



Bengalla Mining Company Pty Limited

Water Management Plan

Revision Status

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1.0 INTRODUCTION

This section provides background information on the Bengalla Mine, describes Bengalla Mine and its history, and outlines the objectives of this Water Management Plan.

1.1 Background

Bengalla Mining Company Pty Limited (BMC) operates the Bengalla Mine (Bengalla) which is located approximately 4 km west of Muswellbrook in the Upper Hunter Valley, New South Wales (NSW) (see **Figure 1**).

BMC was granted Development Consent for State Significant Development (SSD) 5170 on 3 March 2015 by the Secretary of Department of Planning and the Environment (DPE) for the Continuation of Bengalla Mine. BMC commenced under SSD-5170 on 1 October 2015.

This Water Management Plan (WMP) has been developed in accordance with the requirements of Schedule 3, Conditions 24 and 25 of SSD-5170 (as modified) to provide a framework for water management associated with the operation of Bengalla.

1.2 History of Operations

BMC was originally granted development consent Development Application (DA) 211/93 in 1996 to construct and operate an open cut coal mine and associated activities. Mining operations at Bengalla commenced in 1998. DA211/93 was surrendered on 22 December 2016. SSD-5170 (as modified) is the applicable development consent for Bengalla. **Sections 1.2.1 to 1.2.6** below provide a high level overview of the development approved by SSD-5170.

1.2.1 State Significant Development 5170

In September 2013, BMC sought a new development consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The application was supported by the 'Continuation of Bengalla Mine Environmental Impact Statement' (Bengalla EIS) (Hansen Bailey, 2013) as modified by the 'Continuation of Bengalla Mine Response to Submissions' (Hansen Bailey, 2014).

SSD-5170 provides approval for development including but not limited to the following:

- Open cut mining towards the west at a rate of up to 15 Million tonnes per annual (Mtpa) Run of Mine (ROM) coal for 24 years to a total of 316 Mt;
- Continued use of the existing dragline, truck fleet and excavator fleet (with progressive replacement or substitution with equivalent);
- An out of mining area Overburden Emplacement Area (OEA) to the west of Dry Creek, which may be utilised for excess overburden material until it is intercepted by mining;
- Continued use, extension or relocation to existing and new infrastructure, including administration and parking facilities, in-mining area facilities (including dragline shut down and erection pad), helipad, tyre laydown area, explosives and reload storage facility, core shed

workshop, roads, reject bin, ROM hopper, stockpiles, conveyors, water management infrastructure, bioremediation area, supporting power infrastructure, rail and rail loading infrastructure and ancillary infrastructure;

- Construction and use of various items of new infrastructure (including radio tower, extensions to the Mine Infrastructure Area (MIA), additional raw coal stockpile and upgrade to the ROM coal stockpile (along with associated conveyor network) generally as shown on the infrastructure plans and construction of the Mount Pleasant Staged Discharge Dam and associated water reticulation infrastructure;
- Processing, handling and transportation of coal via the (upgraded) Coal Handling and Preparation Plant (CHPP) and rail loop for export and domestic sale;
- Continued rejects and tailings co-disposal in the Main OEA and in the temporary in-mining area reject emplacement;
- Relocation of a 6 km section of Bengalla Link Road at approximately Year 15 near the existing mine access road to facilitate coal extraction;
- The diversion of Dry Creek via dams and pipe work with a later permanent alignment of Dry Creek through rehabilitation areas when emplacement areas are suitably advanced;
Relocation of water storage infrastructure as mining progresses through existing dams (including the Staged Discharge Dam (SDD) and raw water dam); and
- A workforce of up to 900 full-time equivalent personnel (plus contractors) at peak production.

1.2.2 Bengalla Development Consent – Modification 1

SSD-5170 was modified on 16 December 2015 by the Executive Director – Resource Assessments and Compliance for the DPE as delegate of the Minister for Planning for the activities described in the *‘Bengalla Mine Development Consent Modification Statement of Environmental Effects’* (Hansen Bailey, 2015a) as modified by the *‘Bengalla Mine Development Consent Modification Response to Submissions’* (Hansen Bailey, 2015) (MOD 1 SEE). The MOD 1 SEE provides approval for the following:

- Alterations to various water management infrastructure components including:
 - Utilisation of the Satellite Pit as a temporary dirty water catchment dam;
 - Relocation of the SDD Hunter River Salinity Trading Scheme (HRSTS) staged discharge release point;
 - Construction of clean water diversion levees in locations other than those already approved; and
 - Revised locations for the proposed relocation of the Hunter River and Washery Dams.
- Additional locations for the siting of the Explosives Storage Facility; and
- The placement of fill from the excavation of the Clean Water 1 (CW1) Dam adjacent to it.

No additional conditions pertaining to water management were included in SSD-5170 as a result of the MOD 1 SEE. This WMP incorporates the changes to the Bengalla water management system as described in the MOD 1 SEE.

1.2.3 Bengalla Development Consent – Modification 2

SSD-5170 was modified on 1 July 2016 by the Director – Resource Assessments for the DPE as delegate of the Minister for Planning for the activities described in the '*Bengalla Mine Development Consent Modification Statement of Environmental Effects*' (Hansen Bailey, 2016) as modified by the '*Bengalla Mine Development Consent Modification 2 Response to Submissions*' (Hansen Bailey, 2016) (MOD 2 SEE). The MOD 2 SEE provides approval for the following:

- Alterations to the approved height of the Main OEA to improve visual amenity from primary viewing locations in and surrounding the township of Muswellbrook and Denman Road, in two selected locations (Visual Relief Areas):
 - The Northern Relief Area constructed to a maximum height of Reduced Level (RL) 300; and
 - The Southern Relief Area constructed to a maximum height of RL 290.
- Establishment of a new gravel access road from Wybong Road to the Dry Creek Diversion Project Construction Site Office being a former homestead (Homestead Access).

No additional conditions pertaining to water management were included in SSD-5170 as a result of the MOD 2 SEE.

1.2.4 Bengalla Development Consent – Modification 3

SSD-5170 was modified on 23 December 2016 (MOD 3) by the Director – Resource Assessments for the DPE as delegate of the Minister for Planning for the activities described in the '*Bengalla Mine Development Consent Modification 3 Statement of Environmental Effects*' (Hansen Bailey, 2016) as modified by the '*Bengalla Mine Development Consent Modification 3 Response to Submissions*' (Hansen Bailey, 2016) (MOD 3 SEE). The MOD 3 SEE provides approval for the repositioning of the following approved activities:

- The construction and operation of an explosives facility and reload facility;
- The alignment of the Hunter River pipeline; and
- The emplacement and use of temporary topsoil stockpiles during the mining process.

No additional conditions pertaining to water management were included in SSD-5170 (as modified) as a result of the MOD 3 SEE.

1.2.5 Bengalla Development Consent – Modification 4

SSD-5170 was modified on 19 December 2018 (MOD 4) by the Director – Resource Assessments as delegate of the Minister for Planning for the activities described in the '*Bengalla Mine Development*

Consent Modification 4 Statement of Environmental Effects' (Hansen Bailey, 2017) as modified by the *'Bengalla Mine Development Consent Modification 4 Response to Submissions'* (Hansen Bailey, 2018) and the *'Bengalla Mine Development Consent Modification 4 Residual Issues'* (Hansen Bailey, 2018b) (MOD 4 SEE). The MOD 4 SEE provides approval for the following:

- Changes to the approved water management system to reflect operations at Bengalla including proposed enlargement of the approved SDD (ED1), and construction and use of the Dry Creek East Dam;
- Temporary storage of approximately 2,500 m³ of excess materials from the construction of ED1;
- Increase in the capacity and additional locations of ROM coal stockpiles;
- Additional storage locations for temporary emplacement of coal processing reject material, prior to permanent emplacement; and
- Temporary clay emplacement within the Main OEA or to the west of this for later use in the reinstatement of Dry Creek.

This WMP includes the changes to the Bengalla water management system as described in the MOD 4 SEE and included in SSD-5170 (as modified).

1.2.6 SSD-5170 – Modification 5

SSD-5170 was modified by DPE as the delegate for the Minister for Planning for the activities in accordance with activities described in the *'Bengalla Mine Development Consent SSD-5170 Modification 5 Modification Report'* (James Bailey Associates, 2021), Submissions Response and *'Response to Request for Additional Information'* (James Bailey Associates, 2022) (MOD 5). The MOD 5 Report provides approval for the following:

- Operation of a mobile rock crushing facility and ancillary equipment, and the use of that crushed rock at Bengalla;
- Geotechnical investigations in connection with any activities approved under SSD-5170;
- Prospecting operations (including exploration drilling) in accordance with BMC's mining leases issued under the *Mining Act 1992* (Mining Act);
- Realignment of the Western Diversion Levee within the approved Disturbance Boundary;
- Enlargement of the ROM coal stockpile located adjacent to the ROM dump hopper from 40 kt to 150 kt approximate maximum capacity;
- Upgrade/widening of an existing haul road (Southern Endwall Road) adjacent to the Southern visual bund, which may require removal of part of the visual bund (to be replaced by an equivalent measure);
- Disposal of tyres in pit; and
- Minor administrative changes to conditions of SSD-5170.

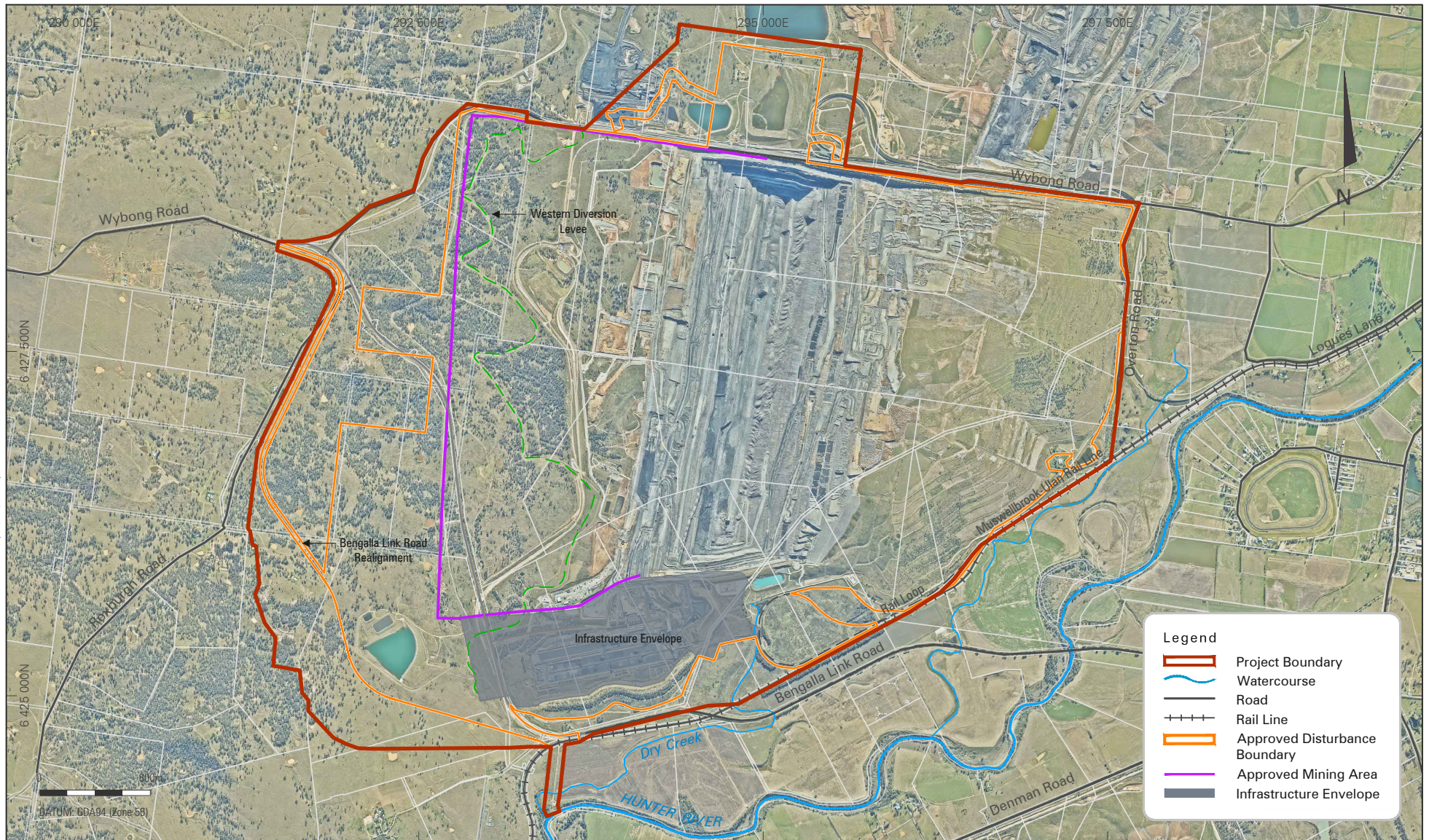
The revised development layout is presented in **Figure 2**.



BENGALLA MINE

Regional Locality

FIGURE 1



BENGALLA MINE

Conceptual Development Layout (MOD 5)

FIGURE 2

1.3 Scope and Objectives

This WMP sets out the procedures for the management of water at Bengalla. This WMP has been developed in accordance with the requirements of Schedule 3, Conditions 24 and 25 of SSD-5170 (as modified). The objectives of this WMP are to:

- Describe the configuration and operation of the Bengalla water management system including key principles for surface water and groundwater management and the site water balance;
- Set out the water monitoring program;
- Identify conditions to trigger corrective actions in the operation of the Bengalla water management system;
- Identify the actions that will be taken when trigger conditions are exceeded; and
- Confirm the applicable framework for reporting and auditing.

The future re-instatement of Dry Creek and description of the final void will be addressed within the Rehabilitation Management Plan, as required for Schedule 3, Condition 46 of SSD-5170 (as modified).

Table 1 outlines the water management performance measures which are contained in Schedule 3, Condition 24 of SSD-5170 (as modified). The specific WMP requirements which are contained in Schedule 3, Condition 25 and Schedule 5, Condition 3 of SSD-5170 (as modified) are set out in **Table 2** and **Table 3**. **Table 2** and **Table 3** also show where each requirement is addressed within this WMP.

Table 1
Water Management Performance Measures

Feature	Performance Measure
Water management – General	• Minimise the use of clean water on-site; • Minimise the need for make-up water from external supplies; and • Minimise cumulative water impacts with the other mines in the region.
Construction and operation of infrastructure	• Design, install and maintain erosion and sediment controls generally in accordance with the series <i>Managing Urban Stormwater: Soils and Construction including Volume 1, Volume 2A – Installation of Services and Volume 2C – Unsealed Roads</i>; • Design, install and maintain the infrastructure within 40 m of watercourses generally in accordance with the <i>Guidelines for Controlled Activities on Waterfront Land</i> (DPI 2007), or its latest version; and • Design, install and maintain any creek crossings generally in accordance with the <i>Policy and Guidelines for Fish Habitat Conservation and Management</i> (DPI, 2013) and <i>Why Do Fish Need To Cross The Road? Fish Passage Requirements for Waterway Crossings</i> (NSW Fisheries 2003), or their latest versions.
Clean water diversion & storage infrastructure	• Design, install and maintain the clean water system to capture and convey the 100 year ARI flood; • Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on-site; and • Design, install and maintain any temporary clean water diversion infrastructure to minimise erosion potential at discharge locations.

Feature	Performance Measure
Sediment dams	Design, install and maintain the dams generally in accordance with the series <i>Managing Urban Stormwater: Soils and Construction – Volume 1 and Volume 2E Mines and Quarries</i>.
Mine water storage	- Design, install and maintain mine water storage infrastructure to ensure no unlicensed or uncontrolled discharge of mine water off-site; - On-site storages (including mine infrastructure dams and treatment dams) are suitably designed, installed and maintained to minimise permeability; and - Adequate freeboard within the pit void at all times to minimise the risk of discharge to surface waters.
Overburden emplacements	- Design, install and maintain emplacements to encapsulate tailings, acid forming and potentially acid forming materials, and saline and sodic material; and - Design, install and maintain emplacements to prevent and/or manage long term saline groundwater seepage.
Chemical and hydrocarbon storage	Chemical and hydrocarbon products to be stored in bunded areas in accordance with the relevant Australian Standards
Aquatic and riparian ecosystem	- Maintain or improve baseline channel stability; and - Develop site-specific in-stream water quality objectives in accordance with ANZECC 2000 and <i>Using the ANZECC Guidelines and Water Quality Objectives in NSW procedures</i> (DECC, 2006), or its latest version.

1.4 Environmental Management

This WMP will form part of Bengalla’s overall environmental management system under its approvals platform.

1.5 Management Plan Requirements

The specific requirements for the WMP are provided in Schedule 3, Condition 25 of SSD-5170 (as modified) and are listed in **Table 2**, as is where each is addressed within this document.

Table 2
Water Management Plan Requirements

Condition	Requirement	WMP Section
25	The Applicant must prepare a Water Management Plan for the development to the satisfaction of the Secretary. This plan must:	This Plan
	(a) Be prepared in consultation with the EPA and DPI - Water, and submitted to the Secretary for approval within 6 months of the date of this consent; and	Section 2.0 Appendix A
	(b) in addition to the standard requirements for management plans (see Condition 3 of schedule 5), include a:	
	i. Site Water Balance,	Section 5.0
	ii. Surface Water Management Plan, and	Section 3.0
	iii. Groundwater Management Plan.	Section 6.0

Condition	Requirement	WMP Section
25 (b) i	The Site Water Balance must:	
	- include details of - sources and security of water supply, including contingency planning for future reporting periods;	Section 3.2 Section 5.2
	water use and management on-site;	Section 3.2, Section 3.3
	any off-site water transfers and discharges;	Section 3.2.6 Section 5.3
	reporting procedures, including the preparation of a site water balance for each calendar year; and	Section 5.4
	investigates and implements all reasonable and feasible measures to minimise water use on-site.	Section 3.2
25 (b) ii	The Surface Water Management Plan must include:	
	detailed baseline data on surface water flows and quality in the watercourses that could potentially be affected by the development;	Section 3.1 Appendix B
	- a detailed description of the water management system on-site, including the: - clean water diversion systems;	Section 3.2 Section 4.0
	erosion and sediment controls (mine water system); and	Section 3.2 Section 3.4
	mine water management systems;	Section 3.2 Section 3.3 Section 3.4
	- detailed plans, including design objectives and performance criteria, for: - design and management of final voids;	Section 3.6
	design and management for the emplacement of coal reject materials;	Section 3.5
	design and management of the temporary Dry Creek diversion infrastructure and discharge points;	Section 4.0
	reinstatement of drainage lines on the rehabilitated areas of the site; and	Section 3.4
	control of any potential water pollution from the rehabilitated areas of the site;	Section 3.4
	- performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the development: - mine water management system;	Section 3.7
	surface water quality of the Hunter River;	Section 3.7
	- a program to monitor and report on: - the effectiveness of the mine water management system; and	Section 3.7
	surface water flows and quality, stream and riparian vegetation health in the Hunter River potentially affected by the development;	Section 3.7
	a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the development; and	Section 7.1 APPENDIX E

Condition	Requirement	WMP Section
25 (b) iii	The Groundwater Water Management Plan which includes;	
	detailed baseline data on groundwater levels, yield and quality in the region, and any privately-owned groundwater bores, that could be affected by the development;	Section 6.2 Section 6.3
	groundwater impact assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;	Section 6.3.5 Appendix E
	- a program to monitor and report on: - the seepage/leachate from water storages, emplacements, backfilled voids, and final voids;	Section 6.3.5
	- The impacts of the development on: - groundwater inflows to the open cut pits; - regional aquifers; - groundwater supply of potentially affected landowners; - the Hunter River alluvial aquifer; and - any groundwater dependent ecosystems and riparian vegetation; and - base flows to the Hunter River;	Section 6.3.5
	a program to validate the groundwater model for the development, including an independent review of the model with every independent environmental audit, and compare the monitoring results with modelled predictions; and	Section 6.3.4
	a plan to respond to any exceedances of the groundwater assessment criteria.	Section 7.1 APPENDIX E
	The Applicant must implement the approved plan as approved from time to time by the Secretary.	This Plan

Table 3
Management Plan Requirements

Condition	Requirement	WMP Section
3	The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:	
(a)	a summary of baseline data;	Section 3.1 Section 6.2
(b)	a description of: - the relevant statutory requirements (including any relevant approval, licence or lease conditions); - any relevant limits or performance measures/criteria; - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	Section 1.2 Section 3.8 Section 6.3 Appendix E

Condition	Requirement	WMP Section
(c)	a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	This Plan
(d)	a program to monitor and report on the: - impacts and environmental performance of the development; - effectiveness of any management measures (see c above);	Section 3.7 Section 3.8 Section 3.9 Section 6.3
(e)	a contingency plan to manage any unpredicted impacts and their consequences;	Section 7.0 Appendix E
(f)	a program to investigate and implement ways to improve the environmental performance of the development over time;	Section 3.7 Section 6.4 Section 6.5 Section 7.0 Appendix E
(g)	a protocol for managing and reporting any: - incidents; - complaints; - non-compliances with statutory requirements; and - exceedances of the impact assessment criteria and/or performance criteria; and	Section 8.4 Section 8.5 Section 7.0
(h)	a protocol for periodic review of the plan.	Section 8.3

2.0 STAKEHOLDER CONSULTATION

This section summarises the stakeholder consultation undertaken as part of the development of this WMP.

2.1 WMP 2019

Schedule 3, Condition 25 of SSD-5170 (as modified) states that the WMP must be developed in consultation with the Environment Protection Authority (EPA) and the Department of Industry – Water (Dol-Water) (now the Department of Planning and Environment - Water (DPE- Water)), to the satisfaction of the Secretary of DPE.

This review of the WMP was undertaken to address the approval of SSD-5170 (as modified) for MOD 4. A copy of all relevant regulatory correspondence associated with the preparation of the 2019 WMP will be included in **Appendix A**.

2.2 WMP 2023

This review of the WMP will be undertaken in consultation with the EPA, DPE Water and DPE in accordance with the requirements of Schedule 3, Condition 25 of SSD-5170 (as modified). A response has been received from DPE Water and incorporated into this WMP where relevant. A copy of all relevant regulatory correspondence associated with the preparation of the 2023 WMP will be included in **Appendix A**.

3.0 SURFACE WATER MANAGEMENT PLAN

This section summarises the baseline surface water data and describes the Bengalla water management system.

3.1 Baseline Data

3.1.1 Hunter River Flow

Flow volume data for the period 1913 to 2013 for the Hunter River was sourced from NSW Office of Water (now DPE-Water). The historical flow rates and baseline data presented in **Appendix B** was used to inform the Bengalla EIS.

Appendix B Figure B1 shows the recorded flow-duration relationship for the Hunter River at Muswellbrook Bridge, approximately 4 km east of Bengalla. **Figure B1** indicates that Glenbawn Dam has increased the frequency of low flows (due to regulation) and moderately reduced the frequency of high flows.

Appendix B Figure B2 shows the historical flow rates for the Hunter River at Singleton from 1913 to 2013.

3.1.2 Water Quality

BMC's surface water monitoring program includes:

- Selected on-site dams – mine, sediment and clean water dams;
- Receiving waters – upstream and downstream Hunter River; and
- Discharge waters – monitoring undertaken at the discharge point and in Dry Creek during periods of discharge under the HRSTS.

Further discussion in relation to the surface water monitoring program is provided in **Section 3.7**.

On-site Dams

The on-site dam water sampling at Bengalla is carried out based on spill risk to the surrounding environment. Sampling is undertaken at designated mine and sediment water dams. A summary of the results of the on-site dam monitoring program from 2007 to 2013 are presented in **Appendix B Table B1**.

Discharge Waters

In periods of high or flood flows, excess water from Bengalla can be discharged into the Hunter River under the HRSTS and in accordance with EPL 6538. HRSTS discharges are currently released from Dirty Water Dam 1 (DW1). During discharges monitoring is undertaken at the discharge location and at a monitoring point downstream of Bengalla (see **Figure 4**).

As Bengalla generally operates with a deficit of water, only limited releases in accordance with the HRSTS have occurred. A total of 520 ML of water was discharged from Bengalla under the HRSTS in the period 2006 to 2016.

Receiving Waters

The Hunter River is the receiving water for discharges from Bengalla (via Dry Creek). Prior to the completion of the Dry Creek Diversion works, Dry Creek was monitored at points upstream and downstream of Bengalla. From 2008 to 2013, there were 14 occasions (not including controlled discharges from BMC's former SDD) that Dry Creek had sufficient flow for water quality sampling to be undertaken (results are presented in **Appendix B Table B1**). Due to the completion of the Dry Creek Diversion works it is no longer relevant to monitor Dry Creek at these locations.

Hunter River water quality data has been collected by DoI-Water since the 1970s. The DoI-Water monitoring results indicate that the Hunter River is alkaline, fresh, and has a median TSS of 8 mg/L. The available data is summarised in **Appendix B Table B2 and Table B3**.

3.2 Water Management Strategy

The Bengalla water management system is described by reference to four water types which are listed in **Table 4**. The water management system is designed in the context of the "water management performance measures" in Schedule 3, Condition 24 of SSD-5170 (as modified) (see **Table 1**). Bengalla's existing water management structures are described in **Table 5**.

Table 4
Bengalla Water Type Definitions

Water Type	Meaning
Clean Water	Water pumped from the Hunter River into the Hunter River Raw Water Dam or run-off from a catchment that is undisturbed by mining and associated activities. Runoff from fully rehabilitated mined out areas where the rehabilitation area has been relinquished.
Mine Water	Water that accumulates within, or drains from, active mining and infrastructure areas and any other areas where run-off may have come into contact with coal or carbonaceous material (synonymous with 'dirty water').
Sediment Water	Runoff from areas disturbed by mining and associated activities that has not come into contact with coal or carbonaceous material. Includes water from non-relinquished rehabilitation areas.
Contaminated Water	Associated with water used by the vehicle wash bay and bathhouse that is captured and processed to enable its transfer and reuse in the mine water system.

Water management at Bengalla is based on the following key principles (which are generally followed except where circumstances dictate that there is an overall environmental advantage to do otherwise):

- Minimise use of clean water from external sources;
- Where possible, divert clean water away from areas disturbed by mining and associated activities;
- Collect sediment water in catch drains and direct to sediment traps and settling dams, and where required reuse in the Bengalla water management system;
- Collect runoff from industrial areas (mine water) in catch drains and transfer to storage dams for reuse, where required, in the Bengalla water management system;
- Transfer of open cut pit water (mine water) to storage dams and where required re-use in the Bengalla water management system; and
- Minimal off-site discharge of surplus mine water.

3.2.1 Clean Water Management

Dams, pipelines and associated drainage structures are used to redirect clean water away from disturbed areas. Over the life of Bengalla, there are a minimum of three clean water dams to be constructed:

- CW1 – north of Wybong Road (constructed).
- Hunter River Raw Water Dam – storage dam located to the west of the pit (constructed).
- Spare Dam – highwall dam west of the pit (anticipated around 2030 and as a result is not included in this WMP).

Hunter River water from the Hunter River Raw Water Dam is used at the CHPP, vehicle wash-down, for fire suppression and dust suppression as required. Potable water is used for drinking, shower and toiletry purposes within the main office, bathhouse, adjacent workshop areas and is delivered to relocatable facilities, dragline and drills for similar uses.

The clean water management system is discussed further in **Section 4**.

Where necessary for proper management and to protect the clean water catchment in and around Bengalla, from time to time, diversion levees, structures, dams and associated drainage, pump and pipe infrastructure, to divert and collect clean water may be constructed (altered or realigned in whole or in part) within the development consent boundary in accordance with the water management performance measures.

3.2.2 Mine Water Management

The management of mine water involves the following general principles:

- Mine water is used on site in accordance with SSD-5170 (as modified) and EPL 6538 or discharged in accordance with the WMP and HRSTS;
- Minimising water usage, including use of water from the Hunter River, by reusing mine water as required;
- Utilisation of the pit for mine water storage, as required; and
- Utilisation of the former Mt Pleasant rail loop dam for mine water storage as required.

Where necessary for proper management and to protect the water catchment in and around Bengalla, from time to time, diversion structures and dams to divert and collect mine water may be constructed within the development consent boundary in accordance with the water management performance measures.

3.2.3 Sediment Water Management

Sediment water is detained within the Bengalla water management system according to SSD-5170 (as modified) water management performance measures. Following the relinquishment of established rehabilitation areas it is anticipated that relevant sediment dams will be removed from the Bengalla water management system and water from rehabilitated areas will be released to the environment.

3.2.4 Contaminated Water Management

Contaminated water at Bengalla is generated by the bathhouse and vehicle wash bay. Contaminated water from the bathhouse is processed through the Waste Water Treatment Plant (WWTP) which then directs the water into the process water circuit for reuse in the Bengalla water management system. Contaminated water from the vehicle wash bay is processed through a hydrocarbon separation system which directs waste oil into a waste oil tank and the water component into the facilities sump. The water from the facilities sump is reused in the Bengalla water management system.

3.2.5 Prescribed Dams

The following dams at Bengalla are prescribed under the *Dams Safety Act 1978*:

- DW1; and
- CW1 (see **Section 4.2**).

In accordance with the requirements of the Dams Safety NSW (DS NSW), BMC has prepared a DS NSW Management Plan.

3.2.6 Discharges Under the HRSTS

Under the HRSTS, excess water from Bengalla can be discharged into the Hunter River during periods of “high” or “flood” flows from DW1 (see **Figure 3**). Discharges from DW1 are regulated by BMC’s EPL 6538 (see **Section 3.9 Table 8**). Discharge water from the DW1 is conveyed through the existing drain to Dry Creek and the Hunter River.

3.3 Water Management System

Water management infrastructure has been constructed, replaced or the function has been varied to facilitate ongoing mining operations at Bengalla. Since the last revision of the WMP, a number of changes to the water management system have been implemented:

- Increased water demands associated with increased production rates, including CHPP water use, stockpile, haul road dust suppression and vehicle wash-down;
- Mining operations continuing west through some existing infrastructure. Some water storages and/or other water management structures will need to be relocated as this occurs;
- Construction and/or alteration or replacement of various dams, associated drainage, pump and pipe infrastructure, as required;
- Construction and/or alteration or replacement of various levees, banks and diversion drains, as required; and
- Maintenance of dams where required including lifecycle management (i.e. mine water dam converted to sediment water and then clean water as mining progresses).

The current Water Management System is illustrated on **Figure 3** and described in **Table 5**.

Table 5
Bengalla Existing Water Management Structures (as of June 2023)

Dam	Capacity (ML)	Purpose	Comments
Hunter River Raw Water Dam	5	Clean water	Storage dam for clean water extracted from the Hunter River, supplies the Washery Dam, vehicle wash and fire suppression system.
Washery Dam	25	Mine water	Supplies process water to the CHPP and designed water fill points. The Washery Dam is also used as a transfer dam, receiving excess mine and sediment water which then overflows to DW1.
Endwall Dam	80	Sediment water	Accepts sediment water from the North Dump Sediment Dam, Ramp Dam, Bengalla East Sediment Dam (Homestead Dam) and the Bengalla West Sediment Dam (Farm Dam). Water is transferred to the Dry Creek East Dam.
Ramp Dam	16	Sediment water	Accepts sediment water runoff from the OEA rehabilitation area and diverts it to the Endwall Dam.
East Facilities Dam	79*	Mine water	Accepts mine water runoff from the CHPP stockpile and main infrastructure areas, process water from dewatering of coal reject material, mine water from the ROM North Dam and contaminated water from the WWTP and vehicle wash. Overflows to the West Facilities Dams. Water is also transferred to the Washery Dam.
West Facilities Dam	79*	Mine water	Accepts mine water runoff from the Western CHPP stockpile area and overflow from the East Facilities Dams. Water is transferred to the Washery Dam.
Dirty Water Dam 1 (DW1)	700	Mine water	A Mine water storage and as the licensed release point for mine water under the HRSTS. Relocated as per Bengalla EIS, RTS and MOD 1 SEE; enlarged as per MOD 4 SEE. Prescribed dam under the <i>Dams Safety Act 1978</i> .
Train Loadout Dam	0.5	Mine water	Accepts mine water runoff from the train loadout facility.
Facilities Sump (vehicle wash bay)	0.5	Contaminated water	Accepts contaminated water from the truck and light vehicle wash down. Overflows to the East Facilities Dams.



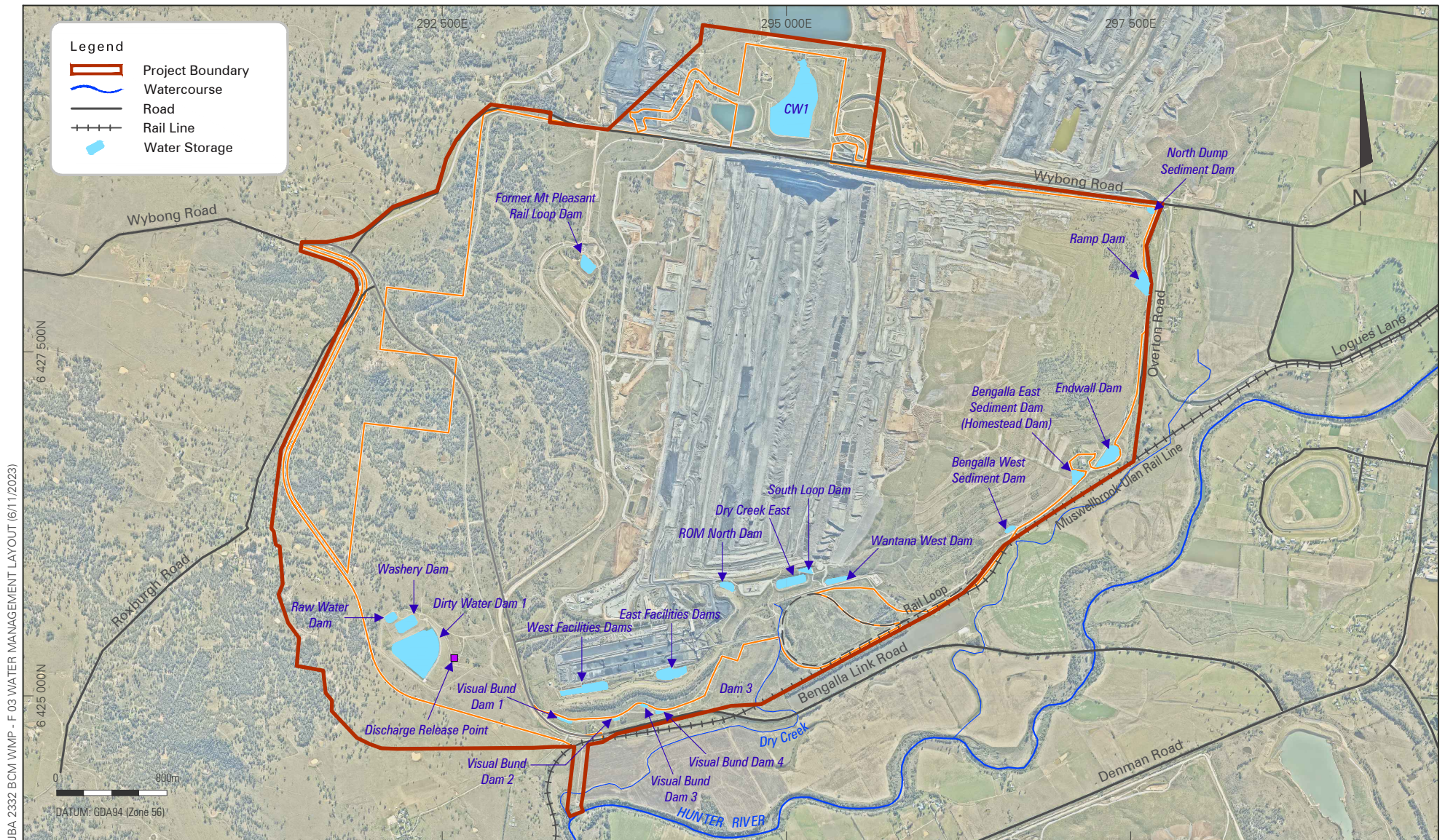
Dam	Capacity (ML)	Purpose	Comments
North Dump Sediment Dam	0.5**	Sediment water	Accepts sediment water runoff from the rehabilitation on the northern dump.
South Loop Dam	0.5	Mine water	Accepts mine water pumped from the pit. Overflows to the Dry Creek East Dam.
ROM North Dam	14	Mine water	Captures mine water runoff from the ROM pad visual bund and ROM haul road.
ROM South Sediment Dam	0.5	Sediment water	Captures sediment water runoff from the ROM visual bund.
Dry Creek East Dam	93	Mine water	Will receive pumped flows from the pit, Endwall Dam and Wantana West Dam. Will pump to the Washery Dam.
Wantana West Dam	16	Sediment water	Captures sediment water runoff from disturbed areas associated with part of the OEA and sediment water runoff from the OEA un-relinquished rehabilitation area.
Bengalla East Sediment Dam (Homestead Dam)	24	Sediment water	Captures sediment water runoff from the OEA un-relinquished rehabilitation area. Water pumped to Endwall Dam.
Bengalla West Sediment Dam (Farm Dam)	5	Sediment water	Captures sediment water runoff from the OEA un-relinquished rehabilitation area. Water pumped to Endwall Dam.
Clean Water Dam 1 (CW1)	900	Clean water	Functions as a dry detention basin and does not remove or divert water from the relevant water source. Intercepts runoff from the Dry Creek catchment upstream of its location. Water captured in CW1 is re-directed around the active mining area and released back into Dry Creek at a discharge point (CWDP1) west of the current Mine Access Road (see Figure 5). Prescribed dam under the <i>Dams Safety Act 1978</i> .
Former Mt Pleasant Rail Loop Dam	16	Mine Water	Utilise as a mine water dam to retain sediment and mine water in the internal system as required.
Western Diversion Levee	n/a	Clean Water	Diverts clean water away from areas disturbed by mining and associated activities.
Visual Bund Dam 1	32	Sediment Water	Dam to the south of the visual bund around the Bengalla infrastructure area captures runoff from the visual bund and surrounding areas.
Visual Bund Dam 2	3	Sediment Water	Dam to the south of the visual bund around the Bengalla infrastructure area captures runoff from the visual bund and surrounding areas.



Dam	Capacity (ML)	Purpose	Comments
Visual Bund Dam 3	6	Sediment Water	Dam to the south of the visual bund around the Bengalla infrastructure area captures runoff from the visual bund and surrounding areas.
Visual Bund Dam 4	7	Sediment Water	Dam to the south of the visual bund around the Bengalla infrastructure area captures runoff from the visual bund and surrounding areas.

**Combined total of 158 ML with short term capacity up to 208 ML.*

Note: This is not an exhaustive list and that there are various other water management structures in place at Bengalla (including dams, drains, levees etc.) which assist in ensuring that the principles and objectives of the WMP and water management performance measures in SSD-5170 are met.



BENGALLA MINE

Conceptual Water Management System

FIGURE 3



JAMES BAILEY & ASSOCIATES
Environmental and Planning Consultants

Table 6
Anticipated Water Management Structures (2022– 2039)

Structure	Capacity (ML)	Purpose	Comments
Western Diversion Levee	n/a	Clean Water	From time to time the Western Diversion Levee, may be altered or realigned in whole or in part within the development consent boundary in accordance with the water management performance measures.
Additional ROM Dam	51*	Mine water	Required if additional storage is appropriate.
Spare Dam	100*	Clean water	Captures clean surface water from the upstream catchment.
Western OEA Sediment Dam A	83*	Sediment water	Captures runoff from the Western OEA. Only required if Western OEA is constructed. Will be used in the mine water system pending final location.
Western OEA Sediment Dam B	16*	Sediment water	Captures runoff from the Western OEA. Only required if Western OEA is constructed. Will be used in the mine water system pending final location.
Relocated Temporary OEA Sediment Dam	58	Sediment water	Revised location for the approved, but not yet constructed Temporary OEA Sediment Dam, as per MOD 4 SEE.
Creek Sediment Dam	270*	Sediment water	Captures runoff from disturbed areas during rehabilitation of Dry Creek.
Mt Pleasant Mine Discharge Dam	300*	Mine Water	Not for use in Bengalla's water management system but will be available to MTP, subject to appropriate approvals to facilitate its use (see Section 4.5).
Visual Bund Dams 1, 2,3 and 4 and North Dump Sedimentation Dam to be connected to mine water system	See Table 5	Sediment Water	Dams to be connect to the mine water system due to Section 6 of the Mining Act 1992.

**Capacities are nominal and will be confirmed as part of detailed design.*

Note: New, replacement or altered water management structures may be required to be implemented from time to time to ensure that the principles and objectives of the WMP and water management performance measures in SSD-5170 are met as mining progresses.

3.4 Erosion and Sediment Control

Sediment mobilisation and erosion will be minimised where reasonable and feasible by:

- Directing clean water runoff away from disturbed areas;
- Installing appropriate erosion and sediment controls, where required, prior to disturbance of land;
- Limiting the extent of the disturbance, where practical;
- Progressively rehabilitating disturbed land;
- Shaping rehabilitated land to minimise sheet flows and to direct water to sediment dams;
- Topsoil cultivation during the rehabilitation process, where required, to promote infiltration;
- Protecting natural drainage lines and watercourses by installing sediment and erosion controls such as diversion banks, channels, levees, sediment control measures (for example hay bales and siltation fencing) and sediment dams;
- Installation of rock riprap, geotextile fabric sediment filters or other suitable measures on steep gradients, as required; and

The following design guidelines are applicable to the future sediment dams the purpose of which is indicated as 'sediment water' in **Table 6**:

- *Managing Urban Stormwater, Soils and Construction, Volume 1* (Landcom, 2004) ('Blue Book');
- *Managing Urban Stormwater, Soils and Construction, Volume 2E Mines and Quarries* (Department of Environment and Climate Change, 2008).

With respect to the guidelines noted above sediment dams at Bengalla will generally be 'Wet Basins'. Key criteria for the design of the sediment dams are contained in Table 6.1 of Volume 2E.

3.5 Reject Material Emplacement

Reject material is dried in cells on the OEA, where it is then buried with inert overburden. BMC will implement the following measures for reject material or Potentially Acid Forming (PAF) overburden:

- No coarse reject or Archerfield Sandstone material will be placed in the Western OEA; and
- Coal reject materials will be buried under at least 5 m of inert overburden.

3.6 Final Void Management and Design

A single final void will remain following the completion of mining under SSD-5170. The final void will be designed as a groundwater sink. The final void will be designed, where reasonable and feasible, to minimise to the greatest extent practicable:

- the size and depth of the final void;
- the drainage catchment of the final void;
- any high wall instability risk; and
- risk of flood interaction (flows in and out of the void).

Further description of the final void will be included in the Rehabilitation Management Plan as required by Condition 47 of Schedule 3 of SSD-5170.

3.7 Surface Water Monitoring Program

A surface water monitoring program is undertaken at Bengalla to monitor compliance with regulatory requirements, improve the understanding and efficiency of the Bengalla water management system and the effectiveness of surface water management. The monitoring program is in respect of:

- Water quality;
- Water quantity;
- Water management system key infrastructure; and
- Stream and riparian vegetation health.

3.8 Water Quality Monitoring

Surface water quality monitoring is conducted in accordance with the requirements provided in *Approved Methods for Sampling and Analysis of Water Pollutants in New South Wales* (Department of Environment and Conservation, 2004) and *AS 5667:1:1998 Parts 1, 4 and 6*.

Surface water quality monitoring is undertaken as identified in **Table 7** and **Figure 4**.

Revisions to the surface water monitoring program may be required from time to time as applicable guidelines are replaced or updated, mining operations progress or when a relevant environmental risk is identified.

Table 7
Existing Surface Water Quality Monitoring Program

ID	Sampling Point Description	Type of Analysis	Frequency
Receiving Water Monitoring			
W01	Hunter River (upstream, near Kayuga Road Bridge)	Basic Surface Water Analysis	Monthly
		Surface Water Speciation	6 monthly
W02	Hunter River (upstream, Thornbro Dairy – North)	Basic Surface Water Analysis	Monthly
W03	Hunter River (upstream, Thornbro Dairy – South)	Basic Surface Water Analysis	Monthly
W04	Hunter River (downstream, Whites Creek Vineyards)	Basic Surface Water Analysis	Monthly
		Surface Water Speciation	6 monthly

ID	Sampling Point Description	Type of Analysis	Frequency
Discharge Monitoring			
EPA26/DW1	Monitoring at outlet from DW1	Basic Surface Water Analysis	Quantity (ML) and EC monitored continuously during discharge. pH and TSS samples taken daily during discharge.
Effluent Quality Monitoring			
EPA25	Effluent quality monitoring point	Basic Surface Water Analysis	Faecal Coliform and pH samples taken quarterly.
Dam Monitoring			
W07 / Endwall Dam	Adjacent to Bengalla Homestead	Basic Surface Water Analysis	Quarterly*
W11 / North Dump Sediment Dam	Corner of Overton and Wybong Roads	Basic Surface Water Analysis	Quarterly*
W12 / East Facilities Dam	South of the CHPP Infrastructure area	Basic Surface Water Analysis	Quarterly*
W15 / Ramp Dam	Accessed off Overton Road	Basic Surface Water Analysis	Quarterly*
W20 / Train Loadout Dam	Inside of Bengalla rail loop adjacent to Train Loadout Bin	Basic Surface Water Analysis	Annually
W22 / Wantana West Dam	Between the Rail Loop and the South Loop Rd Dam.	Basic Surface Water Analysis	Quarterly*
W24 / West Facilities Dam	South of the CHPP Infrastructure area	Basic Surface Water Analysis	Quarterly*
W26 / Farm Dam	Immediately south of the Southern OEA extension area	Basic Surface Water Analysis	Quarterly*
W27 / Homestead Dam	Immediately south of the Bengalla Homestead	Basic Surface Water Analysis	Quarterly*
W28 / North ROM Dam	Adjacent to the ROM pad	Basic Surface Water Analysis	Quarterly*
W29 / Hunter River Raw Water Dam	North of the Washery Dam	Basic Surface Water Analysis	Quarterly*
W30 / Washery Dam	North of the Dirty Water Dam	Basic Surface Water Analysis	Quarterly*

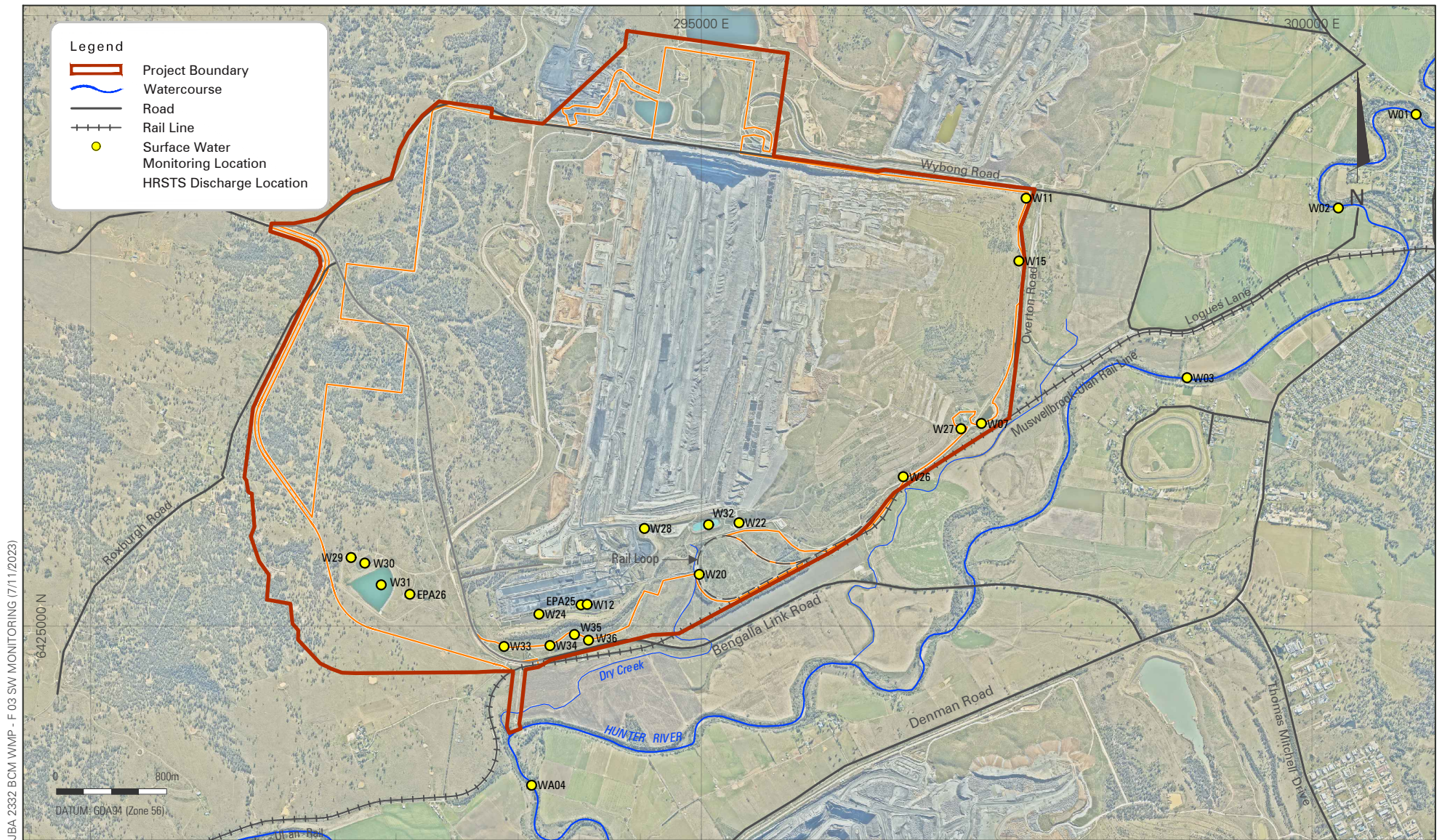
ID	Sampling Point Description	Type of Analysis	Frequency
W31 / Dirty Water Dam 1	West of Bengalla Link Rd	Basic Surface Water Analysis	Quarterly*
		Surface Water Speciation	Quarterly*
W32 / Dry Creek East	East of Dry Creek	Basic Surface Water Analysis	Quarterly*
W33 / Visual Bund Dam 1	South of visual bund	Basic Surface Water Analysis	Quarterly*
W34 / Visual Bund Dam 2	South of visual bund	Basic Surface Water Analysis	Quarterly*
W35 / Visual Bund Dam 3	South of visual bund	Basic Surface Water Analysis	Quarterly*
W36 / Visual Bund Dam 4	South of visual bund	Basic Surface Water Analysis	Quarterly*

Basic Surface Water Analysis: pH, EC, TSS

Surface Water Speciation: pH, EC, TSS, Al, As, Be, B, Ca, Cd, Cl, Cr(VI), Co, Cu, F, Fe, Pb, Li, Mn, Mg, Hg, Mo, Ni, Se, V, Zn

D/S = downstream

** Recorded rainfall > 25 mm in a 24 hour period (i.e. one calendar day). Initiate rain event monitoring at the conclusion of the rainfall event (next business day or when reasonable and feasible to do so).*



BENGALLA MINE

Existing Surface Water Monitoring Locations

FIGURE 4



3.1.1 Water Quantity Monitoring

Water quantity monitoring is undertaken to understand the volumes of water associated with key processes on-site, including to assist in the validation of the site water balance model and comply with conditions of WALs and HRSTS.

The Bengalla water management system is operated with a Real Time Environmental Monitoring System (RTEMS). The RTEMS monitors water storage volumes and water usage at selected locations across the site.

Hunter River surface water flow data from monitoring stations maintained by DoI-Water will be accessed as required.

3.1.2 Water Management System Key Infrastructure Monitoring

Monitoring is undertaken quarterly of key water management infrastructure to determine if the Bengalla water management system is operating as intended. Rain event monitoring is initiated following a recorded rainfall > 25 mm in a 24 hour period (i.e. one calendar day) at the conclusion of the rainfall event (next business day or when reasonable and feasible to do so).

3.1.3 Erosion and Sediment Control Monitoring

Drainage and sediment control structures will be inspected as required. During inspections, sediment control structures will be checked for scouring and accumulation of sediment.

3.1.4 Stream and Riparian Vegetation Health Monitoring

Monitoring of stream and riparian vegetation health in the Hunter River will be undertaken every three years in the year of the Independent Environmental Audit on BMC owned land with Hunter River frontage. Monitoring will assess stream health and change within in-stream habitats.

3.9 Surface Water Triggers

Schedule 3, Condition 25 of SSD-5170 (as modified) stipulates that the surface water management plan must include performance criteria and trigger levels for investigating any potentially adverse impacts associated with Bengalla.

The surface water quality impact assessment criteria that will be used as trigger values for assessing Bengalla's surface water impacts to the Hunter River are shown in **Appendix E Table E1**. Where insufficient local reference data is available, Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000) ecosystem trigger values have been adopted. The adopted trigger values will be refined if required following monitoring.

EPL 6538 stipulates the volume and concentration limits (see **Table 8**) applicable to the discharge point EPA01/SW01.

Table 8
HRSTS Discharge Criteria

Parameter	Unit of Measure	Concentration Limit
pH	pH	6.5 - 9.5
TSS	mg/L	120
Volume	ML/d	200

4.0 TEMPORARY DRY CREEK DIVERSION

This section provides a description of the Dry Creek Diversion interim water management system including the clean water diversion system, a summary of the design, performance objectives and downstream scour protection.

4.1 Existing Dry Creek Catchment

Dry Creek commences north of Wybong Road and drains from north to south to the Hunter River, which is located approximately 1 km south of the Bengalla Project Boundary. Dry Creek is an ephemeral gully that often maintains zero flow which is interrupted sporadically by short periods of flow during prolonged and / or heavy rainfall.

4.2 Clean Water 1 Dam

The construction of CW1 north of Wybong Road was completed in October 2016 and will remain in place until approximately Year 20 under SSD-5170. CW1 intercepts runoff from the Dry Creek catchment upstream of its location (see **Figure 5**). CW1 is capable of containing a 1 in 200 years ARI, 72 hour storm rainfall event.

CW1 has a surcharge capacity of 900 ML to reduce the potential for clean water entering Bengalla's active mining area. A pump rate of up to 1,085 litres/second (L / s) allows a 1 in 200 year ARI, 72 hour storm event to be pumped out of the dam within 14 days (under normal operating conditions). The pumps stationed at CW1 will be activated when water in CW1 reaches the minimum level for pumping and will operate continuously until the dam returns to the minimum level for pumping, so that CW1 functions as a dry detention basin. The design criteria adopted for CW1 are presented in **Appendix C Table C1**.

4.3 Temporary Diversion Hardware

4.3.1 CW1 Pipeline and Discharge Point

The pipeline from CW1 is approximately 5.5 km long and transports the water to a discharge point (CWDP1) west of the current Bengalla access road (see **Figure 5**).

An impact energy dissipating structure designed in accordance with the HEC-14 guideline has been constructed at the end of the pipeline to minimise erosion from the water re-entering the existing drainage line. The impact basin comprises a tall concrete chamber, approximately 3.0 m x 3.7 m x 2.4 m, including internal concrete walls/baffles to dissipate the energy. Downstream of the release point there is scour protection to facilitate increased flows. The CW1 pipeline alignment and discharge point is presented on **Figure 5**. The indicative clean water pumps and pipeline design considerations and the design criteria for the scour protection implemented downstream of the CW1 release point are presented in **Appendix C**.

4.3.2 Power Supply Infrastructure

To facilitate the use of the pumps at maximum capacity (if required), BMC has established mains power to CW1. A generator is also available to provide power to the pumps should the mains power be temporarily unavailable. A generator compound has been constructed adjacent to the pump station.

4.4 Clean Water Diversion Drains

To minimise clean water entering the Satellite Pit or Main Pit, the Western Diversion Levee has been constructed west of the existing Dry Creek location and south of Wybong Road (see **Figure 5**). The Western Diversion Levee diverts clean water from a catchment area of approximately 310 ha around active mining and into Dry Creek, south of the existing Mine Access Road.

Staged construction of the Western Diversion Levee commenced in 2015 and was completed in October 2016. DPE attended the site in November 2016 to inspect the levee prior to its utilisation.

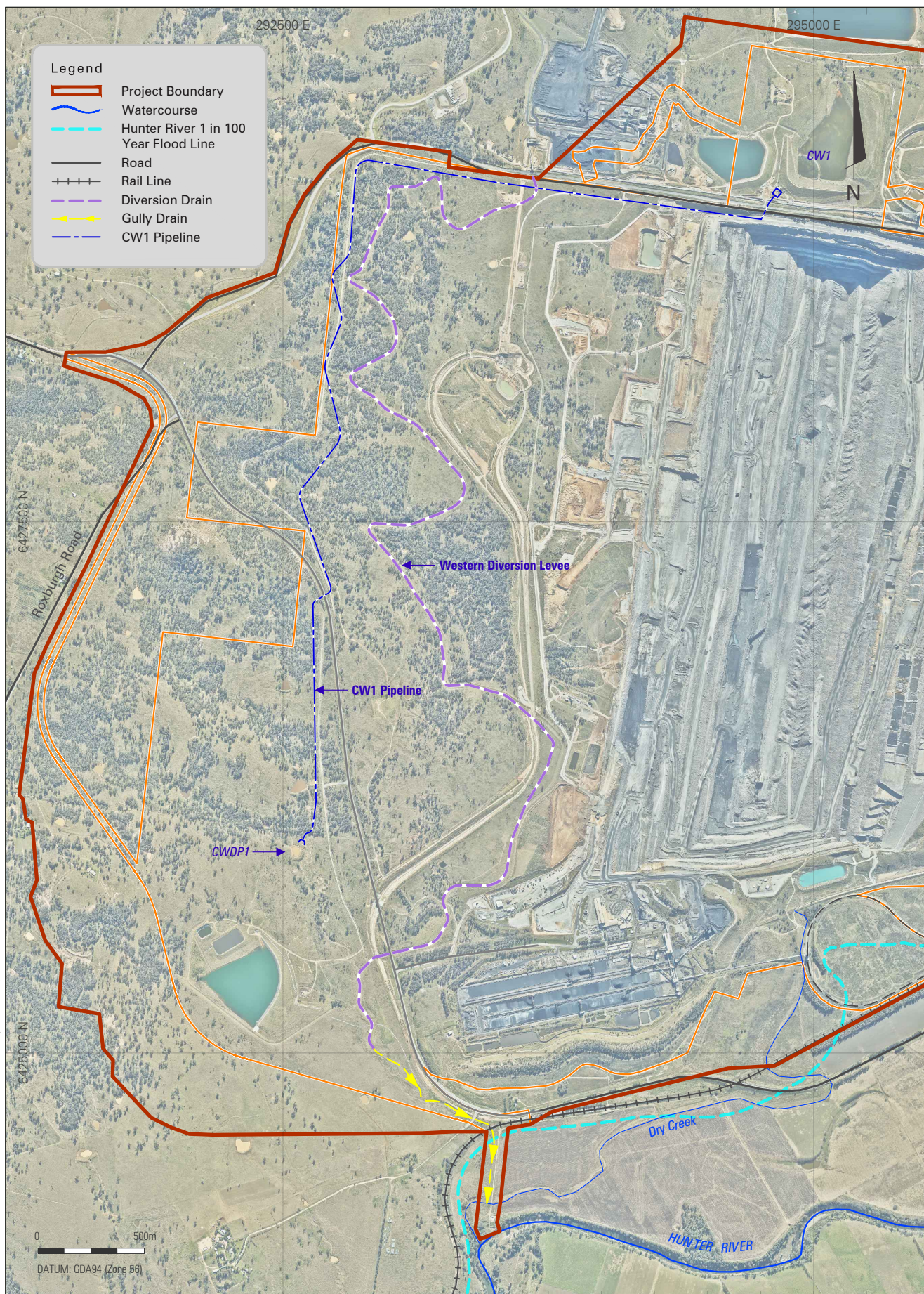
Following commissioning of CW1 and prior to the commencement of mining in the Satellite Pit, the existing Dry Creek culvert located under the Southern Haul Road was closed in December 2016 to facilitate mining operations. Closure of the Dry Creek culvert results in a closed catchment, with surface water runoff south of CW1 and east of the Western Diversion Levee directed into the active mining area where it is captured in the Bengalla water management system (see **Figure 3**).

From time to time the Western Diversion Levee, may be altered or realigned in whole or in part within the development consent boundary in accordance with the water management performance measures.

4.5 Mount Pleasant Discharge Dam

SSD-5170 (as modified) approves the construction of a 300 ML Mount Pleasant Discharge Dam 1 (MTP DW1) and associated pipeline (located generally adjacent to CW1 pipeline) in accordance with relevant guidelines and standards.

When constructed, MTP DW1 will not be utilised in Bengalla's water management system but will be available to MTP, subject to appropriate approvals, for use as the MTP discharge point.



BENGALLA MINE

Conceptual Dry Creek Diversion Infrastructure

FIGURE 5

5.0 SITE WATER BALANCE

This section provides an overview of the Bengalla water balance, water security and reliability, off-site discharges and water balance review requirements.

5.1 Overview

The computer based OPSIM model has been used to simulate the Bengalla water balance (incorporating MOD 4) under varying climatic sequences across four representative mine stages previously utilised for the Bengalla EIS. Activities proposed as part of MOD 5 were not predicted to have a perceptible impact on the site water balance model and as such no further update to the Water Balance has been undertaken.

The key inflows and outflows for the Bengalla water management system are outlined in **Table 9**.

Table 9
Simulated Inflows and Outflows for the Water Management System

Inflows	Outflows
Direct rainfall onto water surface of storage	Evaporation from water surface of storages
Catchment Runoff	Water demands (including CHPP, dust suppression, vehicle wash down)
Groundwater Inflows	Overflows from storages (in accordance with Blue Book design criteria).
Raw water extracted from the Hunter River*	Controlled releases under the HRSTS

As the primary water source relevant to the project. There are other water sources from which BMC extracts water under its water licenses including those described in **Table 11.*

The predicted average conditions annual site water balance is summarised in **Table 10**, based on 'static' simulations of each mine stage over 114 years of historical climate data.

Table 10
Bengalla EIS Annual Water Balance – Average Conditions

Parameter	Year 4	Year 8	Year 15	Year 24
Water Inputs (ML/yr)				
Rainfall/Runoff Yield				
<i>Mine Water System</i>	299	443	453	342
<i>Clean Water System</i>	765	733	468	64
<i>Sedimentation System</i>	336	294	435	325
Total	1,400	1,469	1,356	731
Groundwater Inflows	14	0	3	0
Hunter River Intake	1,323	1,267	1,263	1,345
Gross Water Inputs	2,736	2,736	2,622	2,076
Water Outputs (ML/yr)				
Evaporation from Storages				
<i>Mine Water System</i>	35	21	22	19
<i>Clean Water System</i>	9	9	9	9
<i>Sedimentation System</i>	50	27	45	40
Total	93	57	75	68
Dam Overflows (off-site)				
<i>Mine Water System</i>	0	0	0	0
<i>Clean Water System</i>	0	0	0	0
<i>Sedimentation System</i>	69	74	136	110
Total	69	74	136	110
HRSTS Discharges	19	82	85	44
CHPP Demand (Loss)	1,164	1,164	1,164	1,164
Stockpile Dust Suppression	150	150	150	150
Haul Road Dust Suppression	458	438	528	510
Vehicle Wash	132	132	132	132
Clean Water Pumped to Dry Creek	779	728	464	60
Gross Water Outputs	2,864	2,825	2,735	2,239
Water Balance (ML/yr)				
Change in Storage Volumes	0	0	0	0
Gross Water Balance (deficit)	128	89	114	163

Note: Bengalla Annual Water Balance – Average Conditions may vary with modifications to the development consent and/or as the development progresses (e.g. drought conditions).

5.2 Water Security and Reliability

The water balance model assists in determining the likely water security and reliability of Bengalla by identifying the scale of the forecasted water deficit or surplus based on the anticipated operations. The site water balance indicates a water deficit (for each of the four representative mine stages – Years 4, 8, 15 and 24) that is proposed to be met using water extracted primarily from the Hunter River as well as other water sources under existing water licences held by BMC.

A summary of water licences held by the Bengalla Joint Venture is provided in **Table 11**.

Table 11
Site Water Licences

Water Licence	Water Sharing Plan, Source and Management Zone	Entitlement
WAL1106	Hunter Regulated River Water Source (Zone 1A) Water Sharing Plan for the Hunter Regulated Water Source 2016 NSW	1449 ¹ units
WAL41457	Sydney Basin North Coast Groundwater Source Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016 NSW	365 units
Harvestable Rights	Muswellbrook Water Source Water Sharing Plan for the Hunter Unregulated and Alluvial Water Source 2009 NSW	109 ²

¹. Permanent entitlement to a share of the water source per water year (1 July to 30 June) which generates water allocation based on available water determination made by the Minister for Water (generally at the start of each water year).

². Harvestable rights calculation (Bengalla EIS).

The water licencing requirements for Bengalla based on the water balance model are summarised in **Table 12**.

5.3 Off-site Discharges

BMC participates in the HRSTS and is permitted to discharge from the main mine water storage (DW1 Dam) in accordance with the HRSTS rules. Bengalla normally operates with a net water deficit and the discharge of mine water under the HRSTS is infrequent.

The Bengalla water management system is designed to operate without uncontrolled release of mine water over the life of Bengalla as is reflected in the water balance model.

5.4 Site Water Balance Review

The site water balance will be reviewed annually and updated as appropriate and/or when additional or revised information becomes available with the progression of the mine. Results for the annual water balance will be presented in the Annual Review (see **Section 8.1**).

Table 12
Water Licensing Requirements

Water Type	Water Source	Predicted Annual Take (ML/year)		BMC Current Entitlements	Details of Licences	Additional Licence Allocation Required (ML/year or Units)	Water Available in Water Source
		Avg	Max				
Ground water	Hunter Regulated River Alluvial Water Source under Water Sharing Plan (WSP) for Hunter Unregulated and Alluvial Water Sources 2009.	112	220	442 units	Various	0	23,722 units
	Fractured rock aquifer and basement rocks (Coal seam) – Part 5 Water Act (now Sydney Basin-North Coast Groundwater Source under WSP for the North Coast Fractured and Porous Rock Groundwater Sources 2016 (North Coast WSP))	110	365	365 units	20BL169798 Bengalla's primary groundwater licence authorising extraction of water from the pit. Now converted to WAL 41547 under the North Coast WSP.	0	N/A
Surface Water	Hunter Regulated River Water Source (Management Zone 1A) under WSP for the Hunter Regulated River Water Source 2016.	1,140	1,920	Bengalla holds a total of 25 WALs for the Hunter Regulated River which have a total of 4,562 general security units and 1,455 high security units. Of those units, Bengalla currently has exclusive rights (not subject to third party arrangements) to 1,860 general security units and 1,449 high security units. The remaining units are currently used by BMC's licensees for agricultural purposes.	Various	0	10,378 high security units 75,035 general security units
	Muswellbrook Water Source under WSP for Hunter Unregulated and Alluvial Water Sources 2009.	20	39	109 ML (Harvestable Right)	Spare Dam (see Table 6) is BMC's nominated harvestable rights dam.	0	636 units

6.0 GROUNDWATER MANAGEMENT PLAN

This section of the WMP addresses groundwater related requirements of SSD-5170 (as modified). This section summarises the groundwater monitoring plan for Bengalla.

6.1 Existing Environment

Site geology comprises three distinct units: Permian strata, Permian basement (regolith), and a Quaternary alluvium as shown in **Figure 6**. The alluvium thickens towards the Hunter River and comprises the Hunter River Alluvial aquifer. The Permian coal seams also act as aquifers and interconnect with the Hunter River alluvium at depth. The regolith at Bengalla is generally unsaturated with minor ephemeral drainage. On this basis, the two key groundwater systems are:

- The aquifer associated with the Hunter River alluvial, which is up to 14 m thick and consists of an upper silty clay layer and a basal gravel; and
- The water bearing units of the Permian strata which consist of regolith, fresh basement rock and coal seams.

6.2 Baseline Data

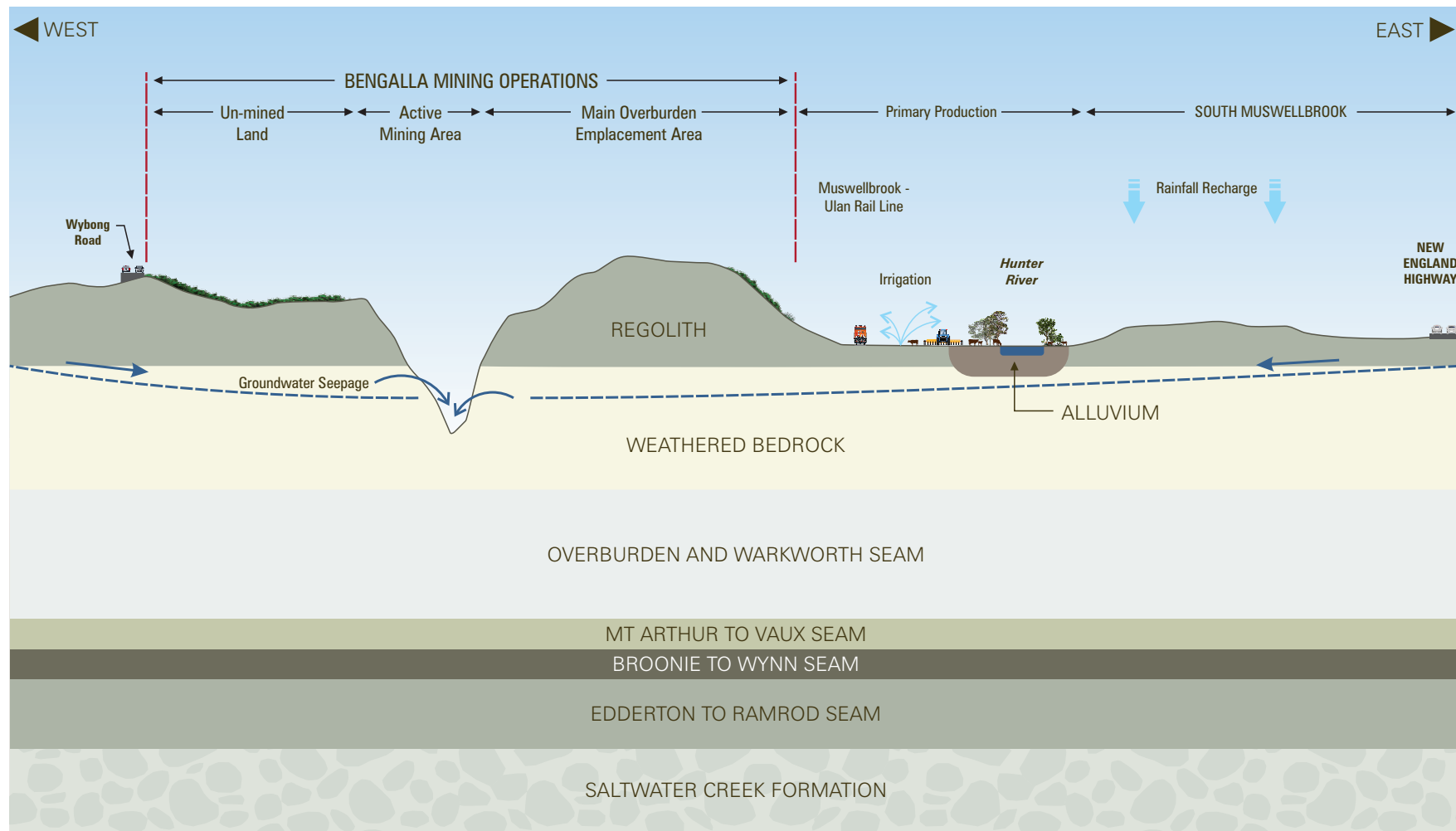
6.2.1 Hunter River Alluvium

The alluvial deposits present along the Hunter River are a highly productive groundwater source according to the NSW Aquifer Interference Policy (AIP) (NSW, 2012). Porosity and hydraulic conductivity are sufficient within the Hunter River alluvium to warrant abstraction for stock and domestic supplies. Water quality within the Hunter River alluvial aquifer varies from fresh to moderately saline, with Total Dissolved Solids (TDS) concentrations ranging from approximately 270 mg/L to 3,800 mg/L.

Government data for stock and irrigation bores on the Hunter River alluvium indicate that bore yields generally vary with the higher yields experienced at bores closest to the Hunter River (AGE, 2007).

On a regional scale, groundwater in the alluvium flows south-west, in the direction of the Hunter River however, close to the Wantana Extension, alluvial groundwater flows towards the Bengalla pit (BMC, 2014).

Recharge to the alluvium is predominantly via leakage from the Hunter River (BMC, 2014).



BENGALLA MINE

Conceptual Groundwater Regime

FIGURE 6

6.2.2 Permian Coal Measures

Permian strata are mapped as less productive groundwater according to the NSW AIP (2012). Groundwater within the Permian coal measures is brackish to saline. The poor quality of this water is typical of coal seams. Due to the generally low yield and poor quality of the groundwater in the coal seams the beneficial use can be classified as primary industry with the main other potential use being for stock watering.

Groundwater from the Permian coal measures seeps into the active mining area at Bengalla and other neighbouring mines.

6.3 Predicted Groundwater Impacts

6.3.1 Impact to Registered Privately Owned Bores

The Bengalla EIS predicted depressurisation may potentially affect one licensed private bore: GW-073576 in approximately Year 21. The indicated drawdown at this bore is predicted to be less than 2 m. Bore GW-073576 lies within a less productive aquifer zone (weathered Permian regolith) as defined by NSW Office of Water (2014).

The Bengalla EIS indicated that no other privately owned bores are predicted to experience drawdown greater than 2 m.

6.3.2 Impact on Pit Groundwater Inflow

Groundwater seeps from the Permian strata and overburden areas into the pit. Groundwater studies simulated that groundwater pit inflow peaks at 0.63 ML/day when mining is closest to the alluvium and then decreases to 0.2 ML/day as the pit moves westward (away from the alluvium) during the final ten years of mining (AGE, 2013).

The final void at end of mining is predicted to act as a groundwater sink with a lake level predicted to develop below the regional water table. Therefore, any saline water within the final void will not flow into surrounding groundwater systems (AGE, 2013).

6.3.3 Impact on Pit Groundwater Dependent Ecosystems

The Bengalla EIS describes that the Hunter Floodplain Red Gum Woodland is the only terrestrial groundwater dependent ecosystem (GDE) identified in the vicinity of Bengalla. Within BMC owned land there is a simulated drawdown of less than 1 m within the Hunter River alluvium to the south (AGE, 2013). The Hunter Floodplain Red Gum Woodland is considered unlikely to be affected by drawdown of this magnitude.

Stygofauna were identified at multiple locations in the Hunter River alluvium, confirming that the Hunter River alluvial aquifer is a GDE. However, as the drawdown in the Hunter River alluvium is predicted to be less than 1 m, no significant impacts on this GDE are predicted to occur.

6.3.4 Groundwater Model Validation

The groundwater model will be validated as a component of the Independent Environmental Audit (IEA). BMC will commission an independent consultant to review the model and compare the monitoring results with modelled predictions. Detail of the groundwater model validation will be included in the Annual Review in years in which validation occurs.

6.3.5 Groundwater Monitoring Program

BMC maintains a groundwater monitoring program to detect any significant changes to the local groundwater resources and monitor any impacts of the development on groundwater. A summary of the existing groundwater monitoring program is provided in **Table 13**.

The current groundwater monitoring network consists of various bores surrounding Bengalla (as shown in **Figure 7**), including three groundwater loggers and five vibrating wire piezometers (see **Table 14**). Long-term data available from these bores is summarised in **Appendix D**.

As mining at Bengalla has progressed in a westerly direction, a number of bores have been removed from the monitoring network. Additionally, several bores are located on land not owned by BMC, monitoring of these bores is subject to access.

New bores (which may include VVPs) will be installed from time to time in appropriate locations to maintain the efficacy of the groundwater monitoring network, including as replacements for existing bores that have been or will be mined through, are no longer accessible to BMC or otherwise no longer meet their purpose.

Other revisions to the groundwater monitoring program may be required from time to time as any applicable guidelines are replaced or updated, mining operations progress or when a relevant environmental risk is identified.

Table 13
Existing Groundwater Monitoring Program

Monitoring type	Data type	Sampling frequency	Sampling parameters	Frequency of data download
Wells and Bores	Standing water level	Quarterly	Metres below top of casing (mbTOC) & metres below ground level (mbgl)	Quarterly
	Field analysis	Quarterly	Basic Groundwater Analysis 2	Quarterly
	Laboratory analysis	Annually	Groundwater Speciation	Annually
Wantana Bores	Standing water level	Monthly	Metres below top of casing (mbTOC) & metres below ground level (mbgl)	Monthly
	Field analysis	Monthly Quarterly	Basic Groundwater Analysis 1 Basic Groundwater Analysis 2	Monthly Quarterly

Monitoring type	Data type	Sampling frequency	Sampling parameters	Frequency of data download
	Laboratory analysis	Annually	Groundwater Speciation	Annually
Vibrating Wire Piezometers	Potentiometric head	12-hourly	Hertz (Hz), Kilopascal (kPa), mbgl, & mAHD	Quarterly
Groundwater Logger	Standing water level	6-hourly	Pressure (psi), temperature (°C) to calculate depth from top of standpipe to water.	Quarterly
Pit Seepage *	Flow Rate/volume	Calculated Annually	ML, cumulative total (ML)	Annually
Weather Station	Rainfall	Daily	Daily rainfall (mm)	Monthly

* Accounting for take of water from the relevant groundwater source as per requirements under the WM Act.

Basic Groundwater Analysis 1: Field determinations for groundwater levels, pH, temperature and EC.

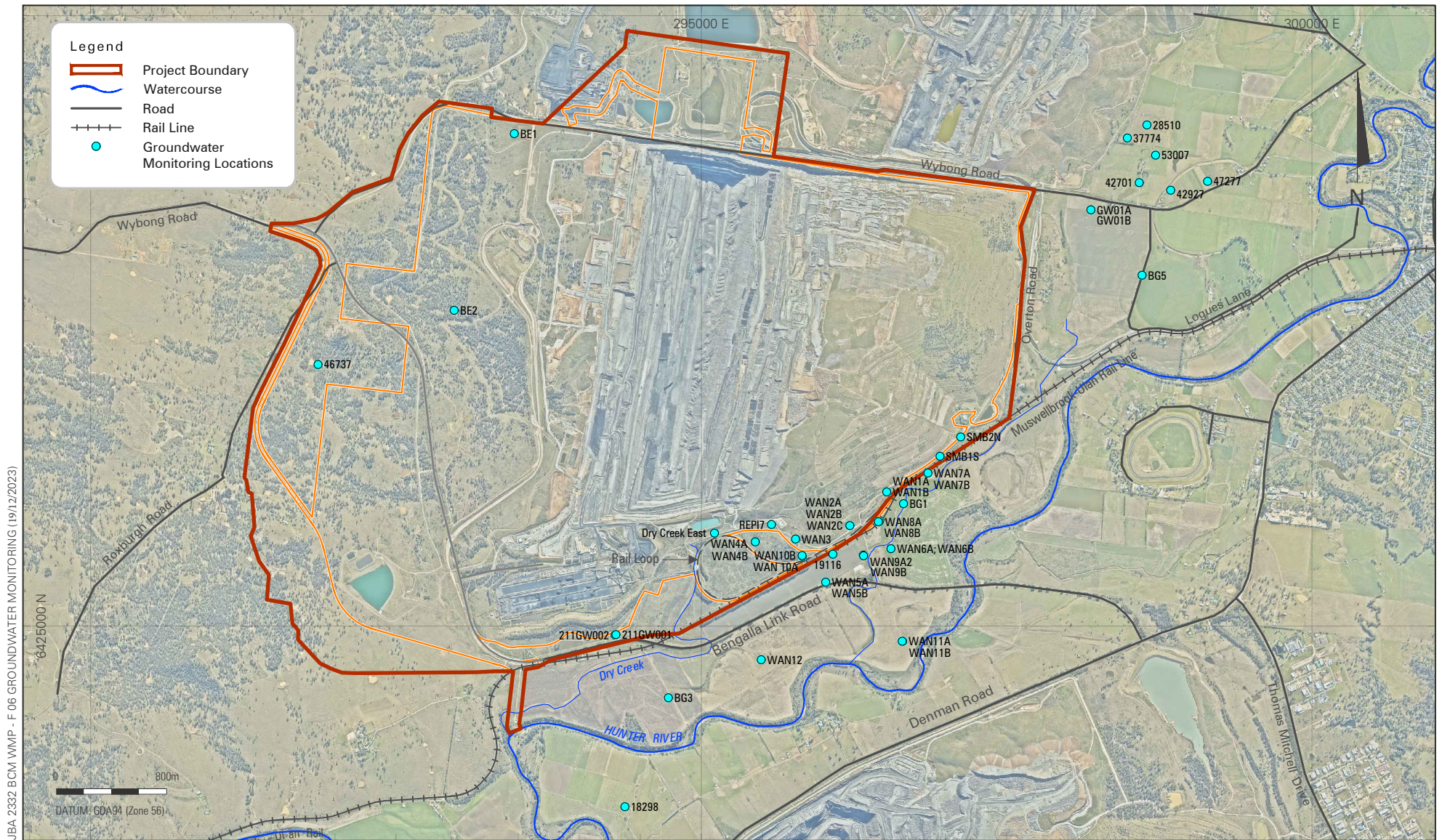
Basic Groundwater Analysis 2: Field determinations for groundwater levels, pH, temperature and EC; and laboratory analysis for TDS.

Groundwater Speciation: Laboratory analysis for:

Total and dissolved metals – aluminium, arsenic, boron, cadmium, copper, iron, manganese, molybdenum, nickel, selenium, and zinc;

Cations and anions – chlorine, fluoride, sulphate, carbonate, bicarbonate, alkalinity, hardness, calcium, magnesium, sodium, potassium, ionic balance, and sodium adsorption ratio; and

Nutrients – total nitrogen, nitrate and nitrite



BENGALLA MINE

Existing Groundwater Monitoring Locations

FIGURE 7



JAMES BAILEY & ASSOCIATES
Environmental and Planning Consultants

6.3.6 Seepage and Runoff from Emplacement Areas

To monitor the impacts of seepage and/or runoff from the OEA, the Endwall Sediment Dam (see **Table 7**) is sampled every two months for EC, pH, TSS and sulphates.

Groundwater bores located between the OEA and the Hunter River (see **Figure 7** and **Table 14**) are sampled annually for speciation analyses. This sampling enables BMC to identify impacts associated with seepage from water storages and emplacement areas.

6.3.7 Monitoring Network

Groundwater quality monitoring conducted at various wells and bores is undertaken to the following standards:

- The Australian/New Zealand Standard Water Quality *'Sampling, Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples'* (AS/NZS 5667.1:1998);
- The Australian/New Zealand Standard Water quality *'Sampling, Part 11: Guidance on sampling of Groundwaters'* (AS/NZS 5667.11:1998);
- Geoscience Australia (2009) *'Groundwater Sampling and Analysis – A Field Guide'*; and
- Murray-Darling Basin Commission (1997) *'Murray Darling Basin Groundwater Quality Sampling Guidelines'*, Technical Report No. 3, Groundwater Working Group.

The existing groundwater monitoring network is summarised in **Table 14**.

Groundwater samples will be collected from the private bore (GW-073576), which may be affected by depressurisation (see **Section 6.3.1**), subject to agreement with the landholder.

Table 14
Existing Groundwater Monitoring Sites

Bore ID	Easting MGA 94	Northing MGA 94	Ground level (RL m)	Top of casing (RL m)	Stick- up (m)	Screen (mbGL)	Geology/ Target seam	Type of Analysis	Frequency	Start date
18298	294375	6423521	132.9	133.5	0.61		Alluvium	Basic 2 Speciation	Quarterly Annually	Jan-97
19116	296078	6425589	135.6	136.4	0.82		Alluvium	Basic 2 Speciation	Quarterly Annually	Jan-97
211GW001	294301	6424930	139.2	140.07	0.87	49.4-55.4 5	Alluvium	tbc	Quarterly	Dec-21
211GW002	294294	6424927	139.2	140.10	0.9	15.8-21.8	Shallow Permian	tbc	Quarterly	Dec-21
28510	298649	6429105	144.0	144.0	1.3		Deep Permian	Speciation	Annually	Jan-97
37774	298488	6428998	146.0	146.0	0.4		Deep Permian	Speciation	Annually	Jan-97
42701	298586	6428632	145.0	145.0	0.97		Deep Permian	Speciation	Annually	Jan-97
42927	298843	6428570	144.3	145.4	1.10		Alluvium	Speciation	Annually	Jan-97
46737	291862	6427143	227.7	227.9	0.21		Shallow Permian	Basic 2 Speciation	Quarterly Annually	Jan-97
47277	299145	6428643	143.5	144.6	1.06		Alluvium	Speciation	Annually	Jan-97
53007	298720	6428857	143.9	144.0	0.04		Deep Permian	Speciation	Annually	Jan-97
BE1	293469	6429033	241.5	242.7	1.19	69-75	Permian Sandstone	Basic 2 VW Download Speciation	Quarterly Quarterly Annually	Jun-12
BE2	292977	6427587	175.2	176.4	1.18	48-54	Permian Sandstone	Basic 2 VW Download Speciation	Quarterly Quarterly Annually	Jun-12
BG1	296656	6426003	138.2	138.8	0.58		Alluvium	Basic 1 Basic 2 Logger Download Speciation	Monthly Quarterly Quarterly Annually	Jan-97



Bore ID	Easting MGA 94	Northing MGA 94	Ground level (RL m)	Top of casing (RL m)	Stick- up (m)	Screen (mbGL)	Geology/ Target seam	Type of Analysis	Frequency	Start date
BG3	294731	6424413	133.6	133.8	0.16		Alluvium	Basic 2 Logger Download Speciation	Quarterly Quarterly Annually	Jan-97
BG5	298609	6427874	142.2	142.6	0.31		Alluvium	Basic 2 Logger Download Speciation	Quarterly Quarterly Annually	Jan-97
Dry Creek East	295108	6425762	136.3	TBC	TBC	TBC	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Aug-19
GW01A	298190	6428409	TBC	TBC	TBC	9-12	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Feb-19
GW01B	298190	6428409	TBC	TBC	TBC	24-27	Shallow Permian	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Feb-19
REPI7	295575	6425832	135.5	136.4	0.91	49-52	Vaux Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Jan-97
SMB1S	296955	6426391	141.2	142.5	1.27	13-19	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Jun-10
SMB2N	297124	6426549	141.7	142.6	0.92	15-21	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Jun-10
WAN1A	296519	6426099	140.6	141.4*	0.75	16-20	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05

Bore ID	Easting MGA 94	Northing MGA 94	Ground level (RL m)	Top of casing (RL m)	Stick- up (m)	Screen (mbGL)	Geology/ Target seam	Type of Analysis	Frequency	Start date
WAN1B	296519	6426099	140.6*	141.4*	0.75	29-33	Edderton Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN2A	296217	6425824	137.7	138.4*	0.7	13-16	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN2B	296217	6425824	137.7*	138.4*	0.74	36-39	Wynn Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN2C	296217	6425824	137.7*	138.4*	0.73	51-54	Edderton Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN3	295772	6425713	136.4	136.7*	0.3	2.5-87	Deep Permian	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN4A	295442	6425690	135.1	135.9*	0.83	11.5-14.5	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN4B	295442	6425690	135.1*	135.9*	0.79	21-24	Deep Permian	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN5A	296019	6425360	135.9	136.7*	0.84	10.5-13.5	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN5B	296019	6425360	135.9*	136.8*	0.88	26-29	Deep Permian	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05

Bore ID	Easting MGA 94	Northing MGA 94	Ground level (RL m)	Top of casing (RL m)	Stick- up (m)	Screen (mbGL)	Geology/ Target seam	Type of Analysis	Frequency	Start date
WAN6A	296553	6425634	136.9	137.7*	0.77	7.5-10.5	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN6B	296553	6425634	136.9*	137.7*	0.76	30-33	Edderton Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN7A	296856	6426254	138.1	138.9*	0.76	12.0-15.0	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN7B	296856	6426254	138.1*	138.9*	0.79	80-83	Edinglassie Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Sep-05
WAN8A	296457	6425854	136.4	137.5	1.07	10.7-11.9	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Apr-09
WAN8B	296450	6425855	136.3	137.4	1.09	15-18	Wynn Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Apr-09
WAN9A2	296326	6425582	136.88	137.98	1.1	8.5-10.5	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Jul-17
WAN9B	296329	6425576	136.9	137.9	0.95	21-24	Wynn Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Apr-09
WAN 10A	295828	6425571	135.1	136.1	1.06	10 - 13	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Apr-09

Bore ID	Easting MGA 94	Northing MGA 94	Ground level (RL m)	Top of casing (RL m)	Stick- up (m)	Screen (mbGL)	Geology/ Target seam	Type of Analysis	Frequency	Start date
WAN10B	295825	6425578	135.0	136.1	1.06	44-47	Vaux Seam	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Apr-09
WAN11A	296649	6424875	135.4	136.4	1.05	9-12	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Feb-19
WAN11B	296645	6424876	135.5	136.5	0.95	24-27	Shallow Permian	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Feb-19
WAN12	295491	6424725	135.3	136.1	0.76	11-14	Alluvium	Basic 1 Basic 2 Speciation	Monthly Quarterly Annually	Feb-19

Notes: Groundwater monitoring points BE1 and BE2 each comprise both a standpipe piezometer and a VWP with two vibrating wires in each VWP (see **Appendix D Table D1**).

Groundwater monitoring point BE4 only comprise a VWP, with two vibrating wires (see **Appendix D Table D1**).

Ground level used to calculate top of casing [R m]).

*Ground level RL m AHD shared between sister bores (e.g. WAN7B GL [RL m] used for WAN7A GL [RL m] as no data provided).

TBC - Updated site details to be confirmed.

Ground level used to calculate top of casing [R m]).

6.4 Groundwater Triggers

Groundwater triggers have been developed based on the modelling completed for the Bengalla EIS.

In 2022 Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) recommended that BMC revise the groundwater quality triggers to avoid false exceedances and to reflect potential mining related impacts. The groundwater quality triggers in **Appendix E Table E3** have been revised by AGE using data available up to 2022.

The groundwater level triggers in **Appendix E Table E4** have been developed based on the maximum drawdown from the groundwater model (AGE, 2013). The most applicable pre-mining groundwater level, sourced from historic data (BMC, 2013), minus the predicted drawdown provides the trigger.

Groundwater quality and level monitoring results will be evaluated against the triggers presented in **Appendix E** as follows:

- pH values recorded outside the range of 6.0 and 8.5 for three consecutive readings (**Table E3**);
- EC values via a two stage process (**Table E3**):
 - Stage 1 – measured values that are above the 95th percentile level over two consecutive readings; and
 - Stage 2 – measured values at maximum value;
- Groundwater level trigger (**Table E4**) in:
 - Three or more alluvial bore levels fall below the trigger levels in one round of monitoring; and/or
 - Water levels in any bores fall below the trigger levels for three consecutive readings.

Aquifer Interference Policy Considerations

The AIP defines the regime for protecting and managing the impacts of aquifer interference activities on NSW's water resources. The AIP details minimal impact considerations relating to water table and groundwater pressure drawdown and changes in surface and groundwater quality.

No AIP minimal impact considerations are predicted to be triggered within the Hunter River alluvium or the Permian coal measures, except for the potential impact to private groundwater bore GW-073576 (see **Section 6.3.1**). The currently predicted drawdown of GW-073576 is less than the AIP > 2 m trigger level for a Porous and Fractured Rock Water Source(s) (NOW, 2012).

Relevant AIP minimal impact considerations are document in **Appendix E Table E5** and **Table E6**. In the event that AIP minimal impact considerations are triggered the actions identified in **Table E5** and **Table E6** will be implemented.

7.0 SURFACE AND GROUNDWATER RESPONSE PLAN

This section outlines the general surface and groundwater response protocol.

7.1 Response Protocol

Should the monitoring program identify the occurrence of a trigger BMC will initiate an investigation (where applicable) to:

- Identify the cause of the event;
- Determine if the event is an incident and/or non-compliance (**Section 8.4**);
- Identify any additional monitoring requirements, mitigation or management strategies required; and
- Review follow-up results, where required, to measure the effectiveness of the mitigation or management strategies.

A technical specialist may be engaged, where required, to undertake the investigation and prepare report.

Specific surface water and groundwater response plans are detailed in **Appendix E**.

8.0 REPORTING AND AUDITING

This section outlines the reporting and complaints management requirements relevant to this WMP. This section also describes the auditing requirements at Bengalla.

8.1 Annual Review

By the end of March each year, BMC will provide an Annual Review to the Secretary of DPE, which will review Bengalla's environmental performance for the previous calendar year. The Annual Review will:

- include a comprehensive review of the complaints recorded over the past year,
- include a comprehensive review of the monitoring results recorded over the past year, including a comparison of these results against the:
 - relevant statutory requirements, limits or performance measures/criteria;
 - monitoring results of previous years; and
 - relevant predictions in the EIS;
- identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;
- identify any trends in the monitoring data;
- identify any discrepancies between the predicted and actual impacts of Bengalla, and analyse the potential cause of any significant discrepancies; and
- describe what measures will be implemented over the next year to improve the environmental performance at Bengalla.

The Annual Review will be made publicly available through BMC's website and will be provided to the Bengalla CCC.

8.2 Auditing

Within 1 year of the commencement of development under SSD-5170 (i.e. 1 October 2016) and every 3 years thereafter, unless the Secretary directs otherwise, BMC will commission and pay the full cost of an Independent Environmental Audit of the Bengalla development.

8.3 Water Management Plan Review

Schedule 5, Condition 5 of SSD-5170 (as modified) requires that within 3 months of the submission of an:

- Annual review in accordance with Schedule 5, Condition 4;
- Incident report under Schedule 5, Condition 7;
- Audit report under Schedule 5, Condition 9; or
- Modification to the conditions of consent (unless the conditions require otherwise).

BMC will review, and if necessary, revise the WMP in consultation with the EPA and DoI-Water to the Satisfaction of the Secretary of DPE. When this review leads to revision in the WMP, then within 4 weeks of the review, unless the Secretary agrees otherwise, the revised WMP will be submitted to the Secretary for approval.

8.4 Reporting an Incident or Non Compliance

In accordance with Schedule 5, Conditions 7 and 7A of SSD-5170 BMC are required to report any Incidents¹ or Non-compliances².

After becoming aware of an Incident the Bengalla Environment Superintendent or delegate will immediately report any Incident to DPE and any other relevant agencies.

Within seven days of becoming aware of a Non-compliance the Environment Superintendent or delegate will provide a written report to DPE and any other relevant government agencies. The report will include the following details:

- The development application number and name;
- The condition of this consent that the development is non-compliant with;
- The non-compliance details (date, time and nature of the non-compliance)
- The likely cause of the non-compliance (if known); and
- Description of actions that have been or are proposed to be implemented to address the non-compliance.

Note: A Non-compliance which has been notified as an incident does not need to also be notified as a Non-compliance.

Where circumstances arise which indicate a possible (but not proven) non-compliance or incident then BMC will promptly investigate the circumstances to establish whether there is a non-compliance or incident. When such investigations are complete so that a determination of whether there is/has been a non-compliance or incident can be made and that determination is in the affirmative then the notification will occur within the required 7 days after the determination.

Under Part 5.7 of the Protection of the Environment Operations Act 1990 NSW and Condition R2 of EPL 6538, BMC is required to notify the EPA and other relevant authorities of incidents causing or threatening material harm to the environment immediately after becoming aware of the incident. Condition R2.2 of EPL 6538 requires written details of the notification to be provided to the EPA within 7 days of the date on which the incident occurred.

¹ Incident defined as an occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance

² Non-compliance defined as an occurrence, set of circumstances or development that is a breach of SSD-5170

8.5 Complaints

BMC will keep a legible record of all complaints made to BMC in respect of Bengalla's operations. The following details will be recorded:

- The date and time of the complaint;
- The method by which the complaint was made;
- The complainant's details (where provided);
- The nature of the complaint;
- The action taken in relation to the complaint, including any follow-up contact with the complainant; and
- If no action was taken by BMC, the reasons why no action was taken.

Complaints and enquiries regarding water issues and any other environmental matters will be directed to the 24-hour complaints hotline: 1800 178 984.

Complaints will be published monthly on BMC's website in accordance with Schedule 5, Condition 11(a) of SSD-5170 (as modified).

8.6 Public Access to Information

In accordance with Schedule 5, Condition 11 of SSD-5170 (as modified), BMC will regularly (in the form of the Annual Review) prepare a summary of monitoring results required by SSD-5170 and make these publicly available on the Bengalla website. In addition, this WMP will be made publicly available on the BMC website.

8.7 Continuous Improvement

Environmental performance of the Bengalla in relation to water management is continuously evaluated through:

- Review and investigation of any incidents;
- Independent environmental audits;
- Feedback from stakeholder consultation or complaints; and
- Annual Review process.

Water quality monitoring results are reviewed continuously as part of the ongoing reporting requirements including:

- Monthly as part of the Environment Protection License 6538 Monthly Monitoring Data Summary (surface water only);
- Annual review of the Bengalla site water balance; and
- In the Annual Review which compares water quality monitoring results for that year against the relevant trigger values and modelled predictions;

- As part of the IEA, the groundwater model is reviewed by an independent consultant.

Water quality monitoring results are assessed relative to trigger levels and impact assessment water modelling predictions. Non-compliances regarding water management are reported in the Annual Review. Following submission of the Annual Review to the DPE and the DPE responding to the Annual Review, BMC will determine if any change to water management practices at Bengalla is required.

8.8 Contingency Plan

This contingency plan outlines procedure(s) for responding to unpredicted impacts. BMC has developed trigger levels and responses based on more than 20 years of operational experience. These systems have proven to be effective at managing potential water impacts that may arise during operations.

The triggers and responses will likely be suitable for managing water impacts where the quantum of the impact is greater than predicted. Notwithstanding, the following contingency plan will be implemented if any unpredicted impacts occur which are inconsistent with Condition 24 of Schedule 3 of SSD-5170:

- BMC will commission a suitably qualified and experienced expert to investigate the cause of the unpredicted impact;
- If the investigation determines that Bengalla is a material cause of the impact, BMC will develop measures to mitigate the impact and/or seek to prevent such an impact from recurring;
- BMC will notify the DPE of the unpredicted impact, the investigation into the impact and any reasonable and feasible response actions to be implemented; and
- If necessary, this management plan will be updated to include the response actions.

9.0 RESPONSIBILITIES

Table 15 provides a detailed summary of responsibilities as stipulated in this WMP, and should be read in conjunction with this document. Responsibilities may be delegated as required.

Table 15
Responsibilities Summary

No	Task	Responsibility	Timing
1.	Controlled releases are to be undertaken in accordance with the EPL and the HRSTS.	BMC Environment Superintendent	As required
2.	Facilitate the design and construction of proposed water management structures as described in Section 3.3 .	BMC Environment Superintendent	As required
3.	Conduct surface water and groundwater monitoring in accordance with Section 3.8 and Section 6.3.5 .	BMC Environment Superintendent	As specified in this WMP
4.	Review the site water balance annually and present results in the Annual Review as per Section 5.4 .	BMC Environment Superintendent	Annually
5.	As per Section 6.3.4 , commission an independent consultant to review the groundwater model as part of the IEA. Include details of the groundwater model validation in the Annual Review.	BMC Environment Superintendent	As specified in this WMP
6.	If a trigger event is identified initiate the Surface and Groundwater Response Plan in Section 7.0 .	BMC Environment Superintendent	As required
7.	BMC will review, and if necessary, revise the WMP in consultation with the relevant authorities as per Section 8.3 .	BMC Environment Superintendent	As required
8.	Report incidents and non-compliances as per Section 8.4 .	BMC Environment Superintendent	As required
9.	Keep a legible record of all complaints made to BMC in respect of Bengalla's operations as per Section 8.6 .	BMC Environment Superintendent	As required

10.0 ABBREVIATIONS

Abbreviation	Meaning
µS/cm	Micro Siemens per centimetre
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AIP	Aquifer Interference Policy
ANZECC	Australian and New Zealand Environment Conservation Council
ARI	Average recurrence interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS/NZ	Australian/New Zealand Standard
Bengalla	Bengalla Mine
Bengalla EIS	Environmental Impact Statement titled <i>Continuation of Bengalla Mine, Environmental Impact Statement</i> (6 volumes), dated September 2013, as modified by the Response to Submissions dated March 2014.
Bengalla MOD 1 SEE	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification Statement of Environmental Effects' dated August 2015 and prepared by Hansen Bailey, including the Response to Submissions document dated October 2015 (SEE (Mod 1));
Bengalla MOD 2 SEE	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification Statement of Environmental Effects' dated April 2016 and prepared by Hansen Bailey, including the Response to Submissions document dated June 2016 (SEE (Mod 2)).
Bengalla MOD 3 SEE	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification 3 Statement of Environmental Effects' dated September 2016 and prepared by Hansen Bailey, including the Response to Submissions document dated November 2016 (SEE (Mod 3)).
Bengalla MOD 4 SEE	'Bengalla Mine Development Consent Modification 4 Statement of Environmental Effects', dated December 2017 and prepared by Hansen Bailey, including the Response to Submissions document dated May 2018 and Residual Issues document dated July 2018 (SEE (MOD 4)).
Bengalla MOD 5	'Bengalla Coal Mine Modification 5 to SSD-5170 Modification Report' (MOD 5) prepared by James Bailey Associates in 2021 including a Submissions Report in 2022 and supplementary Response to Additional Information.
Blue Book	Managing Urban Stormwater, Soils and Construction (2004)
BMC	Bengalla Mining Company Pty Limited
BJV	Bengalla Joint Venture
CCC	Bengalla Mine Community Consultative Committee
CHPP	Coal Handling and Preparation Plant
CW1	Dry Creek Clean Water 1 Dam
DA	Development Approval
DPE	Department of Planning and the Environment
Dol-Water	Department of Industry – Water (formerly DPI-Water)

Abbreviation	Meaning
DRG	Division of Resources and Geoscience
D/S	downstream
DS NSW	Dams Safety New South Wales
DW1	Discharge Dam as approved under SSD-5107 MOD 4
EC	Electrical conductivity
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
EPL	Environment Protection Licence
GDE	Groundwater Dependent Ecosystem
ha	hectare
HRSTS	Hunter River Salinity Trading Scheme
L/s	litres per second
m/s	metres per second
m ³ /s	cubic metres per second
mg/L	milligrams per litre
ML	megalitres
ML/d	megalitres per day
mm	millimetres
m/s	metres per second
MOV	Maximum Operating Volume
MSC	Muswellbrook Shire Council
MTP	Mount Pleasant Mine
DW1	Mount Pleasant Mine Discharge Dam 1
Mtpa	Million tonnes per annum
Mt	Million tonnes
NAF	Non-Acid Forming
NOW	NSW Office of Water
NSW	New South Wales
DPI - Water	NSW Department of Primary Industries - Water
OEA	Overburden Emplacement Area
PAF	Potentially Acid Forming
POEO Act	Protection of the Environment Operations Act 1997

Abbreviation	Meaning
RMP	Rehabilitation Management Plan
ROM	Run of Mine
RTEMS	Real Time Environmental Monitoring System
SSD	State Significant Development
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
WAL	Water Access Licence
WMP	Water Management Plan
WSP	Water Sharing Plan
WWTP	Waste Water Treatment Plant

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APPENDIX A

REGULATORY CORRESPONDENCE

Department of Planning and Environment



Our ref: OUT23/12257

Mr Craig White
Bengalla Coal Mine
Email: craig.white@bengalla.com.au

8 August 2023

Subject: Bengalla Coal Mine Continuation (SSD-5170) - Water Management Plan

Dear Mr White

I refer to your request dated 5 July 2023 providing the Department of Planning and Environment (DPE) Water an opportunity to comment on the above matter.

The Department of Planning and Environment- Water (DPE Water) has reviewed the Bengalla Coal Continuation Water Management Plan and makes recommendations regarding groundwater monitoring, management and water licensing.

Please see attachment A for further detail.

Should you have any further queries in relation to this submission please do not hesitate to contact DPE Water Assessments at water.assessments@dpie.nsw.gov.au.

Yours sincerely,



A/ Manager, Assessments, Knowledge Division
Department of Planning and Environment: Water

Attachment A

Detailed advice regarding the Bengalla Coal Mine Continuation Water Management Plan

1.0 Water take and licensing

1.1 Recommendation - prior to approval

That the Water Management Plan (WMP) be updated to include references to relevant Water Access Licences (WAL) numbers and water supply works.

Explanation

A summary of the total water entitlement held has been mentioned in Table 11 but no detail has been provided of the relevant WALs to enable further consideration. A description of the water taken under each WAL and confirmation that WALs have nominated a relevant water supply work should also be included.

2.0 Groundwater Monitoring and Management

2.1 Recommendation – prior to approval

That the WMP be updated to include a table that presents the rationale for the sites selected for groundwater monitoring. This rationale is to include the purpose or risk that is being monitored at the target locations.

Explanation

There is insufficient information to understand the purpose of each monitoring bore.

2.2 Recommendation – prior to approval

That the WMP include a location map for Groundwater Dependent Ecosystems (GDEs), out of pit emplacement areas, mine water storages and private bores close to the mine operations. A map is also requested of the monitoring bore network that measures change at these sites and/or validates the groundwater model predictions.

Explanation

This information will assist in interpreting the adequacy of the proposed monitoring network and management measures.

2.3 Recommendation – prior to approval

That the WMP include a data gap analysis to ensure each of the different risk and boundary conditions have been considered and that the bore network is suitable to monitor and report on impact.

Explanation

It is understood there is a connection between flows into the pit and the alluvial aquifer as flows to the pit are predicted to be greater towards the alluvial aquifer. There is no detailed information on groundwater flow, levels or hydrogeological parameters in the WMP and there are gaps in the monitoring network towards the south within both the alluvium and Permian aquifers. Therefore it is not clear if there are enough monitoring bores (particularly within the alluvium) to sufficiently monitor impacts and flow direction.

Additionally there is a lack of standpipe monitoring bores (apart from the VWP) to the west of the mine and it is unclear if other risk factors have been considered in the design of the monitoring program. Further information is required to demonstrate that the different risk factors associated with the mine's operations are being appropriately monitored.

2.4 Recommendation – prior to approval

That the WMP include an updated private registered bore monitoring program and reporting of groundwater monitoring results at targeted private bore(s) such as GW073576.

Explanation

The private registered bore monitoring program is insufficient and requires updating. Private bore information on the location of bore GW073576, its construction (i.e. bore depth and screen), aquifer depth and when/how monitoring will commence has not been included. Specific triggers and response actions are general and need to be reconciled.

End Attachment A



Bengalla Mining Company Pty Ltd

Bengalla Road (Locked Mailbag 5)
Muswellbrook NSW 2333 Australia

ABN 32 053 909 470

T: +61 2 6542 9500
F: +61 2 6542 9599

bengalla.com.au

6 November 2023

A/ Manager, Assessments, Knowledge Division
Department of Planning and Environment: Water
4 Parramatta Square, 12 Darcy Street
Parramatta NSW 2150

By email:

water.assessments@dpie.nsw.gov.au

Attention: A/ Manager, Assessments, Knowledge Division

The Proper Officer

Bengalla Mine – SSD-5170 Water Management Plan Response to DPE Water Comments

I am writing on behalf of Bengalla Mining Company (BMC) which operates Bengalla Mine (Bengalla) in the Upper Hunter Valley of NSW. Bengalla is approved by SSD-5170 a Division 4.1 Part 4 development consent under the *Environmental Planning & Assessment Act 1979 NSW* (EP&A Act).

Schedule 3, Condition 25 of SSD-5170 (as modified) requires BMC to prepare a Water Management Plan (WMP) in consultation with Department of Planning and Environment (DPE) Water. A request dated 5 July 2023 was provided to DPE Water inviting comment on the Bengalla Coal Continuation WMP. DPE Water response letter OUT23/12257 was received on the 8 August 2023.

BMC has reviewed the recommendations made by DPE Water. Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) were engaged to review the technical adequacy and relevance of the current groundwater monitoring program, management and water licensing against the various recommendations. A letter report has been included in **Attachment A** and a summary of the BMC approach to DPE Water recommendations provided in **Table 1** below.

Table 1: BMC Response to DPE Water Recommendations

Ref	DPE Water Comment	BMC Response
1.1	That the Water Management Plan (WMP) be updated to include references to relevant Water Access Licences (WAL) numbers and water supply works.	Section 5.2 of the WMP has been revised to include Table 11 summarising the Water Licences held by BMC.
2.1	That the WMP be updated to include a table that presents the rationale for the sites selected for groundwater monitoring. This rationale is to include the purpose or risk that is being monitored at the target locations.	The rationale behind the selection of monitoring bore locations is explained in the attached letter from AGE. Baseline groundwater monitoring data and monitoring bore specifics (such as depth, target geology and aquifer description) are described in Appendix D of the WMP. An independent review of the groundwater monitoring network is undertaken as part of the Independent Environmental Audit (IEA). water quality monitoring results for the year are compared against the relevant trigger values and modelled predictions annually as part of

Ref	DPE Water Comment	BMC Response
		the annual review including recommended improvements to the monitoring program.
2.2	That the WMP include a location map for Groundwater Dependent Ecosystems (GDEs), out of pit emplacement areas, mine water storages and private bores close to the mine operations. A map is also requested of the monitoring bore network that measures change at these sites and/or validates the groundwater model predictions.	In accordance with the 'Continuation of Bengalla Mine Environmental Impact Statement' (Hansen Bailey, 2013) (Bengalla EIS) and associated 'Groundwater Impact Assessment' (AGE, 2013) there are no predicted impacts to GDEs as such no mapping. Due to mine advancement the progression of out of pit emplacement areas and active mining is illustrated in the Annual Review and Annual Rehabilitation Reporting which is made publicly available on the BMC website. Mine water storages are illustrated on Figure 3. An independent review of the groundwater monitoring network is undertaken as part of the Independent Environmental Audit (IEA). Water quality monitoring results for the year are compared against the relevant trigger values and modelled predictions annually as part of the annual review.
2.3	That the WMP include a data gap analysis to ensure each of the different risk and boundary conditions have been considered and that the bore network is suitable to monitor and report on impact.	This is undertaken as part of the independent review of the groundwater monitoring network for the IEA. The monitoring network has been designed and constructed in accordance with the predicted impacts identified in the Bengalla EIS and associated 'Groundwater Impact Assessment' (AGE, 2013). The rationale and limited benefit of further monitoring to the west of Bengalla Mine is described in the attached letter.
2.4	That the WMP include an updated private registered bore monitoring program and reporting of groundwater monitoring results at targeted private bore(s) such as GW073576.	As described in section 6.3.1 and 6.3.7 there is only one private bore in the depressurisation zone in year 21 and the predicted drawdown is less than 2m. Further construction details are currently unavailable and access for monitoring is dependant on landholder access. Until this time triggers and response actions are unable to be developed.

If you require any further information, please do not hesitate to contact me on 02 6542 9525.

Regards



Craig White
Environment Superintendent
Bengalla Mining Company



17 August 2023

Bengalla Mining Company
Bengalla Road
Muswellbrook, NSW 2333

Attention: Ben Simpson
via email: ben.simpson@newhopegroup.com.au

Dear Ben,

Response to DPE Water's letter: "Bengalla Coal Mine Continuation (SSD-5170) – Water Management Plan"

The Department of Planning and Environment- Water (DPE Water) has reviewed the Bengalla Coal Continuation Water Management Plan and makes recommendations regarding groundwater monitoring, management and water licensing via a letter dated 08 August 2023 (ref: OUT23/12257). Bengalla has requested Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) review DPE's recommendations related to the Groundwater Management Plan and provide responses to assist Bengalla in addressing DPE's concerns.

Recommendation 1.1

That the Water Management Plan (WMP) be updated to include references to relevant Water Access Licences (WAL) numbers and water supply works.

DPE Explanation

A summary of the total water entitlement held has been mentioned in Table 11 but no detail has been provided of the relevant WALs to enable further consideration. A description of the water taken under each WAL and confirmation that WALs have nominated a relevant water supply work should also be included.

AGE Response

Details on specific water access license for take of groundwater can be found in AGE (2013) and other documents and can be incorporated into the WMP if necessary.

Recommendation 2.1

That the WMP be updated to include a table that presents the rationale for the sites selected for groundwater monitoring. This rationale is to include the purpose or risk that is being monitored at the target locations.

DPE Explanation

There is insufficient information to understand the purpose of each monitoring bore.

Brisbane Head Office
Level 2, 15 Mallon Street
Bowen Hills QLD 4006
t: (07) 3257 2055

Newcastle
4 Hudson Street
Hamilton NSW 2303
t: (02) 4962 2091

Perth
46B Angove Street
North Perth WA 6006
t: (08) 6383 9970

Townsville
Unit 1, 60 Ingham Road
West End QLD 4810
t: (07) 4413 2020

ageconsultants.com.au | [linkedin.com/company/ageconsultants](https://www.linkedin.com/company/ageconsultants)

AGE Response

Monitoring bore locations are often chosen to provide a balance between broad coverage surrounding the planned mining area, long-term record collection (i.e., bores sited near the workings risk being mined through in time), and targeted data collection. The overall goal of the monitoring network is to collect data that informs how the mining activities are affecting the groundwater resources, oftentimes with the network evolving as further data is collected. Requiring rationale for each individual site would be cumbersome and the rationale for an individual site may change as more data is collected.

Numerical modelling (AGE 2013¹) predicted that the most significant impacts to surrounding groundwater resources would be to the HRA. For this reason, monitoring sites are concentrated near the southeastern corner of the mine area where there is the shortest distance between the mine pit and the HRA aquifer system, and thus the highest likelihood of impact.

The mine progression at Bengalla is from east to west with the mining done along a general north-south axis. As such, monitoring locations are sited east (behind) and west (in front of) the active mining area and also focussing on the Hunter River Alluvium (HRA). Monitoring to the west of the mine is sparser compared to the HRA because there will be less impact to groundwater resources in that direction, even as the mine progresses westward. This is because the target coal seams progress deeper (lower elevation), and there is also thicker overburden, to the west. Additionally, monitoring locations immediately west of the current void would be consequently destroyed ("mined through") as mining progresses. The proximity of Mount Pleasant Operations directly to the north, limits Bengalla's ability to install monitoring locations north of the pit. (A program to install additional monitoring along the north edge of the endwall is currently underway.)

Bengalla's monitoring network was reviewed by AGE (2018), which proposed additional bores targeting both the HRA and Permian strata. The current GWMP requires a review of the groundwater monitoring network annually (most recently AGE 2022) and these annual reviews summarise the monitoring bore network and monitoring results and make recommendations were appropriate.

Recommendation 2.2

That the WMP include a location map for Groundwater Dependent Ecosystems (GDEs), out of pit emplacement areas, mine water storages and private bores close to the mine operations. A map is also requested of the monitoring bore network that measures change at these sites and/or validates the groundwater model predictions.

DPE Explanation

This information will assist in interpreting the adequacy of the proposed monitoring network and management measures.

AGE Response

Earlier ecological reports determined that the only groundwater dependant ecosystems (GDEs) in the vicinity of the mine are located along the Hunter River riparian corridor. The numerical modelling (AGE 2013) estimated that groundwater level drawdown within the HRA, which host the GDEs, will be less than 1 m, and is thus not considered to be a likely impact.

Location details for emplacement areas, mine water storage facilities, and private bores can be found in AGE (2013), AGE (2014), and other supporting documents referenced in the monitoring plan.

Recommendation 2.3

That the WMP include a data gap analysis to ensure each of the different risk and boundary conditions have been considered and that the bore network is suitable to monitor and report on impact.

DPE Explanation

It is understood there is a connection between flows into the pit and the alluvial aquifer as flows to the pit are predicted to be greater towards the alluvial aquifer. There is no detailed information on groundwater flow, levels or hydrogeological parameters in the WMP and there are gaps in the monitoring network towards the south within both the alluvium and Permian aquifers. Therefore, it is not clear if there are enough monitoring bores (particularly within the alluvium) to sufficiently monitor impacts and flow direction.

Additionally, there is a lack of standpipe monitoring bores (apart from the VWP) to the west of the mine and it is unclear if other risk factors have been considered in the design of the monitoring program. Further information is required to demonstrate that the different risk factors associated with the mine's operations are being appropriately monitored.

AGE Response

Previous reports have indeed established that groundwater is predicted to flow from the alluvium aquifer system toward the pit. Specifically, annual groundwater reviews (AGE 2022) provide details such as groundwater levels and potentiometric surfaces, and the numerical modelling report (AGE, 2013) was used to estimate groundwater "take" from the HRA aquifer system. This model was recently the subject of a Model Validation Report (AGE, 2022).

AGE (2013¹) used a numerical model to predict groundwater flow direction, including between the HRA aquifer system and mined Permian strata, and the results show that interaction between the HRA and Bengalla mine is localised along a particular stretch of the river adjacent to the southeast corner of the mine area; this is why there is a concentration of groundwater monitoring locations in this area. The numerical model predicts that impacts to the Hunter River are not likely to occur along the stretch of the river to the south of Bengalla mine. Therefore, monitoring has focused on the stretch of the river that has been predicted to experience the greatest impacts.

Monitoring to the west of the mine is also less consequential to the groundwater resources of the area because the target seams are deeper and there is thicker overburden, so there will be less impact to groundwater resources as the mine progresses westward. Standpipe bores would be considerably expensive to construct toward the west of the current void given the depth to the mined coal seams and, furthermore, would be mined through as mining progresses.

Recommendation 2.4

That the WMP include an updated private registered bore monitoring program and reporting of groundwater monitoring results at targeted private bore(s) such as GW073576.

DPE Explanation

The private registered bore monitoring program is insufficient and requires updating. Private bore information on the location of bore GW073576, its construction (i.e. bore depth and screen), aquifer depth and when/how monitoring will commence has not been included. Specific triggers and response actions are general and need to be reconciled.

AGE Response

The Bengalla Environmental Impact Statement (2013) predicted, based on results of numerical modelling (AGE, 2013), that only one private bore would be impacted by groundwater level declines greater than 1 m, but not greater than 2 m, due to mining at Bengalla. Because the predicted impact is less than 2 m (AIP minimal impact consideration), this bore is not included in Bengalla's groundwater monitoring network, however, it is proposed in the WMP to be sampled provided there is landholder access.

Yours faithfully,



Michael Thoma
Senior - Hydrogeologist
Australasian Groundwater and Environmental Consultants Pty Ltd

References

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APPENDIX B
BASELINE SURFACE WATER QUALITY DATA

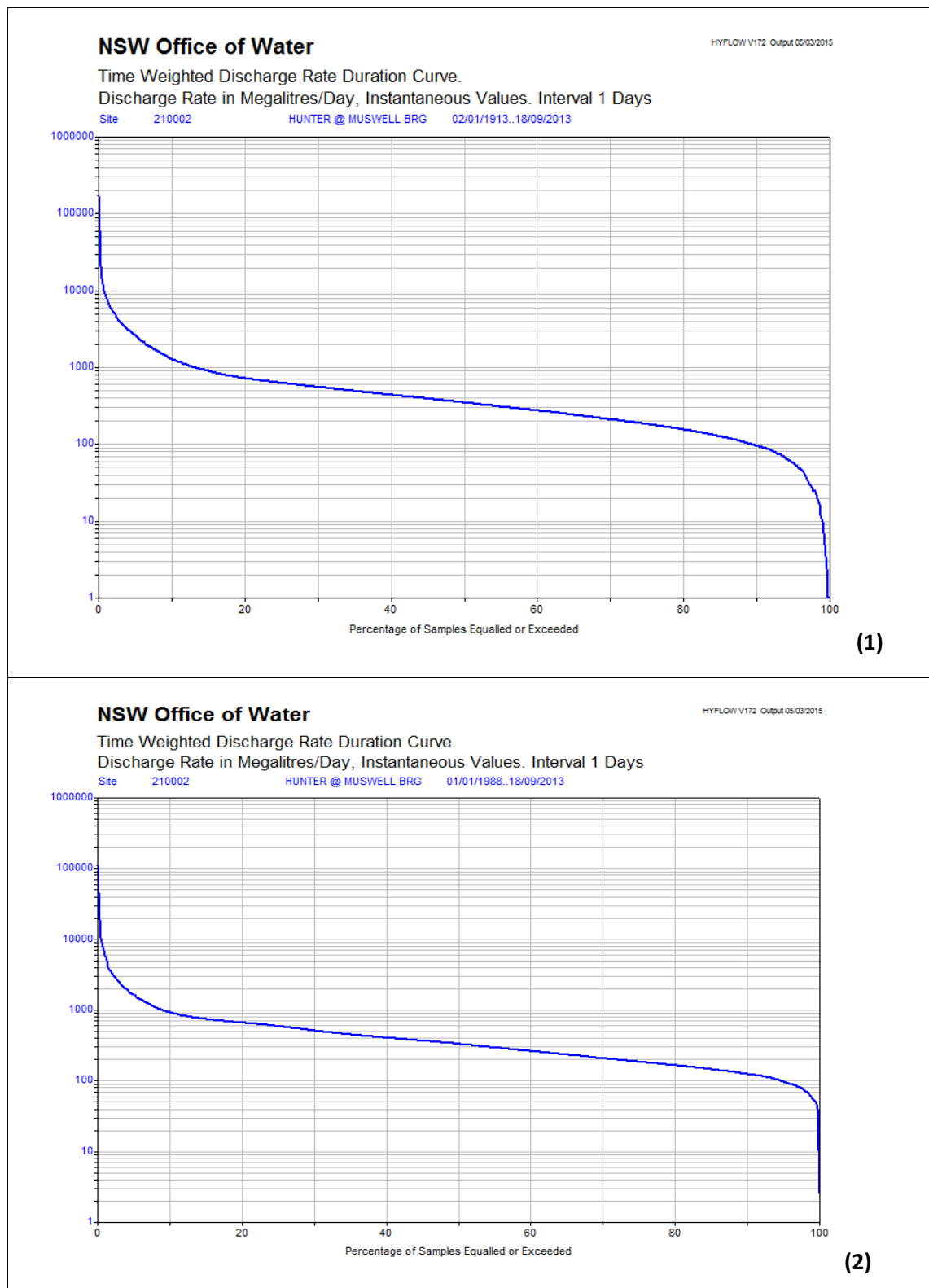


Figure B1 - Hunter River Flow-Duration Relationship at Muswellbrook Bridge

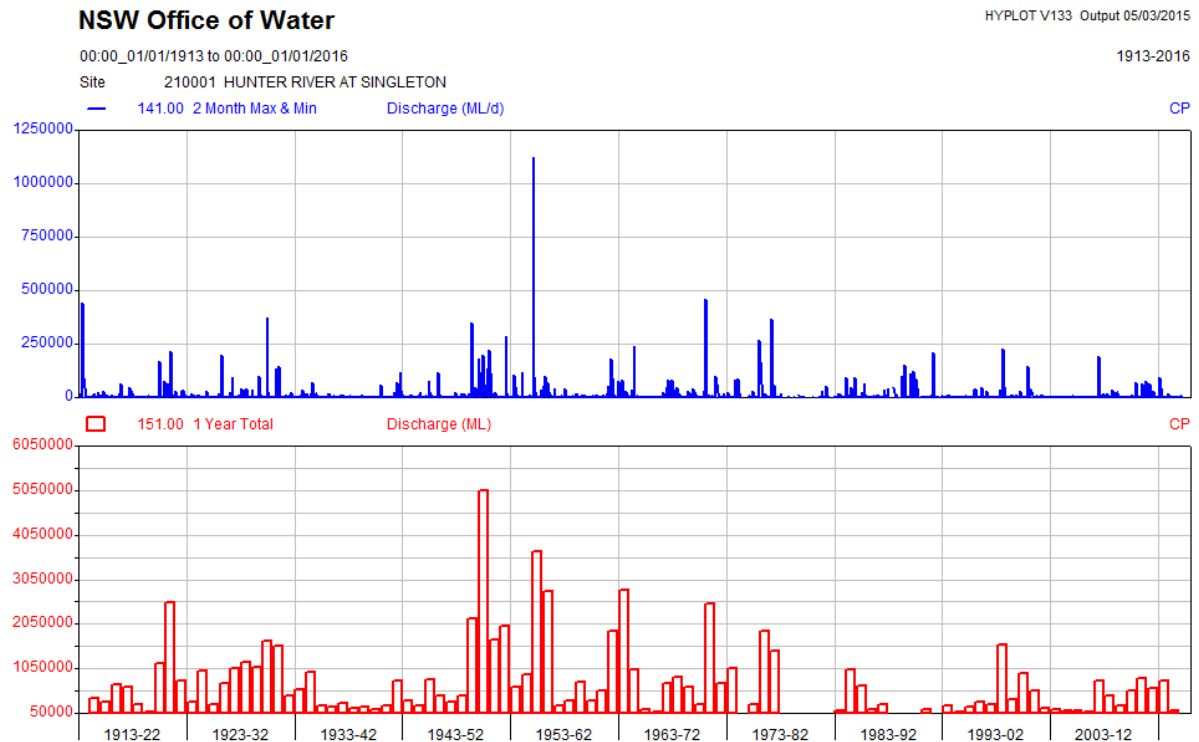


Figure B2 - Hunter River Historical Flows at Singleton

Table B1 - On-site Dams & Dry Creek Surface Water Quality (2007 - 2013)

Parameter		W06 Endwall Dam (Sediment Dam)	W07 Main Endwall Dam	W08 East Windmill Dam	W09 West Windmill Dam	Staged Discharge Dam	SW05 Dry Creek D/S	W10 MTA Sediment Dam	W11 North Dump Sediment Dam
pH	Max	9.7	9.3	9.3	10.3	9.2	8.2	9.2	7.5
	Mean	8.8	8.8	8.7	8.8	8.8	7.85	7.9	7.5
	Min	7.6	7.2	8.0	7.9	8.5	7.40	7.0	7.4
	Count	117	75	66.0	67	10	13.00	31	3.0
EC (µS/cm)	Max	8,960	5,310	6,630	6,560	3,780	1,495.00	3,140	442
	Mean	2,913	3,263	1,995	1,987	2,751	815.46	533	327
	Min	340	620	565	384	1,224	176.00	145	269
	Count	117	75	66	67	10	13.00	31	3.0
TSS (mg/L)	Max	130,000	309	25,800	2,460	93	9,580.00	4,810	1,970
	Mean	1,361	49	632	107	36.7	1,122.36	351	518
	Min	10	6	7	6	6.0	15.00	10	20
	Count	117	73	65	63	9.0	14.00	29	4
SO ₄ (mg/L)	Max	818	1,030	-	-	-	-	-	-
	Mean	391	390	-	-	-	-	-	-
	Min	84	50	-	-	-	-	-	-
	Count	61	28	-	-	-	-	-	-

Table B2 - Hunter River Mean Surface Water Quality (2006 to 2017)

Year	W01 Kayuga Road Bridge			W02 Rail Bridge			W03 Racecourse			W04 Whites Creek Vineyard		
	pH	TSS (mg/L)	EC (µS/cm)	pH	TSS (mg/L)	EC (µS/cm)	pH	TSS (mg/L)	EC (µS/cm)	pH	TSS (mg/L)	EC (µS/cm)
2006 (n=18)	7.9	11	365	8.0	9	363	8.0	8	378	7.9	10	393
2007 (n=25)	7.5	86	452	7.5	127	453	7.5	105	496	7.4	65	603
2008 (n=29)	7.9	44	580	8.0	177	576	8.0	46	605	7.9	35	670
2009 (n=18)	7.9	28	515	7.9	30	505	8.0	37	534	7.9	37	577
2010 (n=22)	8.1	80	506	8.0	70	509	8.0	29	498	8.0	30	513
2011 (n=27)	8.0	45	528	8.0	56	532	8.0	33	577	8.0	54	605
2012 (n=21)	7.9	22	486	7.9	243	508	7.9	59	530	7.7	24	590
2013 (n=19)	7.9	57	480	7.9	83	458	7.8	84	525	8.0	93	490
2014 (n=9)	7.8	24	473	7.9	33	480	7.8	47	541	7.7	93	639
2015 (n=9)	7.8	37	449	7.8	42	453	7.7	27	486	7.7	51	543
2016 (n=14)	7.9	30	489	7.9	40	489	7.8	28	526	7.8	31	546
2017 (n=12)	7.9	8	458	7.9	17.1	459	7.9	14	487	7.9	10	535

n = number of samples

Table B3 - NOW Hunter River Water Quality Data at Muswellbrook Bridge and Denman (NOW, 2011)

Parameter	Unit	ANZECC Trigger Value				U/S (MUSWELLBROOK BRIDGE - 210002)			D/S (HUNTER RIVER DENMAN - 210055)		
		Irrigation	Livestock drinking	Eco-system	Recreational	Median	90%ile	count	Median	90%ile	count
flow	ML/d					286	648	480			
pH	pH	6.0 - 9.0		6.5 - 8 [^]	6.5 - 8.5	8.1	8.5	791	8.2	8.6	48
EC (uncompensated)	µS/cm	1,000 *				430	684	44			
EC (25C)	µ S/cm					440	680	990	485	691	108
Total Dissolved Solids (TDS)	mg/L		2,000*		1,000	162	191	32			
Total Suspended Solids (TSS)	mg/L					8	30.8	142	3	3	1
Calcium (Ca)	mg/L		1,000			37.0	52.6	165	37.6	43.8	12
Magnesium (Mg)	mg/L		2,000**			26.9	36.7	164	25	32.8	12
Sodium (Na)	mg/L	115			300	40.4	55.7	176	44.0	57.4	23
Potassium (K)	mg/L					1.7	2.3	162	1.4	1.8	12
Bicarbonate (HCO ₃)	mg/L	-				232.5	292.8	168	220.7	257.6	15
Sulphate as SO ₄	mg/L		1,000		400	31.3	48.4	164	30.0	43.5	11
Chloride as Cl	mg/L	175***			400	44.2	72.2	174	59.0	91.3	23
Fe (Soluble)	mg/L	0.2	-		0.3	0	0.1	113	0.01	0.02	2
Fe (Total)	mg/L					0.12	0.99	110	0.11	0.37	4
Boron (B)	mg/L	0.5	5	0.37 ^{^^}	1	0	0.3	126	0	0.17	3
Manganese (Mn)	mg/L	0.2	-	1.9 ^{^^}	0.1	0.05	0.07	62			
Zinc (Zn)	mg/L	2	20	0.008 ^{^^}	5	0	0.037	94	0.01	0.016	2
Fluoride (F ⁻)	mg/L	1	2			0.34	0.5	139	0.33	0.44	4
Nitrite and nitrate as N	mg/L		30	0.7 ^{^^^}	11	0.14	0.56	297	0.17	0.40	143
Total Kjeldahl Nitrogen (TKN)	mg/L					0.4	0.8	17			
Total nitrogen (Total N)	mg/L	5		0.5 [^]		0.48	1.00	183	0.52	0.95	183
Total phosphorus (Total P)	mg/L	0.05		0.05 [^]		0.08	0.56	474	0.08	0.13	46

* Lowest recommended value.

[^] Lowland river (<150m altitude).

** Cattle (insufficient information on other livestock).

^{^^} 95% of species protected.

*** Sensitive crops.

^{^^^} Nitrate only.

APPENDIX C
CW1 and Clean Water System Design Criteria

Table C1 - CW1 General Design Criteria

Parameter	Comment
Design Life	Approximately 20 years (decommissioned following reinstatement of Dry Creek)
Catchment Area	665 ha (designed to capture clean water runoff with or without mining operations commencing for the Mount Pleasant Mine)
Storage Capacity	900 ML (including excavated storage)
Surcharge Capacity	Designed to be operated as a dry detention basin and as such the entire dam volume to the invert of the spillway is surcharge capacity Sized for a 1 in 200 year ARI, 72 hour storm event less the pumping capacity required to empty the storage in 14 days
Embankment	Zoned earth-fill embankment with selected clay-fill core and horizontal and vertical sand filters with 3H:1V upstream and downstream batters 3 m trafficable crest width comprising 200 mm gravel capping layer and 2.0 m wide safety bunds (0.5 m high)
Embankment Height	13.5 m maximum at height at centreline
Spillway Capacity	Sized to pass 1 in 100,000 year ARI event to satisfy DSC requirements for High C consequence category Rock rip rap scour protection provided to minimise erosion and scour within outlet channel and at sections of the base of the dam embankment
Spillway Section	Trapezoidal cross section with 35 m base width and 3H:1V side slopes.
DSC Consequence Category	High C
Minimum Freeboard (DSC 3B)	0.4 m

Table C2 - General Clean Water System Design Criteria

Parameter	Comment
Operational Requirements	
System Delivery	Drain CW1 within 14 days or 1,085 L/s
Design Flow Envelope (ML/day)	No envelope – considered to be a batch flow system with no allowance for augmentation
Design Life of System	Approximately 50 years for pipeline and fixed structures. Approximately 15 years for fixed mechanical equipment
System Configuration	Transfer to be uni-directional from CW1 to the creek outlet
Pressure Pipeline Design Criteria	
Pumped medium	Stormwater runoff from the CW1 catchment consistent with slightly turbid surface water with little to no salinity
Pipeline configuration	Single pipeline above ground with buried sections below roadways and access tracks laid parallel to the raw water system pipeline wherever possible
Pipeline optimisation	Undertaken during pre-feasibility study and determined to be a DN710mm size
Kinematic viscosity of water	$1.01 \times 10^{-6} \text{ m}^2/\text{s}$ for water at 20°C (AS 2200 – 2006)
Colebrook –White friction factor (k)	0.015 mm (range in AS 2200 – 2006 : 0.003 – 0.015mm)
Pipeline sizing	Based on acceptable velocity envelope (indicatively DN 710 or DN710/650).

Parameter	Comment
Acceptable velocity range	1.0 = v = 4.0 metres per second (m/s) (infrequently used) maximum velocity more a function of tolerable transients resulting from changes to steady state hydraulics
Selected pipe size	DN710 mm
Design pipeline temperature	35°C
Permissible system operating head after temperature de-rating	PN10 (80 m), PN12.5 (100 m), PN16 (128 m), PN20 (160 m – (Vinidex HDPE Design Manual – Table 4.7)
Allowance for thermal movements	Snaking induced by anchoring the pipe at 60 m intervals to allow for a 2.5 m lateral deflection based on a maximum diurnal temperature fluctuation of 18°C
Minimum Hydraulic Grade Line (HGL) at any point	10 m above natural ground level at all locations
Wave celerity to determine transients	PN10 (290 m/s), PN12.5 (320 m/s), PN16 (360 m/s)
Pipeline appurtenances	
Air valves	At all high points
Air valve sizing	In accordance with American Water Works Association Manual M51 – Air Release, Air Vacuum and Combination Air Valves
Scour valves	At all low points with discharge directly to local creeks
Pipeline bunding	Not specifically required
Fittings	All fittings and appurtenances to be PN16
Transient mitigation measures	None required
Pipeline Outlet	
Flow control	Orifice plate incorporated immediately upstream of outlet point to raise the upstream HGL and achieve an HGL at least 10 m above ground level for the extent of the pipeline
Outlet configuration	Pipeline discharge to creek via an impact energy dissipation structure designed in accordance with the HEC-14 guideline
Pump Station	
Pump station configuration	Land based pump station comprising of an uncovered slab- on-ground structure
Pump configuration	Three duty and single standby pumps (subject to confirmation from supplier)
Maximum dynamic pumping head	CW1– 100 m
Fixed pump type	Centrifugal single stage split case pumps
Pump motor	Fixed speed electrically driven with direct coupled drive
Pump control	Manual operation by way of remote SCADA system at Bengalla infrastructure area control centre
Leak detection	Not specifically provided as pumped medium is not environmentally detrimental

Table C3 - Indicative Clean Water Pumps and Pipeline Design Considerations

Parameter	Comment
Pipeline Material	Pipeline to comprise butt welded co-extruded thermally protected (white) high density polyethylene pipes (PE100) laid on an engineered pipeline formation above ground.
Flanged Joints	Pipeline will not incorporate flanged joints unless they are required for the inclusion of fixtures or appurtenances. Should pipelines require relocation in the future they would have to be cut into moveable sections before relocation and re-welded once re-located.
Alignment	Pipeline will be co-aligned in a services corridor including combined pipeline and access track formation, environmental bunding, an overhead powerline easement and a catch water berm. The formation has been widened to allow for snaking of the pipelines above ground.
Sizing	Pipes are to be sized such that they deliver the required design flow in an aged condition.
Appurtenances	Pipeline appurtenances such as air valves and scour valves are to be located above ground to avoid valve chambers that would constitute a confined space.
Pigging	Pipeline systems will incorporate pigging facilities for cleaning the pipeline.
Pressure Classes	Pipe pressure classes have been determined based on required delivery pressures, making allowances for de-rating due to temperature and surge effects, but not, after taking into account all factors, to be less than PN10.

Table C4 - Scour Protection Design Criteria

Parameter	Comment
Design Life	Life of mine
Design capacity ARI	1 in 100 year ARI peak flow event
Channel cross section	10 m base width, 3H:1V side slopes
Minimum grade	1.0%
Manning's n	0.020 (velocity assessment) 0.035 (capacity assessment)
Channel lining	Channel linings suitable to provide stable channel for 1 in 50 year ARI event Grass lining provided where $V_{50} < 2$ m/s Rock scour protection where $V_{50} > 2$ m/s

APPENDIX D
BASELINE GROUNDWATER MONITORING DATA

Table D1 - Vibrating wire piezometer Depth and Geology

Bore ID	VWP depth	Geology/ Target seam
BE1	120	Warkworth/Mt Arthur
BE1	264.5	Edderton Seam
BE2	97.8	Warkworth/Mt Arthur
BE2	212.5	Edderton Seam
BE4	82	Mt Arthur Seam
BE4	213	Edderton Seam
BE5	74	Mt Arthur Seam
BE5	197.5	Edderton Seam

Note: The historical baseline data presented in Table D1 and D2 was used to inform the Bengalla EIS.

Table D2 - Groundwater Monitoring Data

Site	Depth to groundwater level				pH				Electrical conductivity				Aquifer Description
	No. Pts	Average (m)	Min SWL (mbGL)	Max SWL (mbGL)	No. Pts	Average	Min pH	Max pH	No. Pts	Average (µS/cm)	Min EC (µS/cm)	Max EC (µS/cm)	
11953	28	10.8	2.8	13.8	24	7.2	6.6	8	23	3380	1140	8540	Deep Permian
18298	44	9.8	9.2	10.2	44	7.0	6.6	7.4	44	1043	692	1990	Alluvium
19116	48	9.5	7.3	10.5	48	7.1	6.7	7.7	48	1403	708	2650	Alluvium
28510	24	11.6	1.3	12.6	24	7.0	6.6	7.4	23	1087	844	1480	Deep Permian
37774	24	11.8	2.3	13.0	24	6.9	6.6	7.3	23	2293	410	3060	Deep Permian
42701	26	12.0	1.3	19.7	27	7.2	6.8	8	26	919	735	1340	Deep Permian
42927	28	12.8	10.9	14.4	28	7.0	6.6	7.4	27	1059	930	1380	Alluvial Aquifer
46737	10	39.4	38.1	41.5	10	6.9	6.8	7	10	7507	6610	9290	Shallow Permian
47277	21	11.3	10.2	12.1	21	6.9	6.4	7.2	20	1142	927	1340	Alluvial Aquifer
53007	22	10.6	1.2	11.7	22	7.1	6.8	7.5	21	897	771	1350	Deep Permian
BE1	7	70.5	70.4	70.6	7	7.3	7.2	7.4	7	6144	5680	7190	Permian Sandstone
BE2	7	38.4	37.7	38.6	7	7.4	7.2	7.6	7	5617	4840	8370	Permian Sandstone
BG1	80	10.6	9.7	13.3	74	7.0	6.4	8	74	959	791	1580	Alluvial Aquifer

Site	Depth to groundwater level				pH				Electrical conductivity				Aquifer Description
	No. Pts	Average (m)	Min SWL (mbGL)	Max SWL (mbGL)	No. Pts	Average	Min pH	Max pH	No. Pts	Average (µS/cm)	Min EC (µS/cm)	Max EC (µS/cm)	
BG3	47	7.6	7.1	7.9	47	7.0	6.4	7.3	47	2101	1140	4850	Alluvial Aquifer
BG5	48	9.9	9.3	10.4	48	6.9	6.5	7.2	48	1168	930	1670	Alluvial Aquifer
REPI7	51	35.6	31.9	39.7	45	7.3	7.1	8.3	45	3855	867	4200	Vaux Seam
SMB1	43	12.9	12.6	13.3	42	7.2	6.6	7.4	42	1807	1456	2790	Alluvium
SMB2	43	13.3	13.0	13.9	42	7.2	6.7	7.7	42	2157	1800	2460	Alluvium
WAN 10A	52	8.3	7.8	8.7	45	7.2	7.0	7.6	45	1080	944	1367	Alluvium
WAN 10B	52	17.5	16.3	20.0	45	7.2	6.8	8.6	45	4409	1539	5090	Vaux Seam
WAN 1A	70	19.1	18.9	20.2	62	6.8	6.6	7.8	62	1720	1298	2280	Alluvium
WAN 1B	70	25.5	24.2	29.7	62	7.0	6.8	7.7	62	1681	1359	3790	Edderton Seam
WAN 2A	70	12.2	11.8	13.7	62	6.6	6.2	7.5	62	1171	873	1780	Alluvium
WAN 2B	70	28.4	24.7	32.4	62	7.7	6.5	8.1	62	3564	2350	3930	Wynn Seam
WAN 2C	70	37.4	34.6	37.9	58	7.6	7.0	7.9	58	2901	1840	3840	Edderton Seam
WAN 3	64	27.3	21.3	34.9	49	7.1	6.9	7.5	49	3979	3460	4550	Deep Permian
WAN 4A	69	8.6	8.1	9.9	61	7.2	6.8	7.8	61	2947	1400	4170	Alluvium
WAN 4B	69	11.9	10.8	15.0	61	7.4	6.8	7.9	61	3178	1510	3570	Deep Permian
WAN 5A	66	9.3	8.9	9.7	58	7.1	6.4	7.5	58	4484	710	6180	Alluvium
WAN 5B	70	9.2	8.7	9.7	62	7.1	6.6	8.2	62	1070	773	5770	Deep Permian
WAN 6A	70	9.1	8.5	10.4	62	7.0	6.6	7.3	62	912	777	1280	Alluvium
WAN 6B	70	9.2	8.7	10.4	62	7.4	7.0	7.7	62	1140	12.93	1461	Edderton Seam
WAN 7A	69	11.4	10.9	12.8	62	7.2	6.4	8.1	62	1709	1169	2300	Alluvium
WAN 7B	69	9.6	7.4	12.8	61	7.9	7.6	8.2	61	2895	2570	3220	Edinglassie Seam
WAN 8A	52	11.0	8.7	11.9	8	12.5	7.7	12.9	8	8151#	6380#	7720#	Alluvium

Site	Depth to groundwater level				pH				Electrical conductivity				Aquifer Description
	No. Pts	Average (m)	Min SWL (mbGL)	Max SWL (mbGL)	No. Pts	Average	Min pH	Max pH	No. Pts	Average (µS/cm)	Min EC (µS/cm)	Max EC (µS/cm)	
WAN 8B	52	18.4	17.8	19.8	10	7.7	7.3	8	10	3177#	2870#	3550#	Wynn Seam
WAN 9A	30	10.1	9.2	11.0	Dry*	Dry			Dry*	Dry			Alluvium
WAN 9B	52	17.6	14.6	18.6	45	7.6	7.4	8	45	1173	946	1930	Wynn Seam

Note: BMC environmental data from May 1997 to December 2013 used to inform the Bengalla EIS.

Bores E8, A10 and B18 were mined through and I7 was replaced by REPI7.

WAN8A/8B# and WAN9B presumed to be dry AGE (2014).

mbGL – meters below ground level.

SWL – standing water level.

**Long periods of dry.*

APPENDIX E

TRIGGERS & RESPONSE PLANS

Table E1 - Hunter River Water Quality Triggers

Parameter	Unit	ANZECC Trigger Value				Recorded Baseline Data (80%ile)		Preliminary Trigger Value	Comment
		Irrigation	Livestock drinking	Eco-system ^{a,d}	Recreational	Hunter River ^{a,g} (NOW)	Hunter River (site) ^h	Hunter River	
pH	pH	6.0 - 9.0	-	6.5 - 8.5	6.5 - 8.5	7.9-8.3	7.7-8.1	6.5-8.1	Lower bound based on ANZECC guideline for ecosystem protection, upper bound based on site Baseline data.
EC	µS/cm	1,000 *	-	125-2200	-	520	654	650	Site baseline data adopted, rounded to nearest 10.
DO (% Saturation)	-	-	-	90-110	-	-	-	90-110	Lack of baseline data, adopted ANZECC guideline.
Total Dissolved Solids (TDS)	mg/L	-	2,000 ^a	6-50	1,000	181	-	200	Baseline data adopted. Rounded to nearest hundred.
Total Suspended Solids (TSS)	mg/L	-	-	-	-	20	41	40	Site baseline data adopted, rounded to nearest 10.
Turbidity	NTU	-	-	2-25	-	-	-	2-25	Lack of baseline data, adopted ANZECC guideline.
Calcium (Ca)	mg/L	-	1000	-	-	48.7	-	50	Baseline data adopted, rounded to nearest 10
Sodium (Na)	mg/L	115 ^c	-	-	300	53.3	-	50	Baseline data adopted, rounded to nearest 10
Magnesium (Mg)	mg/L	-	2,000 ^a	-	-	35.2	-	40	Baseline data adopted, rounded to nearest 10
Sulphate as SO ₄	mg/L	-	1000	-	400	46.04	-	50	Baseline data adopted, rounded to nearest 10
Chloride as Cl	mg/L	175 ^c	-	-	400	64.3	-	60	Baseline data adopted, rounded to nearest 10
Arsenic	mg/L	0.1 ^f	0.5	0.013 ^{a,g}	0.05	-	-	0.013	Lack of baseline data, lowest ANZECC guideline adopted.
Barium	mg/L	-	-	-	1	-	-	1	Lack of baseline data, lowest ANZECC guideline adopted.
Boron	mg/L	0.5	5	0.37 ^e	1	0.1	-	0.1	Baseline data adopted. Rounded up to nearest tenth.
Cadmium	mg/L	0.01 ^f	0.01	0.0002 ^e	0.005	-	-	0.0002	Lack of baseline data, lowest ANZECC guideline adopted.
Chromium	mg/L	0.1 ^f	1	0.001 ^e	0.05	-	-	0.001	Lack of baseline data, lowest ANZECC guideline adopted.
Copper	mg/L	0.2 ^f	0.4 ^a	0.0014 ^e	1	-	-	0.0014	Lack of baseline data, lowest ANZECC guideline adopted.
Iron	mg/L	0.2 ^f	-	-	0.3	0.362	-	0.4	Baseline data adopted. Rounded up to nearest tenth.
Lead	mg/L	2 ^f	0.1	0.0034 ^e	0.05	-	-	0.0034	Lack of baseline data, lowest ANZECC guideline adopted.
Manganese	mg/L	0.2 ^f	-	1.9 ^e	0.1	0.0268 ^j	-	0.1	Lack of baseline data, lowest ANZECC guideline adopted.
Nickel	mg/L	0.2 ^f	1	0.011 ^e	0.1	-	-	0.011	Lack of baseline data, lowest ANZECC guideline adopted.
Zinc (Zn)	mg/L	2 ^f	20	0.008 ^e	5	0.008	-	0.008	Baseline data adopted.
Fluoride	mg/L	1 ^f	2	-	-	0.4	-	0.4	Baseline data adopted.
Mercury	mg/L	0.002 ^f	0.002	0.0006 ^e	0.001	-	-	0.0006	Lack of baseline data, adopted lowest ANZECC guideline.
Ammonia	mg/L	-	-	0.013	-	-	-	0.013	Lack of baseline data, adopted lowest ANZECC guideline.
Total phosphorus (Total P)	mg/L	0.05 ^f	-	0.02	-	0.173	-	0.2	Baseline data adopted. Rounded up to nearest tenth.
Total nitrogen (Total N)	mg/L	5	-	0.25	-	0.726	-	0.7	Baseline data adopted. Rounded up to nearest tenth.
Nitrate-N	mg/L	-	400	0.7 ^e	10	-	-	0.7	Lack of baseline data, adopted lowest ANZECC guideline.
Nitrite-N	mg/L	-	30	-	1	-	-	1	Lack of baseline data, adopted lowest ANZECC guideline.

Notes:

- No Trigger Value recommended.
- ^a Lowest recommended value.
- ^{a,b} Cattle (insufficient information on other livestock)
- ^{a,c} Sensitive crops
- ^{a,d} Lowland River
- ^{a,e} 95% of species protected
- ^{a,f} Long term Trigger Value
- ^{a,g} Data from NOW gauge 210002
- ^{a,h} Average of site gauges W01, W02 and W03
- ^{a,i} insufficient data, need at least 24 months

Source: WRM, 2015

Table E2
Surface Water Triggers and Response Plan

Issue	Performance Criteria	Trigger	Action
Water Quality	No adverse impacts on receiving water quality (Hunter River).	Exceedance of water quality trigger values (see Table E1) at downstream receiving water monitoring locations.	Initiate an investigation as detailed in Section 7.0 .
		pH and TSS grab sample taken at Point EPA26 during the HRSTS release are inconsistent with the criteria.	Initiate an investigation as detailed in Section 7.0 .
		Volume discharged during a HRSTS release exceeds the HRSTS calculated allowed discharge volume.	Cease discharge. Initiate an investigation as detailed in Section 7.0 .
Water Quantity	No unlicensed discharge of mine affected water to the receiving environment.	Forecast heavy rainfall	Review status of site water storage inventory and transfer water as required to minimise risk of unlicensed discharge.
		Recorded rainfall > 25 mm in a 24 hour period (i.e. one calendar day)	Initiate rain event monitoring at the conclusion of the rainfall event (next business day or when reasonable and feasible to do so). Review status of site water storage inventory and transfer water as required to minimise risk of unlicensed discharge.
		Out-of-pit mine water storages' inventory exceeds Maximum Operating Volume.	Cease pumped inflows to the storage and transfer water as required to minimise risk of unlicensed discharge. Continue to monitor inventory.
	Minimise draw of raw water from Hunter River, ensuring consumption is within licenced limits.	Pro-rata raw water consumption $\geq 90\%$ of licensed volume.	Review raw water usage requirements. Reassess water supply and contingency water supplies from licensed sources
Water Management System Key Infrastructure	Dam and spillway integrity is maintained.	Dam embankment or spillway damaged or failed.	Notify any downstream personnel who may be affected. Contain any water where possible. Initiate an investigation as detailed in Section 7.0 .

Issue	Performance Criteria	Trigger	Action
	No unlicensed discharge of mine affected water to receiving environment.	Unlicensed discharge from dam/pipeline	Notify any downstream personnel who may be affected. Contain mine water where possible. Initiate an investigation as detailed in Section 7.0 .
	Drain integrity is maintained.	Drain failure.	Contain water where possible. Initiate an investigation as detailed in Section 7.0 .
Erosion and Sediment Control	Sediment accumulation does not exceed the sediment storage capacity.	Sediment accumulation $\geq$ sediment storage capacity.	Excavate sediment to restore full sediment storage capacity.
	Discharges from sediment dams comply with licence conditions.	Off-site discharge inconsistent with SSD5170 (as modified) and EPL6538	Initiate an investigation as detailed in Section 7.0 .
Stream and Riparian Vegetation Health	No adverse impacts on stream and riparian vegetation health in the Hunter River.	Stream and riparian vegetation health assessment identifies action is required.	Implement actions where reasonable and feasible.

Table E3
Groundwater Quality Triggers

Site	Easting MGA 56	Northing MGA 56	Min pH trigger	Max pH trigger	Stage 1 EC 95 th Percent ile	Stage 2 Maximum trigger EC	Aquifer Description
18298	294375	6423521	6.0	8.5	1226	1432	Alluvium
19116	296078	6425589	6.0	8.5	1231	1350	Alluvium
211GW001	294301	6424930	-	-	-	-	Alluvium
211GW002	294294	6424927	-	-	-	-	Shallow Permian
28510	298649	6429105	6.0	8.5	1041	1052	Deep Permian
37774	298488	6428998	6.0	8.5	2511	2560	Deep Permian
42701	298586	6428632	6.0	8.5	991	1035	Deep Permian
42927	298843	6428570	6.0	8.5	1254	1280	Alluvium
46737	291862	6427143	6.0	8.5	9059	9290	Shallow Permian
47277	299145	6428643	6.0	8.5	1244	1247	Alluvium
53007	298720	6428857	6.0	8.5	947	975	Deep Permian
BE1	293469	6429033	6.0	8.5	7420	8280	Permian Sandstone
BE2	293375	6425866	6.0	8.5	6585	6740	Permian Sandstone
BG1	296656	6426003	6.0	8.5	1042	1450	Alluvium
BG3	294731	6424413	6.0	8.5	3463	3660	Alluvium
BG5	298609	6427874	6.0	8.5	1309	1341	Alluvium
Dry Creek East	295108.51	6425762.42	-	-	-	-	Alluvium
REPI7	295575	6425832	6.0	8.5	4370	4470	Vaux Seam
SMB1	296955	6426392	6.0	8.5	2140	2790	Alluvium
SMB2	297125	6426550	6.0	8.5	2420	2460	Alluvium
WAN1A	296519	6426099	6.0	8.5	2109	2510	Alluvium
WAN1B	296519	6426099	6.0	8.5	1880	2000	Shallow Permian
WAN2A	296217	6425824	6.0	8.5	1358	1881	Alluvium

Site	Easting MGA 56	Northing MGA 56	Min pH trigger	Max pH trigger	Stage 1 EC 95 th Percent ile	Stage 2 Maximum trigger EC	Aquifer Description
WAN2B	296217	6425824	6.0	8.5	3800	3930	Edderton Seam
WAN2C	296217	6425824	6.0	8.5	3746	4180	Edderton Seam
WAN3	295772	6425713	6.0	8.5	4348	4550	Deep Permian
WAN4A	295442	6425690	6.0	8.5	3654	4170	Alluvium
WAN4B	295442	6425690	6.0	8.5	3450	3570	Deep Permian
WAN5A	296019	6425360	6.0	8.5	6062	6240	Alluvium
WAN5B	296019	6425360	6.0	8.5	1290	1900	Deep Permian
WAN6A	296553	6425634	6.0	8.5	1063	1280	Alluvium
WAN6B	296553	6425634	6.0	8.5	1294	1461	Edderton Seam
WAN7A	296856	6426254	6.0	8.5	2220	2300	Alluvium
WAN7B	296856	6426254	6.0	8.5	3100	3220	Edinglassie Seam
WAN8A	296457	6425855	6.0	8.5	8804	8870	Alluvium
WAN8B	296450	6425855	6.0	8.5	3216	3550	Wynn Seam
WAN9A2	296320	6425583	6.0	8.5	959	1230	Alluvium
WAN9B	296328	6425576	6.0	8.5	2090	2370	Wynn Seam
WAN10A	295828	6425571	6.0	8.5	1367	1647	Alluvium
WAN10B	295825	6425578	6.0	8.5	5290	5440	Vaux Seam

- Indicates insufficient data for statistical analysis.

Table E4
Groundwater Level Triggers

Bore ID	Geology/ Target Seam	Max Drawdown (m)	Trigger SWL (mAHD)
Model Slice 1			
SMB1	Alluvium	1.5	127.2
SMB2	Alluvium	1.6	127.3
WAN1A	Alluvium	4.2	117.5
WAN2A	Alluvium	6.8	118.5
WAN4A	Alluvium	5.5	121.2
WAN5A	Alluvium	2.4	124.3
WAN6A	Alluvium	1.1	126.9
WAN7A	Alluvium	1.4	125.4
WAN8A	Alluvium	2.4	123.3
WAN9A	Alluvium	2.6	123.7
WAN10A	Alluvium	4.6	122.2
18298	Alluvium	0.3	123.2
19116	Alluvium	4.2	123.2
211GW001	Alluvium	-	-
42927	Alluvium	1.2	131.1
47277	Alluvium	0.8	132.8
BG1	Alluvium	1.4	126.8
BG3	Alluvium	0.2	126.3
BG5	Alluvium	0.9	132.4
Dry Creek East	Alluvium	-	-
Model Slice 5			
211GW002	Shallow Permian	-	-
37774	Deep Permian	5.4	128.7
42701	Deep Permian	1.9	131.3
46737	Shallow Permian	0.7	185.3
53007	Deep Permian	1.8	131.9
BE1	Permian Sandstone	15.5	156.8
BE2	Permian Sandstone	148.9	18.8
Model Slice 6			
WAN2B	Wynn Seam	25.4	86.4
Model Slice 7			
11953	Deep Permian	7.1	129.3
28510	Deep Permian	3.3	129.0

Bore ID	Geology/ Target Seam	Max Drawdown (m)	Trigger SWL (mAHD)
REPI7	Vaux Seam	39.0	63.1
WAN1B	Edderton Seam	15.8	100.1
WAN2C	Edderton Seam	25.4	75.0
WAN3	Deep Permian	26.3	100.3
WAN9B	Wynn Seam	8.1	111.4
WAN10B	Vaux Seam	20.9	98.3
Model Slice 8			
WAN4B	Deep Permian	26.3	98.2
WAN5B	Deep Permian	10.7	116.0
WAN6B	Edderton Seam	4.1	123.8
WAN7B	Edinglassie Seam	2.3	126.4
WAN8B	Wynn Seam	9.5	108.5

- Indicates insufficient data for statistical analysis.

Table E5
Hunter River Alluvium - Impact Assessment Criteria, Triggers and Responses

AIP Level 1 Minimal Impact consideration	BMC Impact assessment criteria	Trigger	Action
Water table - Water supply works			
A maximum of a 2m decline cumulatively at any water supply work.	No drawdown in excess of 2m is predicted within the Hunter River alluvium (registered privately owned bores).	Three or more alluvial bore levels fall below the trigger levels in one round of monitoring, and/or water levels in any bores fall below the trigger levels for three consecutive readings.	Initiate an investigation as detailed in Section 7.0 .
Water pressure - Water supply works			
A cumulative pressure head decline of up to 40% of the “post-water sharing plan” pressure head above the base of the water source to a maximum of a 2m decline, at any water supply work.	N/A	N/A	N/A
Water quality - Hunter River alluvium			
Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity.	The beneficial use of the Hunter River alluvium will not be adversely impacted during and post mining. The Hunter River alluvium will remain classified as ‘primary industry’ with the main potential use being for stock watering, and limited irrigation.	Review of monitoring results identifies changes to the beneficial uses of groundwater in the Hunter River alluvium in or around the Bengalla area during mining.	Initiate an investigation as detailed in Section 7.0 .
Water quality - Hunter River			
No increase of >1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity.	The salinity of the Hunter River is not expected to increase by >1%.	Refer to Section 3.8 .	Refer to Table E1 .



AIP Level 1 Minimal Impact consideration	BMC Impact assessment criteria	Trigger	Action
Excavation adjacent to the Hunter River alluvium			
No mining activity to be conducted below the natural ground surface within 200m laterally from the top of high bank or 100m vertically beneath (or the three dimensional extent of the alluvial water source - whichever is the lesser distance) of a highly connected surface water source that is defined as a “reliable water supply”.	N/A (No proposed mining activity within these specified proximities of the Hunter River alluvium).	N/A	The BMC mine plan will maintain >200m distance from the Hunter River alluvium.
Excavation within the Hunter River alluvium			
Not > 10% cumulatively of the three dimensional extent of the alluvial material in this water source to be excavated by mining activities beyond 200m laterally from the top of high bank and 100m vertically beneath a highly connected surface water source that is defined as a “reliable water supply”.	N/A (No excavation of alluvial material proposed with respect to the open cut mine pit).	N/A	The BMC mine plan will maintain >200m distance from the Hunter River alluvium.

Table E6
Permian Coal Measures - Impact Assessment Criteria, Triggers and Responses

AIP Level 1 minimal impact consideration	BMC Impact assessment criteria	Trigger	Action
Water table - Water supply works			
A maximum of a 2m decline cumulatively at any water supply work.	No drawdown in excess of 2 m is predicted within the Permian coal measures (registered privately owned bores).	Measurements from monitoring bores and/or any water supply work identify a water level decline in the Permian coal measures (registered privately owned bores) that is in excess of the modelled drawdowns, that is sustained over a period of three months.	Initiate an investigation as detailed in Section 7.0 .
Water pressure - Water supply works			
A cumulative pressure head decline of not more than 2m, at any water supply work (excluding Bengalla-owned bores).	No depressurisation in excess of 2 m is predicted within the Permian coal measures (registered privately owned bores).	As above.	As above.
Water quality - Permian coal measure water quality			
Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	It is unlikely that mining induced mixing of groundwater will result in changes to the beneficial uses of groundwater in the Permian rock units in or around the Bengalla area during mining.	Review of monitoring results identifies changes to the beneficial uses of groundwater in the Permian rock units in or around the Bengalla area during mining.	Initiate an investigation as detailed in Section 7.0 .

Table E7
Groundwater Allocation Triggers and Actions

Parameter	Trigger	Action
Groundwater inflow to mining operations	Measured annual pumpable groundwater seepage rate to the open cut mine pit is greater than the licence allocation.	An investigation will be undertaken to determine the volume of additional licence allocation required. Additional allocation will be sought to account for additional take.
Hunter River alluvium	Any review, verification, and re-calibration of the groundwater model that predicts a take of water from the Hunter River alluvium that is greater than the licence allocation.	Additional licence allocation will be sought to account for additional take.