
Appendix E

Water resources impact assessment

Clarence Colliery Modification 11

Water Resources Impact Assessment

Prepared for Centennial Coal Company Pty Limited

December 2025

Clarence Colliery Modification 11

Water Resources Impact Assessment

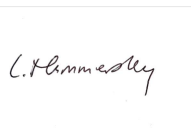
Centennial Coal Company Pty Limited

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December 2025

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Executive Summary

ES1 Introduction

Clarence Colliery is an underground coal mine within the Western Coalfield of New South Wales (NSW) approximately 10 kilometres (km) east of Lithgow, which has been in operation since the 1980s. Clarence Colliery produces high quality, low ash thermal coal for both domestic and export customers.

This Water Resources Impact Assessment (WRIA) supports the modification report (EMM 2025a) for DA 504-00 Modification 11 (MOD 11) by Centennial Coal Company Pty Ltd (Centennial). MOD11 aims to extend the life of mining at Clarence Colliery by an additional five years. The modification is pursuant to section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

ES2 Existing environment

The Clarence Colliery pit top and mining areas are located on the Newnes Plateau. The area is characterised by steep cliff lines, pagodas, gullies and canyons carved by watercourses like the Wollangambe, Wolgan and Coxs Rivers and their tributaries.

Clarence Colliery is within the greater Hawkesbury-Nepean catchment, and in the three sub-catchments for the Wollangambe River, Wolgan River and upper Coxs River. The Newnes Plateau is the headwaters for both the Wollangambe River and Wolgan River, which join the Colo River to the east of the project area. The Coxs River originates within the Ben Bullen State Forest to the north of Clarence Colliery and flows in a south-east direction to Lake Burragorang and Warragamba Dam (Centennial 2022). There are eight non-minor creek systems surrounding the mine described in the Clarence Colliery water management plan (Centennial 2022).

Clarence Colliery is located on the western edge of the Sydney Basin. The colliery is underlain by the Triassic sandstone of the Narrabeen Group and the Illawarra Coal Measures. There are small areas of unconsolidated Quaternary colluvial and alluvial sediments along creek lines and swamps (Centennial 2022). Clarence Colliery targets the Katoomba Seam within Illawarra Coal Measures. Within the project area, the Katoomba Seam is approximately 220 metres (m) below the Newnes Plateau.

Water receptors include surface water users, third order or higher Strahler streams, groundwater users, and groundwater dependent ecosystems (GDEs). Clarence Colliery's water management plan (WMP) identifies one potential surface water user downstream of the mine. The Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023 identifies the high priority GDEs of the Temperate Highland Peat Swamps on Sandstone (THPSS) to occur on the Newnes Plateau within the Clarence Colliery project area.

ES3 Mining operations

There are no changes to the extraction rate of up to 3 million tonnes per annum of coal, the mining methods and coal handling processes as part of MOD 11. Bord and pillar mining methods, which involve first and second workings will continue until the end of 2031. The mining methods used at Clarence Colliery are designed to minimise subsidence and potential impacts to surface water and groundwater systems.

ES4 Water management system

Water sources covered by the water management system include rainfall, catchment run-off, and groundwater inflow. Water demands include underground operations, use in the coal handling and preparation plant (CHPP), dust suppression, wash stations, staff amenities, and maintaining fire-fighting water storage (Centennial 2022).

The water management system is comprised of four water types: clean, dirty, coal-contact and leachate water. The WMP describes the operational water cycle and shows various types of water storage structures, inflows, outflows, water uses and licensed discharge points. Water discharge limits for the proposed MOD 11 will continue in accordance with Environment Protection Licence (EPL) 726.

The main components of the water management system include:

- Water treatment plant (WTP). The WTP treats a blend of raw mine water and leachate water. It has a capacity of approximately 25 megalitres per day (ML/d). The treated water supplies the fire tanks and bathhouse tanks and the remaining is transferred to the settlement dam and discharged via LDP002. There are plans to improve the water treatment process.
- Water storage structures. There are 14 main water storage structures comprising of surface water storage areas and underground storage areas in the old mine workings. The main inputs into the underground storage are groundwater inflows from the mine, transfer of leachate water and transfer from fire tanks for mining activity.
- Leachate water management. The leachate collection system has been designed to intercept any leachate and run off from the rock emplacement areas (REAs). Leachate water is ultimately transferred to the underground prior to treatment at the WTP to achieve a consistent quality of feed water.

Surface water and groundwater monitoring is undertaken in accordance with the WMP, Development Consent DA 504-00 and EPL 726 requirements and includes the following:

- Surface water monitoring for quality and flows at water storage structures, watercourses and swamps.
- Discharge flow and quality monitoring at LDP002, LDP003 and LDP004.
- Underground water transfers for volume and quality.
- Groundwater monitoring at swamp piezometers, standpipe piezometers and vibrating wire piezometers for water levels. Water quality is monitored at select standpipe piezometers.

ES5 Risk assessment

Potential water related impacts as a result of MOD 11 are limited to continued mining.

The key risks and mitigations identified for the modification include:

- **Water management capacity** – There have been uncontrolled discharges from the site during recent wet years from the water management system, however these have not been considered non-compliant due to high rainfall amounts. There was a discharge event that resulted in the issue of a clean-up notice by the NSW Environment Protection Authority (EPA) (22 January 2024). This incident demonstrates that there is a risk of uncontrolled discharges which may be a symptom of inadequate system capacity in certain scenarios.
- **Water quality treatment performance** – The operation of the water treatment plant and its treatment capacity can vary with flow rate specifically over 18 ML/d. Water quality non-compliances have occurred at LDP002 and the number of non-compliances has trended upwards during typically wet years. There are planned future upgrades to the WTP and ongoing works regarding the proposed 'Clarence to Wallerawang Pipeline Project'.

- **Underground water levels** – Underground water volumes are above average due to recent wet years and inflows are predicted to increase with future mining however based on current predictions, inflows are expected to be less than 18 ML/d. The groundwater make for the current mine plan is in line with predictions. There are planned improvements of the WTP to increase capacity and improve water quality discharge to manage the risk.
- **Water licensing** – With increased volumes of water stored underground, dewatering activities may require increased water access licence allocation and increased discharge limits. Historical dewatering volumes (from 2020 to 2024) and discharge volumes at LDP002 has been compliant with the total entitlements and licenced conditions.
- **Aquifer disruption.** There are no changes to the approved mining operation, therefore no additional impacts associated with the modification are expected. The shallow aquifer above the Mount York Claystone, swamp GDEs and groundwater quality have remained unimpacted by mining.
- **Monitoring network adequacy.** The current monitoring network coverage is adequate with new piezometers installed in the future mining areas, and routine monitoring and maintenance ensures the network remains functional. If the network is deemed inadequate, new monitoring locations can be constructed.

ES6 Conclusion

The modification does not seek to make additional changes to the approved mining operations at Clarence Colliery with the approved disturbance boundary, operational hours, mining methodology, mine infrastructure, employees, and coal production rates all remaining unchanged.

As the modification relates to extension in mining duration only, it is expected that potential impacts would result in negligible change to the previously assessed and approved impacts. The key risks are being actively managed with planned improvements for the existing infrastructure and management processes.

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1 Introduction

1.1 Overview

This Water Resources Impact Assessment (WRIA) supports the modification report (EMM 2025a) for DA 504-00 Modification 11 (MOD 11) by Centennial Coal Company Pty Limited (Centennial). MOD 11 aims to extend the life of mining at Clarence Colliery by an additional five years. The modification is pursuant to section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.2 Existing operations

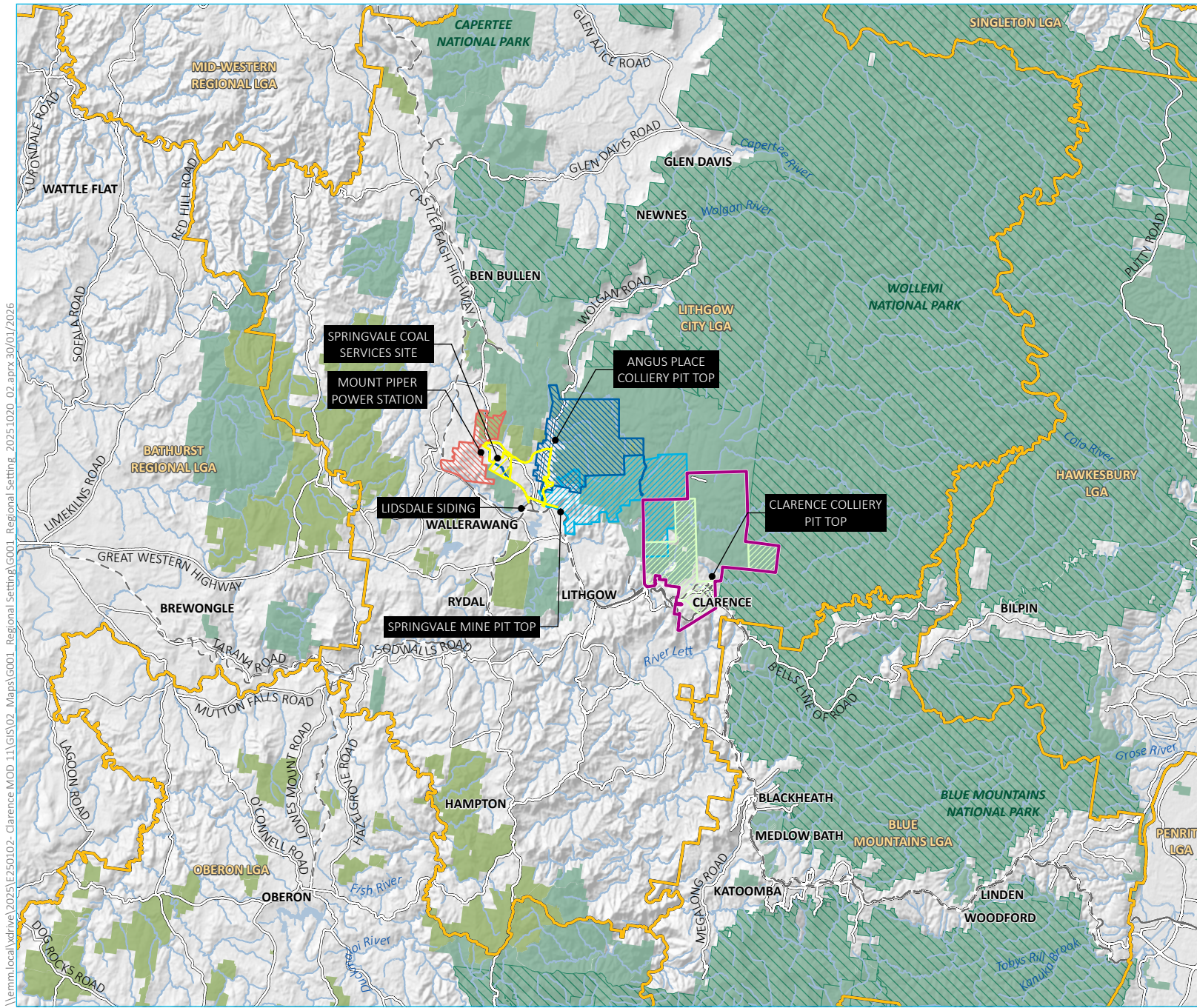
Clarence Colliery is an underground coal mine within the Western Coalfield of New South Wales (NSW) approximately 10 kilometres (km) east of Lithgow, which has been in operation since the 1980s. Clarence Colliery produces high quality, low ash thermal coal for both domestic and export customers.

Clarence Colliery operates under three separate development consents:

- IRM.GE.76 – an interim development consent issued in 1976 by Blaxland Shire Council (now Lithgow City Council (LCC)) for underground mining and the construction of surface facilities
- DA 174/93 – a development consent issued in 1994 by LCC for the extension of underground coal mining, surface reject emplacement areas (REAs) and water management and ancillary structures
- DA 504-00 – development consent issued in 2005 by the NSW Department of Infrastructure, Planning and Natural Resources (now the NSW Department of Planning, Housing and Infrastructure (DPHI)) to expand into Mining Lease (ML) 1583.

Clarence Colliery is approved to extract up to 3 million tonnes per annum (Mtpa) of coal through underground partial extraction mining, until 31 December 2026. The current consent conditions related to the management of water are addressed by the Water Management Plan (WMP) (Centennial 2022) and Environmental Protection Licence (EPL) 726, with reporting of compliance via the Annual Review.

Figure 1.1 illustrates the regional context for the modification and Figure 1.2 shows the existing site features for the Clarence Colliery site.



- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - Angus Place
 - Ivanhoe
 - Springvale
 - Western Coal Services
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - Named waterbody
 - Greater Blue Mountains World Heritage Area
 - NPWS reserve
 - State forest
 - Local government area

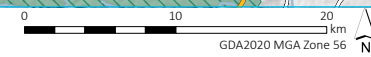
Regional context

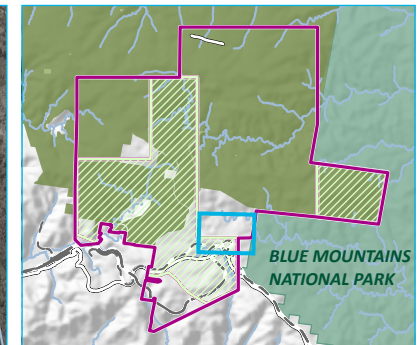
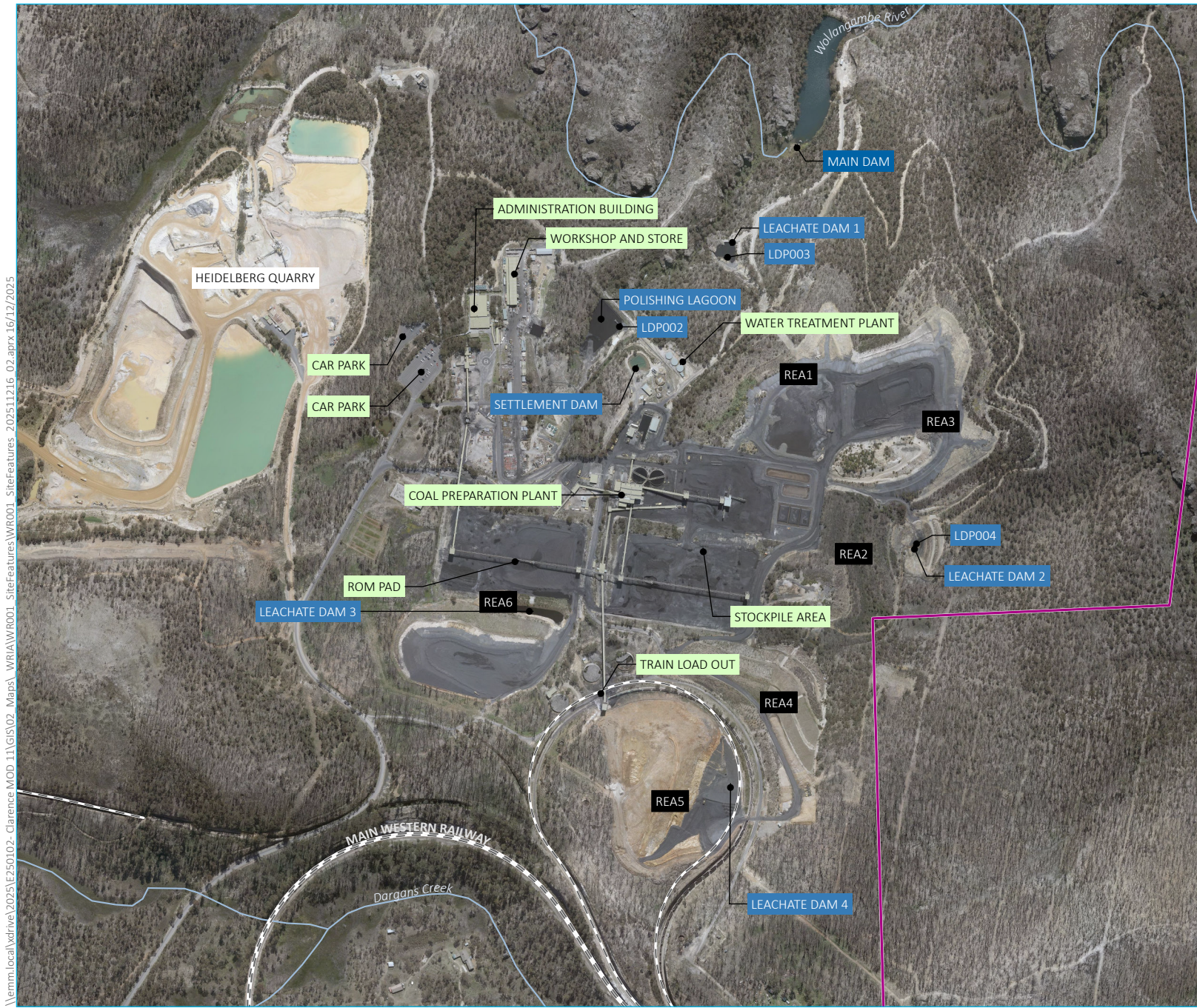
Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 1.1



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Source: Centennial (2025); EMM (2025); ABS (2021); DCSSS (2024); GA (2009)





- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - Existing environment
 - - - Rail line
 - Named watercourse
 - GENERAL INFRASTRUCTURE
 - WATER INFRASTRUCTURE

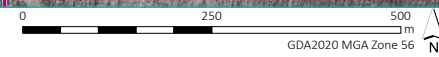
Site features

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 1.2



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Source: EMM (2025); DCSSS (2024); GA (2009); MetroMap (2025)



1.3 Overview of the proposed modification

Centennial is seeking a modification (MOD 11) to DA 504-00 under section 4.55(2) of the EP&A Act to:

- extend the life of mining at Clarence Colliery from 31 December 2026 for a further five years until 31 December 2031, within the existing approved ML1583
- align the transport of coal by road with the proposed extension of the life of mining, thus allowing for the transport of up to 300,000 tonnes (t) of coal by road until 31 December 2031.

The modification does not seek to make additional changes to the approved mining operations at Clarence Colliery. With the exception of the above points, the approved disturbance boundary, operational hours, mining methodology, mining extent and depth, mine infrastructure, employees, and coal production rates will remain unchanged. The proposed modification will not result in any additional surface disturbance activities or changes to the approved water management system (WMS) and associated approved licences (including those associated with discharges).

The proposed modification is hereafter referred to as “the Project”.

1.4 Purpose of this report

This WRIA provides a qualitative assessment of potential impacts to water resources and receptors as a result of the proposed modification. The assessment:

- identifies the components and details of the water cycle for the operational water management
- compares existing discharge water quality to site specific guideline values
- reviews groundwater quality against site specific guideline values
- reviews observed and predicted groundwater make volumes compared to dewatering requirements
- summarises outcomes from the ongoing monitoring network with respect to the existing and future operational mining activities.

Four key potential risks associated with the proposed modification have been identified by EMM Consulting Pty Limited (EMM), and are evaluated in this report:

1. **Water management capacity:** there were uncontrolled discharges from the site during recent wet years. This report reviews the outcomes of these incidents in the context of the proposed extension of mining at Clarence Colliery by five years.
2. **Water quality treatment performance:** the performance of the WTP can vary. The current state of the water quality treatment, including capacity is evaluated in this report in the context of the proposed extension of mining at Clarence Colliery.
3. **Underground water levels:** the underground water levels have been above average due to the recent wet years. Underground inflow forecasts, pumping infrastructure and storages is reviewed to evaluate if they are adequate for the site requirements.
4. **Water licensing:** with increased volumes of water stored underground, current water entitlement held by Centennial will be reviewed to identify if additional entitlement is required.

2 Regulatory and policy context

An overview of the regulatory framework and guidelines relevant to the water assessments is provided in Sections 2.1 to 2.6.

2.1 Legislation overview

The primary water related statutes that apply to Clarence Colliery are the *Water Act 1912* (Water Act), *Water Management Act 2000* (WM Act), *Protection of the Environment Operations Act 1997* (POEO Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The provisions of each Act are applied in accordance with their attendant regulation.

Table 2.1 lists the legislation relevant to the Project to assess potential impacts on water resources and water-dependent assets.

Table 2.1 Relevant legislation and regulations

Legislation	Authority
<i>Water Act 1912</i>	NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW)
<i>Water Management Act 2000</i>	NSW DCCEEW Natural Resources Access Regulator (NRAR)
Water Management (General) Regulation 2025	NSW DCCEEW Natural Resources Access Regulator (NRAR)
<i>Protection of Environment Operations Act 1997</i>	NSW Environment Protection Authority (EPA)
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	Commonwealth DCCEEW Commonwealth Office of Water Science Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) – Section 505D
<i>Environmental Planning and Assessment Act 1979</i>	NSW DPHI

2.2 Commonwealth legislation

2.2.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places which are defined as ‘matters of national environmental significance’ (MNES).

The EPBC Act was amended in June 2013 to include water resources as a MNES in relation to coal seam gas and large coal mining developments (known as the ‘water trigger’). Any action that ‘has, will have or is likely to have a significant impact on a matter of national environmental significance’ is deemed a ‘controlled action’ under the EPBC Act and may not be undertaken without prior approval from the Commonwealth Environment Minister.

Clarence Colliery currently has the following referrals:

- 2024/09856 active under the EPBC Act, which is yet to be determined
- 2012/6446, associated with coal extraction and exploration drilling, which was determined as not a controlled action if undertaken in a particular manner

- 2009/4882, associated with extraction from the 700 mining area, and was determined as not a controlled action.

Activities associated within MOD 11 are covered by the current referrals. The proposed modification is unlikely to have a significant impact on any MNES listed under the EPBC Act, or water resources, and consequently has not been referred to DCCEEW.

2.3 NSW State legislation

2.3.1 NSW Protection of the Environment Operations Act 1997

The POEO Act is administered by the NSW EPA, which is an independent statutory authority and the primary environmental regulator for NSW. The objectives of the POEO Act are to protect, restore and enhance the quality of the environment. Some of the mechanisms that can be applied under the POEO Act to achieve these objectives include programs to reduce pollution at the source and monitoring and reporting on environmental quality. The POEO Act regulates and requires licensing for environmental protection, including for waste generation and disposal and for water, air, land and noise pollution.

Under the POEO Act, an EPL is required for premises at which a 'scheduled activity' is conducted. Schedule 1 of the POEO Act lists activities that are scheduled activities for the purpose of the act. Licence conditions relate to pollution prevention and monitoring and can control the air, noise, water and waste impacts of an activity.

i Environmental Protection Licence 726

Centennial currently holds EPL 726, with water currently licensed to be discharged from the site through the following LDPs:

- LDP002 – discharge from the WTP to Main Dam at the Clarence Colliery pit top
- LDP003 – discharge from Leachate Dam 1 to Main Dam
- LDP004 – discharge from Leachate Dam 2 to the Wollangambe River downstream of Main Dam.

Water quality monitoring is required by EPL 726 at all three LDPs and at the 'Wollangambe River Downstream (DS)' monitoring point (EPA ID 9).

A volumetric discharge limit of 25 megalitres per day (ML/d) is specified by EPL 726 for LDP002, with no volumetric limits specified for any other LDPs. The total volume discharged from LDP002 may exceed 25 ML/d on any day where greater than 10 millimetres (mm) of rainfall is recorded at the pit top. Daily monitoring of discharge volumes by inline instrumentation at LDP002 is required. An estimate of the volume of any discharge via LDP003 and LDP004 is required daily during discharge.

Water quality concentration limits specified by EPL 726 that apply to LDP002, LDP003 and LDP004 are summarised in Table 2.2. The concentration limits do not apply to discharges from LDP003 and LDP004 when the discharge occurs solely as a result of rainfall measured at the site which exceeds 56 mm (defined 95th percentile within Landcom (2004)) over any consecutive five-day period.

Water quality monitoring for the parameters specified in Table 2.2 is required monthly for LDP002 discharges and monthly during any discharge through LDP003 and LDP004. In addition, electrical conductivity (EC) and pH are also required to be monitored monthly during discharge for all LDPs. Further details of the surface water monitoring program are provided in Section 6.2.2. The EPL also includes conditions regarding the management of the stormwater control structures at LDP003 and LDP004, including pump-out requirements and desilting maintenance to retain design storage capacities.

Table 2.2 EPL726 LDP water quality concentration limits

Parameter	Units	100th percentile concentration limits
Arsenic (dissolved)	mg/L	0.013
Boron	mg/L	0.1
Cadmium (dissolved)	mg/L	0.0002
Chloride	mg/L	25
Chromium (dissolved)	mg/L	0.001
Cobalt (dissolved)	mg/L	0.0025
Copper (dissolved)	mg/L	0.0014
Filterable iron	mg/L	0.3
Fluoride	mg/L	1
Lead (dissolved)	mg/L	0.0034
Lithium (dissolved)	mg/L	0.100
Manganese (dissolved)	mg/L	0.5
Mercury (dissolved)	mg/L	0.00006
Nickel (dissolved)	mg/L	0.011
Nitrogen (total)	mg/L	0.25
Oil and grease	mg/L	10
pH	pH units	6–8.5
Phosphorus (total)	mg/L	0.02
Selenium (total)	mg/L	0.005
Silver (dissolved)	mg/L	0.00005
Sulfate	mg/L	250
Total suspended solids (TSS)	mg/L	30
Zinc (dissolved)	mg/L	0.008

Source: EPA (2023)

Table 2.3 summarises the conditions which the EPL 726 point locations (water quality and volumetric discharge) are measured against to assess system performance and determine non-compliances.

Table 2.3 EPL 726 monitoring points - performance conditions

EPA ID no.	Parameter	Conditions/limits/guidelines	Description
LDP002, LDP003, LDP004	Water quality	EPL 726 limits	Limits do not apply to discharges from LDP003 and LDP004 when the discharge occurs solely as a result of rainfall measured at the site which >56 mm over any consecutive five-day period.
LDP002, LDP003, LDP004	Water volume	EPL 726 limits (LDP002 only)	Discharges may exceed limit on any day where > than 10 mm of rainfall is recorded on site.
Point 9 - Wollangambe River DS	Water quality	Site-specific guideline values (SSGVs) within Table 6.1 of the WMP	EPL 726 requires annual reporting to the EPA for licence point 9 which summarises the WQ monitoring data and provides graphical representation of any trends in the data.
Point 9 - Wollangambe River DS	Water volume	Water resources criteria for waterways within Table 6.7 of the WMP	No EPL requirement.

ii Recent variations to EPL 726

The EPL also includes pollution studies and reduction programs relating to the discharges into the Wollangambe River.

On 20 March 2023, a licence variation notice was issued regarding the revised Clarence to Wallerawang Pipeline Project (CWPP). A feasibility study and scoping report for CWPP remains under preparation. Regular communication between Clarence Colliery and the EPA, on the status of the CWPP, is occurring.

On 22 January 2024, a clean-up notice was issued after the EPA was notified by a member of the public, that black water had been observed in the river, just downstream from Clarence Colliery. After investigation, the EPA suspected a build-up of coal fines in the Polishing Lagoon and Main Dam and requested the engagement of a suitably qualified engineer to conduct an engineering assessment of the mine’s WMS and settling ponds and report on findings and recommended options to prevent coal fines from polluting waters. Clarence Colliery has completed the requirements of the Clean Up Notice and associated remedial actions.

On the 1 February 2024, Centennial was provided a prevention notice connected to EPL 726, which included ceasing all discharge from the Polishing Lagoon to LDP002 and/or any other location that would enable a discharge from the Polishing Lagoon into the Wollangambe River. The EPA commenced proceedings in relation to the unlicensed discharges of water within the Land and Environment Court (2024/471797-801). Judgement has been reserved.

2.4 Water management regulations

2.4.1 Water Management Act 2000

The WM Act is based on the principles of ecologically sustainable development and the need to share and manage water resources for future generations. The WM Act recognises that water management decisions must consider economic, environmental, social, cultural and heritage factors. It recognises that sustainable and efficient use of water delivers economic and social benefits to the state of NSW. The WM Act provides for water sharing between different water users, including environmental, basic landholder rights and licence holders. The licensing provisions of the WM Act apply to areas where a statutory water sharing plan (WSP) has commenced.

A key component of the WM Act is the separation of water licences from land, which facilitates opportunities for licence holders to trade water, subject to environmental protection considerations. The WM Act outlines the requirements for taking and trading water through water access licences (WALs), water supply work approvals and water use approvals.

The key regulation made under the WM Act is the Water Management (General) Regulation 2025 (WM Regulation). The regulation specifies important procedural and technical matters related to the administration of the WM Act and also specifies exemptions from licence and approval requirements under the WM Act.

Clarence Colliery does not require any additional approvals or licences under the WM Act as part of the proposed modification.

i Water sharing plans

WSPs are statutory documents that apply to one or more water sources. They define the rules for sharing and managing water resources within water source areas. WSPs describe the basis for water sharing and document the water available and how it is shared between environmental, extractive and other uses. The WSPs outline the water available for extractive uses within different categories, such as local water utilities, domestic and stock, basic landholder rights, irrigation and industrial uses.

The WSPs relevant to Clarence Colliery are:

- *Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources 2023*, this WSP includes the following water sources:
 - Wywandy Water Source (mining area)
 - Colo River Water Source (pit top and mining area)
 - Dharabuladh Water Source (mining area).
- *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2023*; the Sydney Basin West Groundwater Source applies to groundwater in the vicinity of Clarence Colliery.

2.5 Relevant policies

2.5.1 State Rivers and Estuaries Policy

The NSW Government has an overarching policy to encourage the sustainable management of the natural resources of the State's rivers, estuaries and wetlands in order to halt or reduce:

- declining water quality
- loss of riparian vegetation
- damage to river banks and channels
- declining natural productivity
- loss of biological diversity
- declining natural flood mitigation.

To achieve these goals, the NSW Government seeks to encourage and promote projects and activities that will restore the quality of the river and estuarine systems.

The objectives of the *NSW State Rivers and Estuaries Policy* (NSW Water Resources Council 1993) are to manage the rivers and estuaries of NSW in ways which:

- slow, halt or reverse the overall rate of degradation in the systems
- ensure the long-term sustainability of their essential biophysical functions
- maintain the beneficial use of the resources.

Therefore, adoption of the *NSW State Rivers and Estuaries Policy* (NSW Water Resources Council 1993) means that the sustainability of the river and estuarine resources, their biophysical functions and environmental values are given explicit consideration in resource management decision making.

2.5.2 NSW Aquifer Interference Policy

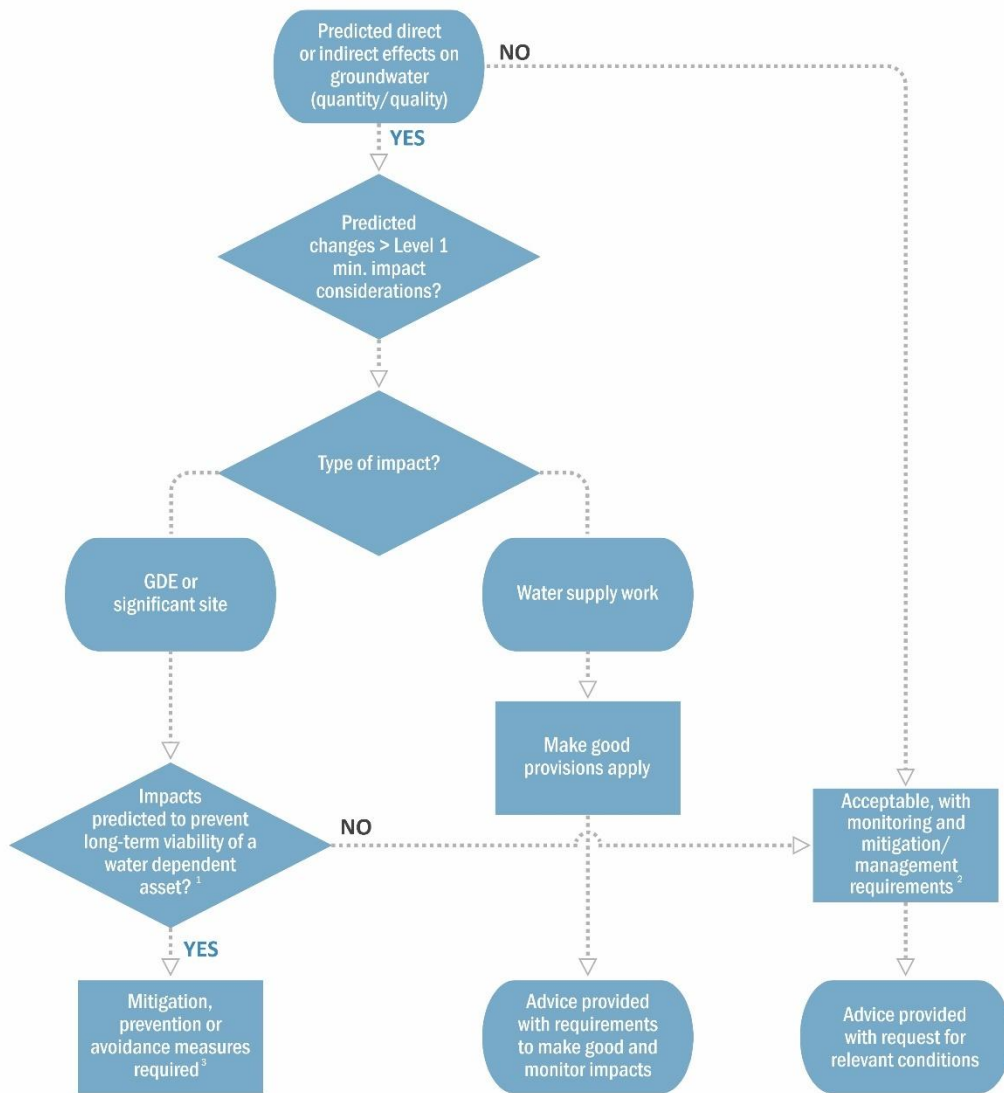
The *NSW Aquifer Interference Policy* (AIP) (DPI 2012) defines the regime for protecting and managing the impacts of aquifer interference activities on NSW’s water resources. The AIP requires consideration of the potential impacts of an aquifer interference activity in respect to the watertable, water pressure and water quality. Proponents must estimate the water take (including incidental take) from each water source and connected water sources. Changes to watertable, water pressure and water quality are assessed against minimal impact considerations for each water source.

The AIP defines water sources as being either ‘highly productive’ or ‘less productive’ based on levels of salinity and average available yields. The AIP categorises water sources by lithological character, being one of alluvium, coastal sand, porous rock or fractured rock, and identifies thresholds for minimal impact considerations. Based on the NSW Government’s mapped areas of groundwater productivity in NSW (NOW 2013), Clarence Colliery is located within a ‘less productive’ groundwater area. Applicable minimal impact considerations for ‘less productive’ groundwater sources are reproduced in Table 2.4. The AIP minimal impact considerations process is presented in Figure 2.1.

Table 2.4 Minimal impact considerations for ‘less productive’ porous rock water source

Watertable	Water pressure	Water quality
<p>1. Less than or equal to 10% cumulative variation in the watertable, allowing for typical climatic ‘post-water sharing plan’ variations, 40 m from any:</p> <p>(a) high priority groundwater dependent ecosystem; or</p> <p>(b) high priority culturally significant site;</p> <p>listed in the schedule of the relevant water sharing plan.</p> <p>A maximum of a 2 m decline cumulatively at any water supply work.</p>	<p>1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.</p>	<p>1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.</p>
<p>2. If more than 10% cumulative variation in the watertable, allowing for typical climatic ‘post-water sharing plan’ variations, 40 m from any:</p> <p>(a) high priority groundwater dependent ecosystem; or</p> <p>(b) high priority culturally significant site;</p> <p>listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister’s satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site.</p> <p>If more than a 2 m decline cumulatively at any water supply work then make good provisions should apply.</p>	<p>2. If the predicted pressure head decline is greater than requirement 1 above, then appropriate studies are required to demonstrate to the Minister’s satisfaction that the decline will not prevent the long-term viability of the affected water supply works unless make good provisions apply.</p>	<p>2. If condition 1 is not met then appropriate studies will need to demonstrate to the Minister’s satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.</p>

Source: DPI (2012).



- 1 Assessment as per Serov et al 2012, with consideration of uniqueness, ecological/cultural value and timeframe of the impact.
- 2 Conditions of approval may include requirements for adaptive management to monitor and mitigate or remediate impacts that exceed level 1 thresholds.
- 3 Where there are no suitable or practical mitigation or prevention options, the proponent may be asked to avoid impacts by modifying the proposed activity.

Figure 2.1 AIP minimal impact considerations process (adapted from DPI 2012)

2.6 Relevant guidelines

2.6.1 Erosion and sediment control guidelines

Managing Urban Stormwater: Soils and Construction – Volume 1 (Landcom 2004) outlines the basic principles for the design, construction and implementation of sediment and erosion control measures to improve stormwater management and mitigate the impacts of land disturbance activities on soils and receiving waters.

Additional guidelines on specific aspects of development and the application of erosion and sediment controls are also available. *Managing Urban Stormwater: Soils and Construction – Volume 2E Mines and Quarries* (DECC 2008) provide specific guidelines, principles and minimum design standards for good management practice in erosion and sediment control during the construction and operation of mines and quarries. *Best Practice Erosion and Sediment Control* (IECA 2008) also provides a range of useful industry guidance.

2.6.2 NSW water quality and river flow objectives

The *NSW Water Quality and River Flow Objectives* (DECCW 2006) provide agreed environmental values and long-term targets for water quality and river flow in each catchment in NSW. The objectives are intended to be considered in assessing and managing the potential impacts of activities associated with waterways.

The NSW Water Quality Index (DCCEEW 2025a) summarises water quality conditions in NSW rivers at a sub-catchment scale. The index was developed as a component of the updated NSW River Condition Index 2023. This document describes the data sources and methods used to calculate the water quality index and the process used to extrapolate data from an individual monitoring site into a sub catchment score for spatial representation

Water quality objectives have been agreed for fresh and estuarine surface waters and are consistent with the national framework for assessing water quality provided in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG 2018). River flow objectives are the agreed high-level goals for surface water flow management that identify the key elements of the flow regime that protect river health and water quality for ecosystems and human uses.

Clarence Colliery pit top is within the Colo River and Hawkesbury-Nepean River catchment. Although there are no specified objectives for this catchment, the typical water quality and river flow objectives for uncontrolled streams in other catchments in NSW are provided in Table 2.5 for reference.

Table 2.5 Water quality and river flow objectives

Environmental value	Objective	Application to proposed modification
Water quality objectives		
Aquatic ecosystems	Maintaining or improving the ecological condition of water bodies and their riparian zones over the long term.	Aquatic ecology species and habitat is present within the upstream of the Wollangambe River.
Visual amenity	Aesthetic qualities of waters.	Access to the Wollangambe River is possible through various walking trails from villages surrounding the mine.
Secondary contact recreation	Maintaining or improving water quality for activities such as boating or wading, where there is a low probability of water being swallowed.	Downstream Wollangambe River is used for recreational activities.
Primary contact recreation	Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed.	Downstream Wollangambe River is used for recreational activities including swimming.

Environmental value	Objective	Application to proposed modification
Livestock water supply	Protecting water quality to maximise the production of healthy livestock.	Agricultural activities are located on the Colo River.
Irrigation water supply	Protecting the quality of waters applied to crops or pasture.	Agricultural activities are located on the Colo River.
Homestead water supply	Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing.	Surface water users are present downstream of the mine extracting water from the Wollangambe River.
Drinking water at point of supply – disinfection only	These objectives apply to all current and future licensed offtake points for town water supply and to specific sections of rivers that contribute to drinking water storages or immediately upstream of town water supply offtake points. The objectives also apply to sub-catchments or groundwater used for town water supplies.	It is unlikely that water from the Wollangambe River is relied upon for drinking water, downstream of the mine.
Drinking water at point of supply – clarification and disinfection		Groundwater supplied under the Clarence Water Transfer Scheme (WTS) to Farmers Creek Dam via Main Dam will continue under the project, to supplement LCC water supplies.
Drinking water at point of supply – groundwater		Groundwater use occurs within the Clarence Village however it is unlikely that this is relied on for groundwater.
Aquatic foods (cooked)	Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.	No commercial activities for aquatic foods exist within the Wollangambe River.
River flow objectives		
Protect pools in dry times	Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows.	Discharges occur to the Wollangambe River as part of the existing operations and currently are proposed to continue until the CWPP is constructed.
Protect natural low flows	Share low flows between the environment and water users and fully protect very low flows.	
Protect important rises in water levels	Protect or restore a proportion of moderate flows and high flows.	
Maintain wetland and floodplain inundation	Maintain or restore the natural inundation patterns and distribution of floodwater supporting natural wetland and floodplain ecosystems.	
Maintain natural flow variability	Maintain or mimic natural flow variability in all streams.	
Manage groundwater for ecosystems	Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems.	
Minimise effects of weirs and other structures	Minimise the impact of instream structures.	

2.6.3 Australian and New Zealand guidelines for fresh and marine water quality

ANZG (2018) provides guidance on monitoring, assessing and managing ambient water quality in a wide range of water resource types and according to specified environmental values, such as aquatic ecosystems, primary industries, recreation and drinking water. The guidelines provide a framework for:

- establishing water quality objectives
- assessing and managing water quality for environmental values
- establishing protection levels, water quality indicators and trigger values.

Environmental values associated with the waterways and water sources surrounding the site include primary industry, aquatic ecosystems, recreational users, irrigation and stock watering. Surface water resources in the vicinity and downstream of Clarence are considered to be representative of a pristine environment due to the presence of the Blue Mountains World Heritage Area (BMWHA) and the associated high conservation value. The criteria is reflective of effectively no change in physical and chemical properties or biological diversity beyond natural variability. Clarence is classified as an 'upland river' as the elevation of the receiving environment is more than 150 m.

Site specific guideline values (SSGVs), compared to default guideline values (DGVs) and the site EPL limits, have been derived for the mine and presented in Table 2.6. The derivation process of the SSGVs including collection of water quality data from an appropriately located reference site is outlined in Appendix G of the WMP (Centennial 2022).

Table 2.6 Site specific guideline values for Wollangambe River (GHD 2022)

Parameter	Units	DGVs	SSGVs	EPL
Physicochemical				
EC	µS/cm	350	100	-
pH	pH units	6.5-9.0	6.5-9.0	6-8.5
TSS	mg/L	25	25	30
Turbidity	NTU	25	25	-
Major ions				
Chloride	mg/L	-	25	25
Sulfate	mg/L	-	250	250
Nutrients				
Ammonia	mg/L	0.32	0.32	-
Nitrate	mg/L	0.017	0.03	-
Nitrate + nitrite	mg/L	0.015	0.03	-
Total fluoride	mg/L	-	0.1	1
Total nitrogen	mg/L	0.2	0.2	0.25
Total phosphorus	mg/L	0.02	0.02	0.02
Dissolved metals				
Aluminium	mg/L	0.027	0.12	-

Parameter	Units	DGVs	SSGVs	EPL
Antimony	mg/L	-	0.001	-
Arsenic	mg/L	0.001	0.001	0.013
Barium	mg/L	-	0.011	-
Boron	mg/L	0.09	0.09	0.1
Cadmium	mg/L	0.00006	0.00006	0.0002
Chromium	mg/L	0.00001	0.00001	0.001
Cobalt	mg/L	0.0025	0.0025	0.0025
Copper	mg/L	0.001	0.001	0.0014
Iron	mg/L	0.3	0.80	0.3
Lead	mg/L	0.001	0.001	0.0034
Lithium	mg/L	-	0.001	0.100
Manganese	mg/L	1.2	1.2	0.5
Mercury	mg/L	0.00006	0.00006	0.00006
Molybdenum	mg/L	-	0.001	-
Nickel	mg/L	0.008	0.008	0.011
Rubidium	mg/L	-	0.001	-
Selenium	mg/L	0.005	0.005	0.005
Silver	mg/L	0.00002	0.00002	0.00005
Strontium	mg/L	-	0.004	-
Uranium	mg/L	-	0.001	-
Zinc	mg/L	0.0024	0.012	0.008
Other				
Oil and grease	mg/L	-	5	10

2.6.4 Guidelines for Groundwater Quality Protection in Australia

The *Guidelines for Groundwater Quality Protection in Australia* (DAWR 2013) is part of the National Water Quality Management Strategy and provides a risk-based management framework to protect and enhance groundwater quality for the maintenance of specified environmental values. The framework involves the identification of specific beneficial uses and values for the major groundwater systems, and several protection strategies that can emerge to protect each aquifer, including monitoring for all aquifers.

2.6.5 Guidelines for controlled activities on waterfront land

The WM Act defines waterfront land as the bed of any river, lake or estuary and any land within 40 m of the riverbanks, lake shore or estuary mean high water mark. Works undertaken on waterfront land require a controlled activity approval, unless defined as exempt. Guidelines for controlled activities have been prepared by the former NSW Office of Water (NOW) (2012). These guidelines provide information on the design and construction of a controlled activity and other ways to protect waterfront land and include:

- *Guidelines for riparian corridors on waterfront land*
- *Guidelines for instream works on waterfront land*
- *Guidelines for outlet structures on waterfront land*
- *Guidelines for vegetation management plans on waterfront land*
- *Guidelines for laying pipes and cables in watercourses on waterfront land*
- *Guidelines for laying pipes and cables in watercourses on waterfront land.*

As Clarence Colliery is categorised as a State significant development (SSD) and includes mining lease conditions, controlled activity approvals are not required under section 4.41(1)(g) of the EP&A Act.

3 Assessment methodology

3.1 Assessment of potential impacts

As stated, MOD 11 seeks to extend the life of mining and will not make additional changes to the approved mining operations. The approved disturbance boundary, operational hours, mining methodology, mining extent and depth, mine infrastructure, employees, and coal production rates will remain unchanged. It is expected the approved environmental impacts to surface water and groundwater sources will also remain unchanged. Given the occurrence of various issues within the environmental management within the surface facilities this assessment is primarily focused on the operational water management at Clarence Colliery.

This assessment has qualitatively assessed potential impacts to water resources and receptors. It has:

- identified and characterised the existing environmental and mining related processes that influence water resources
- identified existing water management processes and used established indicators of the health of water resources
- considered the key potential risks of the proposed modification and potential impacts to water resources.

4 Existing environment

4.1 Data sources

Table 4.1 summarises the data sources used in this assessment.

Table 4.1 Data sources

Data description	Publicly available sources	Centennial sourced information
Climate	Bureau of Meteorology (BoM) Climate database (BoM 2025a)	Weather station monitoring data
	SILO Australian climate gridded data (DES 2022)	
Topography	Digital elevation model (DEM) from ELVIS (Elevation and Depth cloud-based platform hosted by the Intergovernmental Committee on Surveying and Mapping).	Field survey LIDAR of mining lease
Geology	Seamless geological map (Colquhoun et al. 2025)	McHugh 2014 & 2018
		Geological structures (Palaris and SRK)
Hydrology and hydrogeology	Hydro Line (2012) Strahler Stream Order Classification NSW (DCCEEW 2025b)	Water Management Plan (GHD 2022) Western Operations Regional Water Management Plan 2016 Discharge volumes Water management SCADA systems
	BoM Australian Groundwater Explorer (BoM 2025c)	
	Australian Rainfall and Runoff and ARR Data Hub	
	WaterNSW real time data	
Water levels and water quality performance	Centennial Coal Clarence Colliery 2024 Annual Review (Centennial 2025)	Centennial Coal Clarence Colliery 2024 Annual Review (Centennial 2025)
		Clarence Colliery Independent Environmental Audit 2023 (IEMA 2024)
		Clarence Colliery Response to Independent Environmental Audit Recommendations (Centennial 2023)
Water related receptors	Department of Agriculture, Water and the Environment Protected Matters Search Tool	Swamp mapping
	BoM Groundwater Dependent Ecosystems Atlas (BoM 2025b)	Main Dam
	NSW SEED portal for Spatial layer of High Ecological Value Aquatic Ecosystems (HEVAE) vegetation GDEs in NSW	
	Water sharing plans – high priority mapped GDEs	
	NSW water register	
Project understanding and design	Clarence Colliery WMP (Centennial 2022)	Clarence Colliery Subsidence Management Plan 2024 (Centennial 2024)
	Clarence Colliery Mining Operations Plan 2019	
Community complaints	https://www.centennialcoal.com.au/operations/clarence	Monthly complaints register reports

Data description	Publicly available sources	Centennial sourced information
LDP002 water quality and volume reported exceedances	https://www.centennialcoal.com.au/operations/clarence	Monthly environmental monitoring reports

4.2 Location and topography

The Clarence Colliery pit top and mining areas are located on the Newnes Plateau. The Newnes Plateau undulates with gentle to moderate inclines and elevations from approximately 1,000 metres Australian Height Datum (m AHD) to 1,200 m AHD (Centennial 2022). The area is characterised by steep cliff lines, pagodas, gullies and canyons carved by watercourses like the Wollangambe, Wolgan and Coxs rivers and their tributaries.

4.3 Climate data

Daily rainfall is measured at the Australian Laboratory Services Pty Ltd (ALS) Newnes Plateau Prison Farm rain gauge. Observations from this station have been measured since August 1998. Table 4.2 shows the average monthly rainfall since August 1998. The highest rainfall occurs from February to March. Rainfall reduces in autumn and winter. May has the lowest rainfall.

Table 4.2 Newnes Plateau Prison Farm monthly average total rainfall – August 1998 to November 2025

Month	Total average monthly rainfall
January	95.4
February	115.4
March	108.1
April	65.7
May	47.5
June	67.9
July	60.4
August	60.3
September	55.7
October	75.2
November	102.5
December	87.3
Total	941.4

Daily cumulative rainfall deviation (CRD) is presented in Figure 4.1 from 2010 to 2025. An increasing daily CRD trend indicates above average conditions, a flat trend represents average conditions, and a downward trend indicates below-average conditions. The figure shows a long-term decreasing trend from early 2013 to late 2019. From early 2020 to mid-2021, the trend was neutral. From mid-2021 to late 2022 the trend was increasing. Since late 2022, the trend has cycled through above and below average rainfall conditions, with an overall below average longer-term trend.

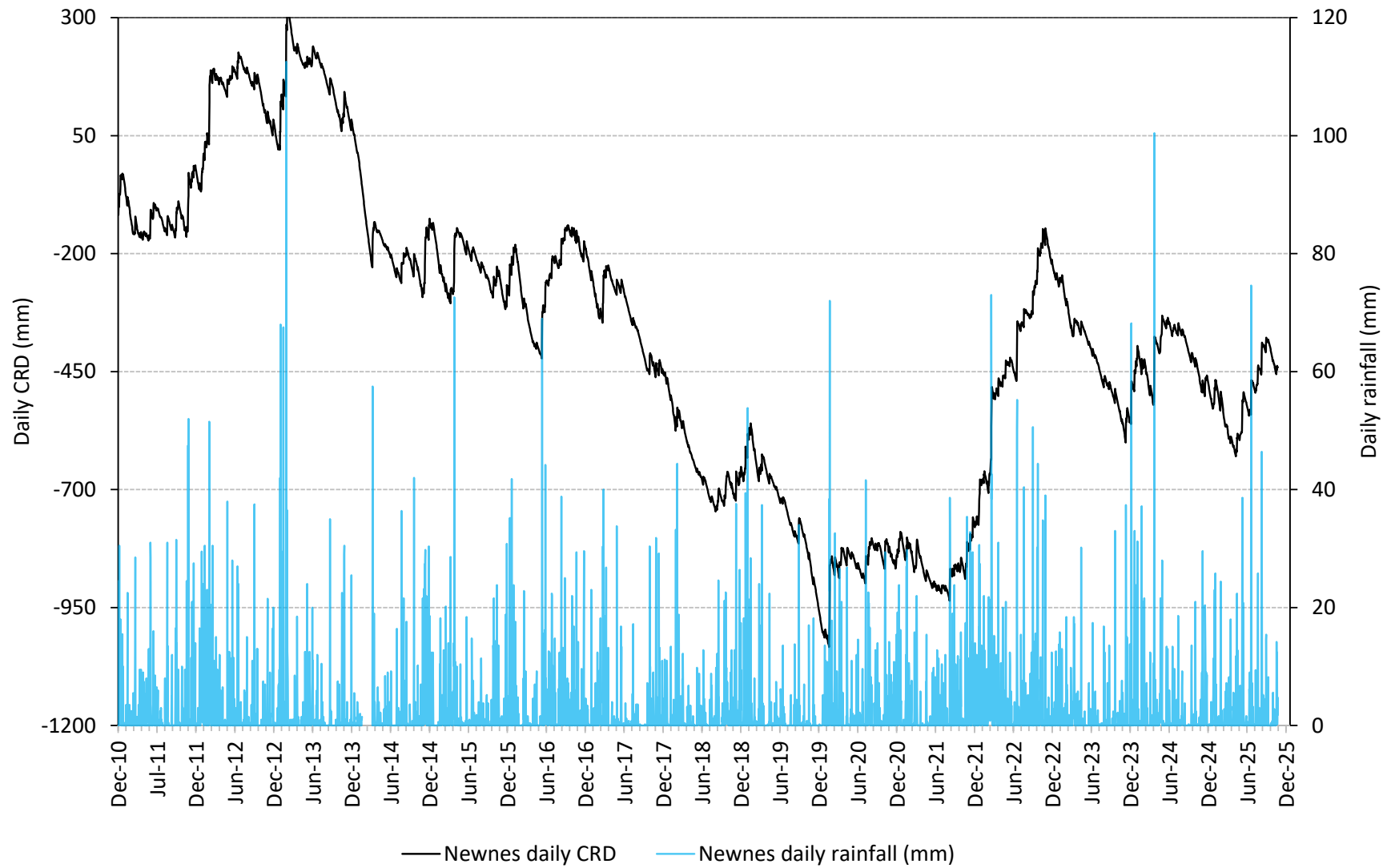


Figure 4.1 Newnes Plateau Prison Farm rain gauge – Daily rainfall and cumulative rainfall deviation from December 2010 to present

4.4 Hydrology

Clarence Colliery is within the greater Hawkesbury-Nepean catchment, and in the three sub-catchments for the Wollangambe River, Wolgan River and upper Coxs River (Centennial 2022). The Newnes Plateau is the headwaters for both the Wollangambe River and Wolgan River, which join the Colo River to the east of the Development Consent Boundary. The Coxs River originates within the Ben Bullen State Forest to the north of Clarence Colliery and flows in a south-east direction to Lake Burragorang and Warragamba Dam (Centennial 2022).

There are eight non-minor creek systems surrounding Clarence Colliery described in the WMP (Centennial 2022), these are:

1. Wollangambe River
2. Bungleboori Creek (including Paddy Creek)
3. Dumbano Creek
4. Dingo Creek
5. Carne Creek (tributary of Wolgan River)
6. Farmers Creek
7. Dargans Creek
8. Reedy Creek.

Figure 4.2 illustrates the catchment areas, watercourses and storages in the vicinity of Clarence Colliery.

Drainage lines off Newnes Plateau are often deeply incised in their lower reaches, incorporating numerous cliff lines and pagodas bordering the valley flanks. In the upper catchment areas, drainage lines are typically poorly defined to non-existent, with overland sheet flow being the typical mode of discharge during rainfall events (Jacobs 2019).

River styles (DCCEEW 2023) characterisations were not available for Bungleboori, Dumbano and Dingo creeks. Other watercourses within the mine lease area including Farmers Creek, Wollangambe River, Dargans Creek and Reedy Creek are watercourses characterised as being within a confined valley setting with transitions into sections of swampy meadows. Watercourse conditions as defined by DPIE 2023 are mapped from moderate to good condition.

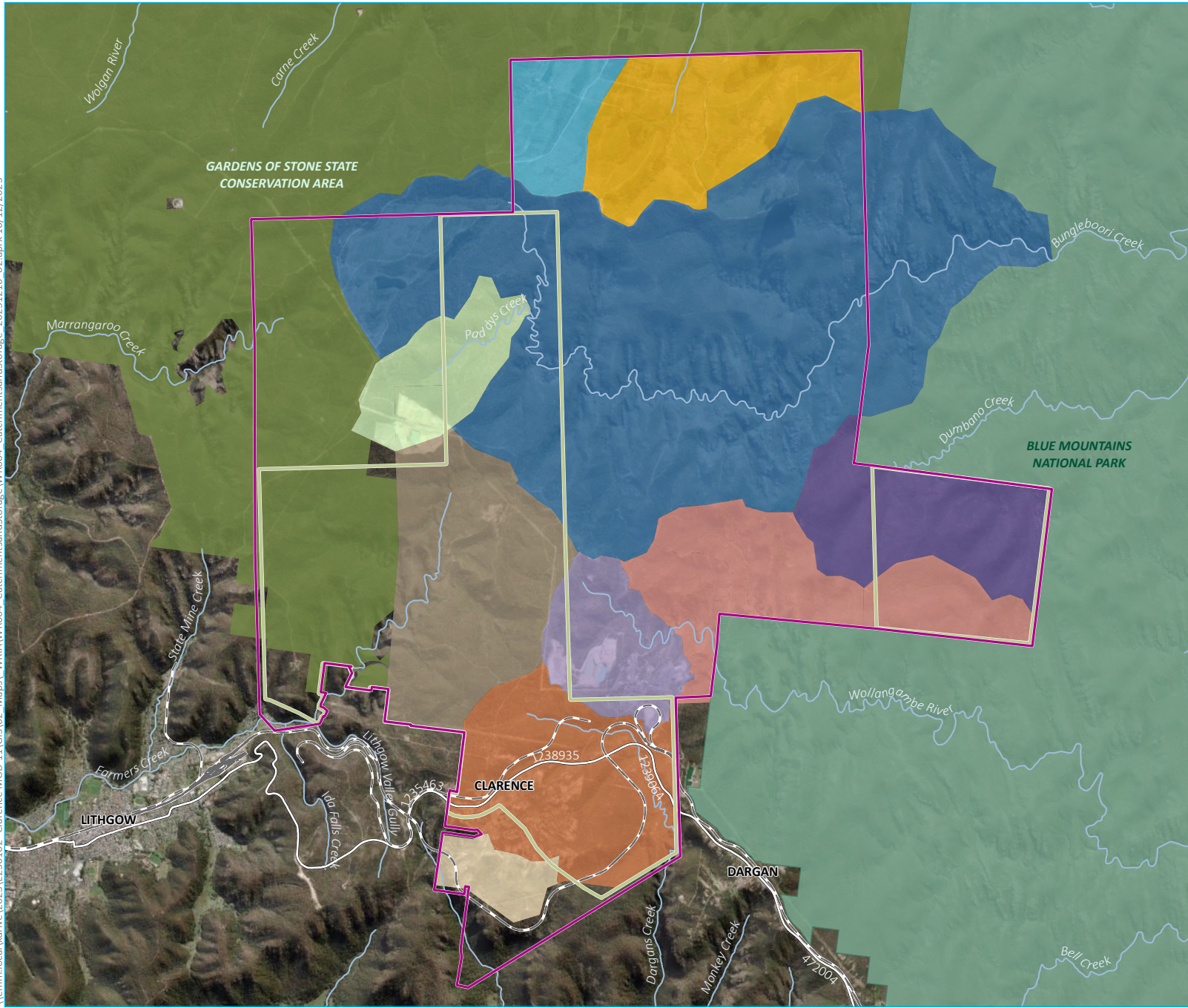
4.4.1 Drainage and flow from Clarence Colliery

The surface water system flow patterns in various areas of Clarence Colliery are described in the WMP (Centennial 2022) and summarised below and shown on Figure 4.2:

- A small portion of the north-west of Clarence Colliery drains to Carne Creek, flowing north and joining the Wolgan River.
- The north-east and central-east portions Clarence Colliery drain to Dumbano Creek and Dingo Creek, respectively. These creeks flow east to join Bungleboori Creek.
- The central area of the Development Consent Boundary drains most of the mine site and flows to Bungleboori Creek. Bungleboori Creek flows east and joins with Wollangambe River approximately 22 km east of Clarence Colliery.

- The south-east portion of Clarence Colliery, including the pit top area, drains to the Wollangambe River sub-catchment. Centennial is licensed to discharge water to the Wollangambe River under EPL 726 at LDP002 (Centennial 2022).
- The south-west portion of Clarence Colliery drains to Farmers Creek. Farmers Creek flows through Lithgow and joins the Coxs River at Lake Lyell and is part of the Sydney drinking water catchment under management by WaterNSW.
- The southern portion of Clarence Colliery, south of the pit top, drains to Reedy and Dargans Creek which joins the Lett River and flows south to join the Coxs River which is also part of the Sydney drinking water catchment.

\\emm.local\drive\2025\LE250102 - Clarence MOD 11\GIS\02 - Maps\ WRI\A\WR004 - CatchmentsandStorage_WR004 - CatchmentsandStorage_20251216_02.aprx.16/12/2025



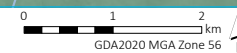
- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - Creek catchment
 - Bungleboori Creek
 - Carne Creek
 - Dargans Creek
 - Dingo Creek
 - Dumbano Creek
 - Farmers Creek
 - Paddys Creek
 - Pit Top Water Management Catchment
 - Reedy Creek
 - Wollangambe River
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - NPWS reserve
 - State conservation area

Catchment areas, watercourses and storages

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 4.2



Source: EMM (2025); DCSSS (2024); ESRI (2025); GA (2009); Centennial (2025)



4.4.2 Surface water storage areas

Farmers Creek Dam (Lithgow Dam No. 2) lies near the western boundary of the site and is part of the Clarence Water Transfer Scheme (WTS), receiving water from the Main Dam at Clarence to support Lithgow’s water supply up to a rate of 14 ML/d or up to 1,200 ML/yr. Water from Farmers Creek Dam serves the Oakey Park WTP, located in east Lithgow. Lithgow Dam No. 1 is located downstream of Farmers Creek Dam but no longer functions as a water supply dam. The original dam wall remains which has an open scour valve which throttles runoff events from the catchment and functions as detention during flood events.

Given the predominate wet conditions present over recent years, the use of the Clarence WTS has been minimal.

4.5 Geology

Clarence Colliery is located in the southern portion of the Western Coalfield region of NSW, on the western edge of the Sydney Basin. The colliery is underlain by the Triassic sandstone of the Narrabeen Group and the Illawarra Coal Measures. There are small areas of unconsolidated Quaternary colluvial and alluvial sediments along creek lines and swamps (Centennial 2022). Geology is summarised (Centennial 2022) in Table 4.3.

Mining at Clarence Colliery targets the Katoomba Seam within Illawarra Coal Measures. At Clarence Colliery, the Katoomba Seam is approximately 220 m below the Newnes Plateau.

Table 4.3 Geological units and stratigraphic sequence

Period	Stratigraphy		Lithology
	Group	Formation	
Quaternary	Alluvium		Silt, clay, sand, gravel
Triassic	Narrabeen	Burralow Formation	Sandstone, siltstone, claystone and shale
		Banks Wall Sandstone	Quartz sandstone
		Mount York Claystone	Red-brown claystone
		Burra-Moko Head Sandstone	Quartz sandstone, red-brown claystone
		Caley Formation	Claystone, shale, quartz sandstone
Permian	Illawarra Coal Measures	Katoomba Seam	Coal, lithic sandstone, claystone
		Middle River Coal	
		Gap Sandstone	
		Glen Davis Formation	Sandstone, claystone, coal, mudstone
		Irondale Coal	
		Long Swamp Formation	
		Lidsdale Seam	Coal, claystone, siltstone, mudstone, conglomerate
		Blackmans Flat Conglomerate	
		Lithgow Seam	
			Marrangaroo Formation
	Shoalhaven Group	Berry Siltstone	Siltstone, lithic sandstone, conglomerate
Devonian	Metamorphic rocks		Quartzite, shale, sandstone, limestone, tuff

Source: Centennial (2022)

4.6 Hydrogeology

The groundwater systems interacting with Clarence Colliery have been conceptualised, and are divided into four distinct aquifers (McHugh 2014):

- Quaternary sediments, unconfined
- perched aquifer, ranging from unconfined to confined
- shallow aquifer, ranging from semi-confined to confined
- deep aquifer, confined and including the Katoomba and Lithgow coal seams.

A high level review of the hydrogeological setting is provided in Table 4.4 and a conceptual diagram is presented on Figure 4.3.

Table 4.4 Hydrogeological setting

Component	Process / description
Hydrostratigraphic units	Quaternary sediments: unconfined and associated with tributaries, shrub swamps, NPSS and NPHS. Thickness of these sediments range from 0.5 to 5 m with typical deposits around 1 to 2 m. The occurrence of Newnes Plateau Shrub Swamps (NPSS) and Newnes Plateau Hanging Swamps (NPHS) are supported by discharge from the perched and shallow aquifers hosted within the Buralow Formation and Banks Wall Sandstone.
	Perched aquifer (Buralow Formation): The aquifer is unconfined to semi confined. Comprises of up to seven distinct fine-grained claystone and siltstone units that are semi permeable, creating discontinuous perched sandstone aquifers that act as localised flow bands that discharge to NPSS and NPHS. The unit can be up to 100 m thick across the Newnes Plateau. At Clarence Colliery, the Buralow Formation may not be present (weathered away) near the non-minor creeks. The lower portion of the Buralow Formation can be connected to the regional shallow aquifer below.
	Shallow aquifer (Banks Wall Sandstone): A regional semi confined to confined groundwater system (also known as the Clarence Aquifer) with a thickness of up to 100 m (McHugh 2018). Discharge from the shallow aquifer supports NPSS and NPHS.
	Aquitard (Mount York Claystone (MYC)): The base of the shallow aquifer is marked by the MYC. This unit comprises a sequence of sandstone, shale and claystone that form a semi-permeable layer which limits connectivity between the shallow and deep aquifers.
Groundwater level, quality and flow	Deep aquifer (Burra-moko Head Sandstone, Caley Formation and Permian Illawarra Coal Measures): A confined sedimentary aquifer up to 200 m thick. Coal seams are typically the most permeable formations.
	Quaternary sediments: Groundwater flow occurs through unconsolidated sediments and is localised and directed toward topographic lows. Groundwater levels are highly responsive to climate, fluctuating between 0 to 2 metres below ground level (mbgl) and can dry out during extended dry periods. Water quality is fresh, with EC typically less than 100 micro siemens per centimetre ($\mu\text{S}/\text{cm}$) and pH ranging from 4 to 7.
	Perched aquifer: Groundwater flow occurs through fractures, bedding planes, and the interface between sandstone aquifers and semipermeable layers. Groundwater flow regime is local, directed toward topographic lows moving towards canyons, gullies, depressions, watercourses, NPSS and NPHS. Depth to groundwater ranges between 1 to 30 mbgl and generally mirrors topography. Groundwater levels have a delayed and subdued response to climatic variability, often lagging from days to months. Water quality is fresh, with EC typically less than 100 $\mu\text{S}/\text{cm}$ and pH ranging from 4 to 7.

Component	Process / description
	<p>Shallow aquifer: Groundwater flow in this system is primarily controlled by interconnective fracturing, bedding planes and structural features such as lineaments and faults, with some contribution from pore porosity (Jacobs 2019). Regional groundwater flow is to the north-east, consistent with the dip of strata. Local groundwater flow is directed toward topographic lows such as canyons, gullies, depressions, watercourses and NPSS. Depth to groundwater ranges between 5 to 50 mbgl and flow generally mirrors topography. Groundwater levels have a delayed and subdued response to climatic variability, often lagging from weeks to months. Water quality is fresh, with EC typically less than 100 $\mu\text{S}/\text{cm}$ and pH ranging from 4 to 7.</p>
	<p>Deep aquifer: Groundwater flow is primarily controlled by interconnective fracturing, bedding planes, cleated coal seams and structural features such as lineaments and faults. The low permeability of the Illawarra Coal Measures means interconnective fracturing is the primary control of groundwater flow. Regional groundwater flow is to the north-east, consistent with the dip of strata. Piezometric pressures are measured using vibrating wire piezometers, with levels ranging from 1,000 to 850 mAHD. Groundwater pressures are typically unresponsive to climatic variability. Some areas of the deep aquifer have depressurised due to mining at Clarence and Springvale. Raw mine water quality is fresh, with EC typically less than 300 $\mu\text{S}/\text{cm}$ and an average pH of 6.3.</p>
Recharge	<p>Quaternary sediments: recharged by the perched and shallow aquifers and infiltration of rainfall.</p> <p>Perched aquifer: recharged by infiltration of rainfall and leakage from watercourses.</p> <p>Shallow aquifer: recharged by infiltration of rainfall where the lithology outcrops and subcrops, leakage from watercourses and downward leakage from the perched aquifer.</p> <p>Deep aquifer: recharged by infiltration of rainfall where it outcrops and subcrops to the west and south-west of the Clarence Colliery, and downward leakage from the shallow aquifer.</p>
Discharge	<p>Quaternary sediments: discharges via evapotranspiration, baseflow to watercourses and leakage to the perched and shallow aquifers.</p> <p>Perched aquifer: Discharges to outcrops and subcrops as seepage, baseflow to watercourses, NPSS, NPHS and leakage to the shallow aquifer.</p> <p>Shallow aquifer: Discharges to outcrops and subcrops as seepage, watercourses, NPSS, NPHS, leakage to the deep aquifer and pumping from landholder bores.</p> <p>Deep aquifer: inferred to occur to the north-east, where the units outcrop in the scarp of the Newnes Plateau and mine dewatering.</p>

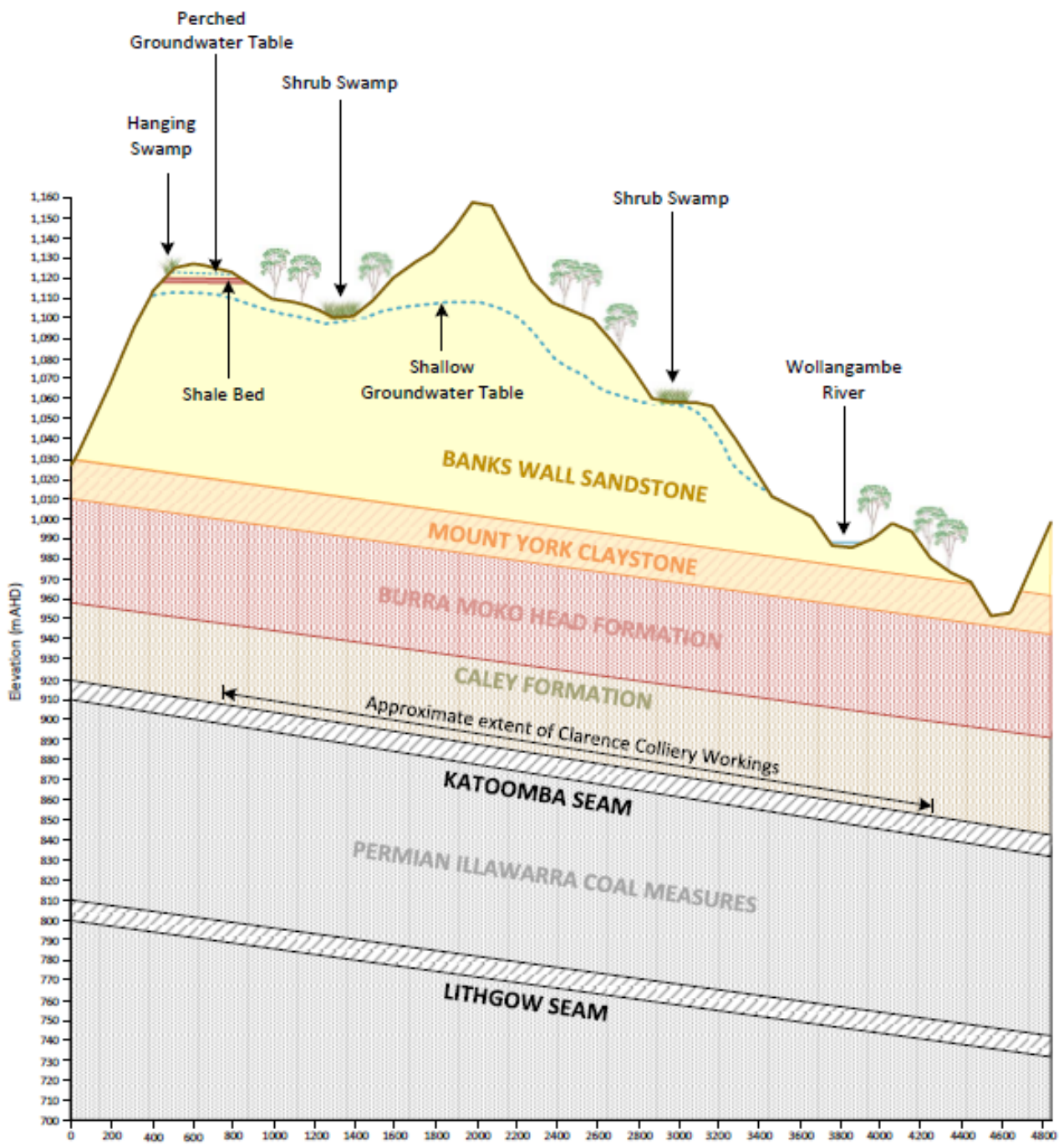


Figure 4.3 Setting of shrub swamps and hanging swamps at Clarence Colliery (Centennial 2022)

4.7 Water receptors

Water receptors include surface water users, downstream watercourses (third order or higher Strahler streams), groundwater users, and GDEs.

4.7.1 Surface water receptors

i Surface water users

Clarence Colliery's WMP identifies one potential surface water user downstream of Clarence Colliery. The user holds WAL26480 and works approval 10CA104563 for the purpose of irrigation. The user is located in Waterfall Creek catchment, approximately 12.3 km south-east of the pit top (Centennial 2022).

The user is outside the catchment of the Wollangambe River and is unlikely to be influenced by mining discharges or extractions (Centennial 2022). The location of the surface water user is shown in Figure 4.4.

ii Third order or higher Strahler streams

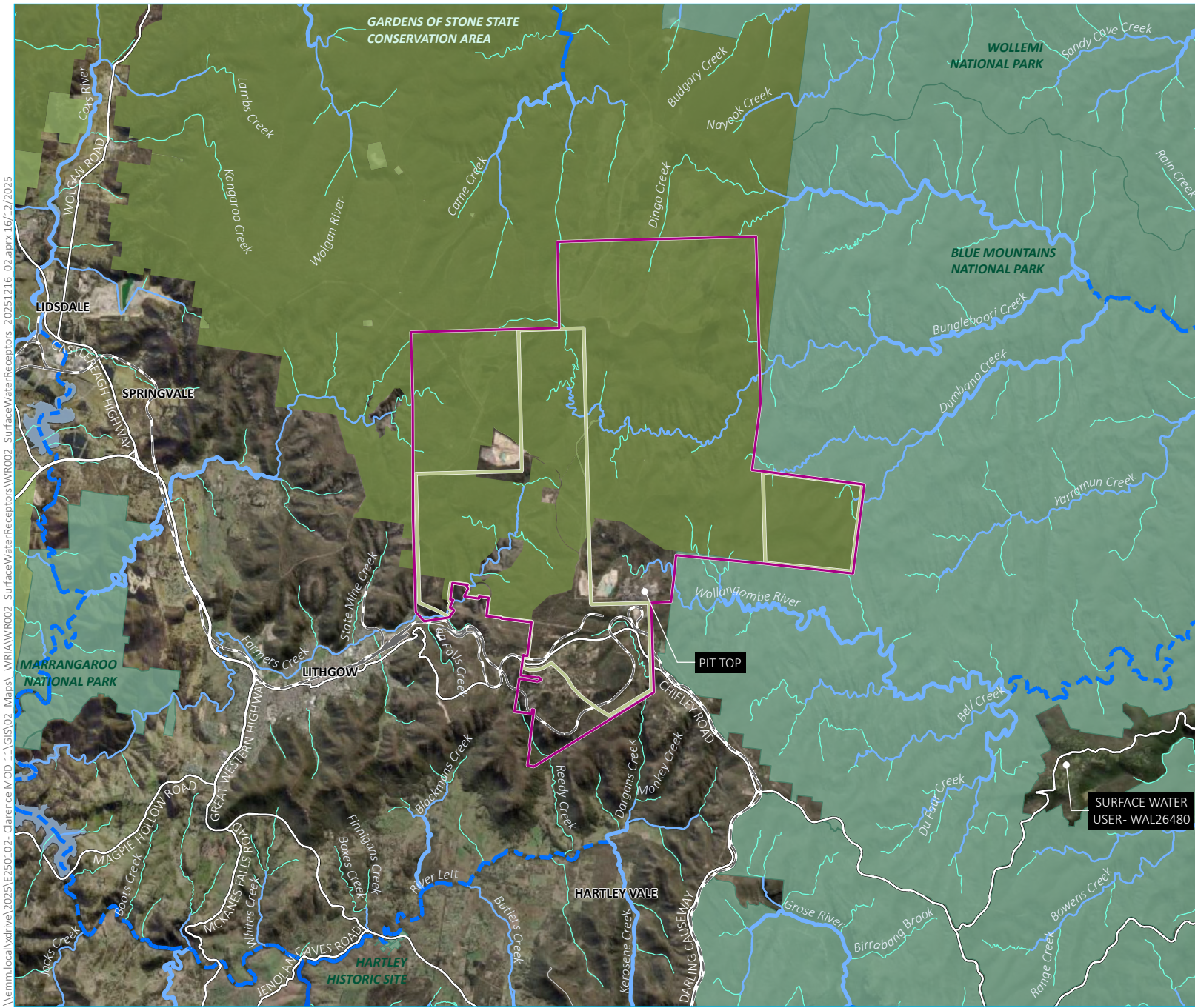
Table 4.5 lists the third order or higher Strahler streams within 10 km of Clarence Colliery. The streams are displayed in Figure 4.4.

Table 4.5 Third order or greater streams with 10 km of Clarence Colliery

Name	Strahler order	Name	Strahler order	Name	Strahler order
Bell Creek	3, 4, 5	Farmers Creek	4	Nayook Creek	3, 4
Birrabang Brook	3	Finnigans Creek	3	Paddys Creek	3
Blackmans Creek	3, 4, 5	Grose River	4, 5	Reedy Creek	3
Boxes Creek	3	Ida Falls Creek	3	Rocky Creek	3, 4
Budgary Creek	3, 4	Jungaburra Brook	3	Sandy Cave Creek	3
Bungleboori Creek	3, 4, 5, 6	Kamarah Gully	3	Short Creek	4
Butlers Creek	4	Kangaroo Corner Creek	3, 4	State Mine Creek	3
Carne Creek	3, 4, 5, 6	Kangaroo Creek	3	Surveyors Creek	3, 4
Dalpura Creek	3	Kerosene Creek	5	Waterfall Creek	3
Dargans Creek	3, 4	Koombanda Brook	3, 4	Whites Creek	3
Dingo Creek	3, 4, 5	Lithgow Valley Gully	3	Wolgan River	3, 4
Dinner Gully	3	Marrangaroo Creek	3, 4, 5	Wollangambe River	3, 4, 5, 6
Du Faur Creek	3, 4, 5	Monkey Creek	3	Yarramun Creek	4, 5
Dumbano Creek	4, 5				

Source: DCS (2012)

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- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - Strahler stream order
 - 3rd order
 - 4th order
 - 5th order
 - 6th order
 - 7th order
 - Existing environment
 - Rail line
 - Major road
 - Minor road
 - NPWS reserve
 - State conservation area
 - State forest

Surface water receptors

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 4.4



Source: EMM (2025); DCSSS (2024); ESRI (2025); GA (2009)



4.7.2 Groundwater receptors

i Landholder bores

Landholder bores are located within Clarence village, just south of Clarence Colliery. Several of these bores are registered for water supply purposes.

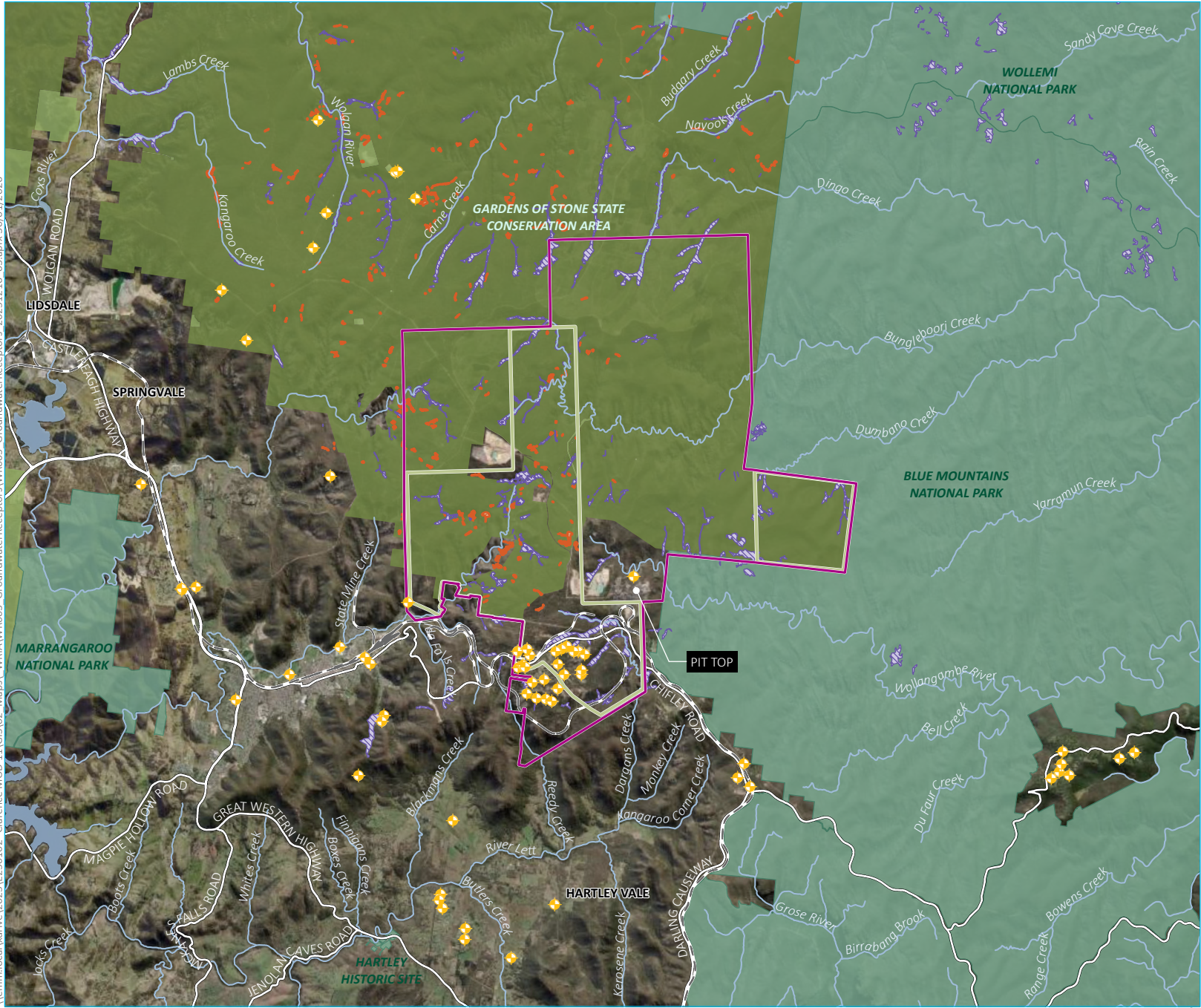
A search of the National Groundwater Information System was conducted to identify registered landholder bores within 10 km of Clarence Colliery (BoM 2024). There were 441 bores classified as functioning, in use, or unknown. Bores listed as abandoned, non-functioning, proposed, and removed were not assessed. Table 4.6 summarises the 441 identified bores by their use type. The bores are shown in Figure 4.5.

Table 4.6 Landholder bores

Use type	Number of bores within the 10 km of Clarence Colliery
Monitoring	226
Water Supply	123
Unknown	65
Irrigation	13
Dewatering	9
Commercial and Industrial	7
Exploration	5
Other	4
Stock and Domestic	3

Source: BoM (2024)

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- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - ◆ Landholder bore
 - Temperate Highland Peat Swamps on Sandstone EEC
 - Hanging swamp
 - Shrub swamp
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - State forest
 - NPWS reserve
 - State conservation area

Groundwater receptors

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 4.5

Source: EMM (2025); DCSSS (2024); ESRI (2025); GA (2009)



ii Groundwater dependent ecosystems

GDEs can include terrestrial vegetation, aquatic communities, and subterranean systems which utilise groundwater. Information on GDEs was gathered from WSPs and the GDE Atlas. The high potential GDEs are listed by name in Appendix C.1.

The WSP for the Greater Metropolitan Region Groundwater Sources 2023 defines Temperate Highland Peat Swamps on Sandstone (including Newnes Plateau Swamps) as a high priority GDE. The Temperate Highland Peat Swamps on Sandstone (THPSS) occur on the Newnes Plateau within the Clarence Colliery project area. These swamps are listed as an endangered ecological community under the EPBC Act and the NSW *Threatened Species Conservation Act 1995*. THPSS have been mapped as Newnes Plateau Shrub Swamps (NPSS) or Newnes Plateau Hanging Swamps (NPHS). NPSS and NPHS coincide with the lithographic and topographic occurrence of semi-permeable layers the Buralow Formation (McHugh 2018). They also occur in the Banks Wall Sandstone where conditions are supportive.

These swamps are considered terrestrial GDEs, and they also host aquatic GDEs. The location of these swamps is shown in Figure 4.5.

A summary of the interaction between groundwater and NPHS/NPSS on the Newnes Plateau is provided in Section 4.8.

4.8 Surface water and groundwater interaction

There are three identified pathways for surface water and groundwater interaction:

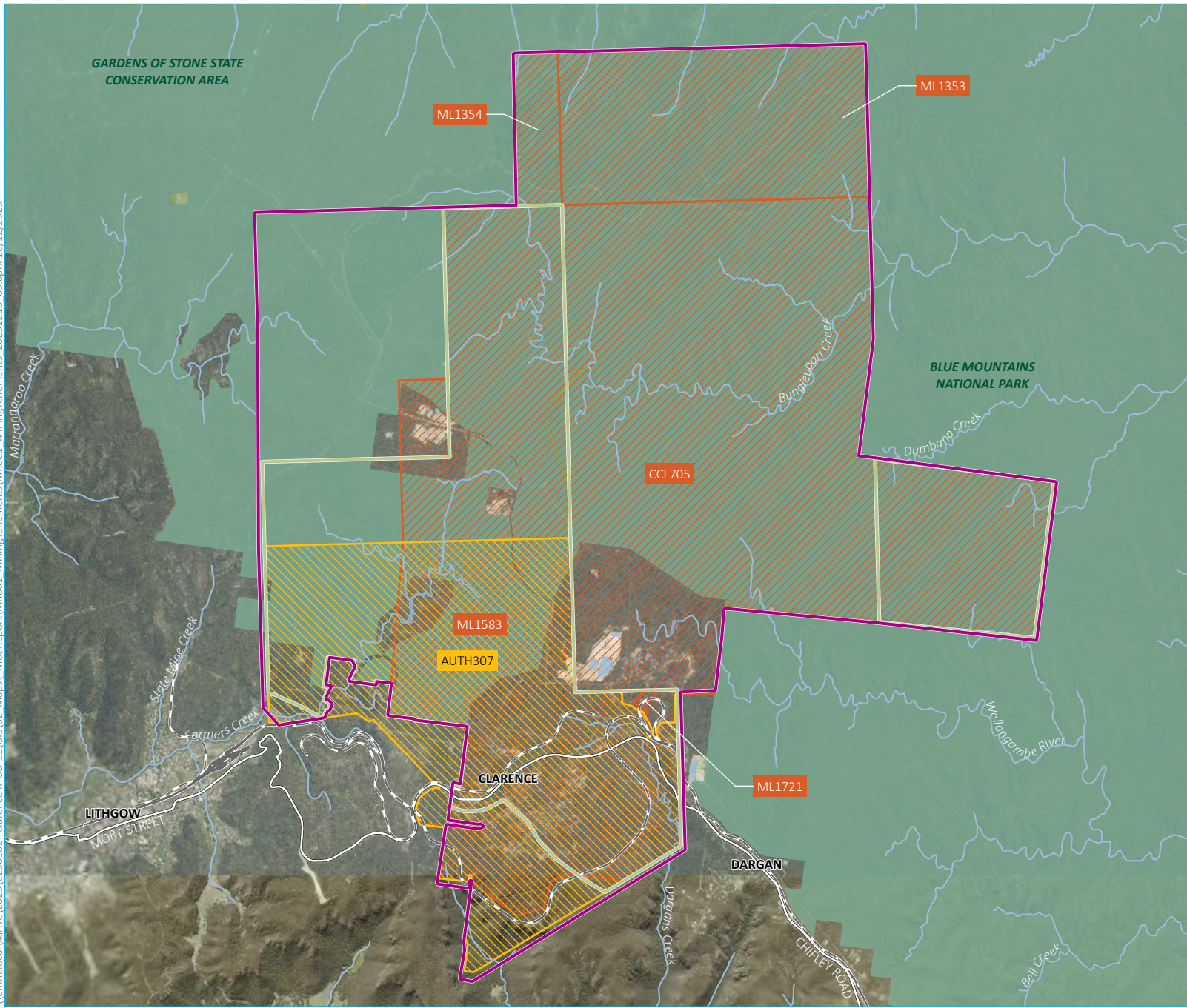
- Surface water recharge to shallow groundwater. This can occur where watercourses overlie exposed aquifer recharge areas and leakage from the watercourse infiltrates into the aquifer.
- Natural groundwater discharge to surface water. This occurs as seepages from exposed aquifers such as cliff faces along drainage lines, or as seepage from sub-cropping aquifers to valley floors (Jacobs 2019). Groundwater discharge may form creeks or contribute to stream baseflow. The development of NPHS or NPSS is thought to be supported by groundwater discharge.
- Mining induced groundwater dewatering and subsequent release to surface water via pumping. Mining at Clarence Colliery requires the dewatering of groundwater. This water is treated and discharged, via LDP002, into Main Dam, located within the upper reaches of the Wollangambe River. Water stored in the Main Dam at Clarence Colliery can be used to supplement the Lithgow town water supply by transfer to Farmers Creek Dam as part of the Clarence WTS. If not transferred to Farmers Creek Dam, flows within Main Dam overflow and contribute to the Wollangambe River.

5 Mining operations

The majority of Clarence Colliery's mining operations are within CCL 705 and ML1583. Clarence Colliery's surface facilities are located within CCL 705 with a small proportion of the existing surface facilities located within ML1721. Centennial undertakes exploration activities in accordance with AUTH 307. The Clarence Holding and relevant mining tenements are shown on Figure 5.1.

There are no changes to the mining methods and coal handling processes as per DA 504-00 as part of MOD 11 (see EMM MOD11 report (EMM 2025a)). Bord and pillar mining methods, which involve first and second workings will continue until 31 December 2031. The mining methods used at Clarence Colliery are designed to minimise subsidence and potential impacts to surface water and groundwater systems.

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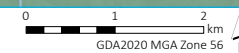
- KEY**
- Clarence Colliery Holdings Area
 - Development consent boundary
 - DA 504-00
 - Mining
 - Exploration
 - Existing environment
 - Rail line
 - Major road
 - Named watercourse
 - Waterbody
 - NPWS reserve
 - State forest

Mining tenements

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 5.1



Source: EMM (2025); DCSSS (2024); GA (2009); LPI (2025)



6 Water management

Clarence Colliery water management will continue to be managed in accordance with the approved WMS, detailed within the approved WMP (Centennial 2022). The Clarence Colliery WMP has been developed as part of a Regional Water Management Plan (RWMP) for all of Centennial's Western Region operations.

6.1 Water management

Water sources include rainfall, catchment run-off, and groundwater inflow. Water demands include underground operations, use in the coal handling and preparation plant (CHPP), dust suppression, wash stations, staff amenities, and maintaining fire-fighting water storage (Centennial 2022).

Four operational WMS are in place for the different types of water, these are the:

1. clean water management system
2. dirty water management system
3. leachate water management system
4. underground water management system.

Clean water is surface water runoff from natural and impervious catchments such as areas of vegetation, rehabilitation, sealed roads and sealed car parks. Dirty water is runoff from disturbed areas, such as fuel storage areas. Coal-contact water is runoff from catchments where coal storage or processing occurs. Leachate water is water that encounters operational reject emplacement areas (REA) or has passed through reject material.

The coal-contact water is managed as part of the dirty WMS. In addition, a WTP is used to reduce concentrations of contaminants, and a sewage treatment plant (STP) is used to tertiary treat effluent.

Surface water and groundwater described in this report has been categorised as follows, based on water quality and intended use:

- **clean water** – surface water runoff from undisturbed areas and where there is no coal storage, transportation, handling or processing and therefore is unlikely to be contaminated with coal fines or sediment
- **dirty water** – surface water runoff from disturbed areas and areas with the potential to contain suspended sediment, oils, grease and hydrocarbons as well as coal-contact water (mine water) from areas where coal storage, transportation, handling or processing occurs
- **groundwater** – water removed from below the ground level, either directly via a bore or passive interception at the surface
- **raw water** – groundwater that has been treated and recirculated into the pit top demands for bathhouse and other non-potable demand
- **wastewater** – water produced by on-site amenities (i.e. sewage).

The WMP describes the operational water cycle and Figure 6.1 shows the water management schematic as seen in the WMP (Centennial 2022). Figure 6.1 shows the various types of water storage structures and indicates the category of water transfer. The water management schematic also identifies inflows, outflows, water uses and licensed discharge points. Figure 6.2 represents the water management in the water balance model (Centennial 2022). Figure 6.3 illustrates the surface WMS with diversion pathways for clean and dirty water on site.

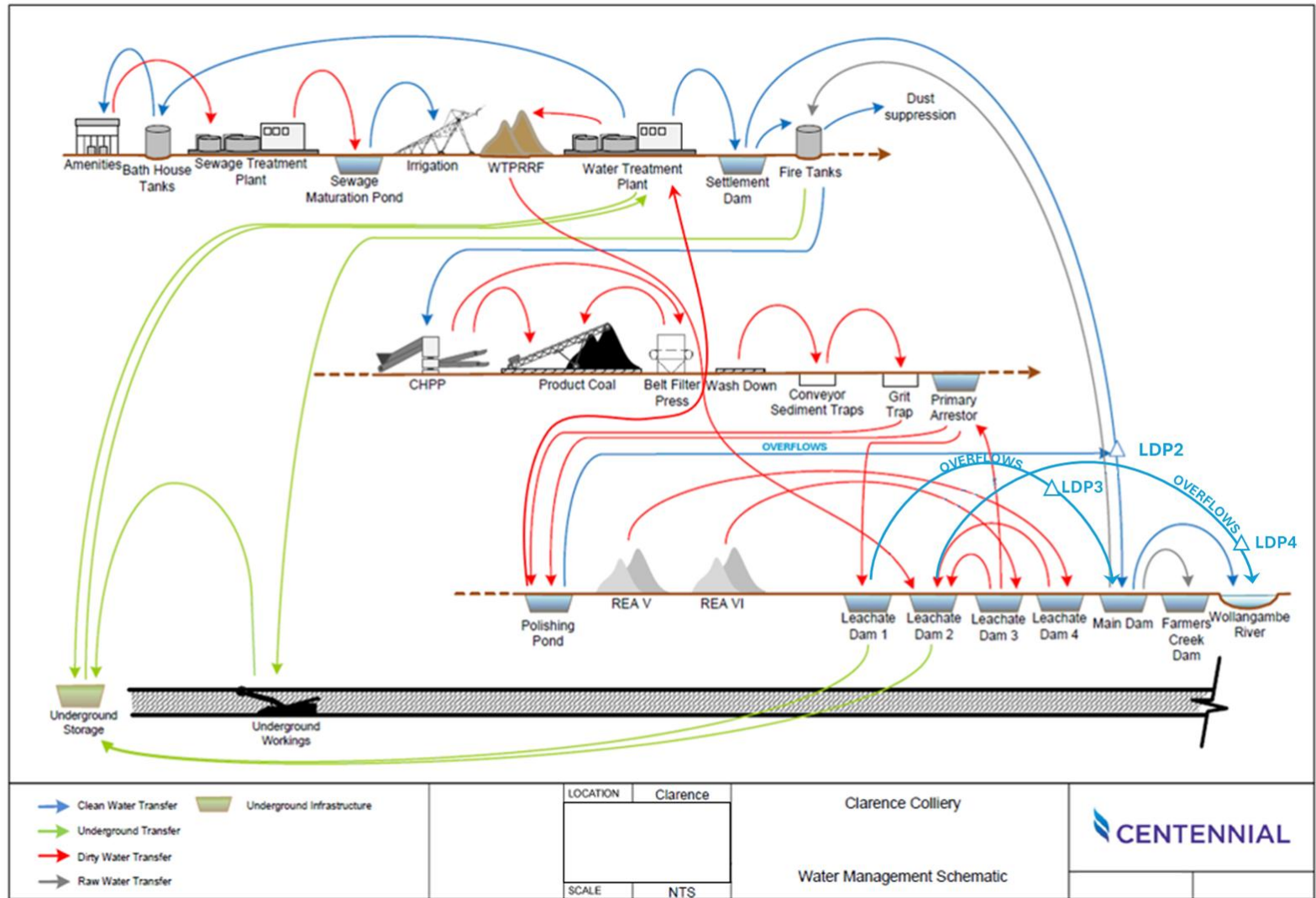


Figure 6.1 Water management schematic (figure amended, Centennial 2022)

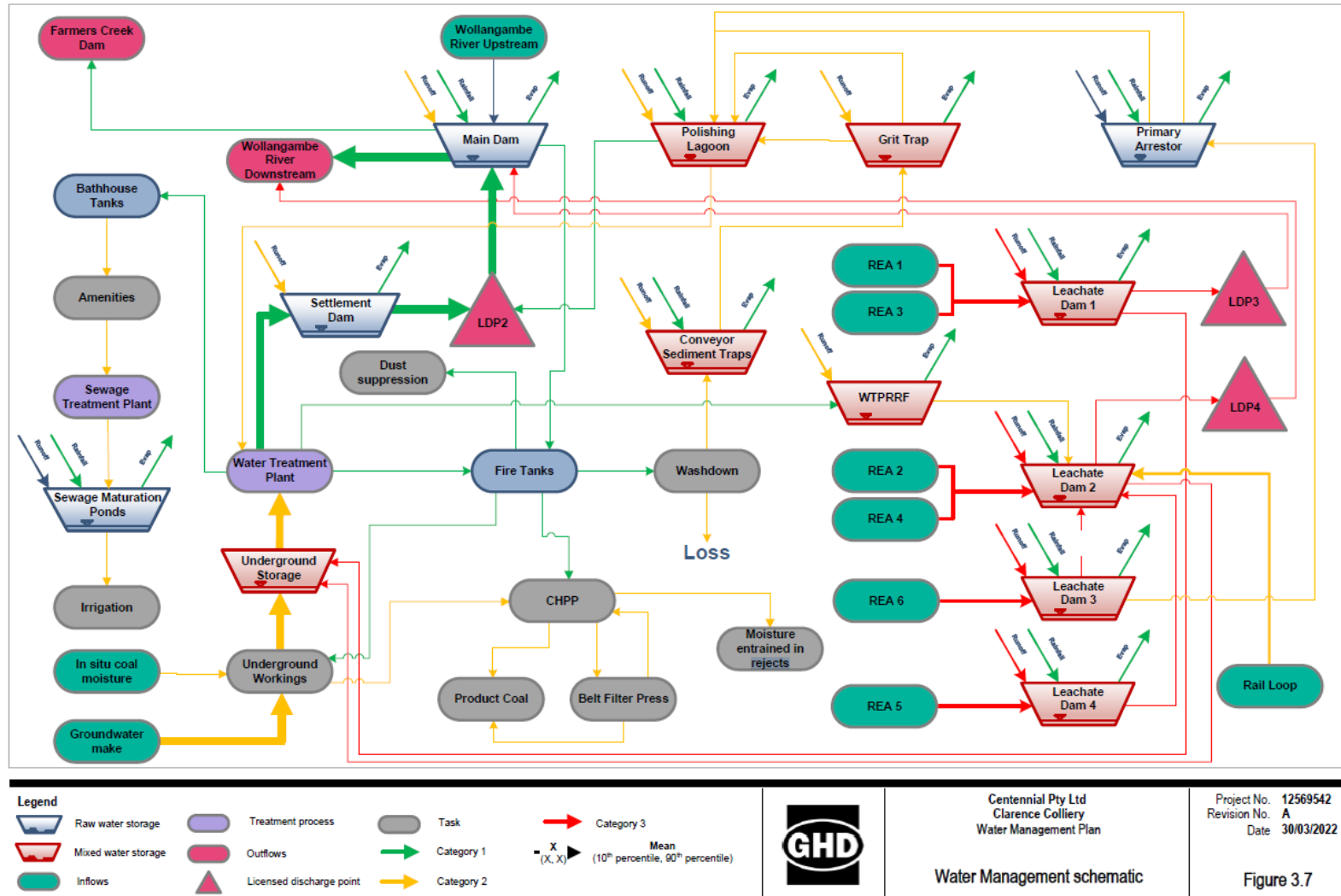


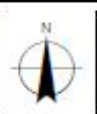
Figure 6.2 Water balance model – water management schematic (Centennial 2022)



LEGEND

Mine lease boundary	Dirty water (drain)	Water storage	Waterway
Licensed discharge point	Dirty water (pipe)	Water storage	Non perennial
Clean water (drain)	Water storage	Perennial	
Clean water (pipe)			

Paper Size A4
 0 80 120 160 240 300
 Metres
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1994
 Grid: GDA 1994 MGA Zone 58



Clarence Colliery
 MP-2041 Water Management Plan
 Job Number: 22-12575473
 Revision: 0
 Date: 05 May 2022

Surface water management system

Figure 3-2

Figure 6.3 Surface water management system (Centennial 2022)

6.1.1 Water storage structures

There are fourteen main water storage structures connected to the four WMS. The structures, purpose, capacity, and relationships are shown in Table 6.1.

Table 6.1 Water storage structures

Structure	WMS	Capacity (ML)	Comments
Main Dam	Clean	38.4	Receives discharge from LDP002 and LDP003. Supplements Lithgow town water supply when required by council. Discharges to Wollangambe River.
Conveyor sediment traps	Dirty	0.03	Sediment control structure. Overflows to Grit Trap.
Grit Trap	Dirty	1.0	Captures coarse material. Overflows to Polishing Lagoon.
Primary Arrestor	Dirty	3.0	Sediment control structure. Overflows to Polishing Lagoon.
Polishing Lagoon	Dirty	9.1 (5.0 ML environmental containment freeboard)	Outflow via pumps to the WTP. In high rainfall events overflows to Main Dam via LDP002. <i>(NOTE: On the 1 February 2024, Centennial were provided a prevention notice connected to EPL726, which included ceasing all discharge from the Polishing Lagoon to LDP002 and/or any other location that would enable a discharge from the Polishing Lagoon into the Wollangambe River.)</i>
Settlement Dam	Dirty	3.2	Treated water storage. Overflows to Main Dam via LDP002.
Leachate Dam 1	Leachate	2.8 (1.7 ML environmental containment freeboard)	Collects from REA 1 and REA 3. Transfer to underground storage. Overflows to Main Dam via LDP003.
Leachate Dam 2	Leachate	9.6	Collects from REA 2 and REA 4. Transfer to underground storage. Overflows to Wollangambe River via LDP004.
Leachate Dam 3	Leachate	8.9	Collects from REA V1. Transfer to Leachate Dam 2. Overflows to Polishing Lagoon.
Leachate Dam 4	Leachate	12.0	Collects from REA V. Transfer and overflow to Leachate Dam 2.
301 Sump	Underground	Large capacity (volume not available)	Groundwater inflow from adjacent strata. Located in the lowest region of the existing workings (including the old longwalls and the 600 Area).
203 Area	Underground	40	Groundwater inflow from adjacent strata, 301 Sump, 304 Area, and infiltration from leachate dams. Water blends before being pumped to the WTP. Sediment settlement with a retention time of two to four days.
304 Area	Underground	Small capacity (volume not available)	Groundwater inflow from adjacent strata, 301 Sump, and 310 Area.

Structure	WMS	Capacity (ML)	Comments
310 Area	Underground	Small capacity (volume not available)	Groundwater inflow from adjacent strata.

The underground water management areas and transfers are shown in Figure 6.4. The major inputs into the underground water storage are (IEMA 2024):

- groundwater inflow from the coal seam and adjacent strata
- transfer of leachate water underground from Leachate Dam 1 and Leachate Dam 2
- transfer of water underground from the fire tanks for mining activities.

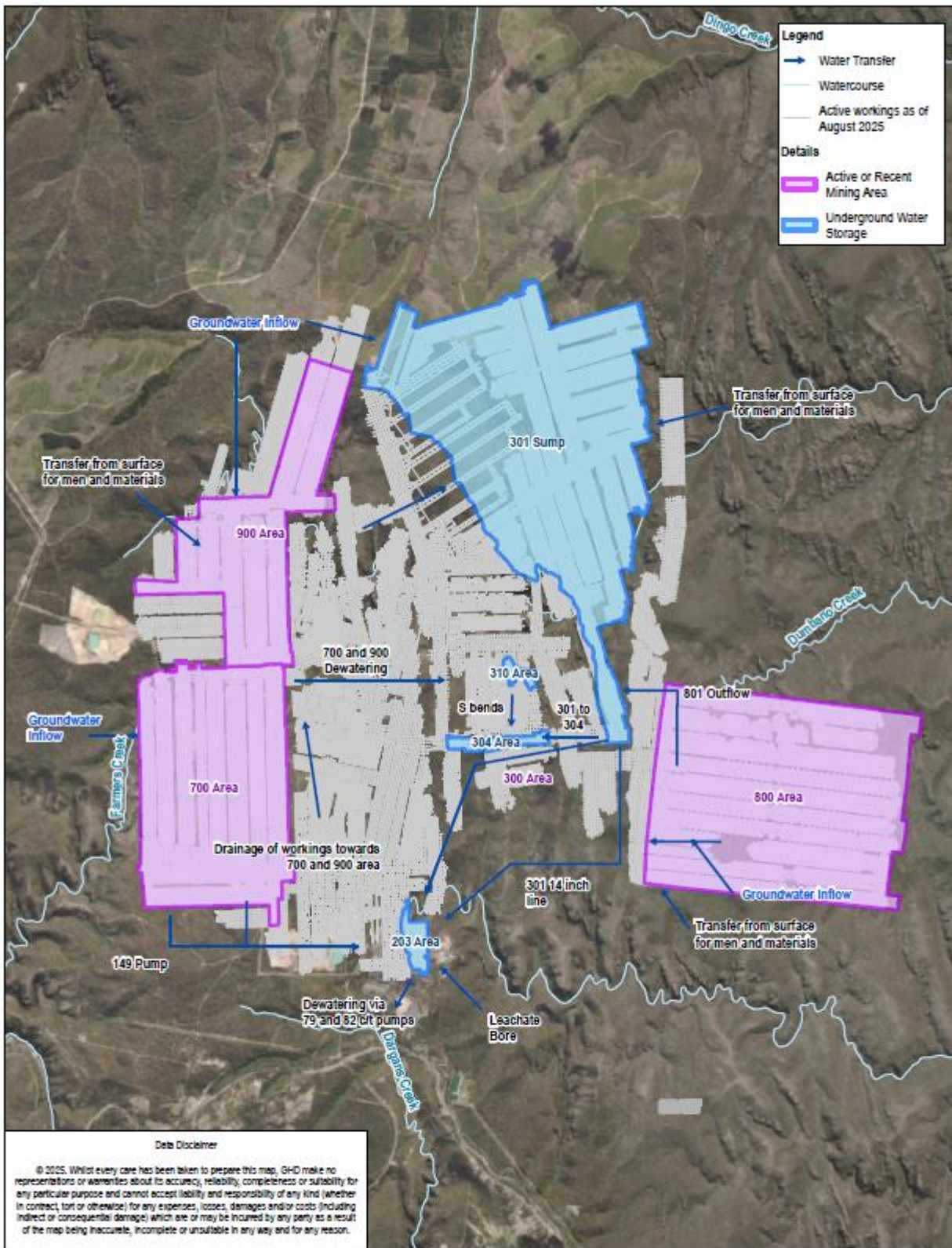


Figure 6.4 Underground water management (Centennial 2025)

6.1.2 Water treatment

i Water treatment plant

The WTP treats a blend of raw mine water and leachate water. It has a capacity of approximately 25 ML/d. Water is pumped from the 203 Area via two bores, 79 c/t and 82 c/t. The WTP uses aeration, chemical dosing and dissolved air flotation (DAF) to treat the water. The primary aim is to reduce concentrations of dissolved manganese and iron. The WMP details the treatment process (Centennial 2022).

The WTP by-product is decanted to the dirty WMS. Treated water is dosed with acid to reduce the pH and supplies the fire tanks and bathhouse tanks. The remaining treated water is transferred to the Settlement Dam and discharged via LDP002. The specific performance of the Settlement Dam, post treatment has identified further opportunity for improvement (Centennial 2022).

Transfer of water underground prior to treatment at the WTP and discharge via LDP002 is intended to achieve a consistent quality of feed water for the WTP process and therefore adequate performance of the WTP.

In the 2024 Annual Review (Centennial 2025), non-compliances regarding exceedance of concentration limits at LDP002 were reported in 11 months of the reporting period. The immediate actions which have been completed and/or are ongoing to address these non-compliances into the future include the following:

- Additional treatment tank with increased treatment capacity – Complete.
- Optimisation of the WTP including multi-staged pH adjustment – Ongoing.
- Regular reviews of pH calibration of critical probes monitoring the WTP – Ongoing.
- Pre-treatment of the WTP feed water (via chemical dosing) to improve DAF performance – Ongoing.
- Routine desilting of the treated water settlement dam – Ongoing.
- Weekly meetings with senior management regarding LDP002 management – Ongoing.
- In 2025, Centennial engaged independent water treatment specialists to trial a media filtration WTP which utilises various physical media to increase residence time and improve the removal of colloidal particles and dissolved metals. The small-scale trial has been completed which confirms this process will likely be effective. Capital funding has recently been approved to improve the water treatment process (IEMA 2024).
- A Pollution Studies and Reduction Program (PRP) is in place to mitigate discharges from LDP002 into the Wollangambe River – Ongoing.

For the three-year period prior (12 October 2020 to 26 October 2023), in the most recent independent environmental audit (IEMA 2024), it was stated that although there have been non-compliances relating to discharge criteria, these have been minor and there is no evidence of material harm.

ii Sewage Treatment Plant

Effluent generated on site is treated by a STP to a tertiary level, before being discharged to a twin pond system, from which effluent irrigation occurs onto dedicated catchment areas (Centennial 2022). Table 6.2 summarises the components of the wastewater management system.

Table 6.2 Wastewater management system components (Centennial 2022)

Sewage management system component	Description
Sewage treatment level	Tertiary
Effluent storage available	1.36 ML
FTE personnel	Up to 400
Effluent generation rates	56 kilolitres per day (kL/d), assuming 140 litres per day (L/d) per person
Irrigation type	Sprinkler
Irrigation area	8.7 hectares (ha) (REA III not able to be used for irrigation due to EPA concerns for uncontrolled runoff to Wollangambe River)

Effluent irrigation activities were last assessed in detail in 2019 as part of the approved increase in personnel from 300 to 400 people. EMM utilised existing information to review the water balance specifically associated with the effluent irrigation activities. The results of the review indicated that a minimum irrigation area of 7 ha and a storage of 1,360 kL would restrict potential overflows of the system to an average of once per year. The WMP (Centennial 2022), summarises the effluent quality parameters and also the activities and controls in place to minimise risk associated with effluent irrigation.

6.1.3 Erosion and sediment control

Erosion and sediment control is managed to reduce soil loss in all phases of operation. As an established mine, no new areas are required to be disturbed for the modification. Disturbed areas are either active, such as coal stockpiles, or are rehabilitated to prevent erosion. The WMP details the erosion and sediment control plan (ESCP).

The ESCP also summarises the water quality objectives for disturbance works that may occur outside a LDP catchment. These are provided in Table 6.3.

Table 6.3 ESCP water quality objectives (outside licensed discharge point catchment)

Parameter	Units	Concentration limit
pH	pH units	6.5–8.5
Oil and grease	mg/L	10
Total suspended solids (TSS)	mg/L	30

During the IEMA (2024), the current ESCP was considered compliant and it was found that the implementation of the ESCP is well managed across the site, with evidence of clean and dirty water separation and routine inspections being carried out. Four improvement recommendations relating to erosion and sediment around the pit top and Leachate Dam 1 were provided and Centennial addressed all improvements by December 2024.

6.1.4 Water balance

A site water balance model has been developed by GHD for Clarence Colliery to quantify water transfers within the site under existing operational conditions using various rainfall patterns. A summary of the predicted average annual inputs and outputs for the Clarence WMS from 2022 to 2024 calendar year is provided in Table 6.4. The model results are based on the predicted average site conditions from the year 2022 to 2024.

Table 6.4 shows that the largest source of inflow at Clarence Colliery is the dewatering of groundwater inflows to the underground workings and the largest water loss is the discharge to the Wollangambe River via LDP002. The Main Dam is located downstream of LDP002, which is where site operational demands of approximately 600 ML/yr on average are extracted under 10WA103852. Water from the Main Dam is pumped to the three fire tanks for use as process water (e.g. underground process water and washery make-up water) and as a permanent supply of water for fire-fighting purposes.

Table 6.4 Water balance summary

Water management element	Average modelled volume in 2022 (ML)	Average modelled volume in 2023 (ML)	Average modelled volume in 2024 (ML)
Water sources (Inflows)			
Direct rainfall onto storages	14	7	10
Catchment runoff	329	147	267
Groundwater inflows into underground workings	6,005	5,346	5,706
In-situ coal moisture	188	45	44
Transfers from Main Dam	833	17	280
Total inputs (rounded)	7,369	5,720	6,307
Water loss (Outflows)			
Evaporation from storages	14	10	12
Discharge through outlets LDP002	6,926	6,479	6,988
Discharge through outlets LDP003	0	8	19
Discharge through outlets LDP004	0	1	2
Irrigation	18	13	14
Dust suppression losses	265	184	172
Wash down losses	27	60	47
Coal product	569	126	123
Moisture entrained in reject material	75	15	16
Total Outputs (rounded)	7,895	6,896	7,393
Change in storage			
Total change in storages	-527	-1,176	-1,086
Water balance			
Change in water inventory (inputs – outputs – change in storage)	0	0	0

Source: Average 2022 annual volumes (modelled) sourced from the WMP (Centennial 2022).

Average 2023 and 2024 annual volumes (modelled) sourced from Clarence Water Accounting Framework.

Water supply to meet site operational demand is sourced from surface water stored on site and groundwater inflows into underground workings treated by the WTP. Water supply from clean water sources is minimised by reuse and recirculation of water on site. Given the security of groundwater extracted from the underground workings, there are no significant water supply risks associated with achieving appropriate environmental management requirements (Centennial 2022).

6.1.5 Leachate water management

As described in the WMP (Centennial 2022), Clarence Colliery has six approved reject emplacement areas (REAs) with REA I, II, IV, and VI having reached capacity and are no longer in use for the emplacement of coarse reject material. Rehabilitation of these REAs includes reshaping, capping and installing lined drainage channels and revegetation. REA III and V are the only currently operational REA. A leachate collection system has been designed to intercept any leachate from the REAs within the following four leachate dams:

- Leachate Dam 1 – Collects runoff from REA I and REA III
- Leachate Dam 2 – Collects runoff from REA II and REA IV
- Leachate Dam 3 – Collects runoff from REA VI
- Leachate Dam 4 – Collects runoff from REA V.

Leachate water is transferred from Leachate Dam 4 and Leachate Dam 3 to Leachate Dam 2. Leachate water from Leachate Dam 1 and Leachate Dam 2 is transferred to the underground. Transfer of water underground prior to treatment at the WTP and discharge via LDP002, is intended to achieve a consistent quality of feed water (blended with underground water) for the WTP process.

An assessment was completed by GHD (2020b) to estimate the performance of the existing leachate management system against the 2% annual exceedance probability (AEP). Based on hydrologic and hydraulic modelling, the assessment found that:

- in isolation, the water storage capacity of Leachate Dam 3 and Leachate Dam 4 were adequate to contain runoff from the 2% AEP, 24-hour duration design rainfall event
- Leachate Dam 1 would fill and discharge over the spillway via LDP003 for the 2% AEP design rainfall event
- Leachate Dam 2, Leachate Dam 3 and Leachate Dam 4 are adequate to contain and recirculate runoff from the 2% AEP design rainfall event to prevent discharge to surface waters via their respective spillways
- however, upwelling from the leachate bore under the 2% AEP design rainfall event means that water from Leachate Dam 2, Leachate Dam 3 and Leachate Dam 4 has the potential to indirectly discharge offsite to surface waters
- no off-site discharges were predicted for the 50% AEP design rainfall event.

Opportunities to increase the capacity of the existing system to meet the adopted design were identified as part of the assessment by GHD (2020b).

6.2 Surface water management

6.2.1 Surface water licensing

Centennial holds water supply work approval 10WA118714 under the Greater Metropolitan Regional Unregulated River Water Sources WSP for the dam wall and spill way of Main Dam on the Wollangambe River. Water flow in the river is required to be equal to the natural flow or 0.05 ML/d, whichever is lesser. Centennial holds a joint water supply works approval 10WA103852 with LCC and water use approval 10UA103853, linked to WAL26195 for 1,293 units. This is for the Clarence WTS to transfer water from Main Dam to Farmers Creek Dam (Centennial 2022). Given the predominate wet conditions present over recent years, the use of the Clarence WTS has been minimal.

Wollangambe River sub-catchment drains the south-east part of Clarence Colliery, including the pit top area, with water licensed to be discharged into the river via LDP002, under EPL 726. LDP002 is the main discharge point for the site, releasing water into the Main Dam which is located within the upper reaches of the river. Wollangambe River flows north-east through the Blue Mountains National Park and Wollemi National Park and then joins the Colo River approximately 47 km downstream of Clarence Colliery.

6.2.2 Surface water monitoring

Surface water monitoring is undertaken in accordance with the Clarence Colliery WMP, Development Consent DA 504-00 and EPL 726 requirements. The site has also developed trigger action response plans (TARPs) to identify and manage potentially adverse impacts, as well as assist with managing the site's surface water during storm events. The surface water monitoring locations are summarised in Table 6.5 and shown in Figure 6.5.

Table 6.5 Surface water monitoring locations

Monitoring group	Location	Comment
Surface water quality	<ul style="list-style-type: none">Main DamLeachate Dam 1 (linked with LDP003)Leachate Dam 2 (linked with LDP004)Leachate Dam 3Leachate Dam 4Raw Polishing LagoonSettlement Dam/Clean Water lagoon inlet (post treatment at the WTP and prior to LDP002)Wollangambe River USWollangambe River DS (EPL monitoring point 9)Farmers Creek USFarmers Creek DSBungleboori Creek USBungleboori Creek DSPaddys Creek	<p>Monitoring undertaken on a monthly/quarterly basis for water quality.</p> <ul style="list-style-type: none">Refer to Table 4.1 of the WMP for the monitoring frequency and parameters of each location.Surface water site-specific guideline values (SSGVs) are set out in Table 6.1 of the WMP.
Surface water flow	<ul style="list-style-type: none">Wollangambe River USWollangambe River DSFarmers Creek USFarmers Creek DSPaddys CreekBungleboori Creek USBungleboori Creek DS	<p>Monitoring undertaken during water quality sampling.</p> <ul style="list-style-type: none">Refer to Section 4.2.2 of the WMP for the monitoring frequency and methodology of each location.The performance criteria is set out in Table 6.7 of the WMP.

Monitoring group	Location	Comment
Swamp	<ul style="list-style-type: none"> • Barrier Swamp • Murrays Swamp • Oleria Swamp 1 • Oleria Swamp 2 • Upper Dingo Swamp • Bungleboori North #2 • Brown Swamp • Dargans DS • PSE1 • PSE2 • Island Swamp • Waterfall Swamp • Muddy Swamp 	<p>Monitoring undertaken on a monthly basis for water quality and flow.</p> <ul style="list-style-type: none"> • Refer to Table 4.2 of the WMP for the monitoring parameters of each location. • The performance criteria is set out in Table 6.7 of the WMP.
Discharge water	<ul style="list-style-type: none"> • LDP002 • LDP003 • LDP004 	<p>Flow monitoring is undertaken daily (inline instrumentation) at LDP002 and daily during discharge (estimated) for LDP003 and LDP004.</p> <p>Water quality monitoring is undertaken monthly at LDP002 and monthly during discharge for LDP003 and LDP004.</p> <p>Conductivity and pH are monitored monthly during discharge at all LDPs.</p> <ul style="list-style-type: none"> • Refer to Table 4.6 of the WMP for the monitoring frequency and parameters of each location. • The discharge water criteria are specified in EPL 726 for volumetric limits and water quality limits.
Underground water transfers	<ul style="list-style-type: none"> • Fire Tanks to underground workings • Underground storage to WTP (via 79 c/t and 82 c/t dewatering bores) • Transfer from Leachate Dam 1 and Leachate Dam 2 to the underground workings via leachate bore. 	<p>Monitoring undertaken daily for flow and monthly for water quality.</p> <ul style="list-style-type: none"> • Refer to Table 4.5 of the WMP for the monitoring frequency and parameters of each location. • The performance trigger is described in the TARPs in Appendix J of the WMP.

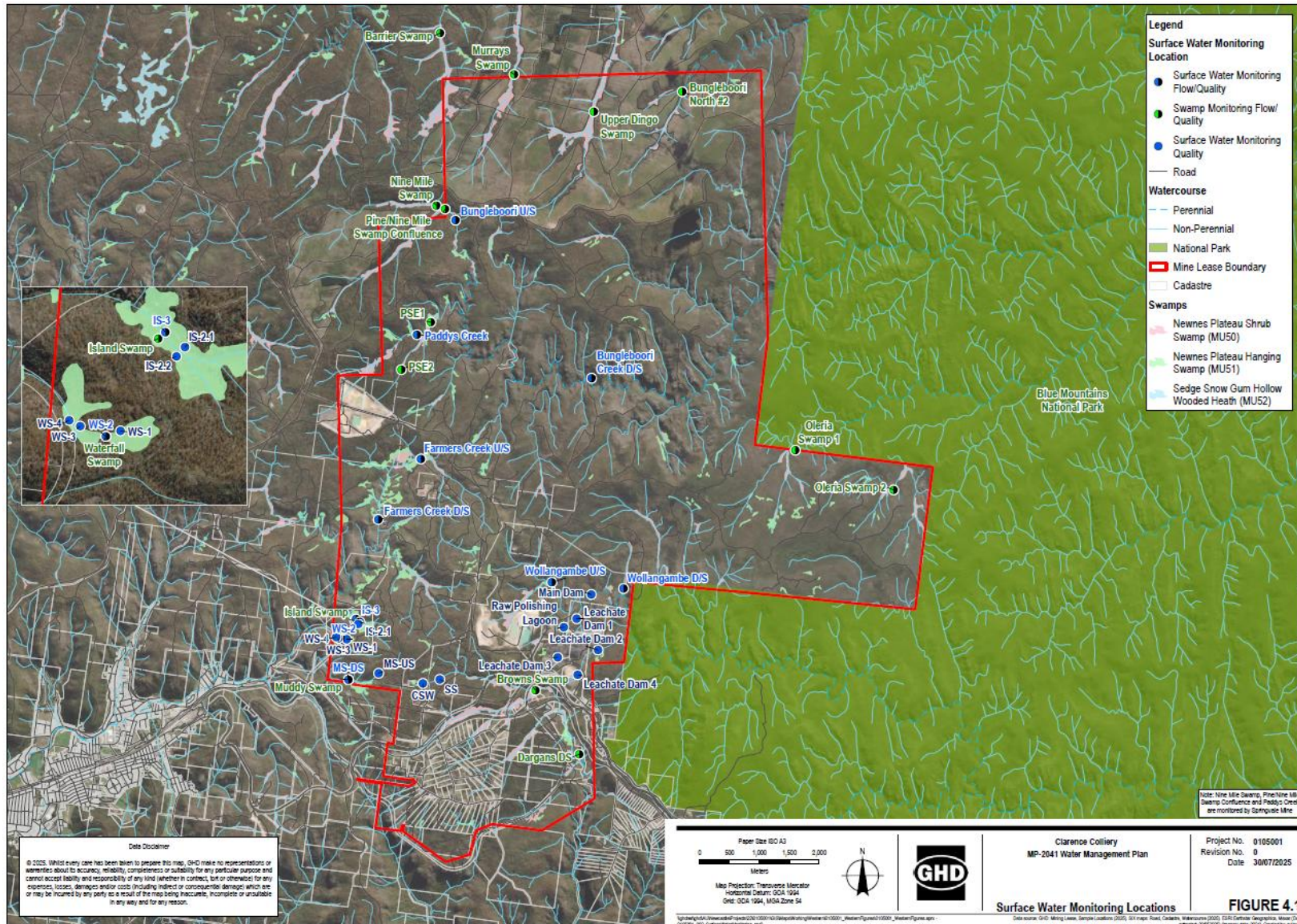


Figure 6.5 Surface water monitoring locations

6.2.3 Surface water management performance

This section summarises the non-compliances in regard to criteria exceedances from 12 October 2020 to 31 March 2025, as reported in documentation provided to EMM and outlined in Table 6.6.

Table 6.6 References used to summarise non-compliances

Reference	Period of reporting/Selected months
2023 Independent environmental audit report (IEMA 2024)	12 October 2020 to 26 October 2023 (3 years)
Monthly environmental monitoring reports	November 2023 December 2023
2024 Annual review report (Centennial 2025)	1 January 2024 to 31 December 2024
Monthly environmental monitoring reports	January 2025 February 2025 March 2025

The non-compliances that have been specifically reported pertain to:

- water quality at LDP002, LDP003 and LDP004 (against EPL 726 limits)
- water volume at LDP002 (against EPL 726 limits)
- water quality at EPL Point 9 (against the SSGVs).

No other non-compliances regarding surface water monitoring and criteria exceedance have been discussed in the 2023 audit report or the 2024 annual review report and therefore this assessment keeps to only these documented non-compliances.

i Surface water quality

a LDP002

The documented water quality non-compliances at LDP002 are summarised in Table 6.7.

Table 6.7 LDP002 water quality non-compliances

Reporting period/Dates available	No. of non-compliances*	Non-compliant analytes	Reported description
2020 (12 October 2020 to 31 December 2020)	1	Limited details provided.	Non-compliances were minor and there was no evidence of material harm. There were no fines relating to discharge events (IEMA 2024).
2021	7	Cobalt, zinc, copper, iron, nitrogen and nickel.	
2022	6	Zinc, cobalt, nickel, TSS, nitrogen and phosphorus.	
2023 (until 26 October 2023)	7	Nitrogen, phosphorus, copper, nickel, zinc and cobalt	

Reporting period/Dates available	No. of non-compliances*	Non-compliant analytes	Reported description
2023 (November and December)	2	Cobalt, zinc, phosphorus, nickel	
2024	11	Copper, nickel, zinc, nitrogen, phosphorus, silver, cobalt, mercury	Exceedances are of a minor nature and the limits are extremely low to ensure a neutral or beneficial impact on the surrounding environment. It is therefore determined that these exceedances have not resulted in material harm to the environment (Centennial 2025).
2025 (until 31 October 2025)	9	Cobalt, zinc, phosphorus	

Note: *Some inconsistencies exist between reference documents in counting non-compliances, hence where possible, EMM has gone back through the detailed non-compliance tables and counted the months with criteria exceedances.

Non-compliances have been assessed minor and have not resulted in material harm to the environment.

b LDP003 and LDP004

In the 2024 annual review report (Centennial 2025), no non-compliances were recorded for water quality at LDP003 and LDP004. This is due to the EPL 726 condition, that concentration limits are deemed not to apply when the discharge occurs solely as a result of rainfall measured at the site that exceeds a total of 56 mm of rainfall over any consecutive five-day period. Water quality monitoring at LDP003 and LDP004 is not documented in the 2023 audit report (IEMA 2024) or the monthly environmental monitoring reports.

c Wollangambe River DS (EPL Point 9)

The water quality exceedances at EPL Point 9 are summarised in Table 6.8. The exceedances are not presented as a number count, but instead as concentration statistics compared to the SSGVs.

Table 6.8 EPL Point 9 water quality (SSGV) exceedances

Reporting period/Dates available	Non-compliant analytes (mean of sample)	Non-compliant analytes (highest sample value)	Reported description
12 October 2020 to 26 October 2023	<i>No reporting in 2023 audit report.</i>		The Wollangambe River downstream location data is not reviewed monthly against SSGVs, therefore the site is non-compliant for implementation (IEMA 2024). No reference was made to non-compliance for water quality.
2024 (14 samples collected and analysed over the year)	EC, TSS, nitrate, nitrate + nitrite, nitrogen, phosphorus, barium, boron, chromium, lead, lithium, molybdenum, nickel, silver, strontium, zinc.	EC, TSS, turbidity, nitrate, nitrate + nitrite, nitrogen, phosphorus, barium, boron, chromium, copper, lead, lithium, molybdenum, nickel, silver, strontium, zinc.	

Reporting period/Dates available	Non-compliant analytes (mean of sample)	Non-compliant analytes (highest sample value)	Reported description
2025 (1 sample per month)		February 2025 – EC, barium, chloride, cobalt, lithium, nickel, nitrate, nitrogen, phosphorus, rubidium, strontium, zinc. March 2025 – EC, barium, cobalt, lithium, nickel, phosphorus, rubidium, strontium, zinc.	Only February 2025 and March 2025 monthly environmental monitoring reports reported on EPL Point 9.

ii [Surface water flows](#)

a [LDP002](#)

In the 2024 annual review report (Centennial 2025), the mean and highest recorded volumetric flows at LDP002 were 19,244 kL/d and 36,085 kL/d. All occasions where discharge was greater than 25,000 kL/d, coincided with greater than 10 mm of rainfall, which is permitted under EPL 726.

No volumetric flow non-compliances were documented in the 2023 audit report (IEMA 2024) and for all the monthly environmental monitoring reports provided between January 2023 to March 2025, no exceedances were recorded at LDP002.

iii [Underground water transfers](#)

The following three underground water transfers occur at Clarence Colliery:

- fire tanks to underground workings
- underground storage to WTP
- transfer from Leachate Dam 1 and Leachate Dam 2 to the underground workings.

The TARP for the underground transfers is as follows (Centennial 2022):

- Stage 1 - Trigger for Clarence Colliery is an increase in flow, measured at the surface, resulting in a greater dewatering effort for the mine to maintain controlled underground storage levels.
- Stage 2 - Groundwater inflow trigger is representative of an exceedance of modelled groundwater inflow (based on inflow predictions from hydrogeological modelling prepared in 2019 by GHD). Following an exceedance of this trigger, the hydrogeological model will be re-calibrated to observed groundwater inflow. If observed inflows exceed the licensed volume under the WALs held by Centennial, then additional WAL allocation will be required to be purchased or traded to cover the excess groundwater volume.

iv [Creek stability and subsidence management](#)

The TARP appended to the WMP notes that stream health monitoring (including watercourse stability monitoring) is only undertaken if subsidence recorded is 1.5 times greater than predicted values. In the 2024 annual review report (Centennial 2025), it is noted that all subsidence results for the past five years (2020-2024) have been below the 100 mm maximum predicted (with the exception of the older panels within the IRM.GE.76 development consent area and the 2022 900D exceedance).

6.3 Groundwater management

6.3.1 Groundwater licensing

Centennial holds two WALs for the extraction of groundwater from the *Sydney Basin West Groundwater Source* under the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan*:

- WAL36479 for 6,623 unit shares
- WAL41882 for 1,095 unit shares.

6.3.2 Groundwater monitoring

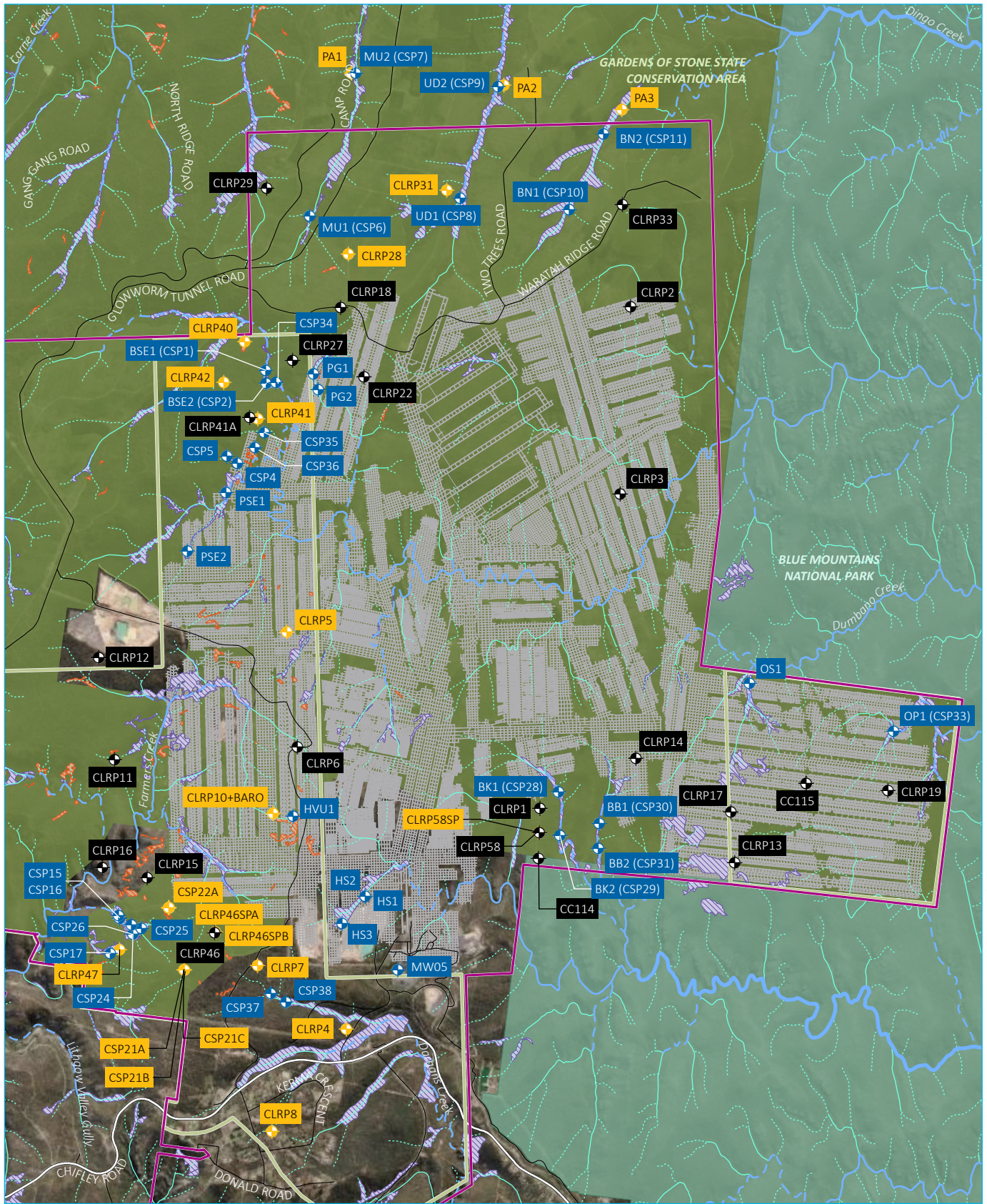
The objective of the Clarence Colliery groundwater monitoring network is to monitoring groundwater level and flow conditions, to detect potential impacts to groundwater systems caused by coal mining. Groundwater monitoring events are conducted every two months to manually gauge groundwater levels, download data loggers and perform routine maintenance. The current groundwater monitoring network is presented in Figure 6.6 and comprises of:

- **Swamp piezometers** -28 piezometers installed across 14 swamps to detect potential mining-related impacts on the swamp groundwater regimes. Groundwater level data loggers record on a daily interval.
- **Open borehole standpipe piezometers (standpipe piezometers)** – 19 piezometers installed within the perched and shallow groundwater systems to detect potential mining-related impacts on the Clarence Aquifer. Groundwater level data loggers record on a daily interval.
- **Vibrating wire piezometers (VWP)** – 18 locations. A network of VWPs measure pore pressure in multiple hydrogeological horizons above the Katoomba Seam to detect mining-related impacts within the shallow and deep groundwater systems. Additionally, VWPs are used to detect any mining induced hydraulic connectivity between the shallow and deep groundwater systems. Data is recorded by data loggers on a daily basis.

Groundwater quality is also collected quarterly at selected standpipes of Clarence Colliery's groundwater monitoring network (including CLRP4, CLRP5, CLRP7 and CLRP8) for parameters set out in Table 4.4 of the WMP. These locations focus on the quality within the Banks Wall Sandstone, specifically the Clarence Aquifer as it is used by a number of landholders in the vicinity of Clarence Colliery.

The details of the groundwater monitoring network are presented in section 4.3 of the WMP and details of the whole monitoring network is provided in Appendix A.

The groundwater level and water quality data is analysed for any trends or potential mining related impacts and presented in the Subsidence Management Status Report (SMSR) submitted to relevant stakeholders every four months as required by the Subsidence Management Plan (SMP).



Source: EMM (2025); ABS (2021); DCSSS (2024); ESRI (2025); GA (2009); ASGC (2006)

KEY

- | | | |
|---|--|--|
| <ul style="list-style-type: none"> Clarence Colliery Holdings Area DA504-00 consent boundary Existing mining extent Monitoring bore ◆ Standpipe ◆ Swamp ◆ VWP | <ul style="list-style-type: none"> Temperate Highland Peat Swamps on Sandstone EEC Hanging swamp Shrub swamp Strahler stream order — 1st order — 2nd order — 3rd order — 4th order — 5th order | <ul style="list-style-type: none"> Existing environment Major road Minor road NPWS reserve State conservation area State forest |
|---|--|--|

Groundwater monitoring locations

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure 6.6



\\emm.local\drive\2025\E250102-Clarence MOD 11\GIS\02-Maps\WRIA\WRO06-GroundwaterMonitoring\WRO06-GroundwaterMonitoring_20260130_03.aprx 30/01/2026

6.3.3 Groundwater management performance

i Swamp piezometer

Groundwater levels at swamp piezometers are routinely assessed against the predefined groundwater trigger levels set out in Table 6.2 of the WMP and the TARPs in Appendix J of the WMP.

The review of the monitoring data has shown that groundwater levels have remained unimpacted by mining activity. The hydrographs of the swamp piezometers are presented alongside the CRD and daily rainfall in Appendix B.1.

The swamps are generally permanently waterlogged due to a significant groundwater contribution and captured of surface runoff. The water level trends are consistent with the prevailing climatic conditions, corresponding to the CRD trend, and fluctuating in response to rainfall events. Some swamp piezometers (HS3 and HVU1) experienced periods of dryness which coincided with an extended period of below average rainfalls as denoted by the prolonged decreasing CRD trend.

ii Standpipe piezometer

Groundwater levels at standpipe piezometers are routinely assessed against the predefined groundwater trigger levels set out in Table 6.3 of the WMP. Groundwater quality trigger values are set out in Table 6.5 of the WMP but are not subject to any specific compliance conditions.

The review of the monitoring data has shown that groundwater levels and groundwater quality has remained unimpacted by mining activity. The hydrographs of the standpipe piezometers are presented alongside the CRD and daily rainfall in Appendix B.2.

Standpipe water levels have recorded trends corresponding to the prevailing climatic conditions, showing a subdued reflection of the CRD. Locations that have been historically directly undermined (i.e. CLRP and CLRP10) have not shown any observable responses to mining to date (i.e. no observable impact to the shallow aquifers). The Independent Environmental Audit (IEMA 2024) for Clarence Colliery also found that groundwater quality remained unimpacted by mining activities.

iii Vibrating wire piezometers

Groundwater piezometric pressures at VWP are routinely assessed against the predefined groundwater trigger levels set out in Table 6.4 of the WMP (specifically in piezometers above the MYC). It is important to note that not all VWPs have trigger levels defined in the WMP.

Based on previous reviews of site hydrogeology it is assumed that groundwater elevations in the Banks Wall Sandstone, above the MYC aquitard, will be unaffected by underground mining as it has limited hydraulic connectivity to the deeper groundwater system (Section 4.6). Aquifer units below the MYC (i.e. within the Burra Moko and Caley Formations) are expected to show depressurisation due to downward vertical gradients caused by underground mining and dewatering.

The review of the monitoring data continues to show that the piezometers above the MYC have generally not shown observable responses to mining (i.e. no observable impact). The Clarence Colliery groundwater correlation assessment (EMM 2025b) found groundwater levels across the swamp, standpipe and VWPs in hydrogeological units above the MYC show mostly strong positive correlation with rainfall trends indicating that groundwater level trends are primarily climate driven rather than mining related. The hydrographs of the VWPs are presented alongside the CRD and daily rainfall in Appendix B.3. It is noted that several data gaps exist due to decommissioning after fire damage in the Gospers Mountain bushfire in 2019-2020, and due to logger failure and logger servicing.

Pore pressures above the MYC show stable trends or trends that are consistent with climatic observations. An exception was observed at CLRP13 where some depressurisation was observed in piezometers #3 and #4 (above the MYC) in August 2021 and May 2022 due to the active mining of Panel 818A and Panel 822, however the depressurisation response was not large enough to exceed the trigger level.

Below the MYC, depressurisation responses were observed at multiple VWP locations coinciding with mining activity. Locations that observed some depressurisation include CLRP2, CC115, CLRP13, CLRP14, CLRP19, CLRP22 and CLRP27. In some instances, communication with some deeper piezometers have been lost following undermining.

iv Groundwater licensing

In the Independent Environmental Audit (IEMA 2024) for the period from October 2020 to October 2023, the groundwater take did not exceed Centennial's entitlement.

The groundwater take for the 2023/24 water year (from 1 July 2023 to 30 June 2024) of 6,578 ML was also below the total entitlement of 7,718 ML. It is noted that during this period, the *WSP for the Greater Metropolitan Region Groundwater sources 2023* commenced, amalgamating the previous water sources into the one Sydney Basin West Groundwater Source.

Across all three collieries (Angus Place, Springvale and Clarence), the 2023/24 total water take of 22,628.1 ML was within the 24,629 ML entitlement.

v Groundwater inflows

Extraction of water from the underground is strongly correlated with rainfall trends. Extraction volumes are around 9 to 12 ML/d during drought conditions, 12 to 18 ML/d during normal rainfall periods and 19 to 23 ML/d during wet periods. The timeseries of water inflow to and outflows from the underground is presented in Figure 6.7.

During the wet period between 2021 and 2023, the inflows exceeded outflows (pumping) for 10 successive quarters. The average inflow was 23.2 ML/d against an average pumping rate of 17.5 ML/d from 2022, resulting in a surplus that is stored underground in historical workings.

The cumulative underground storage volume for the 301, 810, 906 to 910 panel areas is presented in Figure 6.8. It shows the storage volume increasing between the wet period of 2021 to 2023 and stabilising as the inflows balanced with the dewatering system capacity. Based on calculations from March 2025, there is approximately 3,000 ML of additional storage remaining based on the additional storage created from the extraction in panel 806 and 804.

It is predicted that future extraction volumes from the underground will increase by approximately 5.4 ML/d as the mining area increases. Based on these increases, the current pumping capacity (18.5 ML/d) may be inadequate, particularly during extended wet periods. This will be managed through the planned improvements, including increased treatment capacity, water transfer and sealing strategy (Section **Error! Reference source not found.**)

However, it is important to note that the mining area will not change as part of MOD 11.

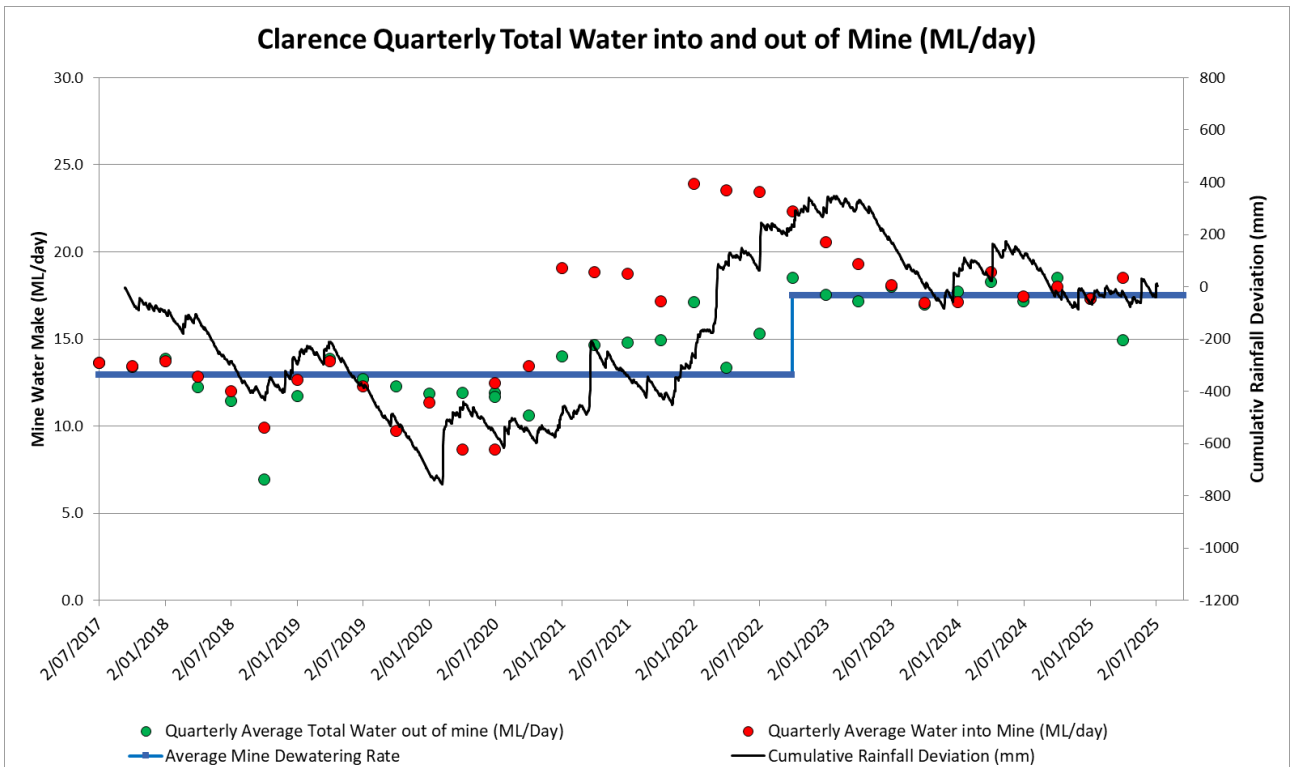


Figure 6.7 Clarence Colliery mine inflow and outflow (Centennial pers. comm. 2025)

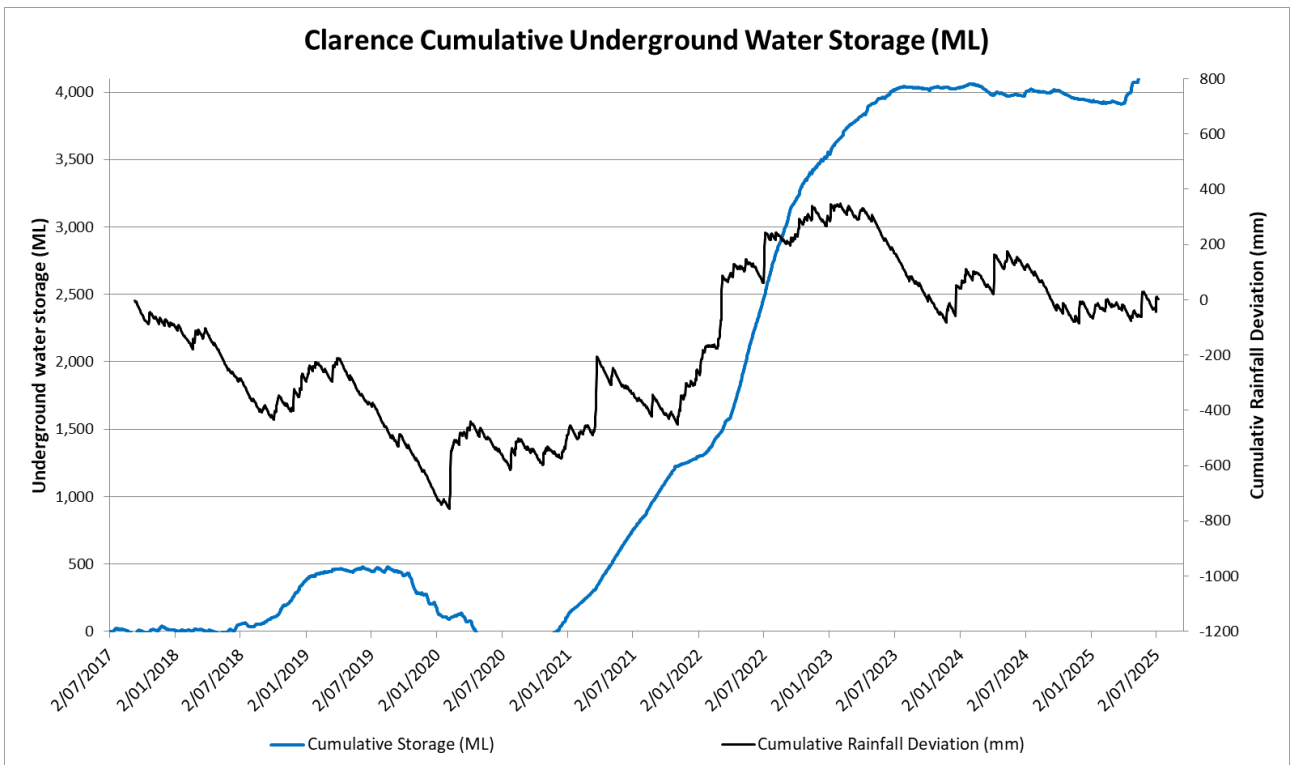


Figure 6.8 Clarence Colliery underground storage volume (Centennial pers. comm. 2025)

7 Risk assessment

7.1 Key potential risks

Mining at Clarence Colliery will continue within the current approved mining areas. The modification does not propose changes to mining depth or extent, disturbance area, or waste and water management. Therefore, the changes under the modification relate to an extension in mining duration only.

The potential effects associated with extending mining at Clarence Colliery are evaluated in Table 7.1. Further discussion on potential impacts to water resources and water-dependent assets is provided in the following sections.

Table 7.1 Summary of risk and potential impacts

Risk	Potential impact	Comments/mitigation measures
<p>Water management capacity</p> <ul style="list-style-type: none"> • Uncontrolled discharge from site • Water quality discharge in excess of EPL conditions • Inadequate WTP capacity 	<ul style="list-style-type: none"> • Impact on stream quality • Impact on water dependent receptors 	<ul style="list-style-type: none"> • Current ongoing practices to optimise the WTP (Section 6.1.2i) and continual implementation of non-compliance and improvement recommendations will improve reliability. There are further plans to upgrade the WTP to achieve more stringent discharge quality (Section Error! Reference source not found.). • Centennial has been in consultation with the EPA for several years as part of the PRP, with a long-term commitment in the mitigation of discharge via LDP002. This would be achieved through the CWPP. • Water quality non-compliances have occurred at LDP002 and the number of non-compliances has trended upwards during typically wet years. Non-compliances have been assessed minor and have not resulted in material harm to the environment. No non-compliances have been recorded for water quality at LDP003 and LDP004. Water quality exceedances at EPL Point 9 were included in the 2024 annual review report and 18 analytes exceeded the SSGV (Section 6.2.3i). • Upgrades of the WTP and water management systems are expected to improve environmental outcomes and mitigate the risks of future non-compliance. • Implementation of the CWPP and upgraded WTP will result in improved water management.
<p>Underground water levels</p> <ul style="list-style-type: none"> • High underground water volumes and high inflows • Inadequate pumping and dewatering capacity • Inadequate water storage capacity 	<ul style="list-style-type: none"> • Exceedance of operational capacity • Uncontrolled discharge or overflows in wet periods 	<p>The 2024 water balance shows decrease in storage volumes as rainfall returns to more average conditions (Section 6.1.4).</p> <p>There are planned improvements of the WTP to increase treatment capacity and improve the reliability of water quality performance in discharge volumes to manage the risk (Section Error! Reference source not found.).</p>

Risk	Potential impact	Comments/mitigation measures
Water licence exceedances <ul style="list-style-type: none"> Increased groundwater inflows during wet period Inadequate groundwater allocation 	<ul style="list-style-type: none"> Breach of licence conditions and allocations 	<p>The historical groundwater extraction (from 2020 to 2024) has been compliant with the total entitlements (Section 6.3.3iv).</p> <p>The WMP TARPs outline a response plan if the expected dewatering is likely to exceed the entitlement. An application will be made to increase the entitlement.</p> <p>The use of the Clarence WTS that transfers water from the Main Dam to Farmers Creek Dam to support Lithgow's water supply has been minimal due to the wet conditions over the recent years. The surface water transfer volumes have been within the allocated limits (Section 4.4.2).</p> <p>Residual impact: Low</p>
Water licence exceedances <ul style="list-style-type: none"> Excessive LDP002 discharge volumes 	<ul style="list-style-type: none"> Impact on stream quality Impact on water dependent assets Breach of licence conditions and allocations 	<p>EPL 726 specifies a volumetric limit of 25,000 kL/d for LDP002 discharge. If more than 10 mm of rainfall is recorded, then the discharge may exceed this limit.</p> <p>All occasions where historical discharge was greater than the limit, more than 10 mm of rainfall was recorded (Section 6.2.3iia). This is not expected to change under the modification.</p> <p>Residual impact: Low</p>
Aquifer disruption <ul style="list-style-type: none"> Mining induced groundwater drawdown/depressurisation Change (degradation) in groundwater quality Change in surface water groundwater interactions 	<ul style="list-style-type: none"> Impact on stream quality Impact on GDEs Impact on groundwater users 	<p>There are no changes to the approved mining method, extent or depth, therefore no additional impacts associated with the modification are expected.</p> <p>Groundwater level monitoring to date has not observed any observable impact to the shallow aquifer above the MYC. Swamp GDEs and groundwater quality have remained unimpacted by mining (Section 6.3.3).</p> <p>Residual impact: Low</p>
Monitoring network inadequacy <ul style="list-style-type: none"> Monitoring network data gaps Network disruptions from damage 	<ul style="list-style-type: none"> Inadequate monitoring data to assess potential environmental impacts 	<p>The current groundwater monitoring network coverage is adequate, and new piezometers have been installed in the 900, 800 and 700 areas where future mining is proposed (Figure 6.6). Routine monitoring and maintenance are conducted every two months to minimise data gaps.</p> <p>The current surface water monitoring network adequately covers the main operational water management structures and surface water receptors. As the modification does not seek to change the mining operations, the establishment of new surface water monitoring locations will not be required.</p> <p>If gaps in the monitoring network are identified, new monitoring locations can be installed.</p> <p>Residual impact: Low</p>

7.2 Management mitigation and monitoring

Centennial has an approved WMP that outlines:

- monitoring requirements for:
 - surface water for water quality, water flows and swamp monitoring
 - groundwater for levels, water quality and underground transfers
 - discharge water for quality and volumes
 - stream health
- performance criteria and trigger values for monitoring locations
- TARPs for:
 - surface site operations
 - water resources
 - groundwater environment
 - discharge management
 - stream health
- site specific reviews and reporting requirements.

The WMP will be reviewed, and if required updated, following the approval of MOD 11 (if granted).

8 Conclusions

Mining at Clarence Colliery will continue within the current approved mining areas. The modification does not propose changes to the approved mining depth or extent, existing and approved disturbance area, or waste and water management (including EPL 726). Therefore, the changes under the modification relate to an extension in mining duration only (extending the life of mining operations by five years).

The key potential risk that has been evaluated in this WRIA relates to water management and associated potential water discharge risks. Centennial have been operating in compliance with their WMP and associated licences (including EPL 726) and will continue to do so through this modification. Centennial is implementing improvements to the water treatment process and reviewing storage capacities. Centennial has also made a long-term commitment to mitigate discharge via LDP002.

Potential impacts of the modification on streamflow, stream water quality, groundwater quality, groundwater pressures and associated receptors are expected to be minimal. Potential cumulative impacts on surface water quality, groundwater quality and levels are also expected to be minimal.

Surface water and groundwater take (direct and indirect) is expected to be consistent with current reported take, which is within Centennial's existing WAL entitlements.

Surface water and groundwater monitoring will continue in accordance with the WMP.

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Appendix A

Groundwater monitoring network

A.1 Clarence Colliery monitoring network

Table A.1 Clarence Colliery groundwater monitoring network

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
CS1	Swamp	243769	6293815	1,052.53	Nov 2013 – Oct 2018	-	0.8	Clarence Swamp
CS2	Swamp	243784	6293633	1,066.96	Dec 2013 – Sep 2014	-	1.1	Clarence Swamp
CS3	Swamp	243770	6293725	1,061.32	Dec 2013 – Sep 2014	-	1.3	Clarence Swamp
MW05	Swamp	243790	6293809	1,053.57	Dec 2013 – present	-	5.1	Clarence Swamp
HS1	Swamp	243417	6294656	1,053.7	Jul 2015 – present	-	19	Banks Wall Sandstone–Hanson Swamp
HS2	Swamp	243417	6294656	1,053.7	Jul 2015 – present	-	5.0	Alluvial sand–Hanson Swamp
HS3	Swamp	243151	6294245	1,069	Jul 2015 – present	-	0.97	Hanson Swamp
HV1	Swamp	241550	6292993	1,094.94	Dec 2009 – Dec 2013	700 Area SMP	1.5	Happy Valley Swamp
HV2	Swamp	241839	6297077	1,120	Dec 2009 – Nov 2013	700 Area SMP	1.7	Happy Valley Swamp
HVU1	Swamp	242590	6295590	1,147.63	Dec 2009 – present	700 Area SMP	1.4	Happy Valley Swamp Upper
HVU2	Swamp	242424	6295520	1,140.07	Dec 2009 – Nov 2013	700 Area SMP	1.1	Happy Valley Swamp Upper
PSE1	Swamp	241821	6299287	1,035*	Mar 2017 – present	West of 900 Area	-	Paddys Swamp East
PSE2	Swamp	241380	6298610	1,085*	Mar 2017 – present	West of 900 Area	-	Paddys Swamp east
OS1	Swamp	247829	6297096	1,059*	Dec 2017 – present	North of 800 Area	-	Oleria Swamp
PG1	Swamp	242721	6300456	1,036	Aug 2019 – present	900 Area	1.6	Pagoda Swamp
PG2	Swamp	242777	6300278	1,032	Aug 2019 – present	900 Area	1.9	Pagoda Swamp
UD1	Swamp	244508	6302668	1,041	Sep 2022 – present	North of 900 Area	1.47	Upper Dingo Swamp

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
UD2	Swamp	244943	6303945	1,021	Sep 2022 – present	North of 900 Area	1.05	Upper Dingo Swamp
MU1	Swamp	242779	6302465	1,074	Aug 2022 – present	North of 900 Area	1.45	Murrays Swamp
MU2	Swamp	243308	6304106	1,051	Aug 2022 – present	North of 900 Area	2.28	Murrays Swamp
BN1	Swamp	245759	6302536	1,029	Oct 2022 – present	North of 900 Area	1.66	Bungleboori North Swamp
BN2	Swamp	246154	6303406	1,004	Oct 2022 – present	North of 900 Area	0.77	Bungleboori North Swamp
BSE1	Swamp	241949	6299627	1,061	Aug 2022 – present	Overlying Panel 918	1.45	Bungleboori East Swamp
BSE2	Swamp	241826	6299710	1,081	Aug 2022 – present	Overlying Panel 918	1.1	Bungleboori East Swamp
PHS1	Swamp	242274	6300691	1,087	Aug 2022 – present	Overlying Panel 918	1.88	Paddys Hanging Swamp
PHS2	Swamp	242280	6300541	1,061	Aug 2022 – present	Overlying Panel 918	0.9	Paddys Hanging Swamp
IS4 (CSP15)	Swamp	240596	6294398	1052.228	Aug 2023 – present	South of 700 area	0.08	Island Swamp
IS5 (CSP16)	Swamp	240584	6294430	1050.529	Aug 2023 – present	South of 700 area	0.11	Island Swamp
WS1 (CSP17)	Swamp	240790	6294002	1082.333	Aug 2023 – present	South of 700 area	0.01	Waterfall Swamp
WS2 (CSP18)	Swamp	240293	6294069	1063.58	Aug 2023 – present	South of 700 area	-	Waterfall Swamp
MD1 (CSP19)	Swamp	240744	6293331	1076.914	Aug 2023 – present	South of 700 area	-	Muddy Swamp
MD2 (CSP20)	Swamp	240559	6293319	1065.795	Aug 2023 – present	South of 700 area	-	Muddy Swamp
IS1 (CSP24)	Swamp	240749	6294217	1081.844	Aug 2023 – present	South of 700 area	0.04	Island Swamp

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
IS2 (CSP25)	Swamp	240847	6294289	1084.855	Aug 2023 – present	South of 700 area	0.08	Island Swamp
IS3 (CSP26)	Swamp	240733	6294325	1073.083	Aug 2023 – present	South of 700 area	0.05	Island Swamp
CLRP4	Standpipe	243204	6293153	1,068.71	May 2008 – present	South of mining areas	180	Banks Wall Sandstone
CLRP5	Standpipe	242517	6297686	1,110.92	May 2008 – present	700 Area AMP, north of 700 Area Panels	51	Banks Wall Sandstone
CLRP7	Standpipe	242181	6293863	1,133.88	May 2008 – present	700 Area SMP, above 702/704 Panels	41	Banks Wall Sandstone
CLRP8	Standpipe	242351	6291961	1,130	May 2008 – present	Clarence Township	28	Banks Wall Sandstone
CLRP10	Standpipe	242355	6297148	1,138.51	May 2009 – present	700 Area SMP, above 706 Panel	60	Banks Wall Sandstone
CLRP15	Standpipe	240907	6294871	1,113.15	Jul 2012 – present	Lithgow No.2 Dam	116.21	Burra-Moko Head formation/Caley formation
CLRP28	Standpipe	243223	6302025	1,090.48	May 2020 – present	North of 900 Area	73.5	Banks Wall Sandstone
CLRP31	Standpipe	244354	6302760	1,050.77	May 2020 – present	North of 900 Area	73.5	Banks Wall Sandstone
CLRP40	Standpipe	242032	6301019	1075.68	April 2023 – present	Panel 920	70	Banks Wall Sandstone
CLRP41A	Standpipe	242088	6300143	1113.33	February 2023 – present	Panel 918	55.8	Banks Wall Sandstone
CLRP42	Standpipe	241794	6300548	1107.70	March 2023 – present	Panel 920	70	Banks Wall Sandstone
CSP12	Standpipe	243257	6304106	1,052	Dec 2022 – present	North of 900 Area	8	Banks Wall Sandstone
CSP13	Standpipe	245009	6303965	1,027	Dec 2022 – present	North of 900 Area	18	Banks Wall Sandstone
CSP14	Standpipe	246364	6303680	993	Dec 2022 – present	North of 900 Area	11	Banks Wall Sandstone
CSP21A	Standpipe	241337	6293814	1,146	April 2024 - present	West 700 area	8	Burralow Formation

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
CSP21C	Standpipe	241340	6293808	1,146.21	April 2024 - present	West 700 area	50	Banks Wall Sandstone
CSP22A	Standpipe	241165	6294522	1,138.86	April 2024 - present	West 700 area	10	Banks Wall Sandstone
CSP22B	Standpipe	241159	6294522	1,138.76	April 2024 - present	West 700 area	24	Banks Wall Sandstone
CSP22C	Standpipe	241161	6294527	1,138.62	April 2024 - present	West 700 area	47	Banks Wall Sandstone
CC113	Standpipe	241691	6293105	1,140.25	May 2008 – Feb 2014	700 Area	37	Banks Wall Sandstone
CLRP1	VWP	245424	6295662	1,002.97	Aug 2004 – present	Eastern Area SMP, within 330 Area	175	Katoomba Seam
							150	Burra-Moko Head Formation/Caley Formation
							100	Banks Wall Sandstone
							60	Banks Wall Sandstone
CLRP2	VWP	246465	6301421	1,029.92	Aug 2004 – present	Eastern Area SMP, above 611E Panel	276	Katoomba Seam (Inactive since Aug 2007)
							190	Banks Wall Sandstone
							130	Banks Wall Sandstone
							70	Banks Wall Sandstone
CLRP3	VWP	246343	6299274	1,037.21	Jan 2006 – present	Eastern Area SMP, above 612 Panel	198	Burra-Moko Head Formation
							138	Banks Wall Sandstone
							85	Banks Wall Sandstone
CLRP6	VWP	242638	6296369	1,121.28	Jun 2008 – Jan 2022	700 Area SMP, above 702/704 Panels	160	Burra-Moko Head Formation/Caley Formation- inactive since Sep 2010
							100	Banks Wall Sandstone
							60	Banks Wall Sandstone

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
CLRP11	VWP	240540	6296221	1,110.96	Aug 2011 – present	700 West SMP Area	165	Burra-Moko Head Formation
							134.5	Burra-Moko Head Formation
							74.5	Banks Wall Sandstone
							61	Banks Wall Sandstone
CLRP12	VWP	240359	6297392	1,146.80	Nov 2010 – May 2020	700 West SMP Area	230	Burra-Moko Head Formation
							180	Burra-Moko Head Formation
							120	Banks Wall Sandstone
							100	Banks Wall Sandstone
CLRP13	VWP	247674	6295052	1,043.15	Nov 2010 – present	800 Area SMP Area	240	Burra-Moko Head Formation
							210	Burra-Moko Head Formation
							140	Banks Wall Sandstone
							110	Banks Wall Sandstone
CLRP14	VWP	246524	6296235	1,056.73	Apr 2011 – present	800 Area SMP Area	220	Burra-Moko Head Formation
							185	Burra-Moko Head Formation (no data since Aug 2014)
							130	Banks Wall Sandstone (no data since Aug 2014)
							100	Banks Wall Sandstone

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
CLRP15	VWP	240912	6294870	1,113.15	July 2011 – present	Lithgow No.2 Dam	160	Burra-Moko Head Formation
							130	Burra-Moko Head Formation
							90	Banks Wall Sandstone
							60	Banks Wall Sandstone
CLRP16	VWP	240400	6294981	1,050.80	Apr 2011 – present	Lithgow No.2 Dam	115	Burra-Moko Head Formation
							70	Burra-Moko Head Formation
CLRP17	VWP	247607	6295623	1,047.98	Mar 2014 – present	800 Area SMP	200	Burra-Moko Head Formation
							170	Burra-Moko Head Formation
							70	Banks Wall Sandstone
CLRP18	VWP	243124	6301413	1,118.77	Dec 2014 – present	900 Area SMP	230	Burra-Moko Head Formation/Caley Formation
							75	Banks Wall Sandstone
CLRP19	VWP	249419	6295862	1,010	Mar 2014 – present	800 Area SMP	170	Burra-Moko Head Formation
							120	Burra-Moko Head Formation
							90	Banks Wall Sandstone
CLRP22	VWP	243397	6300617	1,122.69	Dec 2014 – present	900 Area SMP	220	Burra-Moko Head Formation
							90	Banks Wall Sandstone

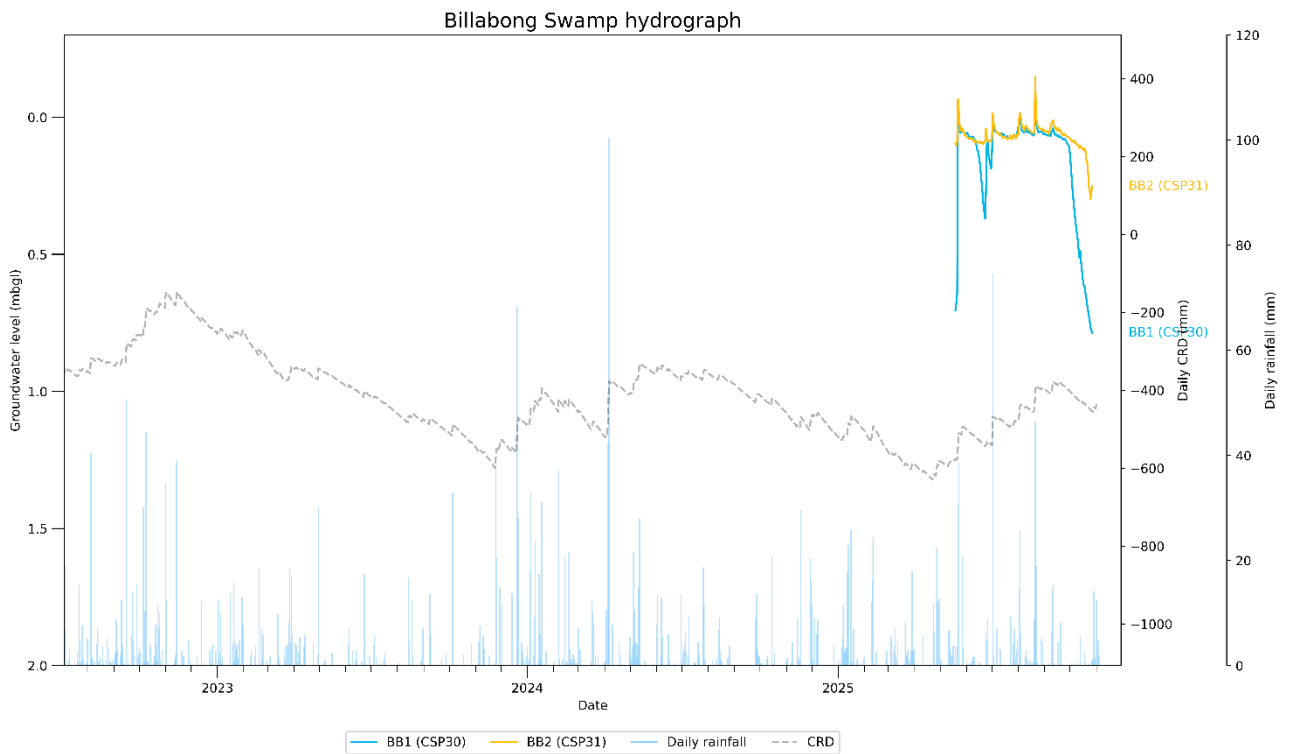
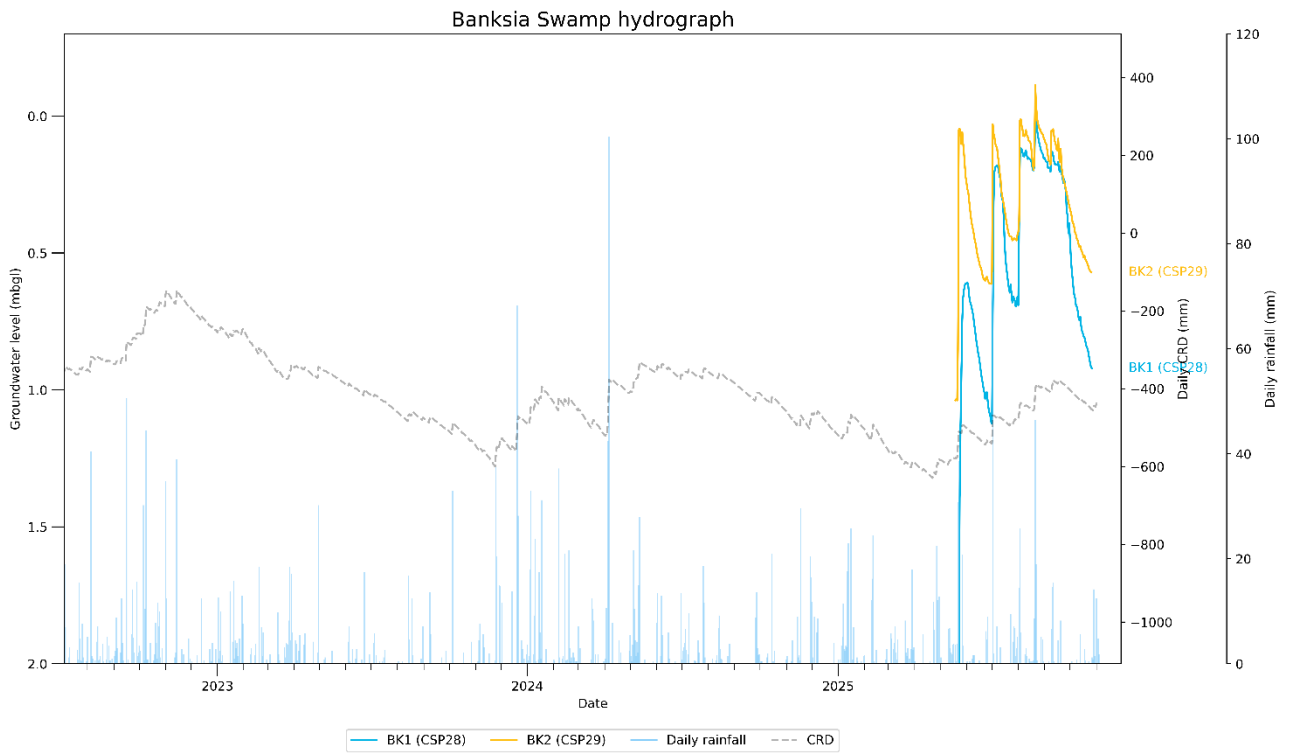
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CLRP27	VWP	242577	6300787	1,110.0	March 2021 – present	North of 900 Area	275	Above Katoomba seam
							220	Caley formation
							190	Burra Moho Head Formation
							130	Banks Wall Sandstone
							80	Banks Wall sandstone
CLRP29	VWP	242285	6302783	~1,070	May 2020 – present	North of 900 Area	260	Katoomba Seam
							248	Caley Formation
							189	Burra-Moko Head Formation
							70	Banks Wall Sandstone
CLRP33	VWP	246372	6302594	~1,058	Jul 2020 – present	North of 900 Area	287	Katoomba Seam
							267	Caley Formation
							236	Burra-Moko Head Formation
							67	Banks Wall Sandstone
CLRP41	VWP	242088	6300143	1113.33	November 2022 – present	Panel 918	259	-
							225	-
							195	-
							122	-
							55	-

Site ID	Installation type	Easting (GDA94 zone 56)	Northing (GDA94 zone 56)	Surface Elevation (mAHD)	Data period	Area	Depth (mbgl)	Lithology
CC114	VWP	245407	6295092	1,014.76	Apr 2009 – present	700 West/800 Area background	165	Burra-Moko Head Formation
							135	Burra-Moko Head Formation
							75	Banks Wall Sandstone
							45	Banks Wall Sandstone
CC115	VWP	248478	6295951	1,037.92	Apr 2009 – present	700 West/800 Area background	270	Burra-Moko Head Formation
							200	Burra-Moko Head Formation
							170	Banks Wall Sandstone
							120	Banks Wall Sandstone (dry since Mar 2014)
							200	Burra-Moko Head Formation
							170	Banks Wall Sandstone
120	Banks Wall Sandstone (dry since Mar 2014)							

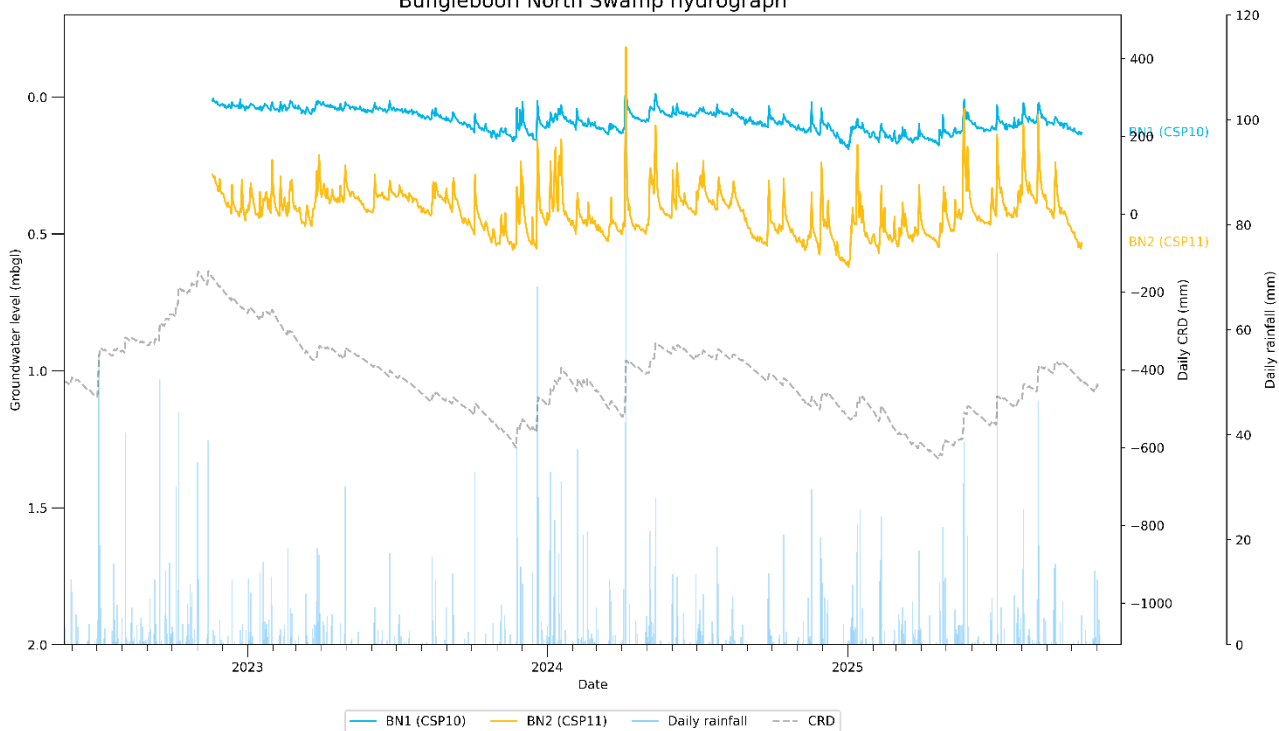
Appendix B

Monitoring results

B.1 Groundwater hydrographs – Swamp piezometer



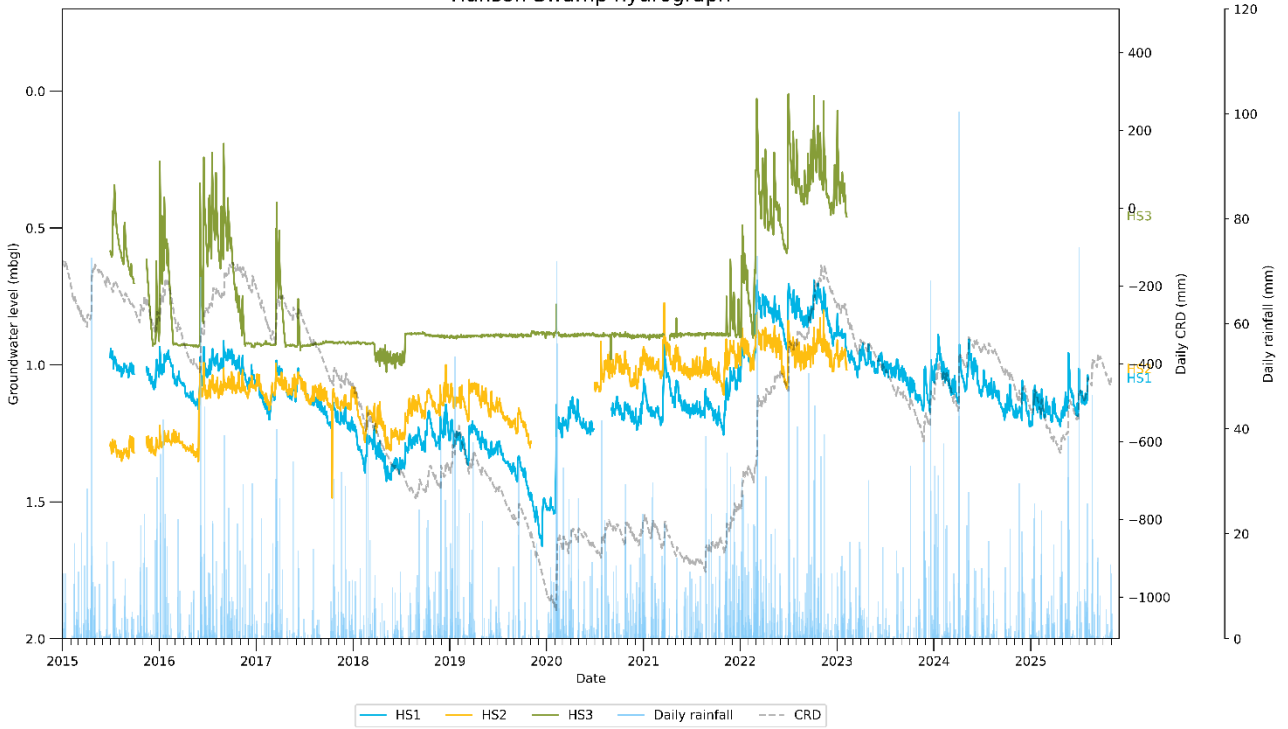
Bungleboori North Swamp hydrograph



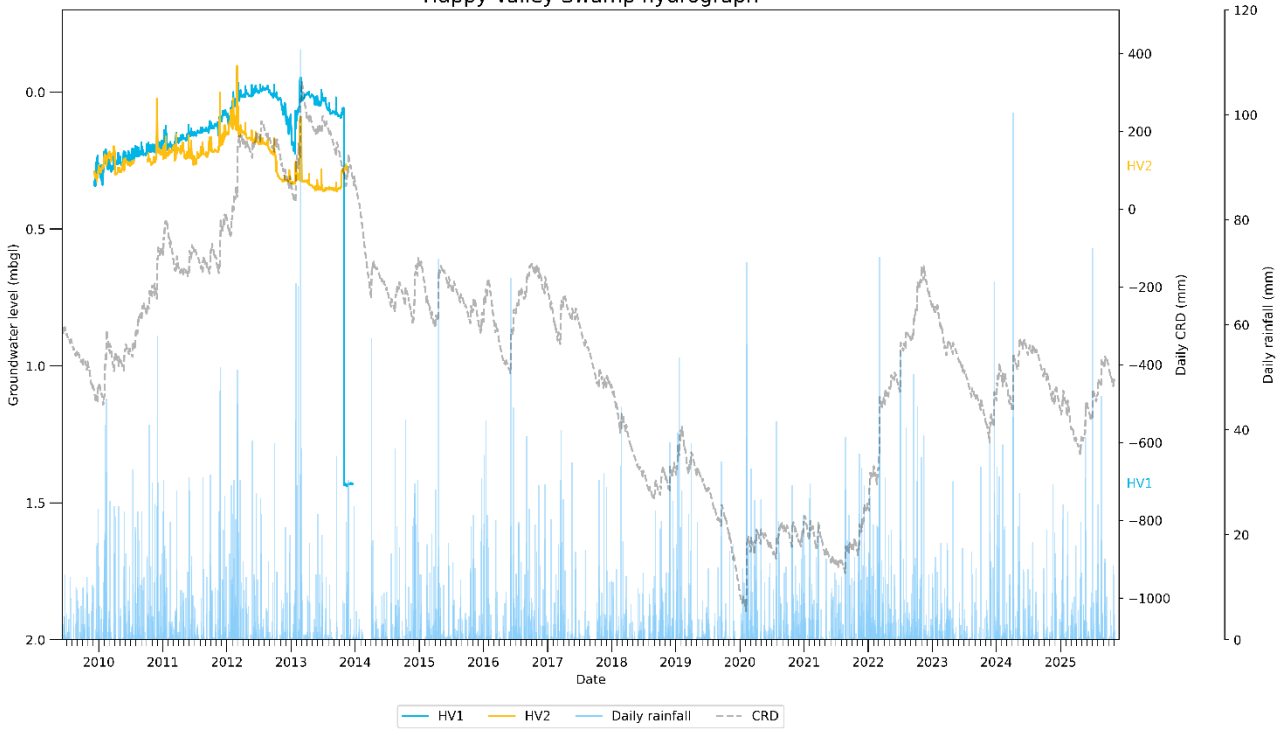
Clarence Swamp hydrograph



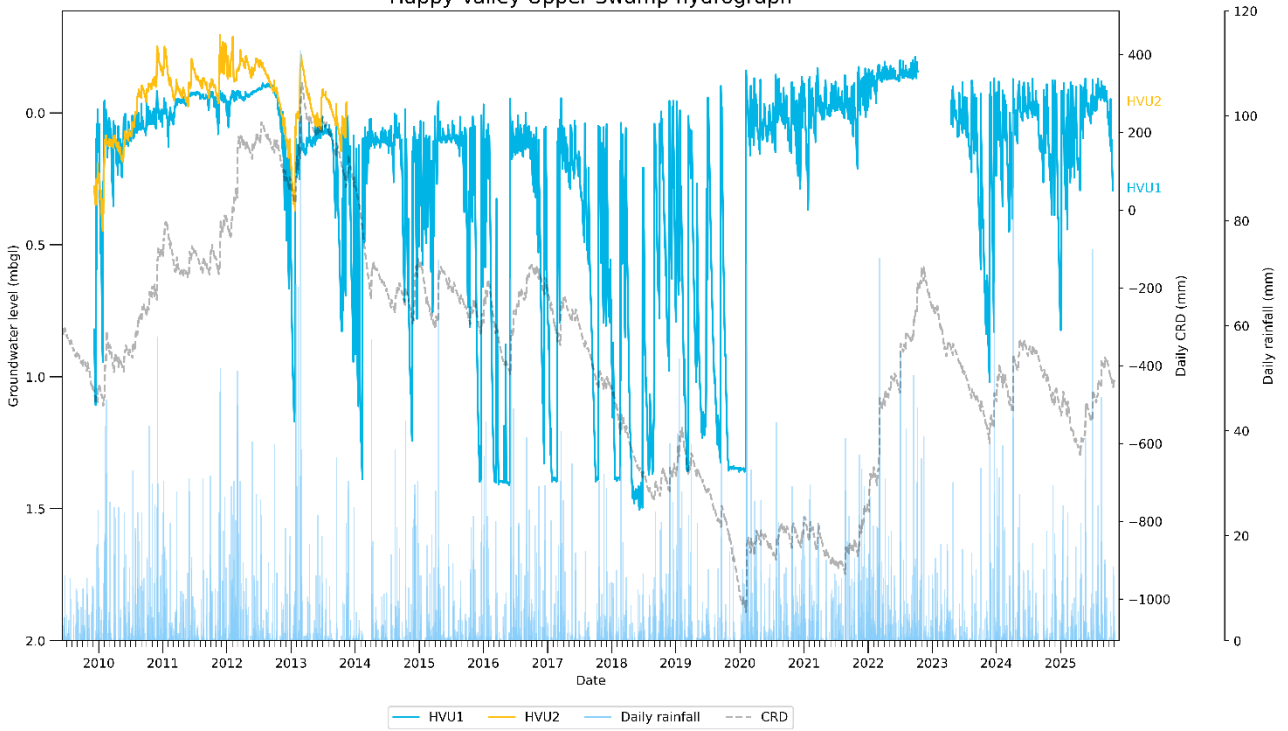
Hanson Swamp hydrograph



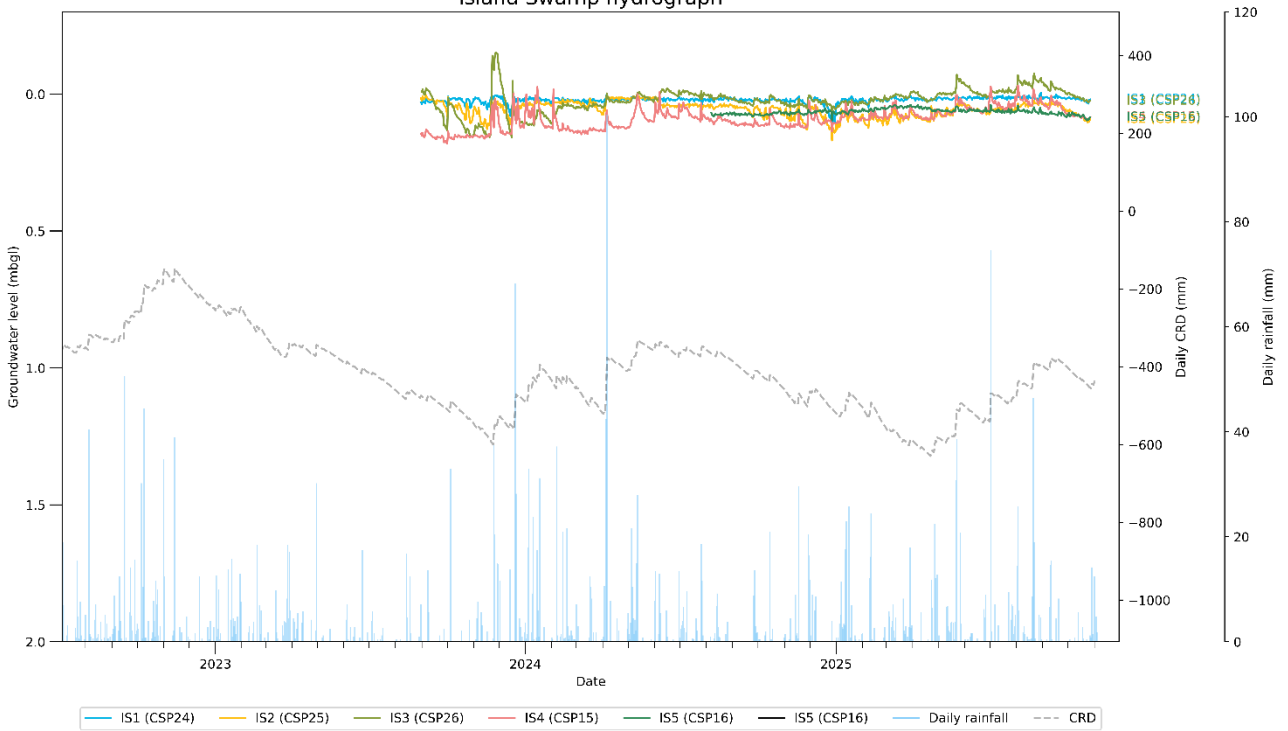
Happy Valley Swamp hydrograph



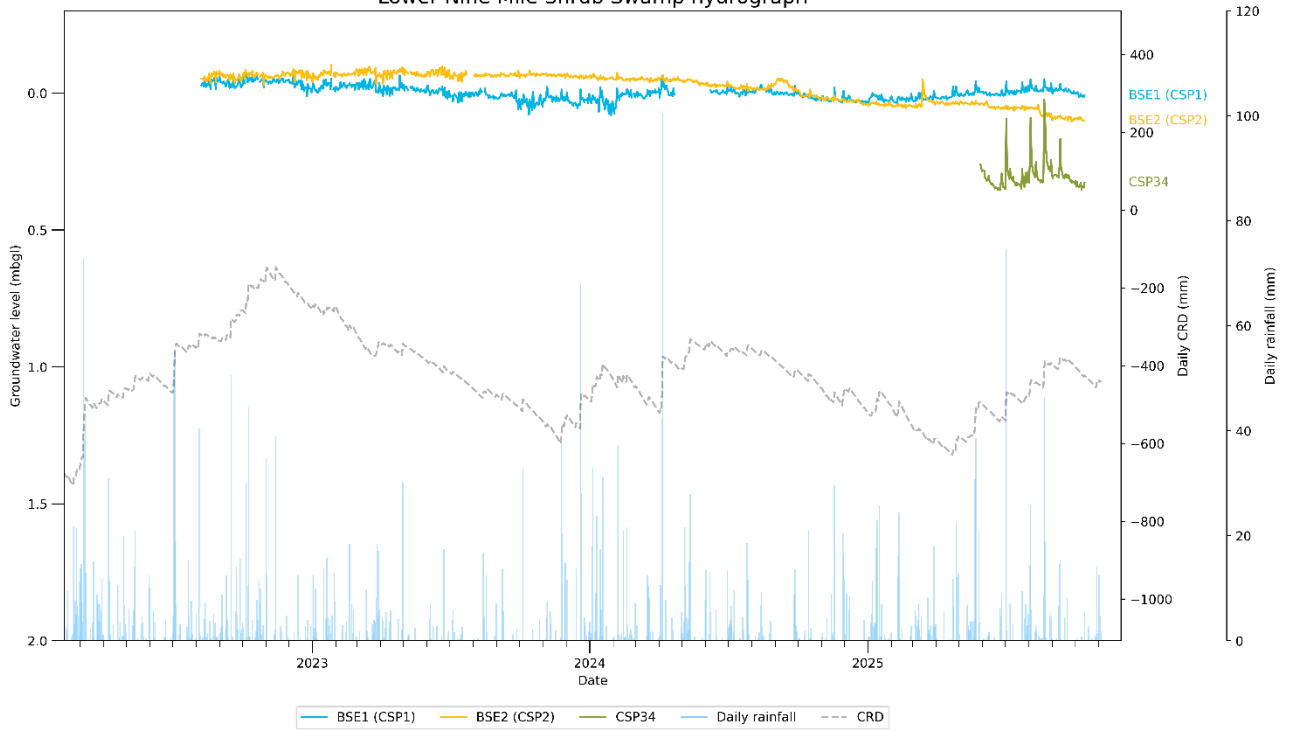
Happy Valley Upper Swamp hydrograph



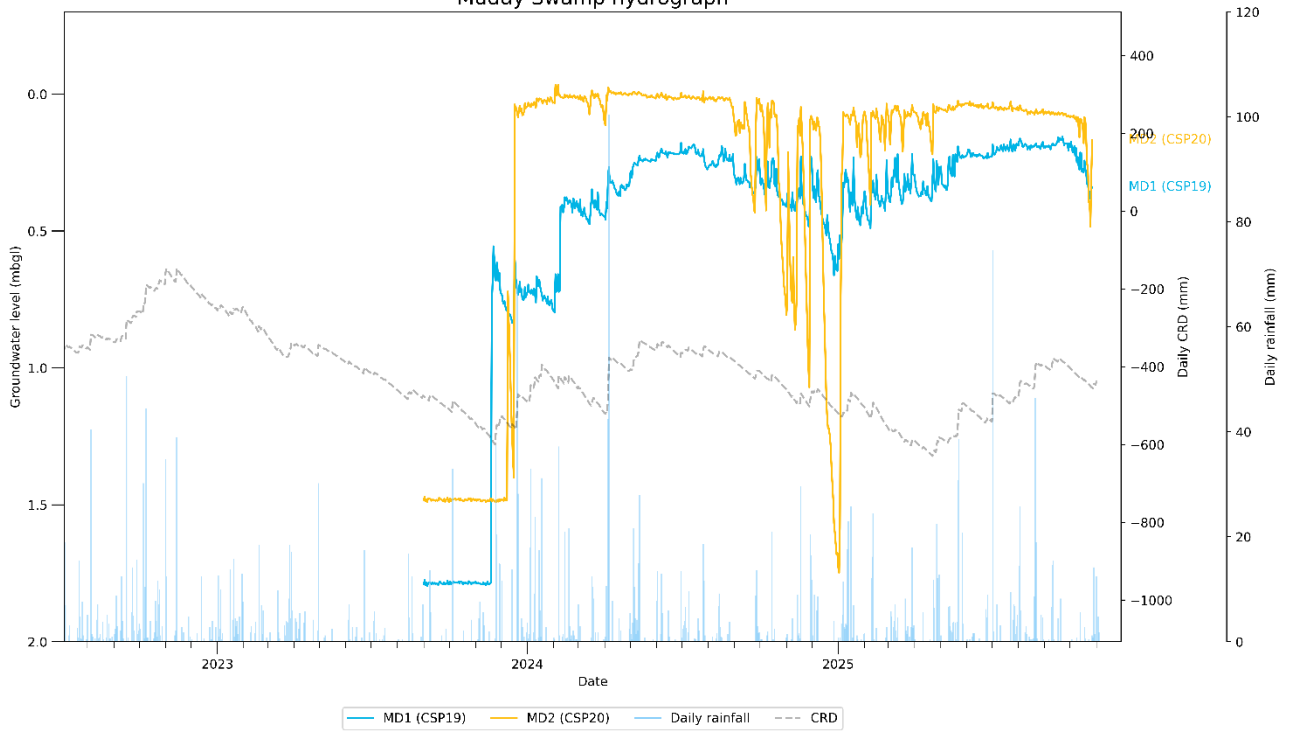
Island Swamp hydrograph

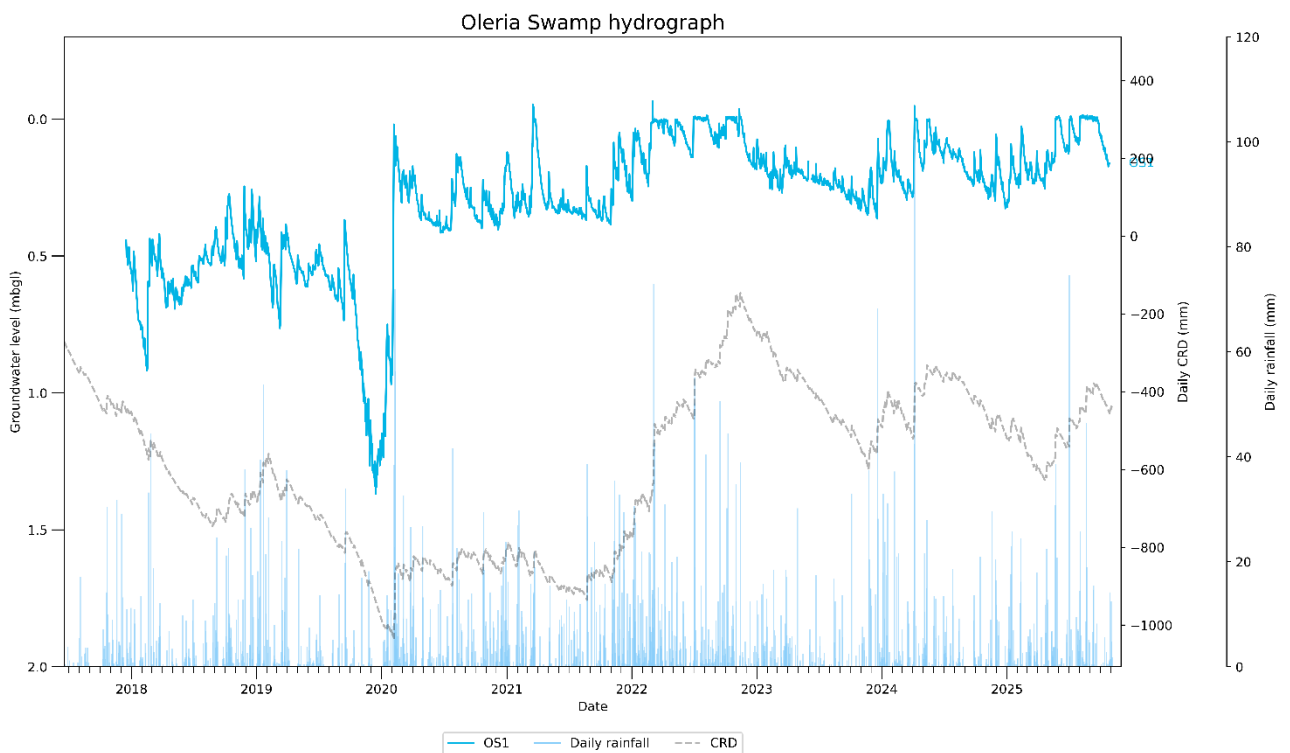
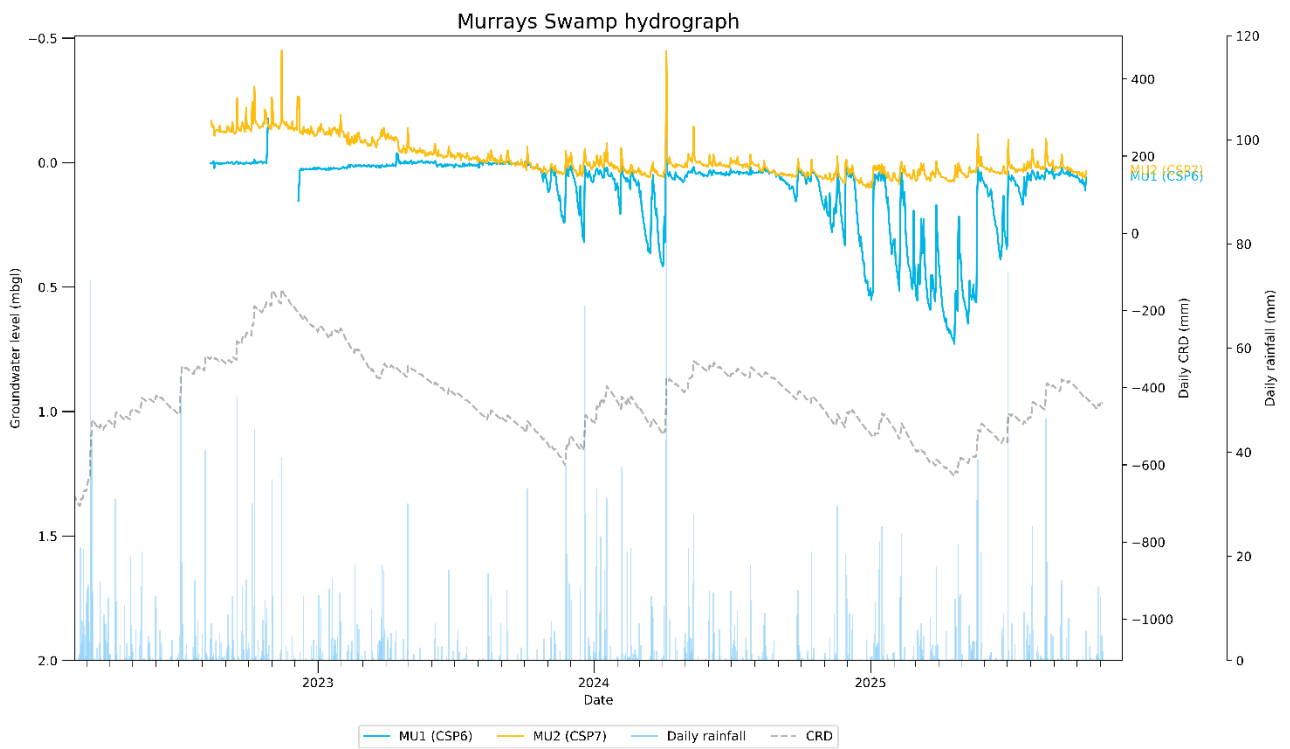


Lower Nine Mile Shrub Swamp hydrograph

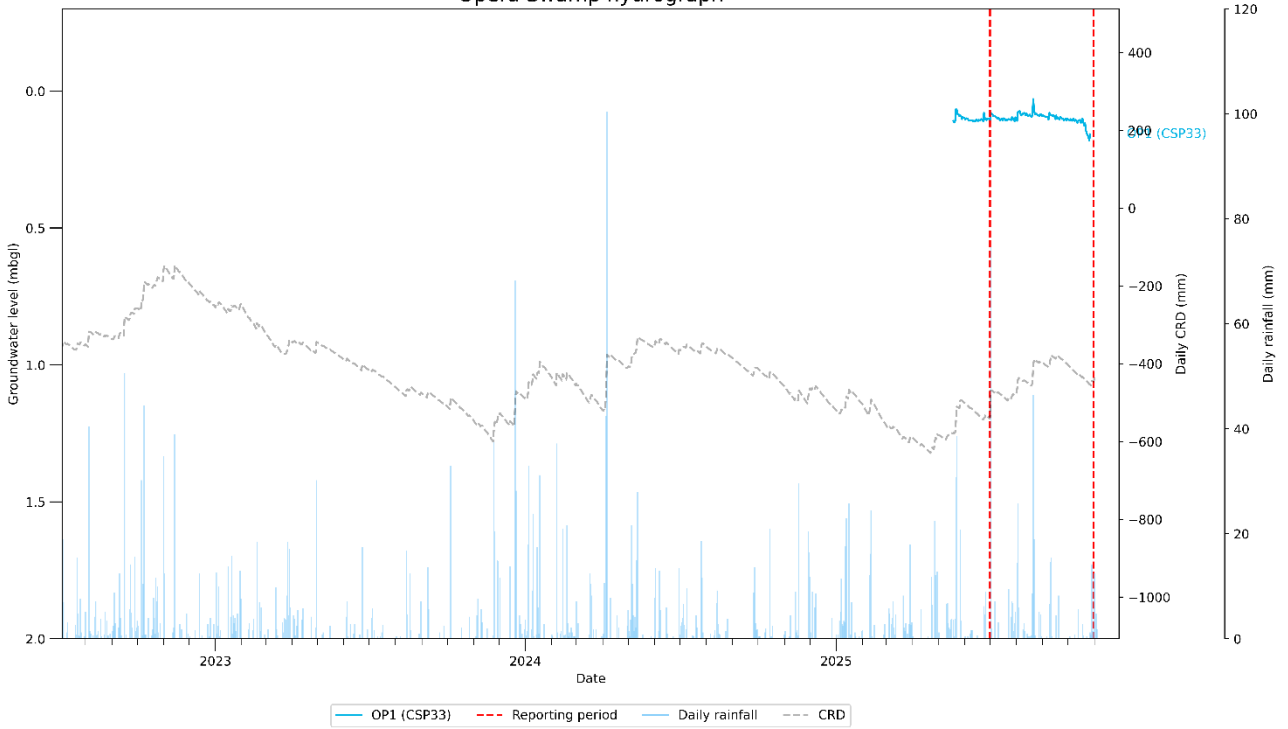


Muddy Swamp hydrograph





Opera Swamp hydrograph



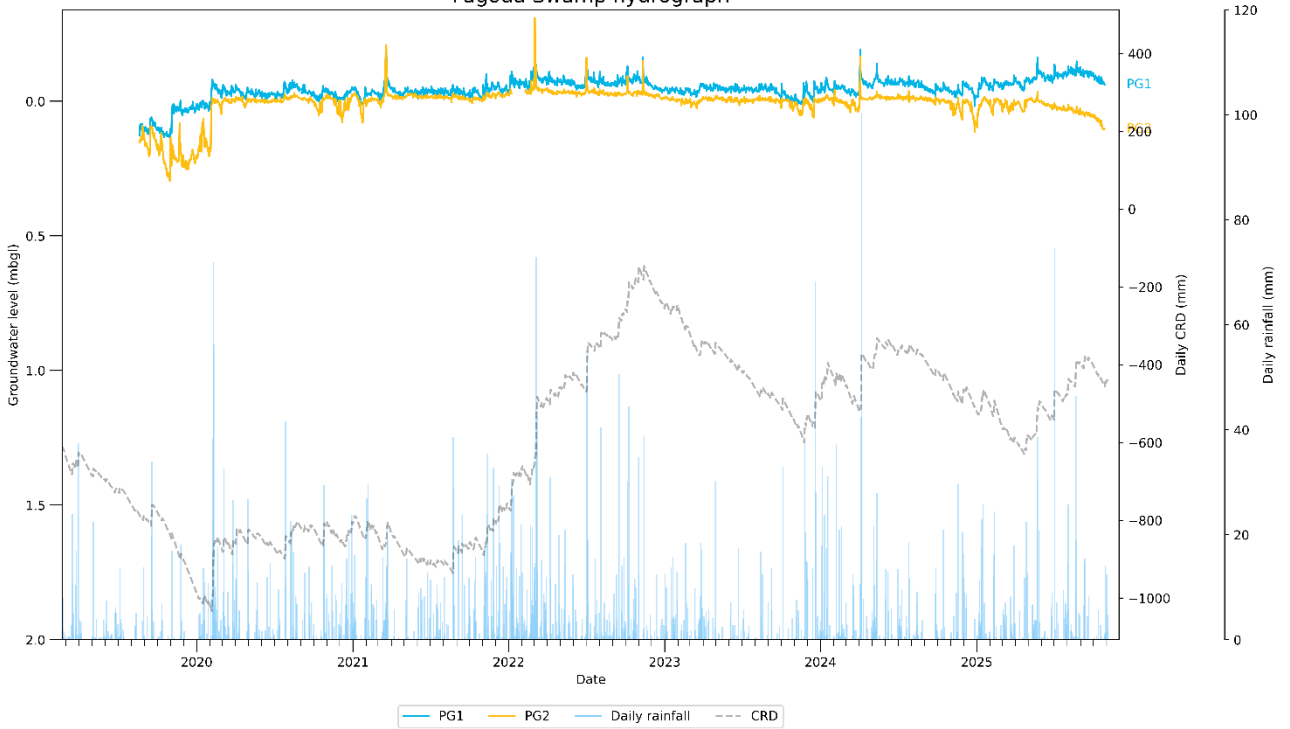
Paddys Hanging Swamp hydrograph



Paddys Swamp East hydrograph



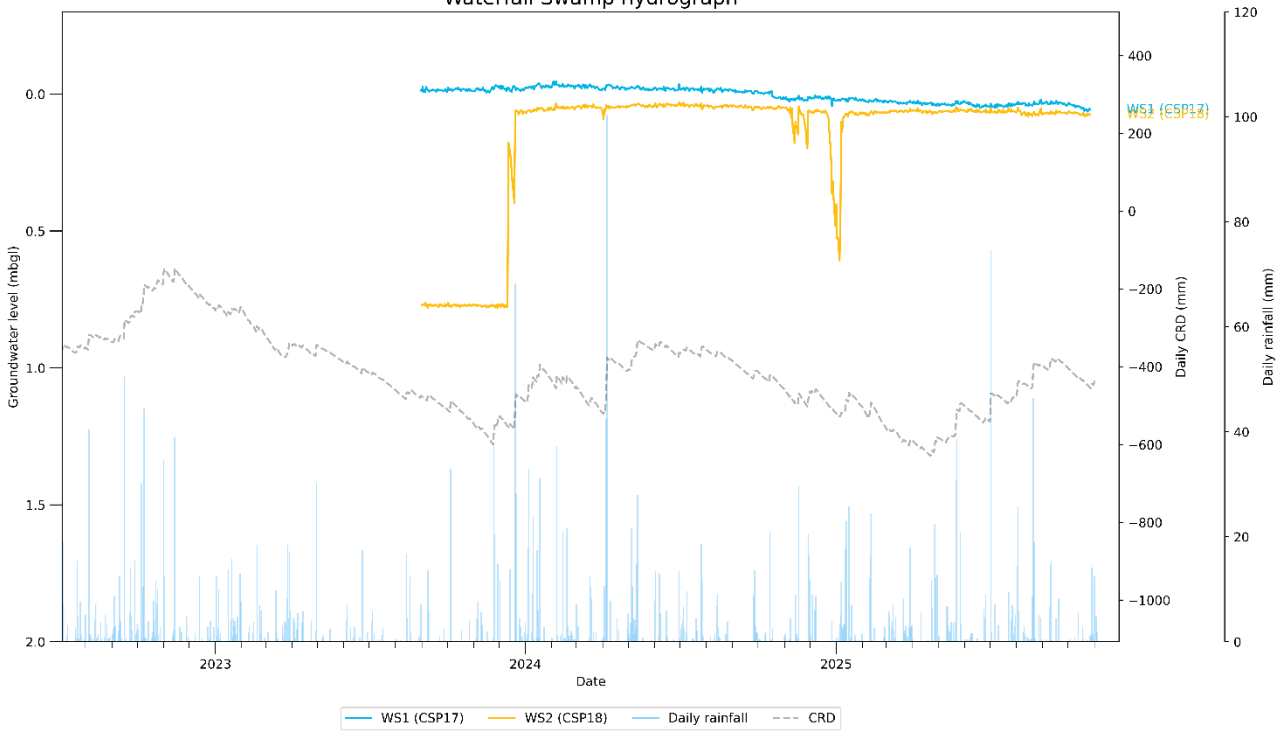
Pagoda Swamp hydrograph



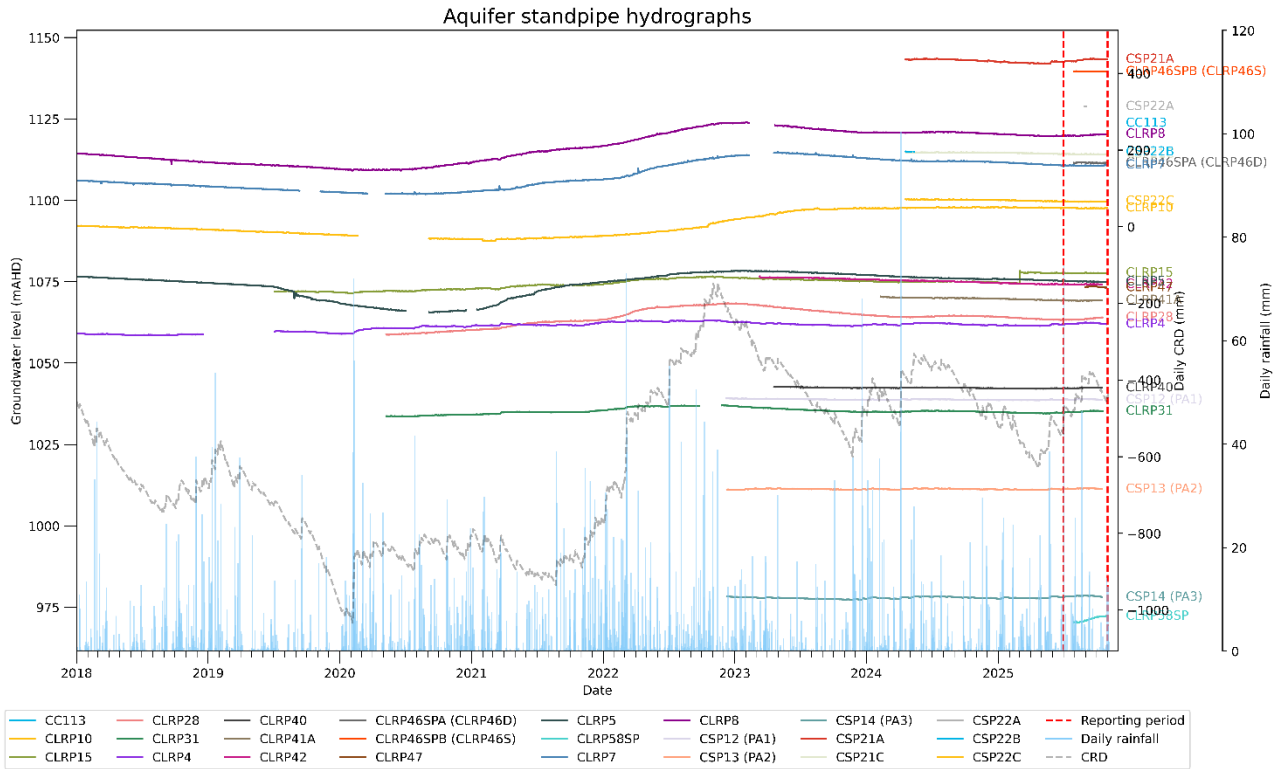
Upper Dingo Swamp hydrograph



Waterfall Swamp hydrograph



B.2 Groundwater hydrographs – Standpipe piezometer

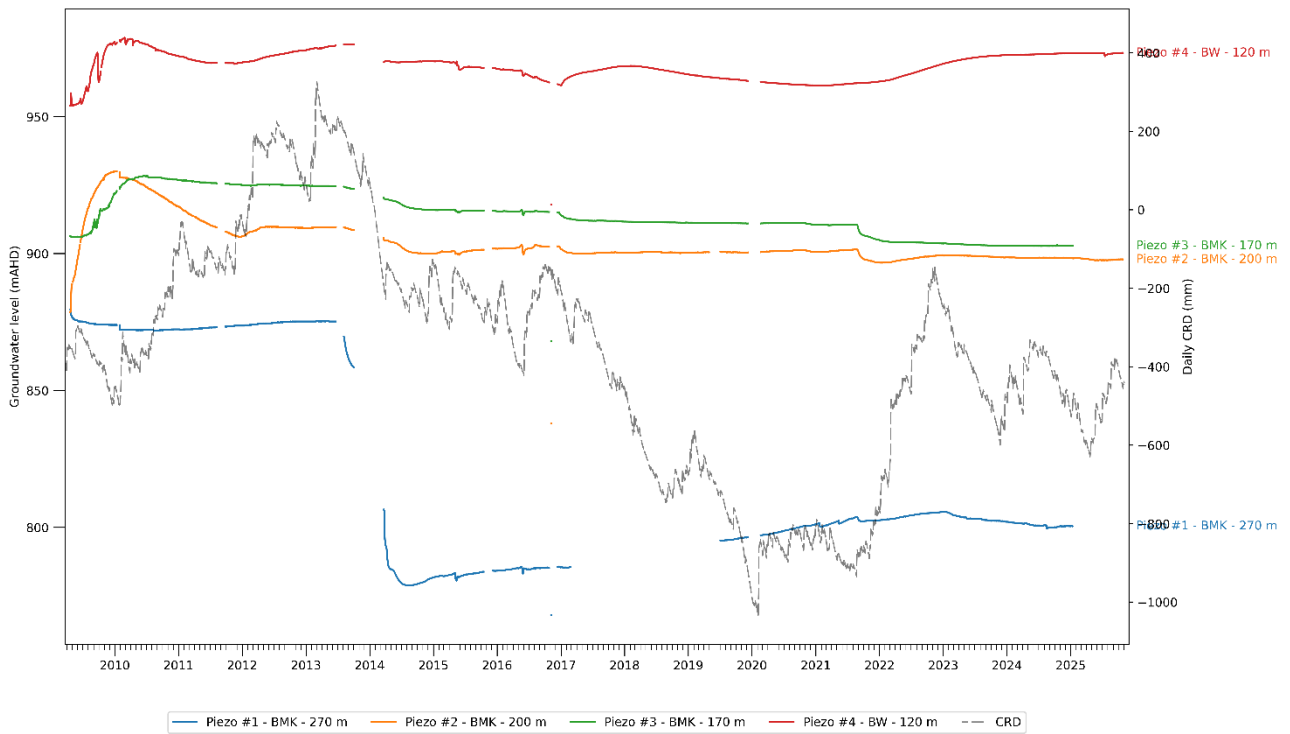


B.3 Groundwater hydrographs – Vibrating wire piezometer

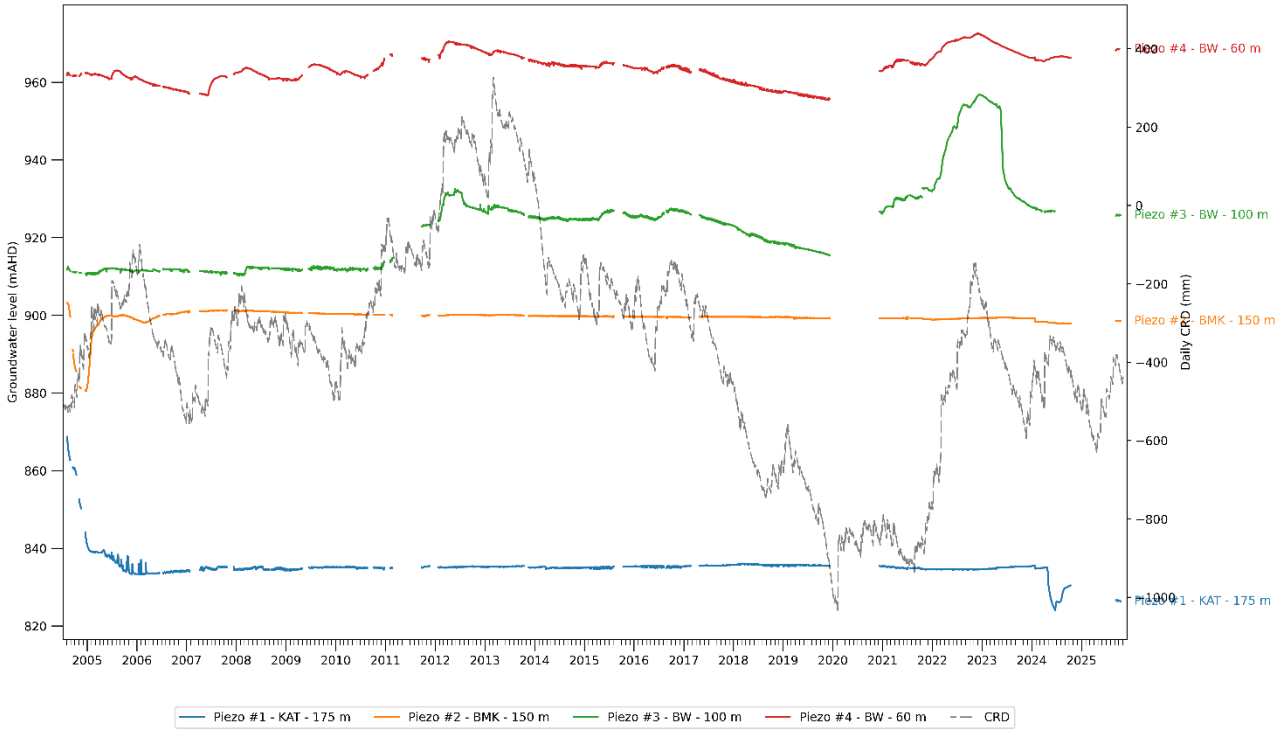
CC114 Vibrating wire piezometer hydrograph



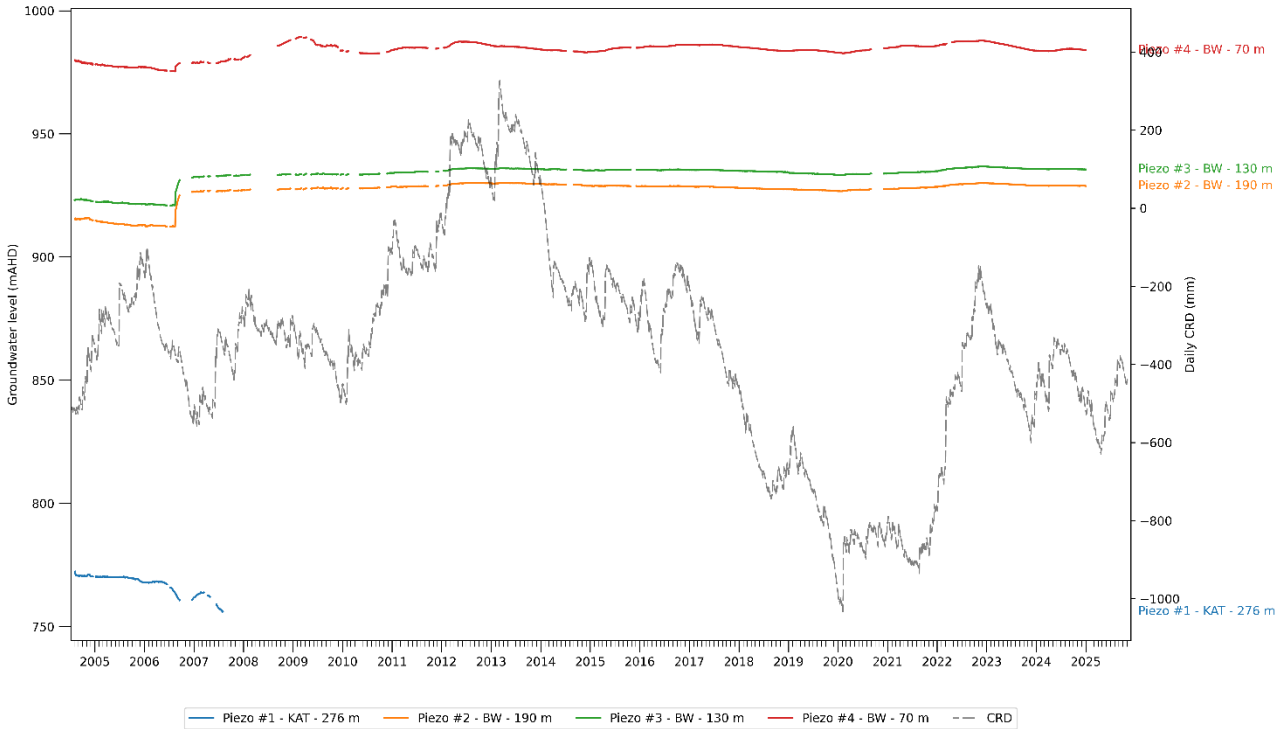
CC115 Vibrating wire piezometer hydrograph



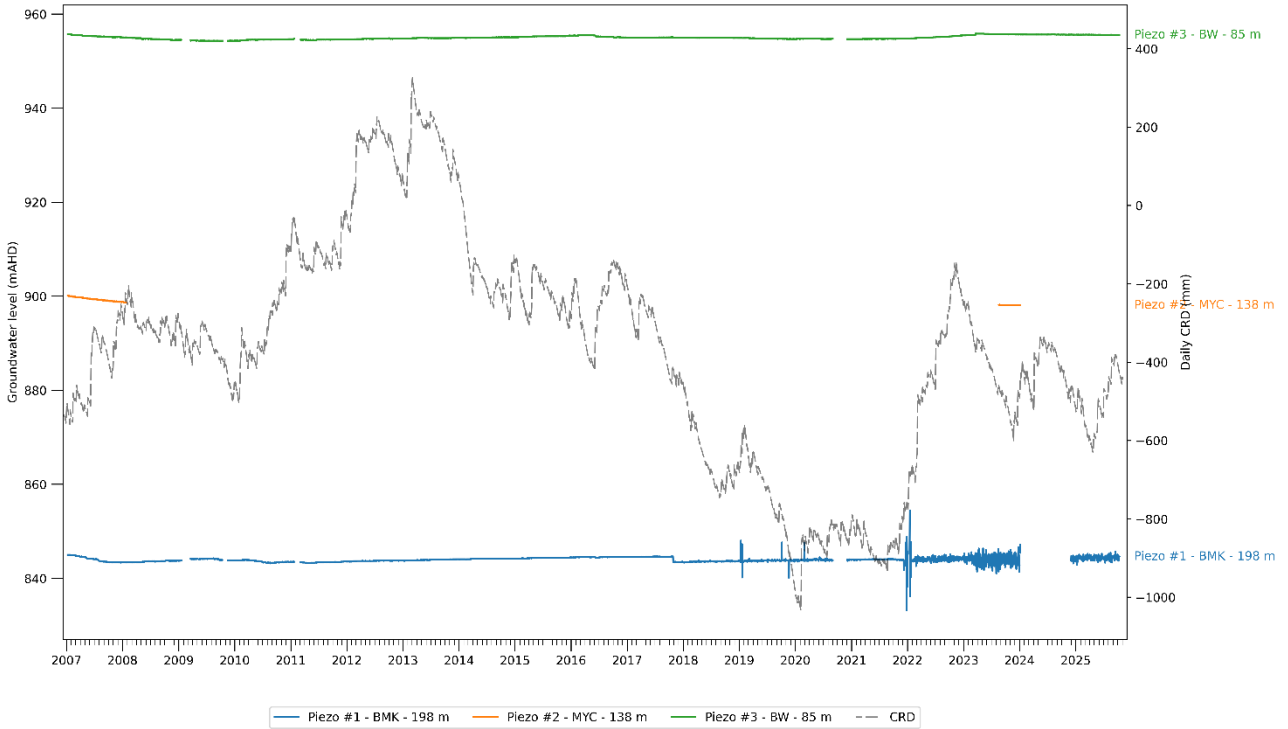
CLRP1 Vibrating wire piezometer hydrograph



CLRP2 Vibrating wire piezometer hydrograph



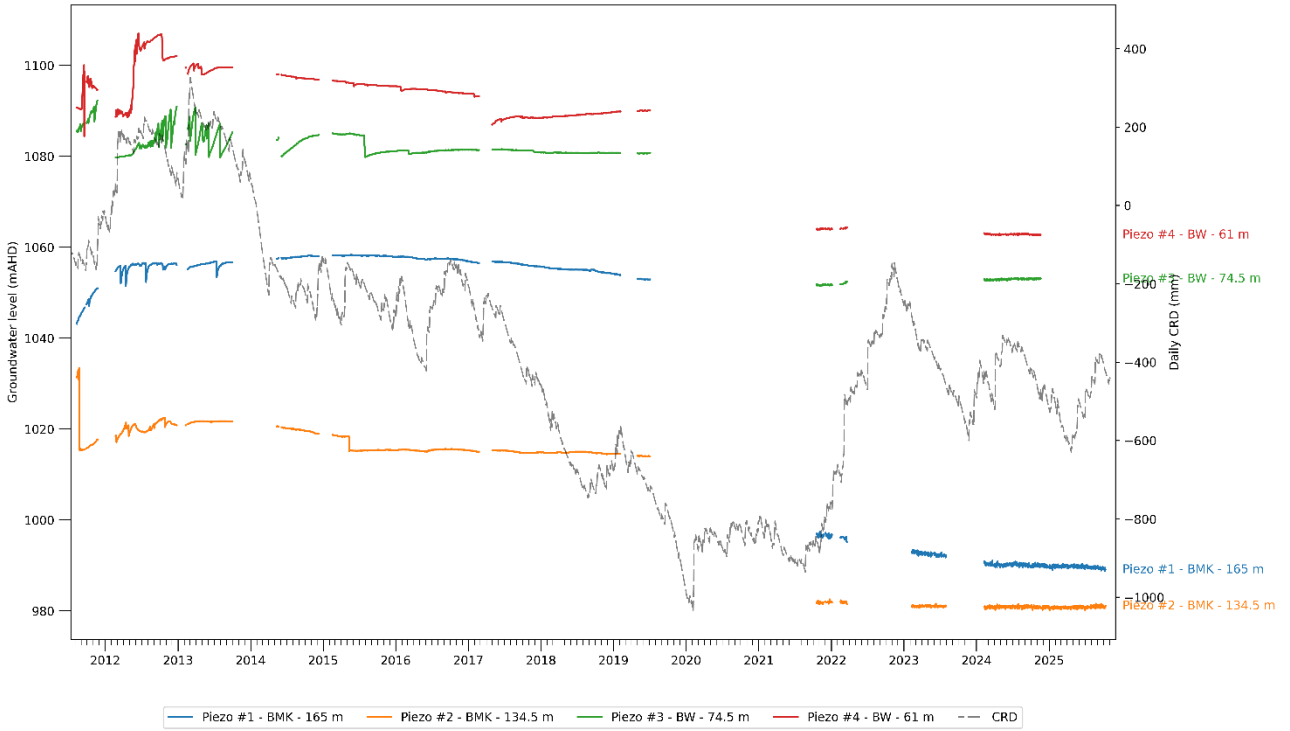
CLRP3 Vibrating wire piezometer hydrograph



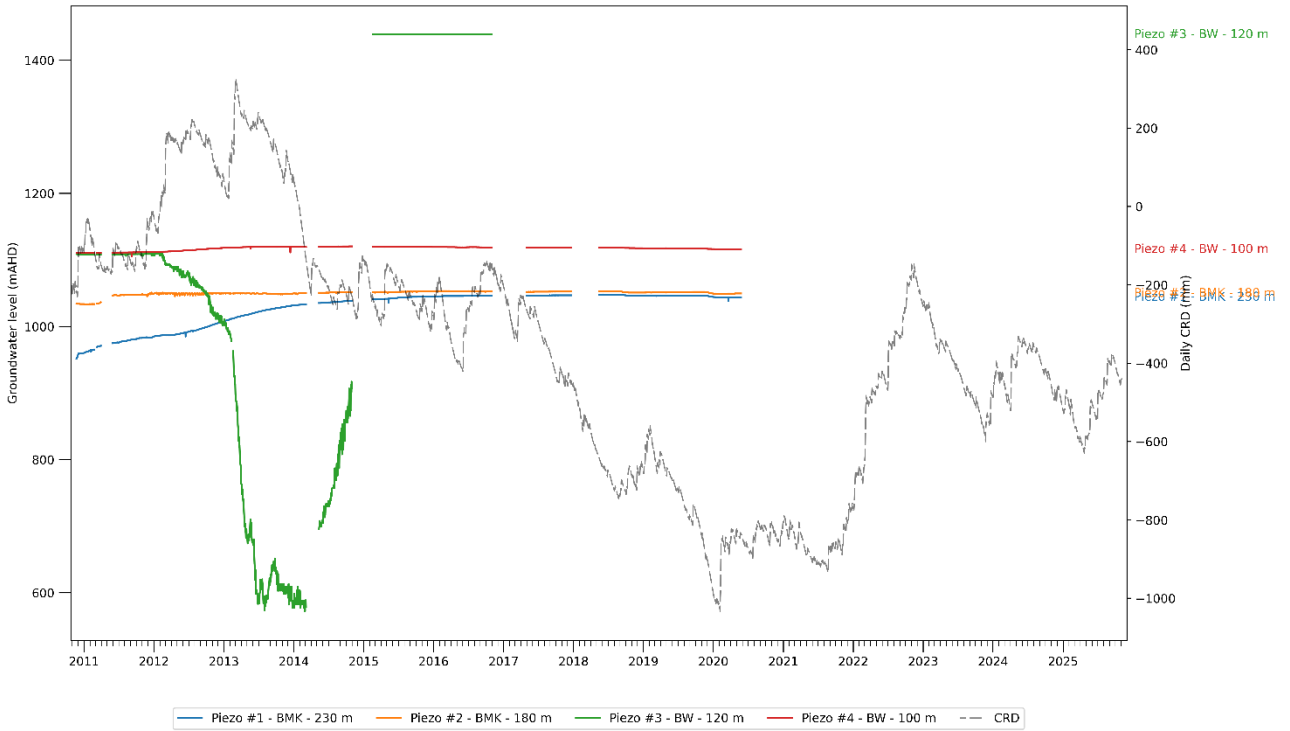
CLRP6 Vibrating wire piezometer hydrograph



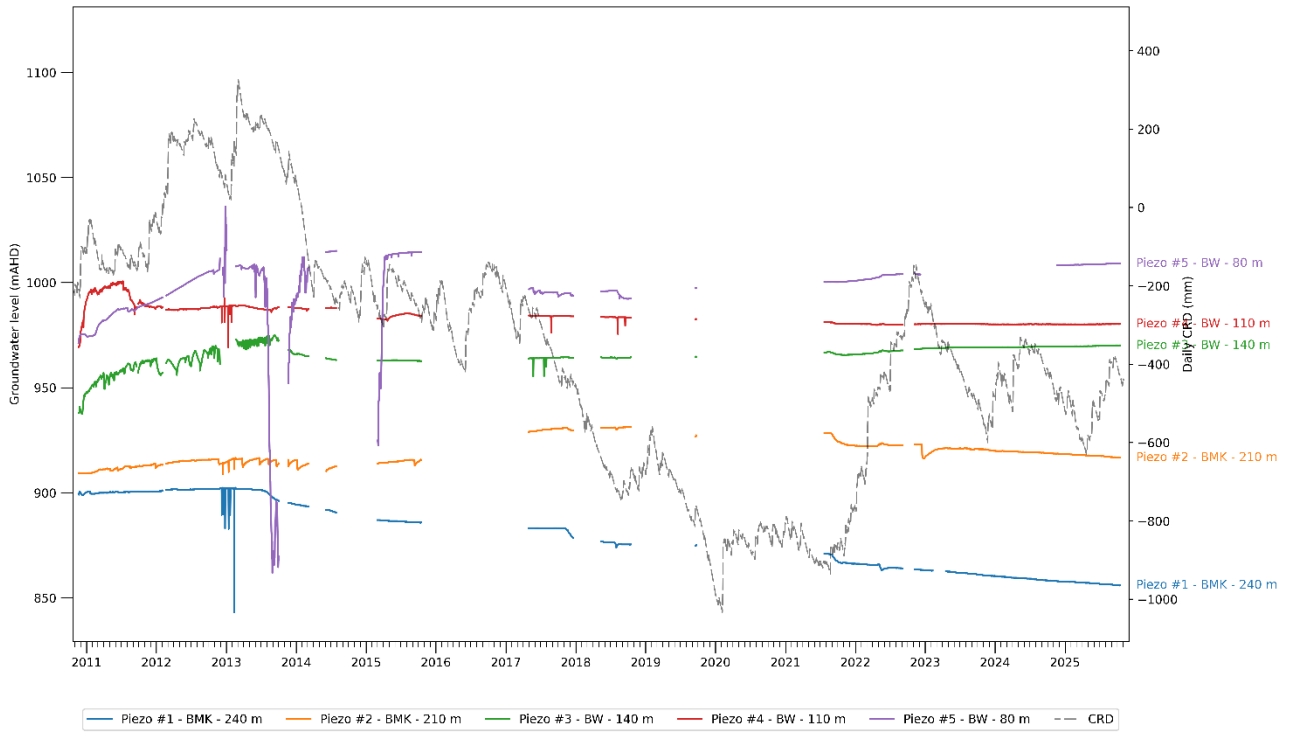
CLRP11 Vibrating wire piezometer hydrograph



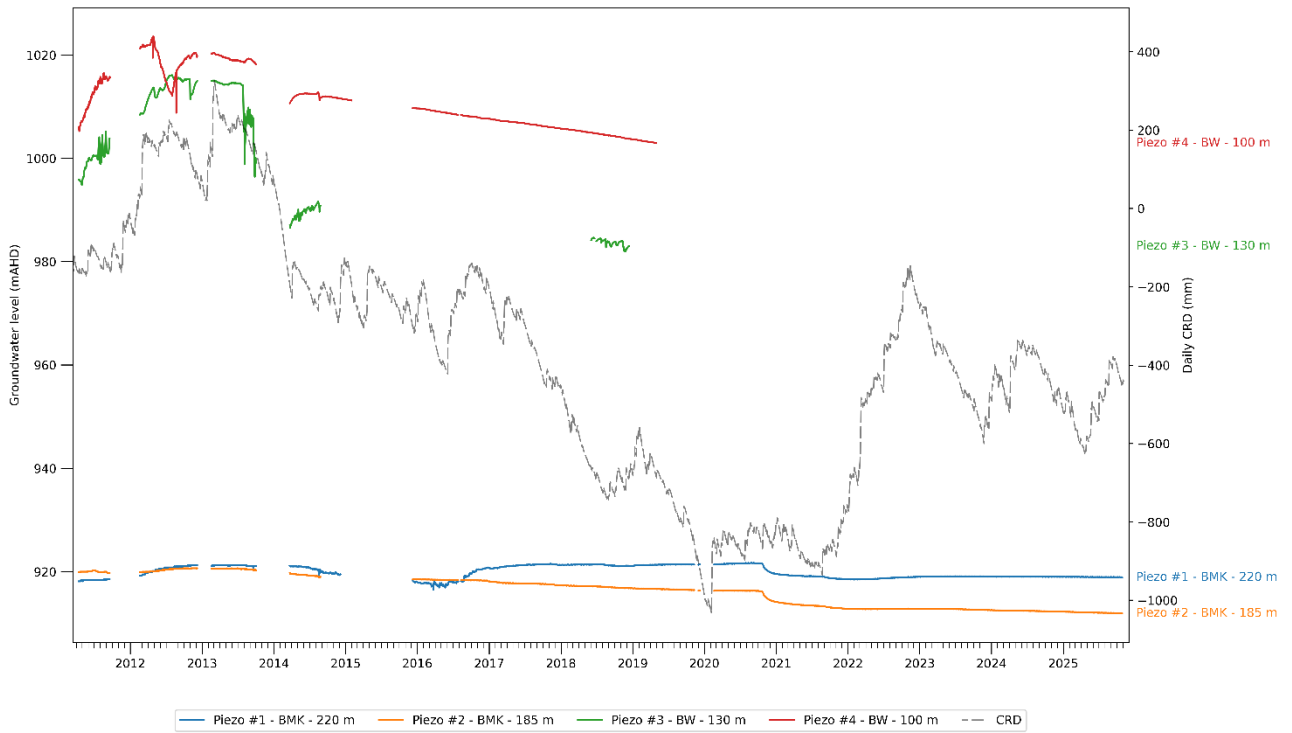
CLRP12 Vibrating wire piezometer hydrograph



CLRP13 Vibrating wire piezometer hydrograph



CLRP14 Vibrating wire piezometer hydrograph



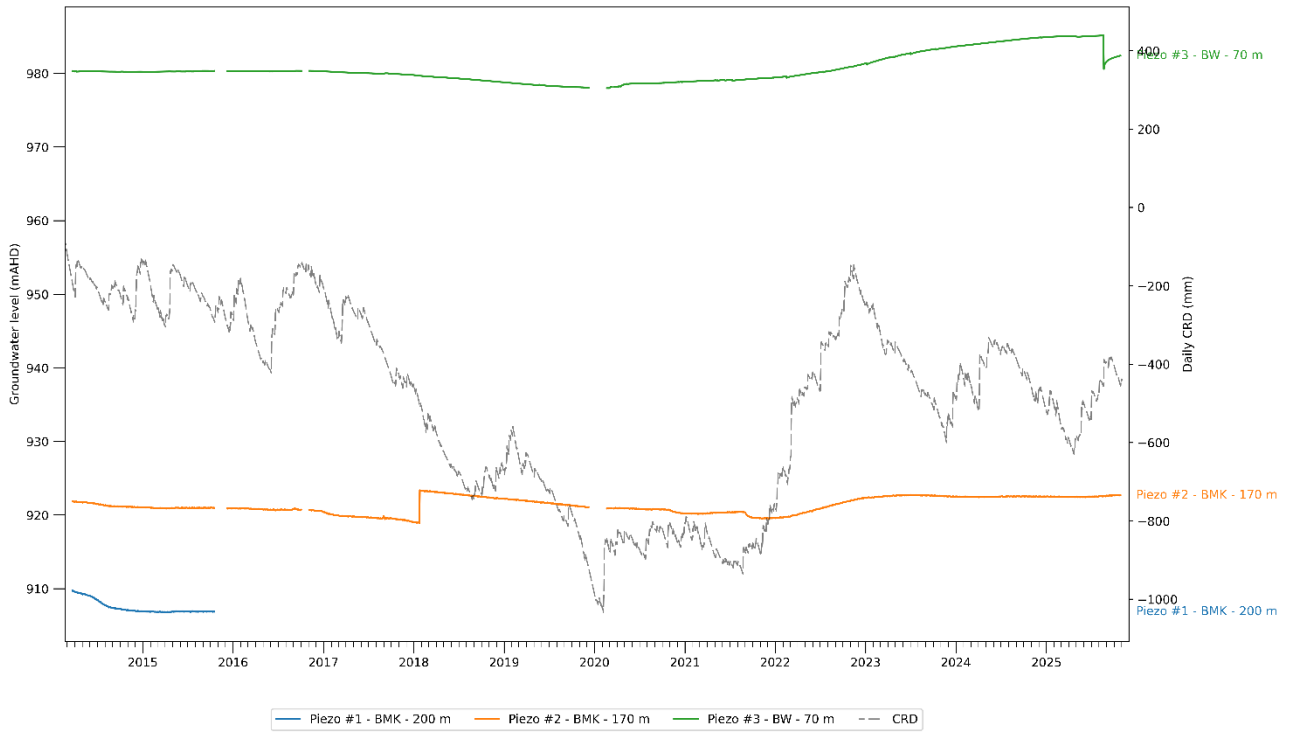
CLRP15 Vibrating wire piezometer hydrograph



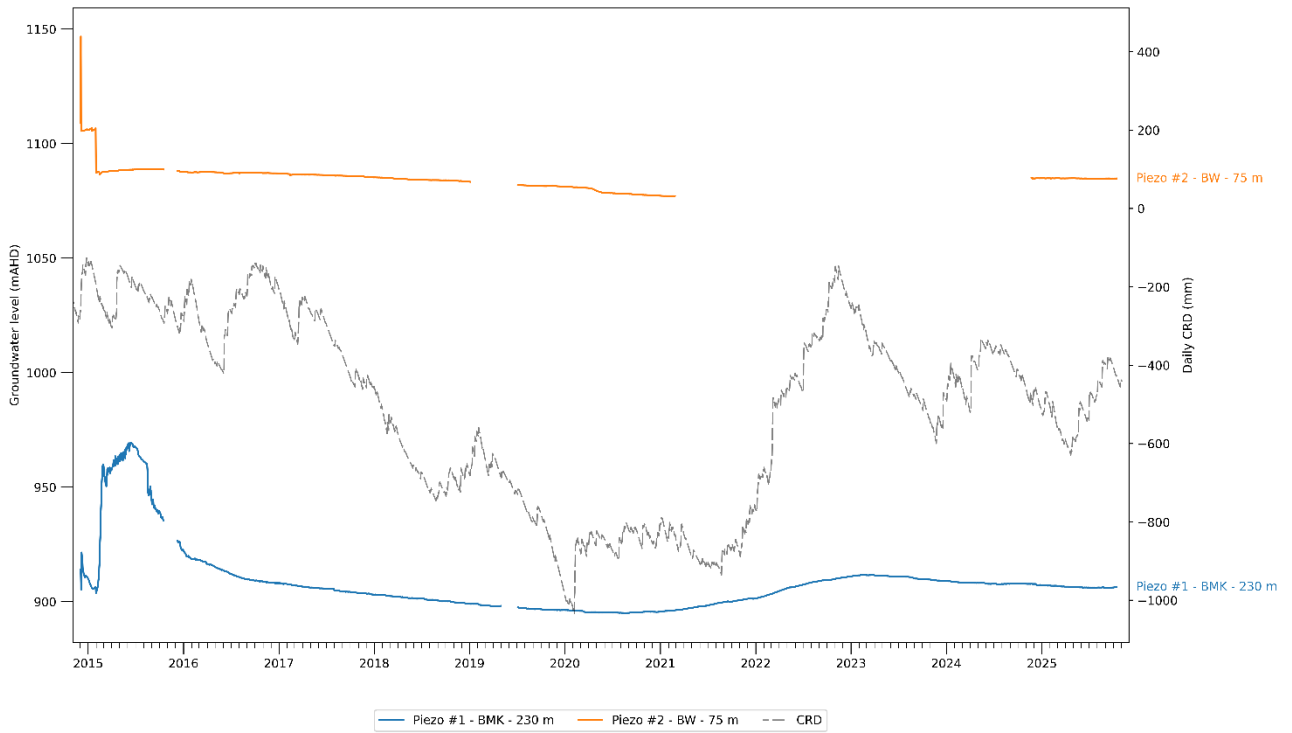
CLRP16 Vibrating wire piezometer hydrograph



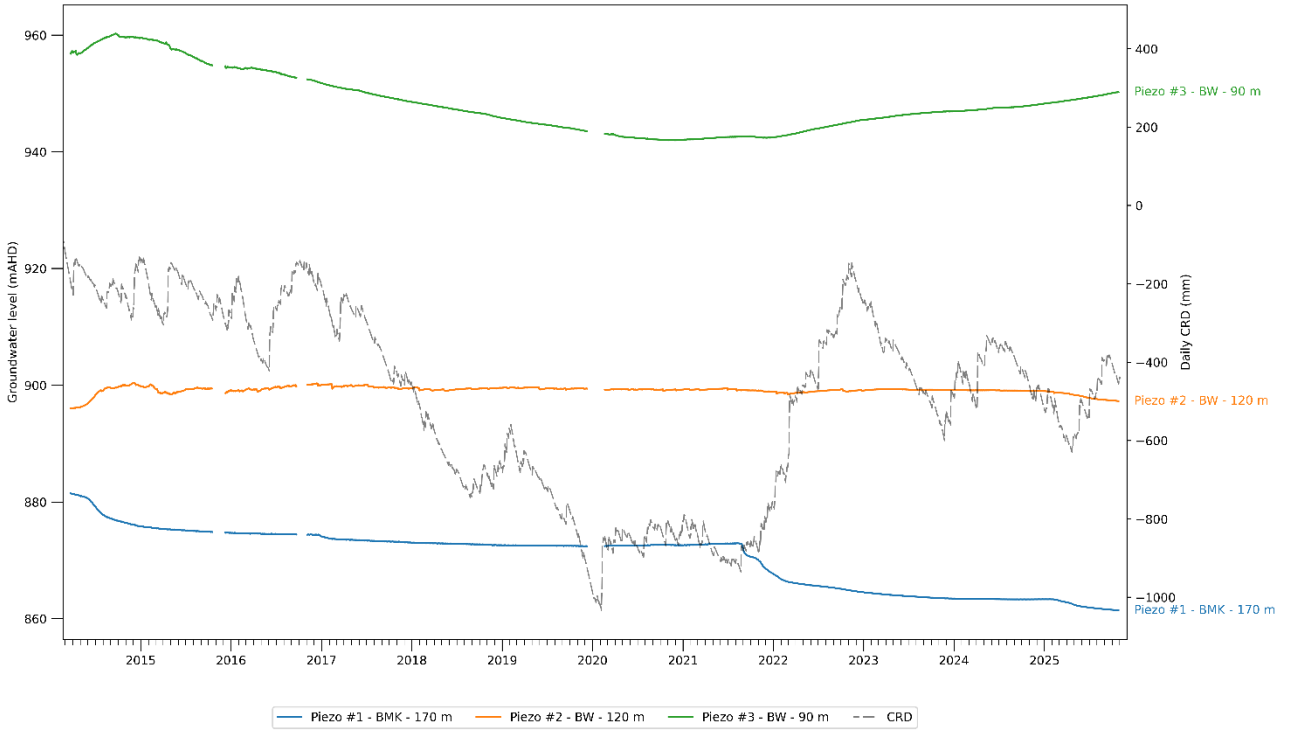
CLRP17 Vibrating wire piezometer hydrograph



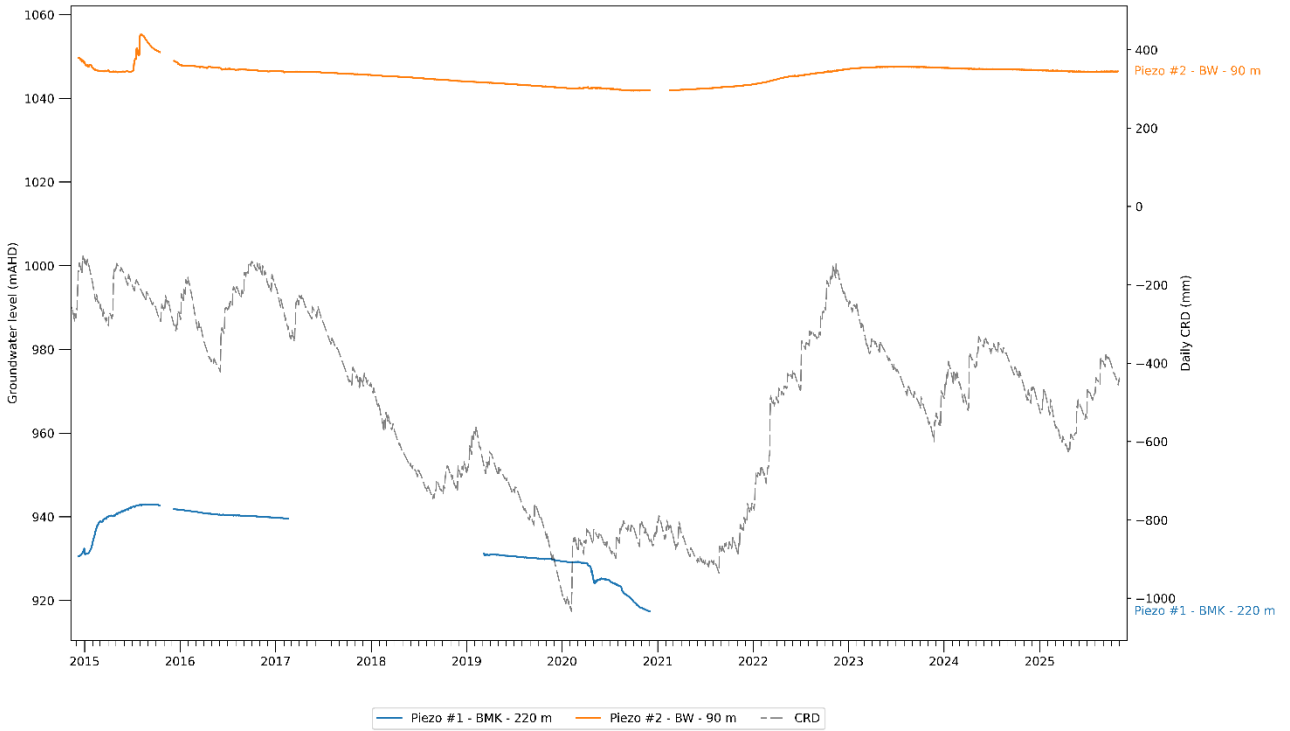
CLRP18 Vibrating wire piezometer hydrograph



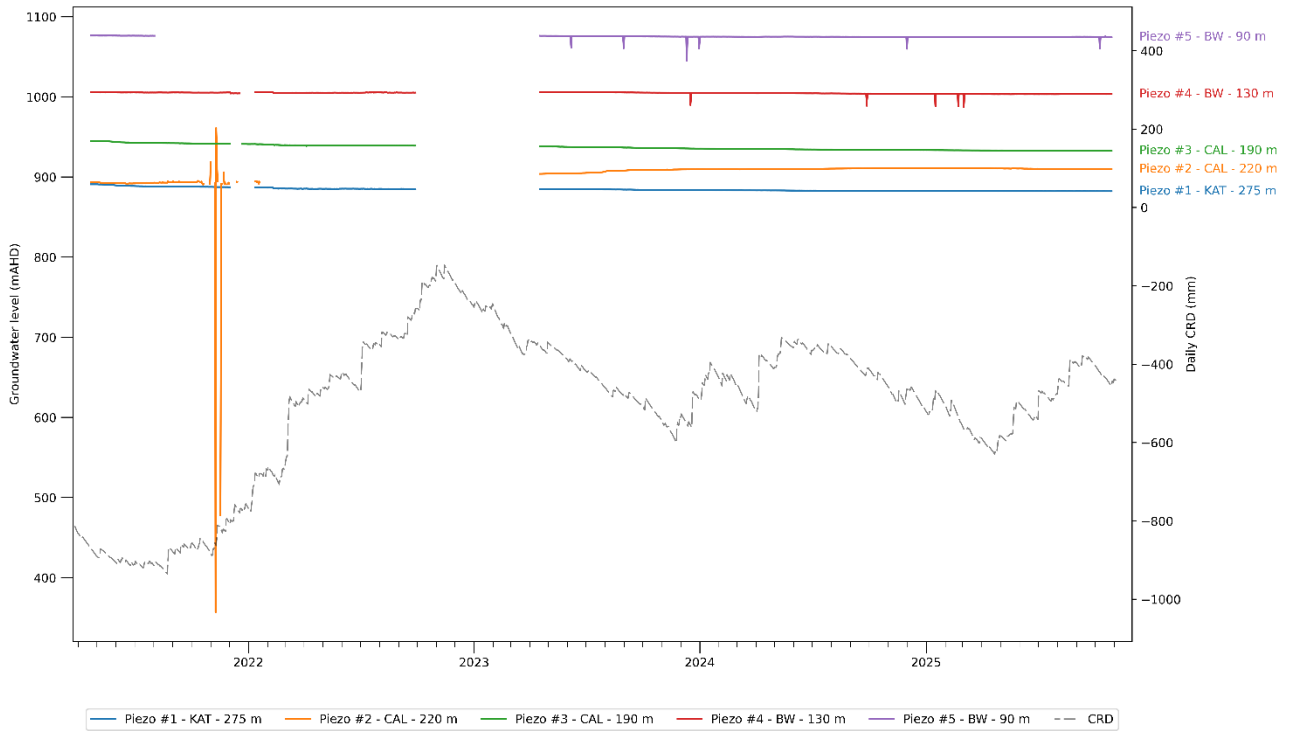
CLRP19 Vibrating wire piezometer hydrograph



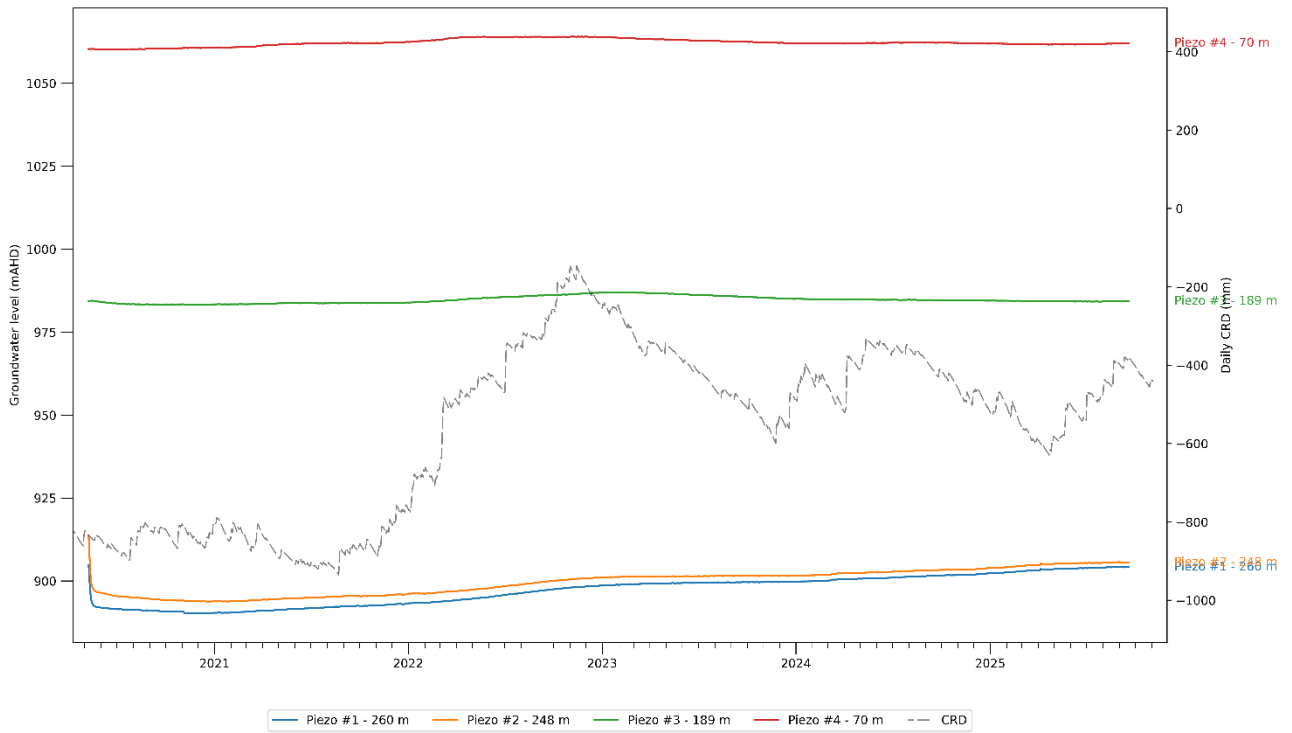
CLRP22 Vibrating wire piezometer hydrograph



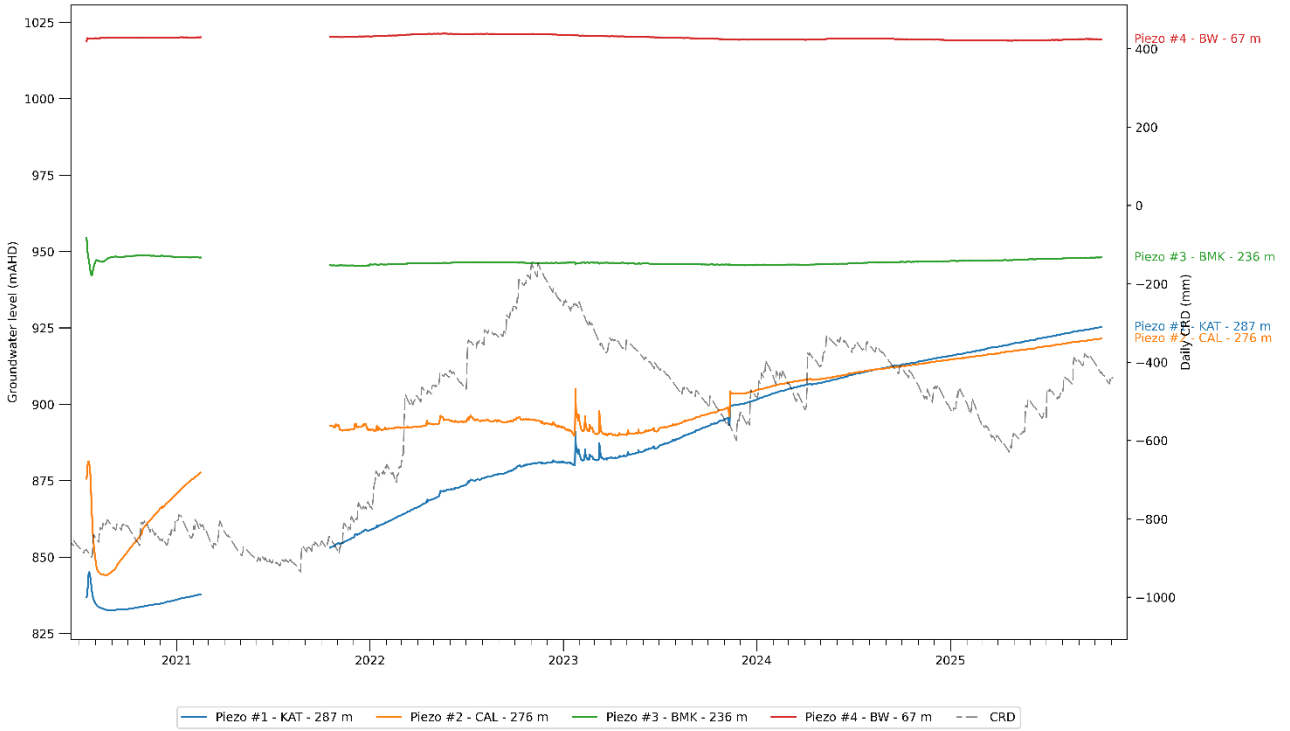
CLRP27 Vibrating wire piezometer hydrograph



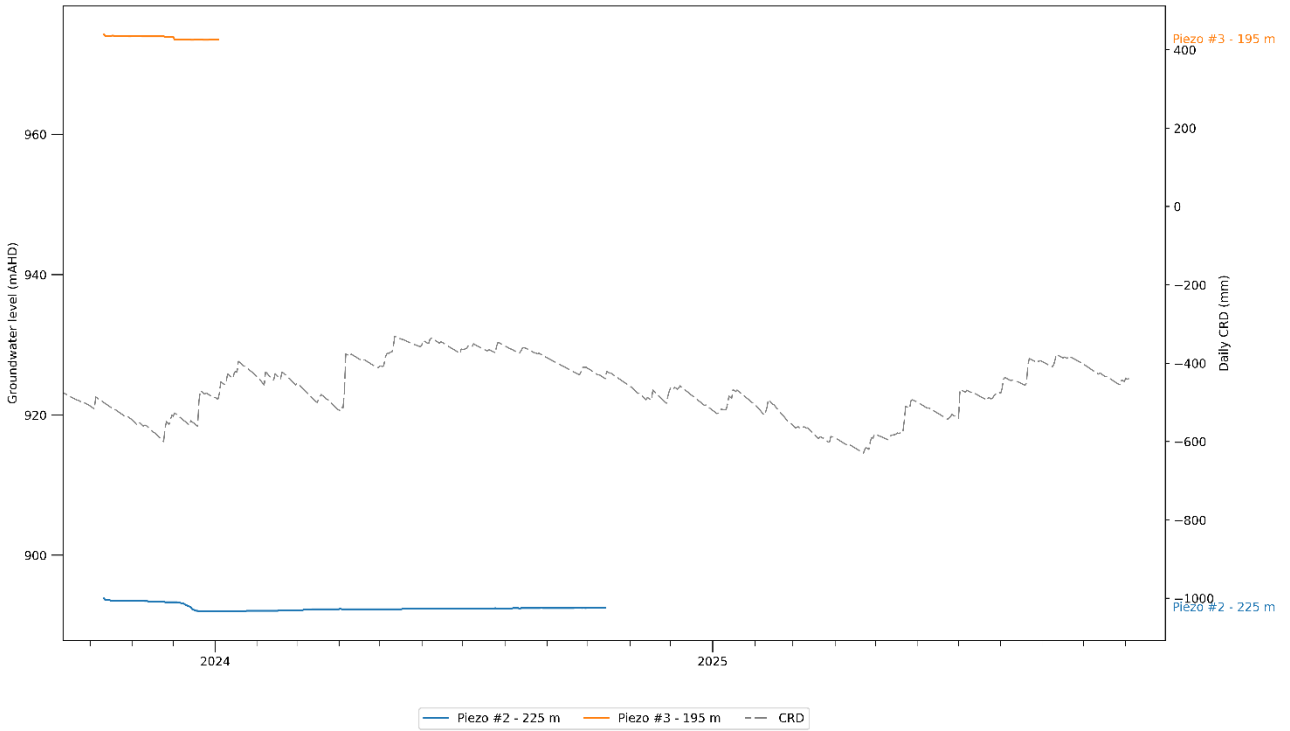
CLRP29 Vibrating wire piezometer hydrograph



CLRP33 Vibrating wire piezometer hydrograph



CLRP41 Vibrating wire piezometer hydrograph



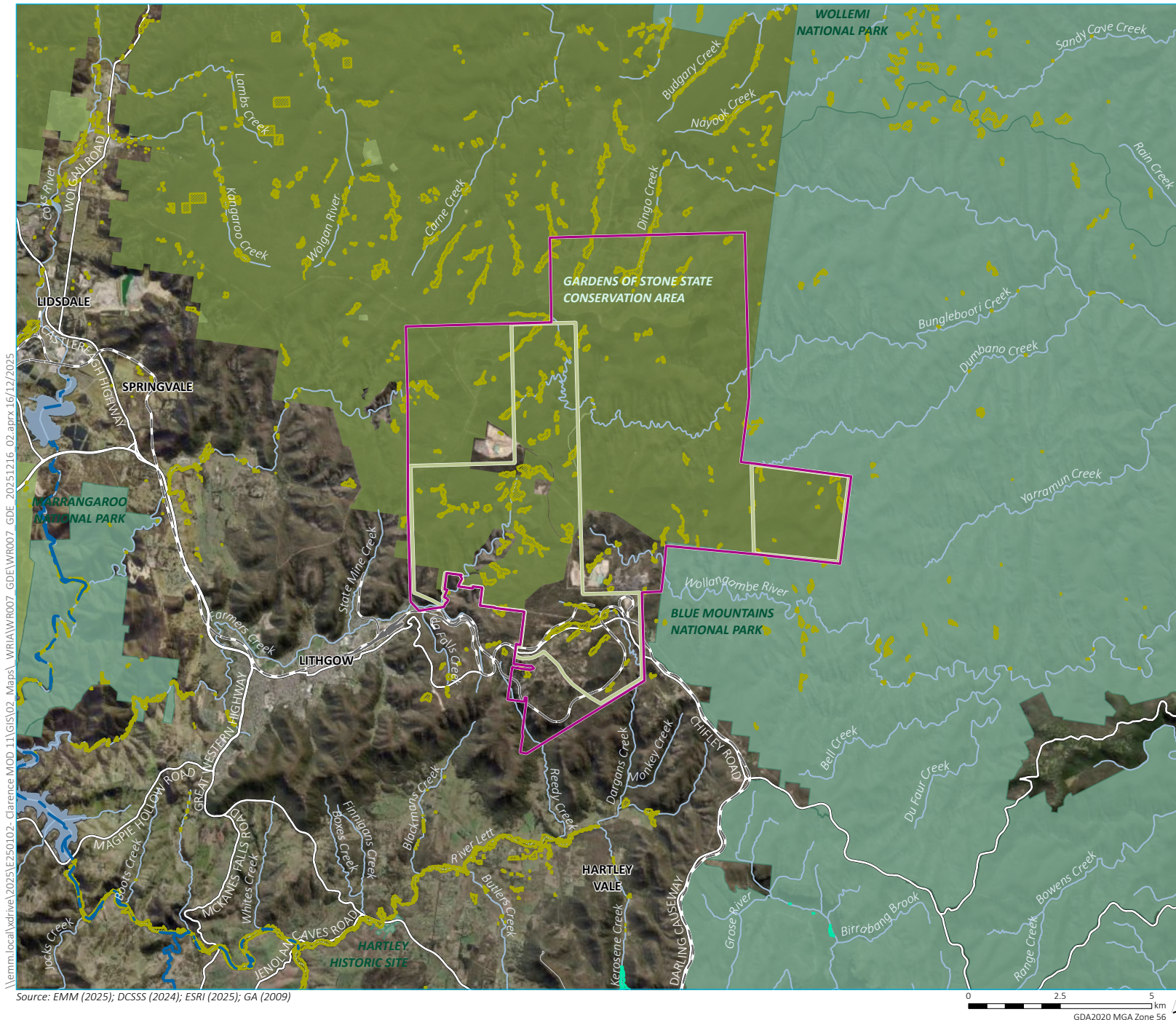
Appendix C

Additional information

C.1 Groundwater dependent ecosystem – GDE atlas High potential

High potential GDEs in the project area were identified by the GDE Atlas; they are within the Hawkesbury River region and listed by name below:

- Blue Mountains Coral Fern Shrub Swamp
- Coral Heath - tea-tree wet heath of escarpment ranges and eastern tablelands
- Broad-leaved Peppermint - Ribbon Gum grassy open forest
- River Oak forest and woodland wetland
- Western Blue Mountains Pagoda Woodland
- Sydney Hinterland Grey Myrtle Dry Rainforest
- Sydney Peppermint - Narrow-leaved Peppermint shrubby open forest
- Central Tableland Ribbon Gum-Apple Gully Forest
- Wollemi Monkey Gum-Peppermint Gully Forest
- River Red Gum shrub/grass riparian tall woodland or open forest wetland
- Hunter Range Stringybark-Apple-Peppermint Forest
- River Red Gum riparian tall woodland / open forest wetland
- Sydney Peppermint - Silvertop Ash heathy open forest
- Ribbon Gum - Yellow Box grassy woodland
- Blue Mountains Sedge Swamp
- Snow Gum - Candle Bark woodland
- Sydney Hinterland Warm Temperate Rainforest
- Central Tableland Sedge Swamp
- Sydney Hinterland Peppermint-Apple Forest
- Blue Mountains Ash Moist Forest
- Unnamed terrestrial GDE
- Hunter Range Grey Myrtle Layered Forest
- Wollemi Yertchuk-Stringybark Exposed Woodland
- Upper Blue Mountains Peppermint Sheltered Forest.



- KEY**
- Clarence Colliery Holdings Area
 - DA504-00 consent boundary
 - Terrestrial groundwater dependent ecosystem
 - High potential (national assessment)
 - High potential (regional studies)
 - Aquatic groundwater dependent ecosystem
 - High potential (national assessment)
 - Existing environment
 - Rail line
 - Major road
 - Minor road
 - NPWS reserve
 - State conservation area
 - State forest

High Potential Groundwater Dependent Ecosystems, identified within the Hawkesbury River Region in proximity to the Project

Clarence Colliery- Modification 11
Water Resources Impact Assessment
Figure C.1

\\lemm.local\drive\2025\EZ50102 - Clarence MOD 11\GIS\02 - Maps\ WRIA\WR007 - GDE\WR007 - GDE\20251216_02.aprx 16/12/2025

Source: EMM (2025); DCSSS (2024); ESRI (2025); GA (2009)



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