  

Boggabri Coal Pty Ltd

Site Water Balance

June 2015

Revision Control Chart

Rev No	Original	1	2	3	4	5	6
Revision Date	27/04/12	14/9/12	19/07/13	09/10/13	18/11/13	12/02/14	04/06/15
Prepared by	L Doeleman	L Doeleman	N Harcombe, A Hedjripour	N Harcombe, A Hedjripour	N Harcombe	K Agllias	L Doeleman
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Approved by	J Rennick	J Green	C Dingle	C Dingle	J Green	J Green	J Green
Signed							

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Company	Position
BCPL	Environment Superintendent
Department of Trade and Investment, Regional Infrastructure and Services – Division of Resources and Energy	Regional Environment Officer
Department of Planning and Infrastructure (DP&I)	Senior Planner
Downer EDI Mining	Project Manager
LCR Coal	Project Manager

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Glossary

Glossary	
AEMR	Annual Environmental Management Report
AGE	Australasian Groundwater & Environmental Consultants
ARI	Average Recurrence Interval
AWBM	Australian Water Balance Model
AWD	Available Water Determinations
BCPL	Boggabri Coal Pty Limited
BOM	Bureau of Meteorology
BTM Complex	Boggabri-Tarrawonga-Maules Creek Complex
CCC	Community Consultative Committee
CD	Clean Water Highwall Dam
CHPP	Coal Handling and Preparation Plant
DECCW	Department of Environment, Climate Change and Water
DP&I	NSW Department of Planning and Infrastructure
EA	Environmental Assessment
EC	Electrical Conductivity
EP&A Act	*Environmental Planning and Assessment Act, 1979*
EPL	Environment Protection Licence
GMP	Groundwater Management Plan
HD	Highwall Dam
IFD	Intensity-Frequency-Duration
MCC	Maules Creek Coal Project
MIA	Mine Infrastructure Area
ML	Megalitres
Mtpa	Million Tonnes Per Annum
MWD	Mine water dam
NCMA	Namoi Catchment Management Authority
NOW	NSW Office of Water
OEH	NSW Office of Environment and Heritage
PAC	NSW Planning Assessment Commission
ROM	Run of Mine
SD	Sediment dam
SWB	Site Water Balance
SWMP	Surface Water Management Plan
TBA	To Be Advised
TCM	Tarrawonga Coal Mine
TCPL	Tarrawonga Coal Pty Ltd
WAL	Water Access Licence

Glossary	
WMP	Water Management Plan
WSP	Water Sharing Plan

1. Introduction

Boggabri Coal Mine is located 15 km north-east of the township of Boggabri in north-western New South Wales and comprises an open cut coal mine that has been operating since 2006. Truck and shovel operations produce a crushed and screened run of mine (ROM) coal product. Coal is transported on a sealed private haul road to a rail loading facility, for dispatch via the port of Newcastle for overseas consumption.

The mine is managed by Boggabri Coal Pty Limited (BCPL), who engages contractors to undertake construction, mining, coal crushing and transportation activities. All contractors working at the Boggabri Coal Mine are required to operate in compliance with the Water Management Plan (WMP), which this Site Water Balance (SWB) forms a component.

In 2009, BCPL lodged a major project application (the Project) under the now-repealed Part 3A of the *Environmental Planning and Assessment Act, 1979* (EP&A Act). In the project application, BCPL sought to extend its mining operations for a further 21 years, and increase its production rate to 7 Million tonnes per annum (Mtpa) of ROM coal from a total resource of 145 Mt. The Project includes operation of existing ancillary equipment; construction of a new coal handling and preparation plant (CHPP); a 17 km rail spur line; bridges over the Namoi River and Kamilaroi Highway; a rail load-out facility located at the mine; upgrade of the overburden and coal extraction haulage fleet (with an option for a drag-line); upgrade of electricity transmission lines; and other ancillary infrastructure.

The project application was determined by the NSW Planning Assessment Commission (PAC), under delegation by the Minister for Planning and Infrastructure. Project Approval 09_0182 (the Project Approval) was received in July 2012.

Schedule 3, Condition 38 (a) of the state Project Approval requires the preparation of a SWB. This SWB has been prepared in fulfilment of the requirements. The specific requirements of the SWB are listed in Table 1.3.

Conditions of approval were released by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) on 11 February 2013. No conditions relate specifically to the SWB, but rather to the broader site Water Management Plan of which this report forms a part.

The SWB described herein considers the entire life of mine and utilises the most current and detailed information available to define components of the SWB. To ensure clarity throughout the document, reference is made to two distinct mine plans for which demand, usage and storage characteristics are based, specifically the:

1. Revised Draft Mining Operations Plan (MOP): lodged with the NSW Division of Resources and Energy (DRE) in March 2015. The MOP spans a 5-year period between 2015 and 2019. Mine plan snapshots and water management systems relevant to mine years 2015, 2017 and 2019 are aligned with the MOP.

2. Environmental Assessment (EA) Mine Plan: lodged in 2009 and conditionally approved by the NSW Minister for Planning and Infrastructure in July 2012, the EA mine plan spans a 21 year period between 2013 and 2034. Mine plan snapshots and water management systems relevant to mine years beyond 2019 reflect the EA mine plan.

1.1 Site contacts

The names and contact details of relevant BCPL employees and contractors are shown in Table 1.1.

Table 1.1 Site contacts

Title	Company	Name	Contact No
General Manager Operations	BCPL	Ken McLaren	0417 161 260
Manager Mining	BCPL	Lloyd Hardy	02 6743 4775
Environment Superintendent	BCPL	Hamish Russell	02 6743 4775 0438 003 915
Mining Contractor	Downer EDI Mining	Mike Williams	0427 460 414
Coal Haulage Contractor	LCR	Mick Schultz	0417 188 007
24 Hour Community Response Line	BCPL	-	1800 Boggabri

1.2 Aim of this SWB

The aim of the SWB is to:

- facilitate compliance with the Project Approval, Environment Protection Licence 12407 (the EPL), conditions of Mining leases CL 368, A355, A339 and all relevant environmental legislation, licences and permits
- detail the sources and security of water supply, including contingency for future reporting periods
- detail water use and water management at Boggabri Coal Mine
- describe management of any off-site water discharges
- outline reporting procedures including the preparation of a SWB for each calendar year
- outline the program to validate the surface water model, including monitoring discharge volumes from the site and comparison of monitoring results with modelled predictions
- describe the measures that would be implemented to minimise clean water use on site

1.3 Application of the SWB

This SWB applies to all employees and contractors at the Boggabri Coal Mine and covers all areas within the ‘Project Boundary’ as defined in the Project Approval.

1.4 Related water management documents

This SWB report has been prepared as an integral part of, and should be read in conjunction with, the documents listed in Table 1.2. The WMP document hierarchy is shown in Figure 1.1.

Table 1.2 Related water management documents

Document	Description
BTM Complex Water Management Strategy	Regional strategy prepared in consultation with Tarrawonga Coal Pty Ltd (TCPL) and Maules Creek Coal Project (MCC)
Water Management Plan	Overarching document setting out water management framework, statutory requirements and procedural requirements
Surface Water Management Plan	Surface water baseline data, performance criteria, monitoring program, response plan, water management system description, erosion and sediment controls
Site Water Balance report	Mine water balance modelling methodology, assumptions and results, mine water management system operating philosophy
Construction Environmental Management Plan	Potential impacts and mitigation measures relating to water management during construction of MIA expansion and rail line.

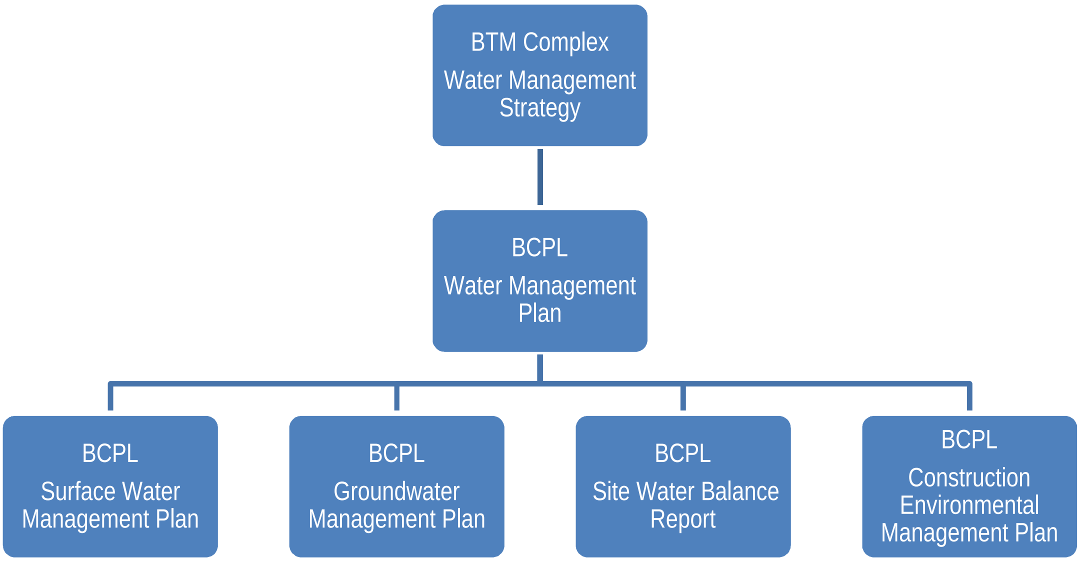


Figure 1.1 Document hierarchy

1.5 Consultation

Previous versions of this SWB have been prepared in consultation with representatives from the NSW Office of Environment and Heritage (OEH), NSW Office of Water (NOW), Namoi Catchment Management Authority (NCMA) and the Community Consultative Committee (CCC).

The SWB has been prepared by suitably qualified persons approved by the DP&I to undertake this work. Draft versions of this WMP have been reviewed by DP&I and comments have been addressed.

Previous versions of this plan have been submitted to regulators (EPA and NOW), NCMA and the CCC, and have been updated to incorporate feedback from regulators and the CCC. Evidence of consultation is presented in Appendix A of the WMP.

1.6 Conditions of the Project Approval

State Government Project Approval conditions outlining the requirements for the SWB are provided in Section 3.3 of the WMP and summarised in Table 1.3. SEWPAC approval conditions did not specify any additional conditions relating to the SWB. Evidence of consultation is presented in Appendix A of the WMP.

Table 1.3 Project conditions of approval – Planning and Assessment Commission of NSW

Applicable Condition	Requirement	SWB Reference
Schedule 3, Condition 38(a)	The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director-General. This plan must be prepared in consultation with OEH, NOW, Namoi CMA and the CCC, by suitably qualified and experienced person/s whose appointment has been approved by the Director-General, and be submitted to the Director-General for approval within 6 months of the date of this approval …(which shall include)…	This SWB forms part of the WMP. Suitably qualified and approved persons have prepared the plan in accordance with this requirement.
	▪ a Site Water Balance, that includes details of: ‣ sources and security of water supply, including contingency for future reporting periods;	Refer to Sections 4 and 6
	‣ water use on site;	Refer to Section 4.5
	‣ water management on site;	Refer to Section 3
	‣ any off-site water discharges;	Refer to Section 4.7 and Table 4.8 which summarises site wide releases to Nagero Creek
	‣ reporting procedures, including the preparation of a site water balance for each calendar year;	Refer to Sections 6.1 and 6.2
	‣ a program to validate the surface water model, including monitoring discharge volumes from the site and comparison of monitoring results with modelled predictions; and	Refer to Sections 6.1 and 6.2
	‣ the measures that would be implemented to minimise clean water use on site	Refer to Section 3.1

1.7 Revision status

The SWB described herein considers the entire life of mine and reflects the mine plans described in both the:

1. Revised Mining Operations Plan (MOP): lodged with the NSW Division of Resources and Energy (DRE) in March 2015.

2. Environmental Assessment (EA) Mine Plan: lodged in 2009 and conditionally approved by the NSW Minister for Planning and Infrastructure in July 2012.

The SWB report is to be reviewed and updated on an annual basis, or when any significant changes are made to mining operations or to the site water management system described in this report. Revisions and updates made to this SWB report are summarised in Table 1.4.

Table 1.4 Revision status

Rev No.	Mine year	Approval reference	Author	Approval	Date	Comment
0	Years 1 to 2 (i.e. calendar years 2012 to 2013)	Boggabri Modification - DA 36/88 as modified on 19 October 2011	L Doeleman	J Rennick	27 April 2012	Issue to DP&I, OEH, NOW, DRE, NCMA
1	Years 1 to 21 (i.e. calendar years 2012 to 2033)	Boggabri Coal Project 09-0182 - as approved on 18 July 2012	L Doeleman	J Green	16 January 2013	Issue to DP&I, OEH, NOW, NCMA, CCC
2	Years 1 to 21 (i.e. calendar years 2013 to 2033)	Boggabri Coal Mine as per Draft MOP lodged June 2013 and Boggabri Coal Project 09-0182 – as approved 18 July 2012	N Harcombe A Hedjripour	C Dingle	19 July 2013	DP&I comments addressed on draft WMPs.
3	Years 1 to 21 (i.e. calendar years 2013 to 2033)	Boggabri Coal Mine as per Revised Draft MOP lodged November 2013 and Boggabri Coal Mine Extension (EPBC 2009/5256) – as approved 11 February 2013	N Harcombe A Hedjripour	C Dingle	09 October 2013	BCPL comments addressed. Issue to DP&I
4	Years 1 to 21 (i.e. calendar years 2013 to 2033)	Boggabri Coal Mine as per Revised Draft MOP lodged November 2013 and Boggabri Coal Mine Extension (EPBC 2009/5256) – as approved 11 February 2013	N Harcombe S Trott	J Green	18 Nov 2013	DP&I and BCPL comments addressed. Issue to EPA and DoE
5	Years 1 to 21 (i.e. calendar years 2013 to 2033)	Boggabri Coal Mine as per Revised Draft MOP lodged November 2013 and Boggabri Coal Mine Extension (EPBC 2009/5256) – as approved 11 February 2013	K Agllias S Trott	J Green	12 February 2014	Relevant agencies comments addressed. Issue to DP&I

Rev No.	Mine year	Approval reference	Author	Approval	Date	Comment
6	Calendar years 2015 to 2033	Boggabri Coal Mine as per Revised Draft MOP lodged March 2015 and Boggabri Coal Mine Extension (EPBC 2009/5256) – as approved 11 February 2013	L Doeleman	J Green	4 June 2015	Updated for revised MOP, water demands and water supplies. Updated for latest available climate data.

Examples of changes that would trigger a review

The following could potentially trigger a future review of this SWB report:

- Changes to the mine staging plans, mine infrastructure or mine operations
- Significant changes to site water demands or water sources
- Changes to the water management structures as described in this report (such as changes in the location or capacity of storages)
- Changes in the timing of commissioning / upgrading water management structures as described in this report
- Commissioning of an onsite irrigation system to dispose of surplus contaminated water
- Changes to groundwater make predictions adopted in this report
- Extension of mining beyond the end of December 2033
- The outcomes from an independent audit required under the approval conditions
- Actions or changes required as a result of an incident report
- Significant differences for results of model validation/calibration

2. Existing environment

2.1 Catchment description

The Boggabri Coal Mine and Mine Infrastructure Area (MIA) are contained within the catchment of an unnamed ephemeral drainage line locally referred to as 'Nagero Creek'. Nagero Creek is an ephemeral stream that is a tributary of the Namoi River.

The Nagero Creek catchment is described in the Surface Water Management Plan (SWMP).

2.2 Climate data

Daily rainfall and evaporation data for the site for the 126 year period between 1889 and 2015 was obtained from the Bureau of Meteorology (BOM) Data Drill service. The Data Drill accesses grids of data derived by interpolating the BOM's station records. The data in the Data Drill are all synthetic; there are no original meteorological station data left in the calculated grid fields. However, the Data Drill does have the advantage of being available for any set of coordinates in Australia (BOM, 2006).

The Data Drill is considered superior to individual BOM station records and site meteorological station data for long-term water balance modelling purposes because it draws on a greater dataset, both spatially and in time. The Data Drill is also considered superior for modelling purposes as it does not contain gaps.

Plots of Data Drill sourced annual rainfall and annual lake evaporation for the 126 year period between 1889 and 2015 are provided in Figure 2.1 and Figure 2.2 respectively. A plot of Data Drill sourced average daily lake evaporation for each month of the year is provided in Figure 2.3. Summary statistics of Data Drill sourced annual rainfall and evaporation are provided in Table 2.1.

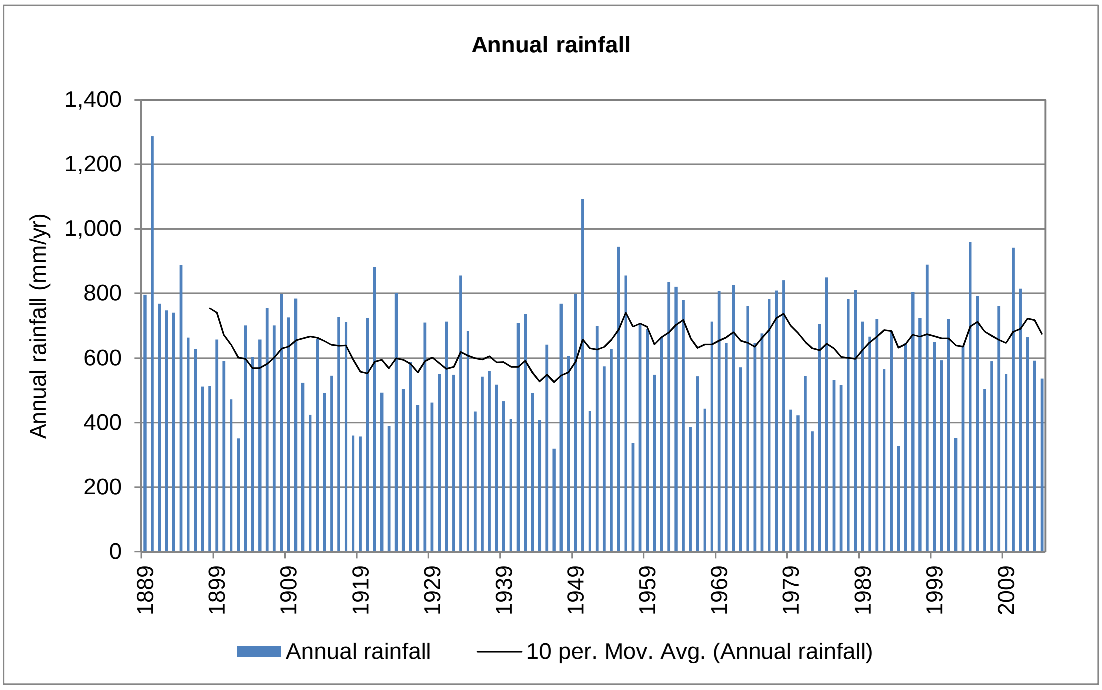


Figure 2.1 Annual rainfall for Boggabri from 1889 to 2015 (Data Drill)

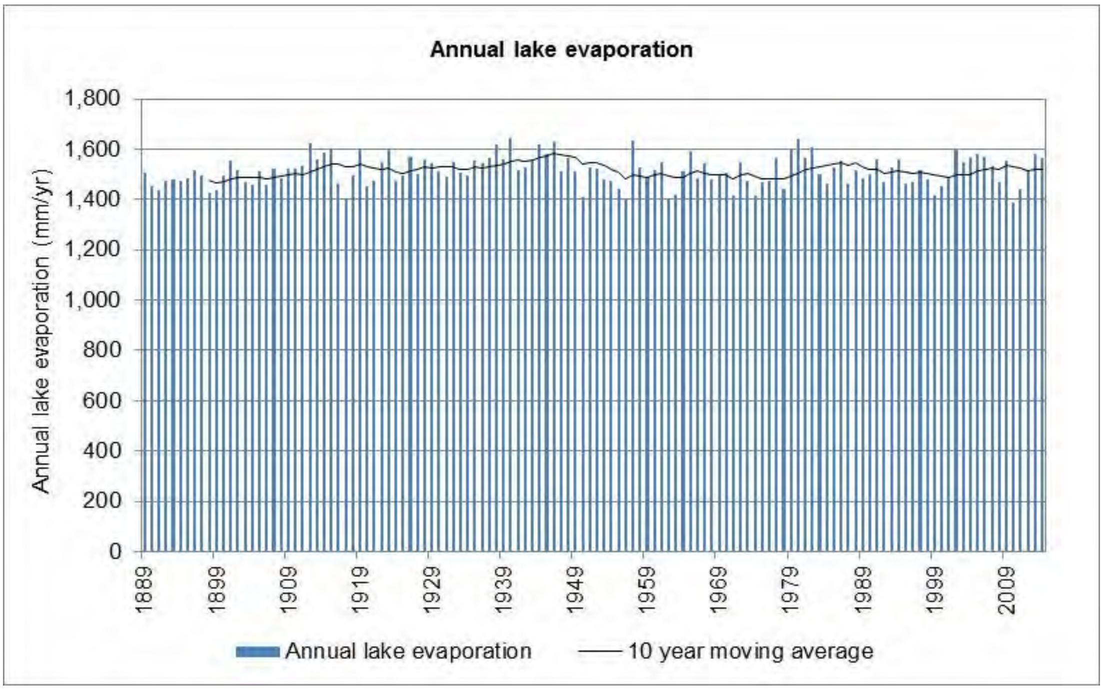


Figure 2.2 Annual lake evaporation for Boggabri from 1889 to 2015 (Data Drill)

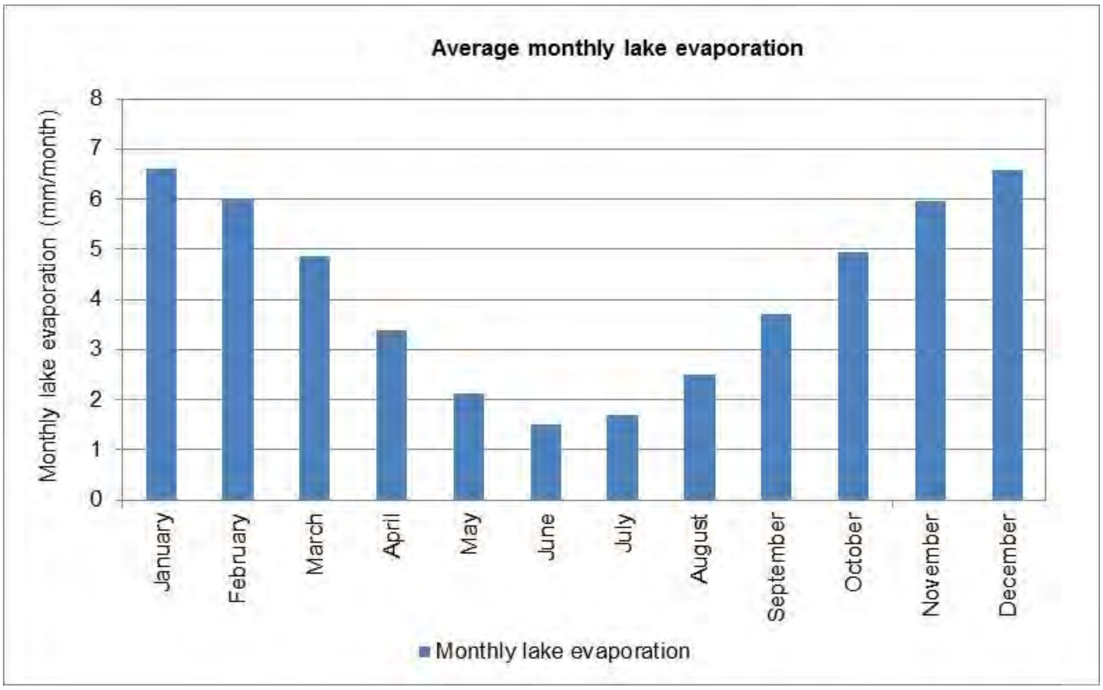


Figure 2.3 Average daily lake evaporation for Boggabri from 1889 to 2015 (Data Drill)

Table 2.1 Annual rainfall and evaporation statistics for Boggabri from 1889 to 2015 (Data Drill)

Percentile	Annual rainfall (mm/yr)	Annual potential evapotranspiration (mm/yr) [1]	Annual lake evaporation (mm/yr) [2]
minimum	319	1,253	1,389
5th percentile	363	1,310	1,414
10th percentile	423	1,339	1,441
50th percentile	658	1,418	1,511
90th percentile	831	1,536	1,594
95th percentile	887	1,574	1,617
maximum	1,287	1,634	1,643

1 Potential evapotranspiration calculated using the Penman-Monteith formula given in Irrigation and Drainage paper No. 56 Food and Agriculture Organization of the United Nations (Smith, 1998).

2 Lake evaporation calculated using Morton formula for shallow lakes given in the Journal of Hydrology, Volume 66, page 1-77, paper (Morton, 1983).

Daily rainfall data has been recorded at the Boggabri Coal Mine meteorological station since July 2006. The site meteorological station data has been used to verify the water balance model against site monitoring results recorded for two significant rainfall events that occurred in 2011 and 2012 (discussed in Section 4.8).

2.3 Design rainfall data

2.3.1 Intensity-frequency-duration rainfall data

Design intensity-frequency-duration (IFD) rainfall data for the mine site area was obtained from the BOM website, and is provided in Table 2.2. This information is typically used in the sizing of contaminated water dams (i.e. 100 year Average Recurrence Interval (ARI) 72 hour volume is typically used to achieve the no spills principal).

Table 2.2 IFD data for Boggabri Coal Mine site

Duration	Rainfall intensity (mm/hr)						
	1 year ARI	2 year ARI	5 year ARI	10 year ARI	20 year ARI	50 year ARI	100 year ARI
5 mins	70.7	92.9	123	144	171	209	240
10 mins	53.6	70.4	93.5	109	129	158	181
20 mins	39.3	51.6	68.3	79.3	93.9	115	131
30 mins	31.9	41.8	55.3	64.1	75.9	92.6	106
1 hr	21.1	27.7	36.6	42.4	50.2	61.2	70.2
2 hrs	13.2	17.3	22.9	26.6	31.5	38.4	44
3 hrs	9.84	12.9	17.1	19.9	23.6	28.8	33
6 hrs	5.91	7.77	10.3	12	14.3	17.4	20
12 hrs	3.58	4.71	6.29	7.34	8.73	10.7	12.3
24 hrs	2.19	2.9	3.9	4.58	5.47	6.73	7.77
48 hrs	1.33	1.76	2.39	2.82	3.39	4.20	4.86
72 hrs	0.95	1.26	1.73	2.04	2.46	3.06	3.55

2.3.2 Five day rainfall depths

Five day rainfall depths for the mine site have been estimated based on the values provided for Gunnedah in the guidelines *Managing Urban Stormwater – Soils and Construction – Volume 1* (Landcom, 2004), and are provided in Table 2.3. These depths are typically used in the sizing of sediment dams. The guidelines recommend designing to the 90th percentile storm event for a sediment dam with duration of disturbance greater than three years and with a standard receiving environment.

Table 2.3 5-day rainfall depths for Boggabri Coal Mine site

Percentile	5-day rainfall depth (mm)
75th percentile	20.0
80th percentile	24.1
85th percentile	30.2
90th percentile	38.4
95th percentile	53.0

2.4 Rainfall-runoff

The volume of surface water runoff in the mine site catchment has been estimated using the Australian Water Balance Model (AWBM) rainfall-runoff model that has been incorporated into the water balance model.

2.4.1 AWBM rainfall-runoff model

The AWBM (Boughton, 1993) was used to derive catchment runoff time series from undisturbed, disturbed and rehabilitated catchments for use in the water balance.

The AWBM is a partial area saturation overland flow model. The use of partial areas divides the catchment into regions (contributing areas) that produce runoff during a rainfall-runoff event and those that do not. These contributing areas vary within a catchment according to antecedent catchment conditions, allowing for the spatial variability of surface storage in a catchment. The use of the partial area saturation overland flow approach is simple, and provides a good representation of the physical processes occurring in most Australian catchments (Boughton, 1993). This is because daily infiltration capacity is rarely exceeded, and the major source of runoff is from saturated areas. A schematic layout of the AWBM is provided in Figure 2.4.

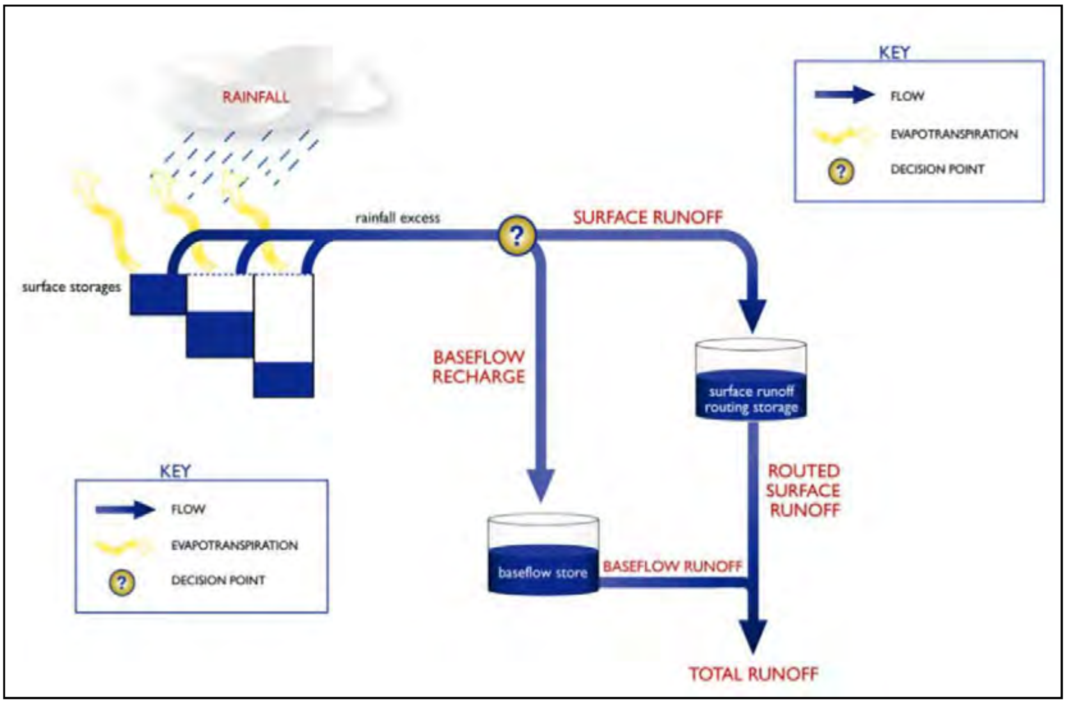


Figure 2.4 Schematic layout of the AWBM rainfall-runoff model (Source: CRC for Catchment Hydrology, 2004)

To implement the AWBM in a given catchment, a set of 9 parameters must be defined as summarised in Table 2.4. These parameters define the generalised model for a particular catchment. The parameters are usually derived for a gauged catchment by a process of calibration where the recorded streamflows are compared with calculated streamflows. The parameters are adjusted to produce the best match between the means and standard deviations of the daily streamflows, to match the difference in peak flow discharge.

Table 2.4 Description of AWBM parameters

Parameter	Description
A1, A2, A3	Partial areas represented by surface storages
C1, C2, C3	Surface storage capacities
K_s	Daily surface flow recession constant
BFI	Baseflow index
K_{base}	Daily baseflow recession constant

Adopted AWBM parameters are provided in Table 2.5, and are based on those adopted in the Boggabri Coal Project Surface Water Assessment (PB, 2010), with some updates where possible over the recent years. The adopted parameters for industrial and rehabilitated spoil areas are taken from the report entitled Boggabri Coal Mine 2008 Site Water Balance (PB, 2009).

The adopted parameters for disturbed areas, such as the mining void and spoil areas are based on past project experience on mine sites in New South Wales. Due to the absence of gauged runoff data from the site, calibration of AWBM parameters has not been undertaken for disturbed landuses. The use of best judgement engineering parameters is typical for mining sites.

Undisturbed AWBM parameters were calibrated using eWater software the “Rainfall Runoff Library”. The Rainfall Runoff Library uses historical flow data, evaporation and rainfall data for a concurrent period to carry out the calibration. Flow gauge data from Namoi @ Turrawan (419023) gauge, approximately 30 km north-west of the mine site (located downstream of the mine on the Namoi River) and SILO daily rainfall and daily evaporation data from 1995 – 2013 was used for the calibration. The catchment area reported to the gauge is 24,110 km^2. Calibrated undisturbed AWBM parameters have been updated in the model and are found in Table 2.5 below.

Table 2.5 AWBM parameters

Landuse	BFI	K_{base}	A1	A2	A3	C1	C2	C3
Undisturbed	0.05	0.803	0.134	0.433	0.433	22.57	230.54	461.07
Rehabilitated spoil	0.2	0.98	0.134	0.433	0.433	5.7	57.8	115.7
Industrial	0	1	0.134	0.433	0.433	2.3	22.9	45.7
Mining void	0	1	0.2	0.2	0.6	5	70	90
Active spoil	0.8	0.7	0.3	0.3	0.4	30	60	120
Pre-strip	0.2	0.98	0.134	0.433	0.433	4.6	46.5	93.0

3. Description of surface water management system

3.1 Design objectives and philosophy

The key objectives of the water management system design for the Boggabri Coal Mine are to:

- segregate clean runoff, dirty runoff and contaminated water generated from rainfall events and mining operations
- minimise the volume of contaminated mine water (surface runoff draining to pit and groundwater seepage) generated by the Project
- preferentially reuse contaminated water for dust suppression and coal washing
- provide sufficient on-site storage to avoid releases of contaminated water that could affect the quality of downstream watercourses
- treat all dirty runoff from unrehabilitated overburden areas to settle coarse suspended solids
- maximise diversion of clean runoff to downstream creeks

The following definitions have been adopted for the various runoff types:

- **Clean runoff** is defined as runoff from catchments that are not disturbed by mining operations.
- **Dirty runoff** is defined as runoff from disturbed areas within the mine site and includes runoff from the spoil dumps, haul roads and parts of the MIA. This water contains high levels of suspended solids.
- **Contaminated water** is defined as runoff generated from coal stockpiles, the CHPP, parts of the MIA and the mining void, as well as groundwater inflows to the mining void. This water contains high levels of suspended solids and is mildly saline.

Water management system conceptual layout plans for 2015, 2017, 2019, 2022 and 2033 are provided in Appendix A. Schematic diagrams showing the general connectivity between water sources, demands and storages for 2015, 2017, 2019, 2022 and 2033 are also provided in Appendix A. Note calendar year 2022 corresponds to 'Year 10' from the EA, and calendar year 2033 corresponds to 'Year 21' from the EA.

3.1.1 Clean water management system

The diversion of clean water runoff from undisturbed catchments will be maximised around the mine working area and into Nagero Creek.

In some instances as the mine pit footprint changes, remanent undisturbed catchments may remain that can't be feasibly diverted around the pit via clean water drains due to topographical limitations. In these instances, where feasible, highwall dams (HD) will be constructed upslope of the pit to intercept these flows and provide temporary storage, with subsequent controlled pump-out and discharge to a suitable receiving creek system at a downstream point.

In other locations it is not feasible to provide diversion drains or highwall dams due to the advancing topsoil stripping and stockpiling. In these circumstances clean water will be allowed to enter the active mining areas and the dirty water diversion system. BCPL will be required to account for the additional captured water and hold adequate licences or harvestable rights.

3.1.2 Dirty water management system

Dirty water runoff will be captured in sediment dams to encourage the settling of suspended solids. Runoff from large storm events (i.e. typically exceeding the 90th percentile 5 day rainfall depth) will overtop sediment dams and discharge to Nagero Creek. Captured water will either be discharged to Nagero Creek (if the water quality meets EPA licence requirements) or pumped to mine water dams (MWDs) for storage and reuse. This will depend on water quality and the SWB.

It is expected that water captured in sediment dams will be suitable for release following settling of suspended solids. However, as there is still the potential for spoil dump runoff to have elevated acidity, salinity, dissolved metals and oils and greases, sediment dams will be provided with manually operated valves on the outlet pipes. Alternatively, sediment dams will be provided with a mobile pump out system only. This will allow discharge to the creek to be prevented if water quality is not suitable (and to allow for flocculation or other measures required to attain the approved discharge water quality criteria).

The Boggabri Coal Project Surface Water Assessment (PB, 2010) predicted that the site would be in an annual water surplus under median climatic conditions for Years 2013 and 2014. Sediment dam water would therefore be discharged to Nagero Creek following settling under normal operating conditions in 2013 and 2014 to minimise the volume of water that accumulates onsite (assuming that the EPL discharge criteria is met; for further detail, refer to the SWMP). Sediment dam water would only be reused onsite in 2013 and 2014 when water quality is not suitable for discharge to the creek system.

After mid-2015 when the CHPP becomes operational, the site is predicted to move to an annual water deficit under median climatic conditions. Sediment dam water would therefore be reused onsite when required to supplement a deficit after mid-2015 in order to minimise external raw water requirements.

3.1.3 Contaminated water management system

Contaminated water will be stored in contaminated water dams, MWDs or the mining void and will not be discharged to Nagero Creek. The water management system will aim to reuse as much contaminated water as possible onsite, and contaminated water will be used as a priority for dust suppression and coal washing (excluding a minimum raw water component required for coal washing). When the capacity of MWDs is reached (and Strips #9 and #40 in 2015), surplus contaminated mine water will be stored in-pit.

The Boggabri Coal Project Surface Water Assessment (PB, 2010) predicted that the site would be in an annual water surplus under median climatic conditions for 2013 and 2014. In 2013 and 2014 temporary in-pit mine water storage will be provided to cater for this surplus. The temporary storage will be a segregated void area within the advancing mining pit area

(Strips #9 and #40). After 2014, water would still be stored in pit during wet weather, however, the existing MWDs will be upsized by mid-2015 to provide additional out-of-pit mine water storage.

The OEH varied the EPL on 16 February 2012 to allow for a one-off emergency discharge of up to 700 Megalitres (ML) of mine water to Nagero Creek to allow for pit dewatering following significant rainfall events that occurred in December 2011 and February 2012. Despite the recent licence variation to allow for a one-off discharge, BCPL commits to not discharging contaminated mine water from the site. Following the controlled discharge, the NSW OEH varied the EPL on 3 August 2012 to remove the emergency discharge point from the licence. The most recent variation of the EPL is dated 19 February 2015 and should be used as the basis for the monitoring locations . A variation to the EPL will be sought to update additional monitoring locations at new sediment dams in line with the updated MOP.

3.2 Design criteria

3.2.1 Dirty water sediment dams

Dirty water sediment dams have been sized based on the criteria recommended in the guidelines *Managing Urban Stormwater - Soils and Construction - Volume 2E Mines and Quarries* (DECCW, 2008).

The Managing Urban Stormwater guidelines recommend that Type F/D sediment basins be provided for catchments with fine or dispersible soils. These are ‘wet basins’, comprising a ‘settling zone’ for temporary treatment storage and a ‘sediment zone’ for storage of sediment.

The Managing Urban Stormwater (“Blue Book”) guidelines recommend that the ‘settling zone’ be sized to capture the 90th percentile 5 day duration storm event, and the ‘sediment zone’ be sized at 50% of the ‘settling zone’ volume. This sizing is based on a site disturbance duration of more than three years, and results in an average sediment dam overflow frequency of two to four overflows per year. For sizing purposes, a runoff coefficient of 0.75 has been adopted for disturbed areas such as overburden emplacement areas and topsoil stockpiles. A runoff coefficient of 0.4 has been adopted for undisturbed areas. As sediment dams have been sized for a 5 day management period, the ‘settling zone’ should be drained or pumped out within 5 days following a rainfall event of sufficient to depth to result in runoff entering the sediment dam.

The sediment dams in the upgraded MIA have also been sized based on the criteria recommended in the Managing Urban Stormwater (“Blue Book”) guidelines. It was assumed that the MIA sediment dams would not capture contaminated runoff, and that any contaminated runoff from the MIA would instead drain to the CHPP contaminated water dams. It is assumed that any contaminated water from the vehicle washdown bay in the MIA would be recirculated within the washdown bay system, or pumped to the CHPP contaminated water dams rather than being discharged to the MIA sediment dam. A runoff coefficient of 0.85 has been adopted for disturbed areas in the upgraded MIA, which are expected to comprise mainly hardstand surfaces. A runoff coefficient of 0.75 was adopted for the existing MIA, which comprises a mix of hardstand surfaces and grassed surfaces.

Key design features of dirty water sediment dams are as follows:

- configured as Type F/D basins as described in the Managing Urban Stormwater guidelines
- 'settling zone' for temporary treatment storage
- 'sediment zone' for sediment storage
- slotted riser and discharge pipe with valve arrangement to allow manual operation of pipe (alternatively a mobile pump pumped out system only)
- slotted riser and discharge pipe sized to drawdown 'settling zone' over three days

Dirty water sediment dams are to be maintained in a drawn down state as much as practical, thus ensuring that sufficient capacity is available in the 'settling zone' to capture water from subsequent storm events. Water will only be stored in the 'settling zone' of dirty water sediment dams on a temporary basis (i.e. the nominated 5 day management period) following a rainfall event of sufficient to depth to result in runoff entering the sediment dam. If water stored in the sediment dam is not suitable for discharge, or is to be reused onsite to supplement a deficit during dry periods, the sediment dam water would need to be pumped to the much larger MWDs for long term storage and onsite reuse. The exception is SD3 that will be upsized to provide an additional 'reuse zone' for long term storage for onsite reuse. For SD3, water can be stored in the 'reuse zone' on a long term basis, but the 'settling zone' would need to be maintained in a drawn down state.

3.2.2 Contaminated water dams

3.2.2.1 Contaminated water dams

Contaminated water dams (also called coal contact dams) capture runoff from the coal stockpile pads in the CHPP. Water stored in contaminated water dams is reused onsite for dust suppression or CHPP process water, or pumped to MWDs for storage.

Contaminated water dams have been designed to store runoff from a 100 year ARI 72 hour duration storm event, with a 20% allowance for sediment storage. A runoff coefficient of 0.85 has been adopted for disturbed areas in the CHPP, which are expected to comprise mainly hardstand surfaces. A runoff coefficient of 0.75 was adopted for the existing coal crushing and handling area which comprises a mix of hardstand surfaces and grassed surfaces.

Key design features of contaminated water dams are as follows:

- 'sediment zone' for storage of sediment
- 'storm zone' for storage of the design storm storage
- pump and pipeline system to draw down the 'settling zone' and transfer water to MWDs

Contaminated water dams are to be maintained in a drawn down state as much as practical, thus ensuring that sufficient capacity is available to capture water from subsequent storm events and minimising the risk of a wet weather overflow. Following a rainfall event, water held within contaminated water dams are to be pumped to MWD's.

Contaminated water dams SD10 and SD12 have been sized by Sedgman in the design of the CHPP and MIA upgrades and have been provided with an additional 'reuse zone' to provide operational capacity for the CHPP. SD10 has been provided with an additional 'reuse zone' for storage of 37.6 ML and SD12 has been provided with an additional 'reuse zone' for storage of 25.5 ML. For SD10 and SD12, water can be stored in the 'reuse zone' on a long term basis, but the 'storm zone' would need to be maintained in a drawn down state. SD10 and SD12 are linked via pressure mains. Excess water captured in SD10 and SD12 can be pumped to MW3, mitigating potential overflows. The catchment areas for SD10 and SD12 have been based on the CHPP and MIA layout from the modified EA (Mod 4) and the Revised Draft MOP lodged with the DRE in March 2015.

3.2.2.2 Mine water dams

MWDs hold water of similar quality to the contaminated water dams, however, generally only receive runoff from a small surface water catchment (i.e. they are primarily a permanent storage facility and are likely to have a 'turkey's nest' configuration). The MWDs are intended to receive and store contaminated water pumped from the sediment dams, contaminated storage dams or in-pit areas. They may also hold clean water 'top-up' sourced from imported water during dry periods when the site is in a water deficit (refer to Section 4.4.3). MWDs will store water on a long term basis.

The sizing of MWDs are based on water balance modelling and are designed to achieve retention of contaminated water generated within the site and derived from pit dewatering under historical climate conditions.

MWDs have been designed so that they do not overflow based on the meteorological conditions from the 126 year historical daily water time series used for the water balance. However, a spillway will be provided if there is an emergency overflow. Boggabri Mine MWDs are not prescribed dams listed under the NSW Dam Safety Regulation so are not subject to specific design requirements under this regulation. The design specifications for MW5 will be lodged with the Dam Safety Committee for assessment before construction commences.

3.2.3 Clean water dams

Clean water highwall dams capture runoff from undisturbed catchments ahead of the pit where practical in order to reduce inflows to the pit and maintain more natural flows in the downstream creek system. Highwall dams are to be maintained in a drawn down state, and are to be pumped out following a rainfall event of sufficient depth to result in runoff entering the dam. Highwall dams are pumped out to the creek system.

Clean water highwall dams are sized to capture runoff from the 100 year ARI 24 hour storm event for the remnant catchment, assuming a runoff coefficient of 0.4 for undisturbed areas. Extreme events in excess of this capacity will spill into the pit. The pump out systems for highwall dams are sized to empty the dam within 10 days. Clean water highwall dams are only present for the 2033 conceptual layout plan. In 2033 the clean water dams are pumped to the east and then south around the edge of the mine footprint. The pumped clean water will be discharged into an existing drainage line/natural depression, which flows back to Nagero Creek north of the rail loop. Scour protection and energy dissipation methods will be provided such as plastic/geotextile and rocks placed at the pump outlet.

A raw water dam is not currently proposed for BCPL.

3.2.4 Diversion drains

Clean, dirty and contaminated water diversion drains are to be designed to convey the peak flow rate from a 100 year ARI time of concentration (t_c) storm event.

3.3 Existing water management system

A summary of the existing storage characteristics is provided in Table B 1, Appendix B. These are the existing storages onsite at the end of calendar year 2014.

A summary of the existing discharge points is provided in Table B 2, Appendix B. These are the existing discharge points and types listed in Section P1.3 of the EPL (12407, 19 February 2015).

A temporary in-pit mine water storage is provided to cater for surplus mine water in-pit until additional out-of-pit mine water storage is constructed onsite. The temporary storage will be a segregated void area within the advancing mining pit area (Strips #9 and #40).

This report reflects the conditions set out on the most current EPL, however a variation to the EPL will be sought so that the monitoring and discharge points match what is proposed to be built on site and to ensure that contaminated sediment dam monitoring point types are corrected.

3.4 2015 water management system

A summary of the proposed 2015 storage characteristics is provided in Table B 3, Appendix B. The ‘required minimum capacity’ in Table B 3 is the minimum capacity required to store the design storm and the nominated sediment allowance.

A new MWD MW5 (capacity 300 ML) will be commissioned at the beginning of 2015 to receive mine water pumped from the mining void. Existing MWD MW2 (capacity 175.8 ML) will continue to operate throughout 2015. Existing MWD MW3 will be upgraded by mid-2015 to a capacity of 600 ML (existing capacity 153.5 ML). The total out-of-pit MWD storage in MW2, MW3 and MW5 will be 629.3 ML from the beginning of 2015 to mid-2015, and 1075.8 ML from mid-2015 to the end of 2015.

New contaminated water dams SD28 (capacity 4.7 ML) and SD29 (capacity 10.5 ML) will be commissioned at the beginning of 2015 as part of the MIA and CHPP upgrades. Existing SD12 will be upgraded by mid-2015 to a capacity of 125 ML (existing capacity 25.9 ML). The upgrade to SD12 will cater for the expanded MIA and CHPP and haul road catchments, as well as a ‘reuse zone’ for storage additional water for reuse in the CHPP. Existing contaminated water dam SD4 (capacity 8.1 ML), located at the existing rail loading facility 15 km west of the mine site, will be decommissioned by mid-2015.

A new diversion drain ahead of the mining void will divert runoff from undisturbed areas to the north of the mining void into the Nagero Creek system. Remnant undisturbed catchments to the east of the mining void will drain directly into the mining void and this water will be managed within the mine water management system.

Topsoil stockpiling occurs to the north west of the new clean water diversion drain ahead of the mining void. Temporary erosion and sediment controls will be required to treat runoff from this stockpile area prior to entry into the clean water diversion drain. Erosion and sediment controls are outlined in the SWMP.

Existing sediment dam SD3 will be upgraded at the beginning of 2015 to a capacity of 260 ML (existing capacity 31.8 ML). This upgrade will cater for the expanding overburden catchment over the life of the mine, as well as a 'reuse zone' for storage of additional water for reuse onsite. Note that BCPL no longer propose to commission sediment dams SD13 and SD27 and storage capacity previously allocated to SD13 and SD27 will now be provided in SD3.

A new diversion drain will divert overflows from the Tarrawonga Coal Mine (TCM) northern waste rock emplacement area dams around the BCPL MIA. The TCM diversion drain will not interact with BCPL onsite water storage infrastructure.

A summary of the proposed 2015 discharge points is provided in Table B 4, Appendix B. The EPL will be reviewed and updated in consultation with the regulators to cater for the additional discharge points proposed in the table. Discharge criteria are outlined in the SWMP.

Although the EPL currently includes a 'discharge water quality monitoring' point at contaminated water dam SD4 (Point 4), it is very unlikely that water stored in SD4 would meet the EPL water quality discharge criteria. As such, only 'wet weather discharges' are proposed from SD4.

3.5 2017 water management system

A summary of the proposed 2017 storage characteristics is provided in Table B 5, Appendix B.

Existing MWD MW2 (capacity 175.8 ML) will be decommissioned by 2017 as mining disturbs this area. Mine water from the mining void will be pumped to MWDs MW5 or MW3. The total out-of-pit MWD storage in MW3 and MW5 will be 900 ML. Strips #9 and #40 will be mined through by 2017. However, water will still be stored in-pit during extreme wet weather.

Topsoil stockpiling occurs to the north west of the clean water diversion drain ahead of the mining void. Pre-stripping occurs to the north east of the clean water diversion drain ahead of the mining void. Temporary erosion and sediment controls will be required to treat runoff from these disturbed areas prior to entry into the clean water diversion drain. Erosion and sediment controls are outlined in the SWMP.

A summary of the proposed 2017 discharge points is provided in Table B 6, Appendix B. The EPL will be reviewed and updated in consultation with the regulators to cater for the discharge points proposed in Table B 6. Discharge criteria are outlined in the SWMP.

3.6 2019 water management system

A summary of the proposed 2019 storage characteristics is provided in Table B 7, Appendix B.

The 2019 storages are the same as those for 2017. However, the catchment area and landuse breakdown within the overburden and mining void areas change compared to 2017 as mining progresses.

Topsoil stockpiling occurs to the north west of the clean water diversion drain ahead of the mining void. Pre-stripping occurs to the north east of the clean water diversion drain ahead of the mining void. Temporary erosion and sediment controls will be required to treat runoff from these disturbed areas prior to entry into the clean water diversion drain. Erosion and sediment controls are outlined in the SWMP.

A summary of the proposed 2019 discharge points is provided in Table B 8, Appendix B. The EPL will be reviewed and updated in consultation with the regulators to cater for the additional discharge points proposed in Table B 8. Discharge criteria are outlined in the SWMP.

3.7 2022 water management system

A summary of the proposed 2022 storage characteristics is provided in Table B 9, Appendix B.

A new dirty water sediment dam SD14 will be provided to cater for runoff from the cleared area ahead of the mining void.

A new diversion drain will divert runoff from the active overburden dump, as well as overflows from SD7, to SD3. Note that BCPL no longer propose to commission sediment dam SD13 and storage capacity previously allocated to SD13 will now be provided in SD3.

A summary of the proposed 2022 discharge points is provided in Table B 10, Appendix B. The EPL will be reviewed and updated in consultation with the regulators to cater for the discharge points proposed in Table B 10. Discharge criteria are outlined in the SWMP.

3.8 2033 water management system

A summary of the proposed 2033 storage characteristics is provided in Table B 11, Appendix B.

New dirty water sediment dams SD19, SD20, SD21, SD22 and SD24 will be provided to cater for runoff from the expanded spoil dump. SD7 will be decommissioned by 2033 as the overburden catchment draining to this sediment dam is expected to be fully rehabilitated.

New clean water highwall dams CD5, CD6, CD7 and CD8 will be provided to minimise inflows from the natural catchment to the mining void. The highwall dams will be pumped out to the Nagero Creek system, however, they will overtop to the mining void during large storm events.

A summary of the proposed 2033 discharge points is provided in Table B 12, Appendix B. The EPL will be reviewed and updated in consultation with the regulators to cater for the discharge points proposed in Table B 12. Discharge criteria are outlined in the SWMP.

4. Site water balance modelling

4.1 Modelling approach

A water balance analysis has been undertaken for the water management system for the Boggabri Coal Mine. The purpose of the analysis was to quantify the water demands (e.g. dust suppression, CHPP process water) and supplies (e.g. groundwater seepage, surface runoff, recycled water) in order to identify the likely water deficits / surpluses and discharges from the Boggabri Coal Mine.

The water balance analysis in Section 4 of this report is used as a strategic planning tool to assess the performance of the water management system for the Boggabri Coal Mine under a wide range of climate scenarios (including both historically dry and wet periods) that may occur over the life of the Project.

The water balance model uses GoldSim software, and incorporates the AWBM to simulate catchment runoff. The mine's development over the life of the Project was represented in the model through the 2015, 2017, 2019, 2022 and 2033 'snapshot' landforms.

4.1.1 GoldSim model

A water balance model of the Boggabri Coal Mine was developed using GoldSim software, a computer simulation software widely used for mine SWB studies.

The existing individual models for the 'snapshot' landforms developed for the Boggabri Coal Project Surface Water Assessment (PB, 2010) were incorporated into a single model spanning the life of the Project, and including the 2015, 2017, 2019, 2022 and 2033 'snapshot' landforms with the model parameters being interpolated between the 'snapshot' landforms.

The GoldSim model was used to calculate the volume of water in storages at the end of each day, accounting for daily rainfall-runoff inflow, groundwater inflow, evaporation from the storage, water usage, pumping between storages in the form of a pumping policy and storage overflow, if it occurs. The water management system plans and schematics provided in Appendix A show the layout and interconnectivity of storages for the mine site.

The GoldSim model was simulated at a daily timestep for a 19-year duration (i.e. from 2015 to 2033). The model was simulated for 108 realisations (i.e. sequences) of rainfall and evaporation data, developed by 'stepping through' the Data Drill sourced historical rainfall and evaporation data for the period 1 January 1889 to 31 December 2011. The first realisation started on 1 January 1889, the second realisation on 1 January 1890 etc. Note that the 19-year duration realisations overlap each other by one year. The model parameters (catchment and landuse breakdown, demands and groundwater inflows etc.) were varied in the model between the 2015, 2017, 2019, 2022 and 2033 'snapshot' landforms. Assumed timing for 'snapshot' landforms in the GoldSim model is summarised in Table 4.1.

Table 4.1 Assumed timing for 'snapshot' landforms in GoldSim model

Mine stage 'snapshot'	Period applied in GoldSim model
2015	1 January 2015 to 31 December 2015
2017	1 January 2016 to 31 December 2017

Mine stage 'snapshot'	Period applied in GoldSim model
2019	1 January 2018 to 31 December 2019
2022	1 January 2020 to 31 December 2022
2033	1 January 2023 to 31 December 2033

4.2 Model assumptions

The following assumptions were made in the water balance analysis:

- A pumping policy based on the existing and proposed infrastructure has been included in the water balance model. It is assumed that pumping occurs at an average pump rate and no allowance has been made to modify the pump rate depending on storage capacity (with the exception of the pit dewatering system, as temporary pumps would be employed under extreme wet conditions). Pump rating curves have not been discretely modelled, and therefore the model does not represent delays that could occur when transporting water around the site.

- It is assumed that the low flow outlets from dirty water sediment dams are opened once water quality criteria has been met before water is released to the environment. Low flow outlets have been represented in the water balance model so that the dams empty over a period of three days. When sediment dam water is to be reused onsite to supplement a deficit, the model assumes that sediment dam water is pumped to MW3 rather than being released to the creek.

- It is assumed that the bottom half of the 'sediment zone' of dirty water sediment dams and contaminated water dams is half full of sediment throughout the simulation. Water that ponds in the top half of the 'sediment zone' evaporates over time and cannot be used to supply dust suppression water or CHPP process water.

- It is assumed that all dams are empty at the start of the simulation (with the exception of deposited sediment, as above).

- No allowance has been made for seepage from water storages, or for moisture loss from product coal.

- It is assumed that all runoff within the water management system drains to a storage, and that the diversion drains capture all runoff from their local catchments. It is assumed that there is no bypass of diversion drains.

- Annual pit inflows have been adapted and distributed uniformly to obtain daily inflow rates for the water balance simulation. Annual pit inflow estimates have been derived from the Boggabri Coal Project Groundwater Assessment (AGE, October 2010) and are considered a best estimate for pit inflows in the context of life of mine water balance. This does not consider cumulative impacts associated with the concurrent operation of Boggabri, Tarrawonga and Maules Creek coal mines.

- It is assumed that adequate groundwater / surface water allocations or alternative water sources are available to makeup the external water requirement (an infinite supply has been adopted in the model). However, where the annual external water requirement exceeds BCPL's current water entitlements, it will be necessary for BCPL to secure additional water to make up the difference, or to adjust the scale of mining operations on site to match its available water supply if necessary.

- Groundwater and surface water extraction pumps have not been included in the model as information on pump rates and priorities is currently limited. It is assumed that all groundwater and surface water entitlements from available WALs can be accessed as needed and are not restricted by pump capacities.

- The approved irrigation system has not been included in the model.

- The Tarrawonga Coal Mine (TCM) catchment area to Nagero Creek discharging across the western boundary of mining lease1579 (at Tarrawonga's LDP1) discharges directly to Nagero Creek, bypassing the Boggabri Coal Mine water management system via a clean water diversion drain. No water from TCM will be captured by a BCPL water storage.

- It is assumed that the CHPP will become operational in mid-2015.

- It is assumed that the upgrade of MW3 to 600 ML will be operational by mid-2015 when the CHPP becomes operational. It is assumed that a new MW5 will be commissioned at the beginning of 2015. It is assumed that existing MW2 will be decommissioned at the end of 2015 and that any water stored in MW2 will be transferred to MW5.

- It is assumed that Strips #9 and #40 will be decommissioned at the end of 2015 and that any water stored in these strips will be transferred to MW5 or the pit.

- It is assumed that the upgrade of contaminated water dam SD12 to 125 ML will be operational at the beginning of 2015. It is assumed that new contaminated water dams SD28 and SD29 will be commissioned at the beginning of 2015.

- It is assumed that the upgrade of sediment dam SD3 to 260 ML will be operational at the beginning of 2015.

- While the model assesses the performance of the system under historical extremes that may reasonably be expected to reoccur in the future, it does not specifically quantitatively incorporate the potential impact of future climate change on runoff.

The proposed water management system operating rules will be refined and optimised as the inter-pumping strategy, water reuse, storage use, water demands, water quality and groundwater make characteristics are confirmed from ongoing monitoring programs and site observation.

4.3 Model data

4.3.1 Catchments

Catchment areas adopted in the water balance model are provided in Table 4.1. Catchments are for Nagero Creek to the point where the creek meets the floodplain approximately 1 km downstream of the Boggabri Coal Mine.

The area of rehabilitated catchment increases from 2015 to 2033. Progressive rehabilitation is undertaken and where the landform is stable and there is no sediment or chemical runoff, then runoff from catchment areas is returned to the natural system. While some of the rehabilitated areas approach the four year mark by 2015, this rehabilitated area is unable to be segregated from the remaining overburden dump. For this reason, runoff from rehabilitated areas occurs only in 2033 when the clean water can be segregated from the dirty water runoff, captured and released.

Table 4.2 Catchment areas

	Storage name	Catchment area (ha)				
		2015	**2017**	**2019**	**2022**	**2033**
Boggabri Coal Mine contaminated water dams [1]	MW2	3.8	-	-	-	-
	MW3	26.5	26.5	26.5	26.5	26.5
	MW5	2.0	2.0	2.0	2.0	2.0
	SD10	30.4	30.4	30.4	30.4	30.4
	SD11	6.3	6.3	6.3	6.3	6.3
	SD12	38.6	38.6	38.6	38.6	38.6
	SD28	1.0	1.0	1.0	1.0	1.0
	SD29	3.1	3.1	3.1	3.1	3.1
	Strip #9	33.7	-	-	-	-
	Strip #40	1.8	-	-	-	-
	Pit	697.9	742.4	719.5	393.8	531.1
	Subtotal	*845.6*	*850.0*	*827.6*	*501.7*	*638.2*
Boggabri Coal Mine dirty water dams	SD3	239.5	239.3	256.9	641.5	193.5
	SD6	74.5	74.5	74.5	74.5	74.5
	SD7	272.0	267.5	272.5	243.0	-
	SD8	14.5	14.5	14.5	14.5	14.5
	SD14	-	-	-	313.7	-
	SD19	-	-	-	-	431.1
	SD20	-	-	-	-	100.2
	SD21	-	-	-	-	121.1
	SD22	-	-	-	-	5.1
	SD23	29.0	28.9	28.7	30.7	30.6
	SD24	-	-	-	-	10.9
	Subtotal	*629.4*	*624.9*	*647.4*	*1,318.0*	*981.4*
Boggabri Coal Mine clean water dams	CD5	-	-	-	-	19.9
	CD6	-	-	-	-	20.7
	CD7	-	-	-	-	102.9
	CD8	-	-	-	-	18.3
	Subtotal	-	-	-	-	*161.8*
Boggabri Coal Mine rehabilitation released directly to Nagero Creek						447.4
TCM water management system within Nagero Creek catchment [2]		403.5	403.5	403.5	403.5	403.5
Boggabri Coal Mine lease area within Nagero Creek catchment		2,396.1	2,396.1	2,396.1	2,051.4	1,642.2
Total		**4,275**	**4,275**	**4,275**	**4,275**	**4,275**

[1] Excludes approved irrigation area draining to Bollol Creek catchment.
[2] TCM lease area within Nagero Creek catchment assumed based on proposed operations at TCM.

4.3.2 Operating rules

Operating rules adopted in the water balance are outlined below. Operating rules change in mid-2015 when the CHPP becomes operational. The Boggabri Coal Project Surface Water Assessment (PB, 2010) predicted that under median climatic conditions the site would be in an annual water surplus in the initial years of the Project, but move to an annual water deficit when the CHPP becomes operational. After the CHPP becomes operational, it is also assumed that the out-of-pit mine water storage capacity onsite will have increased significantly.

4.3.2.1 Beginning-2015 to mid-2015 (CHPP not operational)

- Water stored in the 'settling zone' of dirty water sediment dams is discharged to the creek system following the settling of suspended solids (i.e. the 'settling zone' is maintained in a drawn down state).
- Pumping from the pit sump to MW2 / MW5 ceases if the volume stored in MW2 / MW5 exceeds 90% capacity. During prolonged periods of wet weather it is assumed that runoff and groundwater inflows will be stored in-pit once MW2 / MW5 exceeds 90% capacity.
- Pumping from MW2 / MW5 to Strip #9 / Strip #40 starts if the volume stored in MW2 / MW5 exceeds 50% capacity. Pumping from MW2 / MW5 to Strip #9 / Strip #40 ceases if the volume stored in Strip #9 / Strip #40 exceeds 90% capacity.
- Pumping from MW2 / MW5 to MW3 starts if the volume stored in MW2 / MW5 exceeds 50% capacity and if the volume stored in Strip #9 / Strip #40 exceeds 90% capacity. Pumping from MW2 / MW5 to MW3 ceases if the volume stored in MW3 exceeds 50 ML.
- Minimum pumping volume for the pump to physically start pumping out water to meet demands from MW2 / MW5 and Strip #9 / Strip #40 set to a nominal 30ML.
- Minimum pumping volume for MW3 set as 10 ML. Previously this minimum pumping rule was set to 50% capacity so that a reserve of water was kept for Tarrawonga coal washing and/or the irrigation system. These two conditions do not exist anymore and therefore has been updated so that more water stored in MW3 can be utilised to meet demands.
- Pumping from SD10 / SD11 / SD12 / SD28 / SD29 to MW3 starts if the volume stored in SD10 / SD11 / SD12 / SD28 / SD29 exceeds the 'sediment zone' capacity. Pumping from SD10 / SD11 / SD12 / SD28 / SD29 to MW3 ceases if the volume stored in MW3 exceeds 105 ML. Note that 105 ML is the design maximum operating level for MW3 prior to upgrade.
- The sediment dam capacities modelled in GoldSim assume that half of the sediment zone is full of sediment and is not available for water storage.
- Pumping from sediment dams ceases when the modelled capacity falls below the 'sediment zone' capacity. Pumping from clean water highwall dams to the creek system starts if the volume stored in the highwall dam exceeds zero.

- Dust suppression and general construction water demands for the main mine site are sourced from the following storages in order of priority:
  - MW2 / MW5 or MW3 (sourced from dam with highest volume to total capacity ratio)
  - Strip #9 / Strip #40
  - imported raw water
- Dust suppression demands for the existing rail loading facility located west of the main mine site are sourced from the following storages in order of priority:
  - SD4
  - imported raw water
- Potable water and vehicle washdown water demands are sourced from imported raw water regardless of the SWB.

4.3.2.2 Mid-2015 onwards (CHPP operational)

- Water stored in the 'settling zone' of dirty water sediment dams is discharged to the creek system following the settling of suspended solids and water quality criteria have been met; or transferred to MWDs for reuse (i.e. the 'settling zone' is maintained in a drawn down state). Sediment dam water can be reused onsite to supplement a deficit if required. It is assumed that water from sediment dams can be pumped to MW3 when the combined volume stored in MW5 and MW3 is less than 200 ML. When the combined volume stored in MW5 and MW3 is 200 ML or greater, sediment dam water is released to the creek and is not reused onsite, provided EPL water quality criteria are met as outlined in the SWMP (to avoid an accumulation of water onsite during wet periods, and to maintain spare capacity in mine water storages for collection of contaminated runoff).
- Pumping from the pit sump to MW5 ceases if the volume stored in MW5 exceeds 90% capacity. During prolonged periods of wet weather it is assumed that runoff and groundwater inflows will be stored in-pit once MW5 exceeds 90% capacity.
- Pumping from MW5 to MW3 starts if the volume stored in MW5 exceeds 50% capacity. Pumping from MW5 to MW3 ceases if the volume stored in MW3 exceeds 500 ML.
- Pumping from SD10 / SD12 to MW3 starts if the volume stored in SD10 / SD12 exceeds the 'sediment storage' and 'reuse zone' capacity (i.e. the 'storm zone' is maintained in a drawn down state). Pumping from SD10 / SD12 to MW3 ceases if the volume stored in MW3 exceeds 550 ML.
- Pumping from SD11 / SD28 / SD29 to MW3 starts if the volume stored in SD11 / SD28 / SD29 exceeds the 'sediment storage' capacity (i.e. the 'storm zone' is maintained in a drawn down state) and the volume stored in SD10 / SD12 exceeds the 'sediment storage' and 'reuse zone' capacity. Pumping from SD11 / SD28 / SD29 to MW3 to MW3 ceases if the volume stored in MW3 exceeds 550 ML capacity.
- The sediment dam capacities modelled in GoldSim assume that half of the sediment zone is full of sediment and is not available for water storage.

- Minimum pumping volume for the pump to physically start pumping out water to meet demands from MW5 set to a nominal 30ML.

- Minimum pumping volume for MW3 set as 10 ML. Previously this minimum pumping rule was set to 50% so that a reserve of water was kept for Tarrawonga coal washing and/or the irrigation system. These two conditions do not exist anymore and therefore has been updated so that more water stored in MW3 can be utilised to meet demands.

- Pumping from sediment dams ceases when the modelled capacity falls below the 'sediment zone' capacity.

- SD3, SD6, SD7, SD8, SD19 and SD23 are able to pump water to the MWDs for reuse when in a deficit.

- SD11, SD28 and SD29 are linked to SD10 and SD12 (and also to MW3).

- Pumping from clean water highwall dams to the creek system starts if the volume stored in the highwall dam exceeds zero.

- Dust suppression demands for the main mine site are sourced from the following storages in order of priority:
  - MW3 or MW5 (sourced from dam with highest volume to total capacity ratio)
  - imported raw water

- CHPP make-up water demands are sourced from the following storages in order of priority:
  - SD10 or SD12 (sourced from MW3 or MW5 as required)
  - imported raw water

- Potable water and vehicle washdown demands are sourced from imported raw water regardless of the SWB.

- Surface water entitlements held by BCPL have been included in the model and a reliability of supply factored to the entitlement. The long term extraction factors for general security and supplementary surface water licence categories for the Namoi River have been used (discussed in more detail in SWMP).

4.3.3 Pump rates

The following pump rates were adopted in the water balance model:

- pit sump to MW2 / MW5 – maximum of 5 ML/day under normal conditions, increasing to a maximum of 10 ML/day when there is more than 200 ML stored in-pit

- MW2 to Strip #9 / Strip #40 - maximum 10 ML/day

- MW2 / MW5 to MW3 – maximum 5 ML/day

- SD2, SD10 and SD12 to MW3 – maximum 5 ML/day each

- SD11, SD28 and SD29 to MW3 – maximum 1 ML/day

- low flow outlet / pumping from sediment dams – sized to empty settling zone over 3 day period
- pumping from sediment dams to MW3 for reuse – sized to empty settling zone over 3 day period
- clean water highwall dams to creek system – sized to empty dam over 10 day period

4.4 Water inputs

Water sources for the Project comprise:

- rainfall-runoff
- groundwater inflows to the mining void
- imported water

4.4.1 Rainfall-runoff

Contaminated surface water runoff is captured in dams or the mining void and stored for onsite reuse. The volume of contaminated surface water runoff is dependent on the rainfall depth and the catchment area of the mining void and industrial areas.

Dirty water runoff is also captured in sediment dams for settling of suspended solids prior to discharge to Nagero Creek (assuming that water quality criteria are met). During extended dry periods (i.e. when the site is in a water deficit) or if stored water quality is not suitable for discharge, this water will be pumped out for onsite reuse.

4.4.2 Groundwater inflows to mining void

Estimated seepage rates of groundwater into the mining void have been provided in the Continuation of Boggabri Coal Project Groundwater Assessment (AGE, October 2010). A summary of the groundwater inflows adopted in the water balance model is provided in Table 4.3.

Table 4.3 Estimated groundwater inflows to mining void

Year	Average daily inflow (ML/day)	Annual inflow (ML/yr)
2015	0.561	205
2017	0.684	250
2019	0.786	287
2022	0.938	342
2033	1.123	410

From Table 4.3 it can be seen that groundwater inflow to the mining void will increase over the life of the Boggabri Coal Mine. It is anticipated that much of the predicted pit inflows will be lost through evaporation, however inflows that collect in the mine void will be pumped to MW2 / MW5 / MW3 for onsite reuse and/or to Strip #9 / Strip #40 (in earlier years).

It is important to highlight that numerical groundwater modelling conducted as part of the groundwater assessment predicts a gradual rise in pit inflows when the Boggabri Coal Mine operates in isolation (AGE, 2010). In contrast, a worst case cumulative groundwater impact assessment considering cumulative impacts associated with the concurrent operation of the Boggabri, Tarrawonga and Maules Creek coal mines was carried out by AGE (2010). Findings of the assessment determined that groundwater make within the mine void at Boggabri may be reduced by up to 40% due to cumulative impacts from operations at Tarrawonga and Maules Creek coal mines. This is considered more relevant to later years of the life of mine when TCM and MCC progress their development.

Given the high level approach to the worst case cumulative assessment and the speculative assumptions adopted in the EA, impacts to future mine pit inflows will require regular review as the cumulative numerical groundwater model evolves through verification of simulated heads against those measured.

4.4.3 Imported water

4.4.3.1 Groundwater entitlements

BCPL currently holds licences for the Upper Namoi Zone 4 Namoi Valley Groundwater Source and the Gunnedah-Oxley Basin. Details of these water access licences (WALs) are provided in Table 4.4.

Table 4.4 Summary of groundwater WAL's currently held by BCPL

Source	WAL category	WAL No.	Shares	Expiry	Reliability (%)
Groundwater					
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 29473	142 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 15037	172 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 24103	275 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 12691	219 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 12767	3 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Aquifer	WAL 36547	37 unit shares	Perpetuity	95-100
Upper Namoi Zone 4 Groundwater Source	Supplementary	WAL 14483	131 unit shares	end date 1/7/2015	0 in 2015
Upper Namoi Zone 4 Groundwater Source	Supplementary	WAL 14495	9 unit shares (18 in total but 9 assigned to Whitehaven)	end date 1/7/2015	0 in 2015
Groundwater – pit interference					
Gunnedah-Oxley Basin	Aquifer	WAL 29562	700 unit shares		100

A total of 848 unit shares of groundwater would be available to BCPL from the aquifer access licences. An additional 140 unit shares of groundwater would potentially be available to BCPL from the supplementary category groundwater licence until 1st July 2015. The actual volume of groundwater available would depend on the Available Water Determinations

(AWD) made under the Water Sharing Plan (WSP), but these are likely to be at or close to 1 ML per unit share from the aquifer access licences. Water derived from the pit inflows can be reused onsite under WAL29562 providing further capacity for supplementation.

BCPL currently utilises groundwater pumped from Lovton Bore and Daisymede Bore for existing operations. BCPL is seeking approvals to expand its bore water supply network within alluvial aquifer to include bores at Victoria Park and Cooboobindi.

Groundwater pumped from Lovton Bore is currently treated in an onsite treatment plant and used for potable water and vehicle washdown, as well as dust suppression when there is a site water deficit.

Groundwater pumped from Daisymede Bore is currently used (up until mid-2015) for dust suppression at the existing rail loading facility located approximately 15 km west of the site when there is a water deficit. Pump and pipeline infrastructure to pump groundwater from Daisymede Bore to the mine site has been installed so that the mine site can utilise these existing entitlements from mid-2015 onwards.

Groundwater can also be traded on a temporary or permanent basis within the greater Gunnedah-Oxley Basin Groundwater Source, and within Zone 4 of the Upper Namoi, subject to local impact considerations. If necessary, however, the scale of mining operations on site would be adjusted to match the available water supply.

4.4.3.2 Surface water entitlements

BCPL currently holds general security and supplementary water access licences for the Lower Namoi Regulated River Water Source. Details of these water access licences are provided in Table 4.5. The total share component under these licences is 294 unit shares of general security water and 31.7 unit shares of supplementary water. The actual volume of river water available to BCPL from the general security licences would depend on the Available Water Determinations (AWD) made from time to time in accordance with the Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2003. Supplementary access is also ‘announced’ from time to time, and is dependent on the presence of unregulated flows in the regulated river, and on the operation of the WSP rules.

Table 4.5 BCPL water access licences for Lower Namoi Regulated River Water Source

Source	Water Access Licence category	Water Access Licence number	Share component
Lower Namoi River	General Security	WAL 2571	51 unit shares
Lower Namoi River	General Security	WAL 2595	243 unit shares
Lower Namoi River	Supplementary Water	WAL 2596	26.1 unit shares
Lower Namoi River	Supplementary Water	WAL 2572	5.6 unit shares

The Namoi Regulated River water sharing plan estimates that there are in total 256,400 unit shares of general security access licences and 115,000 unit shares of supplementary water access licences. Access to entitlement will vary from year to year depending on climatic conditions and water availability (see Table 4.6).

‘A continuous accounting system is used in the Namoi Valley for general security entitlements. The maximum that may be held in an account is 2.0 ML per unit share. The amount carried over from year to the next is unlimited (maximum account balance effectively limits carryover volumes). The maximum usage (including trade) in any season is 1.25 ML per unit share. The maximum water use over any 3 consecutive years is 3.0 ML per unit share' (Ribbons, 2009).

Table 4.6 Reliability of supply for Namoi regulated river licences

Reliability measure	High security	General security	Supplementary
Plan Limit Scenario			
Percentage of time full entitlement is available at start of water year (1July)	100%	50%	-
Percentage of time full entitlement is available at end of water year (30 June)	100%	84%	-
Average effective available water on 1 July	100%	95%	-
Average cumulative AWD for water year	100%	76%	-
Average annual percentage of the entitlement used (rounded to 5%)	-	80%	30%
Ultimate Development Scenario			
Long term extraction factor	0.95	0.76	0.18

(Source: Ribbons, 2009)

BCPL is able to access surface water from the Namoi River in accordance with its surface water licences via a pump station from the Namoi River which has been constructed. It can also trade additional water, either temporarily or permanently, to make up shortfalls.

4.5 Water demands

Water demands comprise:

- construction water
- dust suppression water
- CHPP make-up water
- vehicle washdown water
- potable water (for drinking water and amenities)

Water demand information has been provided by BCPL. The demands provided in the Boggabri Coal Project Surface Water Assessment (Parsons Brinckerhoff, 2010) have been revised based on more detailed project design and engineering work that has occurred since the Surface Water Assessment was undertaken in 2010, and updated demand information in line with the updated MOP

4.5.1 Construction water

Water will be required for the construction of the CHPP and MIA upgrades. BCPL has estimated that 0.73 ML/day (equivalent to 267 ML/yr) of general construction water will be required from July 2013 to June 2015. This construction demand includes construction of the rail loop and expansion of the CHPP and MIA.

Mine water will be used as preferentially for construction of the CHPP and MIA expansion as this area is already a coal contact area. Runoff from this area is captured within a controlled drainage area and will not be released to Nagero Creek.

Pumps and standpipes will be made available to Boggabri Rail Spur and 132KV and 11KV transmission line Contractors during construction. The standpipes will be located adjacent to the water distribution pipeline along the haul road. Construction water will be sourced from contained sediment control dams, and as required licensed groundwater bores and surface water allocations from the Namoi River. Other Contractors will utilise existing construction water standpipes within the MIA, Mine Water Dam 3 (MW3) and Sediment Dam 6 (SD6). BCPL will install a water distribution system adjacent to the private haul road. Construction water may be available along the private haul road at existing borrow pit locations. The CEMP document outlines how surface water impacts will be minimised during construction.

Potable water will not be required for the workforce since construction personnel will be housed in the MAC village in Narrabri and are responsible for supplying their own potable water on site.

4.5.2 Dust suppression

Water is required for dust suppression on haul roads and other disturbed areas. Dust suppression for the CHPP coal stockpiles, coal crushing areas, and coal loading areas and MIA are accounted for in the CHPP demands from mid-2015 onwards when the CHPP becomes operational (refer to Section 4.5.3).

BCPL has provided revised estimates of dust suppression demands for the project. A summary of the haul road dust suppression demands adopted in the water balance model is provided in Table 4.7. Haul road dust suppression numbers have been revised following lodgement of the EA, largely due to adjustments to the mine plan (refer to Revised Draft MOP) and more detailed project design and engineering work having been undertaken. BCPL estimates haul road dust suppression demand to be 4 ML/day (equivalent to 1,461 ML/annum).

Table 4.7 Haul road dust suppression demand estimates (average)

Project year	Dust suppression demand (ML/annum)
2015	1,461
2017	1,461
2019	1,461
2022	1,461
2033	1,461

(Source: BCPL, May 2015)

Historical water cart usage information is available for the past five years in BCPL's AEMR documents and is summarised below in Figure 4.1. Historically, it has not been possible to separate haul road dust suppression and mine/pit dust suppression volumes, as water cart records are limited to data collected at the source. It has also been historically difficult to estimate water required for dust suppression and excess water that was disposed of via dust suppression sprayers during high rainfall months. The numbers presented in Figure 4.1 are skewed by the higher dust suppression rates recorded between the end of 2011 and early 2012 associated with disposal of excess water. During November 2011 and January/February 2012, the mine site experienced heavy and prolonged rainfall. A measure to dispose of excess water from mine water storages was via dust suppression sprayers. Therefore this data does not reflect what dust suppression was actually required for dry and windy days.

Given the recent modification to the mine plan (Revised Draft MOP) and reliability of dust suppression volume data obtained to date, it is not possible to accurately estimate future dust suppression rate. Subsequently a BCPL best estimate has been adopted for use in the SWB. There is likely to be variance in the amount of water used during later years, however the above is an average and based on the best estimate by BCPL site personnel. More detailed dust suppression data will be analysed as part of the on-going review of this document.

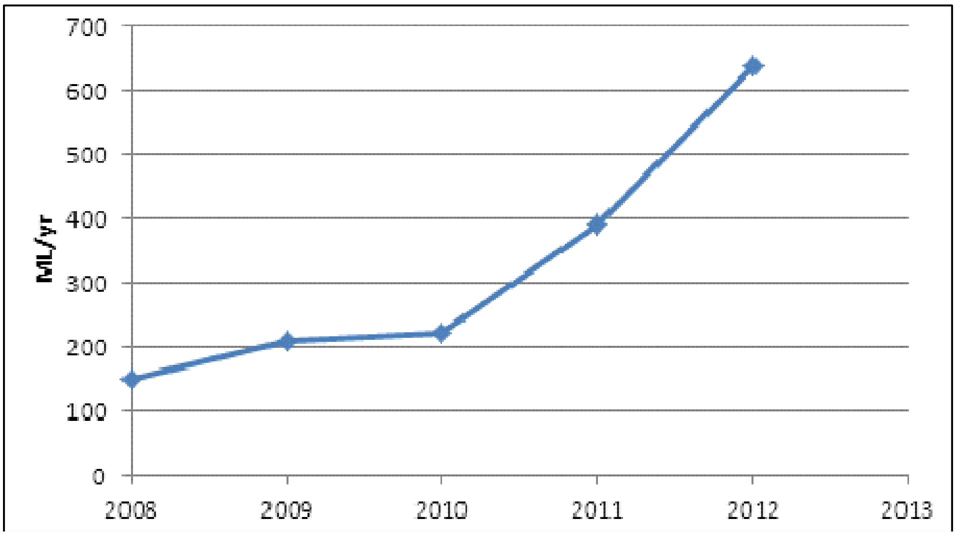


Figure 4.1 Historical water usage for dust suppression (ML/yr)

Water used for dust suppression at the mine site is sourced as a priority from recycled contaminated water contained in MW2 and MW3. When there is a water deficit onsite, imported water will be used to supplement recycled water sourced from MW2 and MW3.

In addition to the above, a demand of 91 ML/yr has been assumed to apply until mid-2015 for dust suppression at the existing rail loading facility located approximately 15 km west of the main mine site. This water is sourced as a priority from recycled water contained in SD4. It is assumed that this rail loading facility would not be operational after mid-2015. This estimate has been updated subsequent to the EA based on historical usage figures.

For the purposes of the water balance analysis, it is assumed that dust suppression water will not be required on days with more than 5 mm of rainfall. On average, there are 35 days per year with more than 5 mm of rainfall based on the historical rainfall record. A scaling factor of +9.6% has therefore been applied to the annual dust suppression demands in Table 4.7 when calculating the daily application rate in the model in order to account for rain days. This will be refined year on year in line with review of the site water balance and changes to the mine plan.

4.5.3 Coal handling and preparation plant

BCPL estimates the net CHPP water demand to be approximately 4 ML/day (equivalent to 1,461 ML/annum). This is the net demand and accounts for water that is returned within the process. This water is required for coal washing, dust suppression and MIA washdown water.

The CHPP is scheduled to be operational in July 2015 and will process up to a 2.0 Mtpa of coal from Boggabri Coal Mine. The breakdown of CHPP demands is summarised in Table 4.8.

Table 4.8 CHPP demand estimates

Project year	Coal washery feed (Mtpa)	CHPP makeup water (ML/yr)
2015	2.0	1,461
2017	2.0	1,461
2019	2.0	1,461
2022	2.0	1,461
2033	2.0	1,461

(Source: BCPL, May 2015)

Note. ^ CHPP becomes operational in July 2015.

4.5.4 MIA and potable water

Water is required for vehicle washdown in the MIA. Washdown water is recycled; however, water is required to make-up evaporative losses. Make-up water for vehicle washdown is currently sourced from groundwater pumped from Lovton Bore. Groundwater is treated in an onsite water treatment plant prior to use for vehicle washdown. Note that non-contaminated water is required for vehicle washdown.

Potable water is utilised in the administration building and amenities during operations. Potable water is currently sourced from groundwater entitlements assigned to the Lovton Bore, and is treated in an onsite water treatment plant prior to use for potable applications. Wastewater from the administration building and amenities will be treated in an onsite Envirocycle treatment plant and irrigated to an adjacent vegetated area. Wastewater generated by the onsite Envirocycle treatment plant has not been considered in the water balance analysis.

BCPL estimates that approximately 1 ML/day (equivalent to 365 ML/yr) of water will be required for the MIA and potable water. This information has been revised following lodgement of the EA based on more detailed project design and engineering work that has occurred since the EA in 2010.

4.5.5 Summary

A summary of estimated water demands is provided in Table 4.9. The water source is also provided in Table 4.9.

Table 4.9 Summary of estimated water demands

Demand description	Source	Demand (ML/yr)	
		Jan 2015 to June 2015	**July 2015 onwards**
Construction – Rail loop and CHPP expansion ^	1st priority (CHPP) –reuse contaminated water, 1st priority (rail loop) – reuse sediment water, 2nd priority – imported raw water	267	0
Dust suppression - rail loading facility west of site ^	1st priority – reuse contaminated water, 2nd priority – imported raw water	91	0
Dust suppression - haul roads	1st priority – reuse contaminated water, 2nd priority – imported raw water	1,461	1,461
CHPP - mine water or raw water component ^^	1st priority – reuse contaminated water, 2nd priority – imported raw water	0	1,461
MIA and potable water	Imported raw water	365	365
Total		**2,184**	**3,287**

Notes ^ Construction water and dust suppression at west rail loading facility required until end of June 2015. ^^ CHPP water required from July 2015 when CHPP becomes operational

4.6 Other losses

4.6.1 Evaporation

Evaporation estimates for open water bodies were based on Data Drill sourced daily Morton's Lake evaporation data. The Data Drill calculates Morton's Lake evaporation using Morton's formula for shallow lakes given in the Journal of Hydrology, Volume 66, page 1-77, paper (Morton, 1983).

Evaporative surface area for dams has been determined based on the stage-storage relationships provided by BCPL. Stage-storage relationships are provided in Appendix C.

4.6.2 Seepage from dams

Some water will be lost from dams as a result of seepage through the foundation. Site dams should have low seepage losses and, depending on the subsoils, an engineered liner will be required. All dams are constructed with the best material available as water is a critical resource for BCPL.

Water balance modelling has assumed seepage losses to be negligible. This assumption is intended to be conservative from the perspective of containment performance but may not be conservative for other outcomes of operational simulation modelling (such as water supply reliability).

4.7 Water balance results

The GoldSim model incorporating the 2015, 2017, 2019, 2022 and 2033 ‘snapshot’ landforms was simulated at a daily timestep for a 19-year duration (i.e. the life of the Boggabri Coal Project to 2033). The model was simulated for 108 realisations of rainfall and evaporation data developed by ‘stepping through’ the Data Drill sourced historical rainfall and evaporation data for the period 1 January 1889 to 1 January 2013. Probability distributions were then developed using the results from each of the 108 realisations.

The 50th percentile annual SWB is provided in Table 4.10 for the 2015, 2017, 2019, 2022 and 2033 ‘snapshot’ year landforms. It is assumed that the 50th percentile result is generally representative of median climatic conditions. Note that the dust suppression demands are applied at an equivalent daily rate (4 ML/day equating to 1,461 ML/year) using operating rules limiting dust suppression only to days with rainfall less than 5mm. Therefore the modelled dust suppression demands on an annual basis differ to the average annual demands presented in Table 4.7 and Table 4.9.

Note that the results for 2015 consider a change to system operating rules and demands in mid-2015 when the CHPP becomes operational. As such, the demands presented in Table 4.10 for 2015 differ to those in Table 4.9.

Table 4.10 Simulated annual mine site water balance for each of the Snapshot Years - 50th percentile (median)

	2015	2017	2019	2022	2033
Inflows (ML/yr)					
Water management system runoff and direct rainfall:					
▪ Clean water (highwall) dams	0	0	0	0	72
▪ Dirty water sediment dams	359	362	374	708	698
▪ Contaminated water dams, MWDs and pit	639	670	640	469	539
Groundwater make	205	250	287	342	410
Imported water requirement	1,933	2,082	2,070	2,065	1,930
Undisturbed catchment runoff and rehabilitated areas to Nagero Creek	542	558	560	455	658
Dirty water from sediment dams reused onsite	100	266	279	423	415
Outflows (ML/yr)					
Demands (mine water or raw water acceptable):					
▪ Dust suppression - haul roads *	1,461	1,461	1,461	1,461	1,461
▪ Dust suppression - rail loading facility west of site *	46	0	0	0	0
▪ CHPP ^^	731	1,461	1,461	1,461	1,461
▪ Construction ^	134	0	0	0	0
Demands (raw water only):					
▪ MIA and potable water	365	365	365	365	365
Evaporation:					
▪ Clean water (highwall) dams	0	0	0	0	3
▪ Dirty water sediment dams	35	41	41	60	91
▪ Contaminated water dams, MWDs and pit	39	49	50	50	55
Site wide release to Nagero Creek (WMS):					
▪ Clean water (highwall dam) controlled discharge to creek	0	0	0	0	69
▪ Dirty water sediment dam overflows to creek	0	0	0	0	0
▪ Dirty water sediment dam controlled discharge to creek	116	0	1	172	117

Notes. ^ Construction water and dust suppression at west rail loading facility required until end of June 2015. ^^ CHPP water required from July 2015 onwards when CHPP operational. *Dust suppression demands only applied in model for days with rainfall less than 5mm.

4.7.1 Imported water requirements

A summary of the estimated peak annual imported water requirement for the period between the snapshot years is provided in Table 4.11 based on the 108 water balance realisations. Note that the values in Table 4.11 do not account from the supply of water from existing entitlements held by BCPL.

Table 4.11 Simulated peak annual imported water requirement for the periods ending to each snapshot year

	Imported water requirement (ML/yr)				
	2015	2017	2019	2022	2033
5th percentile (very wet)	916	994	985	1,272	971
10th percentile (wet)	1,171	1,116	1,134	1,371	1,208
50th percentile (median)	1,933	2,082	2,070	2,065	1,930
90th percentile (dry)	2,403	2,647	2,632	2,576	2,460
95th percentile (very dry)	2,497	2,834	2,815	2,766	2,661
Greatest result (driest on record)	2,547	2,908	2,883	2,819	2,736

When the site is in a water deficit, it is necessary to import water to the mine site to supplement dust suppression and CHPP process water demands. Note that even when the site is in a contaminated water surplus, high-quality imported water is required to meet the potable water and vehicle wash-down demands.

A total of 848 unit shares of groundwater will be available to BCPL from the existing aquifer access licences. The actual volume of groundwater available will depend on the AWD made under the WSP. Assuming an allocation of 1 ML/yr per unit share, it can be expected that approximately 848 ML/yr be available to BCPL from the existing aquifer access licences.

BCPL also holds a total of 294 unit shares of general security surface water entitlements and an additional 31.7 unit shares which would be available to BCPL from the Namoi River. As detailed in Section 2.2.1 of the SWMP a reliability factor is applied to the surface water entitlements based on a long-term extraction factor, to reflect the actual available water for withdrawal from the river.

The greatest result imported water requirement is estimated to be 2,908 ML/yr, peaking around 2017. The 'greatest result' essentially represents the driest year on the historical record. The entitlements from BCPL's existing aquifer and surface water access licences would not be adequate to meet demands under these extreme circumstances, and there would be a potential requirement of up to 1,831 ML/yr in addition to the existing groundwater and reliability-factored surface water entitlements for the direst climatic scenario on record. This potential requirement is based on a need of 2,908 ML/yr of imported water (i.e. aquifer access= 848 ML/yr, reliability-factored surface water entitlement = 229 ML/yr).

BCPL is able to access surface water from the Namoi River in accordance with its surface water licences via a pump station from the Namoi River which has been constructed. It can also trade additional water, either temporarily or permanently, to make up shortfalls. Furthermore, groundwater can also be traded on a temporary or permanent basis within the greater Gunnedah-Oxley Basin Groundwater Source, and within zone 4 of the Upper Namoi, subject to local impact considerations.

BCPL will continue to assess options to ensure water security for operations and will act proactively to manage water demand. Should extreme conditions eventuate and if deemed necessary, the scale of mining operations on site would be adjusted to match the available water supply.

4.7.2 Contaminated water dam and in-pit storage performance

Summaries of the simulated daily time series of water stored in the mining void, strips #9 / #40, and MWDs MW2, MW3 and MW5 over the Project are provided in Figure 4.2 to Figure 4.5. Note that the percentiles shown in the daily time series plots are daily percentile ranks of the daily results based on 108 water balance realisations, whereas the percentile shown in Table 4.10 and Table 4.11 are percentile ranks of the annual results based on 108 water balance realisations.

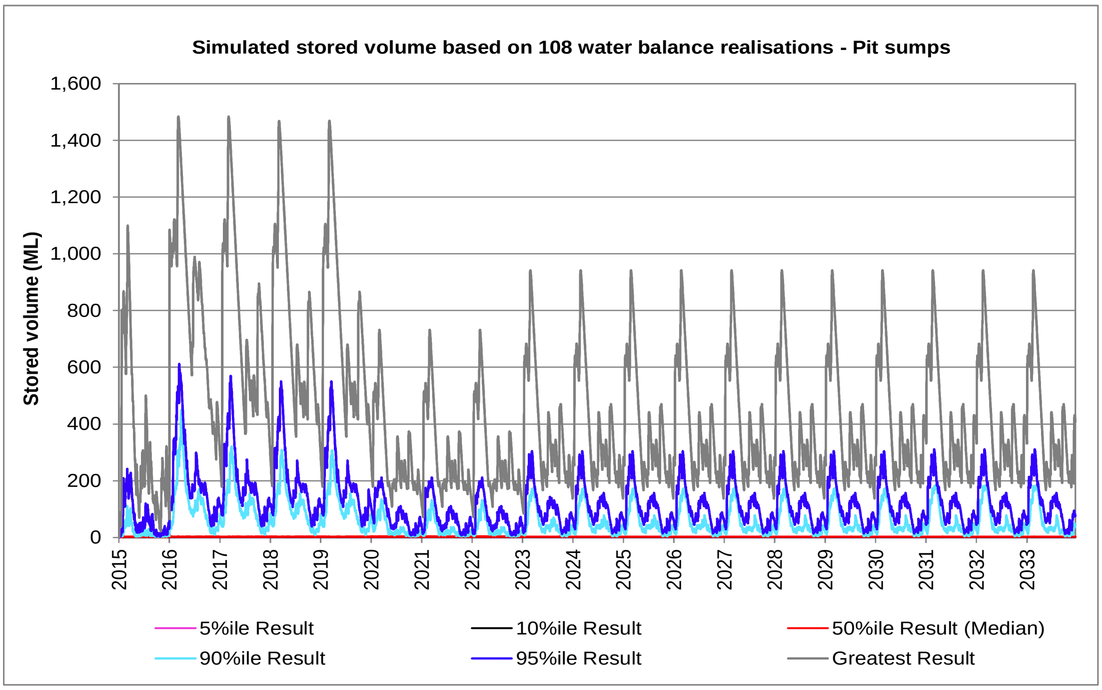


Figure 4.2 Simulated time series of water stored in-pit sumps

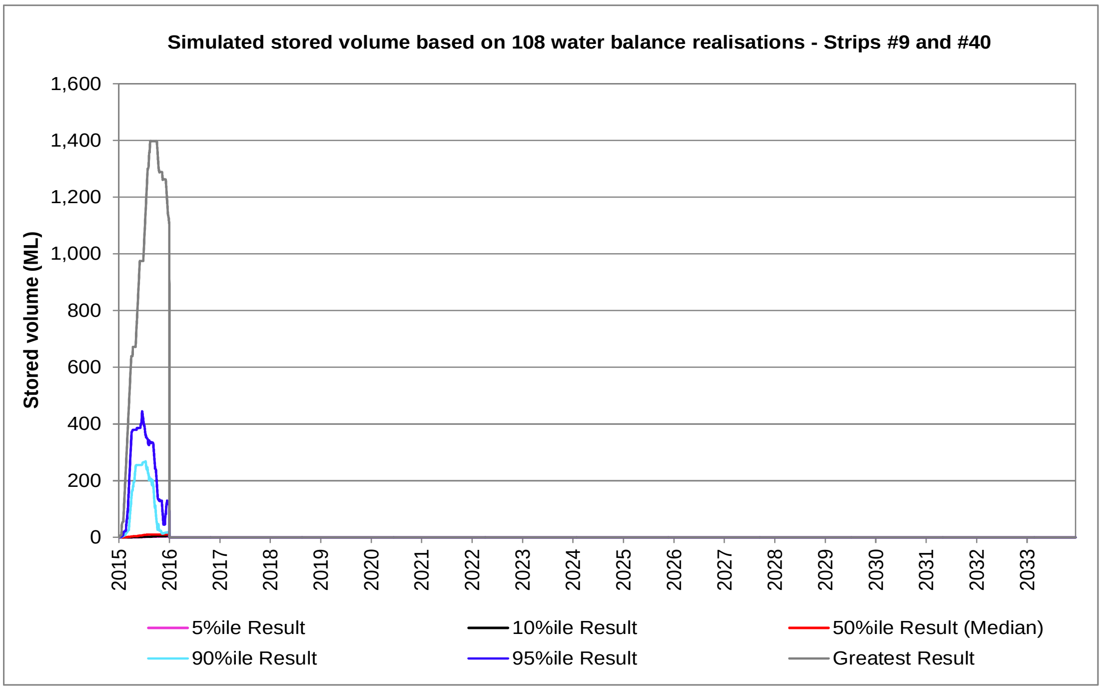


Figure 4.3 Simulated time series of water stored in Strips #9 and #40

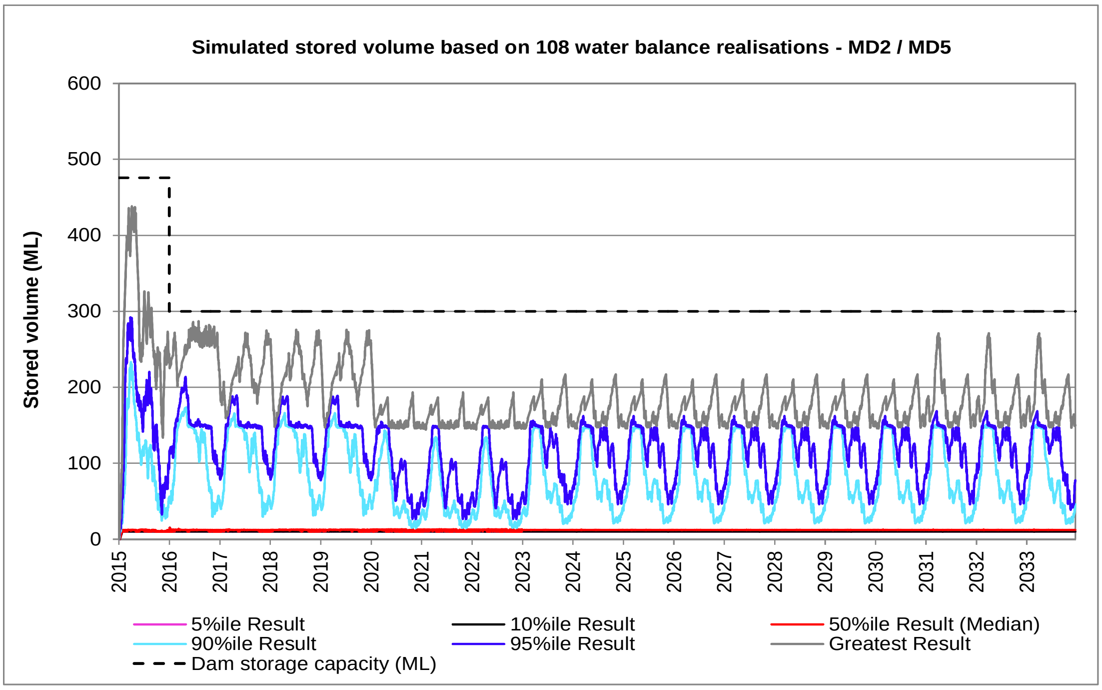


Figure 4.4 Simulated time series of water stored in combined MW2 and MW5

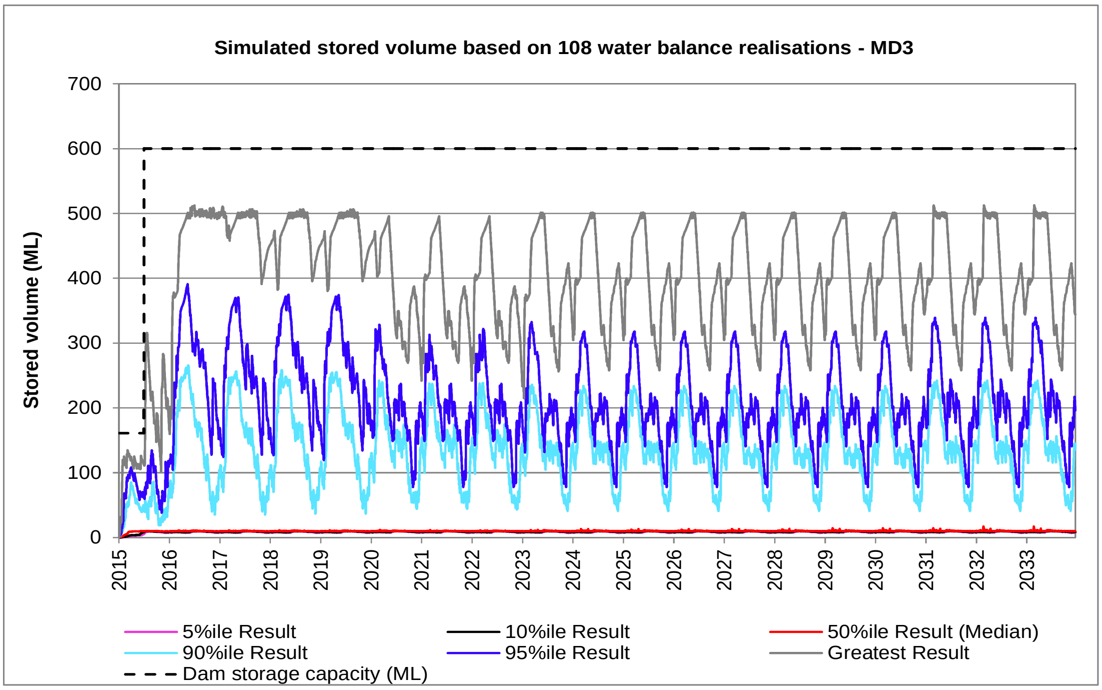


Figure 4.5 Simulated time series of water stored in MW3

The number of days per year that the stored volume in pit sumps exceeds a nominal 200 ML threshold over the Project is provided in Figure 4.6. Note that the percentiles shown in Figure 4.6 are percentile ranks of the annual results based on 108 water balance realisations. The nominal threshold stored volume of 200 ML has been adopted for reporting purposes only to provide an indication of pit availability.

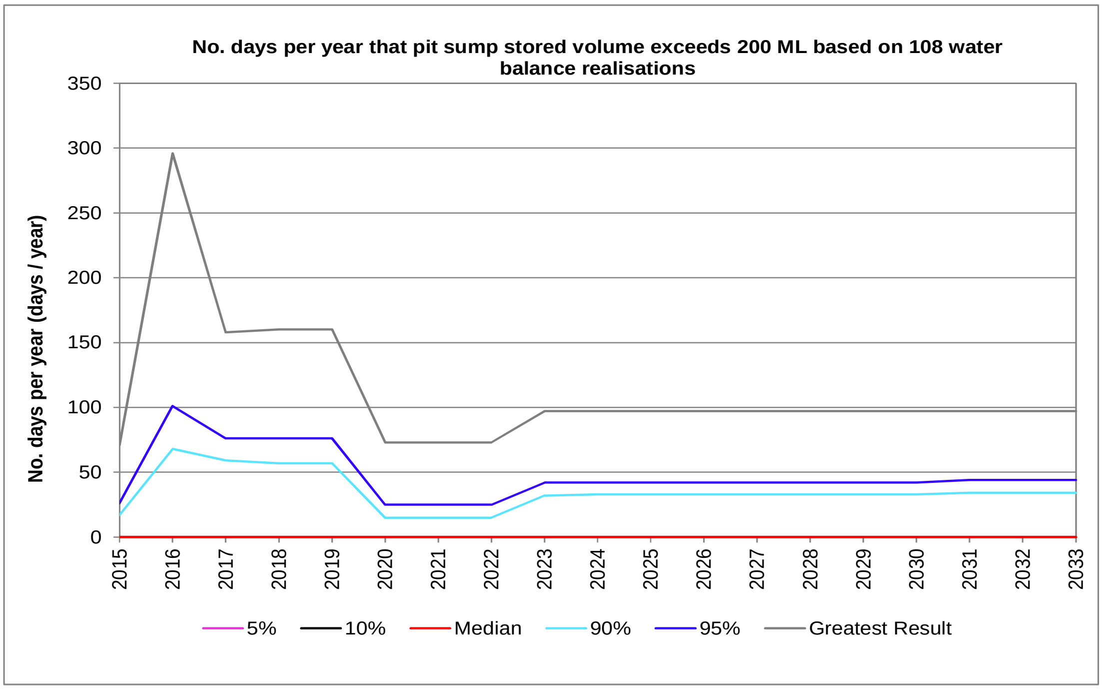


Figure 4.6 Pit availability

4.8 Water balance model verification

4.8.1 Verification for November 2011 to February 2012 wet period

A 'verification' simulation was undertaken to compare the water balance model results against site observations for the period November 2011 to February 2012. This was a particularly wet period, with two significant rainfall events occurring at the mine site. The first significant rainfall event occurred from 24 to 26 November 2011 with 151 mm falling over 72 hours (estimated 11 year ARI event). The second significant rainfall event occurred from 31 January to 2 February 2012 with 171 mm falling over 72 hours (estimated 18 to 19 year ARI).

The verification model was simulated using rainfall and evaporation data from 1 November 2011 to 21 February 2012 sourced from both the site meteorological station and Data Drill data.

The verification model was simulated using similar operating rules to those described above in Section 4.1 to 4.6 for Year 1 of the Project, with the following exceptions:

- The verification model was simulated using the actual dust suppression demand of 471 ML/yr for the period November 2011 to February 2012. This demand is based on actual monthly water cart usage information supplied by BCPL for November 2011 to February 2012. Higher dust suppression rates have been recorded for November 2011 to February 2012 due to disposal of excess water. Note that it was not considered appropriate to simulate the Boggabri Coal Mine water balance with a dust suppression demand of 471 ML/yr in Years 1 and 2 as it does not reflect typical normal usage and this rate was only adopted onsite on a temporary basis from November 2011 to February 2012. Adopting the higher demand for the Boggabri Coal Mine general water balance may have underestimated the surplus or overestimated the deficit under normal operating conditions.

- The verification model was simulated using the construction water demand of 250 kL/yr for the period November 2011 to February 2012, as only minor construction activities were underway at this time.

- The verification model was simulated assuming the starting storage values observed onsite prior to the first significant rainfall event on 24 November 2011.

- A storage capacity of 14 ML was adopted in the model for SD2, and a storage capacity of 35 ML was adopted in the model for SD3.

4.8.1.1 Site observations

Monitoring data on the volume of water stored onsite was available for the period October 2011 and February 2012 for verification purposes. BCPL has advised that the following volumes were stored in MW2, MW3 and in-pit:

Prior to first significant rainfall event (23 October 2011):

- 67 ML stored in-pit (in 'Strip 9')

- 131 ML stored in MW2

- 52 ML stored in MW3
- *250 ML total*

Following second significant rainfall event (12 & 21 February 2012):

- 599 ML stored in-pit
- 164 ML stored in MW2
- 117 ML stored in MW3
- *880 ML total*

Monitoring data on the volume of water discharged from sediment dams / storage dams and the volume of raw water imported to site was not available for the period October 2011 and February 2012 for verification purposes.

4.8.1.2 Verification model results

The simulated daily time series of contaminated runoff generated for the pit catchment for the verification simulations are provided in Figure 4.7.

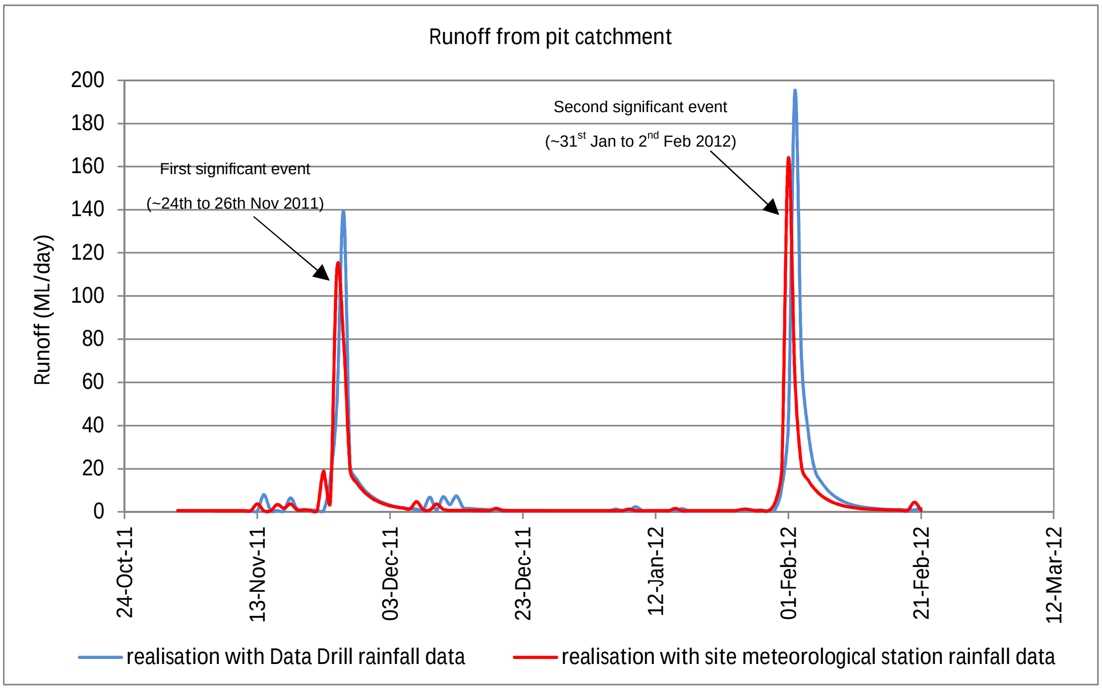


Figure 4.7 Simulated contaminated runoff generated for pit catchment from 1 November 2011 to 21 February 2012 – model verification

When the Data Drill rainfall data was adopted in the model, the volume of contaminated runoff generated for the pit catchment was estimated to be 801 ML for the period 1 November 2011 to 21 February 2012 (comprising 349 ML from 1 November 2011 to 31 December 2012 and 451 ML from 1 January to 21 February 2012). When the site meteorological station rainfall data was adopted in the model, the volume of contaminated runoff generated for the pit catchment was estimated to be 679 ML for the period 1 November 2011 to 21 February 2012 when adopting the site meteorological station rainfall data in the model (comprising 328 ML from 1 November 2011 to 31 December 2011 and 351 ML from 1 January to 21 February 2012). This demonstrates that the runoff volumes estimated using the Data Drill are higher than those estimated from the site meteorological station rainfall data, particularly for the second significant storm event occurring 31 January to 2 February 2012.

The simulated daily time series of water stored in the pit and combined MWDs (MW2 and MW3) for the verification simulations are provided in Figure 4.8 and Figure 4.9 respectively.

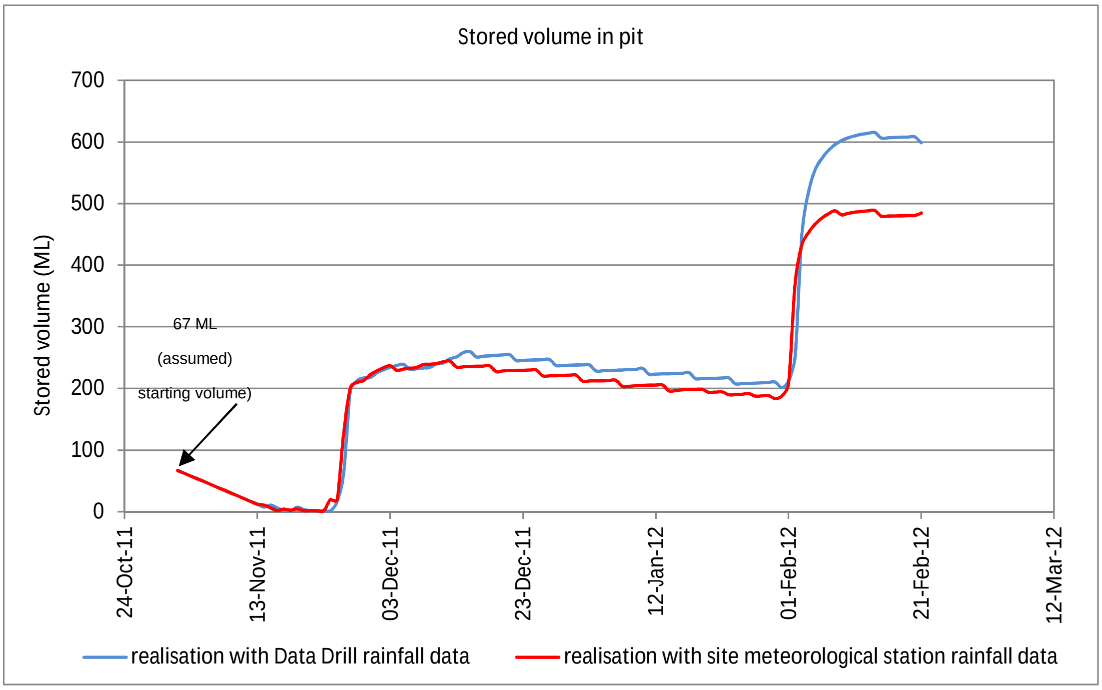


Figure 4.8 Simulated volume of water stored in-pit from 1 November 2011 to 21 February 2012 – model verification

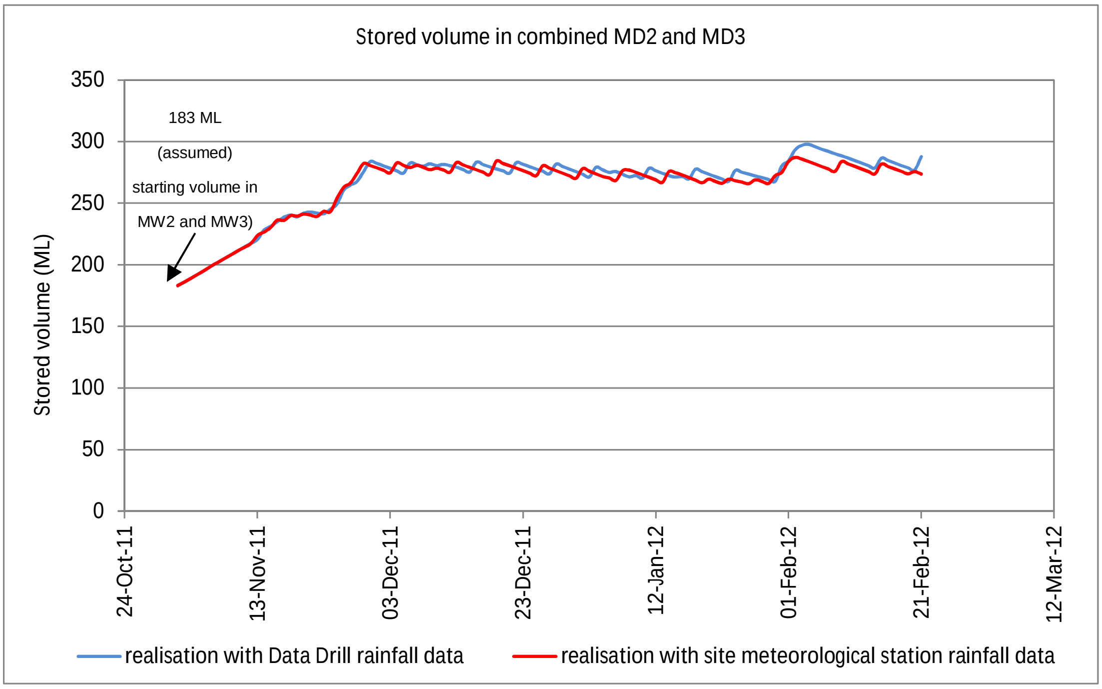


Figure 4.9 Simulated volume of total water stored in MWDs (MW2 and MW3) from 1 November 2011 to 21 February 2012 – model verification

Figure 4.8 shows that the estimated volume of water stored in-pit after the first significant event on 24 to 26 November 2011 is around 260 ML for the simulation using the Data Drill compared to 244 ML for the simulation using the site meteorological station rainfall data. Some dewatering to the MWDs occurs between the first and second events. However, Figure 4.9 shows that dewatering is limited by the available capacity in the MWDs (as the MWDs are close to full by the end of November 2011). After the second event on 31 January to 2 February 2012 the stored volume in-pit is 615 ML for the simulation using the Data Drill compared to 489 ML for the simulation using the site meteorological station rainfall data. After the second event the stored volume in MW2 and MW3 is 298 ML for the simulation using the Data Drill compared to 287 ML for the simulation using the site meteorological station rainfall data.

The model estimates a total contaminated water volume stored in-pit and in MWDs MW2 and MW3 of 895 ML for the simulation using the Data Drill compared to 766 ML for the simulation using the site meteorological station rainfall data after the second event on 12 February 2012.

The modelled volume stored in the pit and MWDs (MW2 and MW3) of 895 ML (using the Data Drill rainfall data) and 766 ML (using the site meteorological station rainfall data) compares to an observed volume of 880 ML on 12 February 2012. The model therefore overestimates the stored volume by 15 ML (+1.7%) when using the Data Drill and underestimates the stored volume by 114 ML (-13.0%) when using the site meteorological station data.

Based on the above, the modelled storage volumes using the Data Drill sourced rainfall data are considered to compare reasonably well to observations under significant rainfall conditions, such as those experienced in November 2011 to February 2012.

5. Monitoring programme

The monitoring program relating to the SWB is outlined in Table 5.1. Other monitoring requirements for the water management system are outlined in the SWMP and Groundwater Management Plan (GMP).

Table 5.1 Site water balance monitoring programme

Monitoring	Frequency	Responsibility
Site meteorological data (including rainfall and evaporation)	Automatic sampling (15-minute data)	BCPL Environment Superintendent
Volume of water consumed onsite: ▪ Dust suppression water for haul roads ▪ Dust suppression water for coal stockpiles ▪ Vehicle washdown water ▪ CHPP ▪ Potable water ▪ Construction activities	Daily	BCPL Environment Superintendent / Mining and Construction Contractors
Volume of raw water imported to site: ▪ groundwater pumped from each bore (Lovton, Daisymede, Victoria Park, Cooboobindi) ▪ surface water via pipeline from Namoi River ▪ Potable water supply	Daily	BCPL Environment Superintendent / Mining Contractor
Volume of water stored onsite (surveyed water level): ▪ dirty water sediment dams (SD3, SD6, SD7, SD8, SD14, SD19, SD20, SD21, SD22, SD23, SD24) ▪ contaminated water dams (SD4, SD10, SD11, SD12, SD28, SD29) ▪ MWDs (MW2, MW3, MW5) ▪ clean water highwall dams (CD5, CD6, CD7, CD8) ▪ mining void and strips	Monthly	BCPL Environment Superintendent / Mining Contractor
Volume of water stored onsite (visual inspection to estimate water level): ▪ dirty water sediment dams (SD3, SD6, SD7, SD8, SD14, SD19, SD20, SD21, SD22, SD23, SD24) ▪ contaminated water dams (SD4, SD10, SD11, SD12, SD28, SD29) ▪ MWDs (MW2, MW3, MW5) ▪ clean water highwall dams (CD5, CD6, CD7, CD8) ▪ mining void and strips	Daily	BCPL Environment Superintendent / Mining Contractor
Volume of water pumped between storages	Transfer event	BCPL Environment Superintendent / Mining Contractor

Monitoring	Frequency	Responsibility
Volume of water discharged from sediment dams / storage dams	Discharge event	BCPL Environment Superintendent / Mining Contractor
Pit inflow monitoring from high wall and end wall: ▪ Seepage locations ▪ Rate of seepage ▪ Volume of seepage	Monthly	BCPL Environment Superintendent / Mining Contractor
Monitor ambient stream flow upstream and downstream of Nagero Creek: ▪ Upstream at SW2 ▪ Downstream at SW1	Monthly and event based until baseline is established	BCPL Environment Superintendent / Mining Contractor

6. Reporting and plan revision

6.1 Reporting

Reporting items related to the SWB report are discussed in Section 6 of the WMP. Specific requirements relating to the SWB report are described below.

6.1.1 Annual site water balance appendix

An Annual SWB Appendix is to be prepared for each calendar year. The results of the Annual SWB Appendix are to be presented as part of the Annual Environmental Management Report (AEMR).

The Environment Superintendent is responsible for coordinating preparation of the Annual SWB Appendix.

The Annual SWB Appendix will utilise the following data:

- actual daily rainfall and evaporation data collected from the mine sites meteorological station for the previous calendar year
- actual starting storage volumes for the beginning of the previous calendar year as determined by the site monitoring programme
- actual site water demands for the previous calendar year as determined by the site monitoring programme

The Annual SWB model predictions for each calendar year are to be verified against the site monitoring data, and the verification results are to be included in the Annual SWB Appendix. The verification process is shown in Figure 6.1.

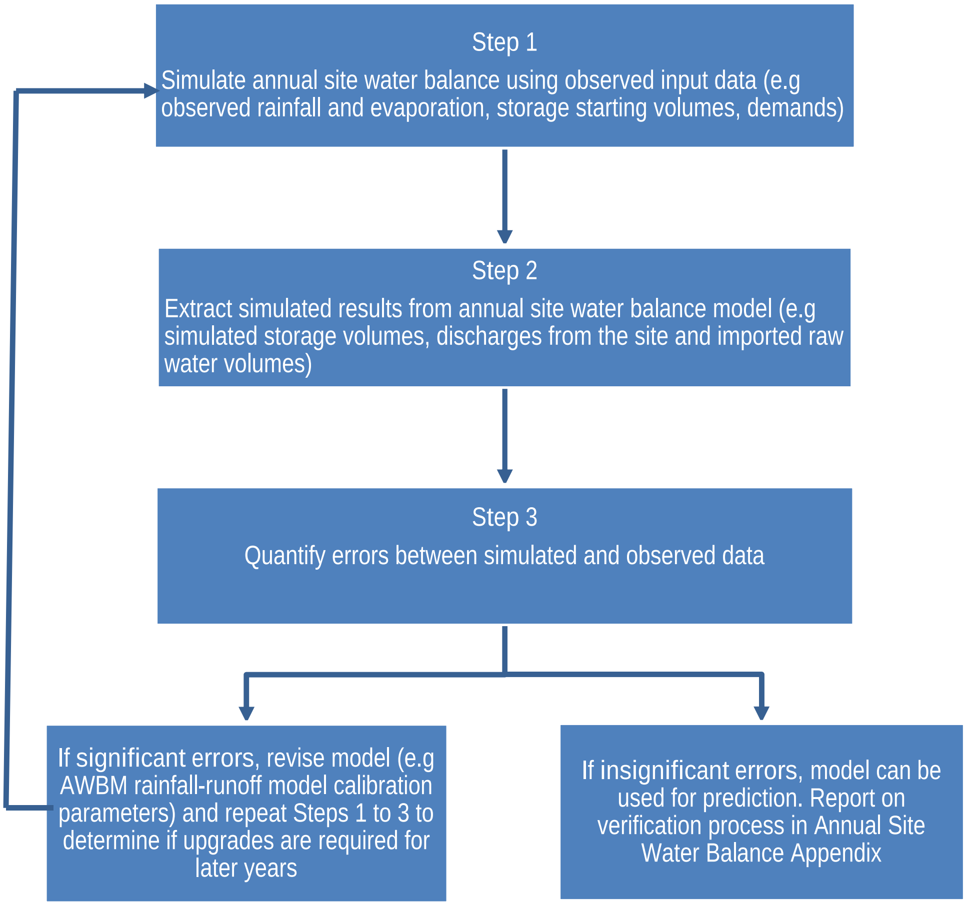


Figure 6.1 Water balance model verification process

6.2 Revision and development

The SWB report is a living document and will be updated, evolve and develop throughout the mine life. Triggers for these revisions could include:

- requirement for additional detail of the water management system in the mid to later years of the Project (the current SWB provides more detail around the first five years of the Project)
- requirement to revise water balance model identified during the Annual SWB verification process
- SWB report review as part of Annual Review
- changes to legislation, regulation and guidance
- changes/amendments to project planning approval
- changes/amendment to environmental licences

- changes to mine operations, mine stage planning, water management strategies and water supply strategies
- feedback loop as part of plan implementation, internal review, testing, training and 'lessons learnt'
- agency consultancy

6.2.1 Annual review

This SWB report will be reviewed at least every twelve months by BCPL's Environment Superintendent, to ensure that the system is conforming to the BCPL Mining Operations Plan, environmental policies, objectives and legal and other requirements.

At any time if Preventative Actions indicate that amendments to the WMP are required, this will also trigger the WMP review process including the related sub-documents (SWMP, GMP, SWB report). Refer to the WMP for further detail.

6.2.2 Planning related changes

Non-site specific changes to legislation, regulation, guidance and related site specific changes to planning approvals and licences are likely to occur over the life of the mine. A process for managing this is provided in the WMP. Any revisions relevant to the SWB will generally be documented as part of the annual review; however specific revisions may be required subject to the Environment Superintendent's direction.

6.2.3 Changes to mine operations

Changes to mine planning and operation are likely to occur over the life of the mine and could result from changes such as budgetary constraints, increased/reduced production demands, water availability etc. Any revisions relevant to the WMP will generally be documented as part of the annual review; however specific revisions may be required subject to the Environment Superintendent's direction. In addition, if there are significant changes to mine operations then this may trigger requirements for revised plans to be approved by DP&I in consultation with agencies and the CCC.

6.2.4 Feedback loop

The SWB report is intended to provide structure and guidance to the surface water management process, many elements relating to licensing compliance can be considered prescriptive in nature however opportunities exist as part of the plans implementation/revision for feedback to be incorporated. This feedback could include:

- mine staff, contractors and environment staff feedback, lessons learnt and previous experience
- testing of flow monitoring, runoff coefficients, soils management and data
- documentation and implementation audit processes (internal and external)
- community, stakeholders, authorities and other parties

6.2.5 Agency consultation

Previous versions of the SWB report have been prepared in consultation with representatives from OEH, NOW, NCMA and CCC.

6.3 Future work

The following section outlines items that should be considered in subsequent revisions of this SWB report:

- modelling of additional 'snapshot' landforms in the mid to later years of the Project (the current SWB provides more detail around the first five years of the Project – with three of the five 'snapshot' landforms relating to the first five years)
- adopting actual starting storage volumes for the beginning of the SWB simulation based on site monitoring data
- ongoing verification of the SWB model, including verification of the simulated discharge volumes against site monitoring data and verification of the simulated imported water volumes against site monitoring data
- verification that the Data Drill rainfall data is representative of rainfall at the mine site (it may be necessary to scale the Data Drill historical rainfall data to remove any bias in the Data Drill)
- augment pit inflow monitoring practices to more accurately record water volumes pumped from the mine void in terms of timing and pumping. This is key aspect of any future refinements both the Boggabri Coal Mine and broader BTM Complex site water balance
- incorporate forecast reductions to pit inflows associated with cumulative impacts as the regional groundwater model evolves through verification of simulated head against those measured. This is particularly relevant in later years when the MCC void extends below the elevation of the proposed Boggabri Mine Void.

7. References

Australasian Groundwater & Environmental Consultants (AGE), October 2010. Continuation of Boggabri Coal Mine Project Groundwater Water Assessment.

Boggabri Coal Pty Limited (BCPL), March 2012. Mine Water Balance Review – Boggabri Coal Project.

Department of Environment, Climate Change and Water (DECCW), 2008. Managing Urban Stormwater - Soils and Construction - Volume 2E Mines and Quarries.

Smith M, 1998. Crop evapotranspiration: Guidelines for computing crop water requirements. Food and Agriculture Organization of the United Nations. Irrigation and Drainage paper No. 56.

Hansen Bailey, December 2010. Continuation of Boggabri Coal Mine Environmental Assessment.

Hansen Bailey, August 2011. Boggabri Coal Mine Environmental Assessment - Modification to Development Consent.

Morton, 1983. Operational estimates of areal evapotranspiration and their significance to the science and practice of hydrology. Journal of Hydrology, Volume 66, 1-77.

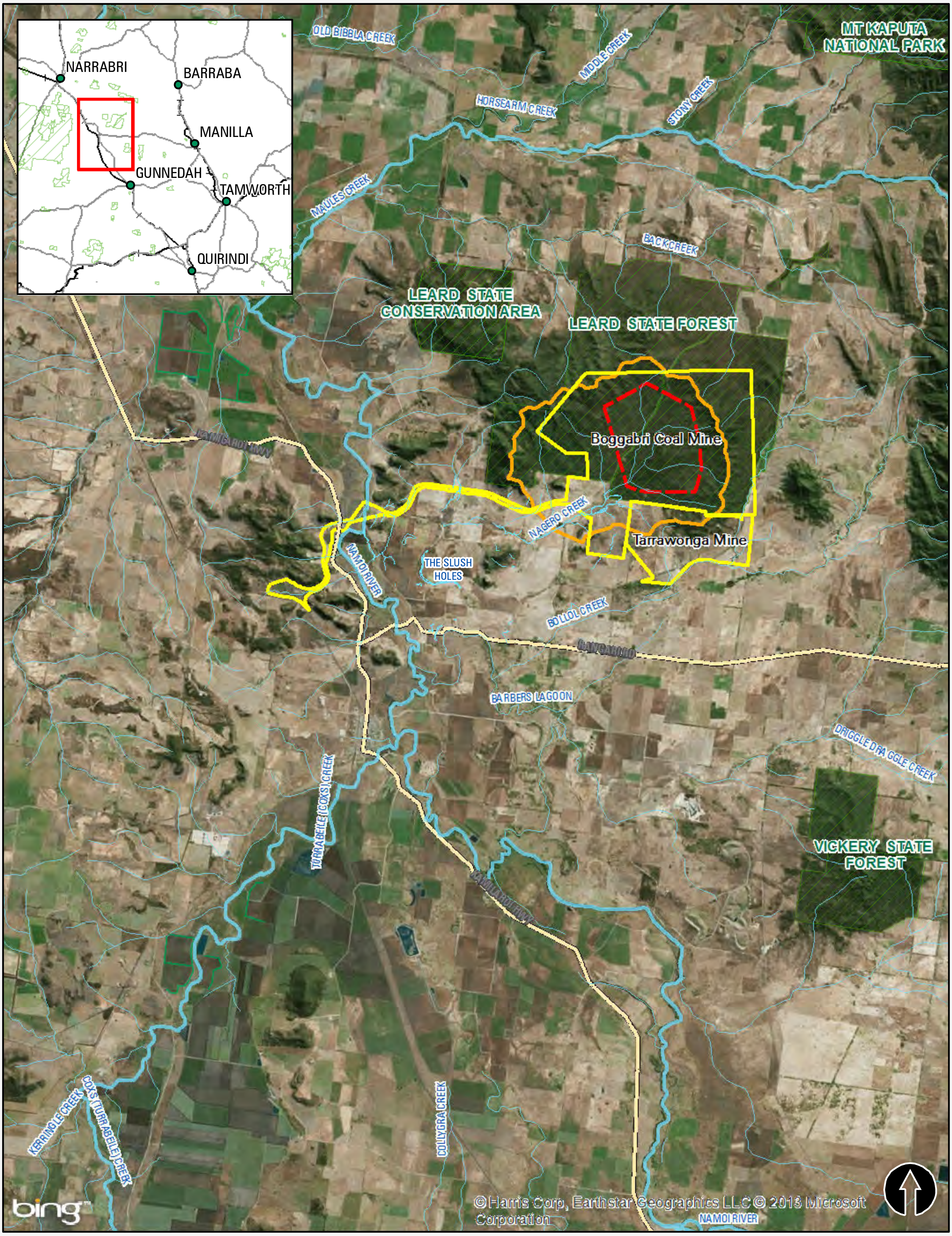
Parsons Brinckerhoff (PB), October 2010. Continuation of Boggabri Coal Mine Project Surface Water Assessment.

Parsons Brinckerhoff (PB), 2009. Boggabri Coal Mine 2008 Site Water Balance.

Ribbons C, 2009. Water availability in New South Wales Murray–Darling Basin regulated rivers, NSW Department of Water and Energy, Sydney.

Appendix A

Water management system layout plans, monitoring and discharge locations, and schematics



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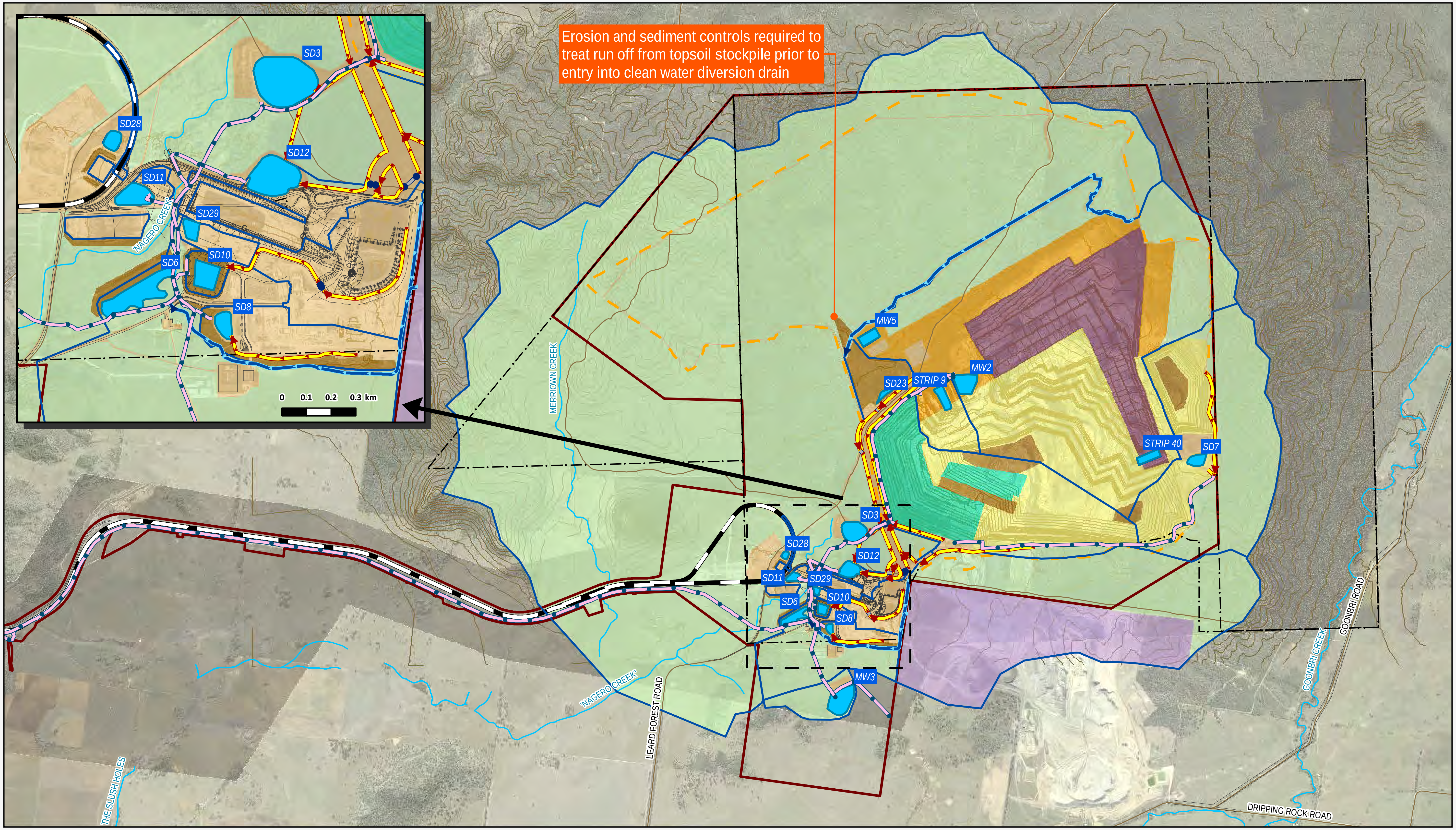
0 1 2 km

- Mining leases
- Mine disturbance area
- Study catchment
- NSW State Forest/ Conservation Area
- NSW Main Road
- Drainage

Figure 1
Locality plan



Waterway
Contours
Mine Infrastructure
Rail Loop
Existing pipeline

Mine tenement
Project Approval Area
EIS Boundary
Federal Approval Limit

Water management
Clean water drain
Dirty water drain
Pump pipeline
Culvert
Water Storage
Water balance catchment

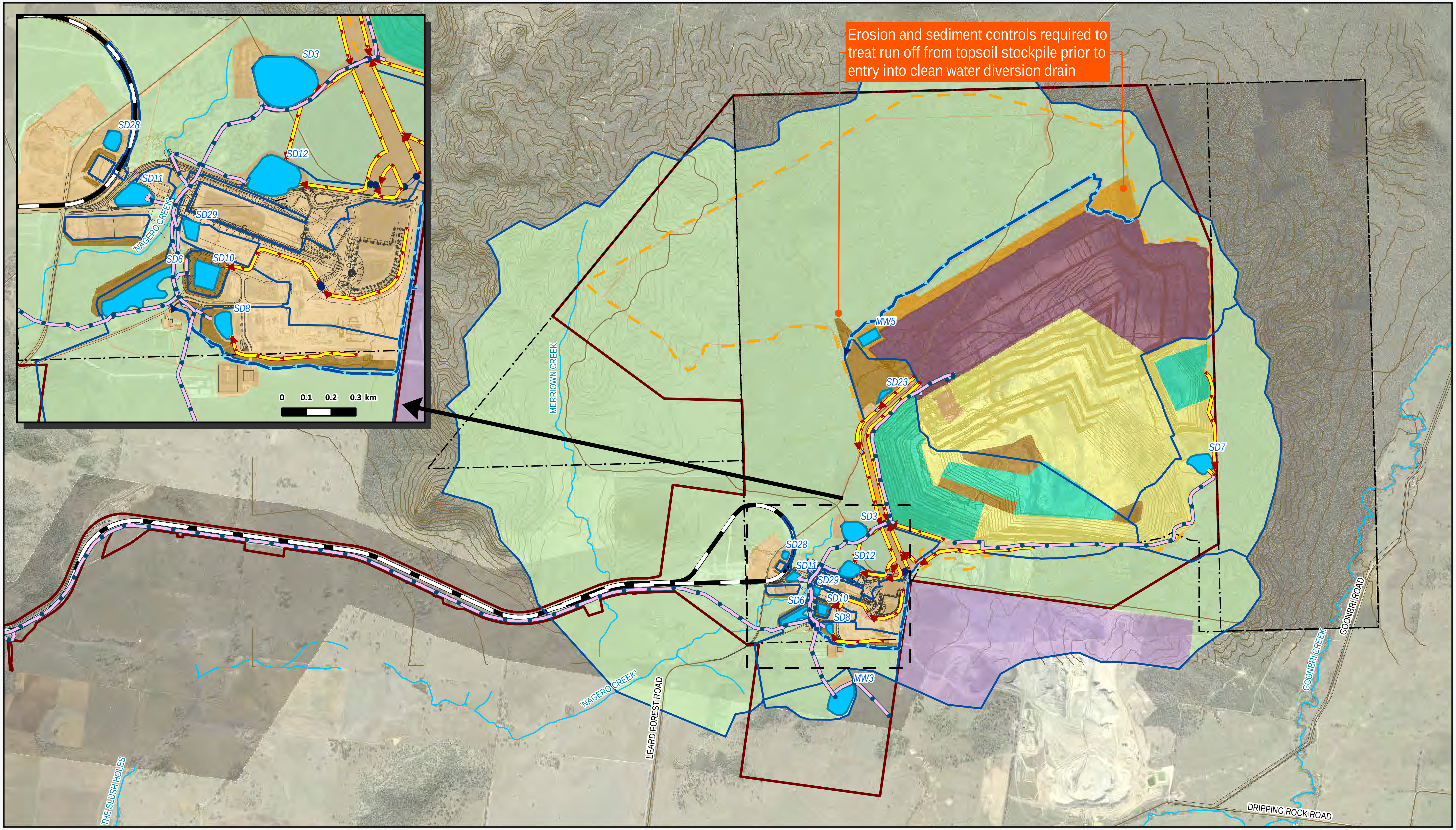
Primary mine domains
Unshaped Spoil Dump
Active Mining Area
Cleared
Road/industrial

Rehabilitation
Mining Void
Tarrawonga Coal Mine
Topsoil Stockpile
Undisturbed

0 0.5 1 1.5 km

Figure 2
Water Management System Concept - Year 2015

\\APNTLFPS01\proj\B\Boggabri_Coal\2200552A_REV_SITE_WATER_BALANCE_BOGGAB\10_GIS\Projects_Drawings_Figures_Sketches\2200552A_GIS_F001_A4.mxd Author: SuansriR 3/06/2015



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EIS Boundary
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Rehabilitation
Mining Void
Tarrawonga Coal Mine
Topsoil Stockpile
Undisturbed

0 0.5 1 1.5 km

Figure 3
Water Management System Concept
- Year 2017

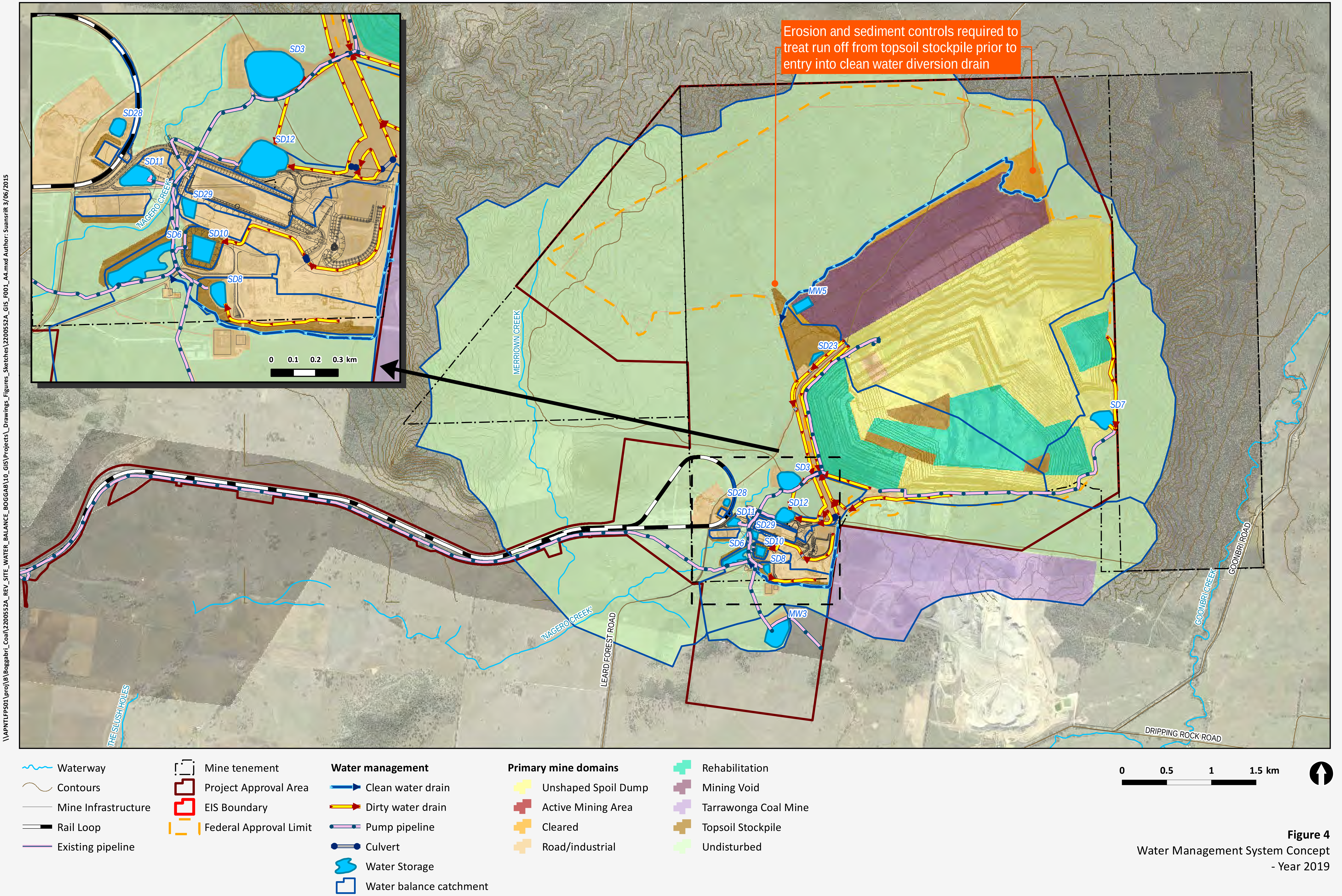


Figure 4
Water Management System Concept - Year 2019

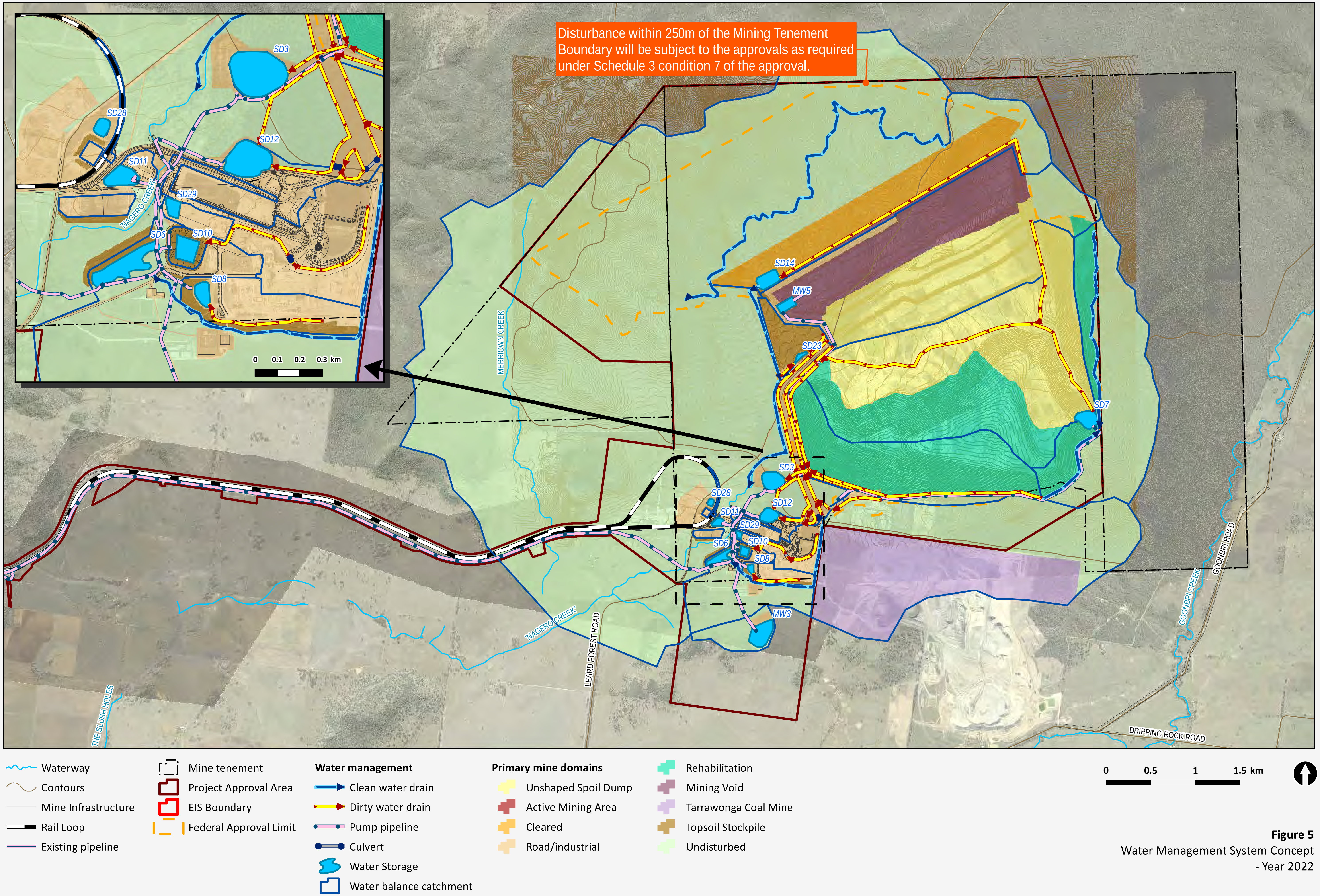
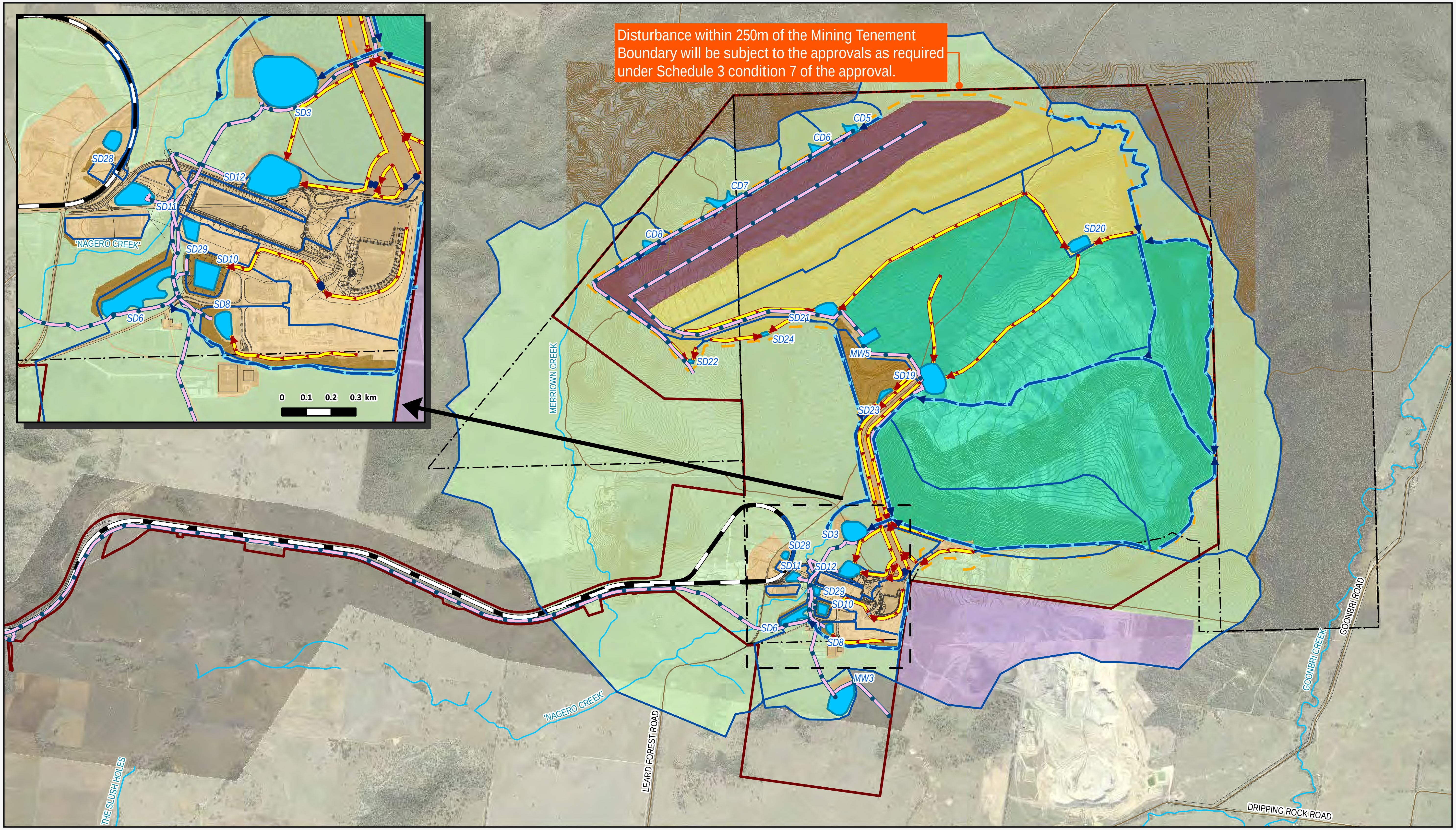


Figure 5
Water Management System Concept - Year 2022



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Rehabilitation
Mining Void
Tarrawonga Coal Mine
Topsoil Stockpile
Undisturbed

0 0.5 1 1.5 km

Figure 6
Water Management System Concept
- Year 2033

PARSONS BRINCKERHOFF

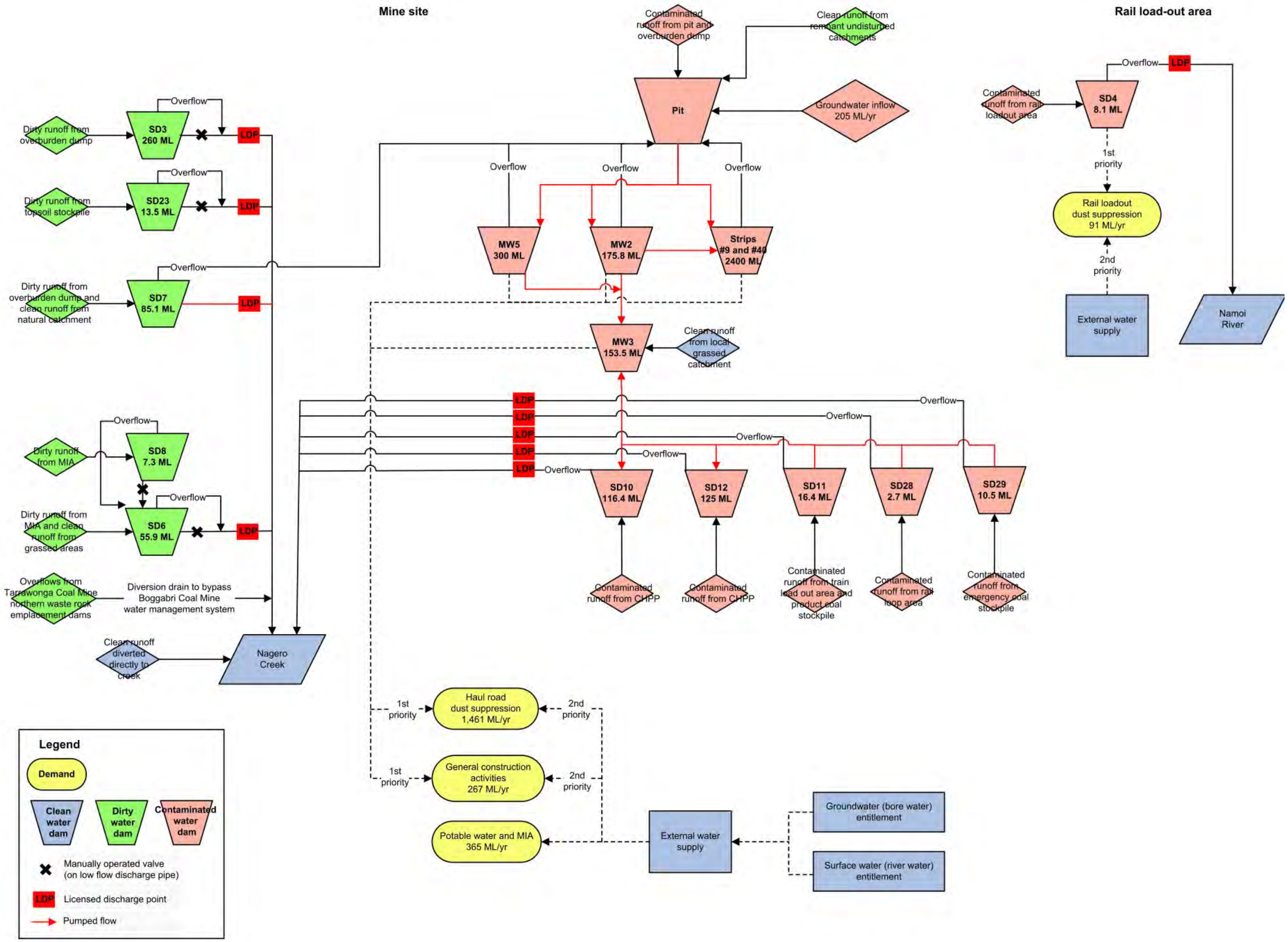

FIGURE 2A
WATER BALANCE MODEL SCHEMATIC – YEAR 2015 (JANUARY TO JULY 2015)

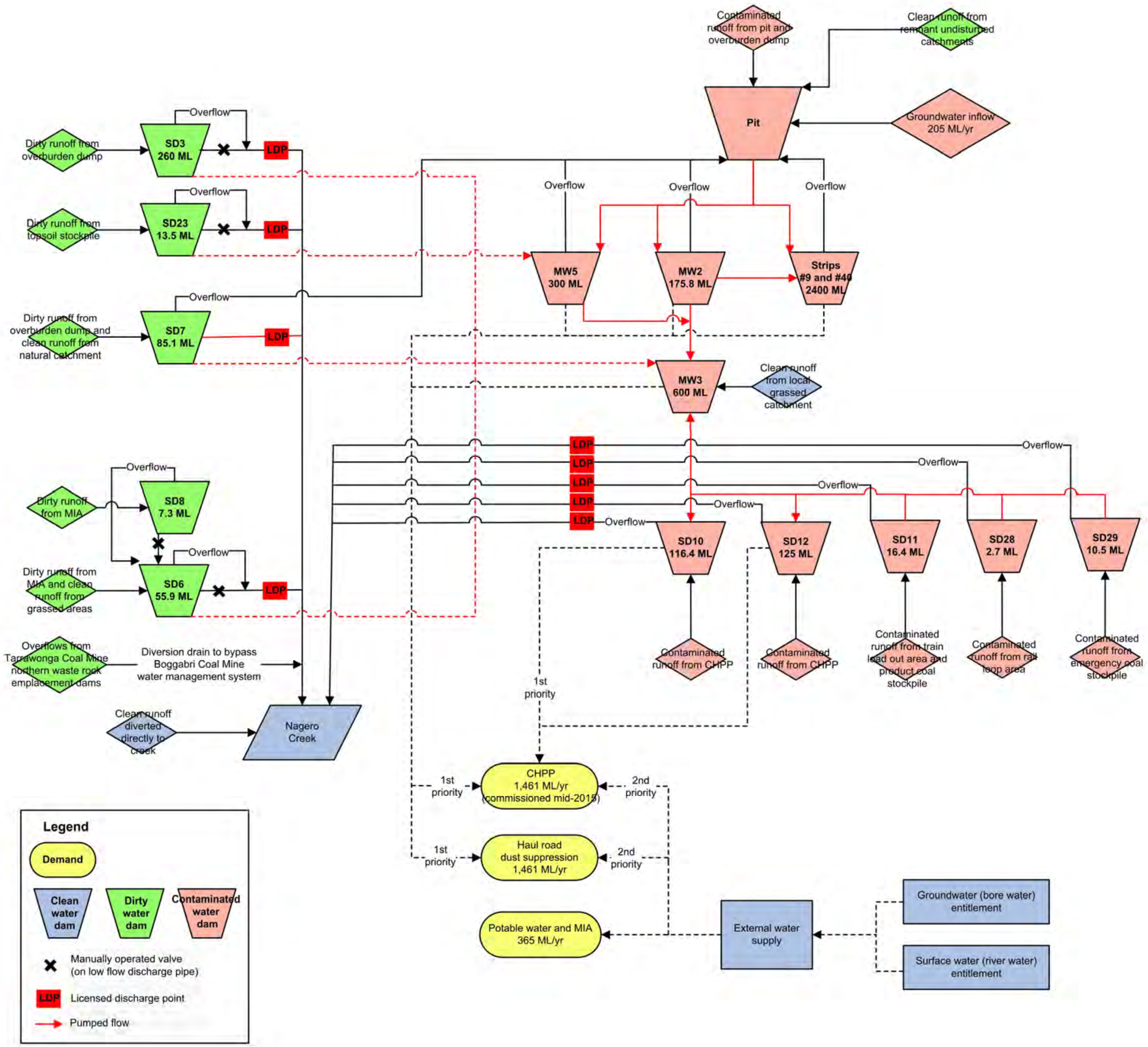

FIGURE 2B
WATER BALANCE MODEL SCHEMATIC – YEAR 2015 (JULY TO DECEMBER 2015)

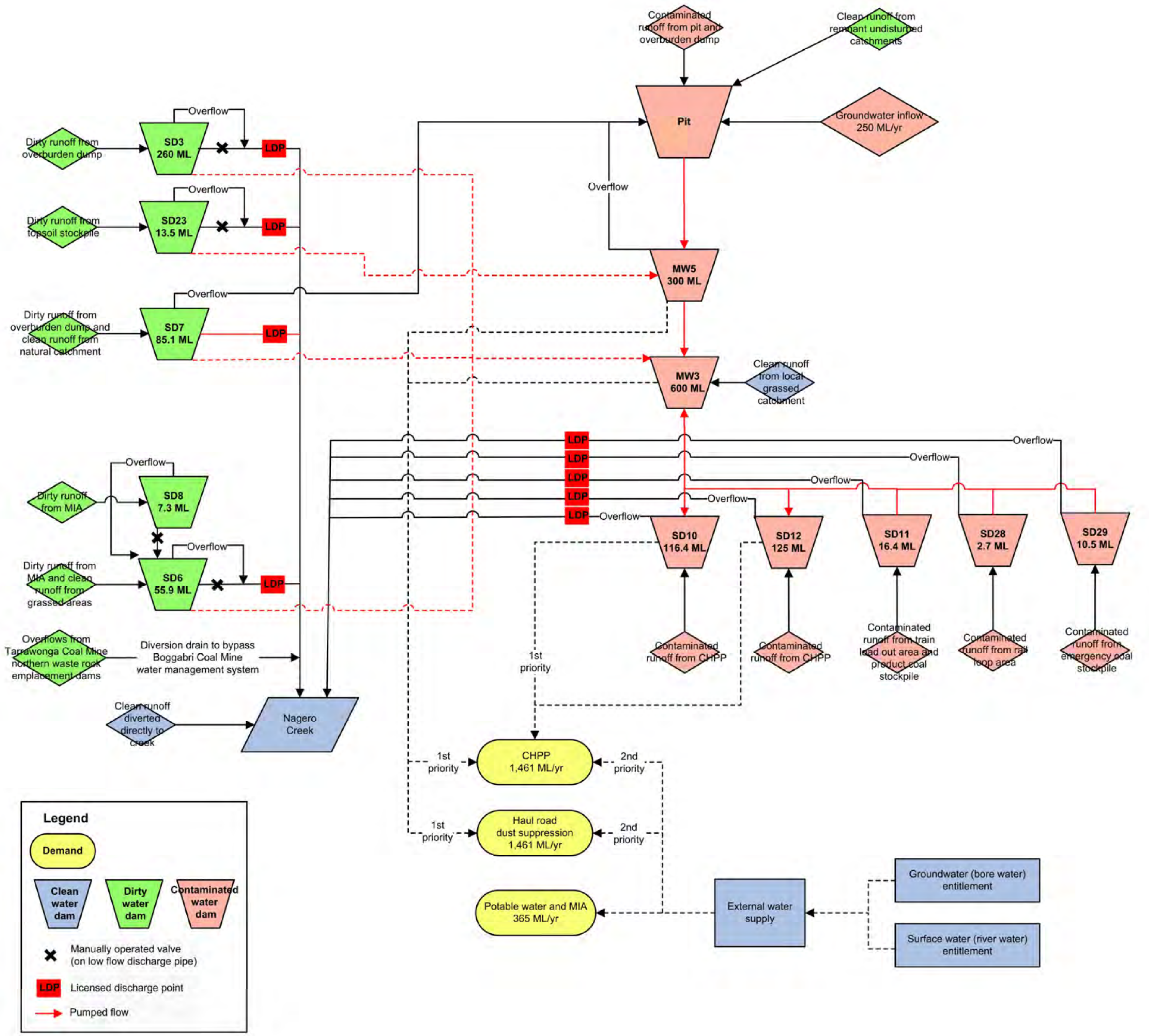

FIGURE 3A
WATER BALANCE MODEL SCHEMATIC – YEAR 2017

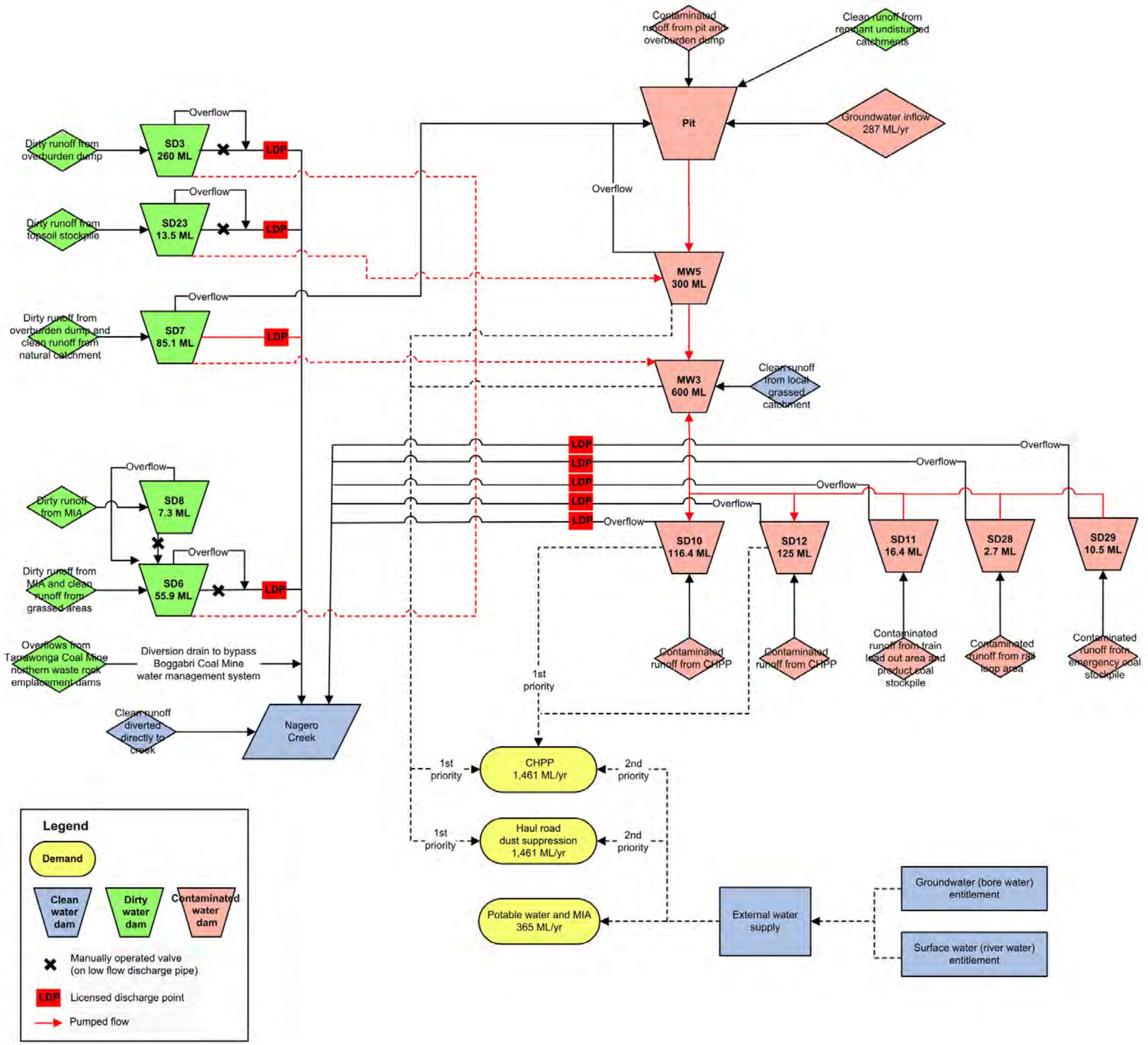

FIGURE 4A
WATER BALANCE MODEL SCHEMATIC – YEAR 2019

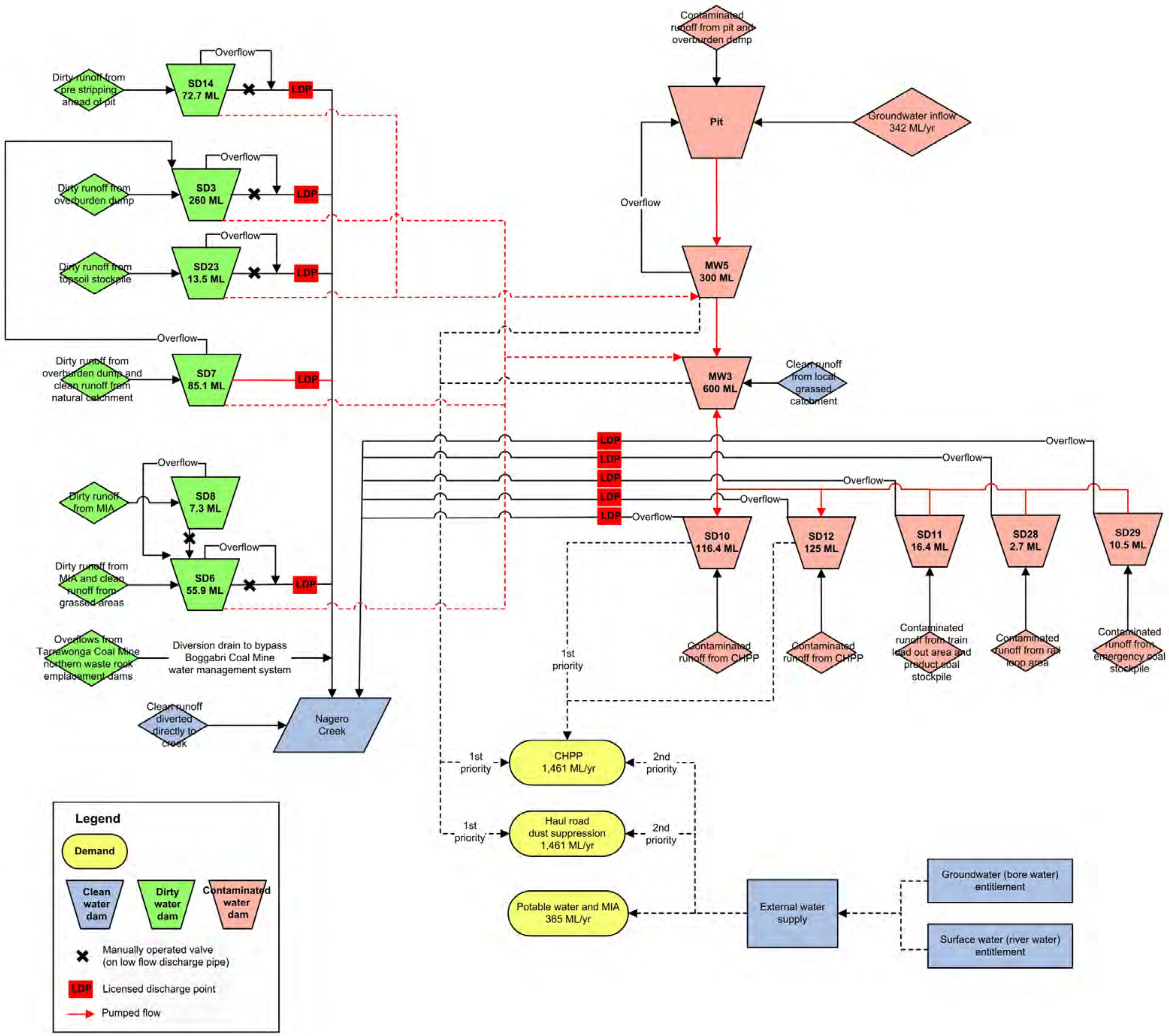

FIGURE 5A
WATER BALANCE MODEL SCHEMATIC – YEAR 2022

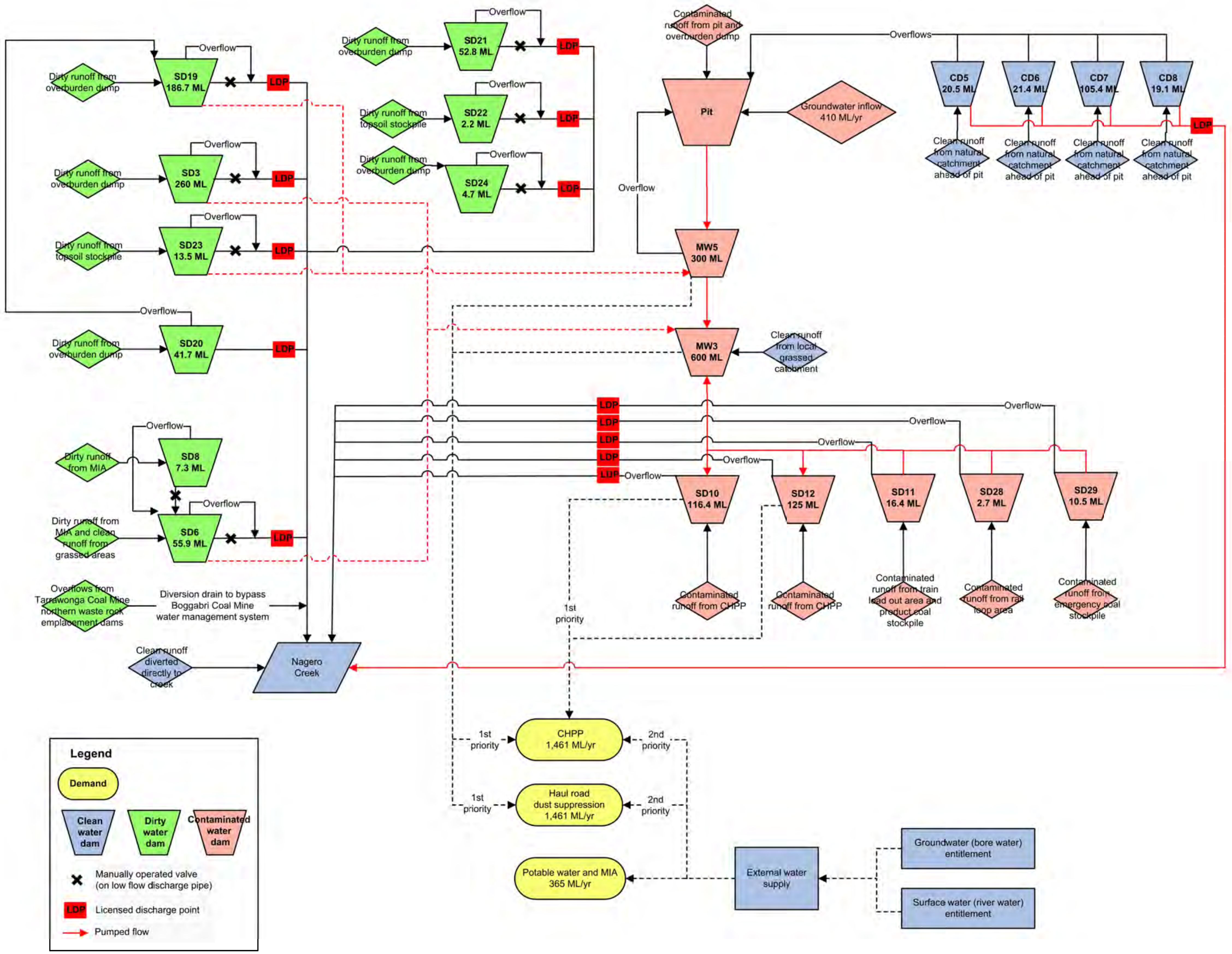

FIGURE 6A
WATER BALANCE MODEL SCHEMATIC – YEAR 2033

Appendix B

Summary of storages and discharge points

Table B 1 Summary of existing storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Existing catchment area (ha)	Required minimum capacity (ML)	Existing capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from spoil dump	90th %ile 5 day	50%	0.4 to 0.75	239.5	82.3	31.8	As-built capacity
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90th %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	As-built capacity
SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment	90th %ile 5 day	50%	0.4 to 0.75	272.0	85.1	69.6	As-built capacity
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90th %ile 5 day	50%	0.85	14.5	6.8	7.3	As-built capacity
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90th %ile 5 day	50%	0.75	29.0	12.7	9.5	As-built capacity
Contaminated water dams									
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100 yr ARI 72 hr	20%	0.85	30.4	78.8	116.4	As-built capacity. Dam sized based on detailed design information from Sedgman.
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100 yr ARI 72 hr	20%	0.85	6.3	16.4	16.4	As-built capacity
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100 yr ARI 72 hr	20%	0.85	38.6	99.5	25.9	As-built capacity
SD4	Contaminated water dam located at rail loading facility west of mine site	Contaminated runoff from existing rail loading facility	100 yr ARI 72 hr	20%	0.75	2.3	5.2	8.1	
MW2	Mine water dam located north-west of mining void (turkey's nest dam)	Contaminated mine water pumped from pit	-	0%	-	-	-	175.8	As-built capacity

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Existing catchment area (ha)	Required minimum capacity (ML)	Existing capacity (ML)	Notes
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD12 and MW2, and clean runoff from small grassed catchment	-	0%	-	-	-	153.5 (max operating level 105 ML)	As-built capacity
Strip 9	Mine water storage	Surplus contaminated water, provided as a backup to MW2 in earlier surplus years	-	0%	-	-	-	2,400ML	
In pit void	SE corner of site	Excess mine water	Based on remodelled site water balance (2012) requiring 1012ML of contaminated water storage until 2015 when CHPP becomes operational In accordance with EL12407 where benches can be flooded for additional storage	0%	-	-	-	At least 1,600ML	

Table B 2 Summary of existing licensed discharge points (EPL 12407 dated 19 February 2015)

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Dirty runoff from spoil dump
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
Point 2	Discharge water quality monitoring and Wet weather discharge	SD2	Contaminated water dam located in existing coal crushing and handling area	Contaminated runoff from ROM stockpile
Point 4	Discharge water quality monitoring and Wet weather discharge	SD4	Contaminated water dam located at rail loading facility west of mine site	Contaminated runoff from existing rail loading facility

Table B 3 Summary of proposed 2015 storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump	90^{th} %ile 5 day	50%	0.4 to 0.75	239.5	82.3	260	Existing capacity 31.8 ML not adequate. Proposed capacity of 260 ML provided by BCPL for Mod 4 EA. Previously proposed to be upgraded to 100ML. Now propose to upgrade to 260 ML so that SD13 and SD27 are no longer required. Size for 2022 catchment with additional allowance for 'reuse zone'.
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90^{th} %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	Existing capacity 55.9 ML exceeds required capacity.
SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment	90^{th} %ile 5 day	50%	0.4 to 0.75	272.0	85.1	85.1	Existing capacity 69.6 ML not adequate.
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90^{th} %ile 5 day	50%	0.85	14.5	6.8	7.3	Existing capacity 7.3 ML exceeds required capacity.
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90^{th} %ile 5 day	50%	0.75	29.0	12.7	13.5	Existing capacity 9.5 ML not adequate. Size for 2022 / 2033 catchment.
Contaminated water dams									
SD4	Contaminated water dam located at rail loading facility west of mine site	Contaminated runoff from existing rail loading facility	100 yr ARI 72 hr	20%	0.75	2.3	5.2	8.1	Existing capacity 8.1 ML exceeds required capacity.

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100yr ARI 72hr	20%	0.85	30.4	78.8	116.4	Existing capacity 116.4 ML exceeds required capacity. Existing capacity based on detailed design information from Sedgman and includes additional 37.6 ML 'reuse zone' for operational capacity for CHPP. Note that catchment area draining to SD10 has changed since Sedgman design and the available 'reuse zone' storage has therefore reduced.
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100yr ARI 72hr	20%	0.85	6.3	16.4	16.4	Existing capacity 16.4 ML adequate.
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100yr ARI 72hr	20%	0.85	38.6	99.5	125	Proposed capacity of 125 ML provided by BCPL for Mod 4 EA. Includes 25.5 ML 'reuse zone' for additional storage to provide operational capacity for CHPP.
SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area	100yr ARI 72hr	20%	0.85	1.0	2.7	2.7	New dam
SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile	100yr ARI 72hr	20%	0.85	3.1	8.0	10.5	New dam. Proposed capacity of 10.5 ML provided by BCPL (for runoff coefficient of 1.0).
MW2	Mine water dam located north-west of mining void (turkey's nest dam)	Contaminated water pumped from pit	-	0%	-	-	-	175.8	Existing capacity 175.8 ML.

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from MW2, MW5, SD10, SD11, SD12, SD28 and SD29 and clean runoff from small grassed catchment	-	0%	-	-	-	600 ML (upgrade mid-2015)	Existing capacity 153.5 ML. Upsize to 600 ML by mid-2015.
MW5	Mine water dam (turkey's nest dam)	Contaminated water pumped from pit	Water balance	0%	-	-	-	300	New dam
In-pit	Temporary segregated in-pit storage (required until additional out-of-pit mine water storage is provided onsite and/or irrigation system)	Contaminated runoff and groundwater make captured in the mining void sumps	Water balance	0%	-	-	-	Maximum modelled volume in-pit 1,100 ML (refer Figure 4.2)	Surplus contaminated water stored in-pit when capacity of MWDs reached.
Strips #9 and #40	Extra mine water storage for earlier surplus years	Surplus mine water from pit and from MW2 and MW5		0%	-	-	-	2,400	Excess mine water to be stored in temporary in-pit storage or Strips #9 and #40 prior to upgrade of MWDs.

Table B 4 Summary of proposed 2015 discharge points

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
Point 4	Wet weather discharge (>100yr ARI 72hr design event)	SD4	Contaminated water dam located in existing cola crushing and handling area 15km wets of mine site	Contaminated runoff from ROM stockpiles
TBA	Discharge water quality monitoring	SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD11	Contaminated water dam located at rail loop	Contaminated runoff from TLO and product stockpile on southern side of rail loop
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile
Point 41	Surface water quality monitoring	MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD11, SD12, SD28, SD29 and MW5, and clean runoff from small grassed catchment

Table B 5 Summary of proposed 2017 storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump	90th %ile 5 day	50%	0.4 to 0.75	239.3	75.5	260	
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90th %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	
SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment	90th %ile 5 day	50%	0.4 to 0.75	267.5	79.1	85.1	
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90th %ile 5 day	50%	0.85	14.5	6.8	7.3	
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90th %ile 5 day	50%	0.75	29.0	12.7	13.5	
Contaminated water dams									
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100yr ARI 72hr	20%	0.85	30.4	78.8	116.4	
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100yr ARI 72hr	20%	0.85	6.3	16.4	16.4	

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100yr ARI 72hr	20%	0.85	38.6	99.5	125	
SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area	100yr ARI 72hr	20%	0.85	1.0	2.7	2.7	
SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile	100yr ARI 72hr	20%	0.85	3.1	8.0	10.5	
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from MW5, SD10, SD11, SD12, SD28 and SD29 and clean runoff from small grassed catchment	-	0%	-	-	-	600	
MW5	Mine water dam (turkey's nest dam)	Contaminated water pumped from pit	Water balance	0%	-	-	-	300	
In-pit	In-pit storage during wet periods	Contaminated runoff and groundwater make captured in the mining void sumps	Water balance	0%	-	-	-	Maximum modelled volume in-pit 1,485 ML (refer Figure 4.2)	Surplus contaminated water stored in-pit when capacity of MWDs reached.

Table B 6 Summary of proposed 2017 discharge points

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
TBA	Discharge water quality monitoring	SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD11	Contaminated water dam located at rail loop	Catchment is from Train Load Out (TLO) area and the product stockpile on the southern side of the rail loop.
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile
Point 41	Surface water quality monitoring	MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD11, SD12, SD28, SD29 and MW5, and clean runoff from small grassed catchment

Table B 7 Summary of proposed 2019 storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump	90th %ile 5 day	50%	0.4 to 0.75	256.9	82.8	260	
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90th %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	
SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment	90th %ile 5 day	50%	0.4 to 0.75	272.5	76.6	85.1	
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90th %ile 5 day	50%	0.85	14.5	6.8	7.3	
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90th %ile 5 day	50%	0.75	29.0	12.7	13.5	
Contaminated water dams									
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100yr ARI 72hr	20%	0.85	30.4	78.8	116.4	
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100yr ARI 72hr	20%	0.85	6.3	16.4	16.4	

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100yr ARI 72hr	20%	0.85	38.6	99.5	125	
SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area	100yr ARI 72hr	20%	0.85	1.0	2.7	2.7	
SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile	100yr ARI 72hr	20%	0.85	3.1	8.0	10.5	
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from MW5, SD10, SD11, SD12, SD28 and SD29 and clean runoff from small grassed catchment	-	0%	-	-	-	600	
MW5	Mine water dam (turkey's nest dam)	Contaminated water pumped from pit	Water balance	0%	-	-	-	300	
In-pit	In-pit storage during wet periods	Contaminated runoff and groundwater make captured in the mining void sumps	Water balance	0%	-	-	-	Maximum modelled volume in-pit 1,470 ML (refer Figure 4.2)	Surplus contaminated water stored in-pit when capacity of MWDs reached.

Table B 8 Summary of proposed 2019 discharge points

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
TBA	Discharge water quality monitoring	SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD11	Contaminated water dam located at rail loop	Catchment is from Train Load Out (TLO) area and the product stockpile on the southern side of the rail loop.
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile
Point 41	Surface water quality monitoring	MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD11, SD12, SD28, SD29 and MW5, and clean runoff from small grassed catchment

Table B 9 Summary of proposed 2022 storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump, and overflows from SD7	90^{th} %ile 5 day	50%	0.4 to 0.75	641.5	209.3	260	
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90^{th} %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	
SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment	90^{th} %ile 5 day	50%	0.4 to 0.75	243.0	56.8	85.1	
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90^{th} %ile 5 day	50%	0.85	14.5	6.8	7.3	
SD14	Sediment dam located in pre-strip	Dirty runoff from cleared area ahead of mining	90^{th} %ile 5 day	50%	0.4	313.7	72.7	72.7	New dam
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90^{th} %ile 5 day	50%	0.75	30.7	13.5	13.5	
Contaminated water dams									
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100yr ARI 72hr	20%	0.85	30.4	78.8	116.4	

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100yr ARI 72hr	20%	0.85	6.3	16.4	16.4	
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100yr ARI 72hr	20%	0.85	38.6	99.5	125	
SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area	100yr ARI 72hr	20%	0.85	1.0	2.7	2.7	
SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile	100yr ARI 72hr	20%	0.85	3.1	8.0	10.5	
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from MW5, SD10, SD11, SD12, SD28 and SD29 and clean runoff from small grassed catchment	-	0%	-	-	-	600	
MW5	Mine water dam (turkey's nest dam)	Contaminated water pumped from pit	Water balance	0%	-	-	-	300	
In-pit	In-pit storage during wet periods	Contaminated runoff and groundwater make captured in the mining void sumps	Water balance	0%	-	-	-	Maximum modelled volume in-pit 735 ML (refer Figure 4.2)	Surplus contaminated water stored in-pit when capacity of MWDs reached.

Table B 10 Summary of proposed 2022 discharge points

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Runoff from rehabilitated spoil dump and overflows from SD7
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
TBA	Discharge water quality monitoring	SD7	Sediment dam located in eastern spoil dump	Dirty runoff from spoil dump and clean runoff from undisturbed catchment
TBA	Discharge water quality monitoring and Wet weather discharge	SD14	Sediment dam located in pre-strip	Dirty runoff from cleared area ahead of mining
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD11	Contaminated water dam located at rail loop	Catchment is from Train Load Out (TLO) area and the product stockpile on the southern side of the rail loop.
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile
Point 41	Surface water quality monitoring	MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD11, SD12, SD28, SD29 and MW5, and clean runoff from small grassed catchment

Table B 11 Summary of proposed 2033 storages

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
Dirty water dams									
SD3	Sediment dam located south-west of spoil dump	Dirty runoff from partially rehabilitated spoil dump	90^{th} %ile 5 day	50%	0.4 to 0.75	193.5	48.6	260	
SD6	Sediment dam located downstream of MIA (referred to as Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8	90^{th} %ile 5 day	50%	0.4 to 0.75	74.5	20.1	55.9	
SD8	Sediment dam located in MIA	Dirty runoff from MIA	90^{th} %ile 5 day	50%	0.85	14.5	6.8	7.3	
SD19	Sediment dam located in spoil dump	Runoff from recently rehabilitated spoil dump and overflows from SD20	90^{th} %ile 5 day	50%	0.75	431.1	186.7	186.7	New dam. Sized using 0.75 runoff coefficient for rehabilitated areas.
SD20	Sediment dam located in spoil dump	Dirty runoff from spoil dump	90^{th} %ile 5 day	50%	0.75	100.2	41.7	41.7	New dam
SD21	Sediment dam located in spoil dump	Dirty runoff from spoil dump	90^{th} %ile 5 day	50%	0.75	121.1	52.8	52.8	New dam
SD22	Sediment dam located in spoil dump	Dirty runoff from spoil dump	90^{th} %ile 5 day	50%	0.75	5.1	2.2	2.2	New dam
SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile	90^{th} %ile 5 day	50%	0.75	30.7	13.5	13.5	

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
SD24	Sediment dam located in spoil dump	Dirty runoff from spoil dump	90th %ile 5 day	50%	0.75	10.9	4.7	4.7	New dam
Contaminated water dams									
SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile	100yr ARI 72hr	20%	0.85	30.4	78.8	116.4	
SD11	Contaminated water dam located at rail loop	Contaminated runoff from rail loop	100yr ARI 72hr	20%	0.85	6.3	16.4	16.4	
SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile	100yr ARI 72hr	20%	0.85	38.6	99.5	125	
SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area	100yr ARI 72hr	20%	0.85	1.0	2.7	2.7	
SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile	100yr ARI 72hr	20%	0.85	3.1	8.0	10.5	
MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from MW5, SD10, SD11, SD12, SD28 and SD29 and clean runoff from small grassed catchment	-	0%	-	-	-	600 ML	

Storage	Location / description	Stored water	Design criteria	Additional sediment allowance	Runoff coefficient	Catchment area (ha)	Required minimum capacity (ML)	Proposed capacity (ML)	Notes
MW5	Mine water dam (turkey's nest dam)	Contaminated water pumped from pit	Water balance	0%	-	-	-	300	
In-pit	In-pit storage during wet periods	Contaminated runoff and groundwater make captured in the mining void sumps	Water balance	0%	-	-	-	Maximum modelled volume in-pit 945 ML (refer Figure 4.2)	Surplus contaminated water stored in-pit when capacity of MWDs reached.
Clean water dams									
CD5	Highwall dam located ahead of pit	Undisturbed catchment runoff	100yr ARI 72hr	0%	0.4	19.9	20.5	20.5	New dam
CD6	Highwall dam located ahead of pit	Undisturbed catchment runoff	100yr ARI 72hr	0%	0.4	20.7	21.4	21.4	New dam
CD7	Highwall dam located ahead of pit	Undisturbed catchment runoff	100yr ARI 72hr	0%	0.4	102.9	105.4	105.4	New dam
CD8	Highwall dam located ahead of pit	Undisturbed catchment runoff	100yr ARI 72hr	0%	0.4	18.3	19.1	19.1	New dam

Table B 12 Summary of proposed 2033 discharge points

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 3	Discharge water quality monitoring and Wet weather discharge	SD3	Sediment dam located south-west of spoil dump	Runoff from rehabilitated spoil dump
Point 1	Discharge water quality monitoring and Wet weather discharge	SD6	Sediment dam located downstream of MIA (Nagero Dam)	Runoff from grassed areas near MIA, and overflows from SD8
Point 40 [1]	Discharge water quality monitoring and Wet weather discharge	SD23	Sediment dam located near topsoil stockpile	Dirty runoff from topsoil stockpile
Point 40 [1]	Discharge water quality monitoring and Wet weather discharge	SD19	Sediment dam located in spoil dump	Runoff from recently rehabilitated spoil dump and overflows from SD20
TBA	Discharge water quality monitoring and Wet weather discharge	SD21	Sediment dam located in spoil dump	Dirty runoff from spoil dump
TBA	Discharge water quality monitoring and Wet weather discharge	SD22	Sediment dam located in spoil dump	Dirty runoff from spoil dump
TBA	Discharge water quality monitoring and Wet weather discharge	SD24	Sediment dam located in spoil dump	Dirty runoff from spoil dump
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD10	Contaminated water dam located in CHPP	Contaminated runoff from product coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD11	Contaminated water dam located at rail loop	Catchment is from Train Load Out (TLO) area and the product stockpile on the southern side of the rail loop.
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD12	Contaminated water dam located in CHPP	Contaminated runoff from ROM coal stockpile
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD28	Contaminated water dam located in CHPP	Contaminated runoff from rail loop area
TBA	Wet weather discharge (>100yr ARI 72hr design event)	SD29	Contaminated water dam located in CHPP	Contaminated runoff from emergency coal stockpile
TBA	Discharge water quality monitoring	CD5, CD6, CD7 and CD8	Highwall dams located ahead of pit	Clean runoff from undisturbed catchment

EPL identification number	Discharge type	Storage	Location / description	Stored water
Point 41	Surface water quality monitoring	MW3	Mine water dam located south of MIA	Surplus contaminated water pumped from SD10, SD11, SD12, SD28, SD29 and MW5, and clean runoff from small grassed catchment

1 Proposed to combine discharge points for SD23 and SD19 at EPL Point 40.

Appendix C

Water management system stage-storage relationships

Table C 1 MW2 stage-storage relationship (existing)

RL	Area (m^2)	Volume (m^3)
279.8	49.042	1.562
279.9	97.532	8.873
280	155.495	21.301
280.1	240.064	40.558
280.2	314.951	68.145
280.3	382.472	102.512
280.4	447.984	143.313
280.5	512.777	190.44
280.6	596.572	244.183
280.7	714.557	308.446
280.8	824.031	384.208
280.9	953.826	469.709
281	1521.506	589.331
281.1	2021.335	763.473
281.2	2526.516	987.746
281.3	3064.19	1262.522
281.4	3639.896	1591.039
281.5	4279.468	1984.034
281.6	5044.956	2442.781
281.7	5691.622	2972.336
281.8	6299.459	3563.109
281.9	7031.475	4217.783
282	7687.273	4945.028
282.1	8243.562	5730.386
282.2	8849.38	6571.075
282.3	9766.201	7484.506
282.4	11586.72	8529.591
282.5	13691.36	9771.12
282.6	17622.04	11303.95
282.7	20294.43	13191.18
282.8	22763.67	15326.79
282.9	25053.48	17697.31
283	26406.67	20252.54
283.1	27139.94	22905.34
283.2	27727.45	25617.37
283.3	28274.48	28384.69
283.4	28963.76	31210.88
283.5	29545.87	34099.57
283.6	30013.92	37038.84
283.7	30359.94	40015.1
283.8	30708.19	43022.87
283.9	31077.74	46063.71
284	31395.93	49136.47
284.1	31643.57	52234.83
284.2	31875.33	55353.91
284.3	32128.47	58494.6
284.4	32347.38	61655.76
284.5	32550.46	64835.09

RL	Area (m^2)	Volume (m^3)
284.6	32748.67	68031.35
284.7	32974.38	71244.95
284.8	33191.01	74479.02
284.9	33319.45	77726.95
285	33433.76	80983.26
285.1	33547.47	84247.72
285.2	33660.58	87520.26
285.3	33773.09	90800.84
285.4	33884.99	94089.37
285.5	33996.29	97385.8
285.6	34106.99	100690.1
285.7	34217.08	104002.1
285.8	34326.58	107321.8
285.9	34435.47	110649.1
286	34543.76	113984.1
286.1	34651.45	117326.5
286.2	34758.53	120676.3
286.3	34865.01	124033.5
286.4	34970.89	127398.1
286.5	35076.39	130769.8
286.6	35206.88	134149.7
286.7	35379.38	137541.6
286.8	35564.89	140948.5
286.9	35751.15	144370.9
287	35938.83	147808.8
287.1	36123.04	151262.3
287.2	36294.49	154730.3
287.3	36454.73	158211.8
287.4	36618.07	161706.1
287.5	36787.39	165213.9
287.6	36988.58	168736.7
287.7	37240.17	172279.1
287.8	37515.36	175844.5

Table C 2 MW3 stage-storage relationship (existing)

RL	Area (m^2)	Volume (m^3)
268.6	0	0
268.7	24	0.02
268.8	107	0.11
268.9	269	0.27
269	533	0.53
269.1	925	0.92
269.2	1380	1.38
269.3	1899	1.9
269.4	2486	2.49
269.5	3145	3.14
269.6	3887	3.89
269.7	4726	4.73
269.8	5672	5.67
269.9	6735	6.74
270	7925	7.93
270.1	9246	9.25
270.2	10679	10.68
270.3	12231	12.23
270.4	13907	13.91
270.5	15714	15.71
270.6	17650	17.65
270.7	19720	19.72
270.8	21929	21.93
270.9	24285	24.28
271	26795	26.79
271.1	29464	29.46
271.2	32272	32.27
271.3	35218	35.22
271.4	38300	38.3
271.5	41516	41.52
271.6	44864	44.86
271.7	48345	48.34
271.8	51960	51.96
271.9	55714	55.71
272	59610	59.61
272.1	63625	63.62
272.2	67707	67.71
272.3	71857	71.86
272.4	76077	76.08
272.5	80367	80.37
272.6	84727	84.73
272.7	89159	89.16
272.8	93662	93.66
272.9	98238	98.24
273	102888	102.89
273.1	107617	107.62
273.2	112416	112.42
273.3	117286	117.29

RL	Area (m^2)	Volume (m^3)
273.4	122227	122.23
273.5	127242	127.24
273.6	132332	132.33
273.7	137498	137.5
273.8	142741	142.74
273.9	148062	148.06
274	153463	153.46