2023

Wambo Coal PTY Limited 2023 Annual Review

1 JANUARY 2023 – 31 DECEMBER 2023

Name of operation	Wambo Coal Mine
Name of operator	Wambo Coal Pty Ltd
Development consent /Project Approval #	DA 305-7-2003, DA 177-8-2004, EPBC 2003/1138, EPBC 2016/7636, EPBC 2016/7816
Name of holder of development consent	Wambo Coal Pty Ltd
Title/Mining lease #	CL365, CL374, CL397, CCL743, ML1402, ML1572, ML1594, ML 1806, A444, EL7211,ML1873
Name of holder of mining lease	Wambo Coal Pty Ltd
Water licence #	As per Table 3
Name of holder of water licence	Wambo Coal Pty Ltd
Forward Program start date	9 March 2022
Forward Program end date	8 March 2025
Annual Review start date	1 January 2023
Annual Review end date	31 December 2023

I, Peter Jaeger, certify that this audit report is a true and accurate record of the compliance status of Wambo Coal Mine for the period 1 January 2023 to 31 December 2023 and that I am authorised to make this statement on behalf of Wambo Coal Pty Ltd.

Note:

a) *The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.*

b) *The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).*

Name of authorised reporting officer	Peter Jaeger
Title of authorised reporting officer	Manager: Environment & Community
Signature of authorised reporting officer	
Date	28/03/2024

Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
EPL529	No
DA 305-7-2003	No
DA 177-8-2004	No
EPBC 2003/1138	Yes
EPBC 2016/7636	No
EPBC 2016/7816	No
CL365	Yes
CL374	Yes
CL397	Yes
CCL743	Yes
ML1402	Yes
ML1572	Yes
ML1594	Yes
ML1806	Yes
ML1873[1]	N/A
A444	Yes
EL7211	Yes
Water licences (as per Table 3)	Yes

[1] ML1873 was granted 29 January 2024, reporting will commence in the next reporting period.

Compliance Status Key

Risk Level	Colour Code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence.
Medium	Non-compliant	Non-compliance with: • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur.
Low	Non-compliant	Non-compliance with: • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur.
Administrative non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions).

Non-Compliances

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
DA 305-7-2003	A2	Terms of Consent	Non-Compliant	Non-compliance with this condition is noted in relation to non-compliances with other conditions of consent.	Section 9.2
DA 305-7-2003	B45	Air Quality Operating Conditions	Non-Compliant	PM_{10} concentration data was not recorded continuously at monitoring points during the audit period due to technical and environmental factors that resulted in a loss of power or data.	Section 5.3.2
DA 305-7-2003	B62	Water Management Performance Measures	Non-Compliant	Exceedances at Groundwater Quality Monitoring Bore P315 resulted in non-compliance occurring due to exceedance of performance criteria in Table 8 of Condition B62 of DA 305-7-2003.	Section 10.1
DA 305-7-2003	B66	Performance Indicators	Non-Compliant	Ongoing exceedance of groundwater performance indicators at one location (P16)	Section 10.1
DA 305-7-2003	B77	Conservation Bond	Non-Compliant	Conservation Bond was required to be lodged by 27 May 2021, which was not achieved. The Conservation Bond was lodged on 22 February 2022.	Section 5.6.2
DA-305-7-2003	D9	Non-Compliance Notification	Non-Compliant	One non-compliance was not reported within seven days of becoming aware (related to groundwater bore P315).	Section 10.1
DA 177-8-2004	A2	Terms of Consent	Non-Compliant	Non-compliance with this condition is noted in relation to non-compliances with other conditions of consent.	Section 9.2

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
DA 177-8-2004	B3	Air Quality Operating Conditions	Non-Compliant	PM_{10} concentration data was not recorded continuously at monitoring points during the audit period due to technical and environmental factors that resulted in a loss of power or data.	Section 5.3.2
EPL 529	M2.2	Air Monitoring Requirements	Non-Compliant	PM_{10} concentration data was not recorded continuously at monitoring points during the audit period due to technical and environmental factors that resulted in a loss of power or data.	Section 5.3.2

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
EPL 529	M2.1	Requirement to Monitor Concentration of pollutants discharged	Non-Compliant	During the audit period there were non-compliances due to: • samples not being collected for discharge from the Sewage Treatment Plant (STP) discharge location because the location was dry or there was no discharge; • water samples not being collected from several monitoring locations because the location was either dry, had no flow, or was inaccessible at the time of monitoring; and • PM10 concentration data not being recorded continuously at monitoring points due to technical and environmental factors that resulted in a loss of power or data.	Section 9.0

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
EPL 529	M2.3	Water and/or Land Monitoring Requirements	Non-Compliant	During the audit period there were non-compliances due to: • samples not being collected for discharge from the STP discharge location because the location was dry or there was no discharge; and • water samples not being collected from several monitoring locations because the location was either dry, had no flow, or was inaccessible at the time of monitoring.	Section 9.2
EPBC 2016/7636	1b	Implement conditions A1 and A2 of Schedule 2 of the state development consent to minimise the impacts of the action on protected matters.	Non-Compliant	The 2023 Independent Environmental Audit identified a non-compliance with Condition A2 DA 305-7-2003. These non-compliances are considered to not be related to the EPBC 2016/7816 or 2016/7816 Action(s) nor would they result in any significant impacts to relevant Matters of National Environmental Significance.	Appendix I
EPBC 2016/7816	1a				

Relevant Approval	Condition #	Condition Description (summary)	Compliance Status	Comment	Where addressed in Annual Review
Standard Conditions (Schedule 8A, Part 2) of the Mining Regulation 2016 (NSW)	Clause 19(2)(a)	Nominated Contact Person	Non-Compliant	The IEA was unable to confirm that the requirements of Clause 19(2)(a) had been completed, that is written notice had been provided to the Secretary of the full name and contact details of the nominated person within 28 days after the date on which the Standard Conditions commenced to apply.	Section 9.2

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1.0 Introduction

The Wambo Coal Mine (the Mine) is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW) (**Figure 1**). The Mine is owned and operated by Wambo Coal Pty Limited (WCPL), a subsidiary of Peabody Energy Australia Pty Limited.

A range of open cut and underground mine operations have been conducted at the Mine since mining operations commenced in 1969. Mining under the current Development Consent (DA 305-7-2003) commenced in 2004 and permitted both open cut and underground operations and associated activities to be conducted. The approved run-of-mine (ROM) coal production rate is 14.7 million tonnes per annum and all product coal is transported from the Mine by rail.

MOD 16 to (DA 305-7-2003) was approved by the Independent Planning Commission of NSW on 29 August 2019 and required development at the Mine to be undertaken in the following stages:

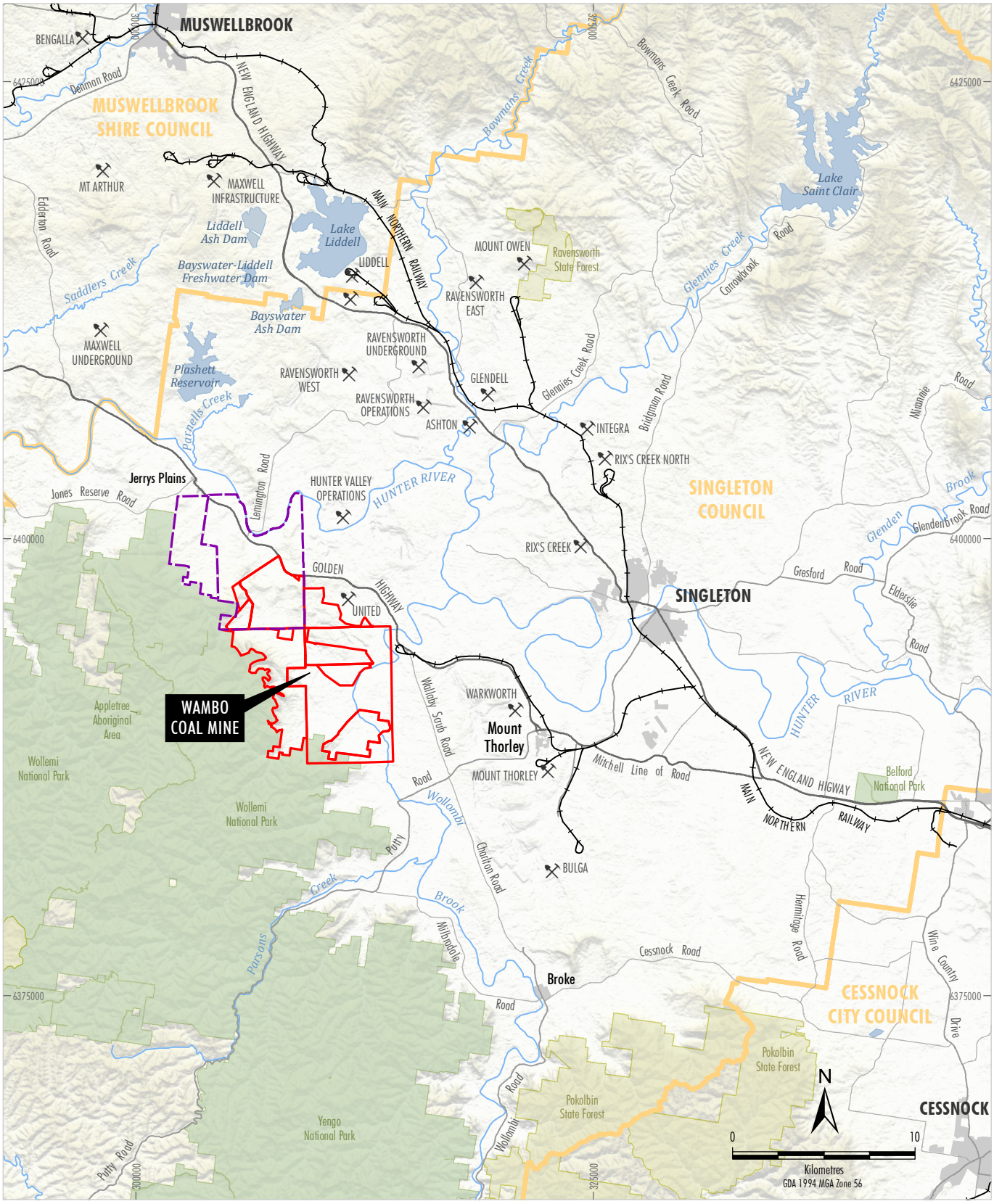
- Phase 1 – open cut mining operations at Wambo open cut mine, underground mining operations at Wambo underground mine and the operation of Wambo mine infrastructure (including minor upgrades to this infrastructure) under DA 305-7-2003.
- Phase 2 – underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure under DA 305-7-2003 and associated surface infrastructure.
- Phase 3 – following the cessation of underground mining operations that includes mine closure.

Phase 2 commenced on 1 December 2020, and open cut operations are now covered under SSD 7142. Operations under Development Consent DA 177-8-2004 have not changed following the commencement of Phase 2.

Upon the commencement of Phase 2 under DA 305-7-2003 (MOD 16), WCPL and United Collieries Pty Limited (United) (owned 95 per cent by Abelshore Pty Limited, a wholly owned subsidiary of Glencore Coal Pty Limited [Glencore] and 5 per cent by the Construction, Forestry, Mining and Energy Union [CFMEU]) entered into a 50:50 Joint Venture at the open cut mine. United manages Joint Venture tenements (i.e. open cut operations), and WCPL continues to operate underground mining operations.

Figure 2 shows the approved Mine layout including mining lease boundaries, current operational disturbance footprint and Remnant Woodland Enhancement Areas (RWEAs) for Phase 2. **Figure 3** shows the approved Mine longwall layout for Phase 2.

Operations at the Mine also include a rail spur and loop, coal reclaim and rail loading facility for the Wambo Coal Terminal under Development Consent (DA 177-8-2004) which was granted in 2004.



Source: NSW Spatial Services (2023)

LEGEND

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Local Government Area
- National Park
- State Forest
- Mining Operation

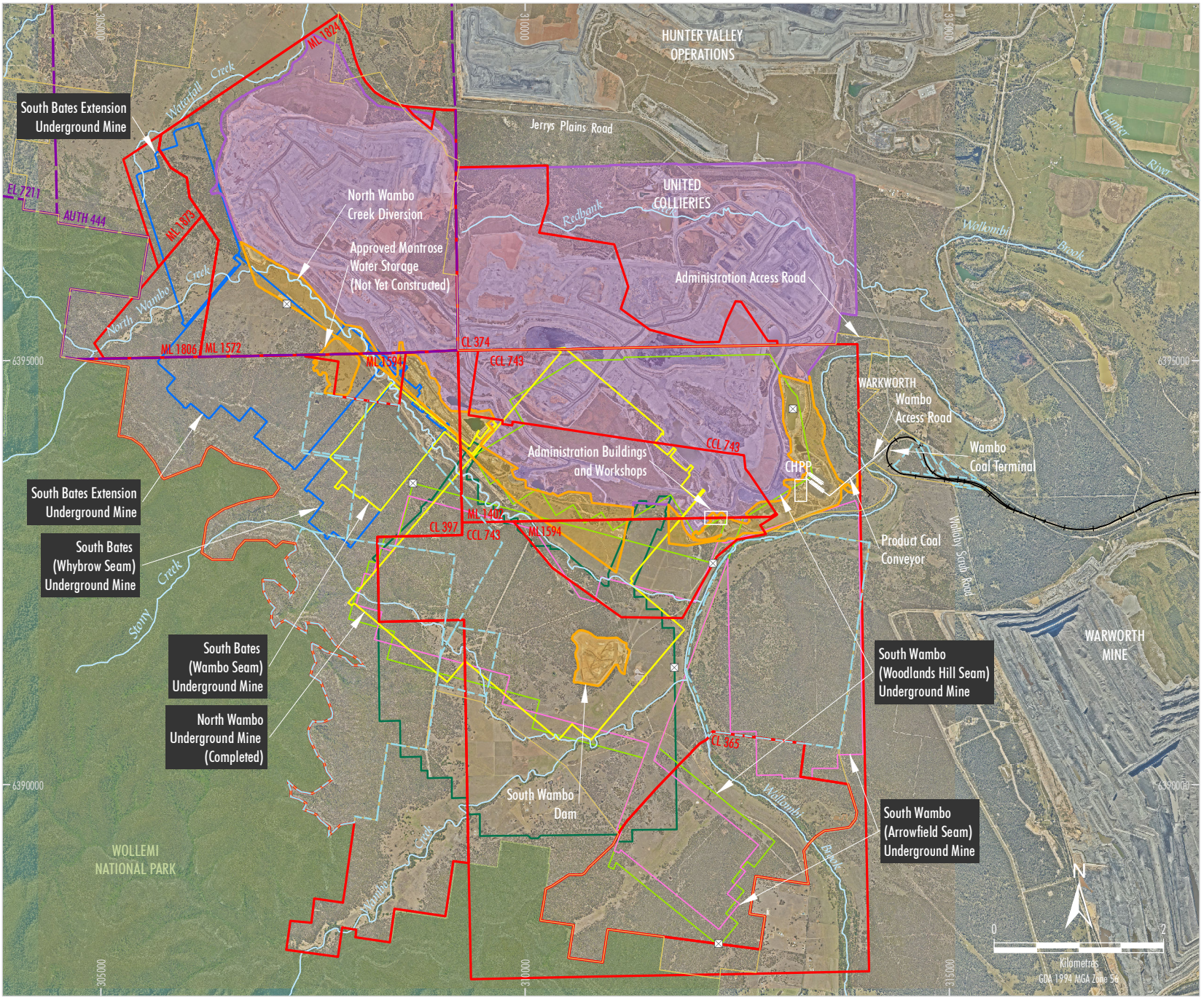
Peabody

WAMBO COAL MINE

Regional Location

Figure 1

WAM-09-15 AR 2023_201A



LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- ⊠ Ventilation Shaft

Underground Mining Areas

- Whybrow Seam
- Wambo Seam
- Woodlands Hill
- Arrowfield Seam
- Previous Underground Workings in Whybrow Seam

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Colleries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2024); NSW Spatial Services (2024)
Orthophoto Mosaic: WCPL (Nov 2023, May 2022)

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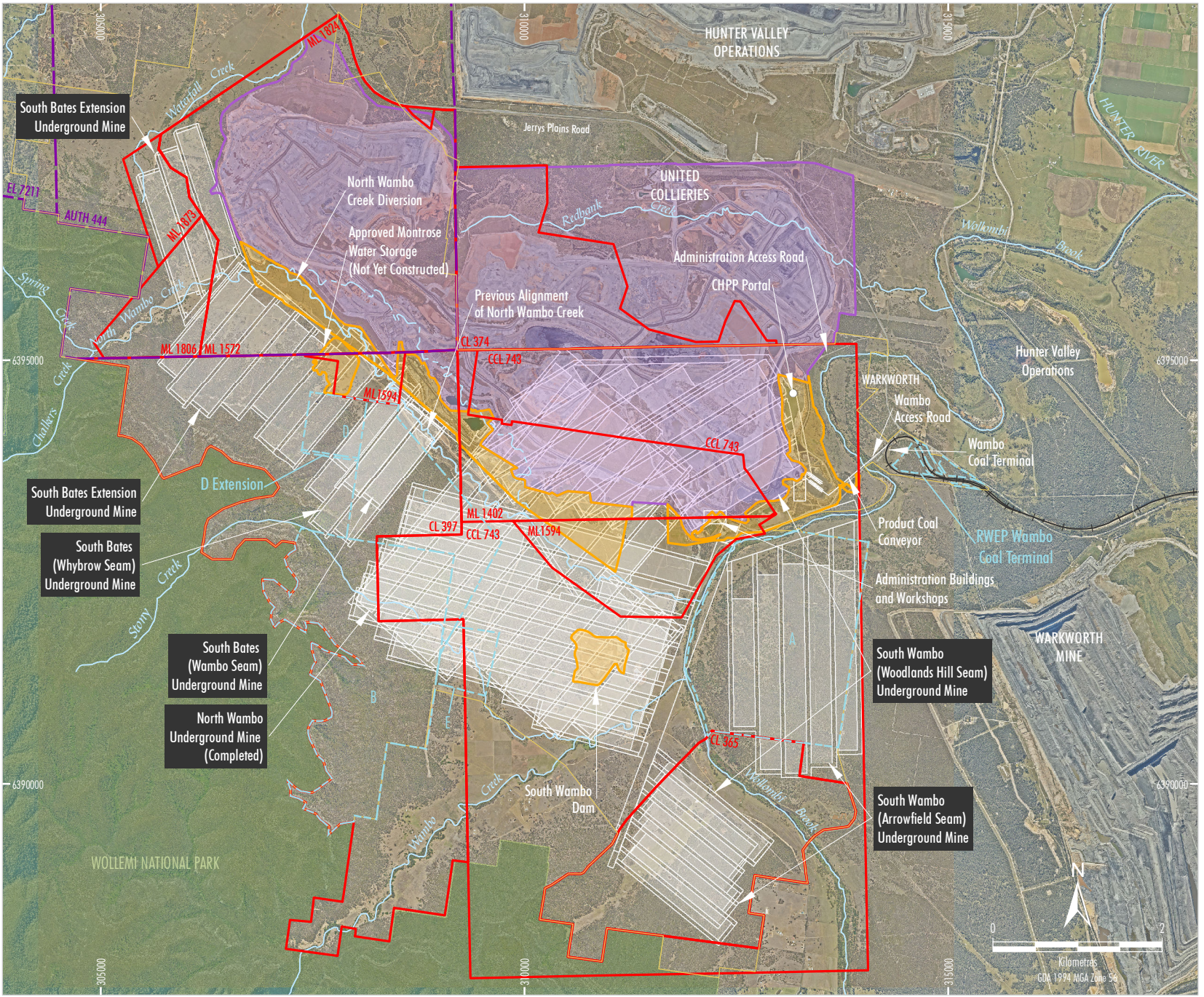
WAMBO COAL MINE

Existing/Approved Wambo Coal Mine General Arrangement

Figure 2



LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine
- Surface Development Area
- Existing/Approved Underground Development

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2024); NSW Spatial Services (2024)
Orthophoto: WCPL (Nov 2023, May 2022)

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WAMBO COAL MINE

Existing/Approved Wambo Coal Mine

Figure 3

WAM-09-15 AR 2023_203A

This Annual Review details WCPL's environmental and community performance for the reporting period 1 January 2023 – 31 December 2023. This Annual Review has been prepared in accordance with the NSW Department of Planning, Housing and Infrastructure (DPHI) *Post-approval requirements for State significant mining developments – Annual Review Guideline – October 2015* (NSW Department of Planning and Environment [DPE] 2015) and WCPL's statutory approvals (**Section 2.1**).

The Annual Review is not intended to be an exhaustive description of WCPL's operations, approvals and activities rather it is a summary of WCPL's compliance status with respect to WCPL's statutory approvals.

This Annual Review is distributed to a range of stakeholders including government authorities, Singleton Council and members of the WCPL Community Consultative Committee (CCC). A copy of the Annual Review will be made available on the Peabody Energy website (www.peabodyenergy.com).

1.1 Mine Contacts

The contact details of key WCPL personnel who are responsible for the environmental management of the Mine are listed in **Table 1**.

Table 1: Contact Details of Key WCPL Personnel

Name	Role	Phone No.
Micheal Alexander	Director Projects & Portfolio Management	(02) 6570 2361
Peter Jaeger	Manager: Environment and Community	(02) 6570 2209

2.0 Approvals

2.1 Current Approvals

WCPL has a number of statutory approvals, leases and licences that regulate activities at the Mine (**Table 2 and Table 3**). Conditions from WCPL's approvals that specifically relate to this Annual Review are detailed in **Appendix A.**

Table 2: WCPL's Statutory Approvals

Type	Description	Issued By[1]	Issue Date	Expiry Date
Development Consent	DA 305-7-2003[2]	DPHI	4/02/2004	31/12/2042
Development Consent	DA 177-8-2004[3]	DPHI	16/12/2004	31/08/2042
EPBC Approval[4]	EPBC 2003/1138	DCCEEW	23/11/2004	31/12/2029
EPBC Approval[4]	EPBC 2016/7636	DCCEEW	30/4/2017	1/3/2037
EPBC Approval[4]	EPBC 2016/7816	DCCEEW	4/5/2018	31/12/2039
Mining Lease	ML1402	MEG	23/09/1996	25/07/2035
Mining Lease	ML1572	MEG	21/12/2005	20/12/2026
Mining Lease	ML1594	MEG	1/05/2007	30/04/2028
Mining Lease	ML1806	MEG	11/08/2020	11/08/2041
Mining Lease	ML1824	MEG	29/11/2021	29/11/2035
Mining Lease	ML1873	MEG	29/01/2024	29/01/2045
Consolidated Coal Lease	CCL743	MEG	9/03/1990	14/08/2043
Coal Lease	CL365	MEG	19/09/1990	19/09/2032
Coal Lease	CL374	MEG	6/12/1991	21/03/2026
Coal Lease	CL397	MEG	4/06/1992	4/06/2034
Exploration Licence	A444[5, 6]	MEG	4/10/2007	16/05/2027
Exploration Licence	EL7211[7]	MEG	29/09/2008	29/09/2026
Environment Protection Licence	EPL529	EPA	4/02/2021	-
S101 Approval[8]	Approval to discontinue use of the North East Tailings Dam (NETD)	MEG	3/09/2009	-

1. DCCEEW = Commonwealth Department of Climate Change, Energy, the Environment and Water, MEG = Mining, Exploration and Geosciences, EPA = NSW Environment Protection Authority.
2. DA 305-7-2003 has been modified 18 times since the original approval was granted in 2004. One modification application was withdrawn subsequent to WCPL submitting the application. The latest modification (MOD19), for the South Bates Extension Underground Mine Longwalls 24 to 26 was granted approval in January 2023.
3. DA 177-8-2004 has been modified three times since the original approval was granted in 2004. The last modification (MOD3), for the United Wambo Joint Venture (UWJV), was granted approval in August 2019.
4. EPBC = *Environment Protection and Biodiversity Conservation Act 1999.*
5. A444 is an Authority to Prospect granted under the *Coal Mining Act 1973* and is deemed to be an Exploration Licence for the purposes of the *Mining Act 1992*.
6. A444 is managed by United.
7. EL7211 is managed by United.
8. Section 101 of the *Coal Mine Health and Safety Act 2002.*

Table 3: WCPL's Water Licences

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
Hunter Regulated River Water Source							
WAL 718 (20SL060212)	Hunter River Pump	Perpetuity	1,000 unit shares (high security)	Regulated River (high security)	20AL200631	20WA200632	30/06/2027
WAL 8599 (20SL061206)	Hunter River Pump	Perpetuity	6 unit shares (high security)	Regulated River (high security)	20AL201457	20CA201459	25/09/2028
WAL 8600 (20SL061206)	Hunter River Pump	Perpetuity	868 unit shares (general security)	Regulated River (general security)	20AL201458	20CA201459	25/09/2028
WAL 43299	TBC (extraction via Hunter River pump)	Perpetuity	80 units (general security)	Regulated River (general security)	20AL220689	-	-
WAL 8604 (20BL061206)	Hunter River Pump	Perpetuity	240 unit shares (supplementary water)	Supplementary Water	20AL203044	20CA201459	25/09/2028
Hunter Regulated River Water Source – Shared with United Colliery							
WAL 929 (20SL050661)	Other Pump	Perpetuity	3 unit shares	Domestic and Stock	20AL201147 (NOW Reference Number)	20WA201148	06/12/2027
WAL 1369 (20SL060416)	80 mm CP	Perpetuity	15 unit shares (supplementary water)	Supplementary Water	20AL203071 20AL204246 20AL204247	20CA201654	30/11/2028

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
WAL 15459 (20SL204246)	80 mm CP	Perpetuity	21 unit shares (general security)	Regulated River (general security)	20AL204246	20CA201654	30/11/2028
WAL 1164	100 mm CP	Perpetuity	180 Unit Shares	Regulated River (general security)	20AL201738	20CA201739	30/11/2027
WAL 902	38 mm CP	-	8 ML	Regulated River	20AL201097	20WA201098	30/06/2027
Hunter Regulated River Water Source –United Colliery							
WAL10541	-	-	300	Unregulated River	20AL200927	20WA200928	30/06/2027
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 18437 (20SL033872)	Wollombi Brook Pump	Perpetuity	366.9 unit shares	Unregulated River	20AL208641	20WA208642	31/07/2032
WAL 23897 (20BL167737)	Well No. 2	Perpetuity	70 unit shares	Aquifer	20AL211371	20WA211372	31/07/2032
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source) – United Colliery							
WAL18445	Bywash Dam	-	200 unit shares	Unregulated River	20AL208713	20WA208714	13/03/2023
WAL18549	Other Pump	-	100 unit shares	Unregulated River	20AL208705	20WA208706	18/11/2032
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin – North Coast Groundwater Source)							
WAL 42373[2]	-	Perpetuity	1,549 unit shares	Aquifer	20AL219997	20MW065010	-
WAL 41532 (20BL172156)	Dewatering	Perpetuity	98 unit shares	Aquifer	20AL218994	20MW065010	-

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin – North Coast Groundwater Source) – United Colliery							
WAL41510	Dewatering	-	300 unit shares	Aquifer	20AL217075	20MW065011	-
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin – North Coast Groundwater Source) – Groundwater Bores							
20BL168997	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL168998	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL168999	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL169000	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL170638	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172237	Monitoring Bore (GW14, GW18, GW21)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172238	Monitoring Bore (GW12)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172240	Monitoring Bore (GW15)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172242	Monitoring Bore (GW16, GW17)	Perpetuity	Groundwater monitoring	NA	-	-	-

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
20BL172244	Monitoring Bore (GW20)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172255	Monitoring Bore (GW22)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172256	Monitoring Bore (GW13)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172257	Monitoring Bore (GW19)	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL172332	Piezometer	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173290	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173291	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173292	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173293	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173946	Monitoring	Perpetuity	Groundwater monitoring	NA	-	-	-
20BL173999	Monitoring Bore	Perpetuity	Groundwater monitoring	NA	-	-	5/12/2023[3]
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214848	-
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214849	-

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Access Licence	Nominated Water Supply Work Approval	Expiry Date
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214850	-
-	Bore	Perpetuity	Stock	Basic Rights	-	20WA214851	-
-	Spearpoints	Perpetuity	Stock/Domestic	Basic Rights	-	20WA215574	-

WAL = water access licence; mm = millimetres.

1. 20BL prefix bore licences with allocations have been replaced with WALs.
2. WAL 42373 was issued in 2019 to consolidate six of WCPL's previous WALs under the North Coast Fractured and Porous Rock groundwater Sources (Sydney Basin – North Coast Groundwater Source) including WAL 39735, WAL 39738, WAL 39803, WAL 41494, WAL 41528 and WAL 41520.
3. DPE-W has confirmed that licenses are not required for groundwater bores less than 40m deep.

2.2 Changes to Approvals

During the reporting period, the following changes were made to WCPL's approvals:

- DA 305-7-2003 – WCPL lodged an application to modify DA 305-7-2003 under section 4.55(2) of the EP&A Act to allow for optimisation and continued operations of the South Bates Extension Underground Mine through the reorientation of Longwalls 24 and 25, and the addition of Longwall 26 with the DPHI in August 2022. This modification (Modification 19) was determined on 25 January 2023.
- Extraction Plan for South Bates Extension Underground Mine Longwalls 24 to 26 – was submitted to the DPHI the 7th June 2023 and was approved 6th December 2023.
- An application for a new Mining Lease for the Longwall 24 to 26 area was lodged with MEG in March 2023. Mining Lease 1873 was granted 29 January 2024 and expires 29 January 2045.
- Aboriginal Heritage Impact Permit #5158 was granted 1 December 2023 for the longwalls 24 to 26 area.

2.3 Environmental Management System

WCPL operates an Environmental Management System to manage compliance and advance continual improvement across the Mine. A summary of the status of required management plans is presented in **Table 4**.

In accordance with Schedule 2, Condition D15(a) of DA 305-7-2003, copies of these management plans have been made available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

In accordance with Schedule 2, Condition D6 of DA 305-7-2003, WCPL will review the strategies, plans and programs required under DA 305-7-2003 within three months of the submission of this Annual Review to relevant government regulators. If necessary, the strategies, plans and programs required under this consent must be revised, and submitted to the Planning Secretary for approval within six weeks of the review in accordance with Schedule 2, Condition D7 of DA 305-7-2003

Table 4: Status of WCPL's Environmental Management Plans

Management Plan	Status	Approved Version[1]
North Wambo Underground Extraction Plan for Longwalls 8 to 10A (and associated component plans)	Approved – 2015	April 2015
South Bates Underground Mine Extraction Plan for Longwalls 11 to 16 (and associated component plans)	Approved – 2017	July 2017[2]
South Bates Extension Underground Mine Extraction Plan for Longwalls 17 to 20 (and associated component plans)	Approved – 2019	Revision C (June 2019)[3]
South Bates Extension Underground Mine Extraction Plan for Longwalls 21 to 24 (and associated component plans)	Approved – 2022	Revision E (December 2022)
South Bates Extension Underground Mine Extraction Plan for Longwalls 24-26 (and associated component plan)	Approved - 2023	Revision C (December 2023)
Forward Program	Resources Regulator Assessment	Forward Program (August 2022)
Environmental Management Strategy	Approved – 2020	Version 7 (November 2020)
Air Quality & Greenhouse Gas Management Plan[4]	Approved – 2020	Version 8 (November 2020)
Noise Management Plan	Approved – 2023	Version 12 (July 2023)
Water Management Plan	Approved – 2023	Version 4 (November 2023)
Groundwater Management Plan	Approved – 2023	Version 6 (November 2023)
Surface Water Management Plan	Approved – 2023	Version 3 (November 2023)
United Wambo and Wambo Site Water Balance	Approved – 2020	Version 2 (August 2020)
United Wambo and Wambo Water Monitoring Plan	Approved – 2023	Version 6 (November 2023)
Erosion and Sediment Control Plan	Approved – 2023	Version 4 (November 2021)
Biodiversity Management Plan (previously the Flora and Fauna Management Plan)	Approved – 2023	Version 5 (June 2023)
Heritage Management Plan	Approved – 2023	Version 2 (June 2023)
Wambo Homestead Complex Conservation Management Plan	Approved – 2019	Version 6 (May 2019)
Pollution and Incident Response Management Plan	Approved – 2023	Version 8 (August 2023)
Rehabilitation Management Plan	Approved – 2023	Version 3 (November 2023)

1. Approved version as at the end of the reporting period.
2. On 11 October 2017, DPHI approved the South Bates Underground Mine Longwalls 11 to 16 Extraction Plan with the exception of the Site Water Management Plan (and associated component plans), which were unable to be approved until they were updated in consultation with Department of Industry – Water (DI-Water) (now NSW Department of Climate Change, Energy, the Environment and Water [NSW DCCEEW). In 2018, the South Bates Extension Underground Mine Longwalls 17 to 20 Extraction Plan (including the Site Water Management Plan which had been updated in consultation with NSW DCCEEW was approved by DPHI.
3. On 4 September 2018, WCPL provided DPHI with correspondence explaining that geological structures had been encountered that may require changes to the main headings and finishing ends of Longwalls 18, 19 and 20. Accordingly, WCPL requested that DPHI approve the Extraction Plan for Longwalls 17 to 20 for extraction of Longwall 17 only. On 7 September 2018, DPHI approved the extraction of Longwall 17 only, on the basis that WCPL would prepare an amended Extraction Plan for Longwalls 18, 19 and 20. On 1 March 2019, WCPL submitted an amended Extraction Plan for Longwalls 17 to 20. DPHI approved the amended Extraction Plan on 4 June 2019.
4. An updated Air Quality Management Plan (version 9) was submitted to the DPHI in July 2023.

3.0 Operations Summary

3.1 2023 Mining Operations

The Mine operates seven days a week, 24 hours a day on a rotating shift basis.. There have been no unplanned shutdowns.

During the reporting period, the following mining operations were undertaken at the South Bates Extension Underground Mine (current longwall mining area):

- Longwall 22 (completed January 2023);
- Longwall 23 (commenced June 2023),
- Longwall 23 (completed November 2023).

Table 3 shows the production summary for 2023, compared to the production for 2022 and the forecast production for 2023 and 2024.

Following the commencement of Phase 2 operations on 1 December 2020, production material (including waste rock/overburden, ROM coal/ore, coarse/fine reject and saleable product) from open-cut operations is covered under SSD 7142.

Table 5: Production Summary

Material	Unit	Approved limit	2022 reporting period (actual)[3]	2023 reporting period (forecast)[3]	2023 reporting period (actual)[3]	2024 reporting period (forecast)[3]
Wambo Coal Mine						
Waste Rock/ Overburden	bcm	-	0	0	0	0
ROM Coal/ Ore	Mt	14.7[1]	1.71	1.9	1.78	1.80
Coarse Reject	Mt	-	2	1.9	2.22	2.67
Fine Reject (Tailings)	Mt	-	0.95	0.85	0.82	0.91
Wambo Coal Terminal						
Saleable Product – Complex	Mt	15[2]	4.9	4.7	5.81	7.22

Note: bcm = bank cubic metres, Mt = million tonnes.

[1] DA 305-7-2003, Condition A16, Schedule 2.

[2] DA 177-8-2004, Condition A8, Schedule 1. Refers to product coal transported off-site.

[3] Under Phase 2 of the UWJV, open cut operations are undertaken by United.

During the reporting period, the ROM coal production at the Mine (1.78Mt) was slightly lower than the forecast ROM coal production (1.8Mt). Saleable product coal from the Mine (5.81Mt) was higher than forecast (4.7).

No overburden production occurred at the Mine as forecast.

During the reporting period, a total of 5.81 Mt of product coal was transported off-site via rail (no coal was hauled off-site by trucks). A summary of 2023 daily train movements, required by Schedule 2, Condition B29(b) of DA 177-8-2004 is provided in **Appendix B**.

The maximum daily train movements on any one day was eight or less in accordance with Condition A9, Schedule 2 of DA 177-8-2004 (**Appendix B**).

Figure 4 shows the amount of saleable product coal transported off-site on a weekly basis.

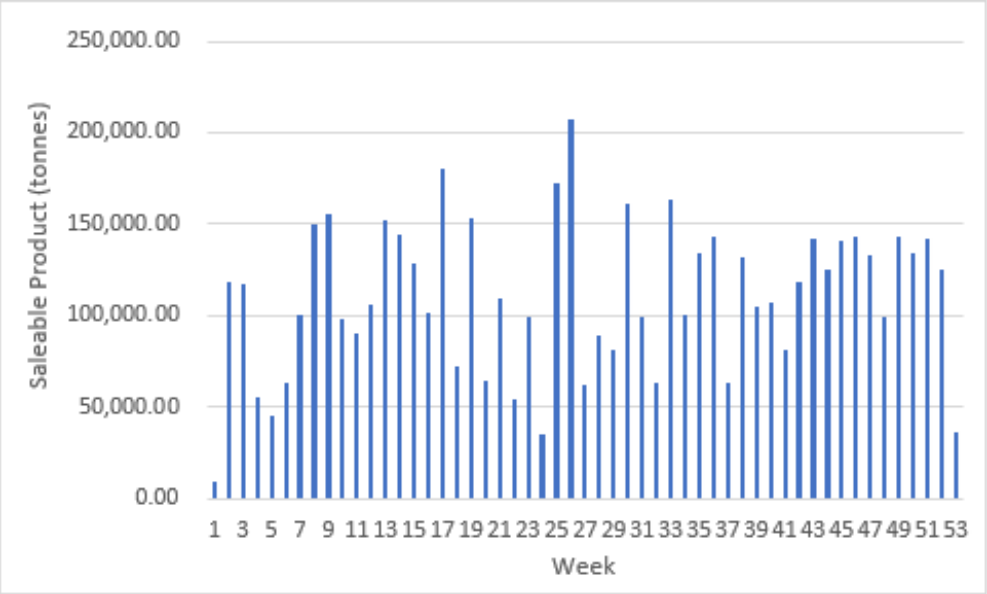


Figure 4: Coal Transported Off-site during the Reporting Period

A total of 652trains were loaded during the reporting period with 27 trains loaded on Friday evening (between 6 pm to 9 pm) and Sunday morning (between 9 am to 12 am). In accordance with Schedule 2, Condition A12 of DA 177-8-2004, WCPL took all reasonable steps to minimise train movements within these hours.

3.2 Next Reporting Period

Operations during the next reporting period will be undertaken in accordance with the approved relevant Extraction Plan and will include continued mining at the South Bates Extension Underground Mine, including:

- Longwall 24 (commenced 17 January 2024); and
- Longwall 24 (anticipated completion in September 2024)
- Longwall 25 (anticipated to commence in January 2025)

4.0 Actions Required from Previous Annual Review

A number of actions and improvements have been identified in the 2022 Annual Review undertaken by WCPL. Actions and improvements recommended in the 2022 Annual Review and their current status are summarised in **Table 4.** In addition, further information/actions requested by DPHI in relation to the 2022 Annual Review are also addressed in **Table 6**.

Table 6: Actions from Previous Annual Review

Action/Improvement required from previous Annual Review	Requested by	Action taken by the Operator	Where Discussed in Annual Review
Construct replacement bores for P106 and P109 with a paired standpipe monitoring site.	SLR	Complete. Installation of GW37a and GW37b in October 2023 near Wambo Creek to replace P106 and P109.	Appendix H
Investigate and repair any damages to GW10.2 as required.	SLR	Inspected 15 September 2023. Scheduled for development/ flushing in 2024.	Appendix H
Update groundwater inflow assessment criteria to reflect peak inflow values from contemporary model predictions.	SLR	Complete. The groundwater inflow assessment criteria were updated to reflect contemporary numerical model predictions (The LW24-26 Modification Groundwater Assessment, SLR 2022) in the November 2023 update of the groundwater management plan (GWMP). The current peak inflow estimate is 480.45 ML/yr.	Appendix H
Investigate observed impacts at P315, GW15 and P16.	WCPL	Ongoing. Investigations into the exceedance of the EC trigger level at P315 is continuing. An investigation into GW15 and P16 was undertaken during the reporting period (SLR, 2023).No further action is required for GW15.	Section 6.2.3
Further investigation into increased EC recorded at SW08	WCPL	Ongoing. Throughout the period EC at SW08 remained elevated until Stony Creek was recorded dry in April 2023. Wambo provided an investigation report to DPHI in March 2023 and an update of monitoring data and progress with report recommendations in November 2023.The next update will be provided to DPHI in November 2024.	Section 6.1.4
Remove VMPs no longer collecting reliable data from the monitoring network	SLR	Ongoing. Further work to be competed in 2024.	Section 6.2.4

Action/Improvement required from previous Annual Review	Requested by	Action taken by the Operator	Where Discussed in Annual Review
Continuation of subsidence remediation	WCPL	Ongoing. During the reporting period, subsidence remediation activities occurred adjacent to the North Wambo Creek Diversion and access tracks above LW 21-23. No subsidence trials were conducted in 2023. Existing subsidence remediation was monitored during 2023, with no reoccurring subsidence occurring at trial sites.	Section 5.9.4
Repair subsidence damage to tracks	WCPL	Ongoing. During the reporting period, minor subsidence damage to internal access tracks was observed. These were repaired at the time of identification.	Section 5.9.4
Continue planned North Wambo Creek Diversion rehabilitation and maintenance works	WCPL	Complete. Stages 3 and 4 were completed in December 2023.	Section 7.2.2 and Figures 10 and 10a.

5.0 Environmental Performance

5.1 Noise

Noise Impact Assessment Criteria for the Mine are defined in Table 4 of DA 305-7-2003 (Schedule 2, Condition B13 and B14) and in EPL529 (Condition L5). Additional noise conditions relating to land acquisition, operating hours, rail noise, noise monitoring and the WCPL Noise Management Plan (NMP) are also detailed in these approval documents.

EMM Consulting (EMM) (2023) prepared an annual noise monitoring report for the Mine and is presented in **Appendix C**.

5.1.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the relevant approval criteria for noise in relation to sensitive receivers is included in **Table 7**.

Table 7: Impact Assessment Criteria for Noise DA 305-7-2003 (Phase 2 Operations)

Noise Assessment Area	Receiver	Applicable Noise Impact Assessment Criteria			
		Day $L_{Aeq,15minute}$ (dB)	Evening/Night $L_{Aeq,15minute}$ (dB)	Night $L_{Aeq,15minute}$ (dB)	Night $L_{A1,1minute}$ (dB)
Area 1 – North Bulga	R007	37	37	37	47
	All other privately-owned residences	35	35	35	45
Area 2 – South Wambo	R025	39	39	39	49
	All other privately-owned residences	35	35	35	45
Area 3 Warkworth Village	All other privately-owned residences	44	44	43	53
All other areas	All other privately-owned residences	35	35	35	45

The noise impact assessment criteria in DA 305-7-2003 did not apply under meteorological conditions of:

1. *The noise criteria in condition B12 are to apply under all meteorological conditions except the following:*
   - a. *where 3°C/100 metres (m) lapse rates have been assessed, then:*
     - i. *wind speeds greater than 3 metres per second (m/s) measured at 10 m above ground level;*
     - ii. *temperature inversion conditions between 1.5°C/100 m and 3°C/100 m and wind speeds greater than 2m/s measured at 10 m above ground level; or*
     - iii. *temperature inversion conditions greater than 3°C/100 m.*
   - b. *where Pasquill Stability Classes have been assessed, then:*
     - i. *wind speeds greater than 3m/s at 10m above ground level;*
     - ii. *stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level;*
     - iii. *stability category G temperature inversion conditions.*

Condition L5.1 of EPL529 includes similar noise emission limits to those identified in DA 305-7-2003 for Phase 1 operations. Conditions L5.3 of EPL529 specify that the noise emission limits identified in Condition L5.1 do not apply under meteorological conditions of:

- wind speeds greater than 3 m/s at 10 m above the ground level;
- stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level; or
- stability category G temperature inversion conditions.

The noise criteria in the Development Consent (DA 305-7-2003) is more conservative than those in EPL529, and therefore have been used to assess compliance in 2023.

As lapse rates were not measured directly, meteorological conditions have been assessed against the Pasquill Stability Classes detailed in Condition 1(b), Appendix 5 of DA 305-7-2003.

In addition to the statutory requirements detailed in DA 305-7-2003, WCPL is also required to meet additional requirements detailed within the WCPL NMP. These requirements include reporting of monthly attended monitoring results on WCPL's website (or when there is an exceedance of criteria) and provision of results to the WCPL CCC.

5.1.2 Performance during the Reporting Period

The noise monitoring network during the reporting period consisted of five attended noise monitoring locations (two of which were coincident with real time noise monitors). During 2023, attended noise monitoring was undertaken monthly at N01, N16, N20A, N21 and N26. For further detail, refer to the WCPL NMP (**Appendix C**).

Noise levels from the Mine were inaudible at all receivers and WCPL complied with relevant noise criteria during all monitoring conducted during the reporting period (**Appendix C**). More detail is provided in **Appendix C**.

Results of monitoring were published on the WCPL website and details were provided to the WCPL CCC during meetings, in accordance with the WCPL NMP.

In addition, WCPL complied with all operational requirements detailed in the WCPL NMP.

No complaints were received relating to noise during the reporting period (**Section 8**).

Based on the performance of the noise management system outlined above, it is considered that the noise management system is effective.

5.1.2.1 Comparison with UWJV EIS Predictions

Phase 2 operations commenced on 1 December 2020, the Mine now only includes underground mining operations at Wambo underground mine, the operation of Wambo mine infrastructure under DA 305-7-2003 and associated surface infrastructure. Open cut operations are now managed by United under SSD 7142.

Subsequently, comparison of measured Mine noise levels against the UWJV EIS noise model predictions (which includes opencut operations) was not possible (**Appendix C**).

5.1.3 Trends and Key Management Implications

EMM (2024) concluded that noise levels from WCM were inaudible at all receivers during 2023 noise monitoring (**Appendix C**). This conclusion is consistent with noise monitoring in the 2022 reporting period (Global Acoustics, 2023). No modifying factors were applicable to WCM operations. WCM complied with relevant noise criteria during all measurements during 2022 noise monitoring.

WCPL will continue to implement the WCPL NMP next reporting period.

5.1.4 Implemented or Proposed Management Actions

WCPL will continue to implement the noise management measures detailed in the WCPL NMP, including documenting the timing and scale of any operational changes made in response to adverse conditions or noise alarms from monitoring units.

5.2 Blasting

Since the commencement of Phase 2, no blasting associated with open cut operations is allowed at the Mine in accordance with Condition B21 of DA 305-7-2003. Blasting activities associated with the UWJV open cut operations are managed by United.

5.2.1 Approval Criteria/EIS Predictions and Management Plan Requirements

DA 305-7-2003 and Condition L6 of EPL529 includes blast criteria associated with Phase 1 operations. Condition B21, Schedule 2 of DA 305-7-2003 requires that no blasting associated with open cut operations is undertaken on site during Phase 2.

5.2.2 Performance during the Reporting Period

No blasting was undertaken at the Mine during the reporting period.

5.2.3 Trends and Key Management Implications

No blast-related trends were identified during the reporting period.

5.2.4 Implemented or Proposed Management Actions

At this stage, no blast-related management actions are currently scheduled in the next reporting period.

5.3 Air Quality

Air quality criteria for the Mine are defined in Table 6 of DA 305-7-2003 (Condition B42, Schedule 2) and EPL529 (Condition M2.2). Additional conditions relating to air quality, odour and greenhouse gas emissions, land acquisition, operating conditions and the WCPL Air Quality and Greenhouse Gas Management Plan (AQGGMP) are also detailed in these approval documents.

Airen Consulting (Airen) (2024) prepared an annual air quality monitoring report for the Mine and is presented in **Appendix D**.

5.3.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the approval criteria for air quality applicable during the reporting period is included in **Table 8.**

Table 8: Approval Criteria for Air Quality

Pollutant	Averaging Period	Criterion
Particulate Matter <10 µm (PM_{10})	Annual	[a,c] 25µg/m^3
	24 hour	[b] 50 µg/m^3
Particulate Matter < 2.5 µm ($PM_{2.5}$)	Annual	[a,c] 8 µg/m^3
	24 hour	[b] 25 µg/m^3
TSP matter	Annual	[a,c] 90 µg/m^3

Note: TSP = total suspended particles, PM_{10} = particulate matter with a diameter less than 10 micrometers, $PM_{2.5}$ = particulate matter with a diameter less than 2.5 micrometers, µg/m^3 = micrograms per cubic metre.

a. Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

b. Incremental impact (i.e. incremental increase in concentrations due to the development on its own).

c. Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.

Following the determination of the UWJV, the appropriate EIS documentation to refer to is the UWJV EIS (Umwelt 2016) in regard to air quality predictions.

A summary of the UWJV EIS predictions for air quality is included in **Section 5.3.2.1**, along with WCPL's performance against these predictions during the reporting period. For more information on the UWJV EIS predictions, refer to the UWJV EIS (Umwelt 2016).

In addition to the statutory requirements detailed in **Table 8**, WCPL is also required to meet additional requirements outlined in the WCPL AQGGMP. These requirements include reporting of greenhouse gas monitoring data in the Annual Review (**Section 5.3.4**).

5.3.2 Performance during the Reporting Period

Air quality monitoring was undertaken during the reporting period, in accordance with the WCPL AQGGMP.

During the reporting period, WCPL completed an Independent Environmental Audit which highlighted administrative non-compliances with DA 305-7-2003 and DA 177-8-2004, noting that on 17 occasions PM_{10} concentration data was not recorded continuously. These breaks in continuous recordings were due to technical and environmental factors resulting in loss of power or data (**Appendix D**). No known adverse impacts resulted due to the non-compliance.

WCPL complied with all additional air quality requirements detailed in the WCPL AQGGMP.

Noted in DA 305-7-2003, determination of compliance against the impact assessment criteria is to exclude "extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary". Notwithstanding the above, as no extraordinary events were identified during the reporting period and therefore, the results with and without extraordinary events are the same.

Airen (2024) concluded that:

- In relation to PM_{10}:
  - The 24-hour average PM_{10} concentration did not exceed 50 µg/m^3 at any monitoring locations.
  - The annual average PM_{10} concentration did not exceed the 25 µg/m^3 criterion.
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as PM_{10}.
- In relation to $PM_{2.5}$:
  - The 24-hour average $PM_{2.5}$ concentration did not exceed 25 µg/m^3 at any monitoring locations.
  - The annual average $PM_{2.5}$ concentration did not exceed the 8 µg/m^3 criterion.
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as $PM_{2.5}$.
- In relation to TSP concentrations:
  - The annual average TSP concentration did not exceed the 90 µg/m^3 criterion/
  - The monitoring demonstrates compliance with DA 305-7-2003 in terms of TSP.

No complaints were received regarding air quality, odour or greenhouse gases from the Mine during the reporting period (**Section 8.3**).

There were no other incidents relating to air quality, odour or greenhouse gases during the reporting period.

Based on the performance of the air quality management system outlined above, it is considered that the air quality management system is effective.

5.3.2.1 Comparison with UWJV EIS Predictions

The UWJV EIS (Umwelt 2016) included predicted cumulative TSP, PM_{10} and dust deposition levels for four operational scenarios (Years 2, 6, 11 and 16). These years approximately translate to 2022, 2026, 2031 and 2036.

A summary of the predicted cumulative annual average TSP, PM_{10} and $PM_{2.5}$ levels for the Year 2 and Year 6 scenarios at the WCPL air quality monitoring sites assessed in the UWJV EIS (Umwelt 2016) air quality assessment, is provided in **Table 9**. The annual average TSP, PM_{10} and $PM_{2.5}$ levels recorded during the reporting period are also provided in **Table 9**.

Table 9: Comparison of UWJV EIS Predictions and 2023 Monitoring Data – Air Quality

Parameter	UWJV EIS Predictions			2023 Monitoring
	Site	Year 2 (2022)	Year 6 (2026)	
Annual Average TSP ($\mu g/m^3$)[1]	HV01	66	63	71.8
	HV02	51	51	50.2
	HV03	52	51	38.8
	HV04	57	54	59.0
Annual Average PM_{10} ($\mu g/m^3$)	AQ01 (PM01)	34	33	23.7
	AQ02 (PM02)	16	16	16.6
	AQ03 (PM03)	17	16	12.8
	AQ04 (PM04)	22	21	19.5
Annual Average $PM_{2.5}$ ($\mu g/m^3$)	AQ01 (PM06)	6	7	7.0
	AQ03 (PM07)	4	3	5.4

Source: After Umwelt (2016) and Airen (2024).

1. TSP is estimated from PM_{10} monitoring data based on the relationship that 33% of TSP is PM_{10}.

The annual average $PM_{2.5}$, PM_{10} and TSP concentrations were below the relevant predicted cumulative annual average concentrations for the Year 2 scenario at all monitoring locations during 2023, except at Site HV01, which was higher than the predicted cumulative annual average, but still in compliance with the air quality criterion provided in Table 6 of Development Consent DA 305-7-2003.

5.3.3 Trends and Key Management Implications

There were no air quality, odour or greenhouse gas management implications arising from WCPL's operations for the reporting period.

5.3.3.1 TSP

A study on co-located TSP and PM_{10} monitors conducted in the Hunter Valley by the NSW Minerals Council (2010) indicated that dust generated from predominately coal mining sources has long-term average PM_{10} concentrations that are approximately 40% of the corresponding TSP concentration (or equivalently, TSP concentrations are approximately 2.5 times PM_{10} concentrations). This ratio was found to be reasonably accurate for long-term averages (e.g. annual averages).

The long-term average ratio of PM_{10} to TSP over the four co-located monitoring sites at the Mine over a six year period was 33% (or equivalently, TSP concentrations are approximately three times PM_{10} concentrations). Using this ratio, TSP levels during the reporting period were lower than those recorded in 2021, as shown in **Table 10** and **Figure 5**. The data shows there was a general increase in recorded TSP levels from 2012 to 2014, with a dip in 2015 and 2016, before increasing again in 2017 and 2018 and then decreasing again in 2019 to 2022. Dry weather throughout 2023 resulted in TSP concentrations increasing across the four monitors.

Table 10: TSP Annual Averages (µg/m3) (2011-2023)

HVAS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
HV01	56.7	64.8	61.0	66.0	54.8	47.8	68.8	77.1	60.0	46.3	62.1	41.9	71.8
HV02	48.8	61.4	62.0	58.0	51.5	47.7	61.6	70.8	62.5	46.0	37.9	31.6	50.2
HV03	49.0	38.9	41.0	48.0	40.6	39.5	50.0	55.8	45.0	40.5	25.5	23.8	38.8
HV04	41.0	58.6	49.0	63.0	60.6	56.6	64.1	75.3	62.5	46.8	40.0	36.3	59.0

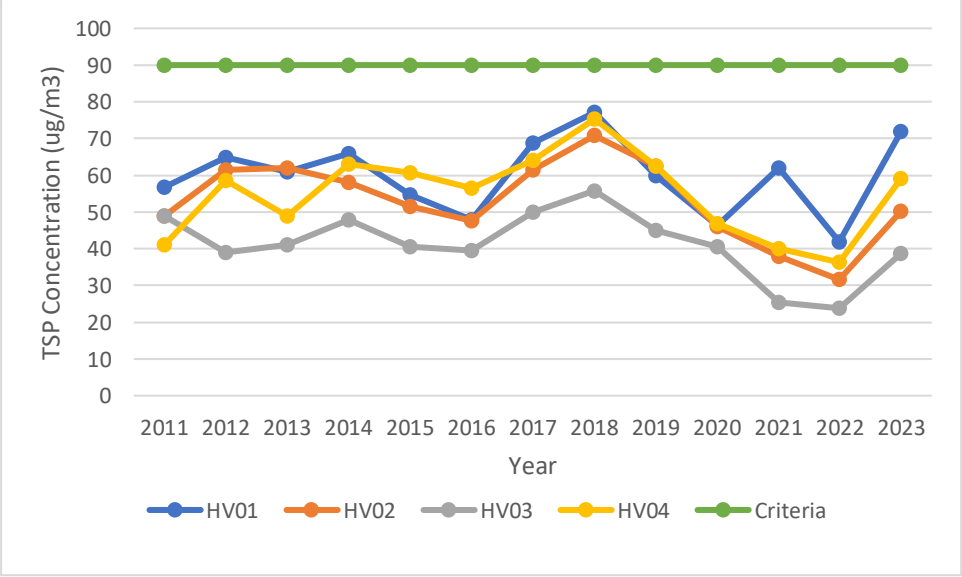


Figure 5: TSP Annual Averages (2011-2023)

5.3.3.2 PM_{10}

PM_{10} concentrations recorded by WCPL's four Tapered Element Oscillating Microbalance Analyser (TEOMs) during the reporting period are shown in **Table 11** and **Figure 6**.

The data shows that PM_{10} concentrations remained relatively consistent from 2011 to 2017, with the highest concentrations recorded to date observed in 2018. This is considered to be due to open cut mining moving to a more exposed location in the Montrose Open Cut Pit during 2018.

Table 11: PM10 Monitoring Results (2011-2023)

TEOM	2011	2012	2013	2014	2015	2016	2017	2018[1]	2019	2020[2]	2021	2022	2023
[3]Annual Average in µg/m³													
AQ01 (PM01)	16.8	21.0	19.3	18.0	15.7	15.6	20.6	25.7	24.1	21.6	20.5	13.8	23.7
AQ02 (PM02)	17.2	21.1	22.3	19.0	16.0	17.5	19.1	23.6	18.8	19.2	12.5	10.4	16.6
AQ03 (PM03)	16.7	16.6	16.5	15.3	12.9	14.1	14.6	18.6	25.1	14.7	8.4	7.9	12.8
AQ04 (PM04)	16.2	18.3	16.8	17.7	16.5	16.3	17.2	25.1	25.1	19.8	13.2	12.0	19.5
[4]Maximum 24-hour Average in µg/m³													
AQ01 (PM01)	49	47	65	55	52	49	66	151.9[1]	59	106.1	66	44.8	97.4
AQ02 (PM02)	83	76	97	70	55	49	52	163.5[1]	54	132.5	35	34	53.1
AQ03 (PM03)	43	47	71	51	43	39	39	143.8[1]	64	137.8	36	27.6	37.8
AQ04 (PM04)	43	45	65	56	71	44	49	125.0[1]	73	131.4	99	32.3	55.4
Number of Days Above 24-hour Average Criteria													
AQ01 (PM01)	0	0	4	2	1	0	5	15	9	13	0	0	9
AQ02 (PM02)	2	7	20	2	3	0	2	9	1	13	0	0	1
AQ03 (PM03)	0	0	1	1	0	0	0	6	9	9	0	0	0
AQ04 (PM04)	0	0	3	1	2	0	0	12	6	9	0	0	3

1. If the results on 22 and 23 November 2018 are discounted as they were the result of a state-wide dust storm, the maximum 24-hour averages are; 80.6 µg/m³ at AQ01, 66.0 µg/m³ at AQ02, 58.70 µg/m³ at AQ03 and 70.9 µg/m³ at AQ04.
2. Results shown are inclusive of “extraordinary days”.
3. Results shown for "Number of Days Above 24-hour Average Criteria" are inclusive of all sources (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
4. Results shown for "Maximum 24-hour Average" are inclusive of all sources (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

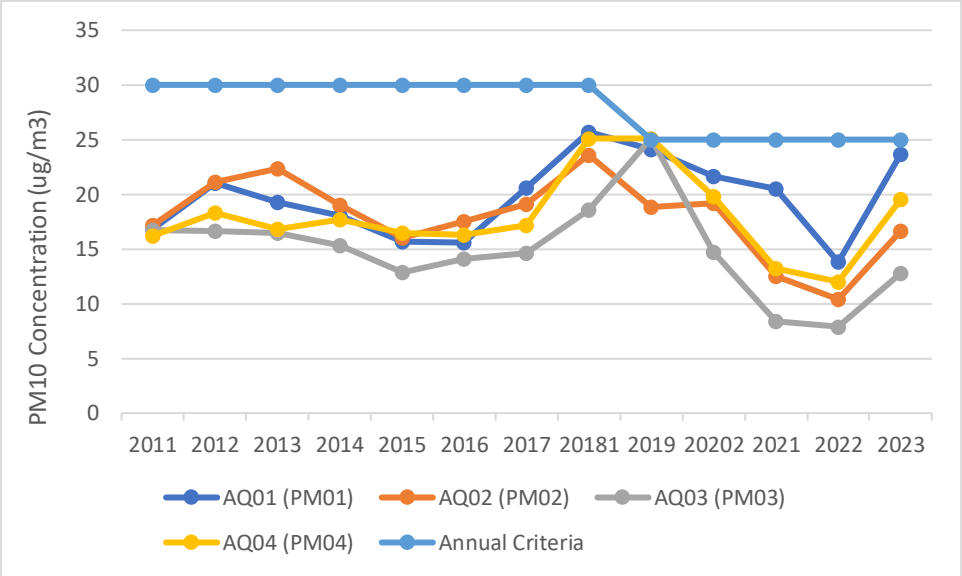


Figure 6: PM_{10} Annual Averages (2011-2023)

5.3.3.3 $PM_{2.5}$

On-site $PM_{2.5}$ data was available from late June 2020 onwards, following installation of the monitors. Results of monitoring during the reporting period are presented in **Table 12.** The data shows that $PM_{2.5}$ concentrations remained relatively consistent between 2020 and 2022, and presents a slight increase in the 2023 reporting year.

Table 12: PM2.5 Monitoring Results (2020-2023)

TEOM	2020[1, 2]	2021	2022	2023
[3]Annual Average in µg/m³				
AQ01 (PM06)	5.2	5.5	4.7	7.0
AQ03 (PM07)	4.2	3.9	3.6	5.4
[4]Maximum 24-hour Average in µg/m³				
AQ01 (PM06)	15	14.9	15.3	22
AQ03 (PM07)	17	28.9	15.4	26.5
Number of Days Above 24-hour Average Criteria				
AQ01 (PM06)	0	0	0	0
AQ03 (PM07)	0	0	0	1

1. Results available from June 2020 onwards.
2. Results shown are exclusive of “extraordinary days”.
3. Results shown for "Annual Average" are inclusive of all sources (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).
4. Results shown for "Maximum 24 hour Average" are inclusive of all sources (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).

5.3.4 Implemented or Proposed Management Actions

During the reporting period, WCPL continued to conduct training sessions with the workforce on real-time dust monitoring and in particular, for the operators responsible for on-shift monitoring of noise and dust.

WCPL investigated methods for capturing extraordinary events impacting air quality with an air quality specialist and it was determined that the current industry practice implemented at site will continue.

WCPL will continue to implement the WCPL AQGGMP during the next reporting period.

5.4 Greenhouse Gas Emissions

There are no approval criteria for greenhouse gas emissions in WCPL's statutory approvals.

5.4.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the EIS predictions for carbon dioxide (CO_2) emissions is included in **Section 5.4.2**, along with WCPL's performance against these predictions from 2014 to 2023. For more information on the EIS predictions refer to the EIS (Resource Strategies 2003).

WCPL is required to report greenhouse gas monitoring data in the Annual Review, in accordance with the WCPL AQGGMP.

5.4.2 Performance during the Reporting Period

WCPL calculates and reports on greenhouse gas emissions at the end of every financial year, hence the summary data provided in **Table 13** below is for the period 1 July 2022 to 30 June 2023. Data for the second half of the 2023 reporting period will be included in the 2024 Annual Review.

A total of 69,387 tonnes of carbon dioxide equivalent (CO_2-e) was emitted by the South Bates Underground Extension Mine's ventilation systems in 2023. This value is lower than predicted ventilation emissions from the South Bates Extension Mine in 2023 (i.e. 110,000 tonnes of CO2-e) (Todoroski Air Sciences, 2022).

It is also noted that ventilation emissions have been gradually decreasing over the years due to the change from methane rich coal seam gas to CO_2 rich coal seam gas, as the Mine has progressed from the North Wambo Underground Mine to the South Bates (Whybrow and Wambo Seam) Underground Mine. This change is part of a regional gas change that happens to occur across the Wambo lease.

A total of 187,901 tonnes of CO2-e was emitted from the other operations (fuel and electricity consumption). This is comparatively greater than the predicted emissions for the South Bates Extension Underground Mine (Todoroski Air Sciences, 2022). It is noted however, that Todoroski Air Sciences' (2022) predictions did not account for the emissions from the decommissioned North Wambo Underground Mine, which contributed and additional 128,957 tonnes of CO_2-e in 2023.

The 2022-2023 financial year was the seventh National Greenhouse and Energy Reporting (NGER) year that the Mine had emissions from a decommissioned mine due to North Wambo Underground Mine closing in April 2016. The total emissions emitted from the Mine during the reporting period (257,288 tonnes CO_2-e) is less than in previous reporting periods and the predicted emissions in the EIS (**Table 13**).

5.4.3 Trends and Key Management Implications

Levels of total CO_2 emissions monitored from the main ventilation shafts in 2014 to mid-2016 were indicative of the active mining at the North Wambo Underground Mine.

Following the closing of the North Wambo Underground Mine in 2016, a significant proportion of the methane (CH_4) emissions previously recorded at the main ventilation shaft shifted to being presented under a 'closed mine calculation'. The overall annual emissions from the Mine during the last seven reporting periods have remained relatively consistent.

During the reporting period, annual emissions from diesel and other sources (58,944 tonnes CO_2-e) for production related electrical generation significantly reduced from the emissions in the 2021 reporting period (100,019 tonnes CO_2-e). The relative reduction in emissions is due to transition from open-cut mining operations to underground mining operations. Electricity use during the reporting period remained consistent with the previous years.

5.4.4 Implemented or Proposed Management Actions

WCPL did not undertake any targeted energy saving projects during 2023, however energy efficiency is considered during mine planning.

Table 13: Comparison of EIS Predictions and Monitoring Data – Greenhouse Gas

Parameter	Monitoring Point	Monitoring Frequency	Emissions Calculated	Calculated CO_2-e tonnes for 2015 – 2016	Calculated CO_2-e tonnes for 2016 – 2017	Calculated CO_2-e tonnes for 2017 – 2018	Calculated CO_2-e tonnes for 2018–2019	Calculated CO_2-e tonnes for 2019–2020	Calculated CO_2-e tonnes for 2020–2021	Calculated CO_2-e tonnes for 2021–2022	Calculated CO_2-e tonnes for 2022-2023	EIS predicted CO_2-e tonnes for 2023[1]
Ventilation Systems												
Methane (CH4)	Main Ventilation Shaft	Real-time continuous	Emission factor to convert from tonnes of CH4 to tonnes of CO_2-e	618,127	137,521	227,824	145,110	82,427	96,017	57,066	**44,541**	**2,644,503**
Carbon Dioxide (CO_2)	Main Ventilation Shaft	Real-time continuous	Tonnes of CO_2-e	30,552	33,184	43,471	41,007	26,004	28,290	17,997	24,846	
Sub-Total				**648,679**	**170,705**	**270,295**	**186,117**	**156,883**	**124,307**	**75,063**	69,387	
Other (Fuel, Electrical Power and Other Fugitive Emissions)												
Diesel Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	97,983	97,274	92,034	101,556	108,790	44,451	7340	**8,475**	**117,770**
Oil Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	339 (plus 104 kL not combusted)	44 (plus 206 kL not combusted)	163 (plus 643.5 kL not combusted)	23	15	210	73	90	
Grease Use	Calculated from invoices	Annually	Emission factor to convert from kL use to tonnes of CO_2-e	0 (plus 42 kL not combusted)	0 (plus 26 kL not combusted)	0 (plus 67.1 kL not combusted)	0	0	0	1	1	
Electricity Use	Calculated from invoices	Annually	Emission factor to convert from kWh use to tonnes of CO_2-e	76,506	63,435	64,185	63,213	59,017	55,358	51,598	50,378	
ROM Coal Production	Calculated from weight meter and survey	Monthly	Fugitive emissions factor based on ROM production[3]	80,543 (UG Stockpile residual emissions) 24,634 (OC Fugitives)	69,202 (UG Stockpile residual emissions) 518,263 (closed mine calculation) 45,227 (OC Fugitives)	45,880 (UG Stockpile residual emissions) 472,331 (closed mine calculation) 18,231 (OC Fugitives)	46,992 (UG stockpile residual) 355,759 (closed mine calculation) 6,212 (OC Fugitives)	48,402 (UG stockpile residual emissions) 270,118 (closed mine calculation) 25,942 (OC Fugitives)	124,307 (UG stockpile residual emissions) 206,026 (closed mine calculation) 20,635 (OC Fugitives)	161,439 (closed mine calculation, U/G Fugitives))	128,957 (closed mine calculation, U/G Fugitives)	
Gas Drainage[4]	-	Annually	Tonnes of CO_2-e	-	-	-	145	0	0	0	0	
Sub-Total				**280,005**	**793,445**	**692,969**	**573,755**	**512,284**	**450,987**	**220,451**	**187,901**	
Total				**928,684**	**964,150**	**963,264**	**759,872**	**669,167**	**575,294**	**295,514**	**257,288**	**2,764,896**

Note: kL = kilolitres, OC = Open Cut, UG = Underground, kWh = kilowatt hours.

1. Refer to Tables 16 and 17 of Appendix B of the WCPL EIS (Resource Strategies 2003).
2. Anomalous results recorded during 2014 for non-combustible grease and oil use are believed to be due to human error in internal accounting procedures.
3. Wambo Open Cut uses Method 2 in situ measured emissions calculations for fugitive emissions. This involves the application of a gas model to as-mined pit shells for the year to generate the measured emissions number.
4. Financial Year 17/18 was the first time that a gas drainage plant was used. The plant was used intermittently.

5.5 Meteorology

WCPL is required to maintain a meteorological monitoring station at the Mine and monitor the parameters specified in Condition B50, Schedule 2 (DA 305-7-2003) and EPL529 (Condition M4), using the specified units of measure, averaging period, frequency and sampling method described in the tables.

WCPL maintains the meteorological monitoring station in accordance with AS 2923-1987. The following parameters are monitored by the meteorological monitoring station, in accordance with WCPL's statutory conditions:

- temperature (at 2 m and 10 m);
- rainfall;
- lapse rate[1];
- wind speed (at 10 m);
- wind direction (at 10 m);
- solar radiation (at 10 m);
- humidity; and
- sigma theta.

Table 14 summarises the annual rainfall, temperature and wind direction data for 2023, compared to previous reporting periods.

Table 14: Environmental Performance – Meteorology (2015-2023)

Parameter	2015	2016	2017	2018	2019	2020	2021	2022	2023
Rainfall (mm)	789.49	721.18	442.50	536.2	387.4	966.6	1,188.6	1192.6	477.8
Maximum Temperature (°C)[1]	40.8 (Nov)	41.6 (Dec)	46.8 (Feb)	43.8 (Jan)	44 (Jan)	45 (Jan)	38.4 (Jan)	36.5 (Feb)	42.9 (Dec)
Minimum Temperature (°C)[1]	-0.85 (June)	-3.4 (July)	-3.5 (July)	-5.5 (July)	-2.9 (Aug)	-1.5 (July)	-2.7 (July)	-1.3 (June)	-3.5 (July)
Mean Temperature (°C)[1]	19.2	18.4	18.5	18.7	19.2	17.9	17.1	16.7	18.2
Predominant Wind Direction	S/SE (summer) W/SW (winter)[2]	S/SE (summer) SW (winter)	S/SE (summer) W/SW (winter)	S/SE/E (summer) NW (winter)	E/SE (summer) WNW/NW (winter)	SE (summer) NW (winter)	SE (summer) NW (winter	SE (summer) NW (winter)	SE/ESE (summer) NW/WNW (winter)

Note: °C = degrees Celsius, E = East, SE = South-east, W = West, NW = North-west, S = South, SW = South-west, mm = millimetres.

1. Measured at 2 m above ground.
2. The winter data (2015) was influenced by the use of the Charlton Ridge weather station which may explain the change in weather direction as WCPL's weather station was experiencing software issues.

[1] WCPL calculates the lapse rate from measurements made at 2 m and 10 m, in accordance with DA 305-7-2003.

5.6 Biodiversity

WCPL implemented the Biodiversity Management Plan (BMP) during the reporting period. The BMP encompasses the extraction of Longwalls 21 to 24 and Longwalls 24 to 26. It also addresses the requirements within the Voluntary Conservation Agreements (VCA) prepared under Condition B74 (g), Schedule 2 of DA 305-7-2003, and the requirements of the EPBC Act 1999 approvals (EPBC 2003/1138, EPBC 2016/7636 and EPBC 2016/7816).

The BMP applies to all activities undertaken within WCPL's mining authorisations and approved mining areas that may impact on biodiversity, as well as biodiversity in WCPL's RWEAs and Open Cut Revegetation Areas. The BMP has been developed to:

- identify lands to be managed in accordance with this BMP;
- provide a framework for the management of biodiversity in the RWEAs and Open Cut Revegetation Areas;
- provide a clear, concise set of management actions and a schedule for the coordinated and effective delivery of biodiversity enhancement;
- define realistic Completion Criteria for RWEAs and Open Cut Revegetation Areas that can be quantitatively evaluated through a seasonally based monitoring program;
- define a seasonally based monitoring program suitable for determining management success (or otherwise);
- provide suitable contingency measures and associated Trigger Action Response Plans (TARPs) that adequately address any deviation from the Completion Criteria; and
- define the responsibilities for implementing, reviewing and reporting on the BMP.

The BMP also meets the requirement for a Biodiversity Management Plan under Condition B7(f), Schedule 2 of DA 305-7-2003 in support of the Extraction Plan for the South Bates Extension Underground Mine Longwalls 17 to 20 and the Extraction Plan for the South Bates Extension Underground Mine Longwalls 21 to 24 and the Extraction Plan for the South Bates Extension Underground Mine Longwalls 24-26.

5.6.1 Approval Criteria/EIS Predictions and Management Plan Requirements

Performance measures for subsidence impacts on biodiversity are detailed in Condition B1, Schedule 2 of DA 305-7-2003 (**Section 5.9.2**). In addition, performance measures for aquatic ecosystems are detailed in Condition B62, Schedule 2 of DA 305-7-2003 (**Section 6.1.1**).

WCPL is required to monitor and report on biodiversity in accordance with the conditions of DA 305-7-2003, DA 177-8-2004, EPBC 2003/1138, EPBC 2016/7636, EPBC 2016/7816 and the approved BMP.

The BMP includes biometric monitoring methodology. In September 2021 the BMP was modified to remove Landscape Function Analysis (LFA) as a monitoring method following recommendations from BCD. The floristic performance criteria are provided in **Table 15**.

Table 15: Floristic Performance Criteria for Plant Community Types in RWEAs and Performance Targets for Older Woodland Areas and Rehabilitation Sites

	Attribute[1]									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Rehabilitation										
Older Woodland Areas with a canopy of Sugar Gum	>15	15-40	5-40	5-15	5-10	5-15	<20	1	-	5
Areas of Narrow-leaved Ironbark – Bull Oak – Grey Box open forest	>20	10-40	5-10	15-50	5-10	5-40	<20	1	-	-
RWEAs										
PCT42[2]	>20	10-50	10-50	20-60	1-5	5-30	<10	1	-	-
PCT1658[2]	>20	10-40	10-50	4-20	5-30	5-35	<10	1	-	-
PCT1603[2]	>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-
PCT1604[2]	>35	15-40	5-20	30-50	5-15	5-40	<5	1	-	-
PCT1176[2]	>21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-
PCT1584[2]	>45	15-45	5-40	5-40	10-20	5-20	0	1	-	-

1. NPS = the number of native plant species (native to NSW), NOS (%) (including *E.cladocalyx*) = projected native foliage cover of canopy, NMS (%) (including *A.saligna*) = projected native midstorey cover, NGCG = native groundcover of grasses, NGCS = native groundcover of shrubs, NGCO = native groundcover of other plant types (sedges, herbs etc.), EPC = exotic plant cover, OR = overstorey regeneration over the whole vegetation zone, HBT = hollow bearing trees, FL= length of fallen logs >10 cm diameter within the vegetation plot, PCT = plant community type.
2. PCT42: River Red Gum/River Oak riparian woodland wetland in the Hunter Valley.

   PCT1658: Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland on sands of the Warkworth area.

   PCT1603: Narrow-leaved Ironbark – Bull Oak – Grey Box shrub – grass open forest of the central and lower Hunter.

   PCT1604: Narrow-leaved Ironbark – Grey Box – Spotted Gum shrub – grass woodland of the central and lower Hunter.

   PCT1176: Slaty Box – Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion.

   PCT1584: White Mahogany – Spotted Gum – Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley.

5.6.2 Performance during the Reporting Period

During the reporting period, WCPL commissioned Eco Logical to monitor the fauna and vegetation structure within the RWEAs and rehabilitation areas. Floristic surveys, bird surveys, LFA and riparian condition surveys were all conducted during Spring 2023across both remnant woodland, general surface and rehabilitation areas. A copy of the Annual Flora and Fauna Monitoring Report Volume 1 and 2 prepared by Eco Logical (2024) is included in **Appendix E**. WCPL also completed an IEA which highlighted an administrative non-compliance with Condition B77 of DA 305-7-2003, noting late lodgement of the required Conservation Bond. No known adverse impacts resulted due to the non-compliance.

Remnant woodland sites within the RWEAs are generally performing well. High diversity of native flora species, increases in native ground cover, and some observable decreases were recorded, likely in response to the above average rainfall recorded during 2019 to 2022 and a lower rainfall in 2023 (**Appendix E**).

High exotic cover was recorded in RWEA A and RWEA Rail Loop within the River Red Gum/River Oak riparian woodland wetland in the Hunter Valley (PCT 42) and Rough-barked Apple – Narrow-leaved Ironbark – Blakely's Red Gum – Bull Oak – Coast Banksia woodland

on sands of the Warkworth area (PCT 1658).The recorded exotic cover levels failed to meet the performance criteria and VCA targets at several sites (**Appendix E**).

Bird survey results from remnant woodland sites reflected the good condition of these woodland areas with RWEA areas continuing to support a large diversity of birds including several threatened species. Bird diversity and communities were largely consistent with the data available from previous monitoring years and the monitoring data does not indicate any declines in local bird communities (**Appendix E**).

The North Wambo Creek Diversion (NWCD) met the completion criteria for the Landscape Organisation Index (LOI) based on average scores across all sites. Gully erosion and areas of bare soil exceeding completion criteria were observed. Major remediation works have taken place over the past four years to improve drainage, erosion and establishment of native plant communities. The remediation works concluded in November 2023 (**Appendix E**).

Floristic monitoring in the NWCD recorded acceptable native species diversity and native ground cover. Cover of shrubs and canopy were low however this is expected during establishment phase. Significant growth in Eucalypt and Acacia trees and shrubs was observed, including several areas where trees have naturally established along the creek channel. A large proportion of the NWCD remains as grassland and will require additional revegetation efforts to establish the target vegetation communities. An increased number of floristic sites is required to monitor this area (**Appendix E**).

Riparian condition scores for North Wambo Creek, Wambo Creek and Stony Creek were similar to 2022 reflecting the ongoing wetter conditions in 2020 to 2022 following previous drought years from 2017 to 2019 and in response to the reduction/exclusion of grazing and drier conditions seen in 2023. Understorey vegetation cover remains high following higher rainfall in 2020 to 2022, although a high proportion of ground cover contribution is from exotic species, owing to the agricultural disturbance history within these systems. Cattle should continue to be excluded from riparian areas to encourage tree regeneration and prevent erosion. Planting native trees in over-cleared areas to facilitate more rapid regeneration is also recommended (**Appendix E**).

The *Melaleuca decora* low forest GDE community along North Wambo Creek was recorded to be in good condition with scores for most attributes increasing since 2019. This community was undermined during 2019 and 2020, and data collected to date may serve as suitable baseline for this community noting that 2019 was a dry year followed by wetter conditions in 2020, 2021 and 2022 and returning to drier conditions in 2023. The River Oak riparian tall woodland GDE recorded strong growth and monitored trees appeared in healthy condition, likely in response to the higher rainfall in 2020 to 2022. The extent of the community remains unchanged since originally mapped in 2019, however recruitment of trees and shrubs was observed following three wetter years, and this may translate into expansion of the community in coming years(**Appendix E**).

Floristic and bird monitoring sites established in 2020 in the South Bates Extension Underground Mine area, including reference sites outside of the mining area, were monitored for the third year. Vegetation and bird communities were recorded in good condition and no significant impacts to floristic attributes or bird communities were recorded at sites within areas impacted by undermining to date (**Appendix E**).

Subsidence was observed in several locations across the site including RWEA C RWEA B, within the Narrow-leaved Ironbark and Slaty Gum communities, however no detrimental impacts of underground mining have been recorded within the RWEAs and there have been no significant effects on flora and fauna or performance criteria exceedances during the reporting period (**Appendix E**).

5.6.3 Trends and Key Management Implications

The majority of RWEAs remain in good condition with high numbers of native species, few exotic species present and with low cover and abundance. No major issues were identified that require urgent management (**Appendix E**).

The number of native species generally increased from the previous year and was relatively high in several PCTs. The 2023results appear to confirm that some lower scores for native species diversity recorded in recent years were a result of the dry conditions, with the increase in 2021 and 2022 in response to higher rainfall (**Appendix E**).

However, as reported in previous years, exotic species cover remains relatively high in riparian and floodplain areas (V1 and V2 plots of RWEA A) and continues to exceed performance criteria and also VCA targets in certain locations. Several weed species listed under the NSW *Biosecurity Act 2015* were observed in these areas that have potential to become problematic in the wider region (e.g. *Olea europaea* subsp. *cuspidata* [African Olive]). WCPL will continue to implement weed management (particularly species listed under the NSW *Biosecurity Act 2015*) to achieve performance criteria in these riparian and floodplain areas.

The Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland (PCT 1658) in RWEA A appears to be suffering from Banksia integrifolia die-off in the mid-storey, first observed in 2019 and continuing this year. Low cover of Banksia integrifolia was recorded in 2023 in RWEA A monitoring plots V5B1 and V5B2. This observation suggested Banksia individuals may be recovering, or new plants may have germinated. Ongoing monitoring within these plots will provide additional data on the recovery or ongoing decline of this species locally. This community recorded a lower than average exotic covers compared to higher exotic covers recorded in 2022. This community occurs on sandy soils, and it is possible the soils suffered more significant drying during the recent dry years than other areas and the rainfall to date has not been sufficient to recharge the soil (**Appendix E**). Future monitoring will continue to record the condition of this community and increased weed control will be applied.

The average number of bird species per site remains consistent with the levels recorded in previous years. Overall diversity across all sites within RWEAs also remains high. Number of birds per survey returned to levels similar to previous years after a lower score was recorded in 2020 (**Appendix E**).

As vegetation and habitat attributes in RWEAs have remained relatively stable over time, variability in diversity and abundance between years is likely explained by a combination of factors such as varying numbers of nomadic and migratory bird species, weather and climate, sampling methods, differences in the skill of observers, the timing of surveys and surveys coinciding with the flowering of trees and also broader landscape scale and seasonal changes across the Hunter Valley. The total number of bird species detected each year has varied over time and the 71 species recorded from 26 monitoring sites during 2023 is within the range of previous years. Threatened species appear to be persisting well within the RWEAs, with Grey-crowned Babbler, Speckled Warbler, Little Lorikeet and Varied Sittella all recorded in similar numbers than the previous year (**Appendix E**).

5.6.4 Implemented or Proposed Management Actions

In 2018, 50 nest boxes were installed in five clusters within RWEAs B, C and D. These nest boxes were generally in good condition, with some occupied or showing signs of use. Three nest boxes had fallen to the ground and were replaced in March 2023. Future monitoring should continue to investigate use by the target species and threatened species.

WCPL will continue to give priority to managing weed species listed under the *Biosecurity Act 2015* that have the potential to become problematic in the wider region (e.g. *Olea europaea* subsp. *cuspidata* [African Olive]). A targeted weed survey and update to Annual Weed Treatment Plan is scheduled for 2024, which will record weed issues, incorporating the results of this monitoring program, and outline proposed strategy for weed treatment in 2024/2025 in detail. WCPL has engaged Enright Land Management (ELM) to facilitate the management of target weed species across WCPL and within RWEAs A, B, C, D and E (Appendix E).

Soil Conservation Services (SCS) completed the final stages of the five year NWCD Rehabilitation and Maintenance Plan during the reporting period. Stages 3 and 4 saw the rebuilding of three chutes, re-profiling and revegetation works and re-grading of the diversion road in sections to improve drainage. Subsidence repairs were also undertaken. The completion of Stages 3 and 4 concludes the five year NWCD Rehabilitation and Maintenance Plan originally developed by Alluvium Consulting (Figure 10 & 10a).

5.7 Heritage

WCPL manages Aboriginal heritage on-site in accordance with the relevant conditions of DA 305-7-2003 and the conditions of Aboriginal Heritage Impact Permits (AHIPs) #2222, #C0001474, #C0002000, #C0003213 and #5158. These AHIPs allow for the disturbance and/or salvage of all known and unknown Aboriginal objects within the extent of the relevant AHIP boundaries. Any Aboriginal objects salvaged under these permits are managed in accordance with a Care Agreement.

In 2016, WCPL developed a Heritage Management Plan (HMP) for the Mine, to consolidate all statutory requirements into one document and assist in the management of Aboriginal cultural heritage on-site. The HMP was approved in June 2018 with the Extraction Plan for Longwalls 17 to 20 at the South Bates Extension Underground Mine. The HMP was updated in July 2020 for inclusion with the Extraction Plan for Longwalls 21-24 at the South Bates Underground Mine and was approved by DPHI in April 2021. The HMP was updated in June

2023 for the inclusion with the Extraction Plan for Longwalls 24 to 26 which was approved in December 2023. AHIP #5158 for the Longwalls 24 to 26 area was approved on 1 December 2023 by Heritage NSW.

Consistent with the requirements of the HMP, WCPL has implemented a Surface Disturbance Permit (SDP) procedure and checklist, applicable to all surface works at Wambo Coal Mine. During the SDP assessment process, WCPL undertake a due diligence assessment to ensure that no artefacts that may have been identified in the area are damaged. South East Archaeology (2023) conducted a due diligence assessment for Aboriginal heritage at two proposed drilling locations. One previously reported Aboriginal PAD #37-5-0561 ("Wambo PAD T"), has been recorded outside of, but within close proximity of the drilling area. Due to these findings, the drilling location was relocated a sufficient distance from the identified PAD such that any such impacts were avoided. No salvage operations were conducted by WCPL during the reporting period.

5.8 Non-Aboriginal Heritage

WCPL is required to prepare a Conservation Management Plan (CMP) for the Wambo Homestead Complex (WHC) in accordance with Condition B89, Schedule 2 of DA 305-7-2003. The current CMP (Version 6) was approved in May 2019.

Maintenance work continued during the reporting period was guided by the Preventative and Cyclic Maintenance Program outlined in Table 15 of the WHC CMP. Maintenance activities conducted at the WHC during the reporting period included general clean-up of the site, additional engineered propping, rebuilding of the servant wing, weed and pest control, erosion and drainage control maintenance, and visual inspections.

Section 57 Standard Exemption 19 works to repair and secure the Kitchen Wing commenced in 2022 and is ongoing. The removal of salt residue with a proprietary chemical poultice system was completed in 2022. This allowed for the filling-in of eroded sandstone, which began in 2022 and is ongoing. The Kitchen Wing roof sheets were lifted in 2022 to inspect the roof rafters and battens, allowing for an assessment to be made regarding for the temporary repair of the Kitchen Wing roof in 2023. After assessment the structural wall remediation and roof repairs to Kitchen Wing began in 2023.

A Section 60 application was submitted and approved in 2020 and the stabilisation works began in 2023.The servants wing underwent significant repair, requiring the careful re-building of the walls, re-stabilising the chimney, rafters, and battens, in addition to securing new roofing sheets.

An annual photographic record of the elevations of all structures at the WHC was completed during the reporting period and lodged with the Heritage Branch, Singleton Council and DPHI in early March 2024, in accordance with Condition B91, Schedule 2 of DA 305-7-2003. During the reporting period, WCPL undertook no blasting that was within 2 km of the WHC.

In an effort to improve access to studies, reports, plans and surveys that have been prepared for the Wambo Homestead, WCPL created a platform on the Peabody website, specific to the WHC. Content includes '*Wambo Homestead-an artist's impression'* by Vivian Dwyer 2007, an outline of the history of the WHC, a drone fly-over video and black and white archive photographs. The website can be accessed at:

https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Homestead

5.9 Subsidence

During the reporting period, underground mining occurred at Longwalls 22 and 23 of the South Bates Extension Underground Mine. Subsidence monitoring was undertaken in the reporting period for Longwalls 22 and 23.

5.9.1 Relevant Extraction Plans

Longwall mining during the reporting periods was undertaken in accordance with the relevant Extraction Plans, in accordance with Condition B9, Schedule 2 of DA 305-7-2003. A summary of the Extraction Plan reporting requirements related to subsidence is provided in the subsection below.

5.9.1.1 Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24

The following reporting is required to be undertaken as part of the Extraction Plan for South Bates Extension Underground Mine Longwalls 21 to 24:

- Incident Report – to be prepared as required and submitted (by email) to DPHI (Manager, Mining Projects), NSW Resources Regulator (Subsidence Executive Officer), Subsidence Advisory NSW (District Manager) and other regulators as specified in management plans.
- Subsidence Management Status Reports – to be updated fortnightly and submitted (by email) if new impacts are identified or upon request, to DPHI (Manager, Mining Projects) and NSW Resources Regulator (Subsidence Executive Officer).
- Six Monthly Report – to be updated annually for the period 1 January to 30 June and submitted (by email) to DPHI (Manager, Mining Projects) and NSW Resources Regulator (Subsidence Executive Officer).
- Annual Review – to be updated annually for the period 1 January to 31 December and submitted (by email and/or post) to DPHI (Manager, Mining Projects), NSW Resources Regulator (Subsidence Executive Officer), NSW Resources Regulator (Manager Environmental Sustainability), Subsidence Advisory NSW (District Manager), BCD/EPA (General Contact), NSW DCCEEW (Water Regulation), Singleton Council (General Manager) and WCPL CCC Members.

5.9.2 Approval Criteria/EIS Predictions and Management Plan Requirements

In accordance with Conditions B1 and B4, Schedule 2 of the Development Consent (DA 305-7-2003), WCPL must ensure that there are no exceedances of the Subsidence Impact Performance Measures detailed in Tables 1 and 2 of the Development Consent (**Table 16**).

Table 16: Subsidence Impact Performance Measures[1]

Aspect	Performance Measures[2]
Water – Wollombi Brook	Negligible subsidence impacts and environmental consequences. Release of water from the site only in accordance with EPL requirements.
Land – Low level cliffs within the South Bates Extension Area	Minor environmental consequences (that is occasional rockfalls, displacement or dislodgement of boulders or slabs, or fracturing that in total do not impact more than 5% of the total face area of such features).
Biodiversity – Wollemi National Park	Negligible subsidence impacts and environmental consequence.
Biodiversity – Warkworth Sands Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – White Box, Yellow Box, Blakely's Red Gum Woodland/ Grassy White Box Woodland Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – Central Hunter Valley Eucalypt Forest and Woodland Ecological Community	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible environmental consequences.
Biodiversity – Conservation Areas (including the proposed Wambo offset area under SSD 7142)	Negligible reduction to previously identified biodiversity credits.
Biodiversity – Threatened Species and Communities	Minor cracking and ponding of the land surface or other subsidence impacts. Negligible Environmental consequences.
Heritage – Wambo Homestead Complex	Negligible impact on heritage values, unless approval has been granted by the Heritage NSW and/or the Minister.
All Built Features (including public infrastructure and all structures on privately-owned land)	Always safe. Serviceability should be maintained wherever practicable. Loss of serviceability must be fully compensated. Damage must be fully repairable, and must be fully repaired or else replaced or fully compensate.
Public Safety	Negligible additional risk.

1. Note, the Subsidence Impact Performance Measures listed in Table 16 have been modified following the approval of MOD 19 in January 2023.
2. Note, the requirements of this condition only apply to the impacts and consequences of mining operations undertaken following the date of approval of Modification 9.

Underground mining was undertaken at South Bates Extension Underground Mine Longwalls 22 and 23 during the reporting period. Longwall 22 was completed in January 2023, then Longwall 23 commenced on the 6th March and concluded the 27th November 2023. Inspections of Longwall 22 and 23 were completed in the reporting period.

No longwall panels encroached upon the Wollombi Brook, Warkworth Sands Woodland Community or the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community.

South Bates Extension Underground Mine Longwall 23 undermined North Wambo Creek (NWC) during the final 170m of the panel. Weekly inspections were conducted of NWC whilst mining occurred within 100m of the creek and identified negligible subsidence impacts not requiring remediation.

Longwalls 22 and 23 are offset from the base of the Wollemi National Park escarpment by a minimum 26.5 degree angle of draw. No impacts to the escarpment were observed during the reporting period (**Section 5.9.3**).

WCPL does not have approval for undermining of the WHC and as such no evidence of subsidence related impacts were identified during the reporting period. No impacts to non-Mine built features or threats to public safety resulting from the discussed mining activities were identified during the reporting period.

5.9.3 Performance during the Reporting Period

5.9.3.1 Subsidence Surveys

During the reporting period, WCPL undertook longwall mining in the South Bates Extension Underground Mine Longwalls 22 and 23 (**Section 3.1**). Subsidence monitoring was undertaken in accordance with the South Bates Extension Underground Mine Longwalls 21 to 24 Extraction Plan. Subsidence monitoring was undertaken for Longwalls 18, 19, 20, 21 and 22 (within 10 months of the longwalls being competed). Results for Longwall 23 will be reported in the next Annual Review.

Table 17 summarises the actual versus predicted subsidence results for Longwall 21 at the South Bates Extension Underground Mine. The monitoring shows that the actual maximum subsidence recorded across Longwall 17 to 21 are generally similar but less than the predicted values. This could be partly attributed to the average mining height of Longwall 21 (2.32 m) being less than the subsidence model of 2.8 m and 3.0 m (Mine Subsidence Engineering Consultants [MSEC] 2023).

Table 17: Subsidence Monitoring – Actual versus Predicted for South Bates Underground Mine Longwalls 17 and 22 (8XL-Line)

Parameter	Predicted[1]	Actual[1]	Consistent with Predicted Range
Maximum Vertical Subsidence (mm)	1800	1379	Y
Maximum Tilt (mm/m)	50	30	Y
Maximum Hogging Curvature (km^{-1})	3.0	1.5	Y
Maximum Sagging Curvature (km^{-1})	2.5	1.0	Y

1. *South Bates Extension Underground Mine Subsidence Review Report for the South Bate Extension Underground Mine WYLW22* and *WYLW23* (MSEC 2023).

5.9.3.2 LiDAR Surveys

The changes in surface level due to mining at the South Bates Extension Underground Mine have been measured using Light Detection and Ranging (LiDAR) surveys. The changes in surface level due to the mining of Longwalls 17 to 22 have been determined by taking the differences between the surface levels measured in the LiDAR surveys carried out in May 2018 (before the commencement of Longwall 17) and May 2023 (during the mining of Longwall 23)

It should be noted that LiDAR surveys have an accuracy in the order of ±50 to ±150 mm. The accuracy of the observed changes in surface levels (i.e. the difference between the two surveys), therefore is in the order of ±100 to ±300 mm.

LiDAR survey results for Longwalls 17 to 22 are as follows (MSEC, 2023):

- The measured changes in surface level are greater than predicted above the south western ends of Longwall 21 and 22 partially due to the effects of the steep slopes beneath the escapement on the LiDAR surveys.
- The measured profile is slightly flatter than the predicted.
- It is considered that the ground movements measured using the LiDAR surveys are consistent with the prediction provided in the South Bates Extension Underground Mine Longwalls 21 to 24 Extraction Plan.
- The subsidence model appears to be providing conservative predictions based on the single-seam mining conditions.
- No changes to the subsidence model are recommended based on the measured subsidence effects from the LiDAR survey.

5.9.3.3 Visual Inspections

Visual inspections were carried out by WCPL during and after the extraction of Longwalls 17 to 21 at the South Bates Extension Underground Mine (WCPL, 2021). The surface cracks were mapped and added to the WCPL's subsidence impacts register.

Cracking was not identified adjacent to the maingate and tailgate of Longwalls 22 or 23 as observed for the previous longwalls. However, long grass above Longwall 21 made identification of surface deformations more difficult. Cracking was identified in seven locations along and adjacent to the unsealed roads and tracks towards the finishing (i.e. north-eastern) end of the longwall (MSEC, 2022).

The recorded surface crack widths above Longwalls 17 to 23 typically ranges between 10 mm to 50 mm (i.e 90% of cases) which is less than the predicted surface deformation and the majority of the recorded crack width are less than 200 mm (99% of cases), the maximum crack widths are greater than 500 mm, where localised potholing occurred due to weathering and erosion (MSEC, 2023).

It is considered that the recorded surface deformations above Longwalls 17 to 23 are typically within the range assessed. While surface cracking up to approximately 500 mm occurred in isolated locations, these impacts represent less than 1% of the total length of mapped surface cracking above the mining area (MSEC, 2023).

5.9.3.4 Bi-annual Audits of Subsidence Impacts

Bi-annual audits (May and November) of subsidence impacts were undertaken during the reporting period to identify new subsidence impacts over the South Bates Extension Underground Mine and to determine the status of known subsidence impacts (e.g. have they self-repaired, are they stable but pose a risk to long-term sustainable land use, or are they deteriorating in condition).

During the reporting period, subsidence monitoring and remediation focused on the South Bates Extension Underground Mine in the vicinity of Longwalls 19, 20, 21, 22 and 23. In 2023 12 sites in and adjacent to the North Wambo Creek Diversion (NWCD) Were remediated during the Stage 3 and 4 works on the NWCD.

The remediation of sites on and adjacent to access roads occurred throughout the year and consisted primarily of reactive subsidence remediation. The sites ranged from small potholes to cracks several meters in length. Due to a high volume of ground vegetation above Longwalls 22 and 23, limited subsidence impacts were observed. This resulted in no targeted subsidence campaign occurring in 2023. .

The methodology used continues to be fine-tuned with remediation of sites primarily including:

- Excavate the subsided area using an excavator. Store topsoil and subsoil in separate piles for later use.
- Excavate site until no subsurface void is identified or to the limit of the excavator.
- Insert geofabric to line the floor of the excavated pit.
- Backfill the pit using the excavated material mixed with gypsum at 2%.
- Compact the excavated material in layers using the back of the excavator bucket up to surface level.
- Topsoil and seed the disturbed area.

Bi-annual detailed subsidence monitoring will continue to monitor further subsidence, vegetation coverage and weeds in the next reporting period.

5.9.3.5 Remediation of Subsidence Impacts to 'Kharlibe'

In 2018, a Subsidence Remediation Plan (SRP) was developed for the 'Kharlibe' property located in Bulga, approximately 20 km west-southwest of Singleton in the Upper Hunter Valley of NSW.

Between 1991 and 2000, the property was undermined by the former Homestead Mine (owned by WCPL, now a subsidiary of Peabody Energy Australia Pty Ltd). The mining occurred within CL 397 and CCL 743 held by WCPL. The longwall mining resulted in the surface of the ground being lowered, and the formation of subsidence cracks – some of which took time to migrate through the alluvium to reach the surface.

Historical subsidence remediation works have been undertaken across the property by various contractors and consultants since the late 1990's. The success of these works was mixed and, in some instances, require remedial works.

In February 2018, the Resources Regulator issued a Notice under Section 240 (1)(b) and (c) of the *Mining Act 1992* (Mining Act) that required WCPL to prepare a SRP for Kharlibe. SLR and SCT Operations Pty Ltd (SCT) were approved as suitably qualified experts to prepare the SRP in consultation with the landholder and the Resources Regulator.

A second Section 240 Notice was issued by the Resources Regulator on 19 September 2019, requiring WCPL to:

- implement subsidence remediation works and associated works in accordance with the Subsidence Remediation Plan (with timing of works and associated monitoring bound by the Project Gantt Chart); and
- to provide quarterly Subsidence Remediation Reports including field observations, remediation works methodologies and results of any monitoring.

Initial (Phase 1) remediation works were undertaken at two sites on 21 and 22 May 2019. These features included an isolated sinkhole, a close spaced row of sink holes and five small depressions. The purpose of this initial remediation works was to identify constraints and opportunities to guide future remediation works.

The Phase 2 remediation works were undertaken from 17 – 21 June 2019 as they were considered high priority works. These works included the remediation of 20 sites.

Phase 3 remediation works were undertaken from 15 July – 20 December 2019 and included landform design and remediation works. Phase 3 works in 2019 included the remediation of 51 sites, with 33 completed in October to December 2019.

Phase 4 remediation works were undertaken across the Kharlibe property within Stony Creek (Site 99) between 3 – 24 March 2020. Further Phase 4 remediation works were undertaken throughout each quarter of 2020 with both newly treated areas and maintenance works on previously remediated sites occurring.

During the reporting period, maintenance works continued across the Kharlibe property. Throughout the reporting period ongoing care and maintenance works and monitoring was conducted across rehabilitated sites. Care and maintenance works included minor remediation works in Quarter 4 with both newly treated areas and maintenance works on previously remediated sites occurring.

5.9.3.6 Visual Inspections of Wollemi Escarpment (via Drone)

Baseline cliff top mapping of the Wollemi National Park escarpment in the vicinity of the South Bates Underground Mine was undertaken during 2015 utilising an Unmanned Aerial Vehicle (Microdrone MD4-1000) and a high-resolution camera along a designated route. Photos were taken of the cliff top at designated intervals and stitched to form a high-resolution panoramic image which can be used to assess subsidence. The route has been recorded and programmed to be repeatable from year to year.

The cliffs associated with the Wollemi escarpment were visually inspected using drones. The cliffs were inspected in October 2018 (before the extraction of Longwall 17), August 2019 (after the extraction of Longwall 17), August 2020 (after extraction of Longwall 19), April 2021 (after extraction of Longwall 20), October 2022 (after extraction of Longwall 21) and March 2023

(after extraction of Longwall 22). There were no cliff instabilities identified from the drone surveys along the section of escarpment adjacent to Longwalls 17 to 22.

It is noted that a boulder and train was previously observed along these section of escarpment, however the baseline arial photographs show that this occurred before May 2017, and, therefore before the commencement of mining at the South Bates Extension Underground Mine (MSEC 2022).

Two rockfalls have been identified along sections of the escarpment located well away from the active longwalls at the South Bates Extension Underground Mine. The starting point of the site is approximately 1.9 km north-west from the maingate of Longwall 21.

5.9.4 Trends and Key Management Implications

It is considered by MSEC (2023) that the observed ground movements for South Bates Extension Underground Mine Longwalls 17 to 22 were consistent with predictions. It is also considered that the impacts on the natural and built environment are similar to those assessed and predicted.

Given the above, WCPL will implement the approved Extraction Plans for South Bates Extension Underground Mine Longwalls 24 to 26 in the next reporting period.

5.9.5 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the approved Extraction Plans for South Bates Extension Underground Mine Longwalls 24 to 26.

WCPL will also continue with the program of works for the remediation of the subsidence impacts identified by the bi-annual subsidence audits in areas away from active subsidence (**Section 5.9.3**).

5.10 Exploration

During the reporting period, no exploration activities were conducted in WCPL's exploration licence and mining lease areas.

Overall, 20 boreholes from the previous drilling programs have been rehabilitated, however, WCPL's final sign-off on drill site rehabilitation is yet to be completed.

5.11 Waste

Waste management at WCPL is undertaken by a licensed waste management company under the basic principles of the Total Waste Management System (TWMS). Significant benefits of the TWMS include:

- segregation of waste at the source;
- expansion of recycling capabilities;
- reduction in the risk of contaminating non-hazardous waste;
- comprehensive monthly reports detailing volumes, recycling, disposal and transportation of waste; and
- improved data capture to increase the efficiency and accuracy when reporting.

During the reporting period, a total of 1,731,902 kilograms (kg) of waste was generated by the Mine. Of this, 1,194,002kg was taken off-site for disposal or recycling of the waste disposed off-site, 60.01%was recycled.

The total waste sent off-site by the Mine in 2023 (1,193,524Kg) was less than the amount of waste sent off-site in 2022 (2,610,000 kg) and the recycling rate for 2022 (80.58%) was similar to 2021 (80.6%). The recycling rate for 2023 (60.01%) was lower than 2022(80.58%) likely due to the reduced amount of waste produced from site (**Figure 7**).

As the amount of waste generated during 2021 to 2023 was significantly lower than 2017 to 2020, it is considered that waste minimisation program at the Mine has been effective during 2021 to 2023.

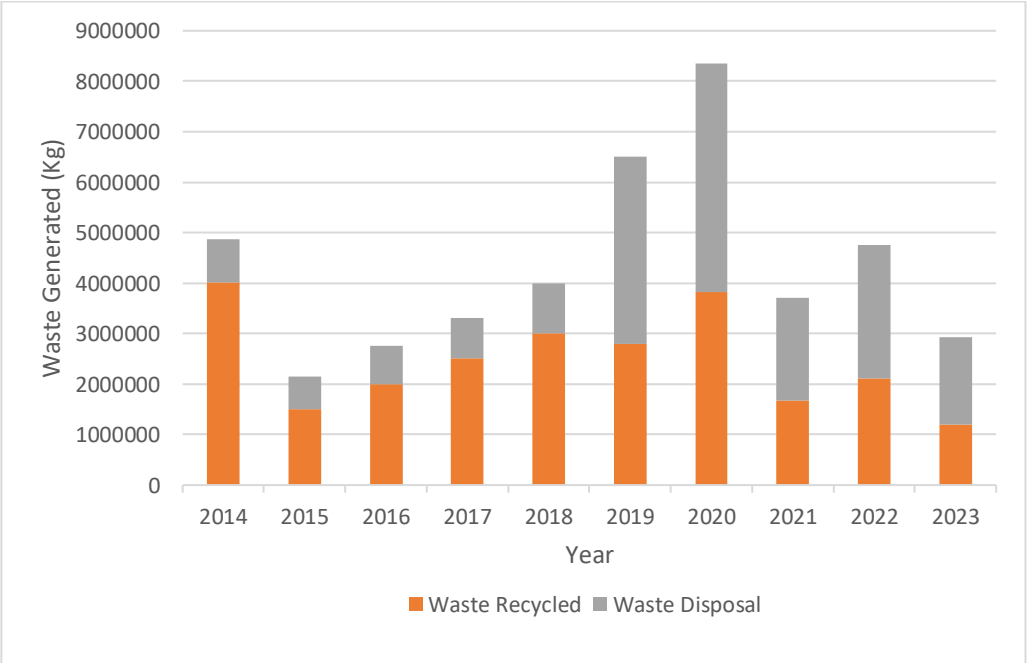


Figure 7: Waste Volumes (2014-2023)

5.12 Visual Amenity and Lighting

All mobile lighting plants are strategically positioned to avoid light being directed towards WCPL's neighbours and other identified potential sensitive receptors.

There were no complaints received during the reporting period relating to lighting impacts from WCPL's mining operations (**Section 8**).

5.13 Contaminated Land

No contaminated land event, that posed a threat of potential or material harm to the environment, occurred during the reporting period. Where possible, any contaminated material is managed on-site..

5.14 Topsoil Management

During Phase 2 operations at the Mine (i.e. from 1 December 2020), WCPL will no longer undertake topsoil management for open-cut disturbance areas. It will be managed by United as a component of the UWJV. During projects conducted for underground and complex infrastructure, where salvageable quantities of topsoil are generated, these will be managed and stockpiled per the Wambo Topsoil Management Procedure.

5.15 Weed and Pest Management

WCPL commissioned ELM to undertake management and control of weed species within the operational and offset areas at the Mine during 2023. Weed management techniques included spraying and manual removal (cut and paint). During the reporting period, a total of 55 days of weed control work at the Mine was undertaken by a two-person crew (ELM, 2023).

Weed management was undertaken in RWEA A, RWEA B, RWEA E, rail loop area and Wambo general areas, including Hales Crossing, areas adjacent to offices and CHPP Area. A summary of the total areas of specific weeds treated by ELM (2023) is provided in **Table 18** and shown in **Figure 8**.

Table 18: Approximate Area of Weeds Treated at the Mine during 2023

Weeds Treated	Area (ha)
African lovegrass and natal grass (dense)	16
African olive (sparsely scattered)	42
Blue Heliotrope (sparse to medium)	69
Paterson's Curse (dense)	68
Silverleaf Nightshade, Fireweed, thistles, galenia and saligna (medium)	10
Mother of millions	115
Prickly pear (medium)	75
Total Average	**56.4**

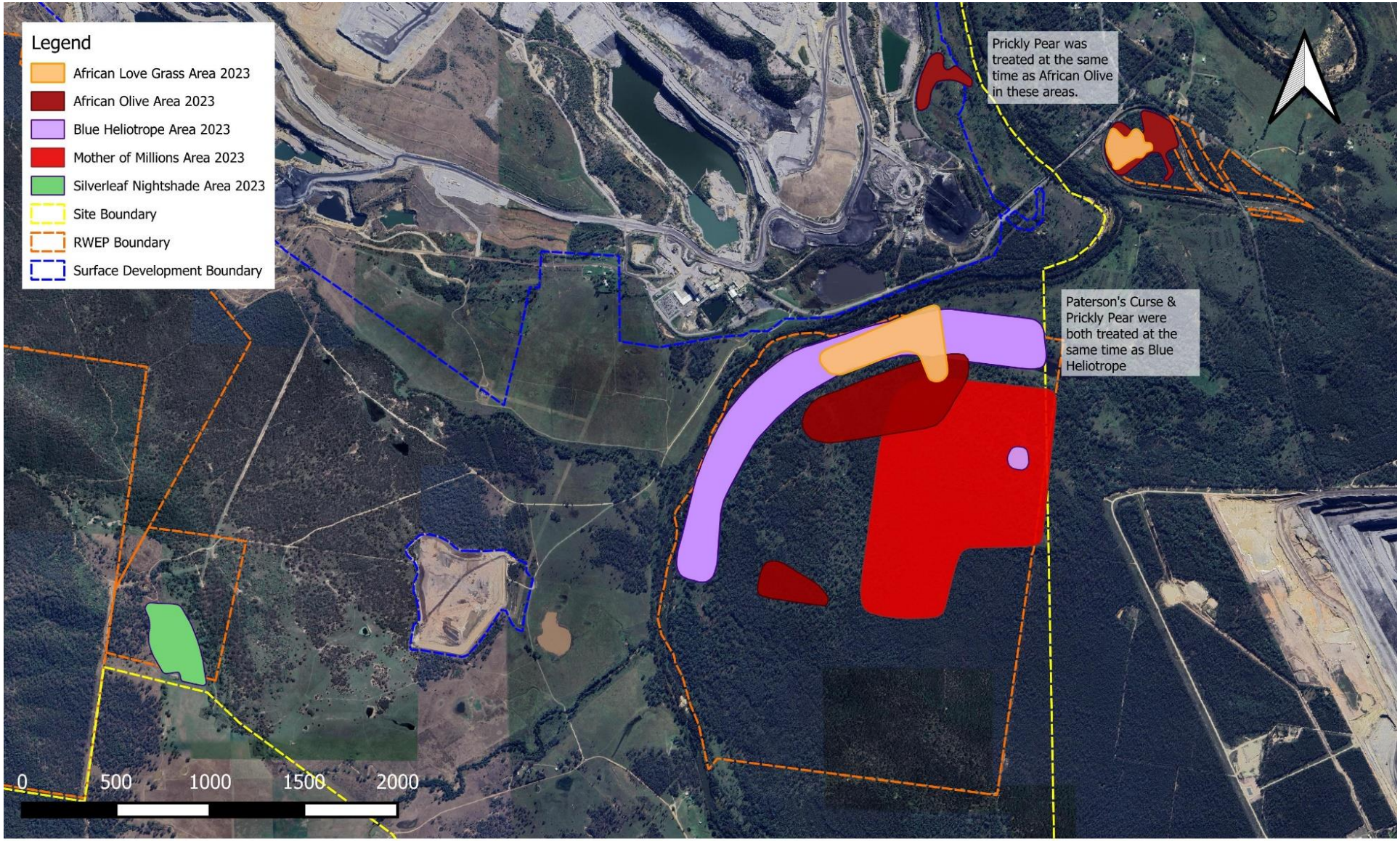
Note: ha = hectares.

During the reporting period, WCPL undertook a vertebrate pest management program as part of the Hunter Local Land Services Pest Species Management program, along with other mines in the area, in Autumn (May) and Spring (October and November), targeting wild dogs and foxes. A combination of ground and ejector baiting was used (REM 2023 and ELM 2023).

The results of the baiting program were considered to be positive due to the high rate of baits being taken by the target species. A total of 59 (in Autumn) and 60 (in Spring) bait locations were set up with a baiting efficiency of 47% and 68%. The baiting efficiency decreased slightly in Autumn and increased in Spring compared to the previous year.

Fox takes decreased from 16% to 7% in Spring and increased from 9% to 13% in Autumn for the preceding two baiting programs..

During the next reporting period, WCPL intends to continue to work with Local Land Services and neighbouring landowners and participate in coordinated pest control programs.



WAMBO PEABODY
WEED WORKS COMPLETED 2023
Weed Locations - Map 1

Compiled by ENRIGHT LAND MANAGEMENt 31/12/2023

ENRIGHT LAND MANAGEMENT

WCPL prepared an Annual Weed Treatment Plan in 2023 which guided weed management activities in 2023 and will continue to do so into the future. Pest and weed management will continue as required on-site and on agistment managed properties throughout the next reporting period.

5.16 Bushfire Management

No grassfires or bushfires were reported within the Mine during the reporting period. WCPL undertakes proactive grass slashing and maintenance around all site infrastructure and boundary fences where practical.

Although Development Consents DA 305-7-2003 and DA 177-8-2004 no longer require a Bushfire Management Plan, hazard reduction and maintenance of fire trails will continue to be conducted as required.
During the next reporting period, WCPL will review opportunities to implement hazard reduction / environmental burning into the management of the Remanent Woodland Enhancement Areas (RWEA).

5.17 Spontaneous Combustion Management

Inspections for spontaneous combustion form part of daily WCPL inspections across the two main operating areas (i.e., Underground and CHPP).

No spontaneous combustion events were identified by WCPL during the reporting period.

6.0 Water Management

Water management performance measures for the Mine are defined in Table 8 of Condition B62, Schedule 2 DA 305-7-2003 and Condition L2 of EPL529. Additional conditions relating to water supply, water and salt balances, discharge volume, effluent application to land, monitoring and recording requirements (including for the HRSTS), the NWCD, Chitter Dump Dam, South Wambo Dam, WCPL's Water Management Plan and independent water audits are also detailed in these documents.

WCPL must also operate in accordance with the conditions of various water licences issued under the *Water Management Act 2000* as well as conditions of DA 177-8-2004.

6.1 Surface Water Monitoring

WCPL undertakes surface water monitoring at the Mine in accordance with the approved Surface Water Management Plan (SWMP), which is a component of the WCPL Water Management Plan. The SWMP has been developed to ensure WCPL complies with its statutory conditions relating to surface water monitoring at the Mine.

6.1.1 Approval Criteria/EIS Predictions and Management Plan Requirements

WCPL's EPL529 details the approval criteria for off-site water discharges (**Section 6.3.1**). WCPL has developed impact assessment criteria for surface water quality and stream flow as part of the SWMP.

For the surface water quality criteria (**Table 19**), where actual site-specific water quality monitoring data is available, the criteria have been set based on the 20th and 80th percentile for the available dataset. Where insufficient data is available, WCPL has adopted the applicable Australian and New Zealand Environment and Conservation Council (ANZECC) default guidelines values for slightly to moderately disturbed ecosystems (ANZECC 2000) or the Water Quality Objectives for the Hunter River.

Triggers for the local ephemeral creeks in the SWMP are based on the unexpected absence of flow in climatic situations when flows would be expected. The triggers would be met if there was no flow recorded at the flow monitoring site either on the day or the day after the recorded rainfall was equal to or greater than the nominated amount. Applicable criteria for stream flow are included and **Table 20.**

Table 19: Surface Water Quality Impact Criteria[1,2]

Sampling Site	Parameter[3]	Lower Limit	Upper Limit
SW02 – Wollombi Brook	pH	7.4	8.1
	EC (µS/cm)	599	1,947
	TSS (mg/L)	17 (low flow) to 308 (high flow)[4]	
SW05 – North Wambo Creek	pH	7.3	8.0
	EC (µS/cm)	1,155	2,350
	TSS (mg/L)	53 (low flow) to 1,110 (high flow)[4]	
SW07 – Wambo Creek	pH	7.4	7.9
	EC (µS/cm)	360	724
	TSS (mg/L)	29 (low flow) to 331 (high flow)[4]	
SW08 – Stony Creek	pH	6.8	7.4
	EC (µS/cm)	288	416
	TSS (mg/L)	5 (low flow) to 15 (high flow)[4]	
SW39 – Waterfall Creek	pH	7.3	7.8
	EC (µS/cm)	159	429
	TSS (mg/L)	582 (low flow) to 1,922 (high flow)[4]	

1. From Table 15 of the SWMP.
2. An exceedance occurs when water quality results exceed the impact criteria on three consecutive sampling events.
3. EC = electrical conductivity, TSS = total suspended solids, µS/cm = microSiemens per centimetre, mg/L = milligrams per litre.
4. Low flow condition based on 80th percentile of recorded concentrations and high flow criteria based on maximum recorded concentrations.

Table 20: Surface Water Flow Impact Assessment Condition

Watercourse and Flow Monitoring Site	Daily Rainfall when Flow Commenced on 80% of Recorded Occasions[1]
North Wambo Creek (FM1)	100 mm[2]
Stony Creek (FM13)	20 mm
South Wambo Creek (FM15)	20 mm

1. From Table 14 of the SWMP.
2. Streamflow measurements in North Wambo Creek daily rainfall data from stations adjacent to the catchment have been analysed and indicated a total depth of continuous rainfall depth of approximately 100 mm (can occur over more than one day) is required to generate surface flow in North Wambo Creek upstream of the diversion.

Condition B62 of DA 305-7-2003 and Condition B9 of 177-8-2004 require WCPL to comply with general water management performance measures. Performance indicators relevant to surface water are outlined in **Table 21**.

In addition**,** WCPL is also required to meet additional requirements, in accordance with the SWMP. These requirements include annual reporting on performance against the performance indicators detailed within the SWMP (**Table 22**).

Table 21: Surface Water Performance Measures

Aspect	Performance measure	Performance Indicator/Trigger
Downstream Surface Water Quality	Negligible change in surface water quality (compared to predicted impacts	Surface water quality monitored is outside of the adopted trigger values for at least one parameter for more than two monitoring rounds.
Channel Stability	No increase in areas of instability within watercourses	Channel stability monitoring indicates one or more areas of decreasing stability in watercourses.
Downstream Flooding Impacts	Negligible change in downstream flood access (compared to predicted impacts)	No change to flood inundation of downstream properties in major flood events.
Stream and Riparian Health	Riparian Health	No evidence of significant weed growth or death of vegetation
	Condition of channel	No evidence of significant rill erosion, undercutting or slumping
	Deposition of sediment and debris	No evidence of significant accumulation or deposition, large blockages in channel
	General conditions	No evidence of significant hazards presented to the public, poor aesthetics or feral animals, or geomorphic instability
Surface Water User Supplies	Negligible impact to downstream surface water users (compared to predicted impacts)	• Mining extents / disturbance areas lie within approved boundaries. • Surface water take associated with baseflow impacts is licensed. • No complaints from downstream water users regarding loss of surface water (quality and/or quantity).
Post-mining Water Pollution from Rehabilitated Areas of the Site	Water discharged from the site is suitable for receiving waters and fit for aquatic ecology and riparian vegetation	• Runoff water quality from rehabilitation areas is within the range of water quality data recorded from analogue sites and/or baseline data and does not pose a threat to downstream water quality. • Drainage structures (including drainage lines established in the final landform) are stable and there is no evidence of overtopping or significant scouring as a result of runoff

Table 22: Surface Water Performance Indicators

Performance Indicator
Number of complaints received relating to surface water.
Number of non-compliances relating to surface water.
Number of exceedances of surface water impact assessment criteria[1].
Number of reportable environmental incidents relating to surface water.

1. An exceedance occurs when water quality results exceed the 80th Percentile Trigger Value (**Table 19**) after three consecutive sampling events.

6.1.2 Performance during the Reporting Period

Surface Water Quality

An exceedance of the surface water quality triggers is considered to have occurred when water quality results exceed the impact criteria (**Table 23**) for three consecutive sampling events.

WCPL recorded exceedances of the surface water quality impact criteria during the reporting period, at SW08 for (pH and EC) and SW07 (EC).

Table 23: Summary of Exceedances of the Surface Water Quality Impact Criteria

Site	pH	EC
SW07[1]	June to September	May to September
SW08[2]	Ongoing - January to April	Ongoing - January to April

[1] Sample location dry from September 2023.

[2] Exceedances at SW08 have been recorded since April 2021 and are part of an ongoing investigation.

WCPL notified DPHI of the exceedances at SW07 on 6 December 2023. SLR has been commissioned to undertake a preliminary surface water quality investigation into factors which may be contributing to the observed water quality trigger exceedances, and evaluate whether the exceedances have potentially occurred as a direct result of WCPL operations. These factors include:

- Meteorological conditions;
- The location of current or historical operational activities;
- Any incidents or changes in operations which could have contributed to the exceedances; and
- Upstream/ upgradient and/or neighbouring surface water and groundwater conditions.

It is anticipated that this preliminary investigation will be completed in April 2024.

With regards to the continuing EC and pH exceedance at SW08, (first observed in June 2021) investigations concluded that the large magnitude recharge event in March 2021 may have resulted in sufficient recharge to the shallow groundwater system to enable the migration of surface and shallow groundwater through fractures in bedrock or dilated bedding planes within the Newcastle Coal Measures underlying the creek. Higher salinity was attributed to oxidation of freshly fractured rock and leaching of oxidation products during the period of sustained rainfall following several years of drought. Investigation reports and monitoring data was provided to DPHI in March and November 2023. The next update will be provided in November 2024 however it is noted that conditions are currently dry in Stony Creek.

WCPL reported to the EPA that, due to dry conditions or unsafe access, monthly water quality samples were unable to be collected at the required frequencies at monitoring locations, SW03, SW04, SW05, SW6, SW07, SW08, SW27a, SW32a, SW39, SW40 and SW41 during the reporting period, resulting in a non-compliance with Condition M2.3 of EPL529. No known adverse impacts resulted due to the non-compliance.

No complaints relating to surface water quality were received during the reporting period.

A summary of the surface water quality monitoring data is included in **Appendix G.**

Surface Water Flows

AECOM (2023) prepared an annual stream flow monitoring report for the Mine and is presented in **Appendix H**.

The WCPL stream flow monitoring system consists of (**Figure 9**):

- five monitoring stations on North Wambo Creek (US-FM1, FM1, FM2, FM3 and FM4);
- three monitoring stations on South Wambo Creek (FM9, FM15 and FM16);
- two Water NSW operated flow gauging stations monitoring stations on Wollombi Brook (FM11 and FM10);
- two monitoring stations on Stony Creek (FM12 and FM13); and
- one monitoring station on a major tributary to Stony Creek (FM14).

Table 24 presents a summary of flow events observed at the relevant streamflow monitoring stations on the days during the reporting period when 20 mm or greater rainfall was recorded at the WCPL meteorological station.

There were four days during the reporting period that recorded 20 mm or greater of rainfall. FM13 and FM15 both recorded zero flow events throughout the year. Flow monitoring was re-established at FM15 in June 2023.

Table 24: Surface Water Flow Results

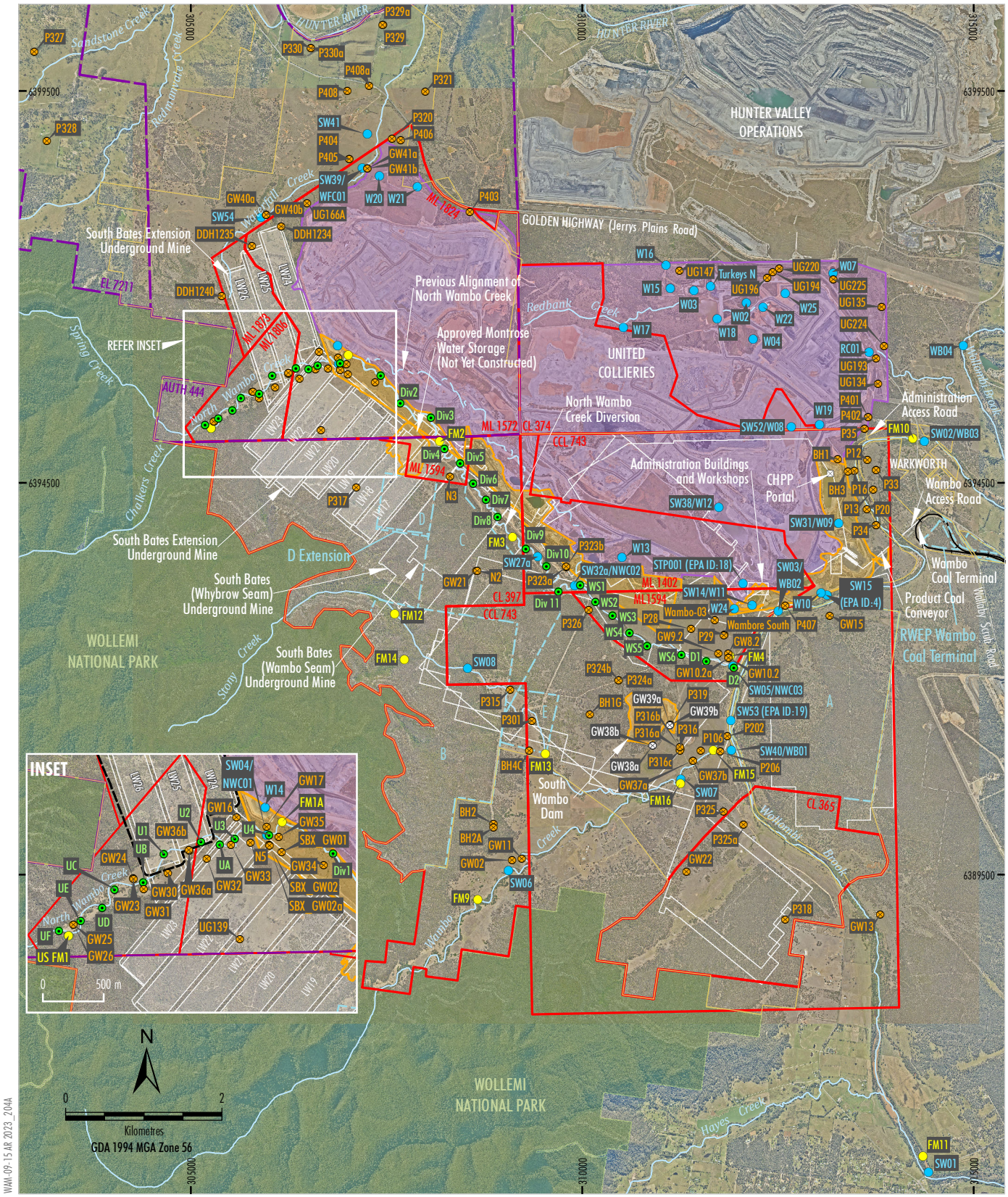
Date	24 hour rainfall (mm)	Site FM15	Site FM13
22/2/2023	46.0	Flow monitoring site re-established 20 June 2023.	No flow event recorded
27/3/2023	36.2		No flow event recorded
20/12/2023	31.4	No flow event recorded	No flow event recorded
24/12/2023	21.4	No flow event recorded	No flow event recorded

6.1.3 Trends and Key Management Implications

WCPL recorded exceedances of the surface water quality impact criteria on during the reporting period at SW07 and SW08 (for pH and EC) (**Table 25**).

SW08 on Stony Creek remains the subject of an ongoing investigation with update reports provided to DPHI in March and November 2023. Investigations have concluded that the large magnitude recharge event in March 2021 may have resulted in sufficient recharge to the shallow groundwater system to enable the migration of surface and shallow groundwater through fractures in bedrock or dilated bedding planes within the Newcastle Coal Measures underlying the creek. Higher salinity was attributed to oxidation of freshly fractured rock and leaching of oxidation products during the period of sustained rainfall following several years of drought. It is noted that conditions are currently dry in Stony Creek. The next update will be provided by the end of November 2024.

SW07 is located on South Wambo Creek. pH observations were below the lower limit trigger level (pH 7.4) from June to September 2023. This follows a series of low pH observations made in 2021 and 2022 (reported in the 2022 Annual Review) and investigated by Umwelt Australia, who concluded…*Given all of the results except for one ..were within the historical and ANZG 2018 DGV ranges, it is considered that the exceedances are a result of natural variation.* were above the trigger level (724 µS/cm) from May to September 2023. South Wambo Creek was dry during the October and November sampling. A preliminary investigation is currently being completed and is expected in April 2024.



Source: WCPL (2024); NSW Spatial Services (2023)
Orthophoto Mosaic: WCPL (Nov 2023, May 2022)

LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Existing/Approved Underground Development

Monitoring Sites

- Groundwater Monitoring Sites
- Proposed Groundwater Monitoring Sites
- Surface Water Flow Monitoring Site
- Surface Water Quality Monitoring Site
- Diversion and Subsidence Monitoring Site

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

Peabody

WAMBO COAL MINE

Location of Surface Water and Groundwater Monitoring Sites

Figure 9

6.1.4 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the SWMP. If management actions are required as a result of the required preliminary investigations, WCPL will implement the actions accordingly.

6.2 Groundwater Monitoring

WCPL undertakes groundwater monitoring at the Mine in accordance with the approved Groundwater Management Plan (GWMP), which is a component of the WCPL Water Management Plan. The GWMP has been developed to ensure WCPL complies with its statutory conditions relating to groundwater monitoring at the Mine.

In 2022, the Wambo groundwater model was updated to accommodate the Longwalls 24 to 26 Modification (DA 305-7-2003, Modification 19). It was identified in 2023 that there were differences between simulated and actual/ planned mining progression in the UWJV (open cut) so the model was updated to include a more accurate representation of mining in the open cut mine. No other changes were made to the model.

6.2.1 Approval Criteria/EIS Predictions and Management Plan Requirements

The GWMP includes triggers for groundwater levels and quality in shallow bores. These triggers have been developed using statistical analysis of baseline monitoring data and data acquired to 2014 (from a number of monitoring bores on and around the Mine) and the predicted effects presented in the EIS (Resource Strategies 2003) and subsequent Environmental Assessments.

The trigger values are not assessment criteria but are used to initiate investigations into the groundwater levels or groundwater quality as reported by the groundwater monitoring program. A summary of the groundwater triggers for shallow bores, as detailed in WCPL's approved GWMP is included in **Table 25**. In order to avoid false triggering, as a trigger would be initiated 20% of the time due to natural causes, triggers for groundwater level are defined to occur when two consecutive bi-monthly observations (over a 2-month interval) exceed or fall below the specified depth to groundwater. Triggers for groundwatr quality are defined to occur when three consecutive bi-monthly observations (over a 2-month interval) exceed or fall below the specified pH or EC values.

In addition to the groundwater monitoring triggers detailed in **Table 25,** WCPL is also required to meet additional requirements, in accordance with the GWMP and approved Extraction Plans. These requirements include annual reporting on performance against the performance indicators detailed within the GWMP (**Table 26**).

Table 25: Water Quality and Level Trigger Values – Shallow Bores

	Depth to Groundwater (mBTOC[1])		Conductivity (µS/cm)	pH	
Bore	Min (10th percentile)	Max (90th percentile)	Maximum (Three Consecutive Bi-Monthly Exceedances)	Minimum (Two Consecutive Bi-Monthly Exceedances)	Maximum (Two Consecutive Bi-Monthly Exceedances)
P109[2]	4.6	6.7	695	6.5	7.6
P301	NA[5]	NA[5]	9,200	6.1	7.2
P315[2]	NA[5]	NA[5]	552	6.0	7.4
GW08.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW09.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW10.2[3]	ND[4]	ND[4]	NA[5]	NA[5]	NA[5]
GW15	10.4	11.1	730	6.7	7.2
P16	7.1	7.8	10,832	7.0	7.7
P20	7.1	8.2	10,625	7.0	7.6

1 mBTOC = metres below top of casing.

2 Monitoring has ceased at this location and will recommence once replacement bores are constructed in 2023. P315 was dry prior to NWU mining activity. Therefore, a specific depth to water trigger is not appropriate to indicate Wambo mining impacts. Data will be reviewed as part of the Annual Review to determine whether there are changes in groundwater level that can be attributed to Wambo mining activity. Monitoring has ceased at this location and will recommence once replacement bores are constructed in 2023.

3. GW08.2, GW09.2 and GW10.2 have been installed within unconsolidated strata near North Wambo Creek to serve as replacement bores to GW08 and GW09. Trigger levels for these bores will be established following the collection of baseline data and based on predicted drawdown from the revised groundwater model.

4. ND – Insufficient baseline data to develop meaningful trigger level.

5. NA – trigger level not appropriate for assessing Wambo mining impact at this location.

Table 26: Groundwater Performance Indicators

Performance Indicator	
Groundwater Management Performance Indicators	
Alluvial aquifers (including Wollombi Brook alluvium and excluding the NWC alluvium)	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: • A greater than negligible change in groundwater levels; • A greater than negligible change in groundwater quality; and • A greater than negligible impact to other groundwater users.
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: • Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c); and • Channel stability is not maintained or improved
North Wambo Underground Subsidence Performance Indicators	
• The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergences away from the modelled groundwater	

Performance Indicator
South Bates and South Bates Extension Subsidence Performance Indicators
• The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (Table 11 of the GWMP). • The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (Table 13 of the GWMP). • The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.

Groundwater monitoring data from the Permian monitoring bores is assessed and reviewed as part of the Annual Review. Data is also used to validate the groundwater model.

6.2.2 Performance during the Reporting Period

Monitoring of groundwater levels and quality in alluvial and Permian bores was undertaken in accordance with the GWMP.

SLR (2024) prepared an annual groundwater monitoring report for the Mine and is presented in **Appendix H**. Below average rainfall conditions occurred at the Mine during the reporting period leading to a gradual groundwater level decline within the Wambo Creek, North Wambo Creek and a number of Wollombi Brook alluvial bores.

The following GWMP trigger value exceedances were recorded during the reporting period:

- P315 (Stony Creek Alluvium) – ongoing exceedance of EC trigger level (first reported in 2021).
- GW15 (Wollombi Brook Alluvium) – maximum groundwater level trigger breach.
- P16 (Wollombi Brook Alluvium) - minimum groundwater level trigger breach.

Consistent with the GWMP, an investigation was commenced into the exceedances listed above (**Section 6.2.3** and **Appendix H**). No bores exceeded the pH trigger guidelines in 2023.

No complaints from groundwater users were received during the reporting period.

Groundwater model performance is consistent with previous Annual Review assessments, with generally good matches to absolute observed groundwater levels (**Appendix H**).

SLR (2023) reviewed compliance against the groundwater performance indicators (**Table 26**) and concluded that WCPL was compliant with the exception of the performance indicators for P315, GW15 and P16. P315 remains the subject of an ongoing investigation with reports provided to DPHI in March and November 2023 (**Section 6.1.2**). The exceedances of the minimum groundwater elevation trigger level at P16 is likely related to below average rainfall conditions in 2023 and a Glen Munro Pit mining effect. The results from the updated model may help revise trigger levels at P16 to reflect the influence of both approved impacts and climatic conditions (**Section 6.2.3**). Bore GW15 breached the maximum groundwater elevation trigger level in 2023, however it was concluded this is not related to WCPL's mining activity and requires no further investigation (SLR, 2023).

6.2.3 Trends and Key Management Implications

Groundwater monitoring data collected during the reporting period has been reviewed and assessed against the triggers in the approved GWMP (**Table 25)** by SLR (2023).

During the reporting period exceedances of the EC trigger level were recorded at P315 (Stony Creek Alluvium). EC was above the trigger level of 552 µS/cm for all of 2023 with a maximum of 1,674 µS/cm recorded in October before falling back to 1,571 µS/cm in December 2023. This is considered an ongoing exceedance that was first identified in 2021 and is the subject of ongoing investigations. As outlined in **Section 6.1.3**, investigations have concluded that high rainfall from 2020 to 2022 may have resulted in sufficient recharge to enable "flushing" of groundwater through fractures in bedrock caused by undermining in the Newcastle Coal Measures (which is historically observed to have saline groundwater), which may flow laterally in to the Stony Creek alluvium, leading to the observed increase in EC. While declining

groundwater levels are observed at P315 in 2023 due to below average rainfall, antecedent conditions (above average rainfall from 2020-2022) have maintained some saturation of the shallow groundwater system at P315. While P315 remains saturated and there is no further flushing from low EC rainfall or surface water flow, the EC observations above the trigger level are expected to continue.

Groundwater levels at P16 (Wollombi Brook Alluvium) have been below the minimum groundwater elevation trigger level (49.7 mAHD) in all 2023 observations, showing a declining trend that correlates well with the below average rainfall conditions in 2023. Groundwater levels at P16 were previously below the groundwater elevation trigger from 2017 to 2021 and were associated with below average rainfall conditions and a mining effect from the excavation of the Glen Munro Pit that appears to have caused additional drawdown in the order of 1.2 m (SLR Annual Groundwater Review, 2021). The groundwater elevations below the trigger observed in 2023 are likely a continuation of this combined drier climate and an ongoing Glen Munro Pit mining effect. SLR (2023) recommends the results from the contemporary groundwater model be used to revise trigger levels at P16 to reflect the influence of both approved impacts and climatic conditions.

Bore GW15 breached the maximum groundwater elevation trigger level in 2023 which was determined to be not related to WCPL mining activity and requires no further investigation (**Appendix H**):

SLR (2023) has undertaken periodic reviews of the WCPL vibrating wire piezometer (VMP) monitoring network, both on-site and of the downloaded data. Key findings from the data quality assessment include (**Appendix H**):

- Unreliable data at VWP sites where sensors are within shallow overburden, Whybrow or Wambo seams. Sensors are dry or near-dry, likely associated with WCPL or regional mining activity. It is worth continuing to download these while at least one of the sensors is collecting reliable data, and where recovery / re-saturation is possible.
- As recommended in previous reviews, older sites and unlabelled sites , which are no longer collecting reliable data should be considered for removal from monitoring network.

6.2.4 Implemented or Proposed Management Actions

SLR (2023) recommended:

- VWP locations identified with persistent poor-quality data should be considered for inspection, and removed from the monitoring network if they cannot be repaired
- Consider revising groundwater level triggers at P16 to incorporate model predictions which capture the observed mining effect.
- Provide update of groundwater and surface water monitoring data at Stony Creek to DPHI in November 2024.
- The review of groundwater sampling field sheets and VWP data should continue throughout 2024 to enable as-needed repair of monitoring infrastructure and the continued collection of monitoring data.
- Redevelopment and purging of GW15, GW13 should be undertaken in 2024. Sites P329a and P330a could also be considered for purging following review of comments in field sheets.

Further updates of the numerical groundwater model should be scheduled for completion in 2025. During the next reporting period, WCPL will continue to implement the GWMP.

6.3 HRSTS Discharges

WCPL is permitted to discharge water to the Hunter River in accordance with the conditions of EPL529 and the Hunter River Salinity Trading Scheme (HRSTS) guidelines. These guidelines include the following conditions:

- notification from NSW DCCEEW of discharge opportunity must be received;
- flow of water in Wollombi Brook at the NSW DCCEEW Bulga Gauging Station (FM11) needs to be more than 500 megalitres per day (ML/day);
- pH will be measured continuously throughout the discharge with an inline instrument;
- EC will be measured continuously in µS/cm throughout the discharge with an instrument designed to measure between 0 and 10,000 µS/cm; and
- TSS will be measured once a day during discharge.

A representative sample will be collected every day during discharge and sent to the lab for analysis.

During the reporting period WCPL held 61 credits under the HRSTS.

6.3.1 Approval Criteria/EIS Predictions and Management Plan Requirements

A summary of the approval criteria for off-site discharges (from EPL529) is included in **Table 27** in accordance with the Schedule 2, Condition B55 of DA 305-7-003.

Table 27: EPL529 Approval Criteria for Off-site Discharge

Parameter	Criteria[1]
pH	6.5-9.5[2]
TSS	120 mg/L[2]
EC	N/A
Volume	250 ML/day

1. Criteria as per EPL529 and DA 305-7-2003.
2. 100th percentile concentration limit.

6.3.2 Performance during the Reporting Period

During the reporting period, Wambo did not discharge to the Hunter River as permitted by conditions of EPL529 and the HRSTS guidelines.

There were no non-compliances from discharges under the HRSTS during the reporting period.

6.3.3 Trends and Key Management Implications

An overview of HRSTS releases over time is provided in **Table 28**.

Table 28: Summary of HRSTS Releases

Year	Number of Releases	Release Volume (ML)
2014	1	9.6
2015	6	140.1
2016	11	416
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	4	75.1
2022	90	2838.5
2023	0	0

6.3.4 Implemented or Proposed Management Actions

A written report of the activities undertaken by WCPL under the HRSTS (for the period 1 July 2022 to 30 June 2023) was submitted to the EPA on 29 August 2023 in accordance with Condition R5 of EPL529.

During the next reporting period, WCPL forecasts compliance with the HRSTS requirements, and predicts that, if the opportunity arises, it will use all of its HRSTS credits, as dictated by River Register releases.

6.4 North Wambo Creek Diversion Discharge Flows

The NWCD Plan was approved by the then NSW Department of Planning (now DPHI) in April 2008. A requirement of the approval was to comply with the requirements of the then Department of Water and Energy (now NSW DCCEEW). These requirements included reporting on the performance of the NWCD annually in the Annual Review.
During the reporting period, WCPL monitored flow within the North Wambo Creek at five locations:

- US-FM1, approximately 1 km upstream of FM1 (installed in December 2017);
- FM1, upstream of the NWCD;
- FM2, middle of the NWCD, downstream of FM1;
- FM3, middle of the NWCD, downstream of FM2; and
- FM4, downstream of the NWCD.

A review of the flow events at each monitoring site during the reporting period was undertaken by AECOM (2024) (**Appendix I**) and a summary is provided in **Table 29**. Flow monitoring data is included in the AECOM report (**Appendix I**).

Table 29: NWCD Discharge Flow Monitoring – 2023

Flow Monitoring Station	No. of Flow Events Recorded	Maximum Stream Height Recorded (m)	Maximum Theoretical Flow Rate Recorded (ML/day)
US-FM1	3	0.16	3.1
FM1[1]	0	0	0
FM2[2]	0	0	0
FM3[3]	20	0.12	9.8
FM4	0	0	0

[1] Probable flow events at FM1 was detected through the main pressure sensor only.
[2] Flow station was temporary de-commissioned from 21 June to 5 December 2023 while remediation work was being undertaken in the area around the flow station.
[3] Main pressure sensor was damaged/failed during the July 2022 rain event. Probable flow events at FM3 were detected through the backup sensor.

6.5 Water Take

The Wambo Complex (Wambo Underground and the United Wambo Open Cut (UWOC)) maintains a variety of WALs under the *Water Management Act 2000* which consist of High, General and Supplementary securities, as detailed in **Table 30**.

Table 30 shows the predicted annual groundwater volumes required to be licensed the Wambo Complex for both alluvial and porous/fractured rock groundwater sources. These values are from the groundwater model updated to incorporate as-mined and proposed future UWOC mining (SLR, 2023). Predicted take from the Lower Wollombi Brook Water Source (aquifer) in the updated model does not exceed 70 ML (provided in WAL23897) until after 2028.

Table 30: Complex Groundwater Licensing Summary

Water Sharing Plan	Management Zone/ Groundwater Source	Licensed Entitlement (ML/ year)	Predicted annual groundwater inflow volumes requiring Licensing (ML/year)
Hunter Unregulated and Alluvial Water Sources Water Sharing Plan 2009	Lower Wollombi Brook Water Source	736.9[1]	Av. 135 Max. 209 2023. 0[3]
	Jerrys Water Source	-	0
North Coast Fractured and Porous Rock Groundwater Sources ^^	Porous Rock	1,947[2]	Av. 714 Max. 1,110 2023. 670[4]

^^ Porous Rock is the Sydney Basin - North Coast Groundwater Source, as defined in the *WSP for the North Coast Fractured and Porous Rock Groundwater Sources*, released 1 July 2016.

[1]Licence No. WAL23897, WAL18437, WAL18455, WAL18549.

[2]Licence No. WAL42373, WAL41532, WAL41510.

[3] Predicted take from the Lower Wollombi Brook Water Source in the updated model does not exceed 70 ML (provided in WAL23897) until after 2028.

[4] Value derived from the Wambo Complex Numerical Groundwater Model (SLR 2022), Complex modelled groundwater inflow for 2023.

During the 1 July 2022 to 30 June 2023 water year, WCPL extracted a total 373 ML of water from the Hunter River (under WAL 718), 0 ML of water from Wollombi Brook (under WAL 18437), 0 ML of groundwater from Wollombi Brook alluvium (under WAL 23897), and 670 ML from porous rock groundwater sources (under WAL 42373). As shown in Table **30**, all water take during the 2022-2023 water year was less than the allowable limits under the relevant WALs.

No water was used for irrigation purposes between 1 July 2022 to 30 June 2023 (from licence 20WA200632).

6.6 Compensatory Water

WCPL did not provide any compensatory water to any water users during the reporting period.

Table 31: Environmental Performance – Water Take (1 July 2022 to 30 June 2023)

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Passive take/ inflows (ML)	Active pumping (ML)	Total (ML)
Hunter Regulated River Water Source							
WAL 718 (20SL060212)	Hunter River Pump	Perpetuity	1,000 unit shares (high security)	Regulated River (high security)	0	373	373
WAL 8599 (20SL061206)	Hunter River Pump	Perpetuity	6 unit shares (high security)	Regulated River (high security)	0	0	0
WAL 8600 (20SL061206)	Hunter River Pump	Perpetuity	868 unit shares (general security)	Regulated River (general security)	0	0	0
WAL 8604 (20BL061206)	Hunter River Pump	Perpetuity	240 unit shares (supplementary water)	Supplementary Water	0	0	0
Hunter Regulated River Water Source – Shared with United Colliery							
WAL 929 (20SL050661)	Other Pump	Perpetuity	3 unit shares	Domestic and Stock	0	0	0
WAL 1369 (20SL060416)	80 mm CP	Perpetuity	15 unit shares (supplementary water)	Supplementary Water	0	0	0
WAL 15459 (20SL204246)	80 mm CP	Perpetuity	21 unit shares (general security)	Regulated River (general security)	0	0	0
Hunter Regulated River Water Source –United Colliery							
WAL 10541 (20AL200927)	-	-	300 unit shares	Regulated River	0	0	0
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)							
WAL 18437 (20SL033872)	Wollombi Brook Pump	Perpetuity	366.9 unit shares	Unregulated River	0	0	0
WAL 23897 (20BL167737)	Well No. 2	Perpetuity	70 unit shares	Aquifer	0	0	0
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source) – United Colliery							
WAL18445	Bywash Dam	-	200	Unregulated River	0	0	0
WAL18549	Other pump	-	100	Unregulated River	0	0	0
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source)							
WAL 42373[2]	-	Perpetuity	1,549 unit shares	Aquifer	670 (319 OC + 350.8 UG)[3]	0	670 (319ML OC + 350.8 UG)[3]

Licence Number[1]	Description	Expiry Date	Entitlement	Category	Passive take/ inflows (ML)	Active pumping (ML)	Total (ML)
WAL 41532 (20BL172156)	Dewatering	Perpetuity	98 unit shares	Aquifer	0	0	0
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source) – United Collieries							
WAL41510	Dewatering	-	300 unit shares	Aquifer	0	0	0

1. 20BL prefix bore licences with allocations have been replaced with WALs.
2. WAL 42373 was issued in 2019 to consolidate six of WCPL's previous WALs under the North Coast Fractured and Porous Rock groundwater Sources (Sydney Basin – North Coast Groundwater Source) including WAL 39735, WAL 39738, WAL 39803, WAL 41494, WAL 41528 and WAL 41520.

3 2023 calendar year - complex modelled groundwater inflow. OC = open cut, UG = underground

6.7 Site Water Balance

WCPL reviewed the Site Water Balance at the end of the reporting period, in accordance with the requirements of the Water Management Plan. A summary of the WCPL site water balance for the period 1 January to 31 December 2023 is provided in **Table 32.**

Table 32: Site Water Balance (1 January to 31 December 2023)

Water Sources	Volume (ML)
Hunter River	403
Wollombi Brook	0
United Collieries	923
Rainfall/Runoff	1,156
Underground Seepage	351
Dewatering Bores 2A and 4C	0
Total Water Inputs	**2,833**
Water Usage	**Volume (ML)**
Dust Suppression	45
CHPP Consumption	3,791
Underground (net)	526
United Collieries	805
CHPP/UG Potable Water	12
Domestic Usage	0
Total Water Usage	**5,179**
Water Loss	**Volume (ML)**
Evaporation – Mine Water & Tailings Dam	686
HRSTS Discharge	0
Reinjection	1,018
Seepage	0
CHPP Process (washdown)	142
Total Losses	**1,846**
Change in storages	**Volume (ML)**
Initial (January 2021)	4,040
Final (January 2022)	1,014
Change in Storage	**-3,026**
Water Balance (ML)	**-1,166**

A total of 403 ML was extracted from the Hunter River and 0 ML was extracted from the Wollombi Brook during the reporting period. This total is above the EIS forecast annual average extraction volume of 106 ML (Resource Strategies 2003).

As 923 ML of water was transferred from the United Collieries during the reporting period, this brings the total volume of water imported to approximately 46% of the total water input. This is considerably higher than the EIS forecast of an average of 2.6% (Resource Strategies 2003).

A total of 1,156 ML of runoff from rainfall was intercepted during the reporting period, 1,821 ML less than intercepted during 2022 (2,977 ML).

Underground seepage represented 12.3% of total supply compared to the 2003 forecast of 13.8% (Resource Strategies 2003), this is slightly lower than seepage in 2022. The contemporary numerical groundwater model predicts that 351ML of seepage will have reported to the combined sources of the South Bates Underground Mine and South Bates Extension Underground Mine in 2023. This value has informed the site water balance (Engeny, 2024) and has been used to evaluate compliance with relevant groundwater licences.

No water was exported off-site during the reporting period. No water was discharged during the reporting period.

6.7.1 Salt Balance

WCPL reviewed the Salt Balance at the end of the reporting period, in accordance with the requirements of the Water Management Plan. A summary of the WCPL salt balance for the period 1 January to 31 December 2023 is provided in **Table 33.**

Table 33: Salt Balance (1 January to 31 December 2023)

Inputs	Salt (t)
Raw water- Hunter	164
Raw water- Wollombi	0
Runoff	1,259
Groundwater (ROM coal)	389
Groundwater (Bores)	0
Groundwater (Seepage)	2,238
Transfer from UWJV	1,732
Total	**5,783**
Outputs	**Salt (t)**
Product Coal	720
Dust suppression	174
Release to HRSTS	0
Transfer to UWJV	**1,153**
Total	**2,048**
Balance	**3,735**

6.8 Erosion and Sediment Control

WCPL has developed an ESCP to address the relevant consent conditions and regulatory requirements.

6.8.1 Performance during the Reporting Period

During the reporting period, WCPL complied with all requirements ESCP under DA 305-7-2003 from 1 January 2023 to 31 December 2023.

No complaints were received relating to erosion and sediment control.

6.8.2 Trends and Key Management Implications

No trends or key management implications for erosion and sediment control were identified during the reporting period.

6.8.3 Implemented or Proposed Management Actions

During the next reporting period, WCPL will continue to implement the approved ESCP.

7.0 Rehabilitation

7.1 Rehabilitation Performance during the Reporting Period

In August 2022, a Rehabilitation Management Plan (RMP) was prepared by WCPL in accordance with the new standard rehabilitation conditions on mining leases imposed through an amendment to the *Mining Regulation 2016*, under the *Mining act 1992*. The RMP is available on the Peabody Website and addresses the rehabilitation requirements prescribed in the mining leases and Condition B107, Schedule 2 of DA 305-7-2003.

Version 3 of the RMP was approved in November 2023 to incorporate changes associated with the approval of Modification 19 to DA 305-7-2003.

Rehabilitation Activities at the Mine are conducted in accordance with the RMP.

In accordance with clauses 9 and 13 of Schedule 8A of the *Mining Regulation 2016* and Part 1 of the *Form and Way – Annual Rehabilitation Report and Forward Program for Large Mines* (NSW Resources Regulator, 2021), WCPL will prepare and submit an Annual Rehabilitation Report which describes the rehabilitation activities undertaken throughout the 2023 reporting period.

7.1.1 Status of Disturbance and Rehabilitation

WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities. Due to the nature of this disturbance, there will be minimal progressive rehabilitation reported by WCPL over the coming years (i.e. as the disturbed surface area will be required for the life of the underground mine).

A summary of the proposed and actual rehabilitation activities undertaken in 2023 is provided in **Table 34**.

Table 34: Actual versus Proposed Rehabilitation Activities (2023)

	2023 Proposed	2023 Actual (at 31 December)	2024 Proposed
Total Disturbance (ha)	0	0	0
Total Rehabilitation (ha)	0	0	0
Cumulative Rehabilitation (ha)	121.9	121.9	121.9

During the reporting period, subsidence remediation focused on access roads above Longwalls 19 to 23 and impacts along the North Wambo Creek Diversion. During the reporting period, subsidence monitoring of trenches that were remediated with geofabric and those without geofabric showed little difference with no further subsidence in either area.

7.1.2 Status of North Wambo Creek Diversion Remediation

In 2019, WCPL commissioned Soil Conservation Services (SCS) to commence a five year program of remediation works which built on the NWCD Rehabilitation and Maintenance Plan produced by Alluvium Consulting. Rehabilitation and maintenance was completed in four stages, with Stage 1 completed in 2020, Stage 2 in 2021 and the final Stages, 3 and 4 completed in 2023.

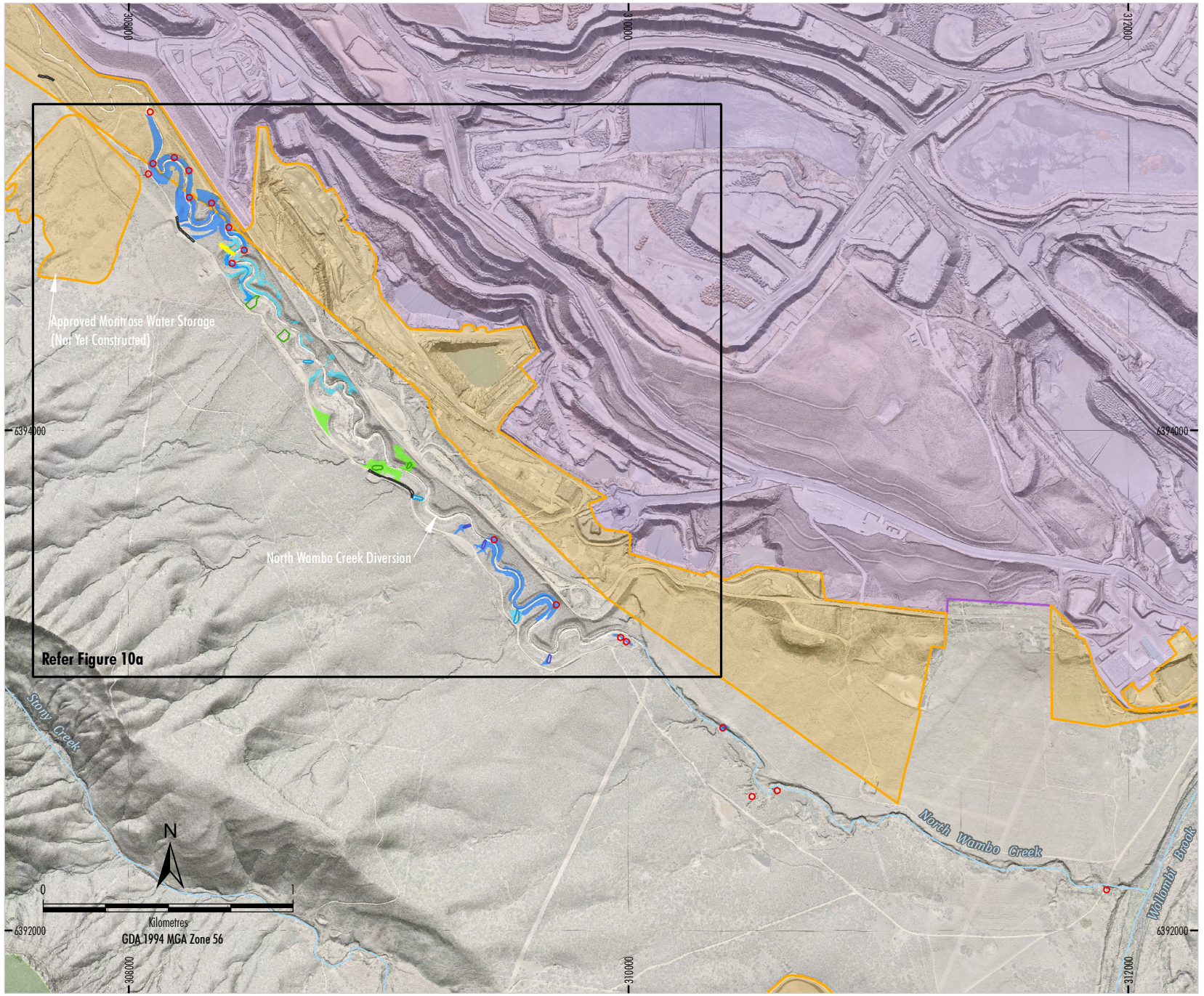
A summary of completed works includes (as shown on **Figure 10 and 10a**):

- construction of seven new batter chutes (numbered 3, 7, 8, 9; 10, 11 and 12);
- dismantling and reconstruction of three existing chutes (numbered 2,5 and 6);
- construction of road crossing protection and road re-alignments along the access track;
- subsidence and instability repairs;
- bench reprofiling, ripping, soil amelioration of approximately 11.3 hectares; and
- implementation of the revegetation strategy.

7.1.3 Agreed Post Rehabilitation Land Use

The agreed post rehabilitation land use for the Mine is detailed in WCPL's EIS (Resource Strategies 2003), DA 305-7-2003 and the RMP. The final landform for WCPL proposes a balanced rehabilitation outcome which recognises the alternative land uses that exist in the region, and therefore aims to establish the potential for both sustainable agriculture and endemic woodland habitat. The proposed design of final landforms and the revegetation strategy are described in the RMP and in United's RMP.

All rehabilitation activities completed at the Mine are undertaken with consideration to the agreed post rehabilitation land use goals.



LEGEND

- National Park
- SSD 7142 Operational Area #
- Existing/Approved Wambo Coal Mine Surface Development Area

REMEDIATION WORKS

Stage 1 (2019-2020)

- New Batter Chute
- Areas Ripped, Reworked and Seeded

Stage 2 (2021)

- Longwall 15/16 Drop Structure
- Road Re-grading
- New Batter Chute
- Amelioration/Ripping and Benching

Stage 3 and 4 (2022-2023)

- Remediated Areas of Instability
- Reworked Batter Chute
- Reprofiled Area

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

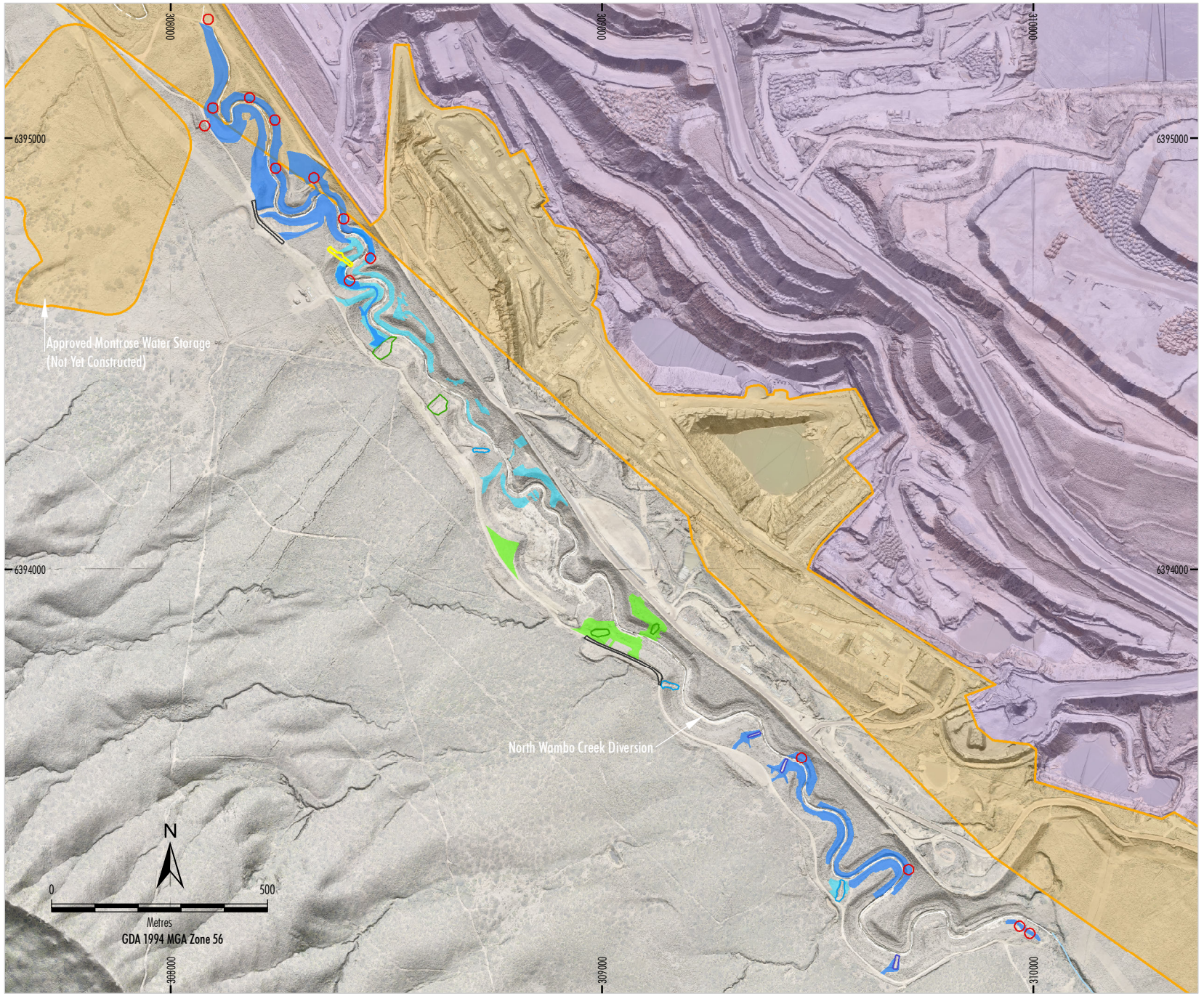
Source: WCPL (2024); NSW Spatial Services (2024)
Orthophoto: WCPL (Nov 2023)

Peabody

WAMBO COAL MINE

North Wambo Creek Diversion Remediation Works

Figure 10



LEGEND

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REMEDIATION WORKS

Stage 1 (2019-2020)

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- Areas Ripped, Reworked and Seeded

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- Road Re-grading
- New Batter Chute
- Amelioration/Ripping and Benching

Stage 3 and 4 (2022-2023)

- Remediated Areas of Instability
- Reworked Batter Chute
- Reprofiled Area

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2024); NSW Spatial Services (2024)
Orthophoto: WCPL (Nov 2023)

Peabody

WAMBO COAL MINE

North Wambo Creek Diversion
Main Remediation Area
- Inset

Figure 10a

WAM-09-15 AR 2023_207A

7.1.4 Key Rehabilitation Performance Indicators

Table 35 summarises WCPL's rehabilitation status at the end of the reporting period, compared to the previous reporting period.

As outlined above, WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities. As such, there will be minimal progressive rehabilitation reported by WCPL over the coming years.

Table 35: 2023 Rehabilitation Status and Forecast

Annual Reporting Period	2023 (Forecast) (ha)	2023 Actual (at 31 December) (ha)	2024 (Forecast) (ha)
A. Total Disturbance Footprint – Surface Disturbance[1]	323.21	323.21	323.21
B. Total active disturbance[2]	201.31	201.31	201.31
C. Rehabilitation – Land Preparation[3]	0	0	0
D. Ecosystem and Land Use Establishment[4]	121.9	121.9	121.9
E. Ecosystem and Land Use Development[5]	0	0	0
E. Rehabilitation Completion[6]	0	0	0

1. All areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to surface disturbance activities. The total disturbance footprint is the sum of the total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem and land use establishment, ecosystem and land use development and rehabilitation completion (see definitions below). Underground mining operations should not include the footprint of underground mining areas/subsidence management areas in the total disturbance footprint.
2. Includes on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste rock emplacements (active/unshaped/in or out-of-pit), tailings dams (active/unshaped/uncapped) and temporary stabilised areas (e.g. areas sown with temporary cover crops for dust mitigation and temporary rehabilitation).
3. Includes the sum of all disturbed land within a mining lease that has commenced any, or all, of the following phases of rehabilitation – decommissioning, landform establishment and growth medium development.
4. Includes the area which has been seeded/planted with the target vegetation species for the intended final land use. However, vegetation has not matured to a stage where it can be demonstrated that it will be sustainable for the long-term and/ or require only a maintenance regime consistent with target reference/analogue sites. Typically, rehabilitation areas would be in this phase for at least two years (and usually more) before rehabilitation can be classified as being in the ecosystem and land use development phase. This phase does not apply to infrastructure areas that are being retained as part of final land use for the site.
5. Rehabilitation has matured to a level where target revegetation outcomes are on a trajectory towards meeting the approved rehabilitation objectives and rehabilitation completion criteria (as verified by monitoring). This phase includes infrastructure areas that are to be retained for an approved final land use, following completion of all necessary measures to render the infrastructure fit for this purpose (for example structural integrity).
6. The NSW Resources Regulator has determined in writing that the mining area has achieved the approved rehabilitation objectives and approved rehabilitation completion criteria and final landform and rehabilitation plan following the submission of the relevant application by the lease holder.

7.1.5 Renovation or Removal of Buildings

No buildings were renovated or removed during the reporting period.

7.1.6 Other Rehabilitation Activities

In consultation with DRE (now MEG), an extensive audit of historical exploration works commenced during 2015. The scope of the audit was to identify all historical exploration sites, rehabilitate as required and relinquish the sites to DRE (now MEG). Of the identified sites:

- 9 sites were rehabilitated;
- 21 sites were inspected;
- 8 sites were identified as suitable for relinquishment; and
- 13 sites were identified as mined through.

In 2016, the scope of the audit was finalised and a total of 222 sites associated with historical exploration were identified in A444 and 17 in EL7211. The sites were identified as requiring inspection, possible rehabilitation and eventual relinquishment.

Both the EL7211 and A444 audits were completed during 2017. Copies of these reports were provided to DRG (now RR) on 17 April 2017. In December 2017, DRG (now RR) requested an ESF2 Form (Rehabilitation Completion and/or Review of Rehabilitation Cost Estimate) be completed to accompany the Audit Reports. The ESF2 form was submitted to DRG (now RR) on 14 December 2017. Follow up inspections required for the remaining holes associated with this audit were delayed. These bores will be inspected as part of the ongoing exploration rehabilitation program (refer to **Section 5.10**).

7.1.7 Trials, Research Projects and Other Initiatives

There were no new trials, research projects or other initiatives undertaking during the reporting period.

7.1.8 Variations in Activities Proposed in the RMP

During the reporting period, rehabilitation was undertaken in accordance with the activities proposed in the WCPL's approved RMP and approved Forward Program (March 2022 – March 2025).

7.1.9 Key Issues That May Impact Successful Rehabilitation

WCPL is responsible for rehabilitating the remaining surface area and activities related to the Mine's approved underground activities.

Due to the nature of this disturbance, there will be minimal progressive rehabilitation reported by WCPL over the coming years (i.e. as the disturbed surface area will be required for the life of the underground mine).

7.2 Actions for the Next Reporting Period

7.2.1 Rehabilitation Trials, Research Projects and Other Initiatives

The following rehabilitation trials, research projects and other initiatives are proposed over the next reporting period:

- Continuation of subsidence repairs.
- Continuation of maintenance to the NWCD.

7.2.2 Proposed Rehabilitation in the Next Reporting Period

Following the commencement of Phase 2 of the UWJV, rehabilitation activities for open cut operations is managed by United. Rehabilitation work for the Mine proposed during the next reporting period is limited to continued subsidence remediation works as triggered by subsidence monitoring.

Remediation works are proposed for South Wambo Creek in the later part of 2024.

8.0 Community

WCPL operates a 24 hour Community Enquiry Line (02 6570 2245), and a dedicated community email account (wambocommunity@peabodyenergy.com), to enable community members to make enquiries or lodge complaints regarding the operation of the Mine.

8.1 Community Engagement Activities and Initiatives

8.1.1 Community Consultative Committee

The WCPL CCC is made up of residents from the surrounding district, a representative of Singleton Council and WCPL management. The CCC representatives act as the point of contact between the mine and the community. The CCC is chaired by an independent chairperson.

During the reporting period WCPL held four CCC meetings:

- Tuesday 31 January 2023;
- Tuesday 9 May 2023;
- Tuesday 25 July 2023; and
- Tuesday 14 November 2023.

Minutes of these meetings are available on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

8.1.2 Newsletters

No community Newsletters were published during the reporting period.

8.1.3 Other Community Engagement Activities

No community information sessions were held during the reporting period.

8.2 Community Contributions

During the reporting period, WCPL contributed to the community through the following:

- Singleton PCYC;
- The Art of Being Here – Vivien Dwyer Exhibition;
- Bulga Flood Donation;
- Cancer Council;
- Mates in Mining;
- Hunter Valley Coal Festival – Singleton Community Day & Careers Expo;
- Singleton Hall of Fame; and
- Movember Foundation.

8.3 Community Complaints

WCPL received no community complaints during the reporting period (**Figure 11**). This follows the trend of a significant reduction compared to eighty-three (83) in 2020, compared to forty-six (46) in 2019 and forty-four (44) in 2018. The reduction in complaints associated with the Mine is due to the commencement of Phase 2 operations which do not include open cut mining operations.

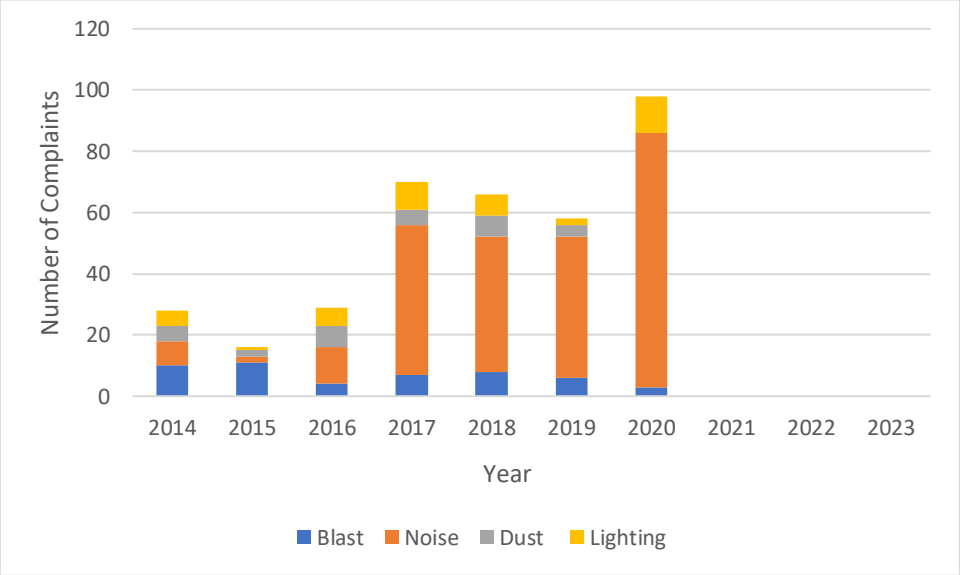

Figure 11: Community Complaints (2014-2023)

9.0 Independent Audits

Audits completed by WCPL are summarised below with details of any outstanding actions.

- 2015 Independent Environmental Audit for South Bates Underground Mine Extraction Plan. All actions from the independent audit were reported as complete in the 2020 Annual Review;
- 2016 Independent Rehabilitation Audit for Annual Environmental Management Report. All actions from the independent audit were reported as complete in the 2020 Annual Review;
- 2017 Independent Environmental Audit, undertaken by Hansen Bailey. **Table 36** summarises WCPL's actions taken to address the remaining continual improvement recommendations;
- 2019 Independent Environmental Audit for EPBC 2003/1138 and the Biodiversity Management Plan. All actions from the independent audit were reported as complete in the 2022 Annual Review;2020 Independent Environmental Audit completed by GHD. All actions from the independent audit were reported as complete in the 2023 Independent Environmental Audit;
- 2020 Pollution Monitoring Data - EPA Desktop Audit focusing on the requirements for licensees to publish pollution monitoring data. All non-compliances identified by the audit have been addressed;
- May 2021, NSW Biodiversity Conservation Trust (BCT) conducted a site visit and inspection of the Wambo offset areas subject to Conservation Agreements. A number of recommendations were made following the visit, generally relating to weed and pest management, fencing requirements, and suggested improvements to the annual reporting format. These recommendations will be implemented by WCPL;
- June 2023, representatives from the NSW Biodiversity Conservation Trust (BCT) conducted a site visit and inspection of the Wambo offset areas subject to Conservation Agreements. A number of recommendations were made following the visit, generally pertaining to the continuation of existing weed and pest management, fencing requirements, which are further described in **Section 9.1**; and
- 2023 Independent Environmental Audit, undertaken by Onward Consulting. There were no medium or high risk non-compliances identified during the audit. Thirteen (13) non-compliances were identified, including four (4) low-risk non-compliances and nine (9) administrative non-compliances. The findings of this Independent Environmental Audit are further described in **Section 9.2**.

A copy of the audit reports is available on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports
under the Audits tab. Audits completed more recently are outlined in the sections below.

Table 36: Continual Improvement Recommendations Made by the 2017 IEA for DA 305-7-2003 and DA 177-8-2004

Ref	Description	WCPL Response	Timing
DA 305-7-2003 Continual Improvement Recommendations			
Other			
N/A	• The diversion management program should be implemented to improve the operation of the diversion;	Agreed. The revised NWCD Plan contains a detailed rehabilitation plan including: • Table 13: 5 Year NWCD Rehabilitation and Maintenance Plan. • Appendix C – Detailed Rehabilitation Plan.	Complete Stage 1 work completed in 2019, Stage 2 works completed in 2021. Stages 3/4 works completed in 2023 concludes the 5 Year Rehabilitation and Maintenance Plan.
N/A	• Ongoing management is required in order to ensure that soil erosion is minimised and ground cover is given adequate opportunity to become established; and		
N/A	• Rehabilitation of subsided areas of the diversion is required in accordance with an Extraction Plan (or SMP), including repairing surface subsidence cracks and undertaking subsidence remediation where necessary in areas where the diversion has been subsided.		
N/A	The area in RWEA B is rehabilitated to prevent further damage and reduce risks to the surrounding Central Hunter Grey Box-Ironbark Woodland Endangered Ecological Community (EEC) as per Ecological Australia's recommendations.	Most appropriate method of rehabilitation to be determined, in order to reduce impacts if rehabilitation is undertaken with machinery.	Ongoing.
N/A	Subsidence affected sites identified as 'intolerable' by SLR Consulting should be remediated to an acceptable standard as per SLR's recommendations. Photos of completion should be kept within the database along with a report checklist with date and signature demonstrating works were completed.	Most appropriate method of rehabilitation to be determined, in order to reduce impacts if rehabilitation is undertaken with machinery.	Ongoing.

9.1 2023 Audit of the Wambo Conservation Agreements

On 22 June 2023, representatives from the NSW Biodiversity Conservation Trust (BCT) conducted a site visit and inspection of the Wambo offset areas subject to Conservation Agreements. An inspection report weas provided following the visit which notes – CA461 is currently *being well managed and is currently in good condition. The land managers have been putting in considerable effort in monitoring the CA and implementing a weed control and feral animal control plan. High threat weeds are being effectively managed and revegetation efforts are being pursued in cleared areas (although, currently with poor results from direct seeding).* A number of recommendations were made following the visit as outlined in **Table 37**.

Table 37: Recommendations From the 2023 BCT Audit of Wambo Conservation Agreements

BCT Summary and Further Action Required	WCPL Response
CA461 – Wambo Remnant Woodland Enhancement Areas Further action required -	
Continue treatment of identified weed infestations, and follow-up treatment where required.	WCPL will implement the 2024 Weed Treatment Plan
Continue monitoring for new weeds and treating when discovered	Noted
Continue revegetation efforts in cleared areas with minimal natural regeneration. Suggest incorporating tube-stock planting to supplement the current direct seeding efforts.	Tube stock trial areas will be considered in 2024
Include feral pig and feral cat control activities into the vertebrate pest control program.	Noted
Replacement fencing to be constructed in a wildlife friendly manner – see BCT guidelines provided	Agreed
Contact the NSW Rural Fire Service and NPWS to discuss options and timing to implement a hazard reduction burn. Consider engaging a professional bushfire expert to develop a burn plan.	Agreed.
CA464 – Wambo Coal Terminal RWEP Further Action Required -	
Continue treatment of identified weed infestations, and follow-up treatment where required and include African Love Grass as a target weed.	WCPL will implement the 2024 Weed Treatment Plan
Continue monitoring for new weeds and treating when discovered	Noted
Include feral pig and feral cat specific control activities into the vertebrate pest control program	Noted

9.2 2023 Independent Environmental Audit

An IEA was undertaken in October 2023 by Onward Consulting to assess compliance against DA 305-7-2003 and DA 177-8-2004 and other relevant environmental approvals and licences. The audit was conducted for the period 21 November 2020 to 30 October 2023. The IEA was undertaken in accordance with AS/NZS ISO 19011:2003 – *Guidelines for quality and/or environmental management systems auditing* and the Independent Audit Post Approval Requirements (DPE, 2020). The audit report was finalised 11 December 2020 and submitted to DPHI on the same day.

There were no medium or high risk non-compliances identified during the audit. Thirteen (13) non-compliances were identified, including four (4) low-risk non-compliances and nine (9)

administrative non-compliances. The non-compliance summary, as it appears in the IEA is presented in **Table 38.** A number of these non-compliances were interrelated and a number do not relate to the 2023 Annual Review reporting year. The report also included corrective actions and recommendations for improvements which are included in **Table 39** and **Table 40.**

Table 38: Non-Compliance Summary from the 2023 IEA

Finding ID	Non-compliance	Source	Condition	Risk rating[1]
NC01	Non-compliance with this condition is noted in relation to non-compliances with other conditions of consent.	DA 305-7-2003	A2	Low
NC06		DA 177-8-2004	A2	Low
NC02	PM_{10} concentration data was not recorded continuously at monitoring points during the audit period due to technical and environmental factors that resulted in a loss of power or data.	DA 305-7-2003	B45	ANC
NC07		DA 177-8-2004	B3	ANC
NC11		EPL 529	M2.2	ANC
NC03	Exceedances at Groundwater Quality Monitoring Bore P315 resulted in non-compliance occurring due to exceedance of performance criteria in Table 8 of Condition B62 of DA 305-7-2003.	DA 305-7-2003	B62	Low
NC04	Review of relevant documentation indicates that the BMP was approved by the DPE on 27 November 2020. Therefore, the Conservation Bond was required to be lodged by 27 May 2021, which was not achieved and is identified as a non-compliance with Condition B77. After 27 May 2021, an extension request for lodgement of the Conservation Bond was made on 23 August 2021. DPE provided a response on 24 September 2021, noting the lodgement of the Conservation Bond was overdue and requested submission by 31 December 2021. On 24 December 2021, DPE approved an extension until 18 February 2022. The Conservation Bond was lodged on 22 February 2022.	DA 305-7-2003	B77	ANC
NC05	One non-compliance was not reported within seven days of becoming aware.	DA 305-7-2003	D9	ANC
NC08	Inundation events of the Hales Crossing Sump resulting in non-compliance with Section 120 of the *Protection of the Environment Operations Act 1997.*	DA 177-8-2004	B6	Low
NC09		EPL 529	L1.1	Low
NC10	During the audit period there were non-compliances due to: – samples not being collected for discharge from the Sewage Treatment Plant (STP) discharge location because the location was dry or there was no discharge; – water samples not being collected from several monitoring locations because the location was either dry, had no flow, or was inaccessible at the time of monitoring; and PM_{10} concentration data not being recorded continuously at monitoring points due to technical and environmental factors that resulted in a loss of power or data.	EPL 529	M2.1	ANC
NC12	During the audit period there were non-compliances due to:	EPL 529	M2.3	ANC

Finding ID	Non-compliance	Source	Condition	Risk rating[1]
	– samples not being collected for discharge from the STP discharge location because the location was dry or there was no discharge; and water samples not being collected from several monitoring locations because the location was either dry, had no flow, or was inaccessible at the time of monitoring.			
NC13	Conduct of the audit was unable to confirm that the requirements of Clause 19(2)(a) had been completed, that is written notice had been provided to the Secretary of the full name and contact details of the nominated person within 28 days after the date on which the Standard Conditions commenced to apply.	Standard Conditions (Schedule 8A, Part 2) of the Mining Regulation 2016 (NSW)	Clause 19(2)(a)	ANC

[1] ANC = Administrative non-compliance,

Low risk non-compliance is defined as non-compliance with potential for moderate environmental consequences, but is unlikely to occur, or potential for low environmental consequences, but is likely to occur.

Table 39: Corrective Actions Identified in the 2023 IEA

Consent / licence / lease	Condition	Corrective Action ID	Corrective Action Requirement	Timing
DA 305-7-2003	D9	01	Develop a formal process for reporting non-compliances within seven days of becoming aware, where non-compliance occurs due to consecutive/multiple triggers under TARPs (e.g. multiple exceedances which result in a non-compliance) resulting in exceedance of performance criteria in relevant conditions of consent. *Note: should the 2026 IEA determine compliance with the requirements of Condition D9 of DA 305-7-2003, CA01 can be considered closed*.	31 March 2024
DA 177-8-2004	B6	02	Consult with the EPA to understand their expectations in relation to flooding events of the Hales Crossing Sump and whether this location should be made a licensed discharge point via an EPL variation.	30 April 2024
EPL 529	L1.1			

Table 40: Opportunities for Improvement Identified in the 2023 IEA

Consent / licence / lease	Condition	Corrective Action ID	Corrective Action Requirement	Timing
DA 305-7-2003	B54	01	Consult with the DPE appointed surface water expert to determine if additional analytes should be tested in upstream monitoring sites (e.g. SW3, SW5, and SW40) to support ambient water quality monitoring at the discharge point on Wollombi Brook (e.g. SW15) and understand whether other water quality parameters are present in discharge water. The outcomes of this consultation should be provided to DPE.	Agreed
DA 177-8-2004	B6			
EPL 529	L1.1			
DA 305-7-2003	B66	02	Review the WMP document to confirm currency of some documents referenced (e.g. strategy), as some documents have been superseded.	Agreed. The WMP will be reviewed within 3 months of completing the 2023 Annual Review (by 30 June 2024).
		03	Provide additional detail in the ESCP: – to confirm the type of each water storage (i.e. sediment capture or mine water management); and covering flood conditions from Wollombi Brook within the context of potential impacts to the Hales Crossing Sump located at the train loading facility adjacent to the watercourse.	Agreed. The ESCP will be reviewed within 3 months of completing the 2023 Annual Review (by 30 June 2024).
		04	Review and revise elements of the surface water management system, as it relates to the monitoring of flow rates over mined areas, and incorporate into a calibrated hydrology model approach that is reviewed on a six monthly to annual basis for those watercourses where there is a risk of flow diversion/flow loss due to mining.	The SWMP will be reviewed within 3 months of completing the 2023 Annual Review (by 30 June 2024).

Consent / licence / lease	Condition	Corrective Action ID	Corrective Action Requirement	Timing
		05	Update Table 2 of the SWMP to include performance criteria associated with aquatic, riparian and groundwater dependent ecosystems.	The WMP will be reviewed within 3 months of completing the 2023 Annual Review (by 30 June 2024).
		06	Remove the commitment to include bi-monthly updates of groundwater monitoring data on the WCPL website from the GWMP.	Complete.
N/A	N/A	07	Provide an update in the 2023 Annual Review on the progress of actions identified in the *Offset Conservation Site Audit Report for CA461 – Wambo Remnant Woodland Enhancement Areas CA* and *Offset Conservation Site Audit Report for CA464 – Wambo Coal Terminal RWEP* completed by BCT.	**Table 37**

10.0 Incidents and Non-compliances during the Reporting Period

The following incidents and non-compliances were identified during the reporting period (refer **Statement of Compliance** at the front of this document):

- Exceedances of groundwater performance indicators (**Section 10.1**).
- Non-compliances identified in the 2023 IEA (**Section 10.2)**.
- Non-compliances identified in the 2023 Annual Compliance Report for EPBC2016/7636 and 2016/7816 (**Appendix I**).

10.1 Groundwater Performance Indicators

SLR (2023) reviewed compliance against the groundwater performance indicators (**Table 26**) and concluded that WCPL was compliant with the exception of the performance indicators for P315, GW15 and P16.

P315 remains the subject of an ongoing investigation with reports provided to DPHI in March and November 2023 (**Section 6.1.3**). The exceedances of the minimum groundwater elevation trigger level at P16 is likely related to below average rainfall conditions in 2023 and a Glen Munro Pit mining effect. The results from the updated model may help revise trigger levels at P16 to reflect the influence of both approved impacts and climatic conditions (**Section 6.2.3**).

Bore GW15 breached the maximum groundwater elevation trigger level in 2023, however it was concluded this is not related to WCPL's mining activity and requires no further investigation (SLR, 2023).

10.2 2023 Independent Environmental Audit (IEA)

An IEA was prepared to assess compliance against DA 305-7-2003 and DA 177-8-2004 and other relevant environmental approvals and licences (**Section 9.2**). The IEA was conducted for the three year period 21 November 2020 to 30 October 2023. As such, some non-compliances (such as the inundation of the Hales Crossing sump in 2021 and 2022, were reported in previous Annual Reviews).

Thirteen (13) non-compliances were identified, including four (4) low-risk non-compliances and nine (9) administrative non-compliances. A number of these non-compliances were interrelated and some were not recorded during the 2023 Annual Review year. There were no medium or high risk non-compliances identified during the audit.

A copy of the IEA was provided to DPHI 11 December 2023.

10.3 EPBC 2016/7636 and 2016/7816 Annual Compliance Report

Condition 1b of EPBC 2016/7636 and Condition 1a of EPBC 2016/7816 requires WCPL to:

> *Implement conditions A1 and A2 of Schedule 2 of the **state development consent** to minimise the impacts of the action on **protected matters**.*

An Independent Environmental Audit (Onward Consulting, 2023) prepared in accordance with Condition D11 of Development Consent DA 305-7-2003 identified a non-compliance with Condition A2 of Development Consent DA 305-7-2003 based on the following "administrative" or "low risk" non-compliances with Development Consent DA 305-7-2003 conditions:

- Condition B45 – air quality monitoring equipment malfunction (administrative).
- Condition B62 – groundwater quality performance criteria exceedance (low risk).
- Condition B77 – late lodgement of Conservation Bond (administrative).
- Condition D9 – late non-compliance notifications (administrative).

This resulted in a non-compliance with Condition 1b of EPBC 2016/7636 and Condition 1a of EPBC 2016/7816. These non-compliances are considered to not be related to the EPBC 2016/7636 or 2016/7816 Action nor would they result in any significant impacts to relevant Matters of National Environmental Significance (**Appendix I**) .

11.0 Regulator Requests for Information

During the reporting period the DPHI made one request for information relating to WCPL operations.
An overview of the information requested is provided in **Table 41**.

Table 41: Regulator Requests for Information

Date of Request	Relevant Agency	Comment
19 July 2023	NSW Government Agencies including DPHI, NSW RR, EPA, BCD, Heritage NSW and Heritage Council of NSW, DPHI Water, Subsidence Advisor.	WCPL submitted a draft Extraction Plan, including relevant management plans, for Longwalls 24 to 26 on 5 June 2023. The following agencies requested further information - 3 July 2023 – NSW Resources Regulator provided comments on the draft Land Management Plan (LMP). No revision to the LMP was required. 19 July 2023 - DPHI-Water provided comments on the draft Extraction Plan and draft Water Management Plan. Specific updates were made to the Water Management Plan and Groundwater Management Plan to address these recommendations.
12 December 2023	DPE	Air Quality and Green House Gas Management Plan – Report was submitted for approval in September 2023 DPE requested the inclusion of steps taken for scope 1 and scope 2 emission reductions and inclusion of Fuel use efficiency and procurement policy.

12.0 Activities to be Reported in the next Reporting Period

The following activities will be undertaken and reported on by WCPL during the next reporting period:

- Consider revising groundwater level triggers at P16 to incorporate model predictions which capture the observed mining effect;
- Provide update of groundwater and surface water monitoring data at Stony Creek to DPHI in November 2024;
- Outcome of the preliminary investigation into pH and EC exceedances at surface water location SW07;
- Redevelopment and purging of GW15, GW13. Sites P329a and P330a could also be considered for purging following review of comments in field sheets;
- Continuation of subsidence repair trials; and
- Repair subsidence damage to tracks.

Where required, updated management plans and strategies will be submitted to relevant government authorities for approval and uploaded to the WCPL website.

13.0 References

- Airen Consulting, 2024. *Review of 2023 Air Quality Monitoring Data*
- Australian and New Zealand Environment and Conservation Council, 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Canberra.
- Cumberland Ecology, 2020. *Independent Environmental Audit Against Conditions of EPBC 2003/1138.*
- Engeny, 2024. *Site Water and Salt Balance*. Prepared for Wambo Coal Pty Ltd.
- Eco Logical Australia Pty Ltd, 2024. Wambo Coal Mine Annual Flora and Fauna Monitoring Report 2023 – Volume 1. Prepared for Wambo Coal Pty Ltd.
- Hansen Bailey, 2017. *Wambo Coal Mine and Rail Loop Independent Environmental Audit Report.* 7 December 2017.
- Onward Consulting, 2023. *DA 305-7-2003 and DA 177-8-2004 – 2023 Independent Environmental Audit Report* 11 December 2023
- Mine Science Engineering Consultant, 2022. *South Bates Extension Underground Mine Subsidence Review Report for the South Bates Extension Underground Mine WYLW 21 to 24.*
- New South Wales Department of Planning and Environment, 2015. *Post-approval requirements for State significant mining developments – Annual Review Guideline – October 2015.*
- New South Wales Minerals Council, 2010. *Technical Paper Particulate Matter and Mining Interim Report.*
- Niche Environmental Heritage, 2022. *Aquatic Ecosystem Monitoring- Spring 021 Wambo Coal Mine.* Prepared for Peabody Energy- Wambo Coal Pty Ltd. December 2021.
- Resource Strategies, 2003. *Wambo Development Project Environmental Impact Statement.* Prepared for Wambo Coal Pty Ltd. July 2003.
- *Rural & Environmental Management Pty Ltd, 2023. Wambo Coal Autumn Vertebrate Pest Management Report* (16 May – 30 May 2023).
- Enright Land Management Pty Ltd, 2023. *Wambo Peabody Underground Mine 2023 – Completed Weed Works Summary Report* (01 July – 31 December 2023)
- Enright Land Management Pty Ltd, 2023. *Wambo Peabody Wild Dog and Fox Baiting Report* (24 October - 06 November 2023)
- SouthEast Archaeology Pty Ltd, 2021. Wambo Coal Mine-Aboriginal Heritage Due Diligence Investigation Of Drilling Locations, November 2021.
- SouthEast Archaeology Pty Ltd, 2023. Wambo Coal Mine-Aboriginal Heritage Due Diligence Investigation of Groundwater Monitoring Locations, August 2023
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- SLR Consulting Pty Ltd, 2022b. *Stony Creek Water Quality Trigger Investigation*. Report for Wambo Coal Pty Ltd. January 2022.

- SLR Consulting Pty Ltd, 2022c. *Wambo Coal Mine – Longwalls 24-26 Modification Groundwater Assessment Report* 665.10008.00815-R01-v4.0 for Wambo Coal Pty Ltd. 28 July 2022.
- SLR Consulting Pty Ltd, 2023. Wambo – *2023 Annual Review Groundwater*. March 2024
- Todoroski Air Sciences, 2016. *Air Quality and Greenhouse Gas Review – South Bates Extension Modification*.
- Todoroski Air Sciences, 2022. *Greenhouse Gas Assessment – Wambo Coal Mine Longwalls 24-26 Modification.*
- Tongway and Hindley, 2005. *Landscape Function Analysis: A System for Monitoring Rangeland Function.*
- Umwelt, 2016. *United Wambo Open Cut Coal Mine Project Environmental Impact Statement*. August 2016.
- Umwelt, In preparation. *Stream Flow and Water Quality Impact Assessment Criteria Exceedance Investigation. Wambo Coal Mine.* March 2022.
- Wambo Coal Pty Ltd, 2021. *South bates Extension Underground Mine Extraction Plan Longwalls 21 to 24*.

APPENDIX A

APPROVAL CONDITIONS SPECIFICALLY RELATING TO THE ANNUAL REVIEW

Approval	Condition	Description	Where Addressed
DA 305-7-2003	Condition B49, Schedule 2	For the life of the development, the Applicant must: (a) monitor the greenhouse gas emissions generated by the development; (b) investigate ways to reduce greenhouse gas emissions generated by the development; and (c) report on greenhouse gas monitoring and abatement measures in the Annual Review. to the satisfaction of the Planning Secretary.	Section 5.4
DA 305-7-2003	Condition B53, Schedule 2	The Applicant must report on water extracted or discharged from the site each year (direct and indirect) in the Annual Review, including water taken under each licence. *Note: under the water Act 1912 and/or the Water Management Act 2000, the Applicant is required to obtain all necessary water licences for the development, including during rehabilitation and post mine closure*.	Sections 6.3 to 6.7
DA 305-7-2003	Condition B66, Schedule 2	The applicant must prepare a Water Management Plan for the Wambo Mining Complex to the satisfaction of the Planning Secretary. This Plan must: (a) be prepared by a suitably qualifies and experiences person/s whose appointment has been endorsed by the Planning Secretary; (b) be prepared in consultation with DPIE Water and the EPA; (c) describe the measures to be implemented to ensure that the Applicant complies with the water management performance measures: … (vi) a protocol to report on the measures, monitoring results and performance criteria identified above, in the Annual Review referred to in condition D10.	Section 6
DA 305-7-2003	Condition B100, Schedule 2	The Applicant must: (a) take all reasonable steps to minimise the water (including coals rejects and tailings) generated by the development; (b) dispose of all waste at appropriately licensed waste facilities; (c) manage on-site sewage treatment and disposal in accordance with the requirements of Council; and (d) monitor and report of the effectiveness of the water minimisation and management measures in the Annual Review referred to in condition D10.	Section 6
DA 305-7-2003	Condition B111, Schedule 2	The Applicant must: (a) keep accurate records of the amount of coal transported from the site (on a daily basis); and (b) include these records in the Annual Review.	Section 3

Approval	Condition	Description	Where Addressed
DA 305-7-2003	Condition D10, Schedule 2	By the end of March each year or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. This review must: (a) describe the development (including any rehabilitation) that was carried out in the previous calendar year, and the development that is proposed to be carried out over the current calendar year; (b) include a comprehensive review of the monitoring results and complaints records of the development over the previous calendar year, including a comparison of these results against the: (i) relevant statutory requirements, limits or performance measures/ criteria; (ii) requirements of any plan or program required under this consent; (iii) monitoring results of previous years; and (iv) relevant predictions in the documents listed in condition A2(c); (c) identify any non-compliance or incident which occurred in the previous calendar year, and describe what actions were (or are being) taken to rectify the non-compliance and avoid reoccurrence; (d) evaluate and report on: (i) The effectiveness of the noise and air quality management systems; and (ii) Compliance with the performance measures, criteria and operating conditions in this consent; (e) identify any trends in the monitoring of data over the life of the development; (f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and (g) describe what measures will be implemented over the next calendar year to improve the environmental performance of the development.	This Annual Review
EPBC 2016/7636	Condition 5	The person taking the action must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Appendix J

Approval	Condition	Description	Where Addressed
EPBC 2016/7816	Condition 5	By 31 March of each year after the commencement of the action, the person taking the action must: publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of any management plans and strategies required by conditions D10 and D15 of schedule 2 of the state development consent over the previous calendar year; and provide documentary evidence providing proof of the date of publication to the Department, by email to EPBCMonitoring@environment.gov.au (or another email address as stipulated by the Department). The person taking the action must continue publishing annual compliance reports and make all reports available on their website for the life of the approval, unless agreed in writing by the Minister.	Appendix J
S101 Approval (NETD)	Condition (h)	The North East Tailings Dam shall be reported on within the Annual Environmental Management Report for Wambo Coal. Consideration shall also be given to the rehabilitation performance for this site.	Sections 7.1.7 and 7.2.1
Water Licence 20AL200631, 20AL203044, 20AL201457	Condition 1	The licence holder must provide the Minister with figures recording the quantity of water taken via the nominated water supply works approval, when required to do so, and in the form specified by the Minister.	Section 6.5
Water Licence 20WA200632	Condition 9	The account holder must provide the Minister, in the approved form, with the following information when requested: A) A report detailing the quantity of water taken through the authorised work(s) and recorded by the approved measuring device, or where the work does not have a measuring device fitted to it, advise the Minister of the duration of any pumping, and B) Where the water is used for irrigation, the area of land irrigated, the planting date, area and yield of all crops grown on the property for each season. These details must include: i) The volume of water taken from the water source and applied directly to crops and/or pasture; ii) The volume of water taken from the water source and held in on-farm storages; iii) The volume of water taken from on-farm storages and applied to crops (including pasture); iv) The type and area of each crop (including pasture) irrigated; v) The method of irrigation for each class of crop and/or pasture; and vi) The volume of water applied to each individual class of crop and/or pasture.	Section 6.5

APPENDIX B

DAILY TRAIN MOVEMENT SUMMARY

Peabody

Table B1: Daily Train Movements

Date	No Trains per Day	Date	No Trains per Day	Date	No Trains per Day
01/01/2023	1	03/03/2023	3	23/04/2023	2
02/01/2023	2	04/03/2023	3	24/04/2023	3
03/01/2023	4	05/03/2023	4	25/04/2023	1
04/01/2023	2	06/03/2023	3	26/04/2023	1
05/01/2023	2	07/03/2023	1	29/04/2023	1
06/01/2023	1	08/03/2023	1	30/04/2023	3
07/01/2023	1	09/03/2023	2	01/05/2023	2
08/01/2023	1	12/03/2023	3	03/05/2023	4
09/01/2023	2	13/03/2023	2	04/05/2023	3
10/01/2023	2	14/03/2023	2	05/05/2023	2
12/01/2023	3	15/03/2023	2	06/05/2023	6
13/01/2023	2	16/03/2023	1	09/05/2023	1
14/01/2023	3	17/03/2023	2	10/05/2023	1
15/01/2023	1	18/03/2023	2	11/05/2023	3
16/01/2023	2	19/03/2023	2	13/05/2023	1
17/01/2023	1	20/03/2023	3	15/05/2023	3
18/01/2023	1	21/03/2023	4	16/05/2023	1
19/01/2023	1	22/03/2023	1	17/05/2023	2
21/01/2023	1	23/03/2023	2	18/05/2023	2
23/01/2023	1	24/03/2023	1	19/05/2023	1
27/01/2023	2	25/03/2023	3	20/05/2023	1
28/01/2023	1	26/03/2023	2	21/05/2023	3
29/01/2023	1	27/03/2023	1	23/05/2023	1
30/01/2023	1	28/03/2023	1	26/05/2023	2
02/02/2023	1	29/03/2023	2	27/05/2023	2
04/02/2023	3	30/03/2023	2	28/05/2023	1
05/02/2023	2	31/03/2023	3	29/05/2023	2
06/02/2023	3	01/04/2023	5	31/05/2023	1
10/02/2023	1	02/04/2023	1	01/06/2023	3
11/02/2023	3	03/04/2023	2	02/06/2023	1
12/02/2023	3	07/04/2023	4	03/06/2023	2
13/02/2023	1	08/04/2023	4	04/06/2023	2
14/02/2023	3	09/04/2023	4	05/06/2023	1
15/02/2023	1	10/04/2023	2	09/06/2023	1
16/02/2023	1	11/04/2023	3	10/06/2023	1
17/02/2023	3	12/04/2023	1	11/06/2023	1
18/02/2023	4	14/04/2023	1	12/06/2023	1
19/02/2023	3	15/04/2023	1	13/06/2023	2
20/02/2023	3	16/04/2023	3	15/06/2023	3
21/02/2023	2	17/04/2023	4	16/02/2023	3
23/02/2023	3	18/04/2023	3	17/06/2023	4
24/02/2023	3	19/04/2023	2	18/06/2023	5
25/02/2023	3	20/04/2023	2	19/06/2023	5
26/01/2023	4	21/04/2023	4	20/06/2023	2
28/02/2023	1	22/04/2023	3	21/06/2023	2

Peabody

Table B1: Daily Train Movements

Date	No Trains per Day	Date	No Trains per Day	Date	No Trains per Day
22/06/2023	2	16/08/2023	1	08/10/2023	4
23/06/2023	4	18/08/2023	1	09/10/2023	1
24/06/2023	5	19/08/2023	1	10/10/2023	1
25/06/2023	3	20/08/2023	3	11/10/2023	2
26/06/2023	1	21/08/2023	1	12/10/2023	1
27/06/2023	2	22/08/2023	3	13/10/2023	3
29/06/2023	1	23/08/2023	3	14/10/2023	1
30/06/2023	1	24/08/2023	3	15/10/2023	3
01/07/2023	2	25/08/2023	1	16/10/2023	3
02/07/2023	1	26/08/2023	2	17/10/2023	1
03/07/2023	1	28/08/2023	4	18/10/2023	3
04/07/2023	2	29/08/2023	1	20/10/2023	2
05/07/2023	2	30/08/2023	3	21/10/2023	3
06/07/2023	2	31/08/2023	1	22/10/2023	4
07/07/2023	2	01/09/2023	2	23/10/2023	4
09/07/2023	1	02/09/2023	4	24/10/2023	3
10/07/2023	1	03/09/2023	2	27/10/2023	3
11/07/2023	2	04/09/2023	1	28/10/2023	2
13/07/2023	1	05/09/2023	1	29/10/2023	3
14/07/2023	2	07/09/2023	2	30/10/2023	3
15/07/2023	2	08/09/2023	2	31/10/2023	2
17/07/2023	4	09/09/2023	1	1/11/2023	3
18/07/2023	2	10/09/2023	1	2/11/2023	1
21/07/2023	4	11/09/2023	2	3/11/2023	3
22/07/2023	5	12/09/2023	3	4/11/2023	3
23/07/2023	2	13/09/2023	2	5/11/2023	3
24/07/2023	4	14/09/2023	1	6/11/2023	4
25/07/2023	2	15/09/2023	2	7/11/2023	4
26/07/2023	2	16/09/2023	3	8/11/2023	2
27/07/2023	2	17/09/2023	2	9/11/2023	1
28/07/2023	2	18/09/2023	1	10/11/2023	2
30/07/2023	1	19/09/2023	1	11/11/2023	1
31/07/2023	2	20/09/2023	1	12/11/2023	1
01/08/2023	1	21/09/2023	1	13/11/2023	4
02/08/2023	2	22/09/2023	1	14/11/2023	1
03/08/2023	1	23/09/2023	4	15/11/2023	2
04/08/2023	1	24/09/2023	3	16/11/2023	3
08/08/2023	2	25/09/2023	3	17/11/2023	2
09/08/2023	3	28/09/2023	1	18/11/2023	3
10/08/2023	2	29/09/2023	4	19/11/2023	2
11/08/2023	4	30/09/2023	2	20/11/2023	1
12/08/2023	2	02/10/2023	2	21/11/2023	1
13/08/2023	3	03/10/2023	2	24/11/2023	1
14/08/2023	4	06/10/2023	1	25/11/2023	4
15/08/2023	3	07/10/2023	1	26/11/2023	2

Table B1: Daily Train Movements

Date	No Trains per Day	Date	No Trains per Day	Date	No Trains per Day
27/11/2023	4				
28/11/2023	4				
29/11/2023	1				
30/11/2023	2				
1/12/2023	2				
2/12/2023	3				
3/12/2023	1				
4/12/2023	3				
5/12/2023	3				
6/12/2023	2				
7/12/2023	1				
8/12/2023	2				
9/12/2023	2				
10/12/2023	2				
11/12/2023	4				
12/12/2023	5				
14/12/2023	2				
15/12/2023	2				
16/12/2023	2				
17/12/2023	1				
18/12/2023	2				
19/12/2023	2				
20/12/2023	3				
21/12/2023	1				
22/12/2023	4				
23/12/2023	2				
24/12/2023	1				
27/12/2023	1				
30/12/2023	1				
21/12/2023	2				

Table B2: Train Movements within Sensitive Service Hours

(Friday 6pm-9pm & Sunday 9am-12am)

Date	Time
Friday 13 January 2023	8:23:56 PM
Friday 27 January 2023	8:40:17 PM
Sunday 5 February 2023	9:02:03 AM
Sunday 12 February 2023	10:33:30 AM
Friday 24 February 2023	6:20:19 PM
Sunday 26 February 2023	11:42:42 AM
Friday 3 March 2023	6:38:57 PM
Friday 31 March 2023	9:37:05 PM
Sunday 9 April 2023	10:23:00 AM
Friday 5 May 2023	8:32:17 PM
Sunday 21 May 2023	11:13:53
Friday 16 June 2023	7:41:32 PM
Sunday 18 June 2023	9:59:42 AM
Friday 23 June 2023	8:00:54 PM
Sunday 25 June 2023	10:22:10 AM
Friday 7 July 2023	8:35:51 PM
Friday 21 July 2023	7:43:13 PM
Sunday 20 August 2023	10:49:47 AM
Friday 1 September 2023	8:48:08 PM
Friday 15 September 2023	6:11:32 PM
Sunday 17 September 2023	9:53:35 AM
Friday 22 September 2023	8:31:29 PM
Sunday 8 October 2023	11:52:21 AM
Sunday 22 October 2023	11:50:05 AM
Friday 1 December 2023	8:45:27 PM
Friday 15 December 2023	7:20:01 PM
Friday 22 December 2023	7:56:00 PM
Total	**27**

APPENDIX C

ANNUAL NOISE MONITORING REPORT

Wambo Coal Mine

Annual Environmental Monitoring Report 2023

Prepared for Wambo Coal Pty Ltd

February 2024

Wambo Coal Mine

Annual Environmental Monitoring Report 2023

Wambo Coal Pty Ltd

E221378 RP1

February 2024

Version	Date	Prepared by	Reviewed by	Comments
V1	16/01/2024	William Moore	Robert Kirwan	Draft
V2	14/02/2024	William Moore	Robert Kirwan	Final

Approved by

Robert Kirwan
Associate, Acoustics
14 February 2024

Level 3 175 Scott Street
Newcastle NSW 2300

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Executive summary

EMM Consulting Pty Ltd (EMM) was engaged by Wambo Coal Pty Ltd to provide an Annual Environmental Monitoring Report for 2023 to compare noise monitoring results against relevant criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around Wambo Coal Mine (WCM) during the reporting period 1 January to 31 December 2023. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

Attended noise monitoring described in this report was conducted monthly in accordance with the relevant development consents, Environment Protection Licence (EPL), and the WCM Noise Management Plan (NMP).

ES1.1 January to December 2023 compliance

WCM complied with relevant noise criteria during all measurements during 2023 noise monitoring.

ES1.2 Long-term noise trends

During the 5-year period analysed, WCM noise levels at most monitoring locations decreased from 2019 to 2020, likely due to mining activity being deeper in pit and therefore more shielded from receptors. From 1 December 2020, open cut mining was no longer undertaken by WCM, and noise emissions decreased significantly.

ES1.3 EIS comparison

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by UW as part of the UWJV.

Noise levels from WCM were not comparable to Year 6 predictions in the EIS.

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Tables

Figures

1 Introduction

1.1 Background

EMM Consulting Pty Ltd (EMM) was engaged by Wambo Coal Pty Ltd (WC) to provide an Annual Environmental Monitoring Report (AEMR) for 2023, to compare noise monitoring results against modelling predictions and relevant noise criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around WCM during the reporting period 1 January to 31 December 2023. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

1.2 Attended noise monitoring locations

Monitoring locations for WC are detailed in Table 1.1 and shown on Figure 1.1. It should be noted that Figure 1.1 shows the actual monitoring positions, not the location of residences.

Table 1.1 Attended noise monitoring locations

Site Reference [1]	EPA Point [2]	Area Description	Properties Represented [3]
N01	N/A	North Bulga	3, 7, 379
N16	20	Jerrys Plains Road	Privately-owned residences near Jerry's Plains
N20A	21	Redmanvale Road Central	Privately-owned residences near Jerry's Plains
N21	22	South Wambo	25, 35a
N26	23	Redmanvale Road South	Privately-owned residences near Jerry's Plains

Notes: 1. Sourced from NMP – WA-ENV-MNP-503, November 2020.

2. Sourced from Environment Protection Licence 529, September 2021.

3. Property numbering is from Appendix 4 of DA 305-7-2003.

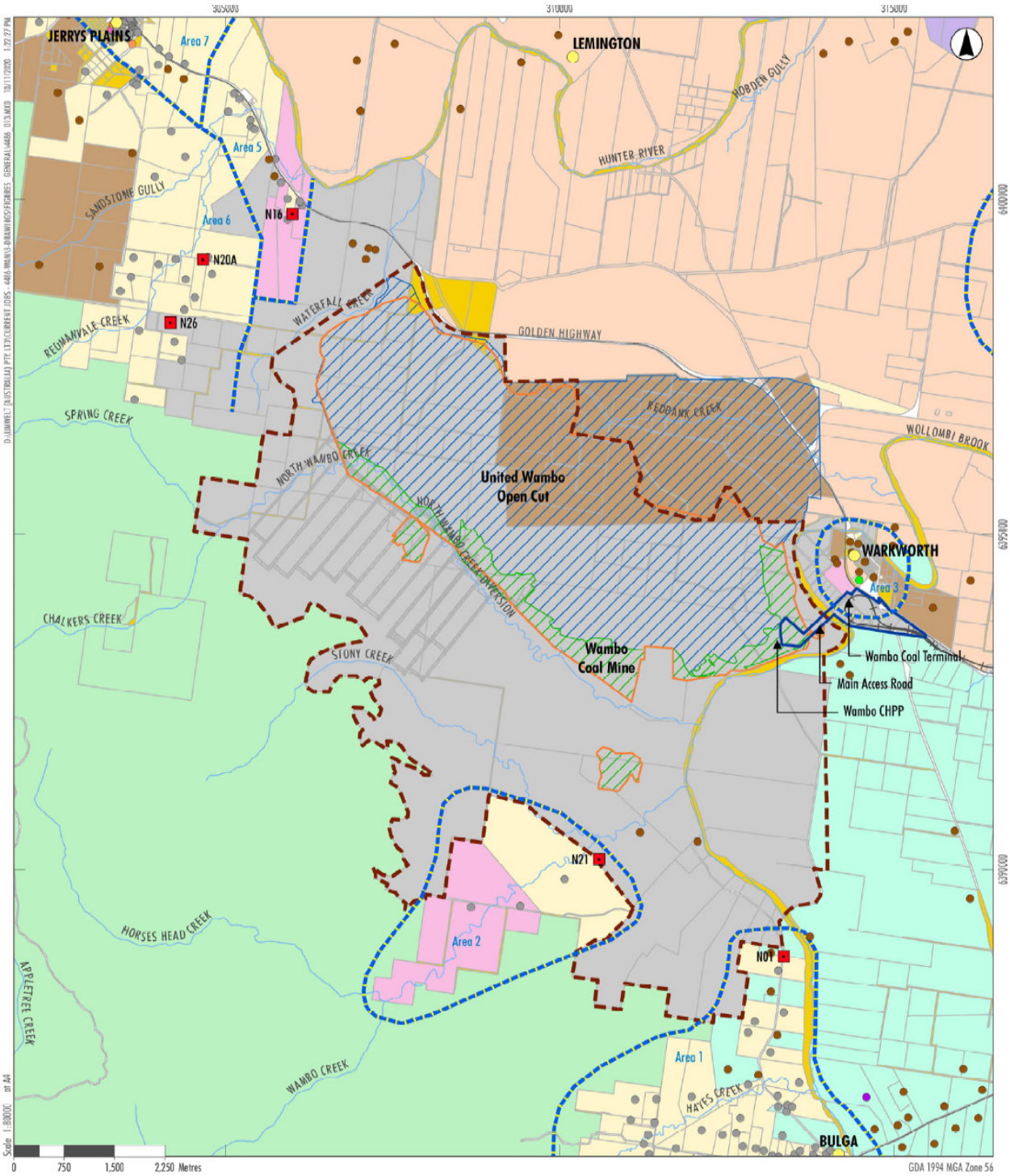

Figure 1.1 **WC noise monitoring locations**

1.3 Terminology & abbreviations

Some definitions of terms and abbreviations which may be used in this report are provided in Table 1.2.

Table 1.2 Terminology and abbreviations

Descriptor	Definition
dB(A)	Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise.
L_{Amax}	The maximum A-weighted noise level over a time period.
L_{A1}	The noise level which is exceeded for 1% of the time.
$L_{A1,1minute}$	The noise level which is exceeded for 1% of the specified time period of 1 minute.
L_{A10}	The noise level which is exceeded for 10% of the time.
L_{Aeq}	The average noise A-weighted energy during a measurement period.
L_{A50}	The noise level which is exceeded for 50% of the time and the median noise level during a measurement period.
L_{A90}	The level exceeded for 90% of the time. The L_{A90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes.
L_{Amin}	The minimum A-weighted noise level over a time period.
L_{Ceq}	The average C-weighted noise energy during a measurement period. The "C" weighting scale is used to take into account low-frequency components of noise within the audibility range of humans.
SPL	Sound pressure level. Fluctuations in pressure measured as 10 times a logarithmic scale, with the reference pressure being 20 micropascals.
Hertz (Hz)	The frequency of fluctuations in pressure, measured in cycles per second. Most sounds are a combination of many frequencies together.
AWS	Automatic weather station used to collect meteorological data, typically at an altitude of 10 metres
VTG	Vertical temperature gradient in degrees Celsius per 100 metres altitude.
Sigma-theta	The standard deviation of the horizontal wind direction over a period of time.
IA	Inaudible. When site noise is noted as IA then there was no site noise at the monitoring location.
NM	Not Measurable. If site noise is noted as NM, this means some noise was audible but could not be quantified.
Day	This is the period 7:00 am to 6:00 pm.
Evening	This is the period 6:00 pm to 10:00 pm.
Night	This is the period 10:00 pm to 7:00 am.
WC	Wambo Coal
WCM	Wambo Coal Mine
WCRS	Wambo Coal Road Spur

2 Regulator requirements and noise limits

2.1 WCM development consent

The most current development consent for WCM is DA 305-7-2003 (MOD 19, 25 January 2023). Schedule 2, Part B of the WCM consent details specific conditions relating to noise generated by WCM.

2.2 WCRS development consent

The most current development consent for Wambo Rail Loop is WCRS DA 177-8-2004 (MOD 3, 29 August 2019), last modified to include a rail refuelling facility. Schedule 2, Part B of the WCRS consent details specific conditions relating to noise generated by WCRS.

2.3 Environment protection licence

WCM holds Environment Protection Licence (EPL) No. 529 issued by the Environment Protection Authority (EPA) most recently on 30 September 2021.

2.4 Noise management plan

Noise monitoring requirements are detailed in the Wambo Coal Noise Management Plan WA-ENV-MNP-503 (NMP, November 2020), prepared in accordance with the WCM and WCRS consents.

2.5 Noise limits

Noise criteria detailed in Table 2.1 have been adopted for each monitoring location based on Phase 2 and 3 of the development consent (MOD 18) and the NMP.

Table 2.1 WCM Noise impact limits, dB

Location	Day $L_{Aeq,15minute}$	Evening $L_{Aeq,15minute}$	Night $L_{Aeq,15minute}$	Night $L_{A1,1minute}$
N01 [1]	38	38	38	48
N16	35	35	35	45
N20A	35	35	35	45
N21 [2]	39	39	39	49
N26	35	35	35	45

Notes: 1. Noise criteria for the nearest privately-owned property (R003) have been adopted.

2. Noise criteria for the nearest privately-owned property (R025) have been adopted.

EPL noise limits have not been updated for Phase 2 and 3 of operations. As noise criteria in the development consent and NMP are now more conservative than those in the EPL, they have been adopted in Table 2.1.

2.6 Meteorological conditions

Appendix 5 of MOD 19 details specific meteorological conditions required for noise limits to be applicable:

APPENDIX 5 NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The noise criteria in condition B12 are to apply under all meteorological conditions except the following:
   - (a) where 3°C/100 metres (m) lapse rates have been assessed, then:
     - (i) wind speeds greater than 3 metres/second (m/s) measured at 10m above ground level;
     - (ii) temperature inversion conditions between 1.5°C and 3°C/100m and wind speeds greater than 2m/s measured at 10m above ground level; or
     - (iii) temperature inversion conditions greater than 3°C/100m.
   - (b) where Pasquill Stability Classes have been assessed, then:
     - (i) wind speeds greater than 3m/s at 10m above ground level;
     - (ii) stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level;
     - (iii) stability category G temperature inversion conditions.

As lapse rates (VTG) were not measured directly, meteorological conditions have been assessed against requirements detailed in 1.(b), which are consistent with the EPL.

2.7 Additional requirements

Monitoring and reporting have been done in accordance with the NSW EPA 'Noise Policy for Industry' (NPfI) issued in October 2017 and the 'Approved methods for the measurement and analysis of environmental noise in NSW' (Approved Methods) issued in January 2022.

2.8 Very noise-enhancing meteorological conditions

In accordance with the Approved Methods, monthly noise monitoring for the site is scheduled to occur during forecasted meteorological conditions where noise limits in Table 2.1 will be applicable. However, in cases where actual meteorological conditions do not align with forecasts and noise limits are subsequently not directly applicable, it is the expectation of regulators that noise impact still be managed.

The NPfI states that:

> Noise limits derived for consents and licences will apply under the meteorological conditions used in the environmental assessment process, that is, standard or noise-enhancing meteorological conditions. For 'very noise-enhancing meteorological conditions' … a limit is set based on the limit derived under standard or noise-enhancing conditions (whichever is adopted in the assessment) plus 5 dB. In this way a development is subject to noise limits under all meteorological conditions.

Therefore, if monthly noise monitoring occurs during meteorological conditions outside of those specified in Section 2.6, site limits will be adjusted based on Table 2.1 plus 5 dB.

3 Methodology

3.1 Overview

Attended environmental noise monitoring was done in general accordance with Australian Standard AS1055 'Acoustics, Description and Measurement of Environmental Noise' and relevant NSW EPA requirements. Meteorological data was obtained from the WCM automated weather station (AWS) which allowed correlation of atmospheric parameters with measured noise levels.

3.2 Attended noise monitoring

During this survey, attended noise monitoring was conducted during the night period at each location. The duration of each measurement was 15 minutes. Atmospheric conditions were measured at each monitoring location.

Measured sound levels from various sources were noted during each measurement, and particular attention was paid to the extent of site's contribution (if any) to measured levels. At each monitoring location, the site-only $L_{Aeq,15minute}$ and L_{Amax} were measured directly or determined by other methods detailed in Section 7.1 of the NPfI.

The terms 'Inaudible' (IA) or 'Not Measurable' (NM) may be used in this report. When site noise is noted as IA, it was inaudible at the monitoring location. When site noise is noted as NM, this means it was audible but could not be quantified. All results noted as IA or NM in this report were due to one or more of the following:

- Site noise levels were very low, typically more than 10 dB below the measured background (L_{A90}), and unlikely to be noticed.
- Site noise levels were masked by more dominant sources that are characteristic of the environment (such as breeze in foliage or continuous road traffic noise) that cannot be eliminated by monitoring at an alternate or intermediate location.
- It was not feasible or reasonable to employ methods such as move closer and back calculate. Cases may include rough terrain preventing closer measurement, addition/removal of significant source to receiver shielding caused by moving closer, and meteorological conditions where back calculation may not be accurate.

If exact noise levels from site could not be established due to masking by other noise sources in a similar frequency range but were determined to be at least 5 dB lower than relevant limits, then a maximum estimate of may be provided. This is expressed as a 'less than' quantity, such as <20 dB or <30 dB.

For this assessment, the measured L_{Amax} has been used as a conservative estimate of $L_{A1,1minute}$. The EPA accepts sleep disturbance analysis based on either the $L_{A1,1minute}$ or L_{Amax} metrics, with the L_{Amax} representing a more conservative assessment of site noise emissions.

3.3 Meteorological data

Meteorological data was obtained from the AWS; this was logged at 10-minute intervals. Atmospheric parameters include wind speed, wind direction, rainfall, and sigma theta. When meteorological data is provided in less than 15-minute intervals, analysis must be conducted to determine the meteorological conditions present for the majority of each measurement period and whether those conditions result in noise criteria being applicable or not.

3.4 Modifying factors

All measurements were evaluated for potential modifying factors in accordance with the NPfI at the time of measurement. If applicable, modifying factor penalties have been reported and added to measured site-only L_{Aeq} noise levels.

Low-frequency modifying factor penalties have only been applied to site-only L_{Aeq} if the site was the only contributing low-frequency noise source. Specific methodology for assessment of each modifying factor is outlined in Fact Sheet C of the NPfI.

3.5 Comparison with United Wambo EIS model predictions

The MOD 17 environmental assessment (EA) and MOD 16 EIS both reference the noise impact assessment (NIA) prepared in July 2016 to support application for the United Wambo Joint Venture (UWJV) project. The NIA includes noise impacts associated with ongoing operations from both WCM and United Wambo (UW).

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by UW as part of the UWJV. It is feasible for noise emissions from WCM ventilation fans, conveyors, coal preparation plant, and/or rail loop to contribute to total UWJV noise levels.

The NIA uses a cumulative distribution methodology wherein all meteorological conditions are considered and weighted based on how often they occur. Using this weighting, measured noise levels are expected to be greater than predicted noise levels provided in the NIA approximately 10% of the time. Measured noise levels are expected to be lower than noise levels predicted in the NIA the remaining 90% of the time. In order to compare measured and predicted noise levels, comparison should only occur when noise-enhancing atmospheric conditions are present.

Noise-enhancing conditions have been determined for each monitoring location in accordance with the NPfI. Meteorological parameter bounds used to identify corresponding meteorological conditions during attended monitoring are summarised in Table 3.1.

Table 3.1 Applicable meteorological condition definitions

Location	Condition	Wind speed m/s	Wind direction (°)	Stability category
N01	Wind only	Up to 3.0	W (267.5°-292.5°)	D and E
	Inversion	Up to 2.0	W (267.5°-292.5°)	F
N16	Wind only	Up to 3.0	SE (112.5°-157.5°)	D and E
	Inversion	Up to 2.0	SE (112.5°-157.5°)	F
N20A	Wind only	Up to 3.0	SE (112.5°-157.5°)	D and E
	Inversion	Up to 2.0	SE (112.5°-157.5°)	F
N21	Wind only	Up to 3.0	NNW (315°-360°)	D and E
	Inversion	Up to 2.0	NNW (315°-360°)	F
N26	Wind only	Up to 3.0	SE (112.5°-157.5°)	D and E
	Inversion	Up to 2.0	SE (112.5°-157.5°)	F

In the NIA, a subset of meteorological conditions were used to determine worst-case sleep disturbance and low-frequency noise impacts, reproduced below:

- 3 m/s wind from the south east (a vectored wind condition that can occur greater than 30% of the time during the evening and night time)
- 3 m/s wind from the north-west (a vectored wind condition that can occur up to 20% of the time during the day time)
- F Class stability, modelled as 4°C/100 metre inversion 1.3 m/s drainage flow from the south (the vectored wind condition can occur greater than 30% of the time during inversion conditions during winter night times (6pm to 7am)).

Predicted noise levels for "3 m/s wind from the north-west" atmospheric conditions were based on occurrence during the day period and have not been compared to attended monitoring results for sleep disturbance, which can only occur during the night period. Subsequently, three comparisons against predicted noise levels were feasible:

- Sleep disturbance noise predictions for "calm" atmospheric conditions are compared to attended measurements where wind speeds were less than 0.5 metres per second (m/s), including all wind directions, and Stability Category was D or E according to Table D2 of the NPfI.
- Sleep disturbance noise predictions for "3 m/s wind from the SE" atmospheric conditions are compared to attended measurements where wind speeds were in the range 0.5 to 3.0 m/s and Stability Category was D or E, according to Table D2 of the NPfI. The modelled wind direction was SE (135 degrees). Wind directions 22.5 degrees either side of the modelled direction were included.
- Sleep disturbance noise predictions for "F Class stability" atmospheric conditions are compared to attended measurements where wind speeds were up to 2.0 m/s and Stability Category was F according to Table D2 of the NPfI. The modelled wind direction was S (180 degrees). Wind directions 22.5 degrees either side of the modelled direction were included.

Meteorological parameter bounds used to identify corresponding meteorological conditions during attended monitoring are summarised in Table 3.2.

Table 3.2 Meteorological condition definitions

	Night		
Parameter	**Clam**	**SE wind**	**Inversion**
Wind speed (m/s)	0.0–0.5	0.5–3.0	0.0–2.0
Wind direction (°)	all	112.5° – 157.5°	157.5°–202.5°
Stability category	D and E	D and E	F

Noise predictions for Year 6 are closely aligned with 2023 calendar year so were compared with measured levels from attended compliance monitoring for corresponding meteorological conditions.

4 Results

4.1 January 2023

4.1.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.1.

Table 4.1 Total measured noise levels, dB – January 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	26/01/2023 00:12	46	42	41	40	41	37	34
N16	25/01/2023 23:29	54	48	44	43	43	41	38
N20A	25/01/2023 22:33	48	40	39	37	37	36	35
N21	25/01/2023 23:44	54	40	39	38	37	35	32
N26	25/01/2023 22:01	53	46	44	43	43	42	39

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.1.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.1.3 Attended noise monitoring

Table 4.2 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.2 Site noise levels and limits – January 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	26/01/2023 00:12	0.3	218	F	No	38	48	IA	IA	Nil	Nil
N16	25/01/2023 23:29	0.8	218	E	No	35	45	IA	IA	Nil	Nil
N20A	25/01/2023 22:33	1.1	143	F	No	35	45	IA	IA	Nil	Nil
N21	25/01/2023 23:44	0.9	199	E	No	39	49	IA	IA	Nil	Nil
N26	25/01/2023 22:01	2.2	181	D	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties, if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.2 February 2023

4.2.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.1.

Table 4.3 Total measured noise levels, dB – February 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	28/02/2023 00:19	46	45	44	42	41	38	37
N16	27/02/2023 23:38	51	47	44	43	42	42	40
N20A	27/02/2023 22:45	48	38	37	36	35	35	33
N21	27/02/2023 23:52	50	37	34	33	33	31	29
N26	27/02/2023 22:16	62	44	40	40	39	38	36

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.2.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.2.3 Attended noise monitoring

Table 4.4 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.4 Site noise levels and limits – February 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	28/02/2023 00:19	1.3	151	F	No	38	48	IA	IA	Nil	Nil
N16	27/02/2023 23:38	1.8	123	E	No	35	45	IA	IA	Nil	Nil
N20A	27/02/2023 22:45	1.8	132	F	No	35	45	IA	IA	Nil	Nil
N21	27/02/2023 23:52	1.5	132	E	No	39	49	IA	IA	Nil	Nil
N26	27/02/2023 22:16	1.5	108	E	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.3 March 2023

4.3.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.5.

Table 4.5 Total measured noise levels, dB – March 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	15/03/2023 23:32	55	54	53	52	52	51	47
N16	15/03/2023 23:13	54	45	43	42	42	41	40
N20A	15/03/2023 22:26	42	38	37	36	36	34	32
N21	15/03/2023 23:59	56	49	39	39	38	37	35
N26	15/03/2023 22:00	45	43	42	41	41	40	37

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.3.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.3.3 Attended noise monitoring

Table 4.6 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.6 Site noise levels and limits – March 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	15/03/2023 23:32	0.7	137	E	No	38	48	IA	IA	Nil	Nil
N16	15/03/2023 23:13	0.5	147	F	No	35	45	IA	IA	Nil	Nil
N20A	15/03/2023 22:26	0.9	168	F	No	35	45	IA	IA	Nil	Nil
N21	15/03/2023 23:59	0.8	96	F	No	39	49	IA	IA	Nil	Nil
N26	15/03/2023 22:00	0.9	114	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.4 April 2023

4.4.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.7.

Table 4.7 Total measured noise levels, dB – April 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	18/04/2023 23:55	44	41	40	38	38	37	35
N16	18/04/2023 23:24	48	43	40	38	37	35	33
N20A	18/04/2023 22:29	44	38	36	35	35	33	31
N21	18/04/2023 23:27	42	38	37	35	35	34	31
N26	18/04/2023 22:00	47	46	44	41	40	35	32

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.4.2 Modifying factors

Modifying factors, as defined in the NPfI, were applicable during one measurement of the survey and are detailed in Table 4.8.

Table 4.8 WCM modifying factor assessment – April 2023

Location	Start date and time	Measured WCM L_{Aeq} dB	Very enhancing?	Intermittency modifying factor?	Tonality modifying factor?	Frequency of tonality [1]	Low-frequency modifying factor? [1]	Exceedance of reference spectrum [1,2]	Total penalty dB [1,2]
N21	18/04/2023 23:27	34	No	No	No	NA	Yes	**2 dB @ 80 Hz**	**+2**

Notes: 1. NA denotes 'not applicable'
2. Bold results indicate that application of NPfI modifying factor(s) is required.

4.4.3 Attended noise monitoring

Table 4.9 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.9 Site noise levels and limits – April 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	18/04/2023 23:55	0.6	229	E	No	38	48	IA	IA	Nil	Nil
N16	18/04/2023 23:24	0.7	196	D	No	35	45	IA	IA	Nil	Nil
N20A	18/04/2023 22:29	1.0	171	E	No	35	45	IA	IA	Nil	Nil
N21	18/04/2023 23:27	0.7	196	D	No	39	49	36	39	Nil	Nil
N26	18/04/2023 22:00	1.2	155	E	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.
2. Site-only LAeq,15minute, includes modifying factor penalties if applicable.
3. Degrees magnetic north, "-" indicates calm conditions.

4.5 May 2023

4.5.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.10.

Table 4.10 Total measured noise levels, dB – May 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	17/05/2023 23:50	42	35	32	30	30	29	26
N16	17/05/2023 23:20	46	42	37	35	34	32	30
N20A	17/05/2023 22:28	45	34	31	29	29	27	25
N21	17/05/2023 23:27	40	35	31	29	28	27	24
N26	17/05/2023 22:00	42	32	30	29	28	27	25

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.5.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.5.3 Attended noise monitoring

Table 4.11 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.11 Site noise levels and limits – May 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	17/05/2023 23:50	0.5	29	F	No	38	48	IA	IA	Nil	Nil
N16	17/05/2023 23:20	0.7	221	F	No	35	45	IA	IA	Nil	Nil
N20A	17/05/2023 22:28	0.5	304	F	No	35	45	IA	IA	Nil	Nil
N21	17/05/2023 23:27	0.4	257	F	No	39	49	IA	IA	Nil	Nil
N26	17/05/2023 22:00	0.2	0	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.6 June 2023

4.6.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.12.

Table 4.12 Total measured noise levels, dB – June 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	6/06/2023 23:14	46	40	37	35	34	32	30
N16	6/06/2023 23:24	46	44	41	38	37	34	32
N20A	6/06/2023 22:28	50	40	34	32	31	28	25
N21	6/06/2023 23:38	43	38	32	30	29	28	27
N26	6/06/2023 22:00	43	36	33	32	31	29	27

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.6.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.6.3 Attended noise monitoring

Table 4.13 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.13 Site noise levels and limits – June 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	6/06/2023 23:14	0.8	220	E	No	38	48	IA	IA	Nil	Nil
N16	6/06/2023 23:24	0.9	231	E	No	35	45	IA	IA	Nil	Nil
N20A	6/06/2023 22:28	0.6	225	F	No	35	45	IA	IA	Nil	Nil
N21	6/06/2023 23:38	0.9	235	D	No	39	49	IA	IA	Nil	Nil
N26	6/06/2023 22:00	0.7	154	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.7 July 2023

4.7.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.14.

Table 4.14 Total measured noise levels, dB – July 2023 [1]

Location	Start Date and Time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	27/07/2023 00:07	52	41	35	34	33	31	29
N16	26/07/2023 22:56	57	45	42	40	39	37	34
N20A	26/07/2023 22:28	52	38	33	31	29	26	23
N21	26/07/2023 23:43	45	38	36	35	35	33	32
N26	26/07/2023 22:02	46	42	40	37	35	32	29

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.7.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.7.3 Attended noise monitoring

Table 4.15 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.15 Site noise levels and limits – July 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	27/07/2023 00:07	0.2	147	F	No	38	48	IA	IA	Nil	Nil
N16	26/07/2023 22:56	0.8	209	E	No	35	45	IA	IA	Nil	Nil
N20A	26/07/2023 22:28	0.3	111	F	No	35	45	IA	IA	Nil	Nil
N21	26/07/2023 23:43	0.6	242	E	No	39	49	IA	IA	Nil	Nil
N26	26/07/2023 22:02	0.6	233	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.8 August 2023

4.8.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.16.

Table 4.16 Total measured noise levels, dB – August 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	22/08/2023 00:15	49	38	34	33	33	32	30
N16	21/08/2023 23:20	47	44	42	37	34	30	27
N20A	21/08/2023 22:26	38	33	30	27	25	23	20
N21	21/08/2023 23:49	43	38	36	34	34	32	30
N26	21/08/2023 22:00	35	32	30	27	26	23	20

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.8.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.8.3 Attended noise monitoring

Table 4.17 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.17 Site noise levels and limits – August 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	22/08/2023 00:15	0.5	194	E	No	38	48	IA	IA	Nil	Nil
N16	21/08/2023 23:20	0.3	219	F	No	35	45	IA	IA	Nil	Nil
N20A	21/08/2023 22:26	0.7	232	D	No	35	45	IA	IA	Nil	Nil
N21	21/08/2023 23:49	0.5	241	E	No	39	49	IA	IA	Nil	Nil
N26	21/08/2023 22:00	0.6	181	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.9 September 2023

4.9.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.18.

Table 4.18 Total measured noise levels, dB – September 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	21/09/2023 23:52	48	37	33	32	32	30	29
N16	21/09/2023 23:10	45	41	39	37	36	34	32
N20A	21/09/2023 22:25	40	37	34	32	32	30	27
N21	21/09/2023 23:28	36	32	29	27	27	25	23
N26	21/09/2023 22:01	48	46	43	39	37	33	29

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.9.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.9.3 Attended noise monitoring

Table 4.19 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.19 Site noise levels and limits – September 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	21/09/2023 23:52	2.1	146	F	Yes	43	53	IA	IA	Nil	Nil
N16	21/09/2023 23:10	1.2	146	E	No	35	45	IA	IA	Nil	Nil
N20A	21/09/2023 22:25	1.4	154	E	No	35	45	IA	IA	Nil	Nil
N21	21/09/2023 23:28	1.8	150	E	No	39	49	IA	IA	Nil	Nil
N26	21/09/2023 22:01	1.9	154	E	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.10 October 2023

4.10.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.20.

Table 4.20 Total measured noise levels, dB – October 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	18/10/2023 23:57	57	37	33	31	30	28	23
N16	18/10/2023 23:22	46	43	41	39	38	36	34
N20A	18/10/2023 22:31	40	38	36	35	35	34	31
N21	18/10/2023 23:32	58	38	34	32	31	29	23
N26	18/10/2023 22:00	54	43	39	37	37	35	31

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.10.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.10.3 Attended noise monitoring

Table 4.21 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.21 Site noise levels and limits – October 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	18/10/2023 23:57	0.8	253	E	No	38	48	IA	IA	Nil	Nil
N16	18/10/2023 23:22	0.7	237	D	No	35	45	IA	IA	Nil	Nil
N20A	18/10/2023 22:31	0.8	206	D	No	35	45	IA	IA	Nil	Nil
N21	18/10/2023 23:32	0.7	235	D	No	39	49	IA	IA	Nil	Nil
N26	18/10/2023 22:00	1.2	140	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.11 November 2023

4.11.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.22.

Table 4.22 Total measured noise levels, dB – November 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	15/11/2023 23:18	44	38	34	32	32	30	28
N16	15/11/2023 23:29	46	41	39	38	38	37	35
N20A	15/11/2023 22:34	43	36	35	33	33	32	28
N21	15/11/2023 23:42	42	34	32	30	30	29	27
N26	15/11/2023 22:05	44	34	33	31	31	29	27

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.11.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.11.3 Attended noise monitoring

Table 4.23 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.23 Site noise levels and limits – November 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	15/11/2023 23:18	0.8	162	F	No	38	48	IA	IA	Nil	Nil
N16	15/11/2023 23:29	0.9	181	E	No	35	45	IA	IA	Nil	Nil
N20A	15/11/2023 22:34	1.0	112	F	No	35	45	IA	IA	Nil	Nil
N21	15/11/2023 23:42	0.9	175	E	No	39	49	IA	IA	Nil	Nil
N26	15/11/2023 22:05	1.7	119	F	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

4.12 December 2023

4.12.1 Total measured noise levels

Overall noise levels measured at each location during attended measurements are provided in Table 4.24.

Table 4.24 Total measured noise levels, dB – December 2023 [1]

Location	Start date and time	L_{Amax} dB	L_{A1} dB	L_{A10} dB	L_{Aeq} dB	L_{A50} dB	L_{A90} dB	L_{Amin} dB
N01	18/12/2023 22:40	50	40	33	32	30	28	26
N16	18/12/2023 23:22	62	56	45	44	37	35	33
N20A	18/12/2023 22:28	41	36	34	33	33	32	30
N21	18/12/2023 22:14	49	37	35	33	33	31	29
N26	18/12/2023 22:00	43	41	40	40	40	39	35

Notes: 1. Levels in this table are not necessarily the result of activity at site.

4.12.2 Modifying factors

Measured site-only levels were assessed for the applicability of modifying factors in accordance with the NPfI and methodology described in Section 3.4.

There were no modifying factors, as defined in the NPfI, applicable during the survey.

4.12.3 Attended noise monitoring

Table 4.25 provides site noise levels in the absence of other sources, where possible, and includes weather data from the site AWS. Noise limits are applicable under all weather conditions but are adjusted during very noise-enhancing meteorological conditions as defined by the NPfI.

Table 4.25 Site noise levels and limits – December 2023

Location	Start date and time	Wind		Stability class	Very enhancing? [1]	Limits, dB		Site levels, dB [2]		Exceedances, dB	
		Speed m/s	Direction [3]			$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}	$L_{Aeq,15minute}$	L_{Amax}
N01	18/12/2023 22:40	2.1	184	D	No	38	48	<25	<25	Nil	Nil
N16	18/12/2023 23:22	2.2	184	D	No	35	45	IA	IA	Nil	Nil
N20A	18/12/2023 22:28	1.7	178	D	No	35	45	IA	IA	Nil	Nil
N21	18/12/2023 22:14	1.3	166	D	No	39	49	<30	<30	Nil	Nil
N26	18/12/2023 22:00	1.6	168	D	No	35	45	IA	IA	Nil	Nil

Notes: 1. Noise limits are adjusted by +5 dB during 'very enhancing meteorological conditions' in accordance with the NPfI.

2. Site-only $L_{Aeq,15minute}$, includes modifying factor penalties if applicable.

3. Degrees magnetic north, "-" indicates calm conditions.

5 Long term noise trends

Site-only L_{Aeq} noise levels measured during monthly attended environmental noise monitoring over a 5-year period from January 2019 to December 2023 have been collated and graphed to summarise WCM long-term noise performance. Less than five years of data was available at three locations due to monitoring commencing at those locations during the 5-year period.

Due to the qualitative nature of some attended noise monitoring descriptors, calculation of site noise statistics such as mean, median, and standard deviation is not always possible. Subsequently, site-only L_{Aeq} noise levels for each monitoring event have been grouped into one of three categories:

- WCM only L_{Aeq} was either inaudible (IA), not measurable (NM), or less than 30 dB, which together are represented by green bars
- WCM only L_{Aeq} was between 30 dB and the relevant noise criteria for that location (inclusive) represented by blue bars, or
- WCP only L_{Aeq} was greater than the relevant noise criteria for that location, represented by red bars.

For each calendar year, the percentage of occurrence for each of these categories is shown, as well as annual trend lines over the entire five-year period. Figures show site only L_{Aeq} noise levels, including adjustments due to modifying factors, as defined by the EPA NPfI.

Meteorological conditions and applicability of noise criteria have not been considered.

5.1 Noise trend graphs

Site only L_{Aeq} noise levels measured during attended environmental noise monitoring over a 5-year period have been collated and graphed to summarise long-term noise trends. Figure 5.1 to Figure 5.5 provide percentage occurrence information for WCM noise levels at eight monitoring locations.

As meteorological conditions and applicability of noise criteria have not been considered in long-term trend analysis, potential exceedances indicated in the following graphs may not have been applicable depending on weather conditions at the time of monitoring.

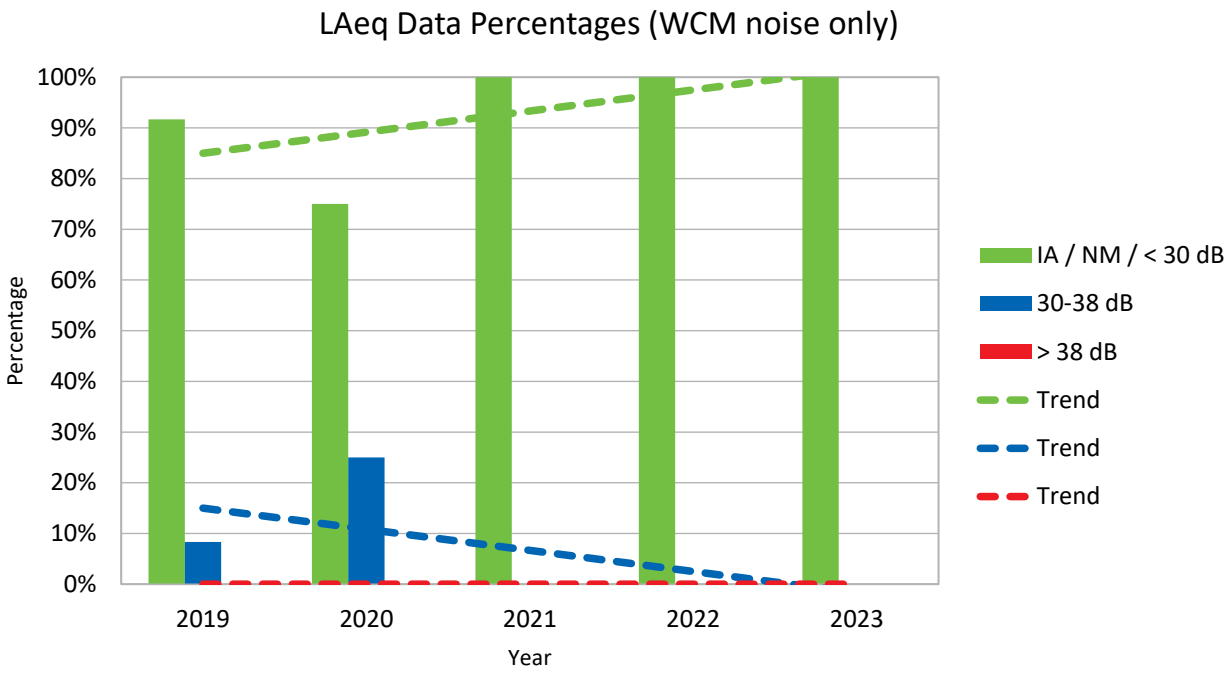

Figure 5.1 **Attended noise monitoring data, N01**

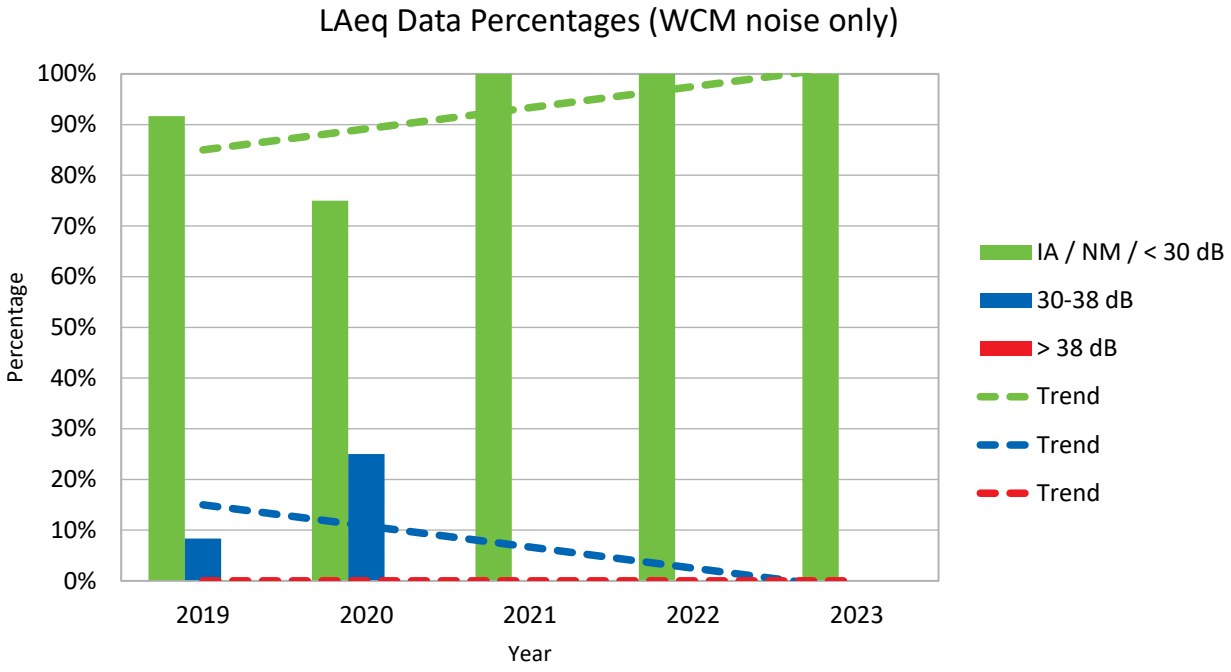

Figure 5.2 **Attended noise monitoring data, N16**

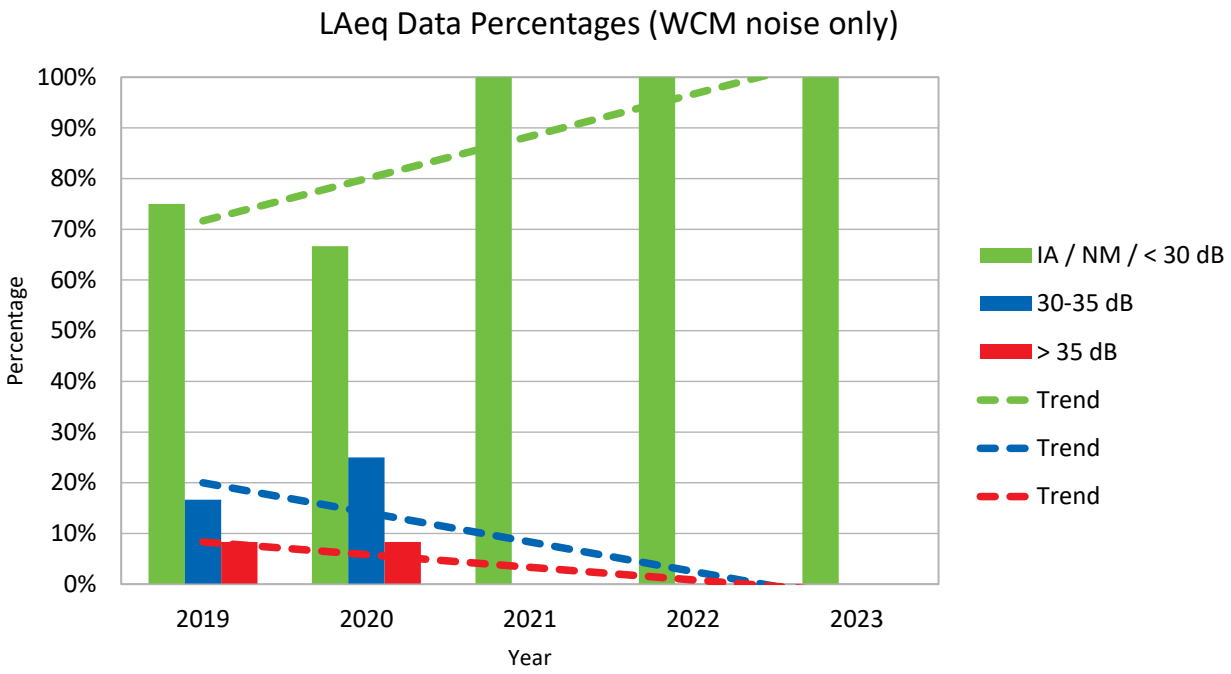

Figure 5.3 **Attended noise monitoring data, N20A**

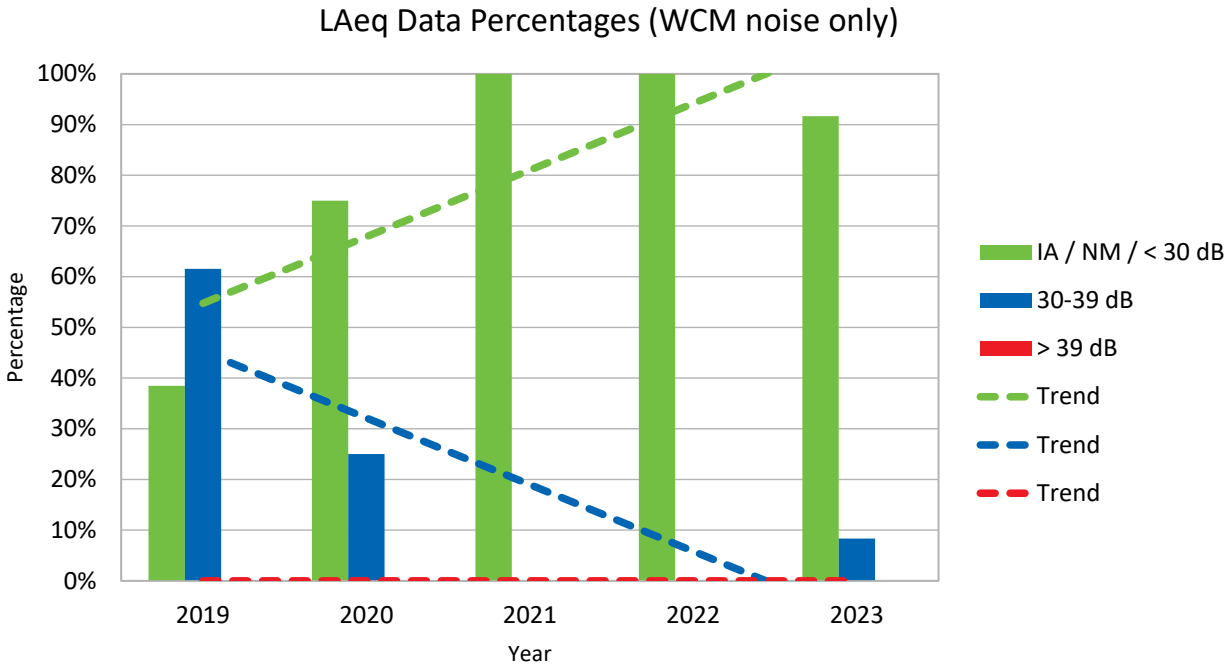

Figure 5.4 **Attended noise monitoring data, N21**

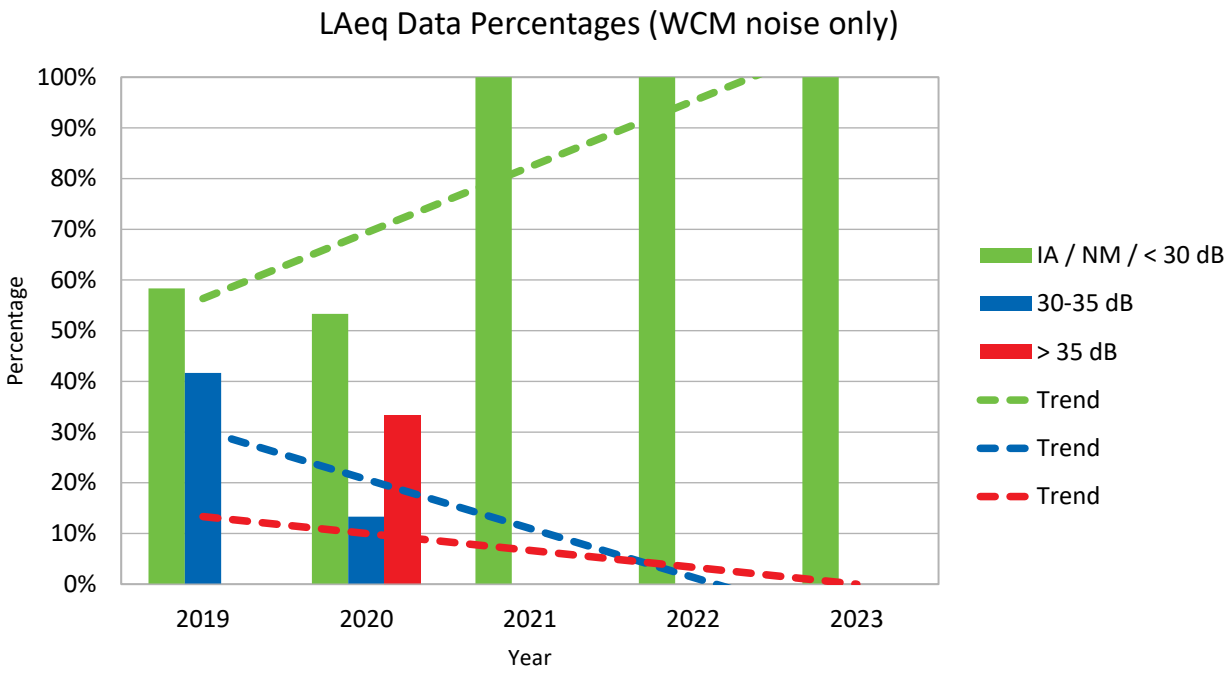

Figure 5.5 Attended noise monitoring data, N26

5.2 Discussion

During the 5-year period analysed, WCM noise levels at most monitoring locations have decreased from 2019 to 2020, likely due to mining activity being deeper in pit and therefore more shielded from receptors.

From 1 December 2020, open cut mining was no longer undertaken by WCM and noise emissions decreased significantly.

6 Comparison with EIS modelled predictions

A NIA was prepared in July 2016 as part of the EIS to support application for the United Wambo project. As part of the modelling assessment, cumulative noise levels from WCM and United Wambo were predicted for representative operating scenarios, time periods and weather conditions.

Predicted noise levels for Year 6 have been used for comparison to measured noise levels, as it most closely aligned to the 2023 reporting year. Table 6.1 summarises predicted $L_{Aeq,15minute}$ noise levels for specific monitoring locations detailed in Table F.1 of the NIA. These have been compared to noise-enhancing meteorological condition defined in Section 3.5 of this report.

Table 6.1 WCM operations predictions, Year 6 - dB

NMP descriptor	Monitoring locations	Nearest property ID	Night $L_{Aeq,15minute}$ Non-Winter	Night $L_{Aeq,15minute}$ Winter
N01	Wambo Road Residence	3	<30	34
N16	Jerrys Plains Road	39	40	42
N20A	Redmanvale Road Central	343	32	34
N21	Wambo South	25	32	37
N26	Redmanvale Road South	345	33	39

Table 6.2 summarises sleep disturbance noise levels for specific monitoring locations detailed in Table F.4 of the NIA under certain meteorological condition defined in Section 3.5 of this report.

Table 6.2 WCM sleep disturbance predictions, Year 6 - dB

NMP descriptor	Monitoring locations	Nearest property ID	Night $L_{A1,1minute}$ Calm	Night $L_{A1,1minute}$ SE Wind	Night $L_{A1,1minute}$ Inversion
N01	Wambo Road Residence	3	<30	<30	<30
N16	Jerrys Plains Road	39	<30	41	40
N20A	Redmanvale Road Central	33 [1]	<30	33	30
N21	Wambo South	25	<30	<30	32
N26	Redmanvale Road South	346 [2]	<30	30	<30

Notes: 1. Sleep disturbance prediction for Property 343 was not provided. Property 33 was the nearest residence with predicted noise levels.

2. Sleep disturbance prediction for Property 345 was not provided. Property 346 was the nearest residence with predicted noise levels

Table 6.3 to Table 6.7 of this report compare the measured operational levels to predicted noise levels in the NIA for Year 6. A positive difference indicates the measured level is greater than the predicted level and a negative difference indicates the measured levels are less than predicted in the NIA.

When meteorological conditions during the attended monitoring measurement do not correspond with those that are modelled, the meteorological conditions are considered “not applicable” (NA) and no further analysis is undertaken. When meteorological conditions during the measurement correspond with modelled conditions, but measured WCM noise levels were not directly quantifiable, measured and modelled noise levels are “not comparable” (NC) and no further analysis is required.

6.1 Results

6.1.1 N01, Wambo Road residence

Table 6.3 Measured WCM noise levels compared to Year 2 predicted noise levels at N01, dB(A)

Month	Applicable Meteorological Condition[1,2]	Measured WCM $L_{Aeq,15minute}$	Predicted WCM $L_{Aeq,15minute}$	Difference[2,3]	Applicable Meteorological Condition[1,2]	Measured WCM $L_{A1,1minute}$	Predicted WCM $L_{A1,1minute}$	Difference[2,3]
January	N/A	IA	-	N/A	N/A	IA	-	N/A
February	N/A	IA	-	N/A	N/A	IA	-	N/A
March	N/A	IA	-	N/A	SE Wind	IA	<30	NC
April	N/A	IA	-	N/A	N/A	IA	-	N/A
May	N/A	IA	-	N/A	N/A	IA	-	N/A
June	N/A	IA	-	N/A	N/A	IA	-	N/A
July	N/A	IA	-	N/A	N/A	IA	-	N/A
August	N/A	IA	-	N/A	Calm	IA	<30	NC
September	N/A	IA	-	N/A	N/A	IA	-	N/A
October	N/A	IA	-	N/A	N/A	IA	-	N/A
November	N/A	IA	-	N/A	Inversion	IA	<30	NC
December	N/A	<25	-	N/A	N/A	<25	-	N/A

Notes: 1. Refer to Table 3.1 and Table 3.2 for applicable meteorological conditions.

2. N/A indicates meteorological conditions during the measurement did not correspond with any modelled meteorological conditions and were not applicable for comparison.

3. NC indicated measured WCP noise levels were inaudible (IA), not measurable (NM), or expressed as a “less than” (e.g. Less than 30 dB), therefore measured and predicted noise levels were not comparable.

6.1.2 N16, Jerrys Plains Road

Table 6.4 Measured WCM noise levels compared to Year 2 predicted noise levels at N16, dB(A)

Month	Applicable Meteorological Condition[1,2]	Measured WCM $L_{Aeq,15minute}$	Predicted WCM $L_{Aeq,15minute}$	Difference[2,3]	Applicable Meteorological Condition[1,2]	Measured WCM $L_{A1,1minute}$	Predicted WCM $L_{A1,1minute}$	Difference[2,3]
January	N/A	IA	-	N/A	N/A	IA	-	N/A
February	Wind only	IA	40	NC	SE Wind	IA	41	NC
March	Inversion	IA	40	NC	Inversion	IA	40	NC
April	N/A	IA	-	N/A	N/A	IA	-	N/A
May	N/A	IA	-	N/A	N/A	IA	-	N/A
June	N/A	IA	-	N/A	N/A	IA	-	N/A
July	N/A	IA	-	N/A	N/A	IA	-	N/A
August	N/A	IA	-	N/A	N/A	IA	-	N/A
September	Wind only	IA	40	NC	SE Wind	IA	41	NC
October	N/A	IA	-	N/A	N/A	IA	-	N/A
November	N/A	IA	-	N/A	N/A	IA	-	N/A
December	N/A	IA	-	N/A	N/A	IA	-	N/A

Notes: 1. Refer to Table 3.1 and Table 3.2 for applicable meteorological conditions.

2. N/A indicates meteorological conditions during the measurement did not correspond with any modelled meteorological conditions and were not applicable for comparison.

3. NC indicated measured WCP noise levels were inaudible (IA), not measurable (NM), or expressed as a “less than” (e.g. Less than 30 dB), therefore measured and predicted noise levels were not comparable.

6.1.3 N20A, Redmanvale Road Central

Table 6.5 Measured WCM noise levels compared to Year 2 predicted noise levels at N20A, dB(A)

Month	Applicable Meteorological Condition[1,2]	Measured WCM $L_{Aeq,15minute}$	Predicted WCM $L_{Aeq,15minute}$	Difference[2,3]	Applicable Meteorological Condition[1,2]	Measured WCM $L_{A1,1minute}$	Predicted WCM $L_{A1,1minute}$	Difference[2,3]
January	Inversion	IA	32	NC	N/A	IA	-	N/A
February	Inversion	IA	32	NC	N/A	IA	-	N/A
March	N/A	IA	-	N/A	Inversion	IA	30	NC
April	N/A	IA	-	N/A	N/A	IA	-	N/A
May	N/A	IA	-	N/A	N/A	IA	-	N/A
June	N/A	IA	-	N/A	N/A	IA	-	N/A
July	N/A	IA	-	N/A	N/A	IA	-	N/A
August	N/A	IA	-	N/A	N/A	IA	-	N/A
September	Wind only	IA	32	NC	SE Wind	IA	33	NC
October	N/A	IA	-	N/A	N/A	IA	-	N/A
November	N/A	IA	-	N/A	N/A	IA	-	N/A
December	N/A	IA	-	N/A	N/A	IA	-	N/A

Notes: 1. Refer to Table 3.1 and Table 3.2 for applicable meteorological conditions.

2. N/A indicates meteorological conditions during the measurement did not correspond with any modelled meteorological conditions and were not applicable for comparison.

3. NC indicated measured WCP noise levels were inaudible (IA), not measurable (NM), or expressed as a “less than” (e.g. Less than 30 dB), therefore measured and predicted noise levels were not comparable.

6.1.4 N21, Wambo Road South

Table 6.6 Measured WCM noise levels compared to Year 2 predicted noise levels at N21, dB(A)

Month	Applicable Meteorological Condition[1,2]	Measured WCM $L_{Aeq,15minute}$	Predicted WCM $L_{Aeq,15minute}$	Difference[2,3]	Applicable Meteorological Condition[1,2]	Measured WCM $L_{A1,1minute}$	Predicted WCM $L_{A1,1minute}$	Difference[2,3]
January	N/A	IA	-	N/A	N/A	IA	-	N/A
February	N/A	IA	-	N/A	SE Wind	IA	<30	NC
March	N/A	IA	-	N/A	N/A	IA	-	N/A
April	N/A	36	-	N/A	N/A	39	-	N/A
May	N/A	IA	-	N/A	N/A	IA	-	N/A
June	N/A	IA	-	N/A	N/A	IA	-	N/A
July	N/A	IA	-	N/A	N/A	IA	-	N/A
August	N/A	IA	-	N/A	Calm	IA	<30	NC
September	N/A	IA	-	N/A	SE Wind	IA	<30	NC
October	N/A	IA	-	N/A	N/A	IA	-	N/A
November	N/A	IA	-	N/A	N/A	IA	-	N/A
December	N/A	<30	-	N/A	N/A	<30	-	N/A

Notes: 1. Refer to Table 3.1 and Table 3.2 for applicable meteorological conditions.

2. N/A indicates meteorological conditions during the measurement did not correspond with any modelled meteorological conditions and were not applicable for comparison.

3. NC indicated measured WCP noise levels were inaudible (IA), not measurable (NM), or expressed as a “less than” (e.g. Less than 30 dB), therefore measured and predicted noise levels were not comparable.

6.1.5 N26, Redmanvale Road South

Table 6.7 Measured WCM noise levels compared to Year 2 predicted noise levels at N26, dB(A)

Month	Applicable Meteorological Condition[1,2]	Measured WCM $L_{Aeq,15minute}$	Predicted WCM $L_{Aeq,15minute}$	Difference[2,3]	Applicable Meteorological Condition[1,2]	Measured WCM $L_{A1,1minute}$	Predicted WCM $L_{A1,1minute}$	Difference[2,3]
January	N/A	IA	-	N/A	N/A	IA	-	N/A
February	N/A	IA	-	N/A	N/A	IA	-	N/A
March	Inversion	IA	33	NC	N/A	IA	-	N/A
April	Wind only	IA	33	NC	SE Wind	IA	30	NC
May	N/A	IA	-	N/A	N/A	IA	-	N/A
June	Inversion	IA	39	NC	N/A	IA	-	N/A
July	N/A	IA	-	N/A	N/A	IA	-	N/A
August	N/A	IA	-	N/A	Inversion	IA	<30	NC
September	Wind only	IA	33	NC	SE Wind	IA	30	NC
October	Inversion	IA	33	NC	N/A	IA	-	N/A
November	Inversion	IA	33	NC	N/A	IA	-	N/A
December	N/A	IA	-	N/A	N/A	IA	-	N/A

Notes: 1. Refer to Table 3.1 and Table 3.2 for applicable meteorological conditions.

2. N/A indicates meteorological conditions during the measurement did not correspond with any modelled meteorological conditions and were not applicable for comparison.

3. NC indicated measured WCP noise levels were inaudible (IA), not measurable (NM), or expressed as a “less than” (e.g. Less than 30 dB), therefore measured and predicted noise levels were not comparable.

7 Summary

EMM was engaged by WC to provide an AEMR for 2023 to compare noise monitoring results against relevant criteria.

This report summarises monthly attended noise monitoring surveys conducted at five monitoring locations around WCM during the reporting period 1 January to 31 December 2023. The purpose of the surveys was to quantify and describe the acoustic environment around the site and compare results with specified limits.

Attended noise monitoring described in this report was conducted monthly in accordance with the relevant development consents, EPL, and the WCM NMP.

7.1 January to December 2023 compliance

WCM complied with relevant noise criteria during all measurements during 2023 noise monitoring.

7.2 Long-term noise trends

During the 5-year period analysed, WCM noise levels at most monitoring locations decreased from 2019 to 2020, likely due to mining activity being deeper in pit and therefore more shielded from receptors. From 1 December 2020, open cut mining was no longer undertaken by WCM, and noise emissions decreased significantly.

7.3 EIS comparison

WCM commenced Phase 2 on 1 December 2020, wherein WCM only manages underground operations and associated plant. Open cut operations are managed by UW as part of the UWJV.

Noise levels from WCM were not comparable to Year 6 predictions in the EIS.

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APPENDIX D

ANNUAL AIR QUALITY MONITORING REPORT

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8 February 2024

Attention: Morgan Katsch
Environmental Advisor
Wambo Coal Pty Ltd
PMB 1, Singleton NSW 2330

Project number: 22014

Dear Morgan

Review of 2023 air quality monitoring data

I have completed a review of the Wambo Mine air quality monitoring data for 2023. Please see attached for the outcomes.

In summary, it has been concluded that Wambo Coal Pty Ltd was in compliance with its development consent in terms of all relevant air quality indicators in 2023.

Yours sincerely

Shane Lakmaker
Director / Atmospheric Scientist
Airen Consulting

1. Background

The Wambo Mine is Ltd owned and operated by Wambo Coal Pty (Wambo Coal), a subsidiary of Peabody Energy Australia Pty Limited (Peabody). Mining is carried out under Development Consent DA 305-7-2003 as modified. The latest modification to DA 305-7-2003 (Mod 19) permits underground mining, operation of Wambo Mine infrastructure and associated surface development; collectively referred to as Phase 2 under DA 305-7-2003.

Wambo Coal has a network of air quality and meteorological monitoring equipment around the Wambo Mine which is designed to meet relevant conditions of DA 305-7-2003.

Figure 1 shows the meteorological and air quality monitoring network. This network includes:

- One (1) meteorological station referred to as M6.
- Four (4) tapered element oscillating microbalances (TEOM) measuring PM_{10}. Compliance is determined at AQ05 (D5 Kelly formerly AQ01), AQ02 (D2 Caban), AQ03 (D4 Thelander) and AQ04 (D1 Muller).
- Two (2) tapered element oscillating microbalances (TEOM) measuring $PM_{2.5}$. Compliance is determined at AQ05 (D5 Kelly formerly AQ01) and AQ03 (D4 Thelander).

A review of the air quality monitoring data collected in 2023 has been carried out. The main purpose of the review was to determine whether Wambo Coal had complied with the criteria specified in the development consent (DA 305-7-2003). Table 1 shows the relevant development consent criteria.

Table 1 Development consent criteria

Indicator	Averaging period	Criterion
Particulate matter (PM_{10})	24 hour	[b] 50 µg/m³
	Annual	[a,c] 25 µg/m³
Particulate matter ($PM_{2.5}$)	24 hour	[b] 25 µg/m³
	Annual	[a,c] 8 µg/m³
Particulate matter (TSP)	Annual	[a,c] 90 µg/m³

[a] *Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).*

[b] *Incremental impact (i.e. incremental increase in concentrations due to the development on its own).*

[c] *Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Planning Secretary.*

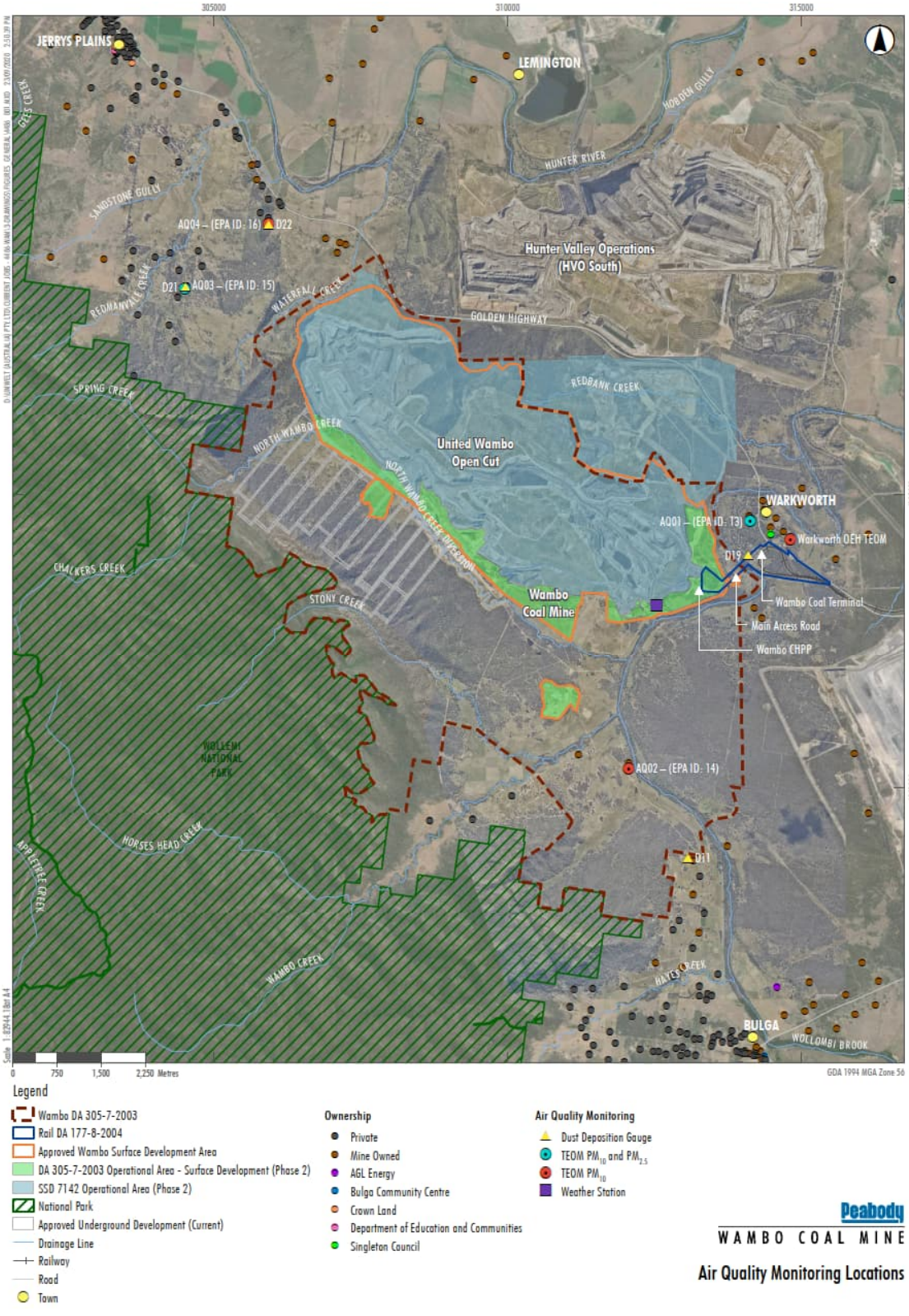

Figure 1 Location of air quality and meteorological monitoring sites

2. Approach to Review

2.1 Extraordinary Events

The Department of Planning, Housing and Industry (DPHI) has historically identified extraordinary events that are relevant to the Hunter Valley based on the Upper Hunter Air Quality Monitoring Network as well as other factors such as bushfires and dust storms. For example, in 2020 the DPHI identified 24 days as extraordinary events. The DPHI did not identify any "extraordinary event" days in 2023.

2.2 Particulate Matter (as PM_{10})

Evaluation of PM_{10} involved:

- Obtaining hourly average PM_{10} concentration data from all monitoring sites for 2023 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from the Wambo Mine weather station for 2023 and calculating the contributions from the direction of Wambo Mine to each hourly PM_{10} concentration result.
- Summarising all monitored PM_{10} concentration data and estimated contributions from the direction of Wambo Mine, and making comparisons to the consent criteria.

There is no standard prescribed methodology for determining contributions to air quality from mining operations. The methodology described below is based on the use of concurrent hourly meteorological and air quality monitoring data from suitably located monitoring stations around the mine site to estimate the potential contribution from the direction of the mining operation. This method is referred to as an "upwind / downwind" calculation approach. In this context, "upwind" is a location that collects data representative of background conditions, not influenced by the source of interest, and does not necessarily need to be upwind of the source of interest.

The maximum contributions from the direction of Wambo Mine to each measured hourly average result was calculated by first determining the wind direction ranges which represented a wind from the direction of Wambo Mine towards the monitor. Table 2 shows the wind direction ranges that represented the direction to Wambo Mine from each monitor.

Table 2 Wind directions to Wambo Mine for PM_{10} contribution calculations

Monitor	Direction to Wambo Mine
D1 Muller	Between 130 and 180 degrees from true north
D2 Caban	Between 320 and 10 degrees from true north
D5 Kelly	Between 255 and 300 degrees from true north
D4 Thelander	Between 110 and 140 degrees from true north

The potential contribution from the direction of Wambo Mine to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a "monitor" concentration minus "background" concentration calculation. Table 3 shows the data representing "monitor" and "background" conditions for each monitoring site. The "monitor" concentration minus "background" concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 3 Data for monitor and background PM_{10} calculations

Monitor	Data representing "background" conditions
D1 Muller	D2 Caban
D2 Caban	D1 Muller

Monitor	Data representing “background” conditions
D5 Kelly	D4 Thelander
D4 Thelander	D5 Kelly

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.3 Particulate Matter (as $PM_{2.5}$)

Evaluation of $PM_{2.5}$ involved:

- Obtaining hourly average $PM_{2.5}$ concentration data from all monitoring sites for 2023 and determining the 24-hour and annual averages.
- Obtaining hourly meteorological data from the Wambo Mine weather station for 2023 and calculating the contributions from the direction of Wambo Mine to each hourly $PM_{2.5}$ concentration result.
- Summarising all monitored $PM_{2.5}$ concentration data and estimated contributions from the direction of Wambo Mine, and making comparisons to the consent criteria.

The maximum contributions from the direction of the Wambo Mine to each measured hourly average result was calculated in the same manner as for the calculated PM_{10} contributions, as described in Section 2.2. Table 4 shows the wind direction ranges that represented the direction to Wambo Mine from each monitor.

Table 4 Wind directions to Wambo mine for $PM_{2.5}$ contribution calculations

Monitor	Direction to Wambo Mine
D5 Kelly	Between 255 and 300 degrees from true north
D4 Thelander	Between 110 and 140 degrees from true north

The potential contribution from the direction of Wambo Mine to each monitor was calculated for every 1-hour average record for every day based on the concurrent wind direction and from a “monitor” concentration minus “background” concentration calculation. Table 5 shows the data representing “monitor” and “background” conditions for each monitoring site. The “monitor” concentration minus “background” concentration result was only calculated for hours with wind speeds greater than 0 m/s.

Table 5 Data for monitor and background $PM_{2.5}$ calculations

Monitor	Data representing “background” conditions
D5 Kelly	D4 Thelander
D4 Thelander	D5 Kelly

The potential contribution to each monitor was then calculated as 24-hour and annual averages (not including negative values) from the 8,760 hourly records.

2.4 Particulate Matter (as TSP)

TSP concentrations were estimated from the measured PM_{10} concentrations assuming that PM_{10} concentrations were 33% of the TSP concentrations, in accordance with the approved Air Quality and Greenhouse Gas Management Plan (Peabody, 2020).

3. Monitoring Results

3.1 Meteorology

Meteorological conditions are important for determining the transport of emissions, and the potential influences on air quality. Rainfall can influence air quality conditions, particularly dust. Figure 2 shows the rainfall data collected by Wambo Coal in the past nine years. Rainfall was well below the long-term average (695 mm) in 2017, 2018 and 2019, coinciding with drought, but exceeded the long-term average in 2020, 2021 and 2022.

Figure 2 Annual rainfall

Wind-roses have been prepared to summarise the wind speed and wind direction data that were collected in 2023. The wind-roses (Figure 3) show the frequency of wind speeds and wind directions based on hourly records for each location. The circular format of the wind rose shows the direction from which the wind blew and the length of each "spoke" around the circle shows how often the wind blew from that direction. The different colours of each spoke provide details on the speed of the wind from each direction.

It can be seen from Figure 3 that winds in 2023 were from the southeast and northwest. This pattern of winds is common for many parts of the Hunter Valley and reflects the northwest-southeast alignment of the valley.

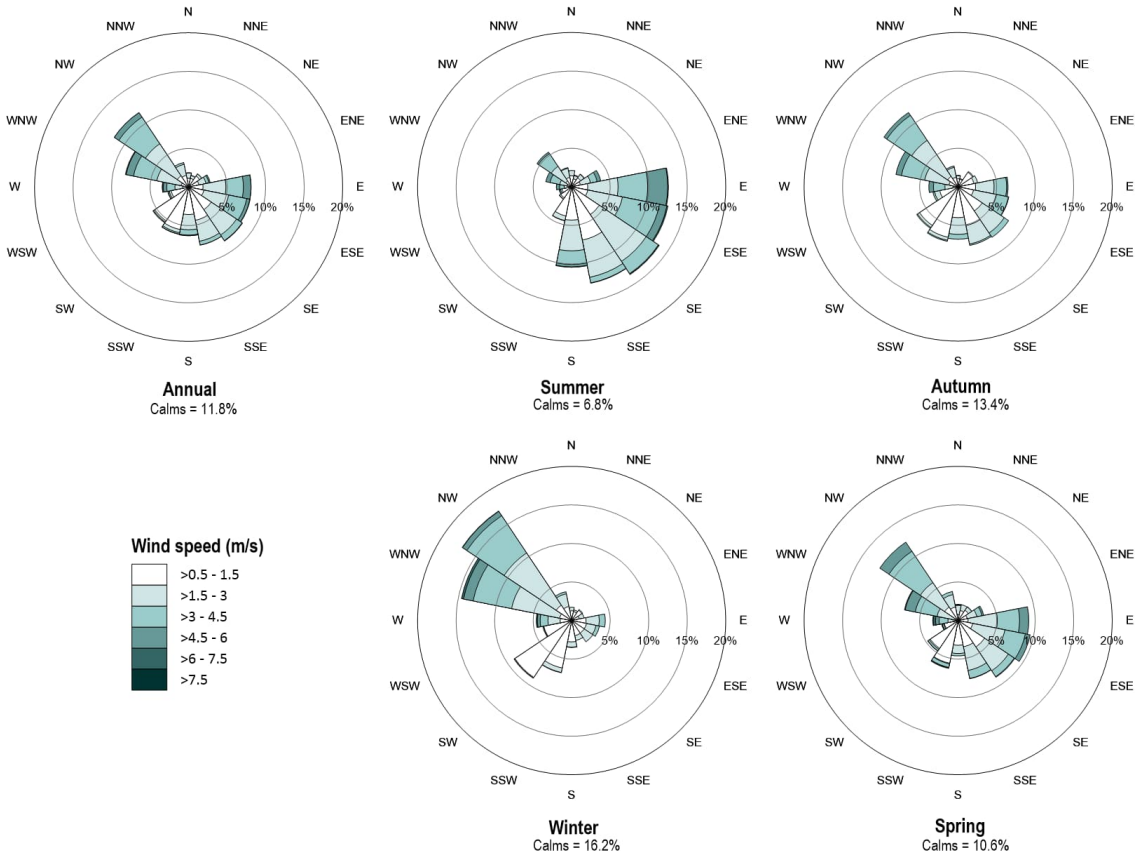

Figure 3 Annual wind-roses from data collected at Wambo Mine in 2023

3.2 Particulate Matter (as PM_{10})

Figure 4 shows the measured 24-hour average PM_{10} concentrations in 2023 from data collected at each compliance monitor. The calculated contributions from the direction of Wambo Mine to each monitoring location have been identified as per the methodology described in Section 2. The contribution from the direction of Wambo Mine is reported in order to assess compliance as the 24-hour average PM_{10} criteria from DA 305-7-2003 relate to an "incremental impact".

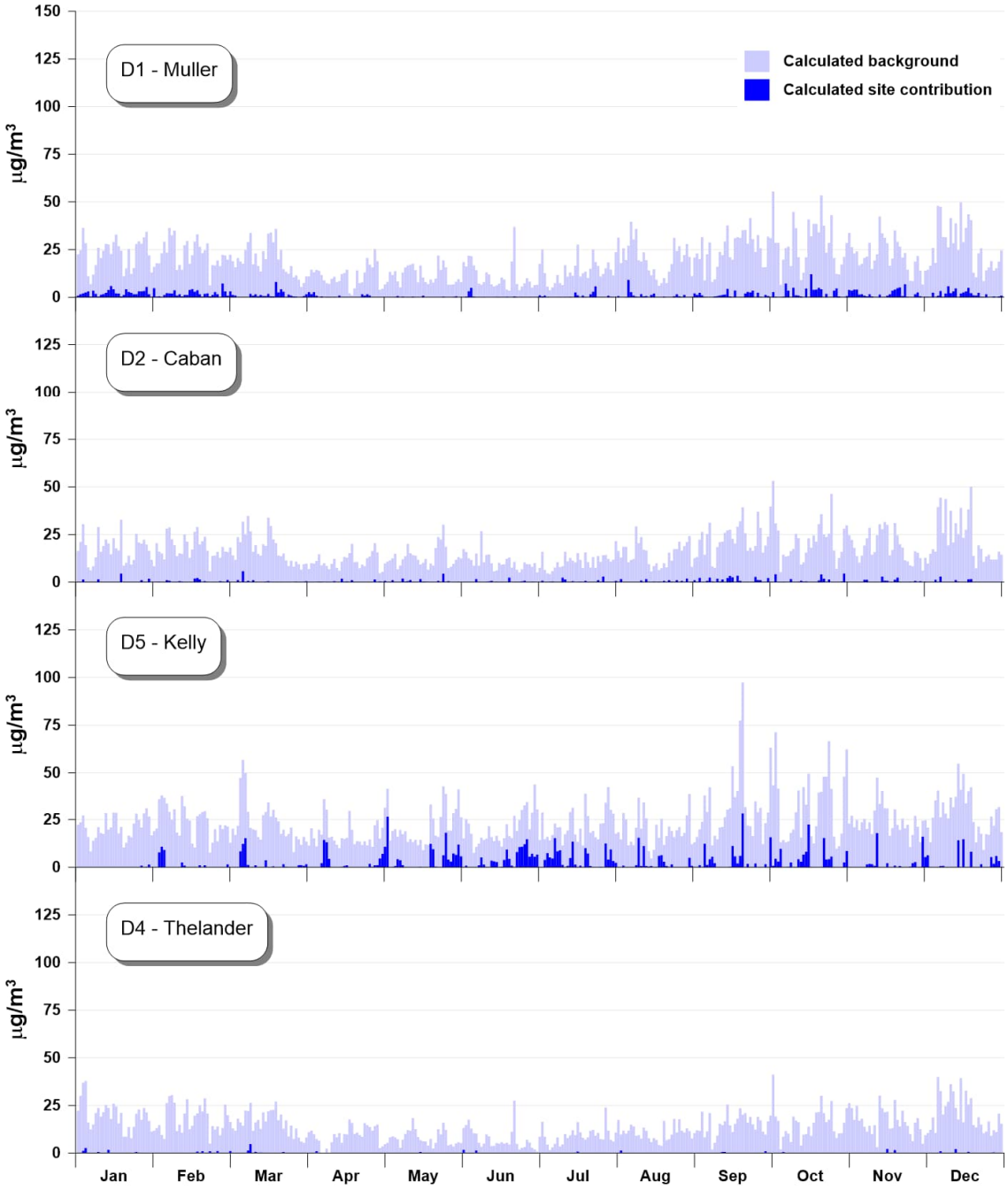

Figure 4 Measured 24-hour average PM_{10} concentrations at Wambo Mine monitors in 2023

Table 6 summarises the measured PM_{10} concentrations. The results have been calculated without extraordinary events (although it is noted that no extraordinary events were identified in 2023). The data in Table 6 show that the PM_{10} concentrations at all monitors were below the 24-hour and annual average criteria. Consequently, the monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as PM_{10}.

Table 6 Summary of PM_{10} concentrations from Wambo Mine monitors in 2023

Statistic	D1	D2	D5	D4	Criterion
Measured maximum 24-hour average due to all sources (µg/m³)	55.4	53.1	97.4	37.8	NA
Calculated maximum 24-hour average from direction of Wambo Mine (µg/m³)	12.1	5.9	28.3	4.7	50
Measured annual average due to all sources (µg/m³)	19.5	16.6	23.7	12.8	25
Calculated annual average from direction of Wambo Mine (µg/m³)	1.1	0.4	2.4	0.0	NA

3.3 Particulate Matter (as $PM_{2.5}$)

Figure 5 shows the measured 24-hour average $PM_{2.5}$ concentrations in 2023 from data collected at each compliance monitor. The calculated contribution from the direction of Wambo Mine to each monitoring location is also shown as per the methodology described in Section 2. The contribution from the direction of Wambo Mine is reported in order to assess compliance as the 24-hour average $PM_{2.5}$ criteria from DA 305-7-2003 relate to an "incremental impact".

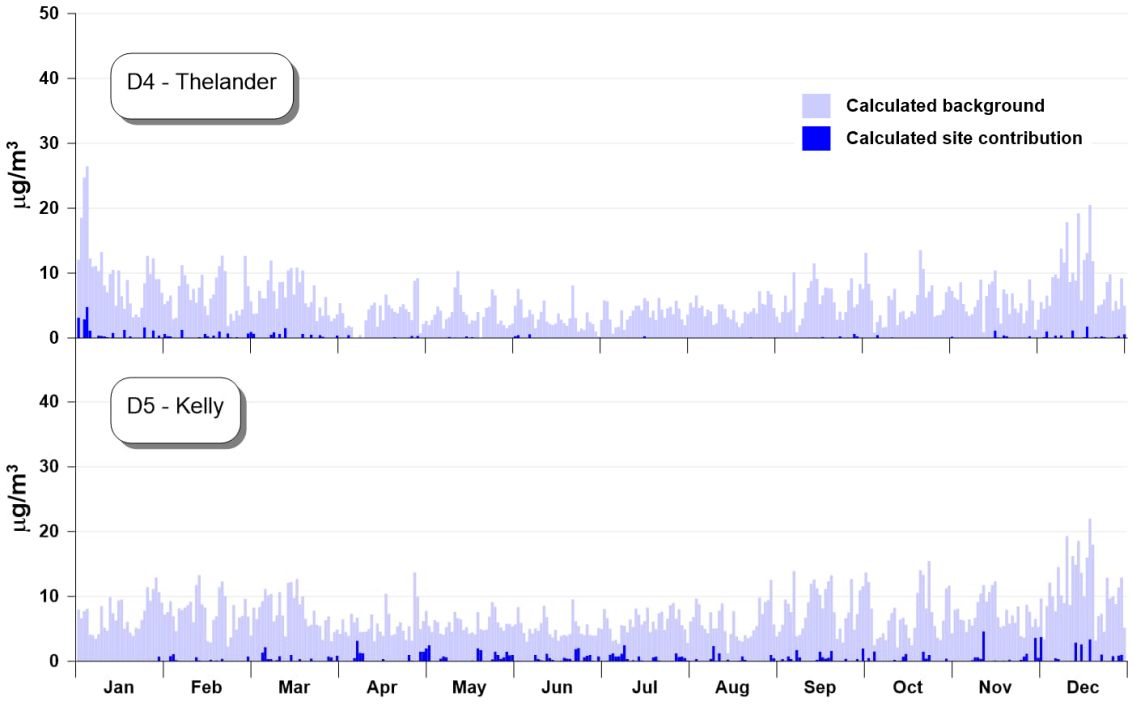

Figure 5 Measured 24-hour average $PM_{2.5}$ concentrations at Wambo Mine monitors in 2023

Table 7 summarises the measured $PM_{2.5}$ concentrations. The data in Table 7 show that the $PM_{2.5}$ concentrations were below the 24-hour and annual average criteria. Consequently, the monitoring demonstrates compliance with DA 305-7-2003 in terms of particulate matter as $PM_{2.5}$.

Table 7 Summary of $PM_{2.5}$ concentrations from Wambo Mine monitors in 2023

Statistic	D5	D4	Criterion
Measured maximum 24-hour average due to all sources (µg/m³)	22.0	26.5	NA
Calculated maximum 24-hour average from direction of Wambo Mine (µg/m³)	4.6	4.8	25
Measured annual average due to all sources (µg/m³)	7.0	5.4	8
Calculated annual average from direction of Wambo Mine (µg/m³)	0.3	0.0	NA

3.4 Particulate Matter (as TSP)

Table 8 shows the estimated annual average TSP concentrations based on the measured PM_{10} data in 2023. The data show that the estimated TSP concentrations were below 90 µg/m³. These results therefore demonstrate compliance with the development consent in terms of particulate matter as TSP.

Table 8 Summary of TSP concentrations from Wambo Mine monitors in 2023

Statistic	D1	D2	D5	D4	Criterion
Estimated annual average due to all sources (µg/m³)	59.0	50.2	71.8	38.8	90

4. Conclusions

A review of the Wambo Mine air quality monitoring data from 2023 has been completed. Based on the review it has been concluded that Wambo Coal complied with its development consent (DA 305-7-2003) in terms of air quality impacts at all reportable monitoring sites for data collected in 2023.

5. Reference

NSW Government (2023) Development Consent issued under Section 80 of the *Environmental Planning & Assessment Act 1979* – Wambo Coal Mine – DA 305-7-2003 as modified in January 2023.

Peabody (2020) "Air quality and greenhouse gas management plan". Document No. WA-ENV-MNP-508. November 2020.

Appendix A Historical summary of air quality around Wambo Mine

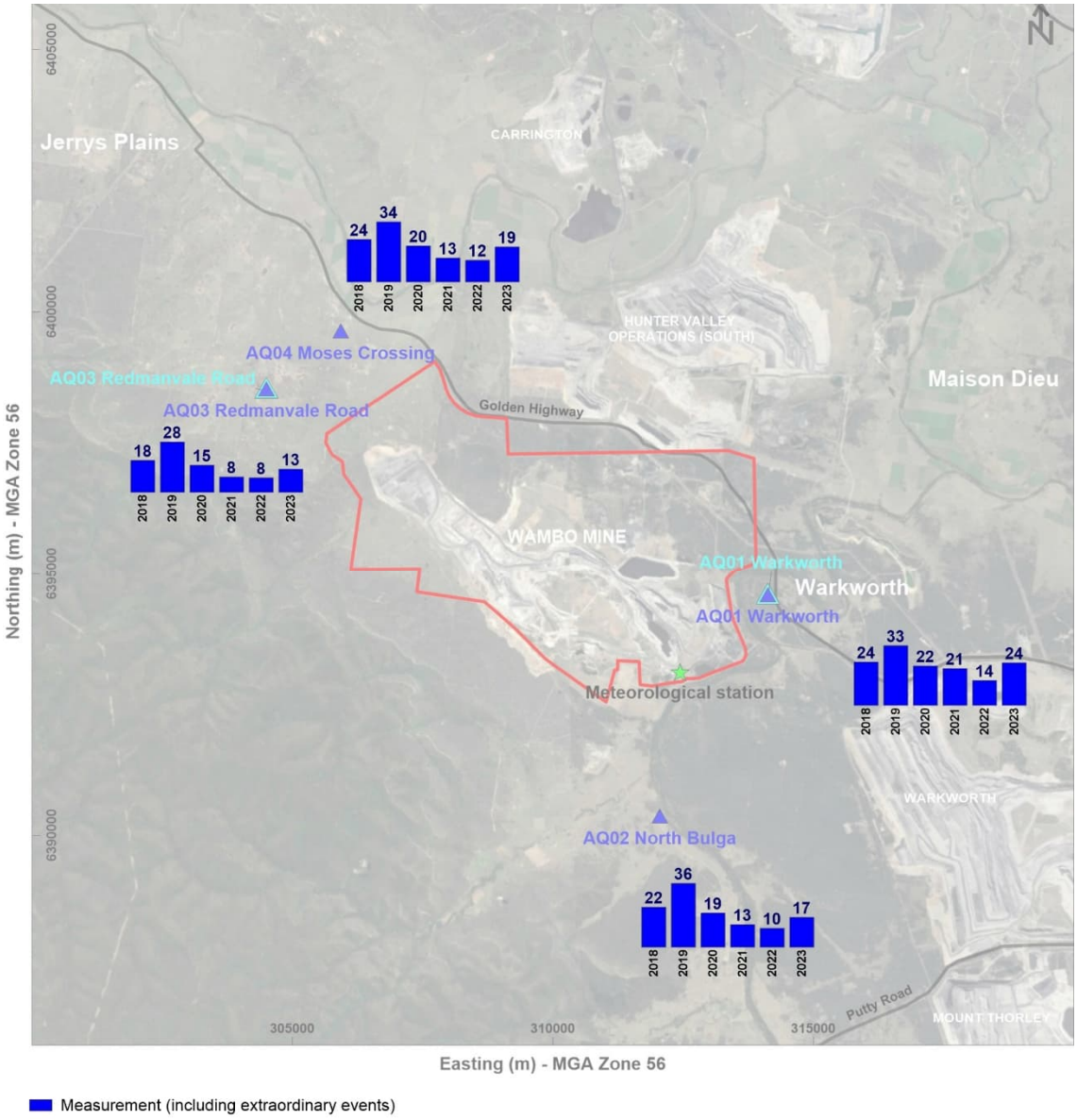

Figure A1 Annual average PM_{10} concentrations at Wambo Mine monitors from 2018 to 2023 (µg/m³)

APPENDIX E

ANNUAL FLORA AND FAUNA MONITORING REPORT

Wambo Coal Mine Annual Flora and Fauna Monitoring Report 2023 – Volume 1

Wambo Coal Pty Ltd

ecological AUSTRALIA
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DOCUMENT TRACKING

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Approved by	Lily Gorrell
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Template 2.8.1

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Abbreviations

Abbreviation	Description
AEMR	Annual Environmental Management Report
BC Act	NSW Biodiversity Conservation Act 2016
BS	Bare soil cover
BOA	Biodiversity Offset Area
BMP	Biodiversity Management Plan
BVT	Biometric Vegetation Type
CEEC	Critically Endangered Ecological Community
DBH	Diameter at Breast Height
DPI	NSW Department of Primary Industries
EEC	Endangered Ecological Community

Abbreviation	Description
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Federal Environment Protection and Biodiversity Conservation Act 1999
EPC	Exotic Plant Cover
FL	The length of Fallen Logs >10 cm diameter
GDE	Groundwater Dependent Ecosystem
HBT	Hollow-bearing Tree
INFI	Infiltration Index
LFA	Landscape Function Analysis
LI	Leaf litter cover
LOI	Landscape Organisation Index
NGCG	Native Ground Cover - Grasses
NGCO	Native Ground Cover - Other
NGCS	Native Ground Cover - Shrubs
NI	Nutrient Index
NMS	Native Mid-storey Cover – the projected native foliage cover of mid-storey (%)
NOS	Native Overstorey – the projected native foliage cover of canopy (%)
NPS	The number of Native Plant Species
NWCD	North Wambo Creek Diversion
OEH	NSW Office of Environment and Heritage
OR	Overstorey Regeneration
PCT	Plant Community Type
RWEA	Remnant Woodland Enhancement Area
RWEP	Remnant Woodland Enhancement Program
SI	Stability Index
SSA	Soil Surface Assessment
TEC	Threatened Ecological Community
VCA	Voluntary Conservation Area
WCPL	Wambo Coal Pty Ltd
WONS	Weed of National Significance

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Executive Summary

The Wambo Coal Mine annual flora and fauna monitoring program was undertaken by Eco Logical Australia (ELA) in 2023. Floristic surveys, bird surveys and riparian condition surveys were conducted during Spring across both remnant woodland, general surface and rehabilitation areas.

Winter bird surveys targeting threatened bird species were scheduled to be undertaken in 2022. The winter bird surveys were not undertaken in 2022 due to high rainfall creating inaccessible track conditions. To compensate, a winter bird survey was undertaken in 2023.

Results from 2023 surveys indicate that remnant woodland sites within Remnant Woodland Enhancement Area (RWEA) areas are generally performing well. Overall, native flora species diversity and native ground cover remains high with some observable decreases, likely in response to the above average rainfall in the past three years and lower rainfall in 2023. Groundcover exceeded the target range in a number of vegetation communities. Although this may be viewed as favourable, and not an urgent management concern, the opportunity to conduct fire management hazard reduction burns during a low-risk fire season should be investigated through liaison with NSW Rural Fire Service and National Parks and Wildlife Service.

High exotic cover was recorded in RWEA A and RWEA Rail Loop within the Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area community and in the River Red Gum / River Oak riparian woodland community. The recorded levels failed to meet the performance criteria and Voluntary Conservation Area (VCA) targets at several sites. Key exotic species in these zones are *Melinis repens*, *Bryophyllum* sp., *Eragrostis curvula*, and *Ehrharta erecta*.

Floristic and bird monitoring sites established in 2020 in the South Bates Extension underground mine area, including reference sites outside of the mining area were monitored for the third year. Vegetation and bird communities were recorded in good condition and no significant impacts to floristic attributes or bird communities were observed at sites within areas impacted by undermining to date.

The *Melaleuca decora* low forest Groundwater Dependent Ecosystems (GDE) community was recorded to be in good condition with scores for most attributes increasing since 2019.

High rainfall and flooding conditions of North Wambo Creek has naturally altered creek geomorphology and associated riparian and in-stream vegetation. Vegetation monitoring plots were not undertaken in this community in 2022, however, results for monitoring in 2023 are consistent with 2020-2021. Tree monitoring shows that trees are healthy and in good condition.

As expected, following high rainfall, Feral Pig (*Sus scrofa*) activity appears to have increased in the area, mostly along creeks in the General Surface Area.

Overall, the higher rainfall from 2021-2022 generally improved vegetation condition across the area, however, also increased exotic plant cover. As expected, with lower rainfall in 2023, vegetation attributes are returning to pre-2021 levels, or remaining stable.

No detrimental impacts of underground mining have been recorded within the RWEAs

1. Introduction

Wambo Coal Pty Limited (WCPL) is situated approximately 15 kilometres (km) west of Singleton, near the village of Warkworth, New South Wales (NSW). A range of open cut and underground mine operations have been conducted at WCPL since mining operations commenced in 1969. Mining under the current Development Consent (DA 305-7-2003) commenced in 2004 and permits both open cut, underground operations and associated activities to be conducted. As part of the development consent, a Remnant Woodland Enhancement Program (RWEP) has been established as a biodiversity offset for lands disturbed by open cut coal mining activities. The RWEP aims to conserve local and regional biodiversity by protecting and enhancing the habitat for flora and fauna within these areas through a conservation agreement.

HLA - Envirosciences Pty Ltd initially established a program to monitor the fauna and vegetation structure within the RWEP areas, as well as to monitor stream and riparian condition within North Wambo, Wambo and Stony Creeks, with the aim of measuring and documenting the status and change in ecological condition. Eco Logical Australia (ELA) was commissioned by WCPL to undertake this monitoring program during Spring 2023, making this the eighth year that ELA has completed monitoring at this location. This monitoring program is conducted in response to the 2004 Development Consent condition (DA 305-7-2003 Schedule 4 Condition 48) and informs WCPL's Annual Environmental Management Report (AEMR).

ELA's scope of works included:

- Collection floristic and fauna habitat data from established monitoring locations throughout land owned by WCPL, including remnant woodland enhancement areas (RWEA) (otherwise known as Biodiversity Offset Areas (BOA) or Voluntary Conservation Areas (VCA))
- Conducting vegetation establishment monitoring along the North Wambo Creek Diversion (NWCD)
- Conducting riparian condition monitoring at North Wambo, South Wambo and Stony Creeks
- Conducting bird monitoring at established monitoring locations throughout land owned by WCPL, primarily in land set aside as part of the RWEP
- Winter bird surveys (in lieu of surveys scheduled to be undertaken in 2022)
- Monitoring GDEs above the South Bates Underground Extension area
- Reporting on any mine subsidence observations and other management issues
- Documenting results and compare to performance criteria or past results (where relevant) and identify what and where management actions may be required
- Providing a summary of management actions.

1.1. Report structure

This report has been set out in the following manner:

- Executive Summary – summary of the key findings of the monitoring works.
- Introduction – provides background information to the current report.

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- Remnant woodland enhancement areas (RWEAs) – provides methods, results and interpretation of data, as well as recommendations from flora and bird surveys primarily within RWEA areas.
- Rehabilitation areas – provides methods, results and interpretation of data from vegetation establishment monitoring quadrats and biometric flora survey plots from the NWCD.
- Riparian condition assessment – provides methods, results and interpretation of data, as well as management recommendations for riparian transects at North Wambo, Wambo and Stony Creeks.
- South Bates Underground Extension area – provides methods, results and interpretation of data from monitoring of GDEs, flora and birds in the area above the South Bates Underground Extension.
- Mine subsidence observations and other management issues – provides observations of mine subsidence and other management issues on land owned by WCPL.
- Summary of management actions – provides a summary of required and recommended actions.

Raw data and photographs from monitoring site surveys are included in Volume 2**.**

2. Remnant Woodland Enhancement Areas (RWEAs)

2.1. Floristic monitoring

2.1.1. Introduction

The aim of floristic and fauna habitat monitoring is to measure the current condition of vegetation within the RWEAs in terms of floristics and habitat complexity. The results aim to provide direction for the management of these areas and to inform monitoring programs in the future.

2.1.2. Methods

Data was collected by ELA ecologists Liam Scanlan and Alex Yates from September – October 2023. A standard biometric plot 50 x 20 m (Figure 1) was used to measure the following parameters and collect data following the BioBanking methodology (DECC 2008a):

- Full floristic species list (including cover abundance scores) in a nested 0.04 ha plot (20m x 20m)
- Canopy regeneration over whole vegetation zone
- Estimation of projected native foliage cover of ground cover from 50 points and canopy and mid-storey layer from 10 points along the 50 m transect
- Occurrence and abundance of weed species in 0.04 ha plot (20m x 20m)
- Number of hollow-bearing trees and length of logs (>10cm diameter) in the plot
- Photograph of each plot (at start of 50 m transect).

The abundance of each species in the 0.04 ha plot was estimated, using a modified Braun-Blanquet scale, as used in previous floristic monitoring at WCPL. These are listed below:

- 1 = few, small cover (<5%)
- 2 = numerous (<5%)
- 3 = 5 – 25%
- 4 = 25 – 50%
- 5 = 50 – 75%
- 6 = >75%.

All vascular plants species were recorded and identified to the lowest taxonomic level possible, with samples of unknown species collected for further identification where possible. Nomenclature followed the Flora of New South Wales (Harden 1992; 1993; 2000; 2002), and any subsequent recent taxonomic changes as presented on PlantNet (RBGDT 2015).

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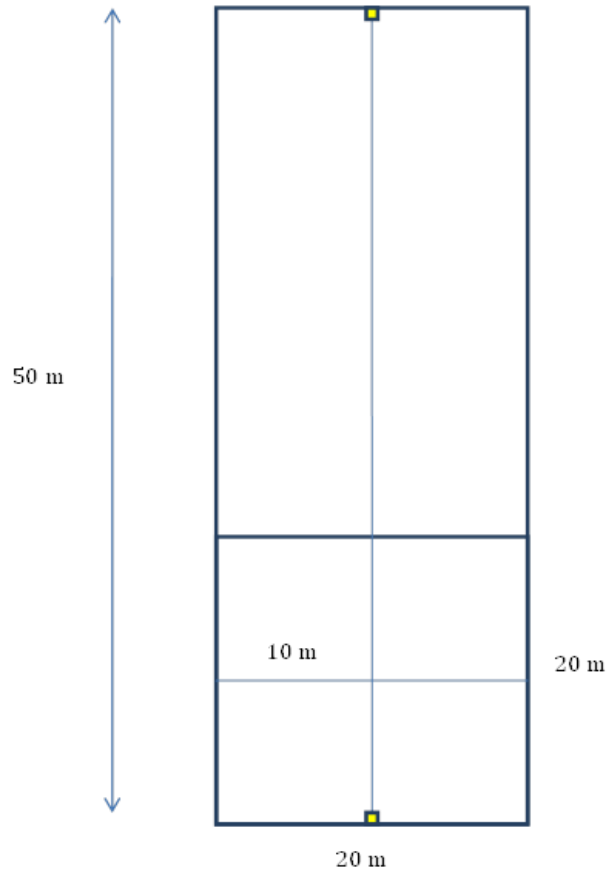

Figure 1: Biometric vegetation plot dimensions

Flora monitoring plots were located within the ten vegetation communities originally mapped and described by Orchid Research (2003). Since this time, a number of changes in vegetation mapping standards in NSW have occurred. Previously a set list of plant communities known as Biometric Vegetation Types (BVT) were used as a state-wide standard by the NSW Office of Environment and Heritage (OEH). These BVTs have now been modified and are now known as Plant Community Types (PCT's). As such, the ten vegetation communities originally mapped and described by Orchid Research (2003) have been converted to their equivalent PCT within this report. Several of these communities are also listed under both State and Federal legislation as Threatened Ecological Communities (TECs) under different nomenclature. Table 1 clarifies the conversion of these vegetation communities.

Data was collected from the 34 locations previously surveyed as part of the RWEP monitoring program. During 2019 and 2020, several additional floristic monitoring plots were added outside of RWEAs in the NWCD and South Bates Extension Underground Mine area as part of the broader Wambo Coal Mine biodiversity monitoring program. These sites are monitored using the same methods described here, with results presented in the relevant sections of this report. All floristic plot locations are shown in Figure 2.

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Table 1: Original vegetation classification, PCT classification and TEC status for each monitoring plot in remnant vegetation

Vegetation Community (Orchid Research 2003)	PCT	TEC	Plot name
River Oak / Rough-barked Apple Forest	PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Listed as Endangered (E) under the NSW *Biodiversity Conservation Act 2016* (BC Act): Hunter Lowland Redgum Forest in the Sydney Basin and New South Wales North Coast Bioregions	V1-A1
			V1-A2
			V1-B1
			V1-B2
			V1-B3
River Red Gum Woodland			V2-A1
			V2-B1
			V2-B2
Yellow Box / Blakely's Red Gum / Rough-barked Apple Forest			V3-B1
Coast Banksia / Rough-barked Apple / Blakely's Red Gum Forest	PCT 1653: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	Listed as E under the BC Act: Warkworth Sands Woodland in the Sydney Basin Bioregion, also listed as Critically Endangered (CE) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as Warkworth Sands Woodland of the Hunter Valley	V5-B1
			V5-B2
			V5-B3
			V5-B4
Narrow-leaf Ironbark/Grey Box/Bulloak/Honeymyrtle Forest	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Listed as E under the BC Act: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V6-A1c
			V6-A3
			V6-B1
			V6-B1c
			V6-B2
			V6-B2c
			V6-B3
			V6-B4
Grey Gum/Narrow-leaf/ Ironbark/Bulloak/Honeymyrtle Forest			V11-B1
			V11-B2
Spotted Gum/Narrow-leaf Ironbark/Bulloak/Paperbark Forest	PCT 1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter	Listed as E under the BC Act: Central Hunter Ironbark - Spotted Gum - Grey Box Forest in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V9-A1
			V9-B1
			V9-B2

Vegetation Community (Orchid Research 2003)	PCT	TEC	Plot name
			V10-B1
Slaty Gum/Narrow-leaf Ironbark/Bulloak/Paperbark Forest	PCT 1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Listed as Vulnerable (V) under the BC Act: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V10-A1
			V10-A2
			V10-B3
White Mahogany/Rough-barked Apple Forest	PCT 1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	N/A	V13-B1
Brush Wilga/Native Olive Shrubland	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Listed as E under the BC Act: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions	V14-A1
			V14-B1
			V14-B2

Cover/abundance scores for each species within each plot in the RWEAs was provided by WCPL from 2010 onwards, with the exception of woodland rehabilitation sites, which were sampled for the first time by ELA during monitoring undertaken in 2015. Biometric plot data using the current method was collected for the first-time during monitoring undertaken in 2014.

Data was examined for changes in native species richness within each sampled plant community over thirteen monitoring periods from 2010 to 2023 and cover of exotic species over the last eight monitoring periods (2016 to 2023). Monitoring point photographs were also compared where possible to determine if major structural elements of each community had changed since the earliest photos available were taken (generally in 2013). Data from each vegetation community was compared to established performance criteria, biometric benchmarks and compared with reference sites outside of the RWEA areas where possible.

Vegetation community condition benchmarks (developed by OEH for each PCT) have been modified to provide realistic, ambitious yet achievable performance criteria for each PCT. Monitoring results can then be compared to these criteria to determine if management actions are likely to be required.

A green, yellow, orange and red colour system has been developed to rank each measured attribute according to performance and management actions required (Table 2). The structure of this table has been derived from the *Terrestrial Biodiversity Assessment Tool – Operational manual* (DECC 2008b). The number of hollow-bearing trees and length of fallen logs have been presented as a measure of fauna habitat attributes. No performance criteria have been set for these attributes in remnant vegetation, as in situations where historical logging or clearing has been intensive, it may take many years for a suitable density of hollows and logs to form naturally.

Table 2: Colour ranking system for floristic attributes and performance targets

Attribute	Red (needs greater improvement)	Orange (in need of improvement)	Yellow (not meeting target but values still acceptable)	Green (excellent – within target range)
Native species richness	0–10%	>10 – <50% of target range	50 – <100% of target range	≥ target range
Native overstorey cover %	0 – 10% or >200% of target range	> 10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native mid-storey cover %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – grasses %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – shrubs %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Native ground cover – other %	0 – 10% or >200% of target range	>10 – <50% or >150 – 200% of target range	50 – <100% or >100 – 150% of target range	within target range
Proportion of native overstorey species regenerating	0	0-0.5	0.5-1	1
Exotic cover	>66%	33-66	5-33	0-5%

Several abbreviations for measured attributes are used in tables throughout the following section. An explanation of these is provided below.

- NPS – the number of native plant species
- NOS (%) – projected native foliage cover of canopy
- NMS (%) – projected native mid-storey cover
- NGCG (%) – native groundcover of grasses
- NGCS (%) – native groundcover of shrubs
- NGCO (%) – native groundcover of other plant types (sedges, herbs etc.)
- EPC (%) – exotic plant cover
- OR – proportion of overstorey species regenerating over the whole vegetation zone
- HBT – number of hollow-bearing trees present in the 20 x 50 m vegetation plot
- FL – length of fallen logs >10 cm diameter.

In addition to those performance criteria listed above, Annexure C of the VCAs for the RWEA areas requires that WCPL aim for an exotic plant cover within the Conservation Areas that does not exceed the percentages detailed in Table 3. Target limits for Years 6-10 are used for the ongoing. Photo-monitoring points established as part of the VCAs in 2013 were compared to photos at the same location during the current vegetation monitoring.

Table 3: Exotic plant cover criteria for VCA areas

RWEA	Aim	Timing
Coal Terminal	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site CT1 - 15% of the foliage cover at monitoring site CT2.	In Year 1 and at the end of Year 5
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site CT1; and - 10% of the foliage cover at monitoring site CT2.	Years 2-5 (2017-2020)
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site CT1; and - 5% of the foliage cover at monitoring site CT2.	Years 6-10 (2021-2025)
RWEAs A, B, C and D	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 70% of the foliage cover at monitoring site A1 within Area A - 20% of the foliage cover at monitoring site A2 within Area A - 30% of the foliage cover at monitoring site A3 within Area A - 10% of the foliage cover at monitoring site A4 within Area A - 5% of the foliage cover at monitoring site B1 within Area B - 5% of the foliage cover at monitoring site B2 within Area B - 5% of the foliage cover at monitoring site C1 within Area C - 5% of the foliage cover at monitoring site D1 within Area D.	In Year 1 (2016)
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 60% of the foliage cover at monitoring site A1 within Area A - 15% of the foliage cover at monitoring site A2 within Area A - 20% of the foliage cover at monitoring site A3 within Area A	Years 2-5+ (2017-2020)

RWEA	Aim	Timing
	- 5% of the foliage cover at monitoring site A4 within Area A - 5% of the foliage cover at monitoring site B1 within Area B - 5% of the foliage cover at monitoring site B2 within Area B - 5% of the foliage cover at monitoring site C1 within Area C - 5% of the foliage cover at monitoring site D1 within Area D.	
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 40% of the foliage cover at monitoring site A1 within Area A - 10% of the foliage cover at monitoring site A2 within Area A - 15% of the foliage cover at monitoring site A3 within Area A - 5% of the foliage cover at monitoring site A4 within Area A - 5% of the foliage cover at monitoring site B1 within Area B - 5% of the foliage cover at monitoring site B2 within Area B - 5% of the foliage cover at monitoring site C1 within Area C; and - 5% of the foliage cover at monitoring site D1 within Area D,	Years 6-10 (2021-2025)
RWEA E	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 10% of the foliage cover at monitoring site E1	In Year 1
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site E1	Years 2-5
	Exotic plant cover within the Conservation Area must not be permitted to exceed: - 5% of the foliage cover at monitoring site E1	Years 6-10

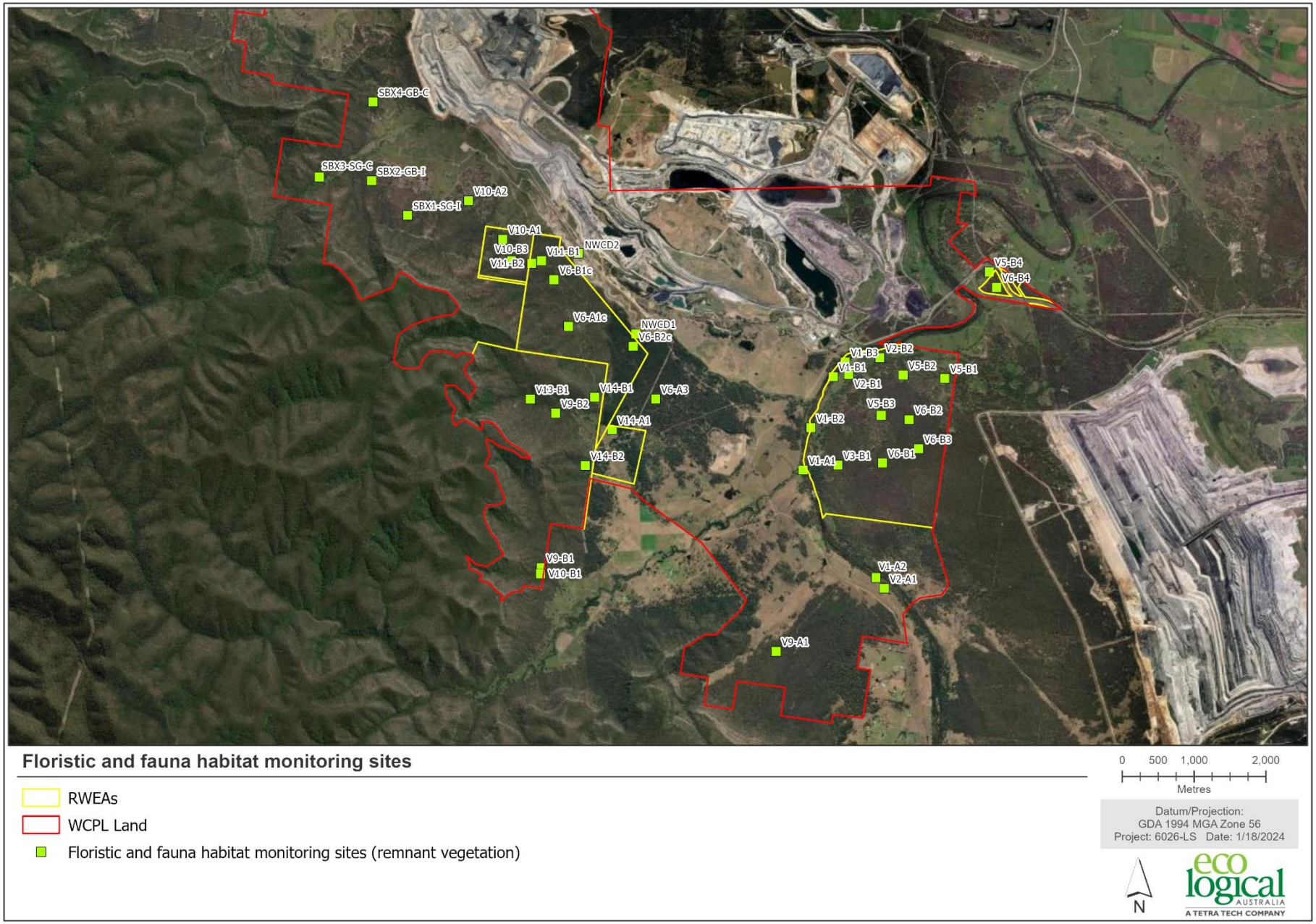

Figure 2: Floristic and habitat monitoring sites and RWEAs

2.1.3. Results

The floristic and biometric data collected during floristic and fauna habitat monitoring is summarised below, with a focus on monitoring features that fell below the performance criteria. The full floristic plot data and other data including plot photographs are provided in Volume 2.

2.1.4. River Red Gum / River Oak riparian woodland wetland in the Hunter Valley

This community is one of the most disturbed vegetation communities on WCPL land, as it occurs on more fertile soils on the banks and floodplains of Wollombi Brook, is naturally disturbed by flood events and has been historically used more intensively for agricultural purposes (Photograph 1).

River Red Gum / River Oak riparian woodland is distinguished by an overstorey of *Eucalyptus camaldulensis* (River Red Gum), *Casuarina cunninghamiana* subsp. *cunninghamiana* (River Oak), *Angophora floribunda* (Rough-barked Apple) and *Eucalyptus melliodora* (Yellow Box) on floodplains and riparian areas. This PCT conforms to the BC Act listed Endangered Ecological Community (EEC) *Hunter Floodplain Red Gum Woodland in the NSW North Coast and Sydney Basin Bioregions*. This community also contains the endangered Hunter Valley population of *Eucalyptus camaldulensis* listed under the BC Act.

Photograph 1: River Red Gum / River Oak riparian woodland wetland on North Wambo Creek in 2023 (Site V1-A1 within the Wollombi Brook channel)

Nine monitoring plots are located within this PCT. V1 monitoring sites are located within *Casuarina cunninghamiana* dominated forest along the banks of Wollombi Brook. V2 monitoring sites are located on the partially cleared red gum dominated floodplains of Wollombi Brook and the V3 monitoring site is located in a slightly wetter location on the boundary of the floodplain and sand dunes supporting Warkworth Sands type vegetation.

Three sites (V1-A1, V1-A2 and V2-A1) appear to have been originally intended as reference sites at the commencement of the monitoring program, as they are located outside of the RWEP areas. However, cattle have been fenced out of the immediate riparian zone on Wollombi Brook (including sites V1-A1, V1-A2) and thus treatments for both reference sites and management sites are similar.

Overall, average NMS was below the performance criteria target and EPC exceeded the upper limit of the performance criteria target in 2023. Targets were met or acceptable for all other performance criteria (Table 5).

2.1.4.1. Native midstorey cover

Native midstorey cover was below the performance criteria target for RWEA monitoring sites in 2023. Average NMS was 1.58% and the target is 10-50%. This is not considered a management concern within these vegetation communities due to the natural disturbance of occasional flooding and inundation. For example, inundation at V3-B1 favours high groundcover of rushes and sedges (Photograph 2 and Photograph 3) and flooding along Wollombi Brook may limit the midstrata (Photograph 4 and Photograph 5).

Photograph 2: Flora monitoring site V3-B1 during 2015

Photograph 3: Flora monitoring site V3-B1 during 2023

Photograph 4: Monitoring site A3 during 2013

Photograph 5: Monitoring site A3 during 2023

2.1.4.2. Exotic Plant Cover

EPC has been recorded since 2014 and results are variable over time (Figure 3). EPC was slightly lower than 2022, 2021 and 2020, however exotic plant cover was still higher than all other years except 2016, which was notably also a year with higher-than-average rainfall. The trends suggest EPC is related to rainfall. Floristic plot data suggests total exotic plant cover is a result of a combination of both annual and perennial species.

Several priority weeds are present within this PCT, these are listed in Table 4 below, along with their biosecurity duty according to NSW Department of Primary Industries (DPI 2017). Priority weed distribution and abundance was generally similar to previous years. *Senecio madagascariensis* (Fireweed) was recorded at all sites except V3-B1.

Photo monitoring points in this PCT show no obvious changes within this PCT between years 2015 and 2023 (Photograph 2 and Photograph 3), and 2013 and 2023 monitoring (Photograph 4 and Photograph 5), although evidence of recent wetter seasonal conditions in the last few years is evident in the understorey of some 2023 photos.

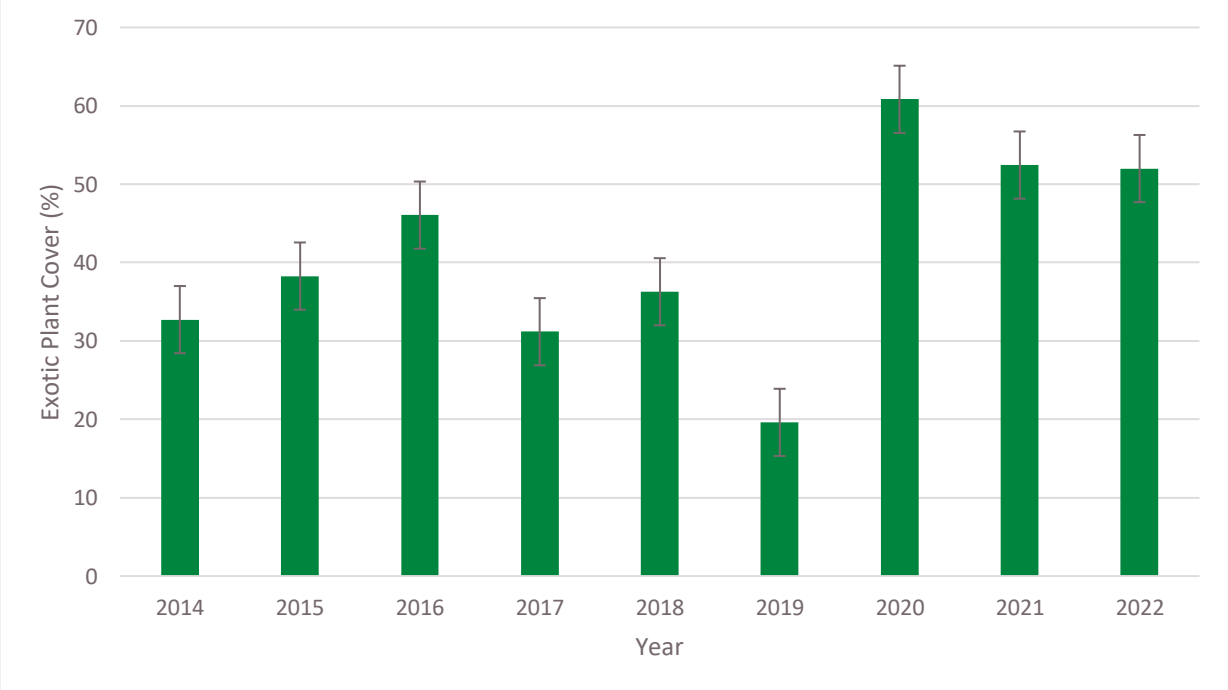

Figure 3: Average EPC within all riparian woodland monitoring sites per year. Error bars represent the standard error of the mean.

Table 4: Priority weeds for the Hunter Region observed within the River Red Gum / River Oak riparian woodland PCT plots in 2023

Scientific Name	Common Name	Site	Biosecurity duty (NSW Biosecurity Act 2015)
Asparagus asparagoides	Bridal Creeper	V2-B1	Prohibition on dealings - Must not be imported into the State or sold.
Echium plantagineum	Patterson's Curse	V1-A2, V1-B3	Regional Recommended Measure - Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. The plant should not be bought, sold, grown, carried or released into the environment.
Eragrostis curvula	African Lovegrass	V1-B3, V2-A1, V2-B1	Regional Recommended Measure Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment.
Galenia pubescens	Galenia	V2-A1, V2-B1	Regional Recommended Measure An exclusion zone is established for all land in the region, except the core infestation which includes parts of: Lake Macquarie Local Government Area, Maitland Local Government Area, Muswellbrook Local Government Area, Newcastle Local Government Area, Singleton Local Government Area, Upper Hunter Local Government Area. Entire Hunter Local Land Services region: Land managers should mitigate the risk of the plant being introduced to their land. Exclusion zone: Notify local control authority if found. Land managers should eradicate the plant from the land and keep the land free of the plant. A person should not deal with the plant, where dealings include but are not limited to buying, selling, growing, moving, carrying or releasing the plant. Core infestation: Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.
Heliotropium amplexicaule	Blue Heliotrope	V1-A2, V2-A1, V2-B1, V2-B2	Regional Recommended Measure Land managers should mitigate the risk of the plant being introduced to their land. Land managers should mitigate spread of the plant from their land. A person should not buy, sell, move, carry or release the plant into the environment. Land managers should reduce the impact of the plant on assets of high economic, environmental and/or social value.
Olea europaea subsp. *cuspidata*	African Olive	V1-B3, V2-B1	Regional Recommended Measure - Land Area 1: Singleton and Maitland. Land Area 2: outbreaks in Hunter region except Singleton and Maitland.

Scientific Name	Common Name	Site	Biosecurity duty (NSW Biosecurity Act 2015)
			Land Area 1: Land managers should mitigate the risk of new weeds being introduced to their land. Land managers should mitigate spread from their land. Land Area 2: Land managers should mitigate spread from their land. Land managers should mitigate the risk of new weeds being introduced to their land. Plant should not be bought, sold, grown, carried or released into the environment.
Rubus fruticosus species aggregate	Blackberry	V1-A1	Prohibition on certain dealings Must not be imported into the state, sold, bartered, exchanged or offered for sale.
Salix species	Willows	V1-A1, V1-B1	Prohibition on dealings - Must not be imported into the State or sold.
Senecio madagascariensis	Fireweed	All sites except V3-B1	Prohibition on dealings - Must not be imported into the State or sold.

Table 5: Floristic results and performance criteria for River Red Gum / River Oak riparian woodland wetland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL (m)
River Oak / Rough-barked Apple Forest	PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	Outside of RWEP	V1-A1	7	24.5	0	30	0	60	72	1	0	80
		Outside of RWEP	V1-A2	8	12	0	76	0	12	46		1	28
		A	V1-B1	10	5.9	0	10	0	0	28		1	60
		A	V1-B2	16	18.5	0	32	6	0	34		0	18
		A	V1-B3	9	7.3	1	8	12	18	80		0	10
River Red Gum Woodland		Outside of RWEP	V2-A1	13	24.7	6	98	26	38	0		2	0
		A	V2-B1	18	14.1	0	34	0	24	76		1	6
		A	V2-B2	13	19.5	8.5	24	14	2	88		2	18
Yellow Box / Blakely's Red Gum / Rough-barked Apple Forest		A	V3-B1	24	24	16	0	60	2	52		4	30
Average values for RWEA monitoring sites				15	13.6	1.6	28	5.7	16	51.7	1	1.3	23.7
Performance criteria				>20	10-50	10-50	20-60	1-5	5-30	<10	1	-	-

2.1.5. Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area

Within WCPL owned land, this community is mostly restricted to the eastern side of Wollombi Brook, primarily within the RWEP area A (Photograph 6). This PCT corresponds to the EPBC Act listed Critically Endangered Ecological Community (CEEC) *Warkworth Sands Woodland of the Sydney Basin Bioregion* and is also listed under the BC Act. This PCT occurs on aeolian sand deposits and is restricted to the Warkworth area.

Banksia integrifolia (Coast Banksia) has been observed to suffer die-back over the past few years and continued to not be recorded as live in any plots in 2021. Live individuals and seedlings were observed more broadly within this PCT during 2022 and 2023. Monitoring should continue to note the health of this species within the PCT. It is assumed that this die-back was related to pre-2019 drought conditions, and regeneration should occur following the higher rainfall in 2020-2022.

Average NGCG was 69.5%, well above the performance criteria target of 4-20%. However, this is not considered to be a major concern, with the higher grassy cover likely to be continuing as a result of continued higher rainfall in 2021 and 2022. Reduction of this high grass cover is not recommended at this stage as increased fire may favour the establishment of exotic grasses including *Melinis repens* (Red Natal Grass) and *Eragrostis curvula*.

Overall, this PCT is performing acceptably, although surveys and ongoing weed control should continue. Extensive work has been undertaken since 2020 to manage *Bryophyllum* sp. (Mother of Millions), and more recently *Melinis repens* and *Eragrostis curvula*.

Photograph 6: Warkworth Sands Woodland within RWEA A in 2023 (Site V5-B2)

2.1.5.1. Exotic plant cover

In 2023 EPC decreased and met the performance criteria. In recent years, the environmental weed *Bryophyllum* sp. (Mother of Millions) was observed to be abundant in certain locations within this vegetation community, both within RWEA A and inside the Rail Loop area. *Bryophyllum* sp. is listed as a priority weed in the Hunter under the *Biosecurity Act 2015* and this species is currently the focus of a weed management program in RWEA A and Rail Loop. *Melinis repens* and *Eragrostis curvula* have also established with high cover in RWEA A in recent years and are being treated on an ongoing basis by land management contractors. The progress of the weed management program is evident in 2023 monitoring results, with *Bryophyllum* sp. occurring only in V5-B2 and *Melinis repens* only occurring in V5-B4. However, these species were recorded opportunistically in other locations outside of the monitoring plots throughout RWEA A and the Rail Loop area.

Photo-monitoring point A2 within this PCT shows a minor change in vegetation between the 2013 and 2023 monitoring periods, with a reduction in cover of *Pteridium esculentum* (Bracken) apparent (Photograph 7 and Photograph 8).

Photograph 7: Photo monitoring point A2 during 2013

Photograph 8: Photo monitoring point A2 during 2023

Table 6: Floristic results in regards to performance criteria for Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Coast Banksia / Rough-barked Apple / Blakely's Red Gum Forest	PCT 1658: Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area	A	V5-B1	32	31.5	0.5	90	4	58	2	1	1	11
		A	V5-B2	22	33.5	12.5	86	18	74	4		3	5
		A	V5-B3	30	17	10.5	62	38	36	0		2	12
		Rail Loop	V5-B4	32	27.5	0	40	10	14	16		1	8
Average values for RWEP and Rail Loop monitoring sites				29	27.4	5.9	69.5	17.5	45.5	5.5	1	1.8	9
Performance criteria				>20	10-40	10-50	4-20	5-30	5-35	<10	1	-	-

2.1.6. Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

This community on land owned by WCPL is generally dominated by the canopy species *Eucalyptus crebra* (Narrow-leaved Ironbark) and occasionally *Eucalyptus moluccana* (Grey Box). A sparse mid-storey or shrub layer of *Allocasuarina luehmannii* (Bull Oak), *Bursaria spinosa* subsp. *spinosa* (Blackthorn) and *Notelaea microcarpa* var. *microcarpa* (Mock Olive), with a grassy understorey is often present. *Eucalyptus punctata* (Grey Gum) and *Melaleuca decora* also occur in some areas.

Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest forms part of the BC Act listed EEC *Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions*. Sections of this community in good condition with a Eucalypt canopy are also likely to be the *Central Hunter Valley eucalypt forest and woodland* CEEC listed under the EPBC Act.

This community appears to be performing well with generally very low cover of exotic species and high diversity of native species present at each monitoring plot. Performance criteria were met or acceptable for all other attributes and exceeded for NGCS. NGCS exceeding the upper limit by 16.2% cover is not considered to be a major management concern as the shrubs contributing to NGCS are native species. However, this high level of shrub cover may indicate that a hazard reduction burn may be beneficial.

Photo monitoring point A4 (Photograph 10 and Photograph 11) samples this community, and increased grass cover is observable between the 2013 and 2023 monitoring periods.

Subsidence cracking is present at four of the eight monitoring plots within this PCT. However, no impacts to vegetation condition have been observed. Very large cracks are present at site V11-B1 in RWEA C and ELA recommends WCPL inspect this area and undertake remediation of large subsidence cracks if possible.

Photograph 9: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest at WCPL (site V6-A3 in 2023)

Photograph 10: Photo-monitoring point A4 during 2013

Photograph 11: Photo-monitoring point A4 during 2023

Table 7 : Floristic results and performance criteria for Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Narrow-leaf Ironbark/ Grey Box/ Bulloak/ Honeymyrtle Forest	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	C	V6-A1c	36	24	17	96	38	36	0	1	2	22
		Outside of RWEP	V6-A3	24	19	9	36	18	16	0		0	15
		A	V6-B1	31	28.5	12	74	0	12	2		2	32
		C	V6-B1c	41	16	14.5	58	34	28	0		0	28
		A	V6-B2	33	17.5	13.5	64	14	30	6		1	50
		C	V6-B2c	33	22.5	17	76	32	24	0		0	24
		A	V6-B3	36	18.5	14	78	22	36	4		3	35
		Rail Loop	V6-B4	16	25	5	50	4	20	4		0	6
Grey Gum/ Narrow-leaf Ironbark/ Bulloak/ Honeymyrtle Forest		C	V11-B1	27	17.5	16	66	72	14	0		0	55
		C	V11-B2	47	15.5	21.5	100	20	44	0		0	28
Average values for RWEP and Rail loop monitoring sites				33.3	20.6	14.5	73.6	26.2	27.1	1.8	1	0.9	31.1
Performance criteria				>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-

2.1.7. Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter

Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter at WCPL is characterised by an overstorey of *Eucalyptus crebra*, *Corymbia maculata* (Spotted Gum) and *E. moluccana. E. punctata* and *Eucalyptus dawsonii* (Slaty Gum) are also occasionally present. The mid-storey or shrub layer often includes *Melaleuca decora, Bursaria spinosa subsp. spinosa, Allocasuarina luehmannii* and *Olearia elliptica* (Sticky Daisy Bush). This community corresponds to the EEC *Central Hunter Ironbark -Spotted Gum – Grey Box Forest* listed under the BC Act. Sections of this community in good condition with a Eucalypt canopy are also likely to be the *Central Hunter Valley eucalypt forest and woodland* CEEC, listed under the EPBC Act.

This PCT is performing well meeting all performance criteria in 2023, except NGCG and NGCS which exceeded the upper limits of the performance criteria (Table 8). Average NGCG exceeded the upper limit by 21.3. This result is consistent with 2022 and 2021 cover, which increased significantly from 2020 and is likely a result of increased growth in response to higher rainfall, and not considered to be a management concern. Similarly, NGCS exceeding the upper limit by 29.7% is not considered to be a major management concern as the shrubs contributing to NGCS are native species. However, this high level of shrub cover may indicate that a hazard reduction burn may be beneficial..

Photo-monitoring points in this community show no negative changes in vegetation structure between the 2013 and 2023 monitoring periods (Photograph 12 and Photograph 13) but an increase in ground cover (grasses and grass-like plants) and midstorey foliage cover is evident. Overall, this PCT is performing well, and no additional management actions are required at this stage.

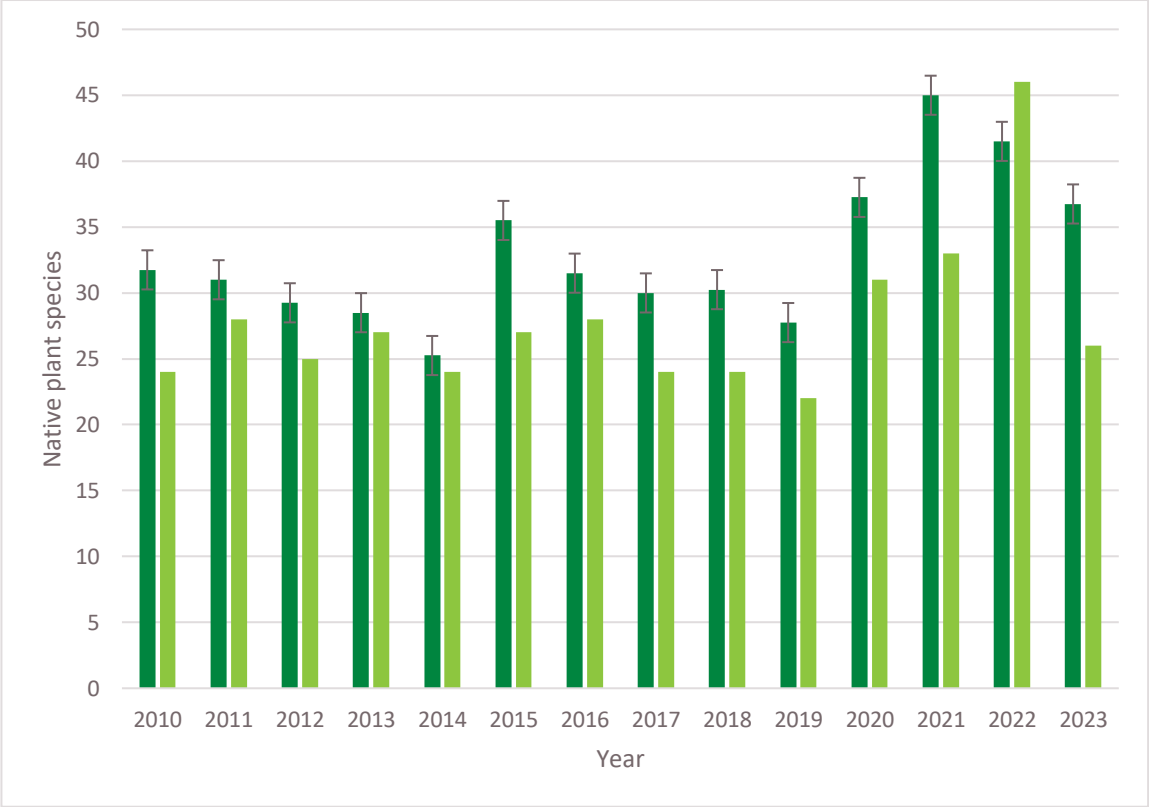

Figure 4: The average number of NPS in Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland within RWEAs (dark green) compared to the recorded number at reference site V9-A1 (light green). Error bars represent the standard error of the mean.

Photograph 12: Photo-monitoring point B2 during 2013

Photograph 13: Photo-monitoring point B2 during 2023

Table 8: Floristic results, performance criteria for Narrow-leaved Ironbark - Grey Box - Spotted Gum woodland at Wambo

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Spotted Gum / Narrow-leaf Ironbark/ Bulloak / Paperbark Forest	PCT1604: Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass of the central and lower Hunter	Outside of RWEP	V9-A1	26	11.5	9.5	50	6	22	2	1	1	18
		B	V9-B1	36	29	6.5	86	36	40	0		2	25
		B	V9-B2	44	21.5	8.5	50	48	14	0		0	17
		B	V10-B1	41	32	15	78	50	66	4		3	36
Average values for RWEP monitoring sites				40.3	27.5	10	71.3	44.7	40	1. 3	1	1. 7	26
Performance criteria				>35	15-40	5-20	30-50	5-15	5-40	< 5	1	-	-

2.1.8. Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion

The canopy of Slaty Box - Grey Gum shrubby woodland is typically dominated by *Eucalyptus dawsonii* and several other species including *E. punctata, E. moluccana* and *E. crebra. Acacia salicina* (Cooba) and *Allocasuarina luehmannii* may form a small tree layer or be part of the upper-most canopy. The shrub layer includes species such as *Olearia elliptica, Acacia cultriformis* (Knife-leaved Wattle), *Canthium odoratum* (Shiny-leaved Canthium), *Notelaea microcarpa var. microcarpa* and *Dodonaea viscosa* subsp. *cuneata* (Wedge-leaf Hopbush). The groundcover is generally sparse to very sparse and can be poor during drier years (Photograph 14). This community is listed under the BC Act as the EEC *Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion*. Sections of this community in good condition with a Eucalypt canopy are also likely to be the *Central Hunter Valley eucalypt forest and woodland* CEEC under the EPBC Act.

At WCPL, this PCT primarily occurs on the smaller ridge tops and slopes and is patchily distributed at lower elevations. *E. crebra* is often present and may co-dominate the canopy with *E. dawsonii*. This PCT is generally in good condition, particularly on the slopes and ridgetops where historical disturbance from forestry and grazing has been minimal. Occasional occurrences of the priority weed *Opuntia* spp. were observed at low densities, similar to other woodland areas at WCPL.

The monitoring sites in this community are located in or near RWEA D. All performance criteria were met or acceptable in 2023. Average NMS which was 1.5 below the performance criteria and average NGCS was 4 above the performance criteria, however these values are still acceptable. Average NGCG was again very high (60%) above the target range of 5-30% (Table 9). Average NMS, NGCS and NGCG outside of the performance criteria are not considered to be major management concern as the shrubs and grasses contributing to NGCS and NGCG are native species. However, this high level of shrub and grass cover may indicate that a hazard reduction burn may be beneficial.. Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 14: A typical example of Slaty Box woodland at WCPL during 2023 (Site V10-B3)

Table 9: Floristic results, performance criteria for Slaty Box - Grey Gum shrubby woodland

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Slaty Gum / Narrow-leaf Ironbark / Bulloak / Paperbark Forest	1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	D	V10-A1	48	14.5	6.5	72	6	8	0	1	0	28
		Outside of RWEP	V10-A2	33	21	4.5	44	34	8	0		0	12
		D	V10-B3	37	25.8	0.5	48	52	8	0		2	40
Average values for RWEP monitoring sites				42.5	20.2	3.5	60	29	8	0	1	1	34
Performance criteria				>21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-

2.1.9. White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley

At WCPL, this community occurs along Stony Creek and is sheltered by steep sandstone escarpments to the south and a large ridgeline to the north. This PCT is in good condition with many native species and occasional large remnant trees with hollows. One monitoring plot (V13-B1) samples this PCT (Photograph 15).

This monitoring site met or exceeded all performance targets. NGCG exceeded the performance target by 38% cover, NGCO by 62% cover and NGCO by 66% cover (Table 10), though this is not considered major management concern as the shrubs contributing to NGCS are native species. However, this high level of shrub cover may indicate that a hazard reduction burn may be beneficial...

Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 15: White Mahogany - Spotted Gum - Grey Myrtle forest at V13-B1 in 2023

Table 10: Biometric scores and performance criteria for White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest at Wambo

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
White Mahogany / Rough-barked Apple Forest	PCT 1584: White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley	B	V13-B1	45	20	29.5	78	82	86	0	1	1	35
Performance criteria				>45	15-45	5-40	5-40	10-20	5-20	0	1	-	-

2.1.10. Brush Wilga/Native Olive Shrubland

The monitoring plots within this PCT are dominated by the shrubs *Notelaea microcarpa var. microcarpa, Geijera salicifolia* (Brush Wilga), *Olearia elliptica* and the small tree *Brachychiton populneus* (Kurrajong) (Photograph 16). Occasional *Eucalyptus crebra* or *E. moluccana* are present as canopy species. The PCT sampled by floristic monitoring may be a partially derived community, resulting from the historic removal of overstorey species in Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest combined with a south facing aspect. These areas are in good condition, with a large number of native species and few exotic species.

NGCG, NGCS and NGCO were above the target range again in 2023 (Table 11). This is not considered a major management concern as the shrubs contributing to NGCS are native species. However, this high level of shrub cover may indicate that a hazard reduction burn may be beneficial.. Overall, this PCT is considered to be performing well and no additional management actions are required at this stage.

Photograph 16: Brush Wilga/Native Olive Shrubland at V14-B2 in 2023

Table 11: Biometric scores and performance criteria for Brush Wilga/Native Olive Shrubland at WCPL

Vegetation Community (Orchid Research 2003)	PCT	RWEP Area	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Brush Wilga/Native Olive Shrubland	PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Reference site/now within RWEA E	V14-A1	42	0	61.5	80	62	50	2	1	0	8
		B	V14-B1	34	11.5	30	94	62	12	0		0	30
		B	V14-B2	43	21.5	41	92	84	94	0		0	7
Average values for RWEP monitoring sites				38.5	16.5	35.5	93	73	53	0	1	0	18.5
Performance criteria				>30	5-40	5-40	30-50	5-10	10-40	<5	1	-	-

2.1.11. Conservation agreement requirements and photo monitoring points

Annexure C of the VCAs requires that WCPL aim for an exotic plant cover within the Conservation Areas that does not exceed the EPC percentages detailed in Table 3. Target limits for Years 6-10 are used.

Three of the ten monitoring plots exceeded the exotic cover limits for the 6–10-year targets (Table 12). The sites exceeding limits are located within RWEA A and RWEA Rail Loop.

Table 12: Exotic plant cover at monitoring sites in regard to VCA targets

RWEA	Site Code for VCA	Corresponding flora monitoring plot	Exotic cover limits yr 1	Exotic cover limits yrs 6-10	Total exotic cover from biometric plots in 2023
Coal Terminal (Rail Loop)	CT1	V6-B4	5	5	4
Coal Terminal (Rail Loop)	CT2	V5-B4	15	15	16
A	A1	V2-B1	70	40	76
A	A2	V5-B1	20	10	2
A	A3	V1-B2	30	15	34
A	A4	V6-B1	10	5	2
B	B1	V13-B1	5	5	0
B	B2	V9-B1	5	5	0
C	C1	V11-B1	5	5	0
D	D1	V10 -B3	5	5	0
E	E1	V14-A1	10	5	2

At Site A1, within the riparian zone of Wollombi Brook in RWEA A, high exotic cover (76%) was recorded, consistent with 2022 and 2021 monitoring. This exceeds the target limit of 60%, which is a high target reflective of the disturbed condition of the site. Exotic cover at this site is dominated by *Eragrostis curvula* (African Lovegrass), *Heliotropium amplexicaule* (Blue Heliotrope) and *Ehrharta erecta* (Panic Veldtgrass). This site has previously had exotic cover as high as 95% in 2014. The high cover in 2023 is a result of continuing strong growth of ground cover vegetation in response to rainfall and surface water flows in the Wollombi Brook channel. Tree planting is recommended in this area with the strategy to shade out the exotic ground covers over time and improve fauna habitat.

At Site CT2 within the Rail Loop, major fluctuations in exotic cover over time has also occurred. Moderate exotic cover (16%) was recorded in 2023, a decrease from 64% which was recorded in 2022. No exotic cover was recorded from 2017-2019, and very high exotic cover (52%) was recorded in 2016. The exotic cover at this site is dominated by *Melinis repens* and *Eragrostis curvula*. It is suspected that the variation in cover of exotic grasses is driven by rainfall, with 2016, 2020 and 2021 all being higher than average rainfall years, and 2017-2019 being relatively dry years. Nevertheless, the species are perennial and likely to be present in all years but contributing more cover in wet years. The data from floristic plot V5-B4 is used as a reference for CT2 results. Plot V5-B4 is technically outside of the RWEA Loop Area although the area receives the same management treatment.

At Site CT1, monitored at V6-B4, exotic cover decreased and was within the exotic cover limit of 5% in 2023. This site recorded three common exotic species with low cover.

At Site A3, monitored at V1-B2, recorded total exotic cover of 34% with dominant exotic species of *E. erecta* and *Cardiospermum grandiflorum (Balloon Vine)*. Total exotic cover at this site has remained relatively stable since 2015, with an average exotic cover from 2014-2022 of 48%. The year 2020 recorded 94% cover, which has steadily decreased since 2021.

Site A2, monitored at V5-B1, recorded total exotic cover of 2% with dominant exotic species of *Richardia humistrata* and *E. erecta*. Total exotic cover at this site has varied over time. The result in 2023 is 20% lower than the exotic cover recorded in 2022.

Exotic cover is very low or zero at the remaining sites (A4, B1, B2, C1 and D1) and all these fell below the exotic cover limits.

Comparison of photo-monitoring sites between 2013 and 2023 monitoring show no major changes in vegetation over this time period. Drier conditions in 2023, compared to wetter conditions during 2020 – 2022, are apparent in some photographs, but in general, no major changes in species composition or structure are apparent. Dry conditions were also observed and reported in previous years (2017-2019). These observations correspond to the floristic data collected within biometric plots with higher ground cover scores recorded across most PCTs during 2023.

2.1.12. Floristic monitoring discussion and recommendations

The majority of remnant woodland areas remain in good condition with high numbers of native species, few exotic species present and with low cover and abundance. No major issues were identified that require urgent management. However, as reported in previous years, exotic species cover remains relatively high in riparian and floodplain areas and continues to exceed performance criteria and also VCA targets in certain locations. Continued weed management will be required to achieve performance criteria in these riparian and floodplain areas.

The number of native species generally remained the same from the previous year and was relatively high in several PCTs. The 2023 results appear consistent with previous findings that some lower scores for native species diversity recorded in recent years were a result of the dry conditions, with the increase in 2021 and 2022 in response to higher rainfall.

Several weed species listed under the Biosecurity Act 2015 were observed in these areas that have potential to become problematic in the wider region e.g. *Bryophyllum* sp., *Olea europaea* subsp. *cuspidata*, or have the potential to severely alter and degrade vegetation community composition e.g. *Melinis repens*, *Eragrostis curvula* and *Ehrharta erecta*. It is recommended to give priority to species such as this in the mine's weed control program. As discussed in previous monitoring reports, planting of canopy species should be considered in RWEA A, where natural regeneration is unlikely to occur in a reasonable timeframe (i.e. the open grassland areas of on the Wollombi Brook floodplain). Once established, these plantings may also reduce issues with exotic flora species in these areas.

Climatic conditions are considered to be a major factor in the fluctuation of results observed over time. Annual rainfall data from 2023 from Bulga (Down Town) (BOM 2023) shows rainfall to date in 2023 has been low. This follows above high rainfall in 2020, 2021 and 2022 and low rainfall in 2017, 2018 and

2019. This data corresponds to the generally higher diversity and cover of native flora species observed in 2021 and 2022, and the lower scores reported in the previous dry years. Similar increased native diversity and exotic cover were reported in 2016 which was also a year of above average rainfall.

The Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland (in RWEA A) appears to be suffering from *Banksia integrifolia* die-off in the mid-storey, first observed in 2019 and continuing this year. Lower exotic covers were also recorded within RWEA A in 2023 compared to higher exotic covers recorded in 2022. This community occurs on sandy soils, and it is possible the soils suffered more significant drying during the recent dry years than other areas and the rainfall to date has not been sufficient to recharge the soil. This community is listed as a CEEC under the EPBC Act, future monitoring should continue to record the condition of this community.

Melinis repens, and to a lesser extent *Eragrostis curvula* and *Ehrharta erecta*, have established within the RWEA A and the Rail Loop, likely in response to high rainfall since 2019. Increased weed control has been undertaken in response, with trials being undertaken by weed management contractors to assess the effectiveness of herbicide application. It is recommended that weed control is continued.

The RWEA Conservation Agreement states that a fire management hazard reduction burn must be implemented between Years 1 – 10 of RWEA management. The high groundcover of shrubs, grasses anbd other within a number of communities in 2023, following high rainfall in 2020-2022, indicates that a hazard reduction burn may be beneficial (Figure 5). Targeted outcomes of hazard reduction burns would be lowering the groundcover to amounts that are closer to target values, and reducing the fuel load for fire management. The Conservation Agreement states that NSW Rural Fire Service or fire management contractor should be consulted to implement a hazard reduction burn. The Agreement also states that the burn must be conducted during a low risk fire season, taking into account the recommended fire intervals given in *Bush Fire Environmental Assessment Code for New South Wales* (Rural Fire Service February 2006) and the guidelines contained in the *Threatened Species Hazard Reduction Lists for the Bush Fire Environmental Assessment Code* or equivalent replacements.

It is recommended that any planning on hazard reduction plans within RWEA A and Rail Loop takes a strong focus on reducing the spread and further establishment of *Melinis repens* and *Eragrostis curvula*.

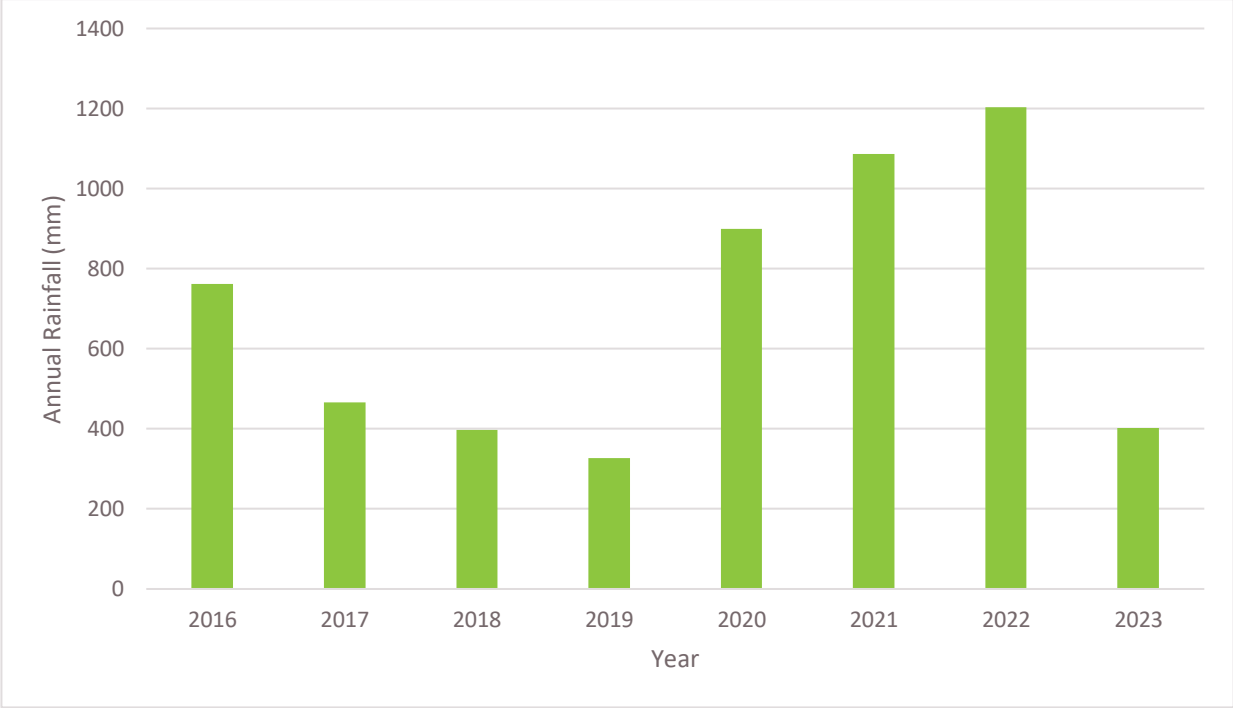

Figure 5: Annual rainfall data for Bulga (Down Town) (Bom 2023) Note: 2023 annual total to October 2023

2.2. Bird monitoring within RWEAs

2.2.1. Introduction

The bird monitoring program is a requirement of the current Development Consent conditions and has been designed in an effort to measure the performance of the WCPL RWEP. The consent conditions (DA 305-7-2003) specify that "Terrestrial fauna surveys should be conducted to monitor the usage of enhancement areas by vertebrate fauna. Monitoring may include fauna species diversity and abundance or, alternatively, the use of indicator species to measure the effectiveness of enhancement measures".

Methods, results (including a comparison with previous monitoring), and interpretation of results, are included below.

Data from previous year's bird surveys are limited to:

- RPS Australia East (RPS) 2009. Annual Ecological Monitoring Report. Remnant Woodland Enhancement Monitoring Program Riparian and Bed and Bank Stability Monitoring, Stoney Creek, South Wambo Creek and North Wambo Creek. Prepared for Wambo Coal Pty Limited
- Niche 2014b. EMP010 Monitoring 2014 – Indicator Species (birds). Prepared for Wambo Coal Pty Limited
- Eco Logical Australia (ELA) 2015-2022. Wambo Coal Mine Flora and Fauna Monitoring Reports Prepared for Wambo Coal Pty Ltd.

2.2.2. Methods

2.2.2.1. Bird monitoring surveys

Bird monitoring during Spring 2023 was consistent with the eight previous monitoring events in methods and general timing of surveys. During the survey, two observers spent 10 minutes recording birds seen and heard within 50 m radius (0.8 ha) of a central point, followed by an additional 10 minutes searching the balance of a 2-ha plot, and recording the total numbers of birds detected (seen and heard). One morning and one afternoon survey was conducted per site.

Thirty (30) bird monitoring sites (Figure 6) were surveyed by ELA ecologists Liam Scanlan and Daniel McKenzie between September – October 2023. Twenty-six bird monitoring sites (BP01 – BP26) are located within RWEAs. The remaining four bird sites (BP27 - BP30) are used in monitoring the South Bates Extension Underground Mine area and are discussed in Section 5.

The total number of bird species recorded each year 2007-2023, average number of bird species per 20-minute bird survey, average number of birds per survey, bird density and the distribution and relative abundance of threatened species were examined. Broad comparisons between the bird species recorded in previous years and the current year were also made.

2.2.2.2. Targeted winter bird survey

Winter bird surveys targeting Swift Parrot and Regent Honeyeater are undertaken every second year and were scheduled to be undertaken in 2022. However, the winter bird surveys were not undertaken in 2022 due to high rainfall creating inaccessible track conditions. To compensate, a winter bird survey was undertaken by ELA ecologists Daniel McKenzie and Liam Scanlan on 13 June 2023.

No fixed survey sites are used; however, the survey targeted areas of high-quality habitat, including any flowering Eucalypts, and sought to cover as much of the site as possible. A rapid call-playback method was used where the calls of the target species were broadcast over a loudspeaker for 2-5 minutes followed by 5-10 minutes of searching the vicinity of the playback site. All bird species observed or heard during the survey were recorded.

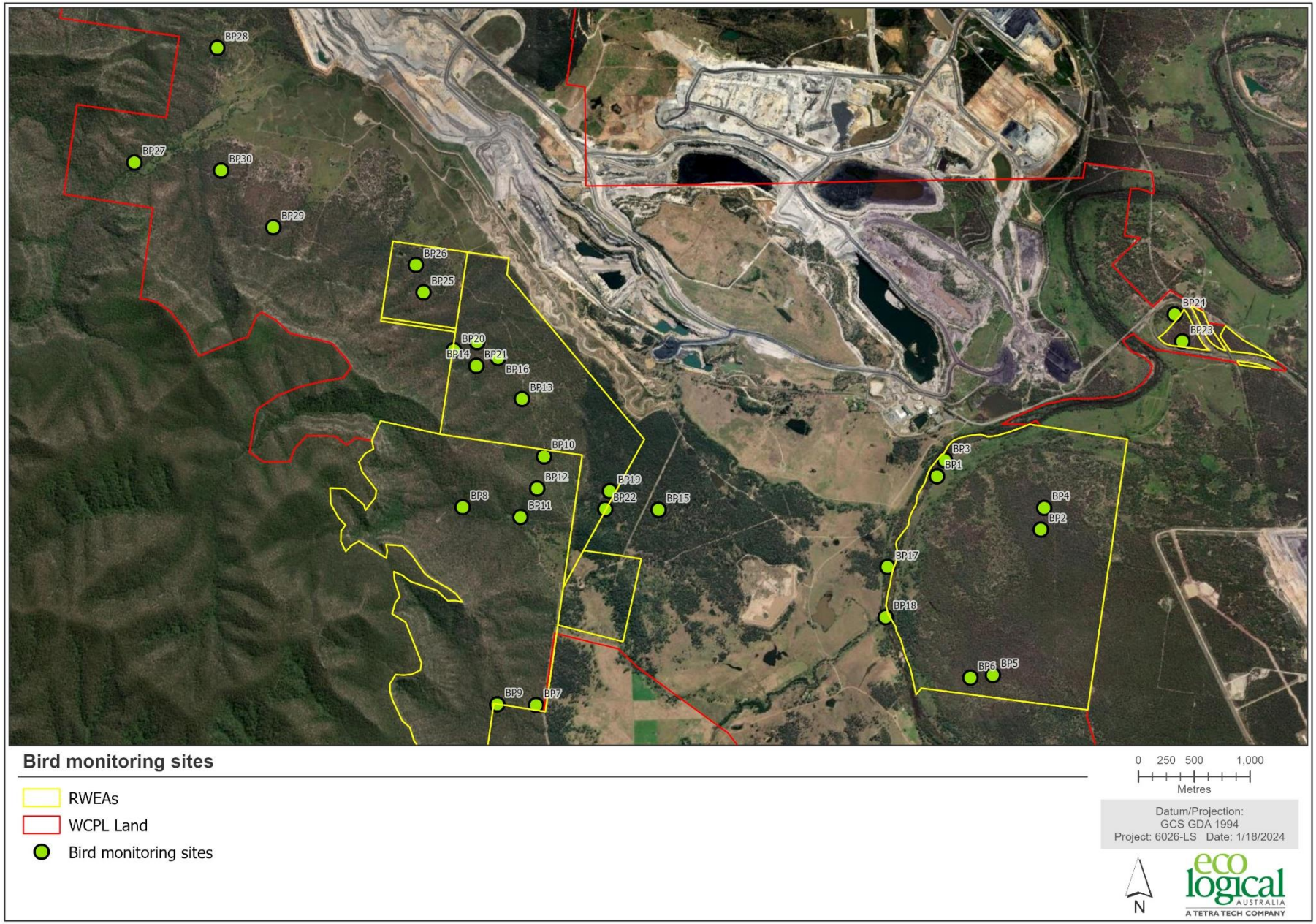

Figure 6: Bird monitoring locations and remnant woodland enhancement areas

2.2.3. Results

2.2.3.1. Bird monitoring surveys

The 2023 monitoring recorded a total of 71 bird species from 26 monitoring sites during formal bird surveys of RWEAs. This number is ten species low than the median from all 26 sites in previous monitoring periods (2007-2022) (Figure 7).

131 bird species have been recorded during timed bird surveys over the last seven years, with 71 of these recorded in 2023 within RWEAs.

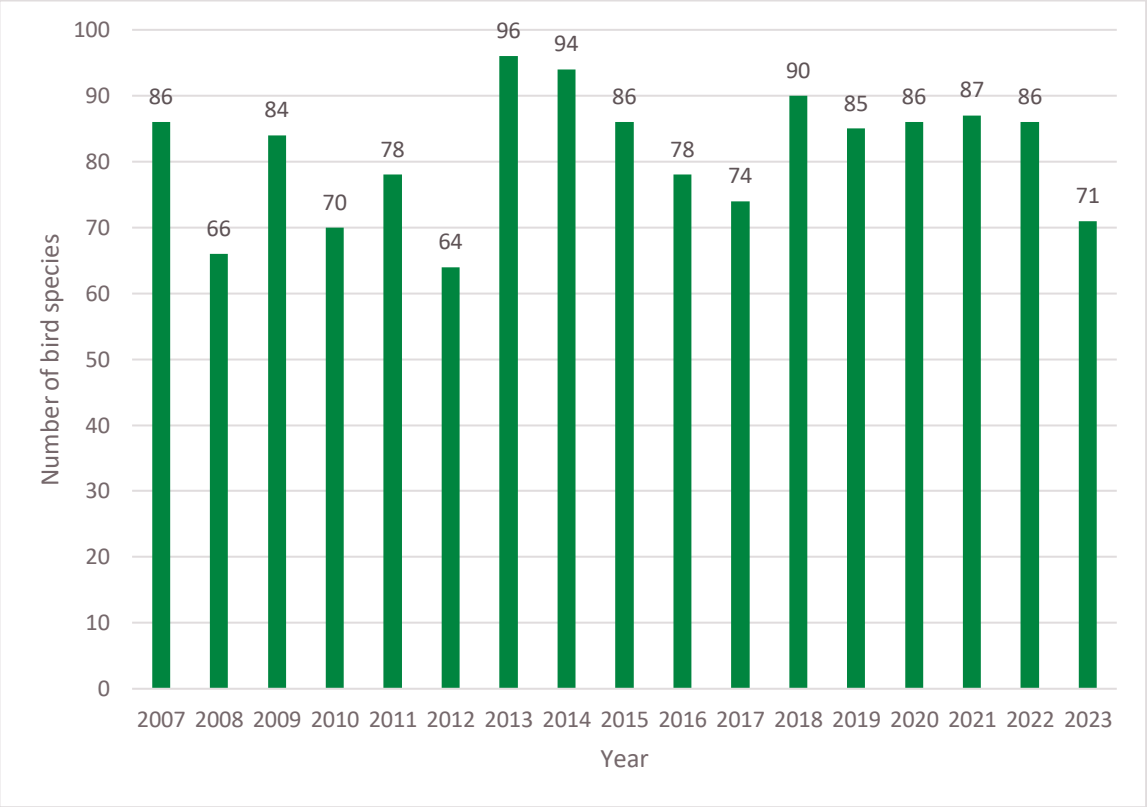

Figure 7: Number of bird species recorded at monitoring plots within RWEAs 2007 – 2023

In 2023, the average number of bird species per 20-minute bird survey (9.94) and bird species per site (14.24), were lower than 2022. However, was similar to the lower limit of previous years with available data (2015 – 2022) (Figure 8 and Figure 9). The year 2017 recorded two species higher than the 2023 average number of bird species per monitoring site at 16.83, and 2009 recorded 17.875.

The average number of birds recorded per survey was 31.01 in 2023. This represents an increase from the previous year (27.9 birds per survey), and is similar to the other years before 2022, with records ranging from 25.5 to 27.9 (Figure 14). Numbers of birds were not presented in RPS (2009), and it is assumed only bird species richness was recorded.

The most species-diverse site during 2023 was BP25 recording 25 species over the two surveys. BP7 recorded 24 species. Other species-diverse sites included BP8 (21 species) and BP17 (20 species). BP23 had the lowest species diversity in 2023, with four species recorded. BP23 also had the lowest species diversity in 2022.

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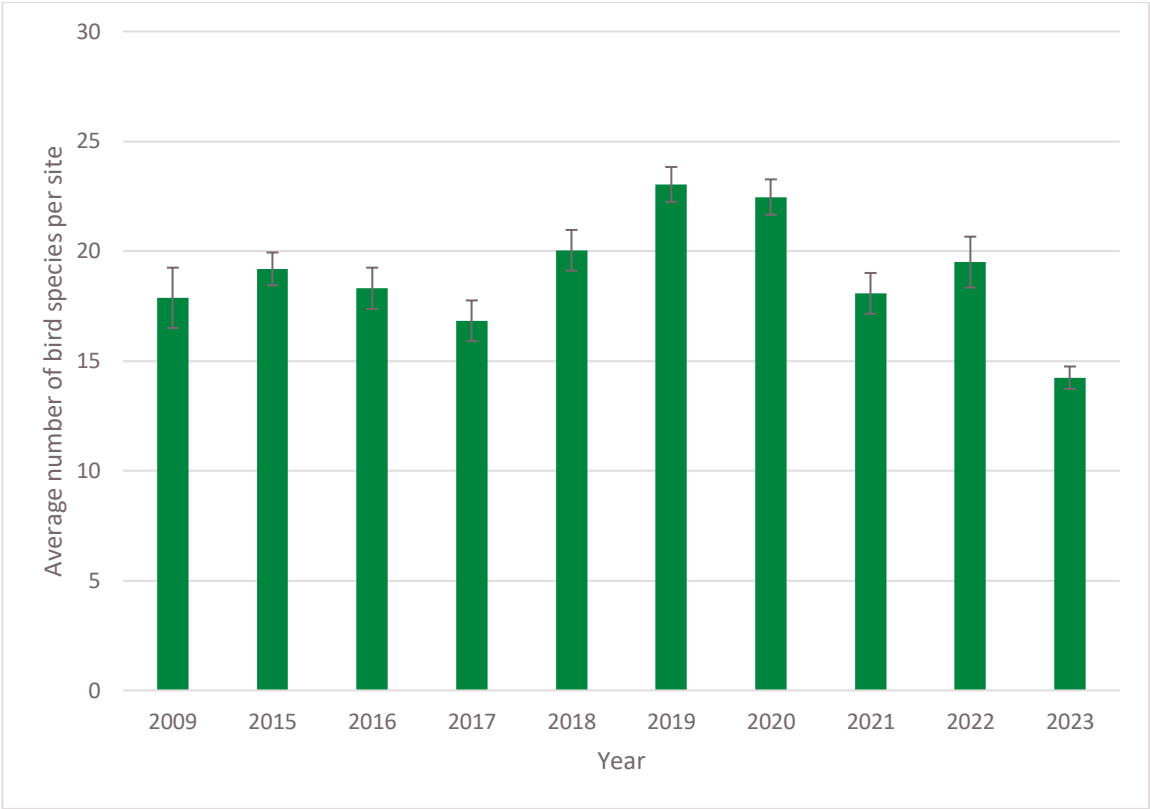

Figure 8: Average number of bird species recorded per monitoring site during 2009 and 2015-2023. Error bars represent the standard error of the mean.

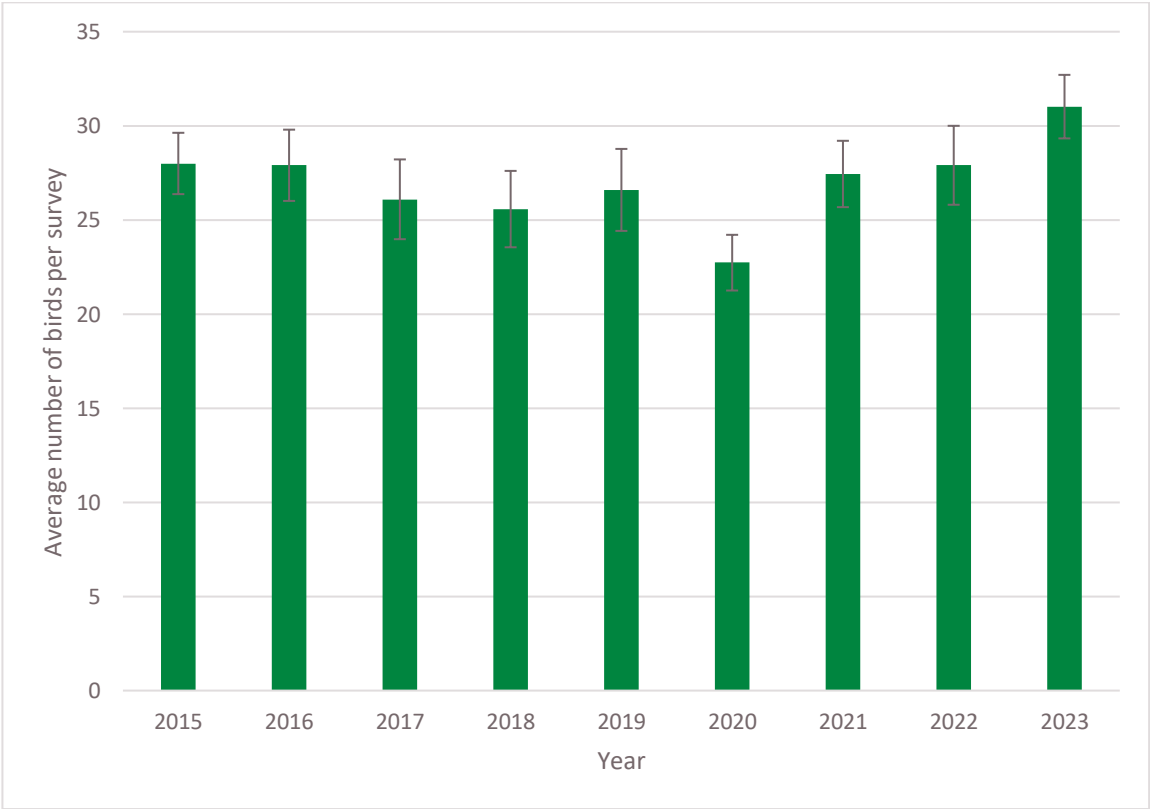

Figure 9: Average number of birds recorded per survey (2015-2023). Error bars represent the standard error of the mean.

Bird assemblages over time were not compared statistically, however, assemblages appear broadly similar to the previous seven years and also to data from 2009 monitoring. When comparing the 20 most widely recorded species from each year, the results from 2023 contain an average of 13.7 of the same species recorded in the top 20 for previous years. The most widely recorded species in 2023 were Yellow-faced Honeyeater (*Lichenostomus chrysops*), Noisy Friarbird (*Philemon corniculatus*) and Spotted Pardalote (*Pardalotus punctatus*), all of which were also widely recorded in previous years.

Five threatened species listed under the BC Act were recorded during 2023 surveys; being Dusky Woodswallow (*Artamus cyanopterus*), Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), Varied Sittella (*Daphoenositta chrysoptera*), Speckled Warbler (*Chthonicola sagittata* and Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*). These threatened species are part of a group that are regularly recorded during the monitoring surveys, with between five and eight threatened bird species annually recorded between 2014 to 2023. No EPBC Act listed species were recorded.

Comparison of numbers of individuals of threatened species during the 2015 to 2023 monitoring periods and the number of sites they were recorded at during the 2009 and 2014 to 2023 monitoring periods was undertaken. Grey-Crowned Babbler was recorded at more sites than the previous year, with 14 individuals across four sites. Speckled Warbler was recorded from two sites, a decrease from the previous year, and a total of two individuals were recorded which is the lowest number of individuals recorded for this species. Varied Sittella was recorded from two sites with six individuals recorded, which is a decrease from the previous year. Dusky Woodswallow was recorded from one site and a total of two individuals were recorded which is the lowest number of individuals recorded for this species. Results for Brown Treecreeper are the same as the previous year, with three individuals recorded across three sites.

2.2.3.2. Targeted winter bird survey

A total of 39 bird species were recorded across the site, however no Swift Parrot or Regent Honeyeater were recorded. Species recorded are included in Volume 2.

2.2.4. Bird monitoring discussion

RWEA and other remnant woodland sites at WCPL continue to support a large diversity of bird species and no introduced bird species were detected within RWEA areas.

The average number of bird species per site was lower than the levels recorded in previous years. It is recommended to continue monitoring this statistic. Number of individual birds per survey returned a higher level than previous years.

As vegetation and habitat attributes in RWEA areas have remained relatively stable over time (see previous section), variability in diversity and abundance between years is likely explained by a combination of factors such as varying numbers of nomadic and migratory bird species, weather and climate, sampling methods, differences in the skill of observers, the timing of surveys and surveys coinciding with the flowering of trees and also broader landscape scale and seasonal changes across the Hunter Valley. The total number of bird species detected each year has varied over time and the 71 species recorded during 2023 is within the range of previous years.

Threatened species appear to be persisting within the RWEAs, with Grey-crowned Babbler and Brown Treecreeper recorded in similar or greater numbers than the previous year.

3. Riparian condition assessment

3.1. Introduction

The riparian monitoring program is a requirement of the 2004 Development Consent conditions. The objective of the monitoring program is to evaluate how the riparian environment is responding to management initiatives (such as cattle exclusion) and document any impacts arising from mine subsidence.

North Wambo Creek drains the mid and eastern sections of the North Wambo Underground Mine development area and flows south-east into Wollombi Brook, approximately 600 m south of the mine (Figure 10). North Wambo Creek has been highly disturbed both by historic and present grazing activities and by the NWCD. The North Wambo Creek diversion channels the creek around the open-cut mining operation, flowing downstream into Wollombi Brook.

Stony Creek drains from Mount Wambo in a north-east direction and meanders across the western boundary of coal lease (CL) 397 near the south-western boundary of the North Wambo Underground Mine and passes in a south-easterly direction through the existing underground development area of WCPL to join Wambo Creek. Wambo Creek then runs east to join Wollombi Brook. Much of the riparian zone along Wambo Creek has been disturbed by historic agricultural activities.

3.2. Methods

Field sampling for the riparian monitoring was undertaken in September and October 2023. The *Rapid Appraisal of Riparian Condition* method (RARC), developed by Jansen et. al. (2005) and used during the 2016 to 2020 monitoring, was utilised during the 2023 survey period. Using this method, an overall score is obtained at each monitoring site by examining the width of riparian vegetation, proximity to large patches of native vegetation, vegetation cover, debris (leaf litter, standing dead trees and fallen logs) and other features (native canopy and understory regeneration, tussock grasses and reeds on creek banks). Areas monitored were:

- North Wambo Creek
- (South) Wambo Creek
- Stony Creek.

Methods followed Jansen et. al. (2005) with four 40 m long cross-section transects sampled at each monitoring site (an approximate 500 m length of riparian zone). Three monitoring sites were measured along each creek. The location of monitoring sites and transects is illustrated in Figure 10 with photographs presented in Volume 2.

The three creeks and sample sites were compared in regard to the following sub-indices:

- *Habitat* - longitudinal continuity of canopy vegetation (> 5 m wide); width of riparian canopy vegetation; and proximity to nearest patch of native vegetation > 10 ha
- *Cover* - vegetation cover and structural complexity
- *Native* - dominance of native species versus exotic species
- *Debris* - leaf litter; standing dead trees; hollow-bearing trees; and fallen logs

- *Features* - other indicative features such as regeneration, presence of large native tussock grasses (e.g. *Austrostipa* spp.) and reeds.

The five sub-indices were assessed across the three separate reaches of each creek and were combined to create a *Total Score.* Site photos and scores from previous monitoring reports (ELA (2016 to 2021) were compared. Although not directly comparable due to differing site locations and methodologies, data and photos from Niche (2014d) and RPS (2009) were also reviewed.

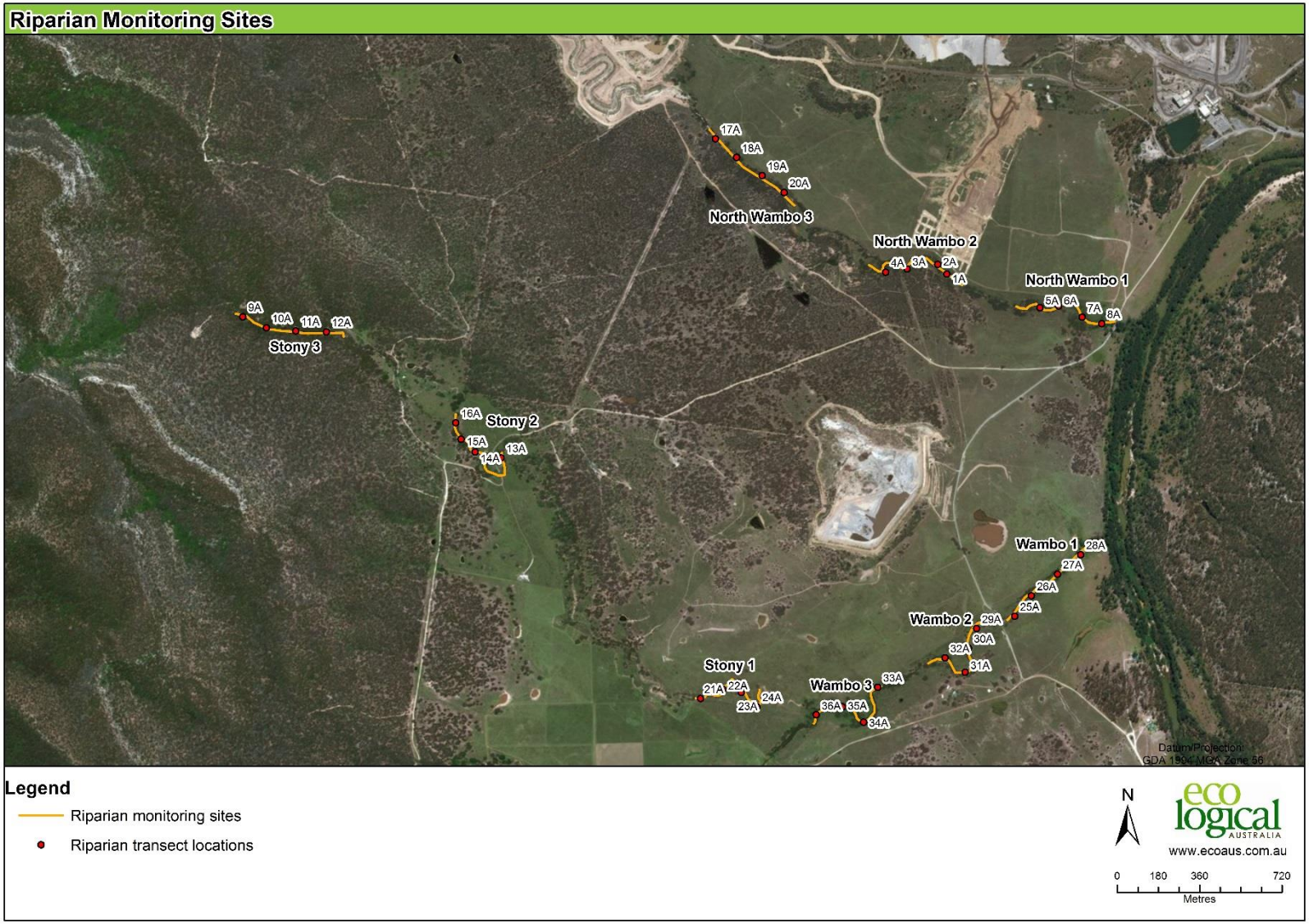

Figure 10: Location of riparian monitoring cross-sections and transects

3.3. Results

The results of the riparian condition monitoring are presented below, with raw data included in Volume 2.

The average total score for Stony Creek, North Wambo Creek and South Wambo were the highest recorded results compared to all years of data. North Wambo Creek and South Wambo Creek recorded an increase in the average total score compared to 2022. Stony Creek recorded an increase in the average total score compared to 2022 and recorded its highest score in 2023 (Figure 11).

South Wambo Creek remains the lowest scoring creek system based on the sub-indices measured.

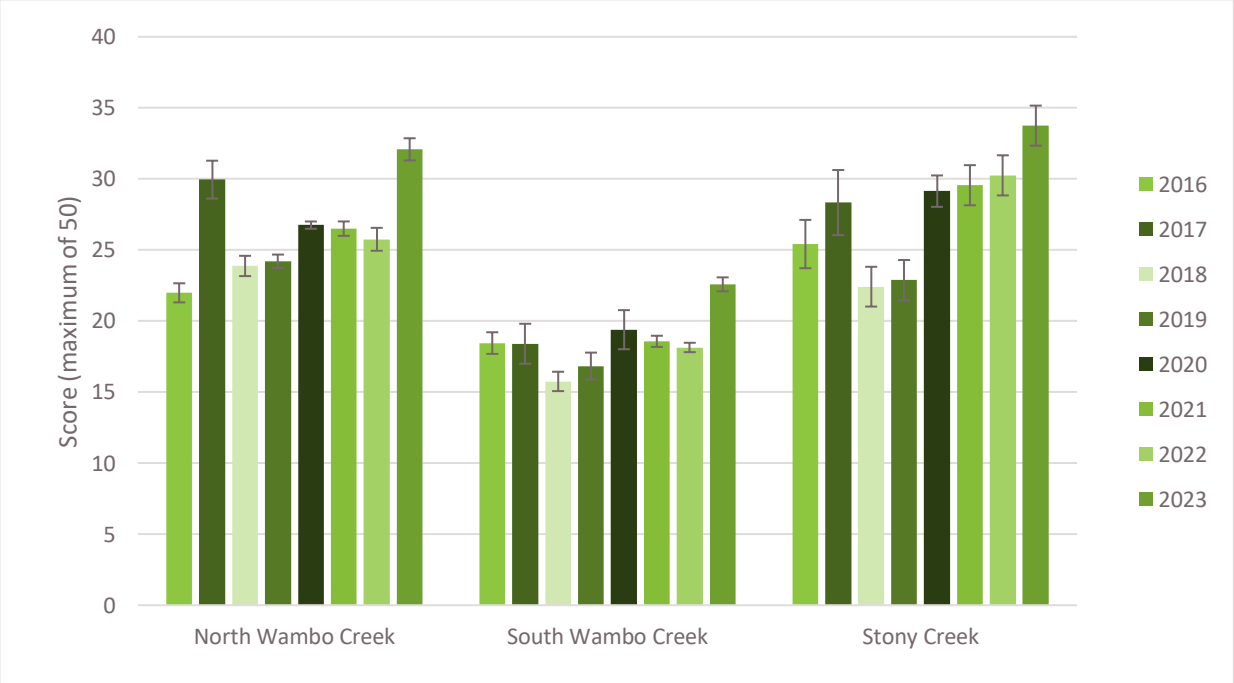

Figure 11: Average "Total Score" for North Wambo Creek, South Wambo Creek, and Stony Creek, from surveys in 2016 - 2023. Error bars represent the standard error of the mean.

3.3.1. North Wambo Creek

North Wambo Creek recorded higher scores for all sub-indices to previous years. This site has acceptable scores for habitat, cover and debris. There were no obvious signs of feral pigs at monitoring sites. Erosion control measures were observed to have been undertaken along North Wambo Creek, outside of monitoring sites.

3.3.2. South Wambo Creek

South Wambo Creek has consistently been the lowest scoring site. In 2023 South Wambo Creek recorded an increase in all sub-index scores when compared to 2022.

Site 3 recorded an increase in natives and cover scores. No evidence of feral pigs was observed within Site 3 of South Wambo Creek in 2023. Pig disturbance reduces the ground cover, regeneration, and destabilises the soils leaving these areas more prone to erosion, which may be attributable to the low scoring at this site in previous years.

No evidence of recent cattle grazing was recorded in this area. Grazing pressure reduces the ground cover and destabilises the soils leaving these areas more prone to erosion. In previous years cattle grazing had impacted riparian condition scores along South Wambo Creek.

3.3.3. Stony Creek

Stony Creek recorded increases in the sub-indices for natives and features, with slight decreases in values for cover and debris (<1% and 3%, respectively). These results may reflect the gradual regeneration of riparian vegetation in the lower reaches and an increase in native vegetation following the wetter years 2020-2022.

The habitat score remained the same as in 2019-2022. The habitat score is controlled by features which change over longer periods of time such as canopy connectivity and proximity to large patches of native vegetation and has always remained at the maximum score at Stony Creek 3 where the site is within high condition native vegetation.

There remains large variability in the habitat sub-index between longitudinal transects at Stony Creek, which reflects the differences in vegetation and habitat features between the cleared lower reaches at Stony Creek 1 (Photograph 17) and the heavily forested upper reaches observed at Stony Creek 3 (Photograph 18).

It is unclear whether cattle have been excluded from the lower reaches of Stony Creek at Stony Creek 1. No evidence of recent cattle grazing was recorded. However, there was no fencing that would prevent cattle accessing the riparian area. In previous years cattle grazing had impacted riparian condition scores along lower reaches of Stony Creek.

Photograph 17: Stony Creek 1 predominately cleared vegetation (23a)

Photograph 18: Stony Creek 3 heavily forested vegetation (11a)

3.3.4. General observations

Overall scores at all creeks were similar to previous years and conditions were similar to 2021 and 2022, which had both received higher rainfall than previous years. Higher ground cover, containing a mix of native and exotic species remains present. The change in ground cover from 2019 to 2023 can be seen in Photograph 19 and Photograph 22.

No evidence of recent subsidence impacts was observed at North Wambo Creek, South Wambo Creek, or Stony Creek during the 2023 riparian condition survey.

Site scores from available past monitoring reports (Niche (2014) and RPS (2009)) show similar results for Stony Creek (particularly the upper reaches) being regarded as in good condition, North Wambo Creek as being either in good or moderate condition and South Wambo creek being in moderate condition. General comparison of riparian area photos from 2023 with those from 2014 show that the riparian vegetation remains similar, with seasonal variation in ground cover in response to rainfall the most obvious change over time.

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Photograph 19: Transect 14 at Stony Creek 2 in 2023 showing high ground cover including exotic *Tagetes minuta* following dry conditions in 2023

Photograph 20: Transect 14 at Stony Creek 2 in 2022 showing higher ground cover following higher rainfall in 2021 and 2022

Photograph 21: Transect 14 at Stony Creek 2 in 2021 showing high ground cover following higher rainfall

Photograph 22: Transect 14 at Stony Creek 2 in 2019 showing drought impacted ground cover

3.4. Riparian condition conclusions and recommendations

Similar scores to the previous year for all creeks reflect the ongoing wetter conditions in 2020-2023 following previous drought conditions from 2017-2019 and the reduction/exclusion of grazing. Understorey vegetation cover remains high following higher rainfall in 2020-2023, although a high proportion of ground cover contribution is from exotic species.

Sub-indices relating to more permanent features such as habitat connectivity, tree canopy and logs and hollows remained similar.

Exclusion of cattle from riparian areas has been recommended in previous monitoring reports and no evidence of cattle grazing was recorded in 2023. Cattle should continue to be excluded from riparian areas to encourage tree regeneration and prevent erosion.

Plantings of trees in over-cleared riparian areas (that are unlikely to regenerate naturally even with cattle exclusion) will also be beneficial to riparian area and the surrounding environment.

4. North Wambo Creek Diversion

4.1. Introduction

North Wambo Creek Diversion (NWCD) vegetation establishment monitoring has previously been undertaken using the Landscape Function Analysis (LFA) methodology. In 2023, a new method replaced LFA to monitor vegetation establishment of the NWCD.

The rehabilitation objectives for the NWCD include:

- To establish pasture species consistent with the revegetation strategy
- Tree species established along creek lines consistent with the riparian zone
- Creek diversion stable and will not present a greater safety hazard than surrounding land
- Creek diversion able to shed water safely without causing excessive erosion, jeopardising landform integrity or increasing pollution of downstream watercourses
- All watercourses subject to subsidence impacts shall be hydraulically and geomorphologically stable, with riparian vegetation established that is the same or better than prior to commencement of mining.

Additional completion criteria for these rehabilitation areas are listed in the Mining Operations Plan (WCPL, 2015) and include ensuring that:

- Minimum 70% of area has a vegetative cover
- No single bare area >20m2
- Biometric monitoring confirms exotic cover <33%
- No tunnel or gully erosion is to be present
- Rill erosion is to be limited to <200 mm deep and/or <200 mm wide.

4.2. Methods

4.2.1. Vegetation establishment monitoring

Field sampling for the North Wambo Creek Diversion monitoring was undertaken in October 2023. The BMP outlines the method for monitoring vegetation establishment which requires approximately 60-90 1x1m^2 quadrats (three per zone across 20-30 zones).

Within each quadrat, the following data was collected in accordance with the BMP:

- Soil surface stability and potential for water infiltration including areas of potentially serious erosion.
- Soil fertility / plant health
- Native plant cover
- Native plant abundance (approximate count of individuals in ground, shrub and tree layers)
- Native species diversity
- Total soil surface cover (rocks, bare ground, organic litter and coarse woody debris)
- Threatening weed cover (only measuring exotic plant species which pose a threat to local biodiversity)

- The vegetation establishment monitoring results are compiled and used to rank the sites as 'good', 'poor', or 'failing'.

At the time of surveying, large areas in the northern area of the NWCD had been reshaped, with revegetation actions not yet taken place, and these areas were excluded from monitoring.

Table 13: Vegetation establishment criterion and measurement

Criterion	Measurement
Soil surface stability and potential for water infiltration including areas of potentially serious erosion.	High = no erosion evident, soil surface cover of 100% (including Rocks, coarse woody debris, perennial plants). Well-developed organic litter layer with evidence of decomposition Medium = erosion limited to minor sheet erosion. Soil surface has >80% cover on slopes or >50% cover on flat ground. Perennial grasses, sedges and/or cryptogams (mosses, lichens) present, ground is rough with elevations/depressions of >1cm. Evidence of organic matter layer. Minor crusting Low = erosion is active (check for deposited material, small rills). <80% total cover on slopes and 25-50% cover on flat ground. Soil heavily crusted or compacted Poor = active erosion, with active rills. <50% soil surface cover. Soil crusted or compacted Extremely poor = active erosion with many or large active rills, gullies or tunnelling. <10% soil cover
Soil fertility/plant health	• Good = All plants appear healthy • Poor = Plants show signs of stress and/or nutrient deficiencies (e.g.: stunting, discoloration, reduced leaf area)
Native plant cover	• High = >75% • Medium = 25-75% • Low = <25% • Absent = no native plant cover
Native plant abundance in Ground, Shrub and Tree layers	• Ground layer abundance: • <5 individuals • 5-20 individuals • >20 individuals • Presence of shrubs • Presence of trees
Native species diversity	Record all native species observed on the site
Total soil surface cover (rocks, bare ground, organic litter and coarse woody debris)	• High = >90%cover • Medium= 50-90% cover • Low = 10-50% cover • Bare = soil surface is entirely bare
Threatening weed cover – only measuring exotic plant species which pose a threat to local biodiversity.	• High = >50% cover • Medium = 10-50% • Low = <10% • Absent = no threatening weeds present

4.2.2. Floristic monitoring

Floristic monitoring is undertaken using the BioMetric plots as described in Section 2.1.2. Two new sites were established within the NWCD in 2020 (Figure 2).

Floristic monitoring targets for the NWCD have been derived from the NWCD Revegetation Management Plan (Cumberland Plains Seeds 2019) and are based on a combination of Benchmark Values for River Red Gum/ River Oak riparian woodland wetland in the Hunter Valley and Narrow-leaved Ironbark– Grey Box – spotted gum shrub grass open forest of the central and lower hunter. The exotic plant cover target has been modified to match the performance criteria for the NWCD from the Wambo Mining Operation Plan (WCPL, 2015).

4.3. Results

4.3.1. Vegetation establishment monitoring

Twenty-six condition zones were identified along the North Wambo Creek Diversion (Table 14). Locations of vegetation zones are shown in Figure 12 and Figure 13. Three plots were assessed within each zone, with a total of 78 plots surveyed across all zones.

Two zones (24 and 25) were assessed to be in good condition (Photograph 23). The majority of the zones (18 zones) were assessed to be in moderate condition with reestablishment of vegetation cover. Five zones (6, 7, 9, 11 and 18) were regarded as low condition and one zone (zone 20) was considered to be failing to reestablish vegetation (Photograph 24).

Overall, most zones have a high cover of exotic grasses particularly *Chloris gayana* (Rhodes Grass) and *Setaria sphacelata* (African Pigeon grass), with a lower proportion of native grasses and forbs. The midstorey is variable across the site but is typically dominated by *Acacia* shrubs and young *Eucalyptus* trees scattered in some areas.

Cover of threatening weeds was generally low, however *Eragrostis curvula* (African Lovegrass) was identified in large patches of Zone 18. Isolated occurrences of Xanthium spinosum (Bathurst Burr), *Lycium ferocissimum* (African Boxthorn) and *Vachellia farnesiana* (Mimosa Bush) were also recorded (Figure 12; Figure 13). Rhodes Grass, African Pigeon grass and *Cynodon dactylon* (Couch) were not considered to be threatened weeds due to their role in providing soil stabilisation during early phases of reestablishment.

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Table 14: Description of North Wambo Creek Diversion condition zones

Zone	Description	Creek	Position	Condition
1	Open, grassy, sparse shrub regeneration	South	Lower bench	Moderate
2	Moderately dense, grassy, shrubs present	South	Slope	Moderate
3	Moderately dense, grassy, shrubs present	North	Slope	Moderate
4	Moderately dense shrub regeneration, open bare groundcover	North	Steep slope	Moderate
5	Moderately dense regeneration with taller shrubs, high grass cover	North	Bench	Moderate
6	Small area lacking woody regeneration, high grass cover	North	Bench	Low
7	Low dense shrub regeneration with high grass cover	North	Bench	Low
8	Moderate - high density regeneration of taller shrubs, grassy groundcover	North	Bench	Moderate
9	Sparse regeneration of low shrubs, high grass cover	North	Bench	Low
10	Moderately dense shrub regeneration, high grass cover	North	Bench	Moderate
11	Minimal woody regeneration, grassy groundcover	North	Bench	Low
12	Higher amount of woody regeneration than Zone 11, grassy groundcover	North	Bench	Moderate
13	High density of low shrub regeneration	North	Bench	Moderate
14	Sparse regeneration of shrubs, grassy groundcover	North	Bench	Moderate
15	Dense, shrubby groundcover	North	Bench	Moderate
16	Sparse, young Acacia regeneration	North	Bench	Moderate
17	Young sparse shrub regeneration, grassy groundcover	South	Bench	Moderate
18	Very sparse shrub regeneration, grassy groundcover	South	Bench	Low
19	Moderate density of tall shrub regeneration, grassy groundcover	South	Bench	Moderate
20	Very low regeneration of shrubs and grasses, lacking topsoil in some areas	South	Bench, slope	Failing
21	Moderate density regeneration of shrubs and trees	South	Bench, slope	Moderate
22	Sparse regeneration of shrubs	South	Slope	Moderate
23	High exotic grass cover (African Lovegrass), older shrub regeneration	South	Bench	Moderate
24	River Red Gum along channel with grassy understorey and scattered shrubs	South	Bench	Good
25	Moderate shrub cover, good regeneration	South	Slope	Good
26	Sparse shrub regeneration, grassy groundcover	South	Slope	Moderate

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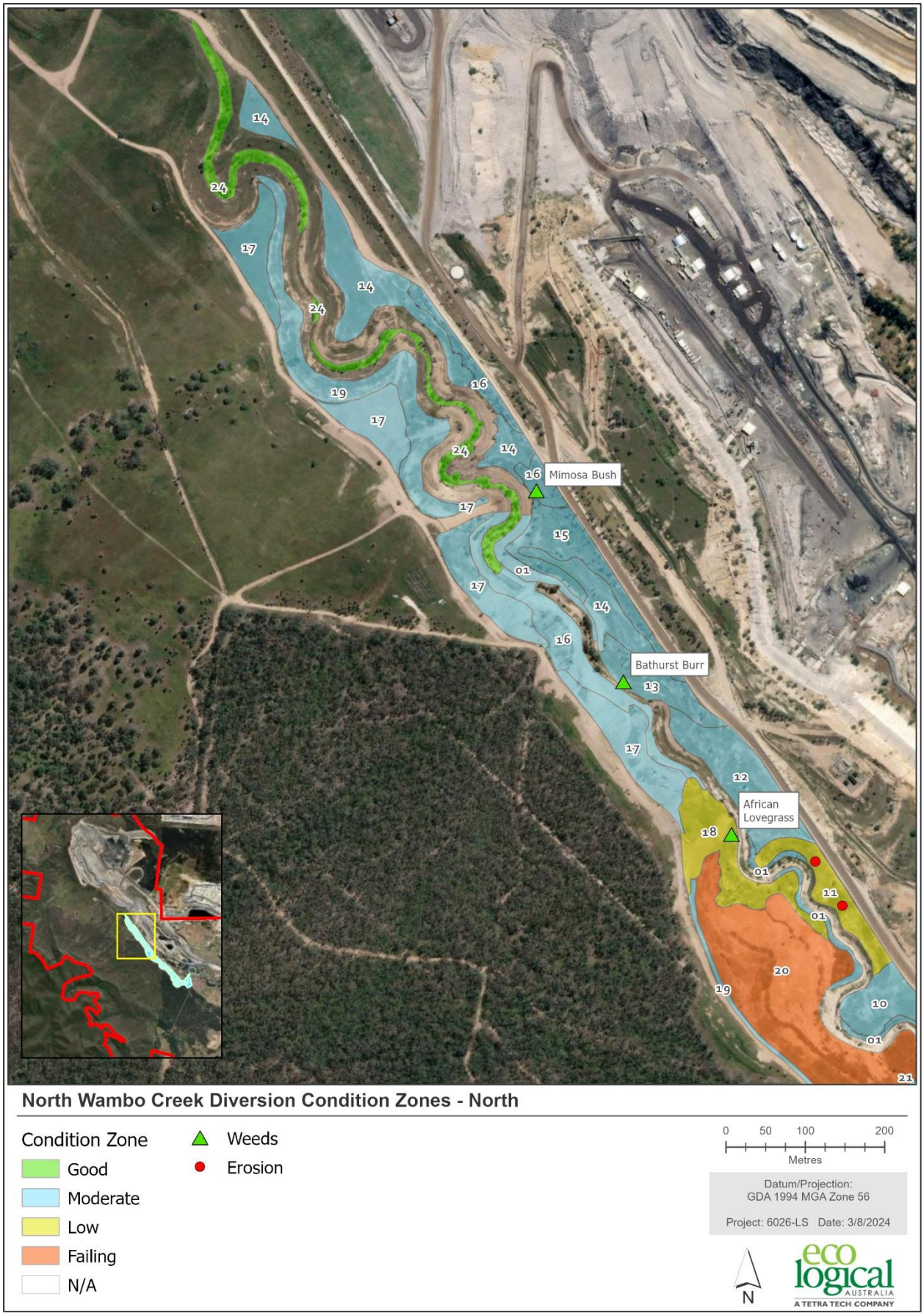

Figure 12: North Wambo Creek Diversion Condition Zones (North)

Figure 13: North Wambo Creek Diversion Condition Zones (South)

Photograph 23: High amount of vegetation establishment assessed as "good" within Zone 25

Photograph 24: Low amount of vegetation establishment assessed as "failing" within Zone 20

4.3.2. Floristic monitoring

Two floristic monitoring sites were established within the NWCD area in 2020 (Figure 2**;** Photograph 25 and Photograph 26). Results of the 2023 floristic monitoring are presented in Table 15.

Results in relation to the performance criteria were mixed. NGCG met the performance criteria target and OR was recorded at both sites.

Native species richness has decreased since 2021, however, was similar to 2020 levels and the target has not been reached. EPC was above the target, at the second highest level to date. Interrogation of floristic plot data suggests a significant proportion of the EPC is attributable to annual species such as *Lysimachia arvensis* (Scarlet Pimpernel), *Chloris gayana* (Rhodes grass) and *Setaria* spp. which is a similar result to 2022 monitoring. This is not an unexpected result, as the rehabilitation is still in early stages, and it is expected that exotic groundcover will decrease as shrub and tree cover develops. NOS and NMS targets were not met however these are likely to take longer to reach for these rehabilitation areas.

These results represent the third floristic monitoring undertaken within the NWCD since the sites were established in 2020. Ongoing monitoring will provide further insights into the vegetation condition and trajectory. Inclusion of additional monitoring sites and methods is likely to assist assessment of the vegetation condition and performance.

Table 15: Biometric scores for NWCD moniotring sites and performance criteria

PCT	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
Target: PCT 42: River Red Gum / River Oak riparian woodland wetland in the Hunter Valley	NWCD1	20	0	2	30	0	0	90	1	0	75
	NWCD2	15	0	0	90	0	0	70	1	0	2
Average 2020		14.5	0	0	26	0	3	50	1	0	35
Average 2021		19	0.25	0.4	34.6	0.05	0.15	28.65	1	0	38.5
Average 2022		14	0	0	62	0	0	88	1	0	39
Average 2023		17.5	0	1	60	0	0	80	1	0	38.5
Performance criteria		>20	10-50	10-50	20-60	1-5	5-30	<33	1	-	-

It is important to note that significant soil remediation works have been undertaken at the NWCD from 2020-2023 and vegetation rehabilitation is continuing with land management contractors.

Photograph 25: NWCD Biometric Plot 1 in 2023

Photograph 26: NWCD Biometric Plot 2 in 2023

4.4. Conclusion and recommendations

These results represent the first year of monitoring using the revised vegetation establishment methods for NWCD. Overall, vegetation is in the early stages of reestablishment with high grass cover (mostly exotic grass species) and young shrubs and trees. One area (zone 20) was identified to have "failed" in reestablishing vegetation, and remediation of this area is recommended in consultation with the appropriate environmental engineering and land management contractors. Further monitoring is required for zones assessed as "low" condition, as they may improve over time, negating the need for management intervention. Zones assessed as "moderate" and "good" condition appear to be on a satisfactory trajectory, and are expected to improve naturally as the vegetation matures over time.

As this method is based on assessment of three 1x1 m plots across large areas, there are limitations in the data that is collected. It is likely that the relatively small plots may not capture the extent of the conditions in each zone. However, the method is useful in providing documentation of the site walkover, identifying threatening weeds, areas of erosion and identifying zones that clearly require management intervention.

Refinement of floristic monitoring plot locations and target values within the NWCD may be appropriate following additional remediation and revegetation works planned during 2020-2025 under the NWCD Management Plan (WCPL, 2020). The original intention of the NWCD was to establish riparian vegetation, however analysis of soils and water flows has indicated that a combination of woodland and riparian vegetation is more appropriate (WCPL, 2020). Additional monitoring to assist in identifying success or issues with early-stage revegetation was recommended in the NWCD Revegetation Management Plan (Cumberland Plains Seeds, 2019). This monitoring was undertaken by Cumberland Plains Seeds in 2021 and is reported separately in the NWCD Monitoring Report (Cumberland plains Seeds, 2021).

Floristic monitoring resampled the two plots established in 2020 for the third time. Sites met targets for native ground cover of grasses and are showing good signs of native species diversity. Sites did not meet targets for shrub and canopy cover, however these are expected to take longer to achieve. The sites also had high exotic plant cover which is not unexpected due to the high light environment of the early-stage rehabilitation, and high rainfall has likely favoured exotic grasses which have outcompeted native species.

Additional floristic monitoring sites are likely to be required to fully characterise the vegetation performance along the NWCD. Floristic monitoring sites should be established across the full range of revegetation areas, i.e. if the final revegetation plan includes multiple target communities such as woodland, riparian areas and pasture. In areas of newly established revegetation additional monitoring methods may also assist in assessing success and provide data to guide future works, if required. This early-stage monitoring should be undertaken using the tailored vegetation establishment monitoring methods (Cumberland Plains Seeds 2020), before transitioning to BioMetric plot monitoring once vegetation has established.

5. South Bates Extension Underground Mine area

5.1. Floristic monitoring

5.1.1. Introduction

Floristic monitoring of the South Bates Extension underground mine area was added to the annual biodiversity monitoring program in 2020 and was continued in 2023. The purpose of this monitoring is to measure the current condition of vegetation in terms of floristics and habitat complexity and identify whether any adverse impacts from undermining are occurring through comparison with previous years (2020 - 2023). The results aim to provide direction for the management of these areas and to inform future monitoring programs.

5.1.2. Methods

Floristic monitoring is undertaken using the BioMetric plots as described in Section 2. The monitoring was undertaken by ELA ecologists Liam Scanlan and Alex Yates in September and October 2023.

Four new sites were established in 2020 to sample the two dominant PCTs in the South Bates Extension area (Table 16).

Data from two existing monitoring plots that are also within the South Bates Extension area were also used for analysis. Of the new sites, two were established outside of the approved mining area and are intended as reference sites. In 2023, three planned longwalls were re-orientated, resulting in SBX4-GB-C now falling within an area that is planning to be undermined in the future (Figure 14), however this site can be assessed as a reference site until it is undermined.

A summary of the monitoring sites is presented in Table 16 and site locations are shown on Figure 2.

Performance targets for the same communities within the RWEP areas have been adopted as an indication of good condition vegetation for reference. Reference sites outside of the approved mining area are used as a comparison for assessing seasonal variation factors.

Table 16: Floristic monitoring sites for the South Bates Extension Underground Mine

Plant Community Type (PCT)	TEC	Plot name	Type	Site age
PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	Listed BC Act, E: Central Hunter Grey Box-Ironbark Woodland in the New South Wales North Coast and Sydney Basin Bioregions, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	SBX2-GB-I	Impact	3 years
		SBX4-GB-C	Reference	3 years
PCT 1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	Listed BC Act, V: Hunter Valley Footslopes Slaty Gum Woodland in the Sydney Basin Bioregion, may also be listed as CE under the EPBC Act as Central Hunter Valley eucalypt forest and woodland, dependant on condition and landscape position	V10-A1	Impact	Existing
		V10-A2	Impact	Existing
		SBX1-SG-I	Impact	3 years
		SBX3-SG-C	Reference	3 years

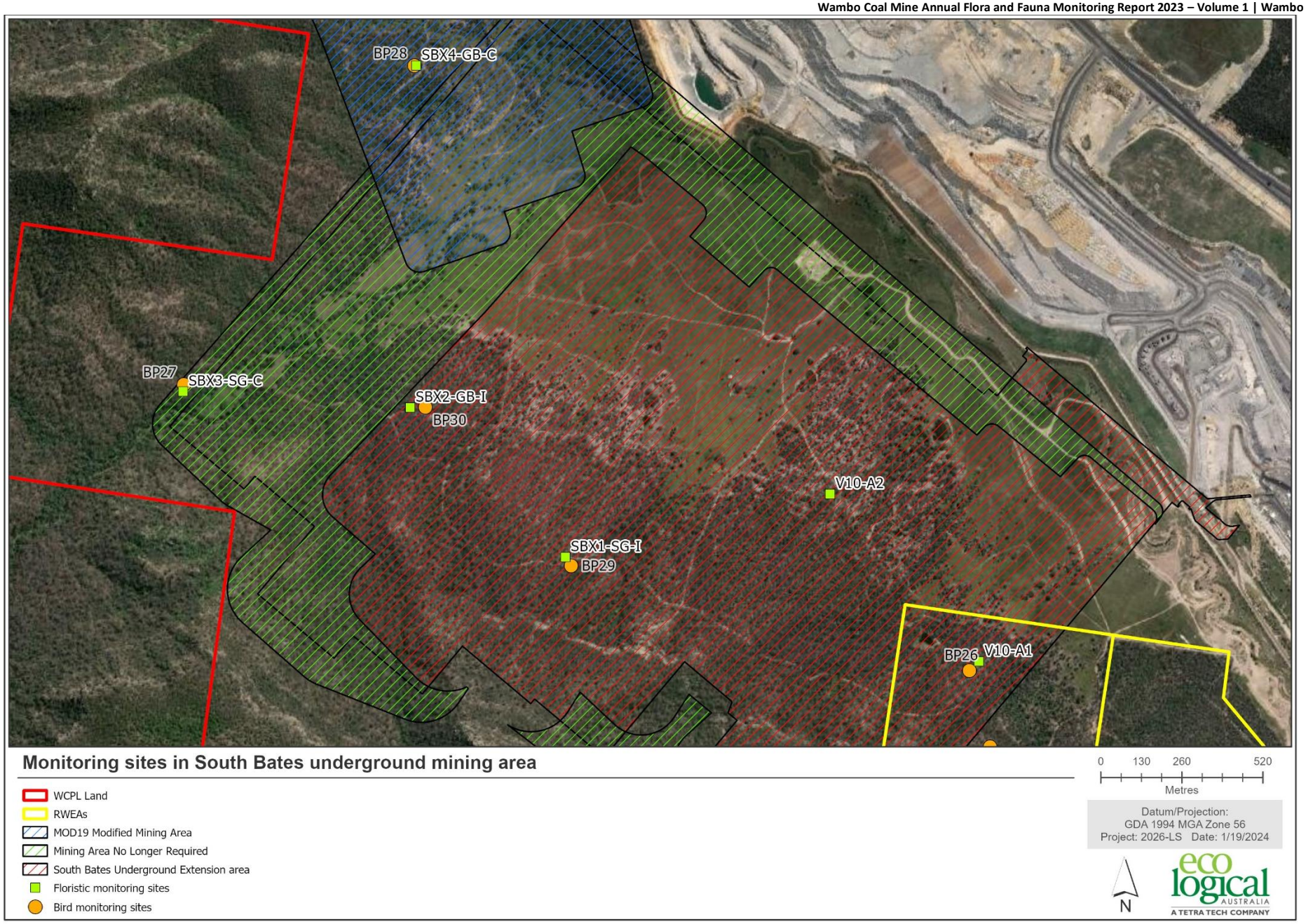

Figure 14: Monitoring sites in the South Bates underground mining area

5.1.3. Results and discussion

Floristic data from sites added in 2020 and existing monitoring sites within the South Bates Extension Underground Mine area indicate the vegetation and habitat features are overall, in a good, stable condition with most attributes meeting the performance criteria (Table 19).

Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest is represented by one reference and one impact plot (SBX2-GB-I and SBX4-GB-C). This impact plot was undermined in 2023, therefore this is the first monitoring period that it is considered to potentially show adverse impacts from undermining. NMS at both sites was 2, slightly below the target of 5-10 but remaining stable since 2022 (Figure 15). The low NMS at this site is likely to represent natural variation within the community. All other indices were within or above the performance target range.

Of the four sites within the Slaty Box - Grey Gum shrubby woodland, three (V10-A1, V10-A2 and SBX1-SG-I) have been undermined and one (SBX3-SG-C) is acting as current reference sites.

NMS was below performance criteria of 5-30 at SBX1-SG-I and V10-A2 which were 2 and 4.5 respectively. SBX3-SG-C and V10-A1 were within the target performance range where it was still relatively low at 11 and 6.5 respectively. NMS results for 2023 are overall consistent with 2022 results.

Figure 15: Native midstorey cover recorded for sites in the South Bates Extension underground mine area

5.1.4. Conclusions and recommendations

Floristic monitoring results for vegetation communities within the South Bates Extension underground reveal vegetation is in good condition, generally meeting performance targets. No evidence of mine subsidence impacting native vegetation condition were detected. Relatively minor changes since 2022 are likely related to rainfall levels in 2021 and 2022 and are expected to show some level of fluctuation in future conditions of higher or lower rainfall.

It is recommended monitoring continue in this area, including the use of reference sites to allow comparison including impacts of seasonal variation.

As the single existing control site for PCT 1603 - Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest is now planned to be undermined (SBX4-GB-C) it is recommended that a new floristic monitoring site is established in 2024, outside of undermining areas within PCT 1603.

Table 17: BioMetric scores from South Bates Extension floristic monitoring sites in 2023

Plant Community Type (PCT)	Plot Name	Site type	Mining status	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL
PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter	SBX2-GB-I	Impact	Undermining has occurred (2023)	36	22	2	75	40	26	0	1	1	12
	SBX4-GB-C	Reference	Outside mining area	43	18	2	75	32	15	0	1	1	48
Performance criteria				>25	10-40	5-10	15-50	5-10	5-40	<5	1	-	-
1176: Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion	V10-A1	Impact	Undermining has occurred	48	14.5	6.5	72	6	8	0	0	0	28
	V10-A2	Impact	Undermining has occurred	33	21	4.5	44	34	8	0	1	0	12
	SBX1-SG-I	Impact	Undermining has occurred (2023)	24	15.5	2	20	45	0	0	0	0	35
	SBX3-SG-C	Reference	Outside mining area	35	18	11	20	40	20	0	0	0	20
Performance criteria				21	15-40	5-30	5-30	0-25	2-10	<5	1	-	-

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5.2. Bird monitoring

5.2.1. Introduction

Bird monitoring of the South Bates Extension underground mine area was added to the annual biodiversity monitoring program in 2020 and continued in 2023. The purpose of this monitoring is to use bird diversity and abundance as an indicator of health of the local fauna populations and identify whether any adverse impacts from undermining are occurring. The results aim to provide direction to management of these areas and for the monitoring program in the future.

5.2.2. Methods

Bird monitoring survey methods are the same as described in Section 2. Surveys were undertaken by ELA ecologists Liam Scanlan and Daniel McKenzie from September – October 2023.

Four new bird monitoring sites (BP27-BP30) in the South Bates Extension Underground Mine area were established in 2020, and one existing bird survey site (BP26) is within the South Bates Extension Underground Mine area.

Of the new sites, two were established outside of the approved mining area (BP27 and BP28), intended as reference sites. In 2023, three planned longwalls were re-orientated, resulting in BP28 now falling within an area that is planning to be undermined in the future (Figure 14).

As of November 2023, BP26, BP29 and BP30 have been undermined, while BP27 and BP28 have not been undermined. This is the first monitoring year that BP29 and BP30 have been undermined.

As such, BP27 and BP28, and pre-2023 results for BP29 and BP30 can be considered baseline data for comparison of post-undermining conditions (Table 18).

Table 18: Bird monitoring sites within the South Bate Extension underground mine area

Site	Mining status	PCT
BP26	Undermining has occurred	1176: Slaty Box - Grey Gum shrubby woodland
BP27	Reference site (outside mining area)	1176: Slaty Box - Grey Gum shrubby woodland
BP28	Mining has not yet occurred	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest
BP29	Mining has occurred (2023)	1176: Slaty Box - Grey Gum shrubby woodland
BP30	Mining has occurred (2023)	1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest

5.2.3. Results

The highest diversity of species and highest abundance of birds was recorded at BP29 in 2023. This differs from the previous three years, in which impact site BP26 recorded the highest species diversity and abundance of birds. When compared to the previous three years of monitoring, number of species recorded has mostly been stable. Across all years and sites, the average number of species recorded is 18.6, and in 2023 all sites were within +/- 4.4 of this average (Figure 16).

There have been larger fluctuations in the number of birds recorded, with the lowest being 18 at BP29 in 2022, and the highest being 81 individuals at BP26 in 2022 (Figure 17). The average number of birds

recorded across all sites for all years is 42.4. In 2023, BP26, BP27 were relatively stable, within +/- 7.6 of this average, while BP28 and BP29 recorded up to 25 species higher than the average.

Two threatened bird species were recorded at the monitoring sites in 2023, with Varied Sitella recorded at BP29 and Grey-crowned Babbler recorded at BP30.

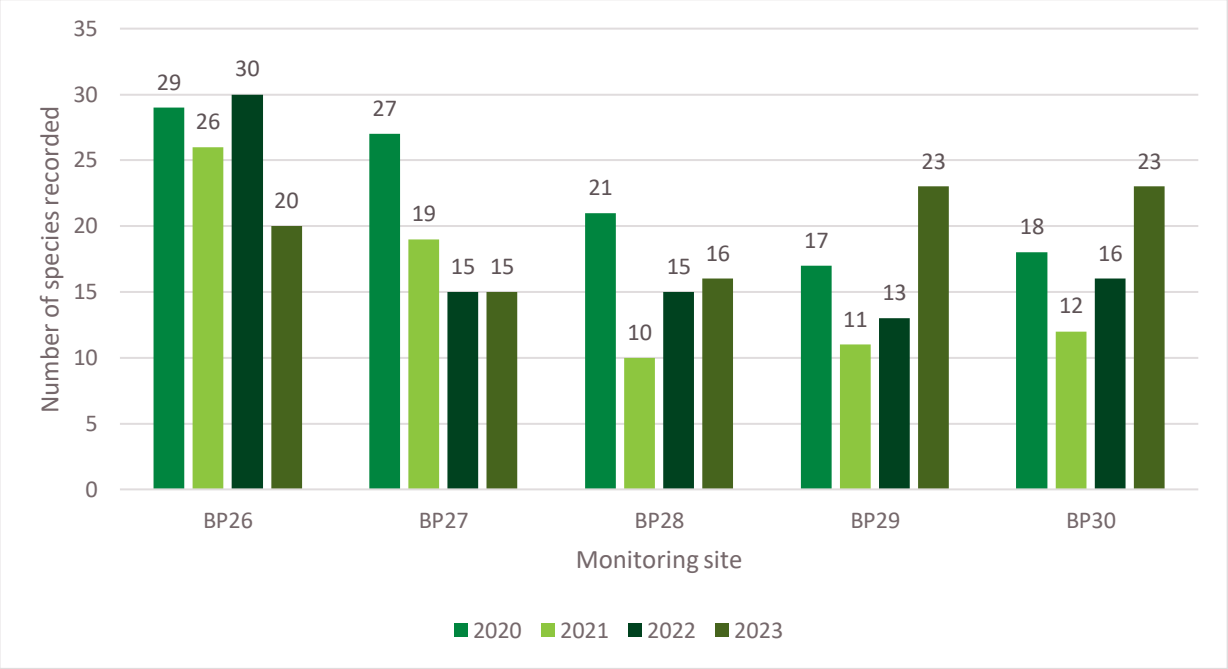

Figure 16: Number of species recorded for sites in the South Bates Extension underground mine area

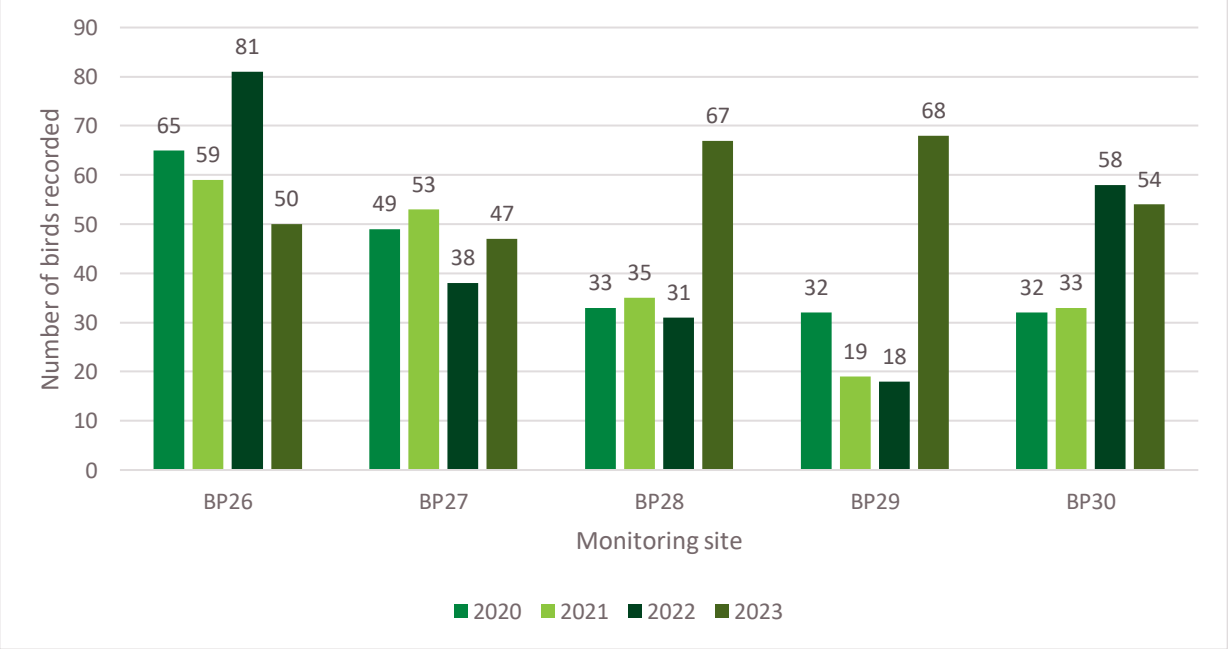

Figure 17: Number of birds recorded for sites in the South Bates Extension underground mine area

5.2.4. Conclusions and recommendations

Bird surveys recorded data at four sites established in 2020 and one existing site associated with the South Bates Extension underground mine area. Three of the five sites are located above an area which had been undermined to date. Two of these sites recorded higher species diversity than previous years, while number of birds was more variable. BP26 (undermined prior to 2023) recorded higher species richness than reference sites BP27 and BP28. BP26 also recorded similar results to BP27, BP29 and BP30 for number of birds recorded. There is no indication that the undermining is having a detectable impact on bird species within this area at this stage.

Continued monitoring is recommended in this area, including the use of reference sites to allow comparison including impacts of seasonal variation and development of long-term averages. Progress of underground mining activities should be correlated to site locations annually to ensure results are appropriately analysed as baseline, or impact once undermining progresses.

As the previous control site is now planned to be undermined (BP28) it is recommended that a new bird monitoring site is established in 2024, outside of undermining areas within PCT 1603: Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest.

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5.3. Groundwater Dependent Ecosystem monitoring

5.3.1. Introduction

Monitoring of GDEs is a new component to the annual biodiversity monitoring program initiated in 2019. The GDE Vegetative Assessment Report (Hunter Eco, 2019) identified two likely GDEs in the area above the South Bates Underground Extension:

- River Oak riparian tall woodland
- M*elaleuca decora* low forest

The South Bates Underground Extension has the potential to impact groundwater in the vicinity of the two GDEs. Hunter Eco (2019) recommended the establishment of a GDE monitoring program including:

- Vegetation condition and extent assessed by aerial imagery and on-ground inspection over time
- Document tree height and diameter at breast height (DBH) of selected River Oak saplings and mature trees

5.3.2. Methods

GDE monitoring was undertaken by ELA ecologists Liam Scanlan and Alex Yates in September 2023. Several methods were used to monitor GDEs, as described below.

5.3.2.1. Vegetation survey plots

Two vegetation monitoring plots (standard biometric plot 50 x 20 m – (refer to Section 2)), previously surveyed in 2019, 2020, 2021 and 2022, are located in each GDE (Figure 21). Vegetation structure and function data compliant with the Biodiversity Assessment Method (BAM) plot method (current standard method for ecological impact assessment) was also collected.

5.3.2.2. Photo monitoring points

At each photo monitoring plot, images were captured at 0, 90, 180, and 270 degrees, as well as one at the ground. A total of eight photo monitoring points were surveyed (Figure 21).

5.3.2.3. Tree measurements

Thirty *Casuarina cunninghamiana* trees (15 mature trees and 15 saplings) were selected for monitoring across the River Oak riparian tall forest GDE area along North Wambo Creek in 2019 (Figure 23). Each tree was permanently marked with a numbered metal tree tag and the DBH was measured. The point of DBH measurement (1.3m above the ground) was sprayed with paint so that the measurement location can be replicated during subsequent monitoring. In 2020, 2021, 2022 and 2023 the DBH for each tree was re-measured.

Crown extent was assessed for each tagged tree. Crown extent was assessed as the percentage of the assessable crown (all live and dead branches on the tree) in which there are live leaves. Two observers each recorded a crown extent estimate from opposite sides of the tree to the nearest 5%, and the average of the two scores was recorded.

5.3.2.4. Mapping of vegetation extent

Mapping the extent of the River Oak riparian tall woodland community along the upper reach of North Wambo Creek was completed in GIS at 1:1000 scale using georeferenced aerial imagery (NearMap,

2022). Polygons were drawn with reference to Rapid Data Points (RDPs) and photos collected during the monitoring survey and using comparison to aerial imagery from 2019 (NearMap) when the community extent was first mapped in detail.

5.3.3. Results

The results of the GDE monitoring are presented below, with raw data and all photographs included in Volume 2.

5.3.3.1. Vegetation survey plots

Two monitoring plots were surveyed in *Melaleuca decora* low forest (Figure 21). BioMetric data from each plot is presented in Table 19.

The BioMeteric results from the *Melaleuca decora* low forest GDE indicated the community is in good condition, with the majority of scores such as average NPS remaining within the ranges of previous year's results. Between 2019 and 2021, NPS approximately doubled, likely as a result of the increased rainfall. NPS in River Oak riparian tall woodland has remained stable since 2021, and NPS in M. decora has decreased since 2022, to levels consistent with 2019-2020 (Figure 18).

Table 19: BioMetric data for GDE monitoring plots in 2023

GDE	Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL	LI
***Melaleuca decora* low forest**	GDE1	33	10	15	65	8	25	2	1	1	30	80
	GDE2	32	8	8	78	65	5	0	1	1	20	82
	Average	32.5	9	11.5	71.5	36.5	15	1	1	1	25	81
River Oak riparian tall woodland	GDE3	36	5	0	15	10	5	30	0	1	30	30
	GDE4	52	10	0.5	12	12	10	10	0	1	45	42
	Average	44	44	7.5	0.25	13.5	11	7.5	20	1	37.5	36

Figure 18: Average number of native species within each GDE over time from 2019-2023

Photograph 27: GDE P3 monitoring plot along North Wambo Creek in 2019

Photograph 28: GDE P3 monitoring plot along North Wambo Creek in 2022 in flooded conditions. Approximate location of transect shown in white.

Photograph 29: GDE P3 monitoring plot along North Wambo Creek in 2023

5.3.3.2. Photo monitoring points

Review of images from photo monitoring points show GDE vegetation in good condition in 2023. A noticeable increase in ground cover vegetation was visible in both *Melaleuca decora* low forest and River Oak riparian tall woodland GDE communities in 2022 compared to site establishment in 2019 (Photograph 30 - Photograph 33). Ground cover vegetation appears to be stable or returning to pre-2021 levels, likely influenced by annual rainfall.

Photograph 30: GDE Photo monitoring point M2 (facing north) in *Melaleuca decora* low forest in 2019

Photograph 31: GDE Photo monitoring point M2 (facing northwest) in *Melaleuca decora* low forest in 2023

Photograph 32: GDE Photo monitoring point M7 (facing north) in River Oak riparian tall woodland in 2019

Photograph 33: GDE Photo monitoring point M7 (facing north) in River Oak riparian tall woodland in 2022

Photograph 34: GDE Photo monitoring point M7 (facing north) in River Oak riparian tall woodland in 2023

5.3.3.3. Tree measurements

Individual tree measurements from 2023 are presented in Table 20. The average DBH for River Oak trees increased in the saplings (4 cm) and slightly increased in mature trees (1 cm) (Figure 19). Sapling growth is expected to be greater than mature trees. Two individual adult trees (Trees 19 and 21) recorded lower DBH in 2023 than the previous year, and this is thought be to a result of a portion of bark falling away. In all cases, trees appear healthy, with the exception of Tree 19 which shows signs of rot in the basal hollow.

The average canopy extent decreased by 1% for mature River Oak trees and decreased by 2% for saplings (Figure 20). This low amount of change is within the range of observer variation, however the small decline in canopy extent may be consistent with low rainfall in 2023.

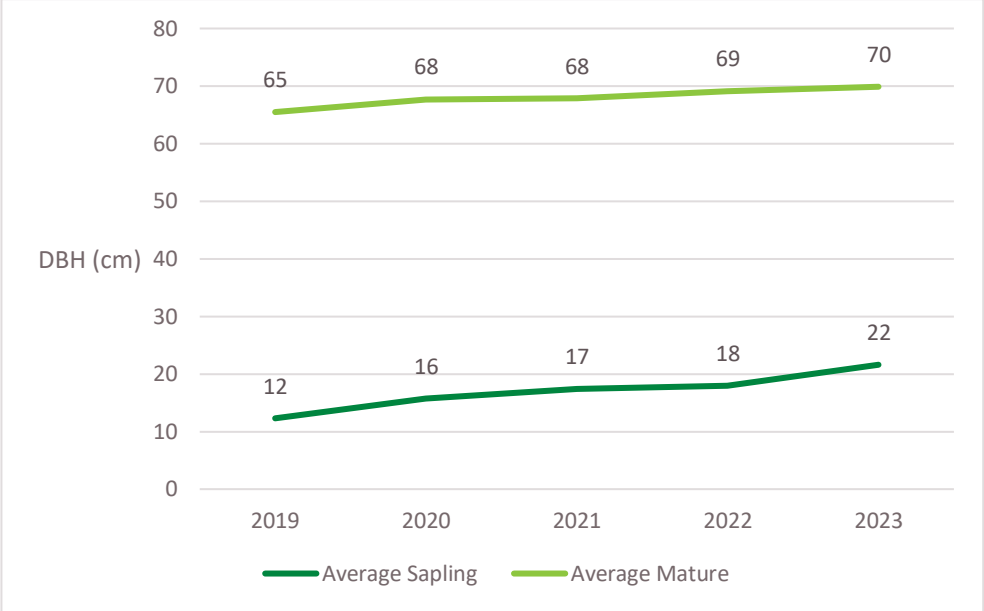

Figure 19: Change in DBH over time of measured trees within the GDE River Oak riparian tall woodland GDE

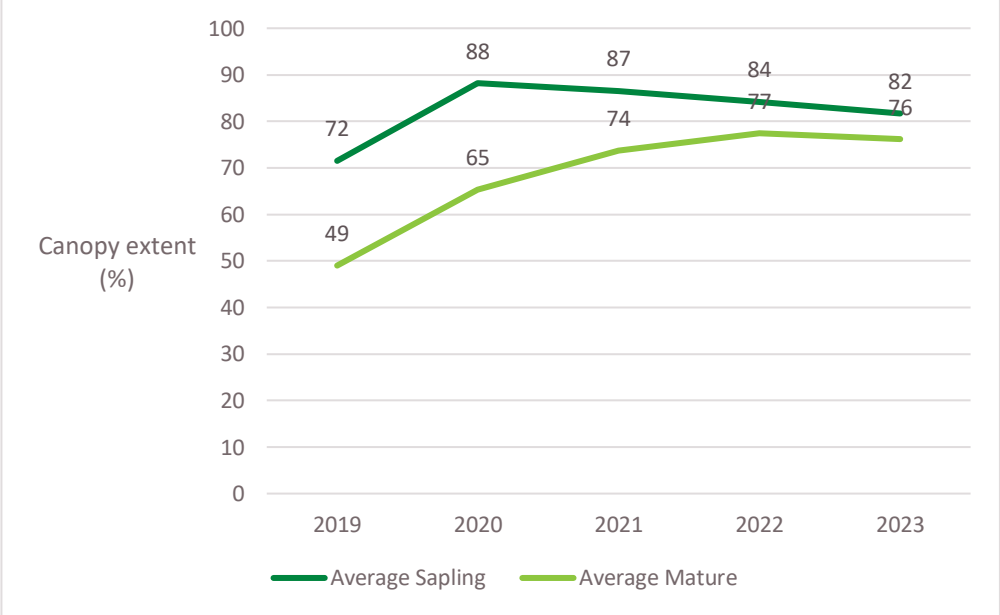

Figure 20: Change in canopy extent over time of measured trees within the GDE River Oak riparian tall woodland GDE

Table 20: River Oak tree monitoring results in 2023

Tree Tag No.	Age class	DBH (cm)	Canopy Extent (%)	Easting	Northing
1	Mature	77.5	82.5	306275	6395900
2	Mature	44.5	95	306164	6395894
3	Sapling	35.1	100	306090	6395881
4	Mature	87.5	95	306050	6395868
5	Mature	34.3	32.5	305952	6395693
6	Mature	103	72.5	305964	6395705
7	Sapling	28.5	75	305811	6395612
8	Sapling	19.9	92.5	305753	6395618
9	Mature	62.5	67.5	305785	6395619
10	Sapling	21.3	90	305529	6395440
11	Sapling	35.5	94	305470	6395438
12	Mature	67.1	90	305442	6395439
13	Sapling	8.7	72.5	305380	6395409
14	Mature	60	47.5	305379	6395410
15	Sapling	10	47.5	305573	6395454
16	Sapling	19.1	94	305587	6395457
17	Sapling	14.4	70	305593	6395493
18	Mature	105	67.5	305566	6395521
19	Mature	77.9	80	305571	6395591
20	Sapling	25.3	77.5	305607	6395612
21	Mature	112	85	305338	6395325
22	Mature	64.6	92.5	305307	6395248
23	Sapling	24.7	77.5	305264	6395213
24	Mature	53.2	57.5	305218	6395224
25	Sapling	29.5	77.5	305202	6395237
26	Mature	51.9	87.5	305171	6395235
27	Sapling	25.7	87.5	305038	6395194
28	Mature	47.2	90	305035	6395190
29	Sapling	17.1	95	305021	6395183
30	Sapling	9.2	75	305004	6395173

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5.3.3.4. Mapping of River Oak riparian tall woodland vegetation extent

No change in extent of River Oak riparian tall woodland was observed in the field or observable in the aerial imagery. The total area of the GDE remains 5.07 ha (Figure 22).

5.3.4. Conclusions and recommendations

Ongoing monitoring of these sites is required to assess whether any impacts to GDEs occurs as a result of planned mining activities in this area.

Floristic monitoring recorded generally decreased scores for both GDEs surveyed. Drier conditions in 2022 after high rainfall in 2020 and 2021 is likely to be the major factor in these results and photo monitoring shows deceased vegetation cover, particularly in the understorey of both areas.

For the *Melaleuca decora* low forest GDE, it may be appropriate to use data collected during 2019, 2020, 2021, 2022 and 2023 as the baseline conditions for the community. This area was undermined during 2019 and 2020, and no obvious impacts have occurred, and any adverse effects to vegetation are unlikely to have been detectable yet. As such, future monitoring surveys may be considered as post impact surveys and compared to the 2019, 2020, 2021, 2022 and 2023 results.

GDE tree monitoring within River Oak riparian tall woodland recorded tree growth and similar canopy extent (with a slight decrease), suggesting the health of the trees is mostly stable.

The River Oak riparian tall woodland remains approximately 200-300m from the closest mined portion of the South Bates Underground Extension mining area. As such, there may be no current impacts from undermining and the current data will serve as a baseline for reference once mining activities occur in the vicinity of the community. Variation in results between the drier years in 2019 and 2023 and wetter years in 2020, 2021 and 2022 is likely to be useful to understand the natural changes which occur in the community when attempting to determine whether any future changes observed are the result of mining impacts or natural variation.

No discernible change in the extent of the River Oak riparian tall woodland GDE was recorded. Changes to the extent of the community are likely to take place over the course of several years. The wetter years in 2020, 2021 and 2022 may have provided suitable conditions for the spread and germination of canopy and mid storey species which in the coming years may result in an increase in the extent of the community.

It is noted that due to the reorientation of three underground mining longwalls, twenty trees now fall outside of the planned underground mining area (trees 7-26) , while six trees (trees 1-6) fall within the new underground mining area, or close to the boundaries. It is recommended that additional trees are monitored within the new underground mining area. While less trees are required to be monitored in the area no longer planned for mining, monitoring of some trees should continue, to act as a reference condition, and to assess any detrimental affects of monitoring in the vicinity of the trees.

Monitoring should continue to assess for impacts to the *Melaleuca decora* low forest GDE and to continue collecting baseline and future impact data for the River Oak riparian tall woodland GDE. Several groundwater monitoring wells have been established in the vicinity of the GDE along North Wambo Creek and the data from these is also likely to assist with determining whether any impacts to GDEs are likely to occur.

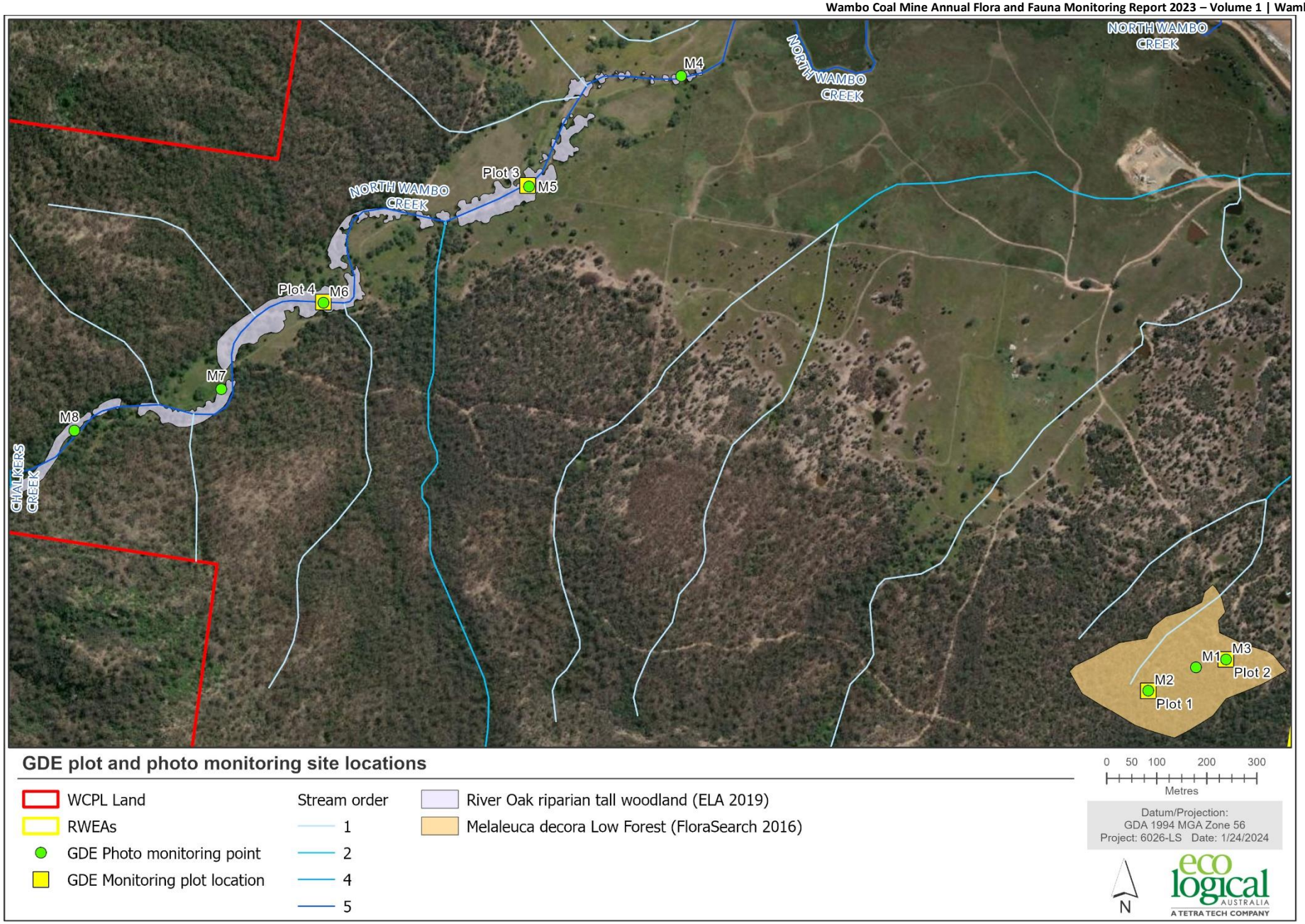

Figure 21: GDE monitoring site locations

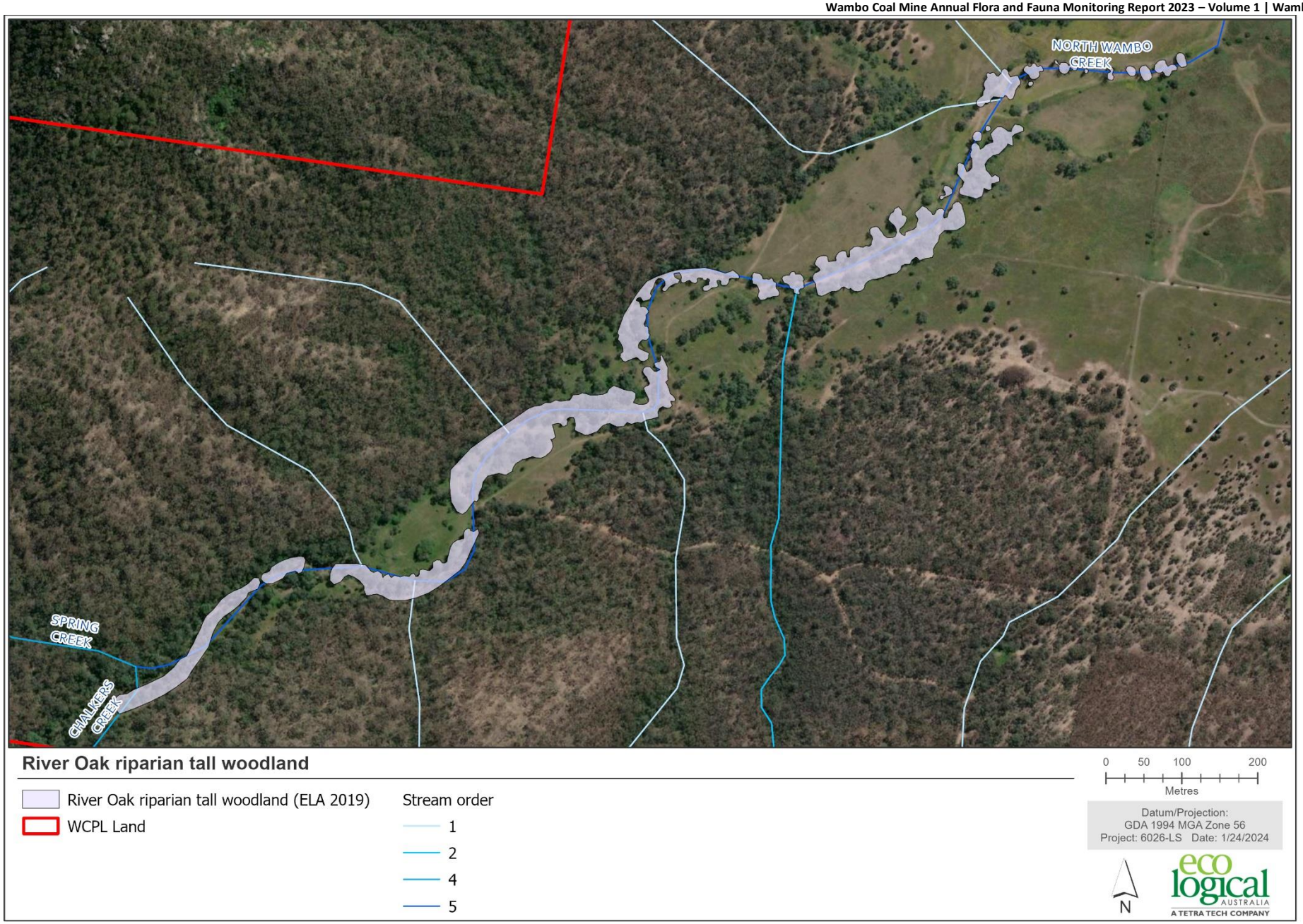

Figure 22: Extent of River Oak riparian tall woodland mapped in Spring 2019, unchanged in 2021, 2022 and 2023

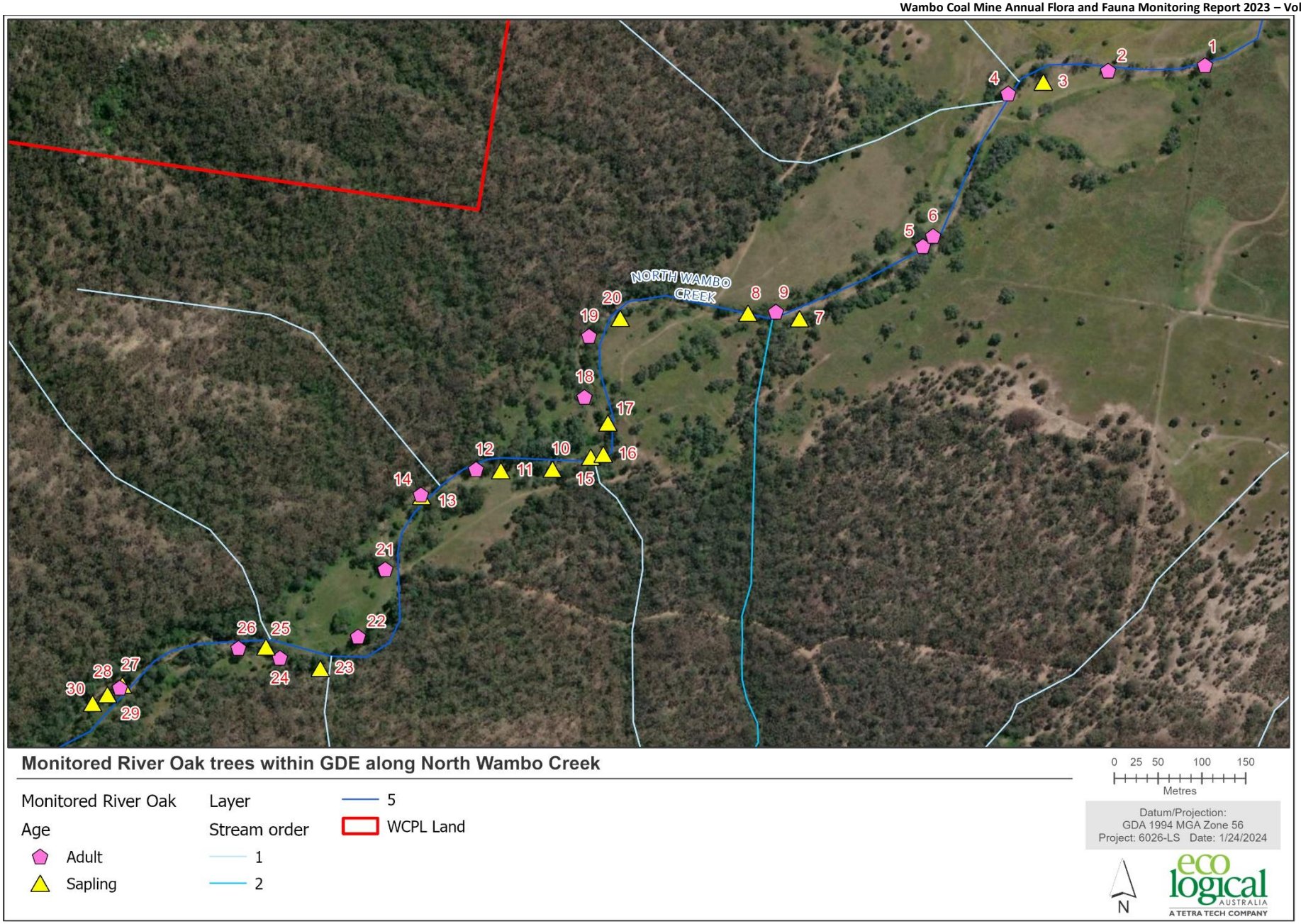

Figure 23: Monitored River Oak trees along North Wambo Creek

6. Mine subsidence observations and other management considerations

6.1. Subsidence observations

Subsidence cracks were noted near flora site V11-B1, as per recent years (Photograph 35 - Photograph 40). These cracks appeared larger in 2023, however the cracking was not having any observable significant impacts on vegetation at the current time, with the adjacent trees and shrubs showing no visible signs of stress or damage.

Several other occurrences of subsidence were noted, most of which have been previously reported.

Photograph 35: Large subsidence cracks near flora monitoring site V11-B1 (in 2019)

Photograph 36: Large subsidence cracks near flora monitoring site V11-B1 (in 2019)

Photograph 37: Large subsidence cracks near flora monitoring site V11-B1 (in 2022)

Photograph 38: Large subsidence cracks near flora monitoring site V11-B1 (in 2022)

Photograph 39: Large subsidence cracks near flora monitoring site V11-B1 (in 2023)

Photograph 40: Large subsidence cracks near flora monitoring site V11-B1 (in 2023)

6.1.1. Performance criteria and results

Performance criteria and findings during the 2023 monitoring for subsidence impacts are presented in Table 21, which is based on Table 12 in the *Wambo Coal Biodiversity Management Plan* (WCPL 2023). These performance criteria exclude any impacts and consequences of mining that occurred prior to February 2011 in accordance with Condition 22, Schedule 4, of Development Consent DA 305-7-2003.

Table 21: Subsidence performance measures, indicators and 2022 findings

Biodiversity feature	Performance measure	Performance indicator (WCPL 2023)	2023 findings
Wollemi National Park	Negligible subsidence impacts and environmental consequences	The performance indicators will be considered to have been exceeded if conventional vertical subsidence exceeds 20 millimetres (mm) or the limit of survey accuracy (whichever is greater) at the base of the Wollemi National Park escarpment. The performance indicators will be considered to have been exceeded if visual inspections identify cliff or rock face instability at the Wollemi National Park escarpment.	N/A - Vertical subsidence as the base of escarpment or cliff or rock face instability not inspected as part of the flora and fauna monitoring program in 2023.
Other species, populations or communities listed under the	Minor cracking and ponding of the	The performance indicator will be considered to have been exceeded if annual monitoring at flora monitoring sites V6-B1c and V11-B1 or bird	Bird monitoring sites above longwalls do not show a downward trend or a decrease

Biodiversity feature	Performance measure	Performance indicator (WCPL 2023)	2023 findings
Biodiversity Conservation Act 2016 or Environmental Protection and Biodiversity Conservation Act 1999	land surface or other impact. Negligible environmental consequences.	monitoring sites (BP14, BP16, BP20, BP21) above Longwalls 11 to 16 indicate a statistically significant downward trend or change between monitoring periods not observed at analogue/reference sites.	not observed at other reference sites (Figure 24). Subsidence cracks were recorded at V11-B1. No significant vegetation damage was observed at these sites. No significant effect of undermining was recorded. Vegetation at these sites and in the wider area remains in relatively good condition.
Warkworth Sands Woodland Community		The Warkworth Sands Woodland Community is absent from the South Bates Underground Mine area. Monitoring and performance indicators relevant to mine subsidence in the Warkworth Sands Woodland Community will be addressed in future revisions of the BMP prior to any extraction under the Warkworth Sands Woodland Community	Area not currently undermined – no subsidence observations.
White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community		The White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community is absent from the South Bates Underground Mine area. Monitoring and performance indicators relevant to mine subsidence in the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community will be addressed in future revisions of the BMP prior to any extraction under the White Box, Yellow Box, Blakely's Red Gum Woodland/Grassy White Box Woodland Community.	Area not currently undermined – no subsidence observations.
Central Hunter Valley Eucalypt Forest and Woodland Ecological Community		Minor cracking and ponding of the land surface or other impact. Negligible environmental consequences.	No additional observations of damage to this community beyond that described in the 2016 flora and fauna monitoring report (ELA 2016). Predominantly minor surface cracks observed.

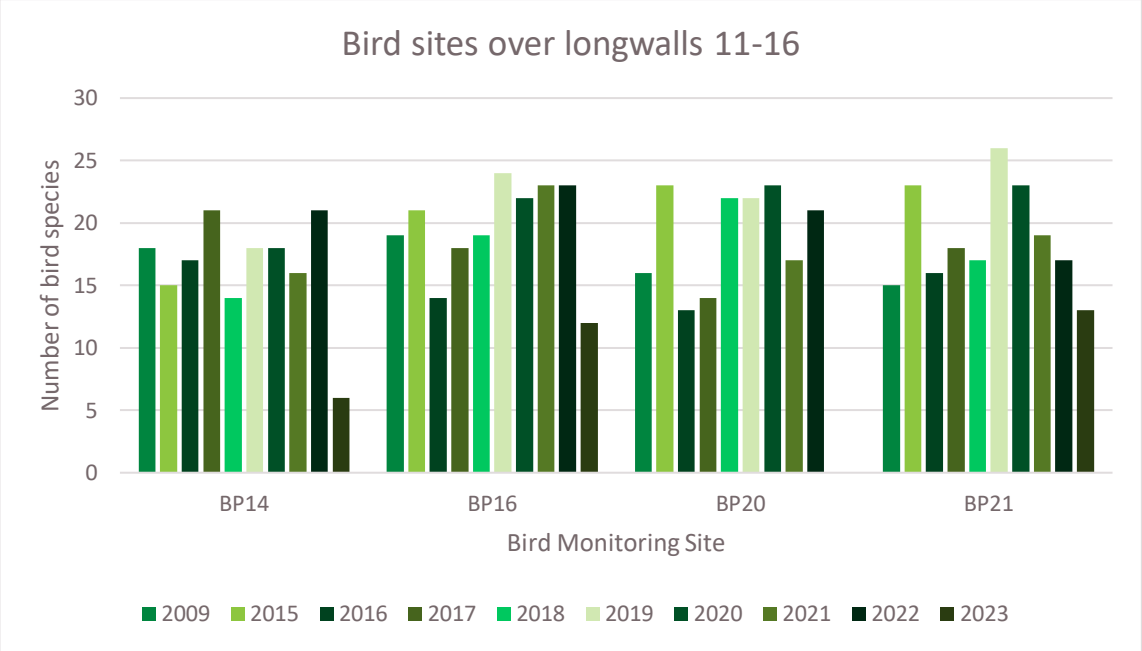

Figure 24: Total number of bird species recorded at sites located over longwalls 11 to 16 in 2009 and 2015-23

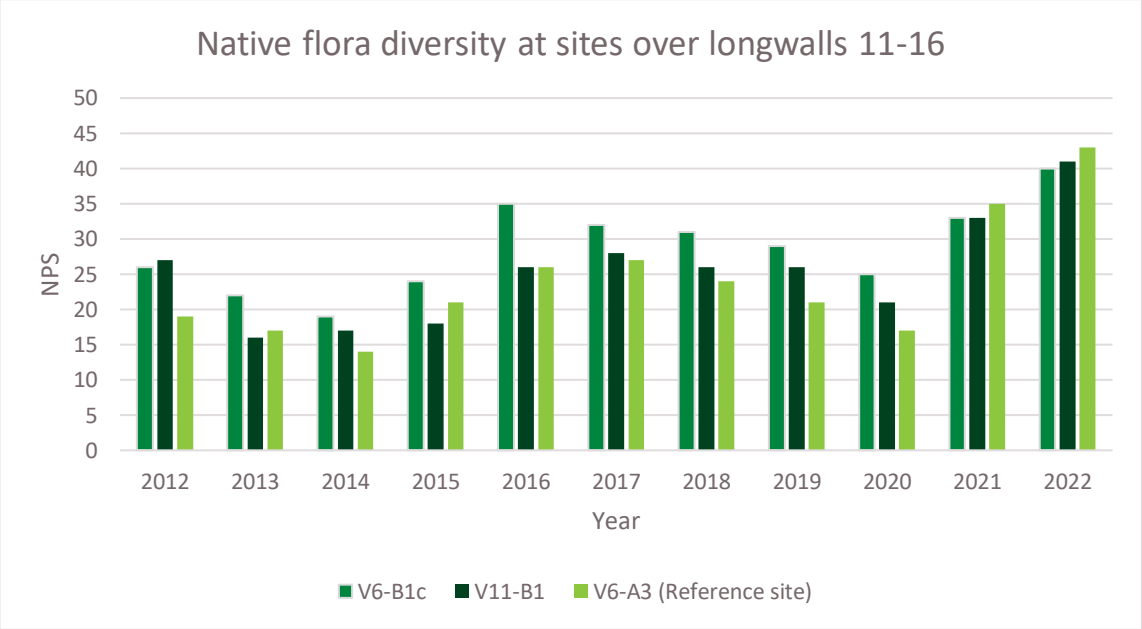

Figure 25: Average number of native flora species recorded at sites located over longwalls 11-16 and reference site 2010-2023

6.1.2. Conclusion and recommendations

Monitoring data or general observations do not indicate any exceedance of the performance criteria or any significant effects on biodiversity values at this stage, however future monitoring should continue to document and assess subsidence impacts across the site.

6.2. Weed issues

Environmental weeds impacted on RWEAs have been discussed in previous sections. Management of weeds across WCPL land should continue, particularly for priority weeds and Weeds of National Significance (WONS), to prevent their spread.

A targeted weed survey and update to Annual Weed Treatment Plan is scheduled for 2024, which will record weed issues in detail, incorporating the results of this monitoring program, and outline proposed strategy for weed treatment in 2023/2024 in detail.

6.3. *Banksia integrifolia* dieback in RWEA A

The Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland (in RWEA A) appears to be suffering from *Banksia integrifolia* die-off in the mid-storey, first observed in 2019. This community occurs on sandy soils, and it is possible that this soil type does not retain moisture in subsurface layers as efficiently as other soil types and has therefore impacted vegetation during these dry years (2017-2019) and the higher rainfall to date has not been sufficient to recharge the soil. Alternatively, this vegetation community may require a longer period of time to see improvements in vegetation condition following more consistent rainfall. The Warkworth Sands Woodland of the Hunter Valley community is listed as a Critically Endangered Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999*, future monitoring should continue to record the condition of this community; increased weed control is also recommended.

Comparison of photo-monitoring sites between 2013 and 2023 monitoring show no major changes in vegetation over this period. Wetter conditions during 2022 are apparent in some photographs, with more green vegetative growth visible in the understorey, and increase in native ground cover, however, in general, no major changes in species composition or structure are apparent. As discussed previously, dry conditions were observed and reported (2017-2019). These observations correspond to the floristic data collected within biometric plots with higher ground cover scores recorded across most PCTs in 2022.

An assessment of soil microbiology has not been undertaken to investigate the potential of *Phytophthora* impacts on the community, however this is planned for March 2024, with soil and plant tissue samples to be sent for analysis at the Plant Disease Diagnostic Unit (PlantClinic) at the Royal Botanic Garden Sydney. It is noted that *Banksia integrifolia* is thought to be relatively high in resistance to *Phytophthora cinnamomi* die-back (McCredie et al. 1985), and this species is not listed as a species that is susceptible to infection by *P. cinnamomi* in "Infection of native plants by *P. cinnamomi* - key threatening process listing NSW Scientific Committee - final determination" (OEH 2002). Warkworth Sands Woodland is not listed as a threatened ecological community that is vulnerable to *P. cinnamomi* infestation (OEH 2002), however OEH (2002) also states that in some circumstances, *P. cinnamomi* may contribute to plant death where there are other stresses present (e.g. waterlogging, drought, and perhaps wildfire), and the Warkworth Sands Woodlands has been subjected to drought and flooding conditions in recent years.

No Banksia cover was recorded in 2022, but low cover of *Banksia integrifolia* was recorded in 2023 in RWEA A monitoring plots V5B1 and V5B2. This observation suggests Banksia individuals may be recovering, or new plants may have germinated. Ongoing monitoring within these plots will provide additional data on the recovery or ongoing decline of this species locally.

7. Summary of management actions required

A summary of the management actions required and recommended to be undertaken by WCPL based on the results of the 2023 annual biodiversity monitoring program is provided in Table 22.

Table 22: Summary of management actions required.

Area/Feature	Performance criteria	Result	Action required
RWEA A and Rail Loop	Exotic plant cover limits within RWEA A and Rail Loop **Targets** • Rail Loop CT2: 15% • RWEA A A1: 60% • RWEA A A3: 20%	Exotic plant cover at CT2 (Rail Loop), and A1, and A3 (RWEA A) exceeded targets. **Results** • Rail Loop CT2: 16% • RWEA A A1: 76% • RWEA A A3: 34%	Conduct annual weed survey and review of weed management activities success. Update Annual Weed Treatment Plan. Continue weed management in RWEA A and Rail Loop in accordance with Updated Weed Treatment Plan – increased weed management effort is recommended. Consider planting native trees in over-cleared riparian areas
RWEA A and Rail Loop	**Performance target:** • Exotic Plant Cover (<10%)	**Average exotic plant cover:** • PCT 42 sites within RWEA A was 51.7	Continue weed management in RWEA A and Rail Loop in accordance with Updated Weed Treatment Plan – continued increased weed management effort is recommended.

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Wambo Coal Pty Ltd (WCPL). 2023. *Biodiversity Management Plan*. Unpublished report by Wambo Coal Pty Ltd

Wambo Coal Mine Annual Flora and Fauna Monitoring Report 2023 – Volume 2

Wambo Coal Pty Ltd

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1. Introduction

This document provides raw data and photographs collected during Spring 2023 monitoring at the Wambo Coal Mine.

2. Flora monitoring

2.1 Monitoring data

Data collected during the 2023 floristic surveys are presented below in Table 1**,** Table 2 and Table 3**.**

Several abbreviations for measured attributes are used in tables throughout the following section. An explanation of these is provided below:

- NPS – the number of native plant species within 20 x 20 plot
- NOS (%) - projected native foliage cover of canopy
- NMS (%) – projected native mid-storey cover
- NGCG – native groundcover of grasses
- NGCS – native groundcover of shrubs
- NGCO – native groundcover of other plant types (sedges, herbs etc.)
- EPC – exotic plant cover
- OR – proportion of overstorey species regenerating over the whole vegetation zone
- HBT – number of hollow-bearing trees present in the 20 x 50 m vegetation plot
- FL – length of fallen logs >10 cm diameter
- LI (%) – leaf litter cover
- BS (%) – bare soil cover

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Table 1: Biometric plot data for remnant woodland areas

Plot Name	NPS	NOS (%)	NMS (%)	NGCG	NGCS	NGCO	EPC	OR	HBT	FL (m)	LI	BS	Cryptogram
V1-A1	7	24.5	0	30	0	60	72	1	0	80	58	4	0
V1-A2	8	12	0	76	0	12	46	1	1	28	30	0	0
V1-B1	10	5.9	0	10	0	0	28	1	1	60	22	42	0
V1-B2	16	18.5	0	32	6	0	34	1	0	18	16	0	0
V1-B3	9	7.3	1	8	12	18	80	1	0	10	0	0	0
V2-A1	13	24.7	6	98	26	38	0	1	2	0	94	0	0
V2-B1	18	14.1	0	34	0	24	76	1	1	6	68	0	0
V2-B2	13	19.5	8.5	24	14	2	88	1	2	18	84	0	0
V3-B1	24	24	16	0	60	2	52	1	4	30	82	0	0
V5-B1	32	31.5	0.5	90	4	58	2	1	1	11	98	0	0
V5-B2	22	33.5	12.5	86	18	74	4	1	3	5	92	0	0
V5-B3	30	17	10.5	62	38	36	0	1	2	12	94	0	0
V5-B4	32	27.5	0	40	10	14	16	1	1	8	98	0	2
V6-A1c	36	24	17	96	38	36	0	1	2	22	98	0	0
V6-A3	24	19	9	36	18	16	0	1	0	15	100	0	2
V6-B1	31	28.5	12	74	0	12	2	1	2	32	100	0	0
V6-B1c	41	16	14.5	58	34	28	0	1	0	28	100	0	0
V6-B2	33	17.5	13.5	64	14	30	6	1	1	50	100	0	0
V6-B2c	33	22.5	17	76	32	24	0	1	0	24	86	0	0
V6-B3	36	18.5	14	78	22	36	4	1	3	35	92	0	2
V6-B4	16	25	5	50	4	20	4	1	0	6	100	0	12
V9-A1	26	11.5	9.5	50	6	22	2	1	1	18	94	0	0
V9-B1	36	29	6.5	86	36	40	0	1	2	25	100	0	2
V9-B2	44	21.5	8.5	50	48	14	0	1	0	17	98	6	0
V10-A1	48	14.5	6.5	72	6	8	0	1	0	28	100	0	0
V10-A2	33	21	4.5	44	34	8	0	1	0	12	94	4	0
V10-B1	41	32	15	78	50	66	4	1	3	36	100	0	0
V10-B3	37	25.8	0.5	48	52	8	0	1	2	40	98	0	0
V11-B1	27	17.5	16	66	72	14	0	1	0	55	96	2	0
V11-B2	47	15.5	21.5	100	20	44	0	1	0	28	84	0	0
V13-B1	45	20	29.5	78	45	20	29.5	1	1	35	100	0	0
V14-A1	42	0	61.5	80	62	50	2	1	0	8	96	4	6
V14-B1	34	11.5	30	94	62	12	0	1	0	30	62	0	0
V14-B2	43	21.5	41	92	84	94	0	1	0	7	100	0	12

Table 2: Biometric plot data for GDE, South Bates Extension and North Wambo Creek Diversion Plots

	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	OR	HBT	FL	LI
GDE-P1	33	10	15	65	8	25	2	1	1	30	80
GDE-P2	32	8	8	78	65	5	0	1	1	20	82
GDE-P3	36	36	5	0	15	10	5	30	1	30	30
GDE-P4	52	52	10	0.5	12	12	10	10	1	45	42
SBX1-SG-I	24	15.5	2	20	45	0	0	0	0	35	90
SBX2-GB-I	36	22	2	75	40	26	0	1	1	12	76
SBX3-SG-C	35	18	11	20	40	20	0	0	0	20	85
SBX4-GB-C	43	18	2	75	32	15	0	1	1	48	58
NWCD1	10	0	0	42	0	0	94	0	1	75	8
NWCD2	17	0	0	82	0	0	82	0	0	2	5

Table 3: Flora species lists from RWEA monitoring plots

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Abutilon oxycarpum	Straggly Lantern-bush	Native																															2			2
Acacia amblygona	Fan Wattle	Native															2		1		4			2	1	2	1	1		2	3					
Acacia binervia	Coast Myall	Native																	2								2	2	3	2		3				
Acacia decora	Western Silver Wattle	Native																												2						
Acacia decurrens	Black Wattle	Native		1		1									2																					
Acacia falcata	-	Native																												1					1	
Acacia falciformis	Broad-leaved Hickory	Native																													1					
Acacia filicifolia	Fern-leaved Wattle	Native	1			2		1		3		2																								
Acacia implexa	Hickory Wattle	Native																			2						1									
Acacia longissima	Long-leaf Wattle	Native																	1																	
Acacia maidenii	Maiden's Wattle	Native																															1			
Acacia parramattensis	Parramatta Wattle	Native							2																											
Acacia salicina	Cooba	Native														2														2				1		
Acacia spp.	Wattle	Native							1								1					1				1							2			1
Acetosella vulgaris	Sheep Sorrel	Exotic						2	1																											
Adiantum aethiopicum	Common Maidenhair	Native																															2			1
Aira cupaniana	Silvery Hairgrass	Exotic	1				2				1																									
Ajuga australis	Austral Bugle	Native																				1														
Allocasuarina luehmannii	Bulloak	Native											3	2	2	4	3		1	4	3	4	3	1	3	3	3			2	3					
Allocasuarina spp.	-	Native																												1						
Alternanthera denticulata	Lesser Joyweed	Native			1																															
Amyema cambagei	Needle-leaf Mistletoe	Native				1																														
Amyema gaudichaudii	-	Native																									1			1						
Ancistrachne uncinulata	Hooky Grass	Native																														2	2			
Angophora floribunda	Rough-barked Apple	Native									2	3		3	4																					
Argemone ochroleuca	Mexican Poppy	Exotic	1																																	
Aristida jerichoensis	Jericho Wiregrass	Native																		2															1	
Aristida ramosa	Purple Wiregrass	Native							1			1		3	1	2	3	1	1	3	2	2	3			3	1		2	4	1	3	1	2	3	1
Aristida vagans	Threeawn Speargrass	Native										2		1	1	1	1		2		1	2		1	4	2	3	3	3	2	2	2				
Arthropodium spp.	-	Native																	1																	
Asparagus asparagoides	Bridal Creeper	Exotic							1																											1
Asparagus officinalis	Asparagus	Exotic							1	1																										
Aster subulatus	-	Exotic													1				1																	
Austrostipa ramosissima	Stout Bamboo Grass	Native							2							2																	4			2

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Austrostipa scabra	Speargrass	Native																1				1												1		
Austrostipa scabra subsp. *scabra*	Rough Speargrass	Native														2										2				1				2	
Austrostipa verticillata	Slender Bamboo Grass	Native		1																														1		1
Axonopus ficilifolius	-	Exotic						2																												
Banksia integrifolia	-	Native										1	2																							
Beyeria spp.	-	Native																	1								1						1			
Bidens pilosa	Cobbler's Pegs	Exotic								1		1	1							1		1					1	1	1				1			
Bossiaea ensata	Sword Bossiaea	Native															1																			
Bothriochloa macra	Red Grass	Native																																		1
Brachychiton populneus subsp. populneus	-	Native							2	1		2	2	1						2	1						1							4	2	
Breynia oblongifolia	Coffee Bush	Native								1		3	2	2	1	2						1		1	1		1	1	1	1	2	1	2	1	1	2
Briza maxima	Quaking Grass	Exotic						1																												
Briza minor	Shivery Grass	Exotic					2																													
Bromus catharticus	Praire Grass	Exotic				2																														
Brunoniella australis	Blue Trumpet	Native														2	1			1		1		1		2	1	1		1			1	1		1
Bryophyllum delagoense	Mother of millions	Exotic											2																							
Bursaria spinosa	Native Blackthorn	Native										2			1	1			1							4	3	2	2	4	2	4	3	3			2
Callistemon pinifolius	Pine-leaved Bottlebrush	Native			1																															
Calotis cuneifolia	Purple Burr-Daisy	Native																				1	1											1		
Calotis lappulacea	Yellow Burr-daisy	Native																												1					1	
Cardiospermum grandiflorum	Balloon Vine	Exotic		1		3	2																													
Carex inversa	Knob Sedge	Native									4																									
Casuarina cunninghamiana	River Oak	Native	4	3	4	4	5																													
Cayratia clematidea	Native Grape	Native					1							1																						
Cenchrus spinifex	-	Exotic					1																													
Centaurium tenuiflorum	Branched Centaury, Slender centaury	Exotic									2																						1			1
Centella asiatica	Indian Pennywort	Native									2																									
Centipeda minima	Spreading Sneezeweed	Native			3	2					3																									
Cerastium glomeratum	Mouse-ear Chickweed	Exotic		2																																
Cheilanthes distans	Bristly Cloak Fern	Native														1			1		1								1						2	
Cheilanthes sieberi subsp. *sieberi*	Rock Fern	Native						1		1	1	1		1	1	2	1	2		2	1	1	2		2	1	1	1	2	1	1	2	1	1		1
Chloris spp.	-	Native																									1	1								

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Chloris truncata	Windmill Grass	Native																1									1									
Chloris ventricosa	Tall Chloris	Native														2		2		4	2	3								3				1	4	
Choretrum candollei	White Sour Bush	Native														2			3						2	1	2	2			2					
Chrysocephalum apiculatum	Common Everlasting	Native						1				1		1	1								1													
Cissus antarctica	Kangaroo Vine	Native																																1		
Claoxylon australe	Brittlewood	Native																															1			
Clematicissus opaca	Pepper Vine	Native																																	1	
Clematis aristata	Old Man's Beard	Native										1																	2							
Commelina cyanea	Native Wandering Jew	Native	1			2																			1							1				3
Conyza bonariensis	Flaxleaf Fleabane	Exotic				2									1												1		1			1		1		
Conyza spp.	-	Exotic	2	3					1		1	1	2			1		1		1		1	1										1		1	
Conyza sumatrensis	Tall fleabane	Exotic					3				2																			1						
Correa sp.	-	Native																											1							
Corymbia maculata	Spotted Gum	Native																						3	3	3			3				3			
Cotoneaster pannosus	-	Exotic										2																								
Cyclospermum leptophyllum	Slender Celery	Exotic	1	2		2			1																											
Cymbopogon refractus	Barbed Wire Grass	Native						1			1				1	2	2	2	4	3	3	3		2	2	3	3	3	2	2	2	3			2	
Cynanchum viminale subsp. *Brunonianum*	Caustic Vine	Native																	1								1									
Cynodon dactylon	Common Couch	Native	3			1		4	4	3	1	3	4	3	2			3				1	1	3					3							
Cyperus enervis	-	Native														1		2	1	1	1	2											1	2		1
Cyperus gracilis	Slender Flat-sedge	Native																				1					1							1		1
Cyperus polystachyos	-	Native																						1												
Cyperus spp.	-	Native																														1				
Datura stramonium	Common Thornapple	Exotic	1																																	
Daviesia genistifolia	Broom Bitter Pea	Native															2	1																		
Daviesia ulicifolia	Gorse Bitter Pea	Native																	1		1					1										
Denhamia silvestris	Narrow-leaved Orangebark	Native																	1							1	1									
Desmodium brachypodum	Large Tick-trefoil	Native															1		2		1	2			1	1								1		1
Desmodium gunnii	Slender Tick-trefoil	Native																								1							2			
Desmodium rhytidophyllum	-	Native																							1	1										
Desmodium varians	Slender Tick-trefoil	Native														3	1		2		1			1	2	1			1	1						2
Dianella caerulea	Blue Flax-lily	Native						1		2						2		1				1			3	1			2	2		2				2
Dianella longifolia	Blueberry Lily	Native															1										2									

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Dianella longifolia var. *longifolia*	-	Native																			2			1					1							
Dianella revoluta var. *revoluta*	-	Native											2	2	2				2		2		1				1	1		2		2				
Dichelachne inaequiglumis	-	Native																		1																
Dichondra repens	Kidney Weed	Native	1										1			1	1	2	1	2	1	2		1			1	1	1	1				2	1	2
Digitaria parviflora	Small-flowered Finger Grass	Native												2		1						3			1	2									
Digitaria spp.	-	Native										1								2									1		3			3	
Dodonaea viscosa subsp. *cuneata*	Wedge-leaf Hop-bush	Native															1		2					2	1	1	1	1	2		3	1			1	
Echinopogon caespitosus	Bushy Hedgehog-grass	Native											2	3	1																					
Echinopogon spp.	-	Native				1																														
Echium plantagineum	Patterson's Curse	Exotic		3			2																													
Ehrharta erecta	Panic Veldtgrass	Exotic	1	2	2	4		2	3	2		2	2																							
Einadia hastata	Berry Saltbush	Native												2																				1		
Einadia nutans	Climbing Saltbush	Native											2									1	1											1		
Einadia trigonos	Fishweed	Native							2										1	1							1		1							
Elaeodendron australe	-	Native																															1			
Eleocharis acuta	-	Native								2																										
Enchylaena tomentosa	Ruby Saltbush	Native																	1															1		
Entolasia spp.	-	Native																												1						
Entolasia stricta	Wiry Panic	Native																						3		2					4	3				
Eragrostis benthamii	-	Native												2	1			2	2				1								1			1	1	2
Eragrostis brownii	Brown's Lovegrass	Native									1			2				3	2			1	2	2	3	2	1	1	2	1	3					
Eragrostis curvula	African Lovegrass	Exotic			3	3	2					2			3			2						1												
Eragrostis elongata	Clustered Lovegrass	Native																					2			2	2									
Eragrostis leptostachya	Paddock Lovegrass	Native														2		3		2	1	2		1	2	1						1		1	3	2
Eremophila debilis	Amulla	Native															1			2	2	1						1	1					1		
Eucalyptus blakelyi	Blakely's Red Gum	Native								4				1																						
Eucalyptus camaldulensis	River Red Gum	Native					3		4	4																										
Eucalyptus crebra	Narrow-leaved Ironbark	Native								1						4	4	1	3		4	2	1	4	3	3	3	3	3		3	2	3			3
Eucalyptus dawsonii	Slaty Gum	Native										1															3	2		3						
Eucalyptus moluccana	Grey Box	Native														2		3		3	3	3											3		3	
Eucalyptus punctata	Grey Gum	Native																											2		3	2				
Euchiton involucratus	Star Cudweed	Native								1								1		1		1				1			1							

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Exocarpos strictus	Dwarf Cherry	Native						2	2	3			1	3											1											
Facelis retusa	-	Exotic		2				1														1														
Romulea rosea var. *australis*	Onion Grass	Exotic							1																											
Ficus coronata	Creek Sandpaper Fig	Native																														1				
Fimbristylis dichotoma	Common Fringe-sedge	Native																3	1																	
Gahnia aspera	Rough Saw-sedge	Native																		2		1				1	2	2		2		2	2	1	2	2
Galenia pubescens	Galenia	Exotic						1	1																											
Galium aparine	Cleavers	Exotic							1																											
Galium propinquum	Maori Bedstraw	Native																														1	2			
Geijera salicifolia	Brush Wilga	Native														1				1	1												1	3	3
Geitonoplesium cymosum	Scrambling Lily	Native																												1					1
Geranium homeanum	-	Native																														1				
Geranium solanderi	Native Geranium	Native																															1			
Geranium spp.	-	Native																														1				
Glycine clandestina	Twining glycine	Native										1	1	1	1			1	1	1	1		1		2						1		1		
Glycine microphylla	Small-leaf Glycine	Native																			1				1				1				1		2
Glycine tabacina	Variable Glycine	Native									1	1	1			1	1	1		1		2		1			1	1	2			2		1	1
Gomphocarpus fruticosus	Narrow-leaved Cotton Bush	Exotic		1														1				1													
Gomphocarpus spp.	-	Exotic															1																		
Gonocarpus teucrioides	Germander Raspwort	Native																									1	1							
Goodenia hederacea	Ivy Goodenia	Native																								1									
Goodenia rotundifolia	-	Native																	2		1		2	2			1	1	2			3			
Grevillea montana	-	Native												2										1	2						2	3			
Hardenbergia violacea	False Sarsaparilla	Native																						1											
Heliotropium amplexicaule	Blue Heliotrope	Exotic		3				1	2	1		1	1	1				1		1															
Hibbertia obtusifolia	Hoary Guinea Flower	Native										2	2	2	2																	2			
Hibbertia spp.	-	Native																									1	1							
Hibiscus heterophyllus subsp. *heterophyllus*	Native Rosella	Native																															3		
Hovea linearis	-	Native												2																					
Hovea spp.	-	Native																														2			
Hydrocotyle bonariensis	-	Exotic				3																													
Hypericum gramineum	-	Native									1																								
Hypochaeris radicata	Catsear	Exotic	1					1				1	1									1													
Hypochaeris glabra	-	Exotic																1																	

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Imperata cylindrica	Blady Grass	Native										4	4																							
Indigofera australis	Australian Indigo	Native																						1												
Isolepis inundata	Club-rush	Native			3	2																														
Isopogon dawsonii	Nepean Conebush	Native												3																						
Jacksonia scoparia	Dogwood	Native										2																				2				
Jasminum volubile	-	Native																																1		
Juncus bufonius	Toad Rush	Native			2						2																									
Juncus polyanthemus	-	Native									4				2																					
Juncus spp.	-	Native					1						1																							1
Juncus usitatus	-	Native										1						1						1												
Laxmannia gracilis	Slender Wire Lily	Native													1								1	2												
Lepidosperma laterale	Variable Sword-sedge	Native																														2				
Leptospermum petersonii	Lemon-scented Teatree	Native				1																														
Leptospermum polyanthum	-	Native						1																												
Leptospermum spp.	Tea-tree	Native					2																													
Leucopogon muticus	Blunt Beard-heath	Native													1																	2				
Lobelia purpurascens	-	Native																1		1					1				1			1	2			
Lomandra filiformis	-	Native						2		1					2			2	1	3		2		1	2	1	1		1	1		1			1	2
Lomandra leucocephala	Woolly Mat-rush	Native													1			1		2	1	2	1			2						1				
Lomandra longifolia	Spiny-headed Mat-rush	Native			3	2						3	3	4																						
Lomandra multiflora	Many-flowered Mat-rush	Native									1	3	2	2	2	2	1	1	1							1	2	1		1		1				
Lomandra spp.	Mat-rush	Native													1																			1		
Ludwigia spp.	-	Native									1																									
Lysimachia arvensis	Scarlet Pimpernel	Exotic		2				1	2			1																								
Lysimachia minima	Kause Chaffweed	Exotic	2			2	2			2																										
Macrozamia flexuosa	-	Native																						1												
Macrozamia reducta	-	Native																								2			1							
Macrozamia spp.	-	Native																	1																	
Maireana microphylla	Small-leaf Bluebush	Native																																1	2	
Marsdenia viridiflora subsp. *viridiflora*	Native Pear	Native																	2																	
Maytenus silvestris	Narrow-leaved Orangebark	Native														1											1	1	1							
Megathyrsus maximus	-	Exotic	2				1																													
Melaleuca decora	-	Native																3	2	3	3	3	2	3	2		4	4	3		3	2				
Melaleuca linariifolia	Flax-leaved Paperbark	Native																														2				

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Melaleuca thymifolia	Thyme Honey-myrtle	Native									2																									
Melia azedarach	White Cedar	Native					2		1	2		2																					2	1		
Melinis repens	Red Natal Grass	Exotic													3																					
Microlaena stipoides var. *stipoides*	Weeping Grass	Native				4	2	2	2	1			2	3		2									2				2			2	3		3
Mistletoe spp.	-	Native															1																		
Myoporum platycarpum	Sugarwood	Native																											3						
Myrsine variabilis	-	Native																															1			
Notelaea longifolia	Large Mock-olive	Native																			1					1							1			
Notelaea microcarpa	Native Olive	Native																						1												
Notelaea microcarpa var. *microcarpa*	-	Native				1			2	3	1	2	3	2	2	4	1	2	3	3	1	2			2	2	3	3	2	3	2	3	3	5	4	5
Notelaea venosa	Veined Mock-olive	Native																															1			
Oenothera stricta	-	Exotic		1				0																												
Olea europaea subsp. *cuspidata*	African Olive	Exotic					3		1				2							1																
Olearia elliptica	Sticky Daisy-bush	Native														2	2	1	3	2	1				3	3			3	2	2	4	1	2	2	3
Onopordum acanthium	-	Exotic	1				2																													
Opercularia diphylla	Stinkweed	Native																																		2
Opercularia hispida	Hairy Stinkweed	Native																							2											
Oplismenus aemulus	-	Native					2																										3	1		3
Oplismenus imbecillis	-	Native																											2				3			2
Opuntia aurantiaca	Tiger Pear	Exotic										1			1																					
Opuntia humifusa	Creeping Pear	Exotic												1					1															1		
Opuntia stricta	Common Prickly Pear	Exotic										1	1		1		1	1		1	1	2	1	1	1	1	1				1	1				1
Oxalis perennans	-	Native						2				1																				1		1		
Oxalis spp.	-	Native							1				1		1																		1			1
Pandorea pandorana	Wonga Wonga Vine	Native																															2			
Panicum effusum	Hairy Panic	Native										2	3				1		1	3															2	2
Panicum queenslandicum	Coolabah Grass	Native														2																				
Panicum simile	Two-colour Panic	Native																												2	2			1	3	
Panicum spp.	Panicum	Native													2					2	1															
Paspalidium distans	-	Native									1									1										1						
Paspalidium spp.	-	Native																													2					
Paspalum spp.	-	Native																1																		
Pavonia hastata	-	Exotic	1		2	2	2	2	5	1																										

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Pellaea falcata	Sickle Fern	Native																															1			
Persicaria decipiens	Slender Knotweed	Native			3																															
Persicaria lapathifolia	Pale Knotweed	Native	1		2						1																									
Persoonia linearis	Narrow-leaved Geebung	Native												3										1				1			2				
Phragmites australis	Common Reed	Native	5	2	4	1	3																													
Phyllanthus spp.	-	Native													1									t												
Pimelea latifolia	-	Native																															1			
Pimelea linifolia	Slender Rice Flower	Native										3		3	2																					
Plantago debilis	Shade Plantain	Native							1		1					1														1		1				
Plantago lanceolata	Lamb's Tongues	Exotic	1					1																												
Poaceae spp.	-	Native																																1		
Polycarpon tetraphyllum	Four-leaved Allseed	Native										1																								
Pomaderris spp.	-	Native																											1							
Pomax umbellata	Pomax	Native																							1							1				
Pseudognaphalium luteoalbum	Jersey Cudweed	Native		1																																
Psydrax odorata	Shiny-leaved Canthium	Native																									3	3		2						
Pteridium esculentum	Bracken	Native										3	4	2																						
Pultenaea spinosa	-	Native																								1										
Rapanea rupestrum	-	Exotic	2	3																																
Rytidosperma spp.	-	Native														4			3							3							3	3			
Richardia humistrata	-	Exotic						2				3	3										1													
Rubus fruticosus agg.	Blackberry	Exotic	1																																	
Rumex brownii	Swamp Dock	Native		1																																
Rumex sagittatus	-	Native		2			1		3	1																										
Salix spp.	-	Exotic	2		1																															
Santalaceae spp.	-	Native																								1	1								1	2
Schoenus apogon	Fluke Bogrush	Native									1																									
Scutellaria humilis	Dwarf Skullcap	Native																															2		1	1
Sebaea ovata	Yellow Centaury	Native									1																									
Senecio madagascariensis	Fireweed	Exotic	2	1	1	2	2	1	1	1					1	1	1	1	1	1		1					1	1	1	1	1	1	1	1	1	
Senna spp.	-	Native																												2			2			
Setaria parviflora	-	Exotic				3	3				1		1																							
Setaria spp.	-	Native																															1			
Setaria viridis	Green Pigeon Grass	Exotic	1	1					1																											

Scientific Name	Common Name	Native/ Exotic	V1A1	V1A2	V1B1	V1B2	V1B3	V2A1	V2B1	V2B2	V3B1	V5B1	V5B2	V5B3	V5B4	V6A1	V6A3	V6B1	V6B1c	V6B2	V6B2c	V6B3	V6B4	V9A1	V9B1	V9B2	V10A1	V10A2	V10-B1	V10-B3	V11-B1	V11-B2	V13-B1	V14A1	V14-B1	V14-B2
Sida corrugata	Corrugated Sida	Native																	1		1						1	1		2		1				
Sida rhombifolia	Paddy's Lucerne	Exotic	1			1																											1			
Sigesbeckia orientalis	-	Native																	1					1											1	1
Solanum brownii	Violet Nightshade	Native											2			1						1				1	1	1			1			1		1
Solanum nigrum	Black-berry Nightshade	Native		1					1																											
Solanum prinophyllum	Forest Nightshade	Native																											1							
Sonchus oleraceus	Common Sowthistle	Exotic	2	2		2			1	1												1					1	1								
Spartothamnella juncea	Bead Bush	Native														2				2						2	1					1	1	3	2	2
Sporobolus creber	Slender Rat's Tail Grass	Native										1			1	2		3	2		2			2			2	1		2	2			1	2	2
Sporobolus elongatus	Slender Rat's Tail Grass	Native						1												2																
Stellaria media	Common Chickweed	Exotic							1																											
Stephania japonica	Snake vine	Native				1																											1			
Swainsona galegifolia	Smooth Darling Pea	Native																																1		
Tagetes minuta	Stinking Roger	Exotic	1						1	1			1																							
Taraxacum officinale	Dandelion	Exotic								1																										
Themeda triandra	-	Native																								1										
Cardamine paucijuga	-	Native							1																											
Tradescantia fluminensis	Wandering Jew	Exotic					2																													
Trema tomentosa	-	Native																											1			2	2			
Tricoryne elatior	Yellow Autumn-lily	Native													1																					
Verbascum virgatum	Twiggy Mullein	Exotic						1																												
Verbena bonariensis	Purpletop	Exotic	1					1			1														1						1			1		2
Verbena rigida	Veined Verbena	Exotic						1													1						1	1						1	
Vernonia cinerea	-	Native																	1																	
Veronica plebeia	Trailing Speedwell	Native							1		1				1							1			1		1				1	1		1		
Vittadinia cuneata	-	Native																		1		1					2	1								
Vittadinia sulcata	-	Native														1	1					1								2					2	
Vulpia bromoides	Squirrel Tail Fesque	Exotic						1	2																											
Vulpia muralis	-	Exotic					2																													
Wahlenbergia communis	Tufted Bluebell	Native				1																							1						1	
Wahlenbergia gracilis	Sprawling Bluebell	Native																									1	1					1			
Wahlenbergia spp.	Bluebell	Native													1																					
Xanthium spinosum	Bathurst Burr	Exotic	1			2																														

2.2 Floristic monitoring plot photographs

A photograph has been taken at the start and end of the 50 m central transect of each biometric monitoring plot. Plot photos for each respective vegetation type are presented below.

2.2.1 River Red Gum / River Oak riparian woodland wetland in the Hunter Valley

Plate 1: V1-A1 – start

Plate 2: V1-A1 – end

Plate 3: V1-A2 – start

Plate 4: V1-A2 – end

Plate 5: V1-B1 – start

Plate 6: V1-B1 – end

Plate 7: V1-B2 – start

Plate 8: V1-B2 – end

Plate 9: V1-B3 – start

Plate 10: V1-B3 – end

Plate 11: V2-A1 – start

Plate 12: V2-A1 – end

Plate 13: V2-B1 – start

Plate 14: V2-B1 end

Plate 15: V2-B2 – start

Plate 16: V2-B2 – end

Plate 17: V3-B1 – start

Plate 18: V3-B1 – end

2.2.2 Rough-barked Apple - Narrow-leaved Ironbark - Blakely's Red Gum - Bull Oak - Coast Banksia woodland on sands of the Warkworth area

Plate 19: V5-B1 – start

Plate 20: V5-B1 – end

Plate 21: V5-B2 – start

Plate 22: V5-B2 – end

Plate 23: V5-B3 – start

Plate 24: V5-B3 – end

Plate 25: V5-B4 – start

Plate 26: V5-B4 – end

2.2.3 Narrow-leaved Ironbark - Bull Oak - Grey Box shrub - grass open forest of the central and lower Hunter

Plate 27: V6-A1c – start

Plate 28: V6-A1c – end

Plate 29: V6-A3 – start

Plate 30: V6-A3 – end

Plate 31: V6-B1 – start

Plate 32: V6-B1 – end

Plate 33: V6-B1c – start

Plate 34: V6-B1c – end

Plate 35: V6-B2 – start

Plate 36: V6-B2 – end

Plate 37: V6-B2c – start

Plate 38: V6-B2c – end

Plate 39: V6-B3 – start

Plate 40: V6-B3 – end

Plate 41: V6-B4 – start

Plate 42: V6-B4 – end

Plate 43: V11–B1 – start

Plate 44: V11-B1 – end

Plate 45: V11-B2 – start

Plate 46: V11-B2 – end

2.2.4 Narrow-leaved Ironbark - Grey Box - Spotted Gum shrub - grass woodland of the central and lower Hunter

Plate 47: V9-A1 – start

Plate 48: V9-A1 – end

Plate 49: V9-B1 – start

Plate 50: V9-B1 – end

Plate 51: V9-B2 – start

Plate 52: V9-B2 – end

Plate 53: V10-B1 – start

Plate 54: V10-B1 – end

2.2.5 Slaty Box - Grey Gum shrubby woodland on footslopes of the upper Hunter Valley, Sydney Basin Bioregion

Plate 55: V10-A1 – start

Plate 56: V10-A1 – end

Plate 57: V10-A2 – start

Plate 58: V10-A2 – end

Plate 59: V10-B3 – start

Plate 60: V10-B3 – end

2.2.6 White Mahogany - Spotted Gum - Grey Myrtle semi-mesic shrubby open forest of the central and lower Hunter Valley

Plate 61: V13-B1 – start

Plate 62: V13-B1 – end

2.2.7 Brush Wilga/Native Olive Shrubland

Plate 63: V14-A1 – start

Plate 64: V14-A1 – end

Plate 65: V14-B1 – start

Plate 66: V14-B1 – end

Plate 67: V14-B2 – start

Plate 68: V14-B2 – end

2.2.8 Groundwater Dependent Ecosystems

Plate 69: GDE P1 – start

Plate 70: GDE P1 – end

Plate 71: GDE P2 – start

Plate 72: GDE P2 – end

2.3 Floristic monitoring point photographs

2.3.1 RWEA Photo monitoring points

Plate 73: A1 – 2013

Plate 74: A1 – 2023

Plate 75: A2 – 2013

Plate 76: A2 – 2023

Plate 77: A3 – 2013

Plate 78: A3 – 2023

Plate 79: A4 – 2013

Plate 80: A4 – 2023

Plate 81: B1 – 2013

Plate 82: B1 – 2023

Plate 83: B2 – 2013

Plate 84: B2 – 2023

Plate 85: C1 – 2013

Plate 86: C1 – 2023

Plate 87: C2 – 2013

Plate 88: C2 – 2023

Plate 89: CT1 – 2013

Plate 90: CT1 – 2023

Plate 91: CT2 – 2013

Plate 92: CT2 – 2023

Plate 93: D1 – 2013

Plate 94: D1 – 2022

2.3.2 South Bates Extension plot photos

Plate 95: SBX1-SG-I – 2023

Plate 96: SBX2-GB-I – 2023

Plate 97: SBX3-SG-C - 2023

Plate 98: SBX4-GB-C – 2023

2.3.3 Groundwater Dependent Ecosystems

Plate 99: GDE M1 – 2023

Plate 100: GDE M2 – 2022

Plate 101: GDE M3 - 2023

Plate 102: GDE M4 – 2023

Plate 103: GDE M5 – 2023

Plate 104: GDE M6 – 2023

Plate 105: GDE M7 - 2023

Plate 106: GDE M8 – 2023

2.3.4 North Wambo Creek Diversion plot photos

Plate 107: NWCD1 – 2023

Plate 108: NWCD2 – 2023

3. Groundwater Dependent Ecosystem Tree Monitoring

3.1 GDE Trees photographs

Plate 109: GDE Tree 1 - 2023

Plate 110: GDE Tree 2 - 2023

Plate 111: GDE Tree 3 - 2023

Plate 112: GDE Tree 4 - 2023

Plate 113: GDE Tree 5 - 2023

Plate 114: GDE Tree 6 - 2023

Plate 115: GDE Tree 7 - 2023

Plate 116: GDE Tree 8 - 2023

Plate 117: GDE Tree 9 – 2023

Plate 118: GDE Tree 10 – 2023

Plate 119: GDE Tree 11 – 2023

Plate 120: GDE Tree 12 – 2023

Plate 121: GDE Tree 13 – 2023

Plate 122: GDE Tree 14 - 2023

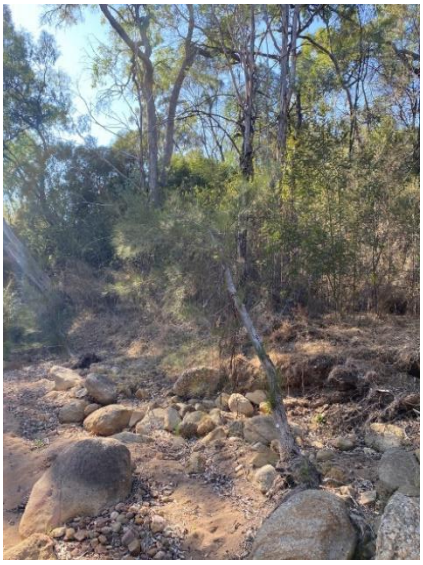

Plate 123: GDE Tree 15 – 2023

Plate 124: GDE Tree 16 - 2023

Plate 125: GDE Tree 17 – 2023

Plate 126: GDE Tree 18 - 2023

Plate 127: GDE Tree 19 – 2023

Plate 128: GDE Tree 20 - 2023

Plate 129: GDE Tree 21 – 2022 (no photo provided for 2023)

Plate 130: GDE Tree 22 – 2023

Plate 131: GDE Tree 23 – 2023

Plate 132: GDE Tree 24 – 2023

Plate 133: GDE Tree 25 – 2023

Plate 134: GDE Tree 26 – 2023

Plate 135: GDE Tree 27 – 2023

Plate 136: GDE Tree 28 – 2023

Plate 137: GDE Tree 29 – 2023

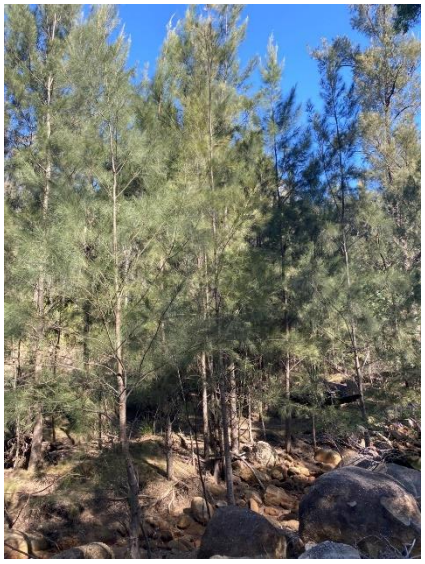

Plate 138: GDE Tree 30 - 2023

5. Riparian condition assessment

5.1 Riparian condition data

Table 4: 2023 Riparian condition scores

Site	Habitat	Cover	Natives	Debris	Features	Total
Maximum Score	**11**	**12**	**9**	**10**	**8**	**50**
North Wambo 1	5.25	7.75	4.5	6	4.5	28
North Wambo 2	8.75	8	4.75	5.25	4.75	31.5
North Wambo 3	7.75	9.75	6.75	7	5.5	36.75
Wambo 1	2.25	6.75	4	4.5	3.5	21
Wambo 2	3	6.75	3.75	5.5	2.5	21.5
Wambo 3	9.5	6.5	1.75	5.25	2.25	25.25
Stony Creek 1	3	8	5.5	6	4.25	26.75
Stony Creek 2	7	8.5	5.25	7.25	3.75	31.75
Stony Creek 3	11	10.75	7.75	8.25	5	42.75

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5.2 Riparian condition assessment photographs

5.2.1 North Wambo Creek

Plate 139: North Wambo Creek 1 - 8a (2023)

Plate 140: North Wambo Creek 1 - 7a (2023)

Plate 141: North Wambo Creek 1 - 6a (2023)

Plate 142: North Wambo Creek 1 - 5a (2023)

Plate 143: North Wambo Creek 2 – 1a (2023)

Plate 144: North Wambo Creek 2 - 2a (2023)

Plate 145: North Wambo Creek 2 - 3a (2023)

Plate 146: North Wambo Creek 2 - 4a (2023)

Plate 147: North Wambo Creek 3 – 20a (2023)

Plate 148: North Wambo Creek 3 - 19a (2023)

Plate 149: North Wambo Creek 3 - 18a (2023)

Plate 150: North Wambo Creek 3 - 17a (2023)

5.2.2 Wambo Creek Riparian condition assessment

Plate 151: Wambo Creek 1 – 28a (2023)

Plate 152: Wambo Creek 1 - 27a (2023)

Plate 153: Wambo Creek 1 – 26a (2023)

Plate 154: Wambo Creek 1 - 25a (2023)

Plate 155: Wambo Creek 2 – 29a (2023)

Plate 156: Wambo Creek 2 - 30a (2023)

Plate 157: Wambo Creek 2 - 31a (2023)

Plate 158: Wambo Creek 2 - 32a (2023)

Plate 159: Wambo Creek 3 - 33a (2023)

Plate 160: Wambo Creek 3 – 34a (2023)

Plate 161: Wambo Creek 3 - 35a (2023)

Plate 162: Wambo Creek 3 - 36a (2023)

5.2.3 Stony Creek Riparian condition assessment

Plate 163: Stony Creek 1 – 24a (2023)

Plate 164: Stony Creek 1 - 23a (2023)

Plate 165: Stony Creek 1 - 22a (2023)

Plate 166: Stony Creek 1 - 21a (2023)

Plate 167: Stony Creek 2 – 13a (2023)

Plate 168: Stony Creek 2 - 14a (2023)

Plate 169: Stony Creek 2 - 15a (2023)

Plate 170: Stony Creek 2 - 16a (2023)

Plate 171: Stony Creek 3 – 12a (2023)

Plate 172: Stony Creek 3 - 11a (2023)

Plate 173: Stony Creek 3 - 10a (2023)

Plate 174: Stony Creek 3 - 9a (2023)

6. Bird monitoring

6.1 Winter and spring bird monitoring data

An outline of bird monitoring data for winter and spring 2023 is presented in Table 5 below.

Table 5: Species and maximum count of birds, heard and observed over two site visits; morning and afternoon during spring 2023 surveys, and winter 2023 survey results.

Scientific Name	Common Name	Monitoring site and maximum count from the two bird surveys																															Winter bird survey
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	No. Sites	
Alisterus scapularis	Australian King-Parrot	4	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	3	0	0	0	0	0	0	2	0	0	0	0	1	14	6	✓
Gymnorhina tibicen	Australian Magpie	1	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7	4	✓
Corvus coronoides	Australian Raven	1	0	0	0	0	1	2	0	1	0	0	0	1	0	4	0	0	1	0	0	0	1	0	1	2	2	0	0	2	0	19	12	✓
Manorina melanophrys	Bell Miner	0	0	0	0	0	0	0	15	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	33	3	✓
Coracina novaehollandiae	Black-faced Cuckoo-shrike	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0	1	1	3	2	0	0	0	0	0	0	1	0	0	0	0	12	8	--
Accipiter fasciatus	Brown Goshawk	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	--
Acanthiza pusilla	Brown Thornbill	0	0	1	1	0	1	0	1	0	2	2	0	0	3	0	0	0	0	0	0	0	0	0	0	1	2	0	0	2	1	17	11	✓
Climacteris picumnus	**Brown Treecreeper**	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	--
Melithreptus brevirostris	Brown-headed Honeyeater	0	0	0	0	0	0	5	0	1	1	0	2	0	0	8	3	0	0	0	0	5	0	0	0	10	10	0	0	10	0	55	10	--
Acanthiza reguloides	Buff-rumped Thornbill	0	0	0	3	3	5	0	0	0	0	0	0	0	0	3	0	0	0	4	0	1	5	0	0	0	0	0	0	0	0	24	7	✓
Phaps chalcoptera	Common Bronzewing	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4	3	✓
Falcunculus frontatus	Crested Shrike-tit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	--
Platycercus elegans	Crimson Rosella	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	--
Stizoptera bichenovii	Double-barred Finch	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	1	--
Artamus cyanopterus	**Dusky Woodswallow**	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	--
Platycercus eximius	Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	2	✓
Acanthorhynchus tenuirostris	Eastern Spinebill	0	0	0	0	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	7	4	--
Psophodes olivaceus	Eastern Whipbird	0	0	0	0	0	0	2	2	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	12	6	--
Eopsaltria australis	Eastern Yellow Robin	0	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	8	7	--
Cacomantis flabelliformis	Fan-tailed Cuckoo	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	2	--
Eolophus roseicapilla	Galah	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	--
Pachycephala pectoralis	Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	--
Cracticus torquatus	Grey Butcherbird	0	0	0	3	2	2	0	1	0	0	0	0	0	2	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	13	8	✓
Rhipidura albiscapa	Grey Fantail	0	2	0	2	0	0	0	0	0	1	0	2	2	0	1	2	0	2	0	0	2	0	0	0	2	0	2	0	2	2	24	13	✓
Colluricincla harmonica	Grey Shrike-thrush	0	0	0	0	0	1	2	0	2	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	10	6	--
Pomatostomus temporalis	**Grey-crowned Babbler**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	8	1	0	0	0	0	0	0	1	0	0	0	0	1	15	5	✓
Microeca fascinans	Jacky Winter	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	--
Dacelo novaeguineae	Laughing Kookaburra	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	1	0	7	5	--
Myiagra rubecula	Leaden Flycatcher	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	--
Meliphaga lewinii	Lewin's Honeyeater	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	5	2	✓
Microcarbo melanoleucos	Little Pied Cormorant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	--
Grallina cyanoleuca	Magpie-lark	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	7	3	✓
Dicaeum hirundinaceum	Mistletoebird	0	0	0	0	0	0	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5	3	--
Glossopsitta concinna	Musk Lorikeet	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	--
Philemon corniculatus	Noisy Friarbird	0	1	1	0	0	0	0	1	1	2	0	1	0	0	8	2	1	4	8	0	2	6	0	0	4	1	0	0	1	2	46	17	--
Manorina melanocephala	Noisy Miner	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	1	0	6	0	0	0	0	1	0	0	0	0	0	5	22	5	✓
Oriolus sagittatus	Olive-backed Oriole	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	1	0	0	0	1	8	4	--

Scientific Name	Common Name	Monitoring site and maximum count from the two bird surveys																															Winter bird survey
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	No. Sites	
Anas superciliosa	Pacific Black Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	✓
Falco peregrinus	Peregrine Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	--
Cracticus nigrogularis	Pied Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	2	✓
Strepera graculina	Pied Currawong	2	0	1	1	1	1	0	2	0	0	6	4	0	0	0	2	0	0	5	0	0	4	0	0	3	2	4	0	3	3	44	16	✓
Merops ornatus	Rainbow Bee-eater	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	--
Anthochaera carunculata	Red Wattlebird	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	✓
Neochmia temporalis	Red-browed Finch	2	0	0	6	0	0	1	0	0	4	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	3	0	0	0	22	6	✓
Pachycephala rufiventris	Rufous Whistler	1	0	1	0	0	2	2	0	3	1	2	2	0	0	1	0	0	0	2	0	0	1	0	0	4	1	1	0	3	1	28	16	--
Ptilonorhynchus violaceus	Satin Bowerbird	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	2	✓
Chalcites lucidus	Shining Bronze-Cuckoo	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	2	--
Zosterops lateralis	Silvereye	0	20	20	6	0	0	0	0	0	20	14	6	3	0	0	0	0	4	0	0	6	0	4	0	0	0	0	0	0	0	103	10	--
Chthonicola sagittata	Speckled Warbler	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	--
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	--
Pardalotus punctatus	Spotted Pardalote	2	0	0	1	3	2	1	8	3	0	5	1	2	0	0	3	2	1	0	0	1	0	0	0	0	0	3	0	6	0	44	16	✓
Pardalotus striatus	Striated Pardalote	2	0	1	0	0	0	1	1	0	0	0	0	1	0	0	2	2	0	0	0	2	0	0	0	4	3	1	0	3	0	23	12	✓
Plectorhyncha lanceolata	Striped Honeyeater	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	4	3	0	0	1	0	11	6	--
Cacatua galerita	Sulphur-crested Cockatoo	0	0	0	0	1	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	10	6	--
Malurus cyaneus	Superb Fairy-wren	10	0	10	5	0	3	2	0	0	4	3	0	0	0	0	6	5	5	0	0	0	0	3	3	2	0	2	0	0	6	69	15	✓
Daphoenositta chrysoptera	**Varied Sittella**	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	7	3	--
Malurus lamberti	Variegated Fairy-wren	4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	8	3	--
Aquila audax	Wedge-tailed Eagle	1	0	0	0	0	0	0	3	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	✓
Smicrornis brevirostris	Weebill	0	0	0	5	0	1	0	0	0	0	0	0	3	5	5	7	0	0	4	0	7	4	0	0	2	1	0	0	5	3	52	13	--
Hirundo neoxena	Welcome Swallow	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	2	✓
Coracina papuensis	White-bellied Cuckoo-shrike	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	4	2	--
Sericornis frontalis	White-browed Scrubwren	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4	2	--
Nesoptilotis leucotis	White-eared Honeyeater	0	0	0	0	1	1	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	--
Egretta novaehollandiae	White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	✓
Melithreptus lunatus	White-naped honeyeater	0	0	0	0	0	0	0	12	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	3	--
Ptilotula penicillata	White-plumed Honeyeater	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	0	0	1	0	19	4	--
Gerygone olivacea	White-throated Gerygone	0	0	0	0	0	0	3	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	10	6	--
Cormobates leucophaea	White-throated Treecreeper	0	0	0	0	0	0	1	0	1	2	0	2	1	2	0	2	0	0	0	0	3	0	0	0	1	0	0	0	1	3	19	11	✓
Corcorax melanorhamphos	White-winged Chough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	10	0	1	0	5	0	0	0	4	5	0	0	0	0	29	6	--
Rhipidura leucophrys	Willie Wagtail	1	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	2	2	0	0	0	0	0	1	0	3	0	0	0	0	13	8	✓
Leucosarcia melanoleuca	Wonga Pigeon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2	--
Acanthiza nana	Yellow Thornbill	10	3	15	10	12	5	0	0	0	1	3	0	0	0	6	0	4	8	0	0	0	0	8	0	0	0	0	0	15	4	104	14	--
Caligavis chrysops	Yellow-faced Honeyeater	6	6	6	8	1	6	1	20	2	12	8	10	23	5	2	10	1	9	5	0	12	1	1	0	10	0	5	0	3	10	183	26	✓
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	8	1	--
Lichenostomus melanops	Yellow-tufted Honeyeater	0	0	0	0	0	0	0	5	14	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	3	--

Scientific Name	Common Name	Monitoring site and maximum count from the two bird surveys																															Winter bird survey
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	No. Sites	
Tachybaptus novaehollandiae	Australasian Grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Alectura lathami	Australian Brushturkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Ardea alba	Great Egret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Aythya australis	Hardhead	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Vanellus miles	Masked Lapwing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Falco cenchroides	Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Psephotus haematonotus	Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Platalea regia	Royal Spoonbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Platalea flavipes	Yellow-billed Spoonbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Zanda funerea	Yellow-tailed Black-Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	✓
Number of species		16	5	10	15	14	17	24	21	17	13	15	15	8	6	17	12	20	17	12	0	13	8	4	5	25	20	13	0	23	23	75	75	39

Bold denotes threatened species.

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APPENDIX F

SURFACE WATER MONITORING DATA SUMMARY

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW01	30 January	7.53	907	<5	
SW01	23 February	7.22	770	8	
SW01	28 March	7.14	790	<5	Low flow
SW01	28 April	7.53	682	<5	Low Flow/ Suspended fines
SW01	31 May	7.23	739	6	Suspended fines
SW01	28 June	7.66	831	<5	
SW01	27 July	7.47	926	<5	Suspended fines
SW01	30 August	7.73	1030	<5	
SW01	26 September	7.44	1060	<5	Suspended fines
SW01	31 October	7.43	977	<5	Suspended fines
SW01	30 November	7.42	915	6	Suspended fines
SW01	21 December	7.57	962	<5	Suspended fines
SW01	28 December	7.58	931	<5	Suspended fines
SW02	30 January	7.54	813	5	
SW02	23 February	7.33	688	6	Suspended fines
SW02	28 March	7.27	697	8	Suspended fines
SW02	28 April	7.52	672	<5	Suspended fines
SW02	31 May	7.42	687	5	Suspended fines
SW02	28 June	7.69	796	<5	
SW02	27 July	7.56	858	<5	Suspended fines
SW02	30 August	7.67	908	5	Suspended fines
SW02	26 September	7.56	934	<5	Suspended fines
SW02	31 October	7.46	897	<5	Suspended fines
SW02	30 November	7.48	893	6	Suspended fines
SW02	21/12/2023	7.59	908	<5	Suspended fines
SW02	28 December	7.66	866	<5	Suspended solids
SW03	30 January	7.50	809	10	-
SW03	23 February	7.31	688	9	-
SW03	28 March	7.28	698	8	Low Flow
SW03	28 April	7.50	671	<5	Low Flow
SW03	31 May	7.39	692	6	
SW03	28 June	7.66	806	<5	
SW03	27 July	7.53	889	9	
SW03	30 August	7.63	930	7	
SW03	26 September	7.52	966	6	
SW03	31 October	7.59	1040	8	
SW03	30 November	7.43	2780	20	

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW03	21 December				No Flow
SW03	28 December				No Flow
SW04	30 January	-	-	-	Dry
SW04	23 February	-	-	-	Dry
SW04	28 March	-	-	-	Dry
SW04	28 April	-	-	-	Dry
SW04	31 May	-	-	-	Dry
SW04	28 June	-	-	-	Dry
SW04	27 July	-	-	-	Dry
SW04	30 August	-	-	-	Dry
SW04	26 September	-	-	-	Dry
SW04	31 October	-	-	-	Dry
SW04	30 November	-	-	-	Dry
SW04	21 December	-	-	-	Dry
SW04	28 December	-	-	-	Dry
SW05	30 January	-	-	-	No Flow
SW05	23 February	-	-	-	No Flow
SW05	28 March	-	-	-	No Flow
SW05	28 April	-	-	-	No Flow
SW05	31 May	-	-	-	No Flow
SW05	28 June	-	-	-	No Flow
SW05	27 July	-	-	-	No Flow
SW05	30 August	-	-	-	No Flow
SW05	26 September	-	-	-	No Flow
SW05	31 October	-	-	-	No Flow
SW05	30 November	-	-	-	No Flow
SW05	21 December	-	-	-	No Flow
SW05	28 December	-	-	-	No Flow
SW06	30 January	7.02	366	42	-
SW06	23 February	7.13	361	5	-
SW06	28 March	7.02	373	5	Trickle
SW06	28 April	7.14	368	5	Trickle
SW06	31 May	-	-	-	Dry
SW06	28 June	-	-	-	No Flow
SW06	27 July	-	-	-	No Flow
SW06	30 August	-	-	-	No Flow

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW06	26 September	-	-	-	Dry
SW06	31 October	-	-	-	Dry
SW06	30 November	-	-	-	Dry
SW06	21 December	-	-	-	Dry
SW06	28 December	-	-	-	Dry
SW07	30 January	7.38	607	<5	-
SW07	23 February	7.28	623	6	-
SW07	28 March	7.16	608	19	Low Flow
SW07	28 April	7.36	705	<5	Low Flow
SW07	31 May	7.3	735	<5	-
SW07	28 June	7.45	758	<5	-
SW07	27 July	7.29	763	<5	-
SW07	30 August	7.38	747	<5	-
SW07	26 September	7.47	752	<5	-
SW07	31 October	-	-	-	No Flow
SW07	30 November	-	-	-	No Flow
SW07	21 December	-	-	-	No Flow
SW07	28 December3	-	-	-	No Flow
SW08	30 January	7.73	4250	16	
SW08	23 February	7.78	4940	5	
SW08	28 March	7.90	4990	5	
SW08	28 April	7.91	4910	13	Trickle flow
SW08	31 May	-	-	-	Dry
SW08	28 June	-	-	-	Dry
SW08	27 July	-	-	-	Dry
SW08	30 August	-	-	-	Dry
SW08	26 September	-	-	-	Dry
SW08	31 October	-	-	-	Dry
SW08	30 November	-	-	-	Dry
SW08	21 December	-	-	-	Dry
SW08	28 December	-	-	-	Dry
SW27a	30 January	-	-	-	Dry
SW27a	23 February	-	-	-	Dry
SW27a	28 March	-	-	-	No Flow
SW27a	28 April	-	-	-	Dry
SW27a	31 May	-	-	-	Dry
SW27a	28 June	-	-	-	Dry

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW27a	27 July	-	-	-	Dry
SW27a	30 August	-	-	-	Dry
SW27a	26 September	-	-	-	Dry
SW27a	31 October	-	-	-	Dry
SW27a	30 November	-	-	-	Dry
SW27a	21 December	-	-	-	Dry
SW27a	28 December	-	-	-	No Flow
SW32a	30 January	-	-	-	Dry
SW32a	23 February	-	-	-	Dry
SW32a	28 March	-	-	-	Dry
SW32a	28 April	-	-	-	Dry
SW32a	31 May	-	-	-	Dry
SW32a	28 June	-	-	-	Dry
SW32a	27 July	-	-	-	Dry
SW32a	30 August	-	-	-	Dry
SW32a	26 September	-	-	-	Dry
SW32a	31 October	-	-	-	Dry
SW32a	30 November	-	-	-	Dry
SW32a	21 December	-	-	-	Dry
SW32a	28 December	-	-	-	Dry
SW39	30 January	-	-	-	Dry
SW39	23 February	-	-	-	Dry
SW39	28 March	-	-	-	No Flow (pool)
SW39	28 April	-	-	-	Dry
SW39	31 May	-	-	-	Dry
SW39	28 June	-	-	-	Dry
SW39	27 July	-	-	-	Dry
SW39	30 August	-	-	-	Dry
SW39	26 September	-	-	-	Dry
SW39	31 October				Dry
SW39	30 November				Dry
SW39	21 December				Dry
SW39	28 December	-	-	-	Dry
SW40	30 January	7.54	795	6	-
SW40	23 February	7.46	707	6	Suspended solids
SW40	28 March	7.41	613	5	Low Flow
SW40	28 April	7.50	741	<5	Slow Flow/Suspended fines

Site	Date	pH	EC (µS/cm)	TSS (mg/L)	Comments
SW40	31 May	7.29	733	5	Suspended fines
SW40	28 June	7.41	764	<5	
SW40	27 July	7.39	787	<5	Suspended fines
SW40	30 August	7.54	806	13	Sheen on surface, Suspended fines
SW40	26 September	7.37	788	8	Surface sheen, Suspended fines
SW40	31 October	-	-	-	No Flow
SW40	30 November	-	-	-	Pool/No flow
SW40	21 December	-	-	-	Pool/No flow
SW40	28 December	-	-	-	No Flow
SW41	30/01/2023	-	-	-	Dry
SW41	23/02/2023	-	-	-	Dry
SW41	28/03/2023	-	-	-	Dry
SW41	28/04/2023	-	-	-	Dry
SW41	31/05/2023	-	-	-	Dry
SW41	28/06/2023	-	-	-	Dry
SW41	27/07/2023	-	-	-	Dry
SW41	30/08/2023	-	-	-	Dry
SW41	26/09/2023	-	-	-	Dry
SW41	31/10/2023	-	-	-	Dry
SW41	30/11/2023	-	-	-	Dry
SW41	21/12/2023	-	-	-	Dry
SW41	28/12/2023	-	-	-	Dry
US FM1	30/01/2023	-	-	-	Dry
US FM1	23/02/2023	-	-	-	Dry
US FM1	28/03/2023	-	-	-	Dry
US FM1	28/04/2023	-	-	-	Dry
US FM1	31/05/2023	-	-	-	Dry
US FM1	28/06/2023	-	-	-	Dry
US FM1	27/07/2023	-	-	-	Dry
US FM1	30/08/2023	-	-	-	Dry
US FM1	26/09/2023	-	-	-	Dry
US FM1	31/10/2023	-	-	-	Dry
US FM1	30/11/2023	-	-	-	Dry
US FM1	21/12/2023	-	-	-	Dry
US FM1	28/12/2023	-	-	-	Dry

APPENDIX G

ANNUAL STREAM FLOW MONITORING REPORT

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5 March 2024

Commercial-in-Confidence

Nicole Dobbins
Environmental Advisor
Wambo Coal Pty Ltd
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PMB 1
Singleton NSW 2330

Dear Nicole

Report on stream flow events along North Wambo, South Wambo and Stoney Creeks for the period 1 January to 31 December 2023.

Please find contained within this report a summary of probable flow events which occurred along North Wambo, South Wambo and Stony Creeks from and inclusive of 1 January to 31 December 2023.

1.0 Locations, Configurations and Observations

The flow monitoring network now comprises of eleven flow monitoring stations. These flow monitoring stations are distributed along the following creeks: -

- North Wambo Creek has five flow monitoring stations;
- South Wambo Creek has three flow monitoring stations, and;
- Stony Creek has two monitoring stations with an additional flow monitoring station located on a major tributary to Stony Creek.

Details of the location (**Table 1, Table 2, Figure 1** and **Figure 2**), configuration (**Table 3**) and observations (**Table 4**) for each flow monitoring station are provided below.

Table 1 Flow Station Locations

Station ID	Location	Easting	Northing
FM1	North Wambo Creek adjacent to the mine	307014	6396139
USFM1	North Wambo Creek upstream of mine	305257	6395201
FM2	Midway along old North Wambo Creek diversion	308217	6395056
FM3	Midway along new North Wambo Creek diversion	309226	6393663
FM4	North Wambo Creek upstream of the confluence of Wollombi Brook	311906	6392160
FM15	South Wambo Creek upstream of the confluence of Wollombi Brook	311561	6391008
FM16	South Wambo Creek upstream of washout of Wambo Mine Road	311279	6390673
FM9(17)	South Wambo Creek downstream	308653	6389125
FM12	Stony Creek upstream of proposed area to be mined	307711	6392744
FM14	Major tributary of Stony Creek upstream of proposed area to be mined	307723	6392242
FM13	Stony Creek downstream of proposed area to be mined	309651	6390785

Table 2 Atmospheric Pressure Correcting Station Locations

Station ID	Location	Easting	Northing
PM2	Midway along old North Wambo Creek diversion at Flow Station FM2 data logging housing	308196	6395042
PM6	South Wambo Creek upstream of washout of Wambo Mine Road inside the data logger housing for old Flow Station FM6	311253	6390711
PM8	Stony Creek upstream on the old Flow Station FM8 infrastructure	307996	6392278
PM7	Stony Creek downstream on the old Flow Station FM7 infrastructure	309400	6391443

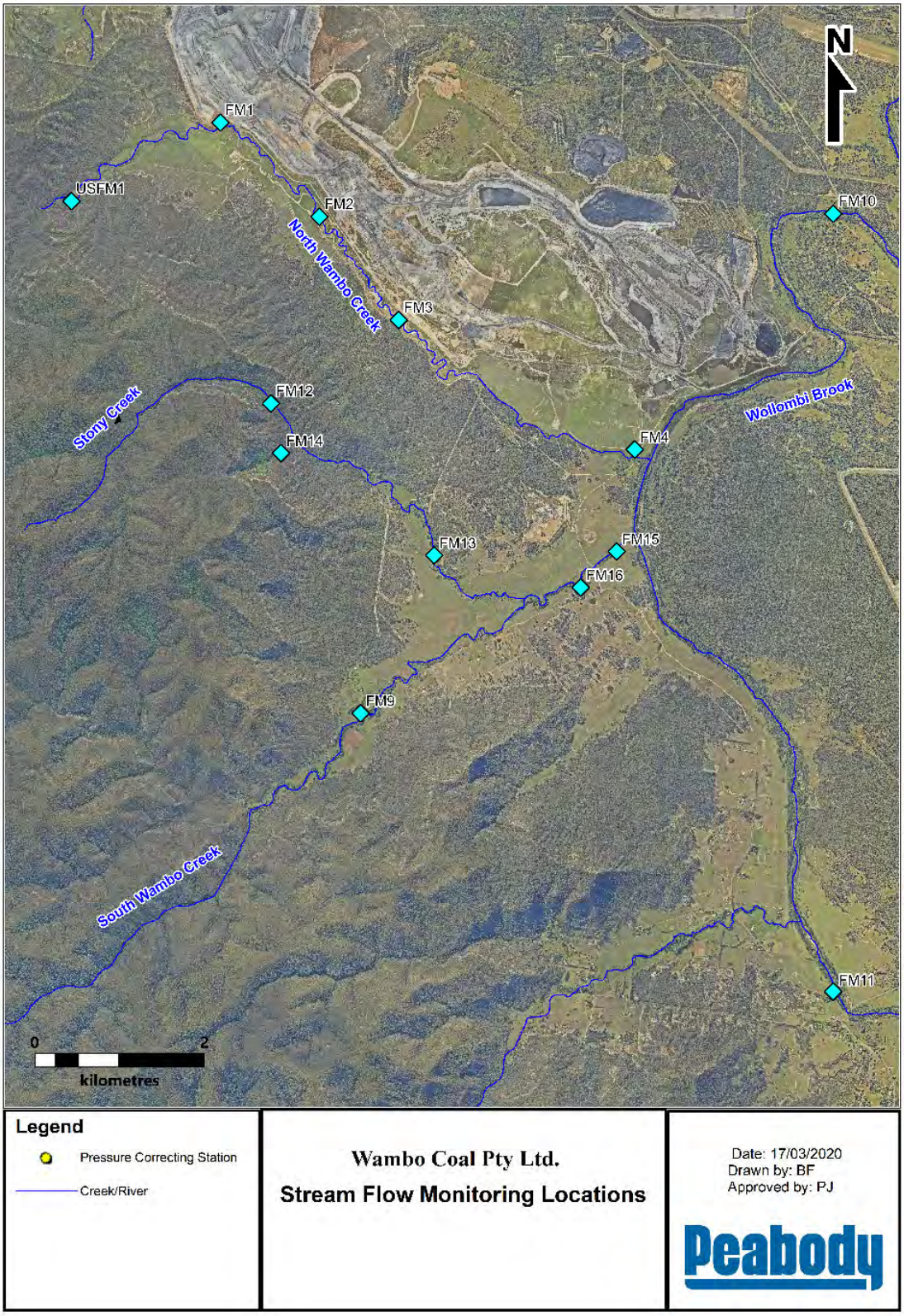

Figure 1 Stream Flow Locations

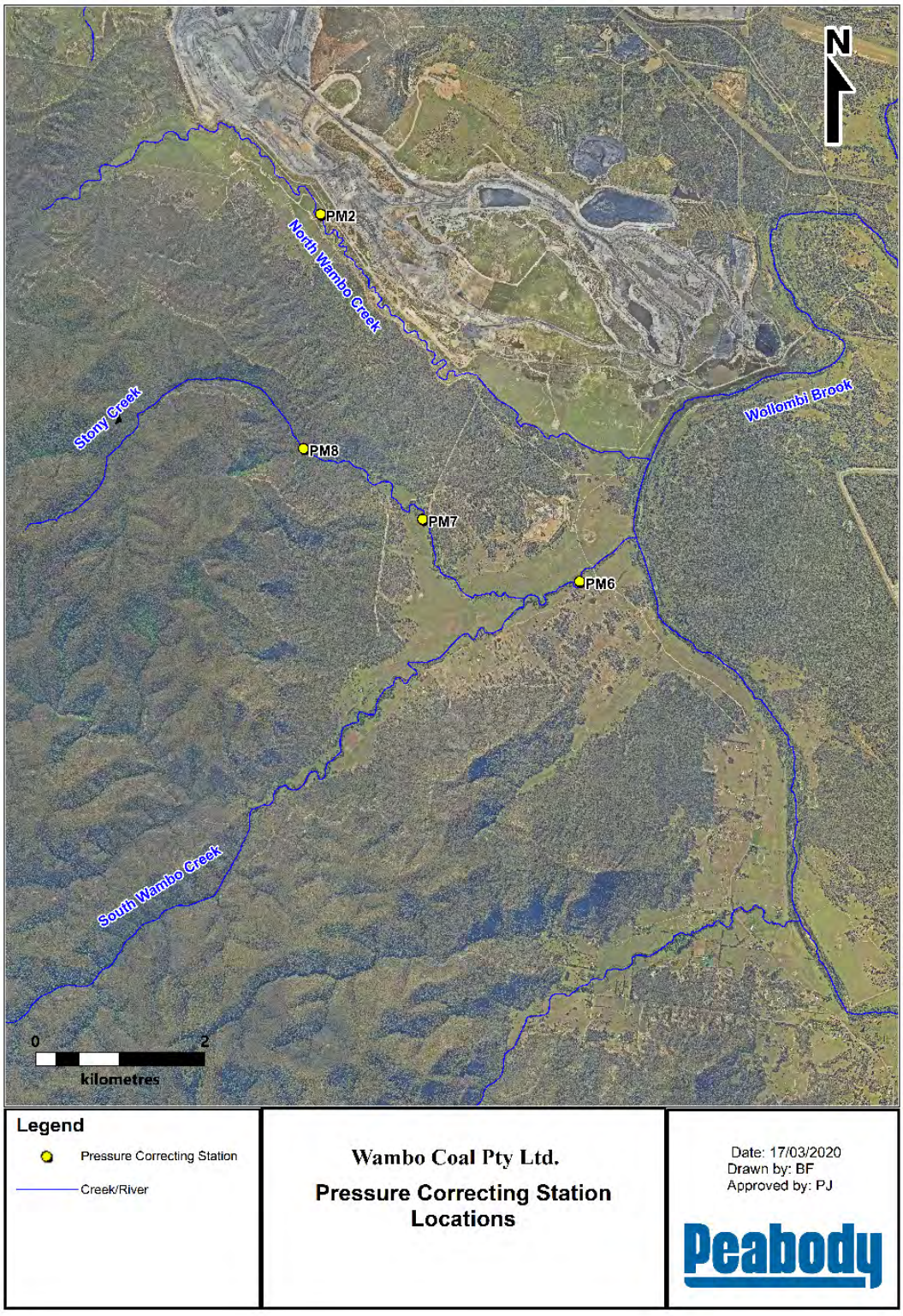

Figure 2 Pressure Correcting Station Locations

Table 3 Monitoring Location Equipment Configurations

Station ID	Equipment	Corresponding Correction Station
FM1	Campbell Scientific (CSA) CS451 SDI-12 pressure transducer connected to a CSA CR800 series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged hourly. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
USFM1	Insitu Rugged TROLL 100 absolute pressure sensor. Data is logged at 10-minute intervals. It was found	**PM2**
FM2	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM3	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM4	CSA CS450 SDI 12 pressure transducer connected to a CSA CR200X series data logger, powered by a 12-volt lead acid battery with solar charging. Data is logged at 10-minute intervals. A backup Insitu Rugged TROLL 100 absolute pressure sensor logging data at 10-minute intervals is also installed.	**PM2**
FM15	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM16	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM9	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals.	**PM6**
FM12	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM8**
FM14	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM8**
FM13	Insitu Rugged TROLL100 absolute pressure sensor which has been configured to record data at 10-minute intervals	**PM7**
PM2	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM6	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM8	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A
PM7	Insitu Rugged BaroTROLL. Data is logged at 10-minute intervals	N/A

Table 4 Monitoring Location General Observations

Station ID	Observations
FM1	Originally located at the top of North Wambo Creek upstream of surface water monitoring site SW04; re-located approximately 300 to 400m further downstream in December 2017 – downstream of surface water monitoring site SW04. This flow station was fully re-established on 21 June 2023. The main pressure sensor recorded date throughout 2023.
USFM1	New station installed on North Wambo Creek during December 2017; located approximately 1 kilometre upstream of the original site of FM1. It was found th
FM2	Located downstream from relocated Flow Station FM1 approximately midway along the old North Wambo Creek diversion. A backup pressure sensor was installed at this location in August 2020. Site was decommissioned while stream bank restoration work was being carried and was re-commissioned June to December 2023. Data was obtained from the backup sensor for the period 1 January to 25 June 2023. No probable flow events were recorded during this period.
FM3	Originally located on North Wambo Creek between the old Wambo Underground Surface Infrastructure and the Open Cut Overburden: relocated in May 2013 to approximately midway along the new diversion of North Wambo Creek downstream of Flow Station FM2. A backup pressure sensor was installed at this location in August 2020. High flow events during 2022 resulted in the failure of the main pressure sensor. A new main pressure sensor was installed during June 2023.
FM4	Located at the Wambo Mine Road culvert which crosses North Wambo Creek upstream of the confluence of North Wambo Creek and Wollombi Brook. The flood event which occurred during July 2022 resulted in water entering the logger box destroying the 12V and the data logger. Both were replaced during the latter half og 2022.
FM15	Located on South Wambo Creek just upstream of the confluence of South Wambo Creek and Wollombi Brook; relocated to approximately 100 to 200m downstream in December 2016. High flow events in mid-2022 resulted the original site becoming non-ideal. The flow station was relocated in 21 June 2023 further upstream on South Wambo Creek GPS E 311561 N 6391008.
FM16	Located on South Wambo Creek approximately 200 to 300 metres up stream of the washout on Wambo Mine Road. A new pressure sensor was installed on 18 May 2023 as the old sensor was approaching end of life.
FM 9(17)	Located approximately 2 kilometres upstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer. High flow events during the first half of 2022 washed away the sensor. The flow station was re-established on 18 May 2023. GPS E 308653 N 6389125.
FM12	Re-located during September 2018 approximately 50 metres downstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer
FM14	Installed in December 2015
FM13	Re-located during September 2018 approximately 50 metres upstream from its original location following a recommendation from Environmental Instrument Solutions' hydrographer. High flow events during 2021 washed away the sensor at this location. The flow station re-established in January 2022 approximately 100 to 200m further downstream of Stony Creek GPS E 309651 N 6390785
PM2	In November 2018 data collection it was identified that this BaroTROLL failed during October 2018. A replacement sensor was installed on 24 January 2019
PM6	A new BaroTROLL was installed on 18 May 2023 due to the old one was approaching end of life
PM8	N/A
PM7	N/A

2.0 Methodology

The results represent a theoretical flow and have been calculated using polynomial equations derived from theoretical flow rating curves. These theoretical flow curves were constructed from data received by AECOM from Wambo Coal and Environmental Instrument Solutions except for:

- The re-commissioned flow monitoring station FM2 on North Wambo Creek,
- Relocated Stony Creek Down FM13 flow monitoring station,
- Relocation of flow monitoring station FM5 on South Wambo and
- The relocation of the monitoring station FM9(17) on South Wambo Creek.

Theoretical flow curves generated by AECOM were utilised to calculate theoretical flow along North Wambo Creek, South Wambo Creek and Stony Creek and its tributary when probable flow events occurred.

The data for each theoretical flow rating curve has been generated from cross and long section surveys. From the surveys a cross sectional area and the wetted perimeter for various theoretical stream heights were derived.

From these derived values the hydraulic radius was calculated for each theoretical stream height. The hydraulic radius is calculated as follows:
Rh = A/P

Where:-

Rh = Hydraulic Radius

A = Calculated cross section area for a give stream height

P = Calculated wetted perimeter for a given stream height

The stream slope was calculated from the long section surveys and the Manning's coefficient of rugosity was determined from the conditions observed in the stream bed and surrounding flood plain.

These values were then entered into the Manning's equation and a theoretical stream velocity was calculated. The Manning's equation is as follows: -

$V = (Rh^{2/3} \times Sw^{1/2})/n$

Where: -

Rh = Hydraulic radius for a given stream height

Sw = Stream slope derived from the long section survey

n = Manning's coefficient of rugosity

The Manning's coefficient of rugosity was sourced from AS 3778.3.3 - 2001 *"Measurement of water flow in open channels, part 3.3: Velocity - area methods – Measurement by slope – area methods".*

The theoretical velocity, derived from the Manning's equation, was then multiplied by the calculated cross-sectional area for a given stream height to give a theoretical flow rate Q. The resultant theoretical flow rates were calculated for a series of stream heights and graphed to generate theoretical flow rating curves. **Appendix B** contains these theoretical flow rating curves for each Flow Monitoring Stations.

The data collected from each Flow Station was presented as a pressure reading in kPa. This pressure was converted to a stream height in metres using the following equation: -

Stream Height (m) = Stream Height (kPa) X 0.101972 (m/kPa)

The calculated stream height was then compared to the cease to flow point at each site. The cease to flow point was identified in conjunction with the long section surveys and represents a point in the reach/stream which the height of the stream must attain before it starts to flow.

The relative level of the cease to flow point was compared to the relative level of the sensor at each station. The difference in height between the cease to flow point and the sensor was calculated. This difference was used to screen the data collected from each station for probable flow events.

Once a flow event had been recognised at a flow monitoring station the resultant stream height was applied to the polynomial equation derived from theoretical flow rating curve, for that flow station, to give a theoretical stream flow rate for the identified flow event at the station. In some instances, more than one polynomial equation was required; see flow rating curves in **Appendix B**.

3.0 Results

Probable flow events for the period 1 January to 31 December 2023 for each flow station (including backup sensors) are presented in the following tables. An absence of a table of results for a flow station means that there were no probable flow events recorded for this period. All results displayed in respect to stream flow are theoretical and should be treated as such. As results have been round to a maximum of two significant figures.

- Upper North Wambo Creek – Flow Monitoring Station USFM1 (
- **Table 5)**;
- North Wambo Creek midway along new diversion – Flow Monitoring Stations FM3 (

Table 6) and FM3BU (**Table 7**) - note that the main pressure sensor failed during the July 2022 flood event and was replaced during June 2023;

- South Wambo Creek upstream of washout of Wambo Mine Road – Flow Monitoring Station FM16 (**Table 8**);
- South Wambo Creek upstream of surface water sampling site SW06 old Brossi Property - Flow Monitoring Station FM9(17) (**Table 9**);
- Stony Creek upstream of proposed area to be mined – Flow Monitoring Station FM12 (**Table 10**)

Table 5 Flow Monitoring Station USFM1 Upper North Wambo Creek – Summary of Results – 1 January to 31 December 2023.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2023 0:02	21/02/2023 15:42	52	0.1	0.16	0.0087	0.75	0.036	3.1
2	22/02/2023 7:12	4/03/2023 19:02	10	0.065	0.12	0.0014	0.12	0.012	1
3	5/03/2023 7:32	5/03/2023 15:52	0.35	0.01	0.024	0.0029	0.25	0.0029	0.25

Table 6 Flow Monitoring Station FM3 North Wambo Creek – Summary of Results – 2 June to 31 December 2023.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	20/12/2023 11:40	20/12/2023 13:40	0.083	0.0092	0.027	0.0044	0.38	0.014	1.2
2	23/12/2023 19:50	23/12/2023 22:20	0.1	0.022	0.048	0.012	1	0.028	2.4
3	24/12/2023 9:50	24/12/2023 12:40	0.12	0.0077	0.016	0.0035	0.3	0.0078	0.67
4	25/12/2023 19:00	25/12/2023 22:00	0.13	0.043	0.11	0.031	2.7	0.098	8.5

Table 7 Flow Monitoring Station FM3BU North Wambo Creek Mid Old Diversion – Summary of Results – 1 January to 31 December 2023.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	4/01/2023 17:49	5/01/2023 3:49	0.42	0.02	0.044	0.01	0.88	0.025	2.1
2	5/01/2023 9:29	5/01/2023 15:59	0.27	0.011	0.02	0.0051	0.44	0.0097	0.84
3	24/01/2023 22:49	25/01/2023 3:59	0.22	0.0039	0.016	0.0017	0.15	0.0075	0.65
4	30/01/2023 11:09	30/01/2023 19:49	0.36	0.01	0.021	0.0046	0.4	0.01	0.9
5	18/02/2023 16:49	18/02/2023 20:29	0.15	0.012	0.026	0.0059	0.51	0.013	1.1
6	19/02/2023 12:09	19/02/2023 15:59	0.16	0.0082	0.017	0.0038	0.33	0.0083	0.71
7	22/02/2023 6:59	23/02/2023 16:19	1.4	0.021	0.064	0.011	0.98	0.041	3.6
8	12/03/2023 23:49	13/03/2023 3:19	0.15	0.0072	0.017	0.0033	0.28	0.0083	0.71
9	13/03/2023 9:09	13/03/2023 14:29	0.22	0.0063	0.016	0.0028	0.25	0.0073	0.63
10	14/03/2023 11:19	14/03/2023 18:29	0.3	0.0039	0.012	0.0017	0.15	0.0055	0.47
11	23/03/2023 18:29	24/03/2023 2:39	0.34	0.01	0.026	0.0047	0.41	0.013	1.1
12	27/03/2023 10:49	27/03/2023 22:19	0.48	0.025	0.097	0.015	1.3	0.079	6.8
13	28/03/2023 11:39	29/03/2023 0:19	0.53	0.0058	0.022	0.0026	0.23	0.011	0.91
14	29/03/2023 9:49	29/03/2023 21:59	0.51	0.022	0.1	0.014	1.2	0.087	7.5
15	30/03/2023 11:09	30/03/2023 17:19	0.26	0.0096	0.017	0.0044	0.38	0.0078	0.68
16	31/03/2023 12:49	31/03/2023 16:09	0.14	0.0061	0.015	0.0028	0.24	0.0068	0.59
17	20/12/2023 12:29	20/12/2023 15:09	0.11	0.014	0.043	0.0069	0.59	0.024	2.1
18	23/12/2023 20:39	23/12/2023 23:49	0.13	0.02	0.055	0.011	0.92	0.034	2.9
19	24/12/2023 10:19	24/12/2023 14:29	0.17	0.011	0.023	0.005	0.43	0.012	1
20	25/12/2023 19:39	25/12/2023 23:39	0.17	0.037	0.12	0.027	2.3	0.11	9.8

Table 8 Flow Monitoring Station FM16 South Wambo Creek upstream of the washout of Wambo Mine Road – Summary of Results – 1 January to 31 December 2023.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2023 0:04	9/05/2023 2:54	128.12	0.11	0.19	0.12	10	0.91	79
2	18/05/2023 9:10	24/10/2023 17:00	159.33	0.07	0.12	0.036	3.1	0.13	11
3	24/10/2023 18:10	25/10/2023 8:30	0.60	0.0043	0.0095	0.0041	0.35	0.0082	0.71
4	26/10/2023 11:20	30/10/2023 17:10	4.24	0.022	0.04	0.014	1.2	0.019	1.6
5	30/10/2023 20:00	31/10/2023 6:10	0.42	0.0027	0.0076	0.0026	0.23	0.0069	0.6

Table 9 **Flow Monitoring Station FM9(17) South Wambo Creek Upstream of Surfacewater Monitoring Site SW06, Old Brossi Property – Summary of Results – 18 May to 31 December 2023.**

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	18/05/2023 10:38	9/07/2023 13:48	52.13	0.018	0.037	0.035	3	0.074	6.4
2	9/07/2023 15:58	10/07/2023 3:28	0.48	0.0042	0.0096	0.0084	0.72	0.019	1.7
3	10/07/2023 8:48	11/07/2023 0:18	0.65	0.0039	0.01	0.0077	0.67	0.02	1.8
4	11/07/2023 10:48	11/07/2023 14:08	0.14	0.0032	0.0059	0.0065	0.56	0.012	1
5	11/07/2023 16:28	11/07/2023 21:58	0.23	0.0037	0.0072	0.0075	0.65	0.014	1.2
6	12/07/2023 15:28	12/07/2023 21:28	0.25	0.0035	0.0097	0.0071	0.61	0.019	1.7
7	13/07/2023 16:18	13/07/2023 21:38	0.22	0.004	0.0083	0.0079	0.68	0.017	1.4
8	14/07/2023 16:58	15/07/2023 0:28	0.31	0.0034	0.008	0.0068	0.59	0.016	1.4
9	15/07/2023 8:38	28/07/2023 8:38	13.00	0.0028	0.0076	0.0057	0.49	0.015	1.3
10	15/07/2023 18:38	15/07/2023 22:08	0.15	0.0032	0.008	0.0065	0.56	0.016	1.4
11	16/07/2023 21:08	16/07/2023 23:48	0.11	0.0016	0.0039	0.0031	0.27	0.0078	0.68
12	17/07/2023 18:58	17/07/2023 22:58	0.17	0.0024	0.0049	0.0048	0.42	0.0099	0.85
13	18/07/2023 17:28	18/07/2023 22:18	0.20	0.0021	0.0051	0.0043	0.37	0.01	0.89
14	30/07/2023 18:28	31/07/2023 4:38	0.42	0.0023	0.0065	0.0046	0.4	0.013	1.1
15	3/08/2023 17:48	3/08/2023 19:58	0.09	0.0033	0.0071	0.0065	0.56	0.014	1.2
16	10/08/2023 21:58	11/08/2023 2:58	0.21	0.0023	0.0074	0.0047	0.4	0.015	1.3
17	11/08/2023 17:18	11/08/2023 21:48	0.19	0.0014	0.0042	0.0027	0.24	0.0085	0.73
18	12/08/2023 17:58	13/08/2023 9:58	0.67	0.0036	0.0099	0.0073	0.63	0.02	1.7
19	13/08/2023 11:28	15/08/2023 13:38	2.09	0.0056	0.012	0.011	0.96	0.025	2.1
20	15/08/2023 16:28	16/08/2023 11:28	0.79	0.0046	0.011	0.0092	0.79	0.023	1.9
21	16/08/2023 17:28	17/08/2023 14:38	0.88	0.0029	0.012	0.0058	0.51	0.024	2.1
22	17/08/2023 17:18	18/08/2023 11:38	0.76	810	90000	0.005	0.43	0.005	0.43
23	18/08/2023 20:28	18/08/2023 23:08	0.11	0.0028	0.0068	0.0055	0.48	0.014	1.2

Table 10 Flow Monitoring Station FM12 Stony Creek upstream of proposed area to be mined – Summary of Results – 1 January to 31 December 2022.

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
1	1/01/2023 0:08	19/02/2023 11:38	49.48	0.01	0.032	0.0076	0.65	0.034	2.9
2	19/02/2023 20:28	20/02/2023 11:18	0.62	0.0039	0.0097	0.0024	0.21	0.0066	0.57
3	20/02/2023 16:38	20/02/2023 20:38	0.17	0.005	0.013	0.0032	0.28	0.0098	0.85
4	20/02/2023 22:28	21/02/2023 10:58	0.52	0.0039	0.0096	0.0024	0.21	0.0065	0.56
5	21/02/2023 22:18	23/02/2023 6:28	1.34	0.0064	0.022	0.0045	0.39	0.019	1.7
6	12/03/2023 23:58	13/03/2023 5:08	0.22	0.0025	0.0063	0.0014	0.13	0.004	0.34
7	13/03/2023 8:38	13/03/2023 11:38	0.13	0.0029	0.0077	0.0018	0.15	0.005	0.44
8	23/03/2023 18:28	24/03/2023 0:28	0.25	0.0048	0.011	0.003	0.26	0.0075	0.65
9	27/03/2023 10:28	28/03/2023 1:28	0.63	0.0065	0.021	0.0046	0.4	0.019	1.6
10	28/03/2023 16:18	29/03/2023 15:28	0.97	0.0036	0.013	0.0022	0.19	0.0092	0.8
11	29/03/2023 18:38	30/03/2023 10:38	0.67	0.0032	0.0073	0.0019	0.17	0.0047	0.41
12	30/03/2023 17:28	30/03/2023 22:08	0.19	0.0014	0.0031	0.00075	0.065	0.0018	0.16
13	4/04/2023 18:18	5/04/2023 8:48	0.60	0.0025	0.0071	0.0014	0.12	0.0046	0.39
14	5/04/2023 19:08	6/04/2023 10:08	0.63	0.0033	0.0084	0.002	0.17	0.0056	0.48
15	6/04/2023 18:18	7/04/2023 12:38	0.76	0.0026	0.0071	0.0015	0.13	0.0046	0.39
16	7/04/2023 14:28	8/04/2023 8:38	0.76	0.0026	0.0078	0.0015	0.13	0.0051	0.44
17	8/04/2023 15:28	9/04/2023 10:48	0.81	0.0024	0.0076	0.0014	0.12	0.005	0.43
18	9/04/2023 19:38	10/04/2023 0:38	0.21	0.0023	0.006	0.0013	0.12	0.0037	0.32
19	10/04/2023 3:48	10/04/2023 9:08	0.22	0.0016	0.0037	0.00087	0.075	0.0022	0.19
20	10/04/2023 16:48	10/04/2023 21:18	0.19	0.0019	0.0055	0.0011	0.095	0.0034	0.29
21	10/04/2023 23:38	11/04/2023 4:08	0.19	0.0016	0.0056	0.00092	0.079	0.0034	0.3
22	11/04/2023 17:08	12/04/2023 8:18	0.63	0.0016	0.0069	0.0009	0.078	0.0044	0.38
23	12/04/2023 18:58	13/04/2023 2:58	0.33	0.0021	0.0085	0.0012	0.11	0.0057	0.49
24	13/04/2023 14:18	14/04/2023 5:38	0.64	0.0022	0.0055	0.0013	0.11	0.0034	0.29
25	14/04/2023 23:58	15/04/2023 8:58	0.38	0.002	0.0068	0.0011	0.098	0.0043	0.37
26	15/04/2023 17:28	16/04/2023 4:28	0.46	0.0021	0.0053	0.0012	0.1	0.0032	0.28
27	29/04/2023 19:38	29/04/2023 23:38	0.17	0.0018	0.0084	0.0011	0.094	0.0056	0.48
28	11/05/2023 8:28	11/05/2023 10:58	0.10	0.0015	0.0046	0.00086	0.074	0.0027	0.24
29	11/05/2023 20:18	12/05/2023 5:28	0.38	0.0019	0.0051	0.0011	0.093	0.0031	0.27
30	12/05/2023 15:48	13/05/2023 6:48	0.63	0.0024	0.0072	0.0014	0.12	0.0046	0.4
31	13/05/2023 17:48	14/05/2023 7:58	0.59	0.002	0.0064	0.0012	0.1	0.004	0.35
32	14/05/2023 17:18	15/05/2023 8:18	0.63	0.0026	0.0078	0.0015	0.13	0.0051	0.44
33	15/05/2023 17:58	15/05/2023 21:58	0.17	0.0024	0.0057	0.0014	0.12	0.0035	0.3
34	16/05/2023 16:08	16/05/2023 19:58	0.16	0.0021	0.0051	0.0012	0.1	0.0031	0.27

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
35	17/05/2023 2:18	17/05/2023 4:58	0.11	0.0025	0.005	0.0015	0.13	0.003	0.26
36	17/05/2023 6:58	17/05/2023 10:08	0.13	0.0022	0.0044	0.0012	0.11	0.0026	0.22
37	17/05/2023 13:48	18/05/2023 4:58	0.63	0.0022	0.0081	0.0013	0.11	0.0054	0.46
38	18/05/2023 16:08	18/05/2023 21:58	0.24	0.0031	0.0072	0.0019	0.16	0.0046	0.4
39	21/05/2023 4:18	21/05/2023 9:48	0.23	0.002	0.0053	0.0012	0.1	0.0032	0.28
40	23/05/2023 18:48	23/05/2023 21:08	0.10	0.0017	0.0069	0.001	0.087	0.0044	0.38
41	26/05/2023 11:58	26/05/2023 19:58	0.33	0.0026	0.0064	0.0015	0.13	0.004	0.35
42	26/05/2023 22:38	27/05/2023 2:28	0.16	0.0024	0.0056	0.0014	0.12	0.0034	0.3
43	27/05/2023 18:48	27/05/2023 20:58	0.09	0.0016	0.0036	0.00092	0.079	0.0021	0.18
44	29/05/2023 16:58	29/05/2023 19:08	0.09	0.0019	0.0044	0.0011	0.096	0.0026	0.22
45	30/05/2023 6:18	30/05/2023 11:28	0.22	0.0021	0.005	0.0012	0.11	0.003	0.26
46	30/05/2023 15:08	30/05/2023 23:48	0.36	0.0023	0.0073	0.0014	0.12	0.0047	0.41
47	31/05/2023 3:08	31/05/2023 10:18	0.30	0.0018	0.0067	0.001	0.091	0.0043	0.37
48	1/06/2023 2:28	1/06/2023 9:18	0.28	0.0021	0.0049	0.0012	0.1	0.0029	0.25
49	1/06/2023 14:58	2/06/2023 8:08	0.72	0.0029	0.0081	0.0017	0.15	0.0054	0.46
50	2/06/2023 21:38	3/06/2023 11:08	0.56	0.0025	0.0084	0.0015	0.13	0.0056	0.48
51	3/06/2023 15:28	5/06/2023 2:58	1.48	0.0027	0.0074	0.0016	0.14	0.0048	0.41
52	5/06/2023 15:18	6/06/2023 6:58	0.65	0.0024	0.0088	0.0014	0.12	0.0059	0.51
53	6/06/2023 16:58	7/06/2023 10:28	0.73	0.0028	0.0065	0.0016	0.14	0.0041	0.36
54	7/06/2023 16:08	9/06/2023 10:48	1.78	0.0035	0.0099	0.0021	0.18	0.0068	0.59
55	9/06/2023 16:18	10/06/2023 7:28	0.63	0.0024	0.0062	0.0014	0.12	0.0039	0.34
56	10/06/2023 14:48	11/06/2023 3:38	0.53	0.0029	0.0072	0.0017	0.15	0.0046	0.4
57	11/06/2023 9:48	11/06/2023 12:48	0.13	0.0011	0.0024	0.0006	0.052	0.0014	0.12
58	11/06/2023 15:48	12/06/2023 11:08	0.81	0.0035	0.0084	0.0021	0.18	0.0056	0.48
59	22/06/2023 16:58	22/06/2023 19:58	0.13	0.0021	0.0072	0.0013	0.11	0.0046	0.4
60	23/06/2023 0:18	24/06/2023 5:38	1.22	0.003	0.0077	0.0018	0.15	0.005	0.44
61	24/06/2023 15:18	25/06/2023 9:48	0.77	0.0025	0.0076	0.0014	0.12	0.005	0.43
62	25/06/2023 15:38	26/06/2023 3:38	0.50	0.0027	0.0079	0.0016	0.14	0.0052	0.45
63	26/06/2023 16:28	27/06/2023 8:58	0.69	0.0031	0.0094	0.0019	0.16	0.0064	0.55
64	27/06/2023 11:38	27/06/2023 15:38	0.17	0.0017	0.004	0.00094	0.081	0.0023	0.2
65	27/06/2023 16:58	1/07/2023 13:18	3.85	0.004	0.012	0.0024	0.21	0.0084	0.73
66	1/07/2023 15:18	2/07/2023 12:28	0.88	0.003	0.0084	0.0018	0.15	0.0056	0.48
67	2/07/2023 14:08	3/07/2023 10:38	0.85	0.003	0.0076	0.0018	0.16	0.005	0.43
68	3/07/2023 15:28	7/07/2023 23:18	4.33	0.0029	0.011	0.0017	0.15	0.008	0.69
69	8/07/2023 7:28	8/07/2023 10:48	0.14	0.0023	0.0075	0.0013	0.12	0.0049	0.42

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
70	8/07/2023 19:58	9/07/2023 10:18	0.60	0.0029	0.0064	0.0017	0.15	0.004	0.35
71	9/07/2023 16:08	10/07/2023 12:28	0.85	0.0028	0.0088	0.0016	0.14	0.0059	0.51
72	10/07/2023 16:18	11/07/2023 2:08	0.41	0.0027	0.0069	0.0016	0.14	0.0044	0.38
73	11/07/2023 8:28	11/07/2023 12:18	0.16	0.0027	0.0087	0.0016	0.14	0.0058	0.51
74	11/07/2023 14:58	11/07/2023 17:38	0.11	0.0016	0.0041	0.00091	0.079	0.0024	0.21
75	11/07/2023 19:08	12/07/2023 1:38	0.27	0.0028	0.0066	0.0016	0.14	0.0042	0.36
76	12/07/2023 4:18	12/07/2023 13:18	0.38	0.0026	0.0077	0.0015	0.13	0.005	0.44
77	12/07/2023 16:08	13/07/2023 13:08	0.88	0.003	0.0086	0.0018	0.16	0.0058	0.5
78	13/07/2023 15:18	14/07/2023 12:28	0.88	0.0043	0.0093	0.0026	0.23	0.0063	0.54
79	14/07/2023 14:18	15/07/2023 12:18	0.92	0.0046	0.013	0.0028	0.25	0.0094	0.82
80	15/07/2023 15:58	18/07/2023 12:58	2.88	0.0049	0.013	0.0031	0.27	0.0094	0.82
81	18/07/2023 16:18	19/07/2023 8:38	0.68	0.0039	0.0095	0.0023	0.2	0.0064	0.56
82	19/07/2023 16:08	19/07/2023 22:38	0.27	0.0025	0.0063	0.0015	0.13	0.004	0.34
83	20/07/2023 13:08	21/07/2023 9:48	0.86	0.0032	0.01	0.0019	0.17	0.0073	0.63
84	21/07/2023 15:58	21/07/2023 22:48	0.28	0.0033	0.0061	0.0019	0.17	0.0038	0.33
85	22/07/2023 0:08	22/07/2023 4:38	0.19	0.0022	0.0065	0.0013	0.11	0.0041	0.36
86	22/07/2023 9:18	22/07/2023 12:28	0.13	0.0024	0.0062	0.0014	0.12	0.0039	0.34
87	22/07/2023 16:18	23/07/2023 4:08	0.49	0.0027	0.0095	0.0016	0.14	0.0064	0.56
88	23/07/2023 20:48	24/07/2023 0:18	0.15	0.0021	0.0064	0.0013	0.11	0.004	0.35
89	24/07/2023 7:18	24/07/2023 12:58	0.24	0.002	0.0053	0.0012	0.1	0.0032	0.28
90	24/07/2023 16:38	25/07/2023 5:28	0.53	0.0023	0.0056	0.0013	0.12	0.0034	0.3
91	25/07/2023 18:38	26/07/2023 4:38	0.42	0.0031	0.0088	0.0018	0.16	0.0059	0.51
92	26/07/2023 15:28	29/07/2023 11:48	2.85	0.028	0.056	0.033	2.8	0.081	7
93	29/07/2023 17:58	30/07/2023 9:38	0.65	0.0033	0.0086	0.002	0.17	0.0058	0.5
94	30/07/2023 18:38	30/07/2023 21:18	0.11	0.001	0.0033	0.00057	0.049	0.0019	0.17
95	31/07/2023 2:58	31/07/2023 8:18	0.22	0.0018	0.0043	0.001	0.089	0.0025	0.22
96	31/07/2023 18:18	1/08/2023 13:58	0.82	0.0068	0.02	0.0047	0.41	0.017	1.5
97	1/08/2023 16:18	1/08/2023 19:18	0.13	0.0025	0.0056	0.0015	0.13	0.0034	0.3
98	1/08/2023 21:48	2/08/2023 7:08	0.39	0.0041	0.0093	0.0025	0.22	0.0063	0.54
99	2/08/2023 20:38	2/08/2023 23:08	0.10	0.0029	0.0046	0.0017	0.14	0.0027	0.24
100	3/08/2023 1:48	3/08/2023 10:18	0.35	0.0028	0.0062	0.0016	0.14	0.0039	0.34
101	3/08/2023 16:38	4/08/2023 11:38	0.79	0.0035	0.011	0.0022	0.19	0.0081	0.7
102	4/08/2023 16:18	4/08/2023 17:38	0.06	0.003	0.0062	0.0018	0.15	0.0039	0.34
103	4/08/2023 19:28	5/08/2023 1:38	0.26	0.0025	0.0061	0.0015	0.13	0.0038	0.33
104	5/08/2023 7:28	5/08/2023 9:28	0.08	0.0018	0.0065	0.001	0.09	0.0041	0.36

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
105	5/08/2023 20:08	6/08/2023 1:58	0.24	0.0014	0.0052	0.00082	0.071	0.0032	0.27
106	9/08/2023 1:18	9/08/2023 10:28	0.38	0.0027	0.0079	0.0016	0.14	0.0052	0.45
107	9/08/2023 16:38	9/08/2023 21:38	0.21	0.002	0.0049	0.0011	0.098	0.0029	0.25
108	10/08/2023 0:48	10/08/2023 10:48	0.42	0.0065	0.015	0.0043	0.37	0.011	0.97
109	10/08/2023 18:28	11/08/2023 12:58	0.77	0.0053	0.017	0.0035	0.3	0.014	1.2
110	11/08/2023 16:08	13/08/2023 11:18	1.80	0.0084	0.036	0.007	0.61	0.04	3.5
111	16/08/2023 0:48	16/08/2023 5:28	0.19	0.0019	0.0057	0.0011	0.095	0.0035	0.3
112	16/08/2023 16:58	17/08/2023 12:38	0.82	0.0027	0.0086	0.0016	0.14	0.0058	0.5
113	17/08/2023 17:08	18/08/2023 8:38	0.65	0.0029	0.0071	0.0017	0.15	0.0046	0.39
114	20/08/2023 0:48	20/08/2023 3:18	0.10	0.002	0.004	0.0011	0.098	0.0023	0.2
115	20/08/2023 5:08	20/08/2023 9:08	0.17	0.0027	0.0074	0.0016	0.14	0.0048	0.41
116	20/08/2023 19:58	21/08/2023 0:58	0.21	0.0019	0.0066	0.0011	0.096	0.0042	0.36
117	21/08/2023 4:18	21/08/2023 8:58	0.19	0.0015	0.0048	0.00086	0.075	0.0029	0.25
118	21/08/2023 17:48	21/08/2023 22:48	0.21	0.0019	0.0059	0.0011	0.096	0.0037	0.32
119	22/08/2023 17:48	23/08/2023 5:18	0.48	0.0027	0.0076	0.0016	0.13	0.005	0.43
120	24/08/2023 23:48	25/08/2023 10:48	0.46	0.0023	0.0068	0.0013	0.11	0.0043	0.37
121	25/08/2023 18:28	26/08/2023 9:58	0.65	0.003	0.0083	0.0018	0.15	0.0055	0.48
122	26/08/2023 17:58	27/08/2023 10:48	0.70	0.0032	0.0086	0.0019	0.17	0.0058	0.5
123	27/08/2023 16:28	28/08/2023 9:38	0.72	0.0029	0.012	0.0017	0.15	0.0084	0.73
124	28/08/2023 16:48	28/08/2023 23:08	0.26	0.0015	0.0053	0.00083	0.072	0.0032	0.28
125	29/08/2023 3:58	29/08/2023 6:08	0.09	0.0022	0.0055	0.0012	0.11	0.0034	0.29
126	29/08/2023 17:08	30/08/2023 10:08	0.71	0.0029	0.0073	0.0017	0.15	0.0047	0.41
127	30/08/2023 16:48	30/08/2023 23:08	0.26	0.0028	0.011	0.0017	0.15	0.0082	0.71
128	5/09/2023 1:28	5/09/2023 6:48	0.22	0.0019	0.0072	0.0011	0.095	0.0046	0.4
129	6/09/2023 19:28	6/09/2023 22:28	0.13	0.0022	0.005	0.0013	0.11	0.003	0.26
130	10/09/2023 1:28	10/09/2023 10:38	0.38	0.005	0.015	0.0032	0.28	0.011	0.99
131	11/09/2023 0:58	11/09/2023 9:58	0.38	0.0058	0.014	0.0038	0.33	0.01	0.88
132	13/09/2023 20:58	13/09/2023 23:28	0.10	0.0019	0.0054	0.0011	0.098	0.0033	0.29
133	16/09/2023 17:38	17/09/2023 7:58	0.60	0.0029	0.012	0.0017	0.15	0.0089	0.77
134	23/09/2023 2:18	23/09/2023 9:58	0.32	0.0034	0.0077	0.0021	0.18	0.005	0.44
135	24/09/2023 1:08	24/09/2023 9:58	0.37	0.0046	0.0093	0.0029	0.25	0.0063	0.54
136	24/09/2023 19:18	25/09/2023 10:28	0.63	0.0042	0.015	0.0027	0.23	0.012	1
137	25/09/2023 18:18	25/09/2023 22:38	0.18	0.0028	0.0088	0.0017	0.14	0.0059	0.51
138	26/10/2023 20:08	27/10/2023 10:38	0.60	0.0092	0.025	0.0069	0.6	0.023	2
139	28/10/2023 0:48	28/10/2023 10:38	0.41	0.016	0.032	0.014	1.2	0.034	2.9

Flow Event No.	Start Date & Time	End Date & Time	Duration (Days)	Average Stream Height (m)	Maximum Stream Height (m)	Average Theoretical Flow Rate		Maximum Theoretical Flow Rate	
						m^3/s	ML/d	m^3/s	ML/d
140	29/10/2023 2:18	29/10/2023 10:58	0.36	0.027	0.047	0.03	2.6	0.062	5.3
141	30/10/2023 2:28	11/11/2023 12:58	12.44	0.22	0.59	1.1	96	6	520
142	11/11/2023 21:28	12/11/2023 12:38	0.63	0.089	0.15	0.21	18	0.45	39
143	12/11/2023 23:48	13/11/2023 14:08	0.60	0.046	0.079	0.069	6	0.14	12
144	13/11/2023 18:28	14/11/2023 12:58	0.77	0.12	0.21	0.35	30	0.82	71
145	14/11/2023 21:18	15/11/2023 12:38	0.64	0.067	0.12	0.13	11	0.3	26
146	15/11/2023 21:38	16/11/2023 11:58	0.60	0.054	0.09	0.087	7.5	0.18	16
147	16/11/2023 19:48	18/11/2023 13:58	1.76	0.15	0.31	0.57	49	1.7	150
148	18/11/2023 18:28	19/11/2023 13:28	0.79	0.18	0.32	0.79	68	1.8	160
149	19/11/2023 20:48	26/11/2023 13:08	6.68	0.14	0.26	0.44	38	1.3	110
150	26/11/2023 19:58	27/11/2023 13:08	0.72	0.11	0.2	0.33	29	0.76	66
151	27/11/2023 20:08	29/11/2023 13:08	1.71	0.095	0.16	0.22	19	0.48	42
152	29/11/2023 17:08	30/11/2023 13:48	0.86	0.11	0.19	0.3	26	0.69	60
153	30/11/2023 19:38	1/12/2023 12:38	0.71	0.093	0.16	0.23	20	0.53	46
154	1/12/2023 20:18	3/12/2023 12:58	1.69	0.072	0.19	0.17	15	0.69	60
155	3/12/2023 20:08	4/12/2023 12:38	0.69	0.071	0.12	0.15	13	0.31	27
156	4/12/2023 19:08	5/12/2023 12:28	0.72	0.081	0.16	0.19	17	0.49	42
157	6/12/2023 0:08	6/12/2023 10:48	0.44	0.011	0.023	0.0082	0.7	0.021	1.8
158	7/12/2023 4:38	7/12/2023 6:58	0.10	0.0075	0.014	0.0052	0.45	0.011	0.94
159	9/12/2023 13:38	9/12/2023 15:08	0.06	0.0036	0.0077	0.0022	0.19	0.005	0.44
160	13/12/2023 0:18	13/12/2023 10:08	0.41	0.0049	0.01	0.0031	0.27	0.007	0.6
161	15/12/2023 2:18	15/12/2023 11:38	0.39	0.0096	0.018	0.0069	0.6	0.015	1.3
162	16/12/2023 0:28	16/12/2023 12:08	0.49	0.02	0.041	0.018	1.6	0.049	4.2
163	17/12/2023 0:48	17/12/2023 12:18	0.48	0.012	0.028	0.0095	0.82	0.027	2.3
164	17/12/2023 23:48	18/12/2023 11:38	0.49	0.0088	0.024	0.0064	0.55	0.022	1.9
165	19/12/2023 23:28	22/12/2023 12:58	2.56	0.027	0.05	0.028	2.4	0.067	5.8
166	22/12/2023 19:28	23/12/2023 13:08	0.74	0.04	0.061	0.051	4.4	0.092	8
167	23/12/2023 19:58	25/12/2023 12:08	1.67	0.027	0.054	0.028	2.4	0.076	6.6
168	25/12/2023 16:58	26/12/2023 12:28	0.81	0.023	0.041	0.022	1.9	0.048	4.2
169	26/12/2023 19:28	27/12/2023 12:18	0.70	0.027	0.05	0.029	2.5	0.066	5.7
170	27/12/2023 19:38	28/12/2023 13:48	0.76	0.026	0.051	0.028	2.4	0.07	6
171	28/12/2023 22:28	29/12/2023 13:48	0.64	0.021	0.035	0.019	1.6	0.039	3.3
172	29/12/2023 18:08	30/12/2023 12:18	0.76	0.02	0.036	0.018	1.6	0.04	3.4
173	30/12/2023 20:58	31/12/2023 23:58	1.13	0.033	0.057	0.037	3.2	0.083	7.2

A summary of total monthly rain fall data presented in **Table 11** below was derived from the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area.

Table 11 Monthly Total Rainfall Data at Wambo Coal Meteorological Station – 1 January to 31 December 2023.

Month	Wambo Coal's Meteorological Station Total Rainfall (mm)	Number of Days Rain Fell in the Month
January	55.0	12
February	69.2	7
March	93.0	11
April	41.2	13
May	5.6	8
June	9.4	8
July	8.0	3
August	22.6	7
September	18.2	6
October	32.8	6
November	36.2	12
December	86.4	8

A second rainfall monitoring station was installed at location FM2 during April 2021. Rainfall data for this monitoring location for 2023 is presented in **Table 12** below.

- There are no monthly rainfall totals for January to March 2023 due to data loss from the monitoring station for the period 20 to 31 January 2023, all of February 2023 and 1 to 6 March 2023.
- Due to the remediation works along North Wambo Creek around Flow Monitoring Station 2 there is no rainfall data for the period 21 June to 4 December 2023.
- Rainfall measurements at FM2 were consistent with those at the Wambo Coal Meteorological Station for all months where data was available.

Table 12 Monthly Total Rainfall Data at FM2 location – 1 May to 31 December 2023

Month	FM2 Monitoring Location Total Rainfall (mm)	Number of Days Rain Fell in the Month
January (1 to 19)	23.2	5
February	-	-
March (from 7)	118.2	9
April	41.2	11
May	11.2	6
June	5.2	5
July	-	-
August	-	-
September	-	-
October	-	-
November	-	-
December (from 5)	105.2	8

Daily rainfall data was used to cross reference the raw data collected from the Flow Monitoring Stations to help identify periods where a flow event may have occurred.

Appendix C contains, where theoretical flow events were recognised, annual graphical depictions of stream height and theoretical flow in conjunction with daily and cumulative rainfall.

The results presented in the above tables should be read with the following qualifying statements in mind: -

- All flow events represent a theoretical flow and have been derived from stream height data. The stream height data was then applied to polynomial equations derived from theoretical flow rating curves to give a theoretical flow. These theoretical flow rating curves were generated using cross and long section surveys in conjunction with the Manning's equation. These theoretical flow rating curves were constructed by AECOM in 2019 on data provided by Environmental Instrument Solutions;

- North Wambo, South Wambo and Stony Creeks are ephemeral and as such only flow after significant rainfall events, therefore the theoretical flow rating curves in **Appendix B** have not been calibrated/checked against actual physical measurements of flow using a current meter;

- Some flow events may have been overlooked due to, but not limited to, poor data quality, data missing, inconsistent data, sensor failure or loss, logger failure, power supply problems and changes to stream bed characteristics, and;

- The three flow monitoring stations installed on Stony Creek and its associated tributary have been positioned such as to be outside a proposed underground mine area and designed to monitor stream flow and any associated effect of underground mining on stream flow. These stations were installed by AECOM on 7 December 2016 and replace flow monitoring stations 7 and 8.

4.0 Recommendations

During the period 1 January to 31 December 2023 the issues which were identified in the 2022 Stream Flow report were addressed as the stream bed conditions allowed for this work to be completed. The stream monitoring network has now been returned to its full capacity.

The following is an outline of the work which was completed during 2023 and January 2024

- Flow Station USFM1:-
    - The stream bed flow characteristics were changed, and a re-survey of the stream bed was undertaken in February 2023. From the re-survey new theoretical flow curves were constructed and used to calculate theoretical flow from March 2022. It was found that the sensor at this flow station had failed in the later part of 2023. A new sensor was installed 15 February 2024.
- Flow Station FM1:-
    - Flow Station fully re-established on 21 June 2023 by installing a concrete pad and anchoring the main sensor to it and installing a new backup sensor. Stream bed characteristic had not changed since the February 2023 survey. The sensors were survey in against the cease to flow point. The main pressure sensor recorded data for all of 2023.
- Flow Station FM2:-
    - During the period (26 June to 5 December 2023) when the remediation works of North Wambo Creek in the area around Flow Station 2 was being performed, the flow station was decommissioned. The backup Sensor was removed the data logger was also powered down.
    - Once this works had been completed the flow station was re-established on the opposite side of North Wambo Creek on 5 December 2023. Both the backup sensor and a new main sensor were installed at the new location in the creek approximately 2 to 3 metres downstream from the previous sensors' location. Most of the old Station's hardware was re-cycled as part of this re-location.
- Flow Station FM3:-
    - The main pressure sensor was successfully replaced on 18 May 2023.
- Flow Station FM9(17):-
    - This flow station was re-established on 18 May 2023 approximately ten metres upstream for its original location. As part of this re-establishment cross section and long section surveys were done and a new theoretical flow curve was generated from the data obtained from these surveys.
- Flow Station FM15:-
    - This flow station was-re-established on 21 June 2023 at a location approximately 100 to 200m upstream from its original location. As part of this re-establishment cross section and long section surveys were done and a new theoretical flow curve was generated from the data obtained from these surveys.
- Flow Station FM16:-
    - The main pressure sensor was replaced on 18 May 2023 as the old sensor was approaching end of life.
- Barometric Pressure Correction Sensor PM6:-
    - The barometric pressure correction sensor for the flow station sensors on South Wambo Creek was release on 18 May 2023 as the old sensor was approaching end of life.

Subsequent visual inspections of the other flow stations in the flow monitoring network did not indicate any significant changes to stream bed characteristics or damage to the stations. It was identified that the sensor at USMF1 had failed during the later part of 2023. A new sensor was installed on 15 February 2024.

As a result of the repairs performed to the flow monitoring network all the spare back up equipment has been utilised. Therefore, it is recommended that at least two flow station sensors and one barometric correction sensor be purchased and held in reserve in case future sensor failures.

If you have any questions or require any clarification of aspects in this report, please contact us in the Singleton office.

Yours faithfully

per

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encl: Appendix A - Flow Station Field Sheets
Appendix B - Stream Theoretical Flow Rating and Profile Curves
Appendix C - Stream Height , Theoretical Flow and Rainfall Charts

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Addendum: Comparison of Flow Monitoring Data with the Surface Water Monitoring Plan (SWMPV2)

SWMPV2 states:

"Flow impact assessment criteria for the local mine site ephemeral creeks are based on the unexpected absence of flow in climatic situations when flows would be expected. The impact assessment criteria would be met if there was no flow recorded at the flow monitoring site either on the day or the day after the recorded rainfall was equal to or greater than the nominated amount. The resulting runoff generating rainfall values are given in Table 14" of the SWMPV2 which has been reproduced as **Table 13** below.

Table 13 Surface Water Flow Impact Assessment Condition

Watercourse and flow monitoring site	Daily rainfall when flow commenced on 80% of recorded occasions
North Wambo Creek – FM1*	100mm
South Wambo Creek – FM15**	20mm
Stony Creek – FM13	20mm

- *Revised Wambo SWMP V2 (approved 20 November 2020) removed North Wambo Creek performance indicator of 20mm daily rainfall at location FM4 replacing with performance indicator of rain event total of 100mm at location FM1 effective 21 November 2020.

- * Flow monitoring site FM15 sensor has been buried under significant amounts of sand resulting in no data available for 2023. The station re-established 20 June 2023.

Table 14 below lists the dates from 1 January to 31 December 2023 when 20mm or greater of 24 hour rainfall was recorded at the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area and corresponding flow events at flow monitoring sites FM15 and FM13.

Table 14 Dates of Daily Rainfall Greater than 20mm and Corresponding Flow Events

Date	24 hour Rainfall (mm)	Site FM15	Site FM13
22/2/2023	46.0	Flow monitoring site re-established 20 June 2023.	No flow event recorded
27/3/2023	36.2		No flow event recorded
20/12/2023	31.4	No flow event recorded	No flow event recorded
24/12/2023	21.4	No flow event recorded	No flow event recorded

Table 15 below lists the periods from 1 January to 31 December 2023 when accumulated rainfall greater than 100mm was recorded at the Wambo Coal's Meteorological Station located next to the helicopter pad near the Mine Infrastructure Area and corresponding flow events at flow monitoring site FM1.

Table 15 Dates of Rain Event Rainfall Greater than 100mm and Corresponding Flow Events

Dates	Total Rainfall (mm)	Site FM1
1/1/2023 to 22/02/2023	122.2	No flow event recorded
23/02/2023 to 08/09/2023	104.2	No flow event recorded
09/09/2023 t 20/12/2023	106.0	No flow event recorded

Appendix A

Flow Station Field Sheets

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	26.4.2023	1015	RuggedTroll	-	-	-	-	100%	43%	Yes	Yes	Yes	No Flow / Dry	0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger /Washed away
FM1 New Location	North Wambo	26.4.2023	1040	CS-CR800	Cycling	13.90	No	No	-	-	Yes	Yes	Yes	No Flow / Dry	0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on New logger /Washed away
FM2	North Wambo	26.4.2023	1110	CS-CR200			No	No	-	-	Yes	No	Yes	No Flow /Dry	0	Main sensor not working
FM2 BU	North Wambo	26.4.2023	1130	RuggedTroll	-	-	-	-	100%	21%	Yes	Yes	Yes	No Flow /Dry	0	
BarroLogger NWC	North Wambo	26.4.2023	1135	BaroTroll	-	-	-	-	100%	34%	Yes	Yes	Yes	-	-	Data wrap on New barrologger
FM3	North Wambo			CS-CR200					-	-					0	Main sensor not working
FM3 BU	North Wambo	26.4.2023	0945	RuggedTroll	-	-	-	No	100%	21%	Yes	Yes	Yes	No Flow / Dry	0	
FM4	North Wambo	26.4.2023	0855	CS-CR200	18.46	13.59	No	No	-	-	Yes	Yes	Yes	No Flow / Dry	0	
FM4 BU	North Wambo	26.4.2023	0915	RuggedTroll	-	-	-	-	100%	34%	Yes	Yes	Yes	No Flow/Dry	0	Data wrap on New logger
FM12 SCUP	Stoney	10.5.23	1000	RuggedTroll	-	-	-	-	65%	12%	Yes	Yes	Yes	Slow flow	0 350-400mm	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary	10.5.23	0905	RuggedTroll	-	-	-	-	65%	12%	Yes	Yes	Yes	No flow /Dry	0	Data wrap on
Stoney Ck Up Barro	Stoney	[redacted] 10.5.23	1040	BaroTroll	-	-	-	-	65%	12%	Yes	Yes	Yes	-	-	Data wrap on
FM13 SCDown	Stoney	10.5.23	1110	RuggedTroll	-	-	-	-	65%	12%	Yes	Yes	Yes	No flow / Dry	0	Data wrap on
Stoney Ck Down Barro	Stoney	10.5.23	1135	BaroTroll	-	-	-	-	65%	12%	Yes	Yes	Yes	-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo	26.4.2023	1210	RuggedTroll	-	-	-	-	100%	51%	Yes	Yes	Yes	Slow Flow	0 222mm	Data wrap on *Look to replace logger
Barro Logger SWC	South Wambo	26.4.2023	1230	BaroTroll	-	-	-	-	100%	51%	Yes	Yes	Yes	-	-	Data wrap on *Look to replace logger
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

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60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	25.7.23	0945	RuggedTroll	-	-	-	-	100%	45%	Yes	Yes	Yes	Dry	0 –	Data wrap on
Old FM1	North Wambo	25.7.23	1030	RuggedTroll	-	-	-	-							0	Data wrap on New logger
FM1 New Location	North Wambo	26.7.23	1030	CS-CR800	14.0V	14.20%	yes		-	-	yes	yes	yes	DRY	0 –	
FM1 New Location BU	North Wambo	25.7.23	1045	RuggedTroll	-	-	-	-	9%	0%	Yes	Yes	Yes	Dry	0 –	Data wrap on New logger
FM2	North Wambo			CS-CR200					-	-					0	Flow station disconnected.
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	No downloads.
BarroLogger NWC	North Wambo	31.7.23	1425	BaroTroll	-	-	-	-	100%	36%	yes	yes	yes	-	-	Data wrap on New barrologger
FM3	North Wambo	26.7.23	0945	CS-CR200	20.8	13.5	-	No	-	-	yes	yes	yes	Dry	0 –	
FM3 BU	North Wambo	26.7.23	0950	RuggedTroll	-	-	-	NO	100%	23%	yes	yes	yes	Dry	0	
FM4	North Wambo	26.7.23	0855	CS-CR200	-20.9	13.78%	yes	NO	-	-	yes	yes	yes	Dry	0 –	
FM4 BU	North Wambo	25.7.23	1330	RuggedTroll	-	-	-	-	100%	36%	yes	yes	yes	Dry.	0 –	Data wrap on New logger
FM12 SCUP	Stoney	26.7.23	1455	RuggedTroll	-	-	-	-	75%	13%	yes	yes	yes	very shallow flow	Slow flow	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary	26.7.23	1330	RuggedTroll	-	-	-	-	75%	13%	yes	yes	yes	Dry	0	Data wrap on
Stoney Ck Up Barro	Stoney	26.7.23	1405	BaroTroll	-	-	-	-	75%	13%	yes	yes	yes	-	-	Data wrap on
FM13 SCDown	Stoney	26.7.23	1130	RuggedTroll	-	-	-	-	75%	13%	yes	yes	yes	Dry	0	Data wrap on
Stoney Ck Down Barro	Stoney	26.7.23	1205	BaroTroll	-	-	-	-	75%	13%	yes	yes	yes	-	-	Data wrap on
FM9 Brossi	South Wambo	25.7.23	1255	RuggedTroll	-	-	-	-	12%	1%	yes	yes	yes	slow / shallow	0 –	Data wrap on
FM15 (FM5)	South Wambo	25.7.23	1200	RuggedTroll	-	-	-	-	9%	0%	yes	yes	yes	Dry	0 –	Data wrap on
FM16 (FM6)	South Wambo	25.7.23	1130	RuggedTroll	-	-	-	-	12%	1%	yes	yes	yes	Slow flow / shallow	0 –	Data wrap on
Barro Logger SWC	South Wambo	25.7.23	1120	BaroTroll	-	-	-	-	12%	1%	Yes	Yes	Yes	-	-	Data wrap on
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

* Old Fm1 - 25.07.23 1030 - unable to locate, photos taken. Possible cover up from river bed.

Toughbook #2.

AECOM

60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	~~23.10.23~~ 30.10.23	1400 1315	RuggedTroll	-	-	-	-						-	0	Data wrap on *
Old FM1	North Wambo	-	-	RuggedTroll	-	-	-	-	-	-	-	-	-	-	0	Data wrap on New logger - covered - can not locate
FM1 New Location	North Wambo	23.10.23	1345	CS-CR800		13.81	Yes		-	-	yes	yes	yes	dry	0	
FM1 New Location BU	North Wambo	23.10.23	1330	RuggedTroll	-	-	-	-	18%	2%	yes	yes	yes	dry	0	Data wrap on New logger
FM2	North Wambo	-	-	CS-CR200	-	-	-	-	-	-					0	
FM2 BU	North Wambo	-	-	RuggedTroll	-	-	-	-	-	-	-	-	-	-	0	
BarroLogger NWC	North Wambo	30.10.23	1345	BaroTroll	-	-	-	-	100%	38%	yes	yes	yes	-	-	Data wrap on New barrologger
FM3	North Wambo	23.10.23	1250	CS-CR200			yes	No	-	-	yes	yes	yes	Dry	0	
FM3 BU	North Wambo	23.10.23	1300	RuggedTroll	-	-	-	-	100%	25%	yes	yes	yes	Dry	0	
FM4	North Wambo	~~23.10.23~~ 30.10.23 ~~1215~~ 1420		CS-CR200	-	-	~~yes~~	~~no~~	-	-	-	-	-	-	0	
FM4 BU	North Wambo	23.10.23	1215	RuggedTroll	-	-	-	-	100%	38%	yes	yes	yes	dry	0	Data wrap on New logger
FM12 SCUP	Stoney	23.10.23	1000	RuggedTroll	-	-	-	-	84%	15%	yes	yes	yes	slow	0.100m	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary	23.10.23	0910	RuggedTroll	-	-	-	-	84%	15%	yes	yes	yes	dry	0	Data wrap on
Stoney Ck Up Barro	Stoney	23.10.23	1050	BaroTroll	-	-	-	-	84%	15%	yes	yes	yes	-	-	Data wrap on
FM13 SCDown	Stoney	23.10.23	1130	RuggedTroll	-	-	-	-	84%	15%	yes	yes	yes	dry	0	Data wrap on
Stoney Ck Down Barro	Stoney	23.10.23	1210	BaroTroll	-	-	-	-	84%	15%	yes	yes	yes	-	-	Data wrap on
FM9 Brossi	South Wambo	23.10.23	1050	RuggedTroll	-	-	-	-	21%	3%	yes	yes	yes	slow	0	Data wrap on - orange snap sticks in stream
FM15 (FM5)	South Wambo	23.10.23	1120	RuggedTroll	-	-	-	-	18%	2%	yes	yes	yes	DRY	0	Data wrap on
FM16 (FM6)	South Wambo	23.10.23	1145	RuggedTroll	-	-	-	-	21%	3%	yes	yes	yes	Pooling @ 100mm	0 depth	Data wrap on
Barro Logger SWC	South Wambo	23.10.23	1155	BaroTroll	-	-	-	-	21%	3%	yes	yes	yes	-	-	Data wrap on
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

~~30.10.23 - FM12 SCUP only logging until 23.10.23 @ 1048~~

Upstream Old FM1 * Device will not connect have tried other comp. ports and cords - failure to connect message appearing.

FM4 - Unable to connect. Tried different cords / Comport No success

AECOM

60248386 - Wambo Coal - Quarterly Flow Station Field Sheet

Flow Station No.	Location (Creek)	Date	Time	Logger Type	Solar Panel Output (V)	Battery(V)	Solar Panel Cleaned	Battery Replaced	Memory Used (%)	Battery Used (%)	Data Collected	Sensor Operating	Logger Operating	Stream Observations	Height of Water Above Sensor (mm)	Comments
Upstream old FM1	North Wambo	23.1.24	0915	RuggedTroll	-	-	-	-							0	Data wrap on Cannot connect.
Old FM1	North Wambo	23.1.24	0925	RuggedTroll				-							0	Data wrap on New logger Unable to locate
FM1 New Location	North Wambo	23.1.24	0935	CS-CR800		11.97(v)	Yes	NO	-	-				Dry	0	
FM1 New Location BU	North Wambo	23.1.24	0945	RuggedTroll	-	-	-	-	28%	4%	Yes	Yes	Yes	Dry	0	Data wrap on New logger
FM2	North Wambo	23.1.24	1030	CS-CR200		13.34(v)	Yes	NO	-	-	Yes	Yes	Yes	Pooling	0	
FM2 BU	North Wambo	23.1.24	1015	RuggedTroll	-	-	-	-	100%	27%	Yes	Yes	Yes	Pooling	0	
BarroLogger NWC	North Wambo	23.1.24	1045	BaroTroll	-	-	-	-	100%	40%	Yes	Yes	Yes	-	-	Data wrap on New barrologger
FM3	North Wambo	23.1.24	0820	CS-CR200		13.44(v)	Yes	NO	-	-	Yes	Yes	Yes	Dry	0	
FM3 BU	North Wambo	23.1.24	0835	RuggedTroll	-	-	-	NO	100%	27%	Yes	Yes	Yes	Dry	0	
FM4	North Wambo	23.1.24	0800	CS-CR200		13.43(v)	Yes	No	-	-	Yes	Yes	Yes	Dry	0	
FM4 BU	North Wambo	23.1.24	0945	RuggedTroll	-	-	-	-	100%	40%	Yes	Yes	Yes	Dry	0	Data wrap on New logger
FM12 SCUP	Stoney	24.1.24	1000	RuggedTroll	-	-	-	-	93%	17%	Yes	Yes	Yes	Pooling	0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary	24.1.24	0900	RuggedTroll	-	-	-	-	93%	17%	Yes	Yes	Yes	Dry	0	Data wrap on
Stoney Ck Up Barro	Stoney	24.1.24	1050	BaroTroll	-	-	-	-	93%	17%	Yes	Yes	Yes	- Dry	-	Data wrap on
FM13 SCDown	Stoney	24.1.24	1135	RuggedTroll	-	-	-	-	93%	17%	Yes	Yes	Yes	dry	0	Data wrap on
Stoney Ck Down Barro	Stoney	24.1.24	1200	BaroTroll	-	-	-	-	93%	17%	Yes	Yes	Yes	-	-	Data wrap on
FM9 Brossi	South Wambo	23.1.24	1435	RuggedTroll	-	-	-	-	31%	5%	Yes	Yes	Yes	Pooling	0	Data wrap on
FM15 (FM5)	South Wambo	23.1.24	1205	RuggedTroll	-	-	-	-	28%	4%	Yes	Yes	Yes	Dry	0	Data wrap on
FM16 (FM6)	South Wambo	24.1.24	1230	RuggedTroll	-	-	-	-	31%	5%	Yes	Yes	Yes	Dry	0	Data wrap on
Barro Logger SWC	South Wambo	24.1.24	1240	BaroTroll	-	-	-	-	31%	5%	Yes	Yes	Yes	-	-	Data wrap on
Upstream old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Old FM1	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM1 New Location	North Wambo			CS-CR800					-	-					0	
FM1 New Location BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM2	North Wambo			CS-CR200					-	-					0	
FM2 BU	North Wambo			RuggedTroll	-	-	-	-							0	
BarroLogger NWC	North Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on
FM3	North Wambo			CS-CR200					-	-					0	
FM3 BU	North Wambo			RuggedTroll	-	-	-								0	
FM4	North Wambo			CS-CR200					-	-					0	
FM4 BU	North Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM12 SCUP	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
FM14 SCtrib	Stoney Ck Trubutary			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Up Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM13 SCDown	Stoney			RuggedTroll	-	-	-	-							0	Data wrap on
Stoney Ck Down Barro	Stoney			BaroTroll	-	-	-	-						-	-	Data wrap on
FM9 Brossi	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM15 (FM5)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
FM16 (FM6)	South Wambo			RuggedTroll	-	-	-	-							0	Data wrap on
Barro Logger SWC	South Wambo			BaroTroll	-	-	-	-						-	-	Data wrap on

A Endersby, E.R.220.

Toughbook #2

- Collected 23/01 + 24/01

Appendix B

Stream Theoretical Flow Rating and Profile Curves

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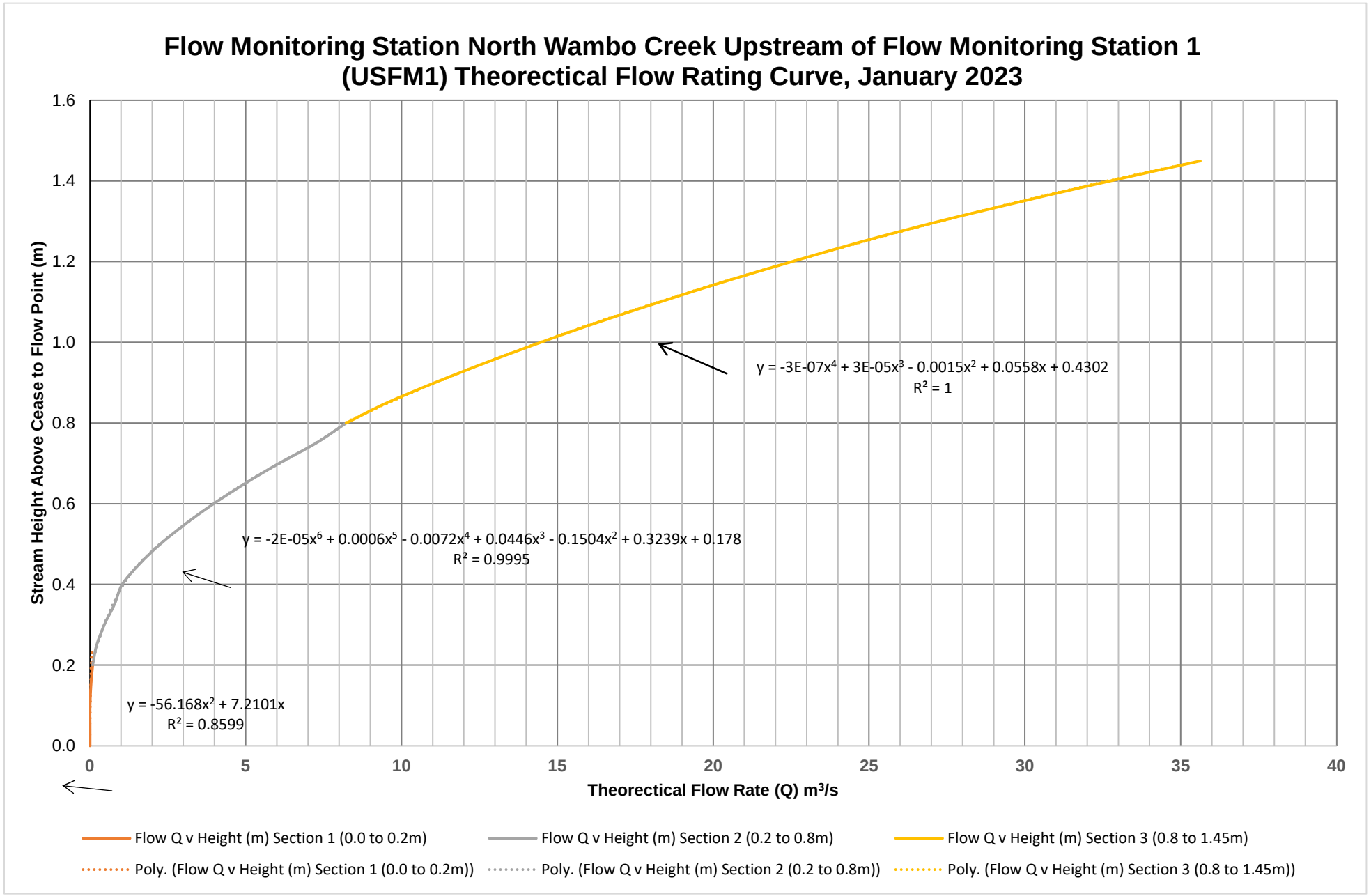
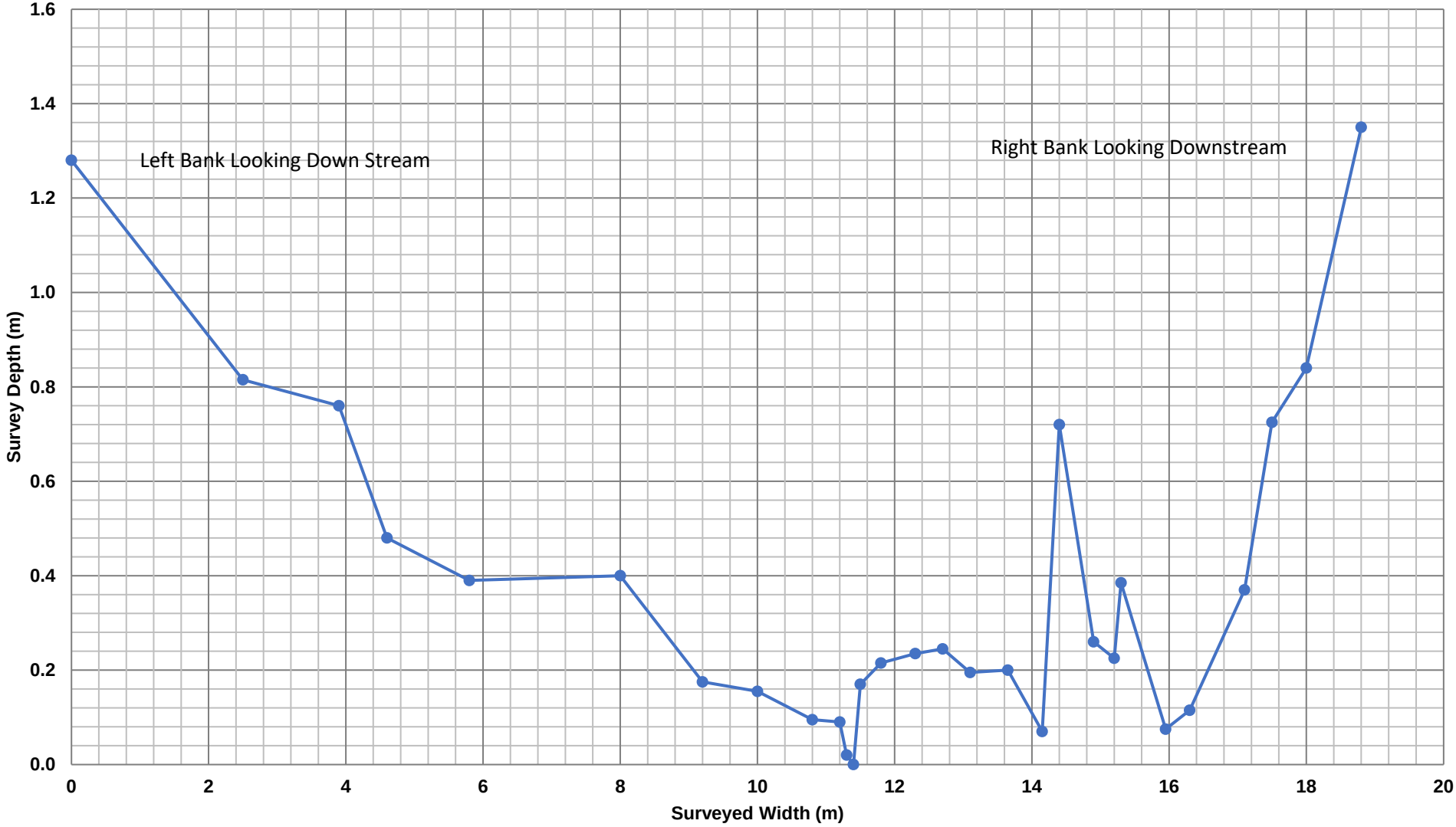
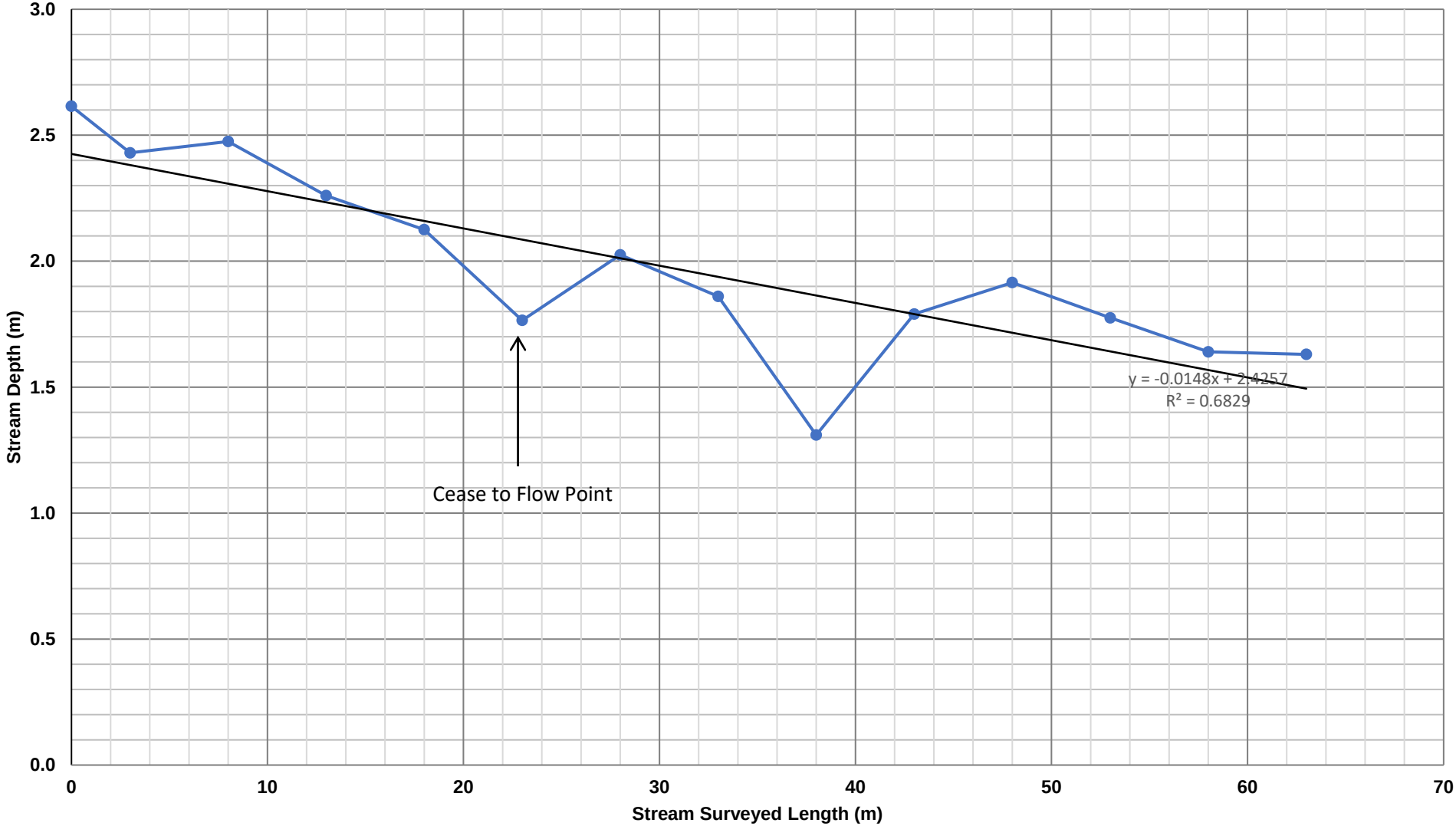

Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1 (USFM1) Theorectical Flow Rating Curve, January 2023
Stream Height Above Cease to Flow Point (m)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
25
30
35
40
Theorectical Flow Rate (Q) m³/s
y = -3E-07x⁴ + 3E-05x³ - 0.0015x² + 0.0558x + 0.4302
R² = 1
y = -2E-05x⁶ + 0.0006x⁵ - 0.0072x⁴ + 0.0446x³ - 0.1504x² + 0.3239x + 0.178
R² = 0.9995
y = -56.168x² + 7.2101x
R² = 0.8599
Flow Q v Height (m) Section 1 (0.0 to 0.2m)
Flow Q v Height (m) Section 2 (0.2 to 0.8m)
Flow Q v Height (m) Section 3 (0.8 to 1.45m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.2m))
Poly. (Flow Q v Height (m) Section 2 (0.2 to 0.8m))
Poly. (Flow Q v Height (m) Section 3 (0.8 to 1.45m))

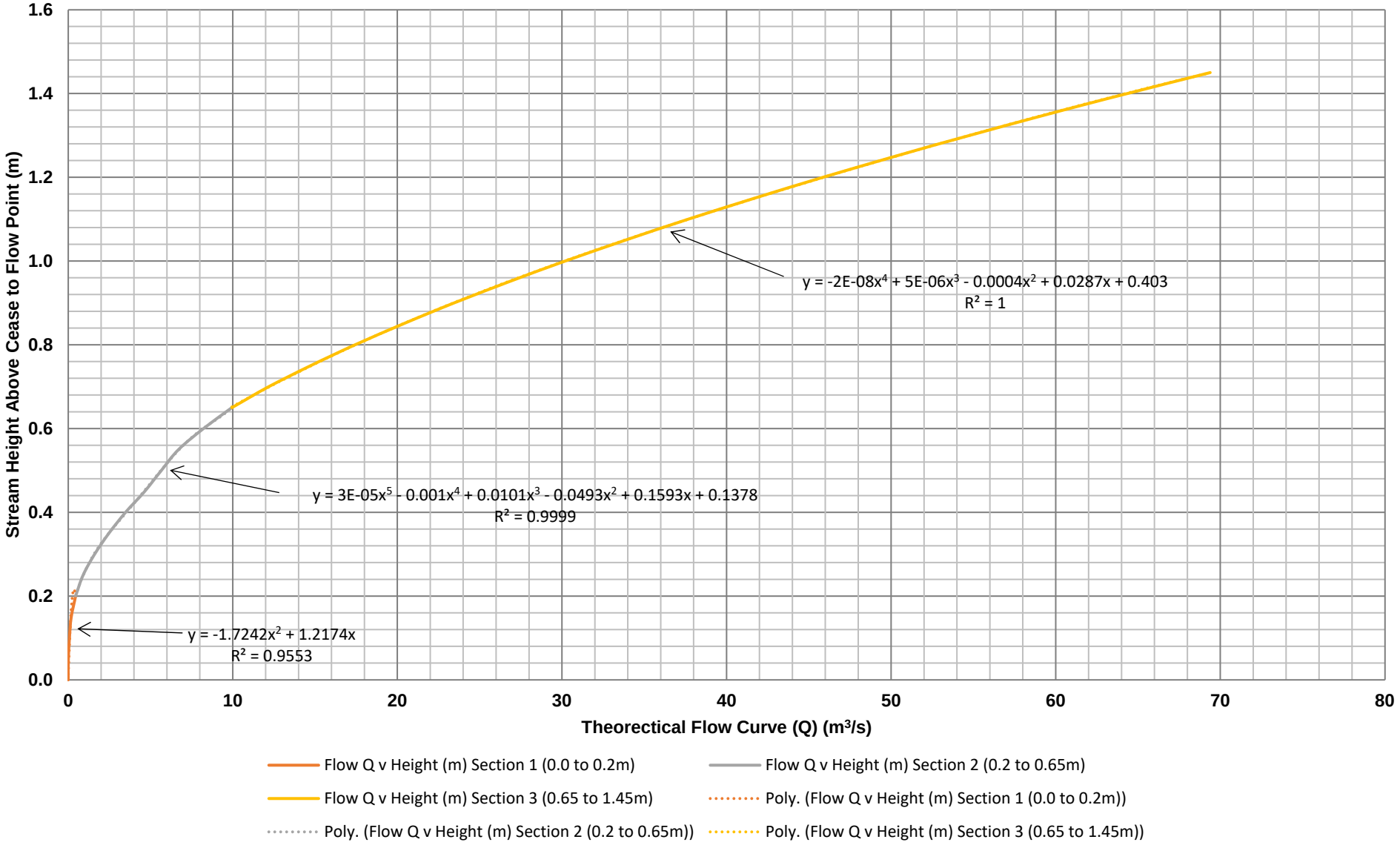
Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1 (USFM1) Cease to Flow Point Cross Section Survey February 2023



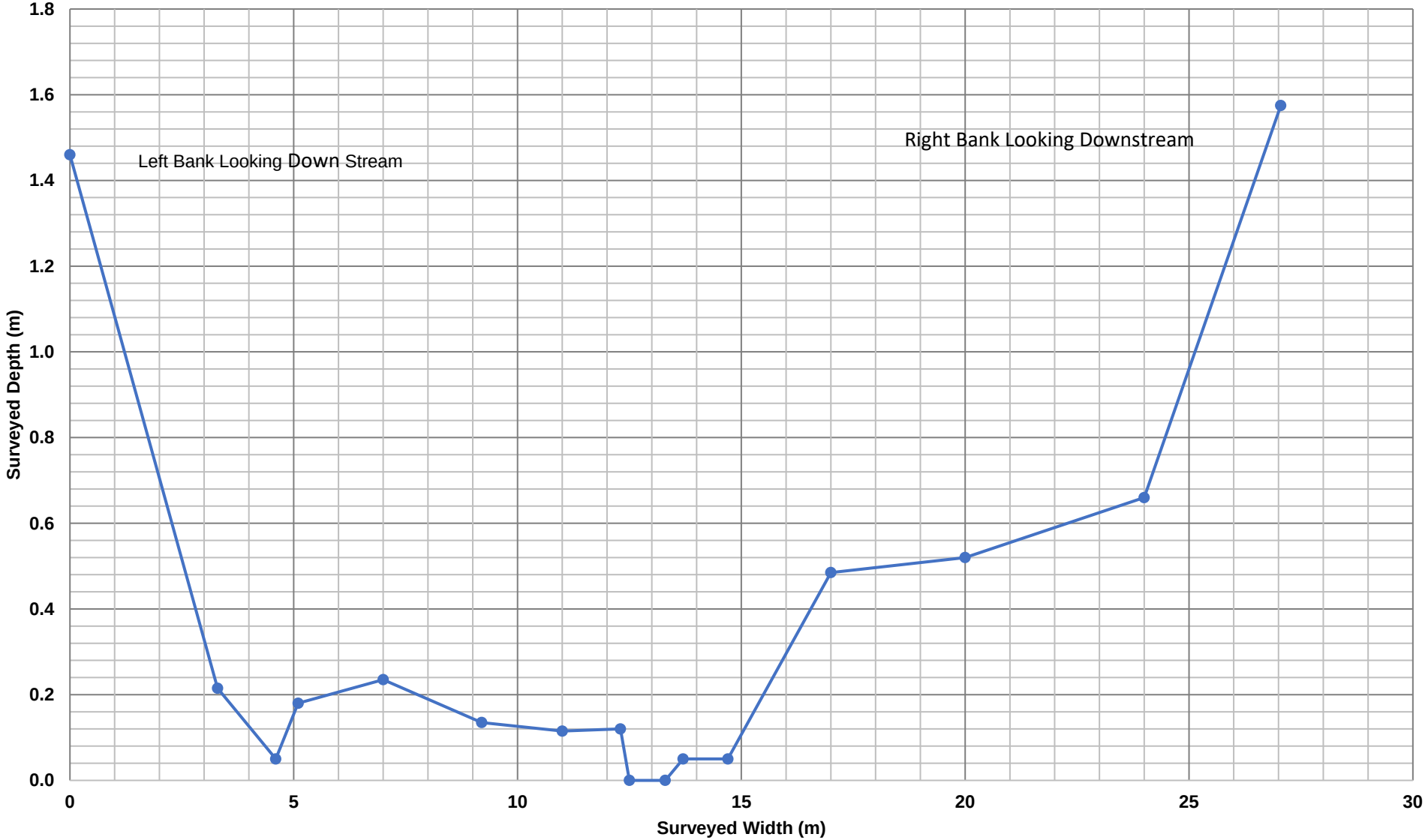
Flow Monitoring Station North Wambo Creek Upstream of Flow Monitoring Station 1 (USFM1) Long Section Profile Through Cease to Flow Point February 2023



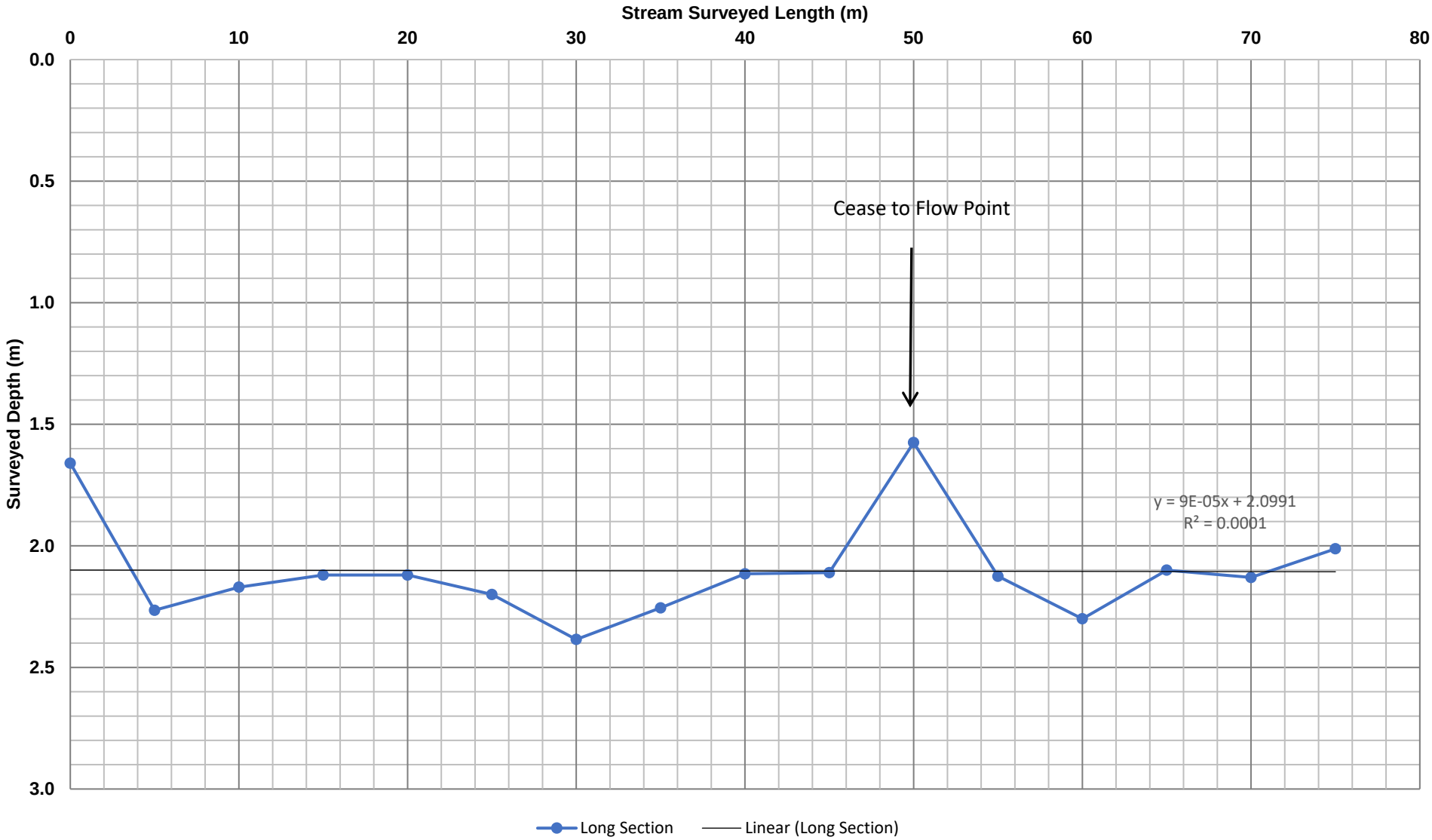
Flow Monitoring Station FM1 North Wambo Creek Theoretical Flow Rating Curve, February 2023



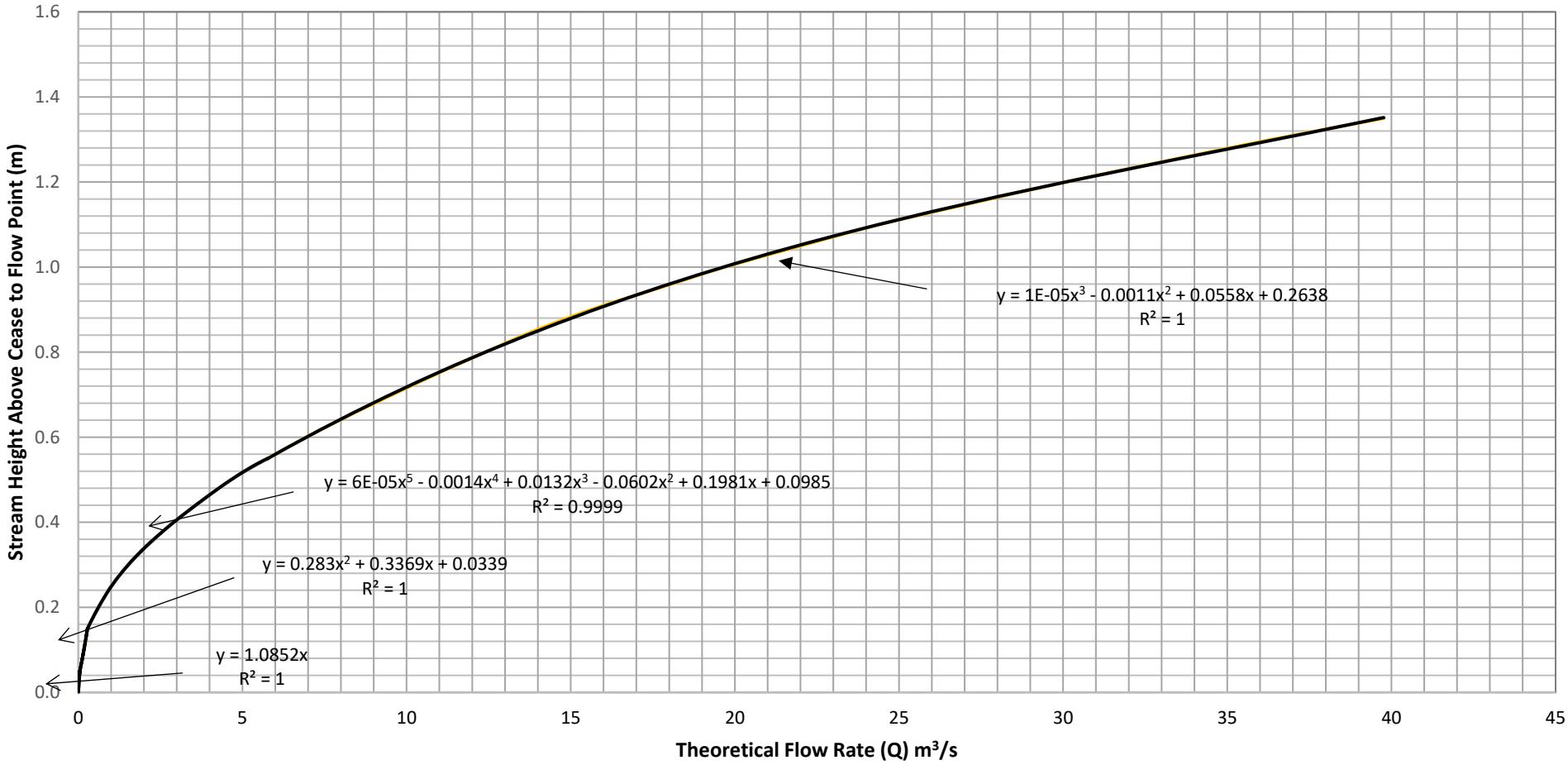
Flow Monitoring Station FM1 North Wambo Creek Cease to Flow Point Cross Section Survey, February 2023



Flow Monitoring Station FM1 North Wambo Creek Long Section Profile Through Cease to Flow Point, February 2023

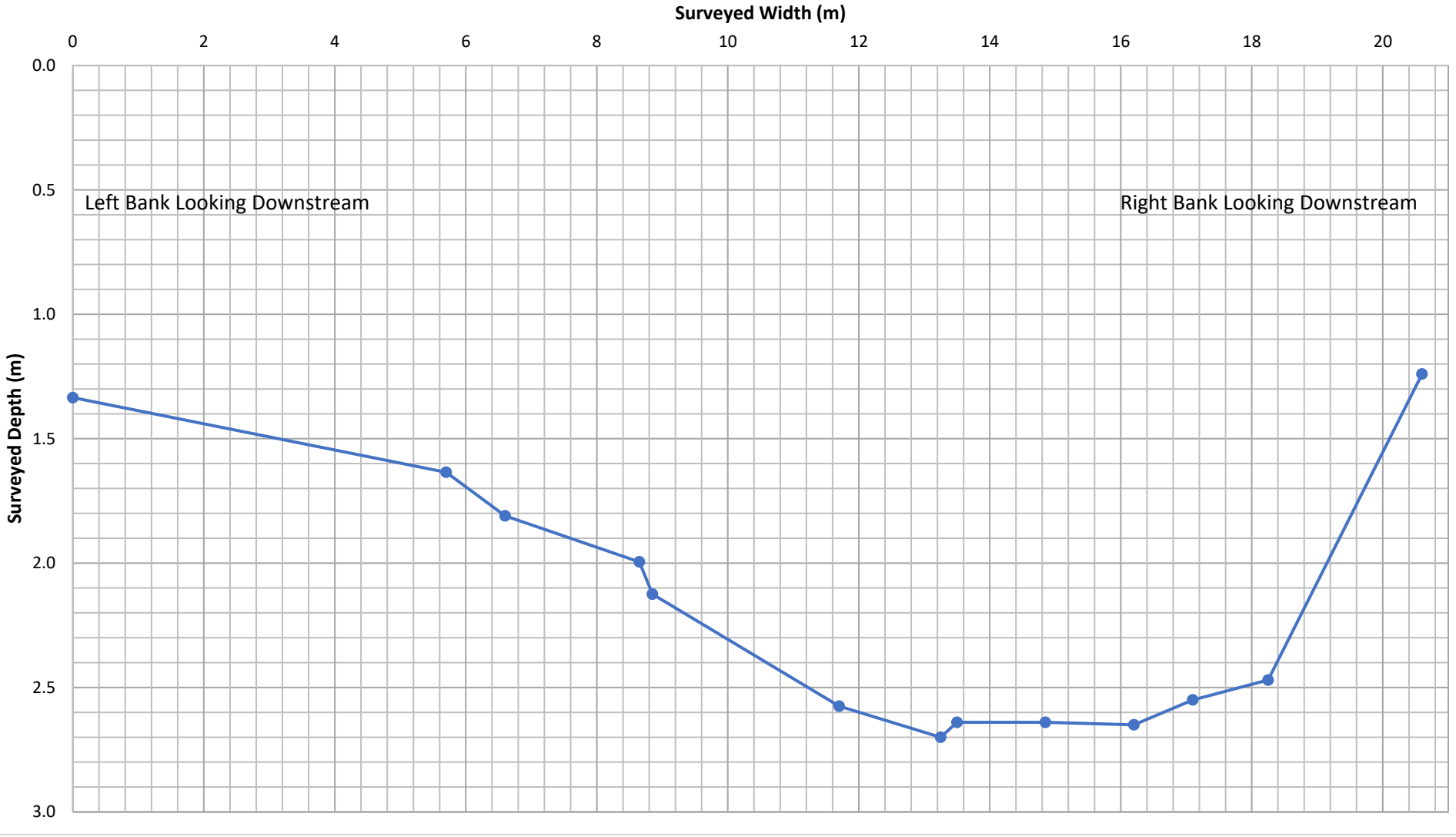


Flow Monitoring Station 2 North Wambo Creek Theoretical Flow Rating Curve, January 2024

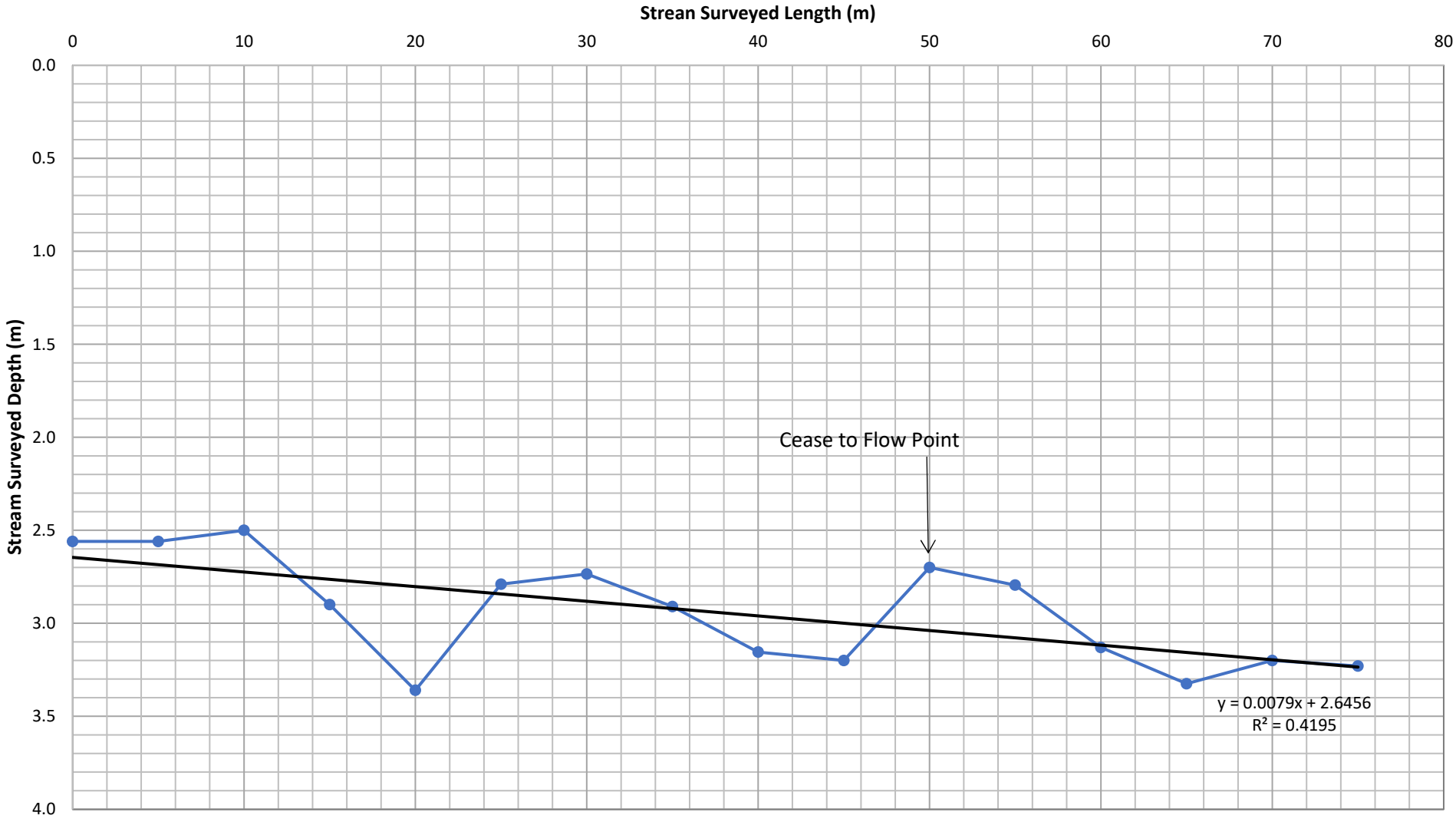


Flow Q v Height (m) Section 1 (0.0 to 0.05m)
Flow Q v Height (m) Section 2 (0.05 to 0.15m)
Flow Q v Height (m) Section 3 (0.15m to 0.55m) Poly.
Flow Q v Height (m) Section 3 0.55m to 1.35m)
(Flow Q v Height (m) Section 1 (0.0 to 0.05m)) Poly.
Poly. (Flow Q v Height (m) Section 2 (0.05 to 0.15m))
(Flow Q v Height (m) Section 3 0.15m to 0.55m))
Poly. (Flow Q v Height (m) Section 3 0.55m to 1.35m))

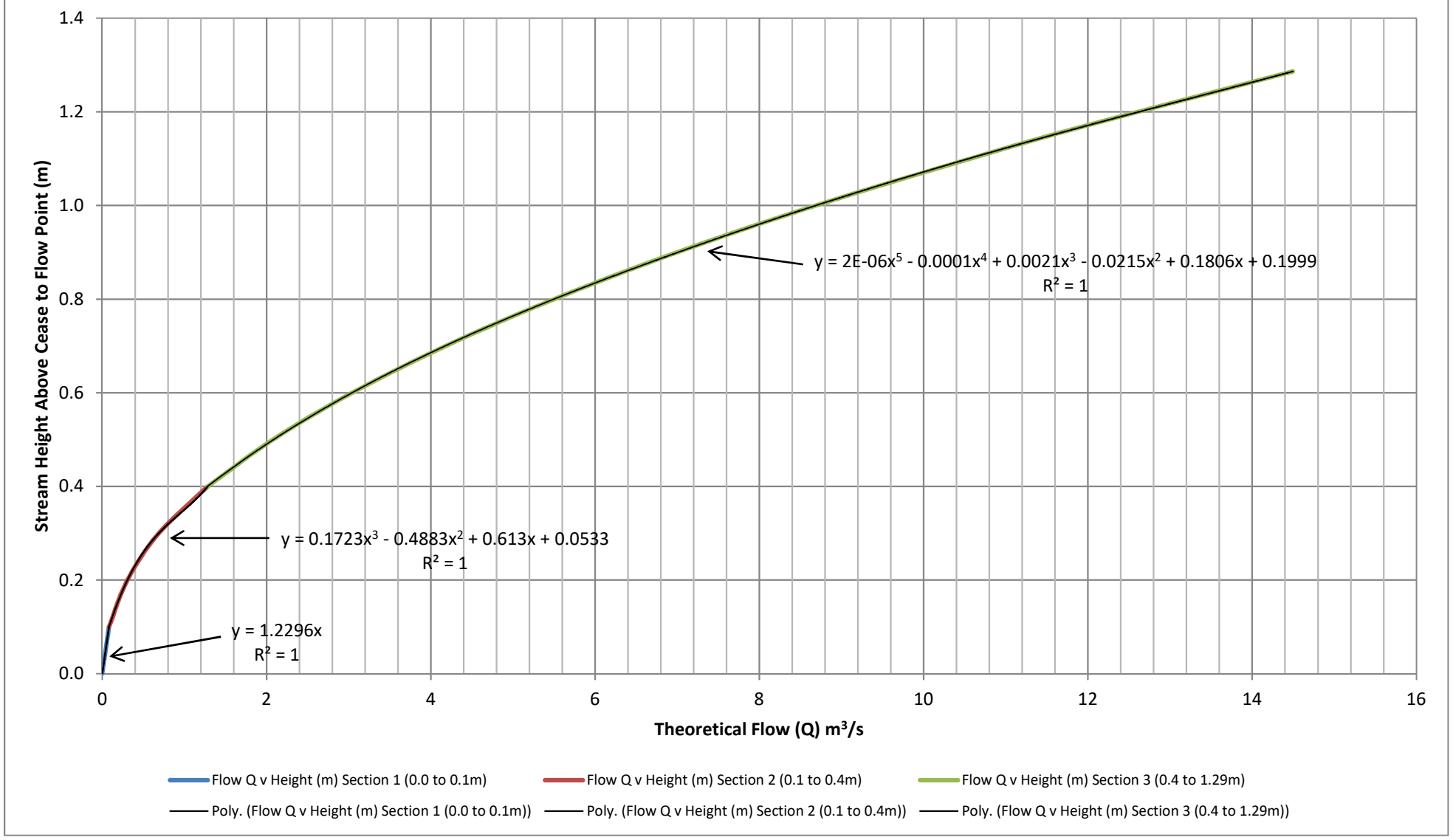
Flow Monitoring Station 2 North Wambo Creek
Cease to Flow Point Cross Section Survey
January 2024



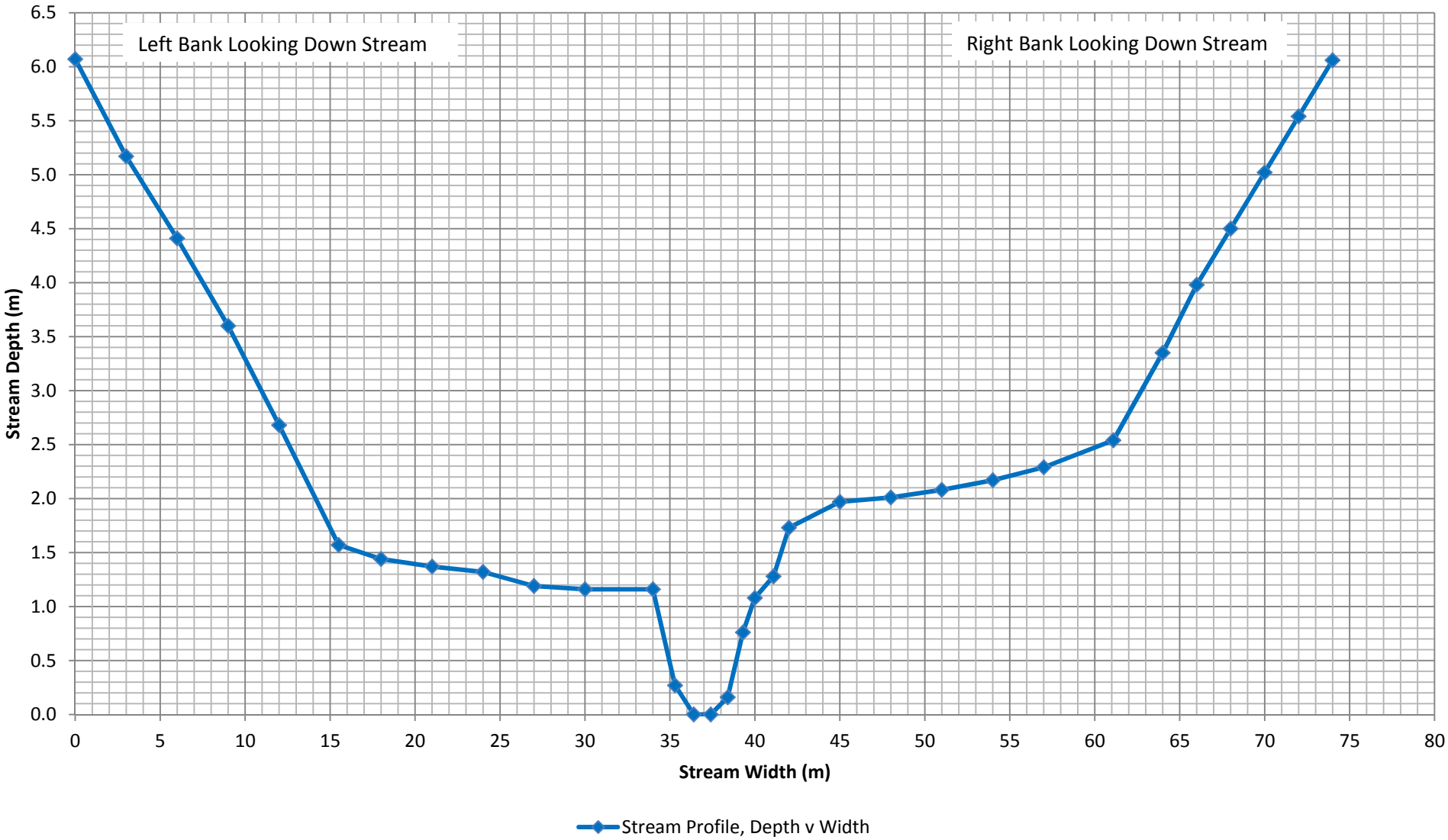
Flow Monitoring Station 2 North Wambo Creek Long Section
Profile Through Cease to Flow Point
January 2024



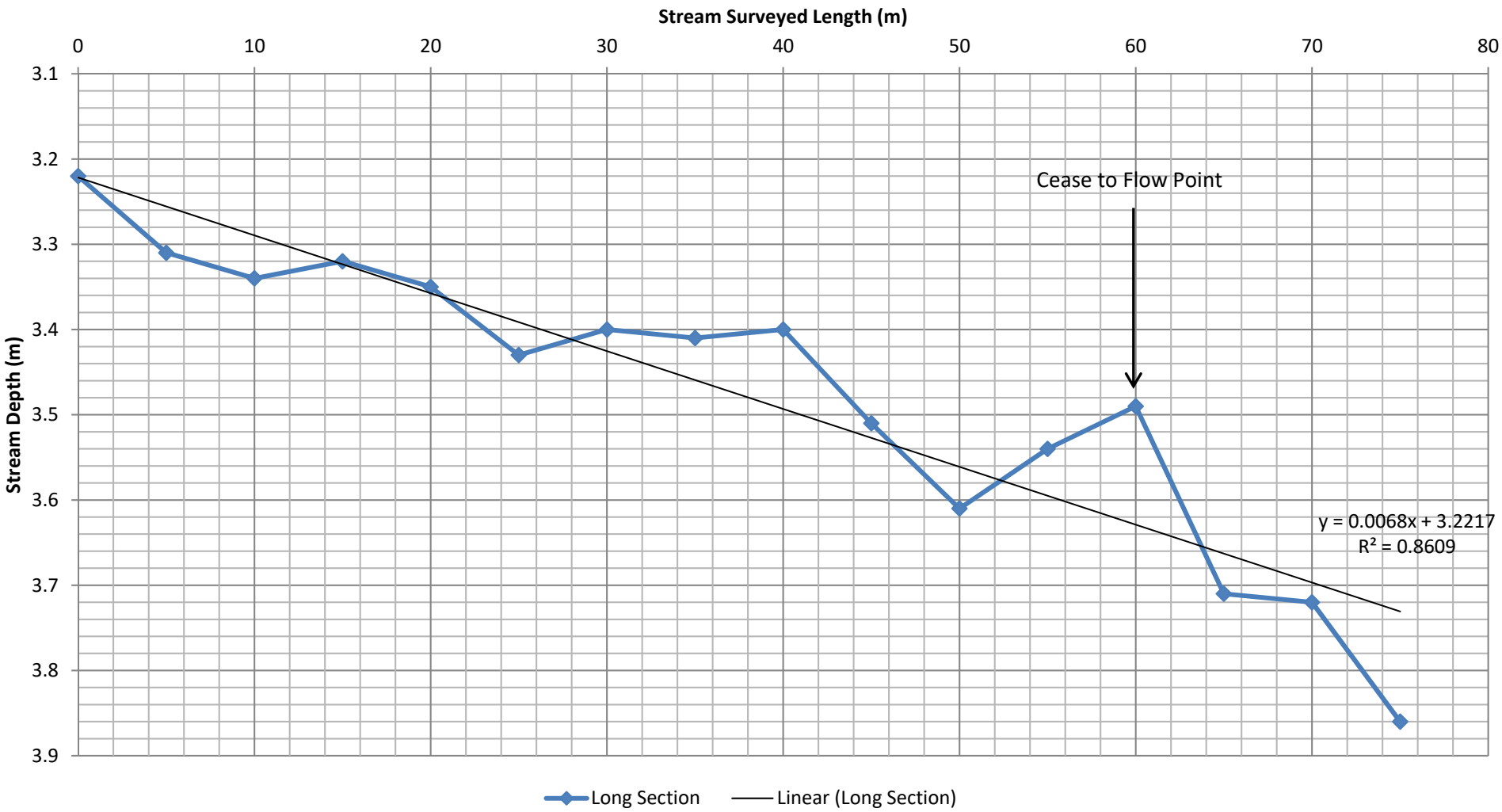
Flow Monitoring Station 3 North Wambo Creek Theoretical Flow Rating Curve, January 2018



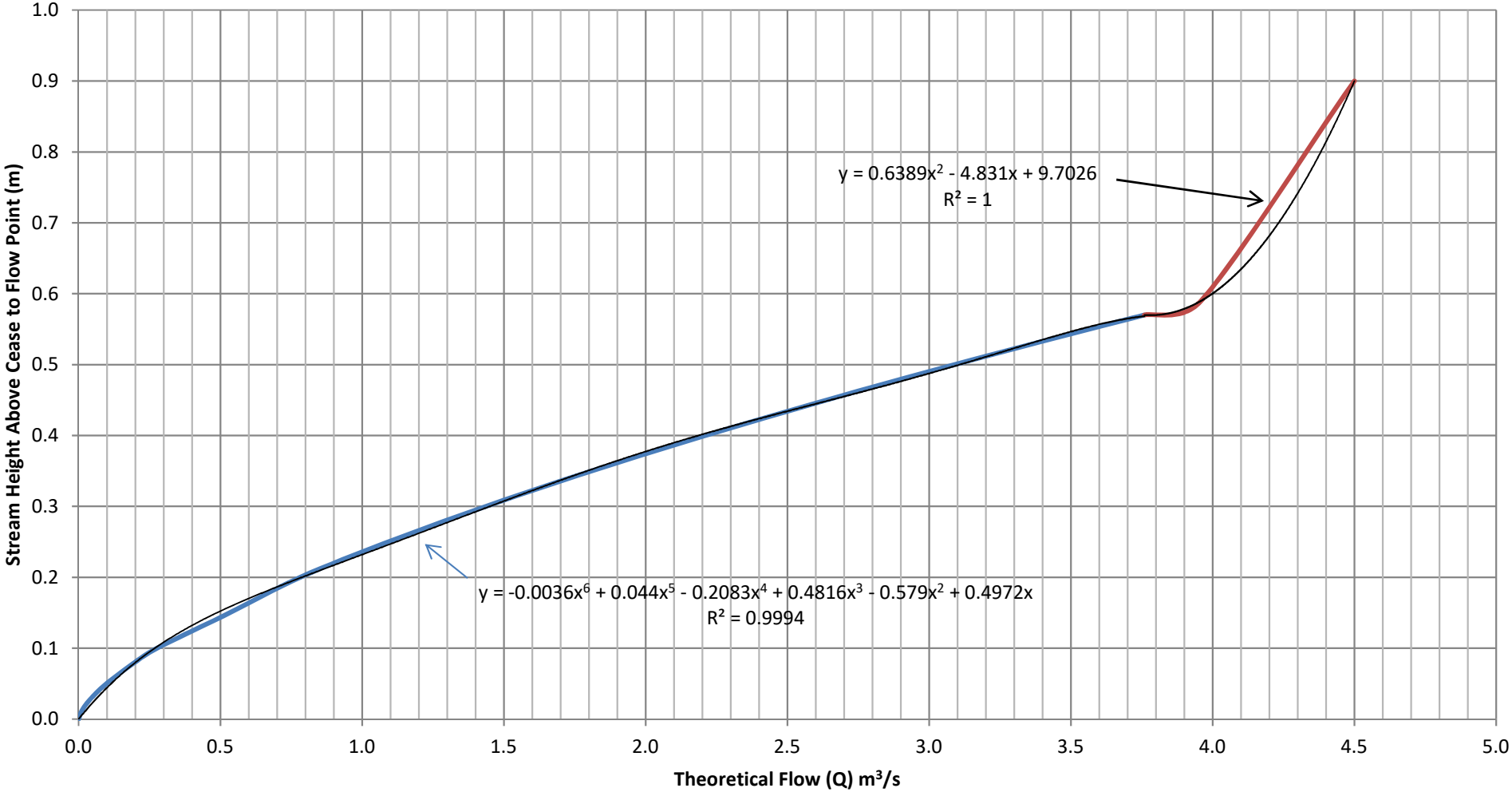
Flow Monitoring Station 3 North Wambo Creek Stream Bed Cross Section Profile, May 2013



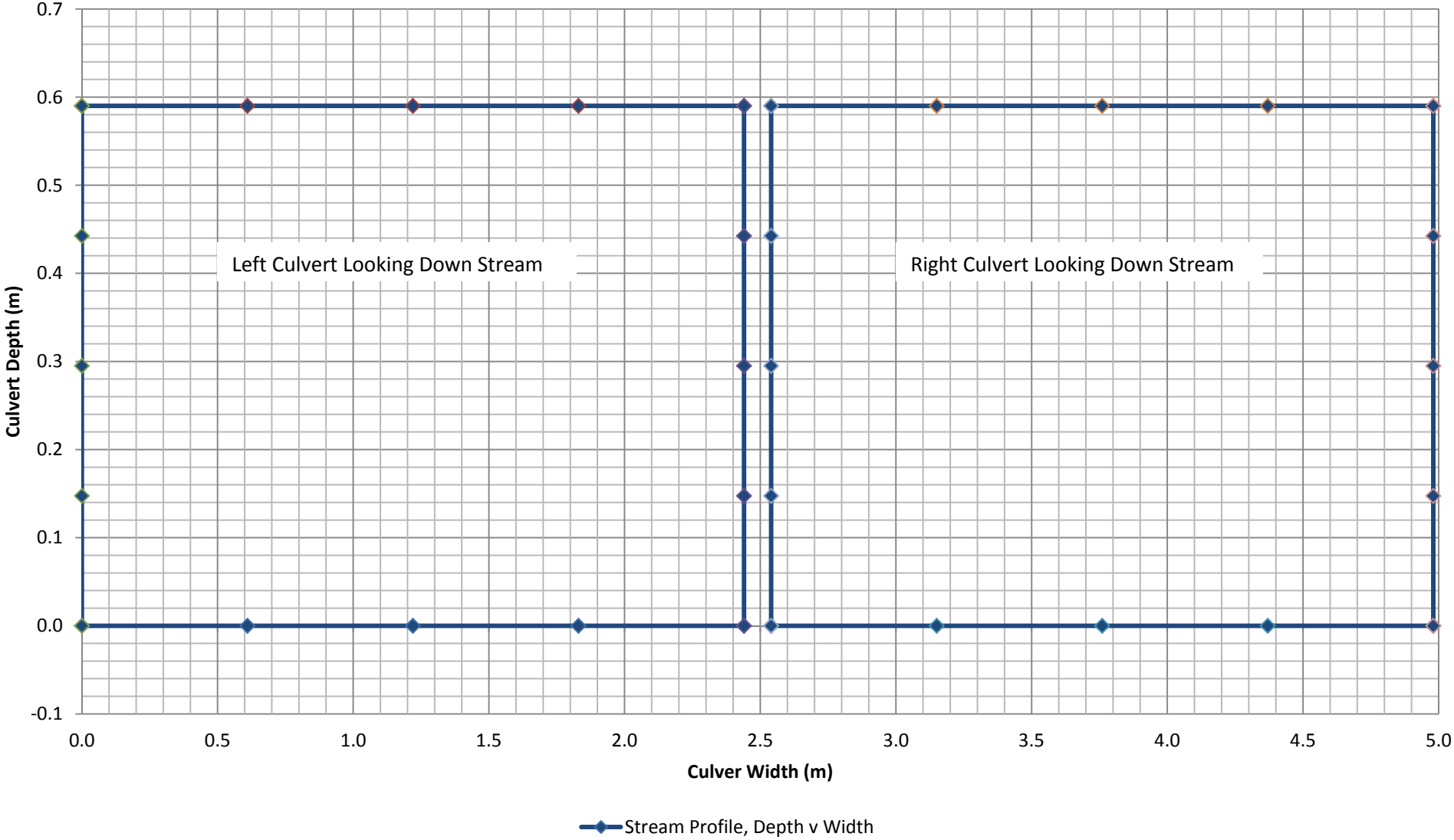
Flow Monitoring Station 3 North Wambo Creek Long Section Profile Through Cease to Flow Point January 2018



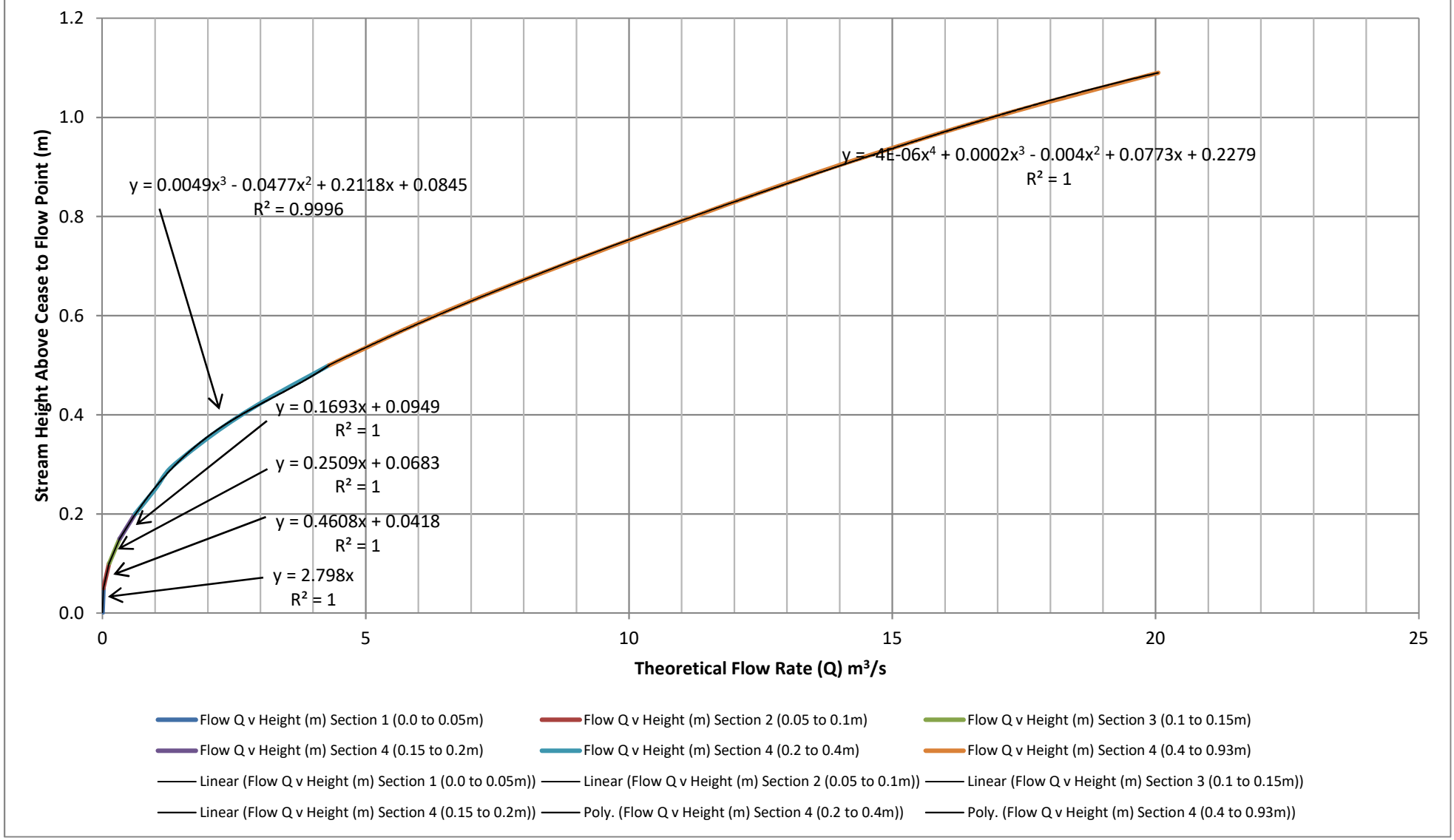
Flow Monitoring Station 4 North Wambo Creek Theoretical Flow Rating Curve, January 2018



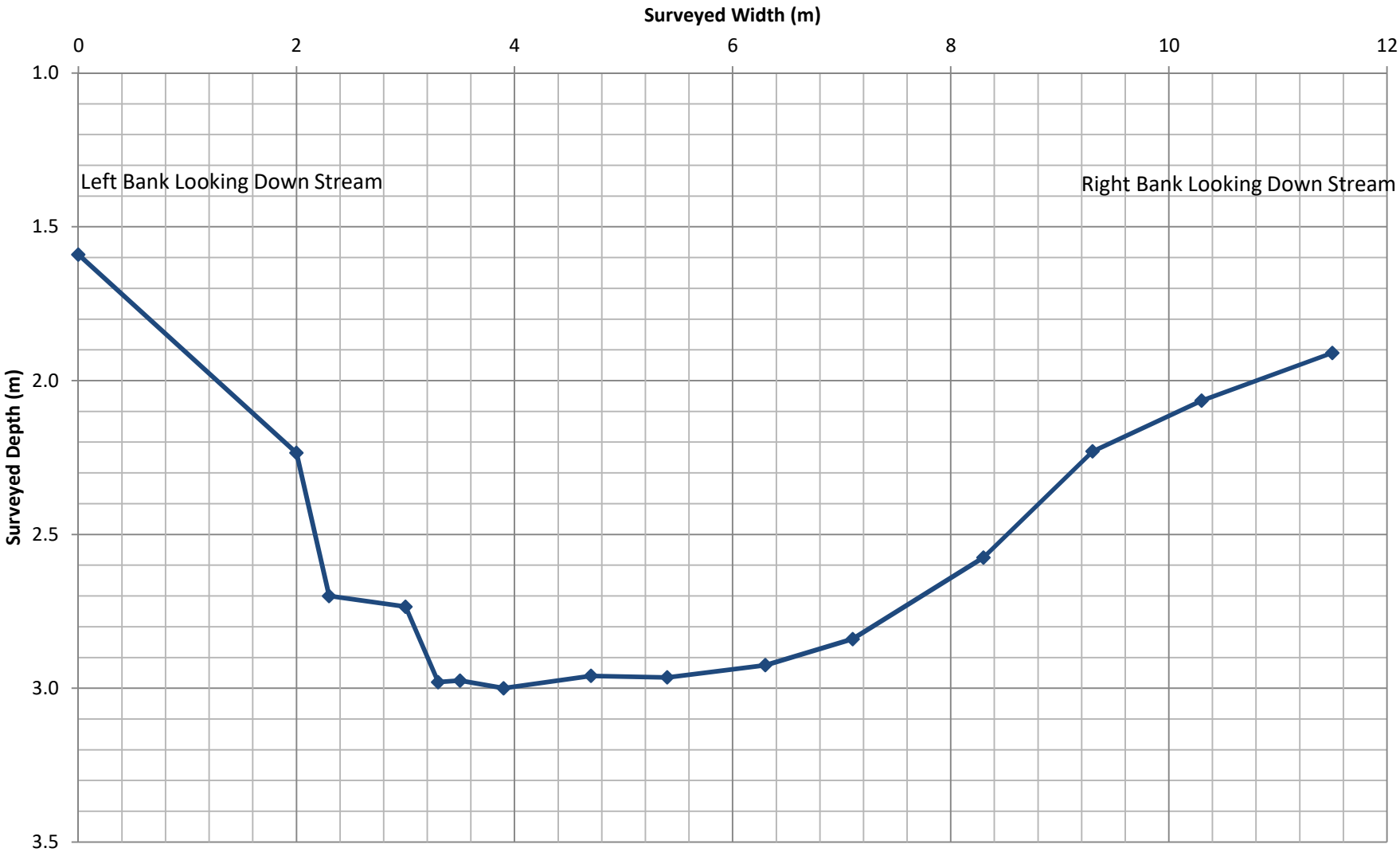
Flow Monitoring Station 4 North Wambo Creek Two Culverts Cross Section Profiles, May 2013



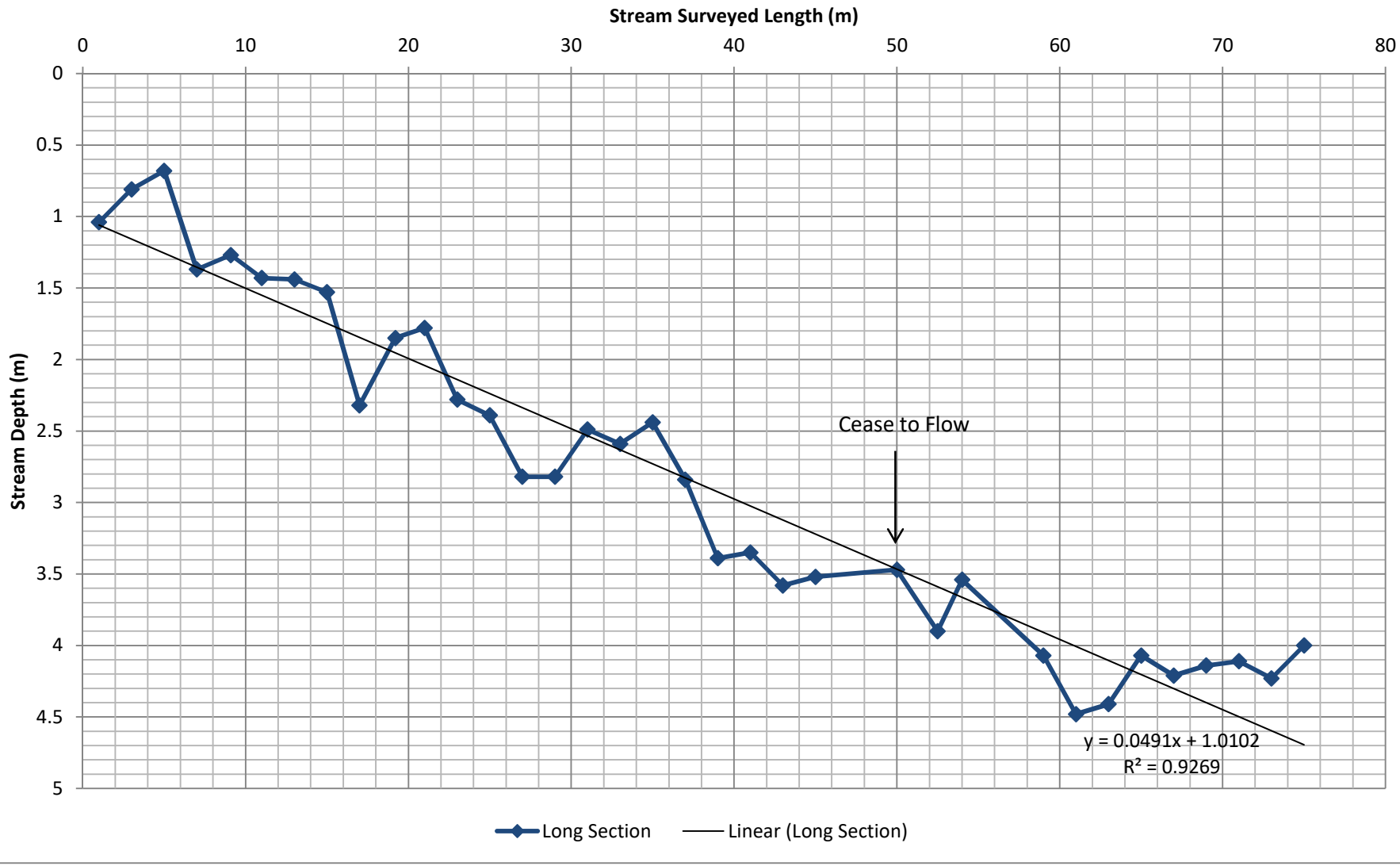
Flow Monitoring Station 12 Stoney Creek Up Theoretial Flow Rating Curve May 2019



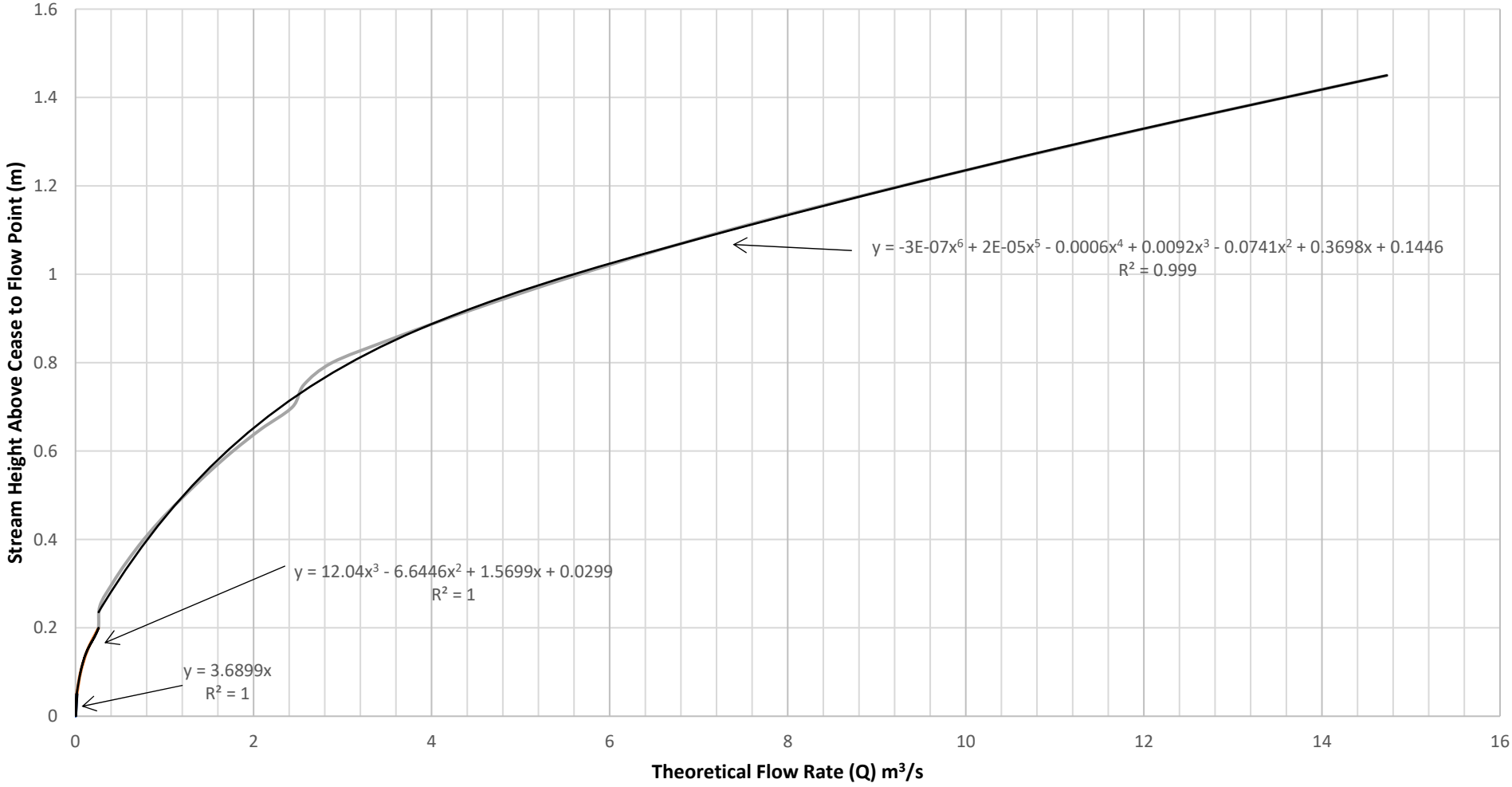
Flow Monitoring Station 12 Stoney Creek Up Flow Cease to Flow Point Cross Section Survey December 2018



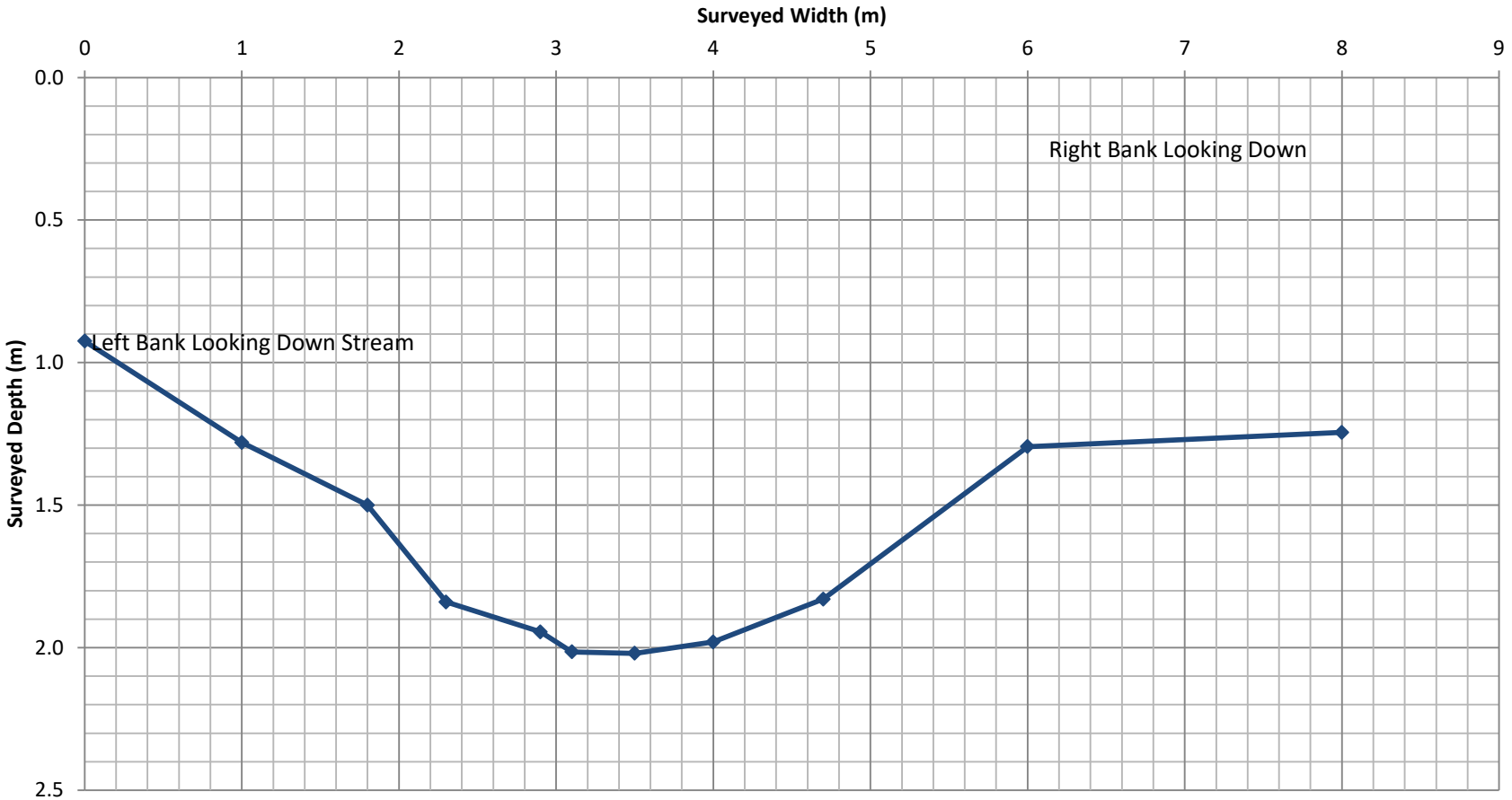
Flow Monitoring Station 12 Stoney Creek Up Long Section Profile Through Cease to Flow Point December 2018



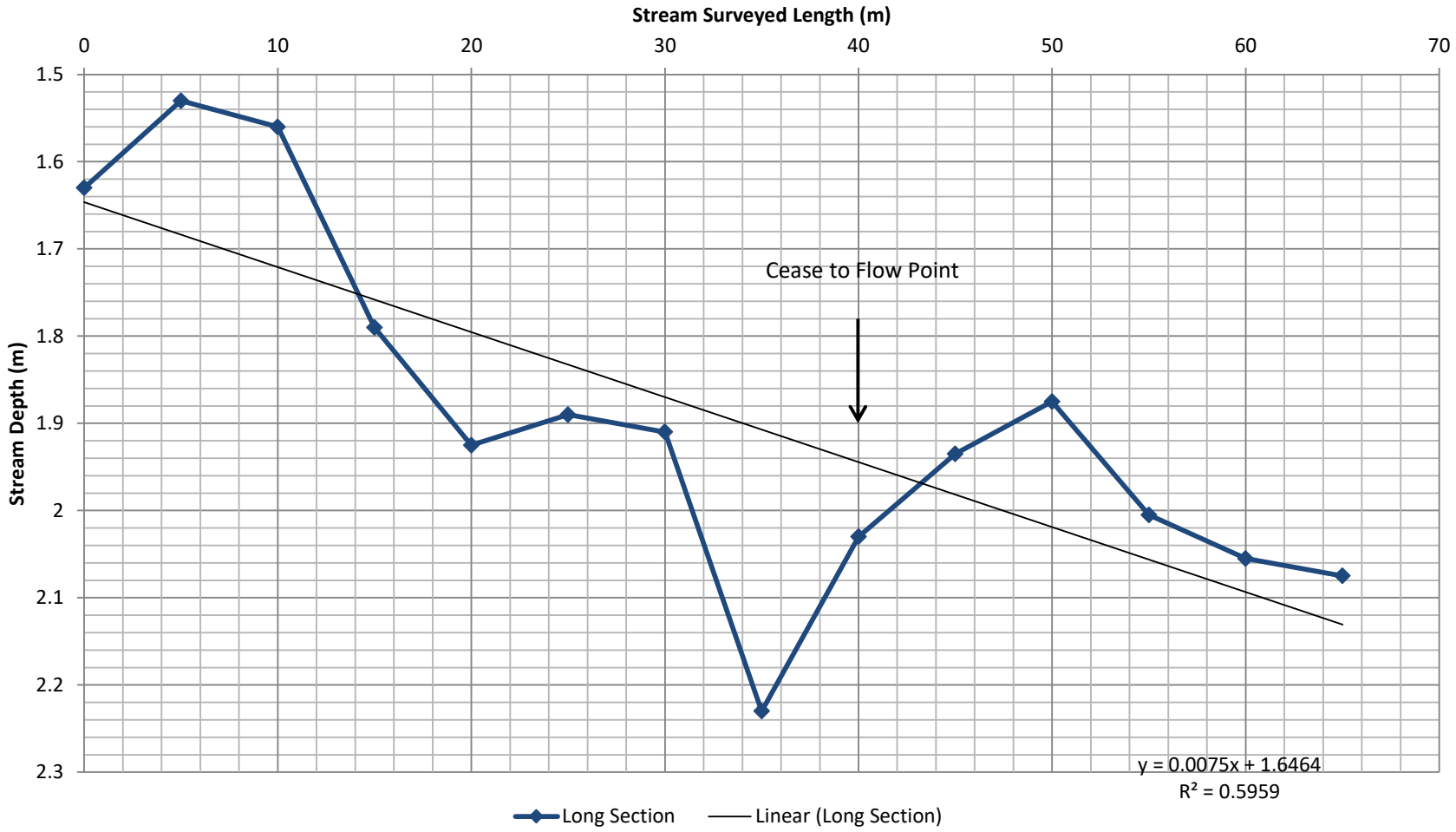
Flow Monitoring Station 13 Stoney Creek Down Theorectical Flow Curve
January 2022



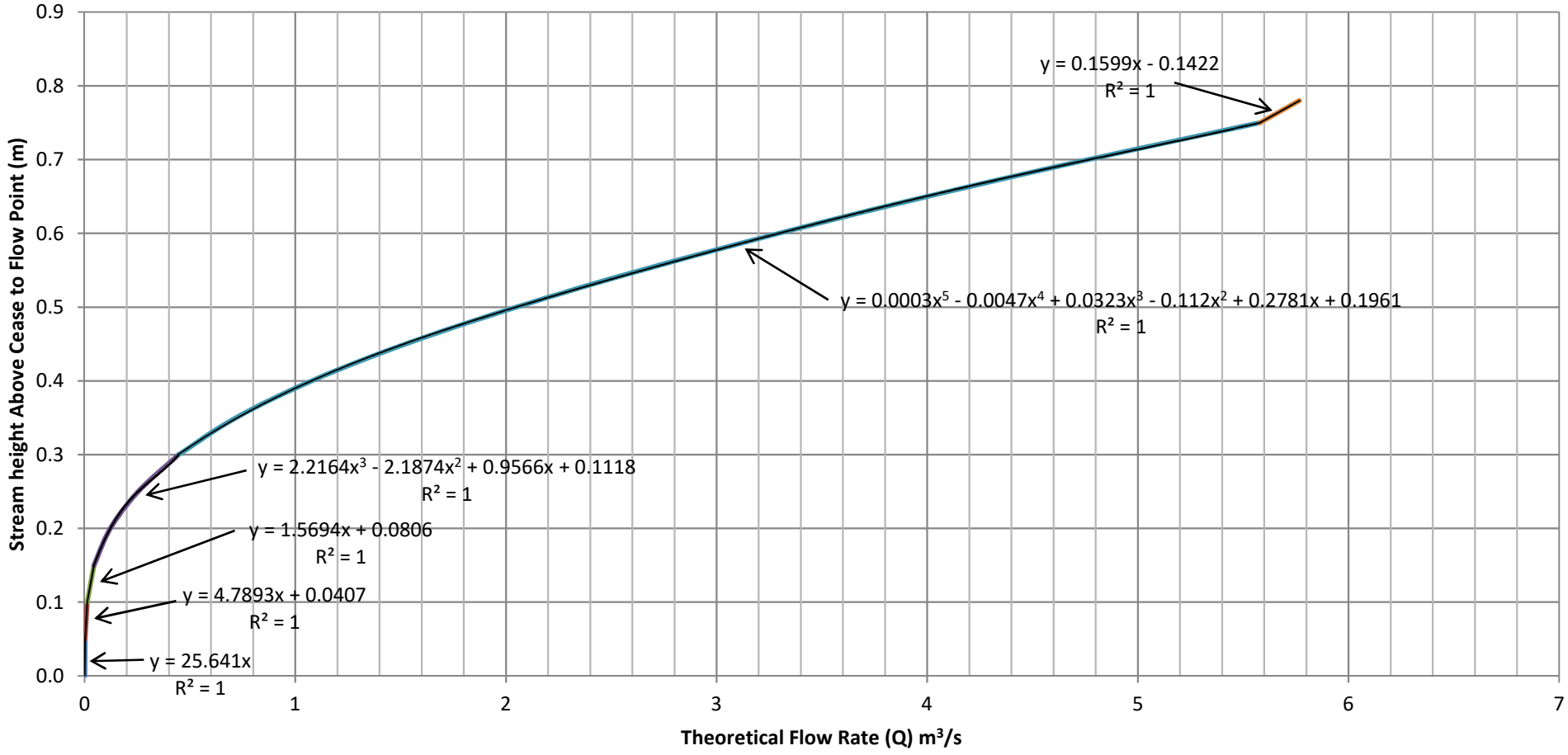
Flow Monitoring Station 13 Stony Creek Down Re-Location Cease to Flow Point Cross Section Survey January 2022



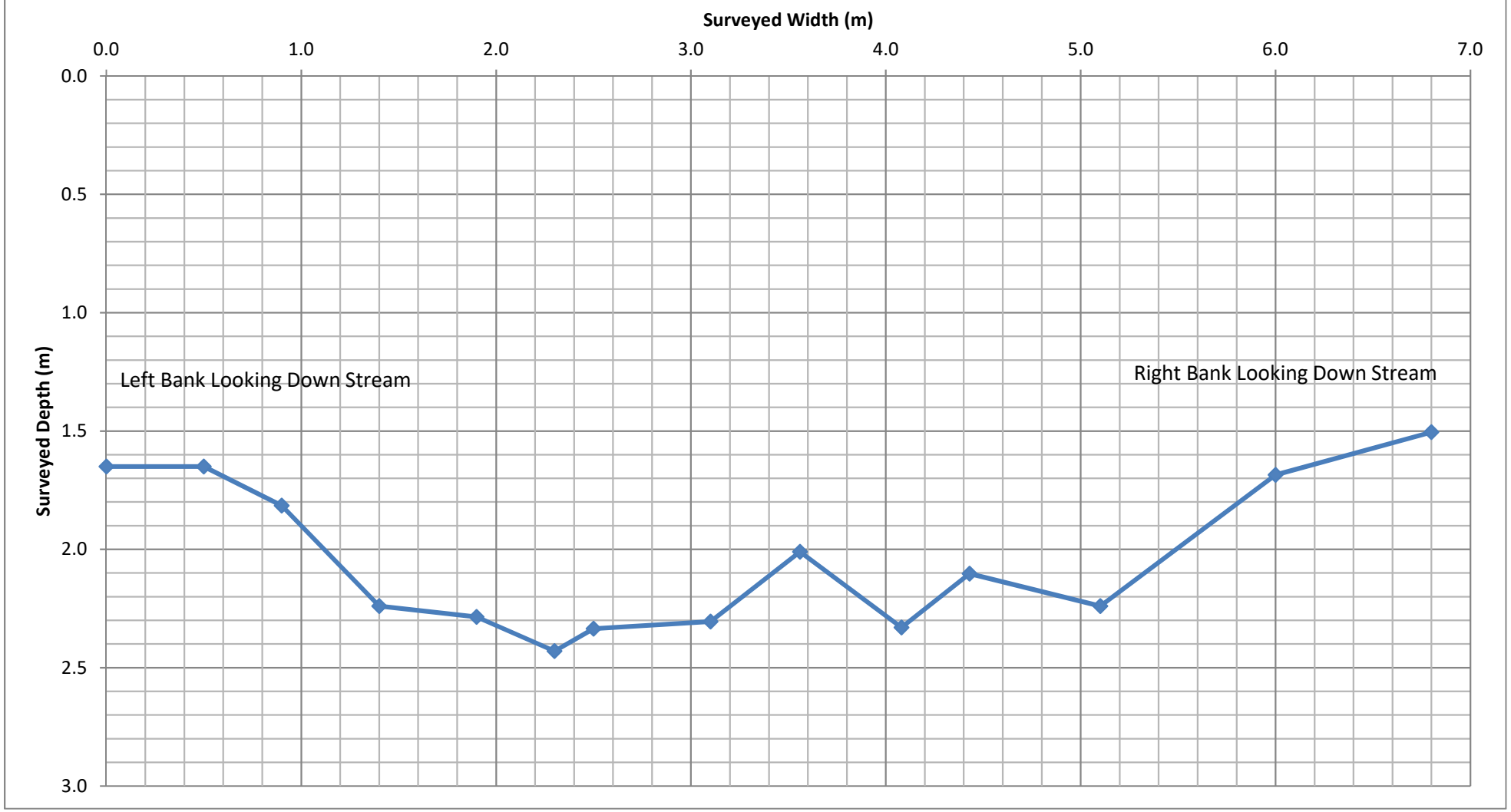
Flow Monitoring Station 13 Stony Creek Down Re-Location Cease to Flow Point Long Section Survey January 2022



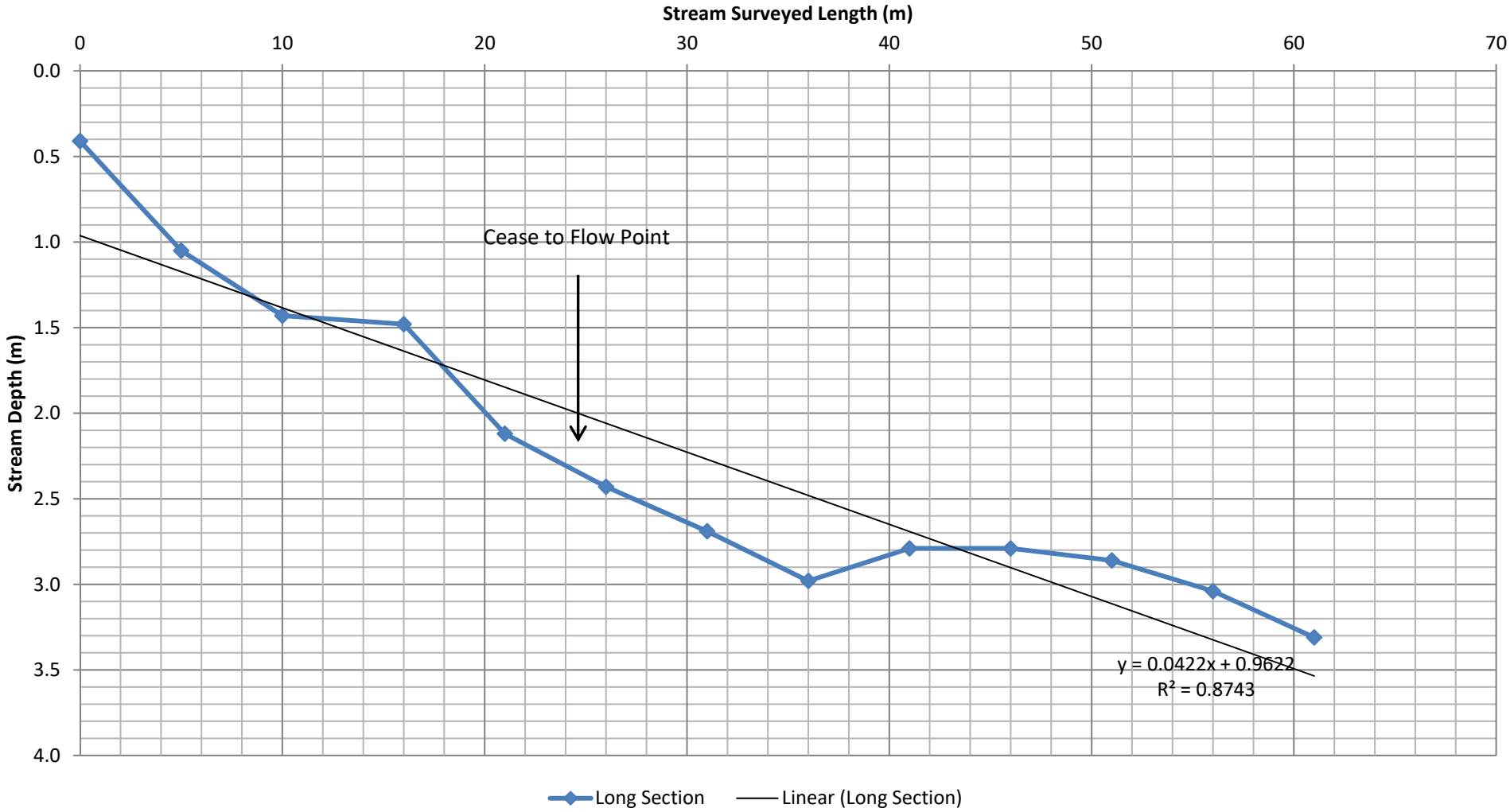
Flow Monitoring Station 14 Stoney Creek Tributary Theoretical Flow Rating Curve January 2018



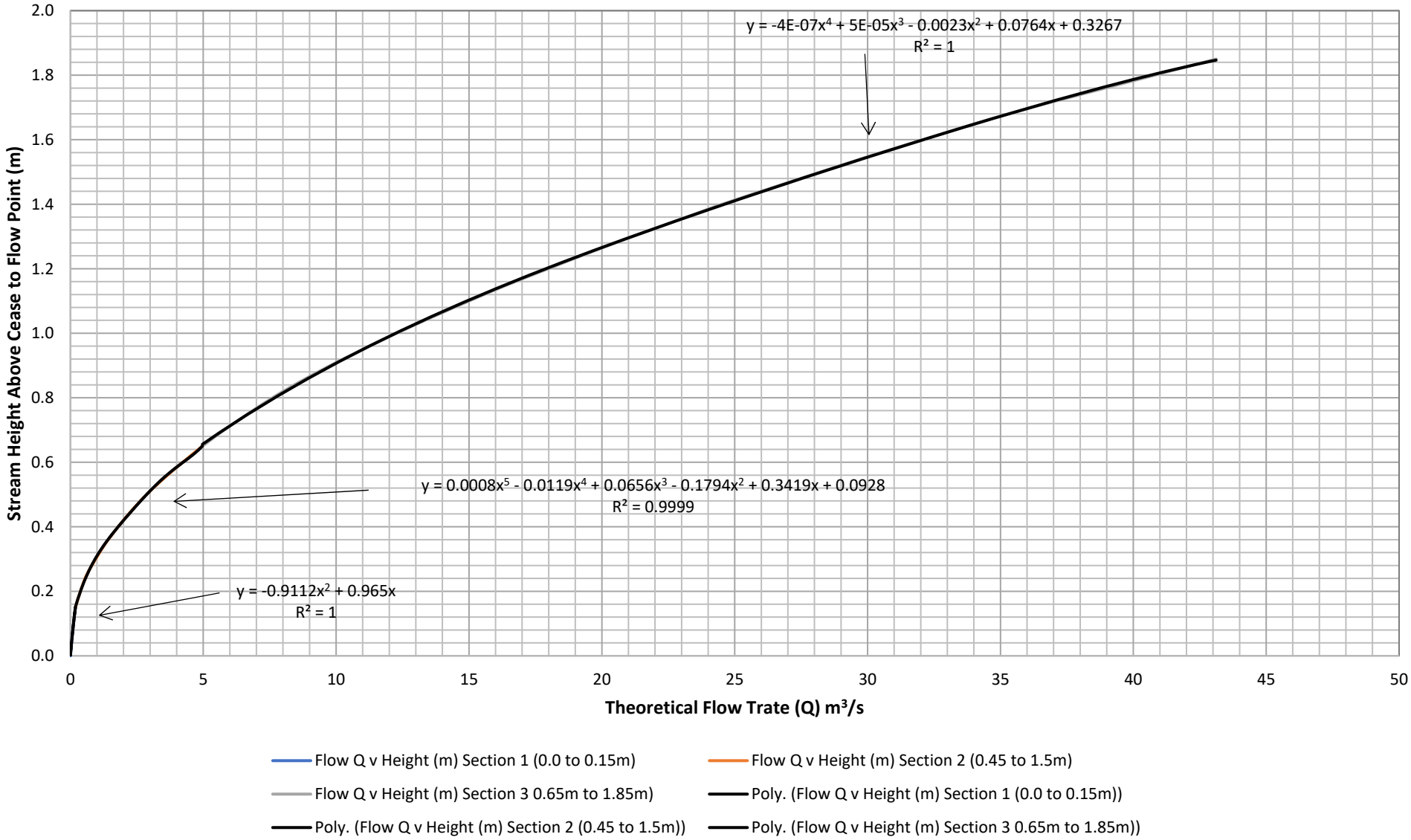
Flow Monitoring Station 14 Stoney Creek Tributary Cease To Flow Point Cross Section Survey December 2018

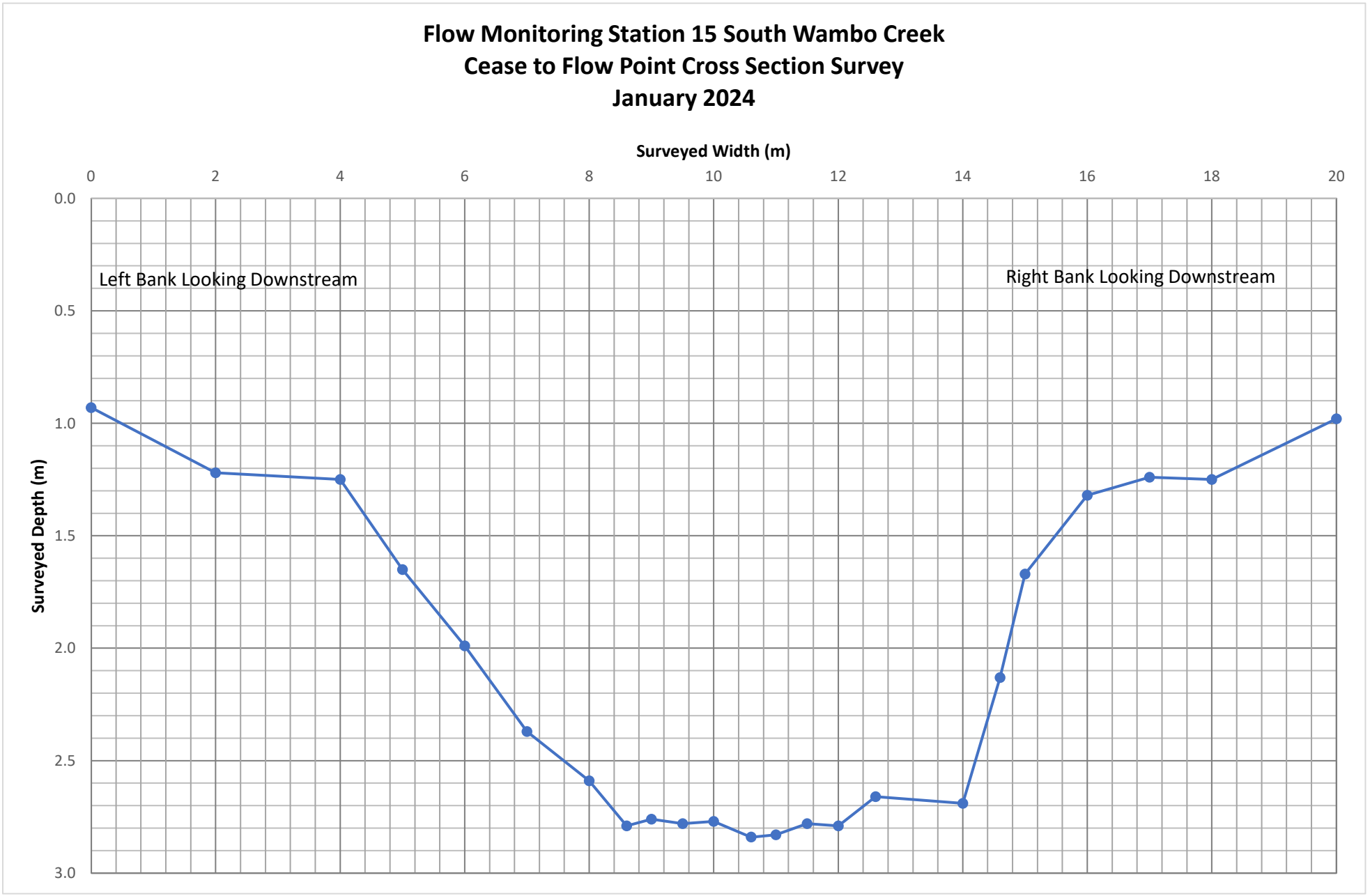


Flow Monitoring Station 14 Stoney Creek Tributary Long Section Profile Through Cease to Flow Point December 2018

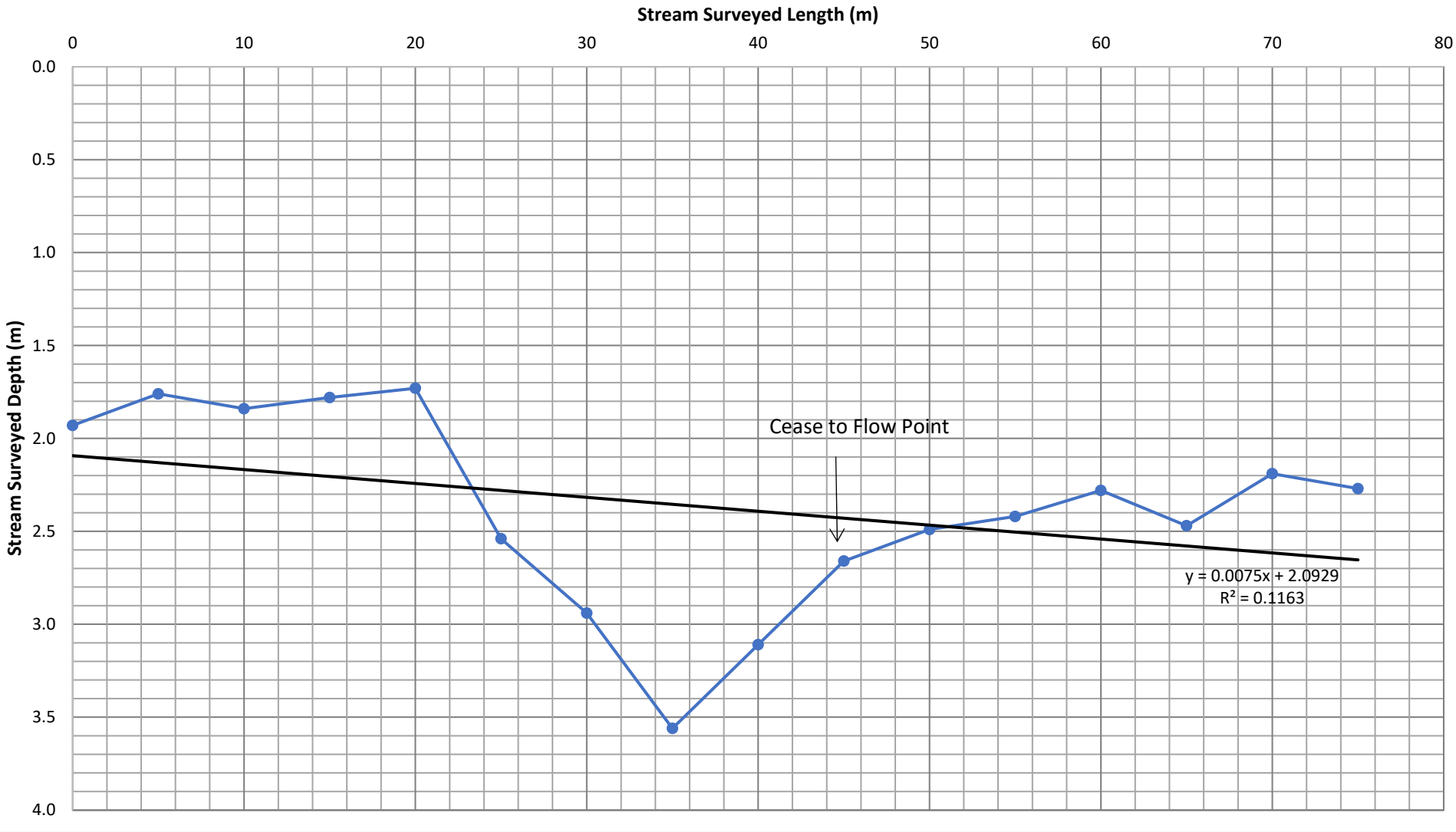


Flow Monitoring Station 15 South Wambo Creek Theoretical Flow Rating Curve, January 2024

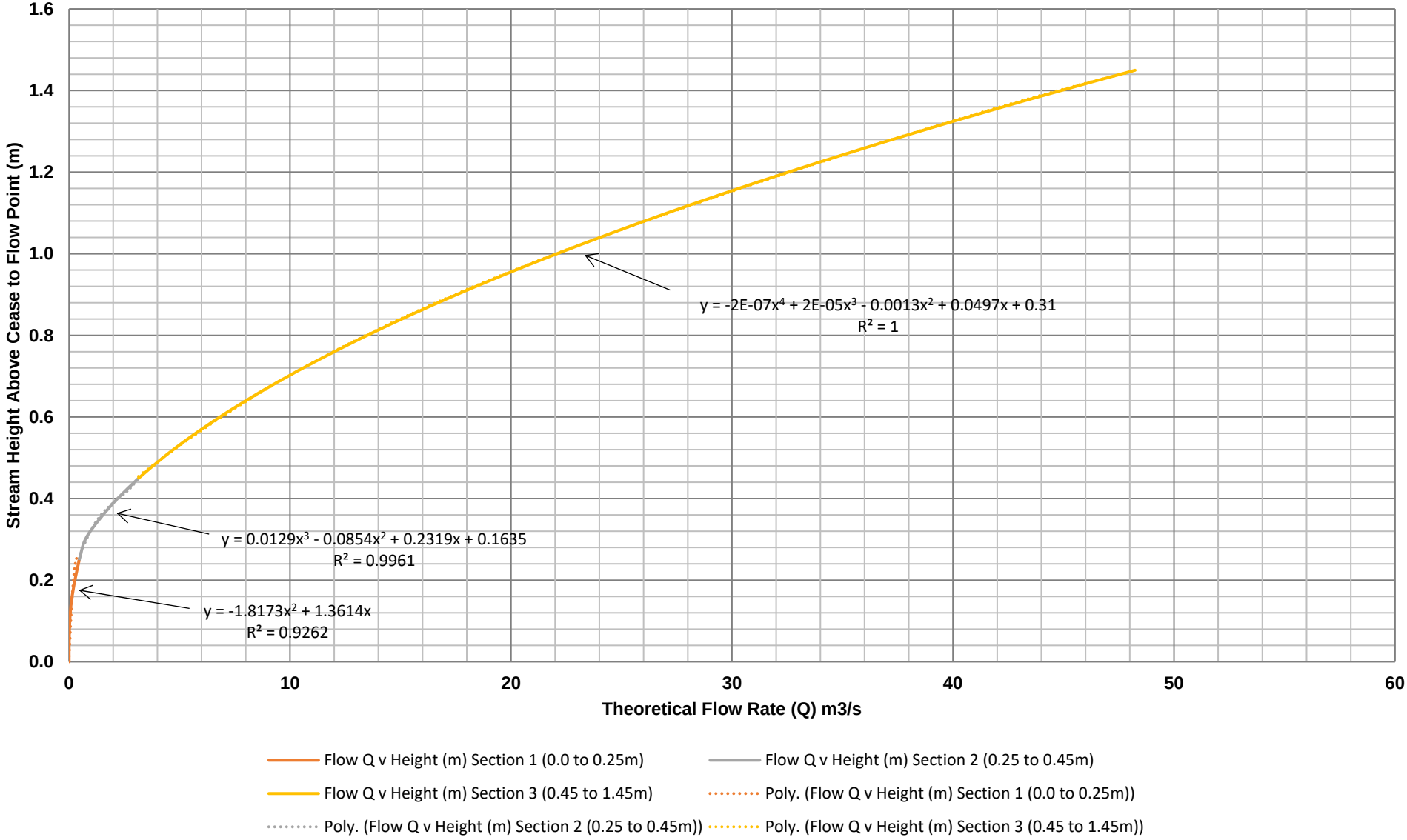


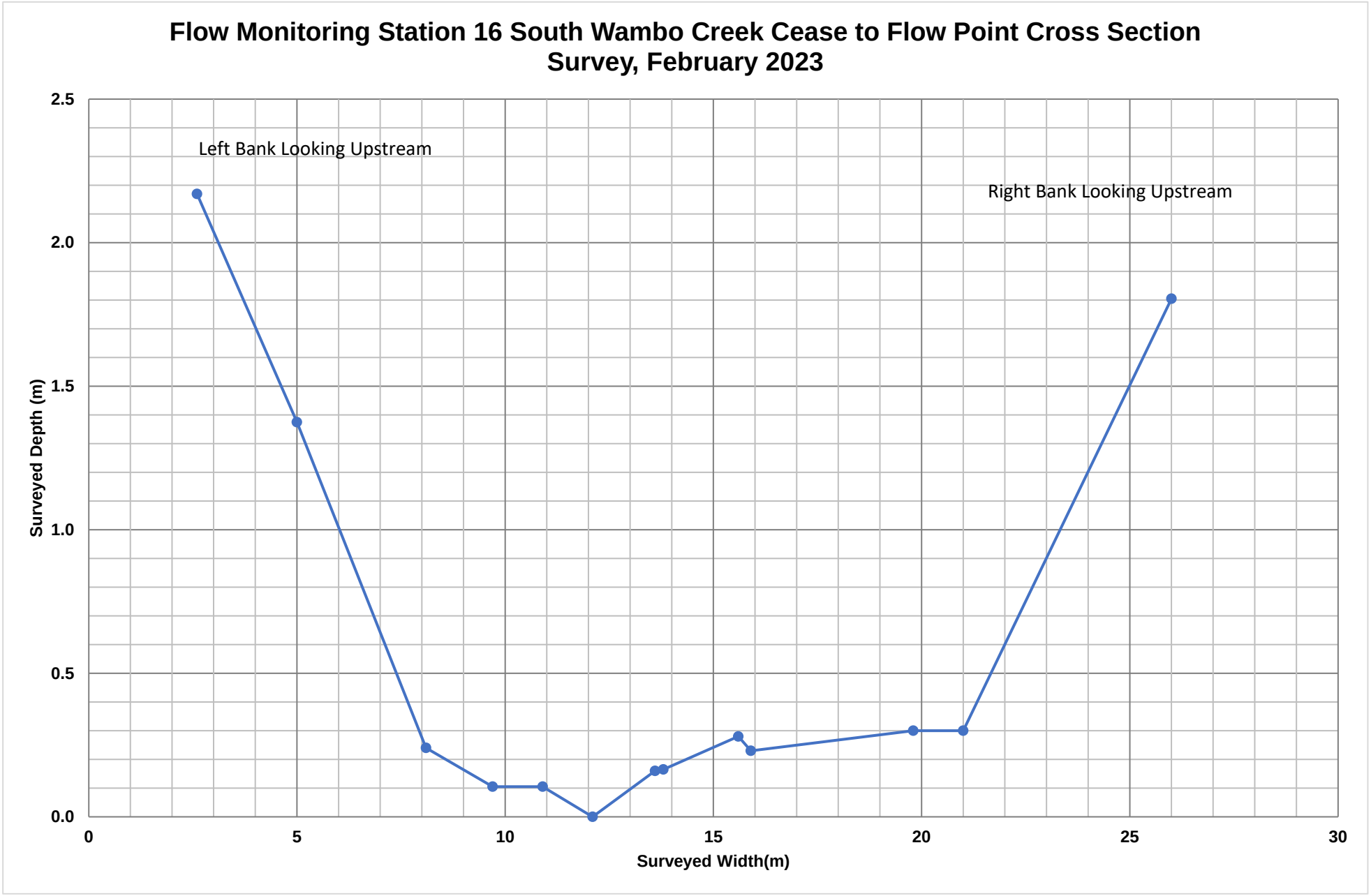

Flow Monitoring Station 15 South Wambo Creek
Cease to Flow Point Cross Section Survey
January 2024
Surveyed Width (m)
0
2
4
6
8
10
12
14
16
18
20
Surveyed Depth (m)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
Left Bank Looking Downstream
Right Bank Looking Downstream

Flow Monitoring Station 15 South Wambo Creek Long Section
Profile Through Cease to Flow Point
January 2024

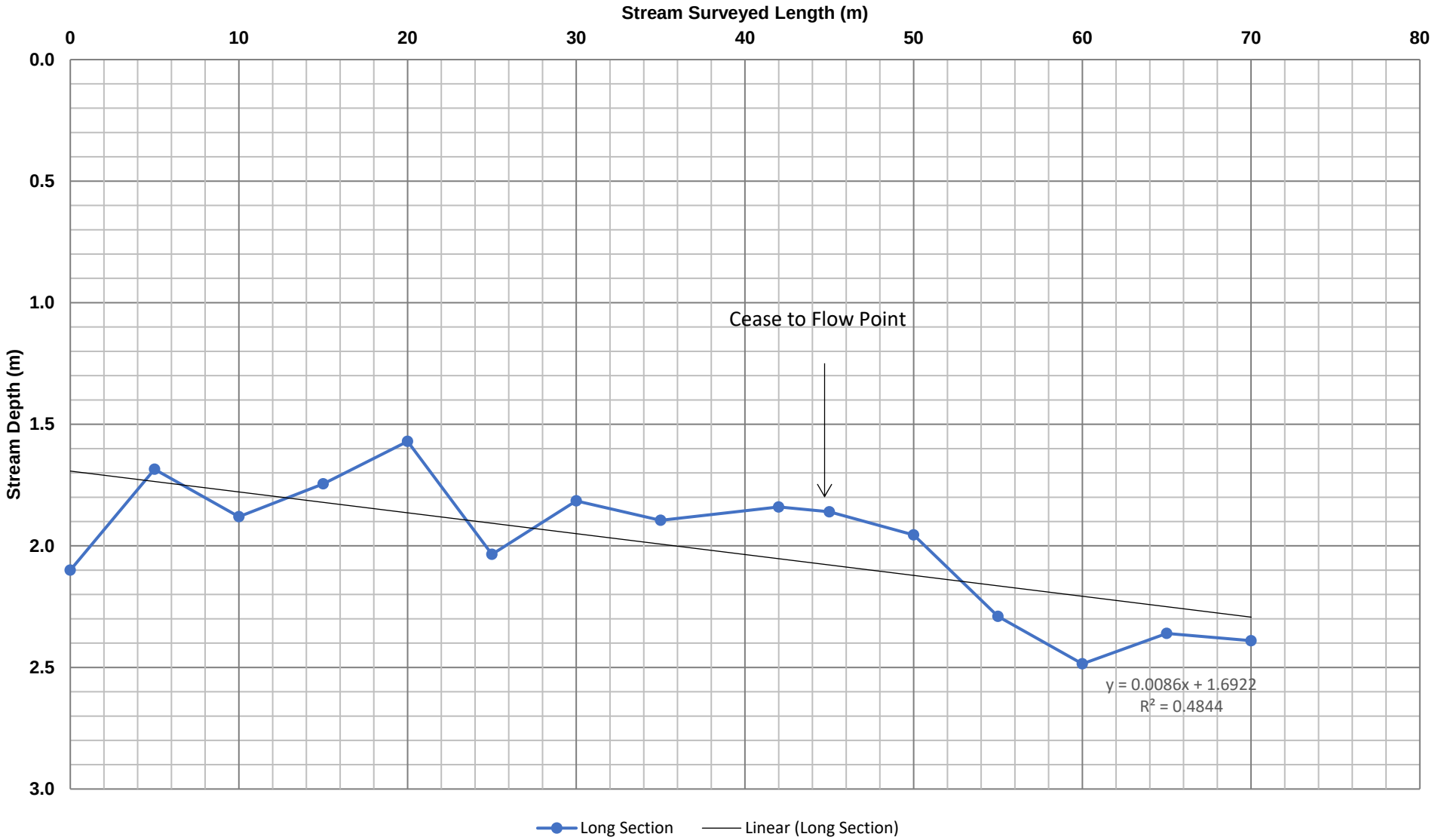


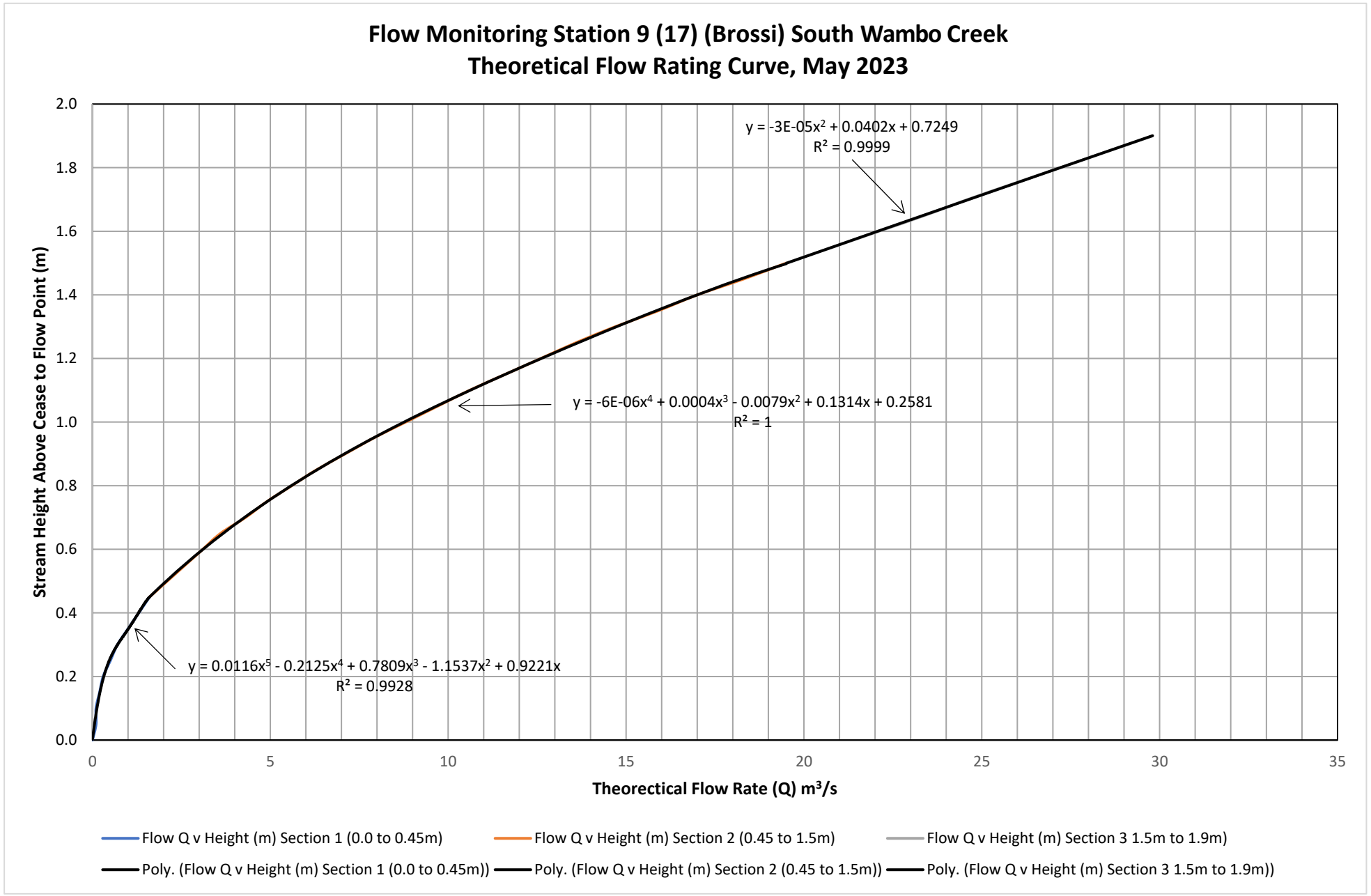
Flow Monitoring Station 16 South Wambo Creek Theoretical Flow Ratint Curve, February 2023



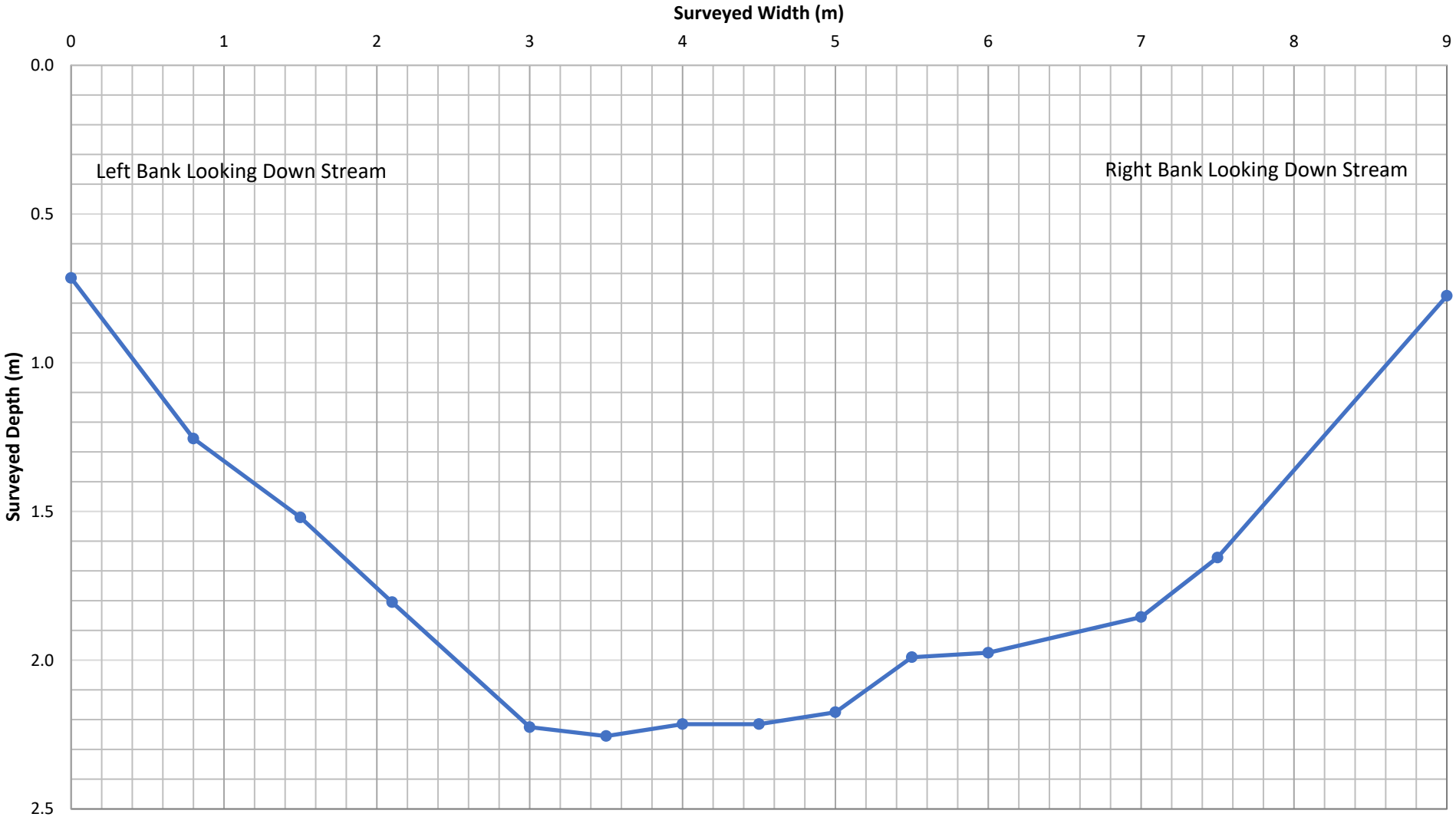

Flow Monitoring Station 16 South Wambo Creek Cease to Flow Point Cross Section Survey, February 2023
Left Bank Looking Upstream
Right Bank Looking Upstream
Surveyed Depth (m)
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
Surveyed Width(m)

Flow Monitoring Station 16 South Wambo Creek Long Section Profile Through Cease to Flow Point, February 2023

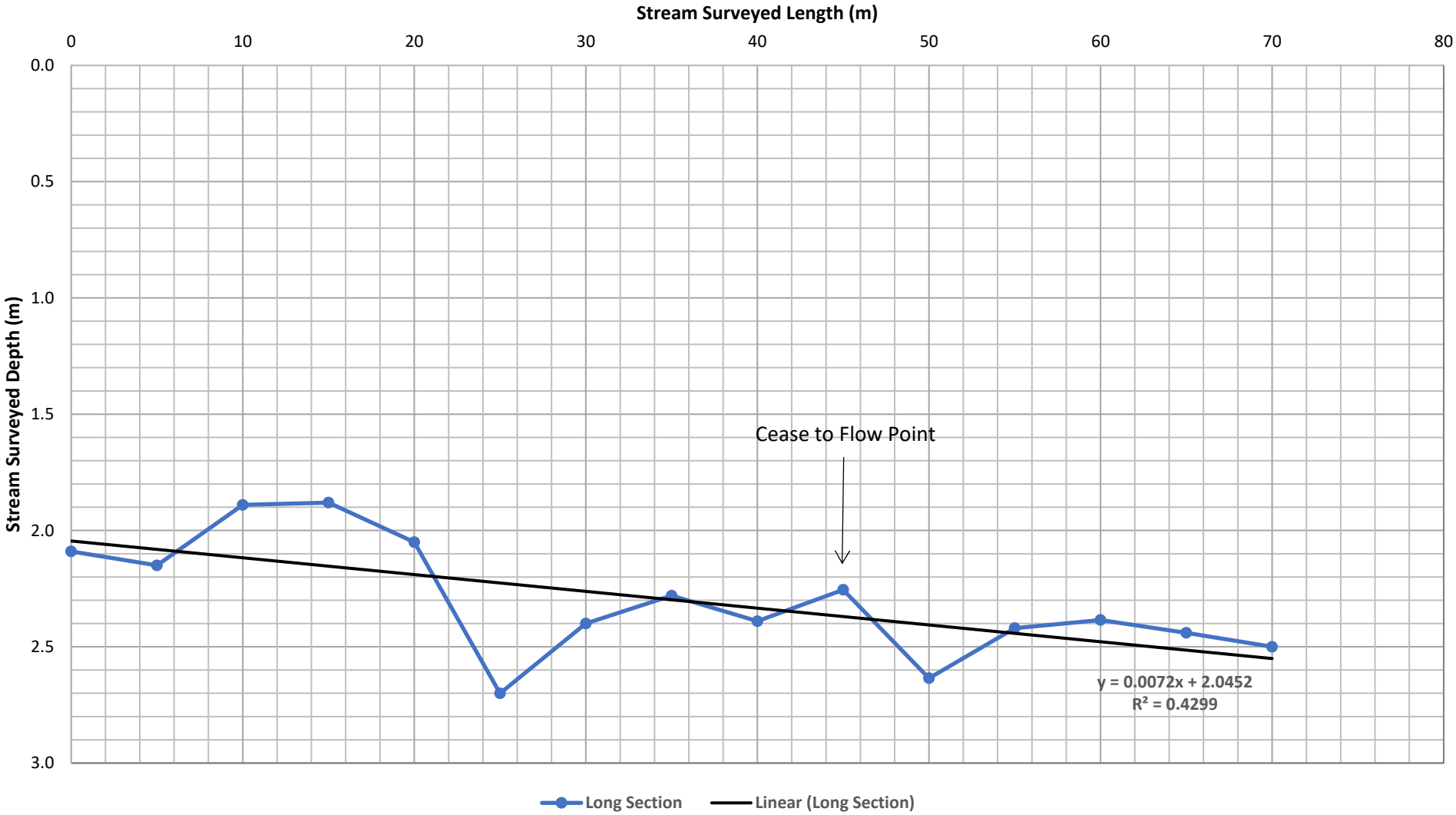



Flow Monitoring Station 9 (17) (Brossi) South Wambo Creek
Theoretical Flow Rating Curve, May 2023
y = -3E-05x² + 0.0402x + 0.7249
R² = 0.9999
y = -6E-06x⁴ + 0.0004x³ - 0.0079x² + 0.1314x + 0.2581
R² = 1
y = 0.0116x⁵ - 0.2125x⁴ + 0.7809x³ - 1.1537x² + 0.9221x
R² = 0.9928
Stream Height Above Cease to Flow Point (m)
Theorectical Flow Rate (Q) m³/s
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
0
5
10
15
20
25
30
35
Flow Q v Height (m) Section 1 (0.0 to 0.45m)
Flow Q v Height (m) Section 2 (0.45 to 1.5m)
Flow Q v Height (m) Section 3 1.5m to 1.9m)
Poly. (Flow Q v Height (m) Section 1 (0.0 to 0.45m))
Poly. (Flow Q v Height (m) Section 2 (0.45 to 1.5m))
Poly. (Flow Q v Height (m) Section 3 1.5m to 1.9m))

Flow Monitoring Station 9 (17) (Brossi) South Wambo Creek Cease to Flow Point Cross Section Survey May 2023



Flow Monitoring Station 9 (17) (Brossi) South Wambo Creek long Section Profile Through Cease to Flow Point May 2023



Appendix C

Stream Height, Theoretical Flow, Daily and Cumulative Rainfall Charts

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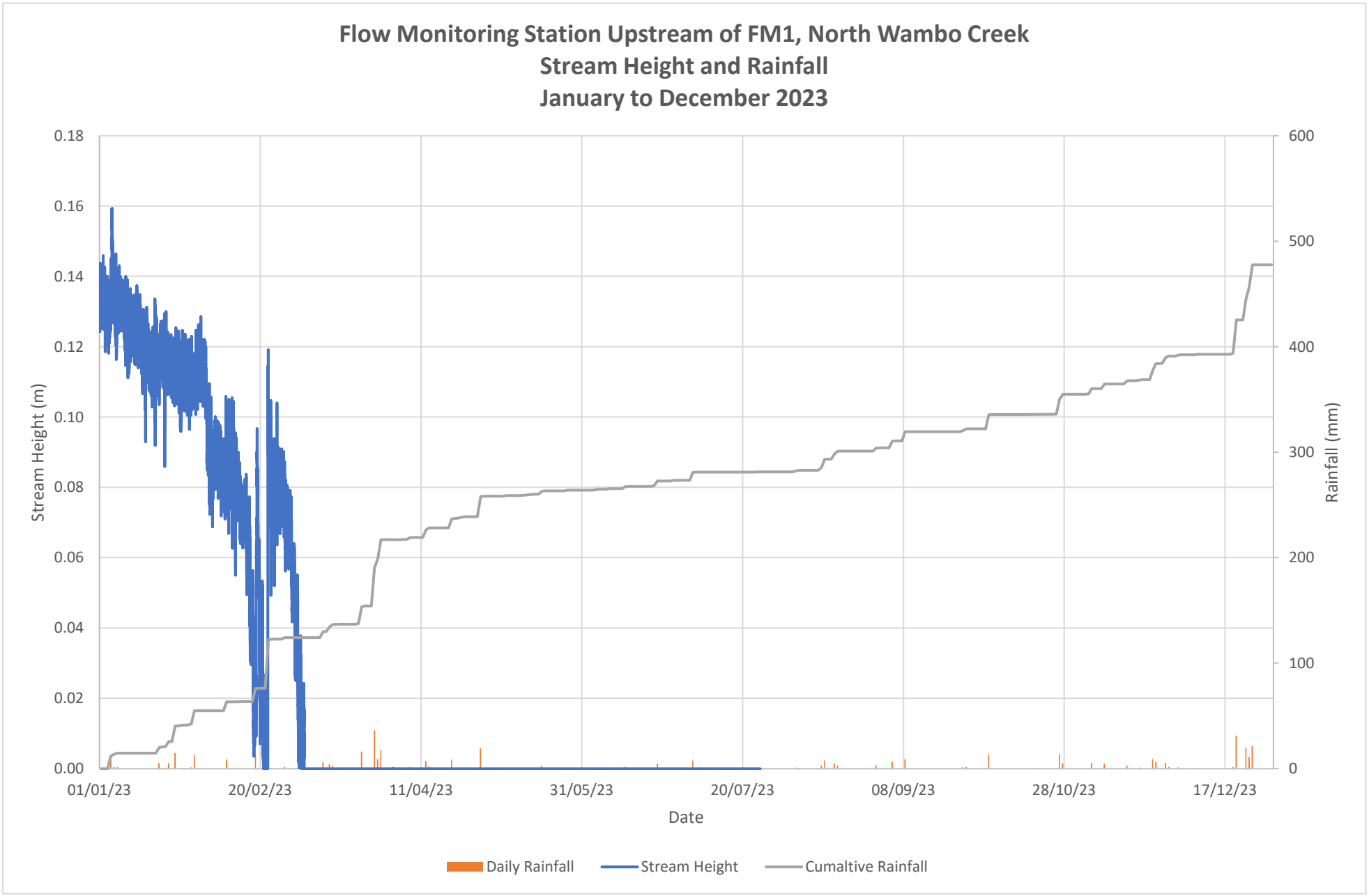
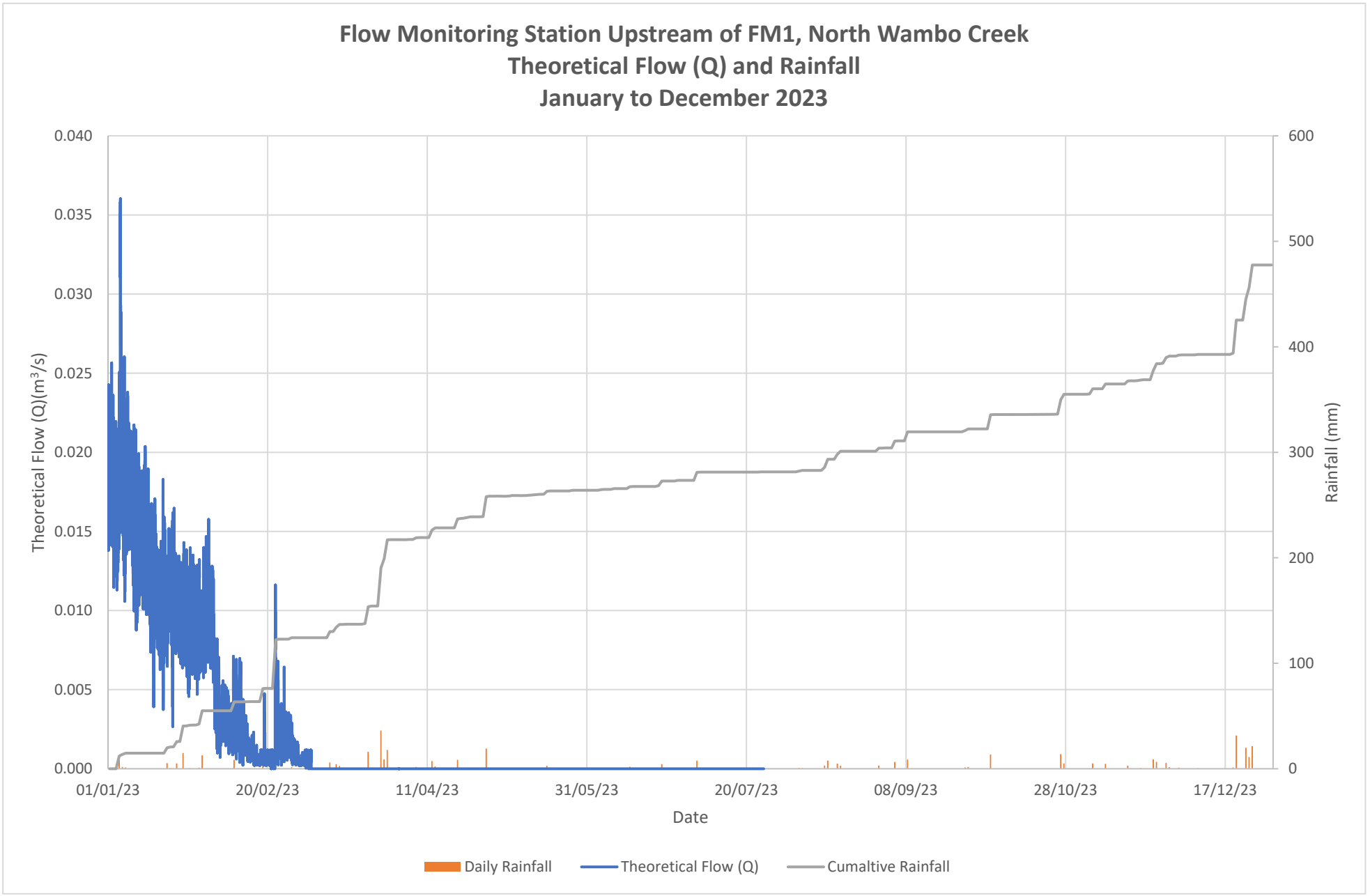
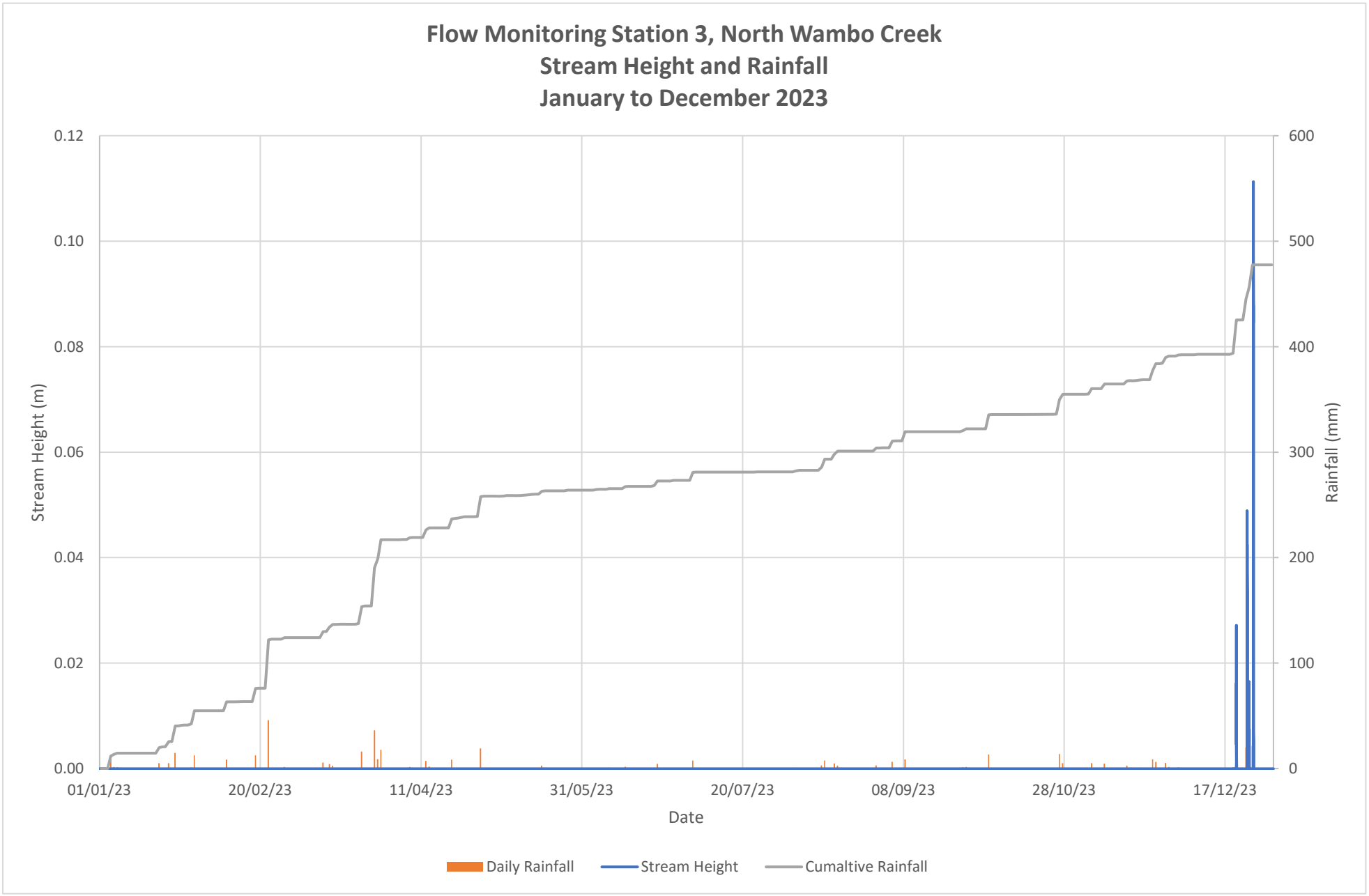
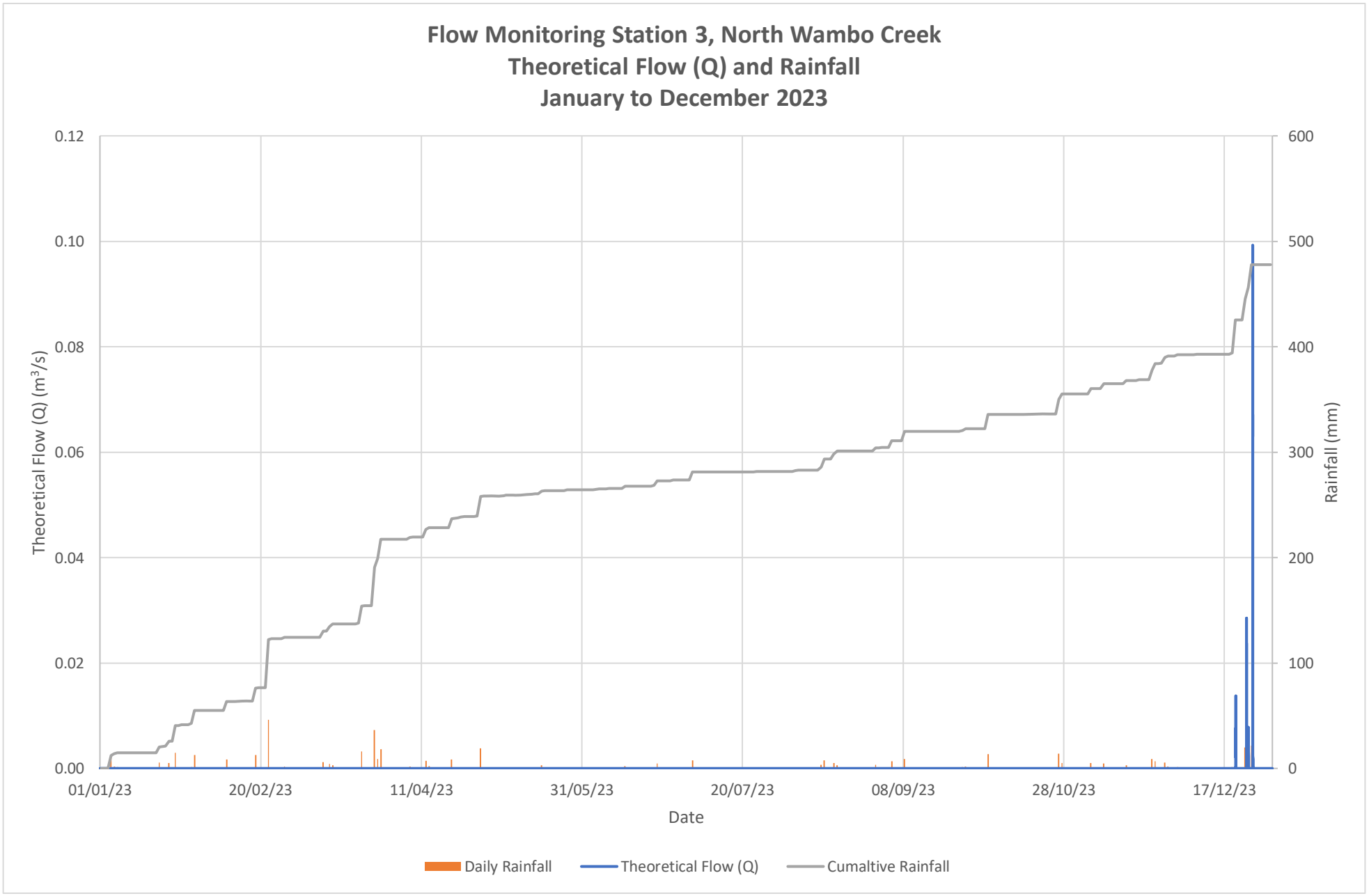
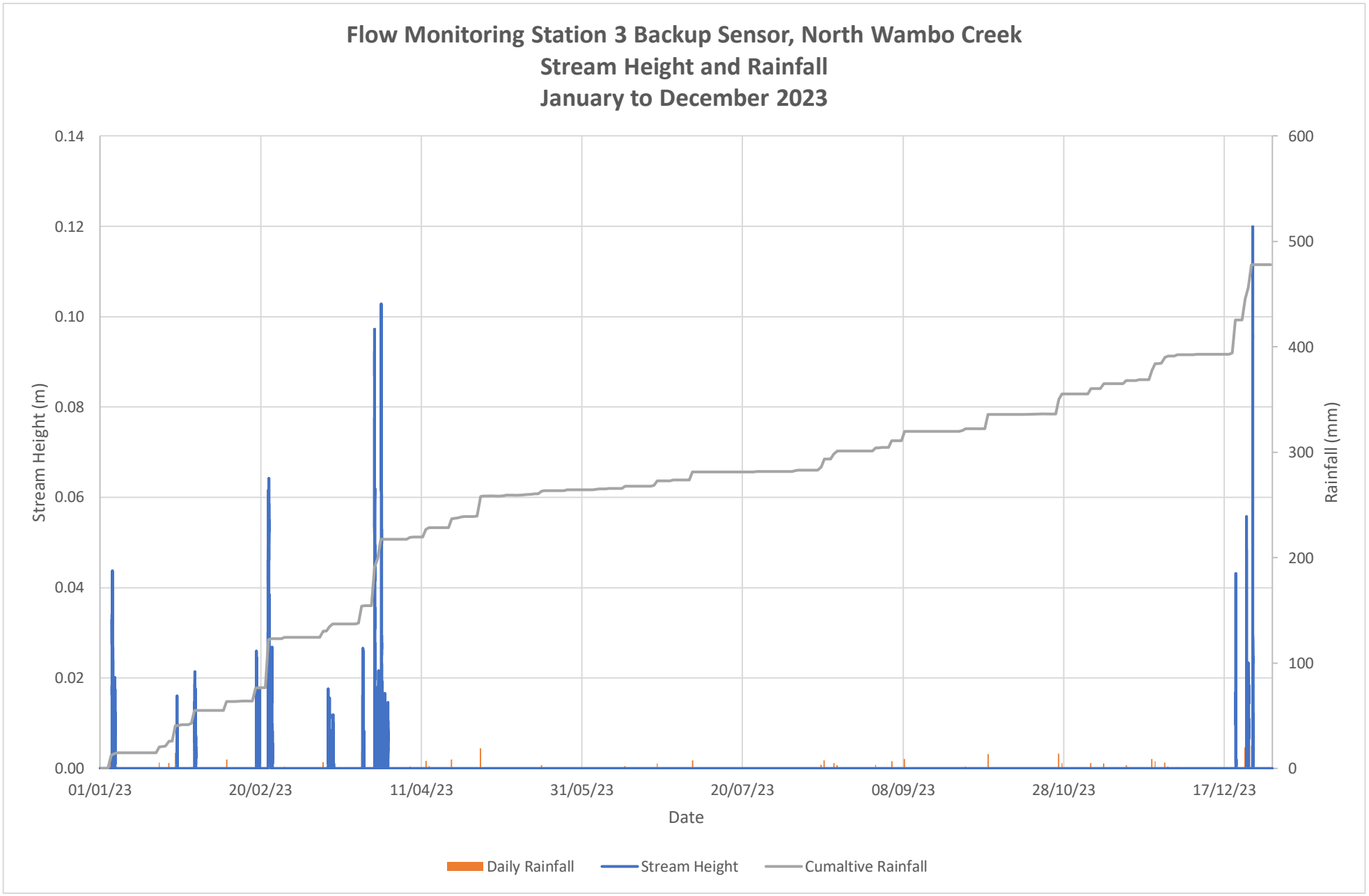
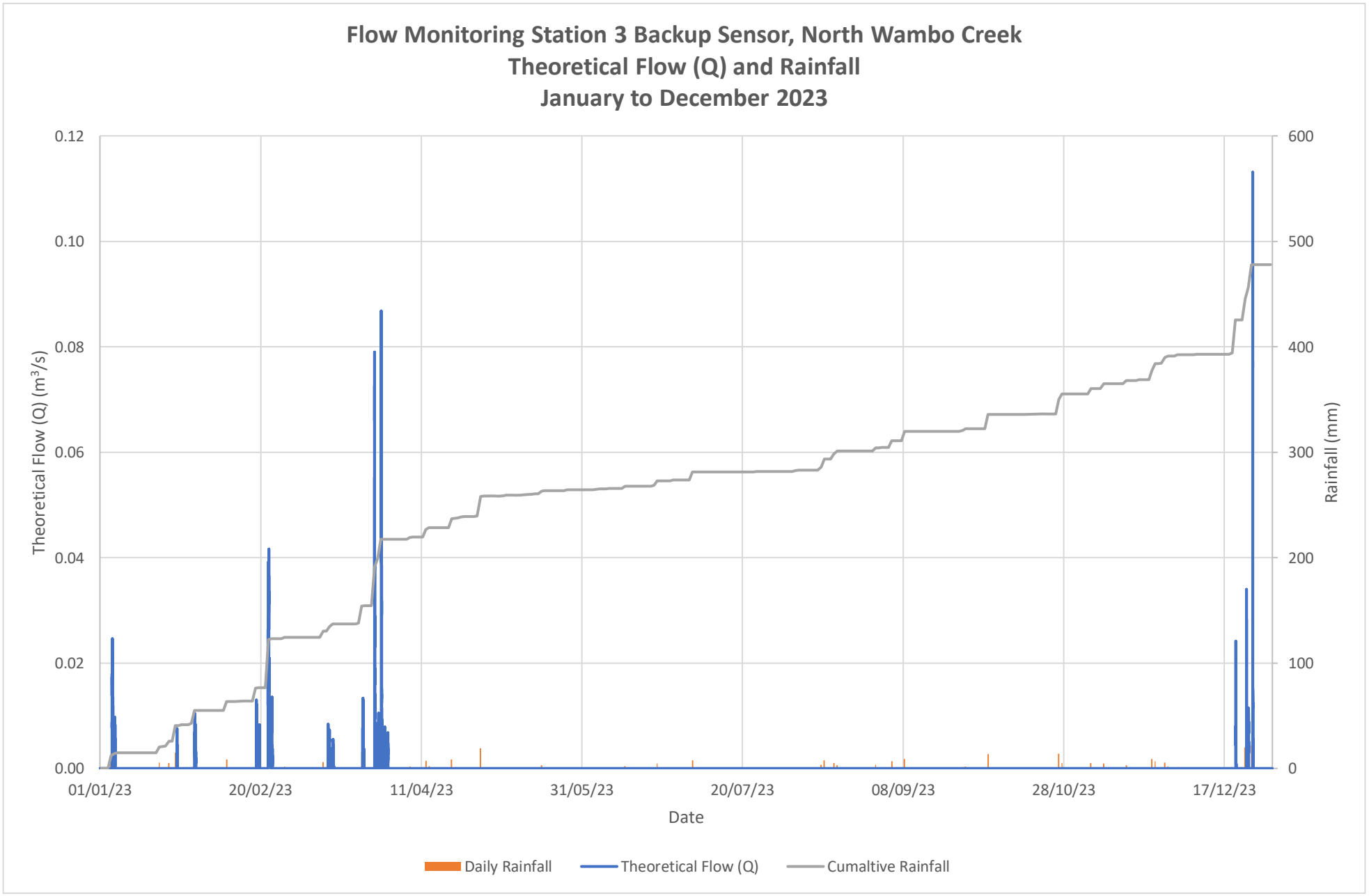

Flow Monitoring Station Upstream of FM1, North Wambo Creek
Stream Height and Rainfall
January to December 2023
Stream Height (m)
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Rainfall (mm)
600
500
400
300
200
100
0
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

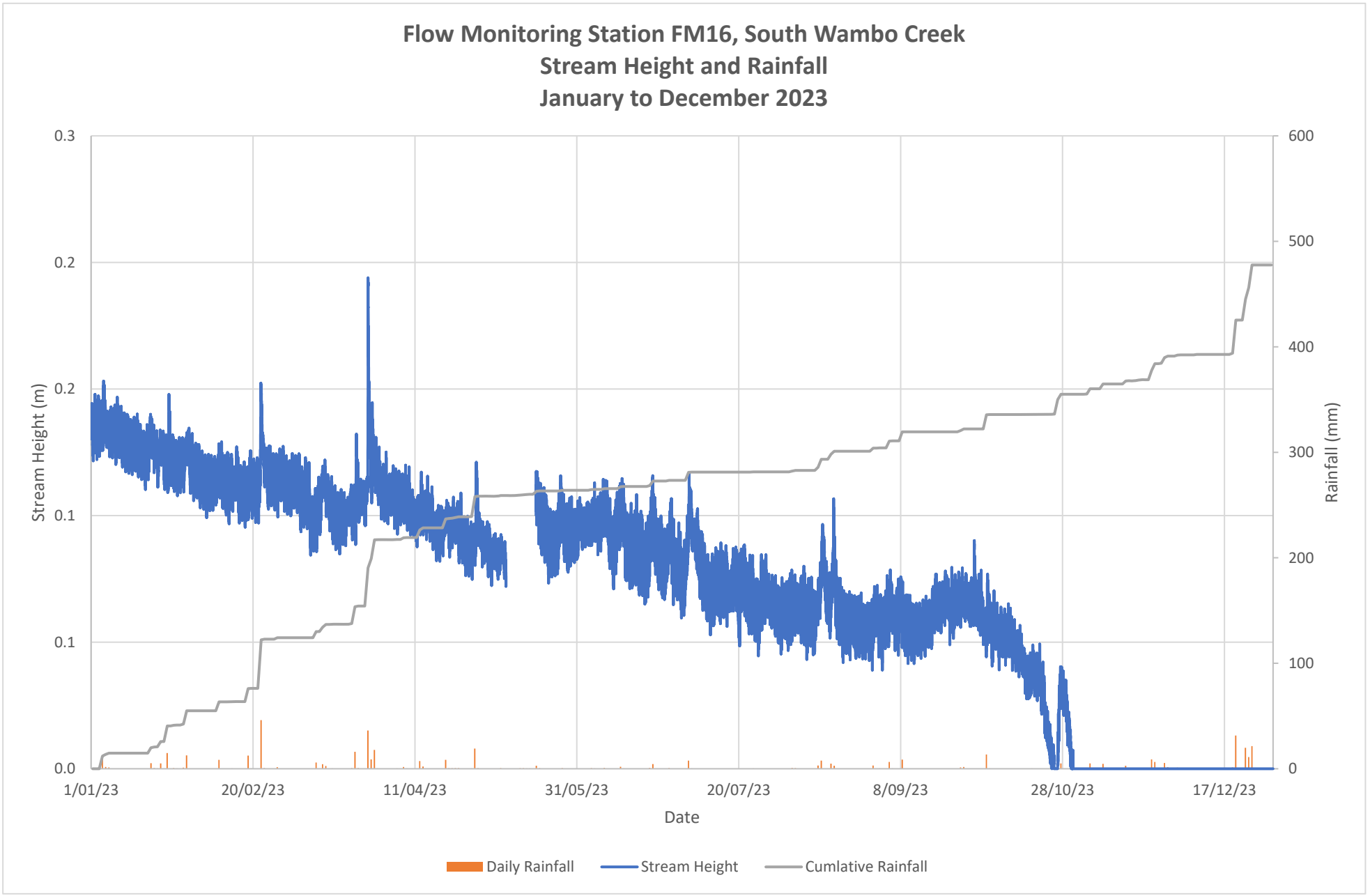

Flow Monitoring Station Upstream of FM1, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q)(m³/s)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
Rainfall (mm)
600
500
400
300
200
100
0
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

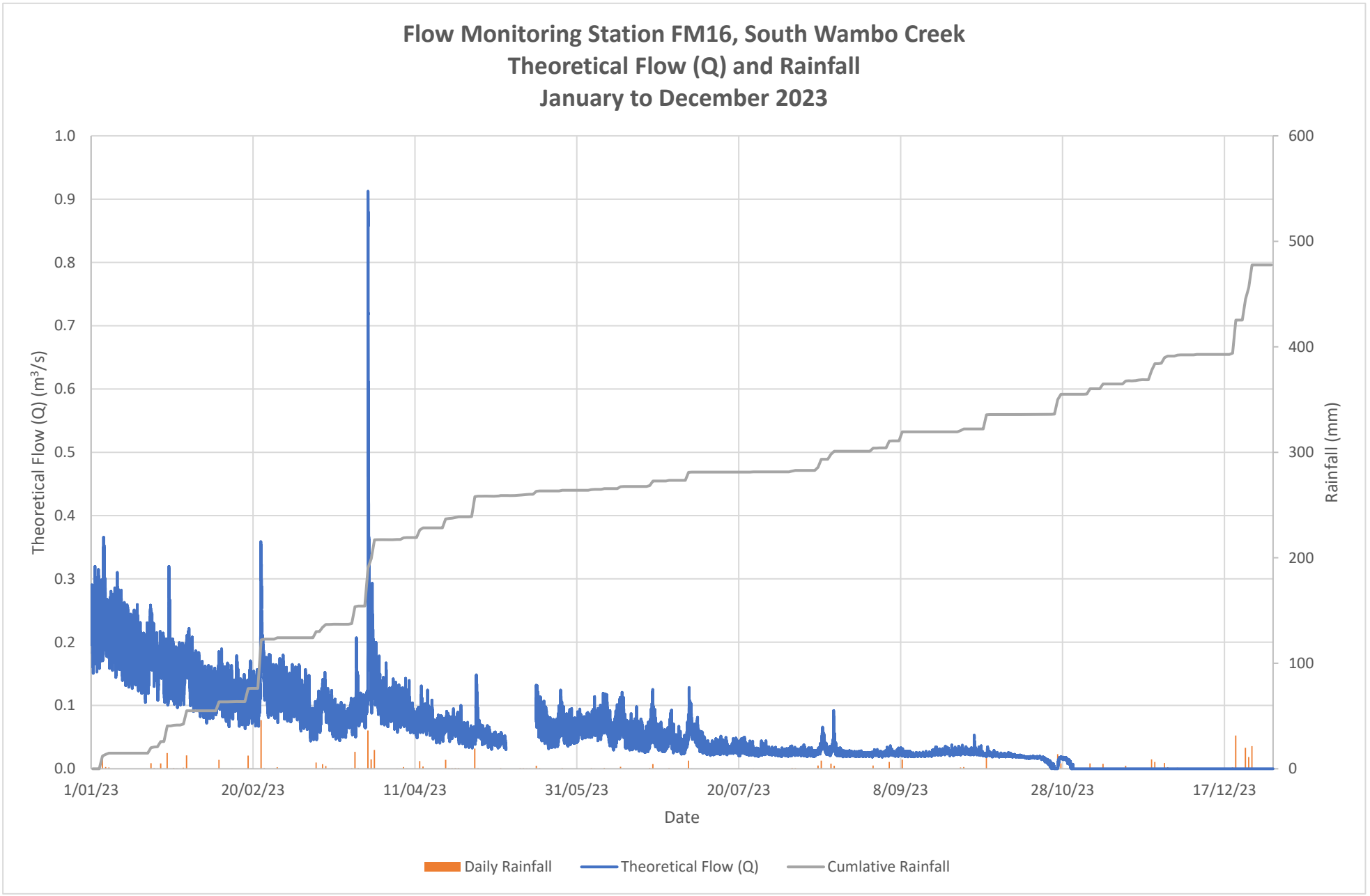

Flow Monitoring Station 3, North Wambo Creek
Stream Height and Rainfall
January to December 2023
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Stream Height (m)
600
500
400
300
200
100
0
Rainfall (mm)
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

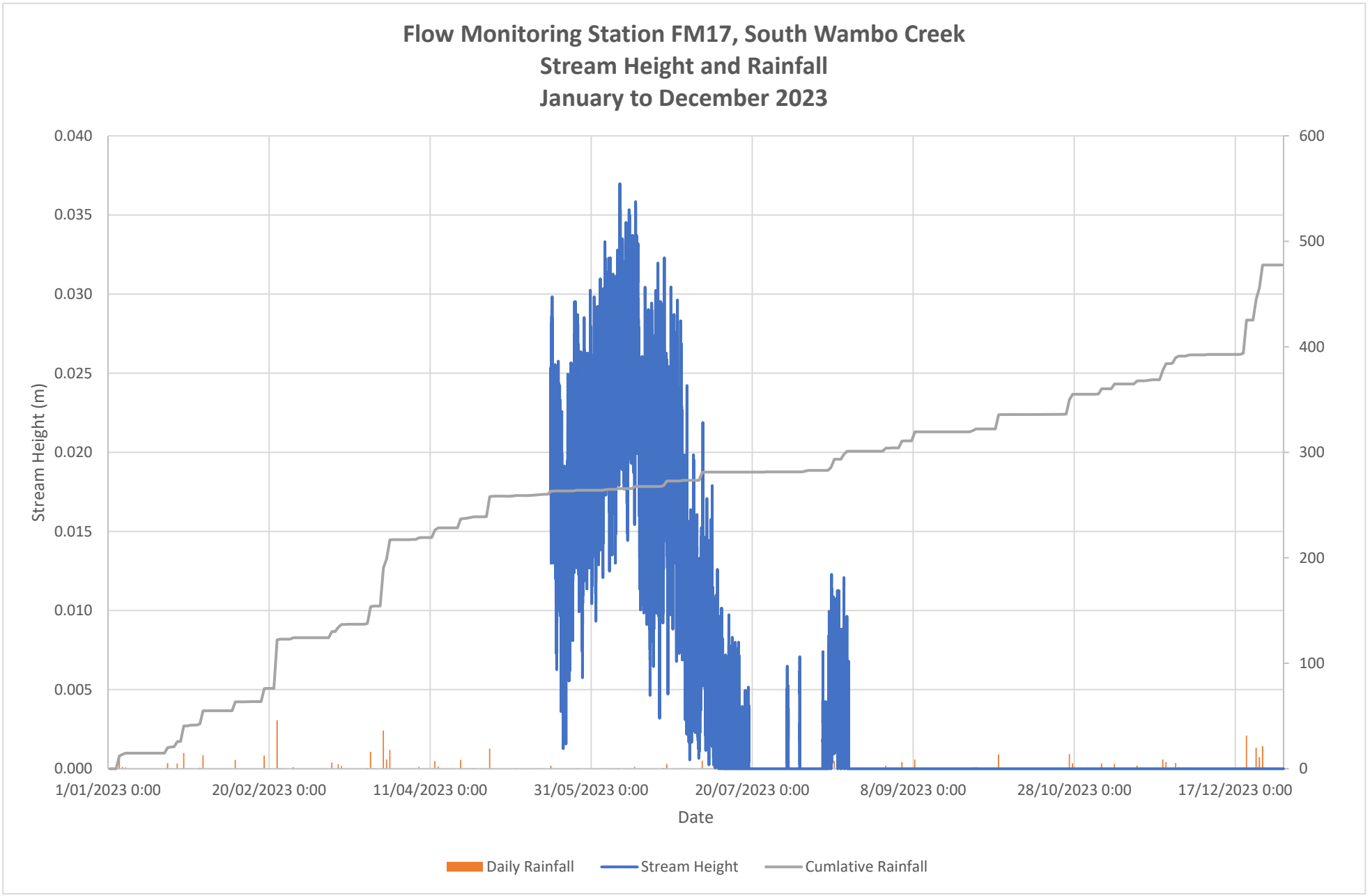

Flow Monitoring Station 3, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q) (m³/s)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Rainfall (mm)
600
500
400
300
200
100
0
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

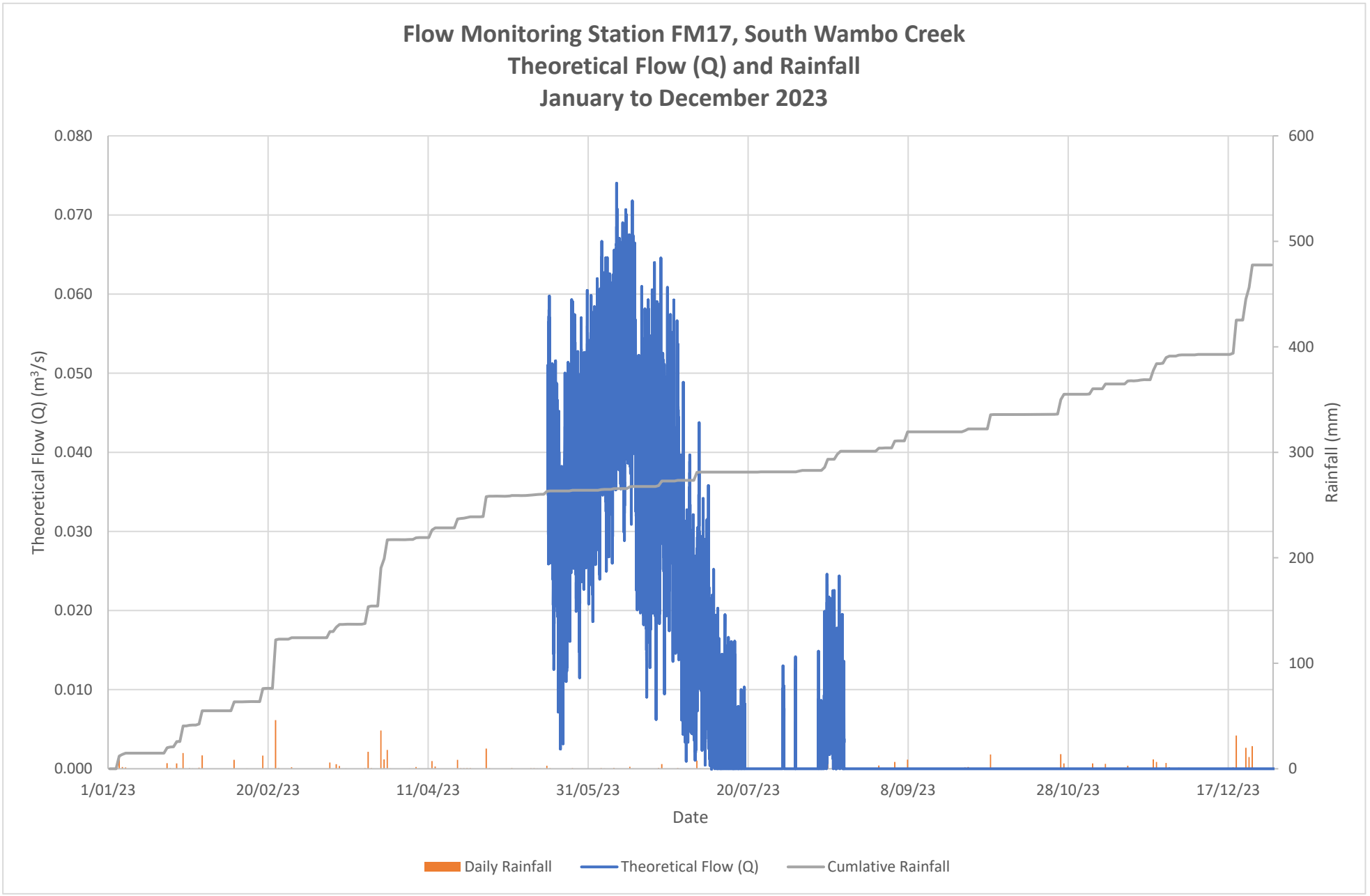

Flow Monitoring Station 3 Backup Sensor, North Wambo Creek
Stream Height and Rainfall
January to December 2023
Stream Height (m)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Rainfall (mm)
600
500
400
300
200
100
0
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

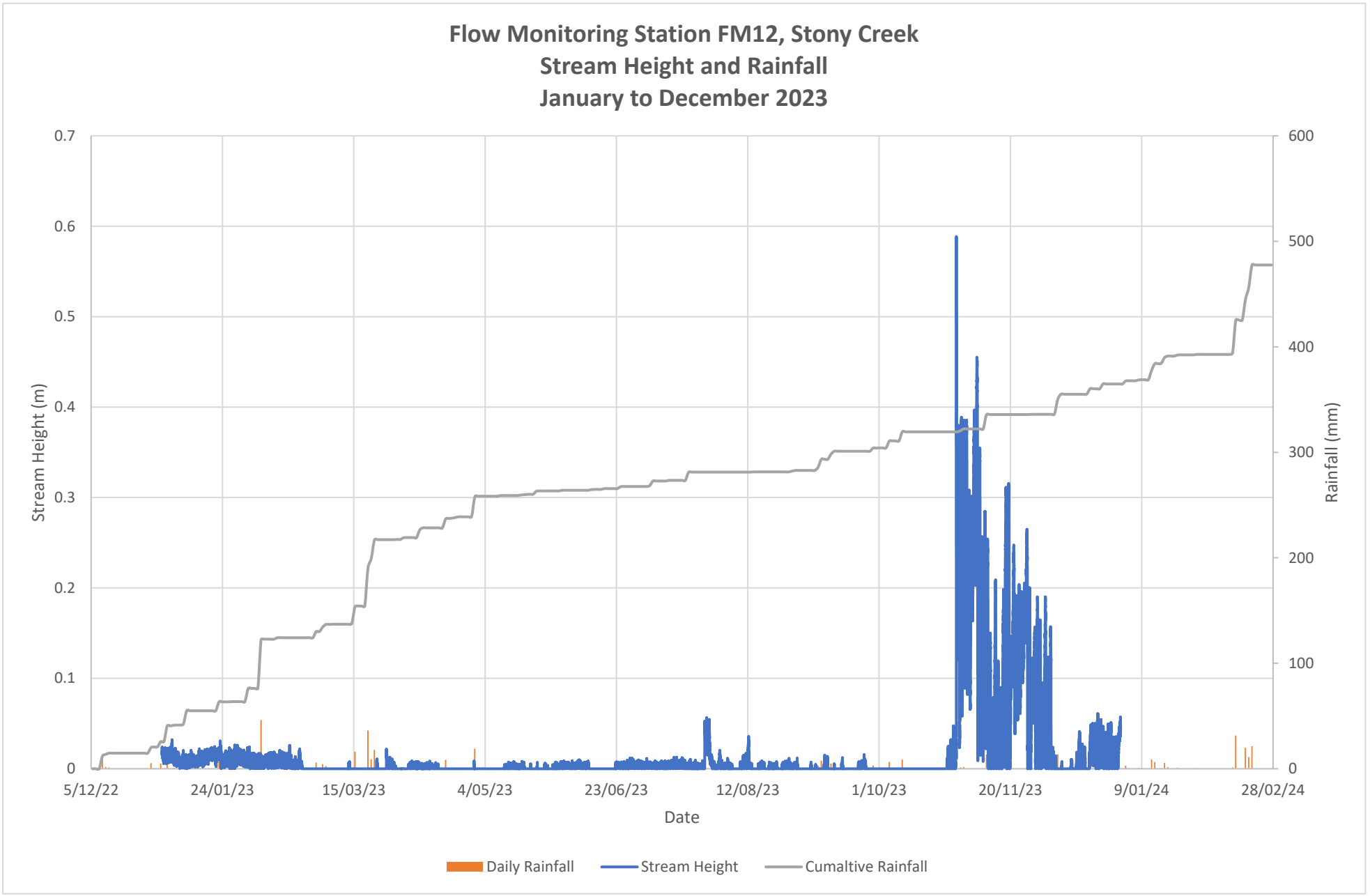

Flow Monitoring Station 3 Backup Sensor, North Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q) (m³/s)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Rainfall (mm)
600
500
400
300
200
100
0
01/01/23
20/02/23
11/04/23
31/05/23
20/07/23
08/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Theoretical Flow (Q)
Cumaltive Rainfall

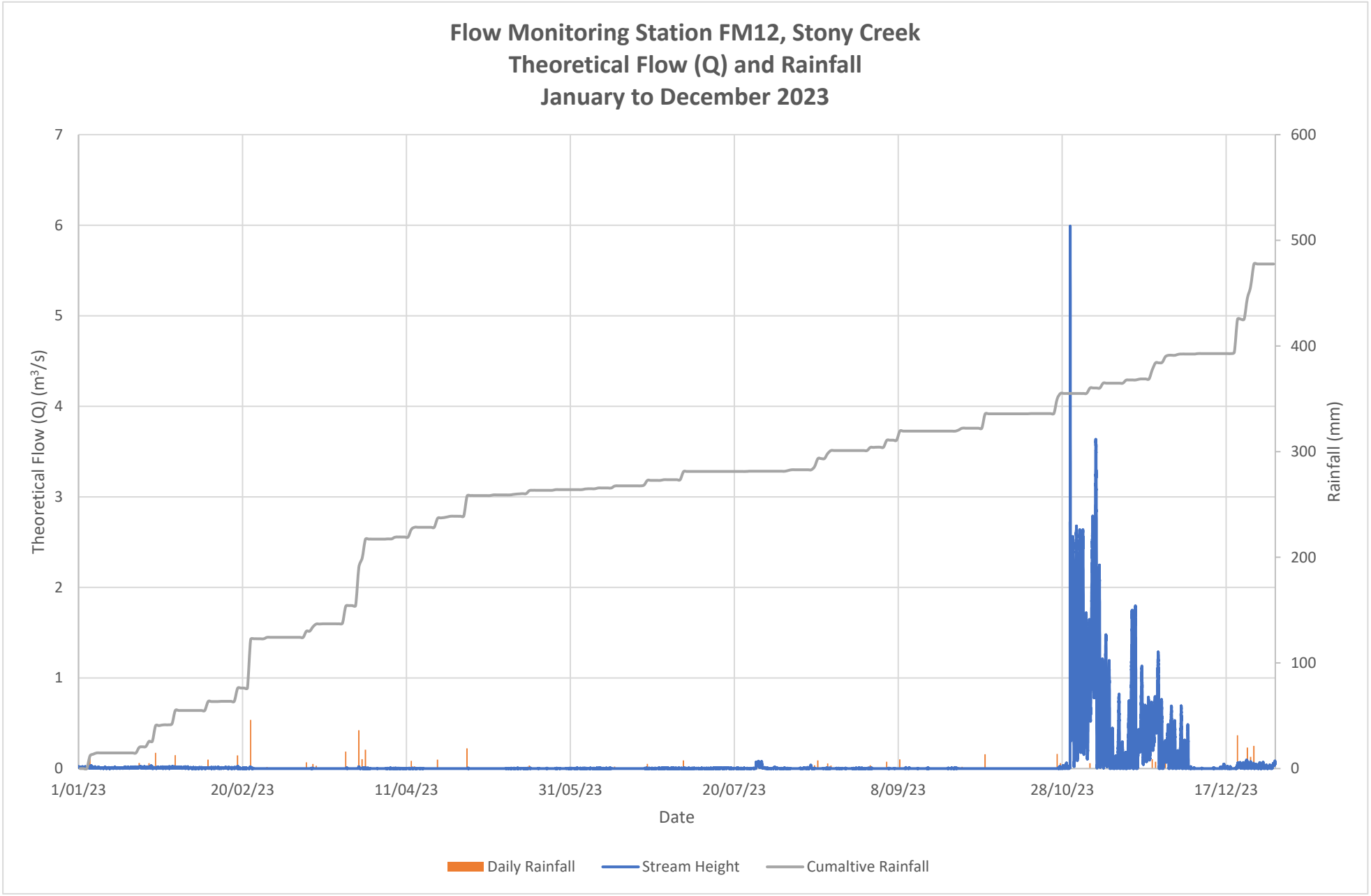

Flow Monitoring Station FM16, South Wambo Creek
Stream Height and Rainfall
January to December 2023
Stream Height (m)
0.3
0.2
0.2
0.1
0.1
0.0
Rainfall (mm)
600
500
400
300
200
100
0
1/01/23
20/02/23
11/04/23
31/05/23
20/07/23
8/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Stream Height
Cumlative Rainfall


Flow Monitoring Station FM16, South Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q) (m³/s)
Rainfall (mm)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
600
500
400
300
200
100
0
1/01/23
20/02/23
11/04/23
31/05/23
20/07/23
8/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Theoretical Flow (Q)
Cumlative Rainfall


Flow Monitoring Station FM17, South Wambo Creek
Stream Height and Rainfall
January to December 2023
Stream Height (m)
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
600
500
400
300
200
100
0
1/01/2023 0:00
20/02/2023 0:00
11/04/2023 0:00
31/05/2023 0:00
20/07/2023 0:00
8/09/2023 0:00
28/10/2023 0:00
17/12/2023 0:00
Date
Daily Rainfall
Stream Height
Cumlative Rainfall


Flow Monitoring Station FM17, South Wambo Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q) (m³/s)
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
Rainfall (mm)
600
500
400
300
200
100
0
1/01/23
20/02/23
11/04/23
31/05/23
20/07/23
8/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Theoretical Flow (Q)
Cumlative Rainfall


Flow Monitoring Station FM12, Stony Creek
Stream Height and Rainfall
January to December 2023
Stream Height (m)
Rainfall (mm)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
600
500
400
300
200
100
0
5/12/22
24/01/23
15/03/23
4/05/23
23/06/23
12/08/23
1/10/23
20/11/23
9/01/24
28/02/24
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall


Flow Monitoring Station FM12, Stony Creek
Theoretical Flow (Q) and Rainfall
January to December 2023
Theoretical Flow (Q) (m³/s)
Rainfall (mm)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
600
1/01/23
20/02/23
11/04/23
31/05/23
20/07/23
8/09/23
28/10/23
17/12/23
Date
Daily Rainfall
Stream Height
Cumaltive Rainfall

APPENDIX H
ANNUAL GROUNDWATER MONITORING REPORT

Groundwater Annual Review - 2023

Wambo Coal Mine

Wambo Coal Pty Ltd

PMB1 Singleton, NSW, 2330

Prepared by:

SLR Consulting Australia

SLR Project No.: 665.v10008.02023

21 March 2024

Revision: 2.0

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
2.0	21 March 2024	A. Skorulis	D Western	D. Western
1.0	20 March 2024	A. Skorulis	D Western	D. Western

Basis of Report

This report has been prepared by SLR Consulting Australia (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Wambo Coal Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

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Tables in Text

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Appendices

1.0 Introduction

1.1 Overview

The Wambo Coal Pty Ltd (WCPL) mining complex is located approximately 20 kilometres (km) north-west of Singleton, New South Wales (NSW). As part of compliance with mine approval conditions, routine groundwater monitoring is conducted across WCPL, and the data reviewed and analysed on an annual basis. This report presents the annual groundwater review for WCPL for the calendar year 2023, developed in accordance with the approval conditions and requirements outlined within the GWMP (Peabody, 2023). The annual groundwater review is required to:

- Compare groundwater levels and quality to trigger levels. Groundwater levels are also compared to long term rainfall trends. Modelled groundwater levels are also compared to observed levels (Sections 4.1 and 4.2 of the WCPL Groundwater Management Plan (GWMP) (Peabody, 2023)).
- Assess the volume and quality of groundwater inflow to Open Cut Pits and Underground Workings (Section 6.1.2 GWMP). Estimated inflow volumes to underground workings are also compared to model predictions.
- Report against specific performance indicators developed for assessing groundwater impacts at North Wambo Underground (NWU), South Wambo Underground (SWU), and South Bates Extension (SBX) mine areas (Sections 4.3 and 4.4 GWMP).

1.2 Scope

This report addresses the following components of the Annual Environmental Management Review (AEMR) for WCPL for the 2023 calendar year:

1 Review hydrographs for relevant groundwater monitoring bores and VWPs and assess whether trends are due to climate variations, mining, or other influences. (**Sections 5.1 to 5.3**)

2 Assess Vibrating Wire Piezometer (VWP) data quality to assist with optimization of the monitoring network. (**Section 5.6**)

3 Assess shallow monitoring bores for compliance against the groundwater level and quality performance indicators (Tables 11 and 13 of the GWMP (Peabody, 2023)). (**Section 5.5**)

4 Assess bores against relevant groundwater performance indicators defined for MOD16, and South Bates Extension (SBX) (Tables 14, and 16 of the GWMP [Peabody, 2023]). (**Section 5.5)**

5 Assess compliance with groundwater inflow assessment criteria and compliance with water licences (**Sections 7.0** and **8.0**).

6 Provision of recommendations (as required) **(Section 10.0**)10.0.

2.0 Wambo Underground Mine

The following section provides a description of the WCPL Complex and operational activity that occurred in 2023 relevant to this annual groundwater review. The general site layout is presented in **Figure 1**.

2.1 Mine Operations

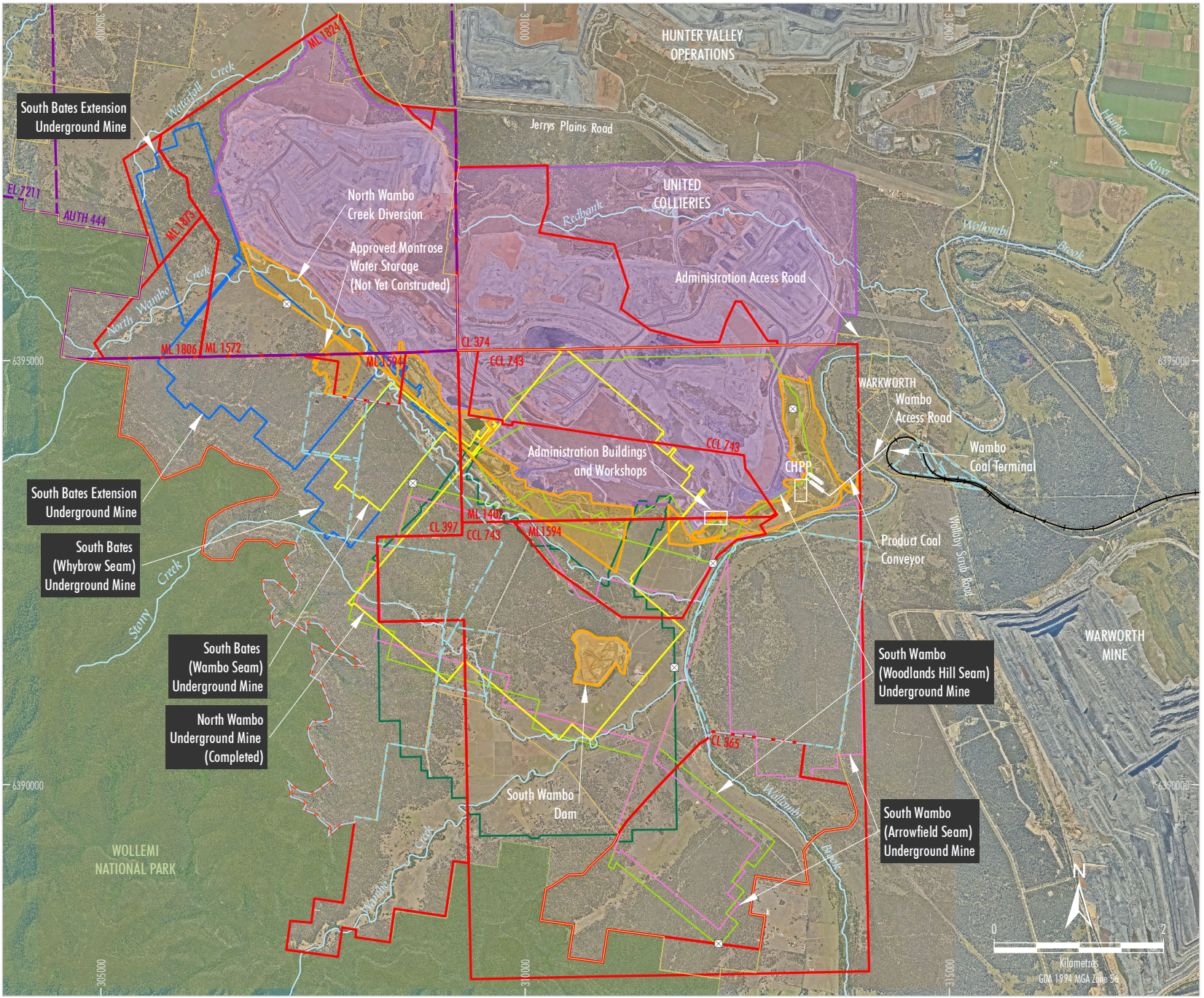
WCPL was granted development consent in February 2004 (DA 305-7-2003). The approved development described in the Project EIS and eighteen subsequent modifications extend the underground mine life until 31 August 2042. Under the most recent modification (Modification 19, determined 25 January 2023) current operations at the Wambo Mine include underground mining and coal processing and handling activities. Open cut mining activities are managed by the United Wambo open Cut Project (UWOCP).

Table 1 presents a summary of mine areas across WCPL, approved mining timeframes and activities conducted during 2023. Mining was only active at South Bates Extension Underground during 2023.

Table 1 Summary of WCPL Activities

Mine Area	Seam Mined To	Approved Life of Mining	2023Activities
North Wambo Underground (NWU)	Wambo Seam	2007 to 2015	Mining complete
South Bates Underground (SBU)	Wambo Seam and Whybrow Seam	2016 to 2018	Mining complete
South Bates Extension (SBX)	Whybrow Seam	2018 to 2024[1]	Mining of SBX longwalls: LW22- complete January 18, 2023 LW23 March 6 to November 27, 2023.
South Wambo Underground	Arrowfield and Bowfield Seam	To 2042	Not yet active

[1] based on current Extraction Plan approvals.



LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Ventilation Shaft

Underground Mining Areas

- Whybrow Seam
- Wambo Seam
- Woodlands Hill
- Arrowfield Seam
- Previous Underground Workings in Whybrow Seam

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

Source: WCPL (2024); NSW Spatial Services (2024)
Orthophoto Mosaic: WCPL (Nov 2023, May 2022)

Peabody

WAMBO COAL MINE

Existing/Approved Wambo Coal Mine General Arrangement

Figure 1

2.2 Site Groundwater Activity

Table 2 provides a summary of groundwater related site work undertaken at Wambo during 2023.

Table 2 2023 groundwater

Description	Date	Detail of works completed
Stony Creek inspection	1 February 2023	• Visual identification of seepage locations and collection of georeferenced photographs. • Collection of spatially referenced field water quality parameters.
Monitoring network maintenance	5 May 2023	• Inspection of sites flagged in the monitoring field sheets for damage. Clean up of GW27 and GW28 which were damaged by high flow in North Wambo Creek. • Damage identified at P320
Monitoring network maintenance	19-20 June 2023	• Inspect and secure surface infrastructure at GW23 (North Wambo Creek) • Repair of damaged VWP (P320) surface infrastructure.
Monitoring network maintenance	10 July 2023	• Installation of RST dataloggers and housings at DDH1234, DDH1235, and DDH1240.
Drill site inspection and network maintenance	15 August 2023	• Replacement of damaged/ leaking SBX_GW02 VWP logger housing • Verify Waterfall Creek and Wambo monitoring well site are suitably located.
Monitoring network maintenance	15 September 2023	• Decomissioning of historical bores PNWU-9A and PNWU-9B near South Wambo Dam construction. • Repair damaged surface works at GW23 and GW25 near North Wambo Creek. Locate GW33. • Download data from recently installed VWPs near SBX LWs24-26. • Inspect GW10.2 which was flagged as damaged on field sheets.
Stony Creek inspection	26 September 2023	• Inspection of Stony Creek to identify potential seepage locations and photograph stream conditions. • Installation of a pressure (water level) logger on Stony Creek, upstream of Wambo underground mining influence. • Collect field water quality measurements where possible.
Monitoring well installations	27+31 October 2023	• Installation of GW40a,b and GW41a,b near Waterfall Creek to improved understating of the alluvial and shallow groundwater systems.

Description	Date	Detail of works completed
		• Installation of GW37a,b near Wambo Creek to replace P106 and P109 which are installed across multiple aquifers

2.3 Groundwater Impacts

Groundwater impacts associated with the approved operations at WCPL have been progressively assessed for each mining area, including:

- Wambo Development Project Groundwater Impact Assessment (AGE, 2003);
- North Wambo Underground Mine Modification Groundwater Assessment (Heritage Computing, 2012);
- North Wambo Underground – Longwall 10A – Modification Assessment (HydroSimulations, 2014a);
- Wambo Coal Mine Open Cut Modification Groundwater Assessment (HydroSimulations, 2014b);
- South Bates Underground Mine Modification – Groundwater Assessment (HydroSimulations, 2015);
- South Wambo Underground Mine Modification Groundwater Assessment (HydroSimulations, 2016a):
- South Wambo Box Cut – Groundwater Assessment (HydroSimulations, 2016b);
- South Bates Extension Modification Groundwater Assessment (HydroSimulations, 2017); and
- Wambo Knowledge to inform NWC GDE Study (HydroSimulations, 2019).
- Groundwater Assessment in Support of South Bates Extension LW21-24 Extraction Plan for SBX LW21-24 EP (SLR, 2020), including an updated version of the HydroSimulations (2017a and 2019b) numerical groundwater model simulating approved mine activities.
- South Bates Extension LW24-26 Modification Groundwater Assessment (SLR, 2022c)
- Longwalls 24-26 Extraction Plan Groundwater Technical Report (SLR, 2023b)

2.4 Groundwater Licensing

Under the *Water Act 1912* and *Water Management Act 2000*, adequate water licences are required for approval of the mine developments. Groundwater licenses held for the Wambo Mining Complex, consisting of Wambo Underground and United Wambo Open Cut are detailed in **Table 3**.

Table 3 Wambo Complex Groundwater Entitlement and Licences

Licence Number	WAL Expiry Date	Entitlement
Hunter Unregulated and Alluvial Water Sources (Lower Wollombi Brook Water Source)		
WAL23897[1,2]	Perpetuity	70 unit shares
WAL18437	Perpetuity	366.9 unit shares
WAL18455	Perpetuity	200 unit shares
WAL18549	Perpetuity	100 unit shares
North Coast Fractured and Porous Rock Groundwater Sources (Sydney Basin - North Coast Groundwater Source)		
WAL42373[1,3]	Perpetuity	1,549 unit shares
WAL41532 [1,2]	Perpetuity	98 unit shares
WAL41510	Perpetuity	300 unit shares
Notes: 1. WAL = water access licence, ML/year = megalitres per year. 2. Former licence number: For WAL 23897 = 20BL167737, WAL41532 = 20BL172156 3. 6 x WALs consolidated on 20/12/18		

3.0 Hydrogeological Setting

This section presents a brief summary of the hydrogeological setting for WCPL. This includes discussion on climate, terrain, drainage, geology, and groundwater bearing units.

3.1 Climate, Terrain, and Drainage

3.1.1 Climate

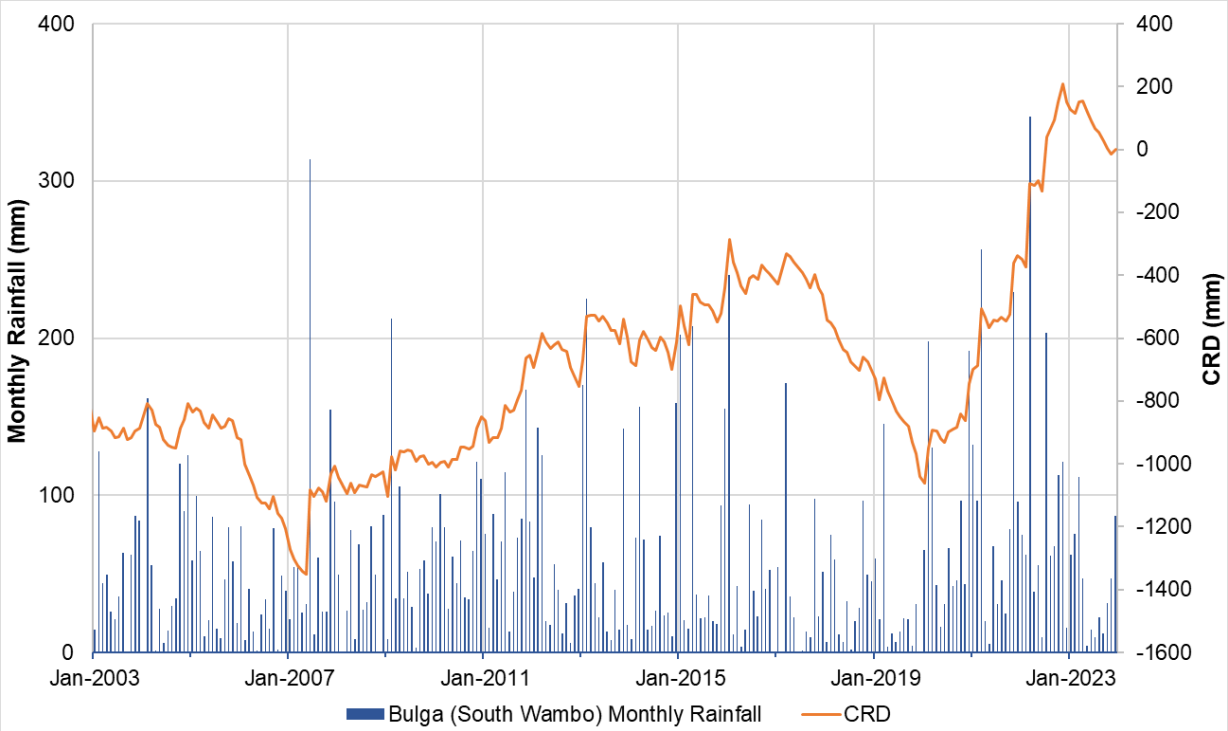
The climate of the Wambo region is temperate and characterised by hot summers and mild dry winters. Rainfall data is available from the Bureau of Meteorology (BoM), Bulga-South Wambo Station (Station: 0611191) which has been collecting data since 1959 and provides a useful dataset for assessing long term rainfall trends. **Table 4** provides the long term historical monthly average rainfall for WCPL and the 2023 monthly rainfall data. From the Bulga- South Wambo dataset, the long-term average annual rainfall is 675.5 mm. In 2023, the total rainfall was 525 mm indicating that the year was dry compared to average, with only 94.5 mm recorded in the 6 months from May to October 2023.

Table 4 Long Term Average and 2023 Climate Data

Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Average Historical[1]	85.9	85.8	75.7	45.4	39.1	43.3	33.0	34.7	38.4	55.9	64.8	73.2	675.2
2023 Rainfall	62.4	75.4	111.8	46.9	4.2	14.7	9.8	22.4	12.0	31.4	46.8	87.2	525
Excess/deficit	-23.5	-10.4	36.1	1.5	-34.9	-28.6	-23.2	-12.3	-26.4	-24.5	-18	14	-150.2
[1] Based on Bulga South Wambo dataset August 1959 to December 2023													

The cumulative rainfall departure (CRD) (**Figure 2**) graphically shows the rainfall trend relative to the long-term average. A positive (upward) slope in the CRD indicates periods of above average rainfall, while a negative (downward) slope indicates periods of below average rainfall. The CRD shows that since late 2022 and throughout 2023, rainfall has generally been below average.

Figure 2 Monthly Rainfall and CRD



3.1.2 Terrain and Drainage

WCPL is located in the Upper Hunter Valley region where landforms are characterised by gently sloping floodplains associated with the Hunter River and the undulating foothills, ridges and escarpments of the Mount Royal Range and Great Dividing Range. Elevations in the vicinity of WCPL range from approximately 60 metres Australian Height Datum (mAHD) at Wollombi Brook to approximately 400 mAHD on the nearest ridges of the hills immediately to the southwest of WCPL.

Wollombi Brook, situated immediately south-west of WCPL, flows north-east to its confluence with the Hunter River (**Figure 1**). Wollombi Brook drains an area of approximately 1,950 square kilometres (km^2) and joins the Hunter River some 4 km east of Wambo. The Wollombi Brook sub-catchment is bound by the Myall Range to the south-east, Doyles Range to the west, the Hunter Range to the south-west and Broken Back Range to the north-east (Hunter Catchment Management Trust, 2002).

The majority of lands within WCPL mining tenements drain via Wambo, Stony, North Wambo and Redbank Creeks to Wollombi Brook, while Waterfall Creek drains to the north-east directly to the Hunter River. These watercourses are generally characterised by ephemeral and semi-perennial flow regimes (Gilbert and Associates, 2003).

3.2 Geology

WCPL is situated within the Hunter Coalfield subdivision of the Sydney Basin, which forms the southern part of the Sydney-Gunnedah-Bowen Basin. The stratigraphy in the Wambo area comprises the Triassic Narrabeen Group, Permian coal measures, and more recent (Quaternary) alluvial deposits associated with major drainage pathways. Folding, faulting and igneous intrusions have affected the Permian sediments after deposition. The target

Seams for WCPL underground mining lie within the Jerrys Plains Subgroup of the Wittingham Coal Measures.

Along the Wollombi Brook, Wambo Creek, North Wambo Creek (NWC), and Stony Creek thin Quaternary alluvial deposits unconformably overlie the Permian strata. The alluvial deposits comprise surficial fine-grained sediments (i.e. sands, silts, and clays). Along major watercourses (i.e. Wollombi Brook) the surficial sediments overly basal sands and gravels that are between 7 m to 20 m thick. **Table 5** presents a summary of site geology.

Table 5 Wambo Generalised Stratigraphy

Age	Stratigraphic Unit		Description
Cainozoic	Quaternary sediments - alluvium (Qa)	Surficial alluvium (Qhb)	Shallow sequences of clay, silty sand, and sand.
		Productive basal sands/gravel (Qha)	Basal sands and gravels along major watercourses (i.e. Hunter River).
	Silicified weathering profile (Czas)		Silcrete
	Alluvial terraces (Cza)		Silt, sand, and gravel
Jurassic	Volcanics (Jv)		Flows, sills, and dykes
Permian	Whittingham Coal Measures	Jerrys Plains Sub-group (Pswj)	Coal bearing sequences interbedded with sandstone and siltstone. Coal seams (youngest to oldest) include Whybrow Seam, Redbank Creek Seam, Wambo Seam, Whynot Seam, Blakefield Seam, Glen Munro Seam, Woodlands Hill Seam, Arrowfield Seam, Bowfield Seam, Warkworth Seam, Mt Arthur Seam, Piercefield Seam, Vaux Seam, Broonie Seam and Bayswater Seam.

3.2.1 Groundwater Units

The hydrogeological regime of the Wambo area and surrounds comprises two main systems:

- Quaternary alluvial aquifers associated with Wollombi Brook, NWC, Wambo Creek, and Stony Creek; and
- Underlying Permian strata of generally low permeability and very low yielding sandstone and lesser siltstone, with low to moderately permeable coal seams which are the prime water-bearing strata within the Permian coal measures. Triassic strata, namely the Narrabeen Group, are present to the south-west of the North Wambo Underground Mine and underlie some areas of alluvium.

3.2.2 Alluvium

Groundwater flow within the shallow alluvial aquifers reflects local topography and the containment of alluvium within the low-lying drainage pathways. Evidence from temporal groundwater monitoring hydrographs (**Appendix B**) within the alluvium indicates that the shallow aquifer is responsive to rainfall recharge, and it is likely that the alluvium plays an important role in supplying recharge to the underlying Permian strata as well as, in places, contributing to baseflow of the perennial surface water features. In some areas upward or

lateral flow may occur from the Permian and Triassic rock, but downward leakage seems to be the more common behaviour.

3.2.3 Permian Coal Measures

Prior to the commencement of mining operations in the region, the piezometric surface across the Wambo area most probably reflected the topography, with elevated water levels/pressures in areas distant from the major drainages and reduced levels in areas adjacent to the alluvial lands. Historical and ongoing open cut and underground mining within the Wambo area and adjoining mining operations have significantly altered the natural regime with a regional zone of depressurisation within the Permian coal measures.

The inter/overburden sediments have low permeability which is primarily is related to secondary porosity i.e. fracture / joint spacing and aperture. Permeability of the rock units generally decreases with depth of burial as the joints tighten and become less frequent.

The permeability of the coal measures is generally low, with rock mass permeabilities typically more than two orders of magnitude lower than the unconsolidated alluvial aquifers. The most permeable horizons are the coal seams, which commonly have hydraulic conductivity one to three orders of magnitude higher than the interburden comprising mudstones, siltstones, shales, and sandstone units.

The coal seams are generally more brittle and therefore more densely fractured than the overburden and interburden strata, which causes the higher permeability. Within the coal seams, groundwater flows predominantly through cleat fractures, although there is some evidence of structure-related fracturing, and this may play an important role in groundwater flow paths.

The impact of fault structures such as the Redmanvale Fault is not known with certainty. However, it is likely that groundwater flow dynamics are complex in the vicinity of these structures.

4.0 Groundwater Monitoring

4.1 Groundwater Monitoring Program

Groundwater monitoring is conducted at WCPL in accordance with the GWMP (Peabody, 2023). The purpose of the GWMP is to monitor and manage groundwater quality and levels to detect potential impacts on surrounding groundwater users, assess the performance of the mine against the performance indicators, and to ensure that relevant legislative and policy requirements are met.

The overall objective of the GWMP is to establish a program of data collection that can be utilised to assess potential impacts of mining activities on local groundwater resources. Groundwater levels are compared to background data, EIS predictions, and historical trends as a means of assessing any WCPL related drawdown impacts to local aquifers.

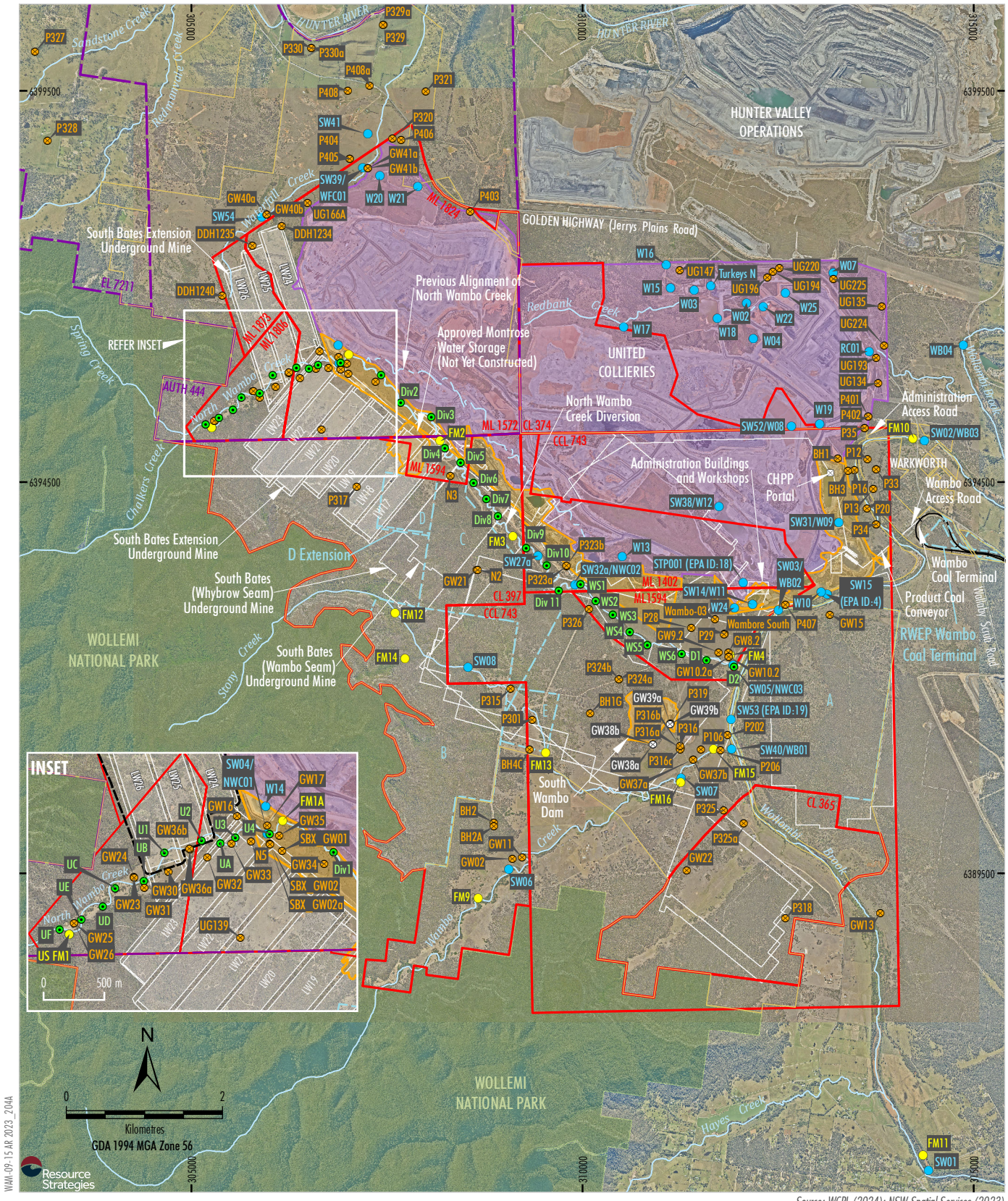
Ongoing groundwater monitoring requirements at WCPL are as follows:

- Groundwater monitoring above and in close proximity to mine workings;
- Monitoring of potential groundwater leakage from alluvial aquifers;
- Monitoring of groundwater inflows to underground and open cut mining operations; and

The monitoring programme at WCPL also assesses the quality of groundwater against background data and historical trends. Bi-monthly monitoring of groundwater levels, pH, and EC is undertaken at all standpipe bores included in the groundwater monitoring program. Comprehensive analysis of major ions is conducted at each standpipe bore annually.

Standpipe and vibrating wire piezometers within the current WCPL monitoring network are tabulated in **Appendix D** and shown on **Figure 3**.

DRAFT



Source: WCPL (2024); NSW Spatial Services (2023)
Orthophoto Mosaic: WCPL (Nov 2023, May 2022)

LEGEND

- National Park
- SSD 7142 Operational Area #
- WCPL Owned Land

Wambo Coal Mine

- Exploration Licence Boundary (AUTH, EL)
- Mining and Coal Lease Boundary (ML, CL, CCL)
- Remnant Woodland Enhancement Program (RWEP) Area
- Existing/Approved Wambo Coal Mine Surface Development Area
- Existing/Approved Underground Development

Monitoring Sites

- Groundwater Monitoring Sites
- Proposed Groundwater Monitoring Sites
- Surface Water Flow Monitoring Site
- Surface Water Quality Monitoring Site
- Diversion and Subsidence Monitoring Site

Under Phase 2 of mining at Wambo Coal Mine (commenced 1 December 2020), this area is operated by United Collieries Pty Ltd under the United Wambo Joint Venture Project.

Peabody

WAMBO COAL MINE

Location of Surface Water and Groundwater Monitoring Sites

Figure 3

WAM-09-15 AR 2023_204A

4.2 Groundwater Monitoring Compliance Criteria

The annual groundwater monitoring data review is undertaken with reference to specific compliance criteria (trigger levels - **Table 6**), and an assessment of the data against specific performance criteria set out in groundwater (**Table 7** and **Table 8**).

4.2.1 Groundwater Trigger Levels

Trigger levels are used to initiate investigations into shallow (primarily alluvium) groundwater levels or groundwater quality at WCPL when they stray beyond anticipated bounds.
The trigger levels specified in the WCPL Groundwater Monitoring Program (Peabody 2020), are based on statistical analysis of pre-mining (i.e. baseline) monitoring data.

Trigger levels for groundwater level, EC and pH are presented in **Table 6**. The trigger for groundwater levels and pH occurs when two consecutive bi-monthly observations exceed or fall below the maximum / minimum trigger levels. Triggers for EC occur when three consecutive bi-monthly observations (a 6-month period) exceed the specified trigger value.

As per the GWMP, several the bores (presented in Table 12 of the GWMP) are no longer assessed against groundwater trigger levels, namely: P106, P114, P116, P202, P206, P301, GW02, GW11, GW12, and GW13. Detailed justification for this is provided in Table 12 of the GWMP (Peabody, 2023).

Future updates to the GWMP could consider the development and inclusion of trigger levels at operationally relevant sites on North Wambo Creek (upstream of the diversion) and Waterfall Creek.

Trigger exceedances and analysis for the 2023 monitoring period are presented in **Section 5.4**.

Table 6 Groundwater Level and Groundwater Quality Trigger Levels (Peabody, 2023)

Bore	Monitoring	Minimum (10th percentile)		Maximum (90th percentile)		Groundwater Quality		
		Depth to Groundwater (mbtoc)[4]	Level (mAHD)	Depth to Groundwater (mbtoc)	Level (mAHD)	EC (µS/cm)	pH Min	pH Max
P301	Stony Creek Shallow Permian	N/A				9200	6.1	7.2
P315[1]	Stony Creek Alluvium	N/A				552	6.0	7.4
GW08.2[2]	NWC (d/s) Alluvium	ND				ND		
GW09.2[2]	NWC (d/s) Alluvium	ND				ND		
GW10.2[2]	NWC (d/s) Alluvium	ND				ND		
P109[3]	Wambo Creek Alluvium	4.6	57.8	6.7	55.7	695	6.5	7.6
GW15	Wollombi Brook Alluvium	10.4	52.0	11.1	51.3	730	6.7	7.2
P16	Wollombi Brook Alluvium	7.1	50.4	7.8	49.7	10832	7.0	7.7

Bore	Monitoring	Minimum (10th percentile)		Maximum (90th percentile)		Groundwater Quality		
		Depth to Groundwater (mbtoc)[4]	Level (mAHD)	Depth to Groundwater (mbtoc)	Level (mAHD)	EC (µS/cm)	pH Min	pH Max
P20	Wollombi Brook Alluvium	7.1	50.3	8.2	49.2	10625	7.0	7.6

N/A = Not applicable

ND = Not defined, due to Insufficient data at present

[1]P315 was dry prior to NWU mining activity. Therefore, a specific depth to water trigger is not appropriate to indicate Wambo mining impacts. Data will be reviewed as part of the Annual Review to determine whether there are changes in groundwater level that can be attributed to Wambo mining activity.

[2]GW08.2, GW09.2 and GW10.2 have been installed as replacement bores to GW08 and GW09. Establishing trigger levels for these bores will be considered following the collection of baseline data and also informed by model predictions.

[3] Monitoring ceased at P109 in 2022 and was not assessed against trigger levels for that year. Monitoring recommenced in 2023 and will be compared against data from replacement bore (GW37b) in the future.

[4]metres below top of casing (mbtoc)

4.2.2 Groundwater Performance Criteria

The current GWMP, published in November 2023 (Peabody, 2023) includes three sets of performance indicators relevant to groundwater (**Table 7** and **Table 8**), the first set are performance indicators relevant to general water management performance (GWMP – Table 14). The second and third sets are specific performance indicators to monitor the subsidence impact for North Wambo Underground (GWMP – Table 15) and South Bates Underground and Extension longwalls (GWMP – Table 16) respectively.

The NWU extraction plan is no longer current and has been superseded by the South Bates Underground Extraction Plan. Table 15 was updated from a previous version of the GWMP (2020) to indicate where the relevant performance indicators are now assessed, and which are no longer relevant and only performance indicators relevant to this annual review are considered.

An assessment of compliance with performance indicators relevant to groundwater (**Table 7** and **Table 8**) is presented in **Section 5.5**.

Table 7 Performance Indicators

Feature	Performance Indicator
Groundwater Management Performance Indicators	
Alluvial aquifers (including Wollombi Brook alluvium and excluding the NWC alluvium)	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: • A greater than negligible change in groundwater levels; • A greater than negligible change in groundwater quality; and • A greater than negligible impact to other groundwater users.
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: • Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c); and • Channel stability is not maintained or improved

Table 8 Subsidence Performance Indicators for Groundwater

North Wambo Underground Performance Indicators
• The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergences away from the modelled groundwater.
South Bates Underground and South Bates Extension Underground Performance Indicators
• The performance indicators will be considered to have been exceeded if the groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (Table 11 of the GWMP). • The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (Table 13 of the GWMP). • The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.

5.0 Monitoring Results

A summary of the groundwater level data for each of the main water bearing units is provided below together with a review of electrical conductivity (EC) and pH (see **Appendix B** for plots). Performance against trigger levels prescribed in the GWMP (Peabody, 2023), is presented in **Section 5.4**.

Data from monitoring bores at key sites has been reviewed to identify potential impact:

- Alluvium (Section 5.1);
- Regolith – Weathered Shallow Strata (Section 5.2);
- Permian Coal Measures (Section 5.3).

SLR has reviewed the groundwater monitoring data collected in 2023 prior to the evaluation of groundwater level and quality trends. This included the review of field sampling sheets and communication with the contractor commissioned to collect the data. This review has found that groundwater data collected from the WCPL monitoring network in 2023 has been collected consistent the requirements of the GWMP (Section 6.1 - Peabody, 2023), and is suitable for the purposes of this annual review.

5.1 Alluvium

Table 9 summarises groundwater level and quality trends for Wambo alluvial monitoring locations.

Table 9 2023 alluvial groundwater trends

Alluvial Aquifer	Reach/ Area	Monitoring bores	2023 Groundwater Observations and Likely Causes	Comment
Wambo Creek Alluvium	Upstream	GW02, GW11	Below average rainfall in 2023 has led to gradual groundwater level decline within the Wambo Creek Alluvium bores. pH was generally observed as stable throughout 2023, while EC showed some decline.	Limited access to bores during year – observations available from August to December 2023. It is noted that GW02 and GW11 are former landholder wells with pumping equipment installed/ nearby. Replacement monitoring-only sites are recommended by SLR.
	Downstream	P106, P316a, GW37a		A replacement site for P106 was installed in October 2023 as previously recommended (GW37a), targeting the Wambo Creek alluvium. Monitoring should continue at P106 for a period of 12-months so that observations can be compared to recently installed GW37a.
North Wambo Creek Alluvium	Upstream	GW23, GW25	Below average rainfall and lack of North Wambo Creek flow events in 2023 has most likely led to declining groundwater levels within the North Wambo Creek Alluvium bores with many dry for some or all of 2023. EC was stable at some site while increased late in 2023 at others (GW36a), while pH was generally stable at sites where data was able to be collected.	SBX Longwall 23 extraction was also completed in 2023 near North Wambo Creek alluvial monitoring locations. There are no clear trends at these locations that indicate a mining effect is causing groundwater level declines additional to what would be expected from low- flow and dry conditions. However, this mining activity should be considered when reviewing future monitoring data. Particularly the level and period of saturation in response to high rainfall and flow events.
	Central Upper	GW28, GW30, GW32, GW33, GW35, GW36a,		
	Downstream	GW08.2, GW09.2, GW10.2		GW10.2 flagged as damaged in Dec 2022, and inspected in September 2023. Likely damaged by LV/ plant and scheduled for development/ flushing in 2024.
Wollombi Brook Alluvium		P16, P20, GW15 and P325a	Below average rainfall in 2023 has resulted in declining groundwater levels within a number of the Wollombi Brook Alluvium bores. EC observations are stable or show a small increase while pH observations are stable.	GW15 may have been flooded/ inundated by surface water during high rainfall and flow events in 2022. The purging/ redevelopment of GW15 is scheduled for completion in 2024.
Stony Creek Alluvium/ Colluvium		P315	A clear relationship between groundwater levels and rainfall exists at Stony Creek due to the steep and narrow catchment area. Below average rainfall in 2023 resulted in declining groundwater levels at P315, but the Stony Creek alluvial aquifer at this location remains relatively saturated due to antecedent conditions. ,. EC has gradually increased at P315, while pH was stable. Fluctuations in P315 groundwater levels in response to low rainfall in 2023 are consistent with previous years' observations. EC has steadily increased since early 2021 with all monitoring events during 2023 exceeding the trigger value, with further detail in **Section 5.4.1**..	

5.2 Regolith – Shallow Weathered

Table 10 summarises groundwater level and quality trends for Wambo monitoring locations within regolith and shallow weathered strata.

Table 10 2023 groundwater trends in regolith/ shallow weathered strata

Regolith Aquifer	Monitoring bores	2023 Groundwater Observations and Likely Causes	Comment
Wambo Creek	P316b, P109, GW37b	P316b has been observed in previous years to fluctuate in response to high rainfall events and declined in 2023 in response to below average rainfall. EC shows an inverse trend to rainfall events, consistent with vertical infiltration by rainfall and has increased throughout 2023.	P109 is screened across multiple aquifers. GW37b has been installed to target the regolith underlying the Wambo Creek alluvium. This well is intended as a replacement for P109. Monitoring should continue at P109 for a period of 12-months so that observations can be compared to recently installed GW37b.
North Wambo Creek	GW24, GW26, GW36b, GW16, GW17, SBX-GW02 and GW10.2a	Similar to alluvial sites, below average rainfall in 2023 has resulted in declining groundwater levels within North Wambo Creek regolith bores. Increasing EC has been widely observed as a response to below average rainfall/recharge. pH has remained stable with generally neutral conditions (6.5-7.5).	SBX Longwall 23 extraction was completed in 2023 near North Wambo Creek monitoring locations. There are no clear trends at these locations that indicate a mining effect is causing groundwater level declines additional to what would be expected from low-flow and dry conditions. However, this mining activity should be considered when reviewing future monitoring data.
Stony Creek	P301	Below average rainfall in 2023 resulted in generally declining groundwater levels at P301, but the regolith/ weathered Permian aquifer at this location remains relatively saturated due to antecedent conditions. EC and pH remained relatively stable at P301 in 2023.	
Wollombi Brook	GW13	Declining groundwater levels observed in 2023, likely in response to below average rainfall, but also may be showing some effect of approaching open cut mining. EC is >9,000 µS/cm in 2023 compared to historical maximums of ~5,000 µS/cm, while pH is consistent with historical observations.	Monitoring was recommenced at GW13 in June 2023. Due to the age of GW13 (installed in 2010) and lack of recent monitoring, GW13 should be considered for purging/ development in 2024 (at same time as GW15).

5.3 Permian Coal Measures

Table 10 summarises groundwater level and quality trends for Wambo monitoring locations within Permian coal measures.

Table 11 2023 groundwater trends in Permian coal measures

Regolith Aquifer	Monitoring bores	2023 Groundwater Observations and Likely Causes	Comment
Wambo Creek Catchment	P202, P206, P316c	Groundwater levels showed some decline throughout 2023 in response to below average rainfall. EC increased at P202 and P206 during the monitoring period consistent with historical observations. pH remained stable and near-neutral. EC remains brackish at P316c (2,500-4,000 µS/cm) and initially high pH observations have started to stabilise at pH 8.5.	
North Wambo Creek Catchment	N2, N3 and N5 VWPs SBX-GW01 and SBX-GW02 VWPs	The shallowest sensor for N5 (4) shows correlation to the rainfall trend and has gradually declined in 2023. Similar trends are observed in the lower 3 sensors in 2023 where levels generally decline. This may reflect SBX mining impact as longwalls approach as well as below average rainfall. Upper three sensors are dry in N2, while the lower three show some SBX mining impact while maintaining some saturation. Lower five sensors at N3 failed since 2019. Upper sensor dry since 2017. The deeper sensor(s) at SBX-GW01 and SBX-GW02 are dry (and/or directly above the Whybrow Seam), while the sensor 10 m above the Whybrow Seam in SBX-GW02 was maintaining saturation in August 2023.	Inspect N3 and consider removal from network. SBX Longwall 23 extraction was completed in 2023 near North Wambo Creek monitoring locations and should continue to be considered in future reviews of monitoring data. SBX-GW02 only collected data for one month in 2023 (August/ September) It is understood the datalogger has been replaced and additional data should be available in the future.
Wollombi Brook Catchment	GW22	Groundwater levels in 2023 have remained near the maximum observed in late 2022. EC has shown a minor increase in 2023. GW22 returns more basic pH levels, with values consistently near pH 8.3.	

5.4 Trigger Level Exceedances

The trigger level exceedances for groundwater level and groundwater quality in 2023 are shown in **Table 12**.

Triggers for pH and EC occur when three consecutive bi-monthly observations (a 6-month period) exceed the specified trigger level (**Table 6**). Triggers for groundwater level occur when two consecutive bi-monthly observations (a 4-month period) exceed or fall below the specified trigger level (Peabody, 2023). Note that due to conditions on site through late 2022 and early 2023, some bores could not be reached for some scheduled sampling events. The trigger levels are still deemed to have been breached if the required number of consecutive exceedances includes an intervening missed event.

During 2023, groundwater levels in bore GW15 exceeded the maximum groundwater elevation (**Table 6)** trigger level , P16 exceeded the minimum groundwater elevation trigger level, and bore P315 exceeded the EC trigger. No bores exceeded the pH trigger guidelines in 2023.

Table 12 2023 Trigger Level Exceedances

Bore (Aquifer#)	Trigger Exceedances				
	Max GW Elevation 2 Consecutive (10th percentile) *	**Min GW Elevation 2 Consecutive (90th percentile) ****	**EC (3 Consecutive)**	**pH min (3 Consecutive)**	**pH max (3 Consecutive)**
P315 (SCA)	N/A	N/A	Yes (6, Feb to Dec 2023)	No	No
P301 (SP)	N/A	N/A	No	No	No
GW15 (WBA)	Yes (6, Feb to Dec 2023)	No	No	No	No
P16 (WBA)	No	Yes (6, Feb to Dec 2023)	No	No	No
P20 (WBA)	No	No	No	No	No
GW08.2 (NWCA)	ND				
GW09.2 (NWCA)	ND				
GW10.2 (NWCA)	ND				

Aquifer: WCA = Wambo Ck alluvium; SCA = Stony Ck alluvium; WBA = Wollombi Brook alluvium; NWCA = North Wambo Ck alluvium; SP = shallow Permian;
ND = Not Defined – currently there is insufficient baseline data to develop appropriate trigger levels
*Minimum depth-to-water is equivalent to maximum groundwater level (mAHD)
**Maximum depth-to-water is equivalent to minimum groundwater level (mAHD)

5.4.1 P315 – Stony Creek Alluvium - EC

EC was above the trigger level of 552 µS/cm for all 2023 with a maximum of 1,674 µS/cm in October before falling back to 1,571 µS/cm in December 2023. This is considered an ongoing exceedance that was first identified in 2021 and reported by SLR (2022a, 2023c, 2023e). The investigation concluded that high rainfall from 2020 to 2022 may have resulted in sufficient recharge to enable "flushing" of groundwater through fractures in bedrock caused by undermining in the Newcastle Coal Measures (which is historically observed to have saline groundwater (SLR, 2022a)) using the longwall mining method, which may flow laterally in to the Stony Creek alluvium, leading to the observed increase in EC. EC has continued to exceed trigger limit values in 2023. While declining groundwater levels are observed at P315 in 2023 due to below average rainfall, antecedent conditions (above average rainfall from 2020-2022) have maintained some saturation of the shallow groundwater system at P315. While P315 remains saturated and there is no further flushing from low EC rainfall or surface water flow, the EC observations above the trigger level are expected to continue.

The following work was undertaken in 2023 to further assess the drivers of water quality change within Stony Creek and its alluvium:

- Ongoing monitoring of real-time level and quality of groundwater and surface water.
- Additional rounds of sampling for dissolved metals and major ions.
- Site inspections by WCPL staff and hydrogeological consultants including the establishment of an additional monitoring location upstream South Bates Underground longwalls of to establish an additional surface water monitoring location.
- Completion of data review reporting in August and November 2023 (SLR, 2023c & 2023e).
- The establishment of quarterly groundwater monitoring at private wells near to Stony Creek and Wambo Creek to help evaluate whether the observed change in at P315 may be influencing downstream groundwater receptors. It is noted that monitoring at these locations to date has not indicated a change in water quality due to the observed trigger exceedance.
- A survey of the monitoring instrumentation near the downstream continuous data logger was completed to compliment the data collected at the adjacent P319 shallow monitoring well.

WCPL has committed to providing updated reporting to DPE and the EPA at the end of November 2024.

5.4.2 GW15 – Wollombi Brook Alluvium - Maximum Groundwater Elevation

GW15 is located 275 m east of the channel of Wollombi Brook and 1.5 km west of the advancing Warkworth Open Cut. Historical observations show a consistent correlation between CRD and groundwater level at GW15. Groundwater levels went above the minimum depth to water (upper/ high groundwater elevation) trigger level of 52.0 mAHD in June 2022 with a value of 54.56 mAHD increasing to a maximum of 55.64 mAHD in December 2022. Groundwater level declined throughout 2023 to 53.05 mAHD, which is still above the maximum groundwater elevation trigger level.

These exceedances coincide with ongoing elevated groundwater levels associated with above average rainfall in 2022 and not with WCPL or other nearby mining activity.

5.4.3 P16 – Wollombi Brook Alluvium - Maximum Groundwater Level

Bore P16 is adjacent to Wollombi Brook and downstream (north) of underground mining at WCPL (**Figure 3**), and less than 200 m east of the South Wambo Boxcut, now known as Glen Munro Pit, which was completed in July 2017. Groundwater levels at P16 have been below the minimum groundwater elevation trigger level (49.7 mAHD) in all 2023 observations, showing a declining trend that correlates well with the below average rainfall conditions in 2023. Groundwater levels at P16 were previously below the groundwater elevation trigger from 2017 to 2021 and were associated with below average rainfall conditions and a mining effect from the excavation of the Glen Munro Pit that appears to have caused additional drawdown in the order of 1.2 m (SLR, 2021). The groundwater elevations below the trigger observed in 2023 are likely a continuation of this combined drier climate and an ongoing Glen Munro Pit mining effect.

The numerical groundwater model rebuilt and recalibrated for the Modification 19 groundwater assessment (SLR, 2022c) captures the observed decline in groundwater level from 2017 to 2019 and following recovery in response to above average rainfall in 2020, to the end of the calibration period in December 2020 (**Appendix A**). Long-term average climatic and Wollombi Brook stage height conditions used from 2021-2023 do not provide representative conditions for those recently observed groundwater level responses at P16.

Future updates of the model will include more recent climate and Glen Munro Pit operational data and will focus on matching observed responses to climate and mining in shallow and alluvial groundwater systems so that impacts and groundwater takes from these water sources are appropriately captured. The results from the contemporary groundwater model could also be used to revise trigger levels at P16 to reflect the influence of both approved impacts and climatic conditions.

5.5 Compliance with Groundwater Performance Criteria

The 2023 groundwater monitoring has been evaluated against the performance criteria, defined within the GWMP (Peabody, 2023). **Table 13**.

Table 14, and **Table 15** below provide an assessment of compliance with the performance criteria defined for general water management performance, and subsidence impacts for North Wambo Underground and South Bates Underground and Extension longwalls.

Table 13 Performance Indicators

Feature	Performance Indicator	2023 Performance Indicator Observations	Overall Compliance
Groundwater Management Performance Indicators			
Alluvial aquifers (including Wollombi Brook alluvium and excluding the NWC alluvium)	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: A greater than negligible change in groundwater levels;	Exceedances of the upper groundwater elevation (minimum depth to groundwater) trigger level at GW15 is related to antecedent above average rainfall conditions from 2022 and not a WCPL mining effect. See **Section 5.4.2**. Exceedances of the minimum groundwater elevation trigger level at P16 are related to below average rainfall conditions in 2023 and a likely a Glen Munro Pit mining effect. This WCPL mining effect does not exceed impacts from contemporary groundwater model predictions (SLR, 2022c). See **Section 5.4.3** and **Appendix A**. Future updates to the numerical model should focus on capturing mining impacts at alluvial and shallow monitoring sites so that licensing obligations for WCPL continue to be appropriately quantified.	**Compliant**
	A greater than negligible change in groundwater quality	EC trigger exceedances continued to be observed at P315 in 2023 (up to 1,674 µS/cm vs a trigger level of 552 µS/cm). This trend was first observed in 2021. Groundwater and surface water quality in Stony Creek is subject to additional ongoing monitoring and investigation (including SLR, 2022a, 2023c, 2023e), with an updated monitoring review report planned for delivery to the Department of Planning and Enivoronemt (DPE) in November 2024. See **Section 5.4.1** for more details on this trigger level breach.	**Not Compliant (subject to further investigations)**
	A greater than negligible impact to other groundwater users.	Previous groundwater assessments for Wambo Coal predicted that some privately-owned bores may experience more than 2 m cumulative drawdown as a result of the approved operations (HydroSimulations, 2017a, 2019b and SLR, 2020a). No complaints have been made to Wambo Coal during the 2023 AR period in respect to groundwater or water. A registered monitoring bore program has commenced following inclusion in the updated GWMP (Peabody, 2023). The sites included in this program will be reviewed for groundwater level or quality impacts that are greater than negligible or outside of relevant predictions.	**Compliant**
Groundwater dependent ecosystems	The performance indicators will be considered to have been exceeded if impacts exceed those predicted in the documents listed in condition A2c) (of DA305-7-2003), including: Greater than negligible environmental consequences, beyond those predicted in the documents listed in condition A2c)	GW36a and GW36b were drilled in 2020 to monitor impacts at the River Oak GDE on North Wambo Creek. In 2023 observed depths to groundwater declined by ~6 m during 2023 and are now ~8 metres below top of casing (mbtoc). The River Oak GDE has been classified as a facultative groundwater dependant ecosystem (utilising opportunistic access to groundwater) (Hunter Eco, 2019) and would likely have had access to groundwater from 2020-2022 when depths to water were generally <3.5 mbtoc. Declining groundwater levels in 2023 appear to be most strongly related to below average rainfall conditions and a lack of flow events in North Wambo Creek. This is likely normal for the North Wambo Creek alluvial groundwater system and does not indicate a mining related risk to the River Oak GDE. Continued monitoring will allow trends/ ranges to be established for these bores under different climatic conditions and evaluate whether SBX mining is impacting groundwater close to this GDE. GW40a, GW40b (upstream), GW41a, and GW41b (downstream) were installed along Waterfall Creek in September 2023 to help understand shallow groundwater conditions in this location, the potential for groundwater interaction with the potential GDE identified in the Ecological (2022) Biodiversity Review for Modification 19 and identify any impacts from approaching SBX mining. A single observation was available at each Waterfall Creek well in December 2023: • GW40a – Bore Depth: 28.30 mbtoc, Depth to Water: 21.26 mbtoc. • GW40b – Bore Depth: 36.95 mbtoc, Depth to Water: 23.73 mbtoc. • GW41a – Bore Depth: 10.80 mbtoc, Depth to Water: 7.78 mbtoc. • GW41b – Bore Depth: 21.10 mbtoc, Depth to Water: 8.36 mbtoc. WCPL will update the GWMP in December 2024 to include water quality triggers for GW40a/b and GW41a/b based on water quality data collected since their installation in October 2023. Future monitoring will evaluate the likelihood of groundwater interaction with the potential GDE at Waterfall Creek.	**Compliant –** noting limited monitoring data at the recently installed Waterfall Creek monitoring bores.

Table 14 North Wambo Underground Performance Indicators

North Wambo Underground Performance Indicators		
The performance indicators will be considered to have been exceeded if monitoring data suggests significant divergence from modelling predictions.	The modelling undertaken for the MOD19 groundwater assessment (SLR, 2022c) involved model rebuild, recalibration and peer review. The history-match of observed groundwater levels and trends have broadly improved in the updated model compared to previous assessments. Drawdown impacts at some alluvial sites are better captured in the SLR (2022c) modelling than previous versions (e.g. HydroSimulations, 2019b) and should better quantify licencing obligations for WCPL. See **Section 6.0**.	**Compliant** (further reviewed in MOD19 numerical modelling)

Table 15 South Bates Underground and South Bates Extension Underground Performance Indicators

South Bates Underground and South Bates Extension Underground Performance Indicators		
The performance indicators will be considered to have been exceeded if groundwater levels in alluvial bores exceed the groundwater level criteria in the GWMP (Table 11 of the GWMP).	Exceedances of the upper groundwater (minimum depth to water) level trigger at GW15 is related to antecedent conditions from above average rainfall and not a WCPL mining effect. See **Section 5.4.2**. Exceedances of the minimum groundwater elevation trigger level at P16 are related to below average rainfall conditions in 2023 and a likely a Glen Munro Pit mining effect. This WCPL mining effect exceeds the groundwater level criteria in the GWMP. The results from the updated model may help revise trigger levels at P16 to reflect the influence of both approved impacts and climatic conditions. See **Section 5.4.3**. for more details on this trigger level breach and the recommendations set out in **Section 10.0**.	**Not Compliant**
The performance indicators will be considered to have been exceeded if the groundwater quality in alluvial bores exceeds the groundwater quality criteria in the GWMP (Table 13 of the GWMP).	EC trigger exceedances continued to be observed at P315 in 2023 (up to 1,424 µS/cm vs a trigger level of 552 µS/cm). This trend was first observed in 2021. Groundwater and surface water quality in Stony Creek is subject to additional ongoing monitoring and investigation. See **Section 5.4.1**. for more details on this trigger level breach.	**Not Compliant** (see **Table 13**)
The performance indicators will be considered to have been exceeded if the impacts observed on riparian, aquatic or groundwater dependent ecosystems are beyond negligible.	GW36a and GW36b were drilled in 2020 to monitor impacts at the River Oak GDE on North Wambo Creek. In 2023 observed depths to groundwater declined by ~6 m and are now ~8 mbtoc . The River Oak GDE has been classified as a facultative groundwater dependant ecosystem (utilising opportunistic access to groundwater) (Hunter Eco, 2019) and would likely have had access to groundwater from 2020-2022 when depths to water were generally <3.5 mbtoc. Declining groundwater levels in 2023 appear to be most strongly related to below average rainfall conditions and a lack of flow events in North Wambo Creek. GW40a, GW40b (upstream), GW41a, and GW41b (downstream) were installed along Waterfall Creek in September 2023 to help understand shallow groundwater	**Compliant**

South Bates Underground and South Bates Extension Underground Performance Indicators		
	conditions in this location, the potential for groundwater interaction with the potential GDE identified in the Ecological (2022) Biodiversity Review for Modification 19 and identify any impacts from approaching SBX mining. Continued monitoring will allow trends / ranges to be established for these bores and determine whether SBX mining is impacting groundwater close to these GDEs.	

5.6 Vibrating Wire Piezometer Data Review

SLR has been undertaking periodic reviews of the WCPL VWP monitoring network, both on-site and of the downloaded data. The table included in **Appendix C** provides details on each of the VWP locations, and also provides a preliminary assessment of data quality collected at each of the sites for 2023. Key findings from the data quality assessment include:

- Unreliable data at VWP sites where sensors are within shallow overburden, Whybrow or Wambo seams. Sensors are dry or near-dry, likely associated with WCPL or regional mining activity. It is worth continuing to download from these sites while at least one of the sensors is collecting reliable data, and where recovery / re-saturation is possible.
- As recommended in previous reviews, older sites and unlabelled sites which are no longer collecting reliable data should be considered for removal from monitoring network.

Discussion and assessment of VWP data has not been undertaken or presented in this report but could be considered for inclusion in future reporting for sites where the data quality is assessed as reliable. A summary of groundwater level observations from site VWPs are provided below:

- Most shallow VWP sensors (~10 m depth) are dry indicating greater depths to water table.
- Depressurisation associated with Wambo mining activity is observed within the Wambo and Whybrow seams and adjacent Permian Coal Measures in sites close to historical and current mining activity. This observed depressurisation is broadly consistent with current model predictions (SLR, 2022c).
- Deeper sensors, installed to monitor impacts of the Approved South Wambo Project, maintain significant pressure head in the absence of South Wambo Project mining activity.

6.0 Verification of Model Predictions

The most recent rebuild and recalibration of the Wambo Complex numerical groundwater model was undertaken for WCPL as part of the Groundwater Assessment in support of the South Bates Extension LW24-26 Modification (Mod19) (SLR, 2022c). This model is calibrated to observed groundwater levels to the end of December 2020 and underwent peer review (Appendix E of SLR, 2022c – HydroAlgorithmics, 2022) as part of the approvals process for MOD19. The peer review (HydroAlgorithmics, 2022) found the model to be *fit for purpose* where the models purpose was defined by the objectives stated in SLR (2022c):

- *"assess the groundwater inflow to the mine workings as a function of mine position and timing;*
- *simulate and predict the extent of dewatering due to the Project and the level and rate of drawdown at specific locations;*
- *identify areas of potential risk, where groundwater impact mitigation/control measures may be necessary;*
- *estimate direct and indirect water take; and*
- *estimate post-mining recovery conditions."*

Detailed discussion of the revised model's performance (ability to represent groundwater level observations) is included in the Groundwater Modelling Technical Report (Appendix D of SLR, 2022c) completed for the MOD19 Groundwater Assessment.

Hydrographs presenting the modelled groundwater levels versus observed groundwater levels to the end of 2023 at Wambo monitoring sites are presented in **Appendix A**.

6.1 Numerical Model Updates

It was identified in 2023 that there are differences between simulated and actual/ planned mining progression in the United Wambo Open Cut (UWOC). The SLR (2022c) numerical model simulates the extent and depth of UWOC open cut progression as digitised in the AGE (2016) United Wambo Joint Venture EIS Groundwater Assessment, while actual recent and planned future forecast open cut progression will target a slightly smaller footprint with different timing to that indicated in AGE (2016).

Detailed pit progression files have been provided by UWOC and the following key differences are summarised in **Table 16.**

Table 16 Open cut mining updates

Mine Area	Approved Mining - AGE (2016)	Actual/ Proposed Mining
Montrose Pit	Mining to Warkworth Seam across entire Montrose Pit footprint. This mining commenced at the start of the UWOC Project (2021)	Current mining to Whynot Seam (to the end of 2023) which is ~200m shallower than the Warkworth Seam. Future mining to Bowfield Seam ~15m shallower than Warkworth Seam, focussing on the north-eastern area of the Montrose pit. Much of the current Montrose pit footprint will not be deepened.
United Pit	Mining to Vaux Seam across entire footprint	Future mining to target Vaux Seam in central area of United Pit. Proposed footprint does not extend as far west as previously modelled footprint.

Use of the approved mine plan (as per AGE, 2016) in the SLR (2022) groundwater assessment for Longwalls 24-26 was suitable for providing a conservative prediction of cumulative groundwater impacts due to approved underground and open cut mining at the Wambo Complex. However, updating the model to include a more accurate representation of mining will help calibrate future models to actual stresses on the groundwater system, and will likely provide more representative values of groundwater interception for the ongoing assessment of compliance with water licences.

The updated open cut progression replaced the approved mine plan (AGE, 2016) in the numerical groundwater model with no other changes. Key outcomes from this updated modelling are provided in the points below:

- Transient calibration statistics are consistent between the SLR (2022c), and updated model runs, with no change to the scaled root mean square error (6.0%), which is within the acceptable limits (i.e. 10%) recommended by the Australian groundwater modelling guidelines (Barnett et al., 2012).
- Due to the consistency in calibration statistics, and minor updates to the UWOC progression during the calibration period, groundwater level outputs from the SLR (2022c) model will continue to be used for comparison with observation data (see **Section 6.0** and **Appendix A**).
- Groundwater inflow predictions (**Section 7.0)** and the assessment of licence compliance for underground and open cut workings (**Section 8.0)** will be informed by the updated model.

6.2 Modelling Considerations

A key consideration for assessing modelled and observed groundwater levels during 2023 is that the transient historical period for the SLR (2022c) and updated (**Section 6.1**) groundwater modelling ended in December 2020. This means that above average rainfall conditions experienced in 2021 and 2022, or the below average rainfall in 2023 will not be included and responses in predicted groundwater levels to recent climatic conditions are not expected.

The WCPL GWMP (Peabody, 2023 – Section 5.3) commits to periodic recalibration and independent peer review of the groundwater model every three years. This will be scheduled for completion in 2025. Future updates of the model will include recent climatic conditions, contemporary groundwater level and flow observations, and updated mine progression (where relevant), to enable further assessment of model performance.

7.0 Inflow to Wambo Complex Mine Areas

Section 6.1.2 of the GWMP (Peabody, 2023) states that "Dewatering volumes and underground water levels will be recorded, and data will be incorporated into the site water balance and annual groundwater review on an annual basis to allow calculation of groundwater inflows including loss of groundwater from alluvium and to verify whether WCPL holds sufficient groundwater licence entitlements."

The assessment of licence compliance regarding the interception of groundwater is undertaken in **Section 8.0**.

7.1 Inflow to Underground Workings

SBX workings in the Whybrow Seam are currently being dewatered as part of WCPL underground mining operations. The current GWMP (Peabody, 2023) requires annual assessments for underground mine inflow against the peak simulated mine inflow from SLR (2022c) of 480.45 ML/yr. An exceedance of this predicted inflow by greater than 50% (i.e. an annual inflow of > 721 ML/yr) will require WCPL to:

- *Investigate if there is a change in the predicted take of water from the Lower Wollombi Brook Water Source from mining related activities;*
- *Where there is an increased take from the Lower Wollombi Brook Water Source, investigate any influence on low flow cease-to-pump criteria specified in the HUA WSP;*
- *Define the Mine inflow volume value triggering this response procedure;*
- *Submit a report summarising the assessment to DPE Water.*

Predictions of annual inflows are currently based on the groundwater model updated to incorporate as-mined and proposed future UWOC mining (see **Section 6.1**). This modelling predicted up to 350.8 ML/year inflow (compared to 351.2 ML/yr for SLR (2022c)) to the South Bates Extension and South Bates Underground mine areas over 2023.

While this number is lower than the '*greater than 50% exceedance*' criteria defined in the GWMP (Peabody, 2023) and does not require WCPL to undertake further action, it is recommended that future assessments compare underground dewatering volumes as a method to validate model predictions.

7.2 Inflows to Open-Cut Pits

Following Modification 16 (determined 28 August 2019) operations at the Wambo Mine include underground mining and coal processing and handling activities. Open cut mining activities have been managed by the United Wambo Open Cut Project since 1 December 2020. However, Wambo manages water across the whole Wambo mining complex, including open cut and underground workings.

Inflows to United Wambo Open Cut pits are currently based on predictions from the groundwater model updated to incorporate as-mined and proposed future UWOC mining (see **Section 6.1**). This modelling predicted up to 319 ML/year inflow into the UWOC pits over 2023.

8.0 Groundwater Licensing Review

Table 17 shows the predicted annual groundwater volumes required to be licensed for open cut and underground mining at the Wambo complex, for both alluvial and porous/fractured rock groundwater sources. These values are from for the groundwater model updated to incorporate as-mined and proposed future UWOC mining (see **Section 6.1**).

The component of flow between alluvium and underlying rock to be considered for alluvial groundwater licensing is an increased leakage from alluvium to Permian induced by Wambo. Reduction in groundwater flow from Permian strata to alluvium has not been considered a component of alluvial licensing, as this reduction in Permian flow is considered licensable take from the North Coast Fractured and Porous Rock Groundwater Sources and is accounted for in predicted groundwater inflow to Wambo mining operations.

Table 17 Complex Groundwater licensing summary

Water Sharing Plan	Management Zone/ Groundwater Source	Licensed Entitlement (ML/ year)	Predicted annual groundwater inflow volumes requiring Licensing (ML/year)
Hunter Unregulated and Alluvial Water Sources Water Sharing Plan 2009	**Lower Wollombi Brook Water Source**	736.9[1]	Av. 135 Max. 209 2023. 0[3]
	Jerrys Water Source	-	0
North Coast Fractured and Porous Rock Groundwater Sources ^^	**Porous Rock**	1,947[2]	Av. 714 Max. 1,110 2023. 670

^^ Porous Rock is the Sydney Basin - North Coast Groundwater Source, as defined in the *WSP for the North Coast Fractured and Porous Rock Groundwater Sources*, released 1 July 2016.

[1]Licence No. WAL23897, WAL18437, WAL18455, WAL18549.

[2]Licence No. WAL42373, WAL41532, WAL41510.

[3]It is noted that predicted take from the Lower Wollombi Brook Water Source in the updated model does not exceed 70 ML (provided in WAL23897) until after 2028.

9.0 Summary

A summary of key findings from the review and analysis of WCPL groundwater data collected during 2023 is presented below:

- 2023 saw below average rainfall conditions at Wambo. This resulted in broad-scale declines in groundwater level across shallow groundwater systems (**Section 3.1** and **Section 5.0**).
- Groundwater data has been collected from the WCPL monitoring network in 2023 consistent with the requirements of the GWMP (Section 6.1 - Peabody, 2023), and is suitable for the purposes of this annual review.
- Bore GW15 breached the maximum groundwater elevation trigger level in 2023 (**Section 5.4.2**), although this exceedance is not related to WCPL mining activity and requires no further investigation.
- Bore P16 breached the minimum groundwater elevation trigger level in 2023 (**Section 5.4.3**), this is interpreted to result from on an ongoing Glen Munro Pit mining effect and below average rainfall in 2023.
- Investigation at Stony Creek regarding the exceedance of the EC trigger level at P315 (**Section 5.4.1**) has been completed in 2023 and is ongoing.
- Non-compliances are recorded against general groundwater performance indicators (**Table 13**) relating to the EC trigger exceedance at P315. Non-compliances are recorded against South Bates Underground and South Bates Extension performance indicators (**Table 15**) relating to the EC trigger exceedance at P315, and depth to water trigger exceedance at P16.
- The data quality assessment undertaken on WCPL VWPs identifies arrays with failed sensors/ poor quality data which can be considered for exclusion from the monitoring program (**Appendix C**). Maintenance undertaken in 2023 has recommissioned several damaged monitoring locations (**Section 2.2**).
- Groundwater model performance (calibration statistics), for the model version updated in early 2024 to incorporate as-mined and proposed future UWOC mining (see **Section 6.1**) is consistent with the SLR (2022c) modelling for the Modification 19 groundwater assessment.
- Predicted inflow volumes for South Bates Underground and South Bates Extension mine areas are 350.8 ML for 2023, this is within assessment limits (**Section 7.1**).
- Predictions of take from alluvial and porous/ fractured rock water sources are within the limits of applicable licences (**Section 8.0**).

10.0 Recommendations

Following the 2023 annual review of groundwater data the following recommendations have been made:

- VWP locations identified with persistent poor-quality data should be considered for inspection, and removed from the monitoring network if they cannot be repaired (see **Appendix C**). These sites include:
  - P321, P322, P325 – no data provided for 2023.
  - N3 – no reliable data in recent years.
  - Older VWPs at Wambo that have not been providing reliable data for a number of years. These should be inspected and assessed for decommissioning.
- Monitoring should continue at P106 and P109 for a period of 12-months to provide reference points to the data collected at the GW37a,b replacement sites.
- It is noted that GW02 and GW11 are former landholder wells with pumping equipment installed/ nearby. Replacement monitoring-only sites are recommended by SLR.
- Consider revising groundwater level triggers at P16 to incorporate model predictions which capture the observed mining effect.
- Provide update of groundwater and surface water monitoring data at Stony Creek to DPE in November 2024 as per SLR (2023e).
- The review of groundwater sampling field sheets and VWP data should continue throughout 2024 to enable as-needed repair of monitoring infrastructure and the continued collection of monitoring data. This should include a review of monitoring wells that are being sampled with hydrasleeves near Wambo Creek.
- Redevelopment and purging of GW15, GW13 should be undertaken in 2024. Sites P329a and P330a could also be considered for purging following review of comments in field sheets.
- Future updates to the GWMP could consider the development and inclusion of trigger levels at operationally relevant sites on North Wambo Creek (upstream of the diversion) and Waterfall Creek.
- Further updates of the numerical groundwater model should be scheduled for completion in 2025 (consistent with GWMP commitments), and should consider recent climatic conditions, contemporary groundwater level and flow observations, and updated mine progression (where relevant), to enable the appropriate prediction of groundwater impacts and ongoing assessment of model performance against observations.

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SLR (2022c) *Wambo Coal Mine – Longwalls 24-26 Modification Groundwater Assessment* Report 665.10008.00815-R01-v4.0 for Wambo Coal Pty Ltd. 28 July 2022

SLR (2023a) *Wambo 2022 Annual Review – Groundwater,* Report 665.10008.01815-R01-v3.0 for Wambo Coal Pty Ltd. 29 March 2022.

SLR (2023b) *Longwalls 24-26 Extraction Plan Groundwater Technical Report,* Report 665.10008.01915-R01-v2.0 for Wambo Coal Pty Ltd. 25 May 2023.

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Appendix A Model Performance (mod vs obs) Hydrographs

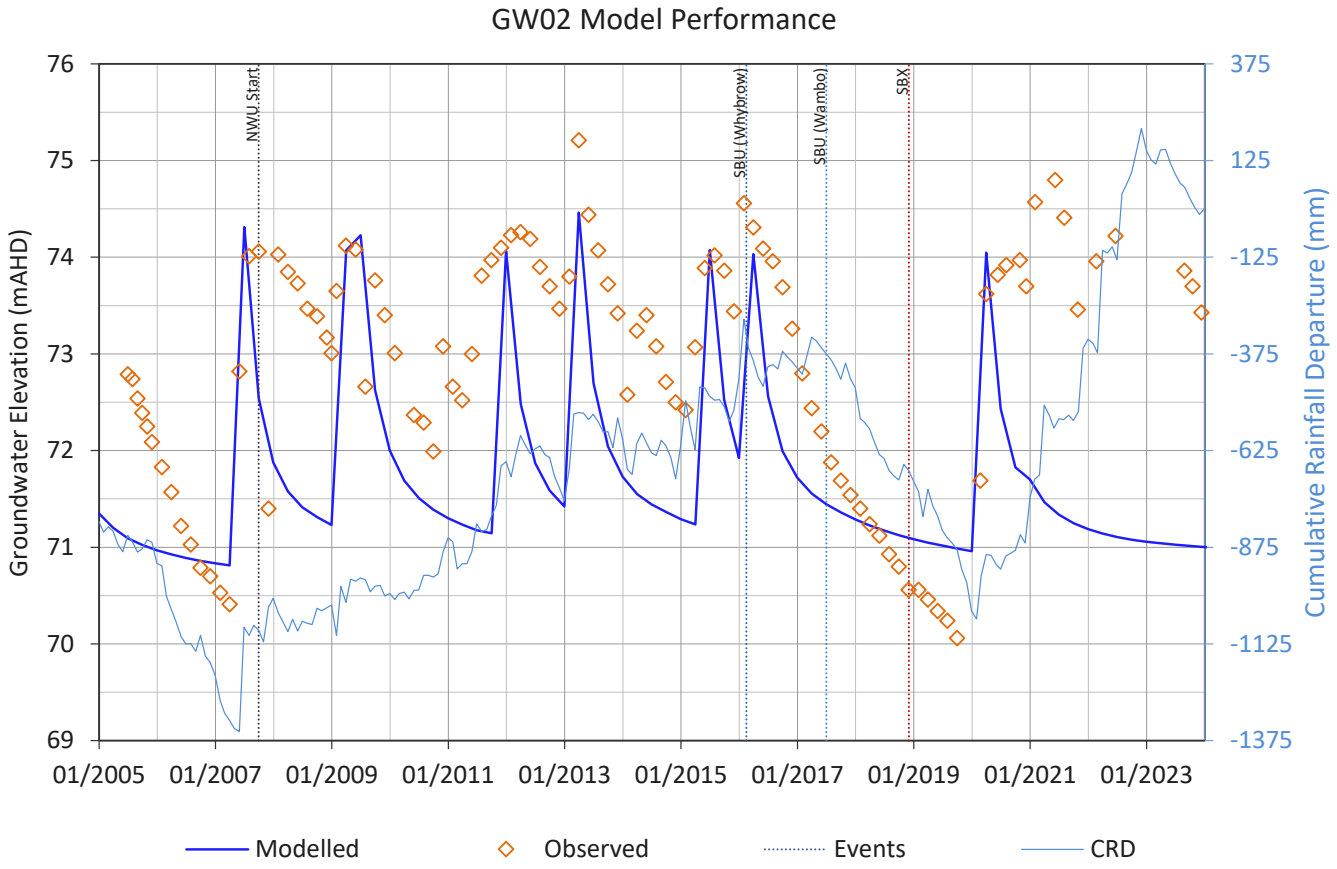
Groundwater Annual Review - 2023

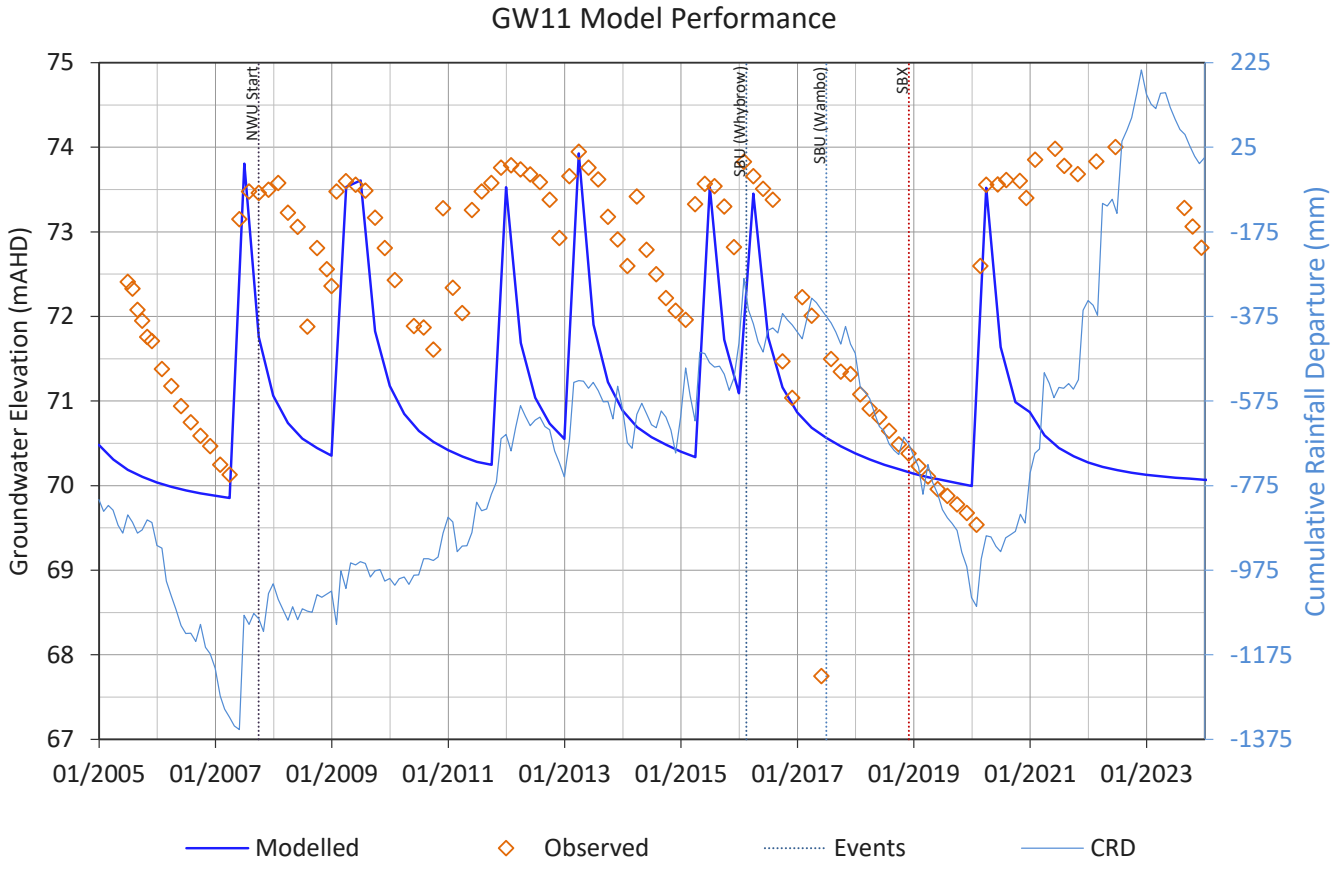
Wambo Coal Mine

Wambo Coal Pty Ltd

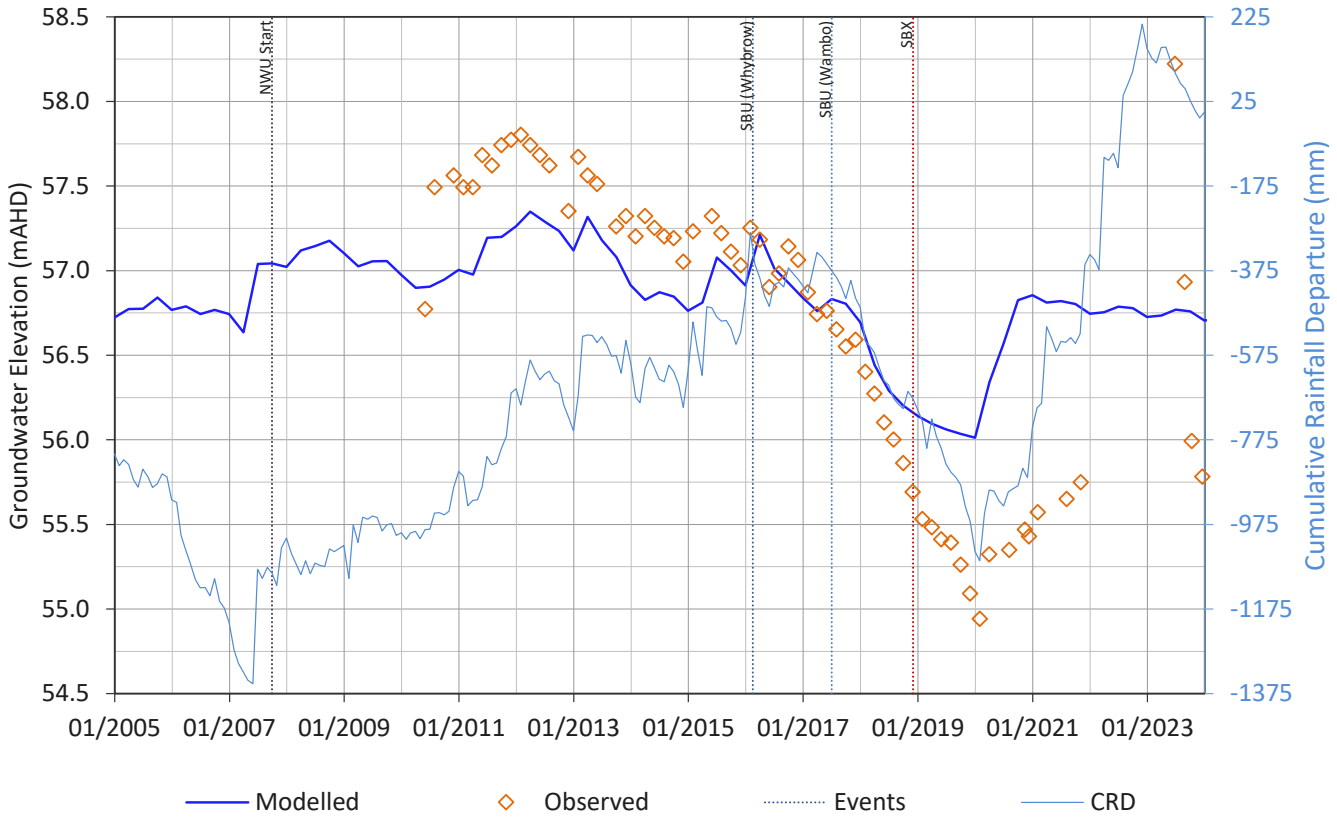
SLR Project No.: 665.v10008.02023

21 March 2024

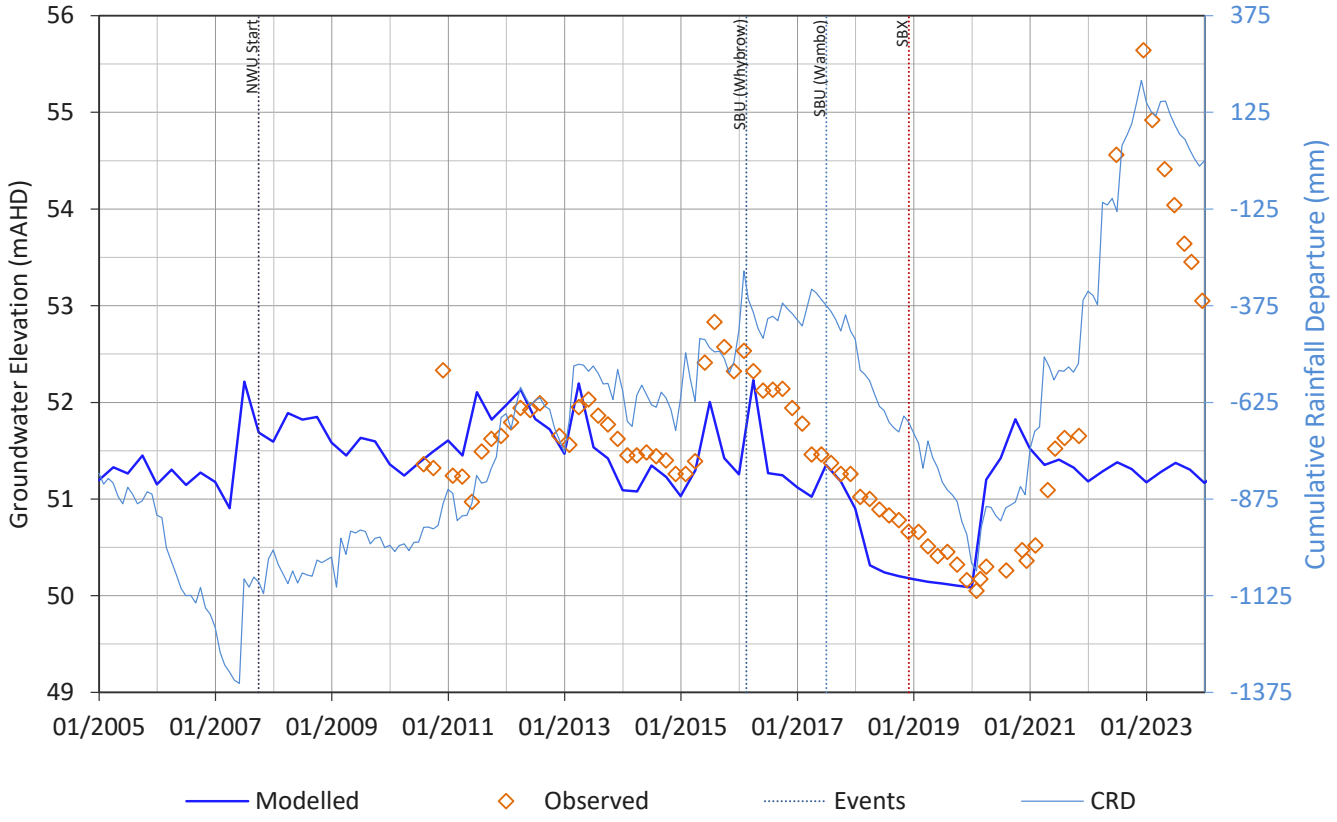

GW02 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
76
75
74
73
72
71
70
69
375
125
-125
-375
-625
-875
-1125
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Modelled
Observed
Events
CRD


GW11 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
75
74
73
72
71
70
69
68
67
225
25
-175
-375
-575
-775
-975
-1175
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Modelled
Observed
Events
CRD

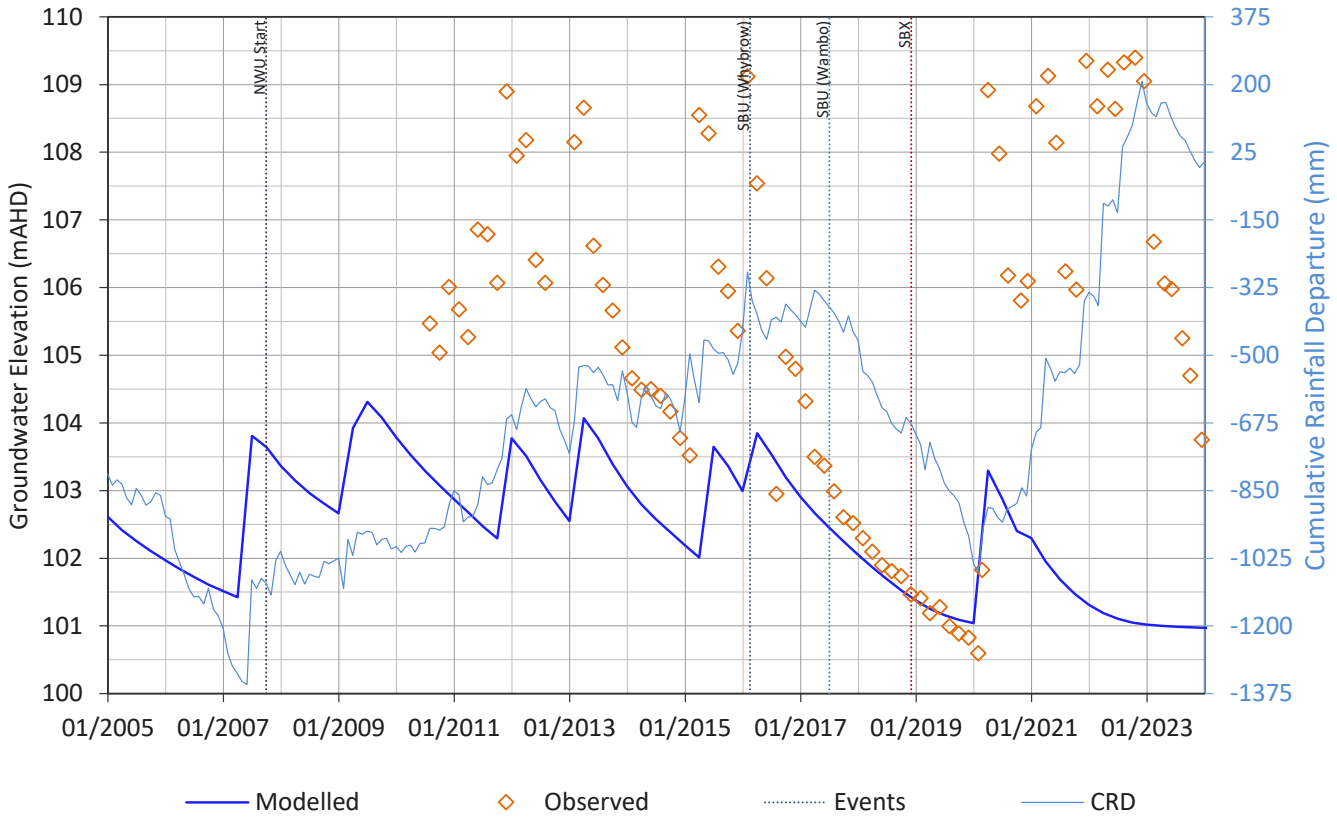
GW13 Model Performance



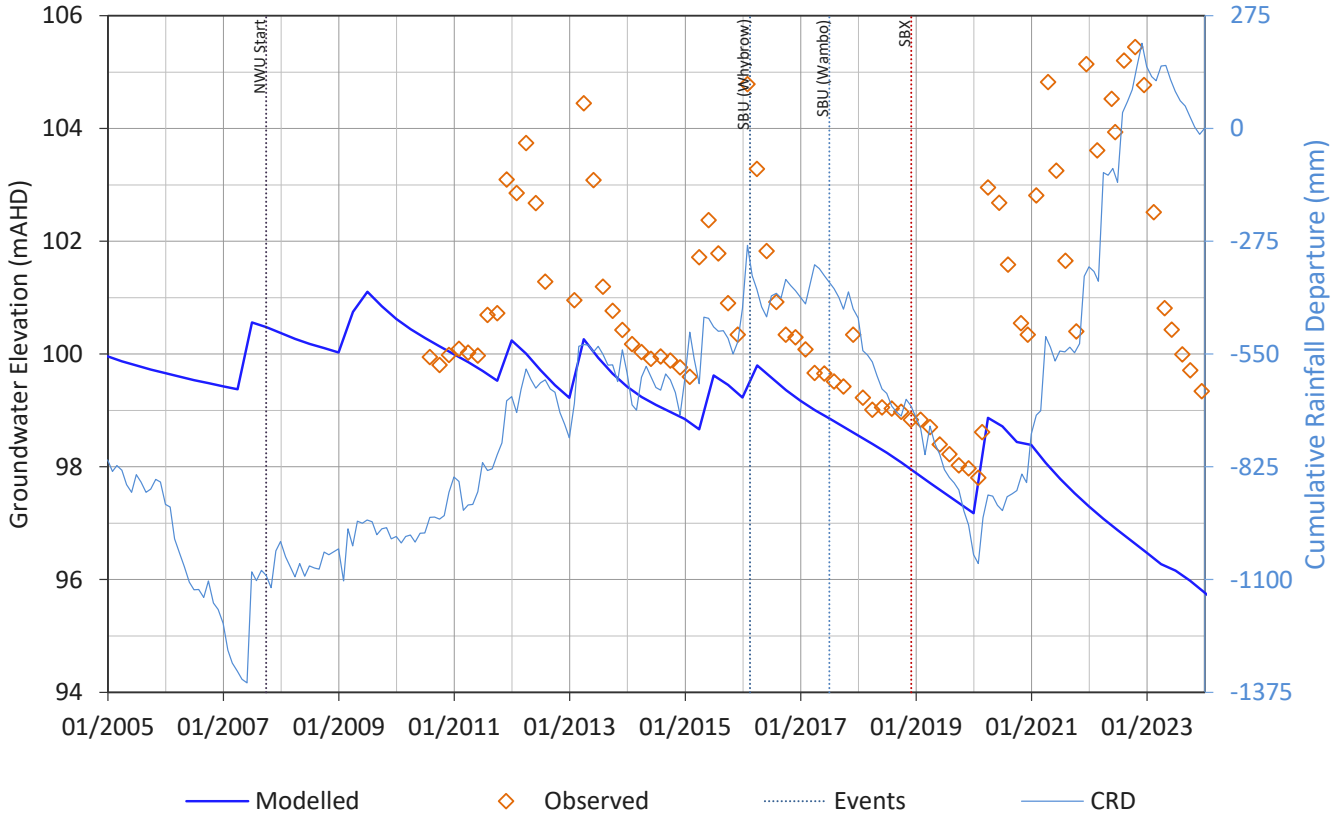
GW15 Model Performance



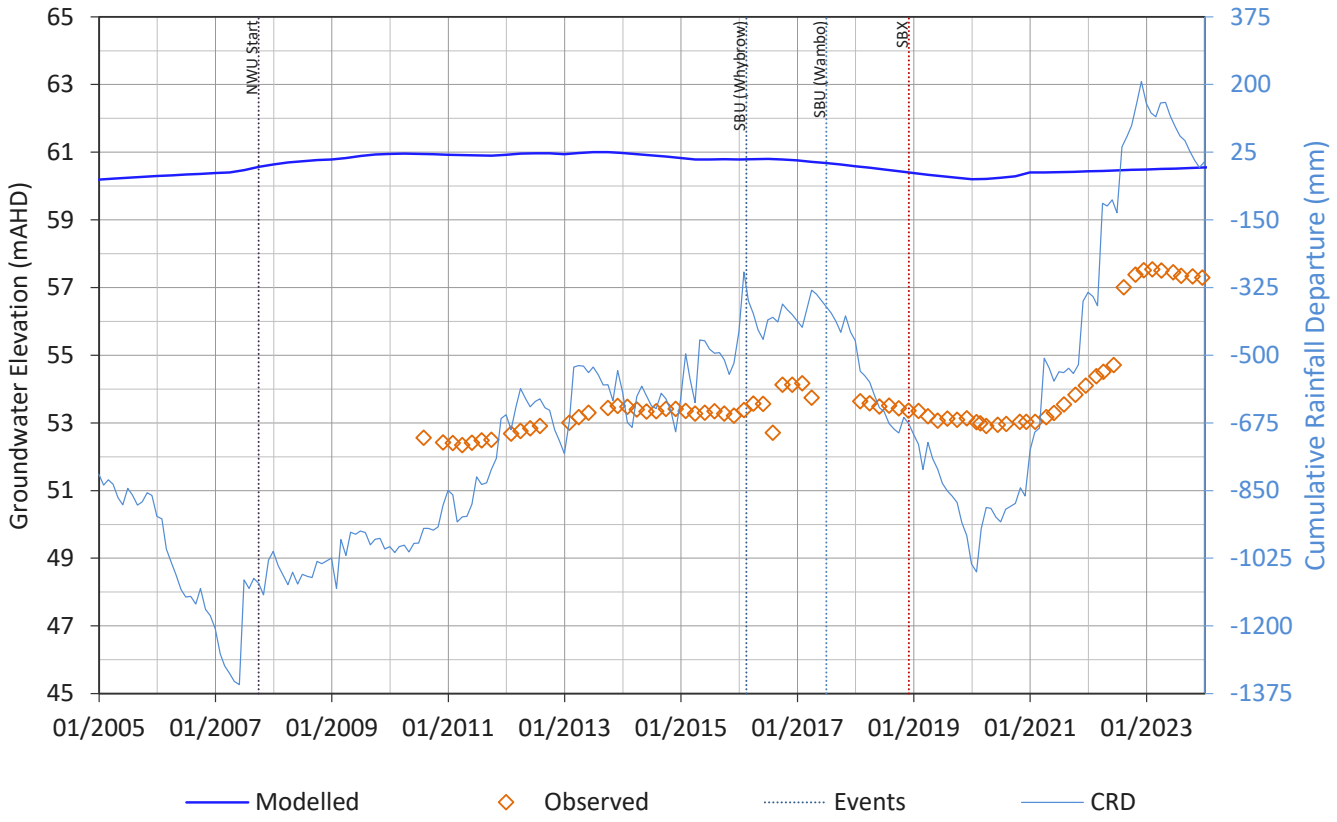
GW16 Model Performance



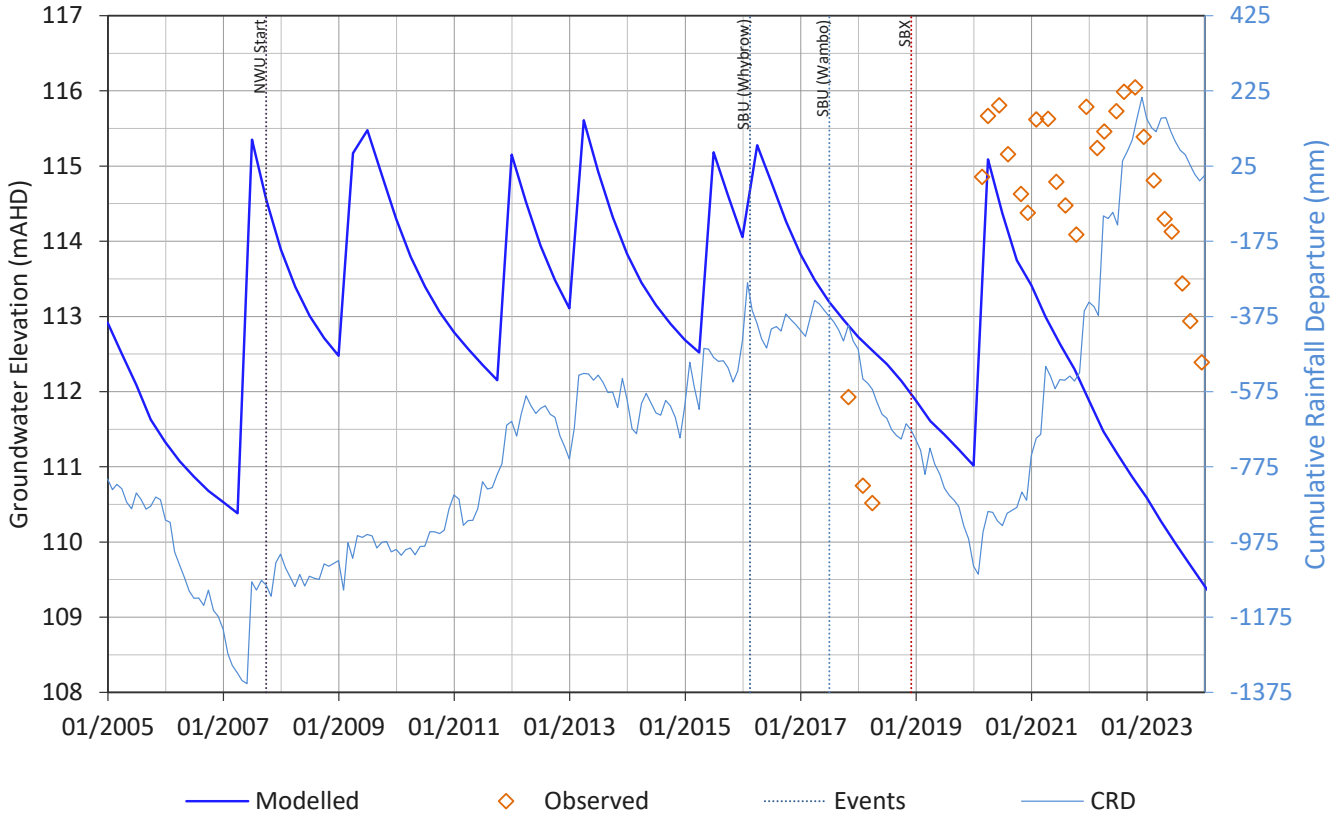
GW17 Model Performance



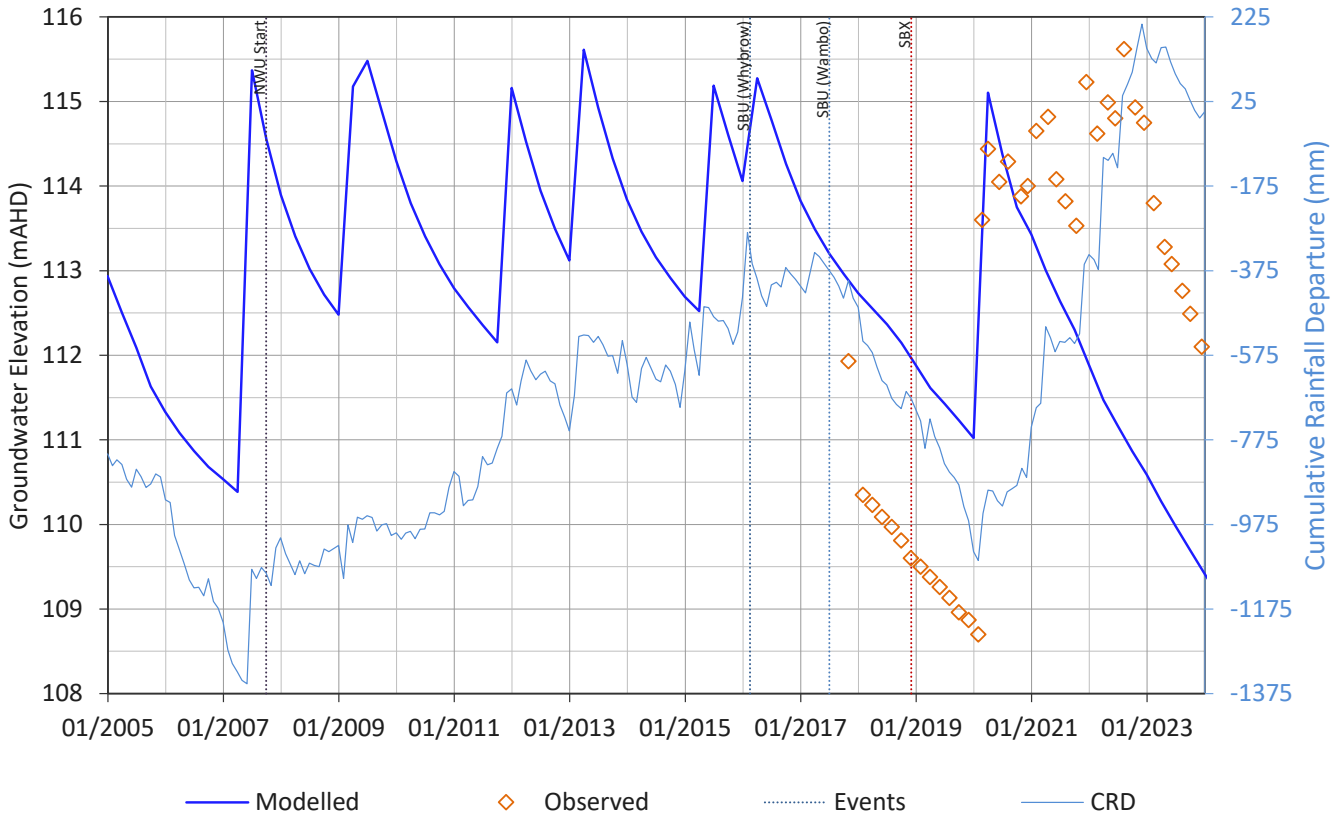
GW22 Model Performance



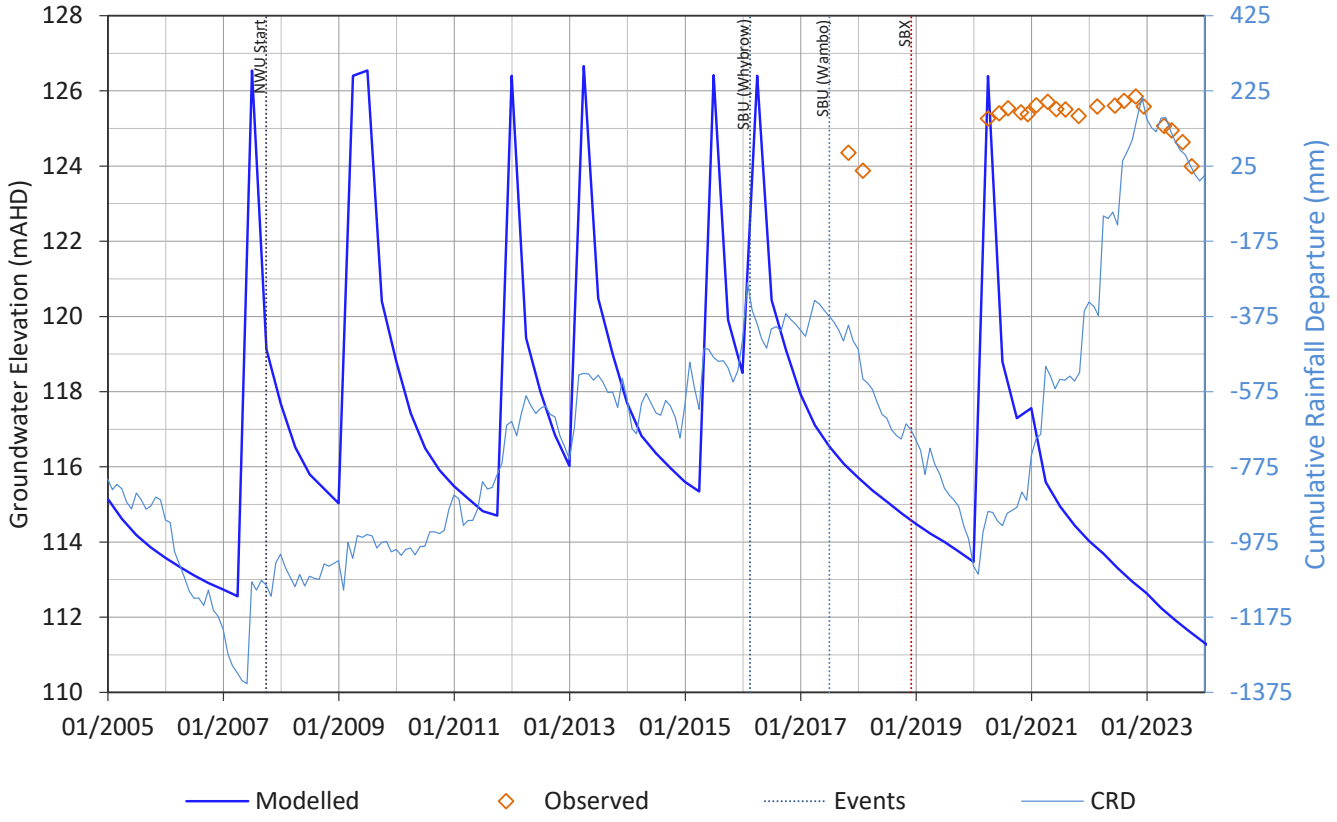
GW23 Model Performance



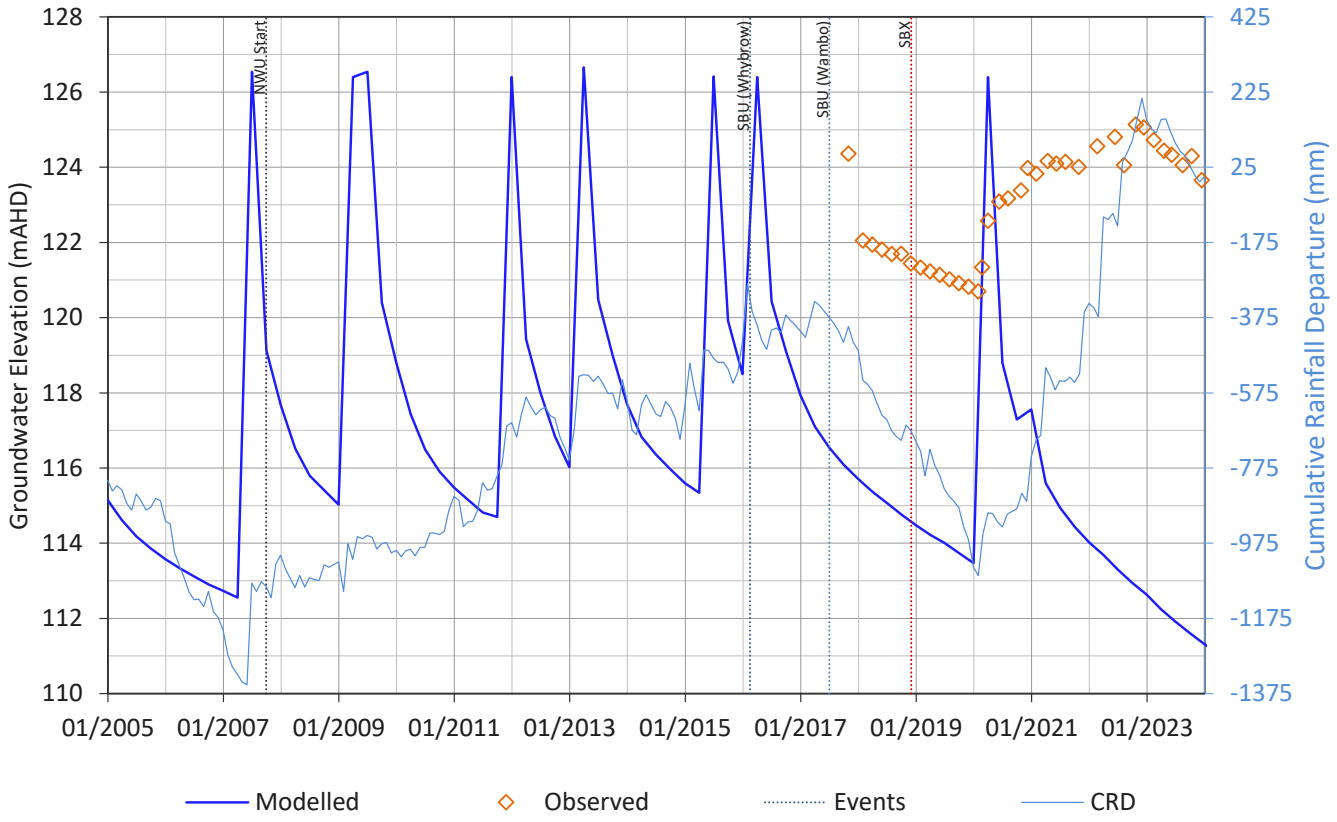
GW24 Model Performance



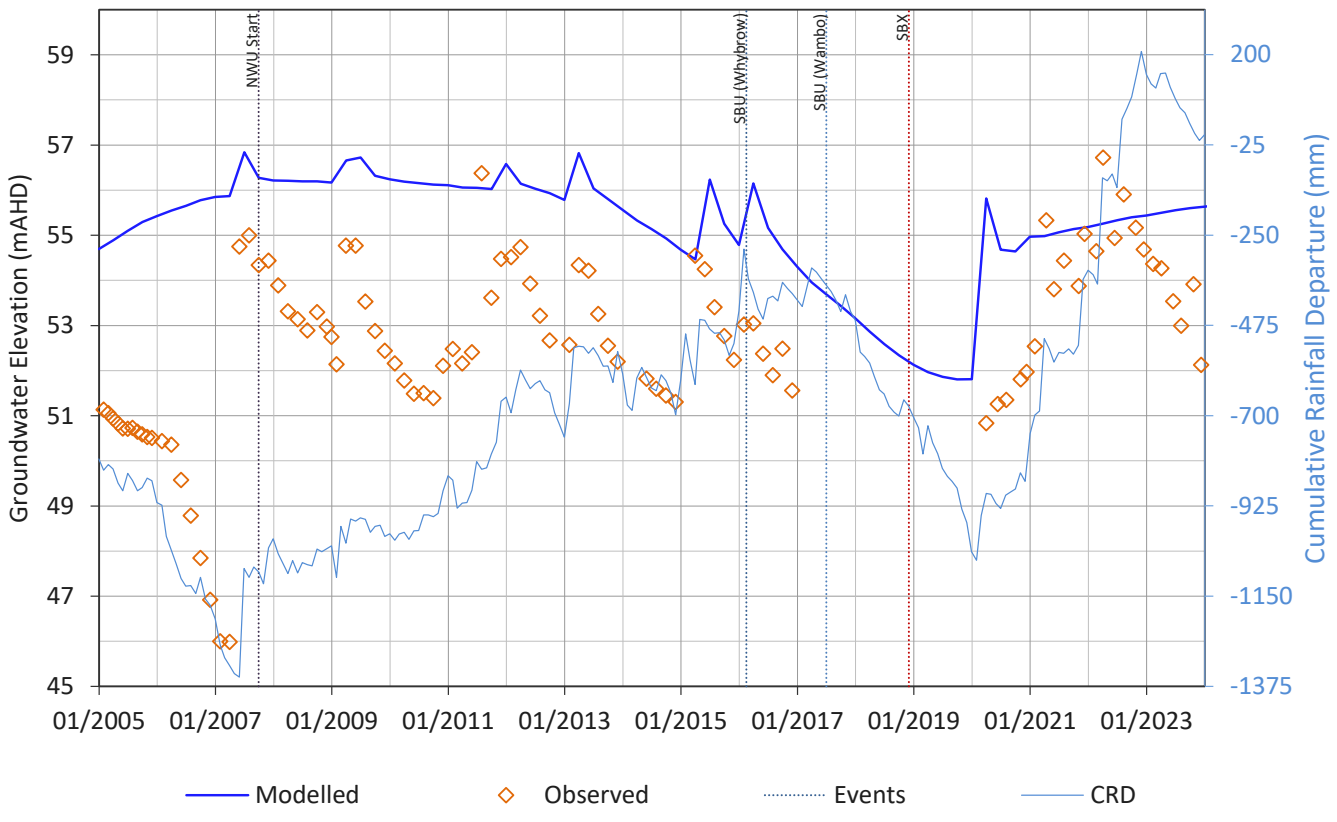
GW25 Model Performance



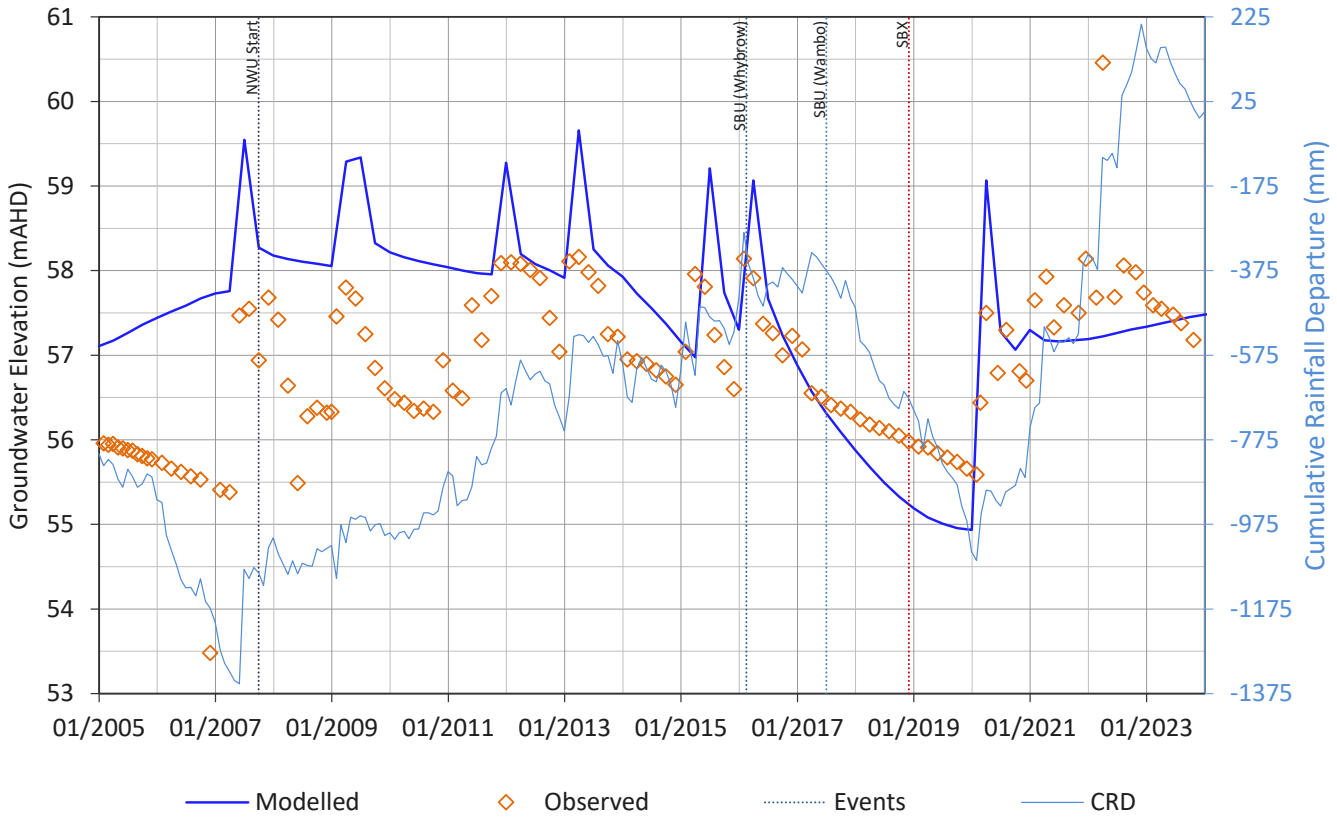
GW26 Model Performance



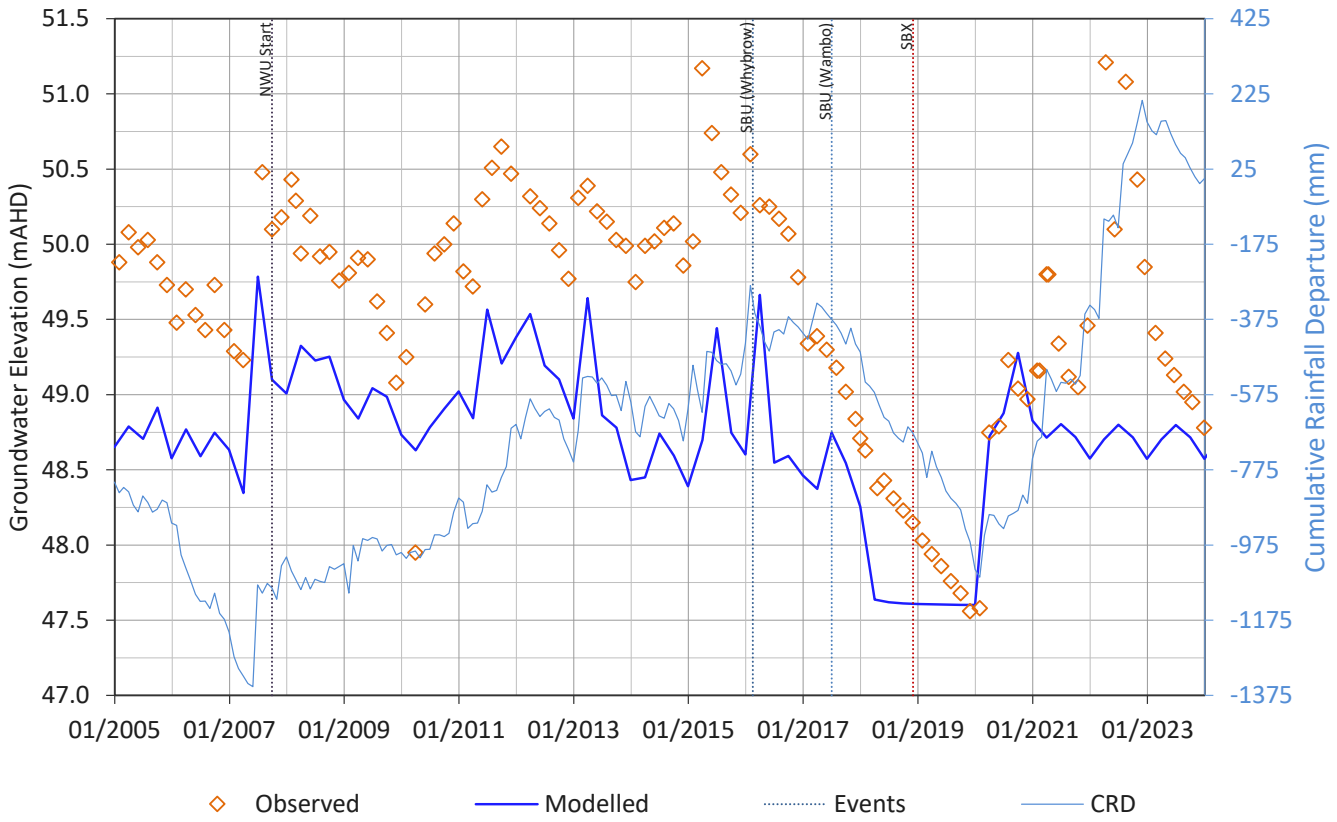
P106 Model Performance



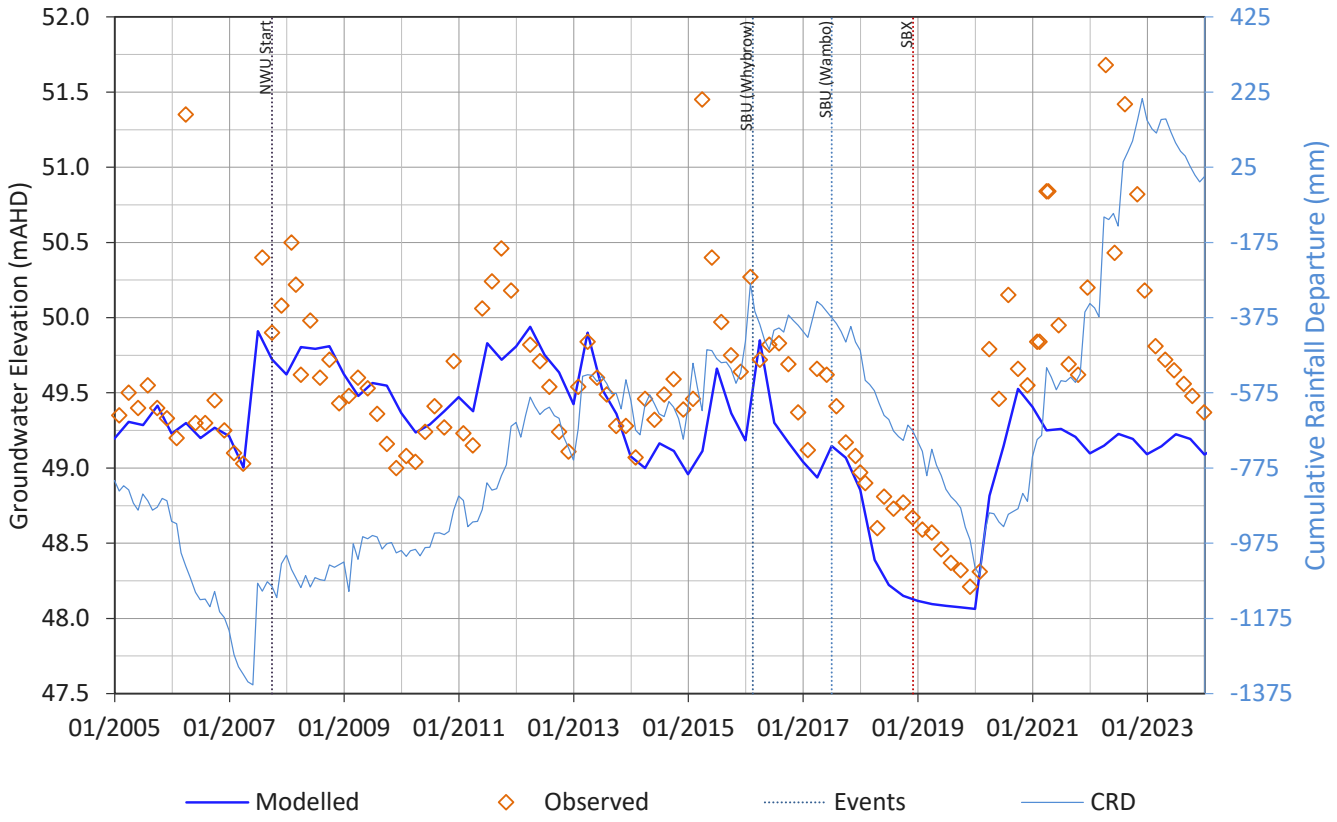
P109 Model Performance



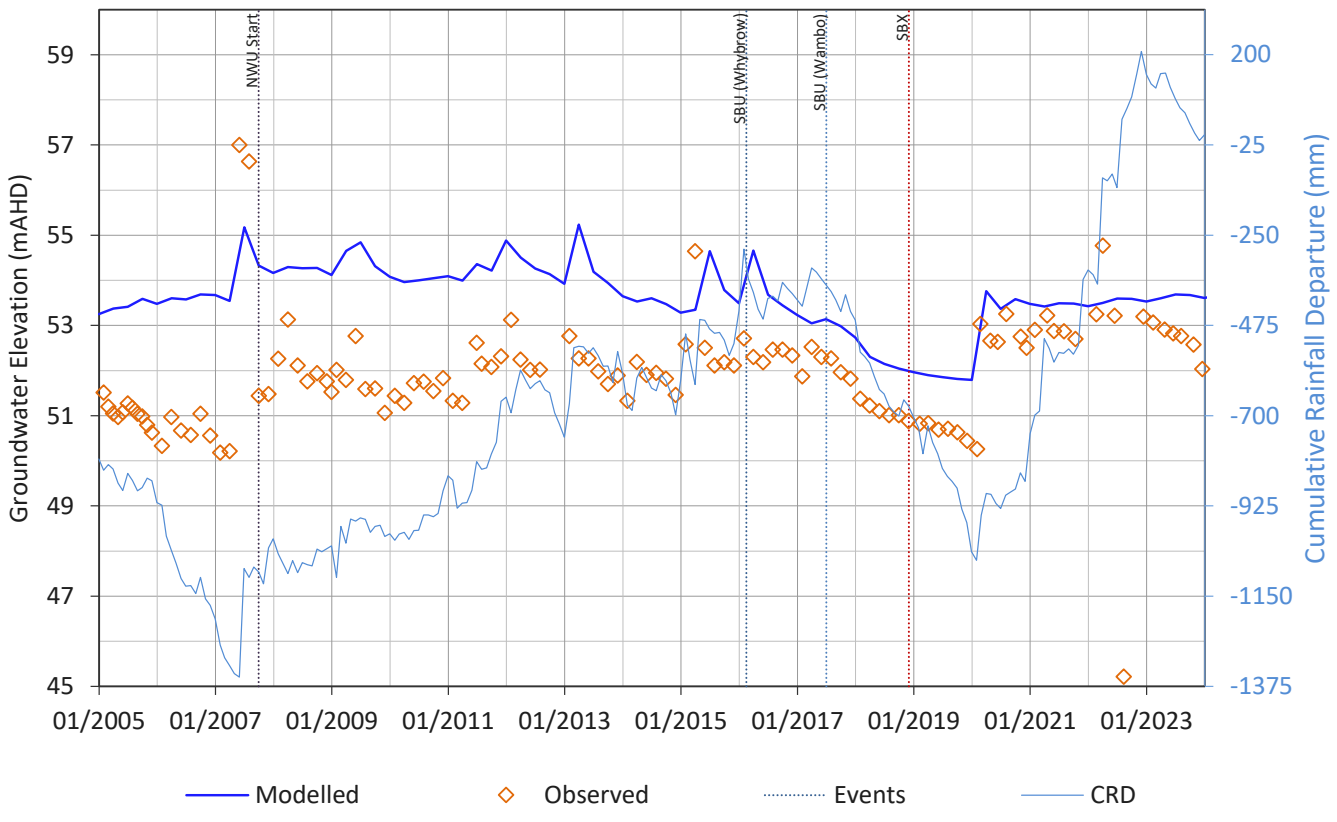
P16 Model Performance

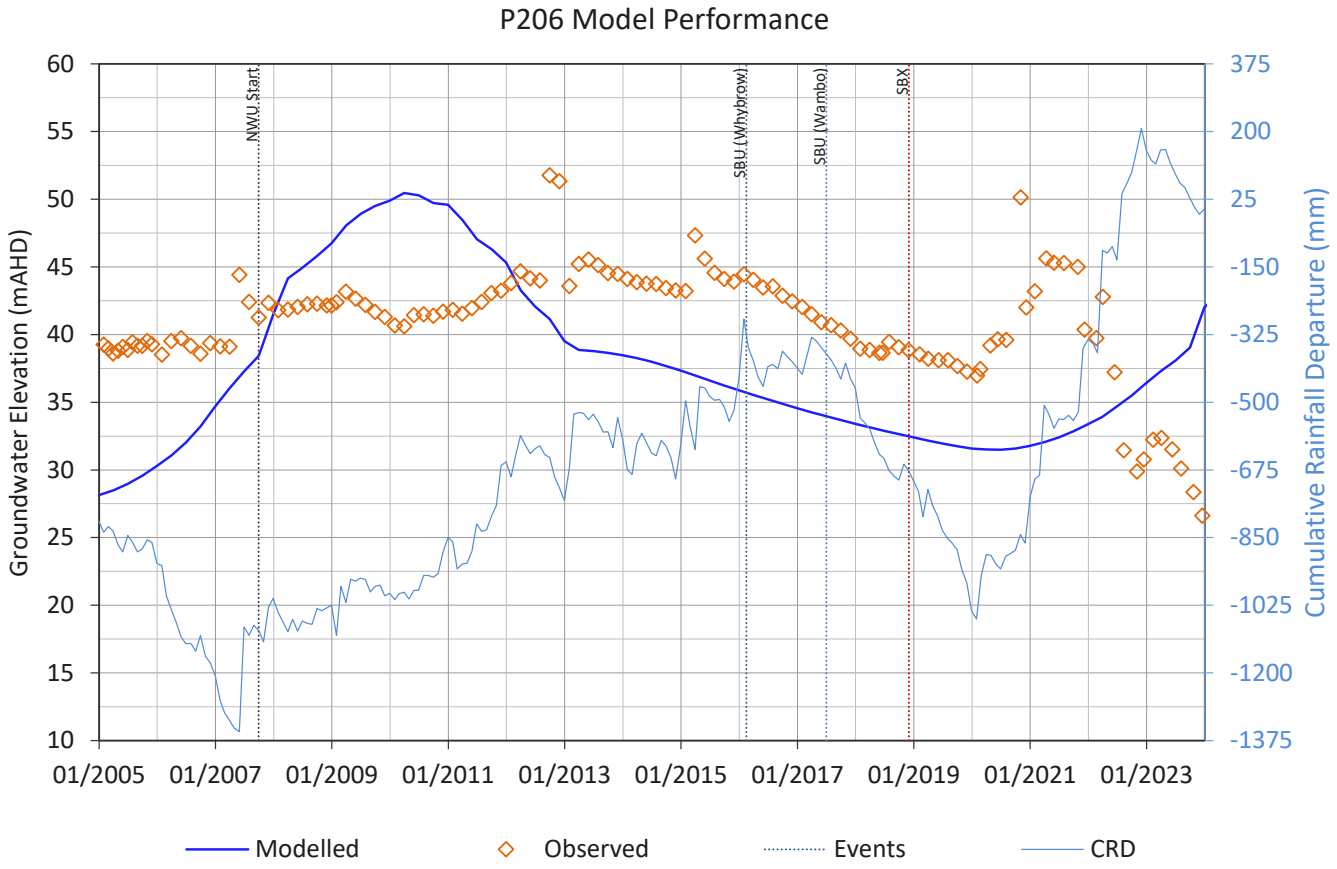


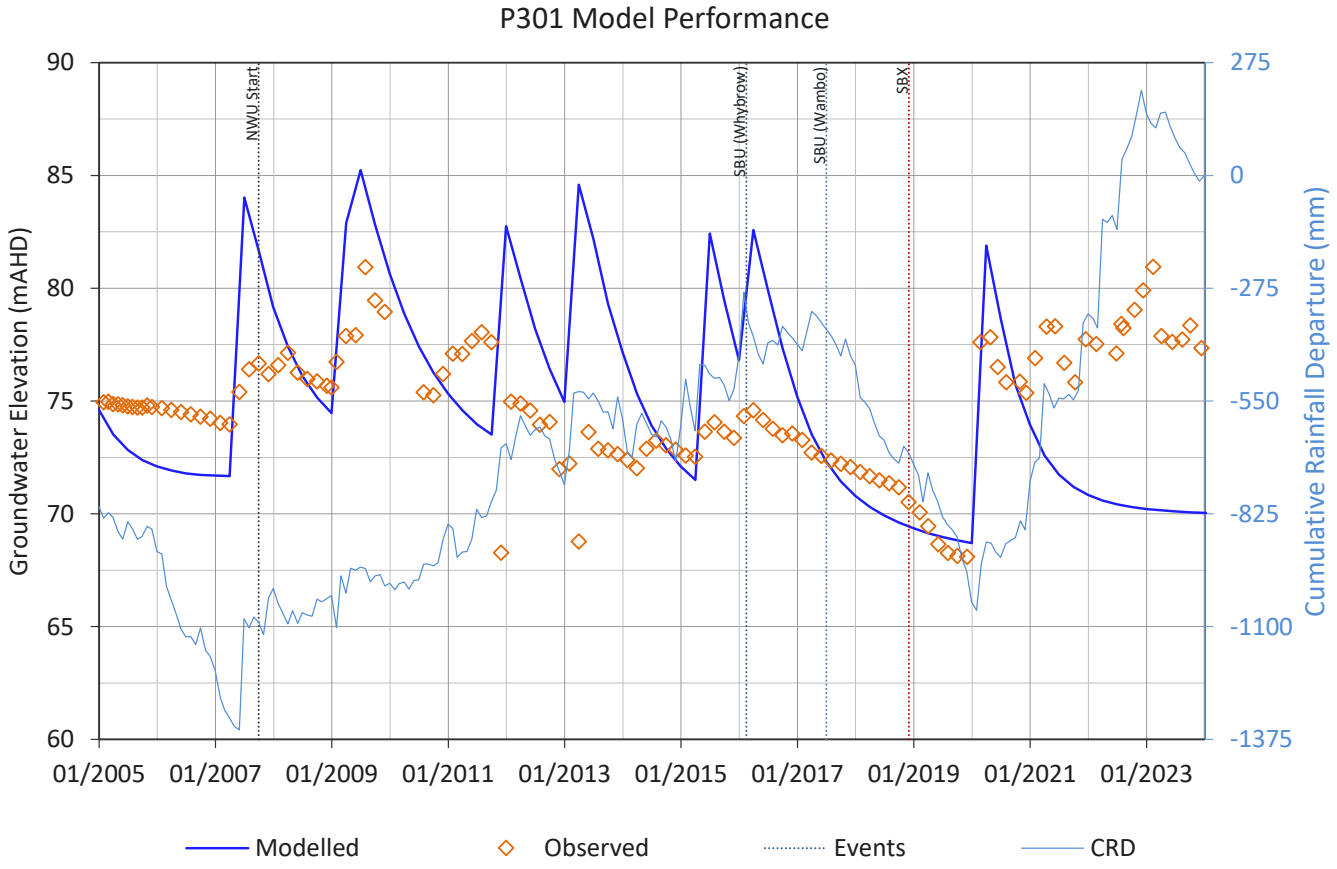
P20 Model Performance



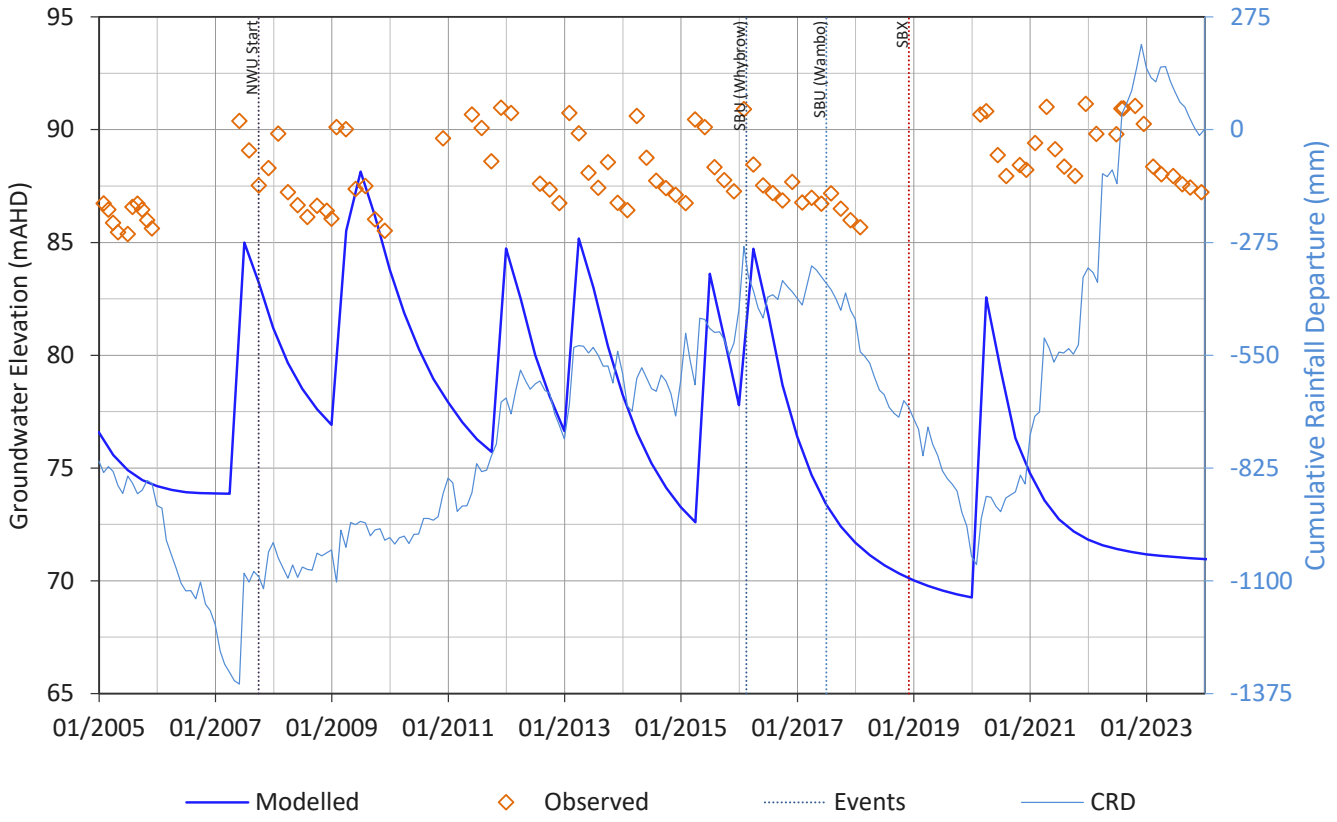
P202 Model Performance



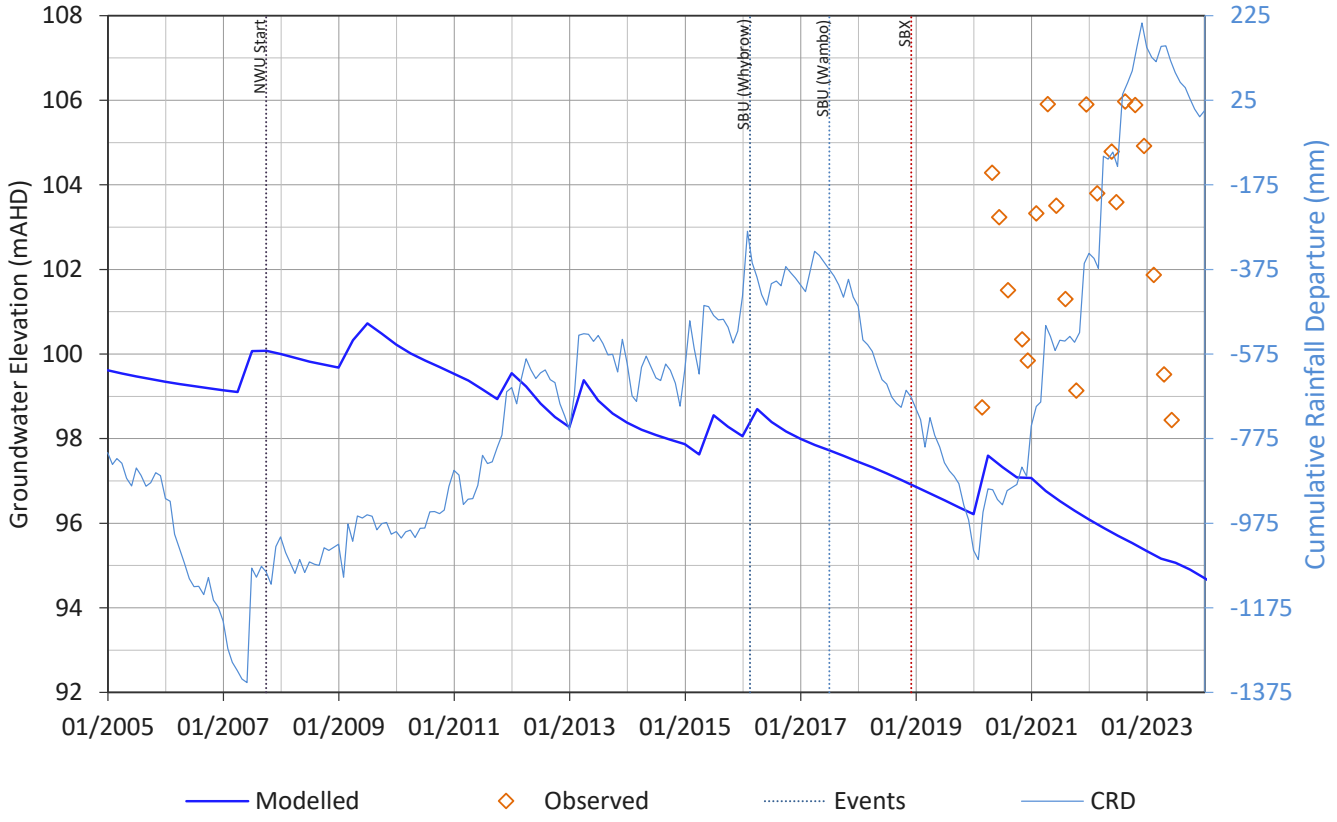

P206 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
60
55
50
45
40
35
30
25
20
15
10
375
200
25
-150
-325
-500
-675
-850
-1025
-1200
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Modelled
Observed
Events
CRD


P301 Model Performance
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
90
85
80
75
70
65
60
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Modelled
Observed
Events
CRD

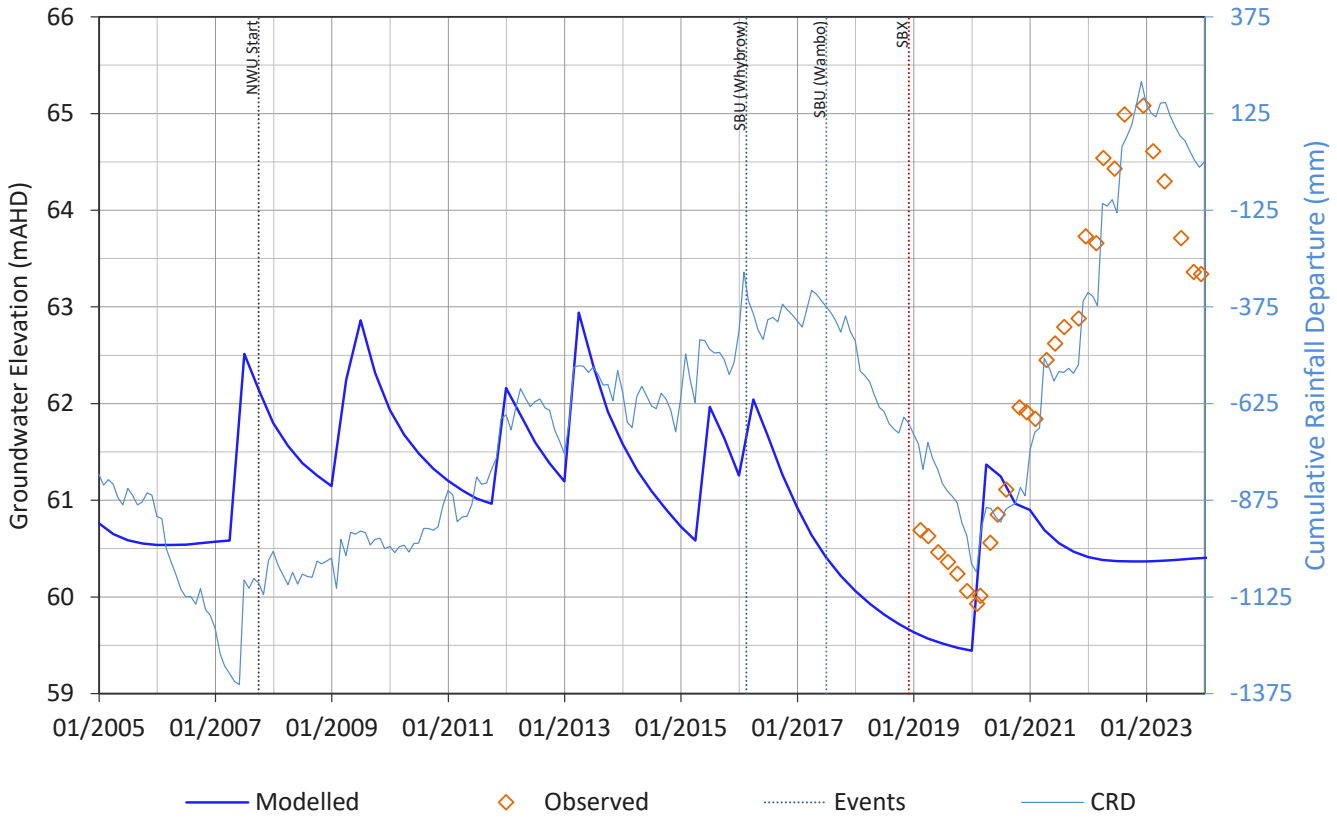
P315 Model Performance



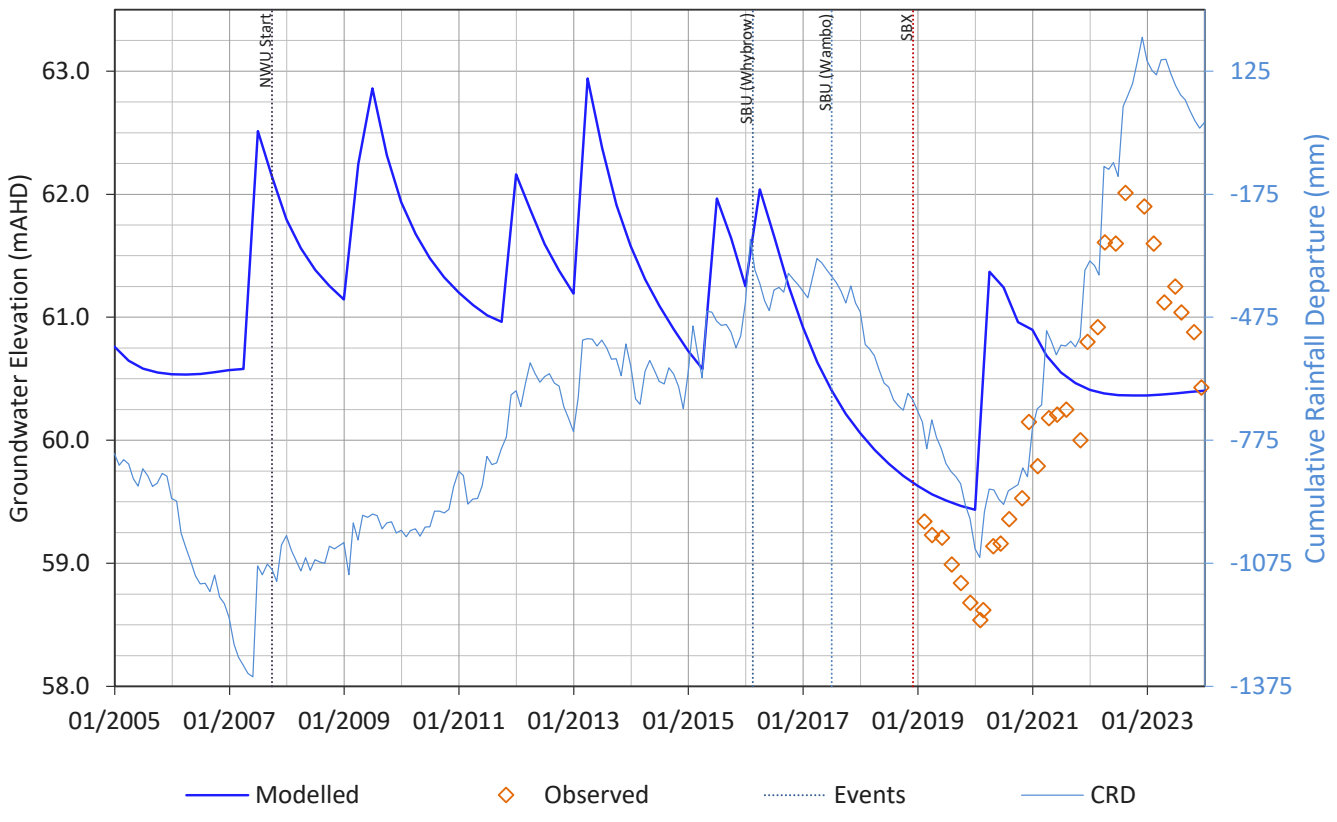
GW35 Model Performance



PNWU-08A Model Performance



PNWU-08B Model Performance



Appendix B Groundwater Level and Groundwater Quality Graphs

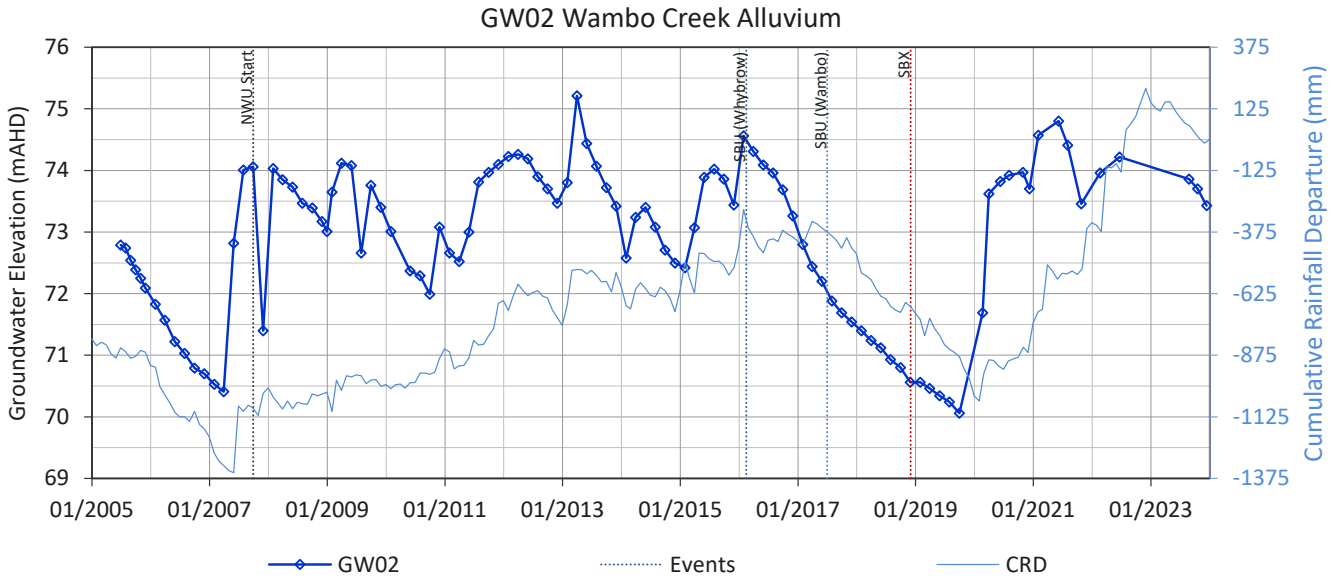
Groundwater Annual Review - 2023

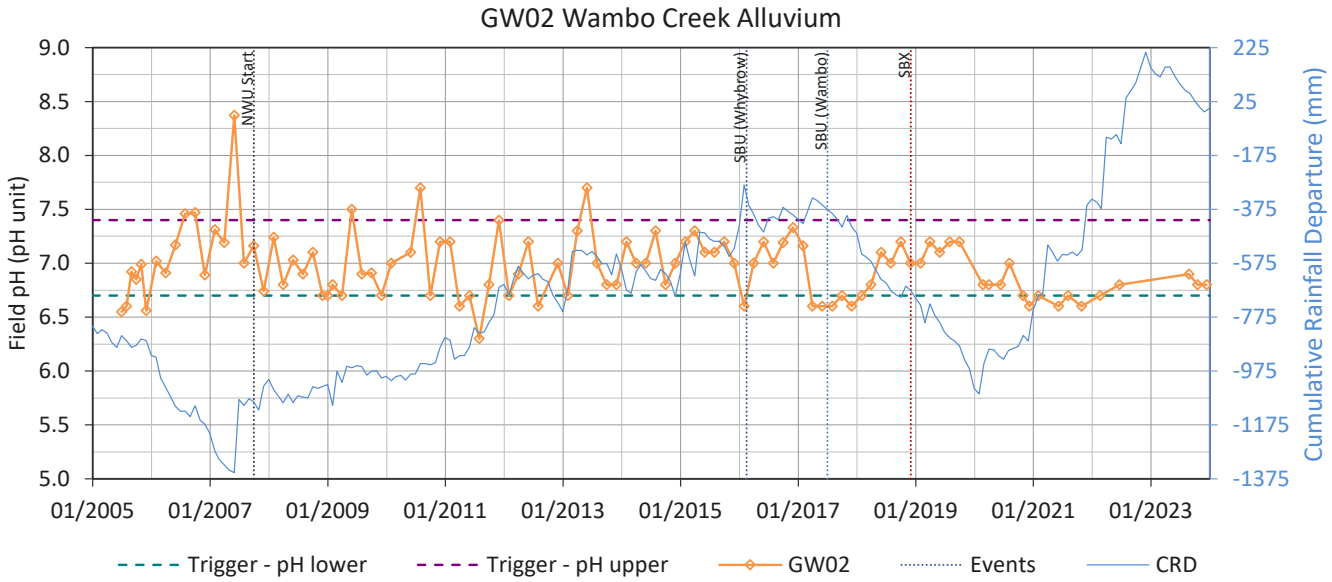
Wambo Coal Mine

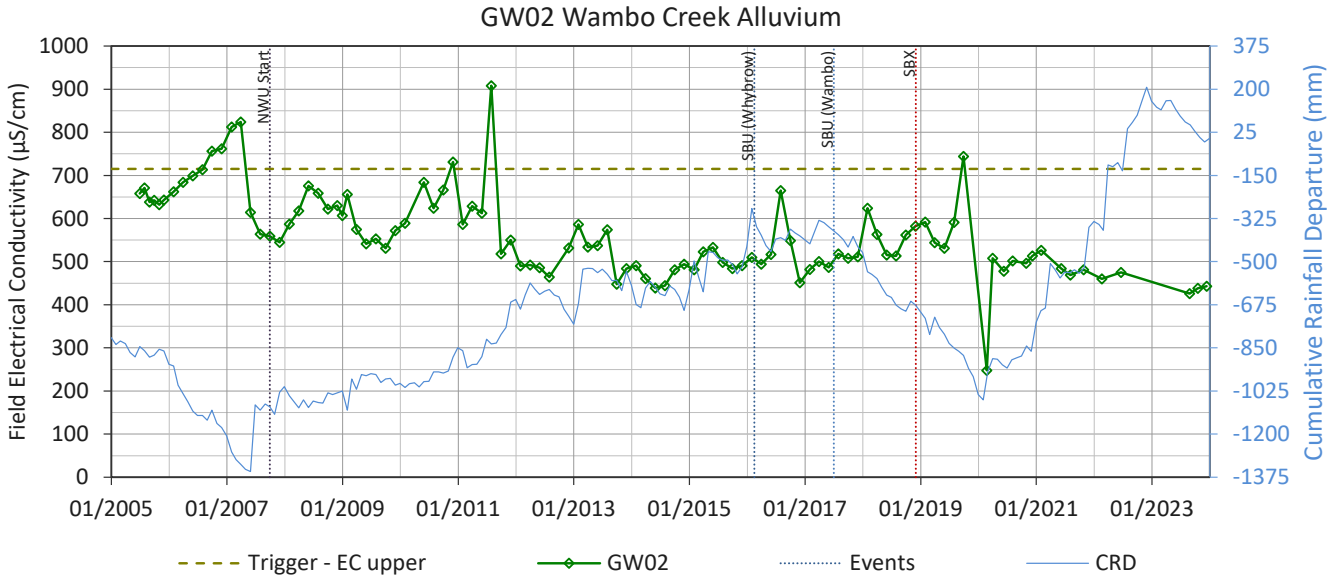
Wambo Coal Pty Ltd

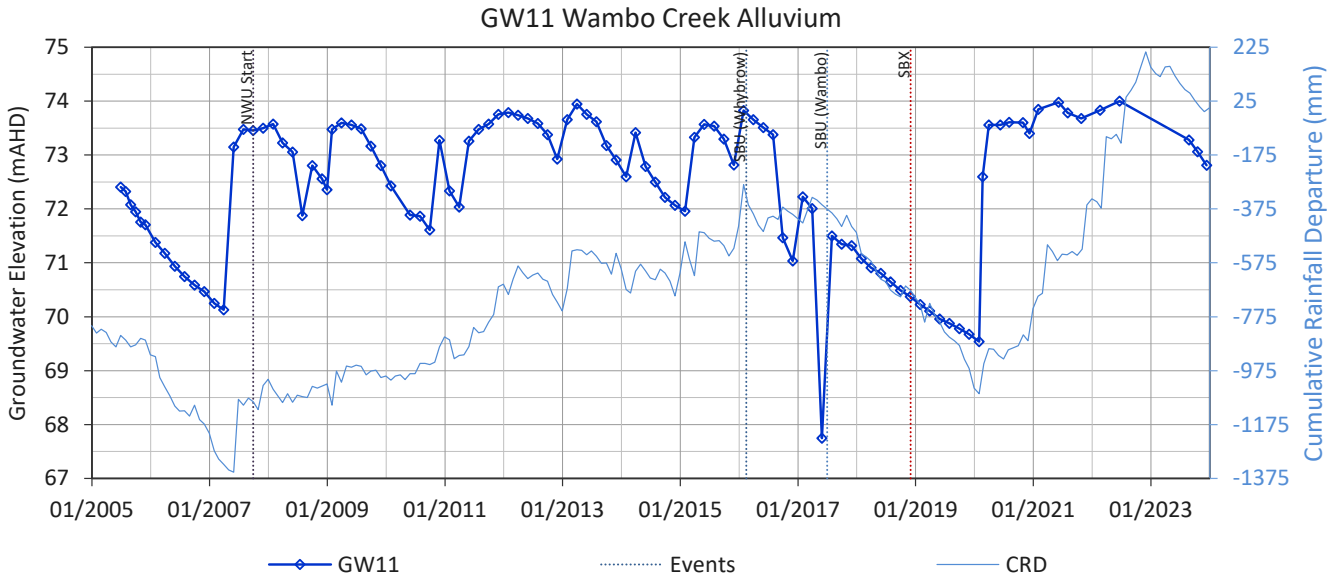
SLR Project No.: 665.v10008.02023

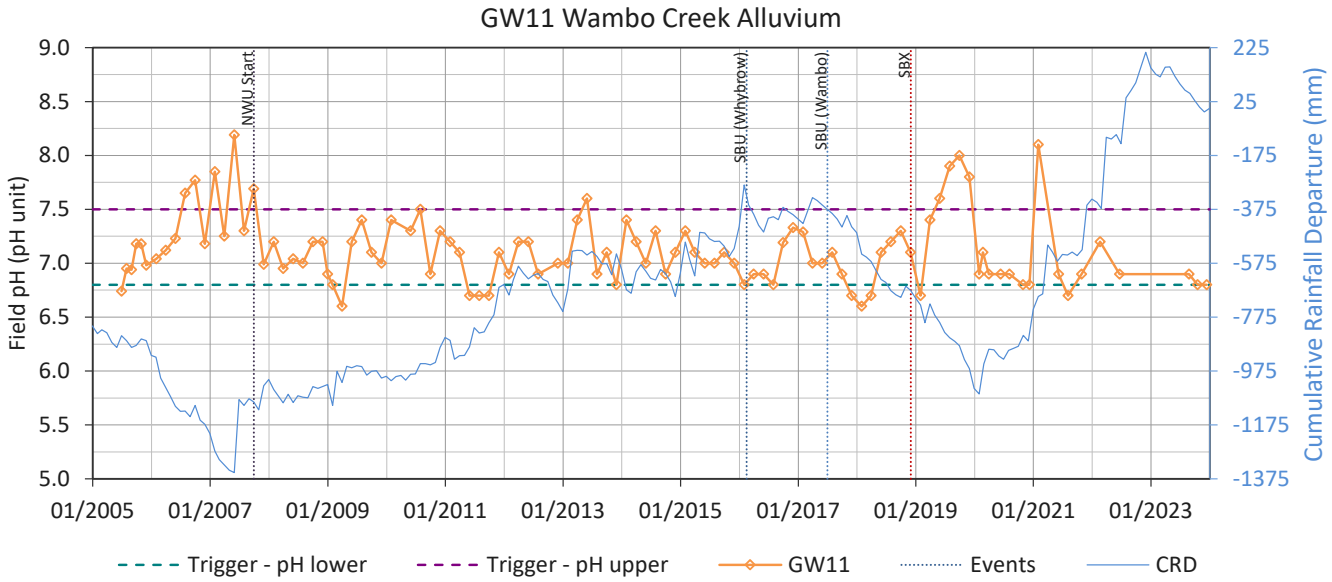
21 March 2024

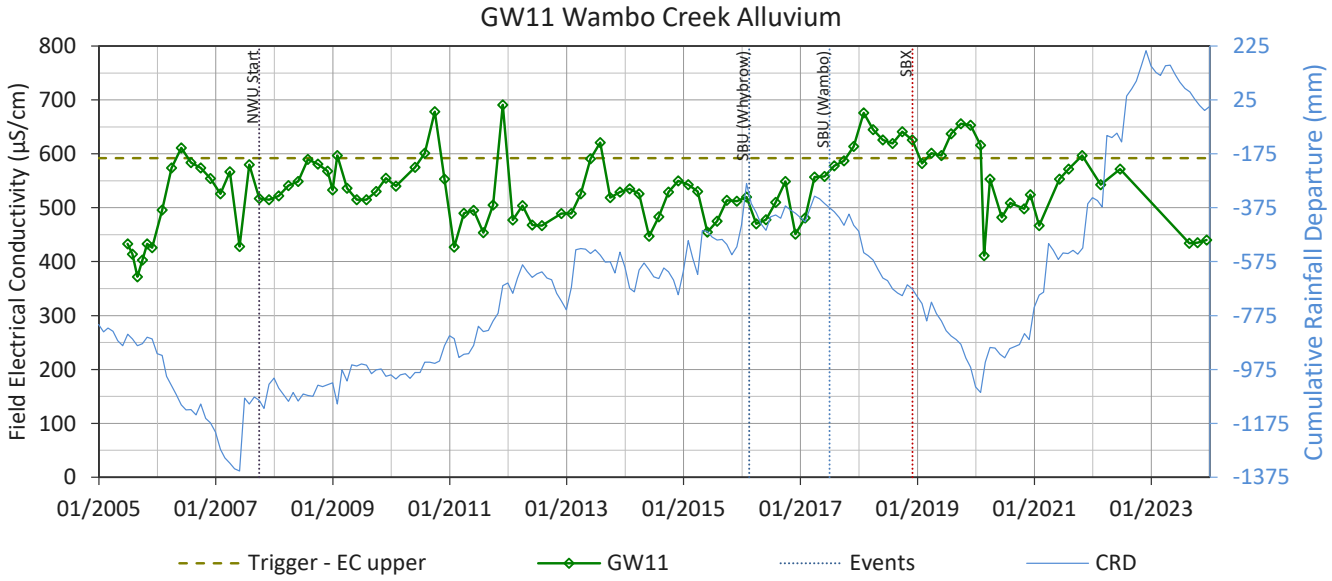

GW02 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW02
Events
CRD

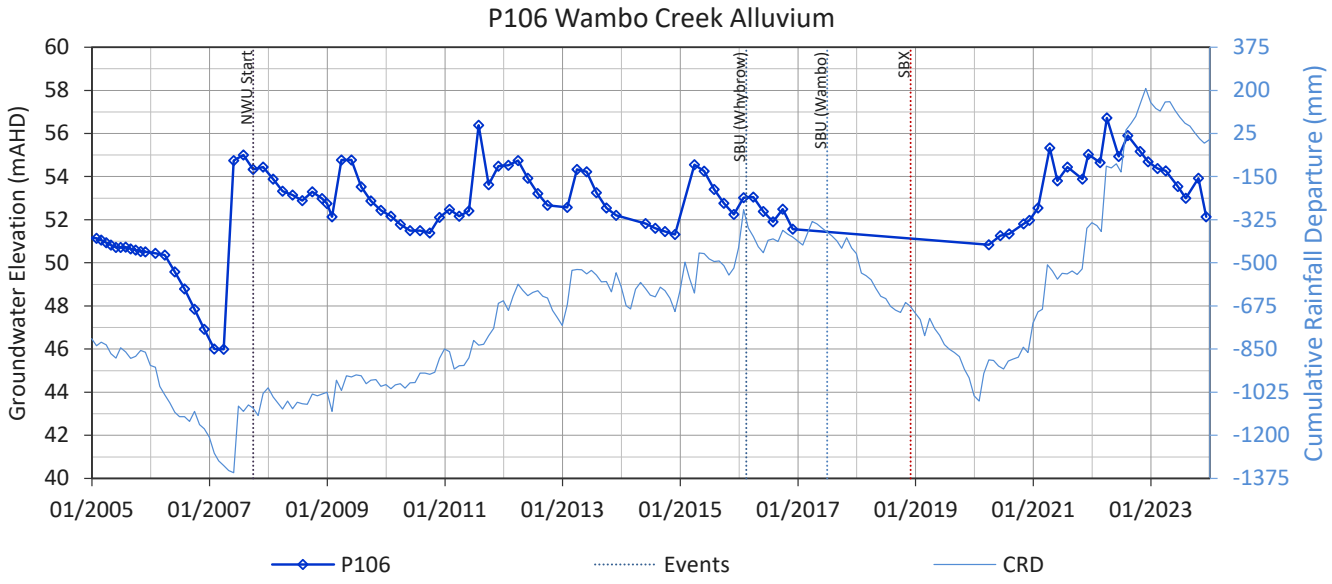

GW02 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
GW02
Events
CRD

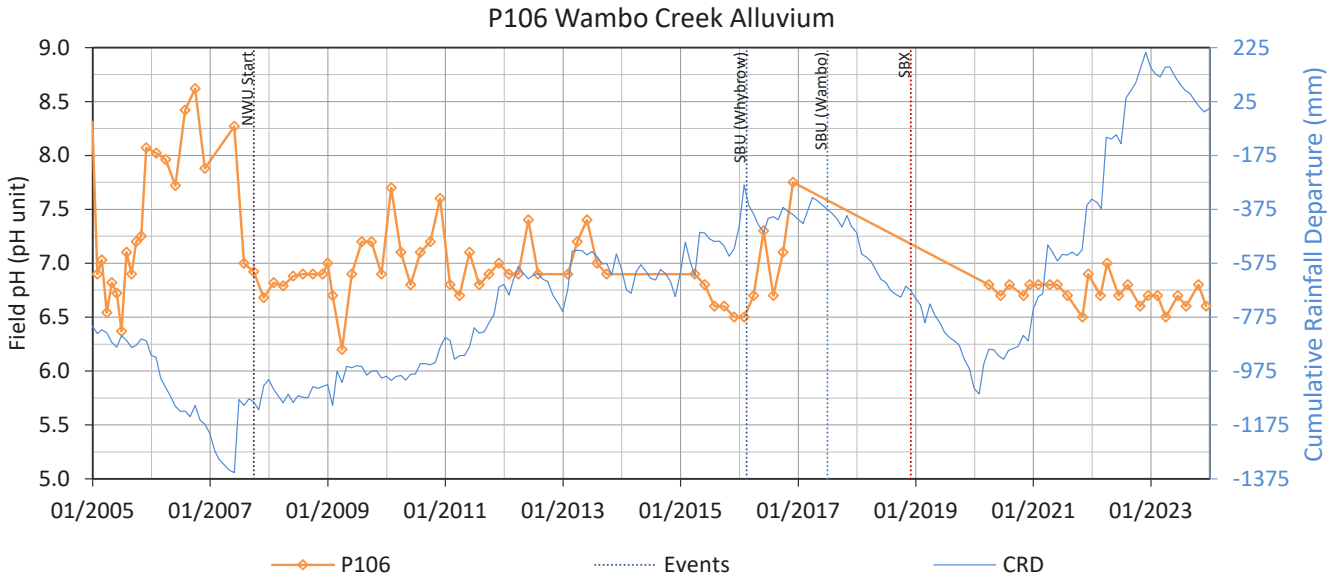

GW02 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
GW02
Events
CRD

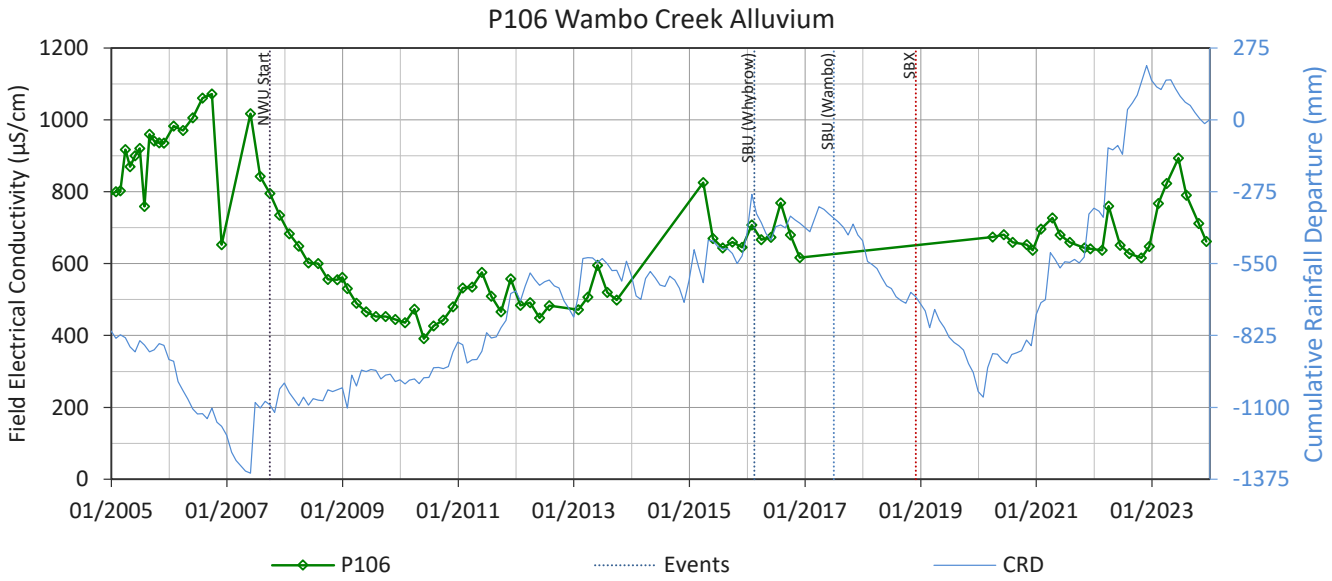

GW11 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW11
Events
CRD

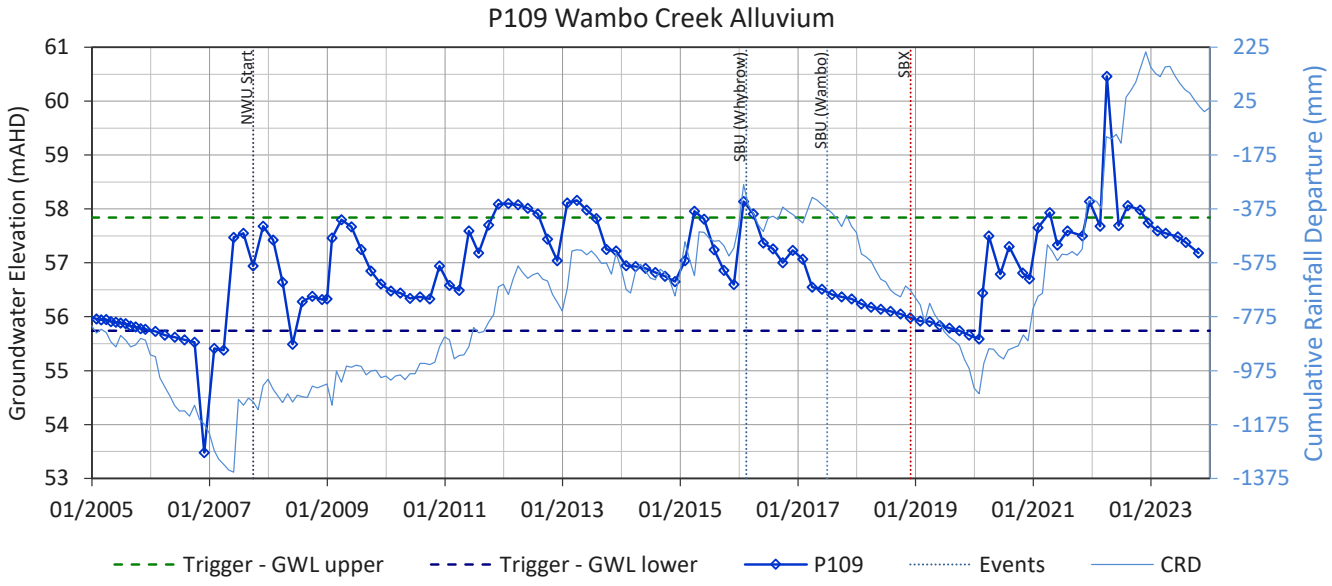

GW11 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
GW11
Events
CRD

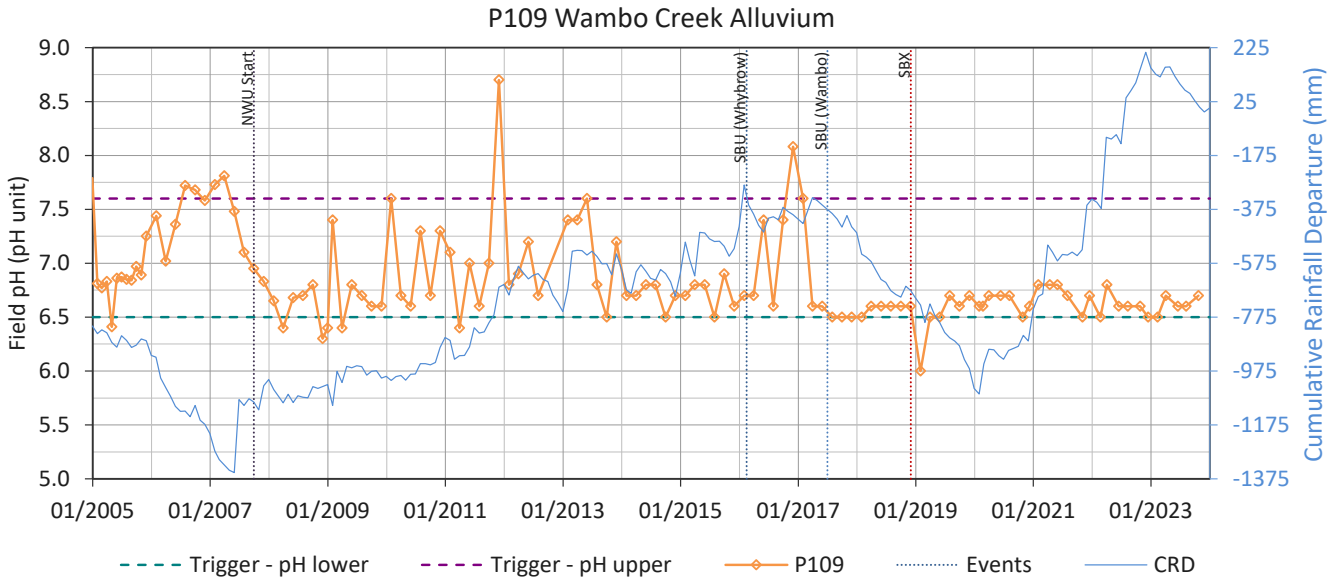

GW11 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
GW11
Events
CRD

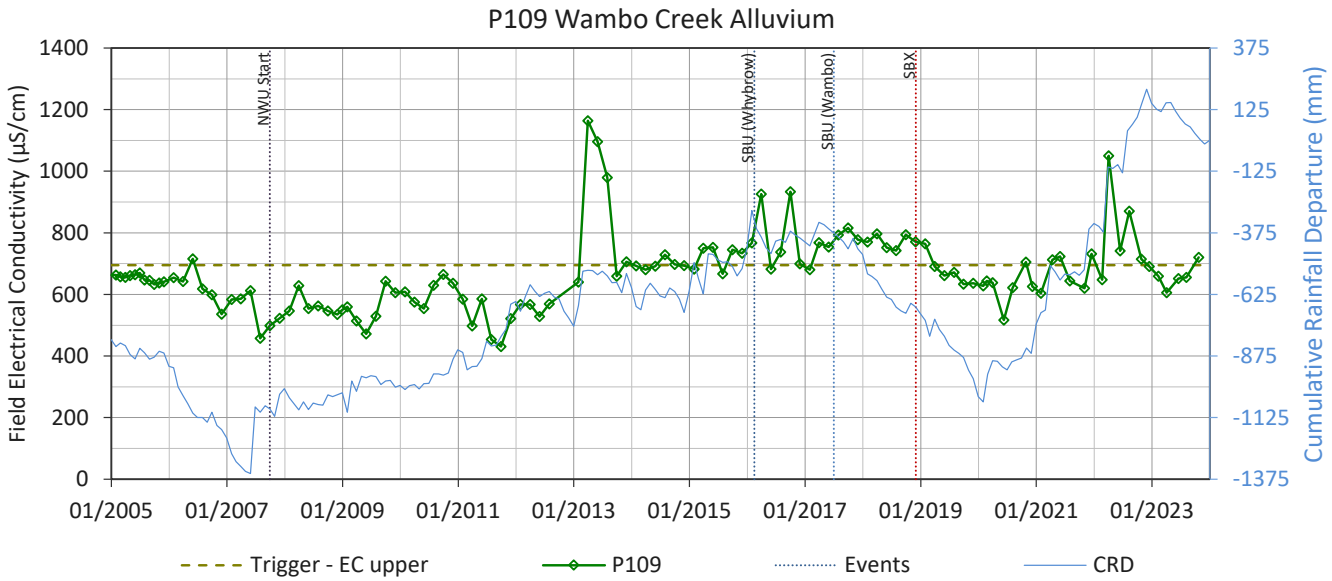

P106 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

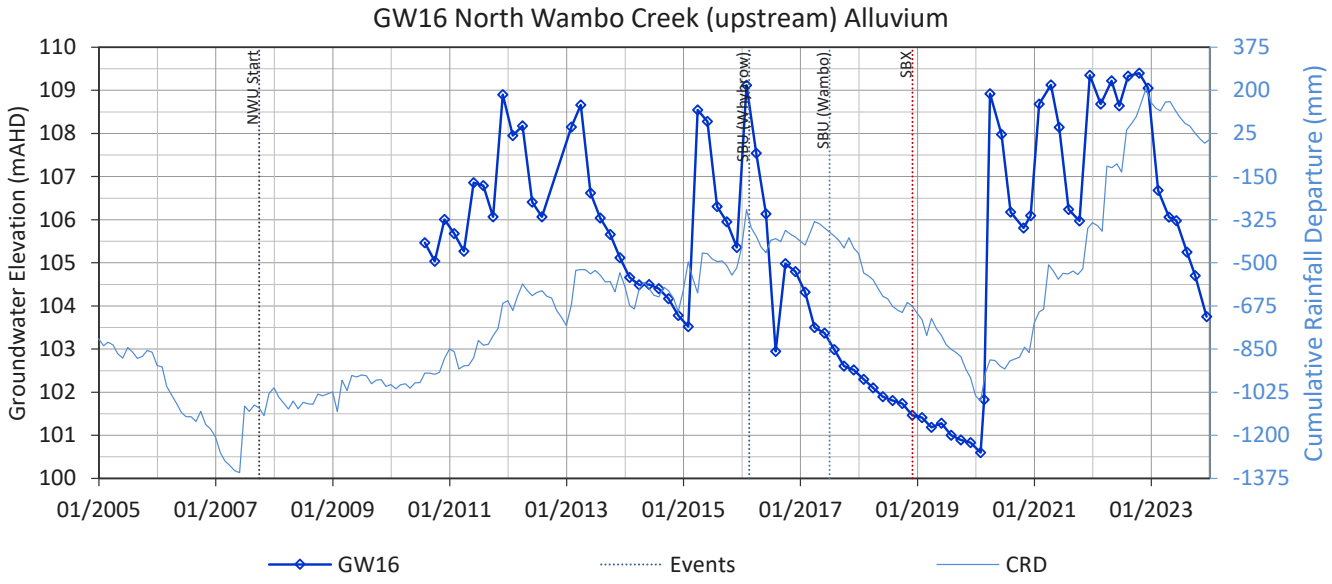

P106 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

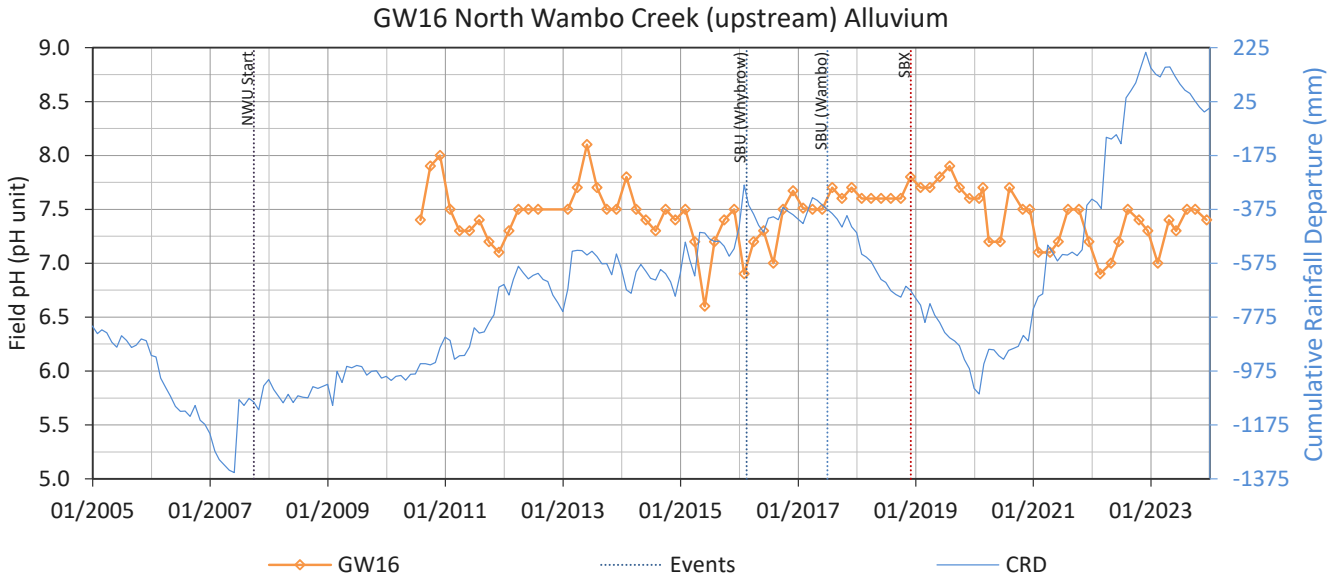

P106 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P106
Events
CRD

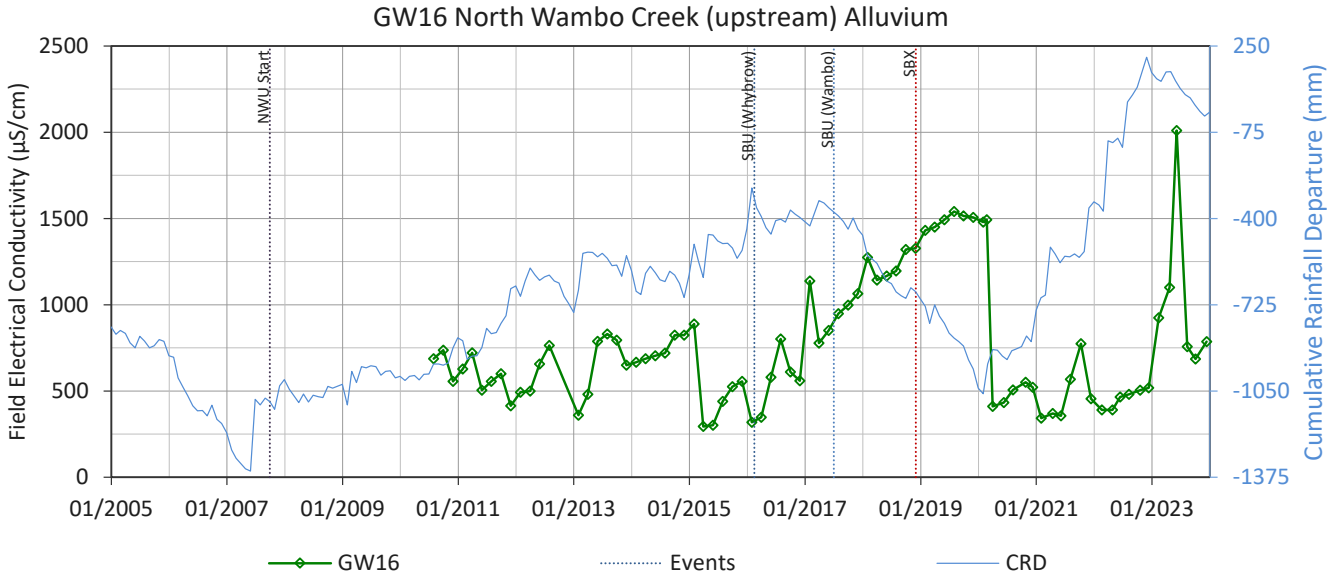

P109 Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - GWL upper
Trigger - GWL lower
P109
Events
CRD

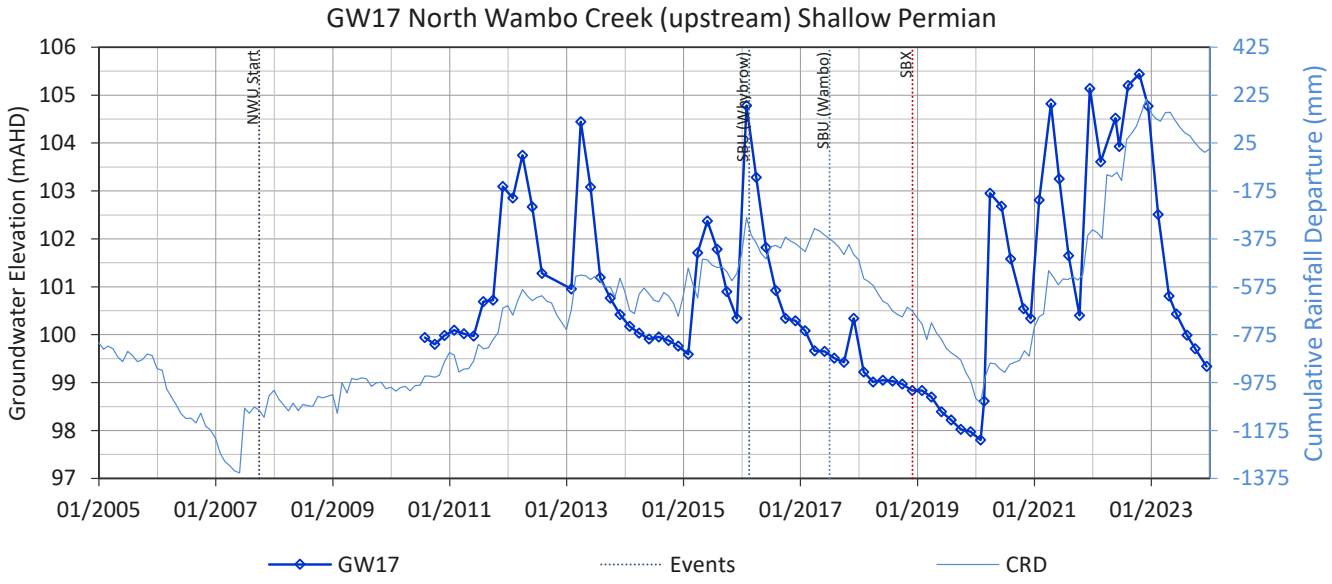

P109 Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
P109
Events
CRD

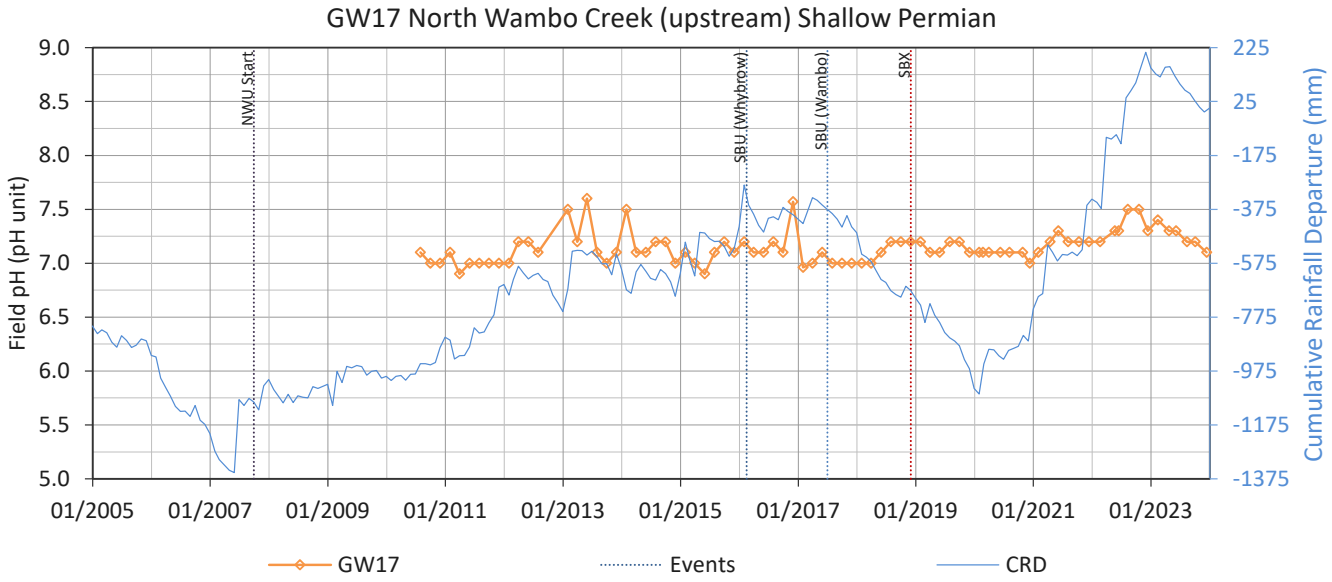

P109 Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
P109
Events
CRD

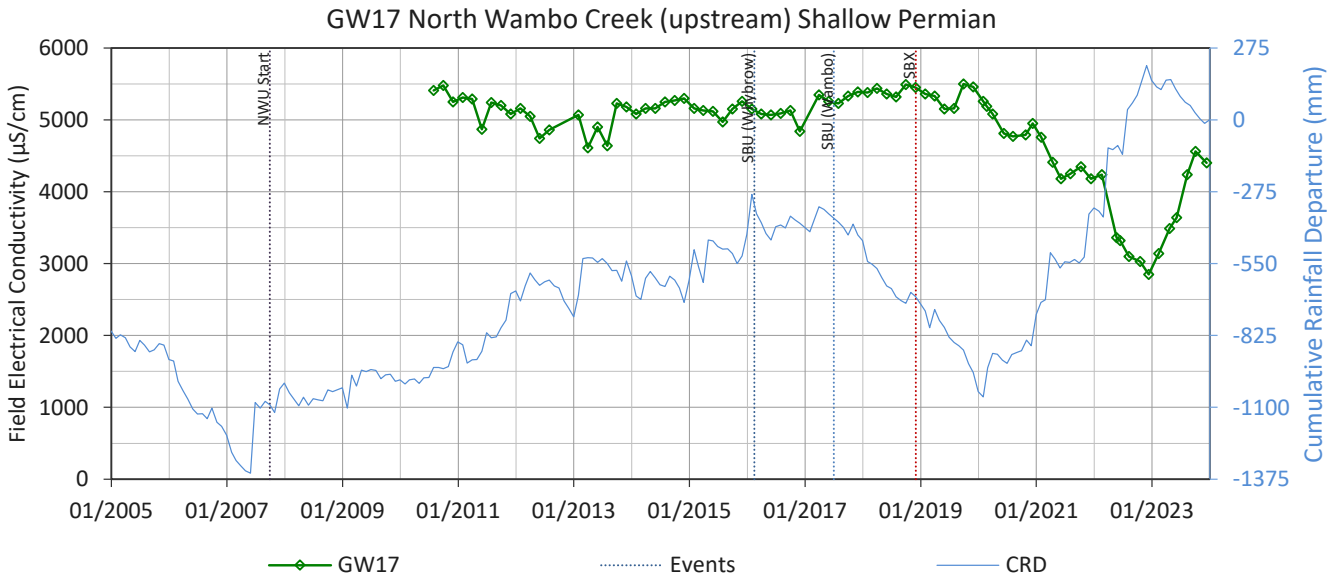

GW16 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

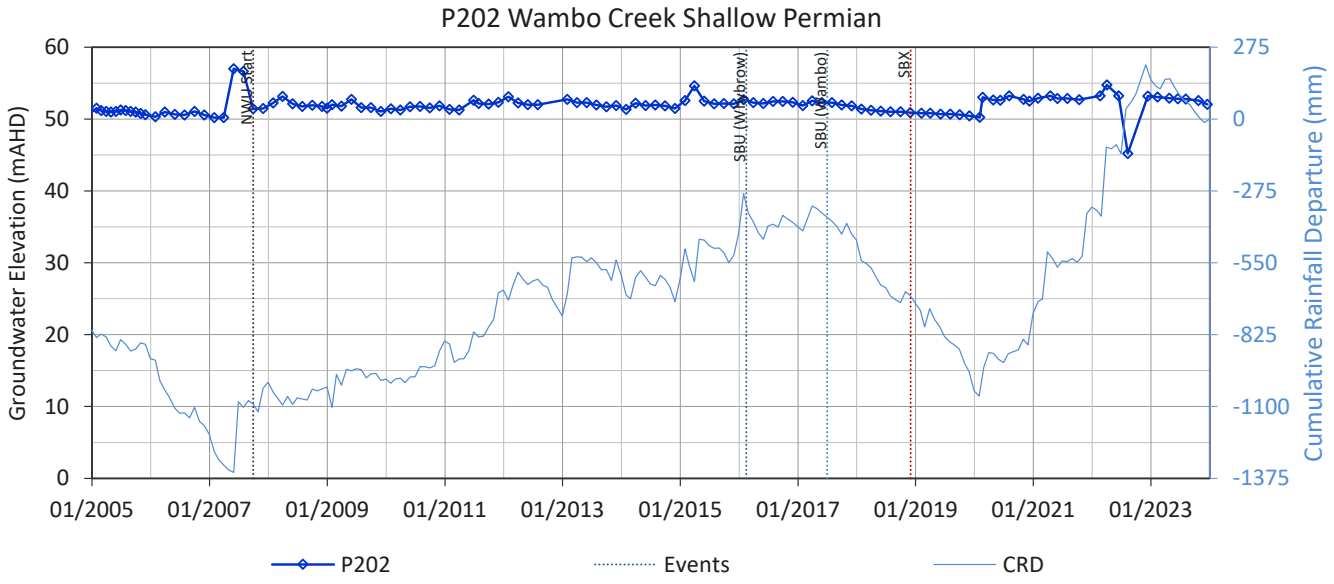

GW16 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

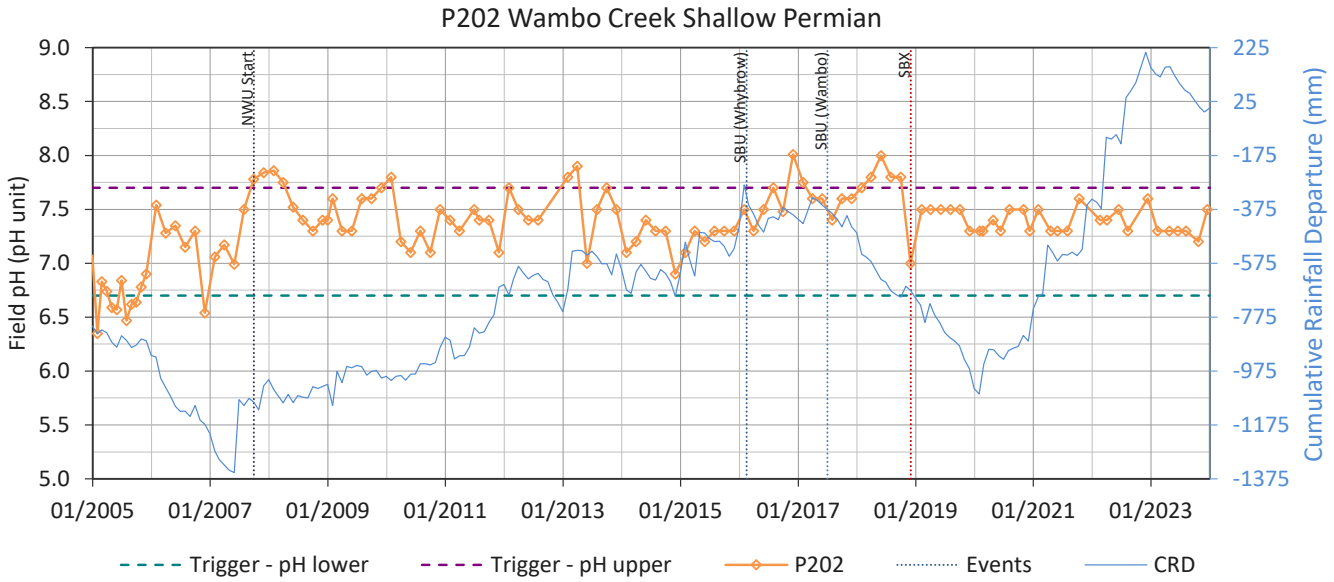

GW16 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW16
Events
CRD

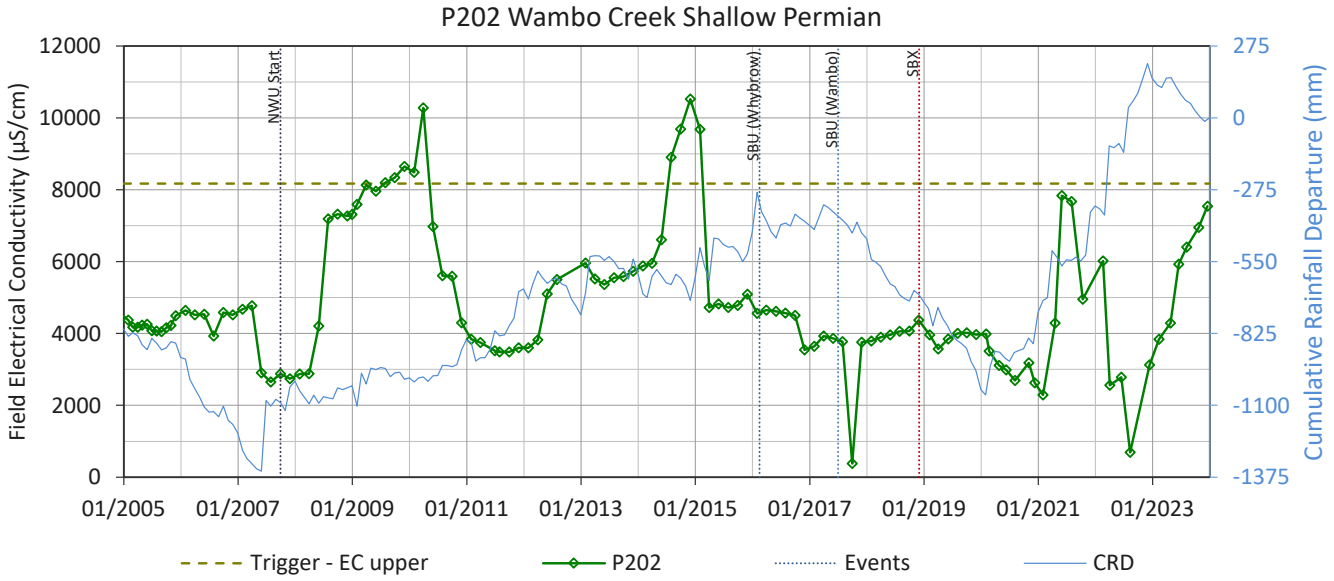

GW17 North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

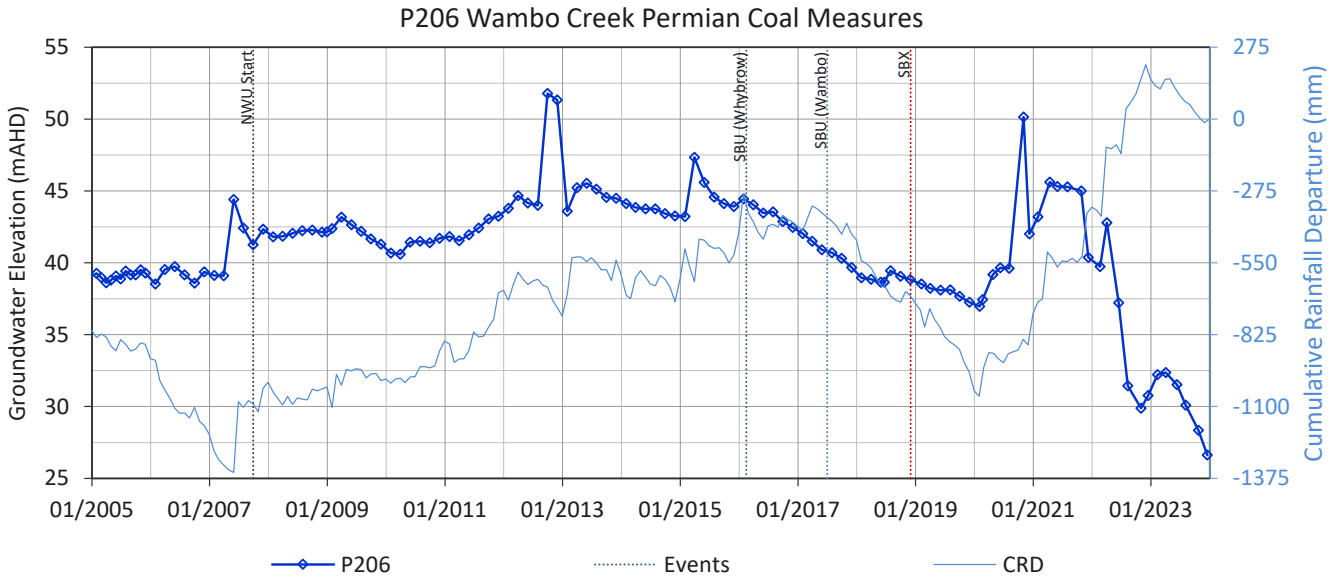

GW17 North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

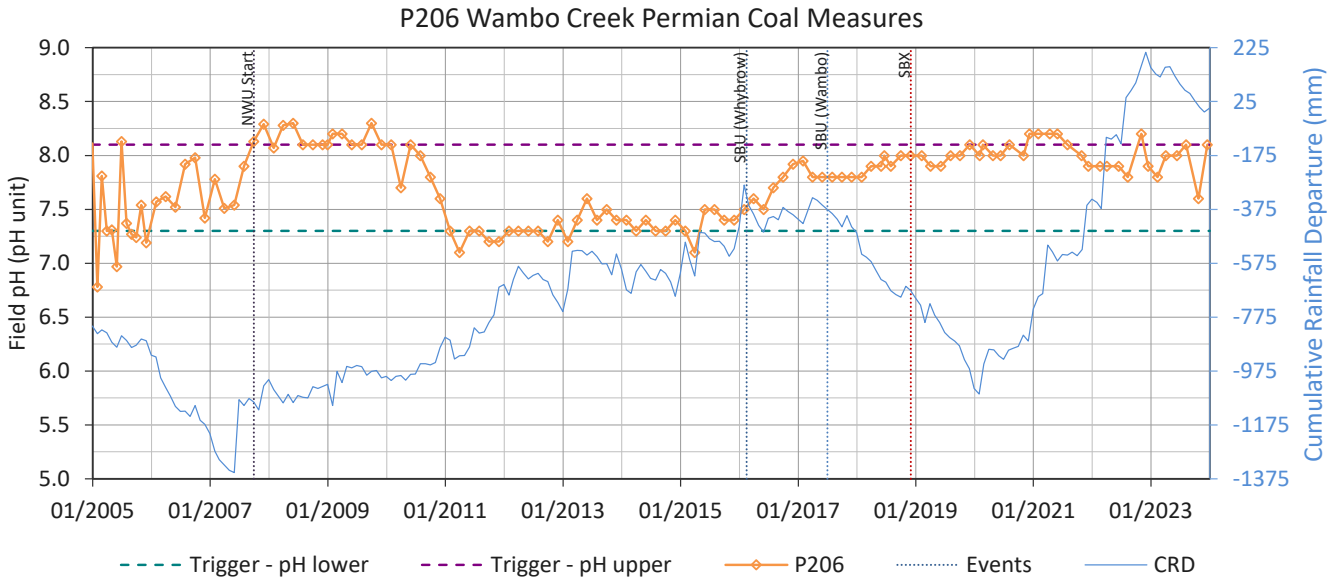

GW17 North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW17
Events
CRD

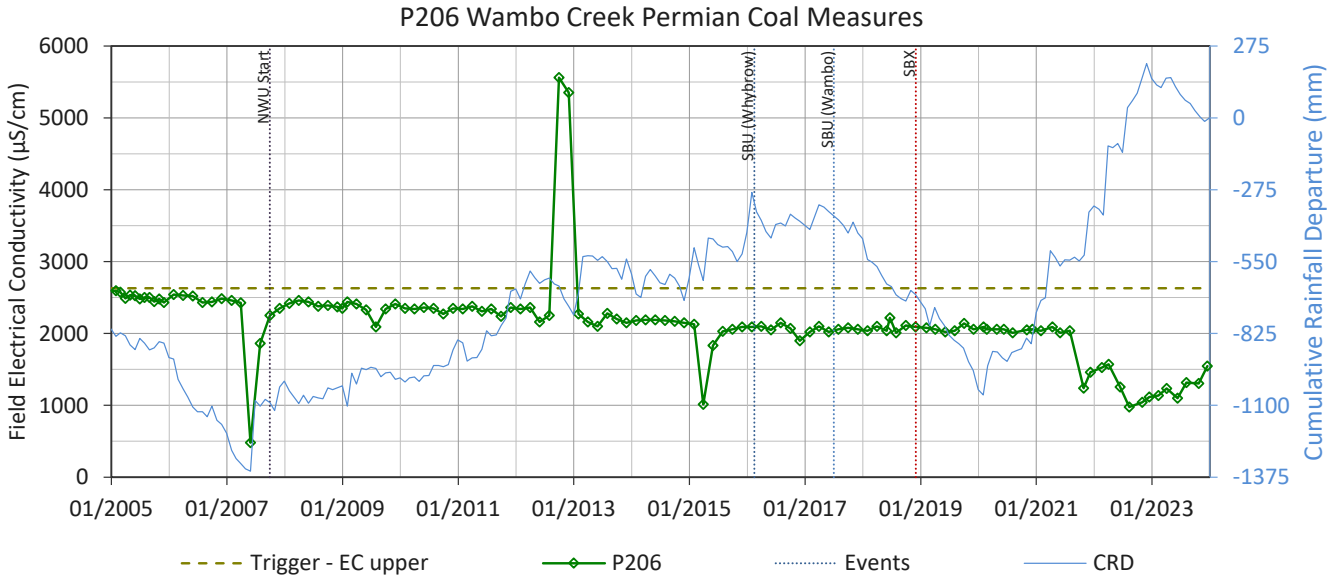

P202 Wambo Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P202
Events
CRD

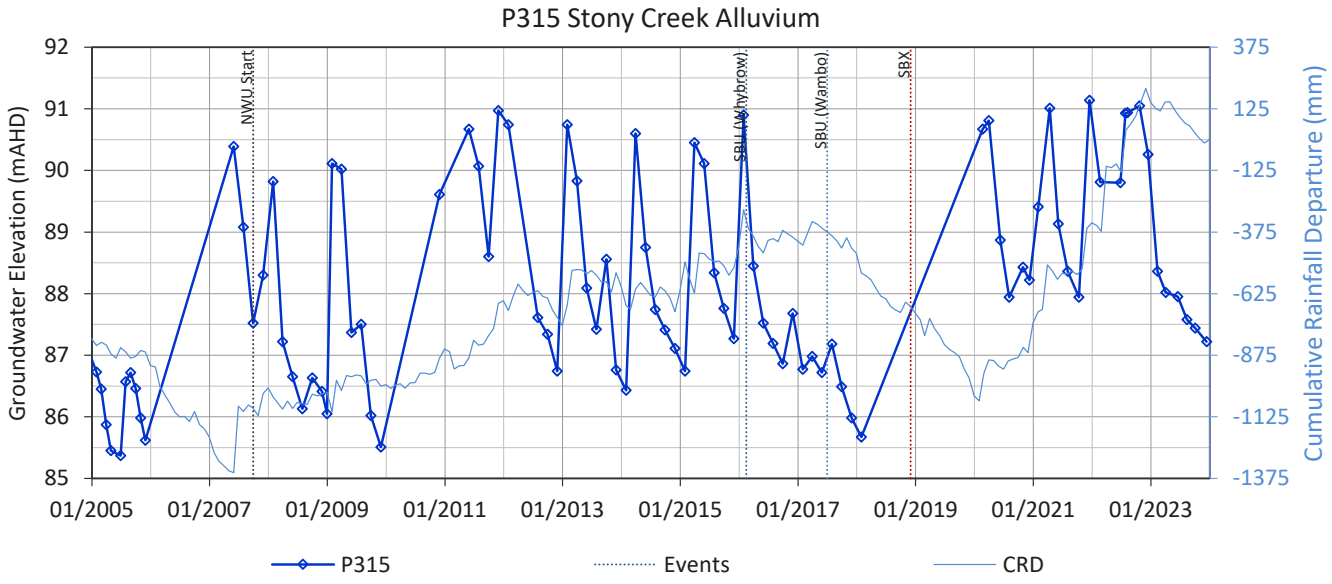

P202 Wambo Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
P202
Events
CRD

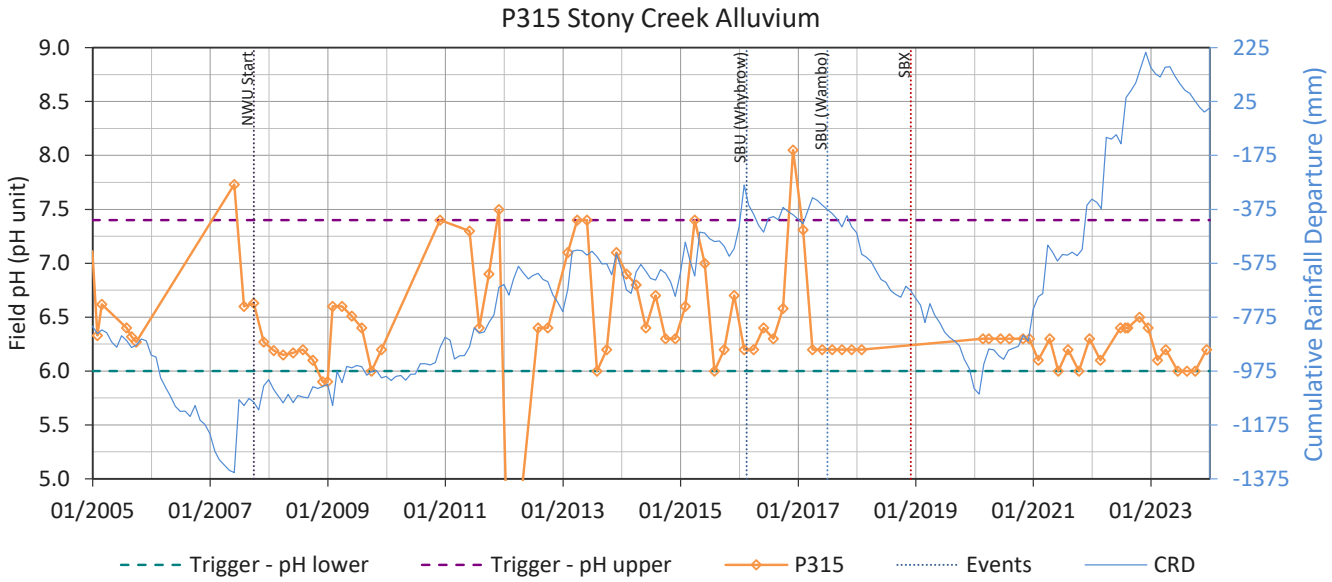

P202 Wambo Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
P202
Events
CRD

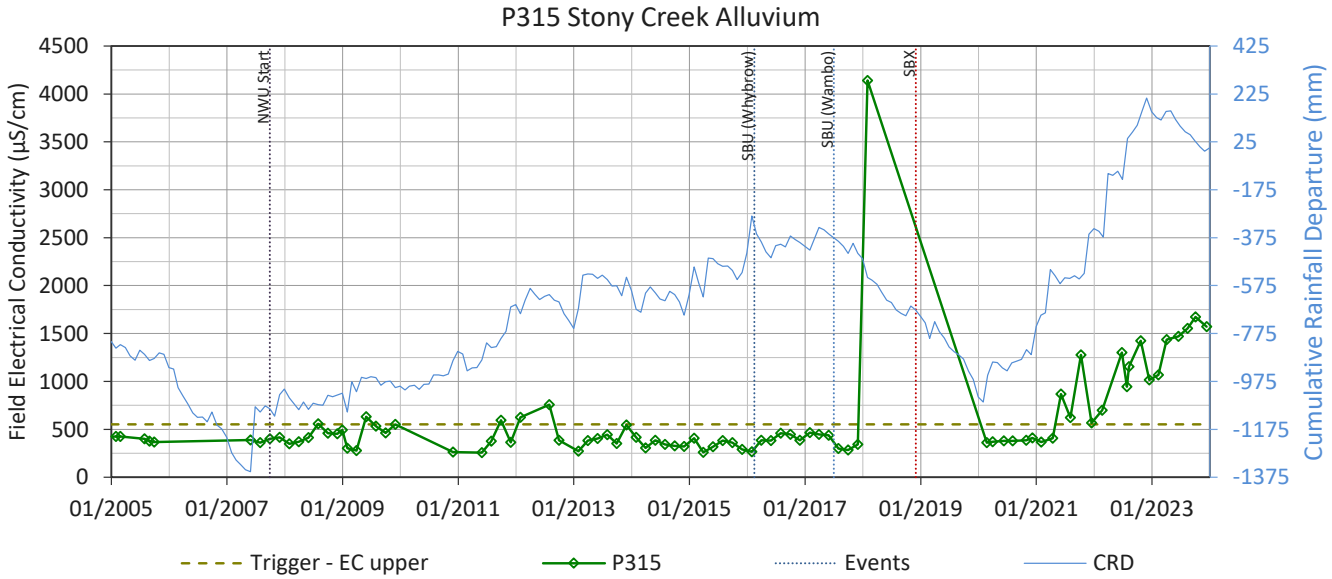

P206 Wambo Creek Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
55
50
45
40
35
30
25
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P206
Events
CRD

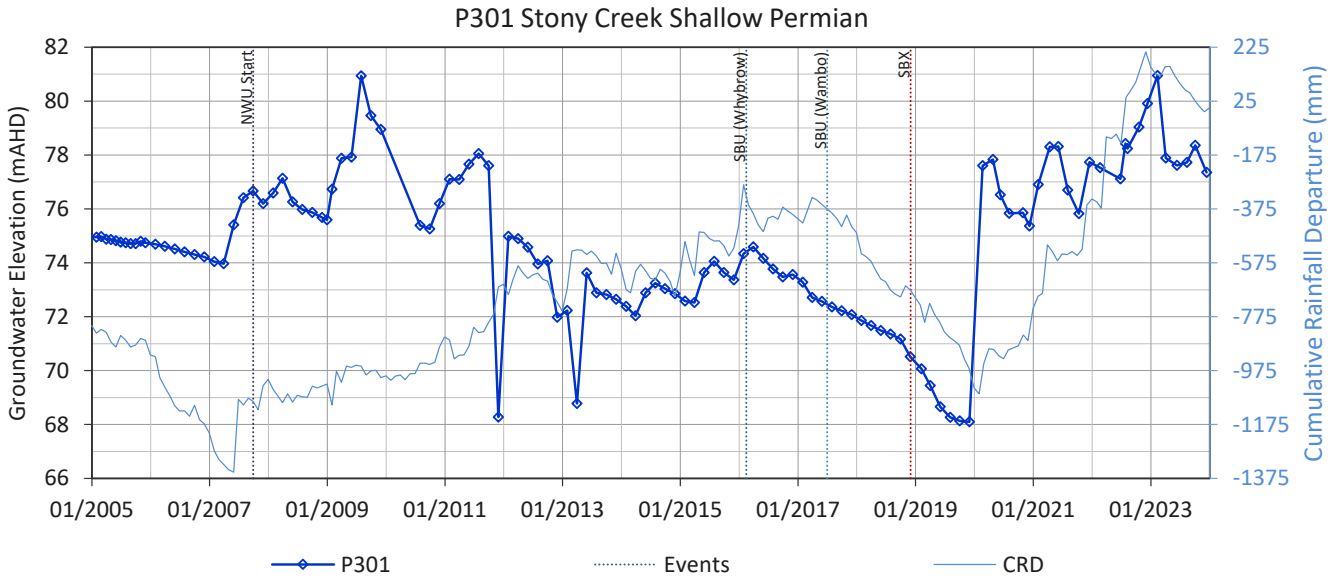

P206 Wambo Creek Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Trigger - pH lower
Trigger - pH upper
P206
Events
CRD

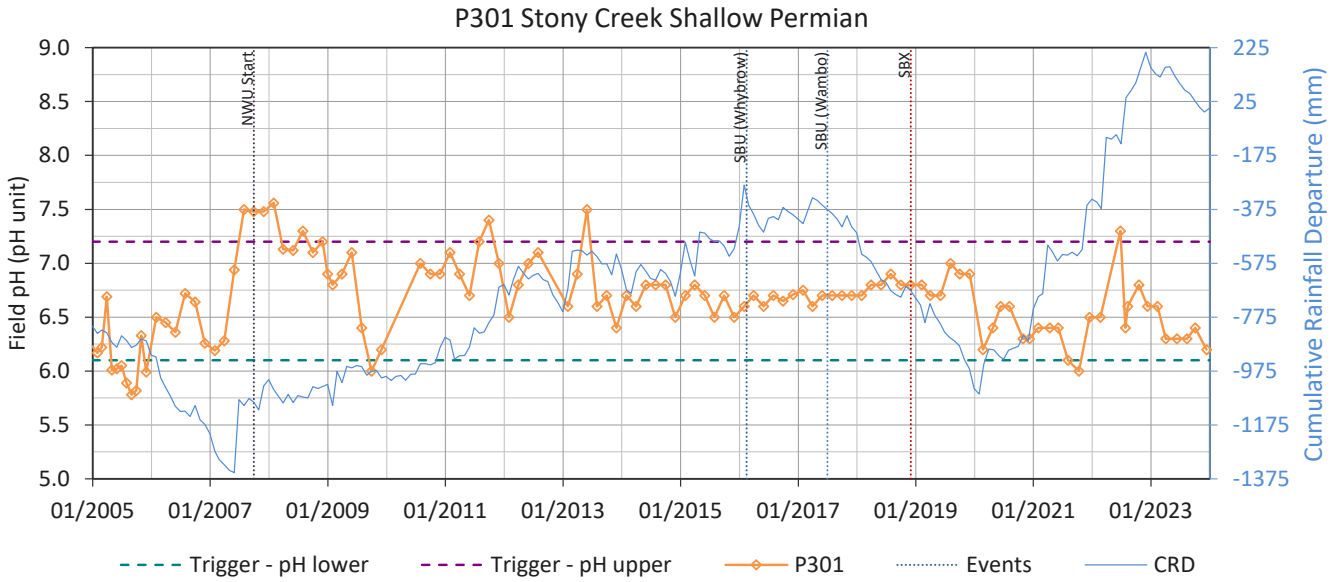

P206 Wambo Creek Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
6000
5000
4000
3000
2000
1000
0
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Trigger - EC upper
P206
Events
CRD

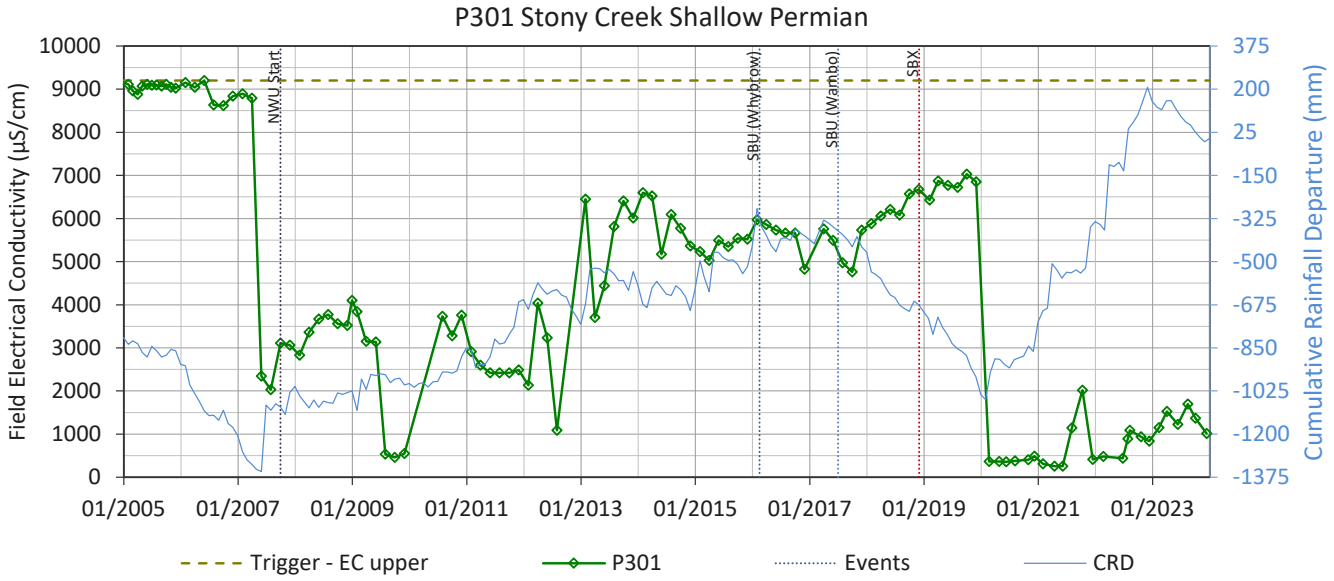

P315 Stony Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
92
91
90
89
88
87
86
85
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P315
Events
CRD

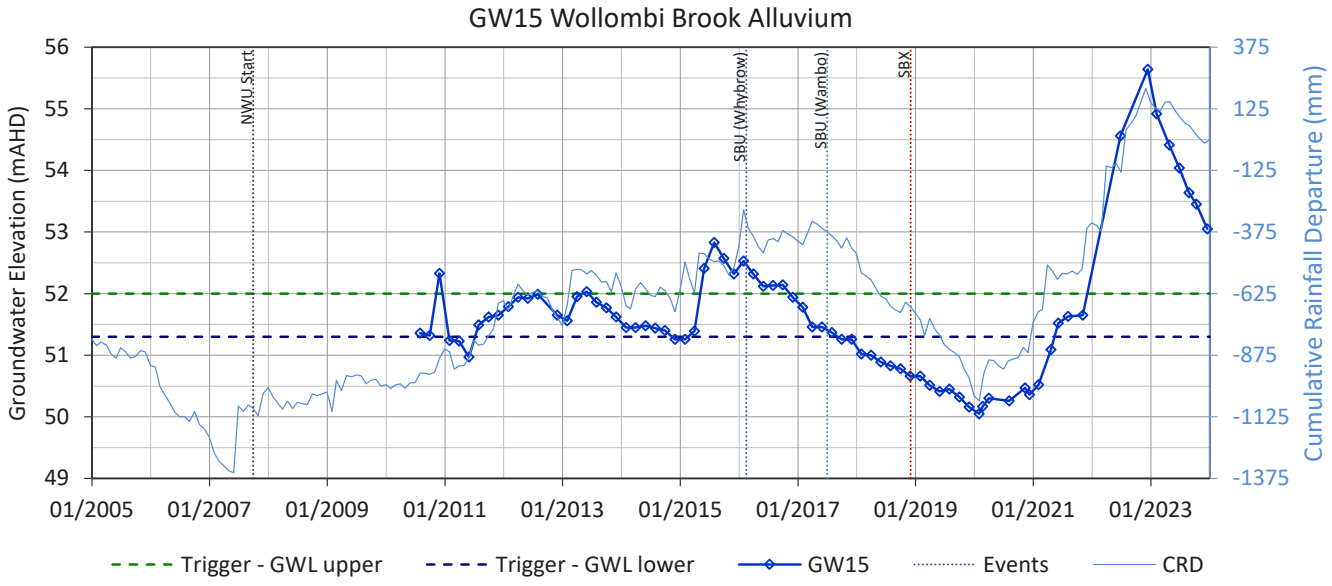

P315 Stony Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Trigger - pH lower
Trigger - pH upper
P315
Events
CRD

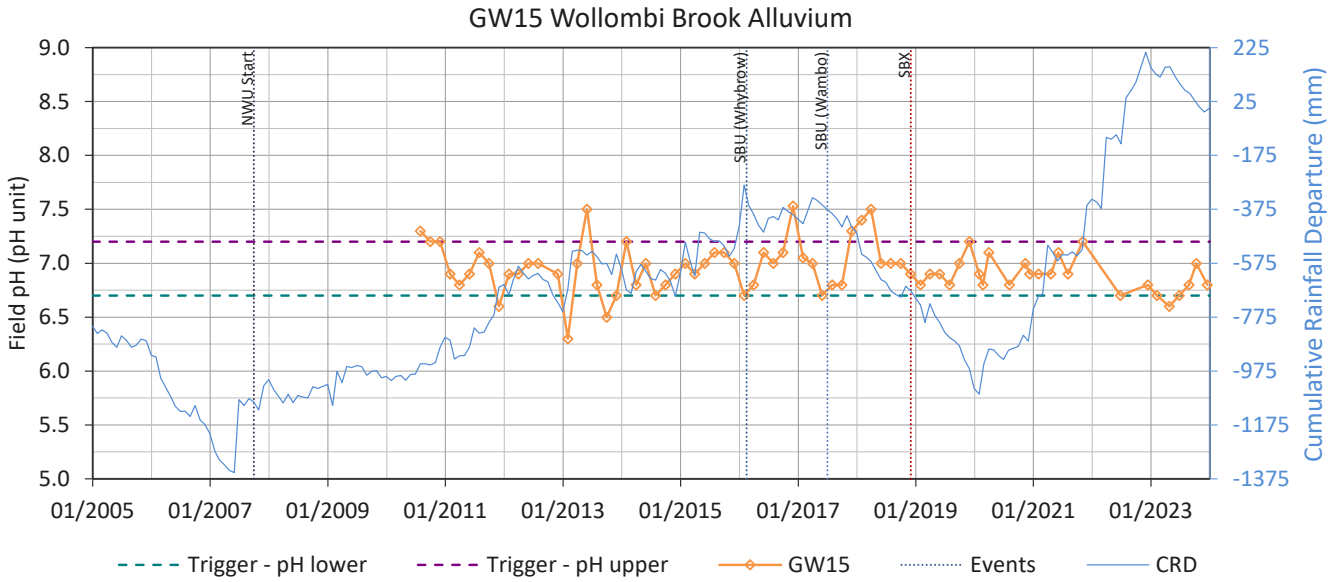

P315 Stony Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
4500
4000
3500
3000
2500
2000
1500
1000
500
0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
Trigger - EC upper
P315
Events
CRD

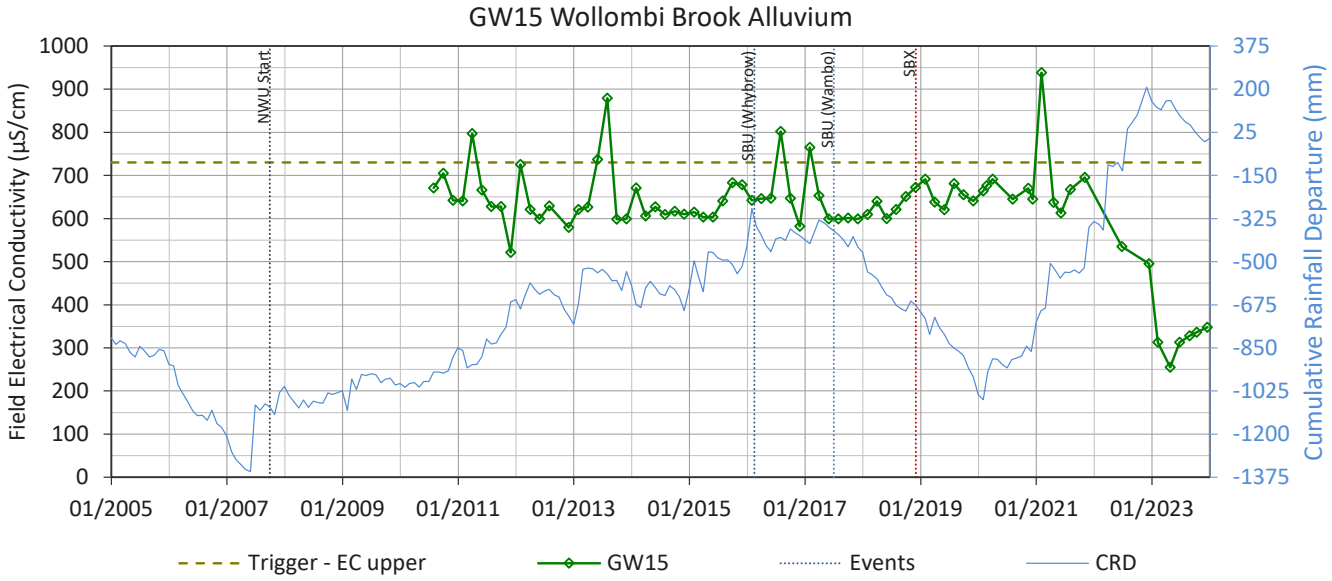

P301 Stony Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P301
Events
CRD

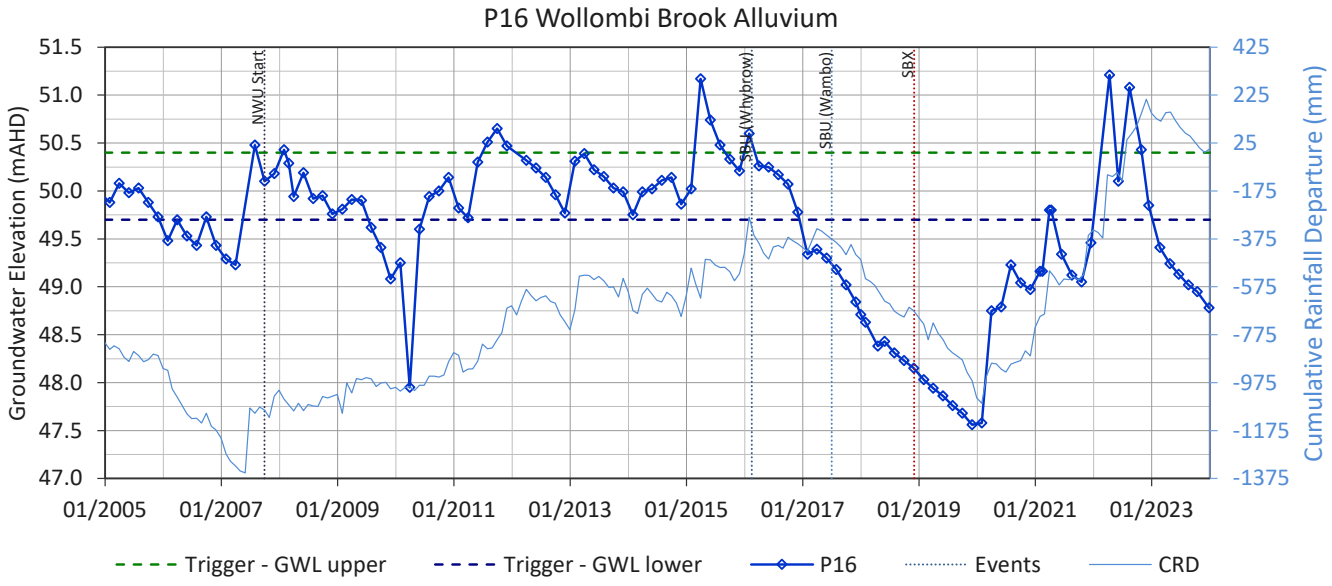

P301 Stony Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
P301
Events
CRD

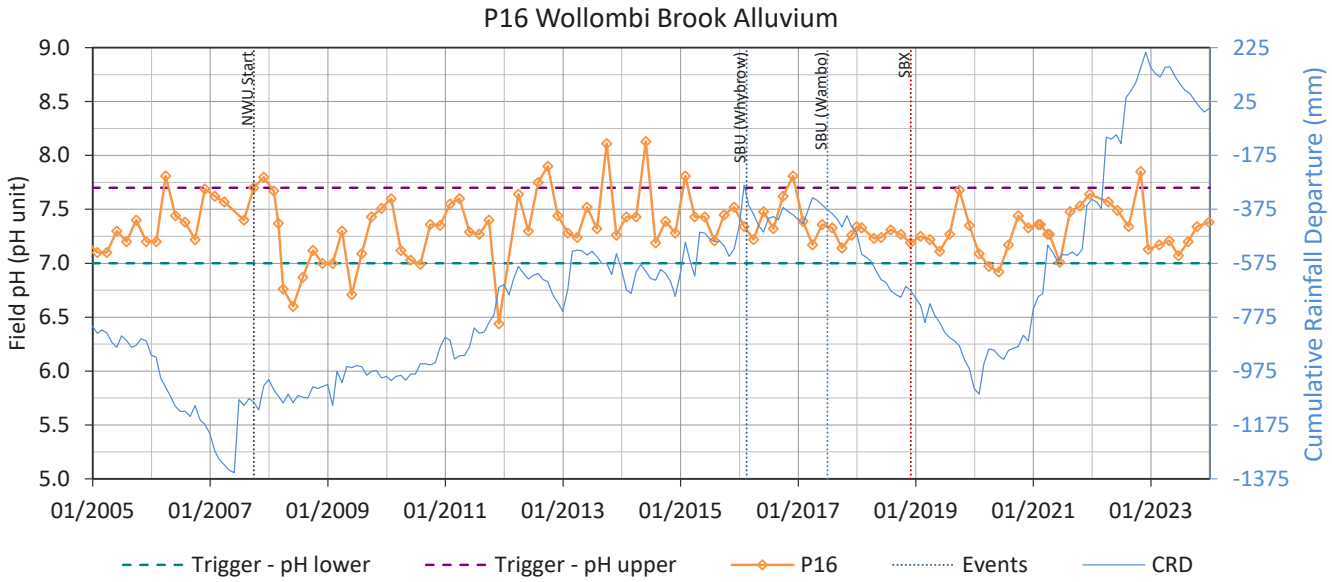

P301 Stony Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
P301
Events
CRD

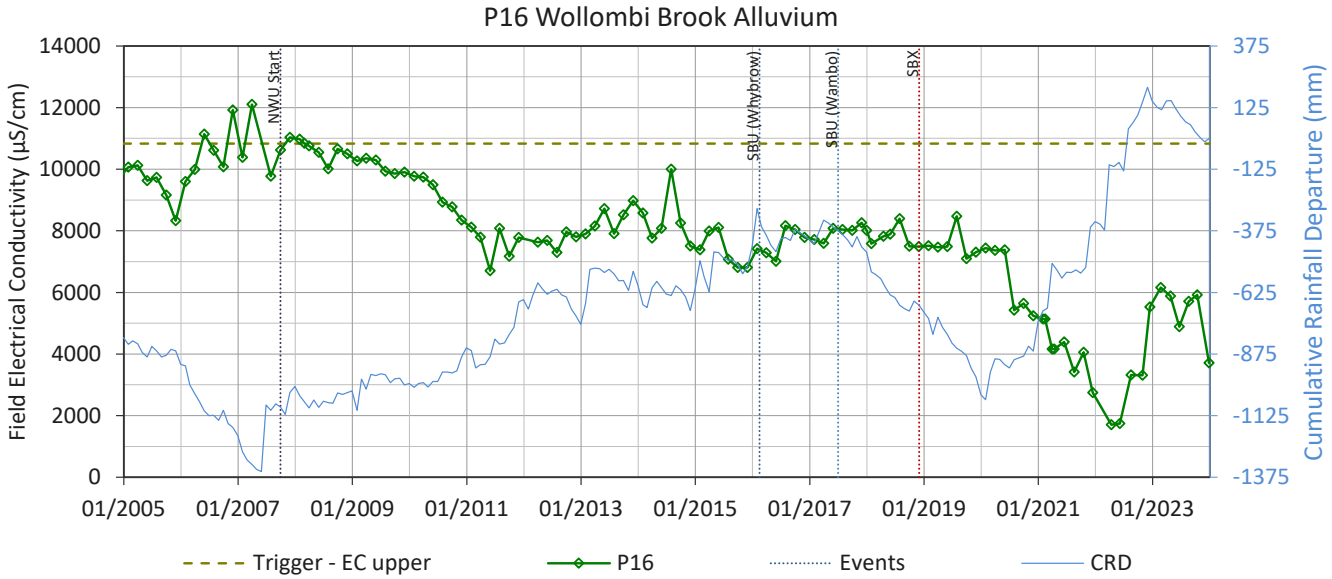

GW15 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - GWL upper
Trigger - GWL lower
GW15
Events
CRD

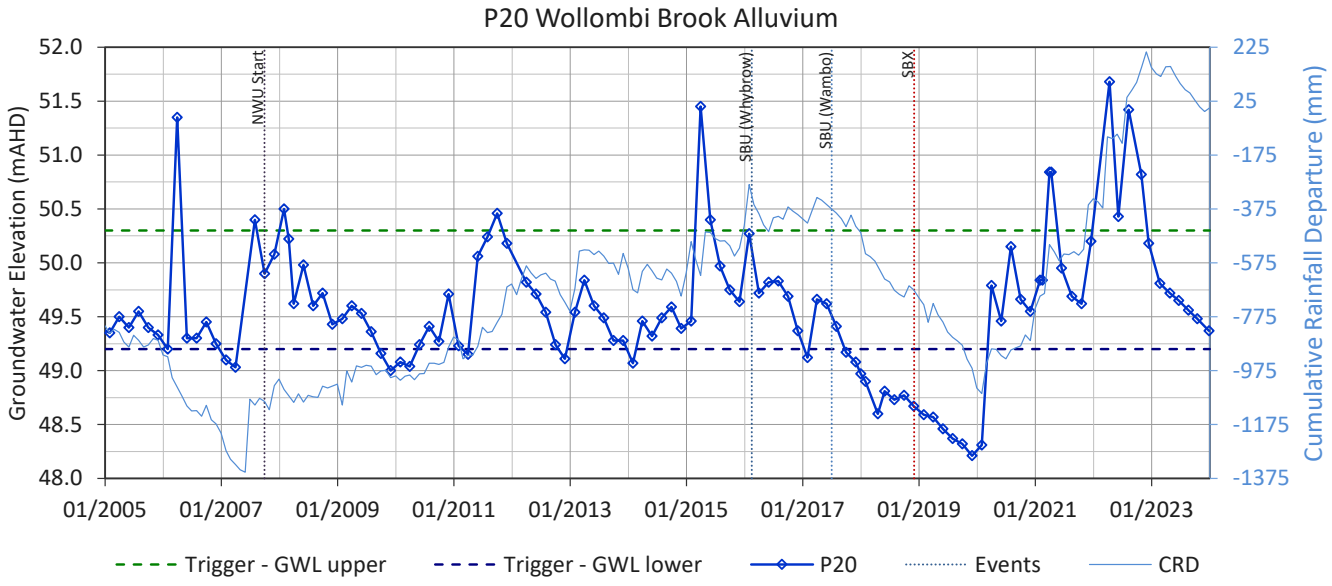

GW15 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
GW15
Events
CRD

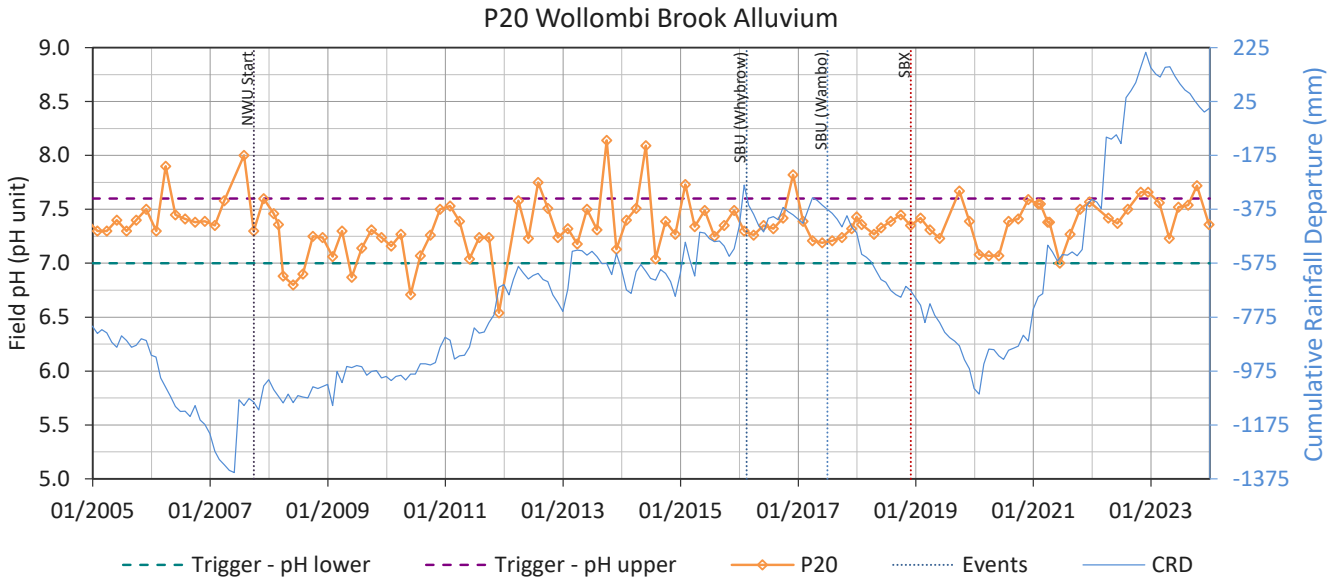

GW15 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
GW15
Events
CRD

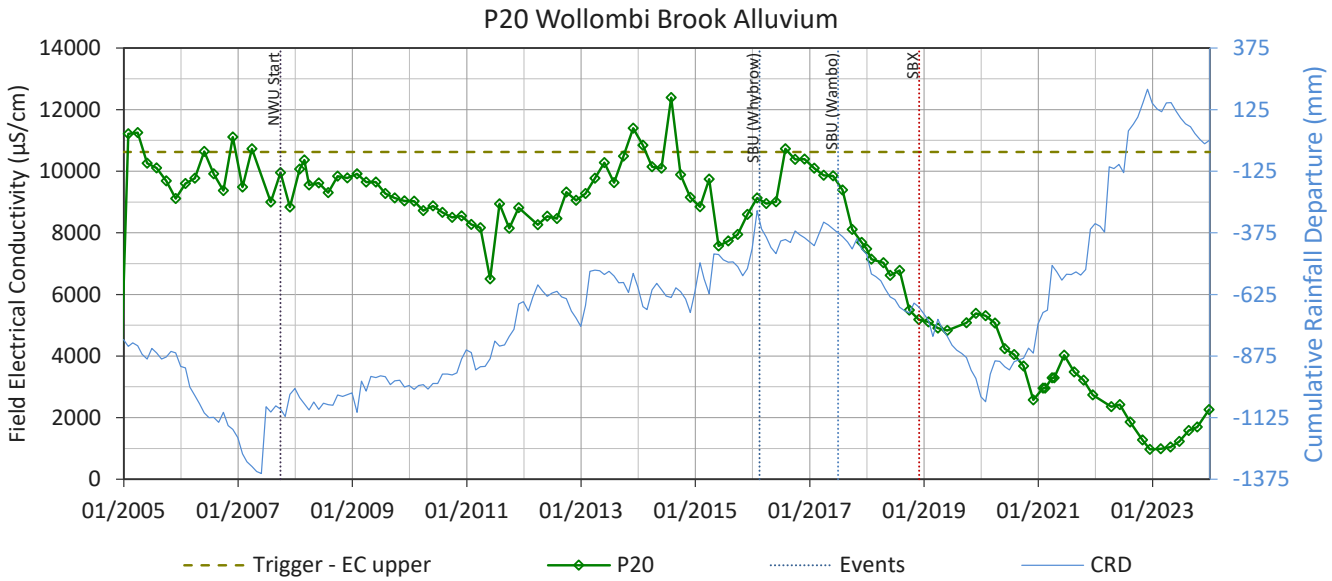

P16 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - GWL upper
Trigger - GWL lower
P16
Events
CRD

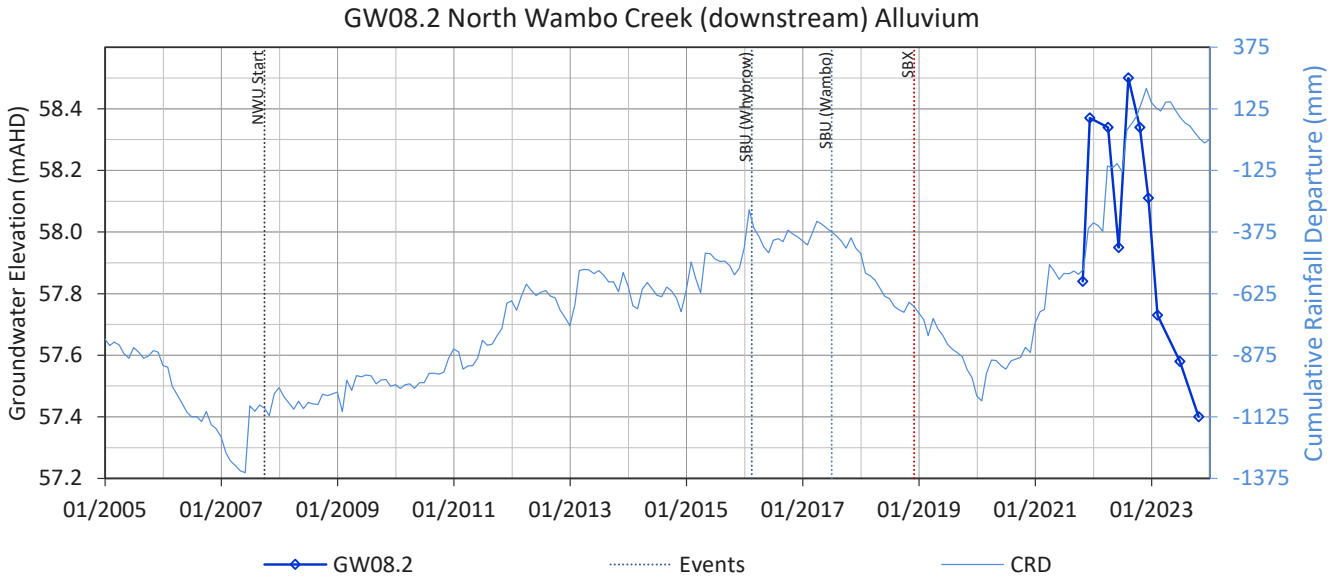

P16 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
P16
Events
CRD

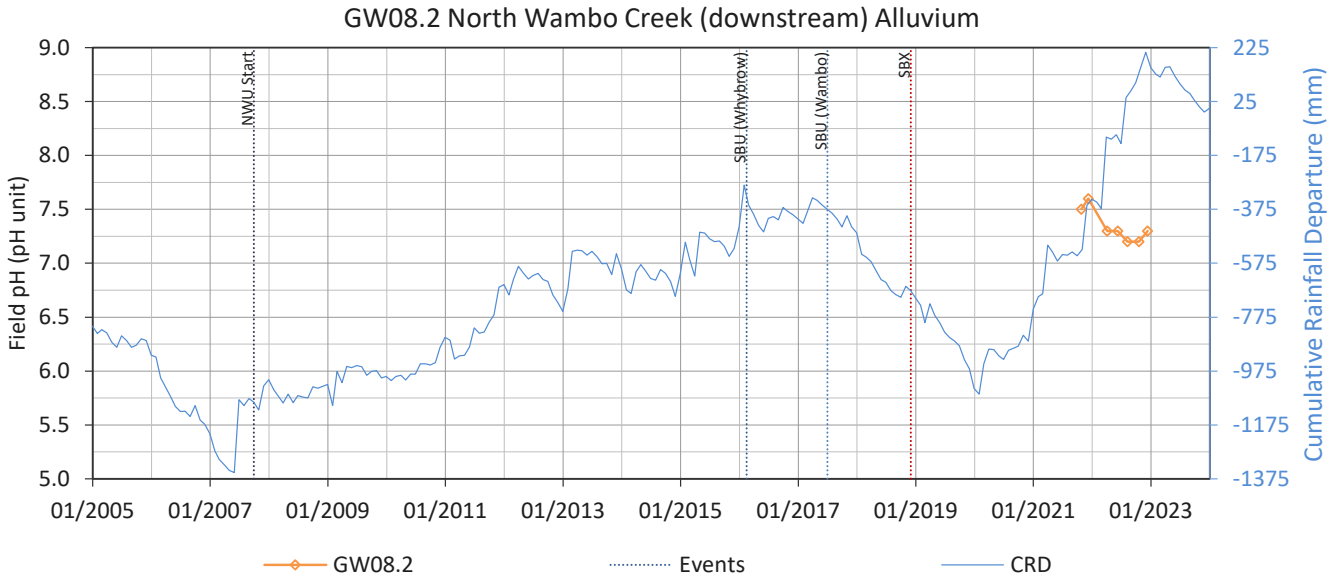

P16 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
P16
Events
CRD

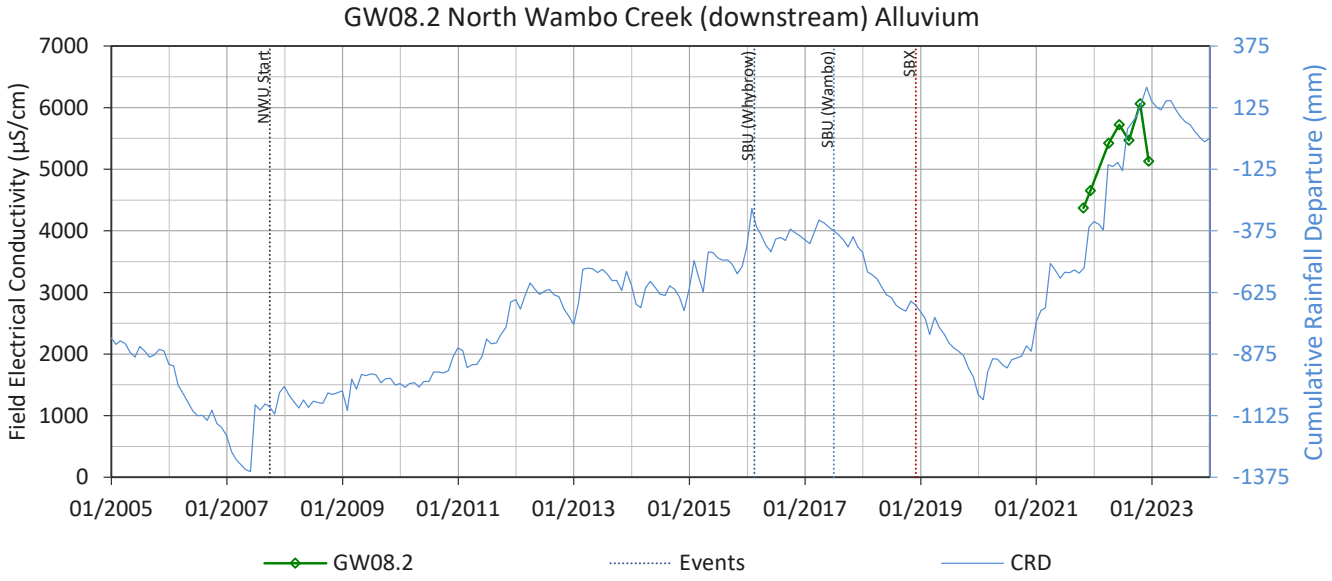

P20 Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - GWL upper
Trigger - GWL lower
P20
Events
CRD

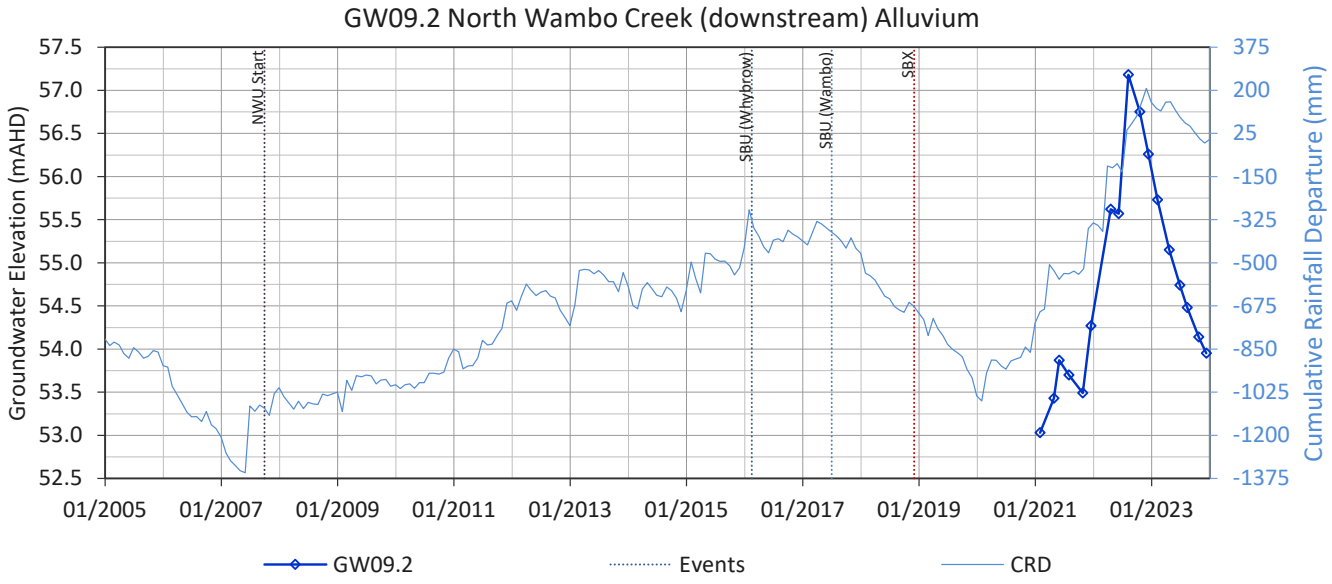

P20 Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - pH lower
Trigger - pH upper
P20
Events
CRD

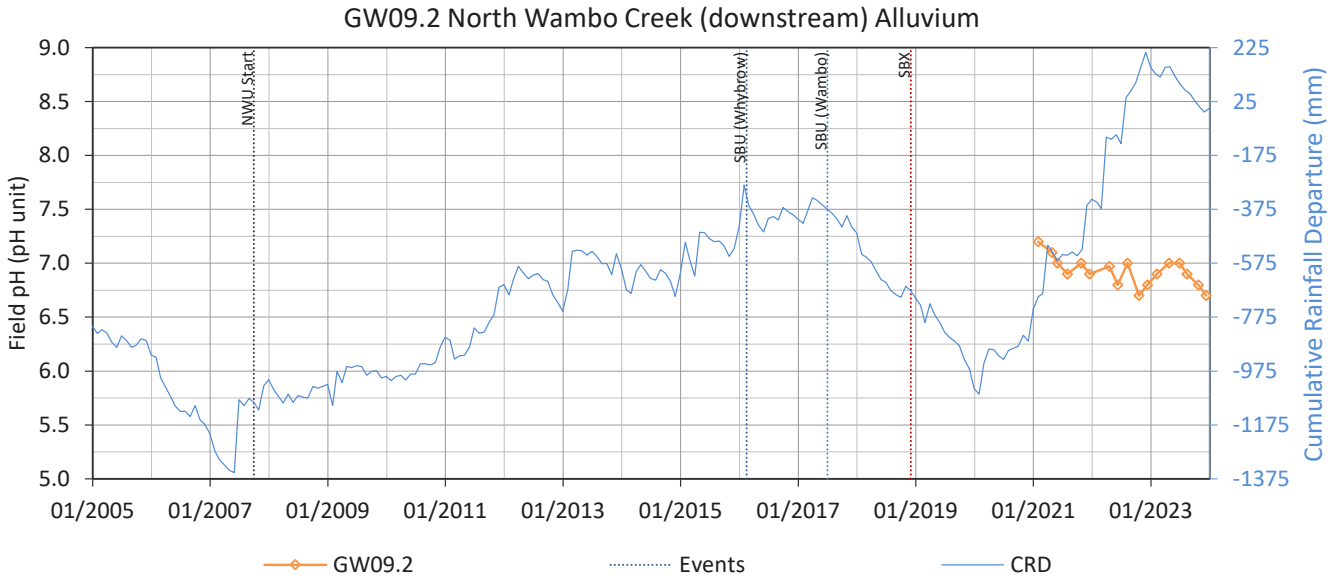

P20 Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
Trigger - EC upper
P20
Events
CRD

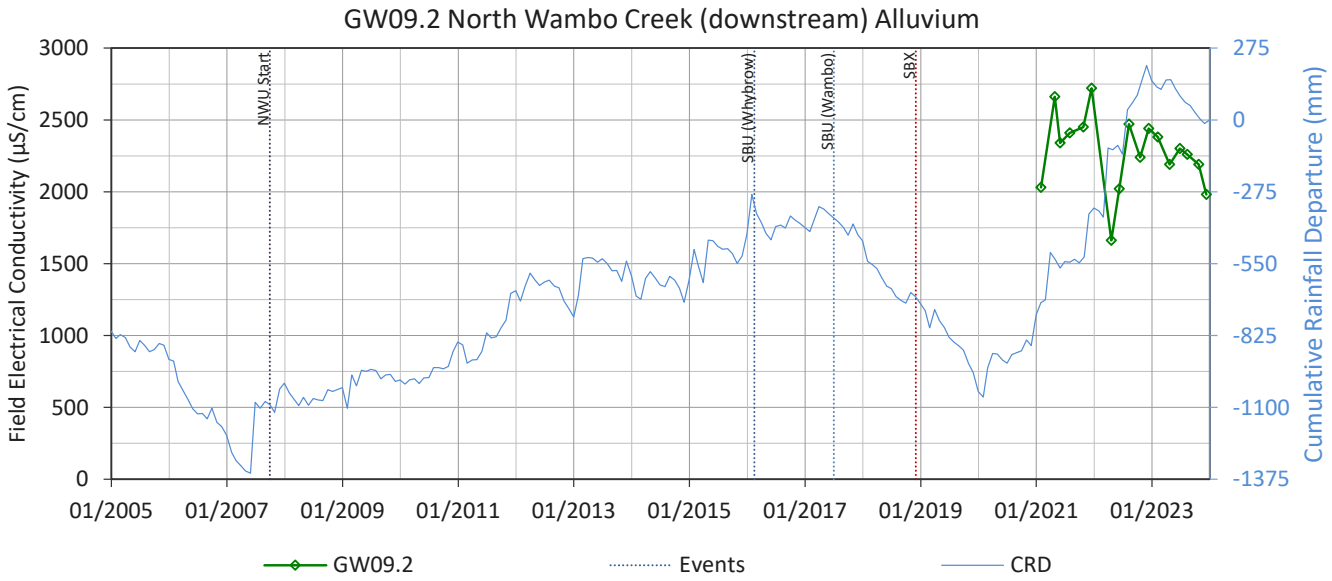

GW08.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW08.2
Events
CRD

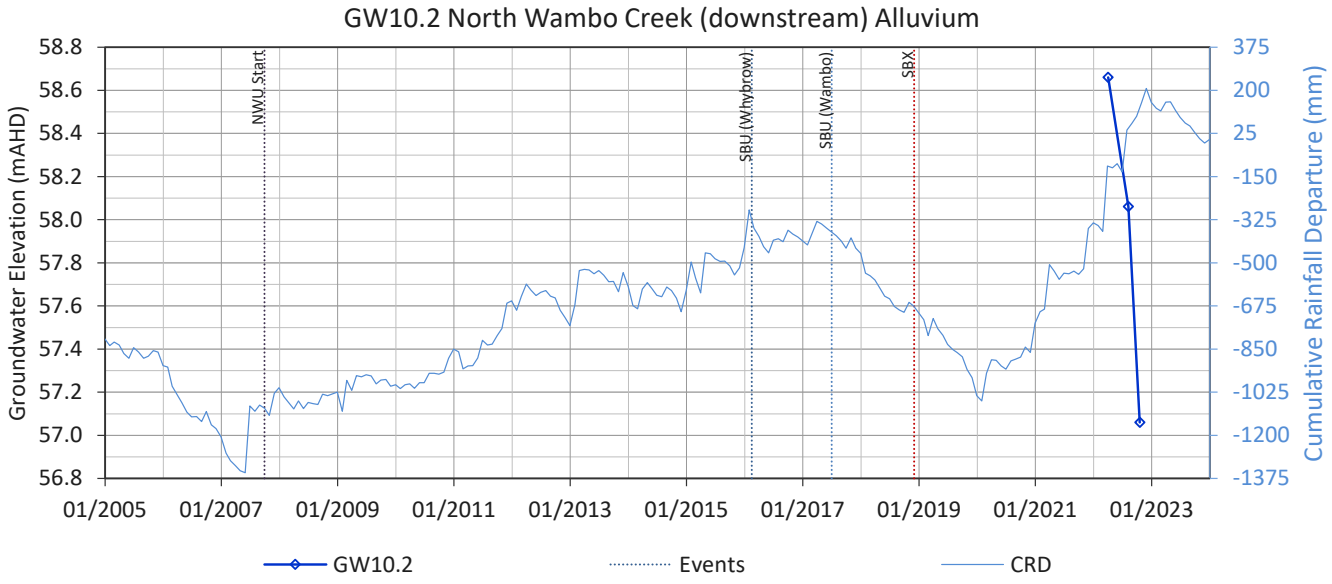

GW08.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW08.2
Events
CRD

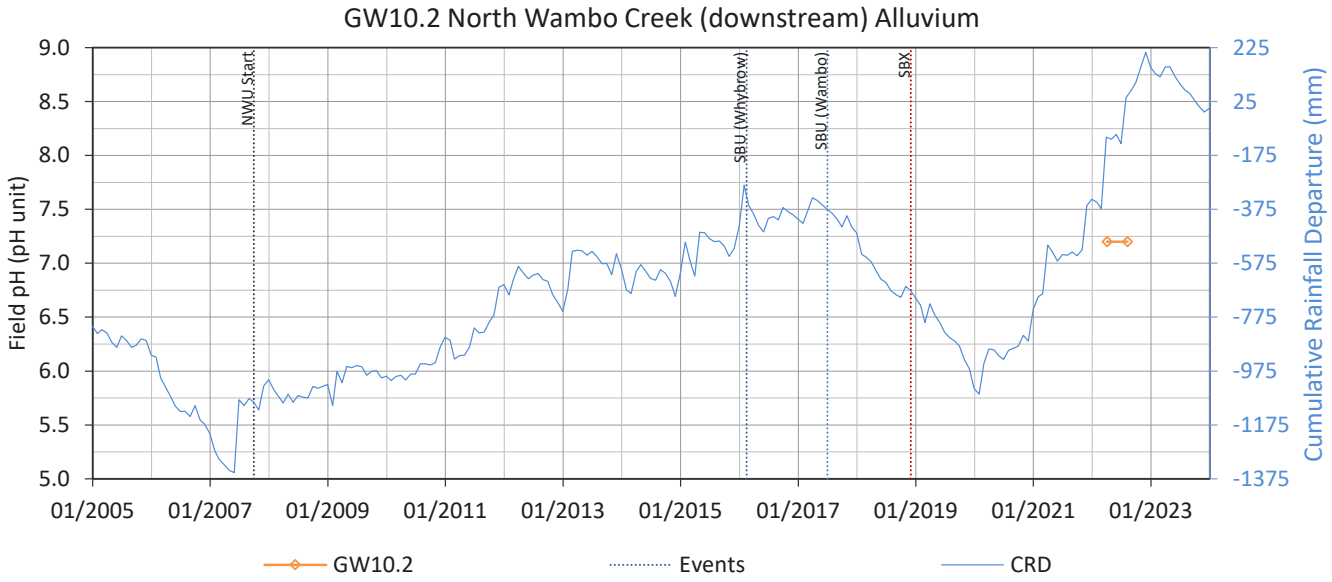

GW08.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW08.2
Events
CRD

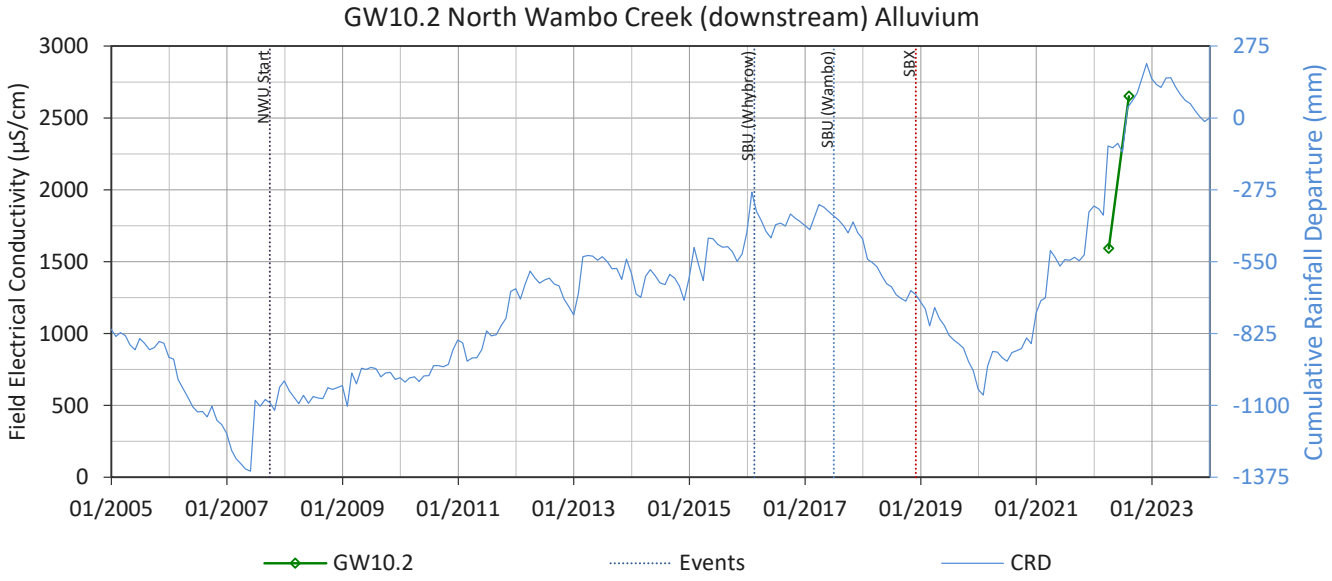

GW09.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD

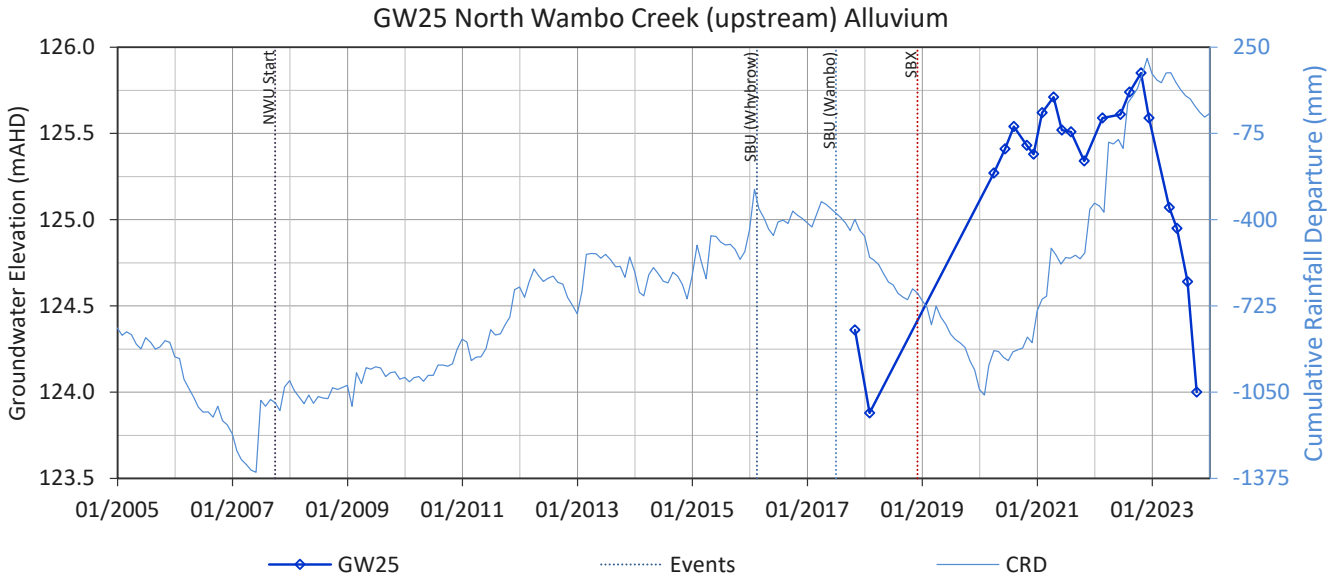

GW09.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD

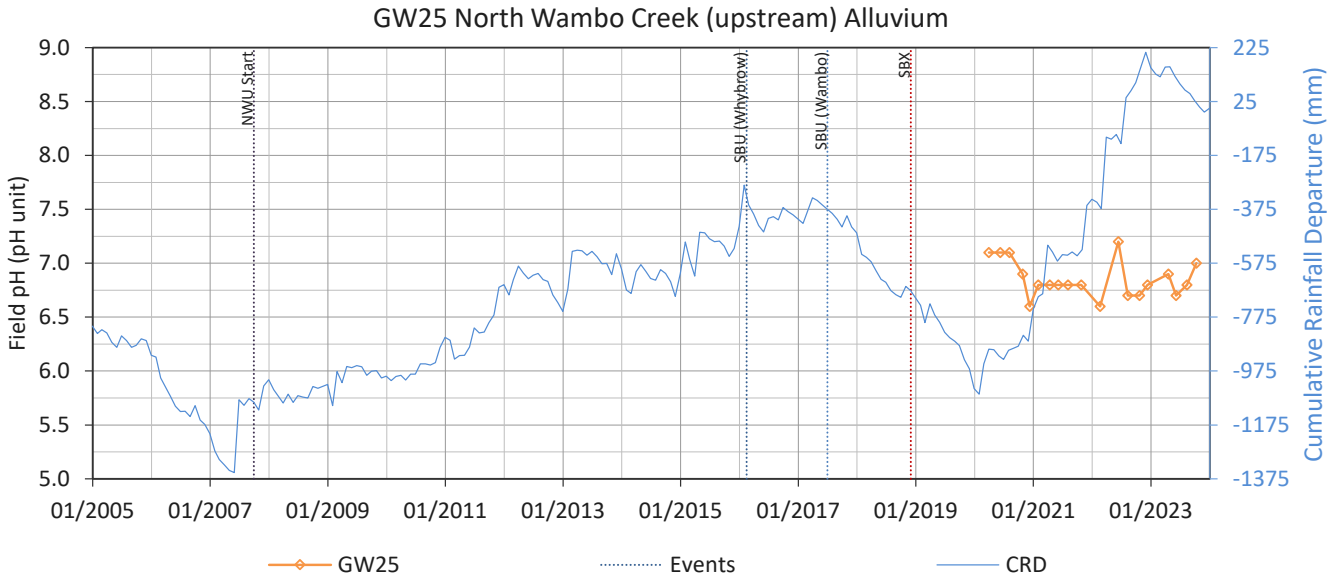

GW09.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW09.2
Events
CRD

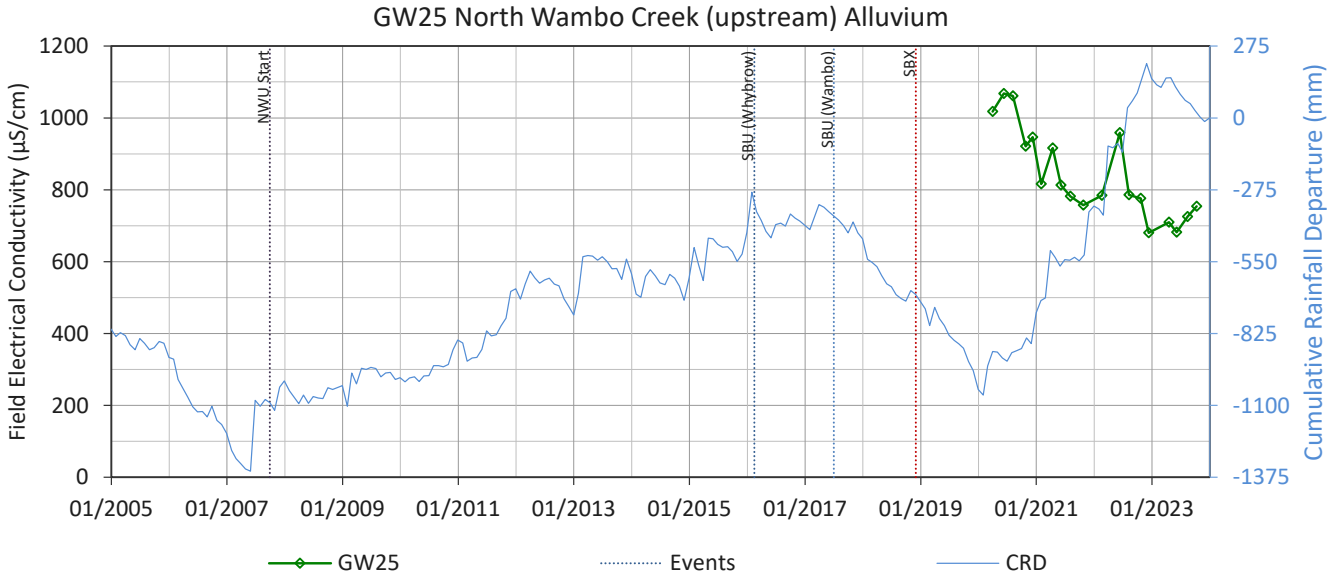

GW10.2 North Wambo Creek (downstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2
Events
CRD

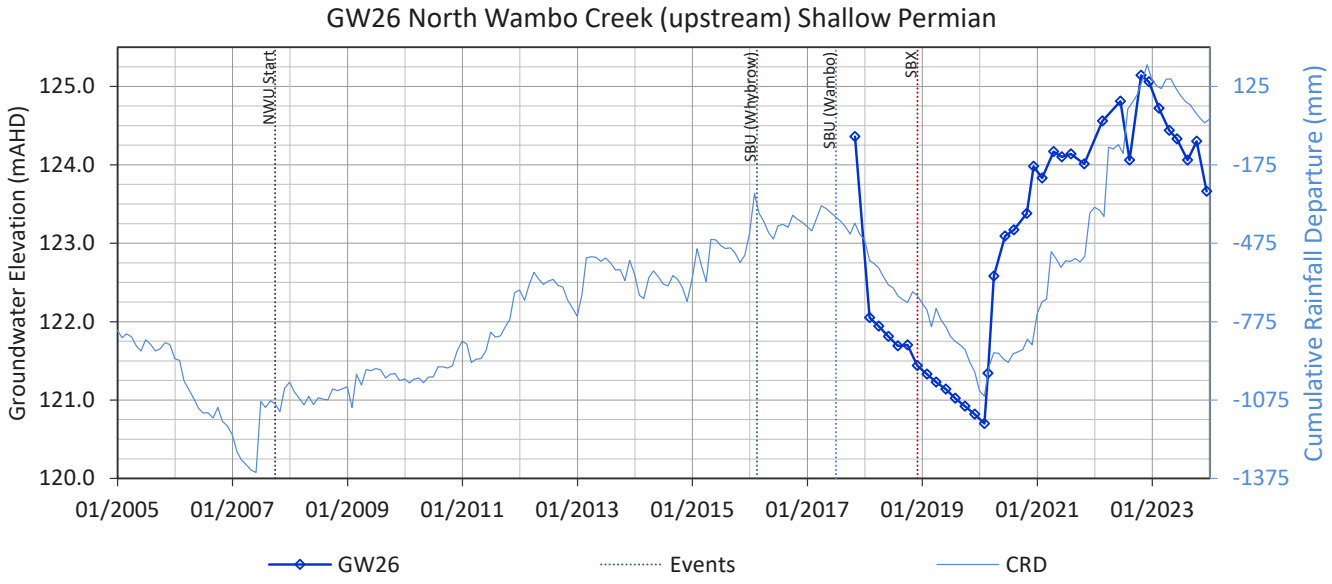

GW10.2 North Wambo Creek (downstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2
Events
CRD

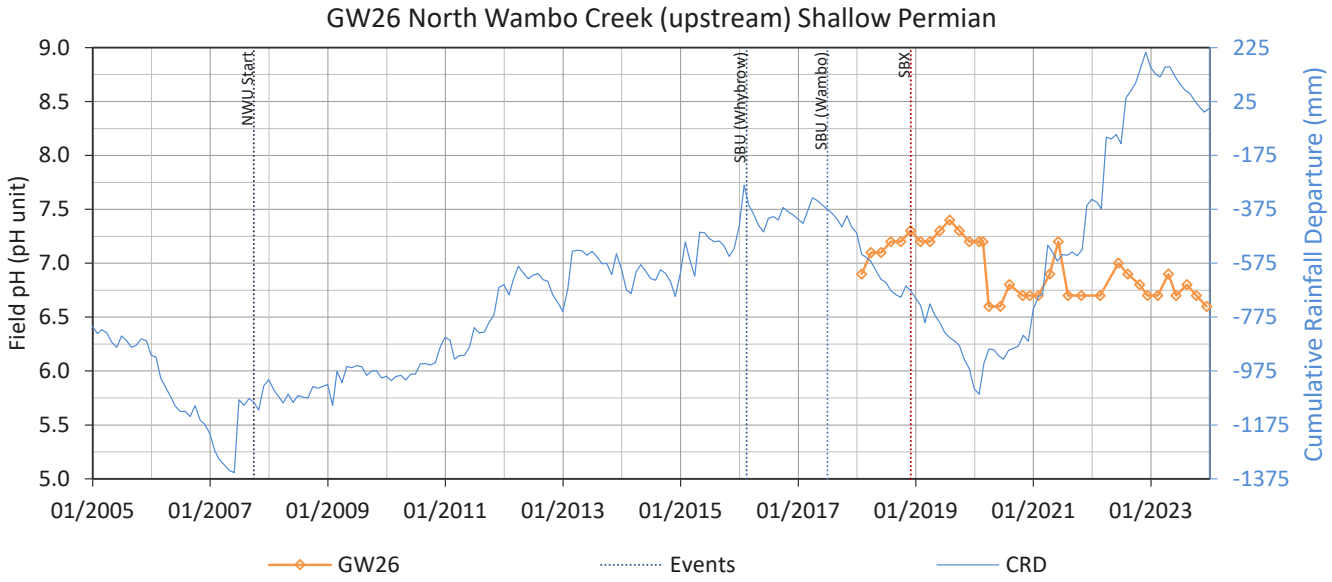

GW10.2 North Wambo Creek (downstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2
Events
CRD

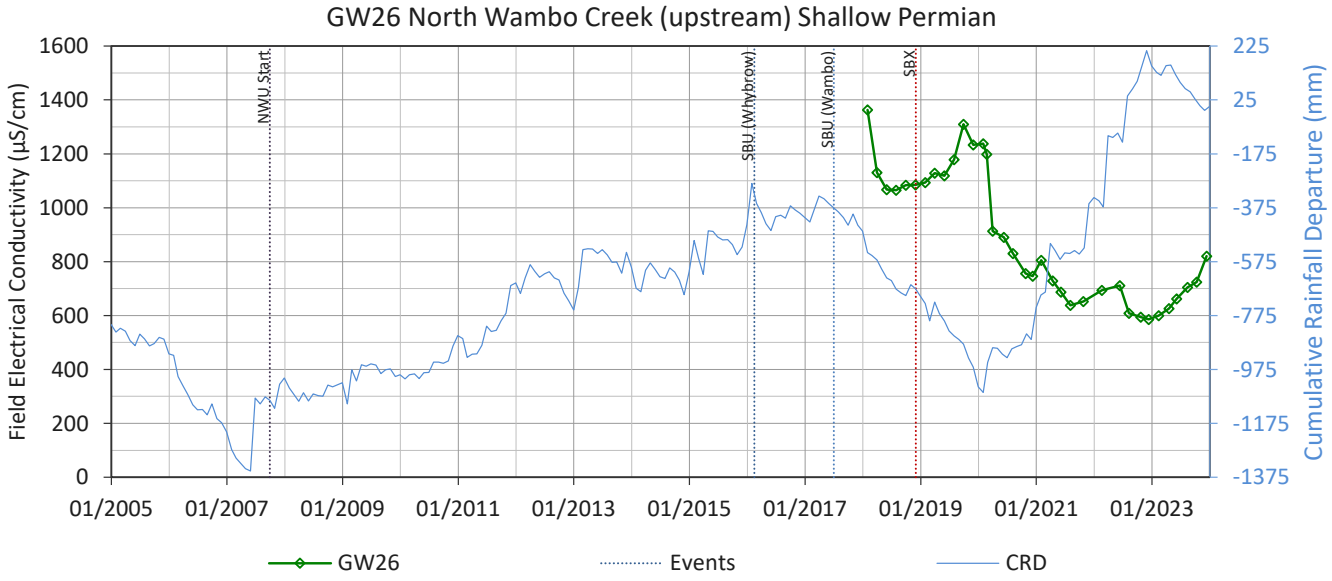

GW25 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
126.0
125.5
125.0
124.5
124.0
123.5
Cumulative Rainfall Departure (mm)
250
-75
-400
-725
-1050
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW25
Events
CRD

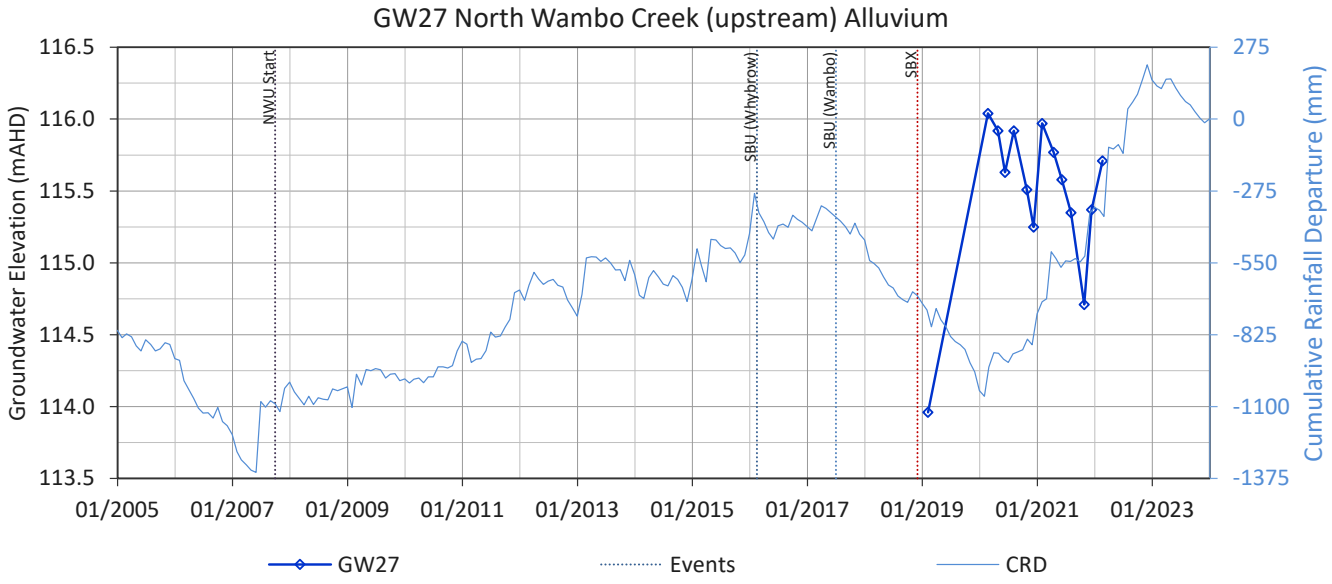

GW25 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Cumulative Rainfall Departure (mm)
225
25
-175
-375
-575
-775
-975
-1175
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW25
Events
CRD

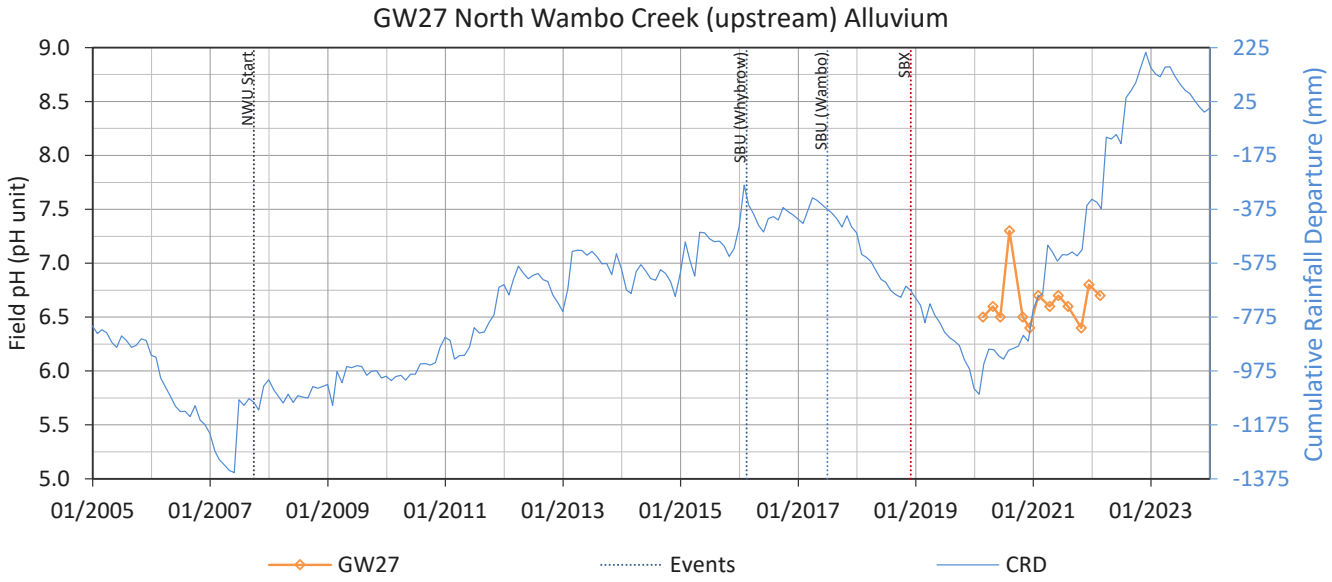

GW25 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
1200
1000
800
600
400
200
0
Cumulative Rainfall Departure (mm)
275
0
-275
-550
-825
-1100
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW25
Events
CRD

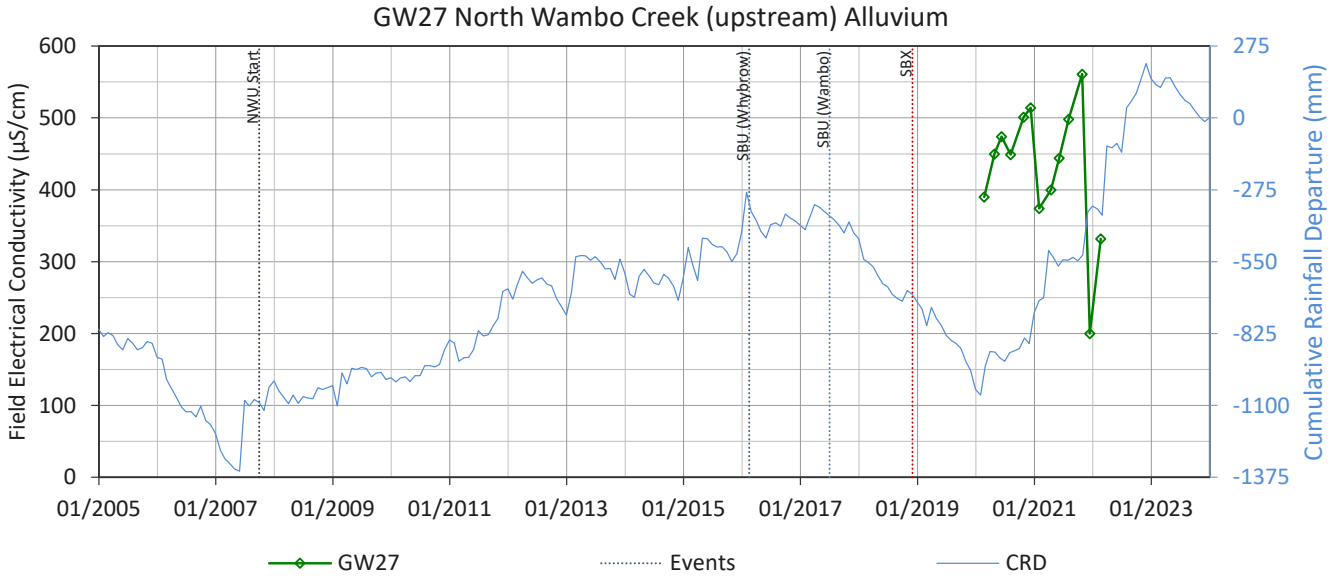

GW26 North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
125.0
124.0
123.0
122.0
121.0
120.0
125
-175
-475
-775
-1075
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW26
Events
CRD

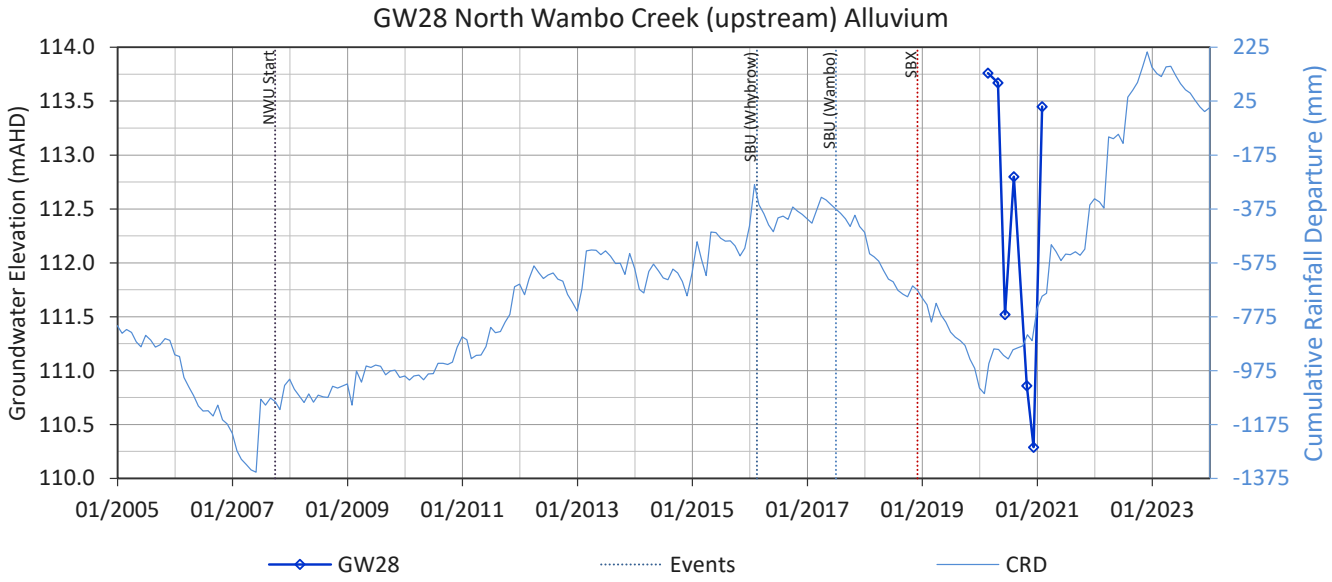

GW26 North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW26
Events
CRD

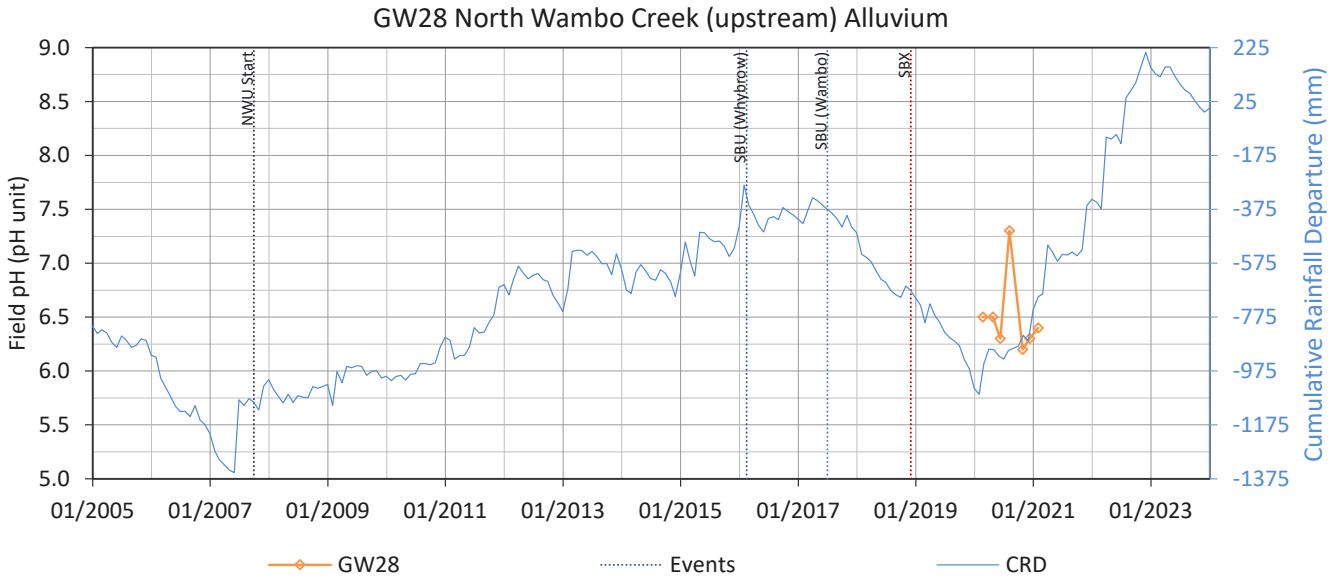

GW26 North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1600
1400
1200
1000
800
600
400
200
0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW26
Events
CRD

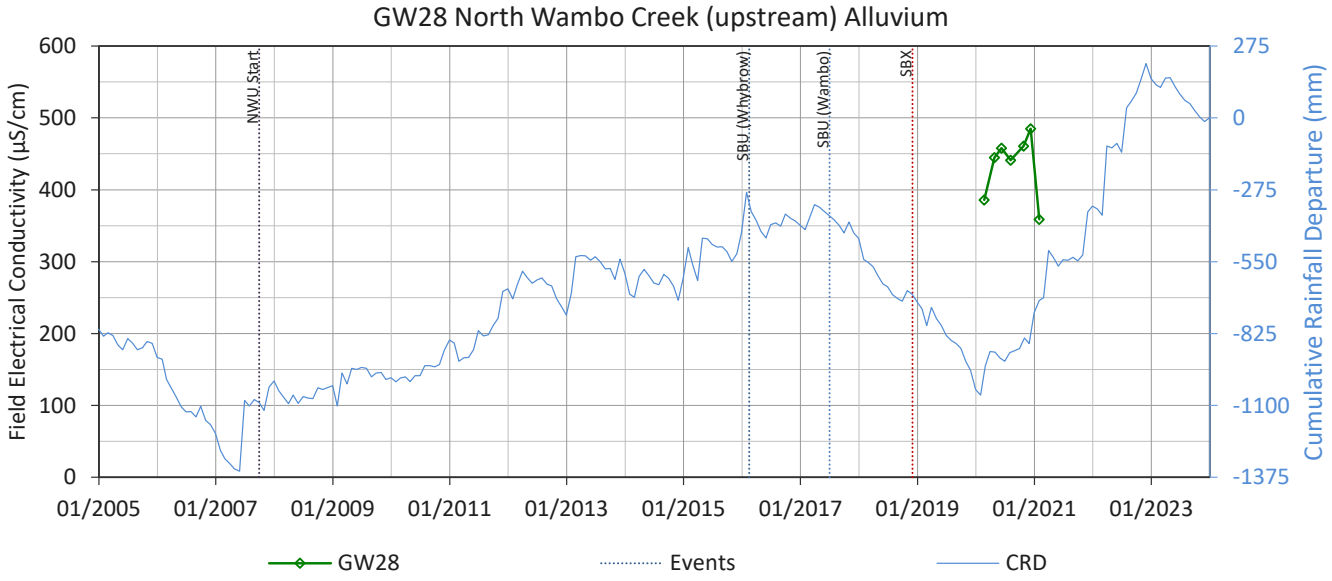

GW27 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW27
Events
CRD

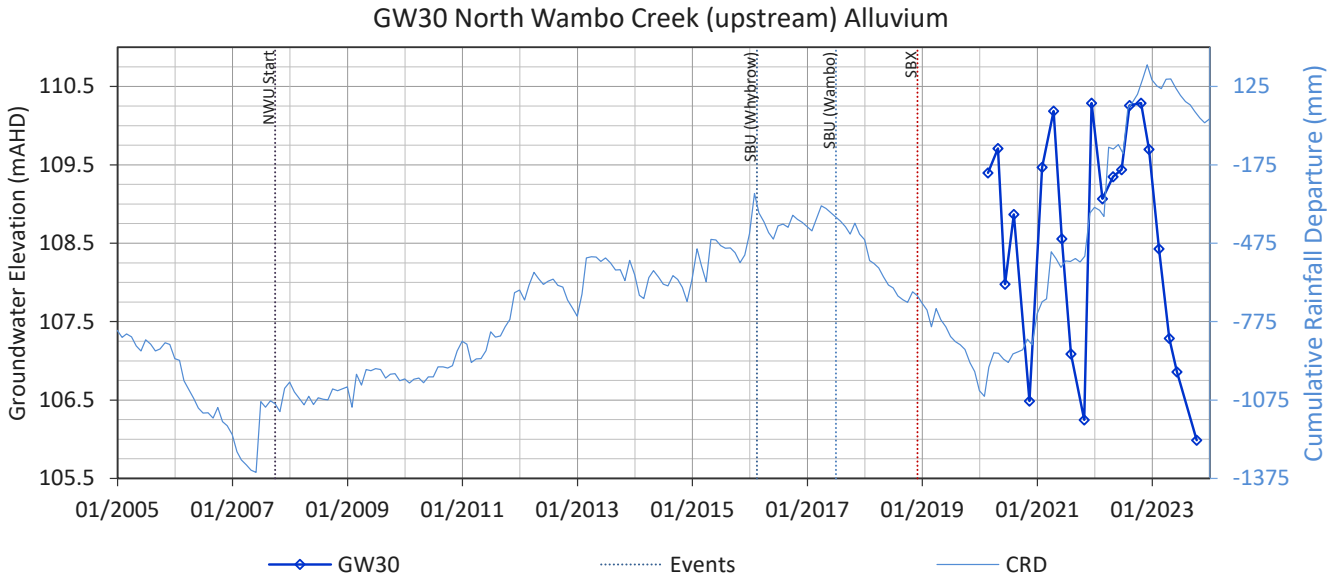

GW27 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW27
Events
CRD

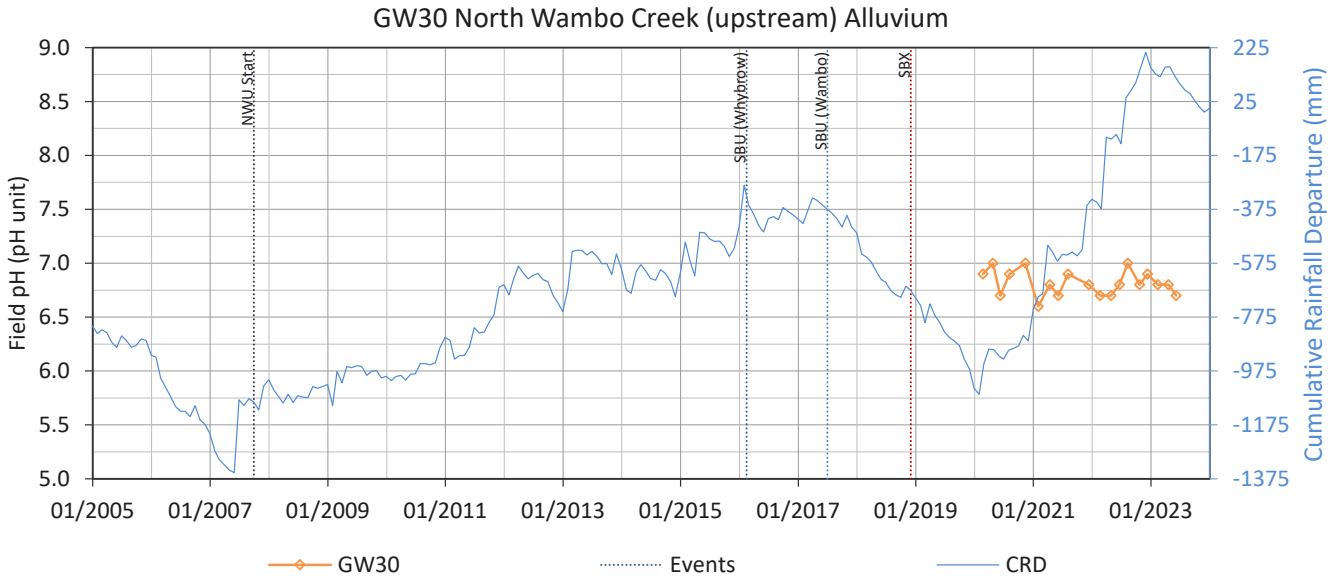

GW27 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW27
Events
CRD

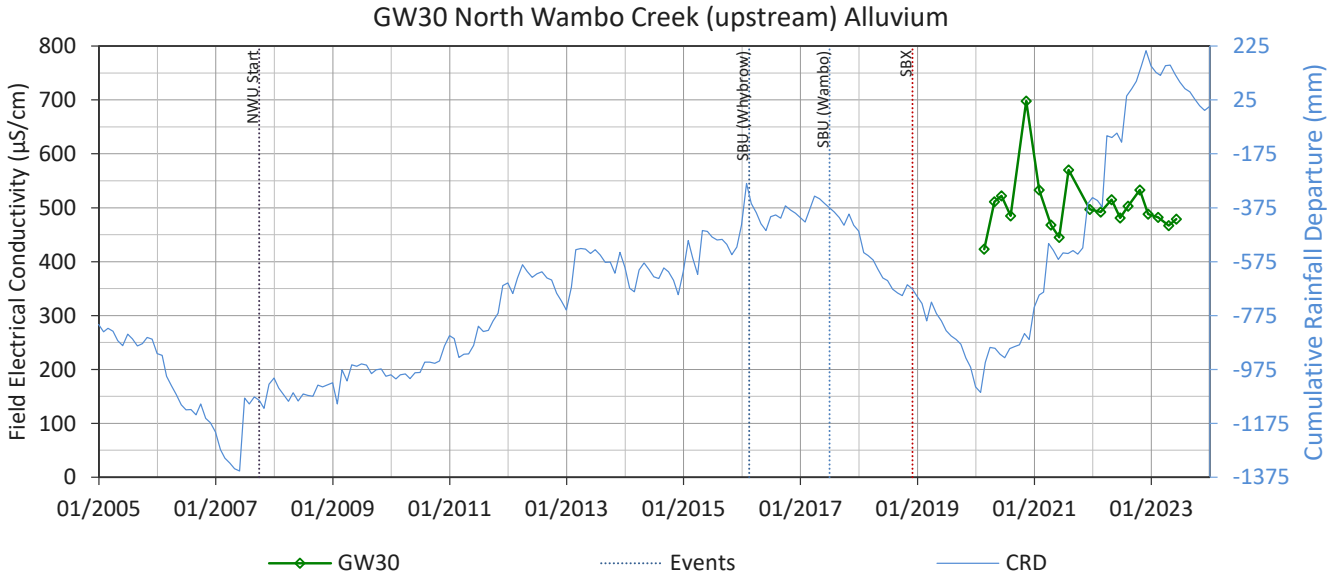

GW28 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

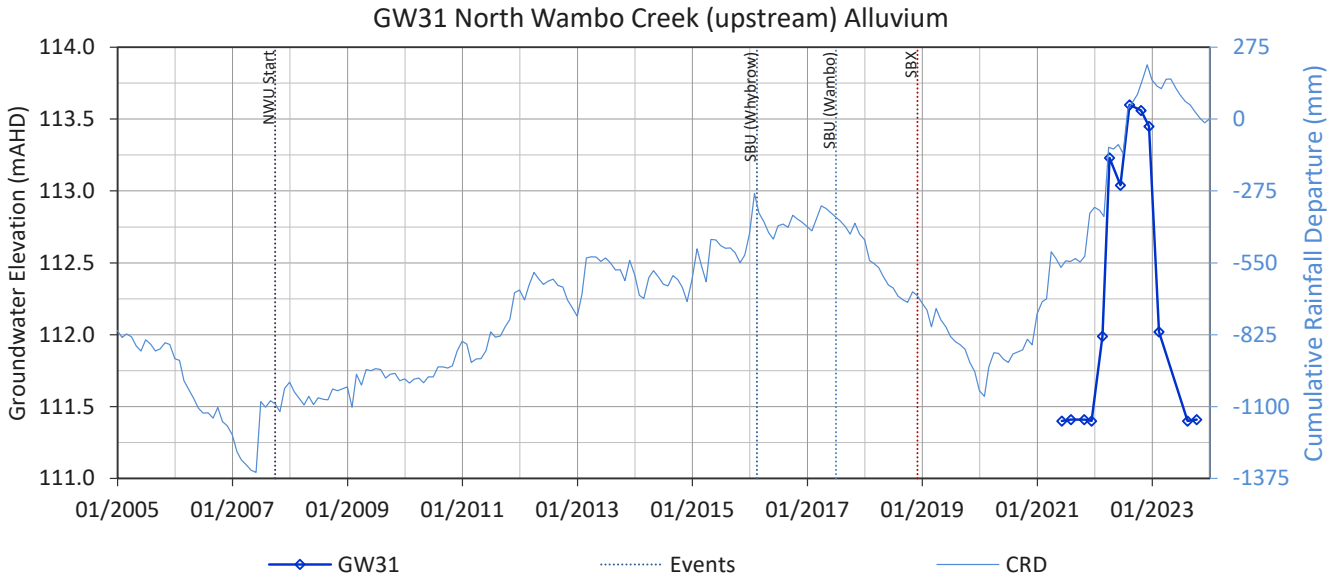

GW28 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

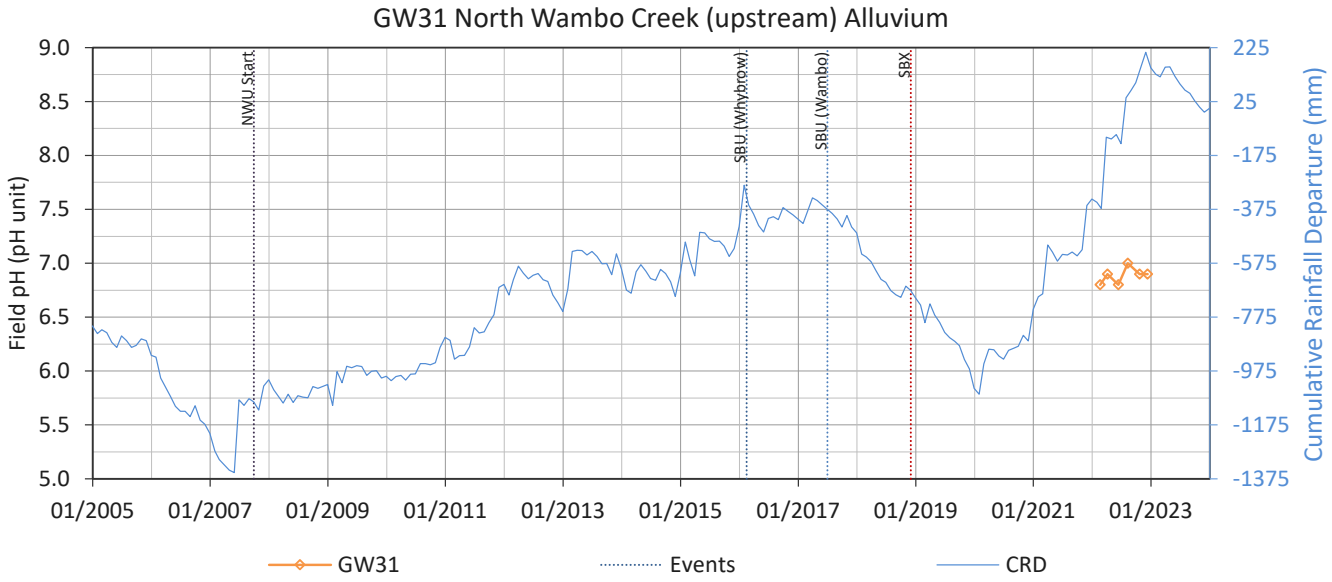

GW28 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW28
Events
CRD

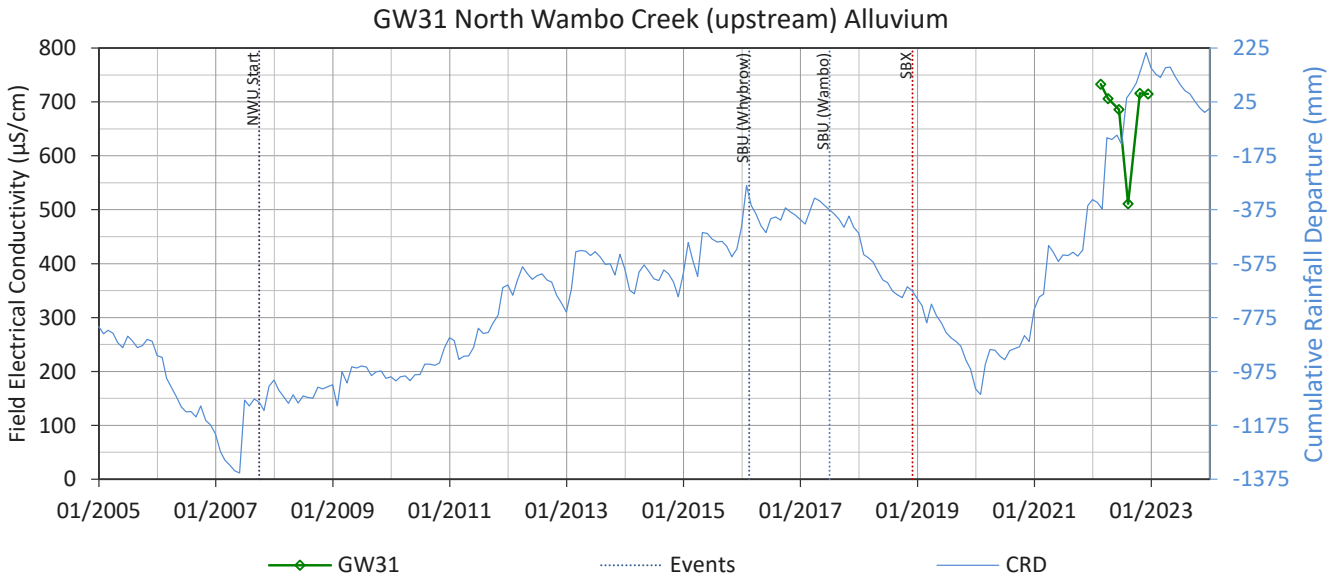

GW30 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
110.5
109.5
108.5
107.5
106.5
105.5
Cumulative Rainfall Departure (mm)
125
-175
-475
-775
-1075
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW30
Events
CRD

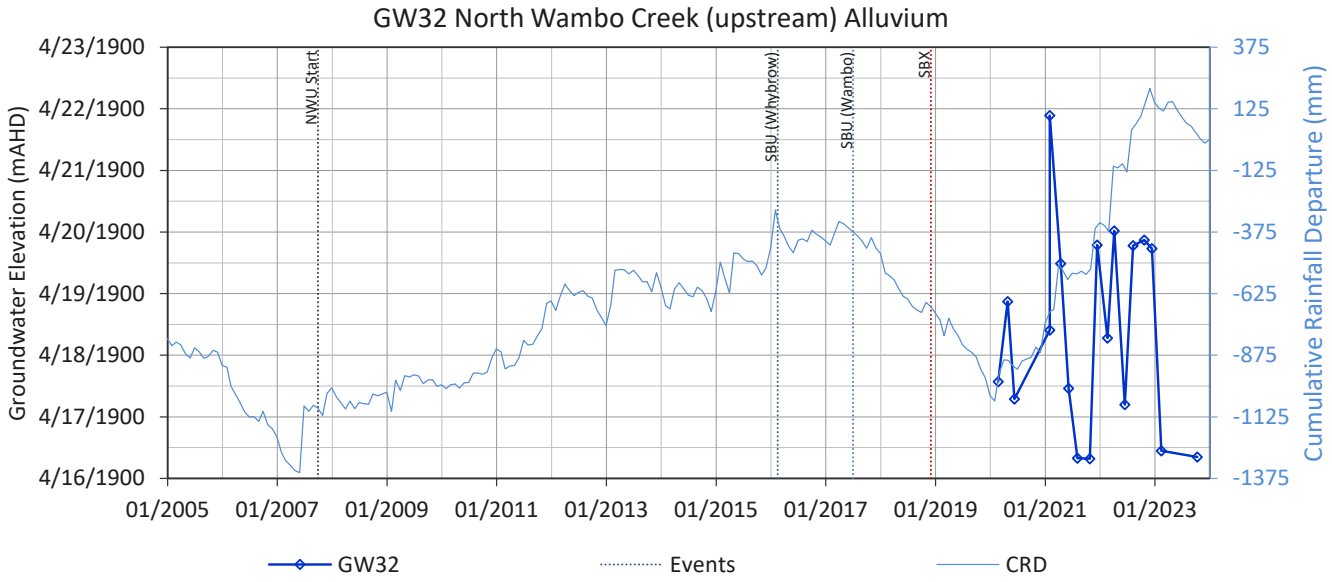

GW30 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Cumulative Rainfall Departure (mm)
225
25
-175
-375
-575
-775
-975
-1175
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW30
Events
CRD

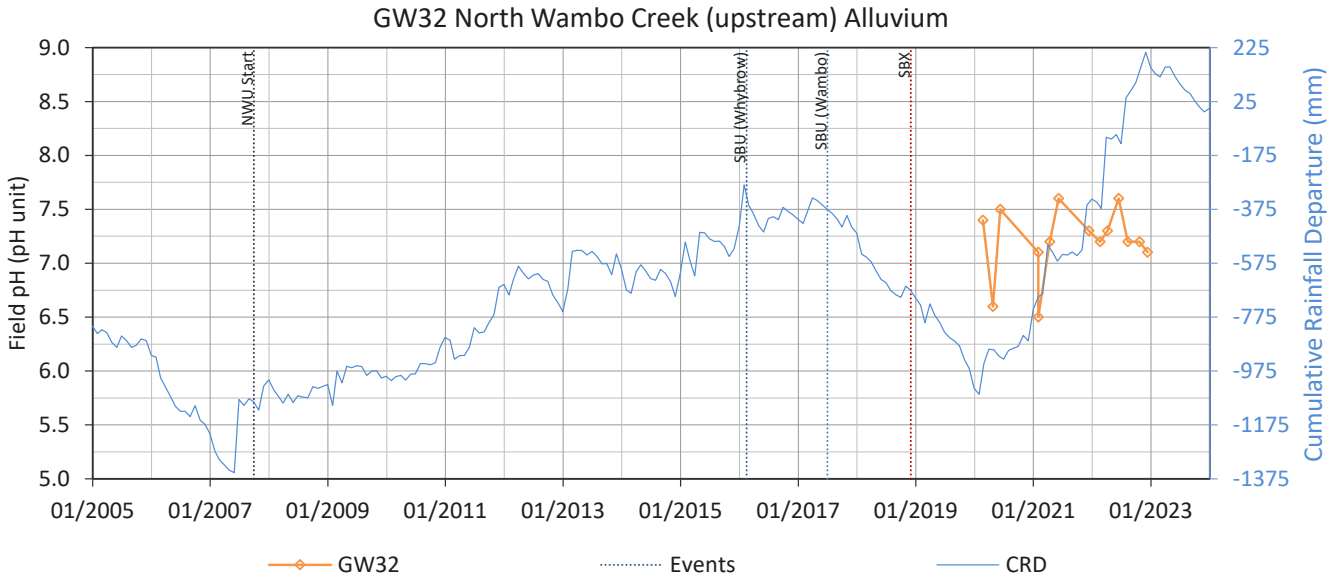

GW30 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
800
700
600
500
400
300
200
100
0
Cumulative Rainfall Departure (mm)
225
25
-175
-375
-575
-775
-975
-1175
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW30
Events
CRD

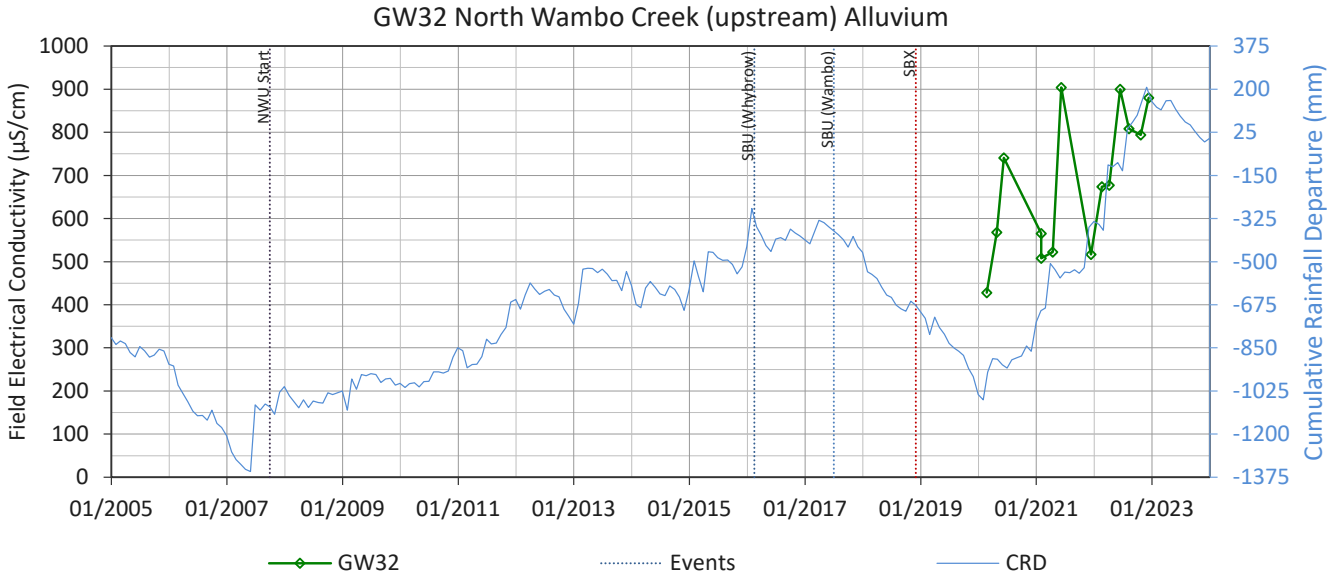

GW31 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW31
Events
CRD

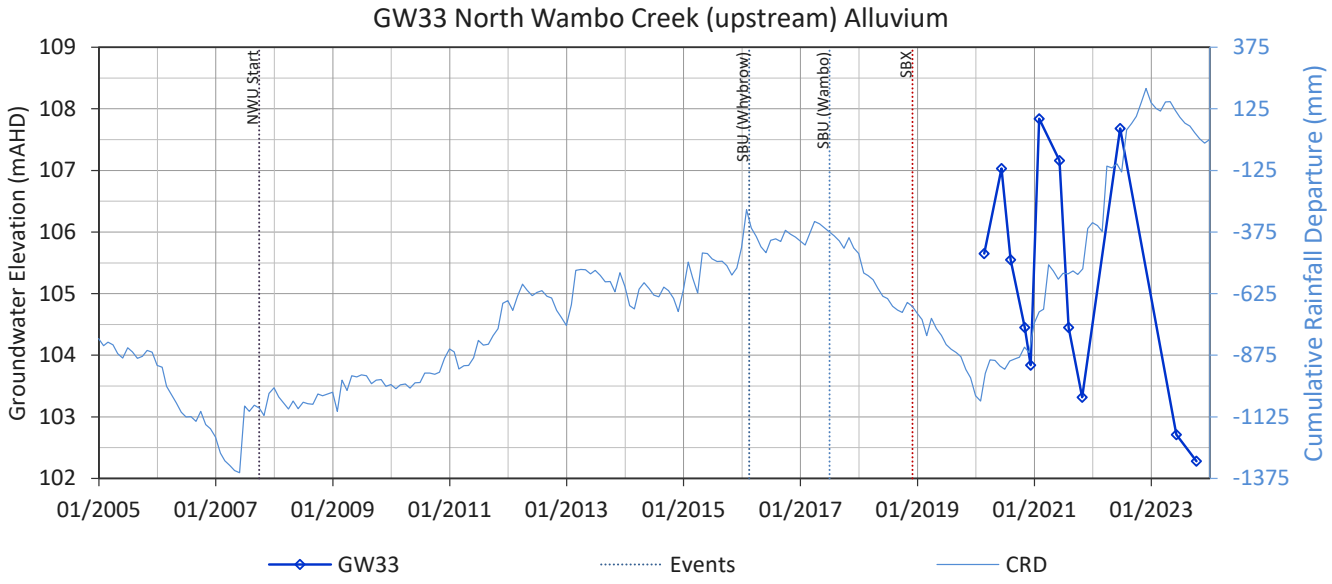

GW31 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW31
Events
CRD

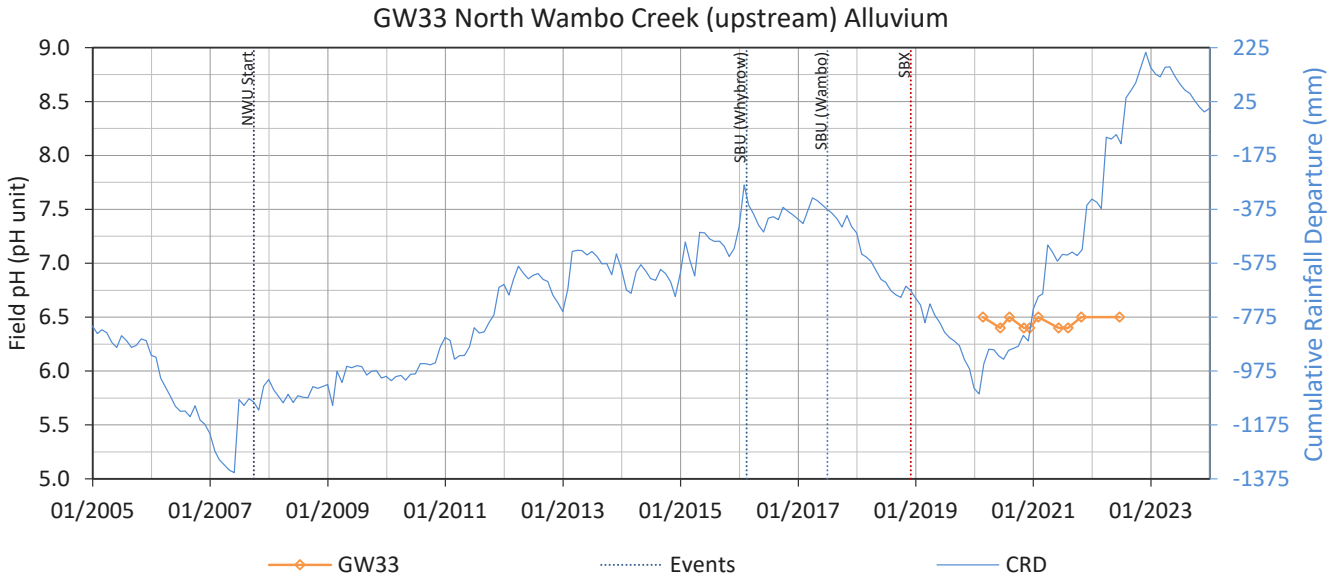

GW31 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW31
Events
CRD

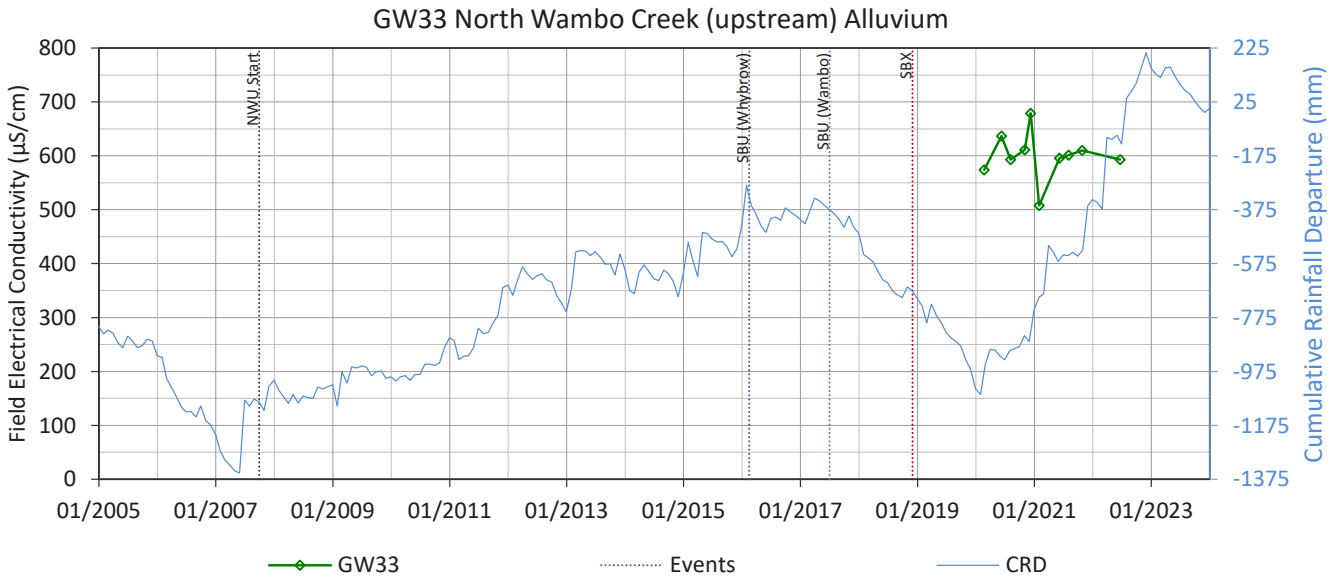

GW32 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
4/23/1900
4/22/1900
4/21/1900
4/20/1900
4/19/1900
4/18/1900
4/17/1900
4/16/1900
Cumulative Rainfall Departure (mm)
375
125
-125
-375
-625
-875
-1125
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW32
Events
CRD

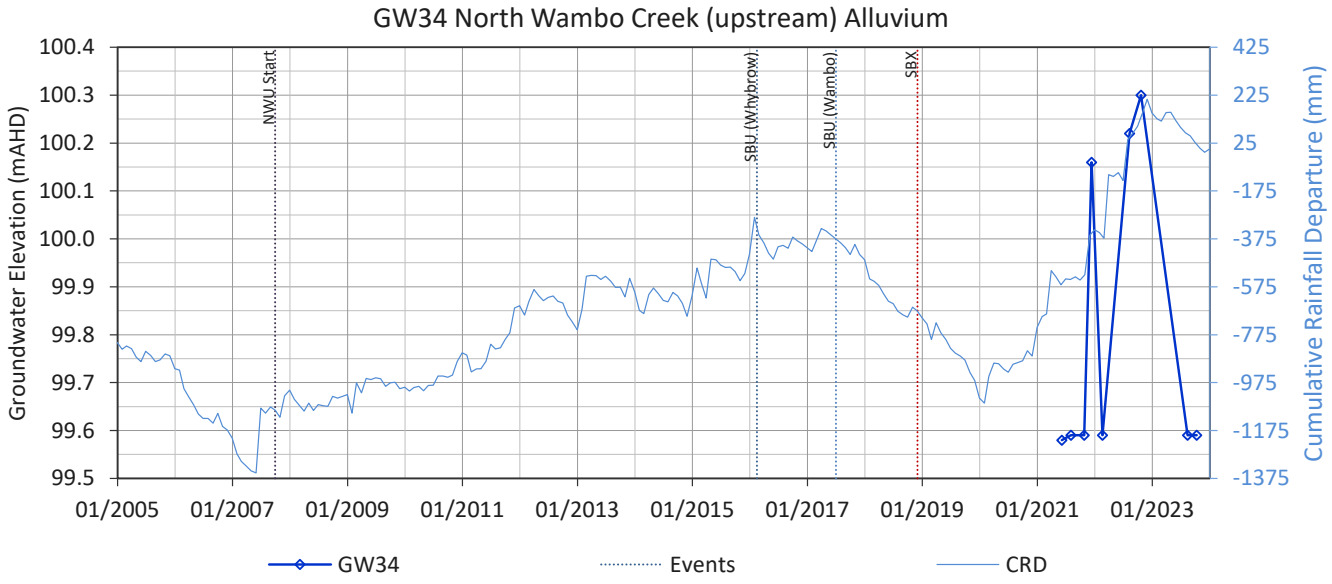

GW32 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
Cumulative Rainfall Departure (mm)
225
25
-175
-375
-575
-775
-975
-1175
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW32
Events
CRD

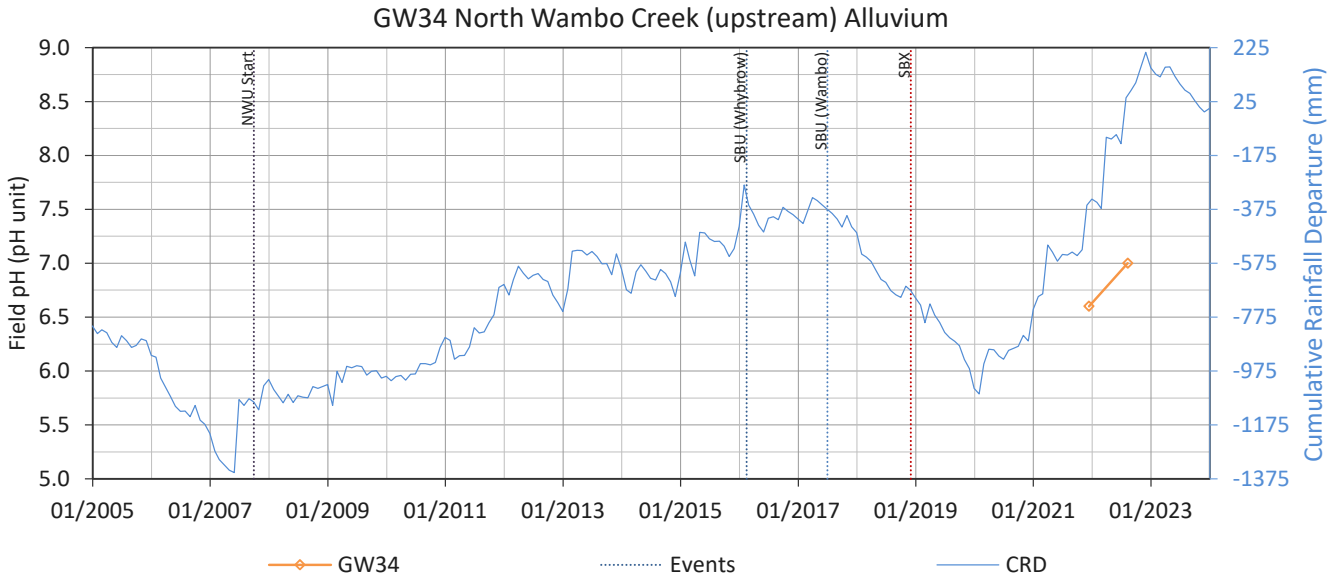

GW32 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
1000
900
800
700
600
500
400
300
200
100
0
Cumulative Rainfall Departure (mm)
375
200
25
-150
-325
-500
-675
-850
-1025
-1200
-1375
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW32
Events
CRD

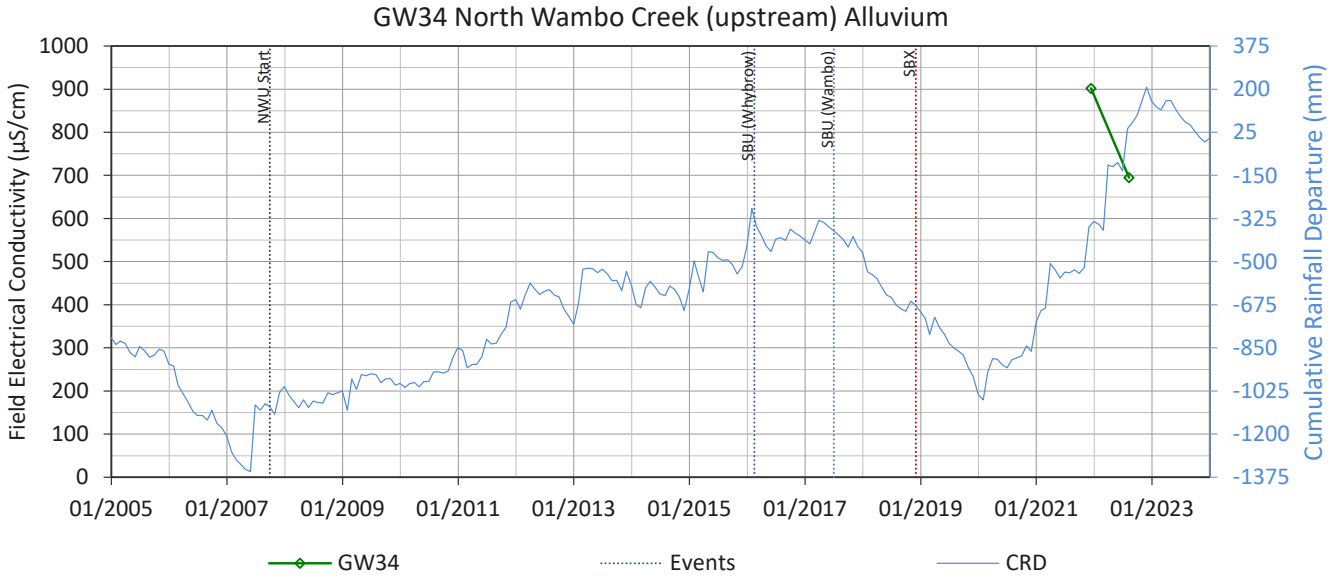

GW33 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

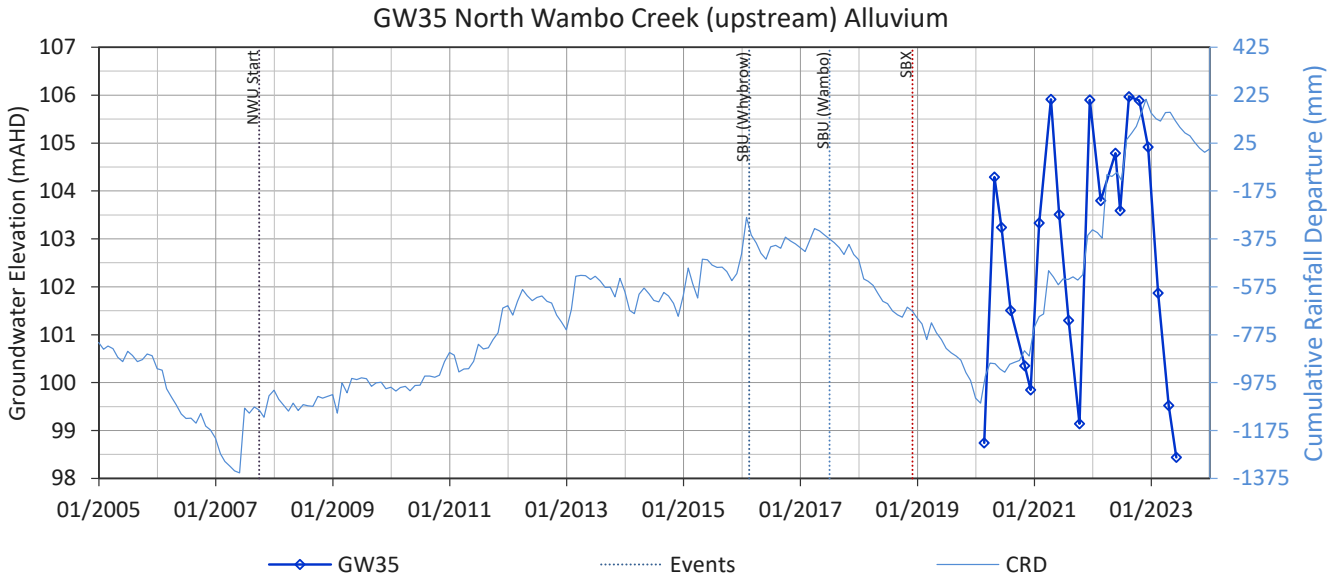

GW33 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

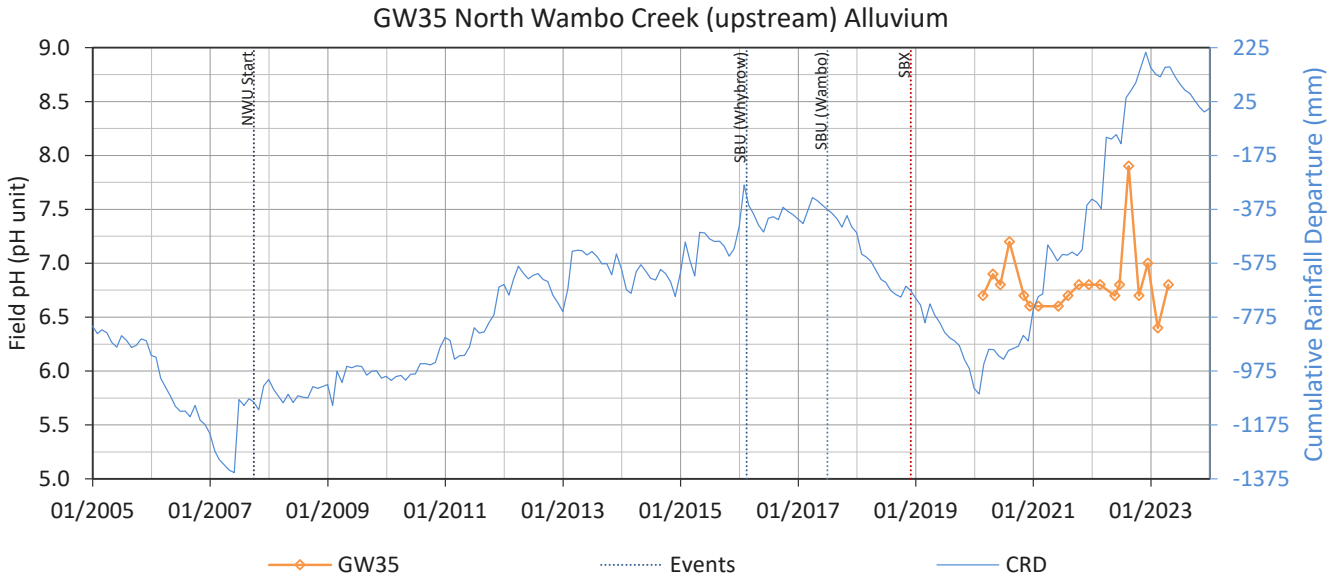

GW33 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW33
Events
CRD

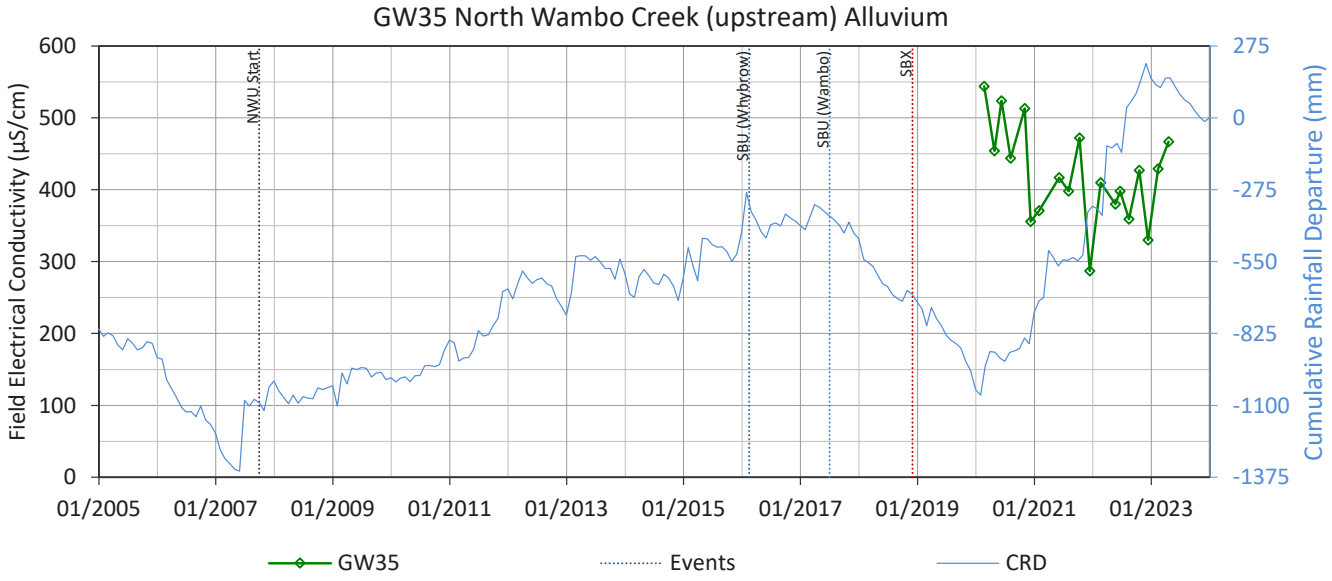

GW34 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

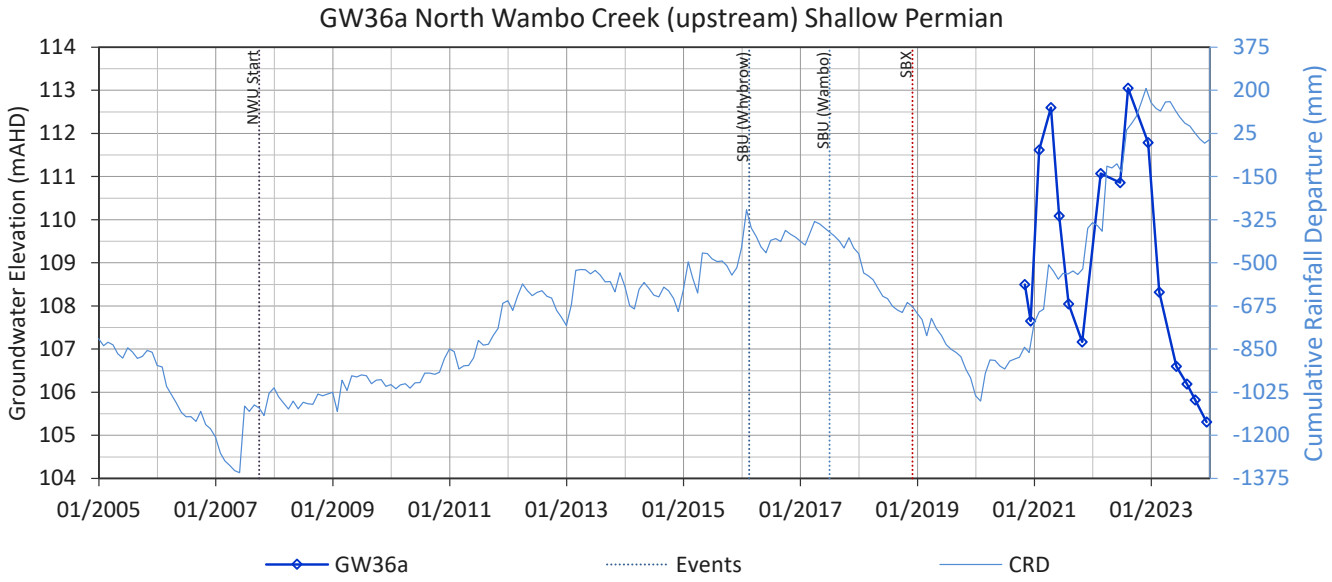

GW34 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

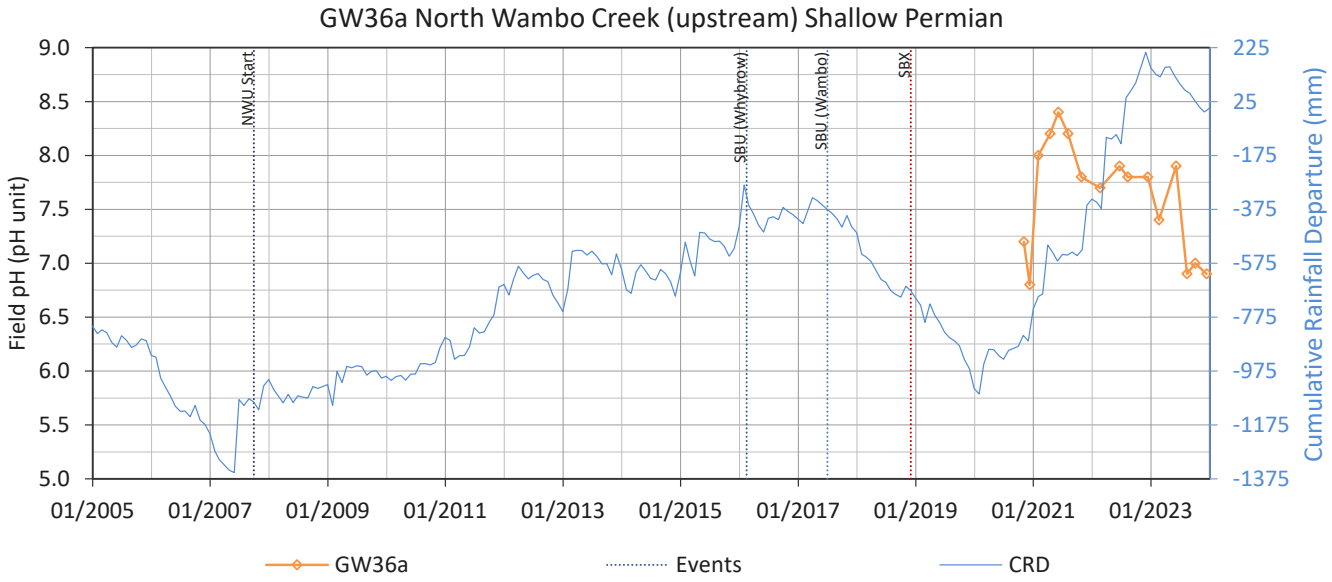

GW34 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW34
Events
CRD

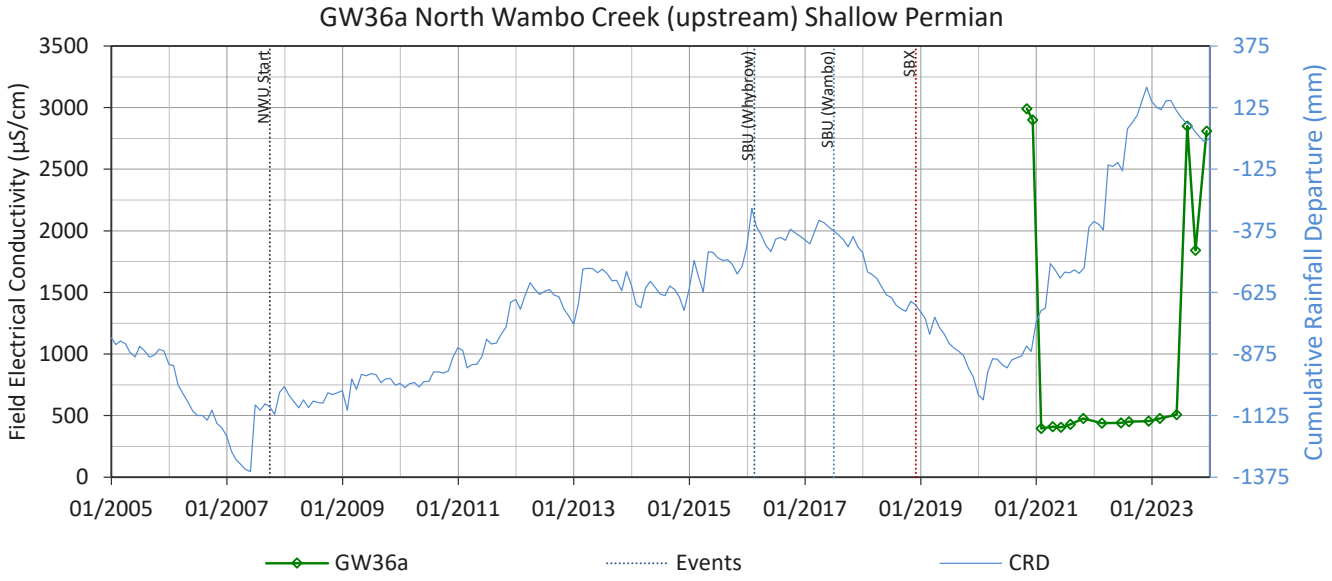

GW35 North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW35
Events
CRD

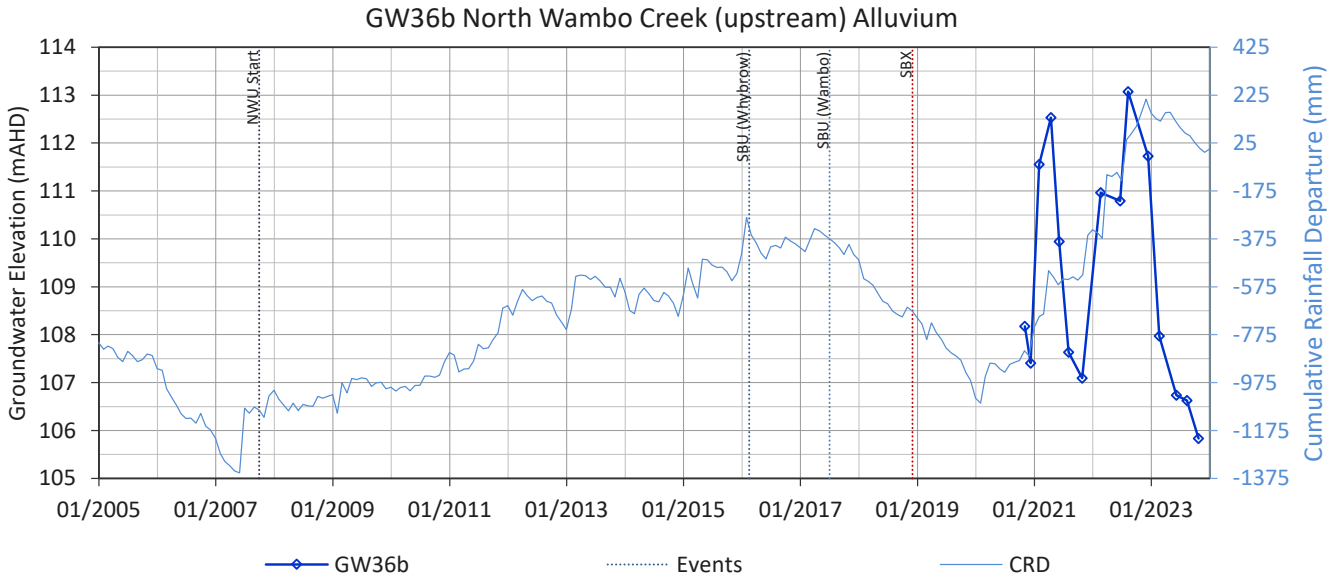

GW35 North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW35
Events
CRD

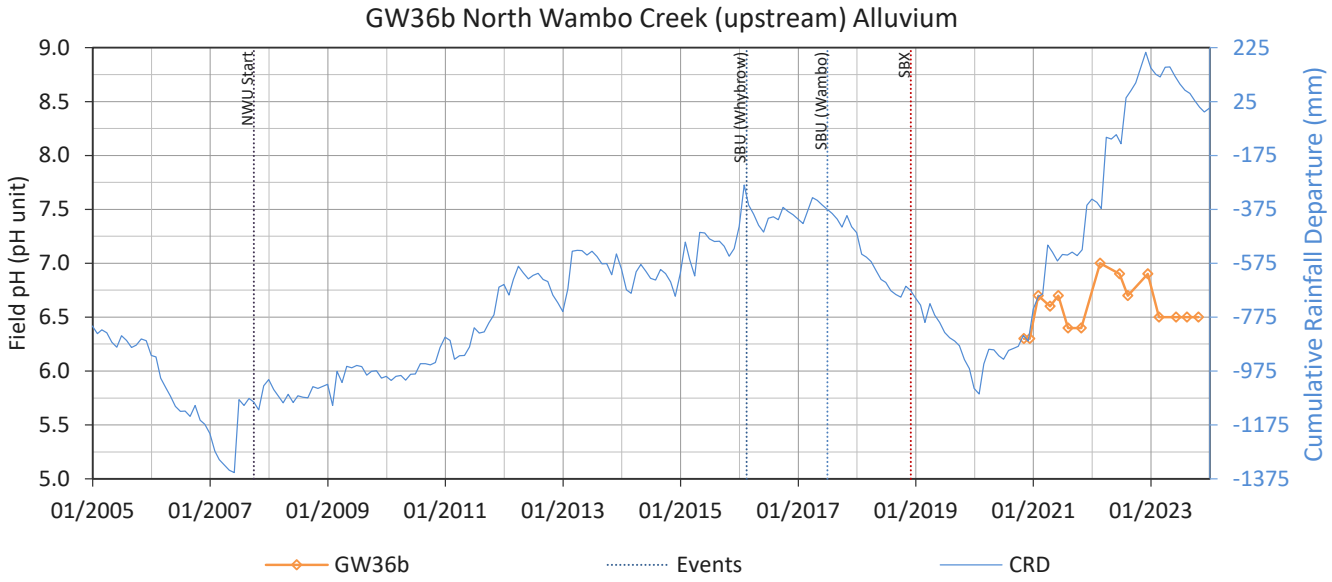

GW35 North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW35
Events
CRD

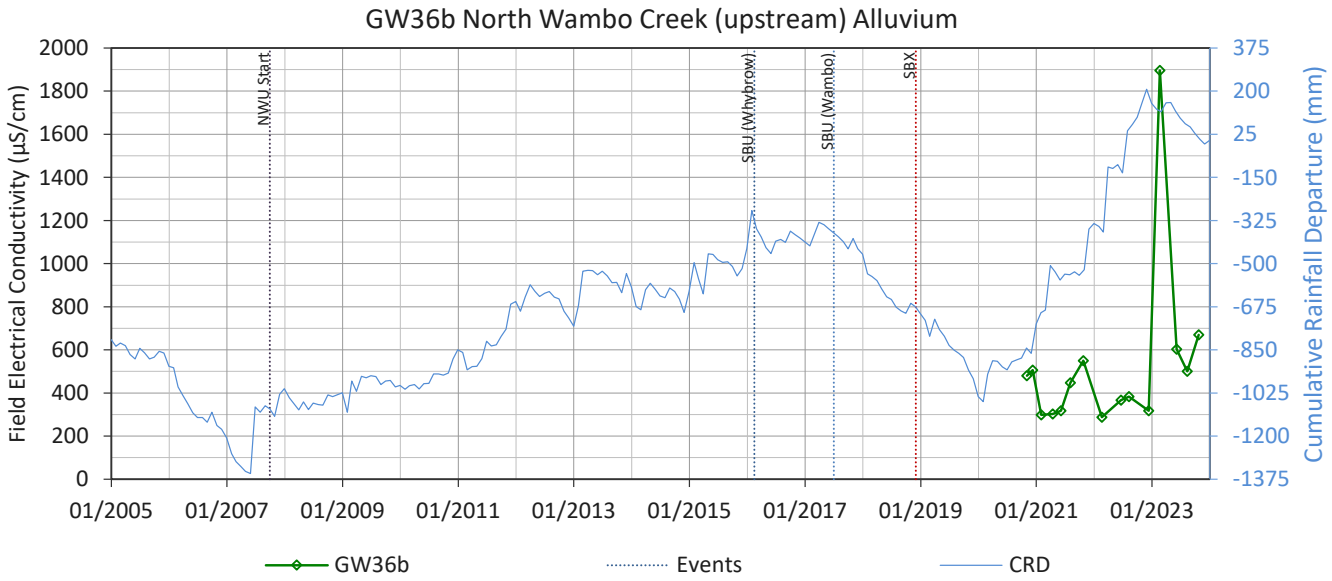

GW36a North Wambo Creek (upstream) Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36a
Events
CRD

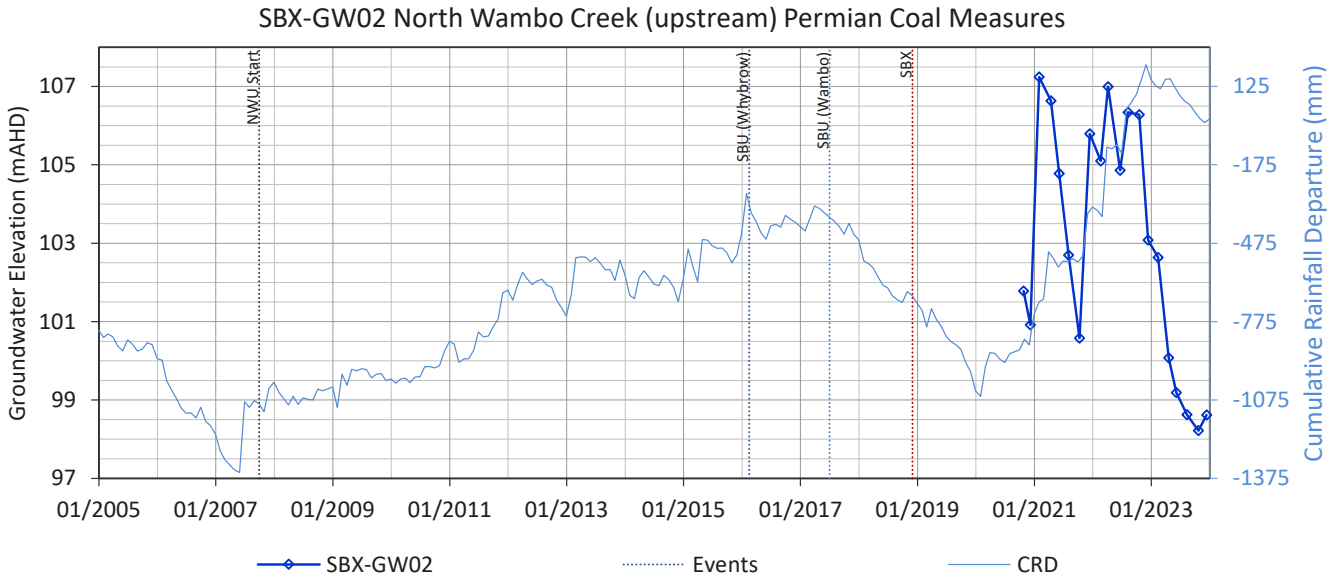

GW36a North Wambo Creek (upstream) Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36a
Events
CRD

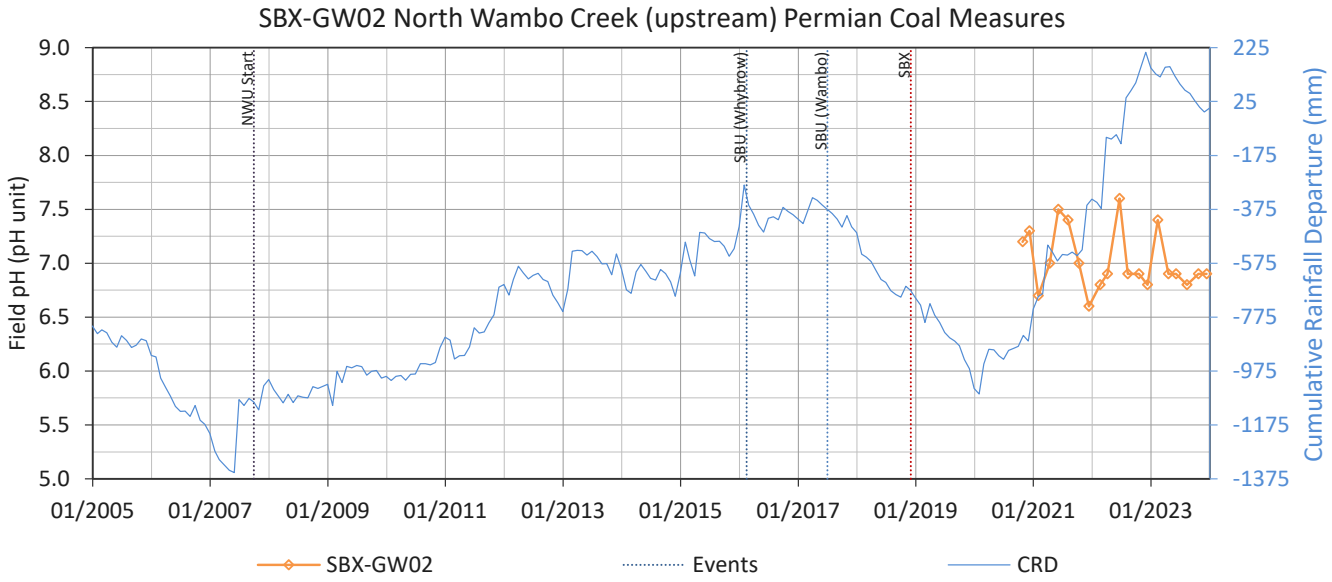

GW36a North Wambo Creek (upstream) Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36a
Events
CRD

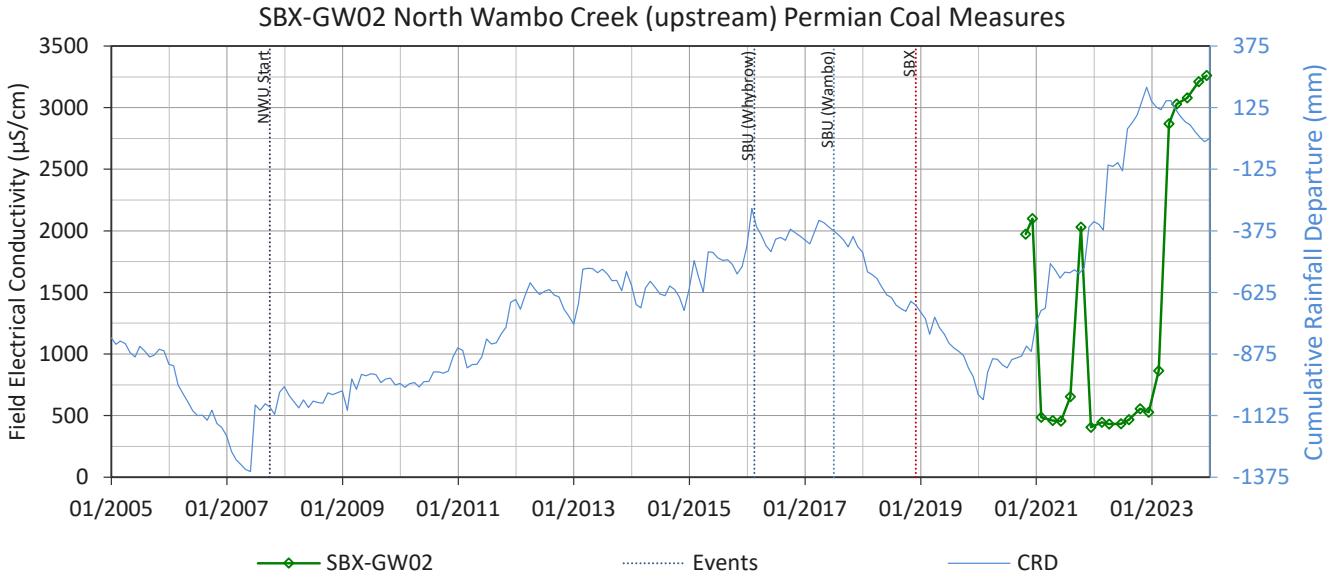

GW36b North Wambo Creek (upstream) Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

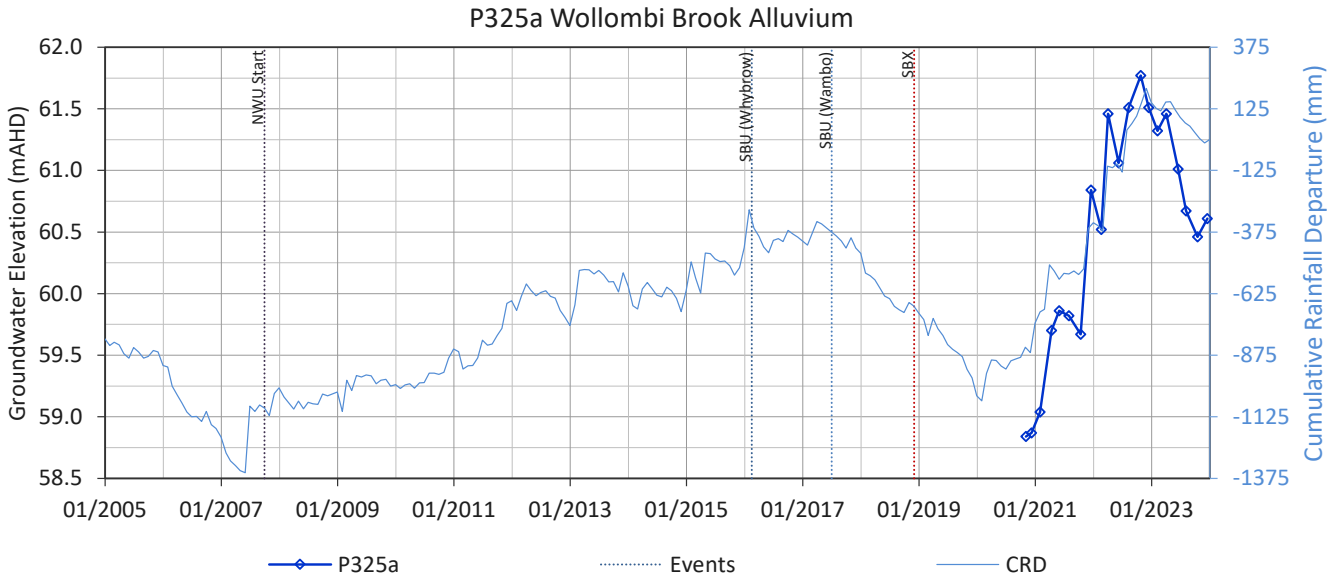

GW36b North Wambo Creek (upstream) Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

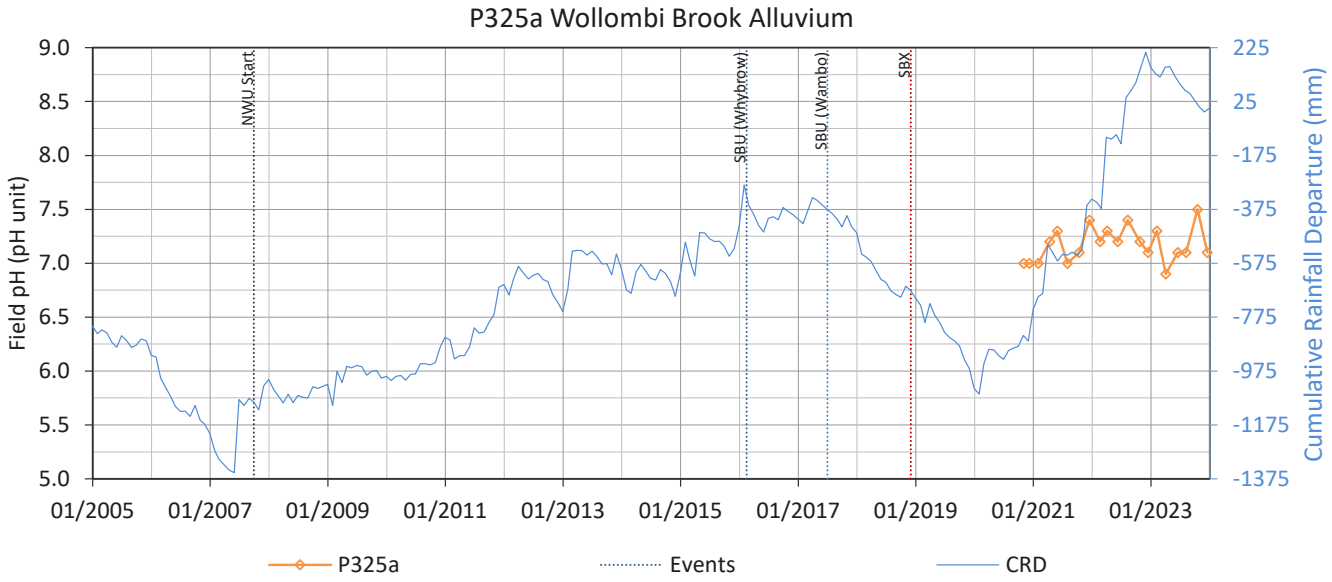

GW36b North Wambo Creek (upstream) Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW36b
Events
CRD

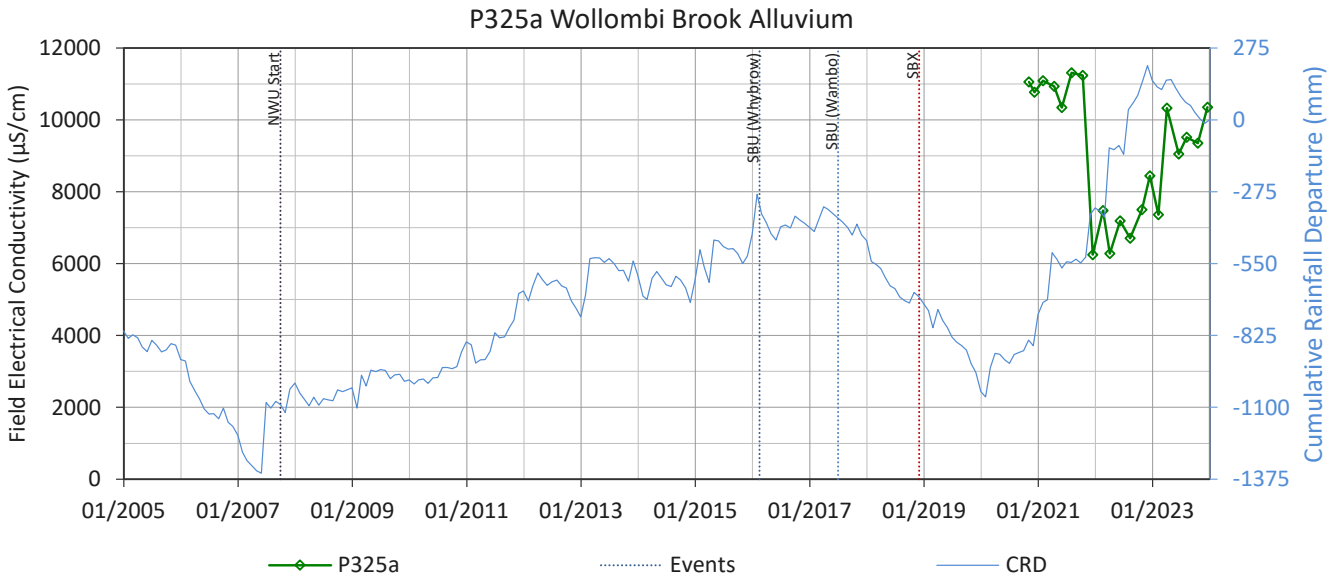

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
SBX-GW02
Events
CRD

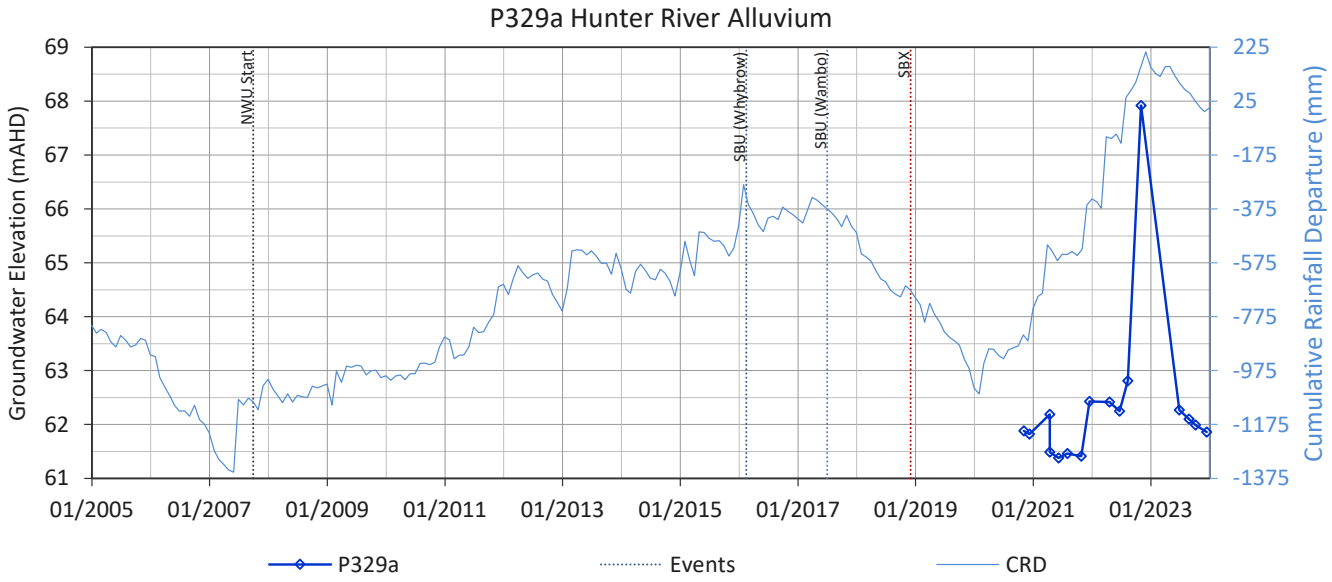

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
SBX-GW02
Events
CRD

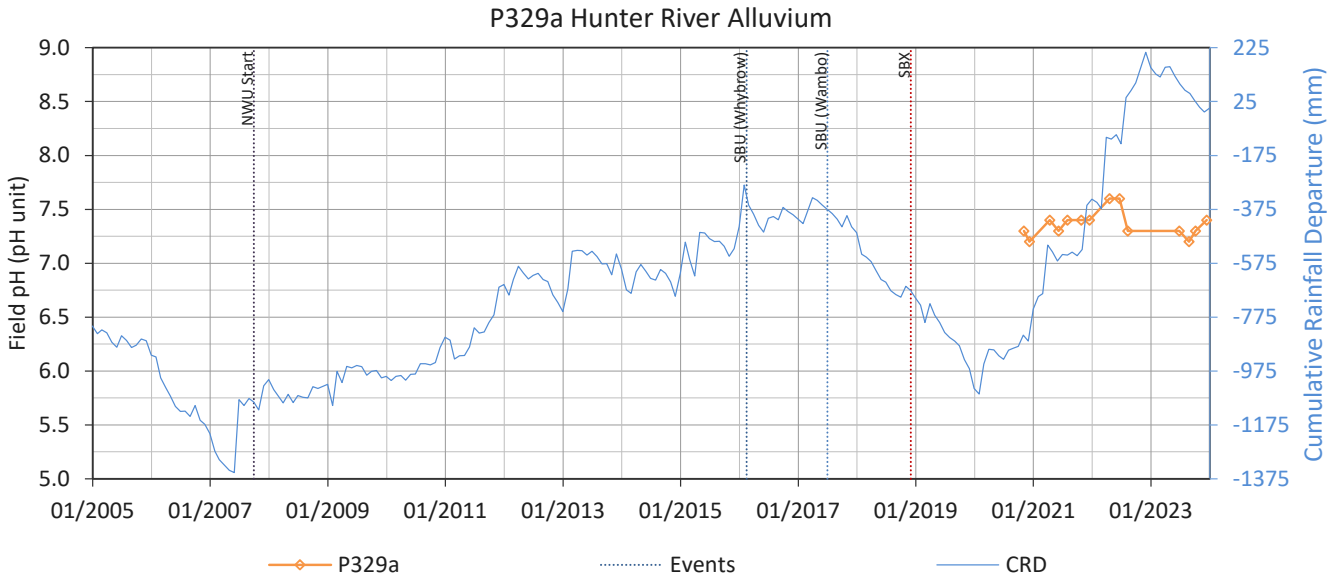

SBX-GW02 North Wambo Creek (upstream) Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
SBX-GW02
Events
CRD

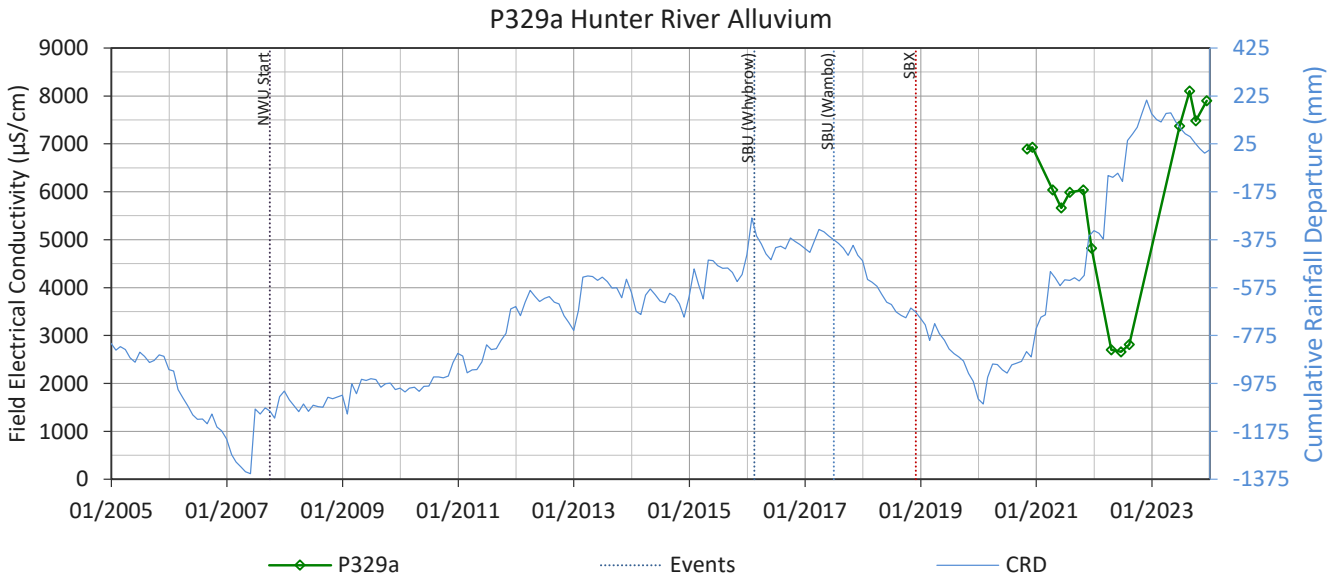

P325a Wollombi Brook Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

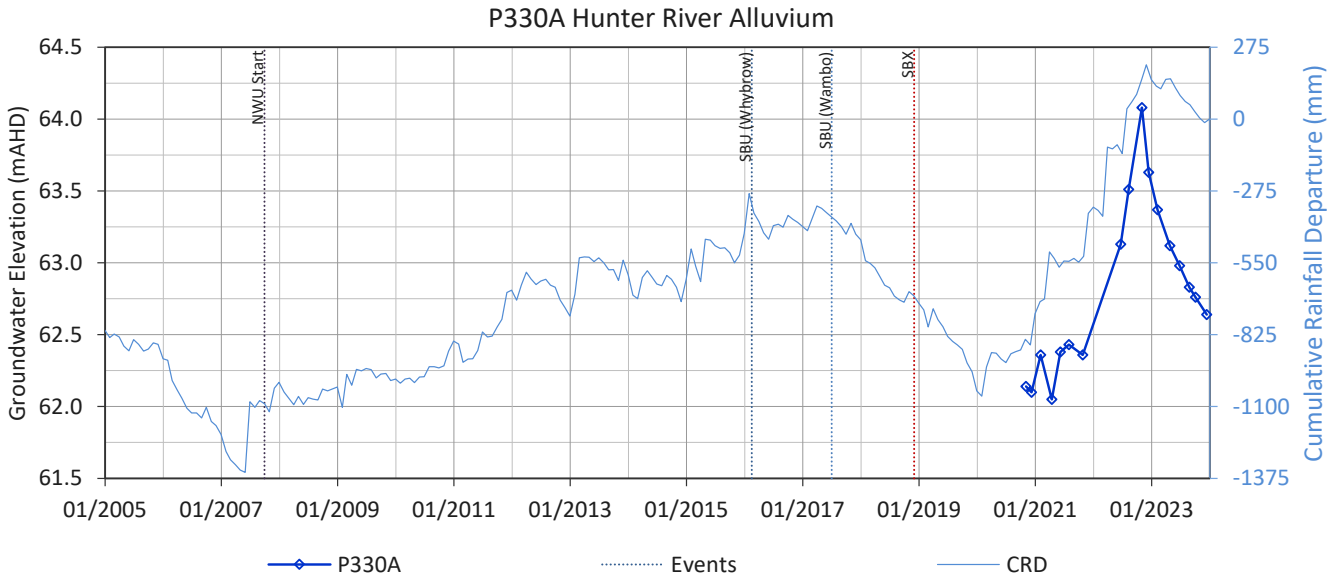

P325a Wollombi Brook Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

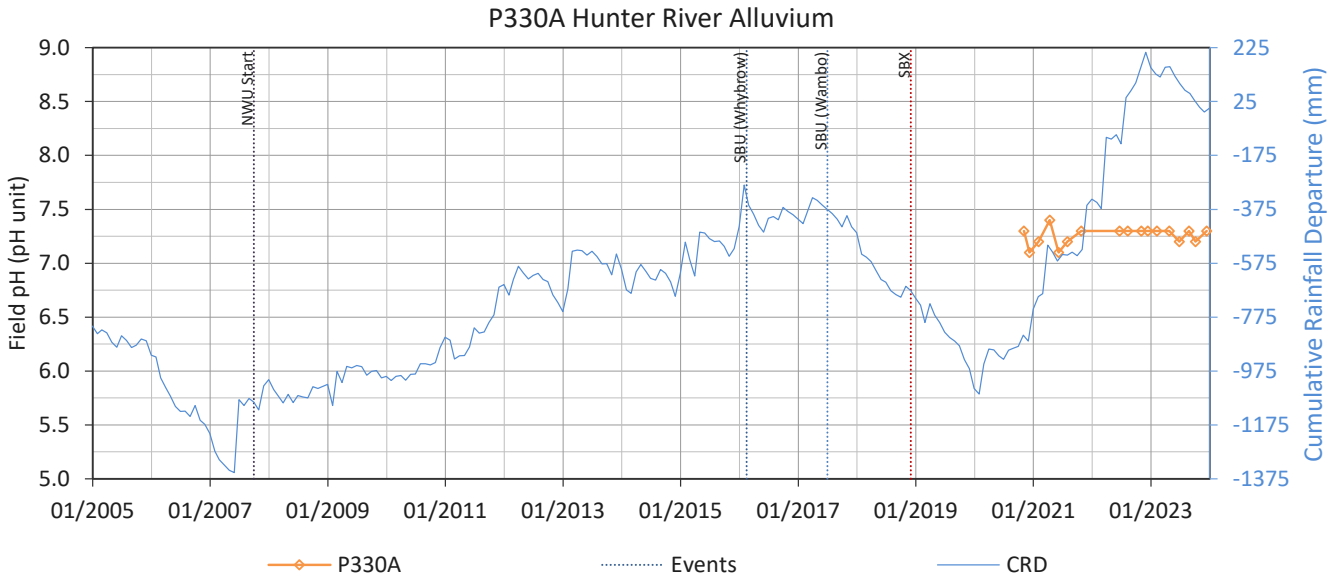

P325a Wollombi Brook Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P325a
Events
CRD

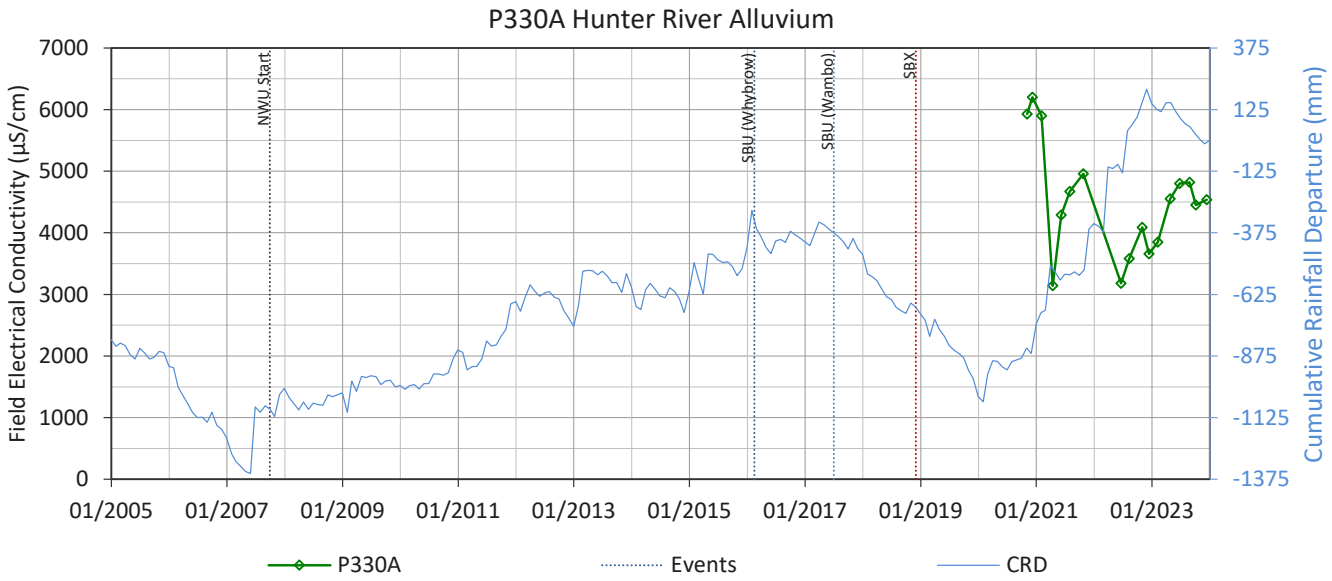

P329a Hunter River Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

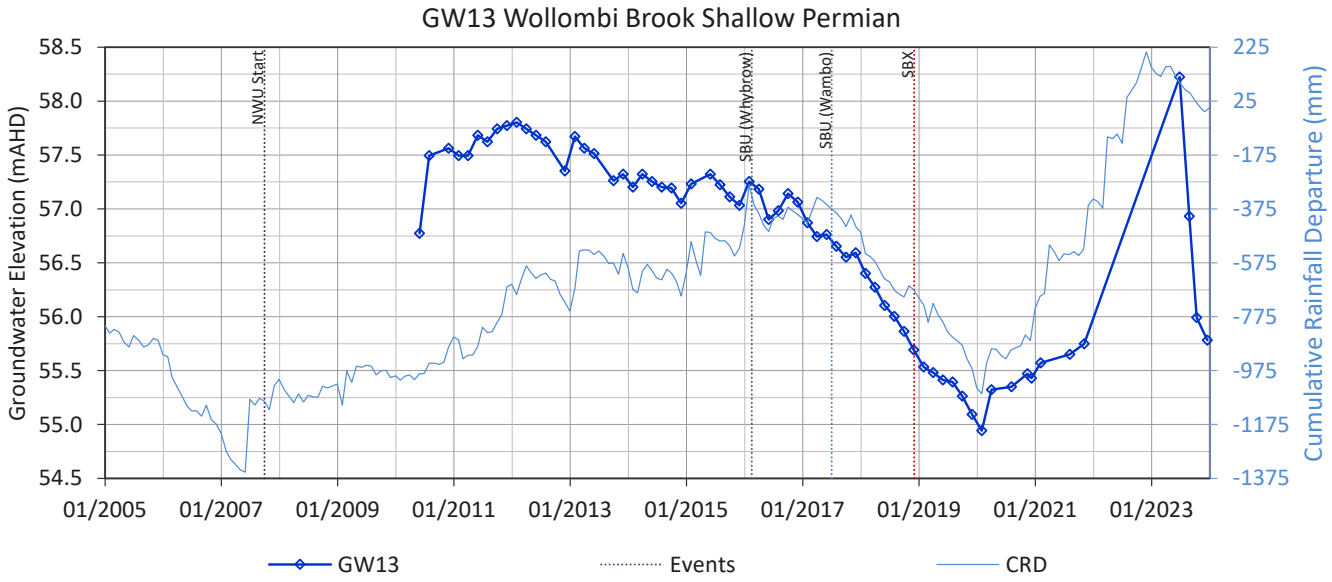

P329a Hunter River Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

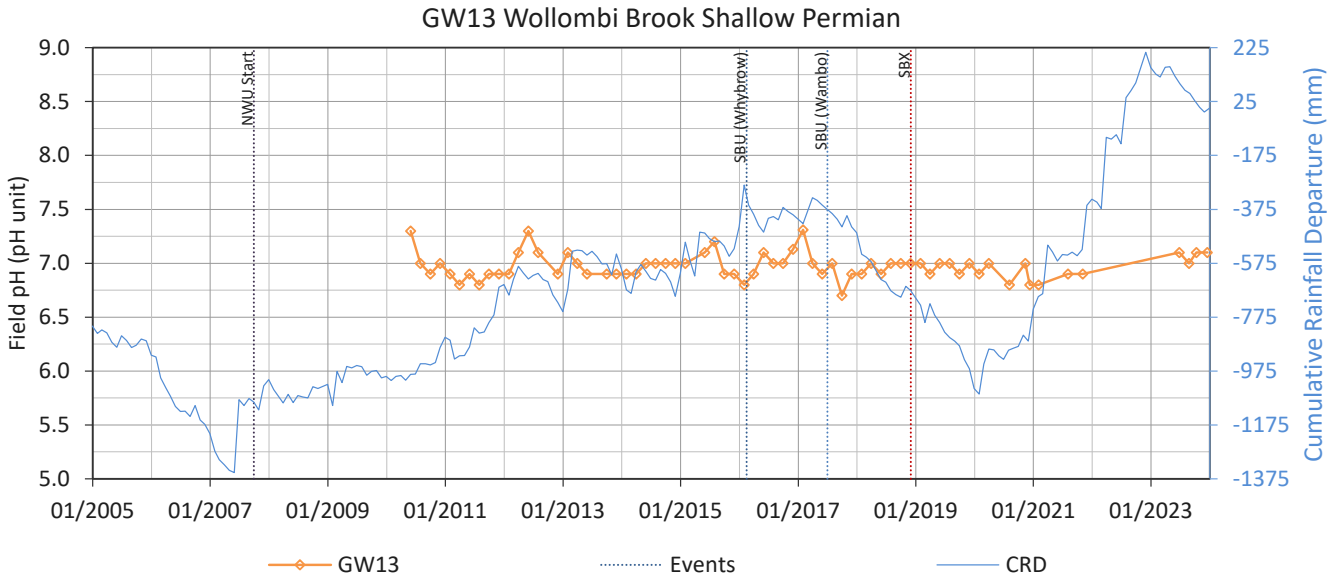

P329a Hunter River Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P329a
Events
CRD

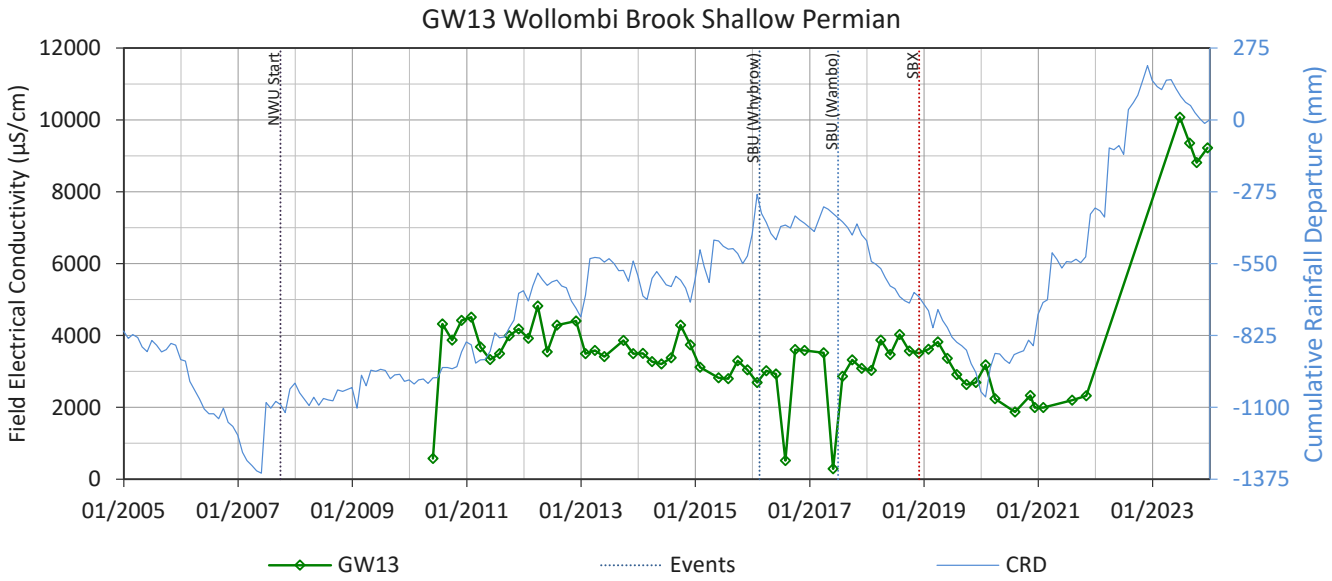

P330A Hunter River Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
64.5
64.0
63.5
63.0
62.5
62.0
61.5
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P330A
Events
CRD

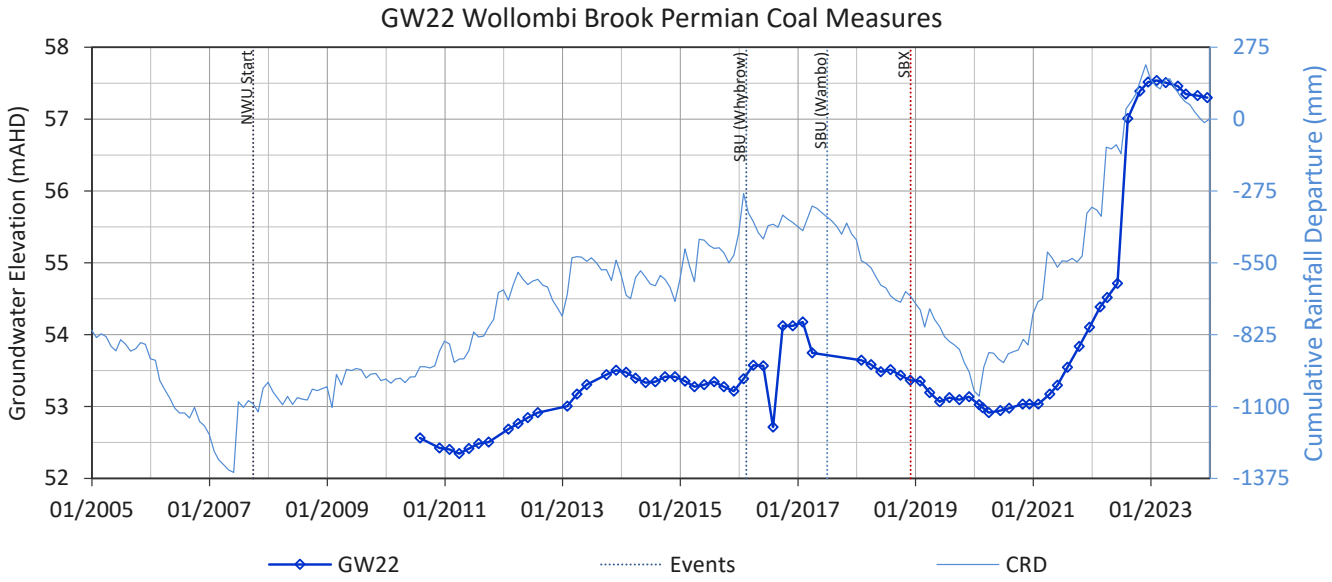

P330A Hunter River Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P330A
Events
CRD

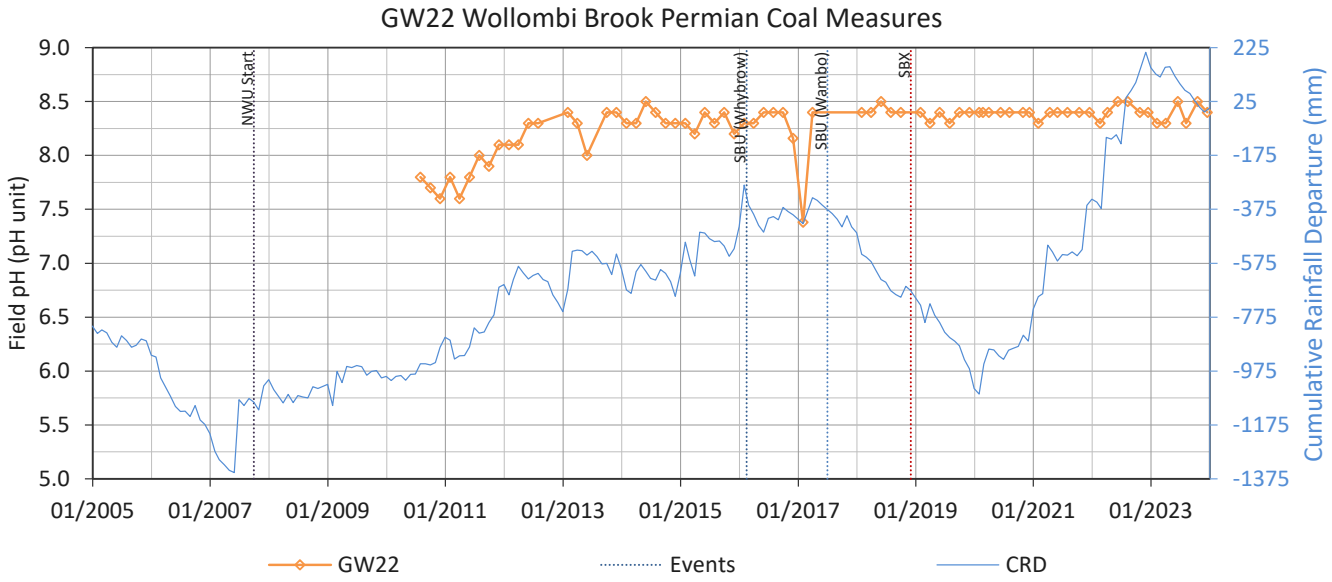

P330A Hunter River Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
7000
6000
5000
4000
3000
2000
1000
0
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P330A
Events
CRD

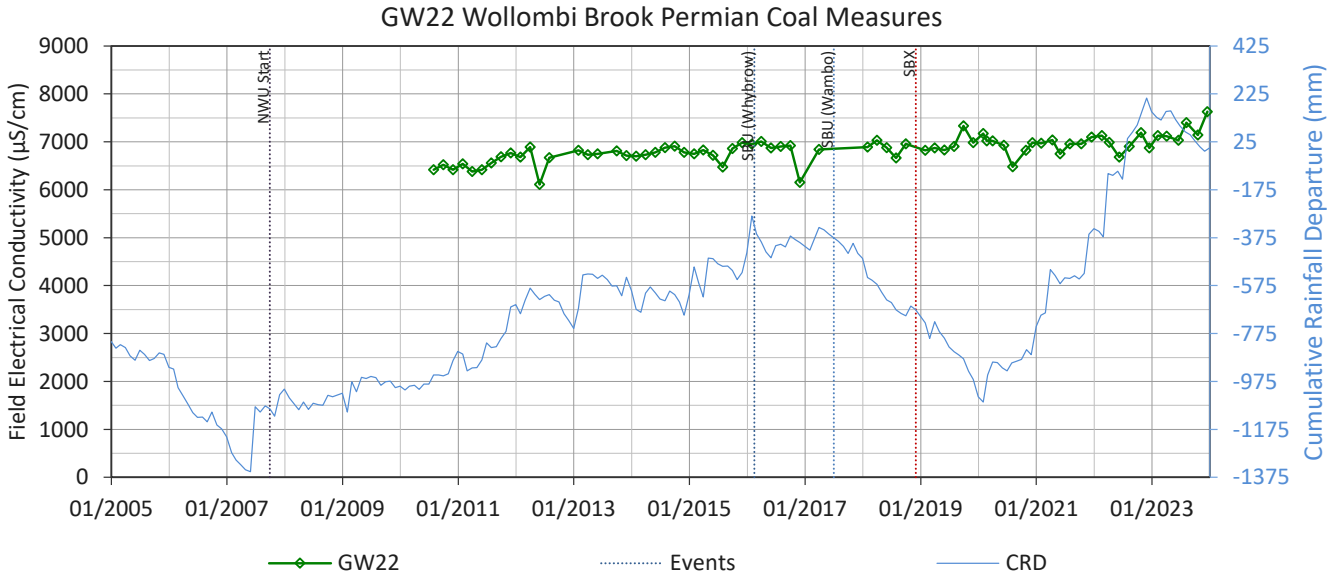

GW13 Wollombi Brook Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

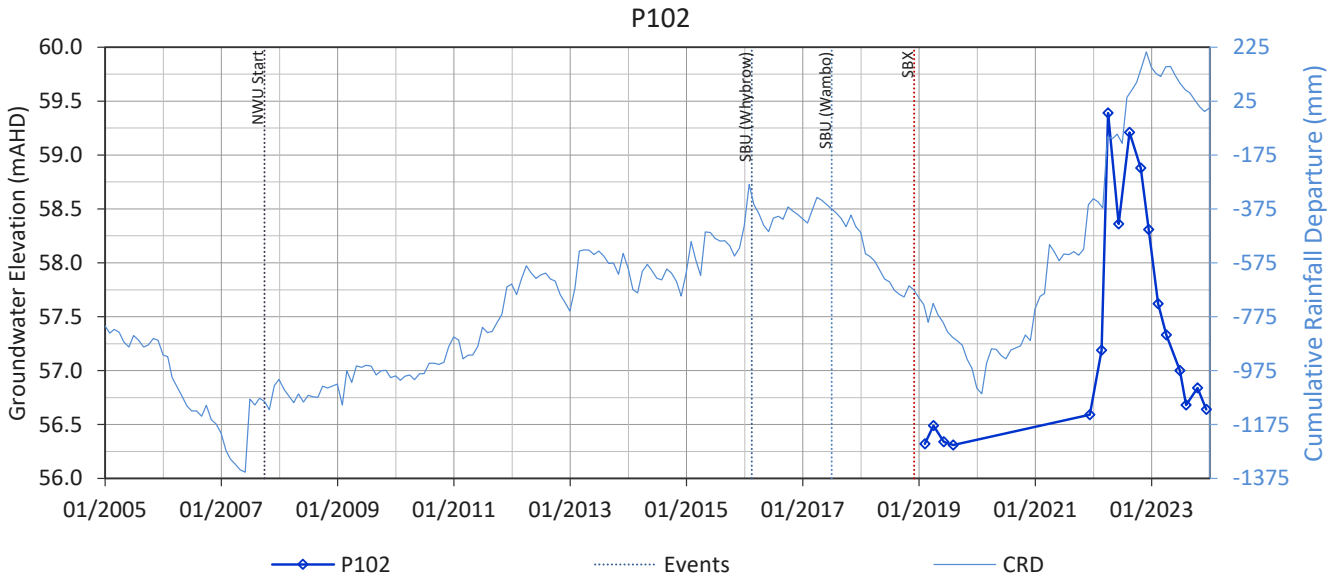

GW13 Wollombi Brook Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

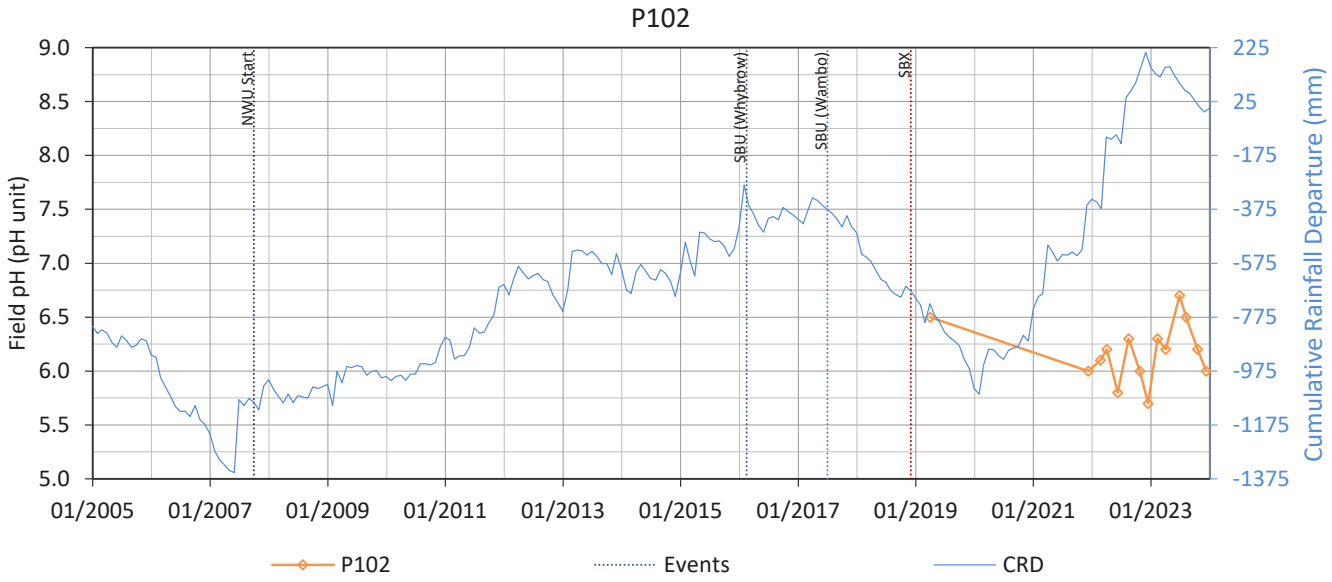

GW13 Wollombi Brook Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW13
Events
CRD

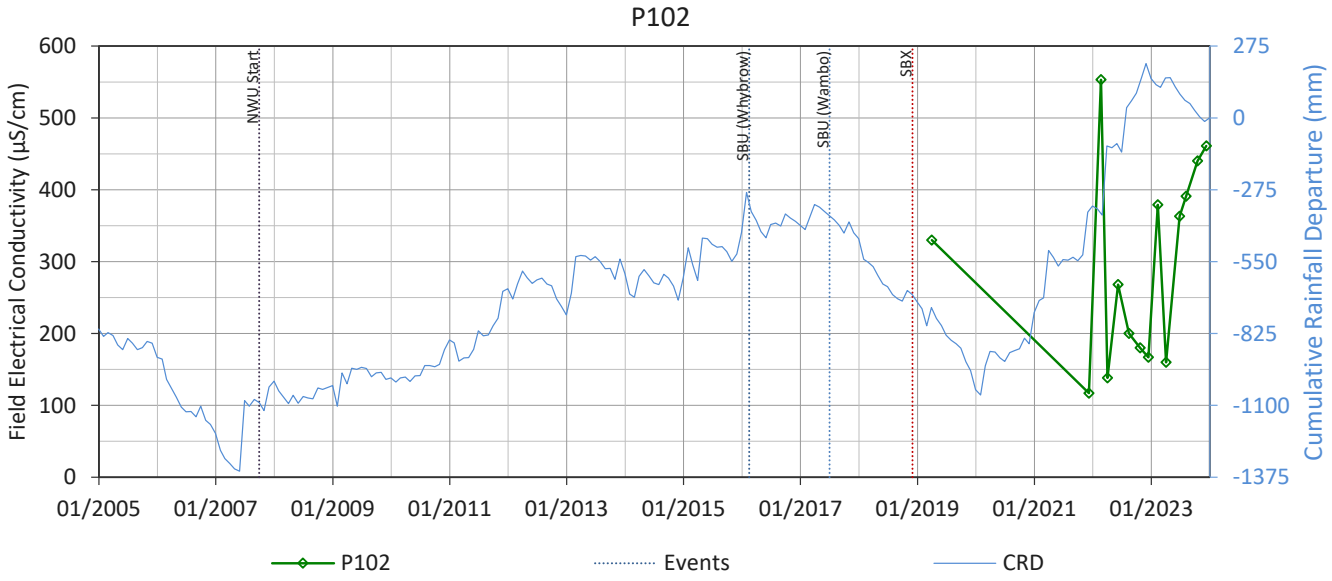

GW22 Wollombi Brook Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

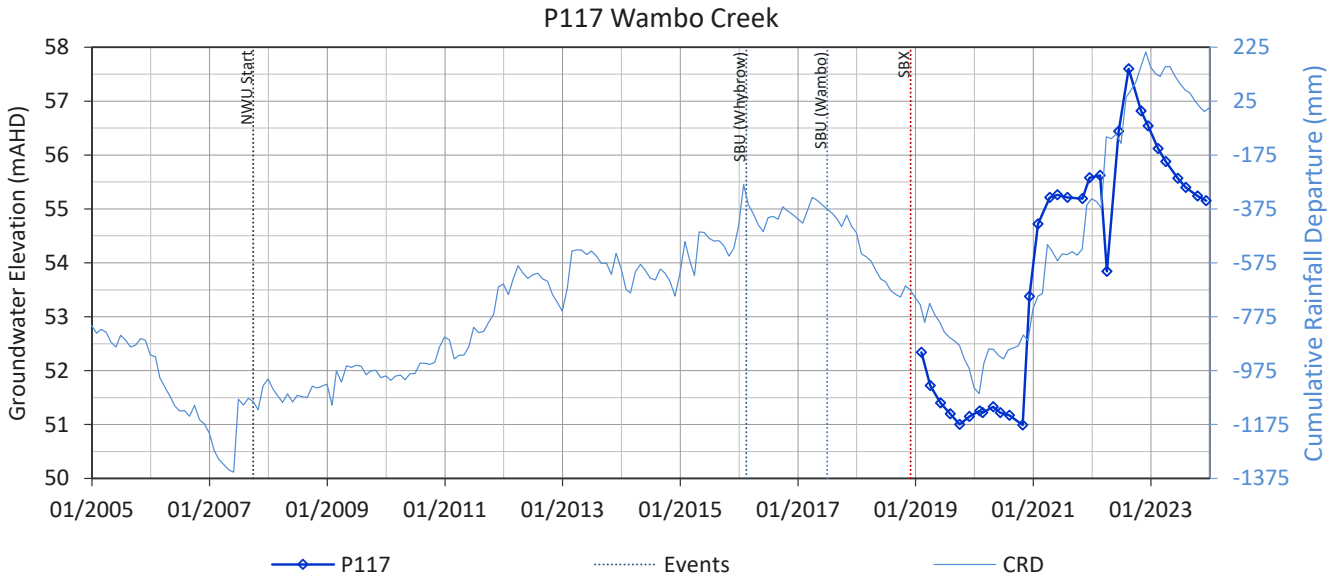

GW22 Wollombi Brook Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

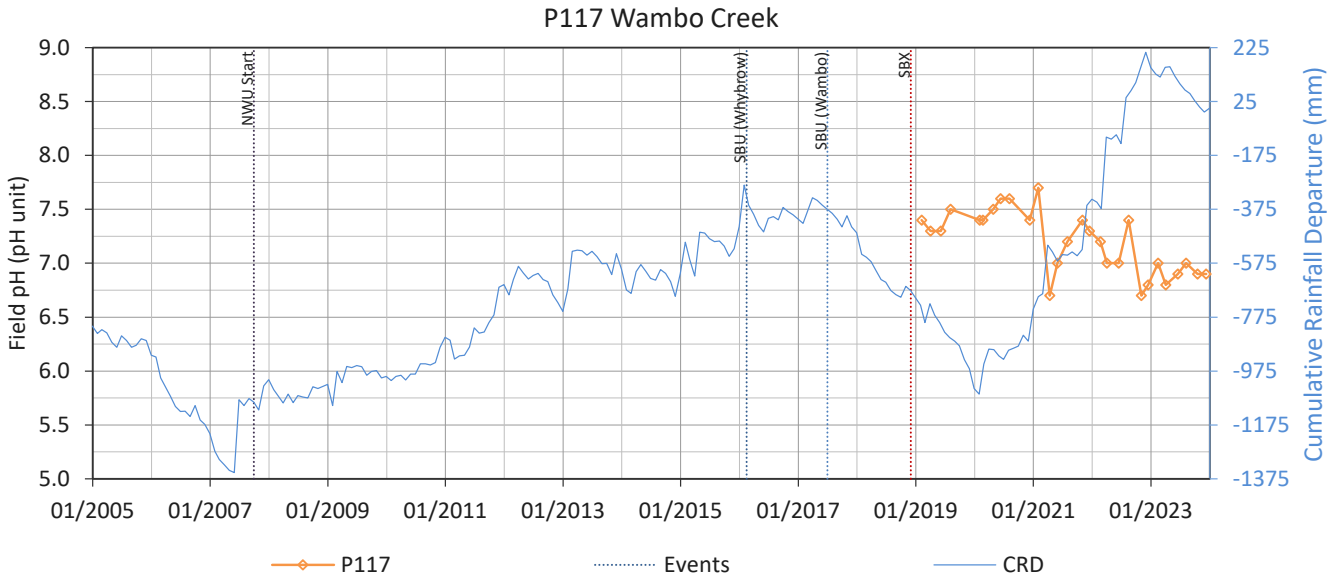

GW22 Wollombi Brook Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW22
Events
CRD

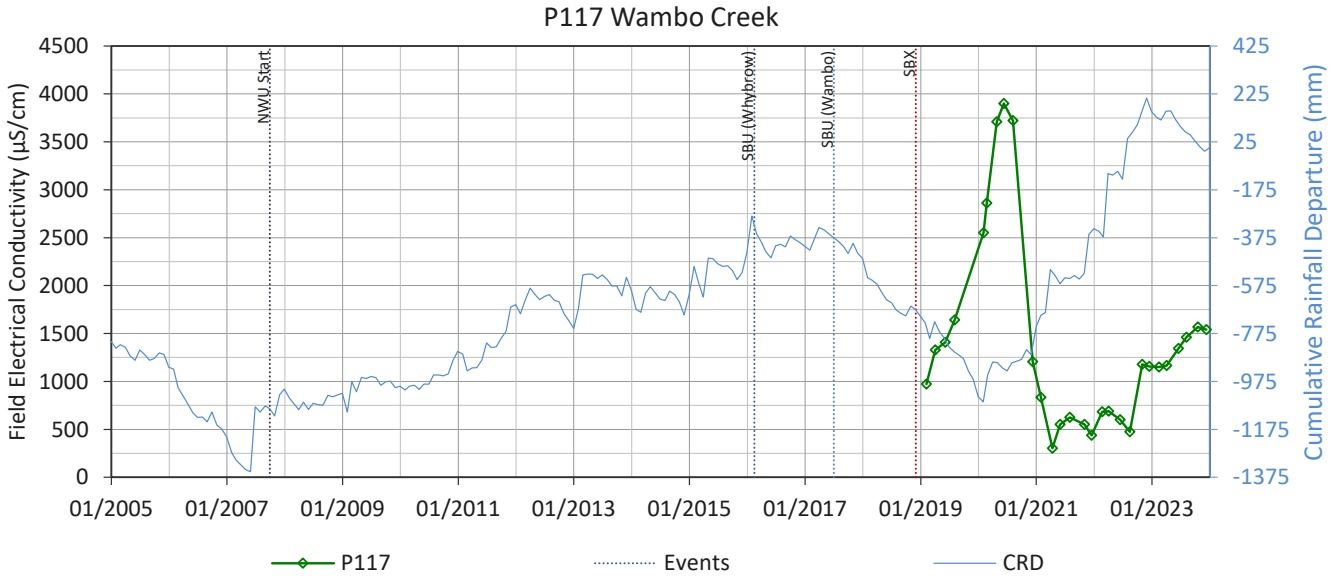

P102
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P102
Events
CRD

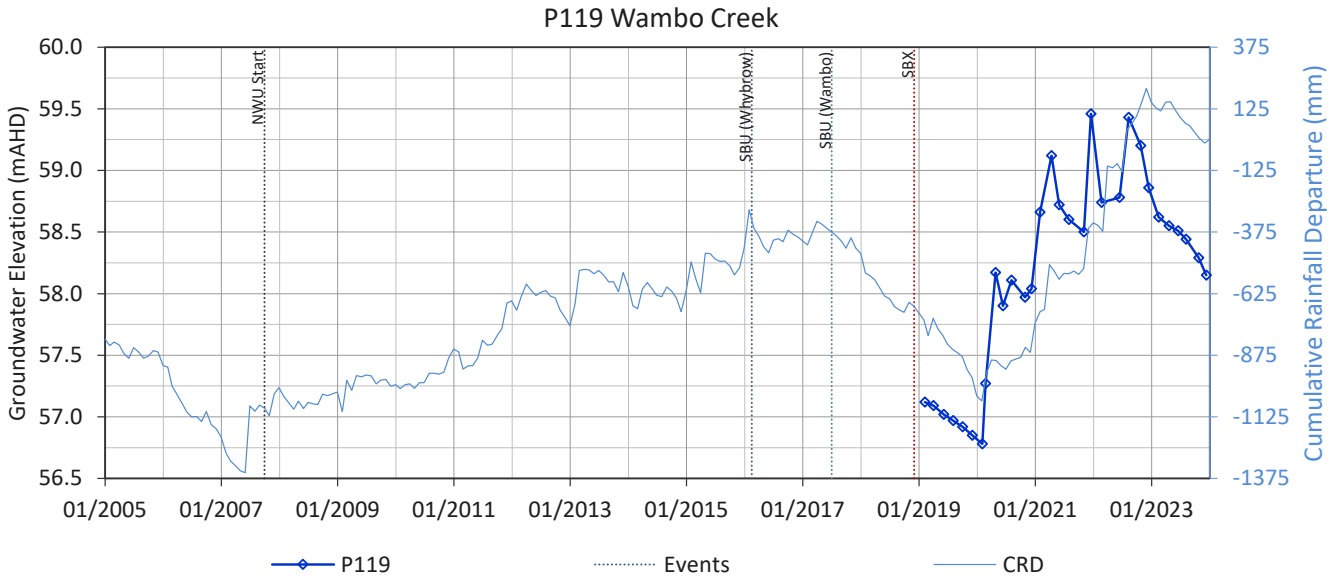

P102
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P102
Events
CRD

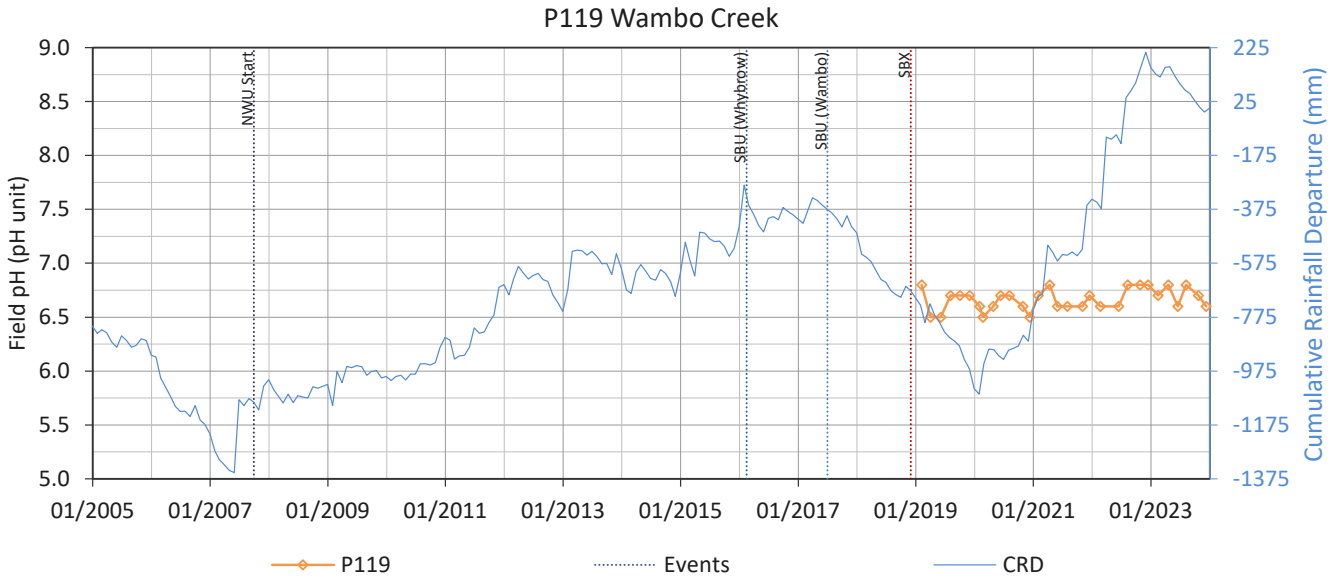

P102
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
600
500
400
300
200
100
0
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P102
Events
CRD

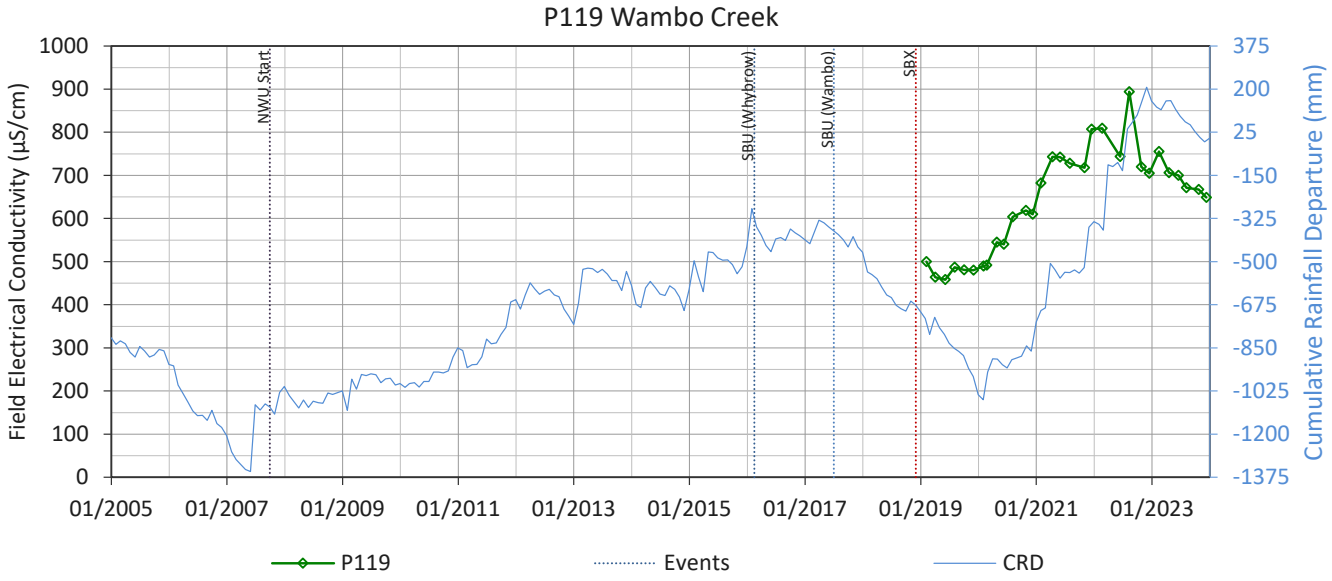

P117 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
58
57
56
55
54
53
52
51
50
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P117
Events
CRD

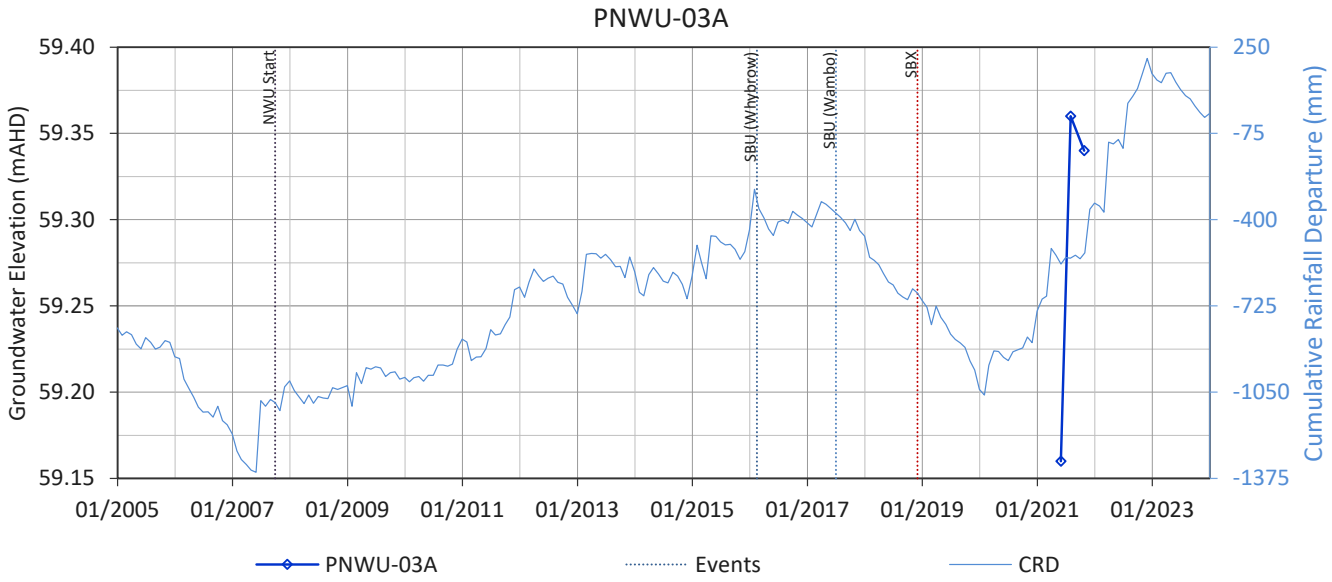

P117 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P117
Events
CRD

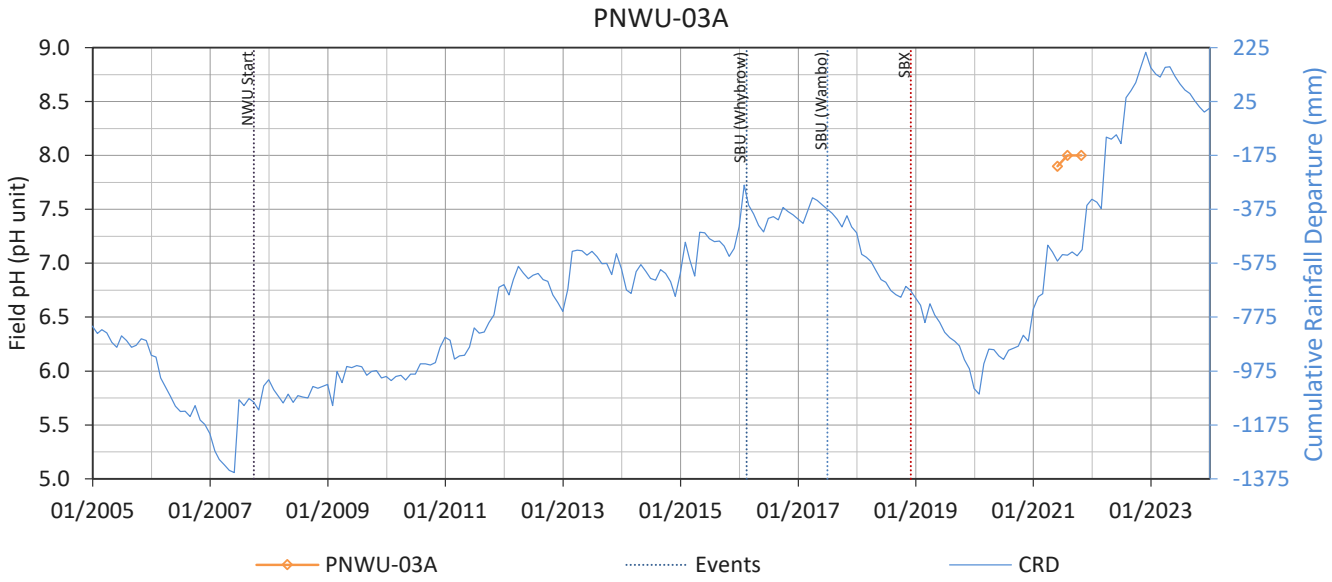

P117 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
4500
4000
3500
3000
2500
2000
1500
1000
500
0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P117
Events
CRD

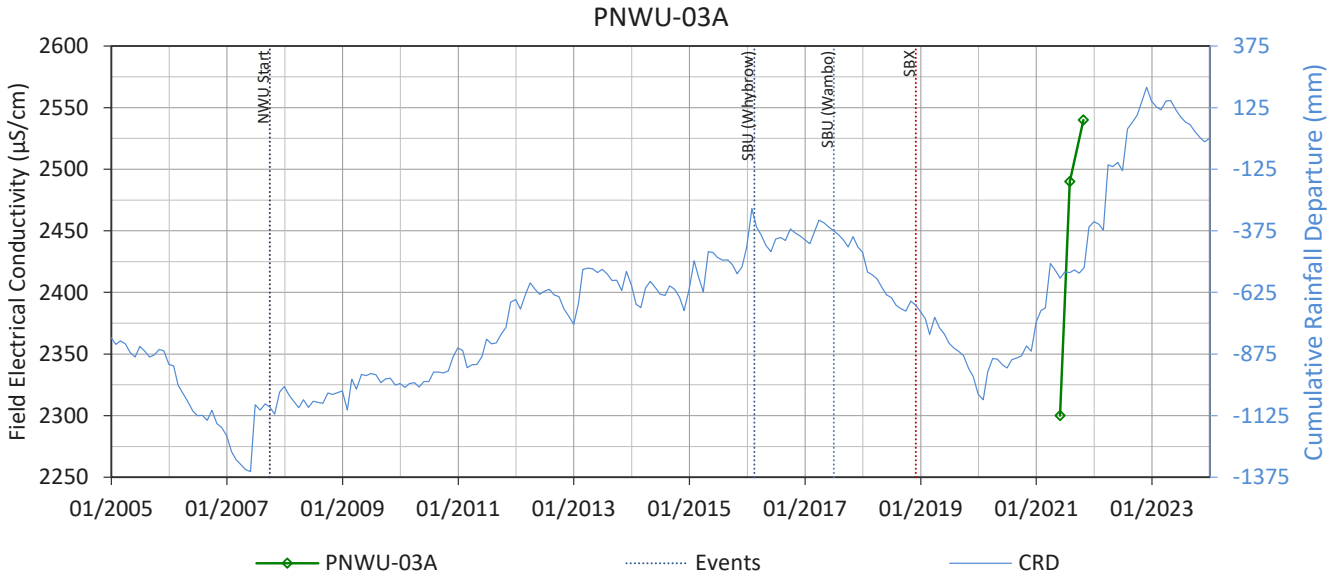

P119 Wambo Creek
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P119
Events
CRD

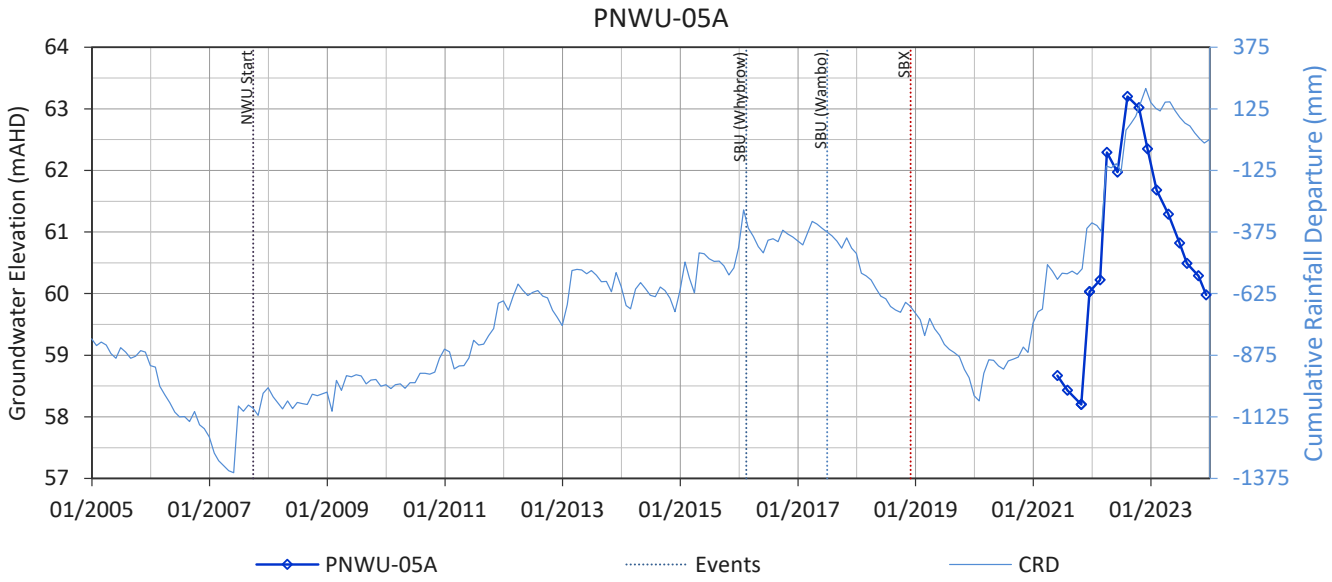

P119 Wambo Creek
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P119
Events
CRD

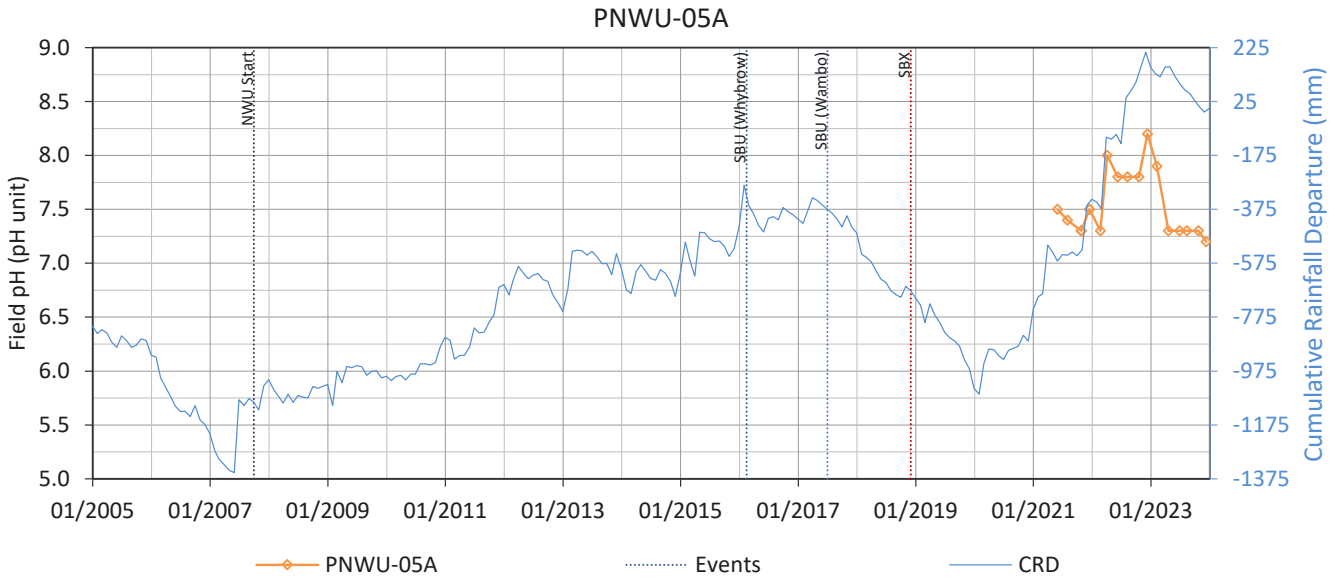

P119 Wambo Creek
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1000
900
800
700
600
500
400
300
200
100
0
375
200
25
-150
-325
-500
-675
-850
-1025
-1200
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P119
Events
CRD

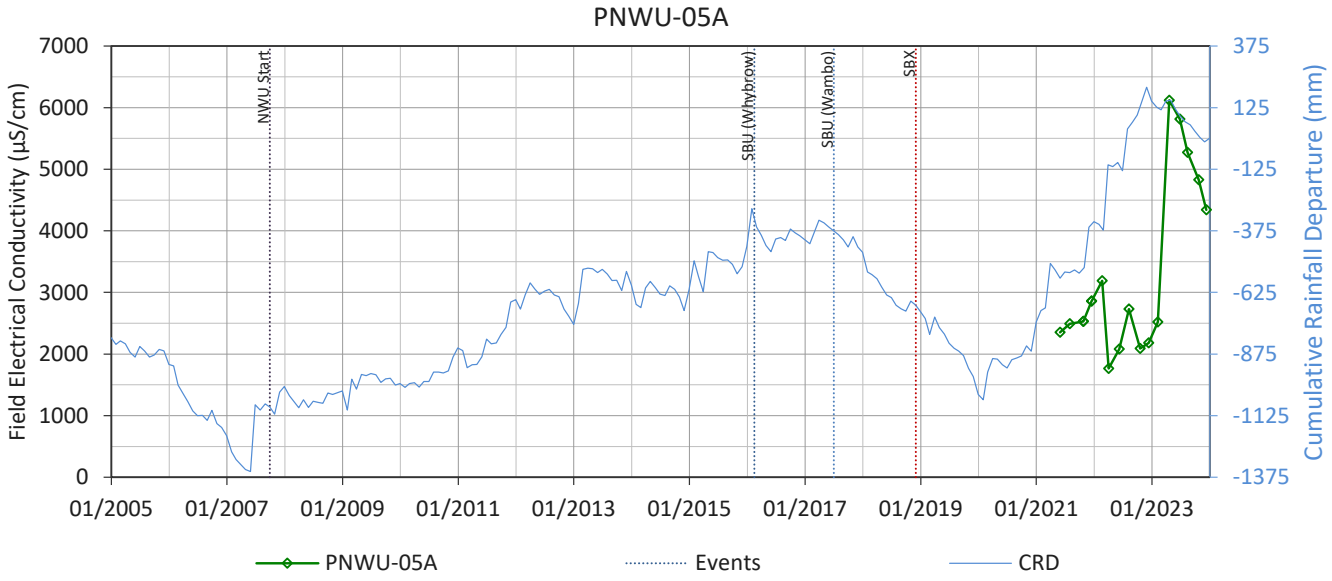

PNWU-03A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
59.40
59.35
59.30
59.25
59.20
59.15
250
-75
-400
-725
-1050
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-03A
Events
CRD

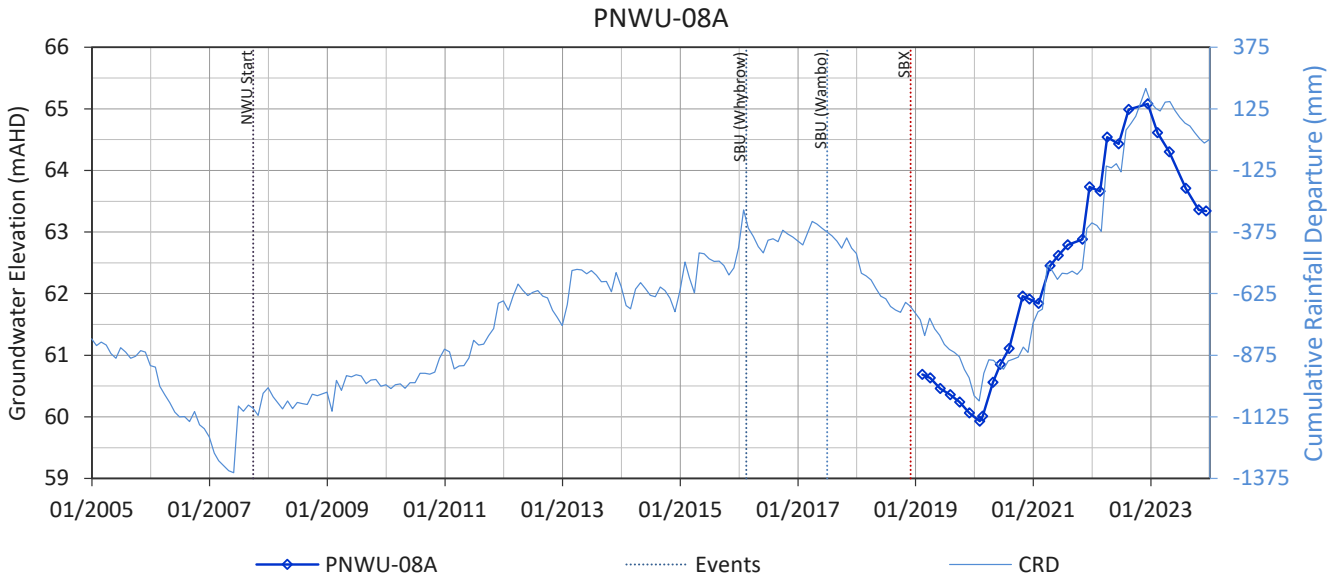

PNWU-03A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-03A
Events
CRD

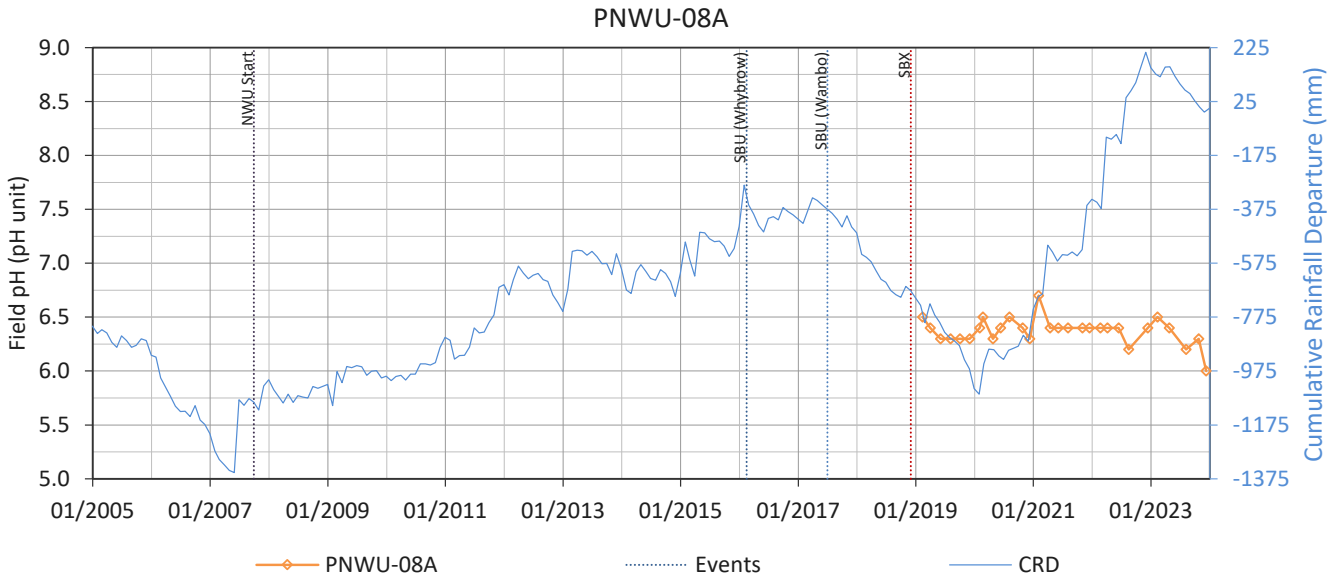

PNWU-03A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2600
2550
2500
2450
2400
2350
2300
2250
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-03A
Events
CRD

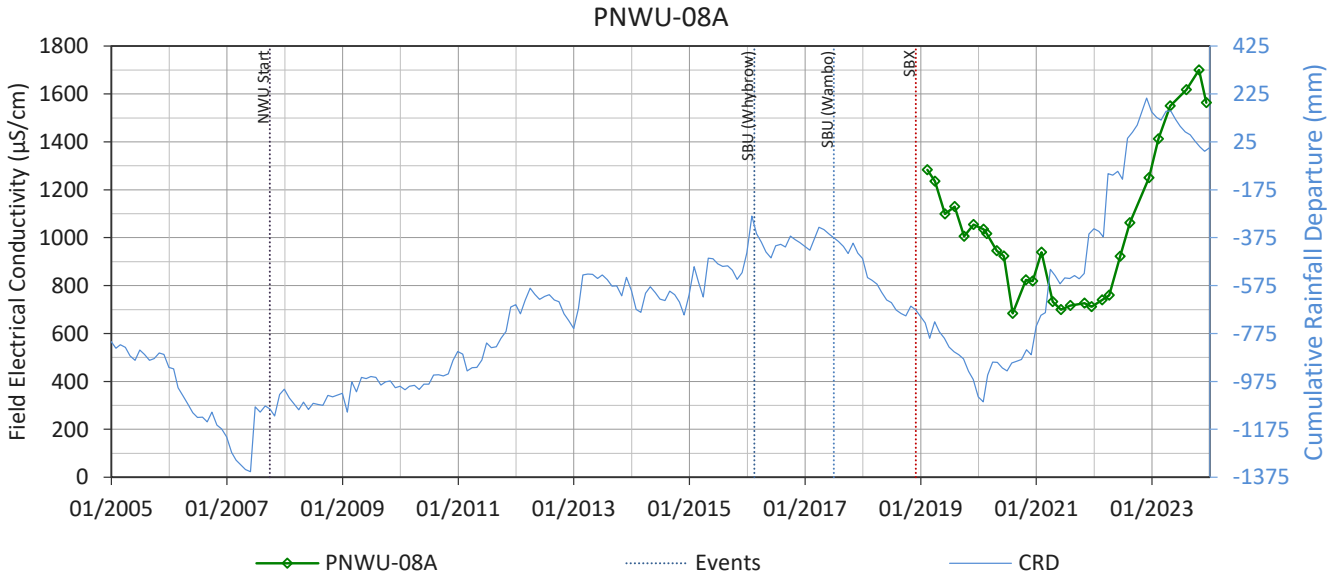

PNWU-05A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

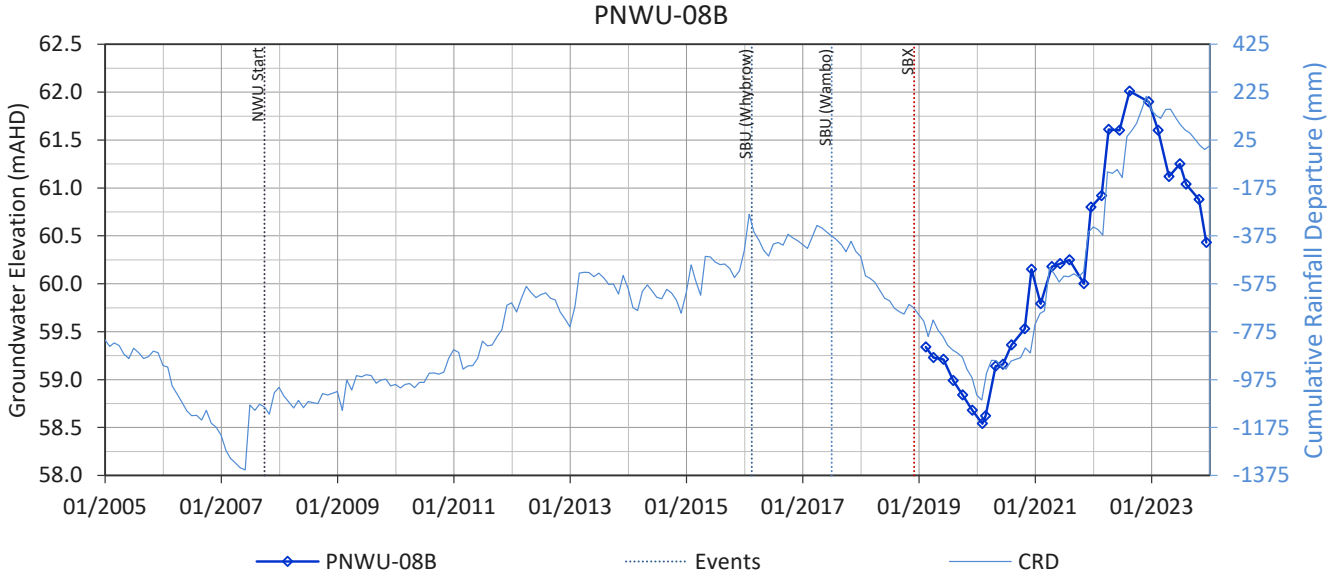

PNWU-05A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

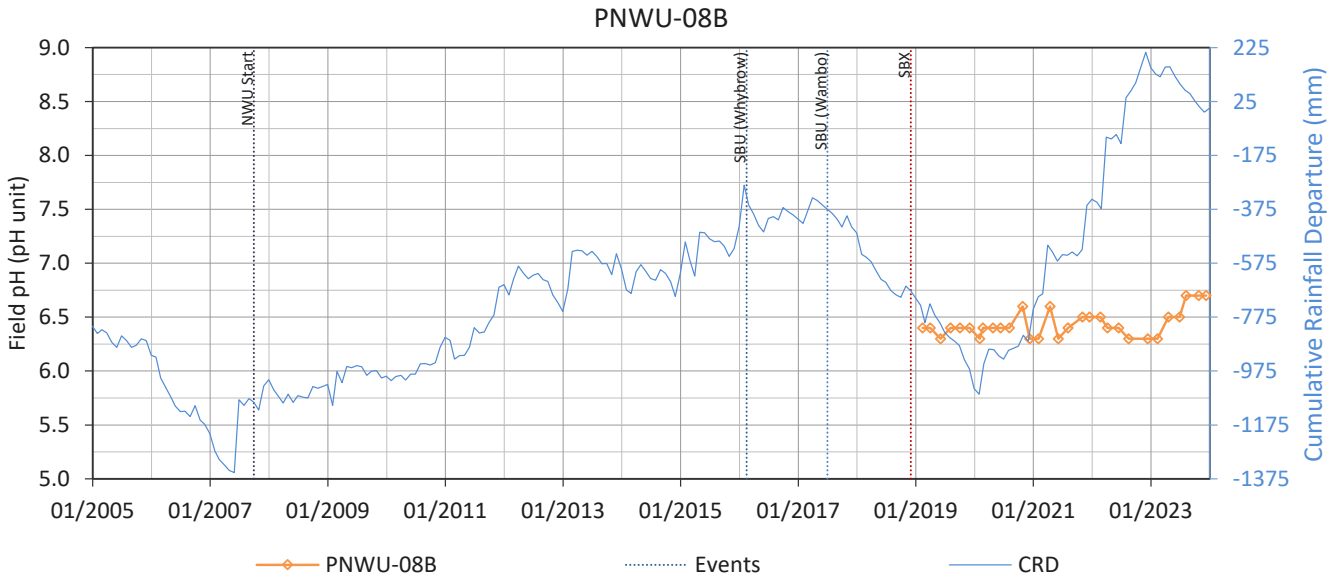

PNWU-05A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
PNWU-05A
Events
CRD

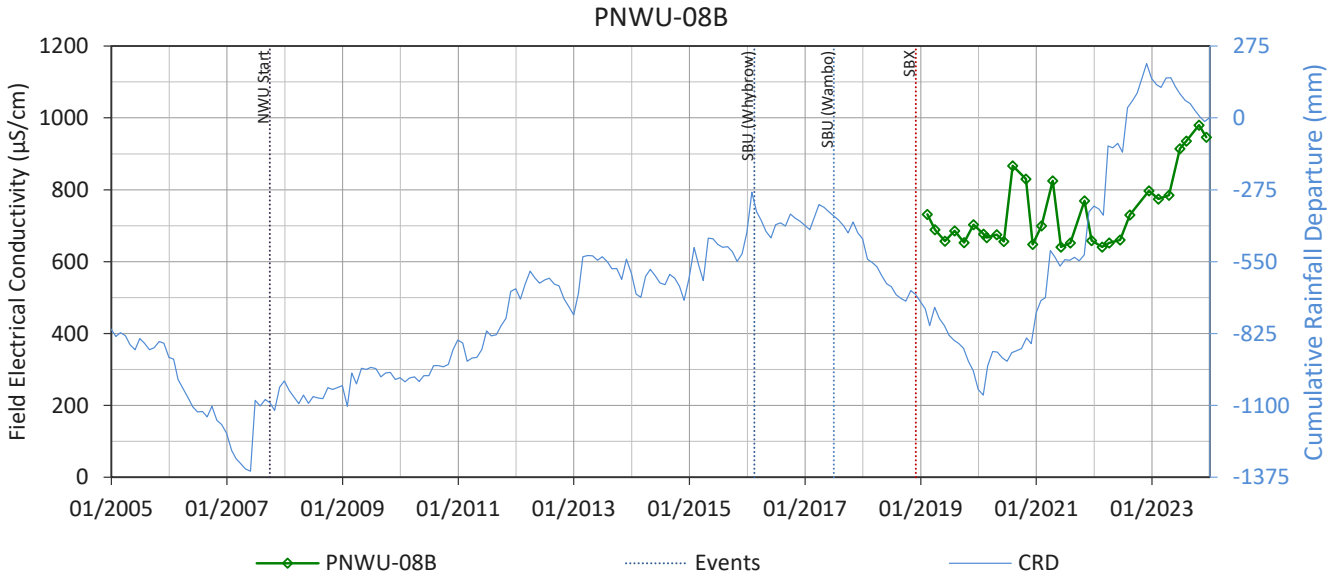

PNWU-08A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
66
65
64
63
62
61
60
59
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08A
Events
CRD

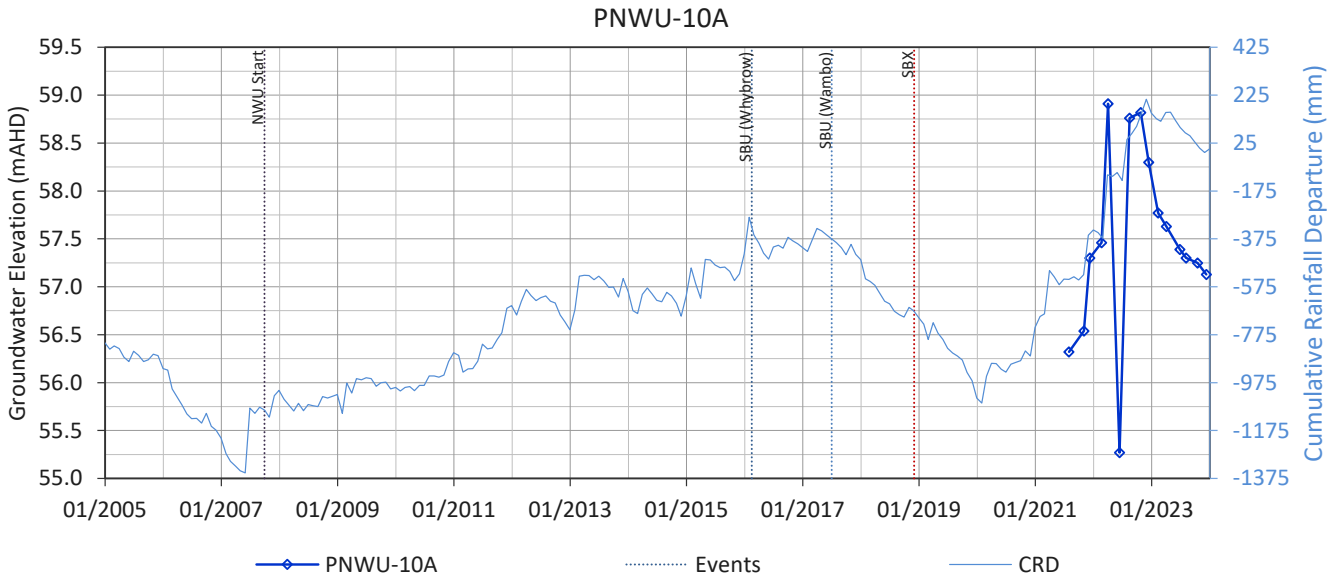

PNWU-08A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08A
Events
CRD

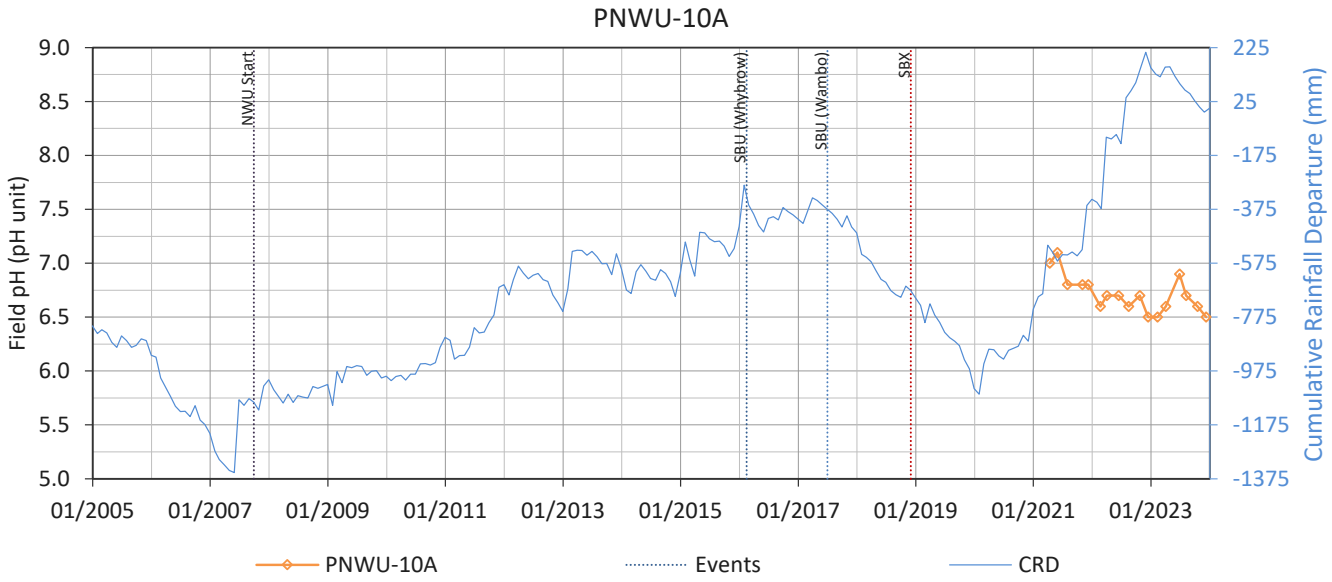

PNWU-08A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1800
1600
1400
1200
1000
800
600
400
200
0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08A
Events
CRD

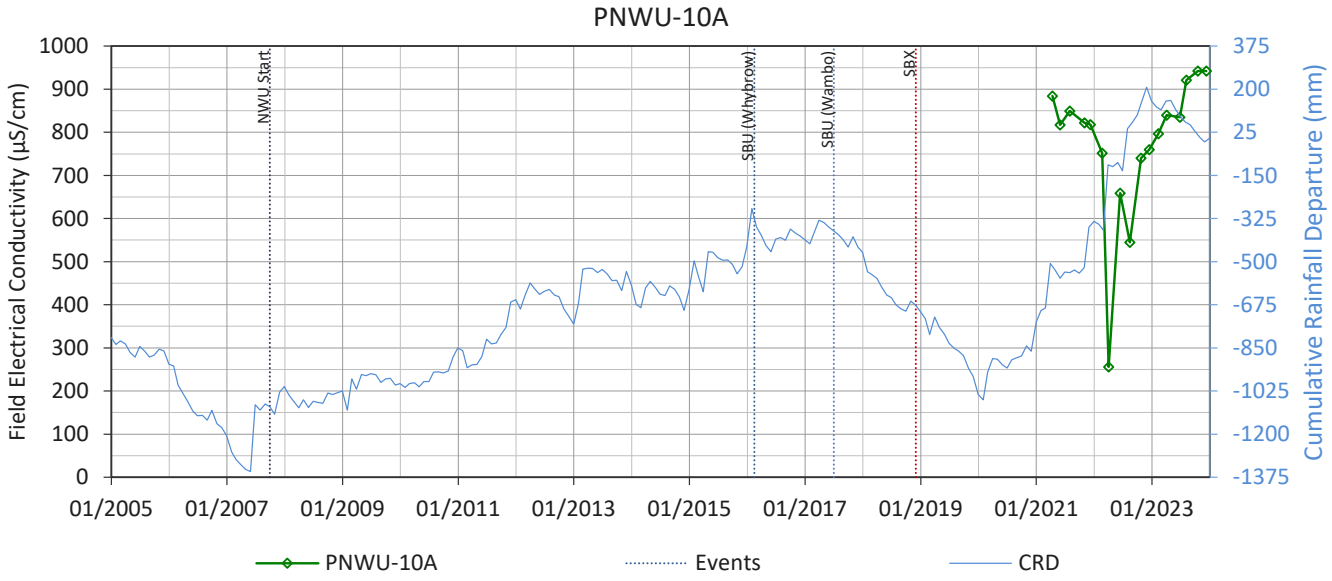

PNWU-08B
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
62.5
62.0
61.5
61.0
60.5
60.0
59.5
59.0
58.5
58.0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08B
Events
CRD

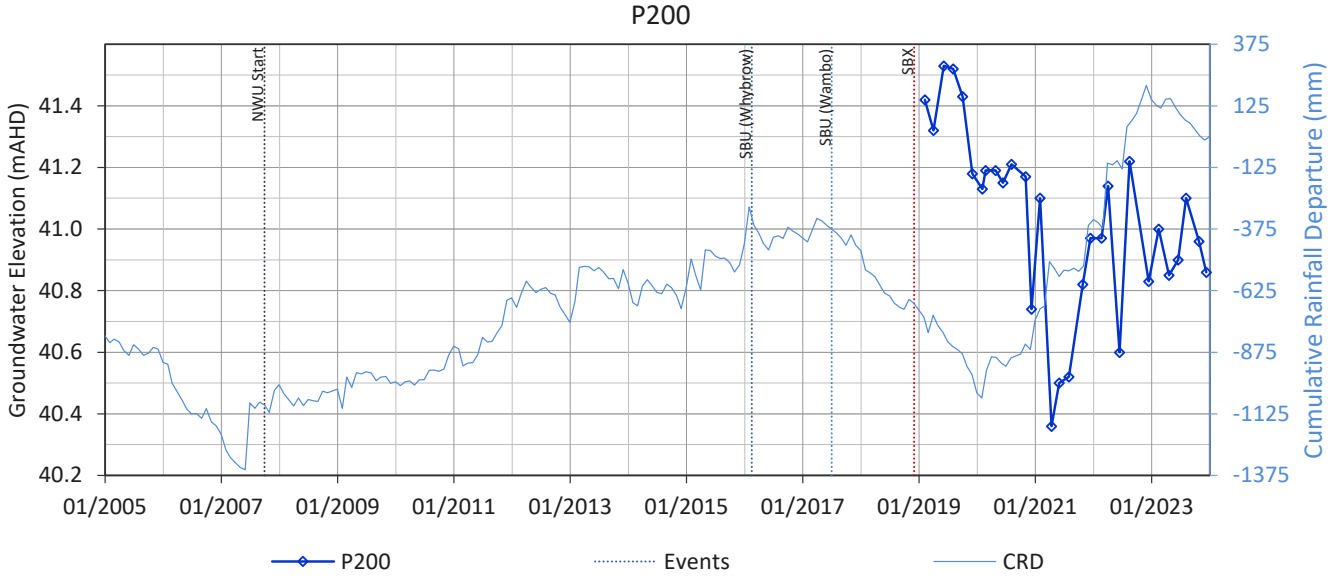

PNWU-08B
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08B
Events
CRD

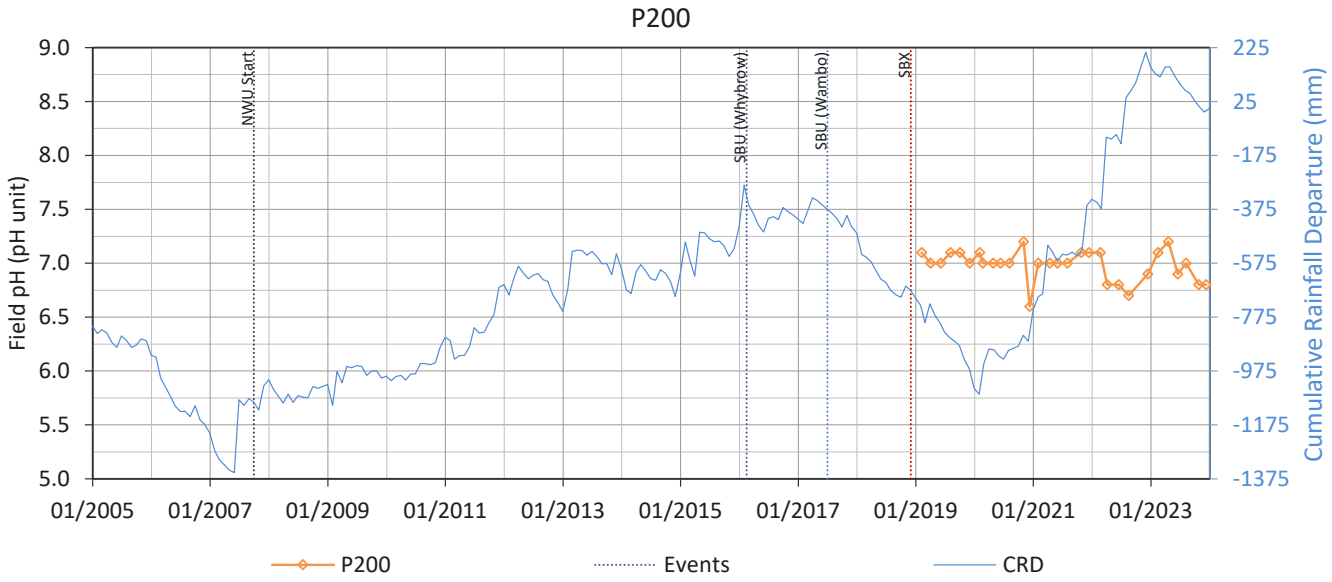

PNWU-08B
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1200
1000
800
600
400
200
0
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-08B
Events
CRD

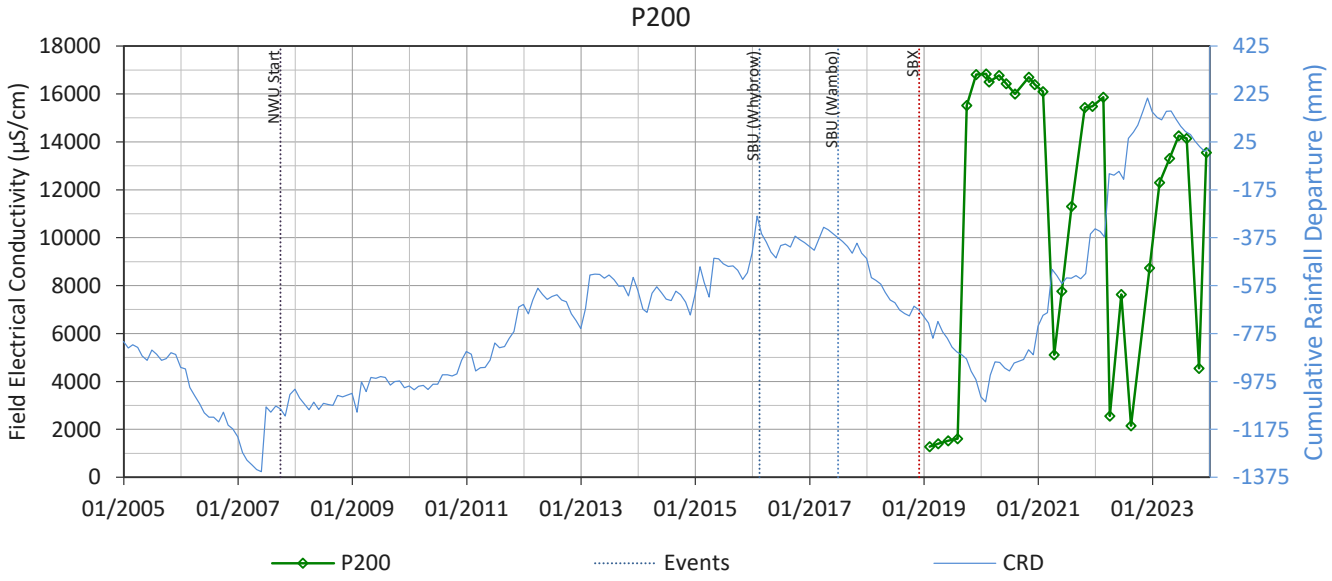

PNWU-10A
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
55.5
55.0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-10A
Events
CRD

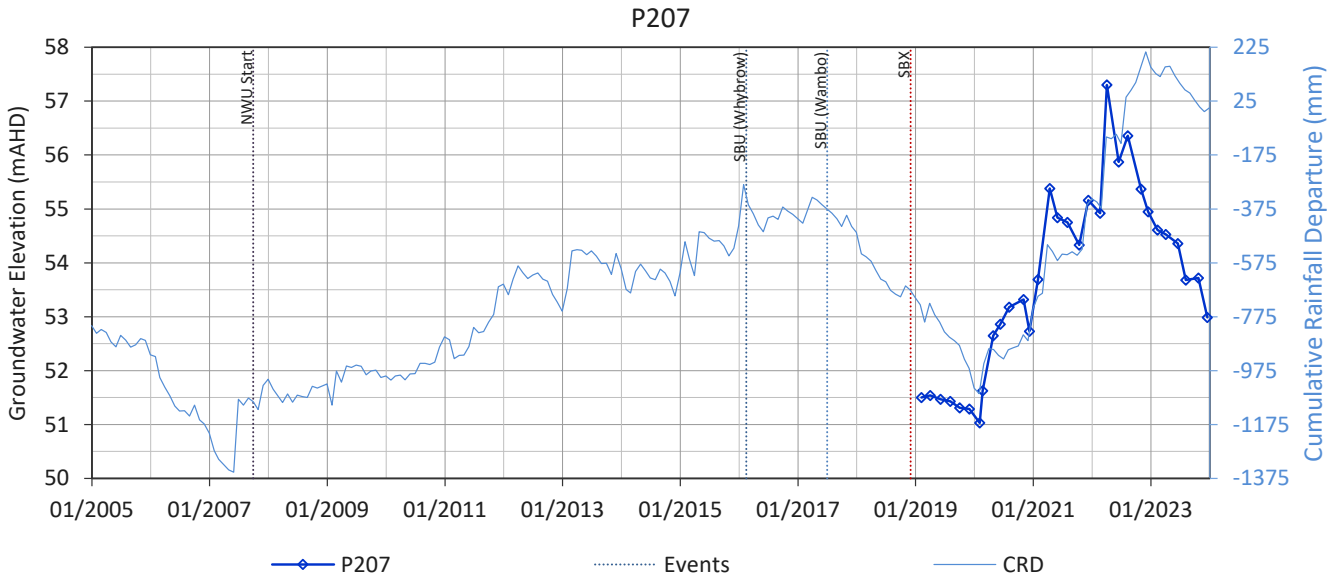

PNWU-10A
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-10A
Events
CRD

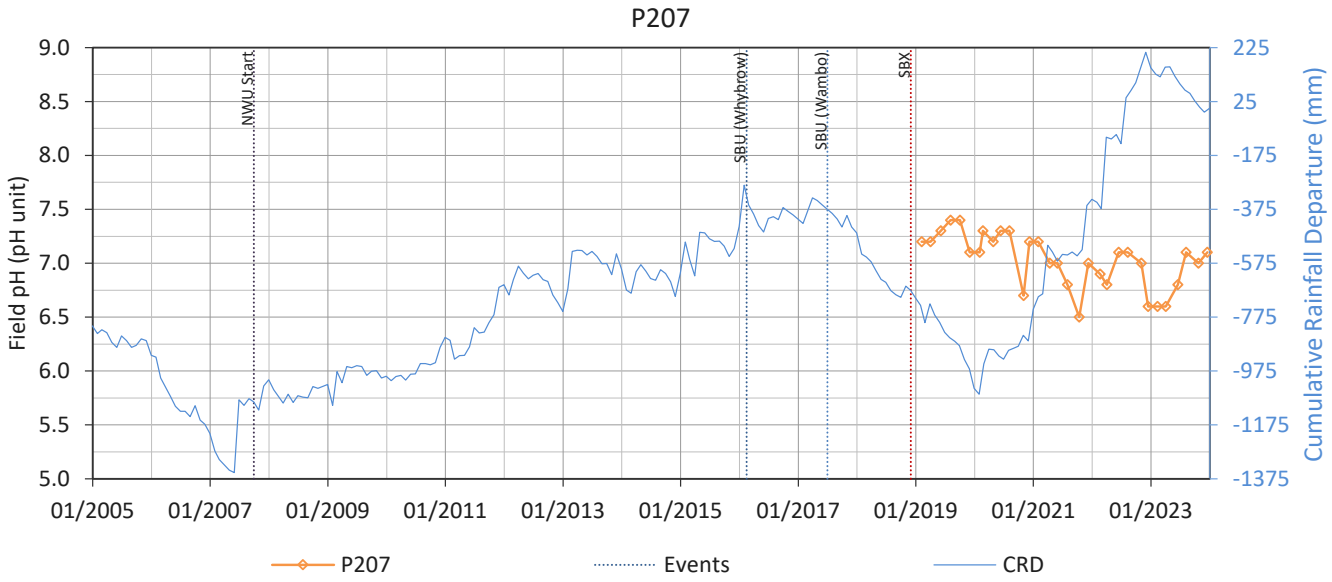

PNWU-10A
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1000
900
800
700
600
500
400
300
200
100
0
375
200
25
-150
-325
-500
-675
-850
-1025
-1200
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
PNWU-10A
Events
CRD

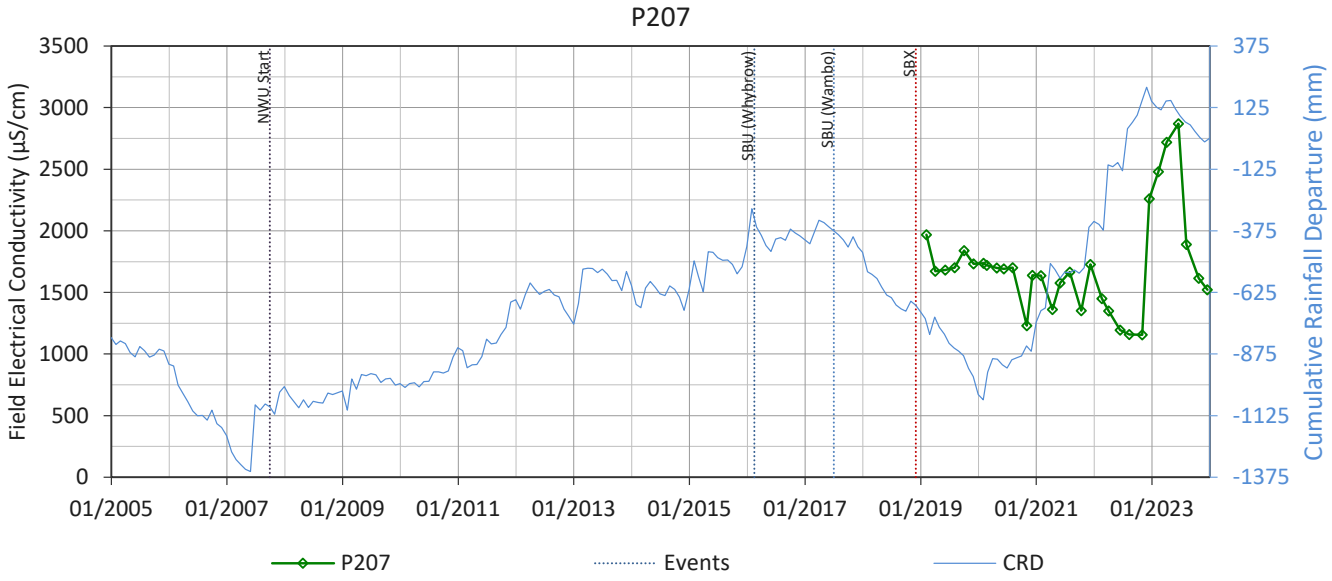

P200
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
41.4
41.2
41.0
40.8
40.6
40.4
40.2
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P200
Events
CRD

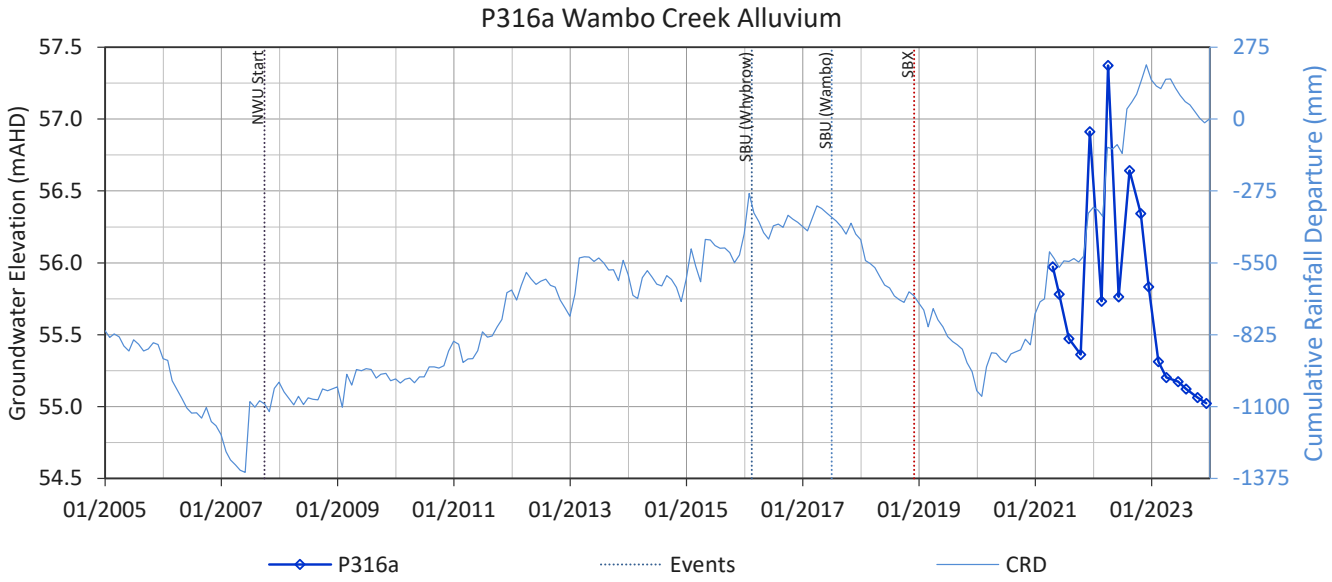

P200
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P200
Events
CRD

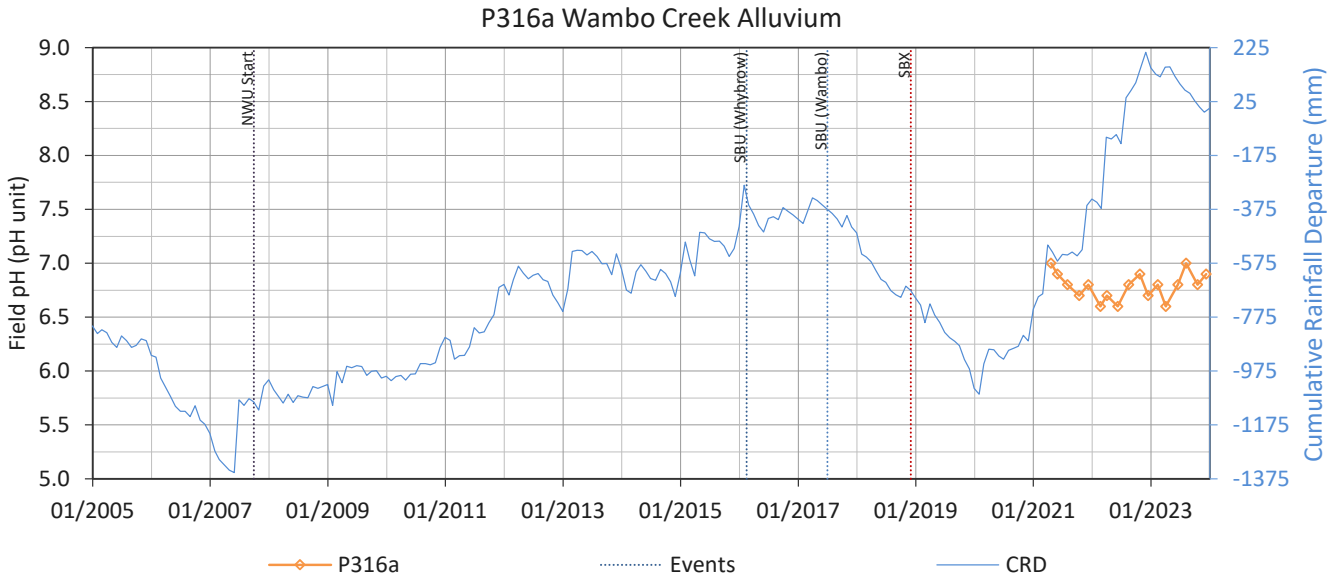

P200
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P200
Events
CRD

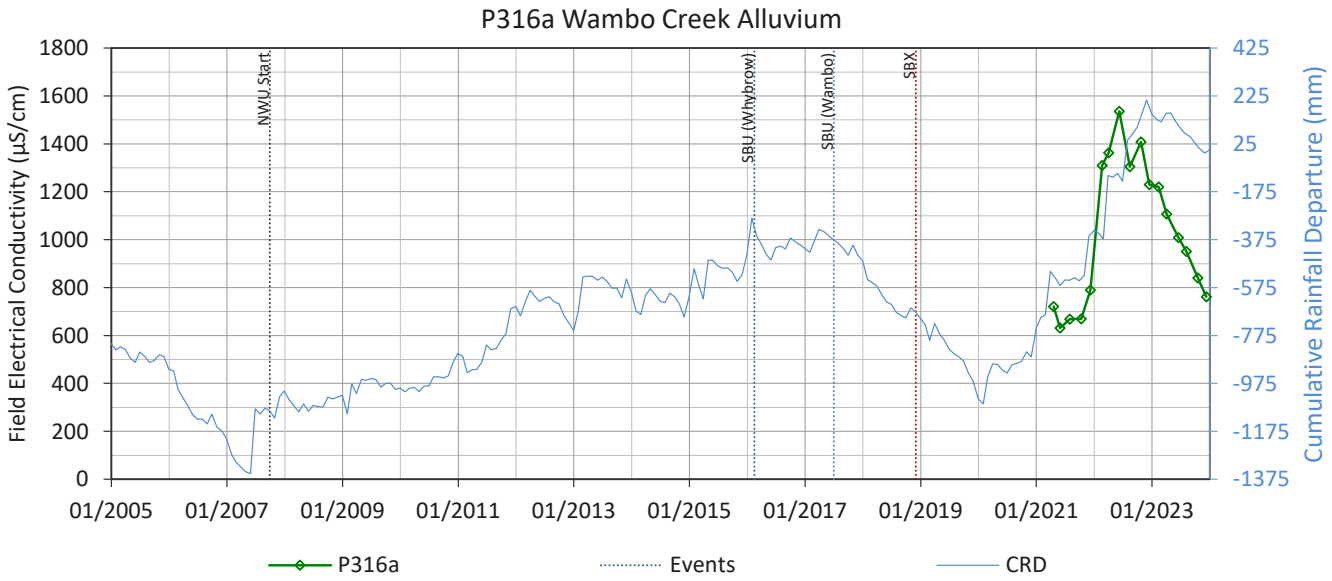

P207
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
58
57
56
55
54
53
52
51
50
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P207
Events
CRD

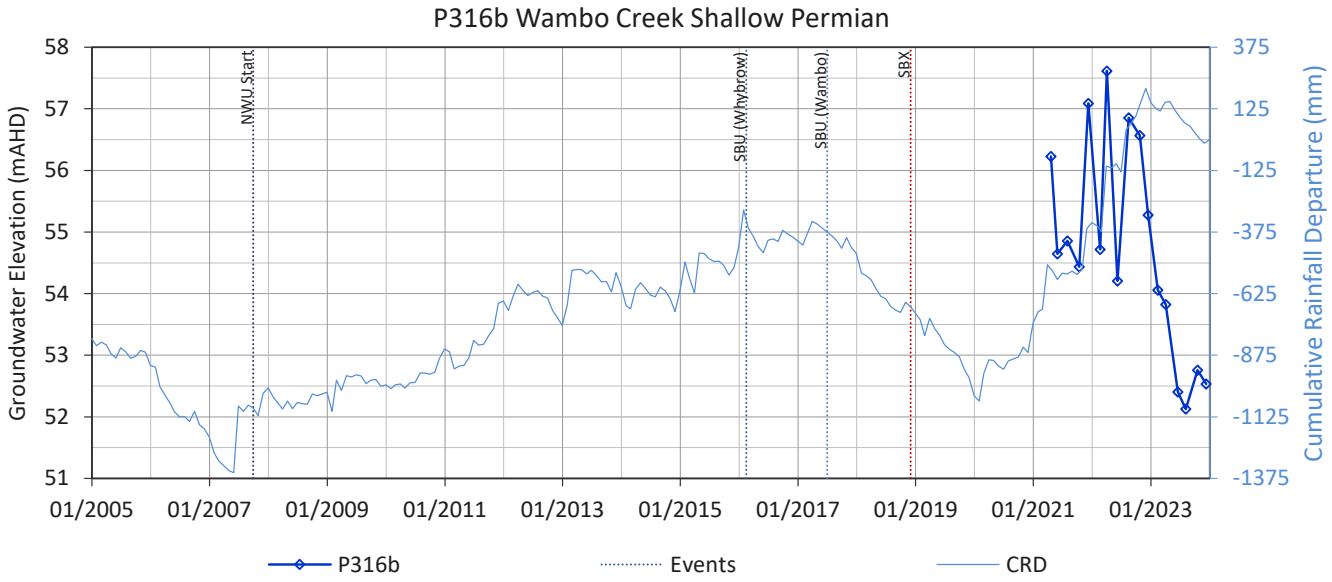

P207
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P207
Events
CRD

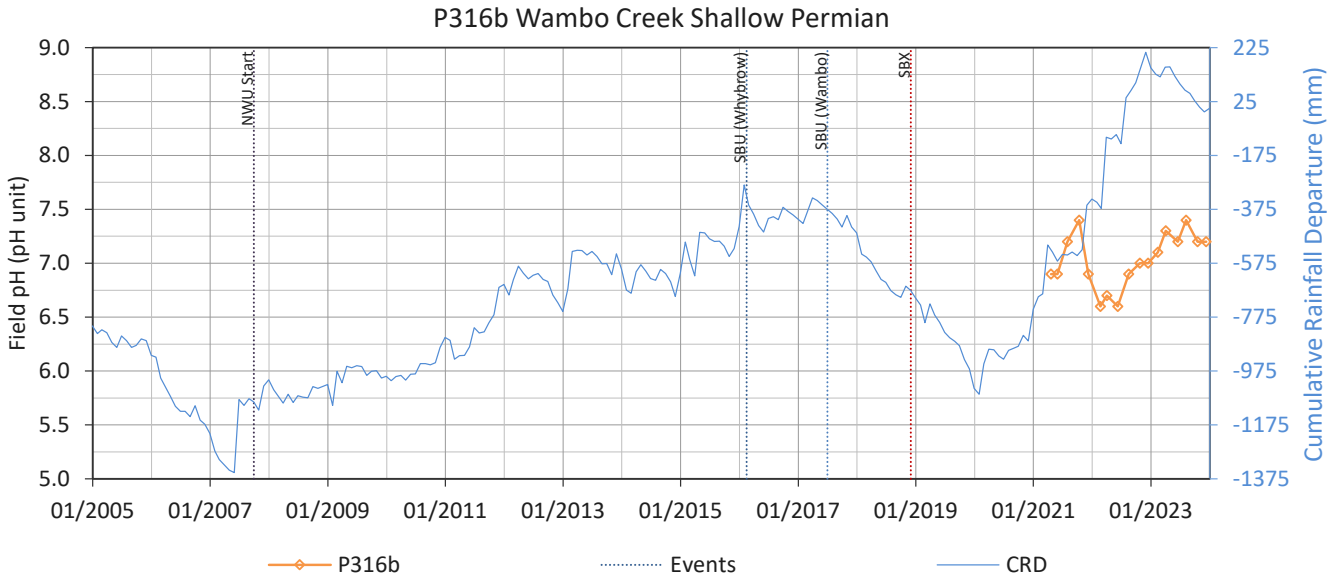

P207
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
3500
3000
2500
2000
1500
1000
500
0
375
125
-125
-375
-625
-875
-1125
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P207
Events
CRD

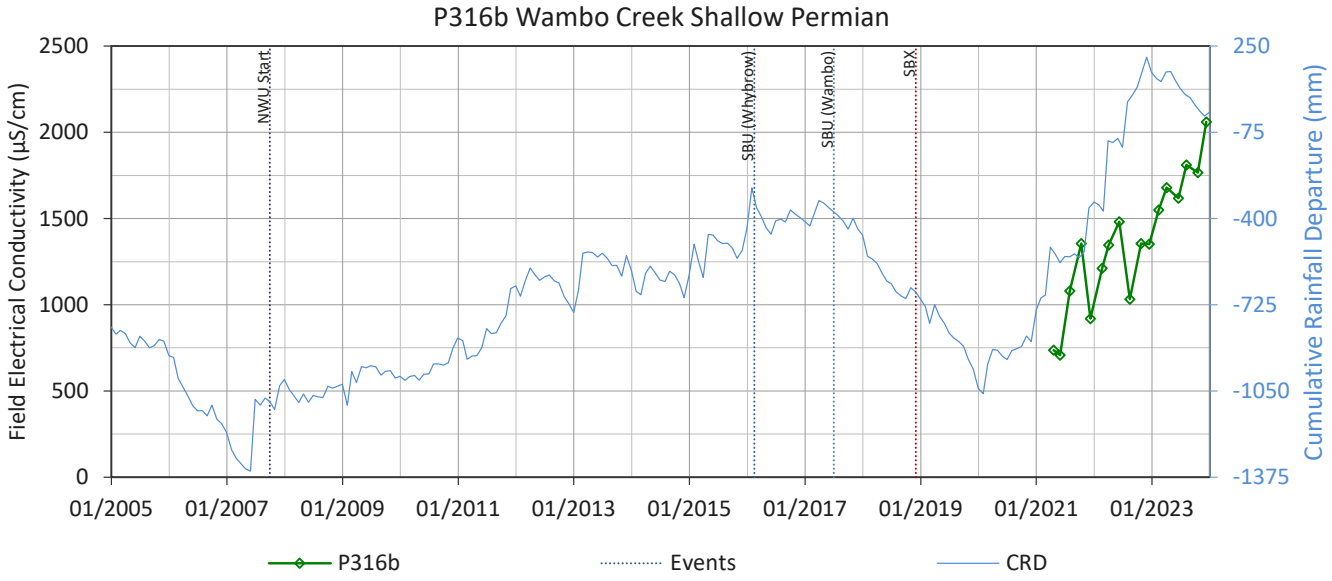

P316a Wambo Creek Alluvium
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
57.5
57.0
56.5
56.0
55.5
55.0
54.5
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316a
Events
CRD

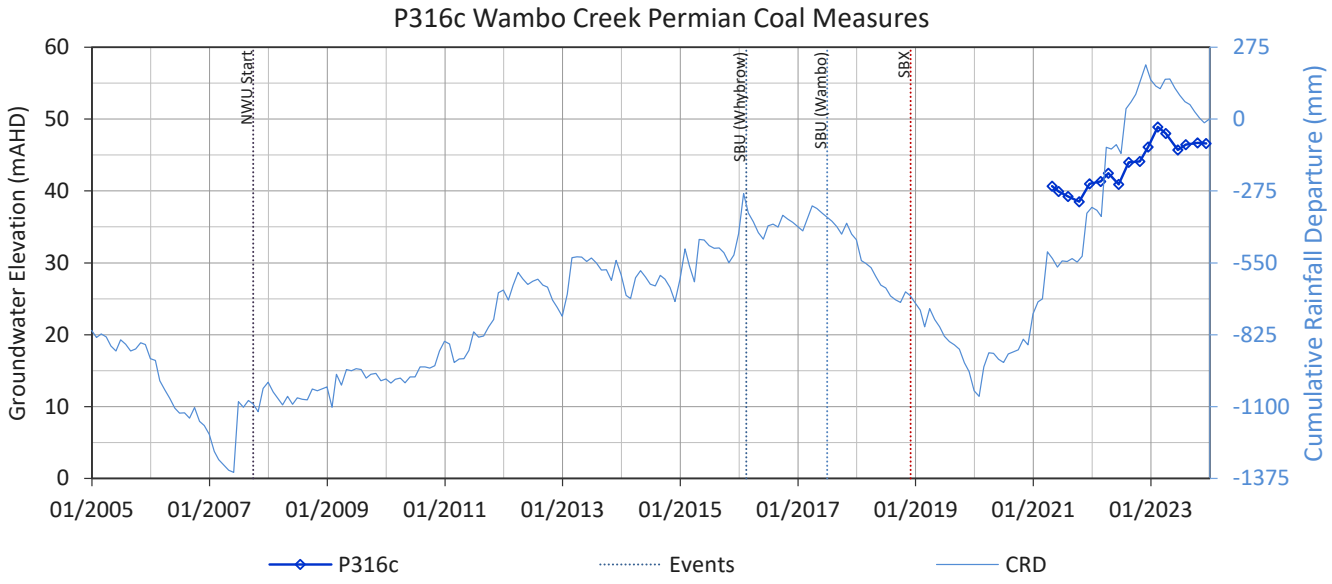

P316a Wambo Creek Alluvium
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316a
Events
CRD

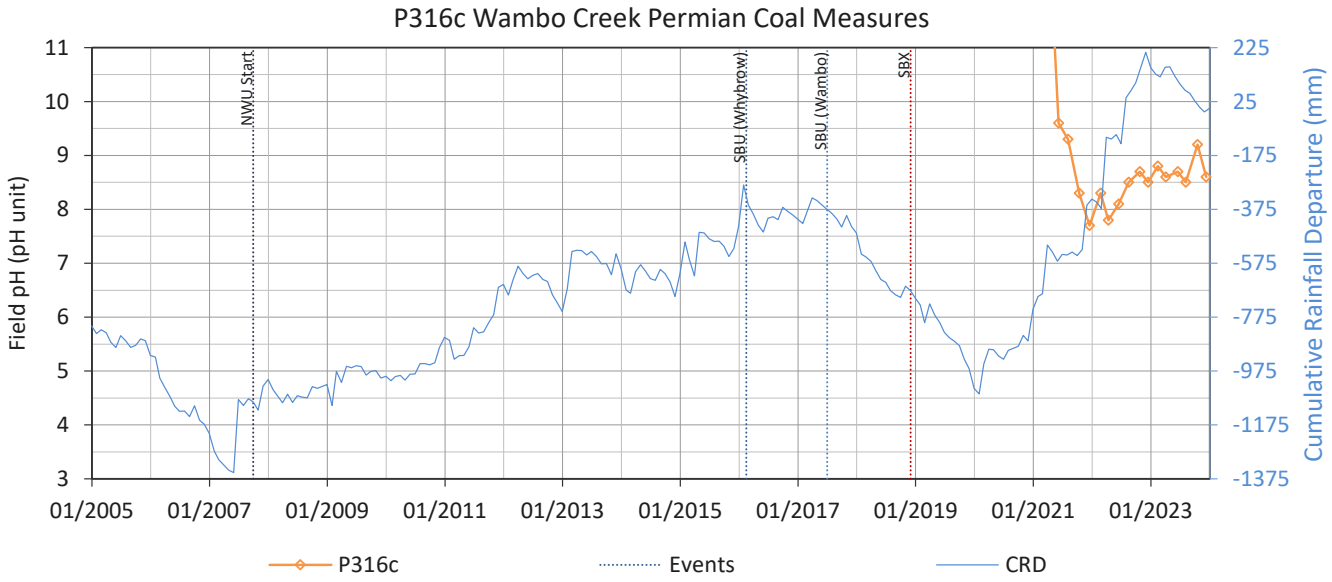

P316a Wambo Creek Alluvium
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
1800
1600
1400
1200
1000
800
600
400
200
0
425
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316a
Events
CRD

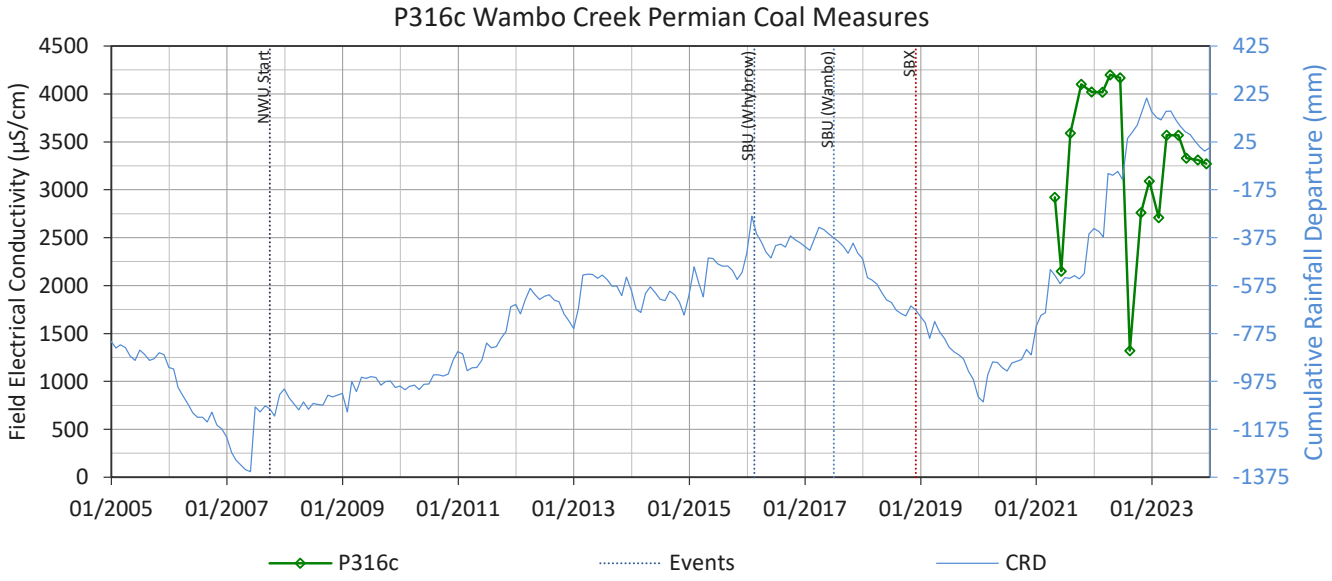

P316b Wambo Creek Shallow Permian
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316b
Events
CRD

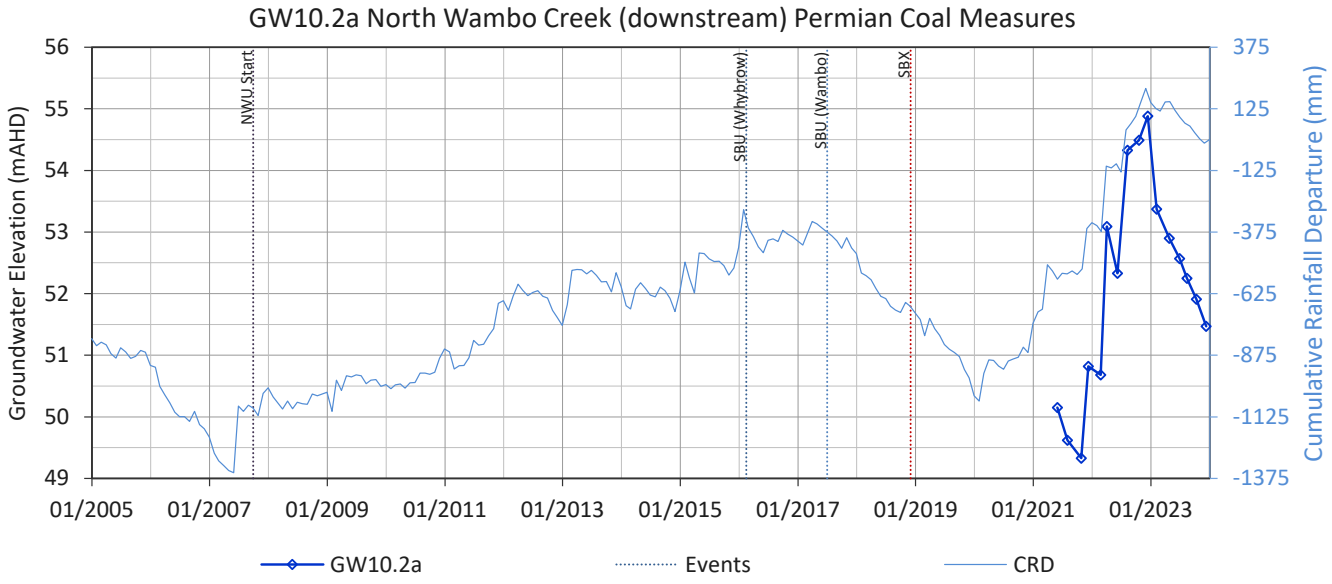

P316b Wambo Creek Shallow Permian
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316b
Events
CRD

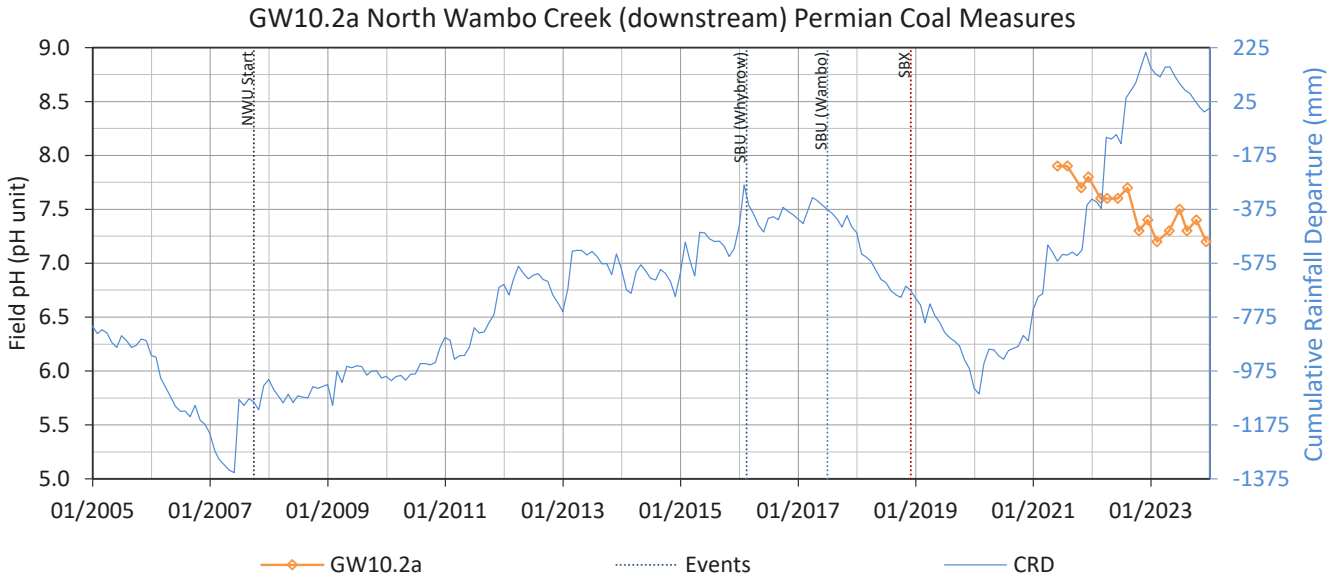

P316b Wambo Creek Shallow Permian
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
P316b
Events
CRD

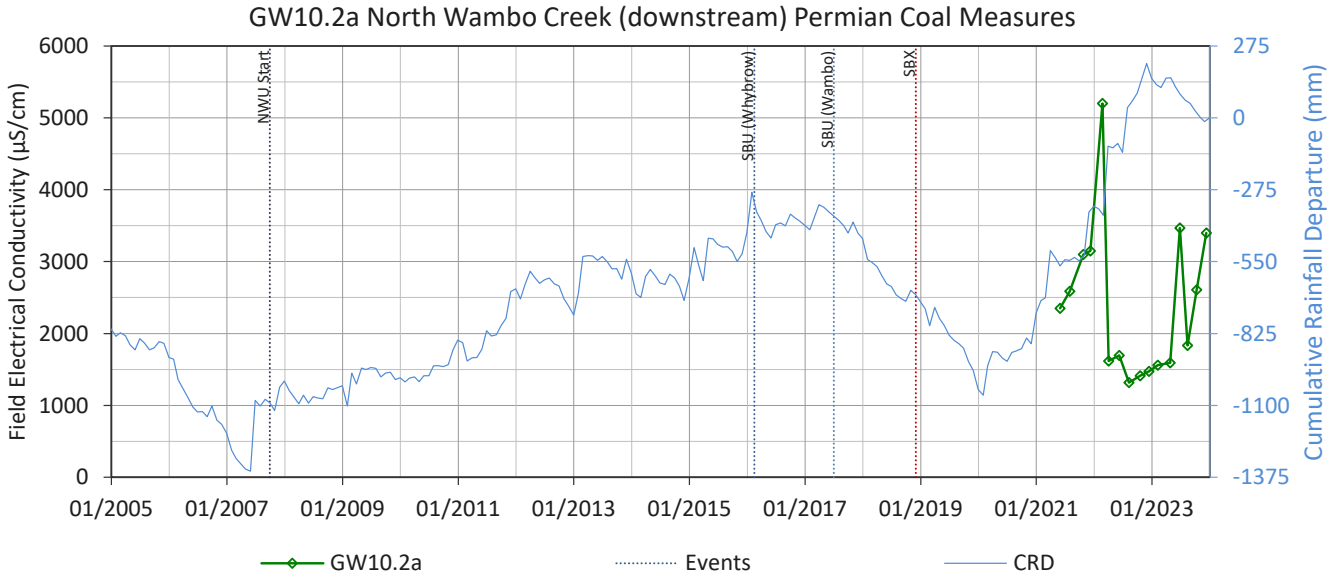

P316c Wambo Creek Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD

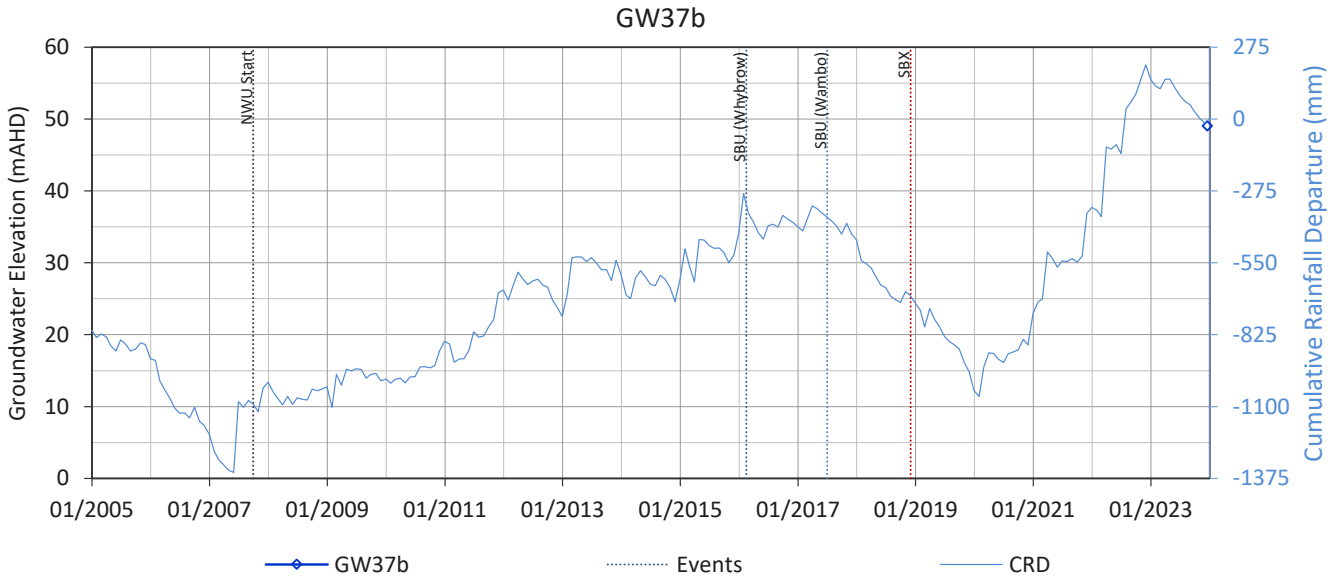

P316c Wambo Creek Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD

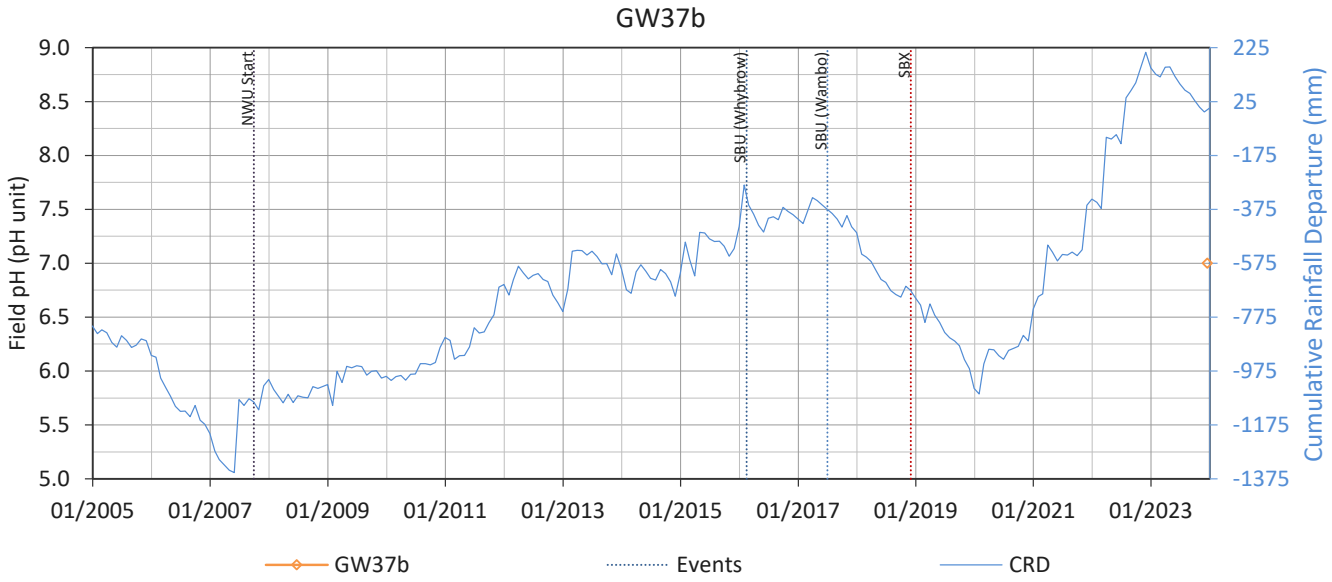

P316c Wambo Creek Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
P316c
Events
CRD

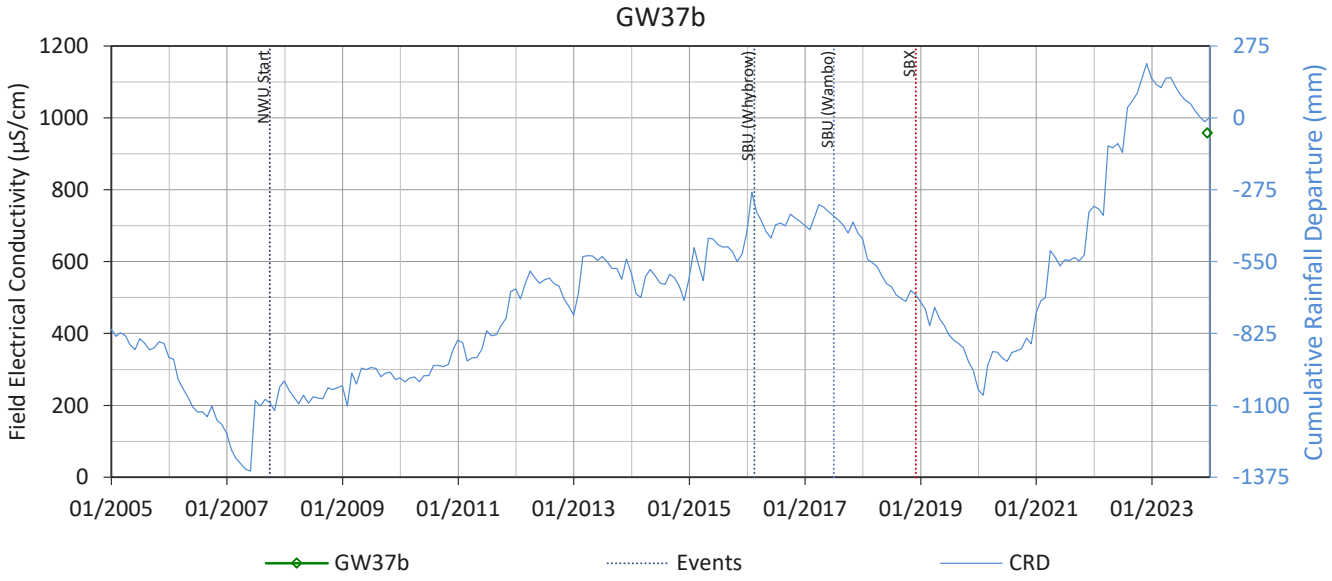

GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2a
Events
CRD

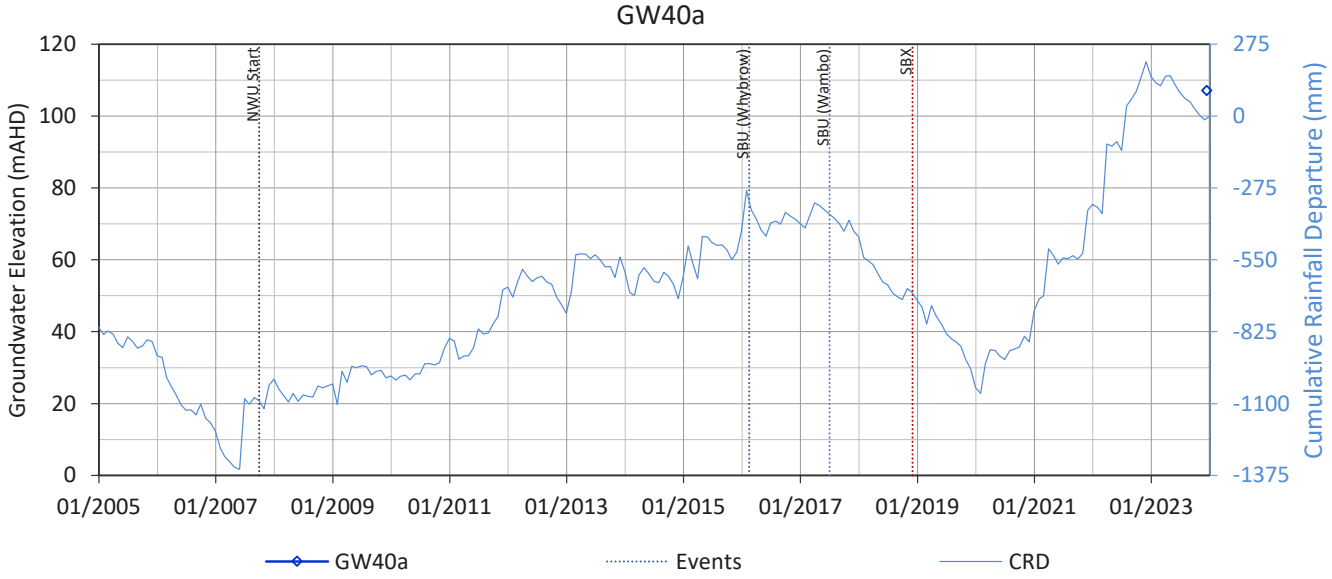

GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2a
Events
CRD

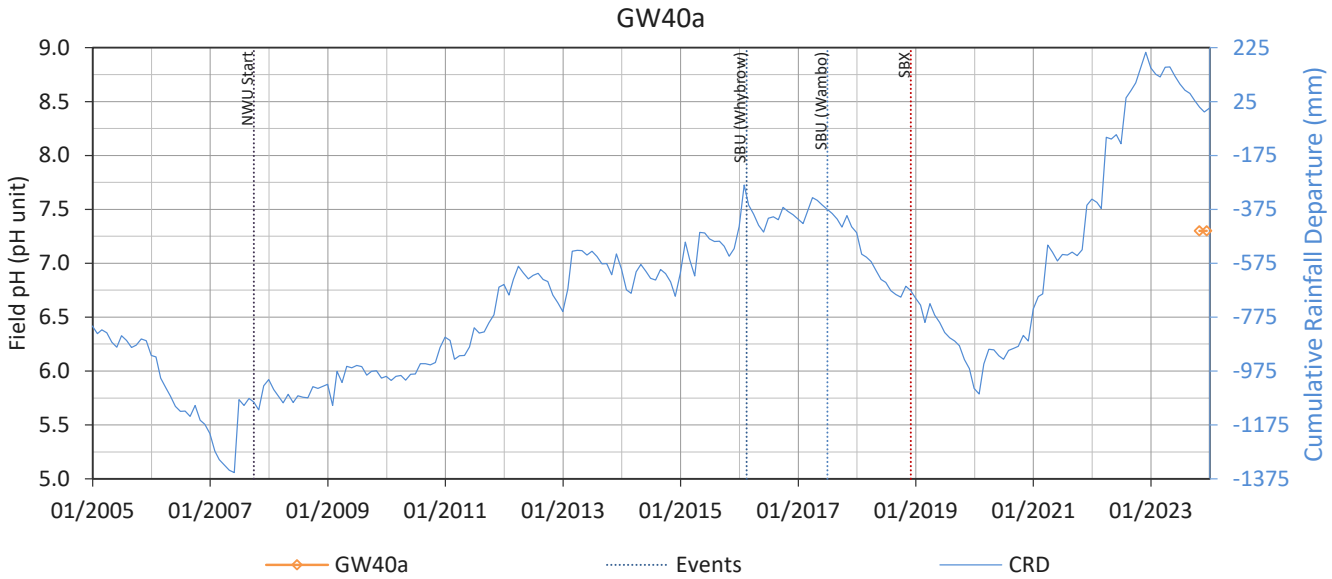

GW10.2a North Wambo Creek (downstream) Permian Coal Measures
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW10.2a
Events
CRD

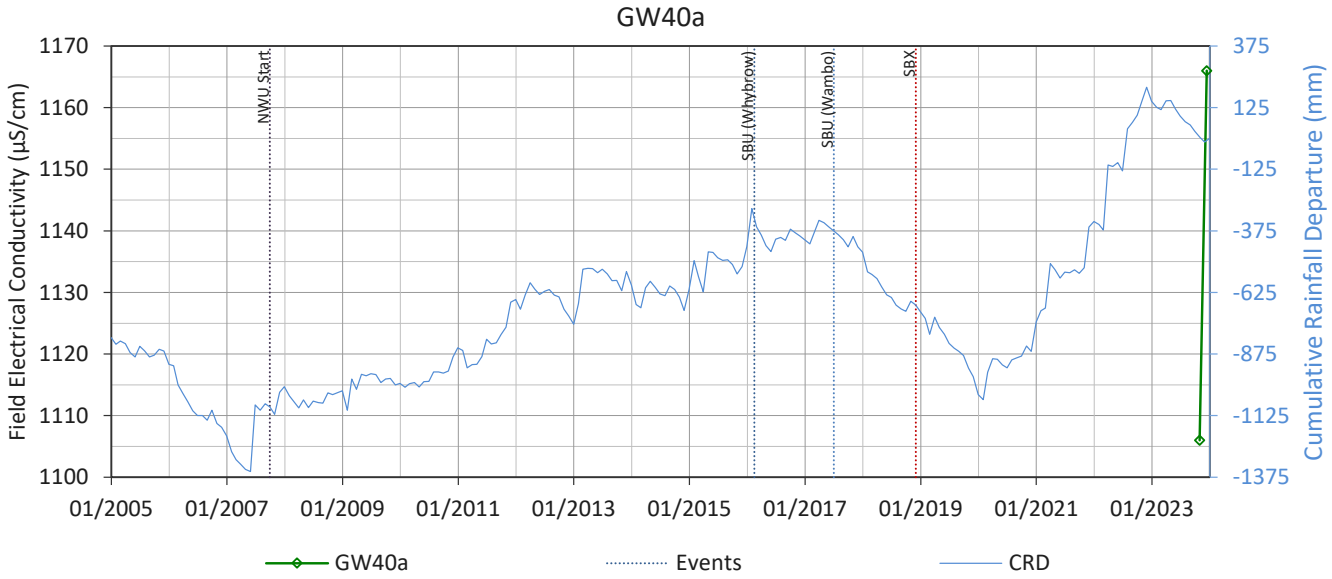

GW37b
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW37b
Events
CRD

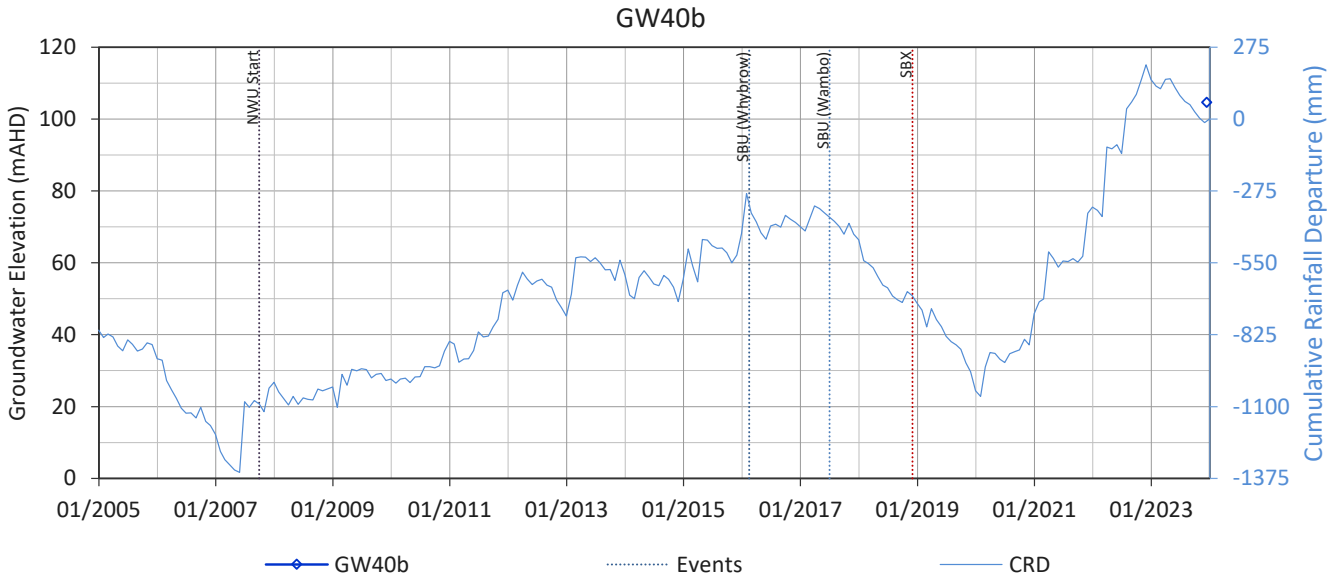

GW37b
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW37b
Events
CRD

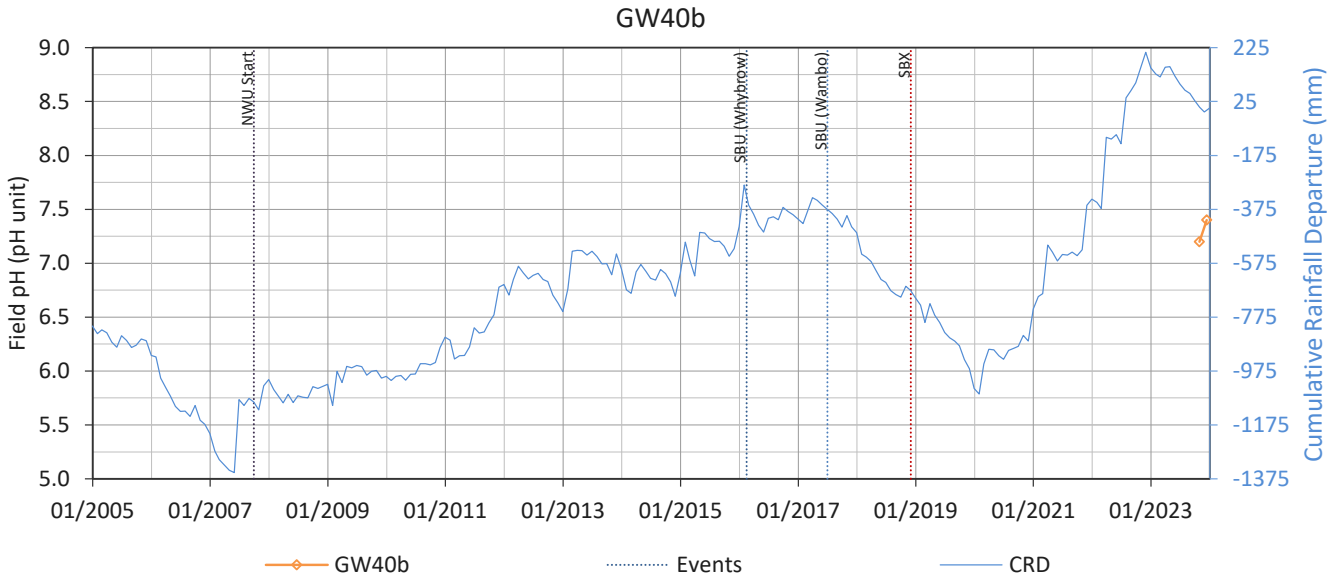

GW37b
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW37b
Events
CRD

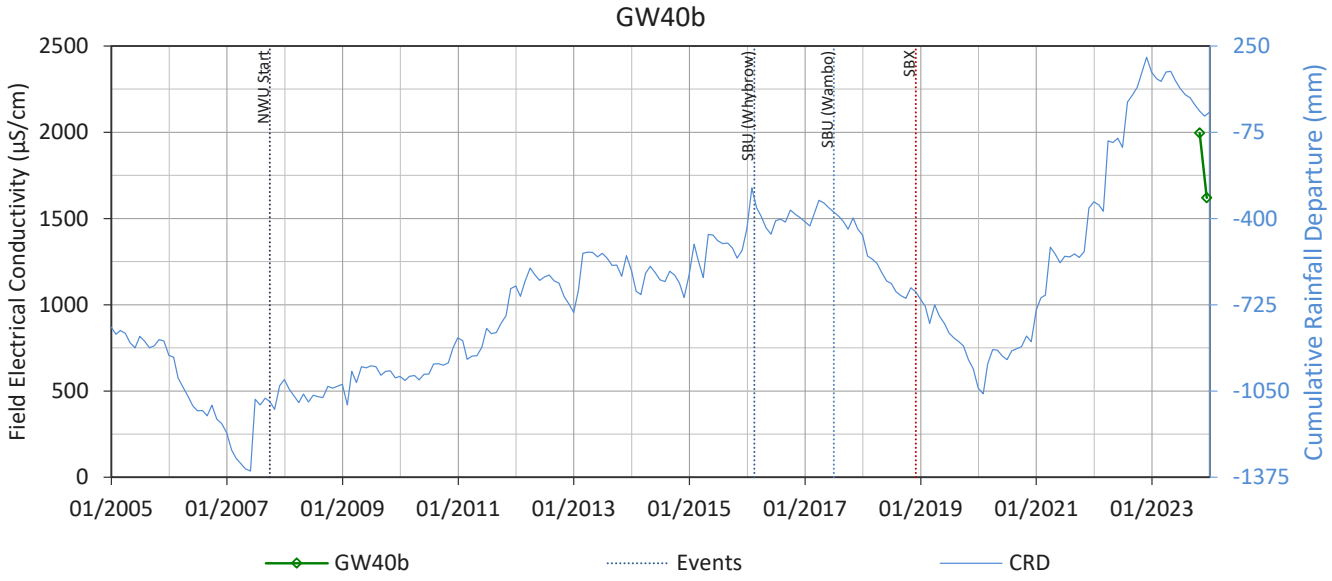

GW40a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW40a
Events
CRD

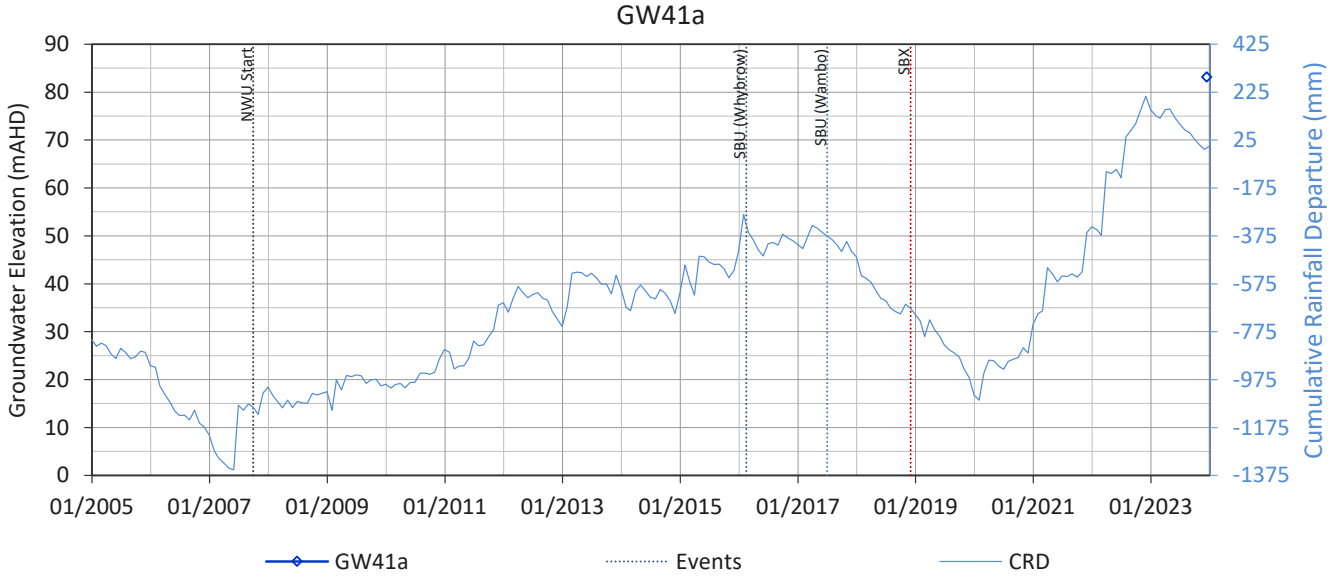

GW40a
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW40a
Events
CRD

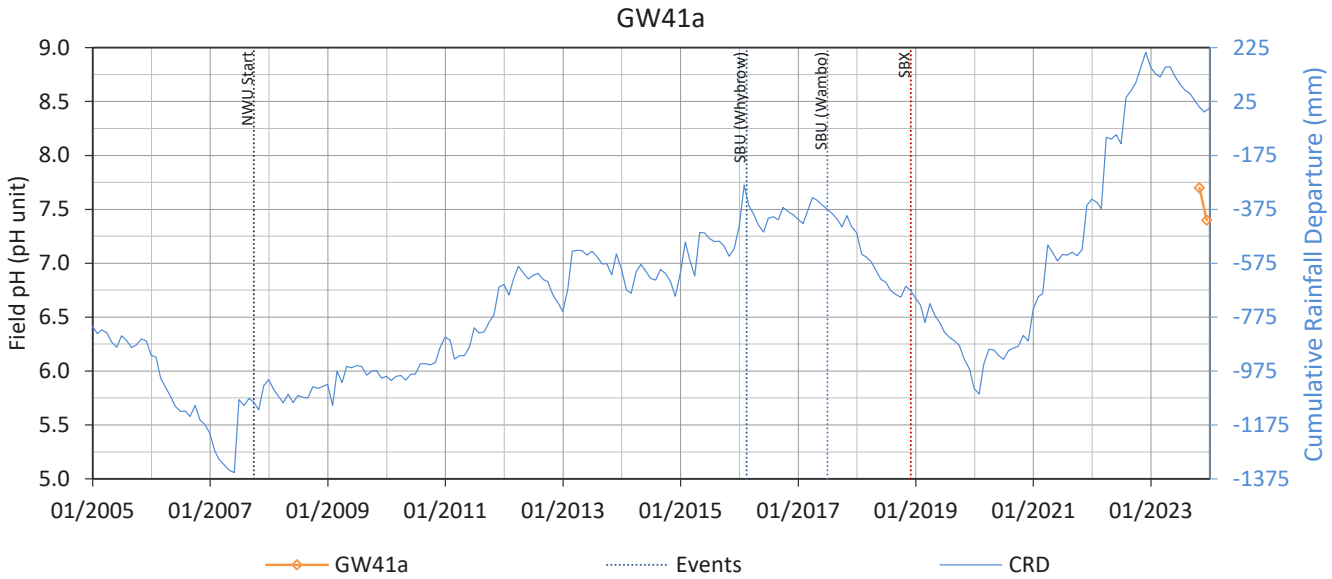

GW40a
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW40a
Events
CRD

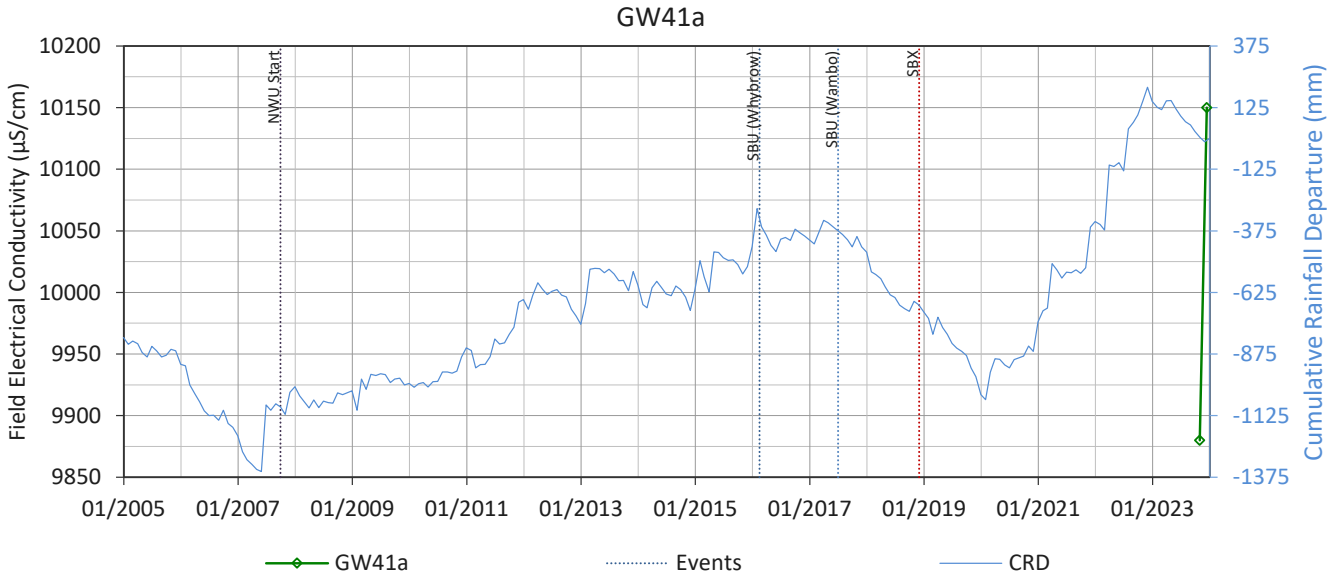

GW40b
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
120
100
80
60
40
20
0
275
0
-275
-550
-825
-1100
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW40b
Events
CRD

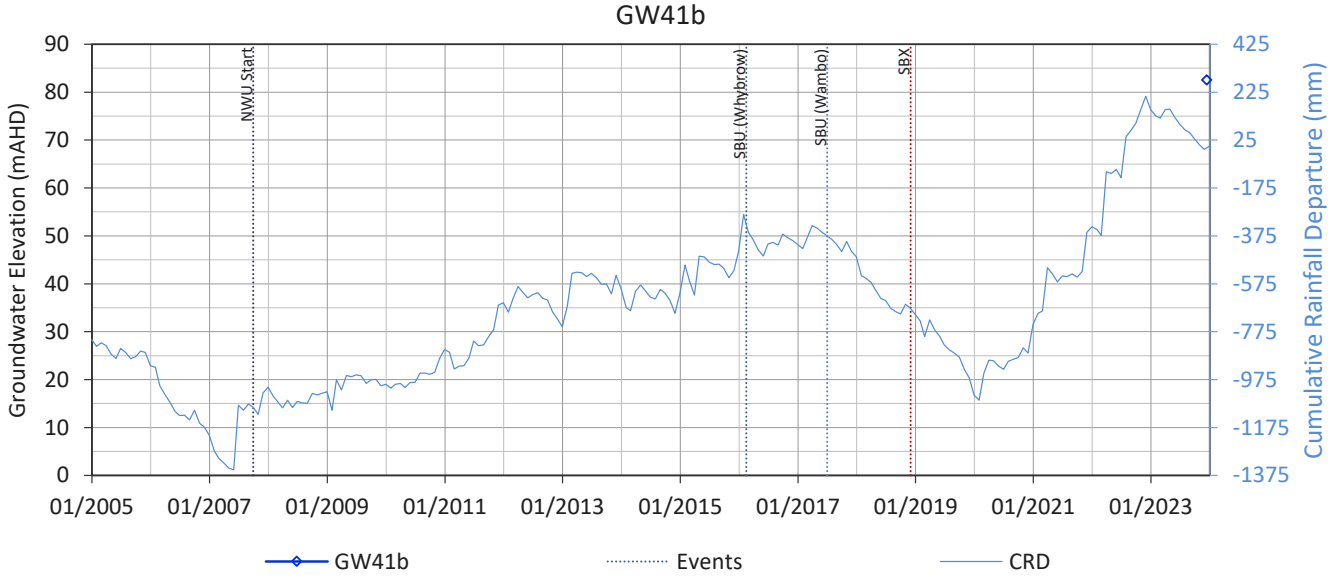

GW40b
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
225
25
-175
-375
-575
-775
-975
-1175
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW40b
Events
CRD

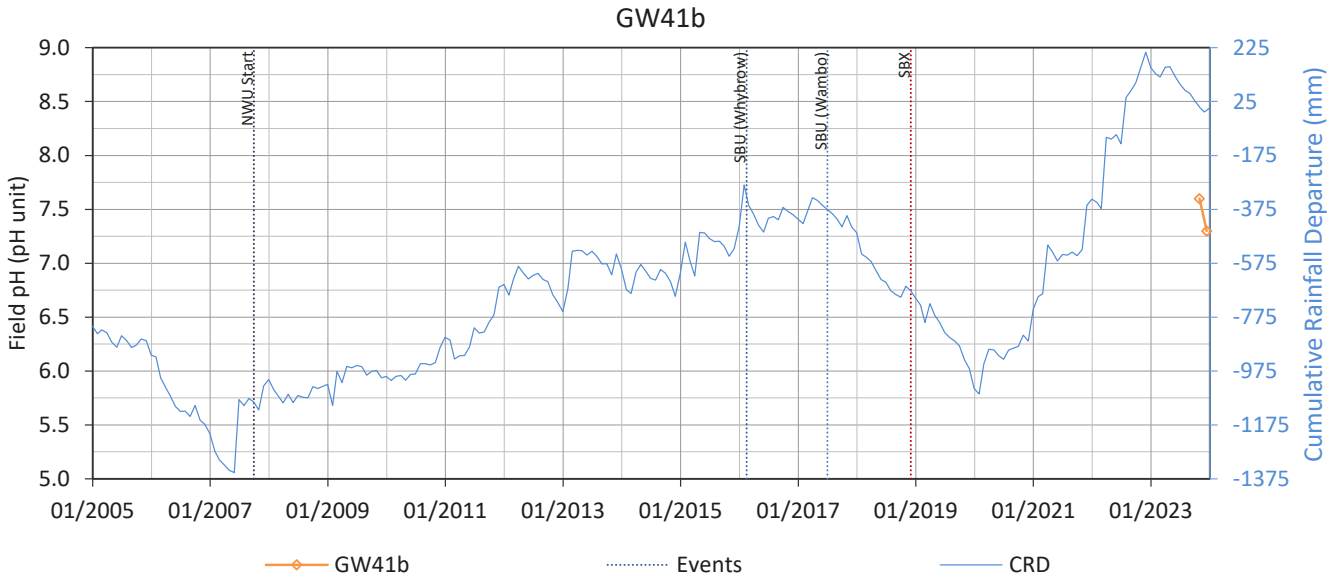

GW40b
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
2500
2000
1500
1000
500
0
250
-75
-400
-725
-1050
-1375
01/2005
01/2007
01/2009
01/2011
01/2013
01/2015
01/2017
01/2019
01/2021
01/2023
GW40b
Events
CRD

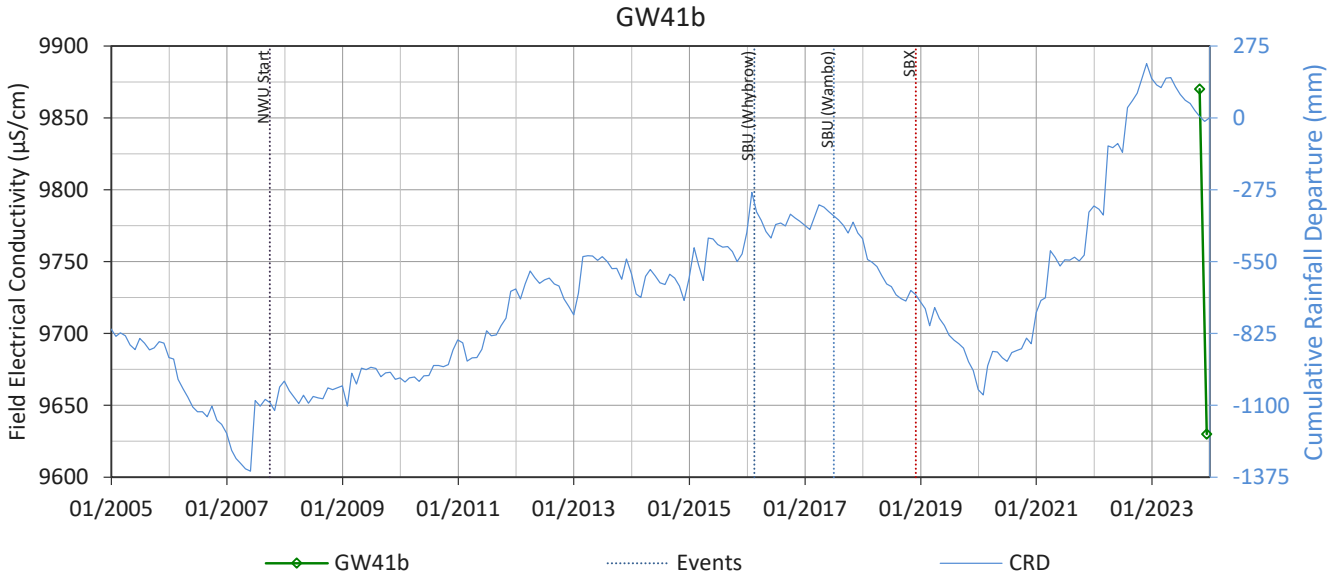

GW41a
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41a
Events
CRD


GW41a
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41a
Events
CRD


GW41a
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41a
Events
CRD


GW41b
Groundwater Elevation (mAHD)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41b
Events
CRD


GW41b
Field pH (pH unit)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41b
Events
CRD


GW41b
Field Electrical Conductivity (µS/cm)
Cumulative Rainfall Departure (mm)
NWU Start
SBU (Whybrow)
SBU (Wambo)
SBX
GW41b
Events
CRD

Appendix C Vibrating Wire Piezometers – Data Quality Assessment

Groundwater Annual Review - 2023

Wambo Coal Mine

Wambo Coal Pty Ltd

SLR Project No.: 665.v10008.02023

21 March 2024

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mbgl)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
EX06	P321	307999	6399498	110.39	31.8	78.6	Arrowfield Seam	No data in 2023
					72.1	38.3	Warkworth Seam	
					161.2	-50.8	Vaux Seam	
					187.8	-77.4	Bayswater Seam	
SW64	P319	311121	6391412	64.4	11.0	53.4	Regolith	Sensor dry - all obs
					74.9	-10.5	Whybrow Seam	Sensor dry - all obs
					161.3	-96.9	Wambo Seam	ok
					265.3	-200.9	Interburden Sandstone	ok
SW30	P325	312068	6390138	65.2	10.5	54.7	Regolith	No data in 2023
					32.5	32.7	Permian Overburden	
					82.0	-16.8	Whybrow Seam	
					159.5	-94.3	Wambo Seam	
					203.0	-137.8	Whynot Seam	
					251.5	-186.3	Woodlands Hill Seam	
					336.5	-271.3	Arrowfield Seam	
P408	P408	307000	6399500	74.62	138.8	-64.1	Vaux Seam	No data after 8/6/2019
					187.0	-112.4	Bayswater Seam	ok
					223.8	-149.1	Pikes Gully Seam	ok
WJ175	P320	307573	6398890	85.86	344.0	-258.1	Middle Barret Seam	ok
					305.0	-219.1	Lower Arties Seam	ok
					263.0	-177.1	Pikes Gully Seam	ok
					217.5	-131.6	Bayswater Seam	ok
					191.0	-105.1	Vaux Seam	ok
					92.0	-6.1	Warkworth Seam	ok
SW65	P324	310471	6391983	74.44	11.5	62.9	Regolith	sensor dry – all obs
					95.8	-21.3	Whybrow Seam	sensor dry – all obs
					157.0	-82.6	Wambo Seam	ok
					269.8	-195.3	Woodlands Hill Seam	ok
					304.5	-230.1	Interburden	ok
SW62	P326	310087	6392874	75.48	43.0	32.5	Overburden	Sensor dry
					113.5	-38.0	Wambo Seam	ok
					234.0	-158.5	Woodlands Hill Seam	ok
					294.5	-219.0	Arrowfield Seam	ok
SW28	P318	312599	6388922	71.05	11.0	60.1	Regolith	Sensor dry
					150.8	-79.7	Whybrow Seam	ok
					205.3	-134.2	Wambo Seam	ok

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mbgl)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
					314.3	-243.2	Woodlands Hill Seam	ok
					357.0	-286.0	Arrowfield Seam	ok
SW12	P323	309798	6393429	76.64	23.0	53.6	Overburden siltstone	sensor near-dry
					33.0	43.6	Whybrow Seam	sensor near-dry
					85.5	-8.9	Wambo Seam	ok
					224.5	-147.9	Woodlands Hill Seam	ok
					273.5	-196.9	Arrowfield Seam	ok
ELA3	P307	302941	6399995	141.25	65.3	76.0	Overburden sandstone	ok
					228.3	-87.0	Whybrow Seam	ok
					301.1	-159.8	Wambo Seam	ok
					332.5	-191.2	Whynot Seam	ok
P114_116	P316	311252	6391128	60.39	10.0	50.5	Alluvium	ok
					25.0	35.5	Regolith	ok
					50.6	9.8	Regolith-overburden	WL below sensor - all obs
					71.0	-10.6	Whybrow Seam	WL below sensor - all obs
Hunter 1	P329	307454	6400351	72.42	67.6	4.8	Vaux Seam	ok
					87.4	-15.0	Vaux Seam	ok
					117.5	-45.1	Bayswater Seam	ok
					150.5	-78.1	Pikes Gully Seam	ok
Hunter 2	P330	306533	6400050	73.62	67.0	6.6	Vaux Seam	All sensors ok: no data in 2022, back online in 2023
					137.3	-63.6	Vaux Seam	
					201.5	-127.9	Pikes Gully Seam	
P317	P317	307115	6394439	155.41	248.5	-93.1	Wambo Seam	No data since 2019
					213.0	-57.6	Wambo Rider Seam	No data since 2019
					174.0	-18.6	Whybrow Seam	No data since 2019
					100.0	55.4	Overburden	ok – near dry
					35.0	120.4	Regolith	ok – near dry
ELA3	P327	302941	6399995	141.25	43	76	Overburden	ok
					113.5	-87	Wambo Seam	ok
					234	-159.8	Woodlands Hill Seam	ok
					294.5	-191.2	Arrowfield Seam	ok
ELA5	P328	303160	6398870	131.89	43.0	88.9	Overburden	Inactive from 25/09/2022
					275.0	-143.1	Whybrow Seam	
					350.0	-218.1	Wambo Seam	
					388.0	-256.1	Whynot Seam	
SW06	P322	312572	6395026	110.13	56.0	54.1	Regolith	No data in 2023

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mbgl)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
					65.0	45.1	Whynot Seam	
					128.0	-17.9	Whynot – Woodlands Hill Interburden	
N5	N5	306753	6395960	110.78	133.0	-22.2	Permian Overburden	ok
					89.5	21.3	Whybrow Seam	ok
					73.0	37.8	Interburden	ok
					30.0	80.8	Wambo Seam	ok
N3	N3	308313	6394574	104.968	190.0	-85.0	Permian Overburden	Sensor dry
					142.0	-37.0	Permian Overburden	Unreliable data since 2018
					108.5	-3.5	Permian Overburden	Unreliable data since 2016
					75.0	30.0	Whybrow Seam	Unreliable data since 2016
					55.0	50.0	Interburden	Unreliable data since 2016
N2	N2	308633	6393372	122.52	204.0	-81.5	Permian Overburden	WL below sensor from mid-2015
					172.5	-50.0	Permian Overburden	WL below sensor from Sept 2016
					140.0	-17.5	Permian Overburden	WL below sensor from Apr 2017
					100.0	22.5	Whybrow Seam	ok
					70.0	52.5	Interburden	ok
					40.0	82.5	Wambo Seam	no data since 2022
SBX_20 GW01	SBX_GW01	307009	6395884	107.9	43	65.0		Sensor dry in 2023
SBX_20 GW01	SBX_GW02	306909	6395939	108.9	65.8	43.1		ok
					61.7	47.2		Sensor dry in 2023
					53.7	55.2		Sensor dry in 2023
DDH1234	DDH1234	306153	6397780	157.2	22	135	Weathered Sandstone	Sensor dry in 2023
					39	118	Siltstone	Sensor dry in 2023
					54	103	Siltstone (5 m above WWA seam)	Sensor dry in 2023
DDH1235	DDH1235	305779	6397521	167	40	127	Sandstone	ok
					80	87	Siltstone	Sensor dry in 2023
					114	53	Coal (WWA seam)	ok
DDH1240	DDH1240	305397	6396881	244.834	50	195	Narrabeen Group*	Sensor dry in 2023
					118	127	Overburden 1	ok
					2185	26	Overburden 2*	ok
					260.5	-16	Whybrow seam*	ok
MG08-01 (Unlabelled)	MG08-01	311054	6392670	65.35	9.0	56.4	Alluvium	ok
					37.0	28.4	Permian	Sensor near dry
					46.0	19.4	Whybrow Seam	Sensor dry
					60.0	5.4	Interburden	Sensor dry

Install ID	Wambo ID	Easting	Northing	Ground Elevation (mAHD)	Sensor Depth (mbgl)	Sensor Elevation (mAHD)	Target Geology	Sensor Quality Assessment
					77.3	-12.0	Redbank Seam	Sensor failed
					90.0	-24.7	Interburden	Sensor failed
					101.0	-35.7	Wambo Seam	Sensor failed
Unknown Fenwick	U/ Fenwick	310636	6390994	70				5 Sensors - no data

Appendix D Groundwater Monitoring

Groundwater Annual Review - 2023

Wambo Coal Mine

Wambo Coal Pty Ltd

SLR Project No.: 665.v10008.02023

21 March 2024

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
GW02	Well	EX	309109	6389680	82.5	11.2		Upper South Wambo Creek Alluvium
GW08.2	MB	EX	311869	6392326		3	2 – 3	North Wambo Creek Alluvium
GW09.2	MB	EX	311743	6392326		7.4	4.5 – 7.4	North Wambo Creek Alluvium
GW10.2	MB	EX	311872	6392264		3	2 – 3	
GW10.2a	MB	EX	311872	6392264		25	22 – 25	
GW11	Well	EX	309228	6389699	76.335	9.6		Upper South Wambo Creek Alluvium
GW13	MB	EX	313810	6388990	61.839	15	6 – 15	Regolith
GW15	MB	EX	313164	6392807	61.895	17.4	13.8 – 17.4	Wollombi Bk alluvium
GW16	MB	EX	306639	6396174	112.445	12.15	6.2 – 12.2	Alluvium, Regolith
GW17	MB	EX	306886	6396096	110.685	14	11 – 14	Regolith
GW21	MB	EX	308647	6393378	121.824	36	24 – 36	Whybrow Coal Interburden
GW22	MB	EX	311335	6389535	88.403	54	42 – 54	Whybrow Coal Interburden
GW24	MB	EX	305791	6395668	118.8	13.4	11.7 – 13.4	North Wambo Creek – Consolidated Bedrock
GW25	MB	EX	305299	6395288	129.6	5.6	2.6 – 5.6	North Wambo Creek – Alluvium
GW26	MB	EX	305299	6395668	129.4	13.2	11.7 – 13.2	North Wambo Creek – Consolidated Bedrock
P106 (repair/ replace)	MB	Blocked	311518	6391084	61.07	11	5 - 11	Alluvium
P109 (replacement)	MB	Proposed	311215	6390768	62.44			Alluvium

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
P109 (replacement)	MB	Proposed	311215	6390768	62.44			Permian
P316(a,b,c)	MB	EX	311255	6391096		7	4 – 7	Wambo Creek alluvium
	MB	EX	311252	6391090		13	10 – 13	Weathered Permian
	MB	EX	311249	6391083		26	23 – 26	Permian
P16	MB	EX	313480	6394655	57.48	11.5	5 – 10.5	West Wollombi Brook Colluvium
P20	MB	EX	313639	6394166	57.4	10.6	6 – 9.2	West Wollombi Brook Colluvium
P28	MB	EX	311396	6392632	63.1	-	-	Whybrow Coal Overburden
P29	MB	EX	311820	6392560	60.8	-	-	Whybrow Coal Overburden
P202	MB	EX	311854	6391262	60.265	20	14 – 20	Overburden Whybrow
P301	MB	EX	309360	6391466	88.18	20.4	??? - 20.4	Alluvium, shallow overburden
P315	MB	EX	309084	6391856	94.74	9.5	??? – 9.5	Stoney Creek Alluvium/Regolith
P317	VWP	Unknown	307115	6394439	155.41	248.5	35	Regolith
							100	Overburden
							174	Whybrow Seam
							213	Wambo Rider Seam
							248.5	Wambo Seam
P318	VWP	Unknown	312599	6388922	71.05	357	11	Regolith
							150.79	Whybrow Seam
							205.25	Wambo Seam
							314.25	Woodlands Hill

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							357	Arrowfield Seam
P319	VWP	Unknown	311125	6391412	64.4	265.3	11	Regolith
							74.9	Whybrow Seam
							161.3	Wambo Seam
							265.3	Interburden Sandstone
P320	VWP	Unknown	307573	6398890	85.86	344	92	Warkworth
							191	Vaux
							217.5	Bayswater
							263	Pike Gully
							305	Lower Arties
							344	Middle Barrett
P321	VWP	Unknown	307573	6398890	110.39	187.8	31.8	Arrowfield
							72.1	Warkworth
							161.15	Vaux
							187.82	Bayswater
UG139	VWP	EX	306665.45	6395172.7	128.9	402.0	263.0	Unnamed D
							281.0	Unnamed E
							319.0	Interburden Glen Munro - Unnamed E
							329.0	Glen Munro
							375.0	Interburden Arrowfield - Glen Munro

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							382.0	Arrowfield
							402.0	Interburden Warkworth - Bowfield
UG166A	VWP	EX	306488.43	6398076	141.5	260.0	130.0	Unnamed D
							153.0	Unnamed E
							183.0	Blakefield
							200.0	Glen Munro
							238.0	Arrowfield
							254.0	Bowfield
							260.0	Bowfield
BH1	MB	EX	313265	6394804	59.09	9.3	2.1 – 8.1	Tertiary Alluvium
BH1G	Dewatering	EX	310104	6391551		-		Whybrow Seam
BH2	Dewatering	EX	308867	6390147		-		Whybrow Seam
BH2A	Dewatering	EX	308868	6390096		-		Whybrow Seam
BH3	MB	EX	313399	6394644	54.39	65.4 -	55.4 – 61.4	Woodlands Hill Seam
BH4C	Dewatering	EX	309323	6391080		-		Whybrow Seam
BH4D	Dewatering	EX	-	-		-		Whybrow Seam, Wambo Seam
GW30	MB	EX	306076	6395716	118.6	8.5	5.5 – 8.5	North Wambo Creek - Alluvium
GW31	MB	EX	305876.6	6395582	122.12	10.0	7 - 10	North Wambo Creek - Alluvium
GW32	MB	EX	306393.8	6395829	115.05	7.0	4 – 7	North Wambo Creek - Alluvium
GW33	MB	EX	306592.4	6395946				North Wambo Creek - Alluvium

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
GW34	MB	EX	307357	6395779	104.23	4.0	2.5 - 4	North Wambo Creek - Alluvium
GW35	MB	EX	306987.9	6396012	107.28	9	6 - 9	North Wambo Creek - Alluvium
GW36a	MB	EX	306248	6395901	113	7.9	4.9 – 7.9	North Wambo Creek - Alluvium
GW36b	MB	EX	306247	6395907	113	16.6	13.4 – 16.4	North Wambo Creek - Weathered Sandstone (In Channel)
GW37a	MB	EX	311432.184	6390925.855	59.269	6.6	3.6-6.6	Wambo Creek – Alluvium
GW37b	MB	EX	311427.880	6390922.742	59.176	12.0	9.0 – 12.0	Wambo Creek – Weathered Permian
GW40a	MB	EX	305981.442	6397928.283	127.812	27.8	21.0 – 27.0	Waterfall Creek -Unconsolidated/ highly weathered.
GW40b	MB	EX	305986.139	6397925.648	127.711	36.0	30.7 – 35.7	Waterfall Creek – Weathered Permian
GW41a	MB	EX	307295.24	6398552.147	90.806	10.0	7.0 – 10.0	Waterfall Creek – Unconsolidated/ alluvium
GW41b	MB	EX	307298.878	6398547.495	90.843	20.0	14.0 – 20.0	Waterfall Creek – Weathered Permian
SBX_20_GW02a	MB	EX	306905.3	6395946.4	108.92	20	17 – 20	
SW Dam 1A	MB	Proposed	310903	6391145		7-10 (approx.)		Alluvium/colluvium
SW Dam 1B	MB	Proposed				14 – 20 (approx.)		Base of weathered Permian
SW Dam 2A	MB	Proposed	311119	6391405		12 – 15 (approx.)		Base of weathered Permian

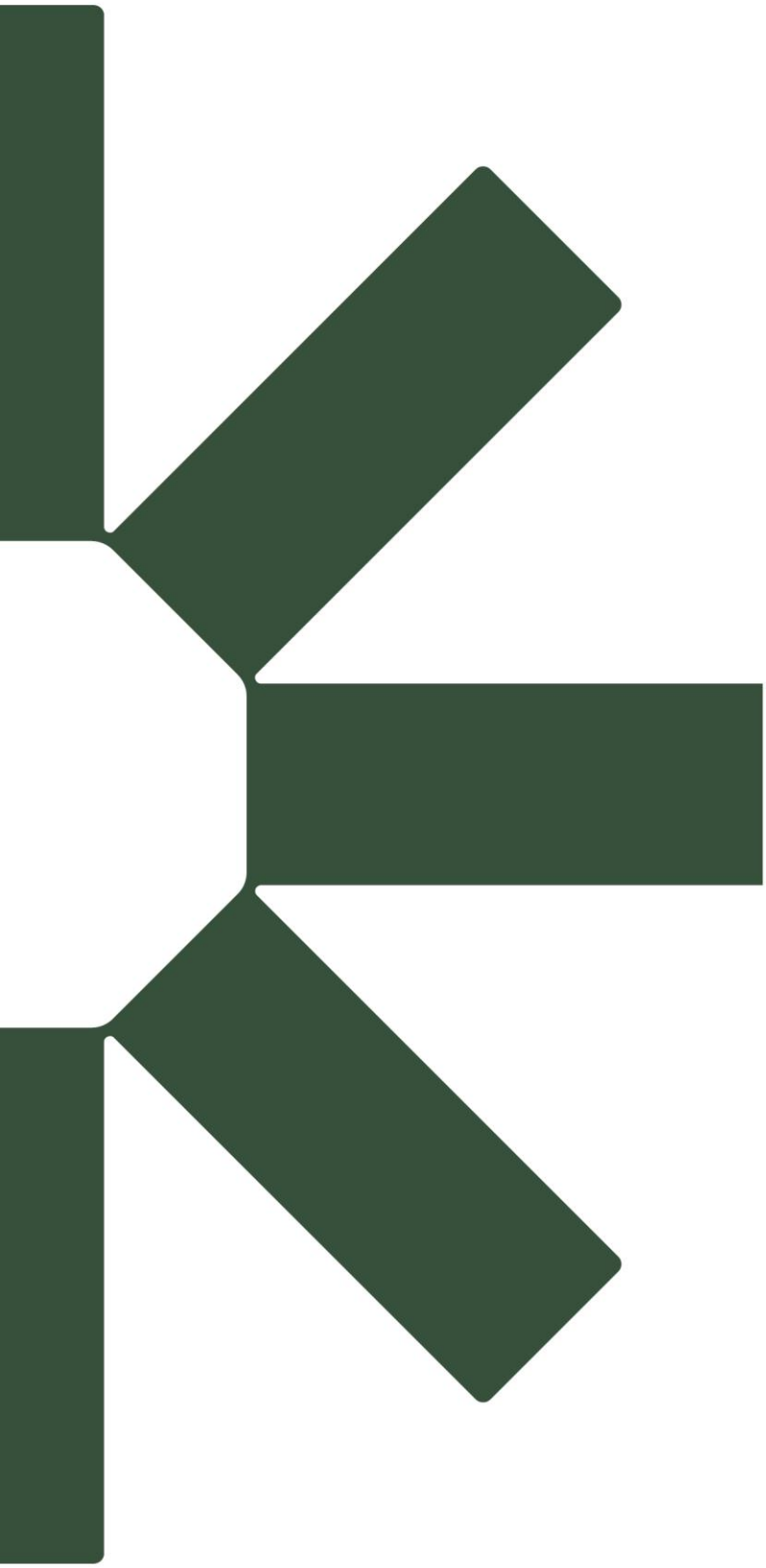
Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
SW Dam 2B	MB	Proposed				22 – 25 (approx.)		Fresh Permian
N2	VWP	EX	308663	6393376	122.53	204	40	Permian Overburden
							70	Permian Overburden
							100	Permian Overburden
							140	Whybrow Seam
							172.5	Interburden
							204	Wambo Seam
N3	VWP	EX	308314	6394575	104.97	-190	30	Permian Overburden
							55	Permian Overburden
							75	Permian Overburden
							108.5	Whybrow Seam
							142	Interburden
							190	Wambo Seam
N5	VWP	EX	306755	6395963	110.78	133	30	Permian Overburden
							73	Whybrow Seam
							89.5	Interburden
							133	Wambo Seam
P316	VWP	EX	311252	6391128	60.39	71	10	Alluvium
							25	Regolith
							50.63	Regolith Overburden

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							71	Whybrow Seam
P323	VWP	EX	309797	6393428	76.65	85.5	23	Overburden siltstone
							224.5	Woodlands Hill Seam
							273.5	Arrowfield Seam
P323	VWP	EX	309799	6393431	76.64	273.5	95.75	Whybrow Seam
							157	Wambo Seam
P324	VWP	EX	310471	6391983	74.44	304.5	11.5	Regolith
							95.75	Whybrow Seam
							157	Wambo Seam
							269.75	Woodlands Hill Seam
							304.5	Interburden
P325 P325	VWP	EX	311806	6390306	65.2	336.5	10.5	Regolith
							32.5	Permian Overburden
							82	Whybrow Seam
							159.5	Wambo Seam
							203	Whynot Seam
							251.5	Woodlands Hill Seam
							336.5	Arrowfield Seam
P325a	MB	EX	312062	6390137	65.2	8	5 - 8	Wambo Creek Alluvium
P326	VWP	EX	310087	6392874	75.48	332.5	43	Overburden
							113.5	Wambo Seam

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							234	Woodlands Hill Seam
							294.5	Arrowfield Seam
P327	VWP	EX	302941	6399995	141.25	332.5	43	Overburden
							113.5	Wambo Seam
							234	Woodlands Hill Seam
							294.5	Arrowfield Seam
P328	VWP	EX	303160.33	6398869.64	131.89	338	43	Overburden
							275	Whybrow Seam
							350	Wambo Seam
							388	Whynot Seam
P329	VWP	EX	307454	6400351	72.42	150.5	67.6	Vaux Seam 1
							87.4	Vaux Seam 2/3
							117.5	Bayswater Seam
							150.5	Pikes Gully Seam
P329a	MB	EX	307456	6400352	72.42	16	10 - 16	Hunter River Alluvium
P330	VWP	EX	306533	6400050	73.62	201.5	201.5	Pike Gully Seam
P330a	MB	EX	306533	6400052	73.63	13	10 - 13	Hunter River Alluvium
SBX_GW01	VWP	EX	307009.9	6395886	107.95	51	61.7	Whybrow Overburden (Siltstone/Sandstone)
SBX_GW02	VWP	EX	306910.5	6395943	108.88	78.3	65.8	Whybrow Seam
							61.7	Whybrow Overburden (Siltstone/Sandstone)

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							53.7	Whybrow Overburden (Siltstone/Sandstone)
P331	VWP	EX	305397	6396881	60.83	282.29	50	Narrabeen Group*
							118	Overburden 1*
							2185	Overburden 2*
							260.5	Whybrow seam*
P332	VWP	EX	305779	6397521	60.9	144.31	40	Sandstone
							80	Siltstone
							114	Coal (WWA)
P333	VWP	EX	306152	6397780	61.05	83.8	22	Weathered Sandstone
							39	Siltstone
							54	Siltstone
DDH1234	VWP	EX	306153	6397780	157.155	83.8	22	Weathered Sandstone
							39	Siltstone
							54	Siltstone (5 m above WWA seam)
DDH1235	VWP	EX	305779	6397521	167.043	144.31	40	Sandstone
							80	Siltstone
							114	Coal (WWA seam)
DDH1240	VWP	EX	305397	6396881	244.834	282.29	50	Narrabeen Group*
							118	Overburden 1
							218.5	Overburden 2*

Bore ID	Type	Status	Easting	Northing	Ground elevation (mAHD)	Bore depth (mbgl)	Screened Interval/ Sensor Depth (mbgl)	Lithology
							260.5	Whybrow seam*
Wambo-03	Dewatering	EX	311699	6392752				Wambo Seam
Wambore South	Dewatering	EX	311812	6392555				Wambo Seam



Making Sustainability Happen

APPENDIX I
ANNUAL COMPLIANCE REPORT
(EPBC 2016/7636 AND EPBC 2016/7816)

WAMBO COAL PTY LTD
2023 ANNUAL COMPLIANCE REPORT

(EPBC 2016/7636 and EPBC 2016/7816)

1 January – 31 December 2023

Document Control

Title	Wambo Coal 2023 Annual Compliance Report (EPBC 2016/7636 and EPBC 2016/7816)
General Description	Review of compliance with the conditions of EPBC 2016/7636 and EPBC 2016/7816
Document Owner	Manager: Environment & Community

Revisions

Rev No	Date	Description	By	Checked	Signature
1	March 2024	Original	WCPL	ND	

This report addresses Condition 5 of the Wambo Coal Pty Limited (WCPL) Environment Protection and Biodiversity Conservation (EPBC) Approval 2016/7636 for the South Wambo Underground Mine, which states:

> *The person taking the action must publish a report on the website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.*

Table 1 provides a reconciliation of the conditions of EPBC 2016/7636 and their compliance status.

This report also addressed Condition 5 of the WCPL EPBC Approval 2016/7816 for the South Bates Extension Underground Mine, which states:

> *The person taking the action must publish a report on the website addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.*

Table 2 provides a reconciliation of the conditions of EPBC 2016/7816 and their compliance status.

Table 1: EPBC Approval 2016/7636 Compliance Summary

Condition	Status	Comment
1. The person taking the action must: a. Not clear more than 0.9 ha of Central Hunter Valley Eucalypt Forest and 3.4 ha of foraging habitat for the Regent Honeyeater *(Anthochaera phrygia).*	Compliant	The action has not yet been commenced. WCPL has not cleared more than 0.9 hectares (ha) of Central Hunter Valley Eucalypt Forest or more than 3.4 ha of foraging habitat for the Regent Honeyeater (*Anthochaera Phrygia*) as part of the action.
b. Implement conditions A1 and A2 of Schedule 2 of the **state development consent** to minimise the impacts of the action on **protected matters**.	Not-compliant	WCPL implements Conditions A1 and A2, Schedule 2 of the Development Consent (DA 305-7-2003). An Independent Environmental Audit (Onward Consulting, 2023) prepared in accordance with Condition D11 of Development Consent DA 305-7-2003 identified a non-compliance with Condition A2 of Development Consent DA 305-7-2003 based on the following "administrative" or "low risk" non-compliances with Development Consent DA 305-7-2003 conditions: • Condition B45 – air quality monitoring equipment malfunction (administrative). • Condition B62 – groundwater quality performance criteria exceedance (low risk). • Condition B77 – late lodgement of Conservation Bond (administrative). • Condition D9 – late non-compliance notifications (administrative). These non-compliances are considered to not be related to the EPBC 2016/7636 Action nor would they result in any significant impacts to relevant Matters of National Environmental Significance.
c. Implement environmental performance conditions B1-B11, B51-B55, B62-B73 and B75-B77 of Schedule 2 of the **state development consent**, where the conditions relate to avoiding, mitigating, managing, offsetting, monitoring or recording, or reporting on impacts to **protected matters**. In implementing these conditions, the approval holder must protect at least 18.3 ha of Central Hunter Valley Eucalypt Forest and at least 27.7 ha of foraging habitat for the Regent Honeyeater *(Anthochaera phrygia)* in perpetuity.	Compliant	WCPL implements Conditions B1-B11, B51-B55, B62-B73 and B75-B77 of Schedule 2 of the Development Consent (DA 305-7-2003). WCPL has amended an existing VCA under the NSW *National Parks and Wildlife Act 1974* to conserve Remnant Woodland Enhancement Program Area E in perpetuity, which includes 18.3 ha of Central Hunter Valley Eucalypt Forest and Woodland and 27.7 ha of foraging habitat for the Regent Honeyeater.

Condition	Status	Comment
2. Within 30 days after the **commencement of the action**, the person taking the action must advise the **Department** in writing of the actual date of **commencement of the action**.	Not applicable	The action has not yet been commenced. Mining at the approved South Wambo Underground Mine is planned to commence after completion of mining at the South Bates Extension Underground Mine. WCPL will advise the Department in writing of the commencement of the action within 30 days of commencement.
3. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all management plans, programs, strategies and reviews required by condition 1. Each management plan, program, strategy and review must be published on the **website**, and notification must be provided to the **Department**, within 1 month of being approved by the Secretary of the NSW Department of Planning & Environment (or nominee of the Secretary).	Compliant	Copies of all management plans, programs, strategies and reviews required by condition 1 of EPBC 2016/7636 are available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports. Relevant management plans include the Site Water Management Plan and Biodiversity Management Plan. An Extraction Plan for areas related to the Action has not yet been prepared. Notification is provided to the Department within one month of the approval of any management plans, programs, strategies and reviews by the Secretary of the NSW Department of Planning & Environment (or nominee of the Secretary).
4. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by condition 1, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of approval.	Compliant	WCPL maintains accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by condition 1. WCPL will make these records available upon request to the Department.
5. The person taking the action must publish a report on their **website** addressing compliance with each of the conditions of this approval, including implementation of any management plan, program, strategy and review required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication and non-compliance with any of the conditions of this approval must be provided to the **Department** (by email to EPBCmonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Compliant	The WCPL 2023 Annual Review (including this report) will be published on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.

Condition	Status	Comment
6. Any potential or actual contravention of the conditions of this approval, including contravention of a commitment made in a management plan, program, strategy and review required by condition 1 must be reported to the **Department** within 7 days of the person taking the action becoming aware of the actual or potential contravention.	Not applicable	No events contravening (or potentially contravening) the conditions of this approval have occurred.
7. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor and audit criteria must be approved by the **Minister** prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the **Minister**.	Not applicable	Upon the direction of the Minister, WCPL will ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister.
8. If, at any time after 5 years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the **Minister**.	Not applicable	WCPL did not substantially commence the South Wambo Underground Mine prior to 30 April 2022 (i.e. five years after the date EPBC 2016/7636 was granted). In September 2023 DCCEEW approved WCPL's request to delay commencement of the action, noting the action must now commence by 31 December 2024. Mining at the approved South Wambo Underground Mine is planned to commence after completion of mining at the South Bates Extension Underground Mine.

Table 2: EPBC Approval 2016/7816 Compliance Summary

Condition	Status	Comment
1. The person taking the action must: a. Implement administrative conditions A1 and A2 of Schedule 2 of the state development consent to minimise the impacts of the action on protected matters.	Not-compliant	WCPL implements Conditions A1 and A2, Schedule 2 of the Development Consent (DA 305-7-2003). An Independent Environmental Audit (Onward Consulting, 2023) prepared in accordance with Condition D11 of Development Consent DA 305-7-2003 identified a non-compliance with Condition A2 of Development Consent DA 305-7-2003 based on the following "administrative" or "low risk" non-compliances with Development Consent DA 305-7-2003 conditions: • Condition B45 – air quality monitoring equipment malfunction (administrative). • Condition B62 – groundwater quality performance criteria exceedance (low risk). • Condition B77 – late lodgement of Conservation Bond (administrative). • Condition D9 – late non-compliance notifications (administrative). These non-compliances are considered to not be related to the EPBC 2016/7816 Action nor would they result in any significant impacts to relevant Matters of National Environmental Significance.
b. Implement environmental performance conditions B1-B3, B7-B10, B51-B55 and B62- B68 of Schedule 2 of the **state development consent**, where the conditions relate to avoiding, mitigating, managing, offsetting, monitoring or recording, or reporting on impacts to **protected matters**.	Compliant	WCPL implements Conditions B1-B3, B7-B10, B51-B55 and B62-B68, Schedule 2 of the Development Consent (DA 305-7-2003).
c. Notify the **Department** in writing of any proposed change to the **conditions** of the **state development consent**, referred to in conditions 1a and 1b, within 5 **business days** of formally proposing a change or becoming aware of any other proposed change.	Compliant	WCPL consulted with DCCEEW in August 2022 to advise that a Modification to DA305-7-2003 was being prepared to allow for the reorientation of longwall 24 and 25, and the proposed addition of Longwall 26.
d. Notify the **Department** in writing of any change to conditions of the **state development consent**, referred to in conditions 1a to 1b, within 5 **business days** of a change to **conditions** being finalised.	Compliant	DA 305-7-2003 Modification 19 was approved 25 January 2023. WCPL notified DCCEEW by email January 27, 2023.
2. Within 25 **business days** after the **commencement of the action**, the person taking the action must advise the **Department** in writing of the actual date of **commencement of the action**.	Notification provided 3 December 2018.	WCPL provided a notification to the Department of the actual date of commencement of the action (3 December 2018), however this was not completed within 30 days of the commencement of the action.

Condition	Status	Comment
3. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all management plans and strategies required by conditions B1-B3, B7-B10, B51-B55 and B62-B68 of Schedule 2 of the **state development consent** on their website. Each management plan and strategy must be published on the **website** within 1 month of being approved by the **Secretary** and remain there for a period of no less than 5 years.	Compliant	Copies of all management plans, programs, strategies and reviews required by condition 1 of EPBC 2016/7636 are available to the public on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports. Relevant management plans include the Extraction Plan for South Bates Extension Underground Mine Longwalls 24 to 26, Site Water Management Plan, Biodiversity Management Plan and Life of Mine Rejects Emplacement Strategy.
4. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to these conditions of **approval**, including measures taken to implement the management plans and strategies required by conditions B1-B3, B7-B10, B51-B55 and B62-B68 of Schedule 2 of the **state development consent**, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with the conditions of this **approval**.	Compliant	WCPL maintains accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement a management plan, program, strategy and review required by Conditions B1-B3, B7-B10, B51-B55 and B62-B68, Schedule 2. WCPL will make these records available upon request to the Department.
5. The person taking the action must publish a report on their website addressing compliance with each of the **conditions** of this **approval**, including implementation of any management plans and strategies required by condition 1. The reporting period and report publication must comply with conditions D10 and D15 of Schedule 2 of the **state development consent**. Documentary evidence providing proof of the date of publication must be provided to the **Department** (by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**) at the same time as the compliance report is published. The person taking the action must continue to publish the report until such time as agreed in writing by the **Minister**.	Compliant	The WCPL 2023 Annual Review (including this report) will be published on the Peabody Energy website https://www.peabodyenergy.com/Operations/Australia-Mining/New-South-Wales-Mining/Wambo-Approvals,-Plans-Reports.
6. Any potential or actual contravention of the conditions of this **approval**, including contravention of a commitment made in a management plan or strategy required by condition 1 must be reported to the **Department** no later than 7 **business days** of the person taking the action becoming aware of the actual or potential contravention, by email to EPBCMonitoring@environment.gov.au or an address as stipulated by the **Department**.	Not applicable	No events contravening (or potentially contravening) the conditions of this approval have occurred.

Condition	Status	Comment
7. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of **approval** is conducted and a report submitted to the **Minister**. The independent auditor and audit criteria must be approved by the **Minister** prior to the commencement of the audit. The audit report must address the criteria to the satisfaction of the **Minister**.	Not applicable	Upon the direction of the Minister, WCPL will ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister.
8. If, at any time after 5 years from the date of this **approval**, the person taking the action has not substantially **commenced the action**, then the person taking the action must not **commence the action** without the written agreement of the **Minister**.	Compliant	WCPL commenced the action within five years of the date of the approval of EPBC 2016/7816.