Appendix D

Surface Water Assessment

Bengalla Modification

Surface Water Impact Assessment

Hansen Bailey Pty Ltd

0643-07-C2, 11 August 2015

Report Title	Bengalla Modification Surface Water Impact Assessment
Client	Hansen Bailey Pty Ltd
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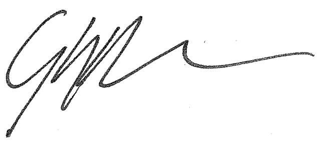

Greg Roads
Director

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1 Introduction

Bengalla Mining Company Pty Limited (BMC) received development consent SSD-5170 (DA 5170) on 3 March 2015 under Part 4 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) for the continuation of Bengalla Mine for a further 24 years producing up to 15 Mtpa ROM coal.

BMC is now seeking approval from the NSW Minister for Planning or their delegate for a modification to SSD-5170. The modification is sought under section 96(2) of the EP&A Act 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 Staged Discharge Dam 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 (possible alternative) location for the siting of the Explosives Storage Facility; and
- The placement of fill from the excavation of CW1 immediately adjacent to it.

A comparison between the approved operations and the Modification elements described above is presented on Figure 1.1 and Figure 1.2 respectively.

This report, prepared by WRM Water & Environment Pty Ltd, presents the methodology and results of surface water investigations undertaken to assess the impacts of the water management infrastructure alterations on the Bengalla water management system and in particular the potential impacts of the Modification on local surface hydrology. The Bengalla water management system is described in detail in the Bengalla Water Management Plan (BMC, 2015).

This report includes a further six sections:

- Section 2 describes the existing water management strategy and the proposed water management system at Bengalla Mine including the proposed modifications;
- Section 3 describes the water balance model developed to assess the effectiveness of the water management system. The operating rules of the various water management storages including the sources of water and demands from the system have also been outlined.
- Section 4 outlines the water balance modelling results to assess the performance of the water management system in:
  - meeting the water management conditions of the Environmental Protection License (EPL);
  - meeting the mine water release conditions of the Hunter River Salinity Trading Scheme (HRSTS) rules;
  - whether sufficient external water licenses are available to meet the site water demands; and
  - assessing the health of the overall water management system.
- Section 5 summarises the findings of the assessment;
- Section 6 provides a list of references.

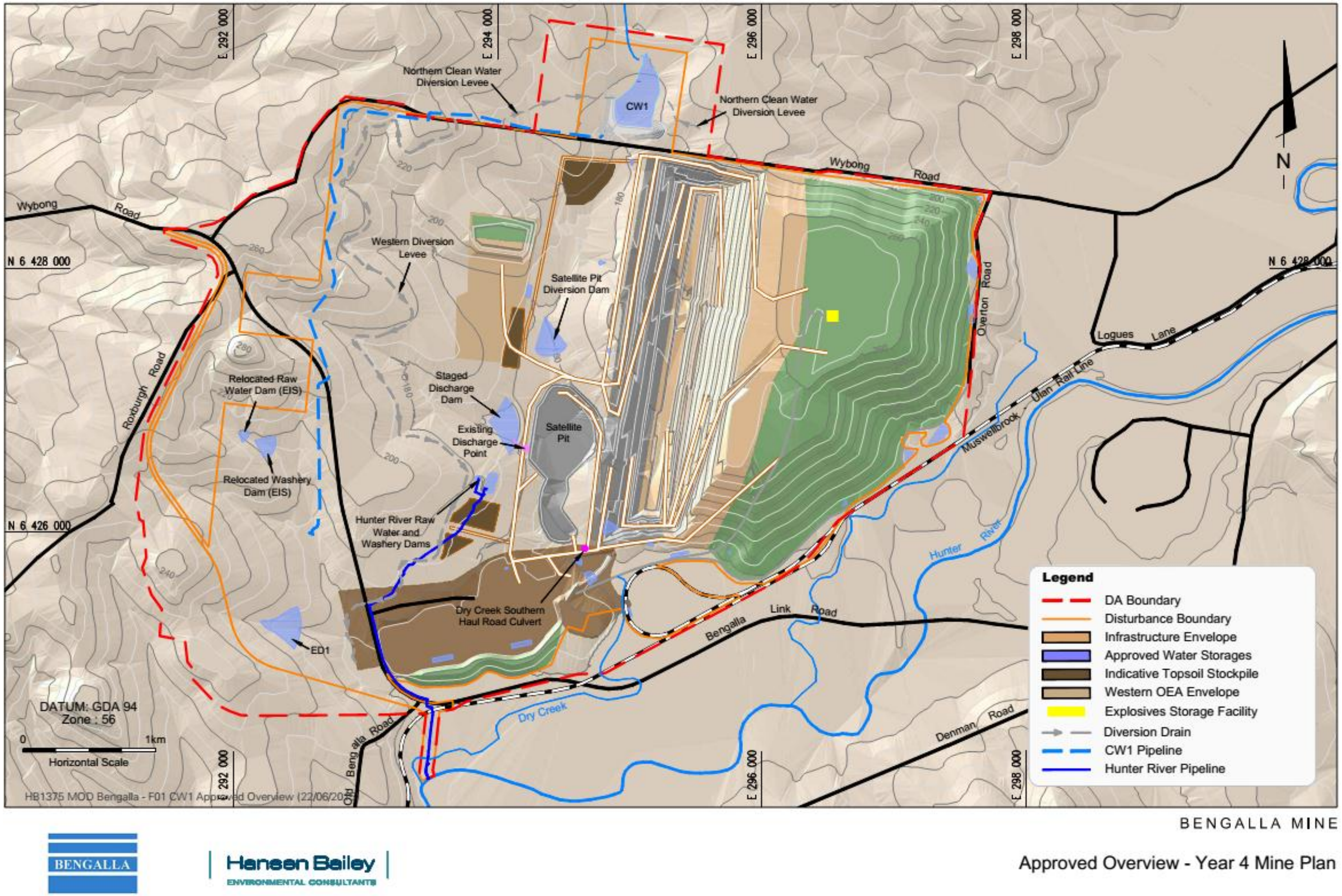

Figure 1.1 - Bengalla Mine Approved Year 4 Mine Plan

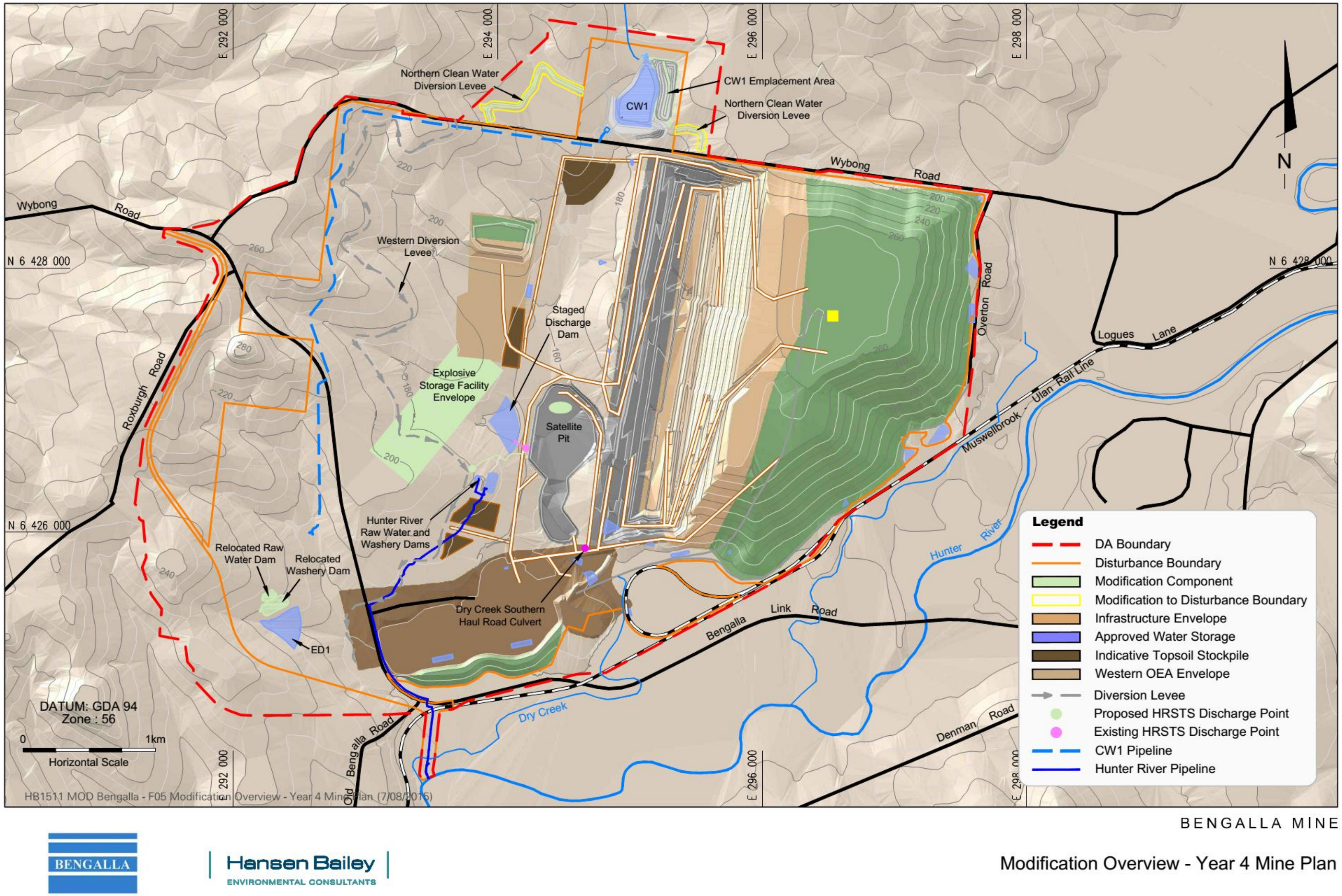

Figure 1.2 - Bengalla Mine Proposed Year 4 Mine Plan including modification elements

2 Water management

2.1 EXISTING WATER MANAGEMENT STRATEGY

The existing Bengalla water management system is operated in accordance with the Bengalla Water Management Plan (BMC, 2015) and the environmental management system (EMS) procedures. BMC's water management system provides an effective and pro-active management tool to ensure best-practice management of all water on site. Surface water management at Bengalla is based on the following key principles:

- minimise use of fresh water from external sources (Bengalla has a current allocation from the Hunter River);
- diversion of clean surface water runoff away from areas disturbed by mining activities;
- collection of surface water runoff from areas disturbed by mining activities in catch drains and direction to sediment traps and settling dams for control of suspended sediment prior to release from site or reuse via the mine water management system;
- collection of runoff from industrial areas in catch drains and direction, via an oil and grease separator, to the Bengalla Waste Water Treatment Plant (WWTP) for treatment and return to storage dams for reuse as mine water supply;
- transfer of open cut pit water to storage dams for reuse as mine water supply; and
- minimal discharge of surplus mine water off-site (i.e. promote recycling of captured water).

2.2 EXISTING WATER MANAGEMENT SYSTEM

The Bengalla water management system includes various water storages for mine water and sedimentation dams for settling of suspended sediment prior to release off site or reuse via the mine water management system as shown in Figure 1.1 and Figure 1.2. The main components of the existing water-related infrastructure include:

- The Washery Dam which supplies process water to the coal handling and preparation plant (CHPP) and truck fill stations. The Washery Dam is also used as a transfer dam, receiving excess mine water which is then pumped to the Staged Discharge Dam.
- The Staged Discharge Dam is the licensed release point for saline water when required in accordance with the HRSTS.
- Water supply infrastructure including the Hunter River intake and pipeline and the Raw Water Dam, which acts as a storage dam for Hunter River water pumped to site.
- The East and West Facilities dams, which capture CHPP return water and runoff from the industrial area.
- The Bengalla WWTP, which treats sewage effluent and directs it into the process water circuit for reuse.
- The Wantana West Dam and Endwall Dam which act as temporary transfer dams receiving pit dewatering for supply to the Washery Dam.
- Sediment traps, drainage channels and sediment dams to collect and treat runoff from spoil and hardstand areas.

- Clean water drains to divert runoff from natural catchments around areas disturbed by mining/infrastructure.

2.3 APPROVED OPERATIONS

To facilitate Bengalla's ongoing operations a number of changes to the original mines water management system were required including:

- Increased water demands associated with increased production rates (when required), including CHPP water use, stockpile and haul road dust suppression and vehicle washdown.
- A potential extension of the existing infrastructure and stockpile areas and associated additional runoff capture capacity to ensure no uncontrolled overflows from the mine water system.
- Mining operations continuing west through existing facilities including the Staged Discharge Dam, Washery Dam and Raw Water Dam. All storages are approved to be relocated at the appropriate time in a location generally west of their current position. The relocated dams will have a similar size and function to the existing dams.
- Mining through Dry Creek, water from which it is proposed to be captured north of Wybong Road in a clean water dam (CW1) and pumped south around the mining operations and released into the Dry Creek tributary west of the Bengalla Link Road. Once mining has progressed sufficiently, Dry Creek will be reinstated through reshaped overburden and CW1 decommissioned.
- Construction of various water management diversion drains and levees along with sediment dams and associated drainage as required.

Further details of the continuation project are given in the Bengalla Continuation EIS (Hansen Bailey, 2013).

2.4 PROPOSED WATER MANAGEMENT SYSTEM

Figure 2.1 to Figure 2.5 show the proposed mine stage plan layouts for Years 1, 4, 8, 15 and 24 incorporating the Modification changes. An overview of progressive development of the water management system is provided below:

- Year 1: Construction of the CW1 and Bengalla East Sediment Dam (completed). Main Pit has advanced so that dewatering is directed to Wantana West Dam only. Endwall Dam is no longer a pit water transfer dam, and now acts as a sediment dam for rehabilitated overburden runoff. Overburden emplacement has commenced at the Western OEA and runoff is collected via the Western OEA Sediment Dam B.
- Year 4: The Satellite Pit is active and dewaters with the Main Pit to Washery Dam (no longer to the Wantana West Dam). The Wantana West Dam now acts as a sediment dam for rehabilitated overburden runoff. The Bengalla Relocated Discharge Dam is being constructed and will be used once the Staged Discharge Mine Dam has been mine through. The additional storages have been constructed to capture the increased infrastructure and stockpile catchment areas (called Additional Facilities Dam and Additional ROM Dam). CW1 is operational on Dry Creek north of Wybong Road with clean water diverted to the discharge point. The infrastructure area has been upgraded, including an additional stockpile capacity.
- Year 8: Satellite Pit has been mined through. The Western OEA is being mined through and runoff is collected via the Western OEA Sediment Dam A. Main Pit has progressed, mining out the Staged Discharge Dam and requiring relocation of the Washery Dam.

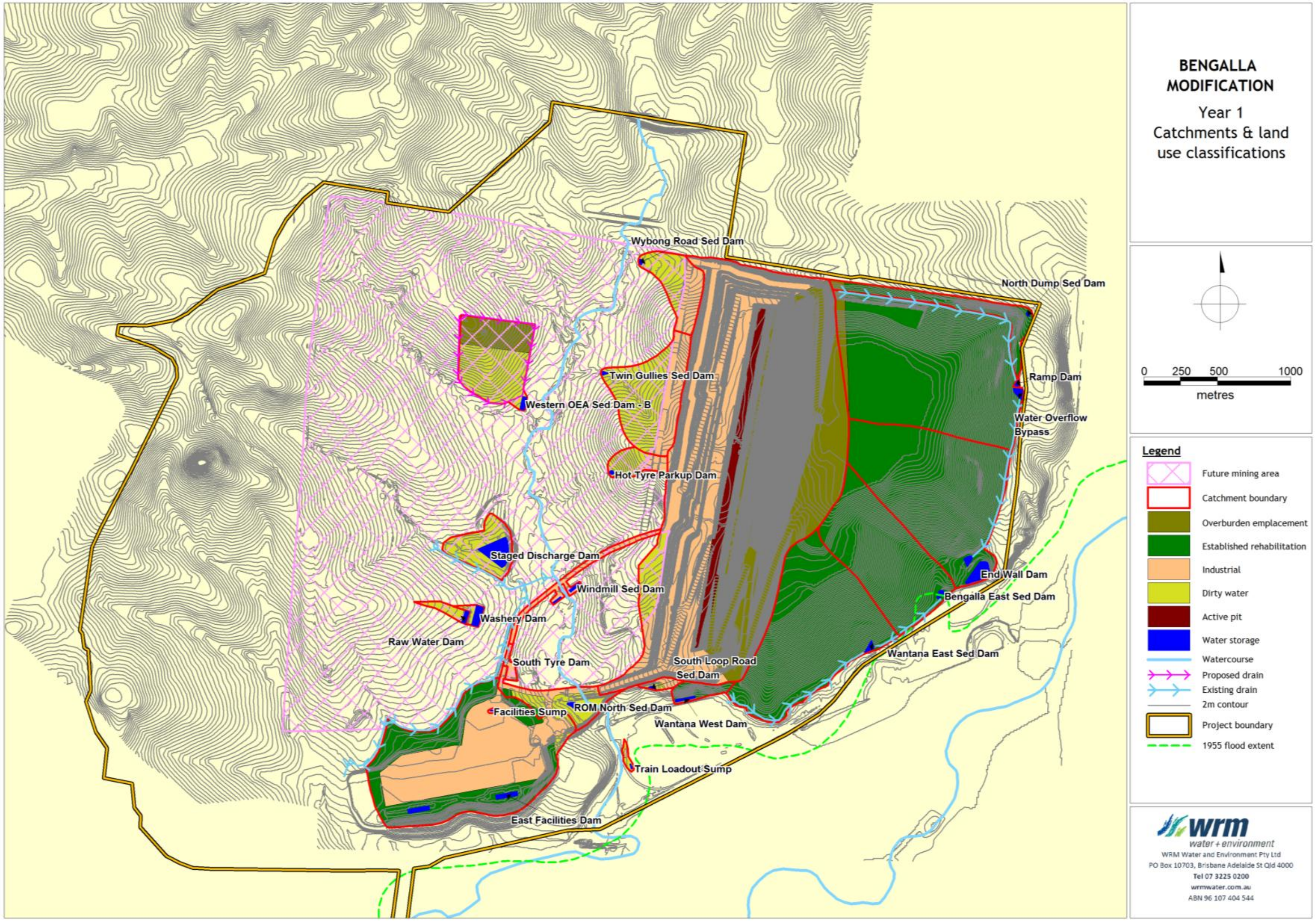

Figure 2.1 - Bengalla Catchments & Land Use Classifications – Year 1

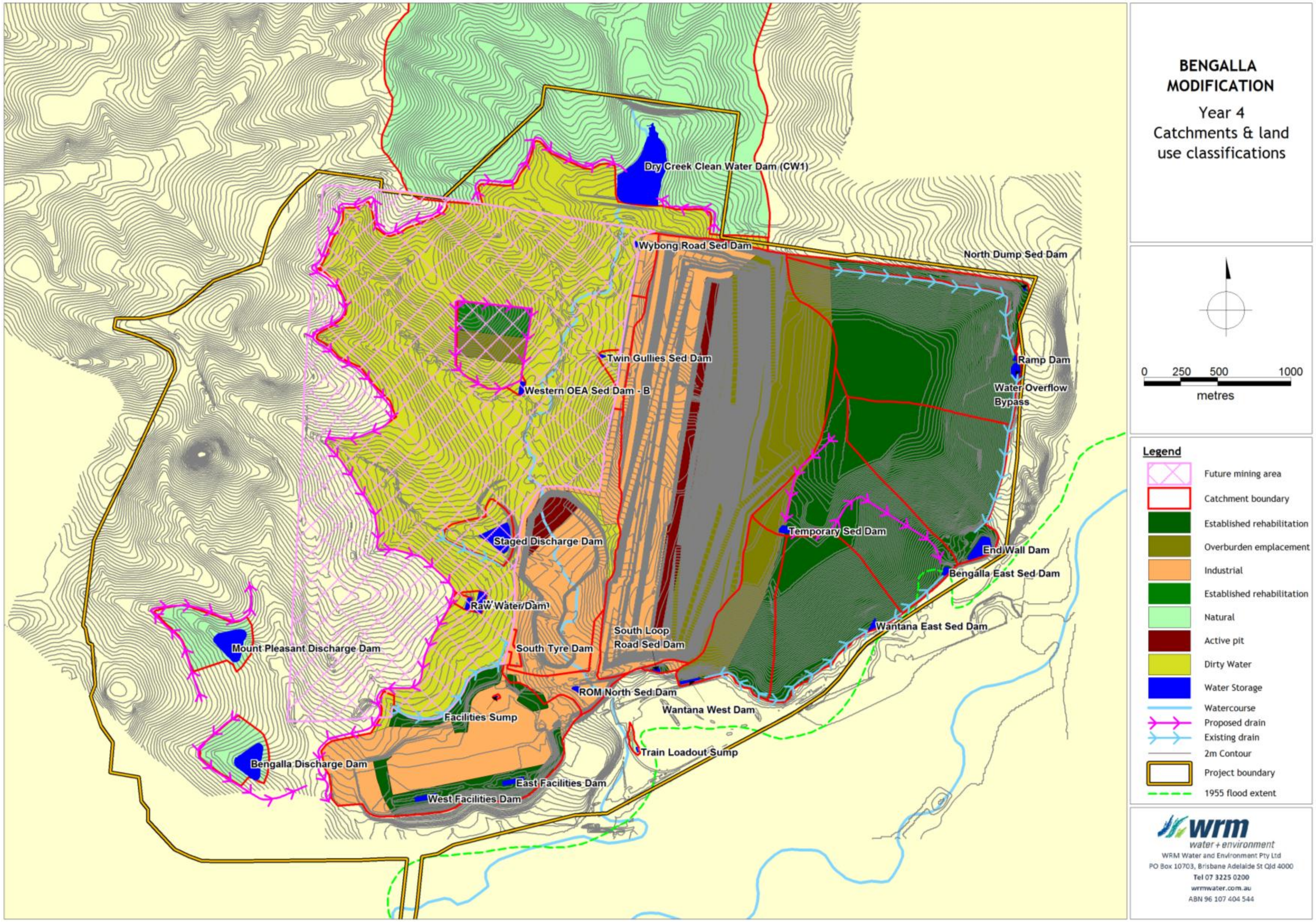

Figure 2.2 - Bengalla Catchments & Land Use Classifications – Year 4

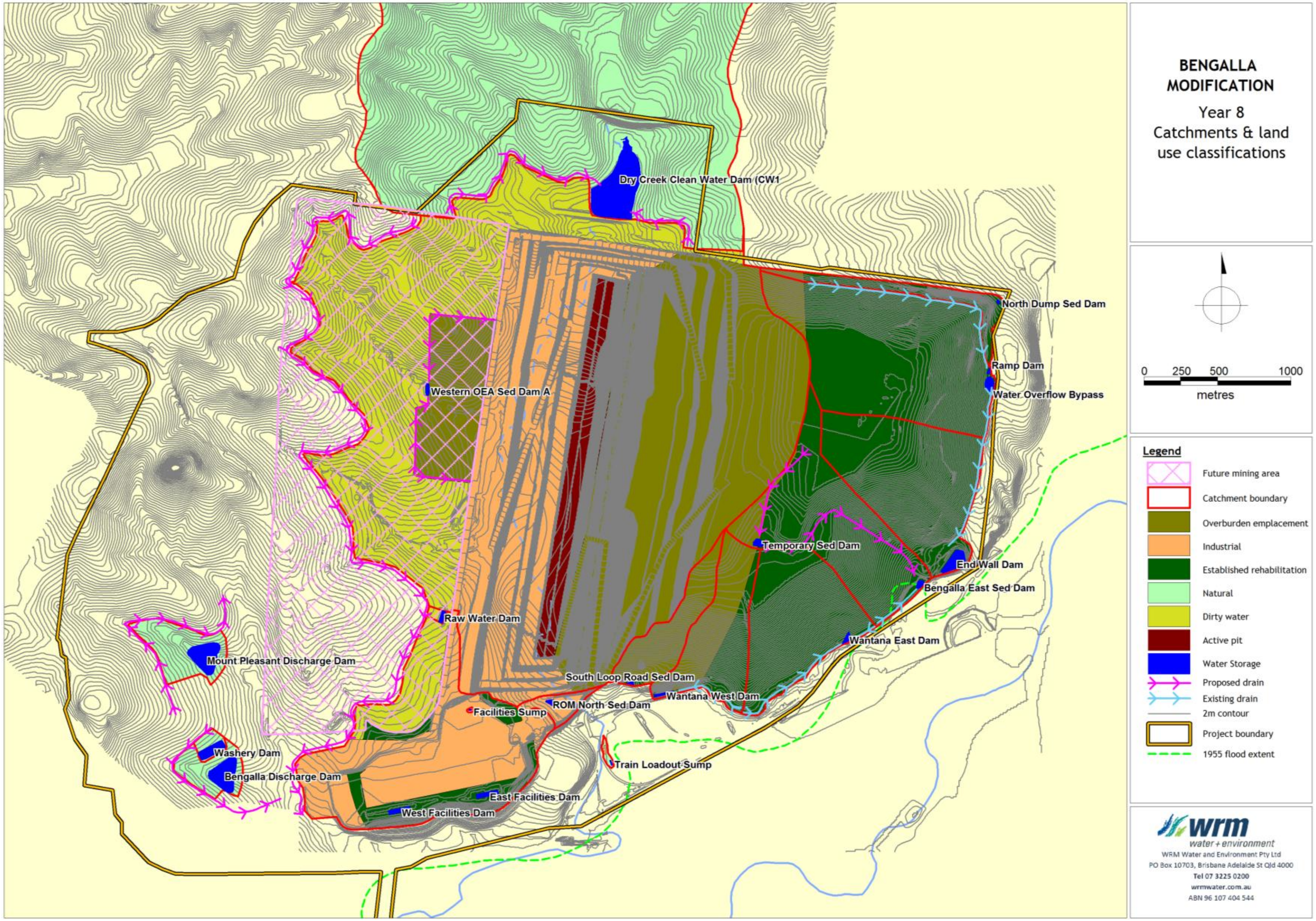

Figure 2.3 - Bengalla Catchments & Land Use Classifications – Year 8

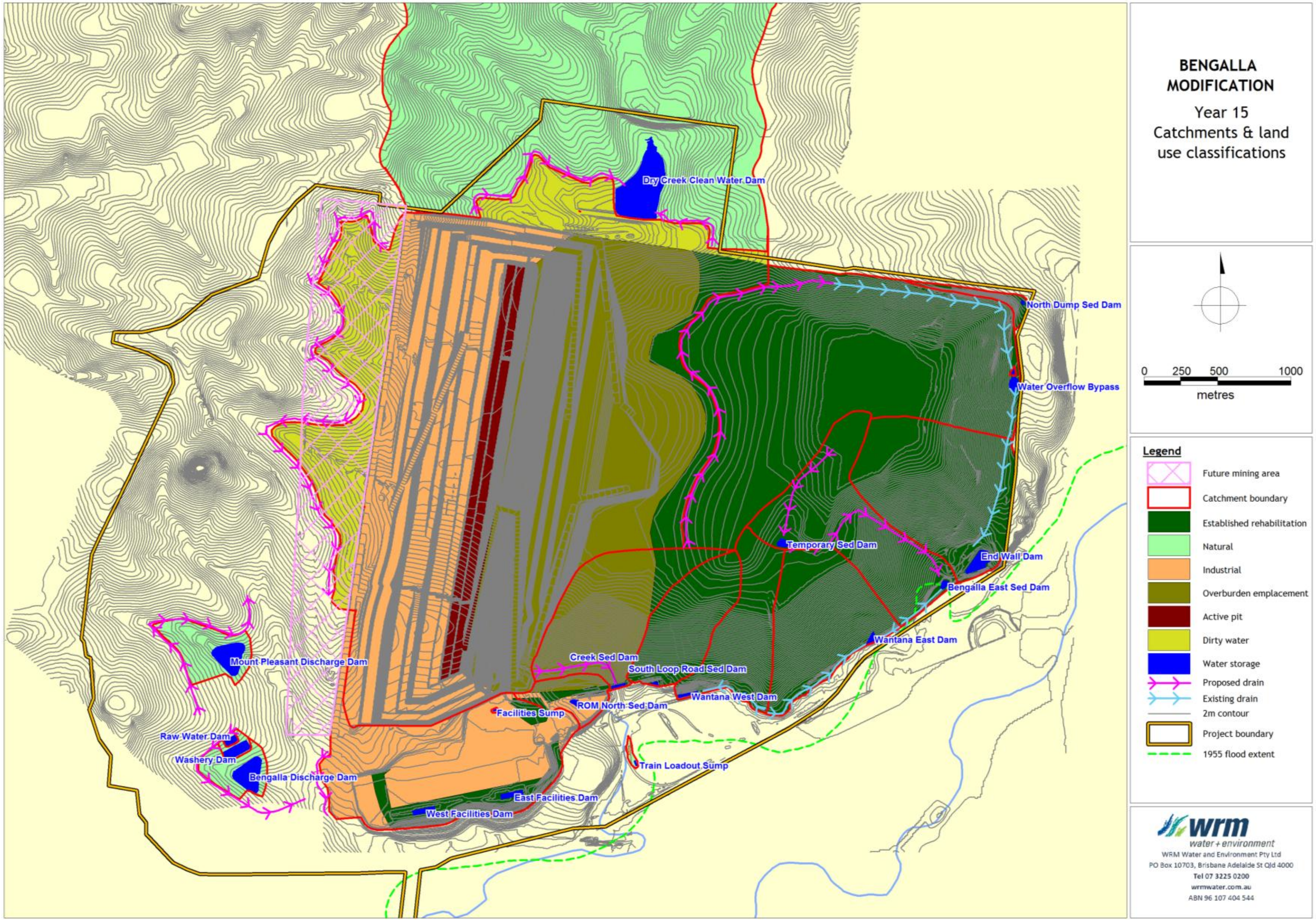

Figure 2.4 - Bengalla Catchments & Land Use Classifications – Year 15

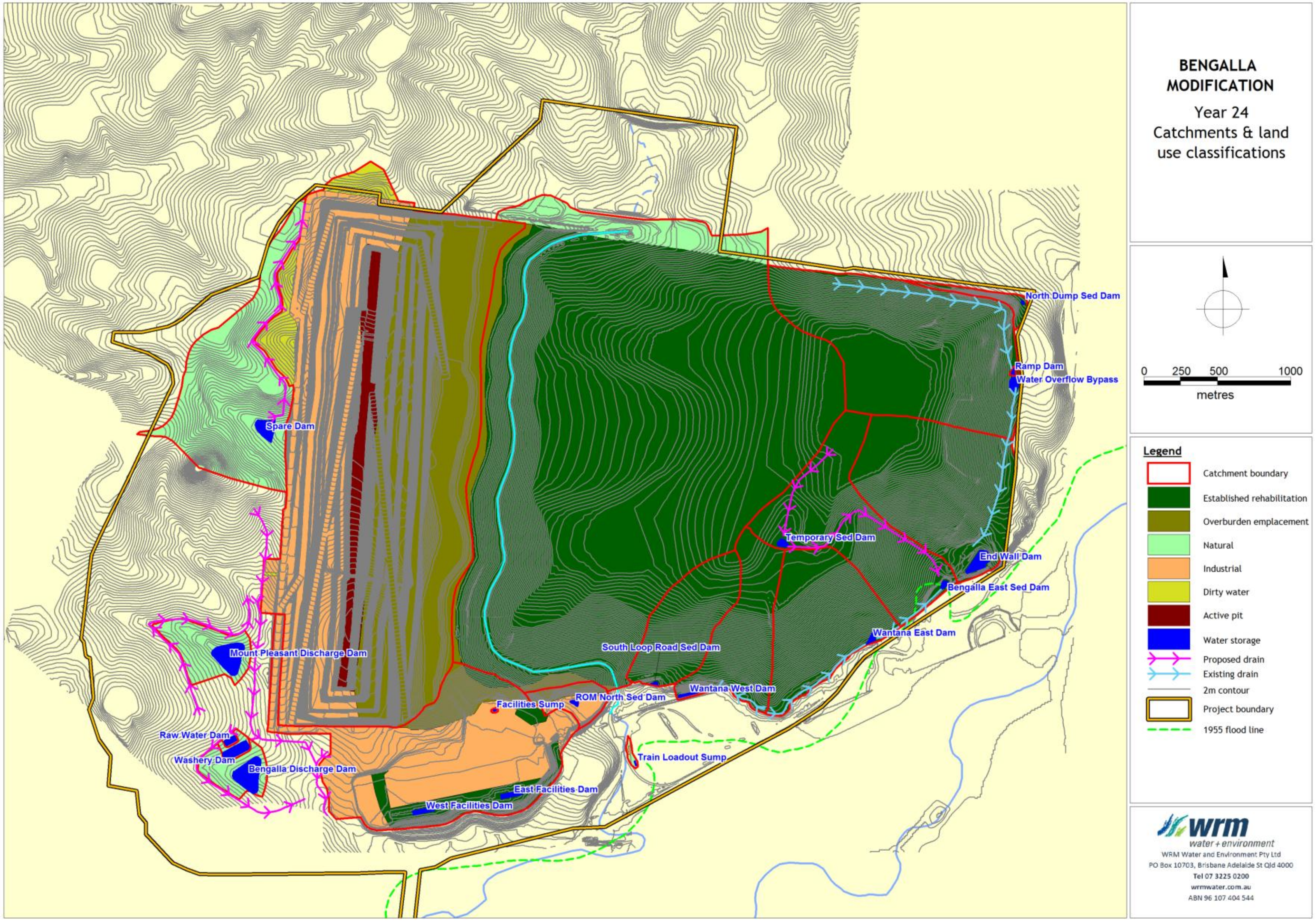

Figure 2.5 - Bengalla Catchments & Land Use Classifications – Year 24

- Year 15: Main Pit has progressed requiring relocation of the Raw Water Dam. The southern end of the Dry Creek relocation has commenced, including a temporary sediment dam (Creek Sediment Dam) to capture the runoff before rehabilitation occurs. The Western OEA has been mined through.
- Year 24: The Dry Creek relocation has been completed and the CW1 and the Creek Sediment Dam are removed. The area to the east of the relocated Dry Creek is now completely rehabilitated. The Spare Dam collects clean water from the west of the pit highwall, which is dewatered to Dry Creek.

The indicative water management system described above will continue to evolve as the mine develops. It is noted that the final timing and positions of relevant infrastructure required for water management system may be subject to change.

2.5 WATER MANAGEMENT STRUCTURES

Table 2.1 shows summary details of the capacity and classification of the existing and proposed storages at Bengalla Mine. The locations of the storages are shown on Figure 2.1 to Figure 2.5. Table 2.2 summarises the period of operation of the existing and proposed storages. All dams have been designed to meet the requirements of SSD-5170. The following dams at Bengalla are prescribed under the Dam Safety Act 1978 (DS Act):

- Staged Discharge Dam; and
- CW1 (pending final confirmation).

Under the DS Act, the NSW Dam Safety Committee requires prescribed dam owners to arrange for:

- proper operation and maintenance of their dams using trained personnel;
- regular dam surveillance using trained personnel;
- appropriate emergency planning and security precautions for their dams;
- ongoing assessment of their dam's behaviour by experienced personnel and regular review of their dam's compliance with current DSC requirements; and
- actions, in response to these assessments to ensure that their dams are maintained in a safe condition.

All prescribed dams at Bengalla will be operated under a safety management system which complies with the requirements of the DSC.

Note that the Additional Facilities Dam and the Additional ROM Dam will only be required should the product stockpile and infrastructure area be extended. It has been assumed that the the product stockpile and infrastructure area will be extended prior to year 4 and the additional storage capacity will be constructed prior to this. For the purpose of the assessment, it has been assumed that the Additional Facilities Dam capacity is incorporated into the East and West Facilities dams and the Additional ROM Dam capacity is incorporated into the existing ROM dam.

Table 2.1 - Bengalla Water Management Structures - Description

Dam	Capacity (ML)	Purpose	Comments
Raw Water Dam^	5.0	Clean Water	Storage dam for Hunter River water, supplies Water Treatment Plant and fire suppression system
Relocated Raw Water Dam*	5.0	Clean Water	
Washery Dam^	25.0	Mine Water	Supply dam for the CHPP and dust suppression water for the water truck fill point and facilities
Relocated Washery Dam*	25.0	Mine Water	
End Wall Dam	80.0	Mine Water/Sediment Dam	Will eventually act solely as sediment dam, accepting rehabilitated overburden runoff
Ramp Dam	16.0	Mine Water	Accepts mine water from the pit and runoff from the pit and spoil area
East Facilities Dam	24.0	Mine Water	Accepts runoff from the CHPP stockpile and main infrastructure area and process water from dewatering of coal reject material
West Facilities Dam	24.0	Mine Water	Accepts runoff from the Western CHPP stockpile area
Additional Facilities Dam**	110.0	Mine water	Additional storage to be constructed should the product stockpile and main infrastructure area be extended
Staged Discharge Dam	280.0	Mine Water	Staging capacity for wet weather conditions.
Bengalla Relocated Discharge Dam^	300.0	Mine water	Licensed release point for saline water under the HRSTS.
Train Loadout Sump	0.5	Sediment Dam	Accepts runoff from the train load out facility
Facilities Sump	0.5	Mine Water	Accepts truck wash down and workshop apron wastewater
Windmill Sedimentation Dams	3.0	Sediment Dam	Accepts runoff from the main haul road adjacent to Dry Creek
Wybong Road Sedimentation Dam	0.4	Sediment Dam	Accepts runoff from pit area, adjacent to Dry Creek
Twin Gullies Sedimentation Dam	32.0	Sediment Dam	Accepts runoff from pit area, adjacent to Dry Creek
North Dump Sedimentation Dam	0.5	Sediment Dam	Accepts runoff from small section of the northern dump
Water Overflow Bypass	10.0	Mine Water	Accepts haul road runoff and runoff from Eastern Overburden Area prior to discharge offsite
Hot Tyre Parkup Dam	0.2	Mine Water	Captures runoff from disturbed areas at Hot Tyre Park up area.
South Loop Road Sedimentation	0.5	Sediment Dam	Captures runoff from disturbed areas associated with Mount Arthur Pit

Dam	Capacity (ML)	Purpose	Comments
Dam			
ROM North & South Sedimentation Dam	1	Sediment Dam	Captures runoff from the ROM visual bund and ROM haul road
Additional ROM Dam**	50	Mine water	Additional storage to be constructed should the main infrastructure area and ROM area be extended.
Wantana West Dam	16**	Mine Water /Sediment Dam	Captures runoff from disturbed areas associated with Wantana Extension and water pumped from the pit up to Year 3. From Year 4 onwards, acts solely as sediment control.
East Wantana Sedimentation Dam	5	Mine Water	Captures runoff from disturbed areas associated with Wantana Extension
Bengalla East Sedimentation Dam*	43**	Sediment Dam	Captures runoff from disturbed areas
Western OEA Sedimentation Dam A*	26**	Sediment Dam	Captures runoff from Western OEA
Western OEA Sedimentation Dam B*	17**	Sediment Dam	Captures runoff from Western OEA
Dry Creek Clean Water Dam (CW1)*	900	Clean water	Captures clean water from upstream Dry Creek catchment
Creek Sedimentation Dam*	36**	Sediment Dam	Captures runoff from disturbed areas during rehabilitation of southern end of Dry Creek
Spare Dam*	100**	Clean water	Captures clean water from upstream catchment

* Dams to be constructed
^ to be relocated as part of Continuation
** Nominal. To be confirmed as part of detailed design.

Table 2.2 - Bengalla Water Management Structures – Period of Operation

Dam	Representative Mine Stage of Continuation				
	Yr1	Yr 4	Yr 8	Yr 15	Yr 24
Raw Water Dam	X	X			
Relocated Raw Water Dam			X	X	X
Washery Dam	X	X			
Relocated Washery Dam			X	X	X
End Wall Dam	X	X	X	X	X
Ramp Dam	X	X	X	X	X
East Facilities Dam	X	X	X	X	X
West Facilities Dam	X	X	X	X	X
Additional Facilities Dam*	X	X	X	X	X
Staged Discharge Dam	X	X			
Bengalla Relocated Discharge Dam		X	X	X	X
Train Loadout Sump	X	X	X	X	X
Facilities Sump	X	X	X	X	X
Windmill Sedimentation Dams	X				
Wybong Road Sedimentation Dam	X	X			
Twin Gullies Sedimentation Dam	X	X			
North Dump Sedimentation Dam	X	X	X	X	X
Water Overflow Bypass	X	X	X	X	X
Hot Tyre Parkup Dam	X				
South Loop Road Sedimentation Dam	X	X	X	X	X
ROM North Sedimentation Dam	X	X	X	X	X
Additional ROM Sedimentation Dam*	X	X	X	X	X
Wantana West Dam	X	X	X	X	X
East Wantana Sedimentation Dam	X	X	X	X	X
Bengalla East Sedimentation Dam	X	X	X	X	X
Western OEA Sedimentation Dam A^			X		
Western OEA Sedimentation Dam B^	X	X			
Dry Creek Clean Water Dam (CW1)	X	X	X	X	
Spare Dam					X
Creek Sedimentation Dam				X	

* for modelling, Additional Facilities Dam capacity was assumed to be captured in existing East and West Facilities Dams and the Additional ROM Dam capacity was assumed to be captured in the existing ROM Dam.
^Only required should the Western OEA be constructed

3 Mine water balance

3.1 OVERVIEW

The computer based OPSIM model has been used to simulate and assess the dynamics of the site water balance at Bengalla Mine (incorporating the proposed changes) under varying climatic sequences. Modelling has been undertaken using the 5 representative mine stages for the project as shown in Figure 2.1 to Figure 2.5. The model simulates the operations of all major components of the proposed water management system on a daily basis using different historical sequences of recorded rainfall data. The simulated inflows and outflows included in the model are given in Table 3.1.

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

Inflows	Outflows
Direct rainfall on water surface of storages	Evaporation from water surface of storages
Catchment runoff	Site water usage (CHPP, haul road and stockpile dust suppression, vehicle wash)
Groundwater inflows	Controlled discharges (under the HRSTS)
Raw water supply from Hunter River	Offsite spills from storages

3.2 SIMULATION METHODOLOGY

The water balance model was run as a dynamic forecast simulation model.

The 24 year Project life was modelled using historical climatic data from the SILO Data Drill service (Jeffrey et al. 2001). The dynamic configuration allows the simulation to change over the modelled Project life, reflecting changes in the water management system over time.

The forecast water balance results are generated by running multiple climate sequences through the model and taking a statistical representation of the results for the different climate cases modelled. These results more accurately reflect the actual performance of the system because they take into account the dynamic nature of the mine staging, groundwater inflows, and CHPP throughputs. In these runs the model configuration changes over time, to reflect the changes due to mine development.

The forecast water balance model has been run on a daily time-step for a 24 year period, corresponding to the period of operation of the project. The model was run for multiple climate sequences, each referred to as a “realisation”. Each realisation is based on a 24 year sequence extracted from the historical rainfall data. The first of 93 realisations is based on rainfall data from 1893 to 1916. The second is based on data from 1894 to 1917, and so on. This approach provides the widest possible range of climate scenarios covering the full range of climatic conditions represented in the historical rainfall record.

The model configuration changes over the 24 year project life, reflecting changes in the water management system over time. The different stages of the mine life are linked in the model to reflect variations over time such as catchments, ROM coal production and groundwater inflows. Five different representative stages of mine life were modelled (Years 1 (existing), 4, 8, 15 and 24). Although the catchment areas will continuously change as mining under the proposal progresses, the adopted approach of modelling discrete stages will provide a reasonable representation of conditions over the 24 year period.

The operational rules and physical layout for each representative stage of mine progression are applied to a range of years given in Table 3.2. The operational rules at each modelled stage are provided in Section 3.3.1. Although the catchment areas are expected to continuously change over the life of the Project, the simplification is expected to reasonably represent conditions over the 24 year period.

Table 3.2 - Application of representative mine stage to full mine life

Representative Mine Stage	Applied Range of Mine Life	Period (years)
Year 1	Year 1 – Year 3	3
Year 4	Year 4 – Year 7	4
Year 8	Year 8 – Year 14	7
Year 15	Year 15 – Year 23	9
Year 24	Year 24	1

3.3 MODEL CONFIGURATION

3.3.1 Model schematic

Figure 3.1 to Figure 3.5 shows the indicative water management system schematics at each of the representative mine stages.

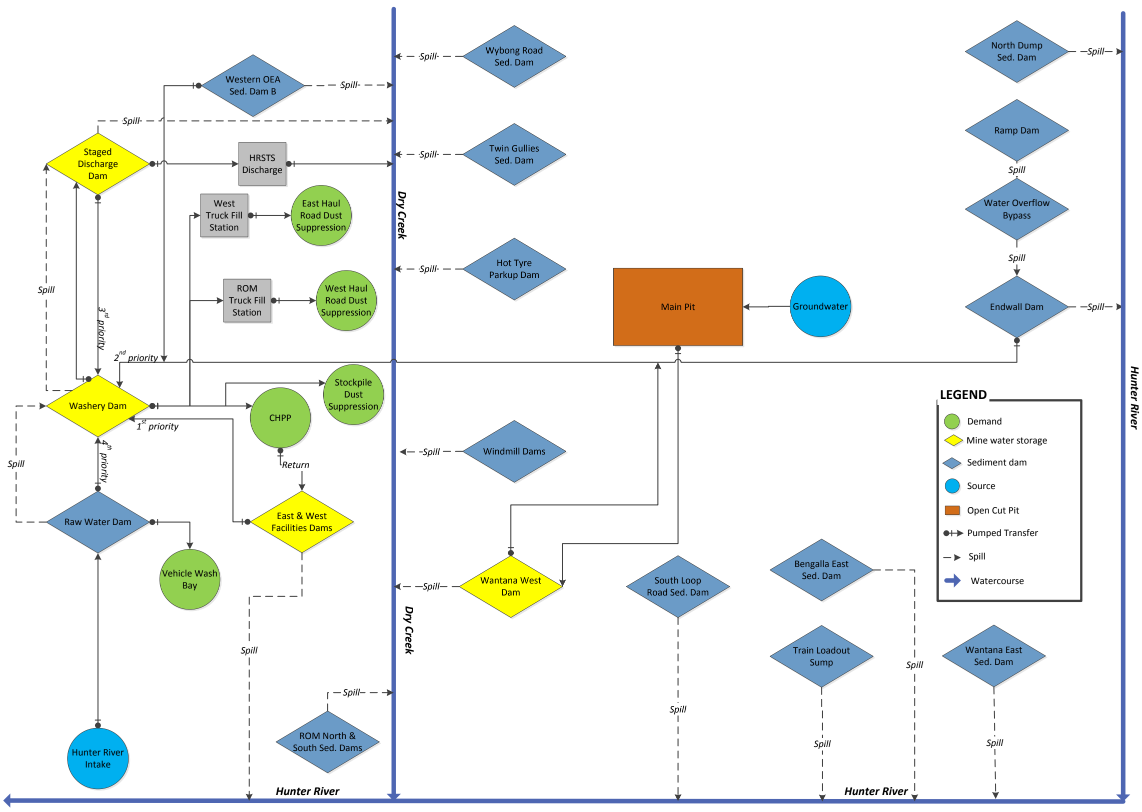

Figure 3.1 - Bengalla Water Management System Schematic - Year 1

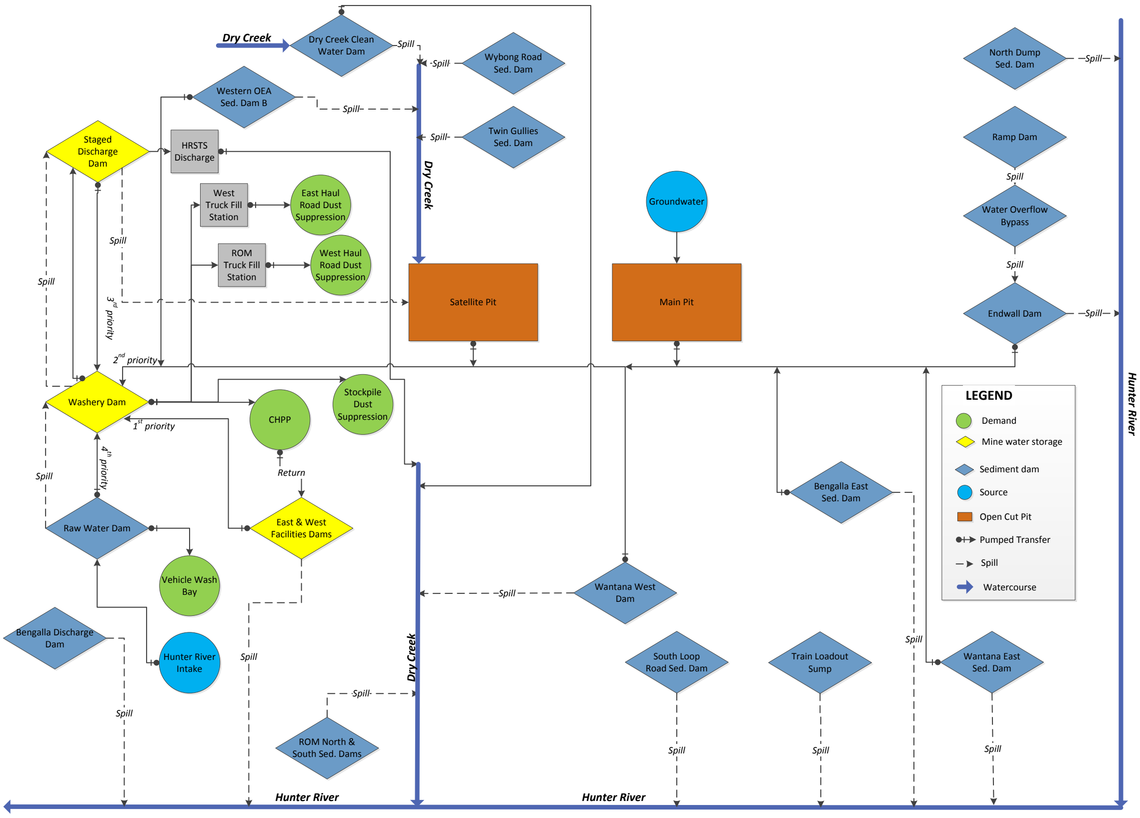

Figure 3.2 - Bengalla Water Management System Schematic - Year 4

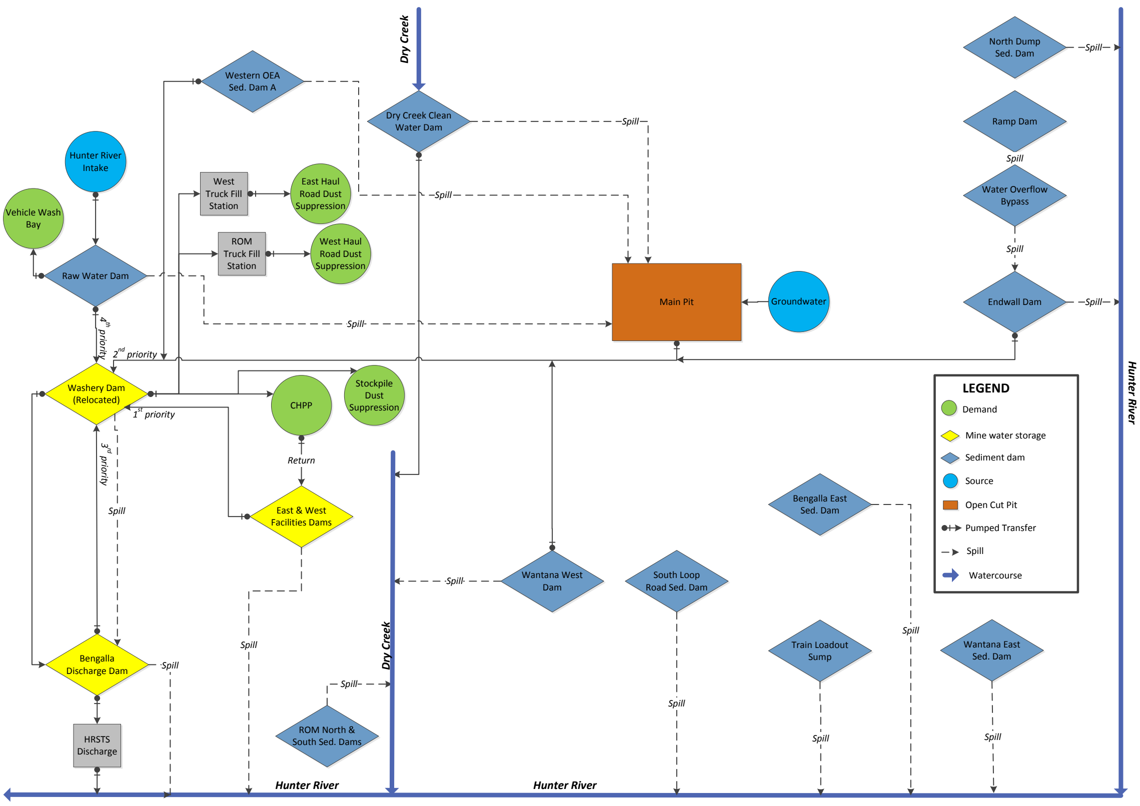

Figure 3.3 - Bengalla Water Management System Schematic - Year 8

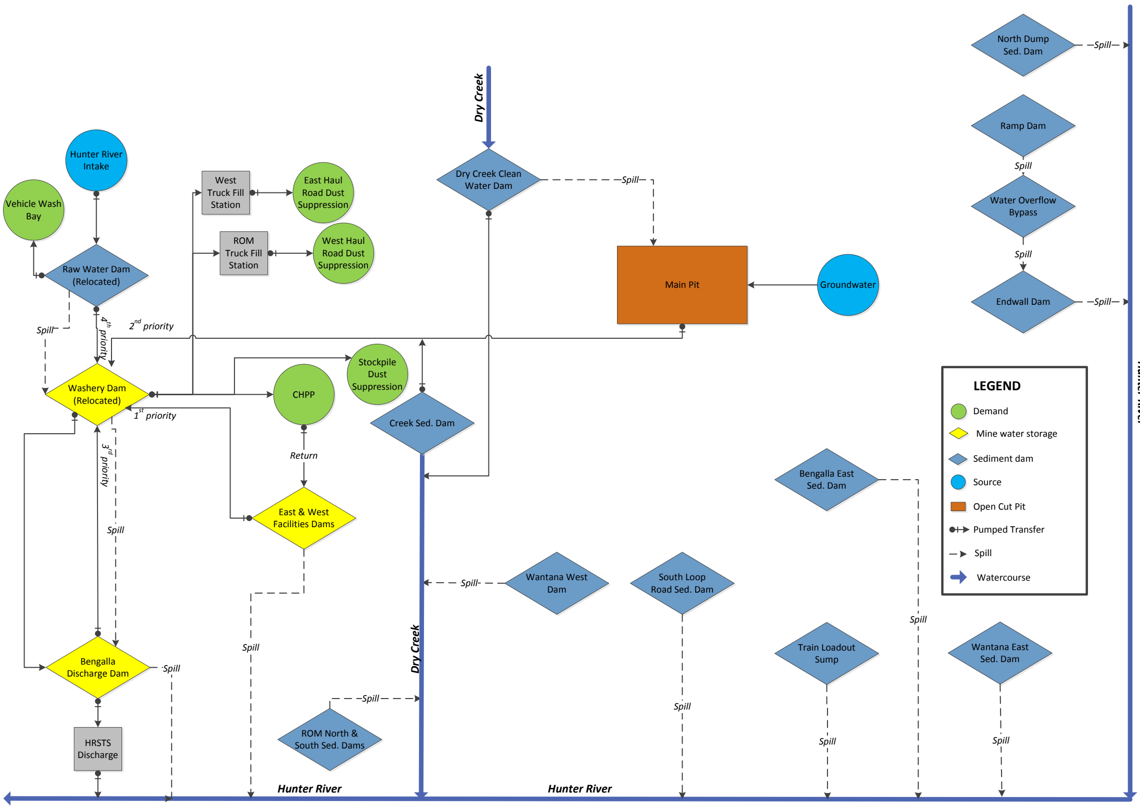

Figure 3.4 - Bengalla Water Management System Schematic - Year 15

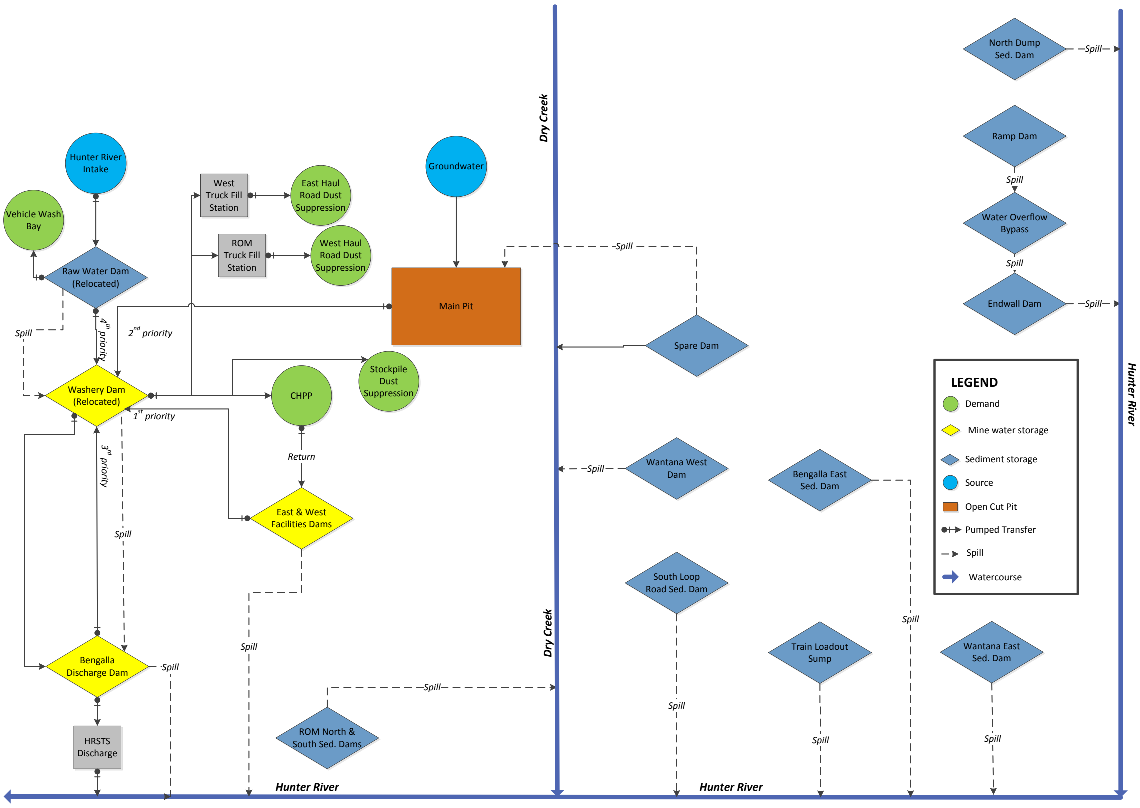

Figure 3.5 - Bengalla Water Management System Schematic - Year 24

3.3.2 Operational rules

Table 3.3 shows the adopted operating rules for the OPSIM water balance simulation.

Table 3.3 - Water balance model operational rules

Item	Node Name	Operational Rules
1.0 1.1	**Raw water supply** Hunter River supply scheme	• Supplies to the Raw Water Dam as required at a maximum yearly allocation of 1,449 ML/a. • Maximum daily rate of 9.5 ML/d.
2.0 2.1	**Water Demands** CHPP	• Supplied from the Washery Dam at the net rates presented in Table 3.8.
2.2	Haul Road Dust Suppression - East	• Supplied from the Washery Dam via the West Truck Fill Station at the rates presented in Section 3.5. • 100% loss assumed.
2.3	Haul Road Dust Suppression - West	• Supplied from the Washery dam via the ROM Truck Fill Station at the rates presented in Section 3.5. • 100% loss assumed.
2.4	Vehicle Washdown	• Supplied from the Raw Water Dam at the rates presented in Section 3.5. • 100% loss assumed.

3.0	**Operational Pits**
	
	Main Pit
	
	Satellite Pit
		• Receives groundwater inflows at the rates provided in Section 3.4.
		• Continuous dewatering at the following rates:
		  ○ Pit volume <100ML: 100L/s
		  ○ Pit volume 100 - 200ML: 200L/s
		  ○ Pit volume >300ML: 300L/s
		• Continuous dewatering to Washery Dam as required at a maximum rates of 200 L/s.

4.0
 	
4.1
	Water Storages
	
	Washery Dam/Relocated Washery Dam
	
	Mine Stages 1, 4, 8, 15, 24
		• Primary mine water storage for site operations.
		• Supplies to the following locations as required:
		  ○ CHPP
		  ○ West Haul Road Dust Suppression via ROM Truck Fill Station
		• Maintained at 10 ML from the following sources in order of priority:
		  ○ East & West Facilities Dams
		  ○ Mining pits
		  ○ Wantana West Dams (Year 1 to 3 only)

Item	Node Name	Operational Rules
		○ Endwall Dam (Year 1 to 3 only) ○ Staged Discharge Dam ○ Sediment dams ○ Raw Water Dam • Pump transfers to the Staged Discharge Dam when >80% capacity (20 ML). • Storage overflows to Staged Discharge Dam.
4.2	Staged Discharge Dam/ Relocated Bengalla Discharge Dam *Mine Stages 1, 4, 8, 15, 24*	• Receives pumped transfers from the Washery Dam. • Controlled releases to Dry Creek via HRSTS under the following conditions: ○ >70% capacity (200 ML). ○ Refer Section 3.6.2. • Receives spills from Washery Dam. • Storage overflows to Dry Creek/Hunter River.
4.3	Endwall Dam *Mine Stages 1, 4, 8, 15, 24*	• Pump transfer to Washery Dam when possible. • Storage overflows to Hunter River.
4.4	Ramp Dam (Mine Stages 1, 4, 8, 15, 24)	• Storage overflows to Water Overflow Bypass.
4.5	East & West Facilities Dams (incl. Additional Storage) *Mine Stages 1, 4, 8, 15, 24*	• Receive return from CHPP. • Pump transfer to Washery Dam to maintain below 20%. • Storage overflows to Hunter River.
4.6	ROM North & South Sediment Dams (incl. Additional ROM Storage) *Mine Stages 1, 4, 8, 15, 24*	• Storage overflows to Dry Creek.
4.7	Facilities Sump *Mine Stages 1, 4, 8, 15, 24*	• Supplies to Vehicle Washdown. • Maintained at 0.5 ML from the Washery Dam. • Storage overflows to East & West Facilities Dams.
4.8	Wybong Road Sediment Dam *Mine Stages 1, 4*	• Storage overflows to Dry Creek.
4.9	Twin Gullies Sediment Dam *Mine Stages 1, 4*	• Storage overflows to Dry Creek.

Item	Node Name	Operational Rules
4.10	Hot Tyre Parkup Dam *Mine Stages 1*	• Storage overflows to Dry Creek.
4.11	South Loop Road Sediment Dam *Mine Stages 1, 4, 8, 15, 24*	• Storage overflows to Dry Creek.
4.12	Train Loadout Sump *Mine Stages 1, 4, 8, 15, 24*	• Storage overflows to Dry Creek.
4.13	Wantana West Sediment Dam *Mine Stages 1, 4, 8, 15, 24*	• Pump transfer to Washery Dam to maintain empty, until rehabilitated. • Storage overflows to Dry Creek.
4.14	Wantana East Sediment Dam *Mine Stages 1, 4, 8, 15, 24*	• Pump transfer to Washery Dam to maintain empty, until rehabilitated. • Storage overflows to Hunter River.
4.15	North Dump Sediment Dam *Mine Stages 1, 4, 8, 15, 24*	• Storage overflows to Hunter River.
4.16	Western OEA Sediment Dam *Mine Stages 1, 4, 8*	• Pump transfer to Washery Dam to maintain empty, until rehabilitated. • Storage overflows to Dry Creek.
4.17	Bengalla East Sediment Dam *Mine Stages 1, 4, 8, 15, 24*	• Pump transfer to Washery Dam to maintain empty, until rehabilitated. • Storage overflows to Hunter River.
4.18	Dry Creek Clean Water Dam	• Pumped transfer to Dry Creek to maintain empty. • Storage overflows to Dry Creek (yr 1), Satellite Pit (yr 4) and Main Pit (yr 8,15).
4.19	Raw Water Dam/Relocated Raw Water Dam *Mine Stages 1, 4, 8, 15, 24*	• Storage maintained at 5 ML from the Hunter River intake at a maximum rate of 9.5 ML/d. • Supplies to Washery Dam as required. • Storage overflows to Washery Dam.
4.20	Windmill Dams *Mine Stage 1*	• Storage overflows to Dry Creek.
4.21	Water Overflow Bypass *Mine Stages 1, 4, 8, 15, 24*	• Storage overflows to Endwall Dam.

Item	Node Name	Operational Rules
4.22	Creek Sediment Dam *Mine Stage 15*	• Pump transfer to Washery Dam to maintain empty. • Storage overflows to Dry Creek.
4.23	Spare Dam *Mine Stage 24*	• Pumped transfer to Dry Creek to maintain empty. • Storage overflows to Main Pit
6.0 6.1	Receiving Waters Dry Creek	• Receives controlled discharges from Staged Discharge Dam under HRSTS. • Receives storage overflows from the following locations: ○ Wybong Road Sediment Dam ○ Twin Gullies Sediment Dam ○ Hot Tyre Parkup Dam ○ Windmill Dams ○ Wantana West Dam ○ ROM North and South Sediment Dams ○ South Loop Road Sediment Dam ○ Train Loadout Sump ○ Creek Sediment Dam
6.2	Hunter River	• Supplies to Raw Water Dam via Hunter River intake. • Receives storage overflows from the following locations: ○ North Dump Sediment Dam ○ Ramp Dam ○ Endwall Dam ○ Water Overflow Bypass Dam ○ Wantana East Sediment Dam ○ East & West Facilities Dams ○ Bengalla East Sediment Dam

3.3.4 Starting inventories

Table 3.4 shows the storage inventories adopted as initial conditions in the water balance model.

Table 3.4 - Inventories at model commencement

Storage	Starting Inventory (ML)
Washery Dam	20 ML
Staged Discharge Dam	38 ML
Endwall Dam	6 ML
East & West Facilities Dam	5 ML

3.4 WATER SOURCES

3.4.1 Groundwater inflows

Adopted groundwater inflows are shown in Table 3.5 (AGE, 2012). The inflows have been corrected for evaporation so that they reflect the 'pumpable' seepage inflows from groundwater to the open cut pit(s), and averaged over the modelled period of the mine stage. The volume of 'pumpable' inflows is the total volume of seepage minus losses due to evaporation. The volume of pumpable inflows will be zero where the evaporation rate exceeds the seepage rate.

Table 3.5 - Groundwater Inflows to Open Cut Pit (AGE, 2012)

Mine Stage	'Pumpable' Groundwater Inflows	
	ML/d	ML/a
Year 1	0.544	199
Year 4	0.038	14
Year 8	0	0
Year 15	0.008	3
Year 24	0	0

3.4.2 Catchment runoff

3.4.2.1 Catchment and land use classifications

The changes in the physical layout are represented in the mine stage plans given in Figure 2.1 to Figure 2.5 for Years 1, 4, 8, 15 and 24 respectively. Table 3.6 shows a summary of the catchment areas reporting to each storage, and further detail is provided in Appendix A, where catchment areas are separated by the different land use types.

Table 3.6 - Storage catchment areas

Storage	Year 1	Year 4	Year 8	Year 15	Year 24
Bengalla Discharge Dam		14.7	14.7	11.6	11.6
Bengalla East Sed Dam	48.5	75.7	75.7	73.1	73.2
Creek Sed Dam				62.4	
Dry Creek Clean Water Dam	631.3	631.3	631.3	630.9	603.7
East & West Facilities Dam	89.2	109.0	134.1	116.0	132.1
End Wall Dam	76.8	76.8	76.8	87.2	87.5
Hot Tyre Parkup Dam	5.9				
Facilities Sump		0.1	0.1	0.1	0.1
Main Pit	285.2	307.8	838.8	759.0	467.5
Mount Pleasant Discharge Dam		18.0	18.0	18.0	18.0
North Dump Sed Dam	13.5	14.8	14.8	4.8	4.8
Ramp Dam	3.8	8.6		0.2	0.2
Raw Water Dam	2.0	1.0	0.9	0.7	0.7
ROM North Sed Dam	12.1	14.2	5.9	13.4	9.9
Satellite Pit		522.9			
South Loop Road Sed Dam	1.7	1.6	24.0	38.2	38.2
South Tyre Dam	1.2	1.2			
Spare Dam					83.8
Staged Discharge Dam	12.0	12.0			
Train Loadout Sump	0.8	0.8	0.8	0.8	0.8
Twin Gullies Sed Dam	29.2	7.9			
Wantana East Sed Dam	71.8	59.4	59.4	59.4	59.4
Wantana West Dam	3.9	40.8	40.8	42.1	
Washery Dam	1.5	1.5	14.7	1,917.9	2.5
Water Overflow Bypass	99.3	105.1	113.7	3,824.2	1,594.0
Western OEA Sed Dam B	25.8				
Windmill Sed Dams	5.2	25.8			
Wybong Rd Sed Dam	13.1	5.4			
Total	**802.5**	**2,056.4**	**2,064.5**	**7,660.0**	**3,188.0**

3.4.2.2 AWBM rainfall runoff parameters

The OPSIM model uses the Australian Water Balance Model (AWBM) (Boughton WC, 1993) model to estimate runoff from rainfall. The AWBM is a saturated overland flow model which allows for variable source areas of surface runoff.

The AWBM uses a group of connected conceptual storages (three surface water storages and one ground water storage) to represent a catchment. Water in the conceptual storages is replenished by rainfall and is reduced by evaporation. Simulated surface runoff occurs when the storages fill and overflow.

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

The model parameters define the storage depths (C1, C2 and C3), the proportion of the catchment draining to each of the storages (A1, A2 and A3), and the rate of flux between them (Kb and BFI) (Boughton, 2003). Catchments across the site have been characterised into land use types, adopted from previous surface water investigations (PB, 2009) including:

- Natural / dirty water;
- rehabilitated spoil;
- industrial;
- open cut pit; and
- active spoil.

The model parameters are shown in Table 3.7.

Table 3.7 - Adopted Rainfall-Runoff Parameters - AWBM Model

Parameter	Natural / dirtywater	Rehabilitated Spoil	Industrial	Open Cut Pit	Active Spoil
A1	0.134	0.134	0.134	0.2	0.136
A2	0.433	0.433	0.433	0.6	0.27
A3	0.433	0.433	0.433	0.2	0.594
C1	5.7	5.7	2.6	5	50
C2	57.8	57.8	26.7	70	100
C3	115.7	115.7	53.3	90	500
C_{avg}	76	76	35	61	331
K_b	0.993	0.933	1	1	1
BFI	0.39	0.39	0	0	0.103
Long-term Volumetric Runoff Coefficient	12.4%	12.4%	21.8%	15.7%	2.7%

3.5 WATER DEMANDS

3.5.1 Coal handling & preparation plant

Table 3.8 shows the net CHPP demand for the project based on production profile provided. The project has a maximum ROM throughput of 15 Mtpa modelled from Year 4. The net CHPP demand is based on the average plant usage of 77.6 L/ROM tonne (wet) which is based on recorded net water use during the 2011 calendar year.

Table 3.8 - Net CHPP Water Loss

Mine Stage	CHPP Throughput (Mtpa)	Net CHPP Demand (ML/a)
1	10.7	830
4, 8, 15, 24	15.0	1,164

3.5.2 Stockpile dust suppression

Stockpile dust suppression rates have been provided by BMC based on existing usage rates. A proposed expansion to the stockpile area in Year 4 will increase dust suppression requirements. Adopted stockpile dust suppression requirements are as follows:

- Existing & Year 1: 115 ML/a
- Year 4 – Year 24: 150 ML/a

3.5.3 Haul road dust suppression

Table 3.9 shows the average dust suppression water requirements for the project. The estimates of haul road lengths were based on the mine plans and an assumed watered width of 25 m. Dust suppression rates were based on a dry day haul road watering rate of 3.1 mm/d. This rate is 66% higher than the average recorded rate over the period 2007 to 2011 to account for the increase in the control rate to 85% for haul road dust suppression to ensure consistency with BMC's existing Air Quality Management Plan and Pollution Reduction Program requirements (J Martin 2012, pers. comm., 15 October).

Table 3.9 - Estimated Haul Road Dust Suppression Requirements

Mining Stage	Dust Suppression Area (ha)	85% Control	
		Maximum Daily Dust Suppression (kL/d)*	**Yearly Average Dust Suppression (ML/a)****
Year 1	42.0	1,319	408
Year 4	47.1	1,478	457
Year 8	45.0	1,414	437
Year 15	54.3	1,706	527
Year 24	52.5	1,648	509

* For a non-rainfall (0 mm) day.
** Based on long-term average including rainfall days.

3.5.4 Vehicle wash down

It is assumed that vehicle wash down is proportional to throughput, and will be adjusted accordingly for the water balance modelling for the Project. The demand rate is based on the 2008 vehicle wash usage.

3.5.5 Demand summary

Table 3.10 presents a summary of the site demands.

Table 3.10 - Summary of the Project Site Demands – Net Usage

Mining Stage	Site Demands (ML/a)				
	CHPP Net Demand	**Stockpile Dust Suppression**	**Haul Road Dust Suppression**	**Net Vehicle Washdown**	**Total Site Demand**
Year 1	830	115	408	97	1,450
Year 4	1,164	150	457	132	1,903
Year 8	1,164	150	437	132	1,883
Year 15	1,164	150	527	132	1,973
Year 24	1,164	150	509	132	1,955

3.5.6 Water quality

Water quality as salinity (electrical conductivity) is modelled in the water balance as a catchment salts generation rate. Salts generation rates for the various land use types are based on analysis of the site water dams water quality monitoring as given in the Bengalla Water Management Plan (BMC, 2015). Table 3.11 shows the salts generation rates adopted in the water balance model. Table 3.11 also shows the adopted open cut pit groundwater inflow salt concentration, based on groundwater quality monitoring results.

Table 3.11 - Adopted Water Quality Salts Generation Rates

Land Use	Salt Generation Rate (µS/cm)	Basis
Natural/dirty water	240	Average of Twin Gullies Sedimentation Dam and Wantana Sedimentation Dam (August 2009)
Rehabilitated Spoil	500	Lower envelope of Endwall Dam & Endwall Sedimentation Dam (January 2007 to July 2011)
Industrial	1,700	Average EC of East & West Windmill Dams (January 2007 to July 2011)
Open Cut Pit	5,000	Upper envelope of Endwall Dam & Endwall Sedimentation Dam (January 2010 to July 2011)
Active Spoil	1,000	Average EC of MTA Pit Sedimentation Dam (December 2008 to March 2009)
Groundwater	1,300	Average EC of alluvial aquifer monitoring (May 1999 to June 2011)
Hunter River Intake	550	Average EC of Hunter River at W04 (2006 to 2011)

3.6 CONTROLLED MINE WATER RELEASES

3.6.1 Overview

Wherever possible, saline mine water and treated sewage water are recycled and used for coal processing and dust suppression, to minimise the risk of requiring off-site discharges of surplus mine water.

During periods of high rainfall, excess water from Bengalla can be discharged into the Hunter River under the Hunter River Salinity Trading Scheme (HRSTS) during periods of 'high' or 'flood' flows. The HRSTS was introduced by the NSW Government to reduce salinity levels in the Hunter River and allows controlled water discharges into the Hunter River. Any required discharges of water are managed under the guidelines of the HRSTS (operated under the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002)* and MERFF. Discharges are conducted strictly in accordance with BMC's Environment Protection Licence (EPL) 6538 administered under the *Protection of the Environment Operations Act 1997* (POEO Act). Bengalla is permitted to discharge no more than 200 ML per day under the HRSTS, in accordance with section L4.1 of EPL 6538 and conditions stipulated in *Managed Envelope of Residual Flood Flows* (MERFF).

All discharges are released from the main Bengalla water storage (Staged Discharge Dam) and additional surface water monitoring is also undertaken during any such discharge event. Discharges at Bengalla have been infrequent since commencement of operations and it is envisaged that discharges will continue to remain infrequent and only be required following prolonged, heavy rainfall.

3.6.2 Hunter River Salinity Trading Scheme

The HRSTS discharges have been modelled as follows:

- Hunter River Streamflow time series - simulated streamflow data was obtained from the NSW Office of Water IQQM model (this model is still under review and not yet signed off for Water Sharing Plan Rules) for the period 1/1/1900 to 30/6/2007.
- Salinity -Recorded salinity data was obtained for the Hunter River at Denman (#210055) from PINEENA, covering the period February 1993 to October 2010. Based on the recorded historical data, a relationship between streamflow and water quality was developed. EC's for high flows only (1,000 – 4,000 ML/d) were plotted against flow rates and a logarithmic trend line fitted to the data, giving salinity as a function of flow rate.
- Using IQQM flows at Denman, Glennies Creek and Singleton – the flow is classified at Denman as low, high or flood on a daily basis (e.g. flow at Denman is only high if high in all sectors).
- The salinity function is then applied to get a Hunter River flow and EC time series at Denman which is used in OPSIM as the reference node.
- In OPSIM, controlled discharges were simulated using an Environmental Transfer (ETN) node with two 'rules' for discharge. Rule 1 limits the volume of discharges based on the flow rates in the Hunter River, as shown in Table 3.12. Rule 2 limits the salt load discharged based on the salinity in the Hunter River, as shown in Table 3.13.

Table 3.12 - HRSTS Rule 1 (Volume Limit Rating)

Hunter River Qref (ML/d)	Site Discharge Qmax (ML/d)	Apply Rule 2	Comment
0	0	x	No site discharges allowed when Hunter River flows are <1,000 ML/d.
999	0	x	
1,000	200	✓	When Hunter River flows are 1,000 -4,000 ML/d, up to 200 ML/d can be discharged from site, with salinty restrictions as per 'Rule 2'.
4,000	200	✓	
> 4,000	200	x	When Hunter River flows are >4,000 ML/d, up to 200 ML/d can be discharged from site, with no salinity restrictions.

Where:

- Q_{ref} is the reference volume [ML/d] (in this case, the Hunter River).
- Q_{max} is the discharge limit [ML/d] for Q_{ref}.

Table 3.13 - HRSTS Rule 2 (TDS Rating)

Method	Cr (µS/cm)	K Value	Comment
K + Cr	0	600	If the EC in the Hunter River is zero, the concentration in the Hunter River can increase by up to 600 µS/cm due to discharges under the HRSTS.
K + Cr	600	0	If the EC in the Hunter River is 600 µS/cm, the concentration in the Hunter River can increase by zero µS/cm due to discharges under the HRSTS.

Where:

- Cr is the concentration at the Reference Node (in this case, the Hunter River).
- K is concentration increase (linearly interpolated between the specified values).
- Limiting transfer concentration is calculated as K+Cr.

For the purposes of the water balance modelling, it has been assumed that a low water inventory trigger of 200 ML is set on the Staged Discharge Dam/Bengalla Relocated Discharge Dam and Main Pit (i.e. no discharges if volume in Staged Discharge Dam + Main Pit < 200ML). For the purposes of the water balance modelling it is assumed that the Washery Dam transfers to the Staged Discharge Dam when it reaches >80% capacity (20 ML).

A sample of the simulated Discharge Dam behaviour is shown in Figure 3.6, including simulated Hunter River flows and salinity (at Denman), Pit and Discharge Dam stored inventories and simulated discharges from the Discharge Dam under the HRSTS.

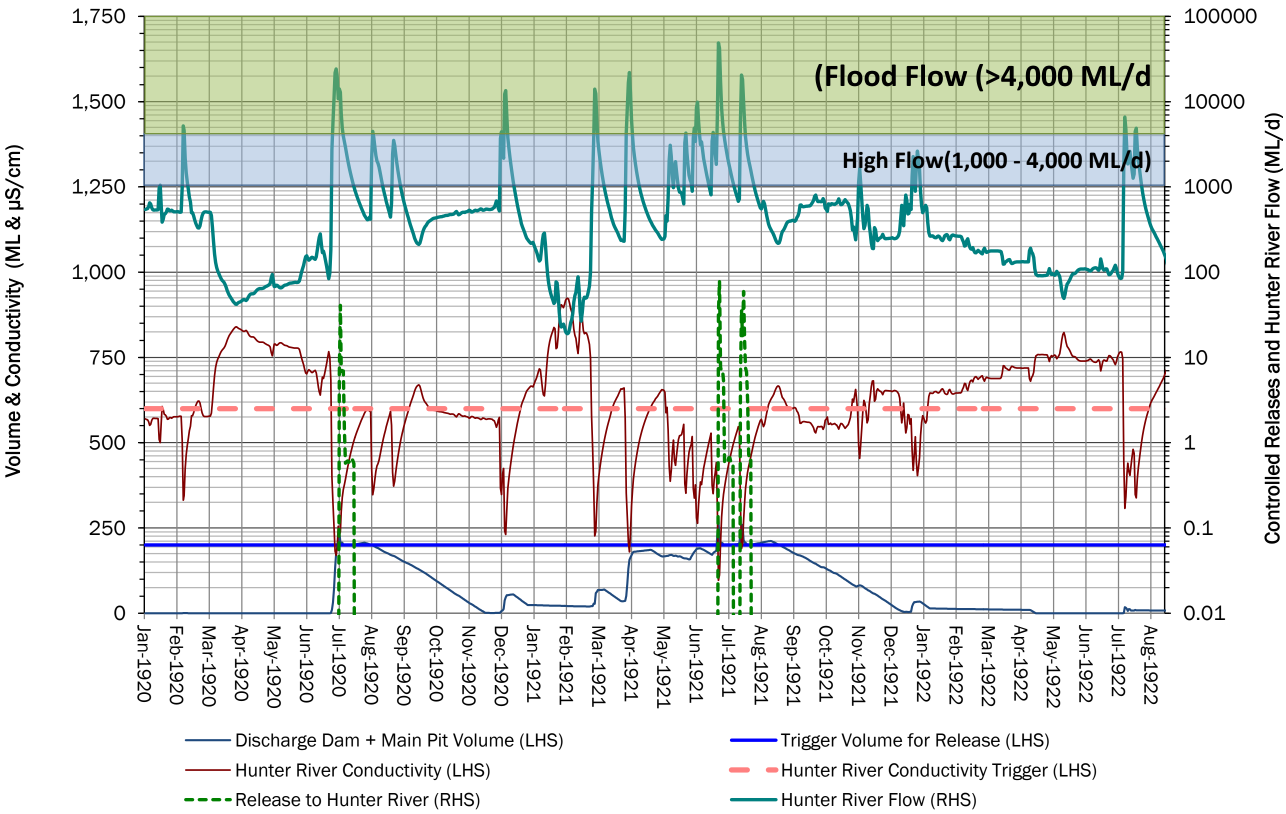

Figure 3.6 - Sample of Simulated Discharge Dam Behaviour

4 Water balance model results

4.1 OVERVIEW

The OPSIM model was used to assess the performance of the proposed water management system against the following:

- meeting the water management conditions of the EPL;
- meeting the mine water release conditions of the HRSTS rules;
- whether sufficient external water licenses are available to meet the site water demands; and
- assessing the health of the overall water management system.

4.2 INTERPRETATION OF RESULTS

The forecast model results indicate the likelihood of the mine water system achieving different levels of performance over the life of the Project. A forecast simulation provides a statistical analysis of the water management system's performance over the 24 year Project life, based on 91 realisations with different climatic sequences. The 50th percentile probability represents the median results, the 10th percentile represent 10% exceedance and the 90th percentile results represent 90% exceedance. There is an 80% chance that the result will fall within the 10th and 90th percentiles and a 98% chance the result will fall between the 1st and 99th percentiles. Importantly, a percentile trace shows the chance of a particular value, and does not represent continuous results from a single model realisation e.g. the 50th percentile trace does not represent the model time series for median climatic conditions.

4.2.1 Uncontrolled Offsite Releases

The results of the site water balance modelling show that the mine water management system can generally be operated in accordance with its EPL conditions. The model results indicate that there is:

- no uncontrolled release of mine affected water from the Staged Discharge Dam or Bengalla Discharge Dam over the Project life;
- no uncontrolled release of mine affected water from Wantana West Dam during Years 1 to 3 prior to it being converted to a sediment dam.
- less than a 1% annual risk of discharge from the East & West Facilities Dam; and

There is one modelled discharge from the East & West Facilities Dam, which is associated with the extreme flood event that occurred between 24 and 29 February 1955, where over 250 mm of rainfall fell over a 72 hour period. This event exceeded the 100 year ARI rainfall intensity for a 72 hour storm duration in the vicinity of the Project.

Uncontrolled offsite releases occur from sedimentation dams, which have been treated for sediment.

4.2.2 Controlled Offsite Discharges under HRSTS

Controlled offsite discharges refers to water discharged under the HRSTS directly from the Staged Discharge Dam/Bengalla Relocated Discharge Dam to Dry Creek. Figure 4.1 shows the total annual water discharges to Dry Creek over the Project period. Review of the results indicates the following:

- The 50th percentile annual discharge shows that no discharges are required under the HRSTS.

- The 90th percentile annual discharge shows that up to approximately 750 ML/a are discharged under the HRSTS.
- The 99th percentile annual discharge shows that up to approximately 1,550 ML/a are discharged under the HRSTS.
- There is a marked increase in potential discharges in Year 8 of Project life, likely associated with the large increase in impervious catchment area reporting to the mine water system. Year 4 has a total 'disturbed' footprint of 531 ha (industrial + overburden + active pit areas), compared to 744 ha in Year 8 (refer Section 3.4.2).

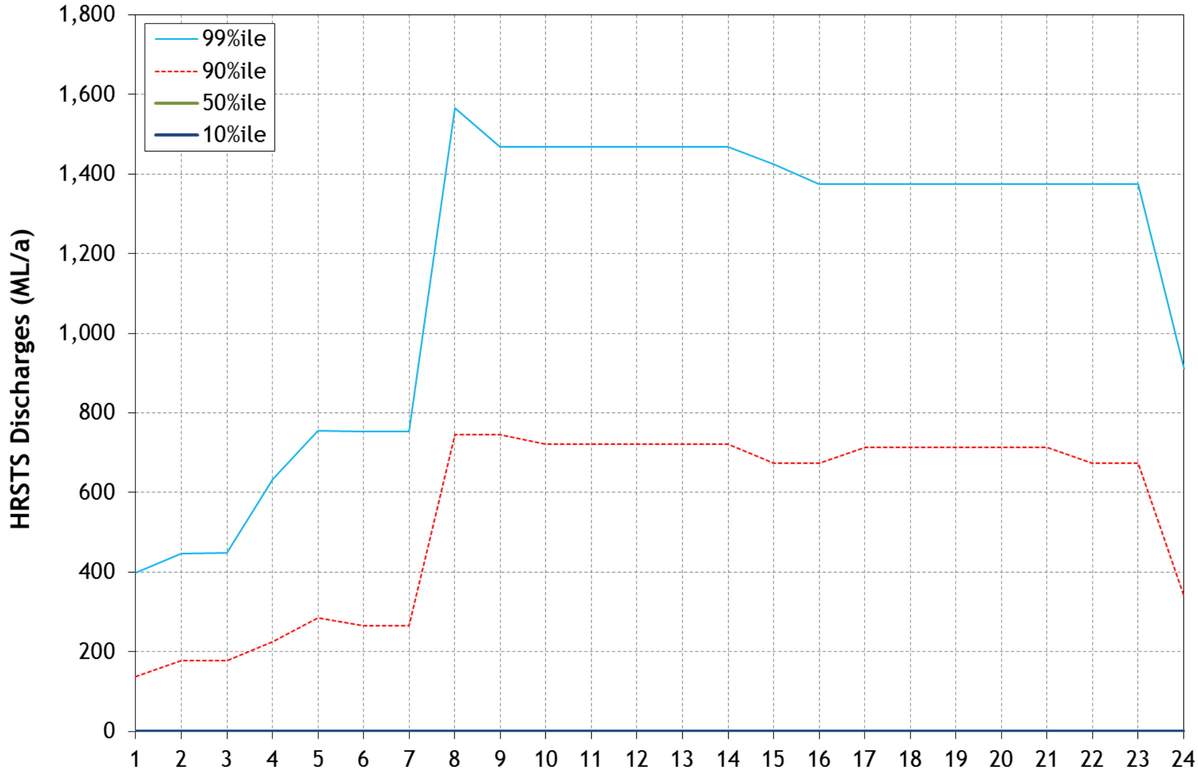

Figure 4.1 - Annual HRSTS Discharges

4.2.3 External Water Supply Requirements

Figure 4.2 shows the total annual modelled demand for water from an external source over the Project period. Review of the results indicates the following:

- There is a marked increase in raw water requirement in Year 4 of the Project life. This is likely due to the increase in CHPP throughput and increased haul road dust suppression requirements.
- The median (50th percentile) raw water requirement from an external source is between 1,140 and 1,530 ML/a during Years 5 to 24; and
- The 99th percentile raw water requirement from an external source is between 1,770 and 1,920 ML/a ML/a during Years 5 to 24.

The raw water source for the site demands is via an existing allocation from the Hunter Regulated River Water Source, which is pumped to the Raw Water Dam when required. Raw water is used as a last priority to meet site demands, with the exception of the vehicle wash demand which ranges between 97 and 132 ML/a.

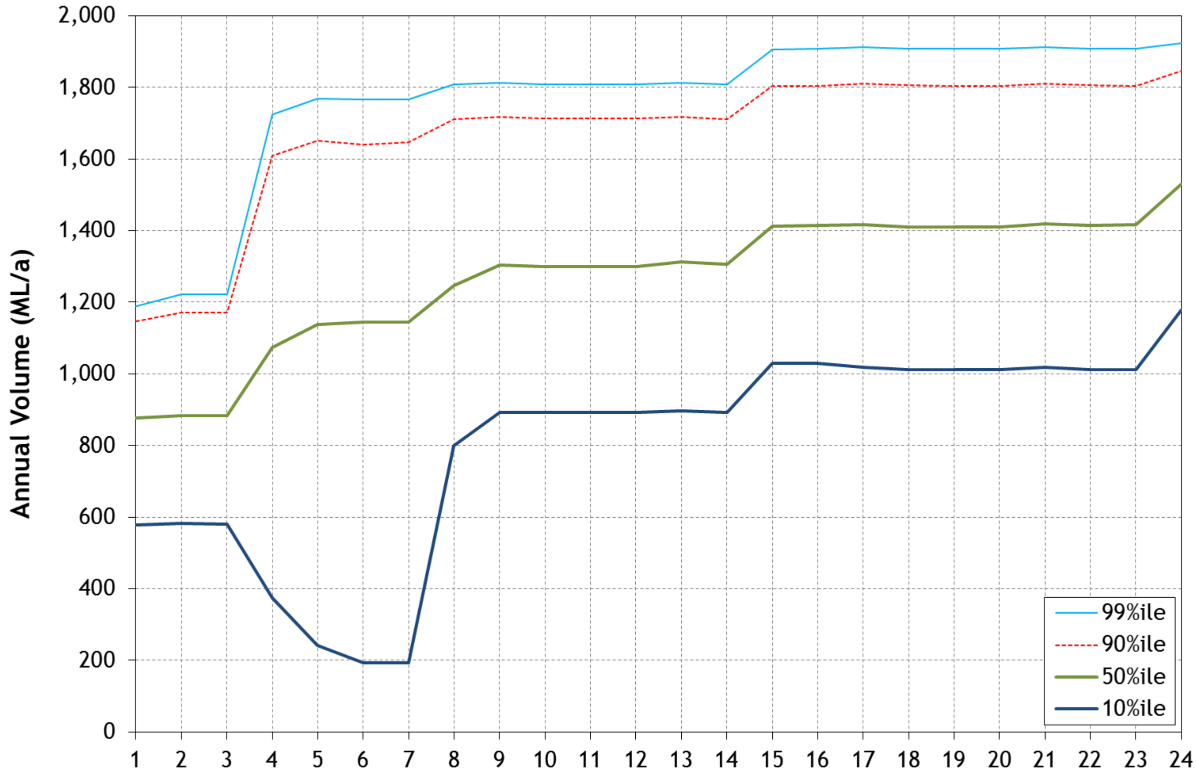

Figure 4.2 - Annual Raw Water Requirements - External Source

BMC hold WALs with sufficient share component totalling 6,017 units (comprising 1,455 high security units and 4,562 general security units) to account for the maximum predicted take for the life of Bengalla based on predicted demands from the Hunter Regulated River Water Source (Management Zone 1A). BMC maintains exclusive rights for the dedicated use of at least 2,534 units (comprising 1,449 high security units and 1,085 general security units) under these WALs. The remaining units of the WALs (comprising 2,702 units) are currently subject to use by licensees of BMC owned land for agricultural purposes.

4.2.4 Health of the water management system

The health of the water management system is reflected in the modelled stored inventory in the open cut pits. The operational rules have been set to ensure that the EPL conditions are met, which means that excess water is stored in-pit until it can be dewatered. The operation of the mine is potentially impacted when there is excess water in the pit. It also suggests that additional out of pit storage is required.

Figure 6.16 and Figure 6.17 show the stored inventory in the Main Pit and Satellite Pit respectively over the Project life. Review of the results indicates the following:

- The median (50th percentile) inventories of Main Pit and Satellite Pit show that the pits are generally maintained dry.
- The 90th percentile inventory in Main Pit reaches 240 ML. This volume generally occurs when the Satellite pit is operational. Excess water will be pumped to the Main pit when and if these wet conditions occur. This has not been explicitly modelled.
- The 90th percentile inventory in Satellite Pit reaches 450 ML (excluding Main Pit water), which would potentially affect mining. There is sufficient flexibility in the mine plan to slow mining in the Satellite Pit if these wet conditions prevail.

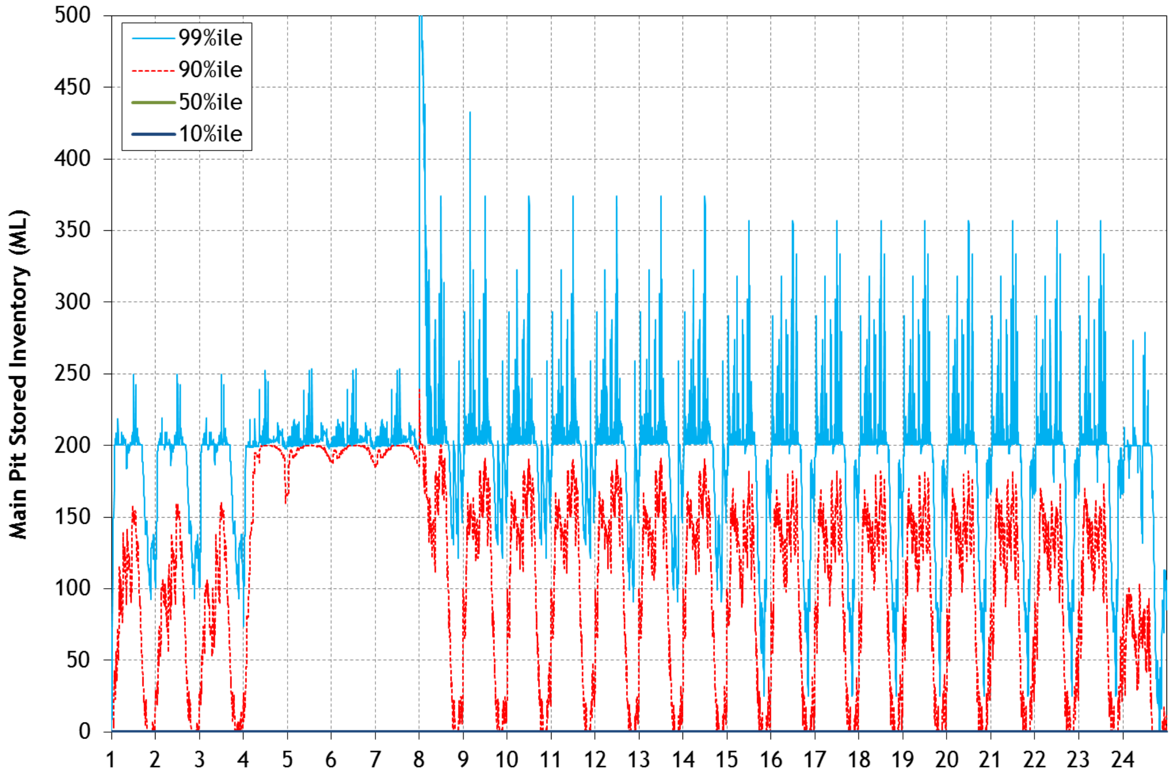

Figure 4.3 - Main Pit Stored Inventory (ML)

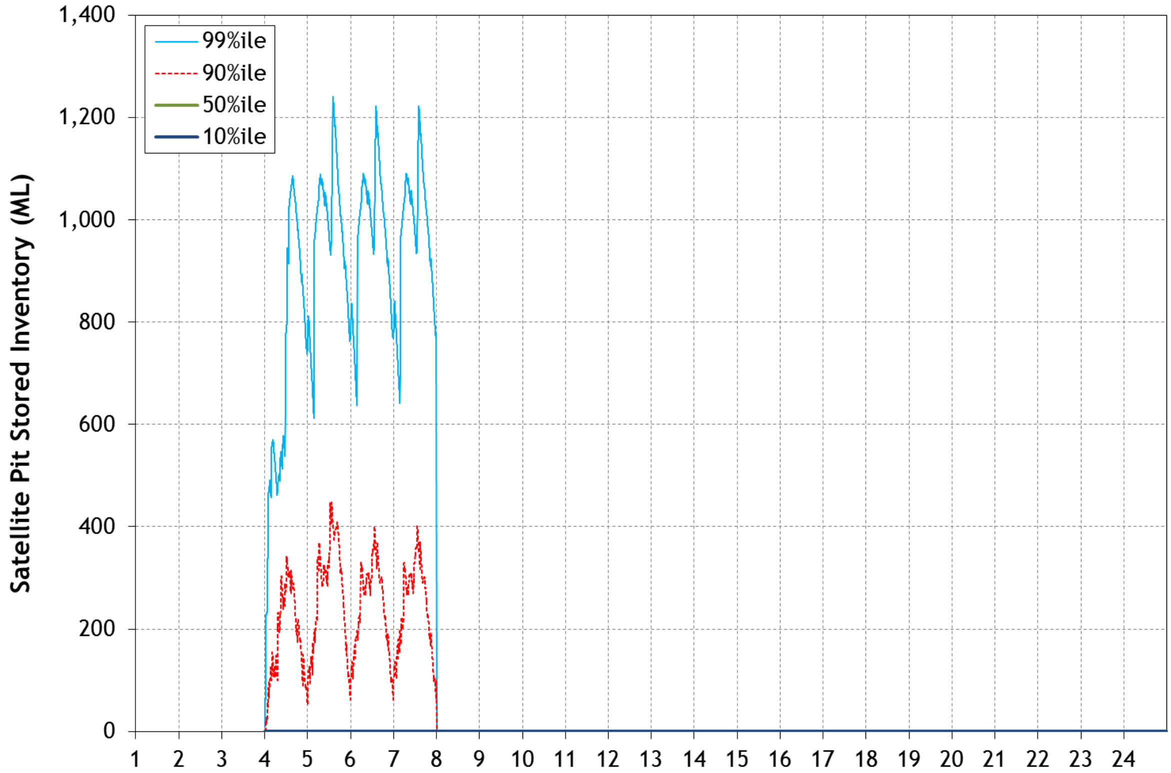

Figure 4.4 - Satellite Pit Stored Inventory (ML)

5 Summary of findings

Water balance modelling has been undertaken to assess the impacts of the proposed water management infrastructure alterations on the Bengalla water management system and in particular the potential impacts of the Modification on local surface hydrology. The results of the mine water balance are summarised below:

- The mine water management system can generally be operated in accordance with its EPL conditions with respect to uncontrolled releases of mine affected water.
  - There is one modelled discharge from the upgraded East & West Facilities Dam (after the existing capacity has been increased). The East and West facilities dam spill is associated with the extreme flood event that occurred between 24 and 29 February 1955, where over 250 mm of rainfall fell over a 72 hour period. This event exceeded the 100 year ARI rainfall intensity for a 72 hour storm duration in the vicinity of the Project.
  - There are no uncontrolled releases from any other mine water dam.
- Controlled releases under the HRSTS will be required if wet conditions prevail. There is a 50% chance of no HRSTS releases, a 10% chance (90^{th} percentile trace) of at least 750 Ml/a of releases and a 1% chance (99^{th} percentile trace) of at least 1,550 ML/a of releases
- External water will be required to meet mine site demand. The median (50^{th} percentile) external water requirement is between 1,140 and 1,530 ML/a during Years 5 to 24 and the 99^{th} percentile raw water requirement from an external source is between 1,770 and 1,920 ML/a during Years 5 to 24. BMC hold sufficient WALs from the Hunter Regulated River Water Source with sufficient share component totalling 6,017 units (comprising 1,455 high security units and 4,562 general security units) to account for the maximum predicted take for the life of the project.
- The overall health of the water management system is reflected in the modelled stored inventory in the open cut pits. The median (50^{th} percentile) inventories of Main Pit and Satellite Pit show that the pits are generally maintained dry with no long term build up. The 90^{th} percentile inventory in Main Pit and the Satellite Pit reaches 240 ML and 450 ML respectively. The Satellite Pit will be used to store excess water when wet conditions prevail. The excess water can generally be managed in Pit when the Satellite Pit has been consumed.

6 References

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BMC, 2015	*Bengalla Mining Company Pty Limited Water Management Plan.* Report prepared by WRM, Hansen Bailey and AGE dated 20 May 2015.
Boughton WC, 1993	*A hydrograph based model for estimating the water yield of Ungaged Catchments*, Hydrology and Water Resources Symposium, June 1993, newcastl
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Hansen Bailey, 2013	*Continuation of Bengalla Mine Environmental Impact Statement* prepared by Hansen Bailey Environmental Consultants September 2013
Jeffrey et al. 2001	*Using Spatial interpolation to Construct a Comprehensive Archive of Australian Climate Data, Environmental Modelling & Software, Vol. 16/4, pp. 309-330, 2001*
PB, 2009	*Existing Surface Water Management Infrastructure Assessment – Bengalla Coal Mine, September 2009*

Appendix A - **Catchments & land use classification**

Table A.1 – Year 1 - catchment and land use classification breakdown (ha)

Storage	Natural/dirty water	Industrial	Rehabilitated Spoil	Overburden	Open Cut Pit	Total
Bengalla East Sed Dam			48.5			**48.5**
East & West Facilities Dam	1.8	47.8	39.6			**89.2**
End Wall Dam			76.8			**76.8**
Hot Tyre Parkup Dam	4.3	1.6				**5.9**
Main Pit	6.9	116.1		135.5	26.7	**285.2**
North Dump Sed Dam			12.9	0.6		**13.5**
Ramp Dam				3.8		**3.8**
Raw Water Dam	2.0					**2.0**
ROM North Sed Dam	7.9	3.5	0.7			**12.1**
South Loop Road Sed Dam	0.7	1.0				**1.7**
South Tyre Dam		1.2				**1.2**
Staged Discharge Dam	12.0					**12.0**
Train Loadout Sump	0.7	0.1				**0.8**
Twin Gullies Sed Dam	19.0	10.2				**29.2**
Wantana East Sed Dam			71.8			**71.8**
Wantana West Dam			3.9			**3.9**
Washery Dam	1.5					**1.5**
Water Overflow Bypass			99.3			**99.3**
Western OEA Sed Dam B	16.1			9.7		**25.8**
Windmill Sed Dams		5.2				**5.2**
Wybong Rd Sed Dam	7.1	6.0				**13.1**
Total	**80.0**	**192.7**	**353.5**	**149.6**	**26.7**	**802.5**

Table A.2 – Year 4 - catchment and land use classification breakdown (ha)

Storage	Natural/dirty water	Industrial	Rehabilitated Spoil	Overburden	Open Cut Pit	Total
Bengalla Discharge Dam	14.7					**14.7**
Bengalla East Sed Dam			69.1	6.6		**75.7**
Dry Creek Clean Water Dam	631.3					**631.3**
East & West Facilities Dams	2.1	73.2	33.7			**109.0**
Endwall Dam			76.8			**76.8**
Facilities Sump		0.1				**0.1**
Main Pit		120.9	1.8	153.4	31.7	**307.8**
Mount Pleasant Discharge Dam	18.0					**18.0**
North Dump Sed Dam			13.5	1.3		**14.8**
Ramp Dam				8.6		**8.6**
Raw Water Dam	1.0					**1.0**
ROM North Sed Dam		13.5	0.7			**14.2**
Satellite Pit	446.8	67.1			9.0	**522.9**
South Loop Road Sed Dam		0.9	0.7			**1.6**
South Tyre Dam		1.2				**1.2**
Staged Discharge Dam	12.0					**12.0**
Train Loadout Sump	0.7	0.1				**0.8**
Twin Gullies Sed Dam	2.2	5.7				**7.9**
Wantana East Sed Dam			59.4			**59.4**
Wantana West Dam			16.3	24.5		**40.8**
Washery Dam	1.5					**1.5**
Water Overflow Bypass			105.1			**105.1**
Western OEA Sed DamB	7.8		9.7	8.3		**25.8**
Wybong Road Sed Dam	0.4	5.0				**5.4**
Total	**1,138.5**	**287.7**	**386.8**	**202.7**	**40.7**	**2,056.4**

Table A.3 – Year 8 - catchment and land use classification breakdown (ha)

Storage	Natural/dirty water	Industrial	Rehabilitated Spoil	Overburden	Open Cut Pit	Total
Bengalla Discharge Dam	14.7					**14.7**
Bengalla East Sed Dam			69.1	6.6		**75.7**
Dry Creek Clean Water Dam	631.3					**631.3**
East & West Facilities Dam	22.9	82.7	28.5			**134.1**
Endwall Dam			76.8			**76.8**
Facilities Sump		0.1				**0.1**
Main Pit	248.0	201.9		333.1	55.8	**838.8**
Mount Pleasant Discharge Dam	18.0					**18.0**
North Dump Sed Dam			13.5	1.3		**14.8**
Raw Water Dam	0.9					**0.9**
ROM North Sed Dam		5.9				**5.9**
South Loop Road Sed Dam			0.7	23.3		**24.0**
Train Loadout Sump	0.7	0.1				**0.8**
Wantana East Sed Dam			59.4			**59.4**
Wantana West Dam			16.3	24.5		**40.8**
Washery Dam	14.7					**14.7**
Water Overflow Bypass			105.1	8.6		**113.7**
Total	**951.2**	**290.7**	**369.4**	**397.4**	**55.8**	**2,064.5**

Table A.4 – Year 15 - catchment and land use classification breakdown (ha)

Storage	Natural/dirty water	Industrial	Rehabilitated Spoil	Overburden	Open Cut Pit	Total
Bengalla Discharge Dam	11.6					**11.6**
Bengalla East Sed Dam			73.1			**73.1**
Creek Sed Dam			9.5	52.9		**62.4**
Dry Creek Clean Water Dam	630.9					**630.9**
East & West Facilities Dam		91.0	25.0			**116.0**
End Wall Dam			87.2			**87.2**
Facilities Sump	0.1					**0.1**
Main Pit	129.0	254.9	33.4	287.3	54.4	**759.0**
Mount Pleasant Discharge Dam	18.0					**18.0**
North Dump Sed Dam			4.8			**4.8**
Ramp Dam			0.2			**0.2**
Raw Water Dam	0.7					**0.7**
ROM North Sed Dam		6.1	2.9	4.4		**13.4**
South Loop Road Sed Dam			38.2			**38.2**
Train Loadout Sump	0.7	0.1				**0.8**
Wantana East Dam			59.4			**59.4**
Wantana West Dam			42.1			**42.1**
Washery Dam	2.5					**1,917.9**
Water Overflow Bypass			255.8			**3,824.2**
Total	**793.5**	**352.1**	**631.6**	**344.6**	**54.4**	**7,660.0**

Table A.5 – Year 24 - catchment and land use classification breakdown (ha)

Storage	Natural/dirty water	Industrial	Rehabilitated Spoil	Overburden	Open Cut Pit	Total
Bengalla Discharge Dam	11.6					**11.6**
Bengalla East Sed Dam			73.2			**73.2**
Dry Creek Relocation	31.1		557.1	15.5		**603.7**
East & West Facilities Dam		91.0	26.7	14.4		**132.1**
End Wall Dam			87.5			**87.5**
Facilities Sump		0.1				**0.1**
Main Pit	20.2	167.9		224.1	55.3	**467.5**
Mount Pleasant Discharge Dam	18.0					**18.0**
North Dump Sed Dam			4.8			**4.8**
Ramp Dam			0.2			**0.2**
Raw Water Dam	0.7					**0.7**
ROM North Sed Dam		5.5		4.4		**9.9**
South Loop Road Sed Dam			38.2			**38.2**
Spare Dam	83.8					**83.8**
Train Loadout Sump	0.7	0.1				**0.8**
Wantana East Dam			59.4			**59.4**
Wantana West Dam			42.1			
Washery Dam	2.5					**2.5**
Water Overflow Bypass			128.6			**1,594.0**
Total	**168.6**	**264.6**	**1,017.8**	**258.4**	**55.3**	**3,188.0**