the haul road are likely to be reduced as a result of the Revised Project Layout mine plan.

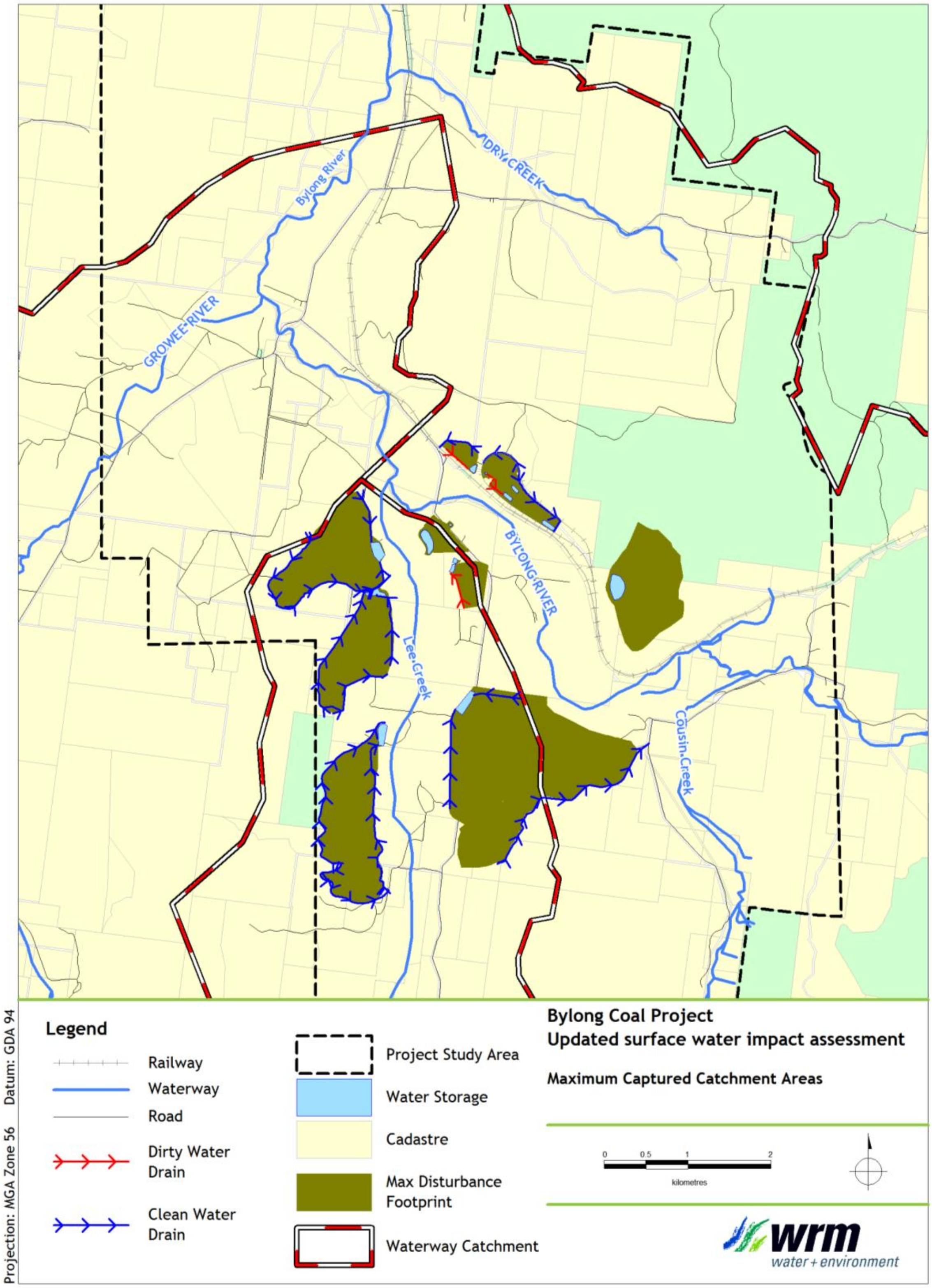


**Figure 5.2 – Maximum captured catchment area during operations**

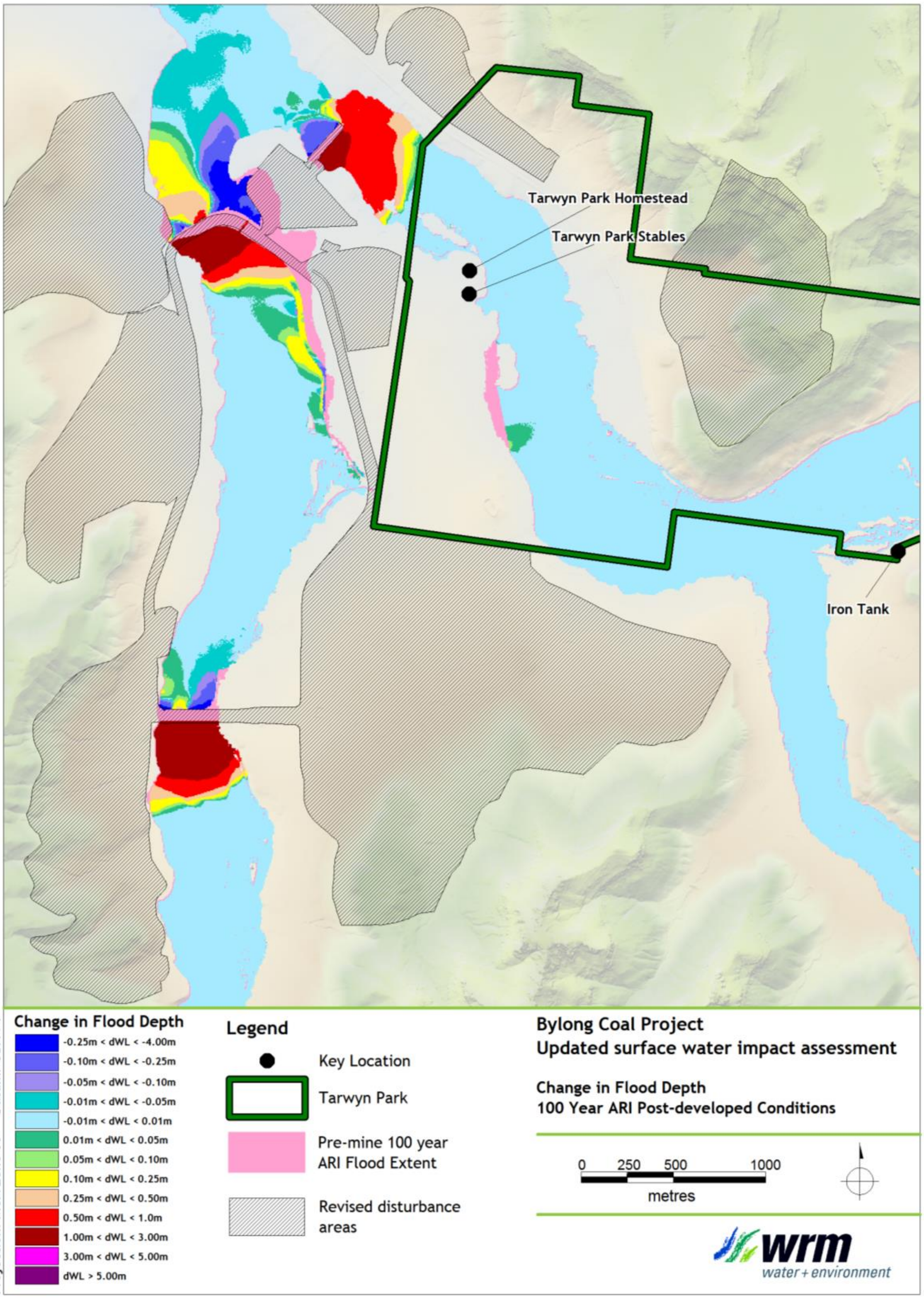


**Figure 5.3 – Flood extent for 100 year ARI post-developed conditions**

# 6 Mitigation and management measures

## 6.1 OVERVIEW

The mitigation and management measures proposed as part of the EIS investigations are generally unchanged by the Revised Project Layout. The key areas of interest identified by the DPE within its letter correspondence to KEPCO are discussed in the following sections.

## 6.2 EXCESS WATER STORAGE CONTINGENCY

The water balance modelling results shown in Section 4.3.3 indicate that, even under very wet climatic conditions, the available storage capacity within the open cut mining areas and underground goaf storage is significantly higher than the 1st percentile prediction of the required water storage volume.

The contingencies as provided within the Response to PAC Review Report therefore remain appropriate, which include:

*"In the unlikely event that further contingencies for excess water storage are required, the following measures could be implemented:*

1. *Sealing of the gateroads between the 100 series and the 200 series would create an enormous storage volume more than capable of containing the potential volume of excess water;*
2. *The capacity of the Eastern void will be determined by the final years of open cut mining (i.e. PY7 to PY10). The performance of the water management system throughout the initial open cut operations, as well as groundwater inflows, will be closely monitored to validate model assumptions and improve the predictions for the excess mine water requiring storage. This updated modelling will assist short term mine planners to determine whether the mining operations plan requires modification to retain a larger void at the completion of open cut mining operations. This would potentially require the development of mounded areas on the Eastern overburden emplacement area to assist in providing additional capacity for the reject materials and excess mine water. Under this scenario, KEPCO would still be committed to developing a final landform with no final void in the landscape, as is currently proposed.*
3. *Further contingency measures which could be considered prior to commencing mining of the 200 series longwall panels may include adjustments to the proposed mine plan, such as:*
    a. *Adjustments to longwall mining widths to minimise hydraulic fracturing and hence potential groundwater inflows;*
    b. *Modifications to the sequencing and timing of mining the 200 series longwall panels;*
    c. *Reorientation of the 200 series longwall panels; or*
    d. *Sealing additional longwall panels within the 200 series to retain further underground capacity."*

## 6.3 RESIDUAL IMPACTS

Whilst the proposed mitigation measures will limit the surface water impacts of the Project, some residual impacts will occur. These residual impacts will include:

- A small reduction in the volume of surface runoff to the Bylong River during open cut mining operations due to capture of runoff in the mine water management system.
- Potential changes to the longitudinal profile of Dry Creek and its tributaries caused by subsidence. The impacts of subsidence would be monitored and managed to maintain or improve stability of the creek channel.

The proposed changes to the Bylong water management system and mine plans will result in a marginal reduction in the volume of surface runoff to the Bylong River (i.e. an improvement compared with the EIS predictions).

# 7 Summary of findings

The revised surface water impact assessment for the Project has been updated to assess the impacts of the Revised Project Layout mine plans on surface water quality and quantity.

The findings of the updated assessment demonstrate that the surface water impacts of the Revised Project Layout mine configuration are essentially similar to the previous assessments undertaken for the EIS, RTS, Supplementary RTS and PAC Response.

The estimated maximum runoff capture volume from undisturbed areas is 149 ML, which is consistent with the volume calculated as part of the EIS investigations. This value still remains well below the available harvestable rights volume of 266 ML.

The results of the updated water balance modelling indicate that there is a 1% probability that the annual volume requirement from the borefield water supply could equal or exceed 1,345 ML/a during the Project. This is consistent with the predictions in the Response to PAC Review Report. The existing water licence allocation from the bores of 3,045 units (currently equivalent to 3,045 ML/year) significantly exceeds the requirement for external water supply to satisfy all site demands for all years of operation, even in the driest climatic sequence experienced over the past 125 years.

Prior to the commencement of underground operations, there is a low risk of significant volumes of water accumulating in the open cut mining areas. Once underground operations commence, groundwater inflows increase significantly which increases the risk of water accumulating within the water management system. However, the water balance modelling for the Revised Project Layout mine plan indicates that the mine water management system will be capable of achieving nil discharge from the mine-affected water system, consistent with the previous assessment. Simulated overflows from sediment dams during rainfall periods that exceed the design criteria are slightly reduced from previous assessments. On this basis, the risk of surface water quality impacts from the updated Project configuration is slightly less than the previous assessments.

The predicted impact through loss of catchment for the Revised Project Layout mine plans is less than the impact predicted as part of the EIS investigations due to the reduced mine footprint.

The flooding impacts of the Revised Project Layout mine plan are similar (and in some cases less than) the previous assessments. Flood impacts will not encroach upon the Tarwyn Park property.

# 8 References


| | |
|---|---|
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# Appendix A Water balance modelling sensitivity results

## A1 Alternate AWBM parameters

### A1.1 OVERVIEW

As part of the PAC Response, in response to a peer review of the water balance modelling completed within the EIS process, an alternate set of AWBM parameters were assessed using the Bylong water balance model (using the EIS mine plan).

The impact of these alternative AWBM parameters on the performance of the Bylong water management system for the Revised Project Layout mine plans has been assessed and the outcomes presented in the following sections.

The AWBM parameters adopted for the sensitivity assessment are presented in Table A.1.

**Table A.1 – AWBM parameters – sensitivity assessment**

| Parameter | Natural/ undisturbed | Roads/ hardstand/pits | Active spoil | Rehabilitated spoil | Topsoil stockpile |
|---|---|---|---|---|---|
| A1 | 0.01 | 0.1 | 0.05 | 0.012 | 0.012 |
| A2 | 0.65 | - | 0.95 | 0.63 | 0.63 |
| C1 | 6 | 3 | 5 | 6 | 6 |
| C2 | 120 | - | 65 | 120 | 120 |
| C3 | 160 | - | - | 160 | 160 |
| BFI | 0.3 | - | 0.7 | 0.3 | 0.3 |
| kb | 0.975 | - | 0.99 | 0.97 | 0.97 |
| Ks | 0.5 | - | 0.15 | 0.5 | 0.5 |
| Long-term $C_v$* | 3% | 53% | 10% | 3% | 3% |

## A1.2 WATER BALANCE MODEL RESULTS

### A1.2.1 Borefield water supply requirements

Figure A.1 and Table A.2 show the total annual modelled demand for water from groundwater bores over the Project period using the alternative AWBM parameters. The sensitivity assessment shows the following changes to the borefield water supply requirements:

- Under very dry (1 percentile) climatic conditions the peak annual borefield demand is reduced by around 140 ML/a.
- In general, the annual borefield requirements reduce by around 100 ML/a to 300 ML/a.

**Table A.2 - Summary of borefield water requirements - sensitivity assessment results**

| Operational period | Borefield water supply 1% chance of requiring | 10% chance of requiring | 50% chance of requiring |
|---|---|---|---|
| Open cut only operations (PY3 to PY5) | 930 to 1,140 ML/a | 870 to 1,020 ML/a | 685 to 755 ML/a |
| Combined mining operations (PY6 to PY9) | 1,090 to 1,210 ML/a | 940 to 1,010 ML/a | 570 to 750 ML/a |
| Underground only operations (PY10 to PY25) | 0 to 645 ML/a | 0 to 525 ML/a | 0 to 70 ML/a |

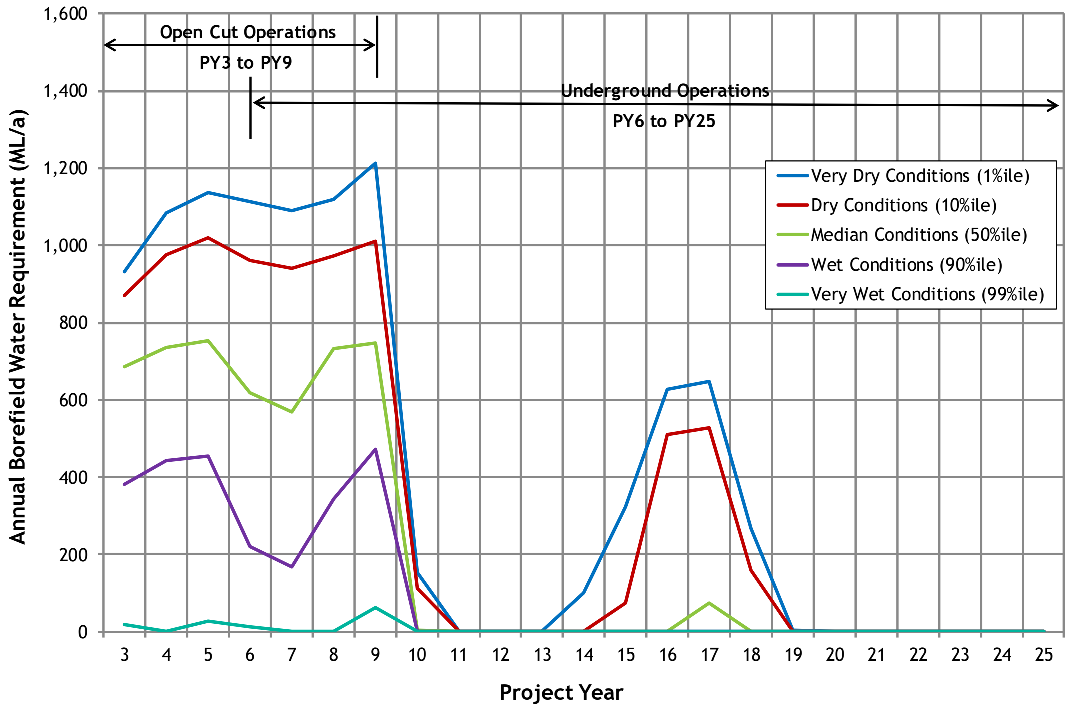


**Figure A.1 - Annual borefield water requirements - sensitivity assessment results**

### A1.2.2 Mining pit inundation characteristics

Figure A.2 show the percentile plots of stored inventory in the combined open cut mining areas over the Project life using the alternate AWBM parameters. The sensitivity assessment shows the following changes to the combined mining pit inventory:

- Under very wet (1 percentile) climatic conditions the predicted inventory at the end of the Project increases by around 1,400 ML.
- In general, the predicted inventory at the end of the Project increases by 1,000 ML/a to 1,500 ML.
- Even if very wet climatic conditions occur, the available storage volume at the very end of Project life exceeds the required storage volume by more than 1,100 ML.

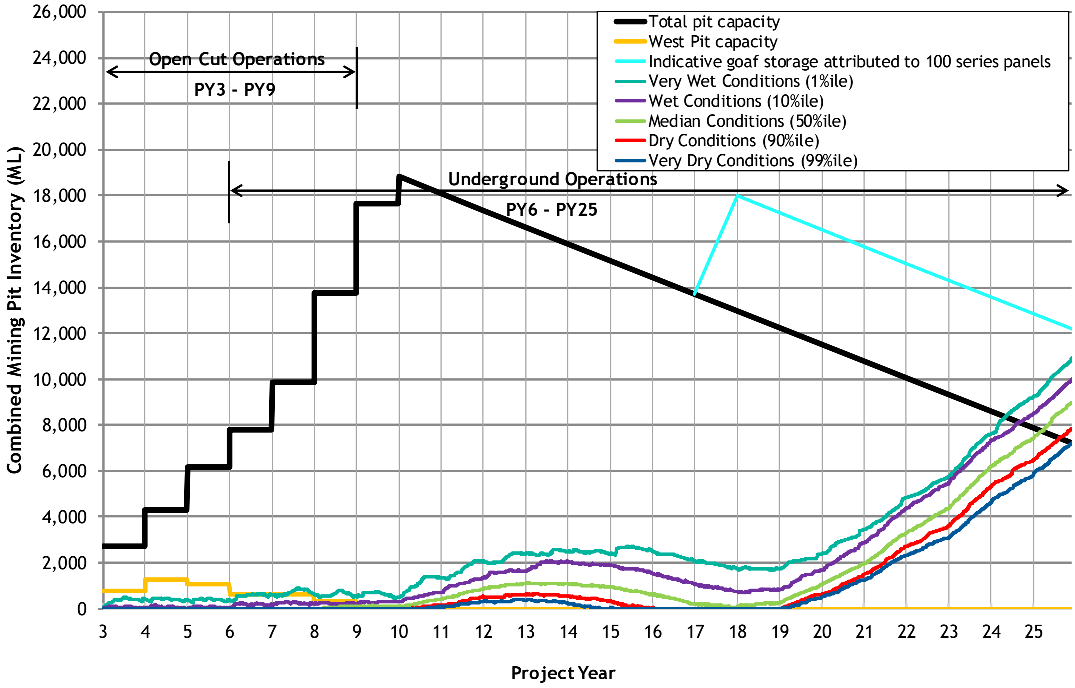


**Figure A.2- Combined open cut mining area stored inventory - sensitivity assessment results**