Water Management Plan

710-005-EN-PLA-0004

CADIA

Document History and Status

Version*	Issued To	Revision date	Approved by	Approval Date
7.0	NSW Department of Planning and Environment	27/8/2019	S. O'Donoghue	26/11/19

* Document history for previous versions is discussed in Section 9.1.

Amendments

Version	Nature of Amendment	Page	Revision date	Revised By
7.0	Refer to Table 9-2	102	August 2019	Nic Bourgeot
	Section 4 reference to all Cadia infrastructure	38	October 2019	Jane Chung
	Table 4.1 included CVO Dewatering Facility containment structure details	40	October 2019	Jane Chung
	Table 5-7 updated to include proposed monitoring changes at the Cadia Dewatering Facility.	58	October 2019	Jeff Burton
	Section 6.5 included reference to approval requirements for the test bores.	89	October 2019	Jane Chung

Contents

List of Tables

List of Figures

Appendices

Abbreviations and definitions

AEMR – Annual Environmental Management Report
AIP – Aquifer Interference Policy
ANZECC – Australian and New Zealand Environmental Conservation Council
ARMCANZ – Agriculture and Resource Management Council of Australia and New Zealand
AUSRIVAS – NSW Australian Rivers Assessment System
BFI – Baseflow Index, the ratio of baseflow to total flow within a watercourse.
Catastrophic Water Supply Failure – not able to access enough water to carry out business activities
CHPL – Cadia Holdings Pty Limited
CTW – Central Tablelands Water
CVO – Cadia Valley Operations
DPE – Department of Planning and Environment
DI–Water – Department of Primary Industries – Water
EMS – Environmental Management Strategy
EPA – Environmental Protection Authority
EPL – Environment Protection Licence
ESCP – Erosion and Sediment Control Plan
GHD – GHD Pty Ltd
GMP – Groundwater Monitoring Program
GS – Gauging Station
HARTT – Hydrograph Analysis: Rainfall and Time Trends
masl – metres above sea level (Australian Height Datum)
ML – Mega litre
Mt – Million tonnes
Mtpa – Million tonnes per annum
Northing – metres north, Australian Map Grid (AMG) Zone 55 (AGD66)
NTSF – Northern Tailings Storage Facility
OEH – NSW Office of Environment and Heritage
PE – Polyethylene
SAOC – Site Asset Operation Centre
SGWRP – Surface and Groundwater Contingency Plan
SSGV – Site Specific Guideline Value
STSF – Southern Tailings Storage Facility
SWMP – Surface Water Monitoring Program
SWRD – South Waste Rock Dump
T - Tonne
TSF – Tailings Storage Facility
URC – Upper Rodds Creek Dam
WAL – Water Access Licence
WMP – Water Management Plan
WSP – Water Sharing Plan

Project Approval PA06_0295 (MOD 12) Conditions

SOIL AND WATER

Water Supply

22. The Proponent shall ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of mining operations to match its licensed water entitlements, to the satisfaction of the Secretary.

    Note: The Proponent is required to obtain all necessary water licences and approvals for the project under the Water Act 1912 and/or Water Management Act 2000.

Discharge Limits

23. The Proponent shall not discharge any water from the site except as may be expressly provided by an EPL, or in accordance with section 120 of the *Protection of the Environment Operations Act 1997*.

Compensatory Water Supplies

24. The Proponent shall provide compensatory water supplies to any landowner of privately-owned land whose water entitlements are impacted (other than an impact that is negligible) as a result of the project, in consultation with DI Water and to the satisfaction of the Secretary.

    The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributed to the project. Equivalent water supply must be provided (at least on an interim basis) within 24 hours of the loss being identified.

    If the Proponent and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.

    If the Proponent is not able to provide an alternative long-term supply of water, the Proponent shall provide alternative compensation to the satisfaction of the Secretary, which may involve acquisition in accordance with the procedures in conditions 5-7 of schedule 4.

    Notes:

    - *For the purposes of this condition:*

        - *privately-owned land means any privately-owned land with direct water dependency on Swallow Creek, Cadiangullong Creek, Rodds Creek, Flyers Creek or Diggers Creek/Panuara Rivulet, and any land within the maximum predicted 1 metre groundwater drawdown contour as indicated on the plans in Appendix 5, or any other privately-owned land as notified by the Secretary;*

- *a water entitlement includes an accessible riparian water right or licensable quantity;*
- *a water entitlement is considered to be impacted if the project results in a loss in pumping yield in bores or pumps, or impacts the quality of the water such that its use is materially affected. (These impact assessment criteria are required to be further quantified in the Site Water Management Plan – see conditions 30-35 below).*

- *Compensatory water supplies may be achieved through provision of baseflow offsets within the applicable catchment (see condition 25 below), or through measures on privately-owned land such as lowering or duplicating pumps, deepening or replacing bores, and/or provision of interim water supplies.*
- *The Proponent is not required to provide additional compensatory water supplies where such long-term compensation has already been provided under previous consents for the project.*
- *In resolving any dispute under this condition, the Secretary will consult closely with DI Water.*

Baseflow Offsets

25. The Proponent shall offset the loss of baseflow to the Belubula River and associated creeks caused by the project, in consultation with DI Water, and to the satisfaction of the Secretary. The offsets shall be provided either incrementally or on one occasion:

(a) prior to the baseflow loss being realised, or within 12 months of the date of this approval for any existing realised baseflow losses that have not previously been offset; and

(b) within the catchments where the baseflow loss is realised, as far as is reasonable and feasible, unless otherwise approved by the Secretary.

Notes:

- *The offsets should be provided via the retirement of adequate water entitlements to account for the loss attributable to the project.*
- *Relevant compensatory water supplies implemented under condition 24 may be subtracted from the offsets required under this condition.*
- *The Proponent is not required to provide additional baseflow offsets where such offsets have already been provided under previous consents for the project. These existing offsets are to be described and evaluated in the Surface and Ground Water Contingency Plan (see condition 35 below).*

26. At least 6 months prior to the cessation of mining operations, the Proponent shall demonstrate that it has made adequate provision to provide long-term offsets to account for the permanent baseflow loss caused by the project, in consultation with DI Water, and to the satisfaction of the Secretary.

Note: The long-term offsets may be provided via the retiring of adequate water entitlements to account for the permanent loss attributable to the project.

Cadiangullong Creek Flows

27. The Proponent shall manage water releases from Cadiangullong Dam to provide: (a) flows of at least:

- 3.4 ML/day, for periods when inflows into the dam are more than 3.4 ML/day and the water level in the dam is at or above the lowest valve level on the multi-level offtake (ie.773.0 metres AHD);
- the volume equal to the inflow into the dam, for periods when inflows into the dam are between 0.4 and 3.4 ML/day and the water level in the dam is at or above the lowest valve level on the multi-level offtake;
- 0.4 ML/day, for periods when inflows into the dam are less than 0.4 ML/day and the water level in the dam is at or above the lowest valve level on the multi-level offtake;
- the volume equal to the inflow into the dam, up to 0.4ML/day, for periods when the water level in the dam is below the lowest valve level on the multi-level offtake and above the level of the scour valve (i.e. 762.8 metres AHD); and
- zero, when the water level in the dam is below the level of the scour valve; and

(b) releases of up to 4 medium flows (of the order of 12 to 15 ML/day) per year, each for a duration of 1 to 3 days, with timing and frequency of such flows determined by hydrographs of typical medium flows, to the satisfaction of, and unless otherwise approved by, DI Water.

28. The Proponent shall not extract any water from Cadiangullong Dam when the volume in the dam drops to 10 percent or less of its total capacity (i.e. 778.8 metres AHD), unless otherwise approved by NOW. Flow releases (see condition 27 above) shall be continued during any such period, except when the level of water in the dam drops below the level of the dam's scour valve (i.e. 762.8 metres AHD).

Flyers Creek Flows

29. The Proponent shall ensure that natural environmental flows of up to 3.5 ML/day into Flyers Creek weir are allowed to pass uninterrupted downstream, and any approved water extraction is limited to medium and high flows, to the satisfaction of DI Water.

Site Water Management Plan

30. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:

(a) be prepared in consultation with DI Water and EPA, and be submitted to the Secretary for approval within 6 months of the date of this approval; and

(b) include a:

- Site Water Balance;
- Erosion and Sediment Control Plan;
- Surface Water Monitoring Program;
- Groundwater Monitoring Program; and
- Surface and Ground Water Contingency Plan.

31. The Site Water Balance must: (a) include details of:
    - sources and security of water supply;
    - water use on site;
    - water management on site;
    - any off-site water transfers;
    - reporting procedures; and

    (b) investigate and implement all reasonable and feasible measures to minimise water use by the project.

32. The Erosion and Sediment Control Plan must:

    (a) be consistent with the requirements of *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition, 2004* (Landcom);

    (b) identify activities that could cause soil erosion and generate sediment;

    (c) describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters;

    (d) describe the location, function, and capacity of erosion and sediment control structures; and

    (e) describe what measures would be implemented to maintain the structures over time.

33. The Surface Water Monitoring Program must include:

    (a) detailed baseline data, based on sound statistical analysis, to benchmark the pre-mining natural variation in surface water flows and quality in creeks and other waterbodies that could potentially be affected by the project;

    (b) surface water and stream health impact assessment criteria;

    (c) a program to monitor and assess:
        - impacts on surface water flows and quality;
        - impacts on water users;

- stream health conditions in Swallow Creek, Cadiangullong Creek, Rodds Creek, Flyers Creek and Diggers Creek, including riparian vegetation;
- potential acid rock drainage;
- potential leakage or spillage from tailings, mineral concentrate and effluent pipelines;

(d) a program for the ongoing verification and refinement of the surface water model; and

(e) reporting procedures for the results of the monitoring program and model verification.

34. The Groundwater Monitoring Program must include:

(a) detailed baseline data, based on sound statistical analysis, to benchmark the pre-mining natural variation in groundwater levels, yield and quality (including privately-owned bores within the maximum predicted 1 metre groundwater drawdown contour, as indicated on the plans in Appendix 5);

(b) groundwater impact assessment criteria (including for monitoring bores and privately-owned bores);

(c) a program to monitor:

- impacts on the groundwater supply of potentially affected landowners;
- impacts on springs and groundwater dependent ecosystems;
- the volume of groundwater seeping into open pit and underground mine workings;
- regional groundwater levels and quality in all potentially affected aquifers;
- potential acid rock drainage;
- the hydraulic gradient and groundwater quality around the base of the cadia hill pit;

(d) a program for the ongoing verification and refinement of the groundwater model; and

(e) reporting procedures for the results of the monitoring program and model verification.

35. The Surface and Ground Water Contingency Plan must include:

(a) a protocol for the investigation, notification and mitigation of any exceedances of the surface water, stream health and groundwater impact assessment criteria;

(b) measures to mitigate and/or compensate potentially affected landowners in accordance with the compensatory water supply requirements in condition 24 above;

(c) a protocol for providing advance warning and water supply measures for landowners of privately-owned land that are predicted to exceed the surface or ground water impact assessment criteria at some stage during the project life;

(d) a protocol for investigating, evaluating and providing the baseflow offsets required under condition 25 above, including a detailed evaluation (in the initial plan) of offsets provided under previous consents for the project; and

(e) the procedures that would be followed if any significant unforeseen impacts on surface or ground water are detected during the project.

1 INTRODUCTION

1.1 Overview

Cadia Valley Operations (Cadia) is a gold/copper mining and processing complex. Cadia is located approximately 25 km south-west of Orange (Figure 1-1), in the Central Tablelands of New South Wales (NSW). Cadia Holdings Pty Limited (CHPL) is the owner and operator of Cadia and is a wholly owned subsidiary of Newcrest Mining Limited.

The Cadia Hill open pit, Ridgeway underground mine and Cadia East underground mine are located in Cadiangullong Creek Valley within Mining Leases ML1405, ML 1472, ML 1481, ML 1449, ML 1689 and ML 1690 issued under the *Mining Act 1992*. The Concentrate Dewatering Facility is located approximately 25 km to the east of Cadia adjacent to the town of Blayney (Figure 1-1).

Operations at the Cadia Hill open pit ceased in 2012 and is currently being used for tailings disposal. The Ridgeway Deeps and Ridgeway underground mine was placed into care and maintenance in March 2016. Cadia East involves panel cave mining to extract approximately 450 million tonnes (Mt) of ore over a period of 21 years, with current approvals taking the project through to June 2031. The ore contains gold, copper and other trace metals.

Land use in the vicinity of the Cadia is dominated by sheep and cattle grazing in the more gently undulating areas, and private and state forestry operations to the north and east; known as the Canobolas State Forest (Cadia 2009).

1.2 Purpose

This Water Management Plan (WMP) has been developed in accordance with the conditions of the Cadia East Project Approval (PA 06_0295). The plan is also consistent with requirements outlined in the Cadia East Environmental Assessment (EA) and Environment Protection Licence (EPL) No. 5590 (issued under the *Protection of the Environment Operations Act 1997).* A summary of the relevant consent conditions and Statement of Commitments, including where these requirements are addressed in the WMP, is provided in Table 1-1.

The WMP covers all operations at Cadia and includes the approved mining operations and associated infrastructure within the site boundary (Figure 1-2). The WMP documents the site's approach to water management, including onsite management and assessing potential impacts on local water resources. The plan covers surface water and groundwater resources in Cadiangullong Creek, Flyers Creek, Swallow Creek and Panuara Rivulet catchments. The treatment/management of potable water is outside the scope of this plan.

A summary of the relevant legislation, guidelines and policies is included in Appendix A.

1.3 Objective

The primary objective of this plan is to ensure Newcrest's activities do not impact on local private water supplies and/or make water unfit for purpose. This is to be achieved through:

- Increase water efficiency
- Improve water reliability
- Ensuring negligible impacts on surface water quality and quantity
- Ensuring negligible impacts on groundwater quality and quantity, and
- Ensuring negligible impacts on spring water quality and quantity.

1.4 Consultation

The draft Water Management Plan was sent to DI-Water for review and comment. Comments received (letter dated 26 July 2018) included (summarised):

- DPI requested additional planned construction details for the proposed bores surrounding the Cadia Hill Pit.
- Clarification of some internal inconsistencies regarding groundwater quality trigger levels within the report.
- Clarification of the methods employed to determine the groundwater hydraulic gradient surrounding the pit

These comments have been addressed in this document.

1.5 Supporting Reports

The WMP should be read in conjunction with the following Cadia policies, reports and management plans:

- Newcrest Water Stewardship Policy[1]
- Environmental Management Strategy (EMS)
- FY18 Annual Environmental Management Report (AEMR)
- ANZECC Water Quality Assessments (GHD 2012[2], 2016[1] and 2018[3])
- Land and Biodiversity Management Plan

[1] Available on the Newcrest website

[2] Publicly available appended to the CVO 2016-17 AEMR.

[3] Appended to this report.

Table 1-1 Cadia East Water Management Plan Approval Conditions

Condition of Consent (06_0295) as modified by Modification 11		Where addressed
30	The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:	This plan.
	a) Be prepared in consultation with DI Water – Water and EPA, and be submitted to the Secretary for approval within six months of the date of this approval; and	
	b) Include a: – Site Water Balance – Erosion and Sediment Control Plan – Surface Water Monitoring Program – Groundwater Monitoring Program – Surface and Ground Water Contingency Plan.	
31	The Site Water Balance must:	Section 3
	a) Include details of: – sources and security of water supply – water use onsite – water management onsite – any offsite water transfers – reporting procedures	
	b) Investigate and implement all reasonable and feasible measures to minimise water use by the project.	
32	The Erosion and Sediment Control Plan must:	Section 0
	Be consistent with the requirements of Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition, 2004 (Landcom)	
	Identify activities that could cause soil erosion and generate sediment	
	Describe measures to minimise soil erosion and the potential for the transport of sediment to downstream waters	
	Describe the location, function, and capacity of erosion and sediment control structures	
	Describe what measures would be implemented to maintain the structures over time.	

Condition of Consent (06_0295) as modified by Modification 11		Where addressed
33	The Surface Water Monitoring Program must include:	Section 5
	a) Detailed baseline data, based on sound statistical analysis, to benchmark the pre-mining natural variation in surface water flows and quality in creeks and other waterbodies that could potentially be affected by the project	
	b) Surface water and stream health impact assessment criteria	
	c) A program to monitor and assess: – impacts on surface water flows and quality – impacts on water users – stream health conditions in Swallow Creek, Cadiangullong Creek, Rodds Creek, Flyers Creek and Diggers Creek, including riparian vegetation – potential acid rock drainage – potential leakage or spillage from tailings, mineral concentrate and effluent pipelines.	
	d) A program for the ongoing verification and refinement of the surface water model	
	e) Reporting procedures for the results of the monitoring program and model verification.	
34	The Groundwater Monitoring Program must include:	Section 6
	a) Detailed baseline data, based on sound statistical analysis, to benchmark the pre-mining natural variation in groundwater levels, yield and quality (including privately-owned bores within the maximum predicted 1 metre groundwater drawdown contour, as indicated on the plans in Appendix 5)	
	b) Groundwater impact assessment criteria (including for monitoring bores and privately-owned bores)	
	c) A program to monitor: – impacts on the groundwater supply of potentially affected landowners – impacts on springs and groundwater dependent ecosystems – the volume of groundwater seeping into open pit and underground mine workings – regional groundwater levels and quality in all potentially affected aquifers – potential acid rock drainage – the hydraulic gradient and groundwater quality around the base of the Cadia Hill Pit	

Condition of Consent (06_0295) as modified by Modification 11		Where addressed
	d) A program for the ongoing verification and refinement of the groundwater model	
	e) Reporting procedures for the results of the monitoring program and model verification.	
35	The Surface and Ground Water Contingency Plan must include:	Section 7
	a) A protocol for the investigation, notification and mitigation of any exceedances of the surface water, stream health and groundwater impact assessment criteria	
	b) Measures to mitigate and/or compensate potentially affected landowners in accordance with the compensatory water supply requirements in condition 24 above	
	c) A protocol for providing advance warning and water supply measures for landowners of privately-owned land that are predicted to exceed the surface or ground water impact assessment criteria at some stage during the project life	
	d) A protocol for investigating, evaluating and providing the baseflow offsets required under condition 25 above, including a detailed evaluation (in the initial plan) of offsets provided under previous consents for the project	
	e) The procedures that would be followed if any significant unforeseen impacts on surface or ground water are detected during the project.	
	Environment Protection Licence	Section 2.5

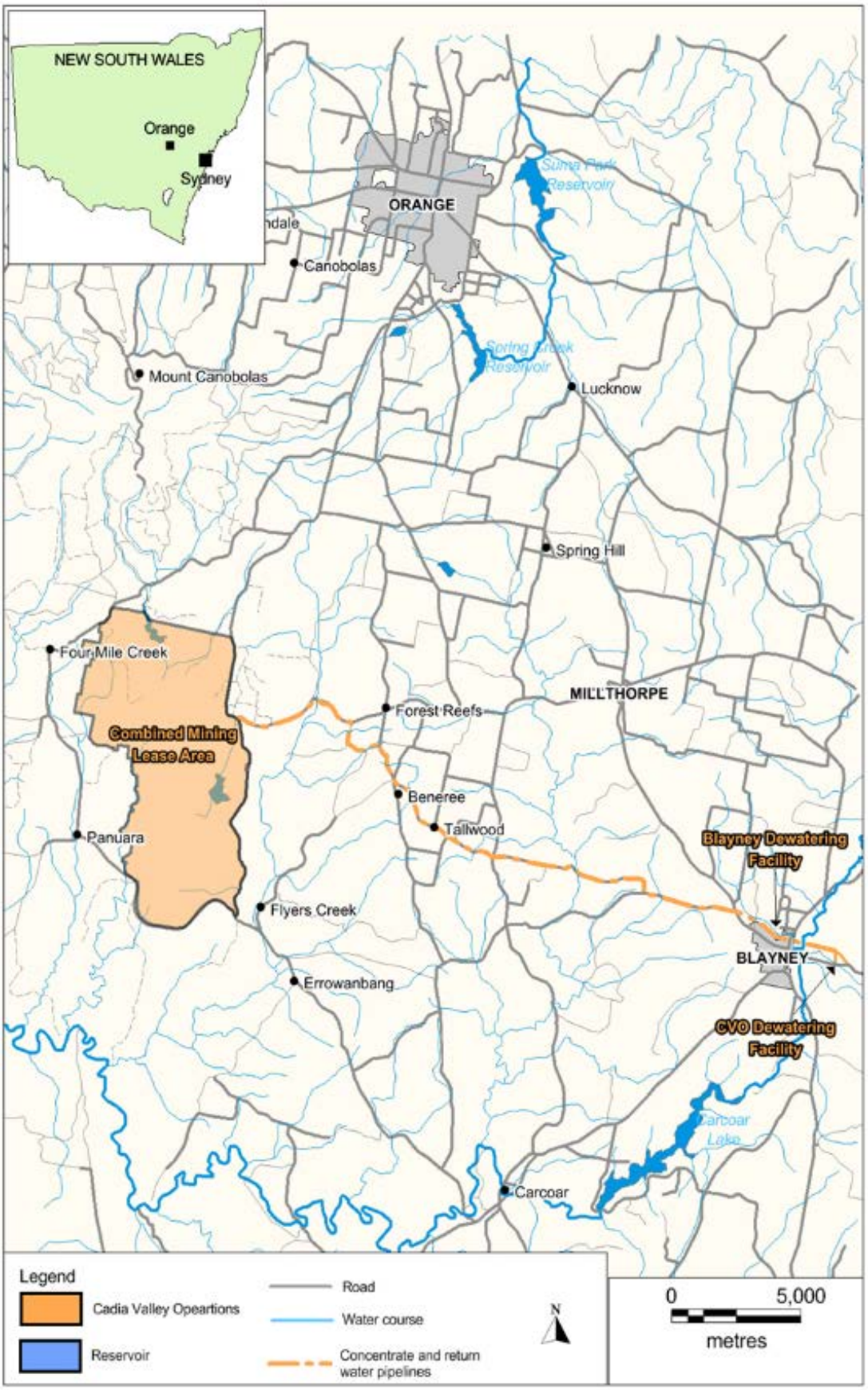

Figure 1-1 Site locality

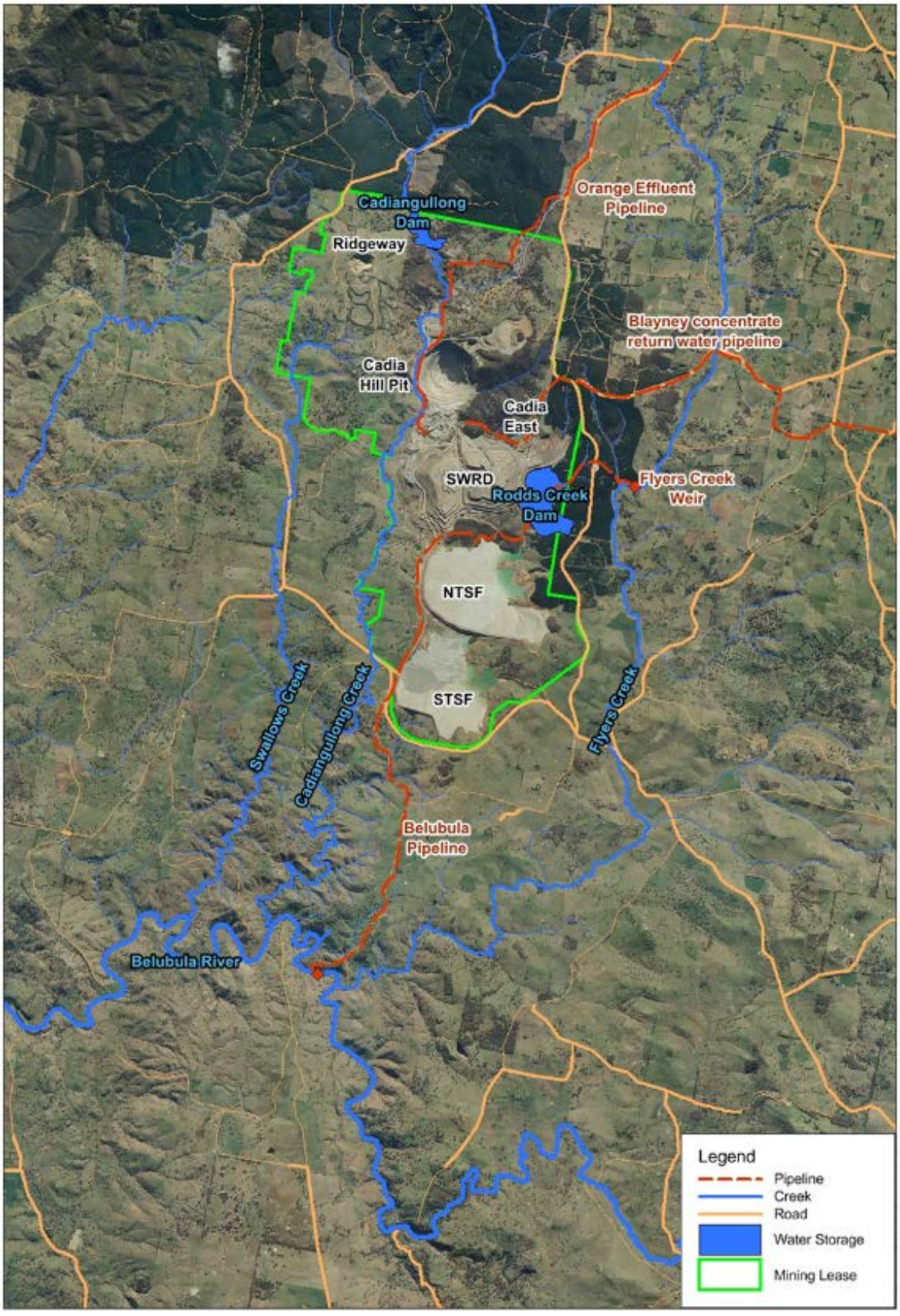

Figure 1-2 Cadia site layout

2 WATER MANAGEMENT SYSTEM

The water management system at Cadia includes separate management systems for clean, mixed and site captured water. The surface water management system at Cadia involves a number of interlinked dams and their catchments, tailings storage facilities, Cadia Hill open pit, the underground mining operations and the water pumping systems. The majority of the site water requirement is for minerals processing, with minor amounts used in mining, dust suppression and for ancillary / maintenance purposes.

Process water is suitable for reuse without treatment. CVO aims to maximise the reuse of process water with the balance of the water requirements made up from raw water stored on site. CVO captures and collects raw water from a diverse range of sources including extraction from creeks and rivers, treated sewage effluent, groundwater inflow to mining areas and bore extraction. Stormwater from disturbed areas is collected in a series of dams and seepage from large mining related infrastructure (tailings storage facilities, waste rock dumps) is captured and collected for re-use and supplements the site's water supply. To manage the variability in water supply over extended time-frames, CVO stores water on site in two main water storages, Cadiangullong Dam (on stream) and Rodds Creek Dam (primarily off stream).

Water security, flood risk and operational management decisions at CVO are actively managed via a committee comprising key internal stakeholders. The water committee sits once per quarter to forecast and plan water demand, supply, transfer and storage requirements and to identify and manage water related risks that arise from changing site and climatic conditions.

The key components of the water management system at Cadia are shown in schematic in Figure 3-1. The capacity of each water storage is provided in Table 2-1.

Table 2-1 Stored water

Water Storage	Storage[1]	Full Storage Level (ML)
Clean water	Cadiangullong Dam	4,200
Site captured water	Cadia Hill Open Pit	>67,500 (current approved tailings storage limit)
	Cadia Extended Pit	~1,000(2)
	Copper Gully Creek Dam	45
	Combined Sediment Dams	101
Mixed water	Rodds Creek Dam	14,500
	NTSF Decant Pond	Interim water storage only(1)
	STSF Decant Pond	Operational water storage only(1)
	Hoares Creek Dam	56
	Combined Process Water, Leachate Collection and Seepage Collection Dams	224

Notes: 1. The NTSF and STSF receive rainfall runoff and tailings production to the STSF only. These TSFs are operated so that ponded water is not stored for longer than the time required for dewatering.

2. Maximum estimated storage within backfilled waste rock.

The largest consumer of water required by the operation is for processing of ore to produce a mineral concentrate (Section 3.4), using up to 5,000 ML/month. Tailings from the process plant is currently deposited in the Southern Tailings Storage Facility (STSF) and in the Cadia Hill Pit Tailings Storage Facility (PTSF) from which water is reclaimed. The Northern Tailings Storage Facility (NTSF) is under care and maintenance during repair of its southern embankment following a failure in March 2018. The majority of the water demand is supplied by recycling water within the ore processing plant and recycling tailings water from the PTSF and the STSF (via Rodds Creek Dam).

Water management is a key operational consideration at Cadia, with water supply reaching critically low levels in July 2007 and 2010, followed by excess water limiting production from the Cadia Hill open pit in January 2011. Maximising the amount of water reuse in the process increases overall efficiency. When combined with the management measures detailed in this document, the risk of releasing potentially contaminated water from the site is significantly reduced.

2.1 Clean Water

Clean water is sourced with water access licences from the catchment above Cadiangullong Dam, the Belubula River and groundwater extracted primarily from groundwater seepage into underground workings and bores for potable water supply.

[1] CVO have a number of dams listed as prescribed dams under the *Dams Safety Act 1978*. The individual Dam Safety Emergency Plans and Operational Manuals list the specific requirements for each dam.

2.1.1 Water Entitlement & Extraction

Cadia holds licences under the *Water Act 1912* for groundwater monitoring bores and Water Access Licences (WAL) under the *Water Management Act 2000* for water. A summary of WALs held by Cadia is shown in Table 2-2.

Table 2-2 Water Management Act 2000 Water Access Licence details

Water Access Licence (WAL)	Water Source	Unit Share (ML)	Nominated Works	Description
31062	Orange Basalt	286	70WA610474	Bore: 'Te Anau' Component of Ridgeway Mine dewatering
31072*	Lachlan Fold Belt MDB	371	70WA610477	Bores: CB3, CB6, CB8, CB9 & RH641
36229	Lachlan Fold Belt MDB	931	70WA614787	Mine dewatering licence for the Ridgeway and Cadia East Mines and the Cadia Hill Pit and Cadia Extended
32255	Belubula River Regulated Water Source	3125	70WA614341	Belubula River - Supplementary
32280	Belubula River Regulated water Source	4080	70WA614341	Belubula River – General Security
31527	Lachlan Unregulated and Alluvial Water Source	4200	80WA716140	Extraction from: Cadiangullong Creek, Cadia Creek, Copper Gully Creek, Rodds Creek, Flyers Creek
31517	Belubula tributaries below Carcoar Dam	6	70CA610656	Irrigation supply for the 'Narambon' property
31505	Lachlan Unregulated and Alluvial Water Source	4	70WA610664	Stock & Domestic supply for 'Stratton Vale' property

* Groundwater extraction from CVO bores will be limited to 2.5 ML/day on average over a year, which is considered to be generally in accordance with the Cadia East EA commitment.

The Water Sharing Plan (WSP) for the Belubula Regulated River Source commenced on 4 October 2012 (DPI – Water, 2013). The WSP for the Belubula Regulated River Water Source allows Cadia to source water from the Belubula regulated river up to the annual extraction limits. The allocation of water to supplementary, high security and general security account holders are detailed in the WSP.

Cadia extracts water in accordance with the WALs and conditions of the Cadia East Project Approval. Cadia has 7,205 ML of licensed entitlements on the Belubula River. Of this, 4,080 ML are regulated General Security Entitlements and 3,125 ML are held as supplementary water entitlement. The General Security water is allocated according to DI – Water, Available Water Determination process. Supplementary water can be taken during supplementary events on the Belubula river, which occur when releases from Carcoar Dam are less than 2 ML/day and the end of system flow is greater than 20 ML/day (as measured at the Helensholme gauging station GS412033). Supplementary events are announced for specific periods by the DI – Water. During supplementary events water can be ordered through Water NSW, with extraction limited to a maximum of 30 ML/day during normal operations and sufficient water available in Cadia's supplementary water account. General security water can be extracted after a successful water order has been placed with Water NSW. General security extraction is limited to a maximum of 30 ML/day during normal operations, with account balance and annual usage limits. Cadia's river pumping infrastructure is capable of extraction at a rate of up to 36 ML/day. This Plan allows for water extraction at up to 36 ML/day if requested by, and/or in consultation with Water NSW. Higher extraction may be considered where it is deemed to; increase the efficiency of water delivery, decrease system losses, reduce overall demand on general security water or benefit other water users within the system.

Cadia holds groundwater licence entitlements to account for incidental groundwater inflow to mining areas and extraction from licensed bores. Figure 2-1 shows the groundwater extraction locations at Cadia. Groundwater is extracted from the underground operations via mine access portals, no dewatering bores exist. Appendix B provides a summary of the monitoring bore licences currently held by Cadia and has additional information on each bore including the aquifer, screen zone and history of monitoring.

Annual volumes of surface and groundwater WAL extraction from the available water sources at Cadia is reported in the AEMR.

2.2 Mixed Water

Mixed water makes up the majority of water stored on site and is sourced from water that has been through the plant or water that is captured from operational areas. Storages holding mixed water are:

- Rodds Creek Dam
- STSF Decant Pool
- PTSF (Cadia Hill Pit)
- Hoares Creek Dam
- Combined Process Water, Leachate Collection and Seepage Collection Dams

The NTSF is currently also used as a mixed water storage to transfer pit dewatering water (and residual fine solids in the decant water) to Rodds Creek Dam and to the Process Water Pond. There are also options, under low storage level conditions to transfer water from Rodds Creek Dam to the NTSF.

2.3 Site Captured Water

2.3.1 Management of Surface Water Runoff (EPL P1.2, 3 & L2.4), (Condition 23)

Stormwater generated from catchments disturbed by mining is collected via a series of drains and bunds and dams. The dams are sized according to catchment areas and the type of water that is collected in them. Disturbed area runoff from the administration/laydown areas and other disturbed areas are collected and transferred to the process water pond or Rodds Creek Dam for inclusion in the water supply system. Water captured within the catchment of the Cadia Extended Pit is stored within the voids in the pit backfill. Four dewatering bores will be commissioned during FY19/20 to extract water from this source in accordance with Water Management (General) Regulations 2018 and the Water Management Act 2000.

A system of sediment dams, clean water diversions, internal runoff drains and culverts have been constructed for the operations. These structures are described in the Erosion and Sediment Control Plan (ESCP) (Section 4). The storage capacity of these structures are periodically reviewed and increased where necessary to accommodate the proposed additional hardstand areas and modifications to the layout of buildings/workshops.

Water from Cadiangullong Dam is discharged through the approved spillway once runoff exceeds the full storage capacity of the dam. Additionally, water can be released from sediment dams, either following rainfall events in excess of the design criteria or following smaller rainfall events (for specified dams) so long as the water quality meets the necessary criteria (in accordance with EPL5590 criteria). No other offsite water transfers are proposed as part of this plan.

2.3.1.1 Stormwater event management

During normal operation, onsite water storage dams are maintained at low levels to ensure that adequate capacity is available for storm events or periods of prolonged rainfall in accordance with the design criteria outlined in Section 4.

EPL 5590 requires that the design capacity of the stormwater control structures be re-established within five or fourteen days following rainfall (depending on the design criteria). The capacity of sediment control structures will be periodically reviewed to ensure the changes in catchment areas and actual storage volumes meet the criteria. Maintenance activities such as desilting, cleaning of drains and reinstating drain embankments may be required as a result of these reviews and will be completed as soon as practicable after an issue is identified.

Figure 2-1 Groundwater extraction locations

2.4 Potable and Wastewater Systems

Potable water to offices, workshops, change house and the underground operations is supplied from licensed extraction bores. Cadia self-manages the water abstraction, collection, storage, treatment, reticulation, distribution and consumption for the site.

Cadia has two sewage treatment plants. Sewage and wastewater from ablution facilities onsite is collected and transferred via a sewerage system to existing onsite sewage treatment plants which are located adjacent to the ore processing facilities at Cadia or adjacent to the Ridgeway workshops. The plants consist of anaerobic and aerobic treatment and final sterilisation. Non-biodegradable solids from the sewage treatment plants are removed periodically by a licensed contractor.

Treated effluent is pumped via the existing raw water supply line to the process water pond.

2.5 Licensed Discharge Points

Cadia manages water with the intent to operate a 'zero-discharge' site. While controlled discharges of treated rainfall runoff from selected areas are permitted from specified dams depending on water quality criteria, the site aims to return this water for mineral processing rather than to discharge it.

Discharge of water from Cadia is permitted by EPL 5590. There are no discharge points for excess water from Rodds Creek Dam (RCD), Cadia Hill open pit or the TSF's. Water can only be discharged in accordance with the conditions in EPL5590 from the following locations:

- Point 1 (except CD11) – General 1:20 year sediment control structures: control discharge at any time when water quality criteria are met or following 44 mm of rainfall over a five days where water quality criteria are not applied
- Point 2 – Overflow from the Orange City Council effluent reuse pipeline break pressure tank to Cadiangullong Creek. CD11 is classified as Point 2 and operated as a zero-discharge control structure.
- Point 3 – 1:100 year, 72 hr storm event process water dams and seepage and leachate collection dams: only after 158 mm of rainfall over 72 hours
- Point 19 – Sample site CAWS63: At any time when water quality criteria are met

There are a number of structures for Points 1 and 3. The function, location and capacity are contained in Section 4. An overview of the sites is shown in Figure 2-2.

The release criteria for points 1 and 2 are provided in Table 2-3 and continuous criteria for Point 19 are provided in Table 2-4. EPL5590 does not authorise pollution of waters by any pollutant other than those specified in the table. Water quality monitoring requirements are detailed in Section 5. All controlled discharges are undertaken in accordance with the EPL conditions and the Cadia Stormwater Trigger Action Response Plan (TARP, Section 7.1).

Table 2-3 EPL 5590 concentration limits for Point 1 and Point 2

Pollutant	Units of measure	100 percentile concentration limit
Oil and grease	Milligrams per litre (mg/L)	10
pH	pH units	6.5-8.5
Total suspended solids	mg/L	50
Turbidity (Point 1 only)	Nephelometric turbidity units (NTU)	25

Table 2-4 EPL 5590 concentration limits for Point 19

Pollutant	Units of measure	Concentration limit
pH	pH units	6.5-8.5
Electrical Conductivity (EC)	Microsiemens per cm (µs/cm)	2,950
Total Suspended Solid (TSS)	mg/L	80
Zinc (Zn)	mg/L	0.2
Aluminium (Al)	mg/L	0.15
Arsenic (As)	mg/L	0.005
Copper (Cu)	mg/L	0.1
Iron (Fe)	mg/L	0.73
Lead (Pb)	mg/L	0.002
Manganese (Mn)	mg/L	0.37
Nitrogen (N)	mg/L	9.0
Phosphorus (P)	mg/L	0.4

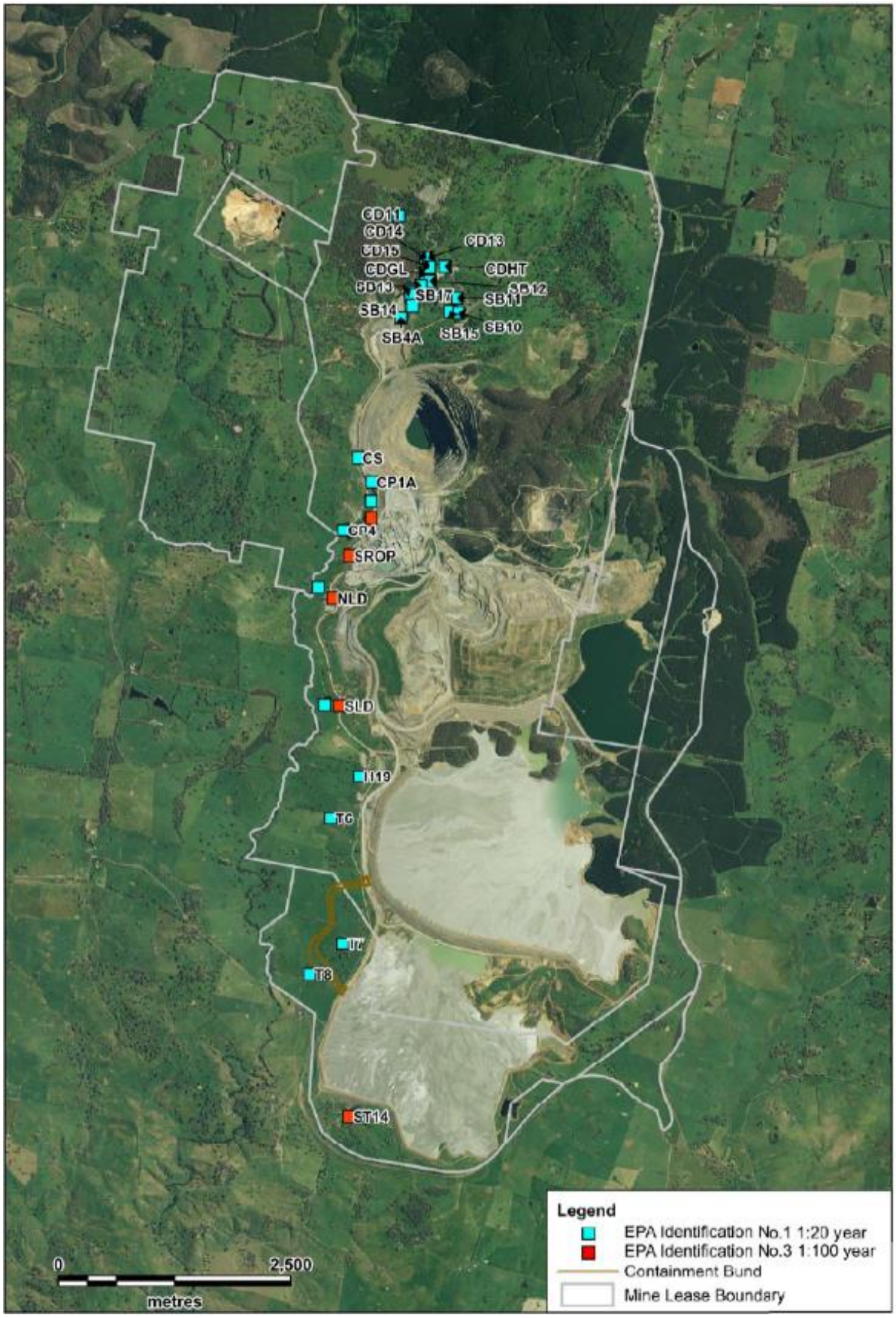

Figure 2-2 EPL discharge points

2.6 Management of Environmental Flows

2.6.1 Cadiangullong Creek

Cadiangullong Dam, a key water supply for mining facilities and environmental flow releases, is located upstream of the main Cadia mining facilities. A 2.4 km diversion was created around open cut mining operations to allow for continuation of water supply to the downstream environment of Cadiangullong Creek.

Water is released from Cadiangullong Dam in accordance with Condition 27 of the Project Approval to meet the criteria listed in Table 2-5. Water from Cadiangullong Dam is also discharged through the spillway when runoff exceeds the full storage capacity of the dam.

Table 2-5 Cadiangullong flow criteria

Cadiangullong Dam			Inflow	Downstream minimum	Other conditions
RL (masl)	Volume (ML)	Capacity (%)	ML/day @ GS412168	ML/day @ GS412702	
>778.8	420 to 4200	10 to 100	0 to 0.4	0.4	
			0.4 to 3.4	inflow	
			>3.4	3.4	
773 – 778.8	170 to 420	4 to 10	0 to 0.4	0.4	No water to be extracted
			0.4 to 3.4	inflow	
			>3.4	3.4	
762.8 – 773	5 to 170	0.1 to 4	0 to 0.4	Inflow*	
			>0.4	0.4*	
<762.8	5	0.1		No release required	

* Measured at the Dam GS412144

In addition to the criteria listed in Table 2-5, there is a requirement for up to four medium flow events per year. A medium flow event is defined as a flow in the order of 12 to 15 ML/day, with a duration of one to three days. Such releases will be made with timing and frequency of such flows determined by hydrographs of typical medium flows. These flows are measured at monitoring point GS412144.

This Plan allows for CVO to occasionally seek approval from DI-Water to temporarily implement a variation in Condition 27 of the Cadia East Project Approval. Any temporary change will be published separately on the Cadia Valley website.

2.6.2 Flyers Creek

Extraction from Flyers Creek Weir is limited to medium and high flow events, where a minimum flow of 3.5 ML/day can be maintained downstream. The downstream flow will be measured at GS412147.

3 SITE WATER BALANCE (Condition 31)

The Cadia water balance is used to predict and quantify the flow of water in and out of the operational boundary. The supply sources include site rainfall runoff, tailings water reclaim, treated effluent, groundwater and surface water extraction. A large component of the water requirements for minerals processing is water recovered from tailings at the thickeners or reclaimed from the tailings storage facilities.

Cadia currently stores water onsite to:

- Maintain supply security during dry conditions
- Maximise the reuse of mixed water and stormwater runoff while minimising clean water abstraction
- Use for dust suppression.

Gilbert and Associates developed an integrated site water balance model of Cadia using the GoldSim® simulation package. The model is able to provide life-of-mine forecasting which is used to predict surface runoff, evaporation, long-term supply reliability and onsite storage level and transfers. The model is used periodically to predict the site water balance and to inform decisions relating to various aspects of water management (e.g. water storage levels, priority water transfers, abstraction rates).

3.1 Surface Water Modelling (31a-3)

The structure of the water balance model is based on the storages and linkages shown in schematic form in Figure 3-1. The model operates on a daily time-step and can be set up to forecast the Cadia water balance over the remaining project life using 118 realisations derived using climatic records from 1895 to 2013. The first realisation uses climatic data from 1895 to 1913, the second realisation uses climatic data from 1896 to 1914, the third realisation uses climatic data from 1897 to 1915 and so on. The results from all realisations are used to generate water balance statistics on the performance of the water management system. This method effectively includes historical climatic events i.e. high, low and median rainfall periods to provide a wide range of possible conditions experienced at Cadia.

The water balance model is linked to outputs from the Belubula River Integrated Quantity and Quality Model (IQQM). The IQQM is the model used by the DPI – Water to determine long-term allocations in the Belubula River, in accordance with the WSP. The IQQM was run using climatic data from 1895 to 2013 to generate predictions of General Security available water determinations, as well as releases from Carcoar Dam and flows at the end of system (Helensholme) for simulation of available water for extraction against supplementary WALs.

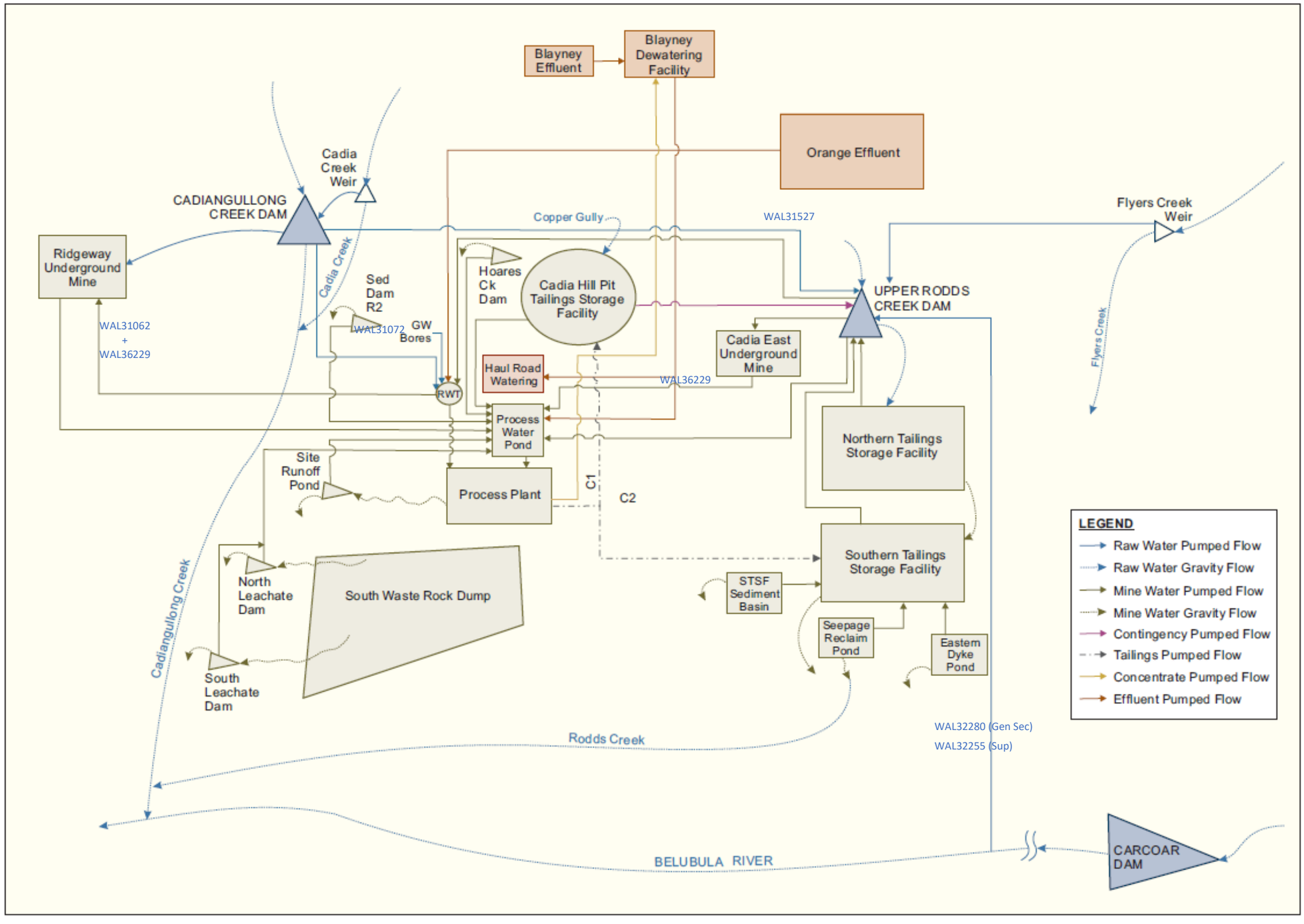

Figure 3-1 Water management system schematic

From the 118 climatic realizations executed in the modelled water balance, the predicted average inflows and outflows are summarised in Figure 3-2.

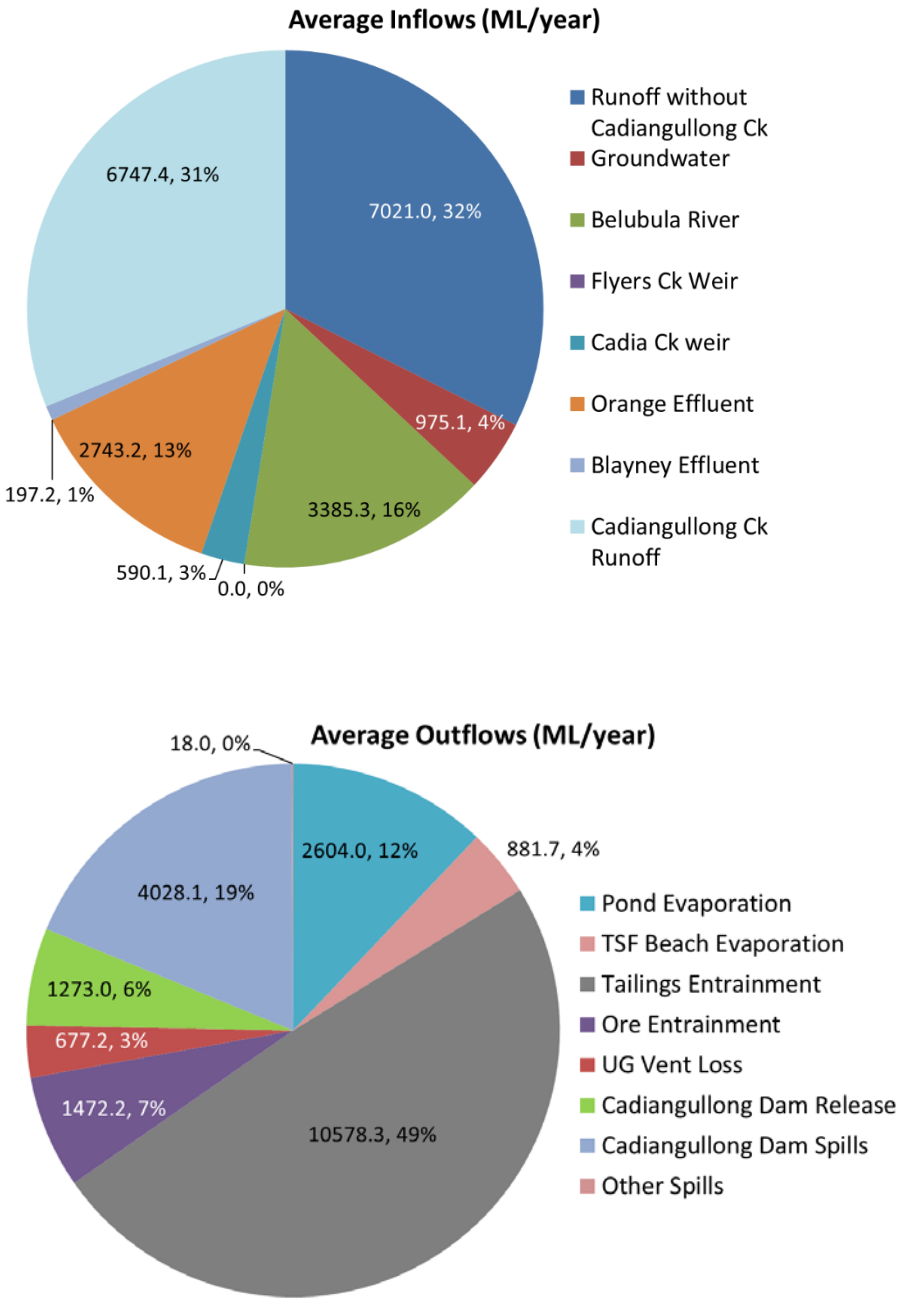

Figure 3-2. Simulated average water balance inflows (top) and outflows (bottom) – 32 Mtpa production

3.2 Water Sources (31a-1)

Cadia water supply scheme comprises recycled water (sourced onsite) and make-up water required to compensate for losses in the system. Mixed water, excess water in the tailings storage facilities and return water from the Blayney Dewatering Facility, is recycled.

Make-up water sources comprise extraction from the Belubula River, Cadiangullong Dam, Flyers Creek Weir, Cadia Creek Weir, Orange Sewage Treatment Plant treated effluent, Blayney Sewage Treatment Plant treated effluent, onsite groundwater extraction bores and site runoff collected from disturbed area catchments such as the TSFs, Cadia Hill Pit, Cadia Extended Pit, Waste Rock Dumps, Ore Treatment facilities and other disturbed areas on site.

The majority of water onsite is recycled. The systems include:

- Recycled water from the tailings thickeners in the low and high grade processing plants
- Recycled water from the tailings storage facilities
- Treated effluent from the onsite wastewater treatment plant
- Recycled water recovered from the filtration process at the Blayney Dewatering Facility.

Water is supplied through a number of onsite water storages. Water at Cadia is stored in surface dams, pit tailings storage, tailings dams and sediment dams. The major onsite dam storages are listed in Table 2-1. Rodds Creek Dam (RCD) is the main storage onsite and is the main source of make-up water for the processing plant and supply to the underground operations.

Water is supplied to RCD by transfers from Cadiangullong Dam (Backbone Pipeline), transfer of reclaimed water from STSF and the Cadia Open Pit, pumping of stormwater from NTSF and extraction from the Belubula River and Flyers Creek Weir.

CHPL constantly monitor water security and reliability and may consider purchasing permanent or temporary transfers on the Belubula River if opportunities arise. Water is traded on the open water market and subject to DI Water requirements.

The onsite storage level will be the indicator of sufficient water supply. Water storage is determined by measuring the relative level of water in storages including Cadiangullong Dam, RCD, TSF and the Cadia Hill open pit.

The volumetric rating curves for Cadiangullong Dam, RCD and the Cadia Hill Pit (since the cessation of mining) are relatively stable, whereas the volumetric rating curve for the TSFs constantly changes due to tailings deposition. The rating curve for the TSFs will be updated as required using bathymetric survey methods.

Onsite storage capacity and maintenance works completed during the reporting year are reported in the AEMR.

3.3 Water Supply Reliability (31a-1)

Water supply security can be described in terms of water supply reliability. The site water balance model is used to predict the reliability of the water management system.

The model predicts that the Cadia water supply scheme can supply water to the project, at a production rate of 32 Mtpa, with a predicted average volumetric supply reliability of greater than 95%.

3.4 Water Use and Recycling (31a-2,3)

The water demand at Cadia revolves around the requirements of the flotation component of the minerals processing. The flotation process requires ground ore slurry of 35% solids to ensure optimal recovery of copper and gold. At the production rate of 32 Mtpa, this equates to approximately 160 ML/day of water demand. Once the copper and gold concentrate is separated from the feed slurry, water is separated from the waste (tailings) by a number of processes. The overall recovery of water from this waste stream is approximately 95 ML/day, resulting in a water demand for mineral processing of approximately 60 ML/day. A significant proportion of the water sent to the TSFs is reclaimed, further decreasing the overall water demand.

Water is supplied to the processing plant from a variety of sources, with the priority of supply as follows:

1. Site runoff pond (collecting return water from disturbed area rainfall runoff)
2. South Waste Rock Dump (SWRD) Leachate ponds (SLD, NLD)
3. Tailings Storage Facilities
4. Mine Dewatering
5. Treated effluent from Orange and Blayney
6. Groundwater Bores
7. Rodds Creek Dam – including extraction from Belubula River, Flyers Creek and Rodds Creek
8. Cadiangullong Dam.- including extraction from Cadiangullong Creek & Cadia Creek

Using the average water balance model prediction from modelling undertaken in August 2019 (Figure 3-2) 49% of water loss is associated with the deposition of tailings in the TSF, with the majority of this water entrained in the tailings. A further 19% on average is predicted to overflow from Cadiangullong Dam and 12% is lost as pond evaporation. The remaining minor water losses are made up by dust suppression, environmental releases and underground mining operations.

An internal water accounting system summarises water use and volume of stored water onsite for Cadia. An annual water account and balance is detailed in the AEMR, including the breakdown of water sources, use, reuse, recycling, change in water storage and loss.

3.5 Water Efficiency (31-b)

The operational water balance is used to quantify flows and water movements within Cadia's water management system. The water balance enables Cadia to prioritise water re-use over freshwater extraction and to improve water use efficiencies as per Condition 31(B) of the Cadia East Project Approval. The statement of operational efficiencies as defined using the Minerals

Council of Australia Reporting Framework (MCA, 2014) is reported in the AEMR, including reuse and recycling efficiency (%).

Ongoing measures to increase efficiency and minimise water use onsite include:

- Increase operational reuse
- Optimize tailings thickening to recover water for immediate re-use.
- Inspections and maintenance of water management infrastructure
- Water recovery from the NTSF, STSF and PTSF. Either stored in Rodds Creek Dam or returned to the plant for immediate re-use.
- TSF decant ponds are maintained at low levels to reduce evaporation
- Water recovered from de-watering processes at Blayney is returned to Cadia for re-use
- Seepage from waste rock dumps is captured and re-used

3.6 Water Balance Review (31a-5)

The water balance model developed for the Cadia East EA will be reviewed annually or where material changes to site water infrastructure occurs. This review process ensures that predictions remain relevant and accurate and allows verification of the modelled results against the site water account.

4 EROSION AND SEDIMENT CONTROL PLAN (Condition 32)

The objective of this Erosion and Sediment Control Plan (ESCP) is to set out strategies to control soil erosion and sediment generation close to the source and thereby minimise the potential for mine activities to adversely affect downstream water quality.

The management and maintenance of sediment control structures is undertaken in accordance with the following specific requirements as detailed in EPL 5590 (Operating Condition O4):

- The stormwater control structures (sediment basins) identified at EPA identification Point 1 must be drained or pumped out as necessary to maintain each basins design storage capacity within five days following rainfall.
- The water discharged to comply with Condition O4.1 may only be discharged to waters from those stormwater control structures (sediment basins) identified at EPA identification Point 1 where the discharged water complies with the discharge limits stipulated at Condition L2.1/L2.4 (and taking into consideration Condition L2.5). A sample of the water discharged is taken for testing and analysis in accordance with condition M2.3.
- The dams identified at EPA identification point 3 must be drained or pumped out as necessary to maintain each dam design storage capacity within 14 days following rainfall.
- There must be no discharge to Cadiangullong Creek, or Rodds Creek from the process water dams, seepage collection dams and leachate collection dams as identified at EPA identification Point 3 except where rainfall at the premises exceeds the 1:100 design criteria for those basins being greater than 158 mm of rainfall recorded over a 72 hour period.
- The licensee must undertake maintenance as necessary to desilt any storage basin identified at EPA identification Points 1 and 3 in order to retain each storage basins design storage capacity.

All erosion and sediment control activities are to be undertaken in accordance with accepted guidelines. The following principles underpin the approach to erosion and sediment control for Cadia and associated infrastructure detailed in the Cadia East Environmental Assessment and subsequent approved modifications :

- Minimise surface disturbance and restrict access to undisturbed areas
- Progressively rehabilitate/stabilise mine infrastructure areas
- Separation of runoff from disturbed and undisturbed areas where practicable
- Construction of surface drains to control and manage surface runoff
- Construction of sediment dams or use of existing/modified water storages to contain runoff up to a specified design criterion.

Activities that have the potential to cause or increase erosion, and subsequently generate sediment laden runoff entering the creek systems include:

- Construction of mine infrastructure i.e. during vegetation clearance, soil stripping and earthworks activities
- Exploration and other drilling activities
- Access and haul roads
- Ore processing activities

- Stockpiling mine materials
- Operation of water management infrastructure.

Prior to any disturbance activities being undertaken or any alternations in site drainage and sediment control structures an Environmental Impact Permit (EIP) is required to be completed. The purpose of the EIP is to identify and minimise any potential for soil erosion and transport of sediment to downstream waters. This also ensures that if the work changes either the catchment area or sediment dam storage that the design storm events can be contained.

Sediment dams are constructed within disturbed area water catchments (including infrastructure areas) to capture and contain sediment laden water for treatment (settling) prior to re-use or discharge. The locations of the sediment control dams at Cadia are shown in Figure 2-2.

The total storage capacity is determined based on requirements of the EPL 5590. The EPL divides the stormwater control structures into:

- 1:20 year structures – 44 mm over any consecutive five-day period
- 1:100 year 72 hour structures – 158 mm over any 72 hour period.

Sediment control structure and drainage calculations are presented in Appendix C.

Following a rainfall event, water from sediment dams is pumped back to the mine water system (primary priority) or discharged (controlled) in accordance with EPL 5590 requirements. The EPL requires that the design capacity of all Point 1 stormwater control basins (sediment dams) be re-established within five days following rainfall; and all Point 3 required volumes re-established within 14 days following rainfall.

All sediment dams will be maintained below the design storage capacity to ensure sufficient volume is available when a rainfall event does occur. The capacity of sediment control structures will be surveyed / reviewed periodically to ensure any changes in catchment areas or storage volumes meet the design criteria. Maintenance activities such as de-silting, cleaning of drains and reinstating drain embankments may be required as a result of these reviews and will be scheduled and completed as soon as practicable after the issue is identified.

Sediment dams are inspected after rainfall events of greater than 10 mm. The inspection involves a visual assessment of the available capacity and determination of any necessary actions, such as the installation of pumps to remove water and reinstate capacity. All sediment dams have an installed peg to indicate the required storage volume and where excess water must be removed.

A new sediment dam (T8 in the table below) has been constructed downstream of the TSF containment bund following the NTSF embankment slump. This dam, combined with an existing farm dam within the containment bund (T7) provide the required storage capacity for a 1:20 year rainfall event. Diesel pumping with capacity of 10 ML/day is available to be used at T8, with pump-back water sent to the STSF. These sediment dams are not included in EPL5590.

Table 4-1 Comparison of dam capacities

Catchment	Containment requirement (ML)	Current Storage Capacity (ML)	Last survey	Comments
1:100 ARI 72 hour Sediment Dam (158 mm)				
Site Runoff Pond (SROP)	57.6	47.6	Jan 15	Permanent pump installed with 14 ML/day capacity. Pond capacity with pumping 61 ML.
Northern leachate (NLD)	57.3	50.7	Mar 13	Permanent pump installed with 10 ML/day capacity. Pond capacity with pumping 77.6 ML.
Southern leachate (SLD)	49.6	105.0	Jun 07	Permanent pump installed with 10 ML/day capacity. Pond capacity with pumping 124.5 ML.
ST14	20.9	22.8	Nov 11	Permanent pump installed with 4 ML/day capacity. Pond capacity with pumping 29.5 ML.
R2[5]	4.8	4.69	Jun 07	Pump installed with 13.5 ML/day capacity. Pond capacity with pumping 9.6 ML.
CDW06 (Cadia DWF)(1)	2.56	TBA(2)	TBA(2)	Permanent pump installed. Pump capacity not considered in containment calculation.
1:20 year Sediment Dam (44 mm over 5 days)				
Pit and concentrator area				
CS	4.24	4.67	Jan 12	
AR1	1.43	1.89	Feb 15	
AR4-5 combined	3.44	3.47	Dec 14	
Ridgeway area				
CD GL	0.10	0.58	Feb 15	
CD HT	0.38	0.30	Oct 15	
SB4A	1.36	1.79	Dec 16	
SB10	0.43	1.00	Dec 14	

[5] Diesel pump generally installed at the pond, but not included in the containment with pumping calculation

Catchment	Containment requirement (ML)	Current Storage Capacity (ML)	Last survey	Comments
SB12	0.66	0.82	Jun 07	
SB14	0.25	0.36	Apr 16	
SB15	0.31	0.47	Oct 15	
CD15	0.43	0.49	Dec 14	
Ridgeway South Portal area				
CP1A*	0.31	0.42	Sep 15	
CP2	0.22	0.75	Dec 16	
CP3	0.85	0.92	Feb 15	
CP4	0.24	0.73	Feb 15	
Cadiangullong Dam area				
CD11	0.17	0.39	Dec 16	
CD13	0.09	0.29	Dec 16	
CD14	0.05	0.11	Dec 16	
Molybdenum Plant Area				
RCD(1)				Stormwater diverted to Rodds Creek Dam
TSF / Containment Bund area				
H18-H19 combined	20	50.0	Jul 10	
T6	7	22.05		
T7-T8 combined(1)	15	14.8	Sep 18	Pump available with 10 ML/day capacity. Pond capacity with pumping 25 ML.

Notes: 1. Not in EPL5590.

2. As built capacity to be determined following construction

Molybdenum plant sediment control

The molybdenum plant sits wholly within the catchment of Rodds Creek Dam. Runoff and sediment control are achieved by construction of two perimeter drains which divert runoff from the plant surrounds into Rodds Creek Dam (see Figure 4-1). Note that all process water within the Molybdenum plant footprint is captured in bunding and pumped to the NTSF.

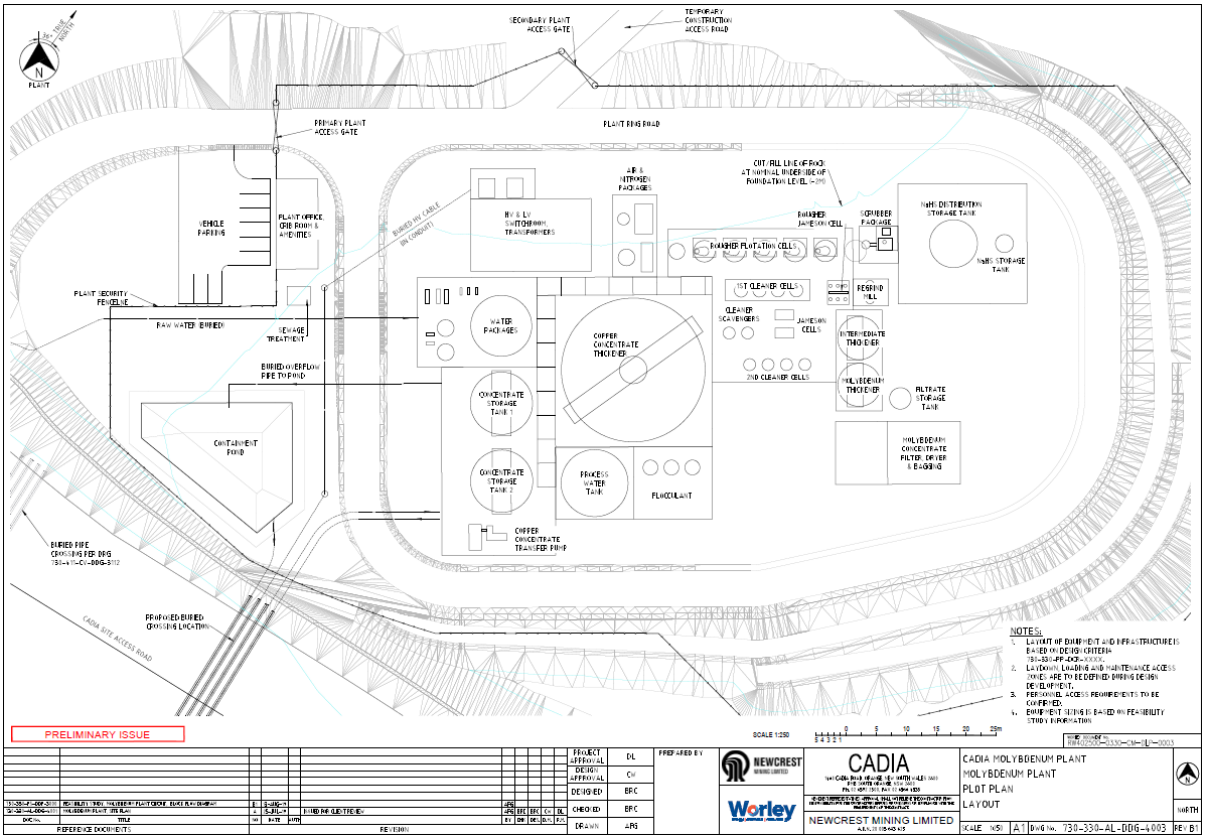

Figure 4-1. Molybdenum Plant infrastructure layout and drainage configuration

Cadia Dewatering Facility Containment Improvements

The Cadia Dewatering Facility (CDWF) is located on the eastern edge of Blayney (Newbridge Road) and was commissioned in June 2016. Concentrate is piped from the Cadia mine site to the CDWF for dewatering, prior to being railed (in sealed containers) to the eastern seaboard prior to being shipped overseas for smelting and refinement.

The design of the facility included formal containment within the liquid and solid concentrate storage areas as well as a significant portion of the concrete apron from where trains are loaded. Any runoff or losses from these areas are contained within the facility or report to a lined runoff containment pond, from where stormwater and 'return water' (from the concentrate dewatering process) are pumped to Cadia for re-use.

The far eastern and western portions of the concrete apron are uncontained, allowing small amounts of residual concentrate material to flow from the apron (following rainfall) into one of

two containment ponds prior to being released from the site. Monitoring conducted as part of this plan has identified slightly elevated copper (above background levels, but generally below site specific guideline values) within these two containment ponds. Data is presented annually in the Cadia Annual Review.

A series of improvement works are proposed that will contain the full extent of the concrete apron, works will generally include :

- Pre and post disturbance soil testing for copper contamination and removal of contaminated material (to be returned to Cadia for encapsulation)
- Installation of a HDPE lined pond to capture runoff from the eastern and western portions of the apron. Pumps to be installed to pump captured water into the existing return water pond from where it will be pumped back to site for re-use.
- Formally line the catch drains that report to the above pond with HDPE liner, HDPE liner to be extended to the edge of the concrete apron to capture the maximum amount of water / residual concentrate that exist the concrete apron.
- Sub-surface drainage to be installed to relieve any groundwater pressure / rising groundwater below the HDPE liners. Water to be released into the existing clean water diversion drain (small pump required in 1 location)
- Existing clean water diversion drain to remain unchanged
- An existing visual bund will require removal to enable the construction of the new pond – materials will be used on site and added to existing visual bunds.

Proposed works are shown in the following figure (Figures 4-2) and are due to commence in late September 2019. The site is otherwise managed in accordance with the CDWF Environmental Management Plan.

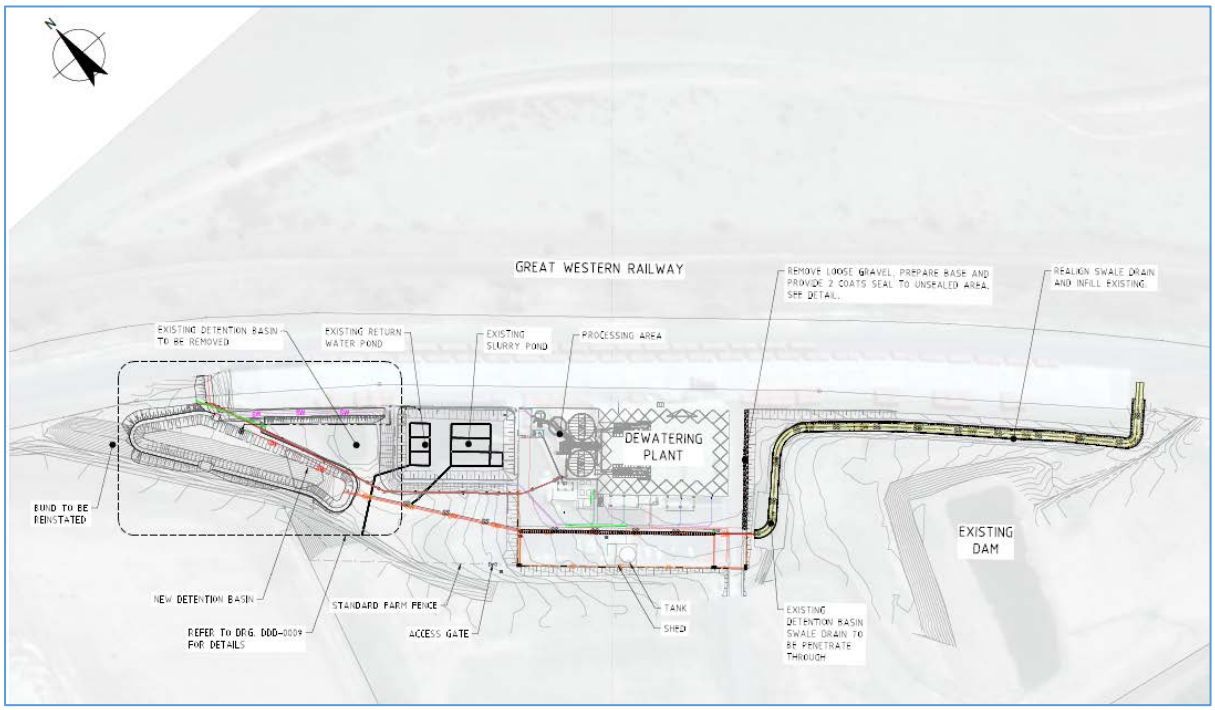

Figure 4-2. Cadia Dewatering Facility Drainage Improvements

5 SURFACE WATER MONITORING PROGRAM (33)

Cadia is located within the catchments of Flyers Creek, Cadiangullong Creek, Swallow Creek and Diggers Creek. These creeks generally flow south towards the Belubula River which forms part of the Lachlan River catchment (Figure 5-1). The Belubula has a catchment area of approximately 2,570 km^2 and has an estimated mean annual flow of 97,400 ML. The Lachlan River is a major inland river system in the NSW section of the Murray-Darling Basin. The surface water environment is described in more detail the Cadia East EA (section 4.3.1).

Potential impacts on surface water quality during operations could include:

- Runoff from the operation containing sediments, dissolved solids, hydrocarbons, process reagents, metals, salts and by products (e.g. tailings).
- Reduced flows in local streams due to extraction for the operations water supply and loss of groundwater contribution through the formation of a permanent subsidence zone; and
- Changes in flows in the Belubula River due to extraction for operational water supply and loss of baseflow in local creeks (tributaries of the Belubula River).

The objectives of the Surface Water Monitoring Program are to:

- continually assess indicators of waterway health
- Continually assess the site's performance regarding prevention of pollution measures
- quantify surface flows and baseflow on the mine site and surrounding areas
- identify and quantify any potential impacts associated with mining activities.

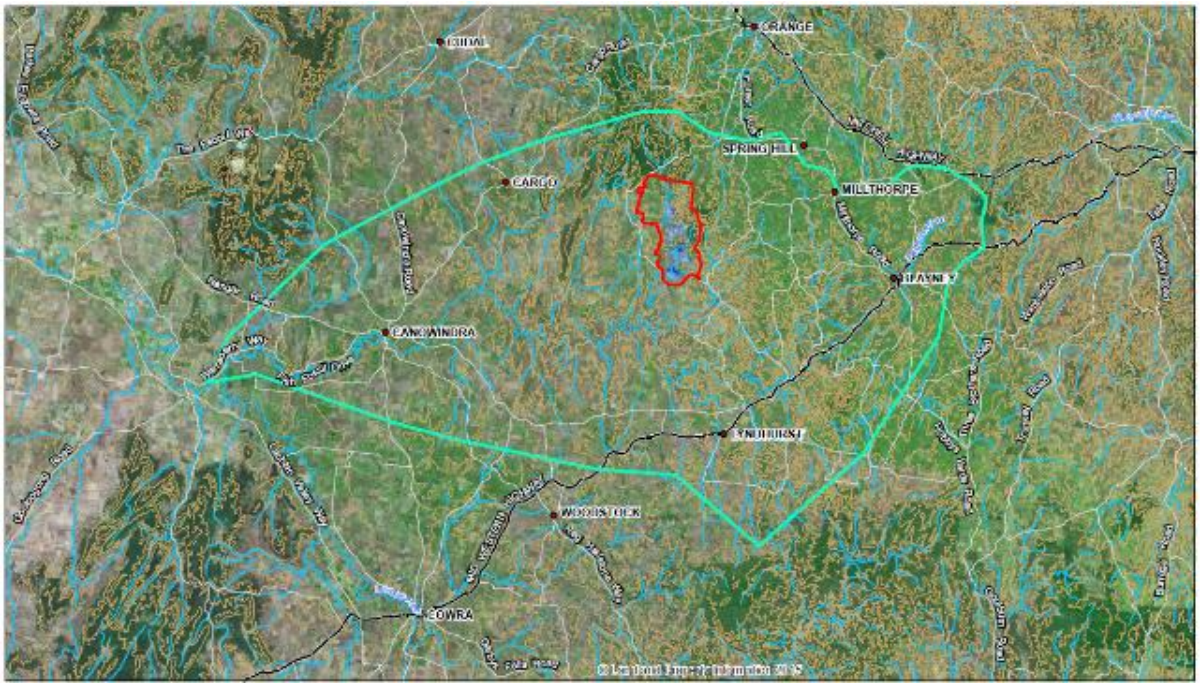

Figure 5-1 Belubula River catchment

5.1 Baseline Data (33a)

Water quality monitoring of creeks in the Cadia Valley area has been conducted by CHPL since 1994, pre-dating the modern mining operations in the Cadia Valley. Data is permanently stored and managed in the CVO environmental database.

5.1.1 Water Quality

Surface water quality sampling points include locations along Cadiangullong Creek, Flyers Creek, Diggers Creek and Swallow Creek, as shown in Figure 5-2. Details on the surface water quality parameters monitored and the frequency of sampling is provided in Section 5.3.

A summary of water quality statistics for the upstream sites in the catchments are shown in Table 5-1. Detailed baseline data for flow and water quality is provided in Appendix D. These sites provide an indication of background/pre-mining conditions. Water quality from these sites has been used in the derivation of the Site-Specific Guideline Values (SSGVs) in Section 5.2.

Table 5-1 Summary of baseline surface water quality monitoring data

Creek	Site	Data Collection Period	pH		EC (µS/cm)		TSS (mg/L)	
			Min	Max	Min	Max	Min	Max
Cadiangullong Creek	412168	1997-2016	6.8	7.7	44	118	2.5	16
Flyers Creek	CAWS44	2007-2016	7.2	8.4	49	520	BDL	66

5.1.2 Stream Flow

Refer to section 5.2.2 for information on baseflow triggers and section 5.3 for information on stream flow monitoring.

5.1.3 Stream Health

Information on stream health is provided in section 5.3.4.

5.2 Impact Assessment Criteria (33b, 33e)

The following sections outline the site's regulatory and site derived water quality guideline values used to assess surface water quality monitoring data.

5.2.1 Surface Water

CVO has developed a range of surface water quality guideline values with which, in combination with an investigation program, potential off-site water quality impacts can be detected at an early stage.

CVO has adopted the following definition for a guideline value:

"… the concentrations (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem specific investigations or implementation of management/remedial actions." (ANZECC/ARMCANZ 2000, Volume 1, Appendix 1).

Guideline values at CVO are derived from various sources, including:

- EPL discharge limits
- ANZEC/ARMCANZ (2000) default trigger values.
- Site Specific Guideline Values (SSGVs)

EPL discharge limits are provided in Section 2.5.

Site specific guideline values have been assessed numerous times by CVO as more data becomes available and in line with changing focus of the ANZECC (2000) guidelines from looking at single number values that are mostly conservative, to guidelines that can be modified according to local environmental conditions. This is accomplished through the use of local reference data and risk-based decision frameworks (ANZECC 2000).

ANZECC and ARMCANZ (2000) states that for some environmental values the guidelines provided may be a suitable guide of water quality (e.g. for recreation use or drinking water). For more specific environmental values such as aquatic ecosystem protection, the guidelines may only be a preliminary step which guide investigations to develop more appropriate guidelines based on the type of water resource and inherent differences in water quality across regions.

The ANZECC/ARMCANZ Guidelines (2000) define ecosystem types and condition. The creek systems on the Cadia site are classified as:

- Upland rivers and streams – greater than 150 m altitude
- Slightly to moderately disturbed systems – where the aquatic biological diversity may have been adversely affected by human activity. This is relevant to the systems on site due to the current and historic mining, forestry and agricultural development in the area.

GHD reviewed the site's surface water quality guideline values in 2012, 2016 and 2018. GHD has developed site specific guideline values (SSGV) for key monitoring sites as an alternative to the ANZECC & ARMCANZ default values. The SSGVs developed are based on local spatial and temporal data that that is more indicative of the local catchment geology and chemistry. Hence these SSGVs provide a more appropriate and risk-based indicator and more robust basis for investigation.

Where insufficient data was available to derive SSGVs, the ANZECC/ARMCANZ (2000) default trigger values have been adopted and modified where appropriate based on the ecosystem type and the condition and hardness of the water.

CVO has water quality trigger values at the following sites:

- Oaky Creek (412702) located in Cadiangullong Creek downstream of all mine area sub-catchments
- Rodds Creek (CAWS63) located downstream of the TSF (see Table 2-4 for EPL limits).
- Diggers Creek (412166)
- Swallow Creek (412167)
- Flyers Creek (CAWS10)

Refer to GHD (2018, attached) for further information relating to the derivation of surface water and biological trigger values.

Table 5-2 Surface water quality SSGVs

Parameter	Unit	412702 (Oaky Creek Gauging Station)	Diggers Creek 412166	Rodds Creek CAWS63 (EPL Point 19)	Flyers Creek CAWS10	Swallow Creek 412167
Physio Chemical						
pH	pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
EC	µS/cm	875	1,960	2,950	965	1,960
TSS	mg/L	50	50	80	50	50
Nutrients						
Nitrogen oxides	mgN/L	0.25	0.25	-	0.25	0.25
Total nitrogen	mgN/L	0.6	0.6	9.0	0.6	0.6
Total phosphorous	mgP/L	0.06	0.09	0.4	0.09	0.09
Dissolved Metals						
Aluminium	mg/L	0.055	0.055	0.15	0.055	0.055
Arsenic	mg/L	0.013	0.013	0.005	0.013	0.013
Cadmium	mg/L	0.0002	0.0002	-	0.0002	0.0002
Copper	mg/L	0.009	0.0014	0.1	0.0014	0.0014
Iron	mg/L	0.12	1.65	0.73	1.65	1.65
Lead	mg/L	0.0034	0.0034	0.002	0.0034	0.0034
Manganese	mg/L	1.9	1.9	0.37	1.9	1.9
Zinc	mg/L	0.057	0.077	0.2	0.077	0.077
Molybdenum	mg/L	0.034	0.034	-	0.034	0.034

5.2.2 Stream Flow

The potential changes to the mean annual flow and baseflow (expressed as changes to baseflow index) have been previously estimated (Gilbert and Associates 2000; Cadia 2009). Proposed SSGVs, based on the estimated potential changes to mean annual flow and baseflow (as BFI), are summarised in Table 5.3. Changes to baseflow are assessed on an annual basis and included in the AEMR.

Table 5-3 Stream flow SSGVs

Catchment	Location	Mean annual flow (ML)		Baseflow index	
		Pre-mining	Post mining	Pre-mining	Post mining
Swallow Creek [A]	SCBW2	101	70	0.28	0.03
	SCBW3	89	55	0.37	0.00
	412167	915	835	0.47	0.43
Diggers Creek [A]	DCBW1	24.5	15.9	0.35	0.00
	412166	278	255	0.43	0.38
Cadia Creek [B]	CWRR	1,400 - 1,800	1,013 - 1,413	0.4 - 0.5	0.38 - 0.52
Cadiangullong Creek [B, C]	412168	5,910	5,482	0.62	0.58
Flyers Creek [B]	412147	3,980	3,801	0.68	0.66

[A] Gilbert and Associates (2000).
[B] Cadia (2009)
[C] Includes Cadia Creek.

5.2.3 Stream Health

The creeks in the vicinity of Cadia (including Cadiangullong Creek) have been historically disturbed by mining, agricultural and forestry activities and are therefore considered to be slightly to moderately or highly disturbed ecosystems (Gilbert & Associates, 2009).

Cadia has implemented an aquatic ecology program to monitor the local and surrounding stream health. The monitoring assesses the populations of macroinvertebrates and fish species, and the condition and classification of aquatic habitat. The results from this program were recently subjected to a 10-year review conducted by GHD (2017). The analysis of macroinvertebrate indices showed no clear difference between Cadiangullong Creek sites upstream of the mine and those downstream over the 10 year period of the project. Importantly the results show that there is no consistent decline in taxa richness at Cadiangullong Creek sites downstream of the main area of mining operations.

To support the monitoring and assessment of downstream river health, CVO has used the findings of the 10-year review to develop biological trigger values for assessment of the ongoing biannual aquatic ecology program. The following trigger values (Table 5-4) apply to the Oaky Creek site (412702).

Table 5-4 Biological index trigger values for Oaky Creek (412702).

Metric	Edge Habitat	Riffle Habitat
	Trigger value[1]	Trigger value[1]
Taxa richness	19	15
EPT richness	5	6
O/E50 score	0.8	0.87
SIGNAL 2	3.70	4.9

Notes: 1. Triggered if survey results fall below the values presented here.

5.3 Water Sampling, Analysis and Reporting (33c, 33e)

Surface water sampling at CVO is undertaken in accordance with relevant Australian Standards, legislation and the NSW Office of Environment and Heritage (OEH) approved methods for sampling, including (but not limited to):

- Approved Methods for the Sampling and Analysis of Water pollutants in NSW (DEC 2004)
- AS/NZS 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples
- AS/NZS 5667.6:1998 Water Quality – Sampling – Guidance on Sampling of Rivers and Streams
- AS/NZS 5667.10:1998 Water Quality – Sampling – Guidance on Sampling of Waste Waters.

The surface water monitoring program includes monitoring of the following elements of the Cadia water management system and surrounding creeks:

- Surface water quality and flows in upstream and downstream watercourses
- Base flow monitoring
- Stream health conditions in upstream and downstream watercourses
- Daily rainfall, as recorded at Cadia's weather stations
- Daily water level monitoring of water management dams
- Offsite discharges
- Mine water quality monitoring.

A description of the monitoring locations, frequency and parameters measured for each of these components of the monitoring program is provided in the following sections.

Cadia will endeavour to implement the surface water monitoring program as described in this section, however from time to time, there may be an unforeseen temporary interruption to the program caused by issues such as restricted access, flood, power failure etc. In these circumstances the interruption will be described in the Annual Review and monitoring resumed as soon as practicable.

5.3.1 Surface water analytical suites

All water samples are analysed by a National Association of Testing and Analysis (NATA) accredited laboratory.

The following sections summarise the Cadia surface water quality monitoring program for the upstream, site water and receiving environments. Water quality parameters have been selected based on the potential contaminants from the operations as identified in the Geochemistry Assessment in the Cadia East EA.

Table 5-5 Surface water analytical suites

Suite name	Suite Code	Parameters
Physical Parameters (field measurement)	FP	- pH, EC, Temperature, ORP
Surface Water Quality	SWQ	- EC, TSS, TDS - Alkalinity; - Major ions: Ca, Mg, Na, K, Cl, SO4, hardness; - Nutrients Nitrite, Nitrate, Total N, Total P; - Dissolved metals (Al, As, Cd, Cu, Fe, Pb, Mn, Mo, Zn, Sb, Co, Cr, Hg, Ni, Ag)
Oil and Grease	O&G	- Oil and Grease
Dam	ALG	Blue Green Algae (counts).

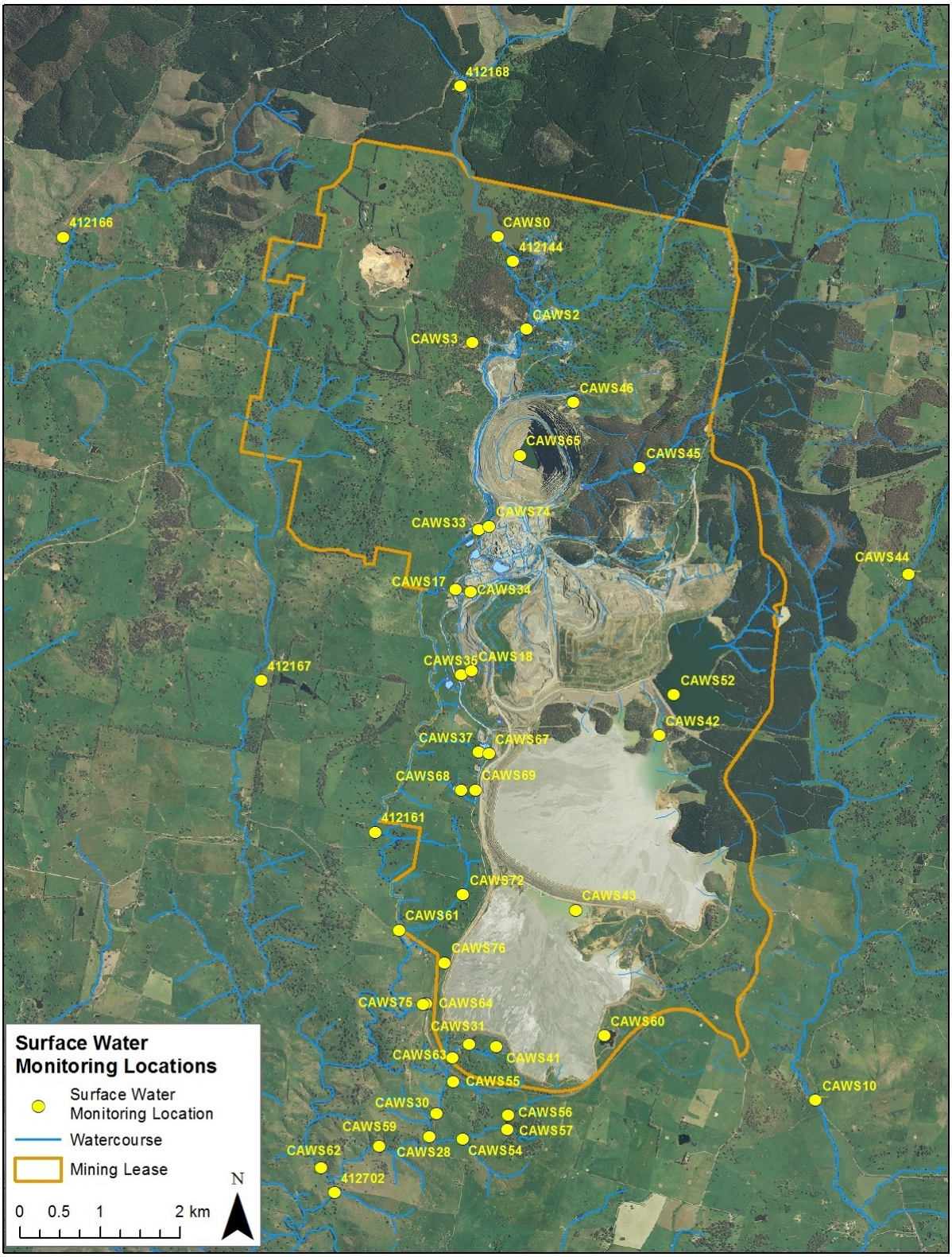

Figure 5-2 Surface water sampling sites

Figure 5-3 Surface water sampling sites (Blayney)

5.3.2 Sampling locations, frequency, parameters and reporting

5.3.2.1 Stream Water

Water quality is monitored in the surrounding creek systems and those that flow through Cadia including upstream and downstream of mining operations and Cadia Dewatering Facilities. The frequency of sampling and parameters tested at each site has been adjusted when consistent trends have been identified.

Samples in the Cadiangullong Creek before December 1996 represent baseline conditions prior to current mining, noting however there were water quality impacts from agriculture, forestry and historic mining upstream of the Cadia Hill open pit (CAWS2) at this time. Similarly, monitoring conducted up to June 2002 in the Swallow Creek and Diggers Creek systems is considered baseline (prior to the development and operation of Ridgeway Mine). Monitoring in the Flyers Creek catchment is considered to be a continuation of baseline monitoring, with only localised changes in groundwater predicted (not yet observed) from the Cadia East Project.

The water quality sampling sites are summarised in Table 5-7, including the purpose of sampling at that location and the frequency of monitoring.

Water quality monitoring results are compared to the SSGVs, with any identified 'trigger' investigated and reported through the AEMR.

5.3.2.2 Water Storages and Sediment dams sampling

Controlled and uncontrolled discharges from sediment control structures are monitored in accordance with the site's EPL (5590). The discharge monitoring program is summarised in Table 5-5.

Table 5-6 Discharge monitoring program

Location	Parameters	Frequency
Point 1 – General 1:20 year stormwater control structures	pH, , Turbidity, Oil and Grease, TSS, Estimated flow / water volume	Daily during any discharge
Point 2 – Overflow from the break pressure tank to Cadiangullong Creek	pH, TSS, BOD, Total Nitrogen, Total Phosphorus, Oil and Grease, Total discharge Estimated flow / water volume	Daily during any discharge
Point 3 – 100 year ARI stormwater control structures	pH, TSS, BOD, Total Nitrogen, Total Phosphorus, Oil and Grease, Total discharge(1) Estimated flow / water volume	Daily during any discharge
Point 19 (CAWS63 downstream TSF)	FP, SWQ Estimated flow / water volume	Monthly

Notes: 1. Discharge sampling at this point would be conducted by CVO in addition to license requirements.

Table 5-7 Stream water sampling location, frequencies and parameters

Site ID	Area	Purpose / Rationale	Continuous	Monthly[(1)]	Quarterly[(1)]	Biannual[(1)]
412144	Cadiangullong Creek	Water quality before interaction with operations	Level		Level + FP + SWQ	
412161		Potential impact from mining, processing & SWRD	Level + EC		Level + FP + SWQ	
412168		Upstream water quality	Level		Level + FP + SWQ	
412702		Potential impacts from entire site	Level	Level + FP + SWQ		
CAWS0		Water quality and algae concentrations for process raw water		Algae (Oct-Apr)	FP + SWQ	
CAWS2		Impact from historic mining			FP + SWQ	
CAWS33		Potential impact from open pit, creek diversion, conveyor etc			FP + SWQ	
CAWS61		Potential impact from mining, processing & SWRD		FP + SWQ		
CAWS62		Potential impact from mining, processing & SWRD		FP + SWQ		
CAWS3	Mine Areas	Impact from historic mining		FP + SWQ		
CAWS34		Monitor development of leachate water quality from yellow and blue waste rock dumps. Used to calibrate geochemical model of waste rock dump and will be used to assess effectiveness of waste rock dump cover	Level		Level + FP + SWQ	
CAWS35	Mine Areas	Monitor development of leachate water quality from pink and blue waste rock dumps. Used to calibrate geochemical model of waste rock dump and will be used to assess effectiveness of waste rock dump cover	Level		Level + FP + SWQ	
CAWS37		Monitor for potential seepage impacts SWRD and NTSF			FP + SWQ	
CAWS45		Determine any changes in water quality as a result of Cadia East Mine				FP + SWQ

Site ID	Area	Purpose / Rationale	Continuous	Monthly[1]	Quarterly[1]	Biannual[1]
CAWS46		Monitor leachate from NWRD			FP + SWQ	
CAWS52		Ensure water quality is suitable for use in the raw water circuit		Algae (Oct-Apr)	Level + FP + SWQ	
CAWS67		Monitor for potential for seepage impacts on the western side of the NTSF and STSF			FP + SWQ	
CAWS68					FP + SWQ	
CAWS69					FP + SWQ	
CAWS72					FP + SWQ	
CAWS75					FP + SWQ	
CAWS76					FP + SWQ	
CAWS73		Site Runoff Pond			FP + SWQ	
CEP02		Monitor any changes in quality as CE mine develops. Ensure water quality is suitable for use in the raw/process water circuit		FP + SWQ + WQ-O&G		
CAWS28	Panuara	Assess the impact of TSF on surface water quality in Rodds Creek (tributary of Cadiangullong Creek)		FP + SWQ		
CAWS54				FP + SWQ		
CAWS55				FP + SWQ		
CAWS56				FP + SWQ		
CAWS57				FP + SWQ		
CAWS59				FP + SWQ		
CAWS10	Regional	Assess potential impact from CE mine and TSF			FP + SWQ	
CAWS44		Flyers Creek Upstream water quality			FP + SWQ	

Site ID	Area	Purpose / Rationale	Continuous	Monthly[1]	Quarterly[1]	Biannual[1]
412147		Flow gauging station, level only	Level			
412166		Determine any changes in water quality as a result of Ridgeway Mine	Level			Level + FP + SWQ
412167			Level			Level + FP + SWQ
CAWS30	TSF (including pit TSF)	Assess the impact of TSF on surface water quality in Rodds Creek (tributary of Cadiangullong Creek)		FP + SWQ		
CAWS31		Determine the influence of STSF water on groundwater contributing to base flow in creek		FP + SWQ		
CAWS41				FP + SWQ		
CAWS42		Monitor development of TSF decant water quality. Used to determine potential impacts of the TSF on surface and/or groundwater quality			FP + SWQ	
CAWS43		Monitor development of TSF decant water quality. Used to determine potential impacts of the TSF on surface and/or groundwater quality			FP + SWQ	
CAWS60		Assess potential for seepage contributions on eastern side of southern TSF		FP + SWQ		
CAWS63 (point 19)		Assess the impact of TSF on surface water quality in Rodds Creek	Level	Level + FP + SWQ		
CAWS64		Assess any influence of TSF on surrounding groundwater quality			FP + SWQ	
CAWS65		Monitor pit decant water quality		FP + SWQ		
NEC061	Blayney Dewatering Plant	Upstream water quality		FP + SWQ		
NEC062		Assess potential impact from Blayney Dewatering Facility		FP + SWQ		
CDW01[2]	Cadia Dewatering Facility	Assess potential impact from NEW Blayney Dewatering Facility – Newbridge Rd		FP + SWQ		
CDW02[2]				FP + SWQ		

Site ID	Area	Purpose / Rationale	Continuous	Monthly[1]	Quarterly[1]	Biannual[1]
CDW03				FP + SWQ		
CDW04				FP + SWQ		
CDW05				FP + SWQ		
CDW06[2]				FP + SWQ		
SPR03	Private Land north east of the mining area	Spring supplies a small dam, which is the main house and stock water supply for the property. Located in close proximity to MB53-56			FP + SWQ	

Notes: 1. Refer to Table 5-5 for a description of the suite codes.

2. Following the completion of drainage improvement earthworks at the Cadia Dewatering Facility, CDW01 and CDW02 will no longer be sampled and sampling will commence at CDW06.

5.3.2.3 Algae Monitoring

EPL 5590 allows the control of blue-green algae in Cadiangullong and Rodds Creek Dams. The dams are monitored seasonally during the warmer months (October to April) in Cadiangullong Dam (CAWS0) and Rodds Creek Dam (CAWS52). Results greater than 50,000 cells/mL of cyanobacteria allow for the treatment of blue-green algae in the reservoir. Treatment of cyanobacteria triggers the cessation of water transfer from the reservoir and additional sampling at three sites in each dam. Sampling frequency specified in the EPL is:

- Immediately prior to the application of pesticides;
- 2 hours after the application of pesticides;
- 24 hours after the application of pesticides; and
- 7 days after the application of pesticides.

5.3.2.4 Stream Flow Monitoring

Surface water flows are monitored using a combination of stream gauging stations and baseflow weirs to:

- Ensure compliance with the release criteria from Cadiangullong Dam
- Ensure compliance with and manage the flow requirements for extraction from Flyers Creek and the Belubula River
- Ensure that mining induced changes in groundwater levels are not reducing baseflow (Cadia, Flyers Creek, Swallow Creek and Diggers Creek).
- Inform the site water balance and management decisions.

The gauging stations and baseflow weirs consist of a control in the watercourse, with level detection and data recording devices. Data from the gauging stations is collected at least monthly with some of the stations connected to the process control system to allow real-time monitoring. Ratings for each of the stations are updated regularly to take into account changes in the stream profile and cross section. The stations used for monitoring of surface water flows are shown in Table 5-8. Measured streamflow from the different creek systems is included in Appendix F.

Flow in Cadiangullong Creek is monitored continuously, with the releases reviewed daily to assess compliance against the release criteria, with flows averaged over a seven-day period. In the case of the medium flow releases, flow is averaged over one day.

Flow in Flyers Creek is monitored continuously, with results from the monitoring station used to automatically control the operation of the pumps at the extraction weir. During periods of extraction, the pumps start automatically when the level reaches a trigger height at the downstream gauging point and stop if the level drops below the trigger point. The trigger level is set to ensure that 3.5 ML/day passes the gauging station when extraction is undertaken.

The stream flow monitoring network is regularly maintained and calibrated against manual measurements.

Table 5-8 Surface water gauging station

Catchment	Station	Site	Purpose
Cadiangullong Creek	412168	Four Mile Creek	Upstream of potential impacts
	412144	Dam gauging station	Downstream of Cadiangullong Dam
	412161	Southern Lease Boundary	Potential impacts to the mining lease boundary
	412702	Oaky Creek	Potential impacts after the confluence of Rodds and Cadiangullong Creek
	CWRR	Cadia Creek	Baseline conditions until there is impact from Cadia East
Flyers Creek	412147	Flyers Creek	Baseline conditions until there is impact from Cadia East
	WBW	Woodville Baseflow Weir	Baseline conditions until there is impact from Cadia East
	USFC	Long Swamp Road	Upstream of potential impacts
	412080	Flyers Creek @ Beneree [A]	Baseline conditions until there is impact from Cadia East
Swallow Creek	SCBW2	Swallow Creek Baseflow Weir 2	Baseline to June 2002, then potential impacts from Ridgeway
	SCBW3	Swallow Creek Baseflow Weir 3	Baseline to June 2002, then potential impacts from Ridgeway
	412167	Swallow Creek	Baseline to June 2002, then potential impacts from Ridgeway
Diggers Creek	DCBW1	Diggers Creek baseflow weir	Baseline to June 2002, then potential impacts from Ridgeway
	412166	Diggers creek	Baseline to June 2002, then potential impacts from Ridgeway
Belubula River	BRPS	Belubula River	Measurement of flows upstream of pump station
Waste Rock Dump Seepage	NLEACH	SWRD Northern Leachate Dam	Characterise waste rock dump leachate and effectiveness of rehabilitation
	SLEACH	SWRD Southern Leachate Dam	
Rodds Creek	RCBW1	Upstream of URCD	Measurement of surface flows into RCD
	RCBW2 (CAWS 63)	Downstream STSF seepage pond	Measurement of surface flows downstream of STSF

[A] Station maintained by DPI – Water

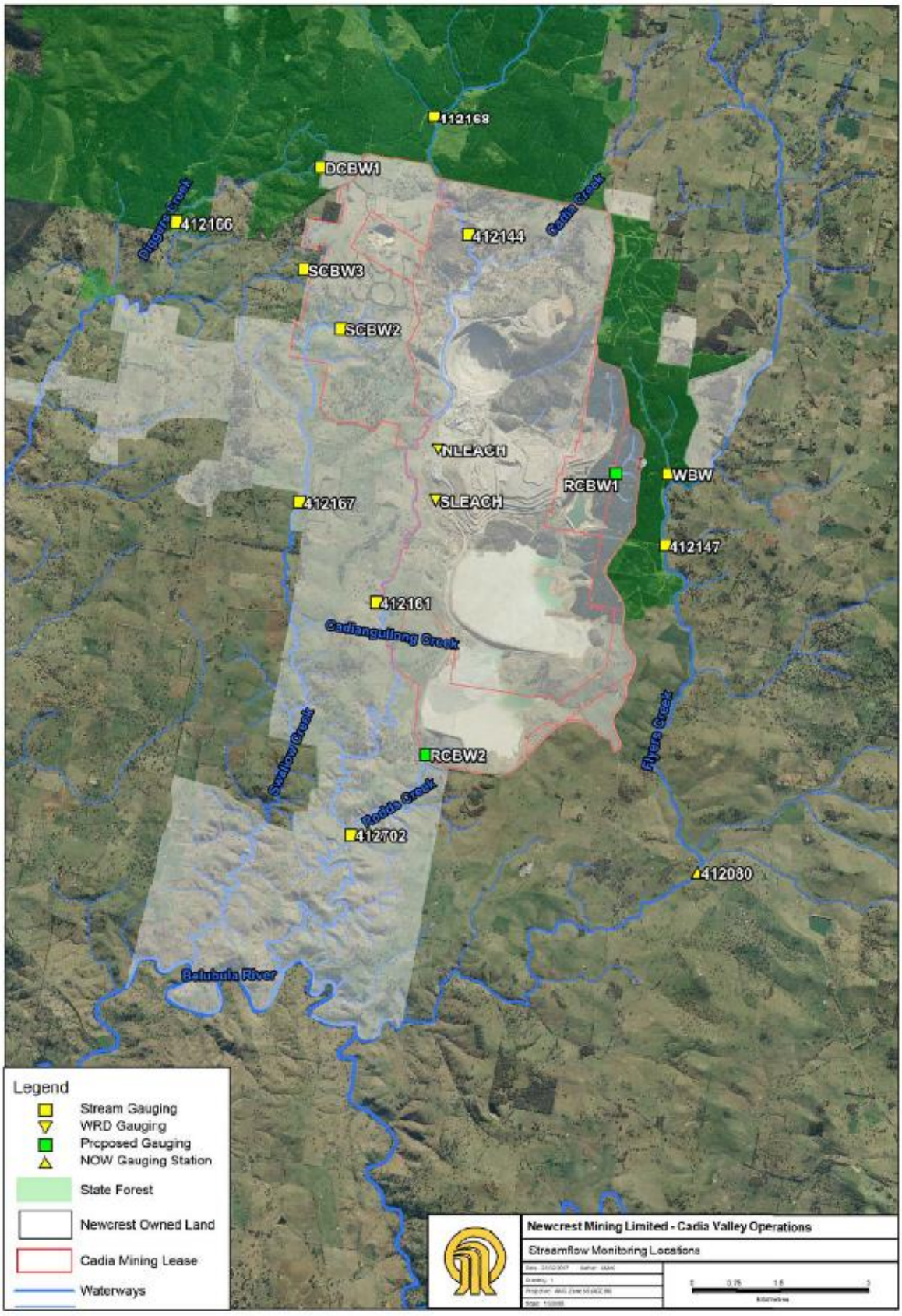

Figure 5-4 Streamflow monitoring points

5.3.2.5 Baseflow Monitoring

Baseflow is assessed using recorded streamflow data, with the baseflow separated from runoff using a Filter Separation Method (HYBASE – Within Kernel Filter). Baseflow for the four catchments of Cadiangullong Creek, Swallow Creek, Diggers Creek and Flyers Creek are detailed in Appendix G with the predicted changes from the Ridgeway EIS and Cadia East EA. Baseflow is assessed annually through the AEMR, with the measured results compared with criteria. Where baseflow is less than the criteria, an investigation is triggered as detailed in Section 7.

5.3.3 Stream Health

Monitoring occurs on a biannual basis (autumn and spring) at the locations indicated in Table 5-9 and Figure 5-5and is conducted by an independent consultant. Results are presented on an annual basis in the AEMR.

Table 5-9 Aquatic ecology monitoring sites

Site Code	Site Name	Position Relative to Potential Impacts and Cadia
CVOCC5	Cadiangullong Creek upstream of Cadiangullong Dam	Downstream of Canobolas State Forest (pine plantation); upstream of Cadia
CVOCC1	Cadiangullong Creek 200 m downstream of Cadiangullong Dam	Downstream of Cadiangullong Dam; upstream of Cadia mining facilities
CVOCC2	Cadiangullong Creek at South Portal Road (lower cutting)	Downstream of Cadiangullong Dam; downstream of Cadiangullong Creek diversion; adjacent to Cadia pit (now in care and maintenance phase)
CVOCC3	Cadiangullong Creek at Southern Lease Boundary	Downstream of Cadia facilities; upstream of tailings dams; grazing in surrounding lands
CVOCC4	Cadiangullong Creek at Oaky Creek Gauging Station	Downstream of Cadia facilities; downstream of tailings dams; grazing in surrounding lands
CVOFC2	Flyers Creek at Extraction Weir	Catchment east and adjacent to Cadiangullong Creek catchment; grazing and pine plantation in surrounding lands; upstream of Flyers Creek Extraction Weir
CVOFC1	Flyers Creek at Martin Road Gauging Station	Catchment east and adjacent to Cadiangullong Creek catchment; grazing and pine plantation in surrounding lands; downstream of Flyers Creek Extraction Weir
CVOSC1	Swallow Creek at Gauging Station No. 412167	Catchment west and adjacent to Cadiangullong Creek catchment; grazing in surrounding lands; downstream of Ridgeway underground mine sinkhole
CVOPR1	Panuara Rivulet upstream of Revegetation Area	Catchment west of Cadia; located on leased sheep grazing property; upstream of conservation offset revegetation area.
CVOPR2	Panuara Rivulet downstream of Revegetation Area	Catchment west of Cadia; located on leased sheep grazing property; downstream of conservation offset revegetation area.
CVORC1	Rodd's Creek upstream of Cadiangullong Creek	Downstream of tailing dams on Rodd's Creek; upstream of **CVO**CC4 confluence with Cadiangullong Creek
CVODG1	Diggers Creek at Diggers Weir Station No. 412166	Upstream of Panuara Rivulet, catchment adjacent to, but not influenced by mining operations.

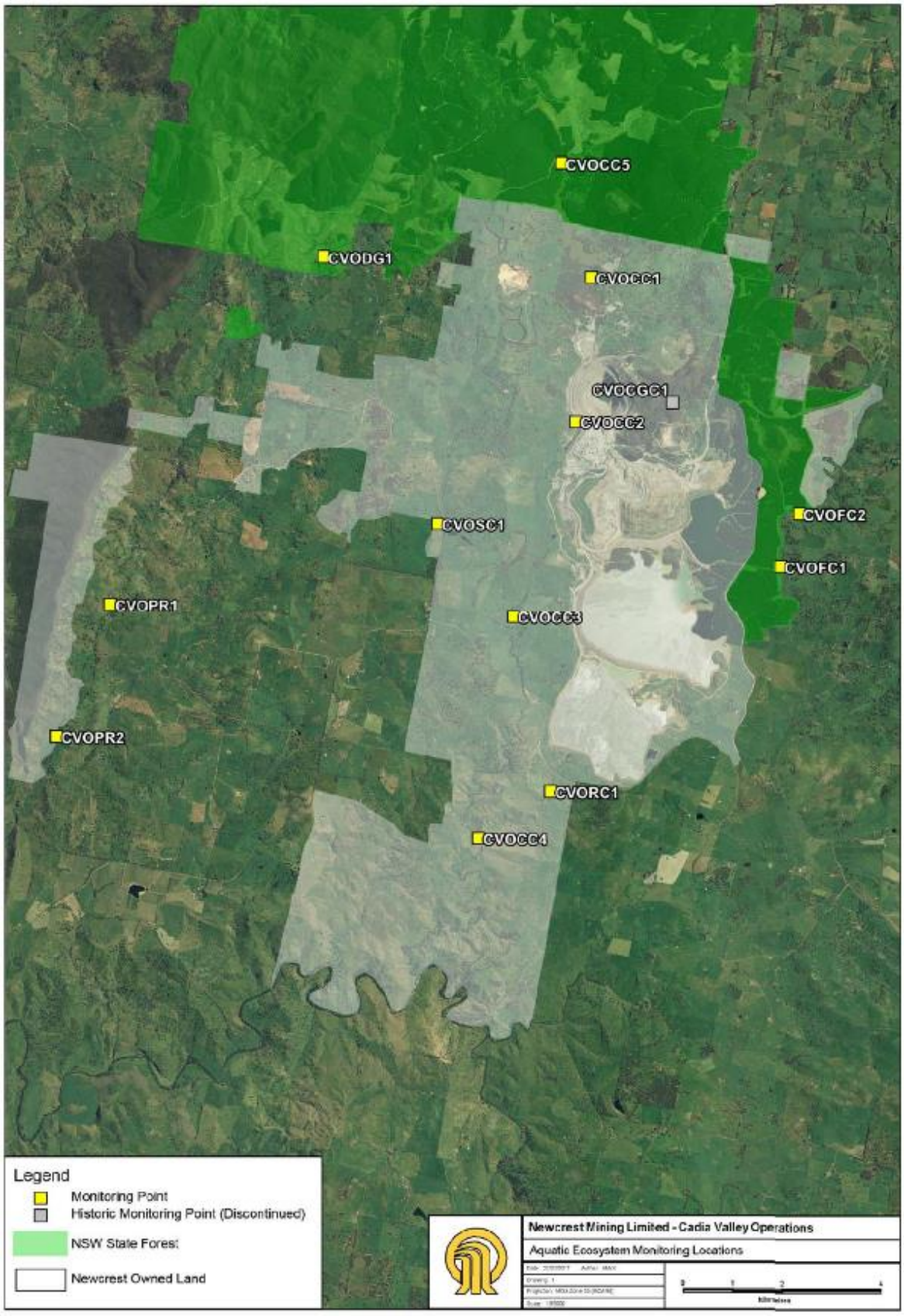

Figure 5-5 Aquatic ecosystem monitoring

6 GROUNDWATER MONITORING PROGRAM

The objective of the Groundwater Monitoring Program (GMP) is to identify if mine operations are having an adverse effect on the local hydrogeological regime.

6.1 Baseline Data (Condition 34a)

6.1.1 Existing Groundwater Regime

There are three main aquifer systems within Cadia's mining leases and surrounding area. The characteristics of each aquifer are described in detail in the Cadia East Environmental Assessment and are summarised below.

Tertiary Basalt

Tertiary Basalt (Orange Basalt) is situated predominately throughout the northern portion of Cadia's area of operations, with small isolated outliers to the east, west and south. The regional groundwater level within this unit is approximately 20 m below ground level (bgl) (AGE 2009) and groundwater quality is typically fresh.

Silurian Sediments

Silurian Sediments are a fine grained low permeability unit with groundwater intercepted within the fractured sandstone/siltstone and limestone layers. Groundwater depths range from 25 to 64 m bgl (AGE 2009). Groundwater quality is typically fresh and calcium-bicarbonate dominant.

Ordovician Volcanics

Ordovician Volcanics are a low yielding groundwater source associated with the fractured basement rocks. Groundwater is typically brackish to saline, calcium-magnesium-sulfate dominant, and flows to the south-west predominantly within faults and fractures.

6.1.2 Existing Groundwater Users

646 registered bores are within the vicinity of Cadia, the majority being of depth less than 60 m within the basalt groundwater source and located within 5 km north-east of the Cadia East subsidence zone (AGE 2009).

6.1.3 Baseline Data

6.1.3.1 Groundwater Quality and Level

Groundwater monitoring of all potentially affected aquifers is undertaken on a regular basis. There is substantial baseline groundwater monitoring data, with monitoring commencing in 1994 and the program expanded continually over the past 20 years. Monitoring parameters have been determined based on the characteristics of the ore body, Cadia East EA Groundwater Assessment and recent groundwater investigations surrounding the TSFs.

Data collected during the baseline monitoring has been used to develop impact assessment criteria (site specific guideline values - SSGVs) to assist in the identification of adverse impacts on the aquifer because of mining activities (refer to Section 6.2). Baseline groundwater

monitoring data is presented in Appendix H. It should be noted that baseline conditions could not be established for all bores, due to changes in local water quality and/or levels from the time of bore installation. Historical monitoring data for currently monitored bores is also included in Appendix H. A comprehensive groundwater quality and level analysis is provided annually in the AEMR.

The groundwater quality data indicates that there is a limited hydraulic connection between the three-aquifer systems. Groundwater quality is predominantly fresh for the Tertiary Basalt foundation and saline for the Ordovician Volcanics aquifer. Groundwater in the Silurian sediment foundation is variable from fresh to saline.

Bore yield monitoring was conducted to establish a baseline yield of selected private bores. Yield monitoring comprised of continuous logging of bore levels using data-loggers, with logged data downloaded monthly. The bores were equipped with a flowmeter to establish an accurate history of usage. The bore yield monitoring results are shown in Figure 6-1. The bore census also contains a record of the baseline yield information (see Appendix I).

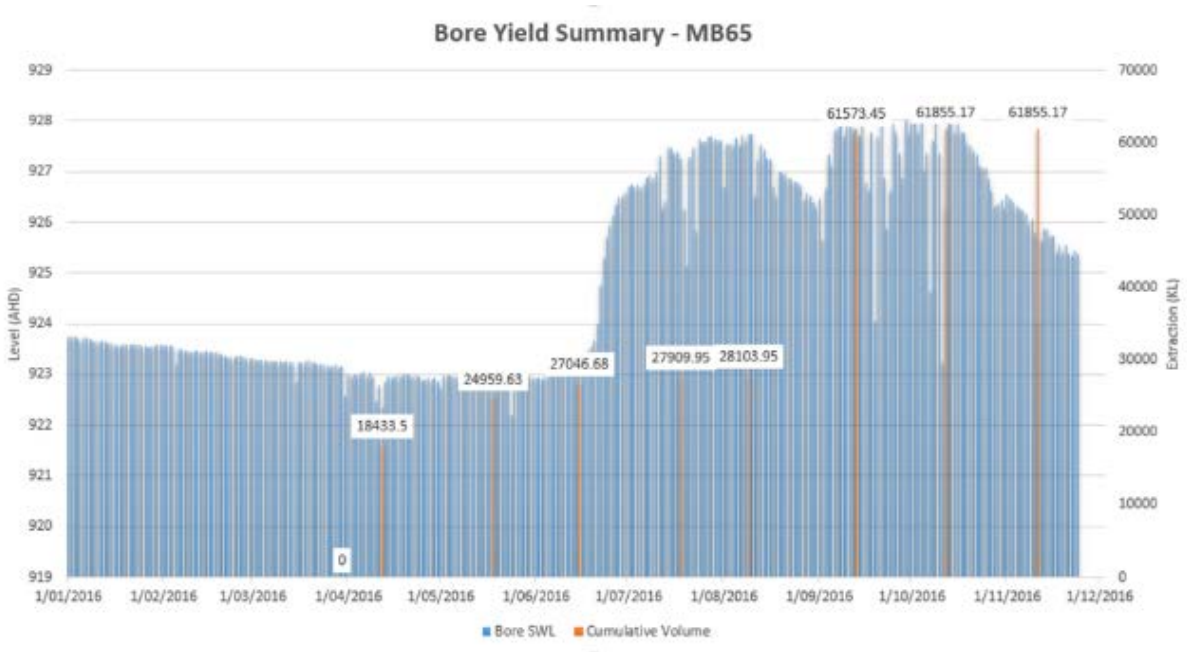

Figure 6-1 Bore yield monitoring summary

The bore yield assessment indicates the bore level is negligibly impacted by the volume of water pumped from the bore and adequately recharges with no obvious trends.

6.1.3.2 Springs

More than 50 individual springs and groundwater seepage areas are located within the vicinity of Cadia (AGE 2009). Flows from these springs ranges from almost no seepage (below the measurable limit) to approximately 22 ML/day. Baseline water quality testing has been conducted since 2009 at four selected springs (Appendix J), a summary of which is presented in Table 6-1.

Table 6-1 Spring water quality

Parameter	Unit	Mean	Min	Max	20th percentile	80th percentile
Physio Chemical						
pH	pH	7.12	6.25	7.83	6.65	7.59
EC	µS/cm	94	52	141	68	121
TSS	mg/L	14	5	74	5	18
Nutrients						
Nitrogen oxides	mgN/L	2.75	<0.01	7.46	0.03	7.08
Total nitrogen	mgN/L	3.6	0.3	10.2	0.8	7.9
Total phosphorous	mgP/L	0.07	<0.01	0.58	0.01	0.09
Metals						
Aluminium	mg/L	1.22	0.31	2.44	0.52	1.83
Arsenic	mg/L	0.001	<0.001	0.002	0.001	0.001
Copper	mg/L	0.001	<0.001	0.001	0.001	0.001
Iron	mg/L	0.48	<0.05	2.18	0.05	1.03
Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	mg/L	0.021	<0.001	0.348	0.002	0.019
Zinc	mg/L	0.056	<0.001	0.141	0.014	0.082

Since 2012, baseline monitoring has indicated seasonal variation in flows as a result of rainfall, use and evaporation. Some of the springs are persistent, while others had long periods where no flow was observed. Details of individual springs were recorded in the 2010 Spring Census. Flow duration curves for the monitored springs are included in Figure 6-2.

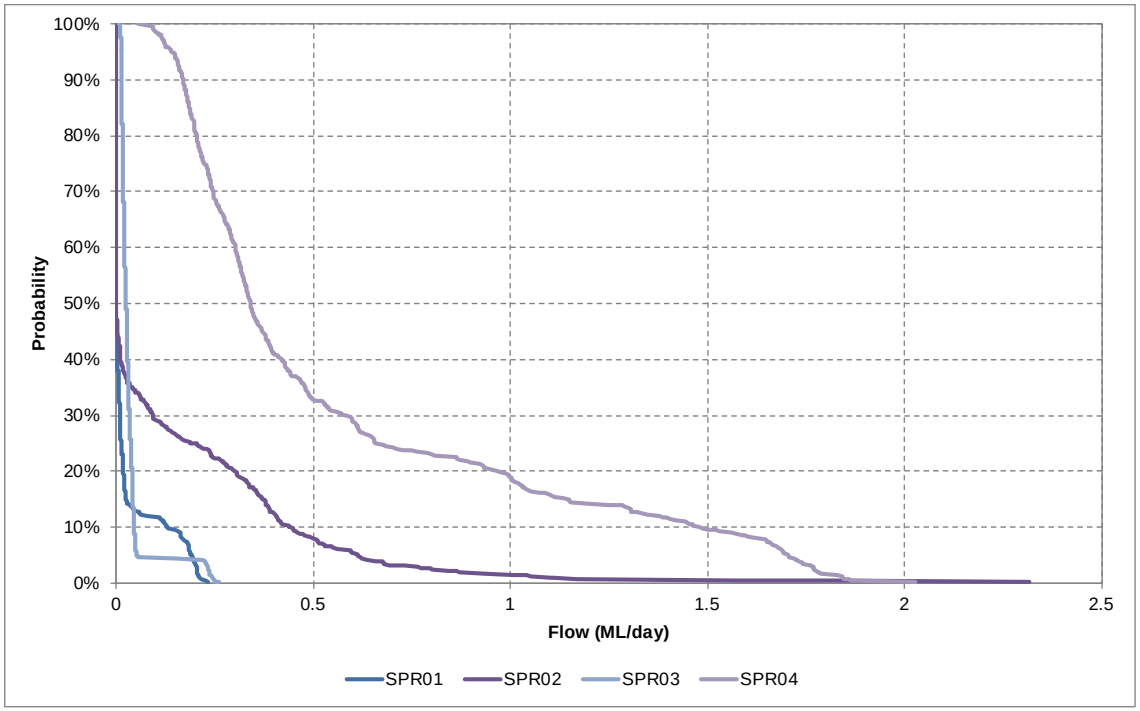

Figure 6-2 Spring flow duration curve

6.2 Impact Assessment Criteria (Condition 34b)

Impact assessment criteria are used to identify changes in groundwater quality and level, which may indicate potential adverse impacts on the environment because of mining operations. Impact assessment criteria are adopted as site-specific guideline values (SSGVs) which trigger further monitoring, investigation and if required remedial action, through activation of the Surface and Groundwater Contingency Plan (SGWRP) (refer to Section **7**).

The NSW Aquifer Interference Policy (AIP) requires that potential impacts on groundwater sources, including their users and Groundwater Dependent Ecosystems (GDEs), be assessed against the minimal impact considerations. Impacts are considered to be acceptable when less than the Level 1 minimal impact considerations. The Level 1 minimal impact considerations for porous and fractured rock groundwater sources are as follows:

- Water table – less than or equal to 10 % cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 m from any high priority GDE or high priority culturally significant site listed in the schedule of the relevant water sharing plan. A maximum of a 2 m decline cumulatively at any water supply work unless make good provisions should apply.
- Water pressure – a cumulative pressure head decline of not more than 40 % of the "post-water sharing plan' pressure head above the base of the water source to a maximum of a 2 m decline at any water supply work.
- Water quality – any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.

6.2.1 Groundwater Quality

ANZECC/ARMCANZ (2000) Guidelines apply to the quality of groundwater as well as surface water.

Groundwater from the Orange Basalt Aquifer and Silurian Sediments to the north and east of Cadia East is used for private drinking water and stock purposes. The impact assessment criteria for these bores are the greater of the Australian Drinking Water Guidelines (2017) or the 80th percentile of baseline conditions. Groundwater from both the Silurian Sedimentary and Ordovician Volcanics Aquifers to the south are generally poorer quality and used for limited stock water supply. The impact assessment criteria for these bores is the greater of the Stock Guidelines (ANZECC 2000) or the 80th percentile of baseline conditions.

Recommended groundwater quality triggers (GHD 2016) for Cadia East monitoring bores are outlined in Table 6-2, and Table 6-3 presents recommended groundwater quality triggers for the STSF monitoring bores and proposed bores in the vicinity of Cadia Hill Pit.

Table 6-2 Cadia East groundwater impact assessment triggers

Bore	pH	TDS	Sulphate	Aluminium	Arsenic	Copper	Mercury	Lead	Manganese	Nickel	Zinc	Nitrite	Nitrate
	(pH units)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
MB47A	6.5-8.5	600	250	0.2	0.01	1	–	0.01	0.1	0.02	3	3	50
MB62	5.7-8.5	600	250	0.2	0.01	1	–	0.01	0.1	0.02	3	3	50
MB48	6.4-8.5	600	250	0.2	0.01	1	–	0.01	1.62	0.02	3	3	50
MB49	6.5-8.5	600	250	0.2	0.01	1	–	0.01	0.68	0.02	3	3	50
MB53	6.5-8.5	600	250	0.2	0.01	1	–	0.01	–	0.02	3	3	50
MB54	6.1-8.5	600	250	0.7	0.01	1	–	0.01	0.1	0.02	3	3	50
MB56	6.2-8.5	600	250	0.2	0.01	1	–	0.01	0.1	0.02	3	3	50
MB63	5.2-8.5	600	250	0.2	0.01	1	–	0.01	0.1	0.02	3	3	50
MB64	6.5-8.5	600	250	0.2	0.01	1	–	0.01	–	0.02	3	3	50
MB65	6.5-8.5	600	250	0.2	0.01	1	–	0.01	0.1	0.02	3	3	50
MB83	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.5	0.02	3	3	50
MB84	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.5	0.02	3	3	50
MB85	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.5	0.02	3	3	50
MB86	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.5	0.02	3	3	50
MB87	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.5	0.02	3	3	50
MB88	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.1	0.02	3	3	50
MB89	6.5-8.5	600	250	0.2	0.01	1	0.001	0.01	0.1	0.02	3	3	50

Note: trigger values for metals refer to dissolved concentrations
* Value greater than drinking or stock water guidelines

Table 6-3 Tailings Storage Facility impact assessment triggers

Bore	pH	TDS	Sulphate	Aluminium	Arsenic	Copper	Lead	Manganese	Nickel	Zinc	Mercury	Nitrite	Nitrate
	(pH units)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
MB20	6.5-8.5	6910*	3090*	10*	0.5	0.4	0.1	-	1	20	-	33	132
MB21	6.5-8.5	4000	1000	5	0.5	0.4	0.1	-	1	20	-	33	132
MB68	6.5-8.5	4000	1000	5	0.5	0.4	0.1	-	1	20	-	33	132
MB69	6.5-8.5	4000	1000	5	0.01**	0.4	0.01**	0.5**	1	20	0.001**	33	132
MB70	6.5-8.5	4000	1000	5	0.5	0.4	0.1	-	1	20	-	33	132
MB77A	6.5-8.5	4000	1000	5	0.5	0.4	0.1	-	1	20	-	33	132
MB77B	6.5-8.5	4000	1000	5	0.5	0.4	0.1	-	1	20	-	33	132
MB78	6.5-8.5	4000	1000	5	0.01**	0.4	0.01**	0.5**	1	20	0.001**	33	132
MB79	6.5-8.5	2000	1000	5	0.01**	0.4 (sheep); 0.1 (cattle)	0.01**	0.5**	1	20	0.001**	9.1	90.3

Note: trigger values for metals refer to dissolved concentrations
* Value greater than drinking or stock water guidelines
** Value is recommended by DPI Water Letter dated 7 February 2017 (Ref: OUT17/6198)

Table 6-4 Pit TSF groundwater quality triggers for proposed bores

Bore	pH	TDS	Sulphate	Aluminium	Manganese	Nickel	Zinc	Nitrite	Nitrate	Arsenic	Copper	Lead	Mercury
	(pH units)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
MB91, MB92, MB93, MB94[4] MB95. MB96[4] MB97[4]	6.5-8.5[1]	4000[1]	1000[1]	5[1]	0.5[1]	0.02[1]	20[1]	33[1]	132[1]	0.01[2]	0.4[2]	0.01[2]	0.001[2]

1 ANZECC/ARMCANZ (2000) Guidelines (Livestock)
2 Value is recommended by DPI Water Letter dated 2 May 2017 (Ref: OUT17/17244)
3 MB89 was last sampled 15 January 2019 due to prohibition notice for subsidence zone
4 Proposed bores – to be drilled during 2019-20.

6.2.2 Groundwater Levels

The Cadia East Environmental Assessment predicted groundwater drawdown up to 8km north of the operation. Subsequent review of the predictive model in 2013 and 2016, revised the predicted groundwater drawdown area. Groundwater levels are monitored monthly and assessed against these trigger levels. Figure 6-3 shows the revised predicted groundwater drawdown from the Cadia East Project, including the location of privately owned bores and springs.

Recommended groundwater level guidelines for the Ridgeway area are detailed in Table 6-5. Groundwater level guidelines were developed as a part of the Ridgeway Project within the Ridgeway Flow Protocol.

Table 6-5 Groundwater level guidelines – Ridgeway area

Bore	Guideline level	
	Depth to water (m)	Water level (AHD m)
RO6A	36	866
RO6B	70	832
RO7	34	865
RO10A	21	882
RO10B	33	870
RO12	29	893

Recommended groundwater level guidelines for Cadia East area are listed in Table 6-5.

Table 6-6 Groundwater level guidelines – Cadia East area

Bore	Aquifer	Drawdown(1) (m)
RB1	Tertiary Basalt	3
MB43	Silurian Shallow	3
MB44A	Silurian Deep	3
MB44B	Shallow Basalt	3
MB47A	Silurian Limestone	3
MB47B	Silurian Sandstone	3
MB55	Shallow Basalt	3
MB62	Silurian Deep	3
MB71	Deep Basalt	3
MB76	Silurian Deep	3

Notes: 1. Groundwater drawdown of greater than 3 m above what is considered normal climatic variation.

Interim 'increasing' groundwater level guidelines for bores in the vicinity of the STSF and NTSF areas (south and west) area are detailed in Table 6-7. Groundwater level guidelines were developed using groundwater modelling undertaken as part of the Cadia East EA. The groundwater assessment conducted by AGE predicted that groundwater levels will increase between 5 m to 40 m as shown in Figure 6-4. The increase predicted is relative to pre-mining conditions.

Table 6-7 Groundwater level guidelines – STSF and Western NTSF

Bore	Guideline level	
	Increase water level (m)*	Relative Level (mAHD)*
STSF		
MB25	40	679.99
MB26B	20	631.36
MB27	5	590.87
MB28B	40	630.35
MB29B	10	625.02
MB77A/B	10	652.70
MB78	5	653.49
MB81	10	651.13
Western NTSF		
MB18	20	698.20
MB23	40	668.56
MB24	20	680.83

Notes: 1. *From initial measured level data

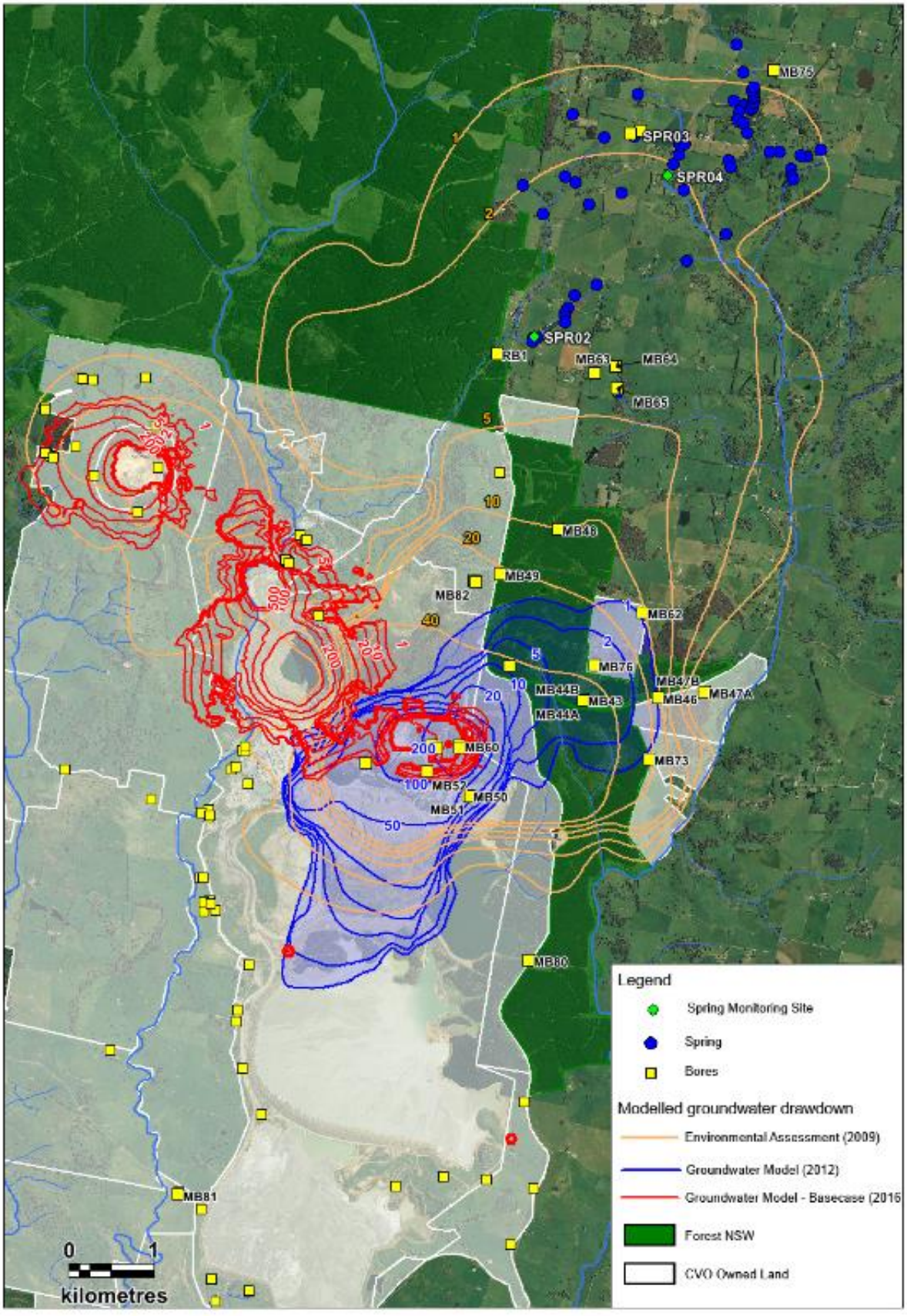

Figure 6-3 Revised predicted groundwater drawdown from the Cadia East Project

Figure 6-4 Simulated Increase Contour during Operations – Model I Minus Model III - South TSF (STSF) and Western NTSF

6.3 Groundwater Monitoring Program (34c, 34e)

6.3.1 Monitoring Standards

Groundwater monitoring at Cadia will be undertaken in accordance with the following standards and guidelines:

- Approved Methods for the Sampling and Analysis of Water pollutants in NSW (Department of Environment and Conservation 2004)
- AS/NZS 5667.1:1998 Water Quality – Sampling – Guidance on the Design of Sampling Programs, Sampling Techniques and the Preservation and Handling of Samples
- AS/NZS 5667.11:1998 Water Quality – Sampling – Guidance on Sampling of Groundwater.

Cadia will endeavour to implement the groundwater monitoring program as described in this section, however from time to time, there may be an unforeseen temporary interruption to the program caused by issues such as restricted access, bore failure, bore blockage, power failure etc. In these circumstances the interruption will be described in the Annual Review and monitoring resumed as soon as practicable.

6.3.2 Monitoring Bores (34c)

Monitoring of water levels and water quality parameters (Table 6-8) is undertaken at many bores as summarised in Table 6-9. Bore locations are presented in Appendix K.

Groundwater monitoring is undertaken in all potentially impacted aquifers from different operation areas.

There are currently 110 groundwater monitoring bores operational within the network. Of these 16 are around Ridgeway, 50 are around Cadia East and 44 are around the southern waste rock dump and Northern (NTSF) and Southern tailings storage facilities (STSF).

In 2018 six new additional bores were installed: one for Cadia East to provide additional monitoring of the cave zone impacts (MB89); one to the west of the NTSF and STSF to monitor for any supernatant water infiltrating from the TSF (MB 90); four installed (MB91, 92, 93, and 95) in and around the Cadia open pit tailings storage facility to provide base line data and monitor for any supernatant water infiltrating from the TSF. Three additional bores are planned for 2019-20 (MB94, MB96 and MB97) to supplement the pit monitoring network. Figure 6-5 shows the proposed location of these bores, final locations may vary due to ground conditions, geotechnical assessments and accessibility within the pit precinct. Seven pre-existing geotechnical Piezo standpipe monitoring bores have been added to the pit monitoring regime, they are PZ4, PZ5, PZ10, PZ10A, PZ89, PZ89A and PZ90. Construction details for the monitoring bores are presented in Appendix B.

Interim water quality triggers have been proposed in Table 6-3 and will be revised and updated in future revisions of the Water Management Plan. Monthly sampling, using the monthly suite of parameters will be used to establish baseline conditions.

Table 6-8 Groundwater quality analytical suites

Suite name	CODE	Parameters
Field Parameters	FP	- pH, EC, Temperature, ORP
Groundwater Quality Suite	GWQ	- EC, TSS, TDS (gravimetric), Turbidity - Alkalinity; - Major ions: Ca, Mg, Na, K, Cl, SO4, hardness; - Nutrients Nitrite, Nitrate, Total N, Total P; - Dissolved metals (Al, Sb, As, Cd, Co, Cr, Cu, Fe, Pb, Mn, Hg, Zn)
Hydrocarbons	O&G	TRH/BTEXN Reporting of TRH

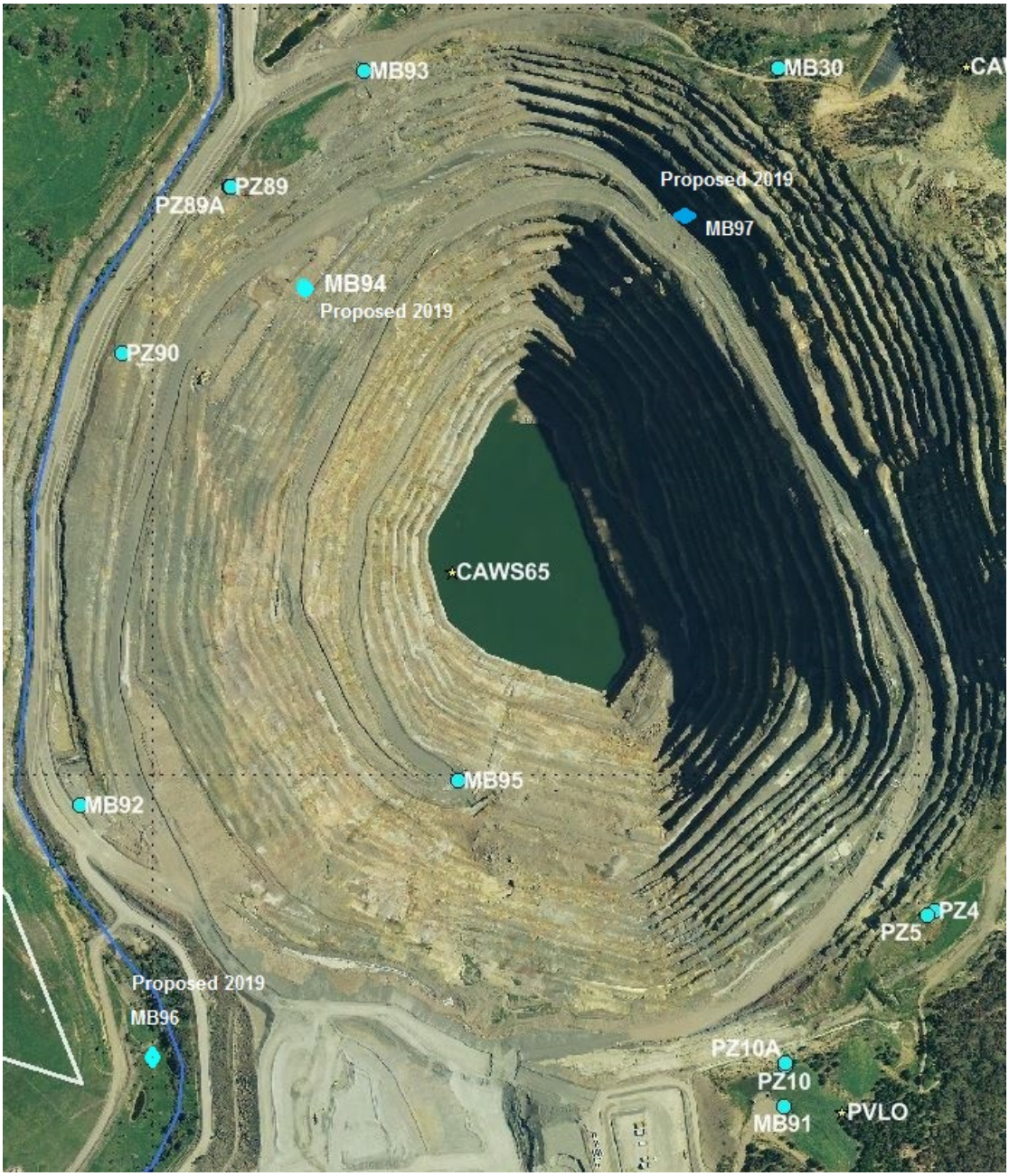

Figure 6-5 Existing (MB30, PZ4, PZ5, PZ10, PZ10A, PZ89, MB91, MB92, MB93, MB95) and proposed groundwater monitoring bores MB94, MB96 and MB97 in the Pit TSF area.

Table 6-9 Groundwater monitoring program (refer to Table 6-8)

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
Cadia East Bores	MB43	Baseline conditions of aquifer (both level and quality), natural variation, development and calibration of groundwater model	Level		
	MB44A		Level		
	MB44B		Level		
	MB46		Level		
	MB47A		Level	FP + GWQ	
	MB47B		Level		
	MB48		Level	FP + GWQ	
	MB49		Level	FP + GWQ	
	MB62		Level	FP + GWQ	
	MB73		Level		
	MB76		Level		
	MB71	Baseline conditions to the east and north of the zone predicted to be impacted by the Cadia East EA		Level + FP + GWQ	
	MB72			Level + FP + GWQ	
	MB74			Level + FP + GWQ	
	MB75			Level + FP + GWQ	
	MB50	Monitor changes in aquifer close to mining activities	Level		
	MB51		Level	FP + GWQ	
	MB52		Level		
	MB88[(1)]		Level + FP + GWQ		
	MB89		Level + FP + GWQ		
	MB53	Pre-mining conditions of aquifer, natural variation, development and calibration of groundwater model		Level + FP + GWQ	
	MB54			Level + FP + GWQ	
	MB55			Level	
	MB56			Level + FP + GWQ	
	MB63			Level + FP + GWQ	

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
	MB64			Level + FP + GWQ	
	MB65			Level + FP + GWQ	
	MB82		Level	FP + GWQ	
	RB01				Level
	RB02				Level
Cadia Hill Pit TSF	MB30	Monitor potential impact of Pit TSF. Data used in conjunction with Groundwater Model to confirm the hydraulic gradient at the base of the pit.	Level + FP + GWQ		
	MB91(1)		Level + FP + GWQ		
	MB92(1)		Level + FP + GWQ		
	MB93(1)		Level + FP + GWQ		
	MB94(2)		Level + FP + GWQ		
	MB95(1)		Level + FP + GWQ		
	MB96(2)		Level + FP + GWQ		
	MB97(2)		Level + FP + GWQ		
	PZ4		Level		
	PZ5		Level		
	PZ10		Level		
	PZ10A		Level		
	PZ89		Level		
	PZ89A		Level		
	PZ90		Level		
Processing Plant	MB1A	Potential for impacts from processing plant		Level + FP + GWQ + HYD	
	MB1B			Level	
	MB2A			Level + FP + GWQ + HYD	
	MB2B			Level	
	MB3A			Level + FP + GWQ + HYD	
	MB3B			Level	

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
	CB14A	Monitoring drawdown from production bore RH641			Level
	CB14B	Monitoring drawdown from production bore RH641			Level
Production Bores	CB3	Core yard supplementary water supply		Level	
	CB6	Supplementary water supply for processing plant (sample from CB6A)		Level + FP + GWQ	
	CB8	Site potable water supply		Level	
	CB9	Site potable water supply		Level	
	RH641	Ridgeway dust suppression (care and maintenance)		Level[3]	
	TW01[2]	Test wells (proposed supplementary water supply for processing plant – pending test pumping, impact assessment and project approval modification)	Level + FP + GWQ		
	TW02[2]		Level + FP + GWQ		
	TW03[2]		Level + FP + GWQ		
	TW04[2]		Level + FP + GWQ		
	TW05[2]		Level + FP + GWQ		
	TW06[2]		Level + FP + GWQ		
	TW07[2]		Level + FP + GWQ		
	TW08[2]		Level + FP + GWQ		
Regional Bores	RB07	Pre-mining conditions of aquifer, natural variation, development and calibration of groundwater model			Level
	MB81	Regional groundwater levels	Level	Level + FP + GWQ	
	RB03				Level
	RB04				Level
	RB05				Level
Cadia Extended Pit	CX1[1,4]	Monitor water quality from the Cadia Extended Pit	Level + FP + GWQ		
Ridgeway Mine Bores	RO10A	Baseline data to June 2002, then determine impact of Ridgeway mine on groundwater levels			Level
	RO10B				Level
	RO11				Level

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
	RO12				Level
	RO6A				Level
	RO6B				Level
	RO7				Level
	RO8				Level
	RS10A				Level
	RS10B				Level
	RS11				Level
	RS12				Level
	RS3				Level
	RS7				Level
	RS8				Level
	RS9				Level
South Waste Rock Dump / TSF	MB4A	Monitor potential impact from extraction, northern leachate dam and SWRD			Level + FP + GWQ
	MB4B				Level
	MB5C			Level + FP + GWQ	
	MB6A				Level + FP + GWQ
	MB6B				Level
	MB7A				Level + FP + GWQ
	MB7B				Level
	MB8A				Level + FP + GWQ
	MB8B				Level
	MB9A			Level + FP + GWQ	
	MB9B			Level	
	MB10A			Level + FP + GWQ	
	MB10B			Level	

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
	MB20	Monitor potential impacts from NTSF		Level + FP + GWQ	
	MB21			Level + FP + GWQ	
	MB23			Level + FP + GWQ	
	MB24			Level + FP + GWQ	
	MB68			Level + FP + GWQ	
	MB69			Level + FP + GWQ	
	MB70			Level + FP + GWQ	
	MB80			Level + FP + GWQ	
	MB25			Level + FP + GWQ	
	TW04MB		Level + FP + GWQ		
	TW06MB		Level + FP + GWQ		
	TW08MB		Level + FP + GWQ		
	MB26A	Monitor potential impacts from STSF		Level	
	MB26B			Level + FP + GWQ	
	MB27			Level + FP + GWQ	
	MB28A			Level	
	MB28B			Level + FP + GWQ	
	MB29A			Level	
	MB29B			Level + FP + GWQ	
	MB77A			Level + FP + GWQ	
	MB77B			Level + FP + GWQ	
	MB78			Level + FP + GWQ	
	MB79			Level + FP + GWQ	
	TW05MB		Level + FP + GWQ		
	MB11A	Monitor potential impacts from SWRD to NTSF			Level + FP + GWQ
	MB11B				Level

Mine Area	Bore ID	Rationale	Frequency of monitoring and parameters		
			Monthly	Quarterly	Biannual
	MB18			Level + FP + GWQ	
	MB83	Monitor potential water quality changes from NTSF/STSF	Level + FP + GWQ		
	MB84		Level + FP + GWQ		
	MB85		Level + FP + GWQ		
	MB86		Level + FP + GWQ		
	MB87		Level + FP + GWQ		
	MB90(1)		Level + FP + GWQ		

Notes: 1. Sampling will be conducted on a monthly basis for the first 24 months to establish baseline chemistry data. Depending on review of baseline data and monitoring requirements at the time, this plan allows for reducing the frequency of monitoring from these bores following the baseline monitoring period.
2. Proposed 'test wells' to be installed during 2019-20

3. RH641 currently under care and maintenance. Quarterly level monitoring will take place if the bore is recommissioned.

4. CX1 bore can only be sampled when the pump is operating.

6.3.3 Springs and Groundwater Dependant Ecosystems (34c2)

AGE (2009) identified that perched and regional springs were present in the region surrounding Cadia. The Cadia East EA did not predict any impacts on springs resulting from mining. There are no known Groundwater Dependant Ecosystems (GDEs) within the Cadia mine operations area and therefore no impact assessment criteria have been set for groundwater dependent ecology.

However, a spring monitoring program is included in the WMP to determine if there are any impacts (from mining operations) on private water supply (predominantly for livestock and domestic uses) from these springs. The program will determine if the springs are connected to the basalt aquifer and if changes predicted to the aquifer will impact on the quality and quantity of spring water. Parameters to be included in the sampling are detailed in Section 5.3.2.

Spring sites were selected based on consultation with landholders following the spring census (Appendix L) and initial investigations completed to identify the most appropriate location of the additional groundwater monitoring bores. The sites selected are shown in Figure 6-6 and Table 6-10.

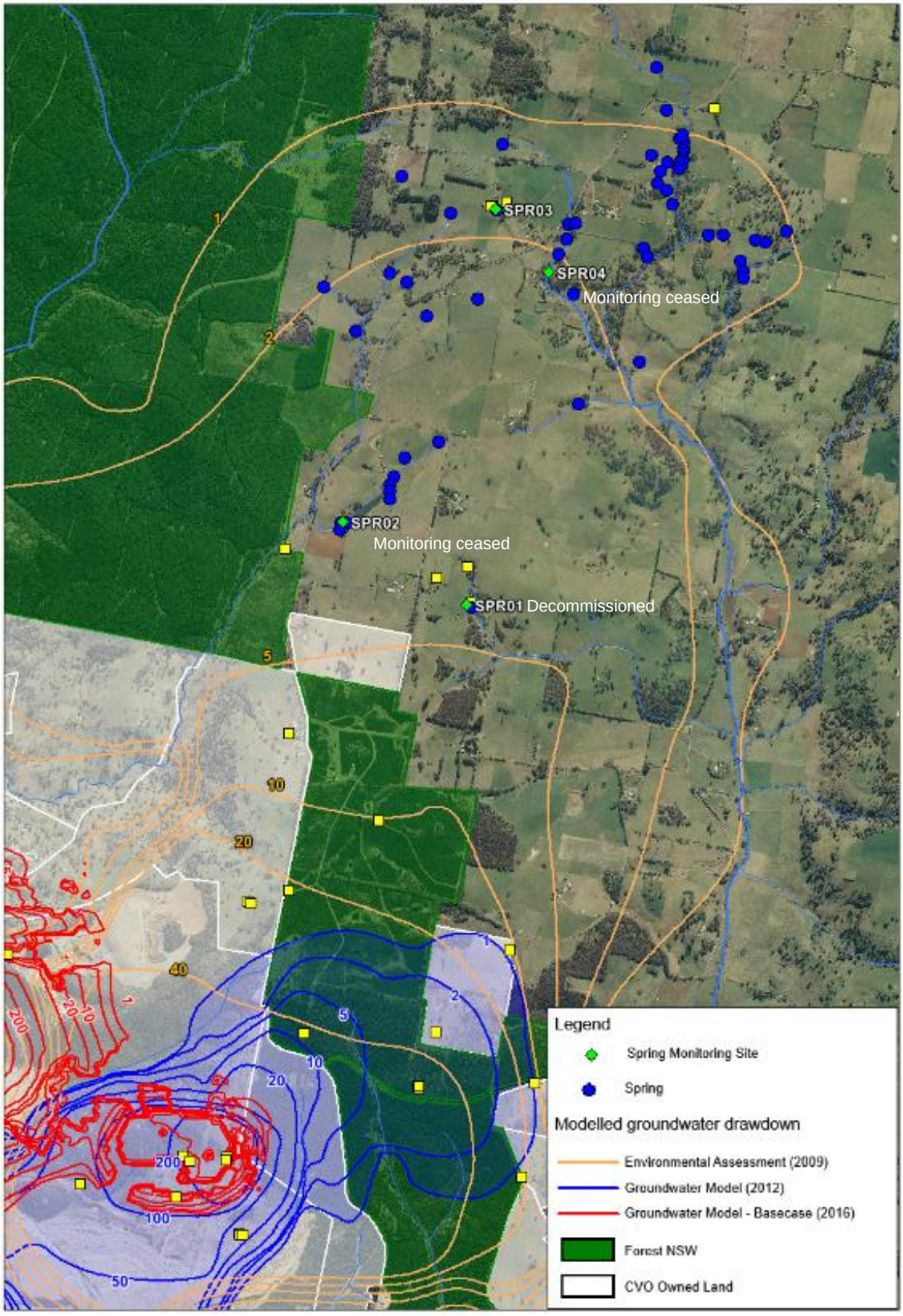

Figure 6-6 Spring monitoring

Table 6-10 Spring monitoring site

ID	Spring census ID	Description
SPR03	2	Direct spring flow - feeds downstream into a small dam, which is the main house and stock water supply for the property. Located in close proximity to MB53-56

6.3.3.1 Review of Spring Monitoring Program

A spring monitoring program has been conducted on four regional springs since 2012, measuring water quality parameters and flow. A review of spring water data has been undertaken to determine any changes or trends (Appendix M). The data analysis indicates no significant changes or trends over the four-year period (2012 to 2016) The following Piper diagrams (Figure 6-7) show no significant changes in water ion chemistry at any of the springs. SPR01 has been decommissioned at the request of the landholder.

Flow results at SPR02 and SPR04 show interruptions in flow where water has been extracted (pumped) for agricultural purposes and/or stock water. Each of these spring monitoring sites are located on 'spring fed' dams, where the flow monitoring flume has been installed at the spillway of the dam. Data collected during periods where extraction has not occurred shows no trends or changes from baseline data, however due to flow interruptions from extraction, there are periods where no flow was measured. Flow results from SPR03, situated directly at the spring source shows response to seasonal variation and recharge from rainfall/snow events with no long-term trends in flow data over the four-year monitoring period.

Based on the above monitoring sites SPR01, SPR02 and SPR04 have been removed from the surface water monitoring programs. The recalibration of the drawdown model (Figure 6.5) above indicates negligible impact to regional springs.

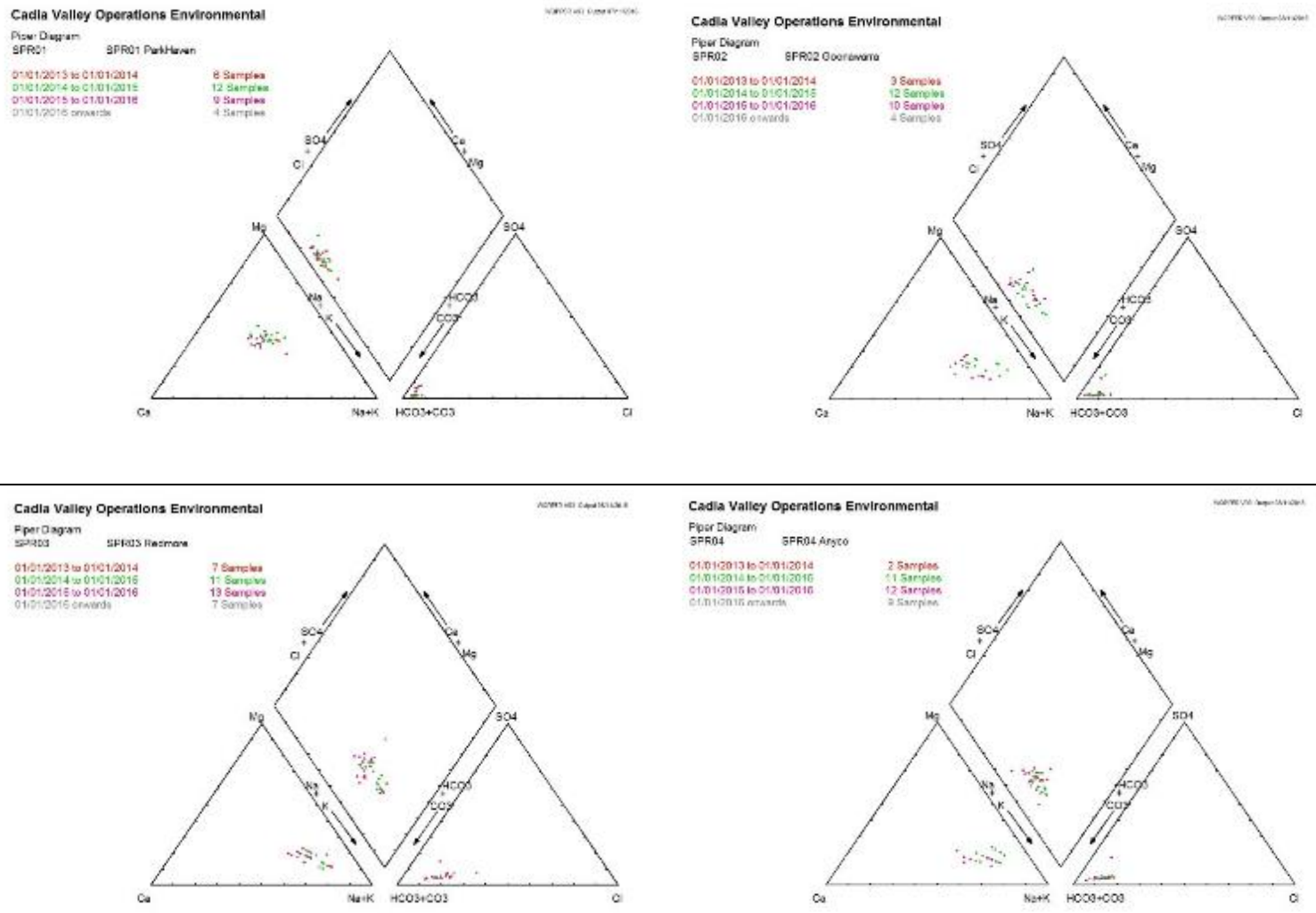

Figure 6-7 Spring Monitoring Piper Diagram – Water Quality ion Chemistry

6.4 Groundwater Model (34d, 34e)

Groundwater modelling was undertaken by AGE for the Cadia East EA in 2009 and updated in 2013 and 2016. The groundwater model is used to predict:

- Impact on groundwater levels
- Flows within and between aquifers
- Flow into the mine workings
- Flows to and from surface features (i.e. streams)

The groundwater model prepared by AGE indicates a negligible effect on alluvial aquifer systems outside the mine boundary, with no impacts expected to occur to privately owned bores, seepage areas, spring fed dams, springs or creeks. Ongoing monitoring of the three aquifer systems is undertaken to validate the groundwater modelling predictions and provide comparison to actual hydraulic gradient.

The groundwater model will continue to be reviewed and updated as required throughout the life of the project (nominally every 3-4 years). The model will be revised and recalibrated using new available or existing groundwater model software and updated groundwater levels data to improve groundwater level predictions (drawdown / increases). If the updated modelling indicates that privately owned bores are to be impacted, supplementary water supplies to the affected landowners will be required and undertaken in consultation with affected landholders.

6.5 Proposed Test Well Program

Previous groundwater investigations have shown that within the Malongulli Formation shale/slate fracture aquifer types within the influence of the Cadiangullong Creek structure zone and the intrusives of the Cadia Hill monzonites, it is considered to be able to support multiple production bores of the CB6 and CB8 type.

Cadia has applied for and received approval for the construction of test bores and associated monitoring bores required to complete sustainable yield tests. These approvals were obtained from DI-Water. Information from this testing program will be utilised to inform a groundwater impact assessment which will form part of an application to modify PA 06_0295 for a new borefield to supplement site water supplies. If approved additional water entitlements will need to be applied for.

Test pumping of the production bores will be completed to evaluate final yield, recharge and the interaction effects on local surface and ground waters. Local and regional modelling of data will be utilised for long term sustainable yield and drawdown on a local and regional scale.

Figure 6.8 shows the conceptual test production borefield.

Figure 6.8 Conceptual Test Production Borefield

6.6 Reporting and Review (34e)

All groundwater monitoring data will be retained in a safe and secure database (for at least 10 years beyond the life of the operations) and will be used to assess potential adverse impacts from mining activity on an ongoing basis. A regular review and assessment of groundwater monitoring data will be undertaken in accordance with the protocols outlined in Section 7 and will include consideration of relevant meteorological and operational data. The AEMR provides

detailed analysis and interpretation with discussion of any emerging trends in the collected data and performance of the site.

The groundwater model will be reviewed and updated by a qualified groundwater consultant:

- Nominally every three years; or more frequently:
- If significant changes to mining operations occur
- If monitoring indicates significant changes to groundwater levels that are inconsistent with the model predictions.

The groundwater model will be validated against historical monitoring data collected as part of the groundwater monitoring program. Details of the groundwater model validation, when undertaken, will be reported in the AEMR.

7 SURFACE AND GROUNDWATER CONTINGENCY PLAN

The following Trigger Action Response Plans (TARPs) are to be implemented in the event that the surface or groundwater site specific guideline values (triggers) are exceeded. The TARPs do not negate Cadia's responsibilities to notify regulatory agencies of environmental incidents, nor the initiation of the Cadia Pollution Incident Response Management Plan (PIRMP).

7.1 Trigger Action Response Plans

A series of Trigger Action Response Plans (TARPs) have been developed to outline Cadia's responses where site specific guideline values (triggers) are exceeded for surface water and groundwater parameters or to respond to increasing or decreasing water storage volumes. Established TARPS include:

1. Water security and flood risk
2. Surface water and groundwater quality
3. Surface water flows / extraction
4. Groundwater level / extraction

7.1.1 Water security and flood risk

The following TARPs have been developed to identify situations where Cadia's water storage levels are increasing from rainfall (risk of discharge) or decreasing (risk of supply shortage). The TARP identifies triggers for active management of water supply options based on site storage volumes. These TARPs provide guidance for the water committee and this plan allows for work outside these triggers to respond to short, medium and long-term climatic forecasts and conditions. This plan also allows for TARPs to be reviewed and revised as conditions at Cadia change (such as production profiles) or new risks are identified.

Table 7-1 TARP – Cadiangullong Dam

Trigger (Cadiangullong Dam level)			Action	Response
RL (masl)	Volume (ML)	Percent		
> 784	> 840	> 20 %	Normal operations	-
<784	840	20%	Normal operations	Inform any downstream water user on Cadiangullong Creek
<781	590	14%	Stop transfer to RCD	Inform any downstream water user on Cadiangullong Creek.
<780	520	12%	Stop use of Cadiangullong in ore processing	Inform any downstream water user on Cadiangullong Creek, DoPE and DPI – Water
<778.8	420	10%	Stop extraction from Cadiangullong	Inform any downstream water user on Cadiangullong Creek, DoPE and DPI – Water

Table 7-2 TARP – Rodds Creek Dam

URCD Level		Response
mRL	**Volume (ML)**	
>777.5	>12,551	Manage RCD inflows (eg. Suspend transfer from Cadiangullong Dam, Flyers Creek, Belubula River)
>778.6	>13,446	Manage process plant inflows to increase drawdown from RCD (eg. Suspend Orange effluent supply; Stop pit transfer to PWP); transfer from URCD to pit.
>779.3	>13,973	Suspend pumping from NTSF & STSF.

Table 7-3 TARP – TSFs

STSF		
RL (masl)	**Volume (ML)**	**Response**
679.4(1)	2,068(1)	prioritise dewatering activities to URCD or PTSF
NTSF(2)		
RL (masl)	**Volume (ML)**	**Response**
737.5	1,883	prioritise dewatering activities to URCD or PTSF

Notes: 1. TSF TARP RLs periodically updated based on beach survey.

2. No tailings deposition at present.

7.1.2 Surface water and groundwater quality

The following TARP is applied to surface and groundwater quality. Sampling is undertaken as per the frequency in this plan for standard samples (Sections 5 & 6) or following an incident or uncontrolled discharge.

Table 7-2 TARP - Surface and groundwater quality

Surface water quality			
Trigger	**Response**	**Responsibility**	**Timing**
> 10 mm rainfall event	Inspect runoff control structures	Utilities Supervisor	Within 24 hours of rainfall event
Runoff control storages have less than the minimum storage capacity	- Remove excess water - Incident when storage volume has not been reinstated within specified timing. Notify EPA immediately	Surface Operations Superintendent	As soon as practical (within five days of rainfall event) for 1:20 structures and within 14 days for 1:100 structures (refer EPL5590).
Incident or sediment dam overflow	- Four samples (discharge, upstream, in mixing zone, and downstream). - Incident - Notify EPA, DoPE	Environment Superintendent	Immediately
Surface water quality above license limits at CAWS 63	Notify EPA. Reported in annual return	Environment Superintendent	Review monthly
Downstream water quality (412702, 412166, 412167, CAWS10) outside surface water quality trigger value	Level 1 investigation[#]	Environment Superintendent	Review monthly
Groundwater quality			
Trigger	**Response**	**Responsibility**	**Timing**
Bore water quality outside groundwater impact trigger	Level 1 investigation[#]	Environment Superintendent	Review monthly

7.1.3 Surface Water flows / extraction

The following TARP applies to downstream flows following extraction from Cadiangullong Creek (Cadiangullong Dam), Flyers Creek and the Belubula River. TARPS are also set for Base Flow Index in Diggers, Flyers and Swallow Creek and are reviewed annually as part of the AEMR / AER process.

Table 7-3 TARP - Surface water flow / extraction

Licensed surface water extraction			
Trigger	**Action, Response**	**Responsibility**	**Timing**
Cadiangullong Dam riparian release below criteria (7 day rolling average)	- Review SWI. - Incident. Report to DPI-Water and DoPE	Environment Superintendent	Review daily
Flyers Creek extraction when flows are <3.5 ML/day	- Adjust system (valve on weir and/or PLC controls) - Incident. Report to DPI-Water and DoPE	Site Asset Operations Centre Superintendent	Review Daily when extracting
Belubula River. <20ML/day at Helensholme. Maximum extraction of 30ML/day	Incident. Report to DPI-Water and DoPE	Environment Superintendent	Review Daily when extracting
Cadiangullong inflow >12 ML/day over a 1-3 day period	Determine if a medium flow release is required and arrange release in accordance with the criteria	Environment Superintendent	Review quarterly
Diggers Creek BFI @ 412166 < 0.38	Level 1 Investigation[#]	Environment Superintendent	Review annually
Swallow Creek BFI @ SCBW2 < 0.03	Level 1 Investigation[#]	Environment Superintendent	Review annually
Swallow Creek BFI @ 412166 < 0.38	Level 1 Investigation[#]	Environment Superintendent	Review annually
Flyers Creek @ 412147 < 1.7 ML/day	Flyers Creek investigation	Environment Superintendent	Review annually

7.1.4 Groundwater Extraction

The following TARP applies to Groundwater extraction (relating to groundwater inflow to voids and associated de-watering including Ridgeway, Cadia East and the Cadia Hill Pit).

Table 7-4 Groundwater extraction

License groundwater extraction			
Trigger	Response	Responsibility	Timing
Ridgeway bore < trigger level	Level 1 investigation#	Environment Superintendent	Review monthly
Cadia East bore < trigger level	Level 1 investigation#	Environment Superintendent	Review monthly
Material impact on private water supply	Provide equivalent water supply, or Implement other measures to the satisfaction of the landholder	Manager HSESR	Within 24 hours of impact
Investigation			
Trigger	Response	Responsibility	Timing
Level 2 investigation# identifies mine related impact which may include: -altered water quality affecting the beneficial use of water -reduction of private water availability / reliability.	Reported to DPI Water, DoPE and affected landholders Cadia to implement measures (arising from level 2 investigation) to the satisfaction affected landholders and the Secretary. Commission Water supply investigation	Manager HSESR	Once level 2 investigation# report is finalised
Resident claims that Cadia has caused catastrophic water supply failure	Water supply investigation	Manager HSESR	Commission as soon as possible
Significant unforeseen impact on surface or groundwater	Revise Water Management Plan	Manager HSESR	As soon as practical
# Refer to Section 7.2			

7.2 Investigations

Where an investigation is triggered by an event in the previous tables an investigation will be undertaken. The requirements of the investigations will be discussed in the following section.

7.2.1 Level 1 Investigation

A level 1 investigation involves a review of monitoring data by Newcrest staff. The aim of the investigation is to:

- Validate the data collected (cross-check data accuracy, check for abnormal catchment wide activity / results, may include additional field monitoring / grab sampling).
- Report if the results definitively meet the criteria.
- Completed within one week of being aware of the trigger.

The investigation process and results will be recorded. If there is a clear and logical explanation for the trigger, and it is not directly related to mining related impacts or influence, the outcomes will be recorded. If the trigger is suspected / likely caused by a mining related impact or influence, a level 2 investigation will be undertaken; DPI Water and DoPE will be notified that a Level 2 investigation has commenced.

7.2.2 Level 2 investigation

A level 2 investigation involves a review of the monitoring data by a recognised independent expert in the field. The aim of this investigation is to:

- Validate data
- Discuss the monitoring results compared to the criteria
- Assess if the results meet the criteria
- Determine if there are any potential impacts on private water supply, ecological values etc.
- Report on any limitations of the monitoring program and potential improvements
- Make recommendations for mitigation, further work etc as required.
- Complete as soon as practical.

Should mitigation be required:

- Finalise mitigation proposal and present to landholder (if required)
- Pending agreement with the landholder, implement mitigation to the satisfaction of the landholder.

The results of investigation and any required mitigation will be provided to DPI – Water, DoPE and any relevant landholders. A summary of the investigation, actions and outcomes will be included in the AEMR.

7.2.3 Water supply investigation

A water supply investigation will be completed by an expert in the relevant field (hydrogeologist, hydrologist, bore installation). The investigation may require input from a number of experts and will involve:

- Detailing the existing water supply system
- Determining the licensed entitlement and water demand for the system
- Determining the impact of the project on water supply
- Quantifying the loss (or range of loss) from the system as a result of the project
- Determine options for increasing supply to meet demands
- Determine budget price for options.

The results of investigation will be provided to the DPI – Water, DoPE and the relevant landholders within one month of the investigation report. A summary of the investigation will be included in the AEMR.

7.2.4 Flyers Creek Investigation

If the flow in Flyers Creek decreases below the minimum modelled pre-mining level as described in the Cadia East EA, an investigation will be undertaken into the potential for baseflow loss in the creek. In the EA, the minimum modelled flow in Flyers Creek would decrease to 1.11 ML/day, compared with the critical riparian flow of 0.49 ML/day.

At this trigger flow rate there is not expected to be an impact on water supply from Flyers Creek but it will act as a trigger to determine impacts not detected by monitoring as part of this plan. The timing of this investigation will also provide sufficient time if baseflow losses are occurring and likely to reduce further, that alternative water supply systems could be developed in consultation with the potentially affected landholder(s) and relevant Government Agencies. The investigation will be undertaken by an expert hydrologist and will involve:

- Complete a survey of the flow at each property boundary between GS412147 and the confluence of Flyers Creek and the Belubula River
- Determine the current licensed water supply and demand of each property with access to Flyers Creek below GS412147
- Determine the extent (and/or range) of loss in baseflow
- Assess if the baseflow is a result of activities at Cadia
- Determine the flow at GS412147 where any landholder on Flyers Creek could experience reduced water supply
- Assess the likelihood for further reduction in flow
- Recommend any further monitoring to be undertaken to improve the certainty of predicted changes in flow in the creek.

The results of investigation will be provided to the DPI – Water, DoPE and the relevant landholders. A summary of the investigation will be included in the AEMR.

7.3 Water supply contingency

7.3.1 Privately-owned land

If a landholder claims catastrophic failure of water supply system (surface or groundwater) Cadia will provide water via a water cart while a level 2 investigation is undertaken. If the investigation concludes water supply or part of water supply has been reduced as a result of mining activities, Cadia will work with the landholder to modify the water supply system to increase the water supply by the amount that water supply has decreased or undertake some other works/compensation to the satisfaction of the landholder and the Department of Planning and Environment, in accordance with Condition 24 of the Project Approval. If a dispute regarding compensatory water supply arises, the landholder of privately owned land shall notify the Director General (DG) and follow an independent dispute resolution process in accordance with Appendix 8 of the Cadia East Project Approval.

Where there is a material loss in water supply identified, Cadia will work with the landowner to provide additional water supply equivalent to the amount water supply has reduced. This may include upgrade of existing systems (refurbishing pumps, deepening dams etc.) or installation of new systems (additional bores, tanks, troughs etc.). The works will be property dependent.

7.3.2 Baseflow

Any baseflow loss from the Belubula River and associated creeks caused by the project shall be offset in consultation with the DPI – Water and DoPE to the satisfaction of the Secretary in line with Condition 25 of the Project Approval.

8 Roles, responsibilities and training

8.1 Roles and Responsibilities

The key roles and responsibilities are shown in Table 8-1.

Table 8-1 Roles and responsibilities

Position	Responsibility
Cadia General Manager	Overall responsibility for Water Management
Manager – Health Safety, Environment & Social Responsibility	Environmental Management Strategy Receiving complaints, particularly claims of catastrophic water supply failure Water supply investigations Development and implementation of compensatory water supply systems (if necessary)
Environment Superintendent	Environmental monitoring and reporting Annual Environmental Management Report Monitoring, reporting and development of corrective actions to ensure with legal and other requirements Assessment of ground disturbance as part of Environmental Impact Permits Periodic review of sediment dam capacity and catchment areas to ensure containment requirements Sampling of discharges from sediment control dams Manage riparian releases from Cadiangullong Dam to meet downstream flow criteria, including quarterly medium flow events Coordination of site personnel in continual improvement programs
Superintendent Surface Operations	Maintain adequate flood storage in URC and Tailings Storage Facilities Operation and maintenance of the surface water management system Maintenance and operation of equipment to measure • dewatering from the Cadia Hill open pit • supply from Cadiangullong Dam • extraction from Flyers Creek • extraction from the Belubula River • extraction from bores Monitoring of capacity in sediment control structures Maintain sufficient capacity in sediment control structures
Site Asset Operations Centre Superintendent	Control of water extraction to requirements (flow rate/timing) Collection and storage of data from flowmeter used in licenced water extraction
Head of Mining Operations (including Cadia East mine)	Maintenance and operation of equipment to measure • water supply to the Ridgeway Mine • water supply to the Cadia East • dewatering from the Ridgeway Mine • dewatering form the Cadia East Mine water balances

9 REPORTING & REVIEW

Cadia prepare a range of reports that address water management, as outlined in Table 9-1.

Table 9-1 Reporting requirements

Report	Details	Responsibility	Timing
Annual Review / Environmental Management Report	Review of monitoring results compared with criteria and predicted impacts	Manager HSESR	Nominally before the end of October each year.
iWAS (Water NSW)	Bore meter readings Annual extraction from unregulated systems Meter readings from the Belubula River	Environment and Community Officer	Within 10 days of the end of each quarter
Cadia Valley Website	Water use per tonne milled (AEMR) Water storage (AEMR) Groundwater level compared to triggers (AEMR)	Environment Superintendent	Annually
	Cadiangullong Creek flow compared to criteria Flyers Creek flow and extraction	Environment Superintendent	Monthly
	Licensed discharge – where any discharges from EPA ID points 1, 2 or 3 occur. This includes: 1:20 and 1:100 year sediment basins, and effluent reuse pipeline break pressure tank	Environment Superintendent	14 days after receiving results
	Community Complaints	Environment Superintendent	Monthly
Global Reporting Initiative (component of Newcrest reporting as part of sustainability report)	EN8 – Total water withdrawn by source EN10 – Percentage and total volume of water recycled EN21 – Total water discharged by quality and destination	Environment Superintendent	Published Annually

9.1 Plan Revision

There have been many plans related to water management through the life of Cadia. This version of the WMP has combined a number of management plans (Integrated Erosion and Sediment Control Plan, Ridgeway Flow Protocol, Water Supply Contingency Plan) refer to table 9-2) to ensure a holistic approach to water management. The WMP will be assessed annually following the AEMR process as to whether a formal review is required to ensure that the goals and targets of the plan are being achieved, both in terms of performance against the specified indicators and that improvement actions are being completed. This will ensure continuous improvement of the WMP through time. Table 9-2 outlines the history of the WMP.

Table 9-2 Water Management Plan history

Document	Approved	Version	Comments
Water Management Plan	Dec 2000	F	Ridgeway Gold Mine Site Water Management Plan, requirement of Ridgeway development consent (Condition 4.2 & 4.3)
	Mar 2007	1	Update required to include actions to minimise risk of water shortage
	Mar 2009	3	General revision
	Dec 2014	4	Revision following the approval of the Cadia East Project
	Draft only	5	Draft submitted to DoPE for approval. Superseded prior to approval.
	April 2018	6	Incorporate in-pit tailings disposal, molybdenum plant, addition of revised surface water and river health SSGVs.
	August 2019	7	Changes relating to the provision for temporary variations to PA Condition 27. Addition of southern borefield testing program and CDF drainage works. Minor changes to monitoring programs.
Integrated Erosion & Sediment Control Plan	Dec 1998	A-F	Updates with changes in site drainage & infrastructure
	Apr 2002	G	Regular update
	Jun 2005	H	Regular update
	Aug 2007	I	Regular update
Ridgeway Flow Protocol	Sep 2001		Requirement of Ridgeway development consent (Condition 4.4(b))
	Feb 2006		Detailed hydrological review, recalculated baseflow volume ratios
Contingency Water Supply Plan	Oct 1997		Requirement of Cadia development consent (Condition 43)

10 REFERENCES

ANZECC/ARMCANZ (2000), Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Australasian Groundwater and Environmental Consultants Pty Limited (2009) Cadia East Project Groundwater Assessment. Report prepared for Cadia Holdings Pty Limited.

Cadia Holdings Pty Limited (Cadia) (2000), Ridgeway Project Environmental Impact Statement.

Cadia Holdings Pty Limited (Cadia) (2009), Cadia East Environmental Assessment

Cadia Holdings Pty Limited (Cadia) (2013), Environmental Management Strategy

Gilbert and Associates (2000), Water Management and Water Supply. Report prepared for Cadia Holdings Pty Limited in support of the Ridgeway Project Environmental Impact Statement.

GHD (2012a), Surface Water Quality Assessment, Report prepared for Cadia Holdings Pty Ltd

GHD (2012b), Salinity Investigation, Report for Cadia Water Quality Assessment, prepared for Cadia Holdings Pty Ltd

GHD (2013), Report for Cadia Aquatic Ecosystem Monitoring Project, Annual Report 2012-2013

GHD (2016a) Cadia ANZECC Water Quality Assessment Review Report March 2016

GHD (2018) Cadia Valley Water Quality Trigger Value Review for Oaky Station (412702)

Landcom (2004), Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Edition

MCA (2014) Water Accounting Framework for the Minerals Industry. User Guide Version 1.3

NSW Department of Planning (2010), Cadia East Project Approval PA_0295

NSW Government (2012), Water Sharing Plan for the Belubula Regulated River Water Source 2012

Turak E, Waddell N and Johnstone G (2004). New South Wales (NSW) Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual.