BENGALLA MINE
ANNUAL REVIEW 2023

BENGALLA

Prepared by:
BENGALLA MINING COMPANY PTY LIMITED
LOCKED BAG 5
MUSWELLBROOK NSW 2333

March 2024

Annual Review Title Block

Name of operation	Bengalla Mine
Name of operator	Bengalla Mining Company Pty Limited
Development consent	SSD-5170 (as modified)
Name of holder of development consent	Bengalla Mining Company Pty Limited
Mining Leases	See **Table 6**
Name of holder of mining leases	Bengalla Mining Company Pty Limited
Water licences	See **Table 6**
Name of holder of water licences	Bengalla Mining Company Pty Limited and the Bengalla Joint Venturers (New Hope Bengalla Pty Limited in 8/10 share and Taipower Bengalla Pty Limited in 2/10 share)
Annual Review start date	1 January 2023
Annual Review end date	31 December 2023

I, Cam Halfpenny, certify that this audit report is a true and accurate record of the compliance status of Bengalla Mining Company Pty Limited for the period 1 January 2023 to 31 December 2023 (as described in Section 1 of this report) and that I am authorised to make this statement on behalf of Bengalla Mining Company Pty Limited.

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	Cam Halfpenny
Title of authorised reporting officer	General Manager
Signature of authorised reporting officer	Cam Halfpenny
Date	28.3.2024

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS

ACARP	**Australian Coal Association Research Programme**
ACHMP	Aboriginal Cultural Heritage Management Plan
AEISG	Australasian Explosive Industry Safety Group
AGE	Australasian Groundwater and Environmental Consultants Pty Limited
ANZECC	Australian and New Zealand Environment Conservation Council
AQMP	Air Quality Management Plan
ARD	Acid Rock Drainage
AS/NZS	Australian/New Zealand Standard
BDMP	Biodiversity Management Plan
Bengalla	Bengalla Mine
BJV	Bengalla Joint Venture
BMC	Bengalla Mining Company Pty Limited
BMP	Blast Management Plan
BOMP	Biodiversity Offset Management Plan
BTOC	Below Top of Casing
CCC	Bengalla Community Consultative Committee
CDF	Community Development Fund
CER	Clean Energy Regulator
CHPP	Coal Handling Preparation Plant
CO2-eq	Carbon Dioxide Equivalent
CST	Community Support Team
CW1	Clean Water Dam 1
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water
DoEE	Department of Environment and Energy
DoI - Water	NSW Department of Primary Industries – Lands and Water
DPHI	NSW Department of Planning Housing and Infrastructure
DW1	Bengalla Discharge Dam (Existing), also referred to as EPA26 under EPL6538
EC	Electrical Conductivity
ED3	Mt Pleasant Environmental Dam 3
EIS	Environmental Impact Statement titled *Continuation of Bengalla Mine, Environmental Impact Statement* (6 volumes), dated September 2013, as modified by the *Response to Submissions* dated March 2014
EMS	Environment Management Strategy
EP&A Act	Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPBC	Environment Protection Biodiversity Conservation Approval
EPL 6538	Environment Protection Licence 6538
ERT	Emergency Response Team
FY	Financial Year (1 July - 30 June)
GDP	Ground Disturbance Permit
GHG	Greenhouse Gas
GIS	Geographical Information System

GJ	Gigajoule
Ha	Hectare
HDWV	High Density Woody Vegetation
HHMP	Historic Heritage Management Plan
HRSTS	Hunter River Salinity Trading Scheme
HVAS	High Volume Air Sampler
IBC	Intermediate Bulk Container
IEA	Independent Environmental Audit
INP	Industrial Noise Policy (EPA,2000)
IR	Infrared
LETA	Low Emissions Technology Australia
LLS	NSW Local Land Services
MAC	Mt Arthur Coal
MACH Energy	MACH Energy Australia Pty Ltd
Mbcm	Million Bank Cubic Meters
MEG	Department of Regional NSW, Mining Exploration and Geoscience
Mining Regulation	*Mining Regulation 2016* (NSW)
ML	Mining Lease (Followed by Number)
ML	Mega Litres (Preceded by Number)
MOD	SSD-5170 Modification (Followed by Number)
MOP	Bengalla Mine Mining Operations Plan 2017 – 2022 (Replaced by Rehabilitation Management Plan and Forward Work Plan in 2022)
MSC	Muswellbrook Shire Council
Mt	Million Tonnes
Mtpa	Million Tonnes per annum
NGER	National Greenhouse and Energy Reporting
Night	Period between 10pm and 7am on Monday to Saturday and 10pm and 8am on Sundays
NMP	Noise Management Plan
NPfI	Noise Policy for Industry (EPA, 2017)
NPI	National Pollutant Inventory
NPWS	National Parks and Wildlife Services
NSW	New South Wales
OEA	Overburden Emplacement Area
Orica	Orica Australia Pty Limited
PIN	Penalty Infringement Notice
PIRMP	Pollution Incident Response Management Plan
PM_{10}	Particulate Matter less than 10 micrograms
$PM_{2.5}$	Particulate Matter less than 2.5 micrograms
POEO Act	Protection of Environment Operations Act 1997
PPV	Peak Particle Velocity
RAP	Registered Aboriginal Party
Reporting Period	1 January 2023 - 31 December 2023

RFS	Rural Fire Service
RL	Relative Level
RMP	Rehabilitation Management Plan
RMS	NSW Roads and Maritime Services
ROM	Run of Mine
RR	NSW Resources Regulator
RTEMS	Real Time Environment Management System
Safeguard Mechanism	National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 Cth
SDD	Stage Discharge Dam (Decommissioned)
SEE (MOD1)	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification Statement of Environmental Effects' dated August 2015 and prepared by Hansen Bailey, including the Response to Submissions document dated October 2015
SEE (MOD2)	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification Statement of Environmental Effects' dated April 2016 and prepared by Hansen Bailey, including the Response to Submissions document dated June 2016
SEE (MOD3)	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification 3 Statement of Environmental Effects' dated September 2016 and prepared by Hansen Bailey, including the Response to Submissions document dated November 2016
SEE (MOD4)	Statement of Environmental Effects titled 'Bengalla Mine Development Consent Modification 4 Statement of Environmental Effects' dated December 2017 and prepared by Hansen Bailey, including the Response to Submissions document dated May 2018 and additional information dated July 2018 and November 2018
SEE (MOD5)	Modification Report titled 'Bengalla Mine Modification 5 Report' dated November 2021 and prepared by Bengalla Mining Company Pty Limited, including the Response to Submissions document dated 29 July 2022 (Prepared by James Bailey & Associates)
SSD-5170 (as modified)	State Significant Development 5170
SWL	Standing Water Level
t	Tonnes
TDS	Total Dissolved Solids
TEOM	Tapered Element Oscillating Microbalance
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
VIMP	Visual Impact Mitigation Plan
VPA	Voluntary Planning Agreement
WAL	Water Access Licence
WMP	Water Management Plan

1 STATEMENT OF COMPLIANCE

1.1 INTRODUCTION

This Annual Review has been prepared to provide a summary of the environmental performance of Bengalla Mine (Bengalla) over the period 1 January 2023 – 31 December 2023 (Reporting Period). The compliance status of Bengalla against relevant approvals for the Reporting Period is summarised in **Table 1**.

Any non-compliances recorded during the Reporting Period were ranked according to the risk matrix included in **Table 2** and a brief description of each is provided in Table 3. Further information about the non-compliances is provided in **Section 11**.

The compliance status described in this Annual Review (**Section 1** and **Section 11**) relates to the conditions of the relevant approvals listed in **Table 1** during the Reporting Period.

Table 1: Statement of Compliance

Were all conditions of the relevant approvals complied with?	Yes/No
State Significant Development consent (SSD-5170 (as modified))	No
Rehabilitation Management Plan and Forward Program	Yes
Environment Protection Biodiversity Conservation (EPBC) Approval 2012/6378	No

Table 2: Non-Compliance Risk Matrix

Risk Level	Risk Level	Description
High	**High**	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	**Medium**	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	**Low**	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	**Administrative non-compliance**	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).

Source: Annual Review Guideline, Post-approval requirements for State significant mining developments. (NSW Government, October 2015)

Table 3: Non- Compliances in the Reporting Period

Approval	Cond. #	Condition Description (Summary)	Non-compliance Status*	Comment	Section described in this Annual Review
(1) EPBC Approval 2012/6378	Condition 4	The approval holder must secure the lands identified as the Offset Areas at Schedule 2 (Figures 1-6) of this notice as a biodiversity offset, in accordance with NSW Approval condition 28.	Administrative non-compliance	All Biodiversity Offset Areas identified in Schedule 2 (Figures 1-6) of the EPBC Approval are owned by the Bengalla Joint Venturers (BJV) and managed by BMC. All Biodiversity Offset Areas are managed in accordance with the BOMP. By letter dated 6 October 2020, the Secretary agreed to an extension of time until 30 June 2022 to finalise the long-term security of the Biodiversity Offset Areas under Schedule 3 Condition 28 of SSD-5170 (Condition 28). At this stage, the DPE has not granted a further extension in which to comply with Condition 28. BMC corresponded with the relevant NSW government departments during 2022 to determine the appropriate long-term mechanism for securing the offsets. Following that correspondence, BMC has taken steps to progress Biodiversity Stewardship Agreements (BSAs) for the offset areas. BMC notified the non-compliance with Condition 28 to DCCEEW on 7 September 2022. By letter dated 12 October 2022, DCCEEW advised that it had reviewed the matter and "*concluded that the issuing of an infringement notice would not be an appropriate course of action in this case. Consequently, no further action will be taken regarding this matter*".	See **Section 11.1.1** for further comments
(2) SSD-5170	Condition 28 of Schedule 3	Implementation for long term security for biodiversity offsets	Administrative non-compliance	Commentary as per the above.	See **Section 11.1.1** for further comments
(3)	Condition 3 of EPBC Approval 2012/6378 and Condition 29		Non-compliance	All Biodiversity Offset Areas identified in Schedule 2 (Figures 1-6) of the EPBC Approval are owned by the Bengalla Joint Venturers (BJV) and managed by BMC. All Biodiversity Offset	See **Section 11.1.2** for further comments

Approval	Cond. #	Condition Description (Summary)	Non-compliance Status*	Comment	Section described in this Annual Review
	of Schedule 3 of SSD 5170			Areas are managed in accordance with the BOMP. By email and the Planning Portal 9 June 2023, BMC notified what is now known as the DPHI of a non-compliance with Condition 29 of Schedule 3 of SSD 5170 under Condition 7A of Schedule 5 of SSD 5170. By email on 6 June 2023 BMC notified the Department of Climate Change, Energy, the Environment and Water (DCCEEW) regarding a non-compliance with Condition 3 of EPBC Approval 2012/6378 under Condition 13 of EPBC Approval 2012/6378.	

2 INTRODUCTION

This section provides an overview of Bengalla, outlines the purpose of this Annual Review, and provides contact details for relevant BMC personnel.

2.1 BACKGROUND

Bengalla Mining Company Pty Limited (BMC) operates Bengalla in the Upper Hunter Valley of New South Wales (NSW), approximately 130 km north-west of Newcastle and 4 km west of the township of Muswellbrook, as illustrated in **Figure 1** and **Figure 2**.

On 7 August 1995, the then Minister for Urban Affairs and Planning granted Development Consent DA 211/93 for the construction and operation of a surface coal mine, coal preparation plant, rail loop, loading facilities and other associated infrastructure (which was subsequently modified on various occasions). DA 211/93 was surrendered to the NSW Department of Planning and Environment (DPE) in December 2016 following the grant of SSD-5170.

On 3 March 2015, the Secretary of what is now the DPE, as delegate for the Minister for Planning, granted SSD-5170 for the continuation of Bengalla to 2039 at a rate of up to 15 Mtpa Run of Mine (ROM) coal production. BMC commenced operations under SSD-5170 on 1 October 2015. Since 2015, five modifications to SSD-5170 have been approved with the latest Mod 5 being approved in February 2023.

The approved Bengalla layout is shown on **Figure 3**, mining leases held by BMC are shown on **Figure 4** and an overview of the Bengalla environmental monitoring network is shown on **Figure 5**. The location of the approved Biodiversity Offset Areas in relation to Bengalla is shown on **Figure 9**.

2.2 DOCUMENT PURPOSE

This Annual Review summarises the environmental performance of Bengalla for the Reporting Period. Subject to comments below, the requirements of SSD-5170 and mining leases held by BMC relevant to the preparation of this Annual Review and where they have been addressed in the document are included in **Table 4**.

The structure and content of this Annual Review was prepared in accordance with the '*Annual Review Guideline, Post-Approval requirements for State significant mining developments'* (NSW Government, October 2015) (Guidelines).

From 2 July 2022, the requirement for an Annual Review was replaced by the requirement for an Annual Rehabilitation Report (ARR) under the statutory mining lease conditions in Part 2 of Schedule 8 of the Mining Regulation. On 31 March 2023, BMC submitted an ARR to the RR covering the period 27 June 2022 to 31 December 2022 as required by the RR.

The 2023 Annual Rehabilitation Report (ARR) will be submitted by 31 March 2023.

Table 4: Development Consent and Mining Lease Requirements for Annual Review

Document	Where Addressed
SSD-5170 (Schedule 5, Condition 4)	
4. By the end of March each year (or as otherwise agreed by the Secretary), the Applicant must review the environmental performance of the development for the previous calendar year to the satisfaction of the Secretary. This review must:	This document
a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the current calendar year;	**Sections 8** and **12**
b) include a comprehensive review of the monitoring results and complaints records of the development over the past year, which includes a comparison of these results against: • relevant statutory requirements, limits or performance measures/criteria; • monitoring results of previous years; • relevant predictions of the EIS;	**Sections 6** to **9**
c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;	**Sections 1 and 11**
d) identify any trends in the monitoring data over the life of the development;	**Sections 6** to **8**
e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and	**Sections 6** to **8**
f) describe what measures will be implemented over the next year to improve the environmental performance of the development.	**Section 12**

2.3 BMC CONTACTS

The relevant contacts for environmental management at Bengalla are outlined in **Table 5**.

Table 5: BMC Contacts

Contact	Contact Details
Cam Halfpenny General Manager	Phone: 02 6542 9500 Email: cam.halfpenny@newhopegroup.com.au
Hayley Frazer Environment Superintendent	Phone: 02 6542 9500 Email: hayley.frazer@newhopegroup.com.au
BMC Website (Copies of public notices, environmental management documents, monitoring results and other information relating to Bengalla's operations)	https://newhopegroup.com.au
Phone	Bengalla General Enquiries 02 6542 9500; or Community Complaints Hotline 1800 178 984.

Figure 1: Regional Locality

Figure 2: Muswellbrook Locality

Figure 3: Approved Site Layout

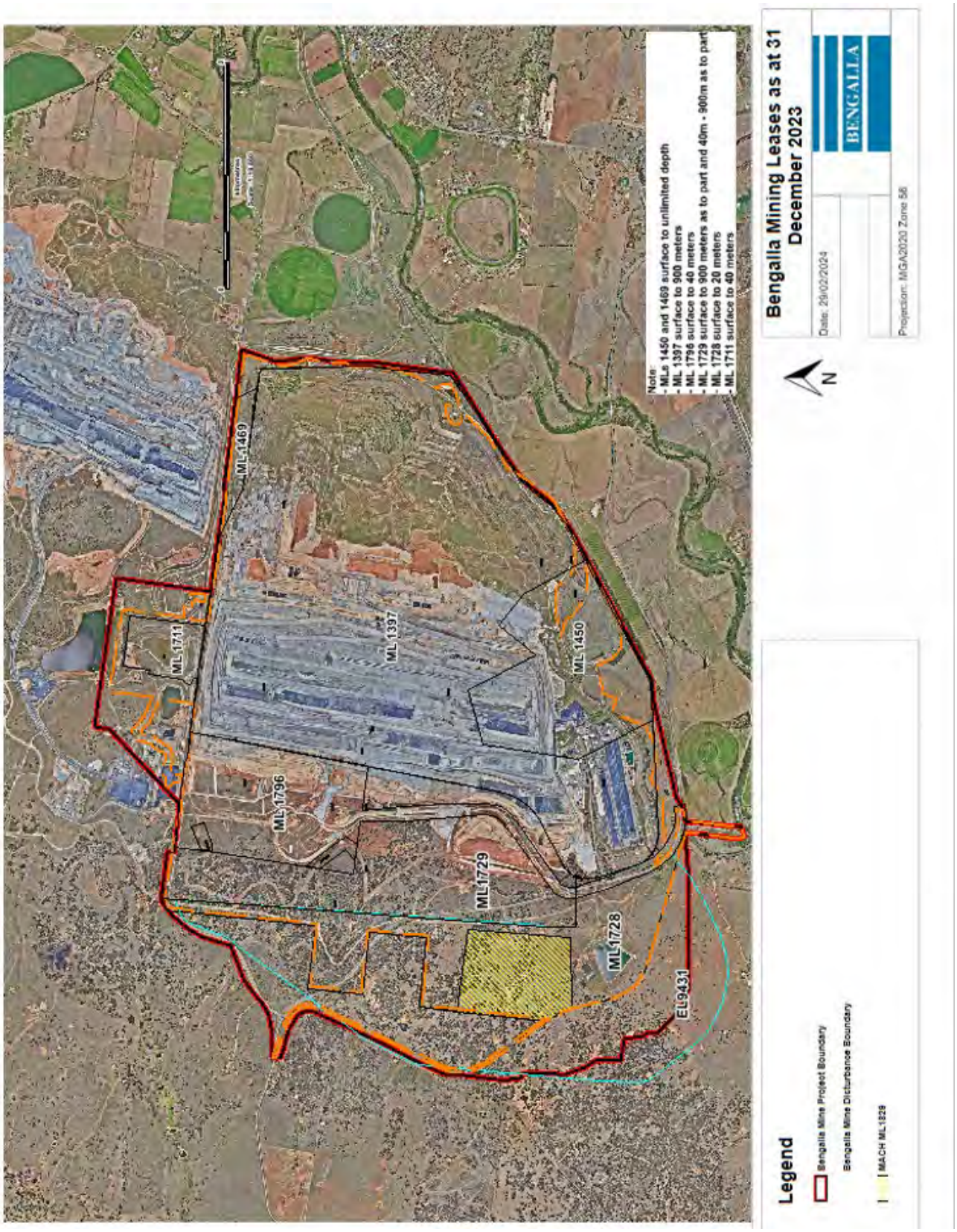

Figure 4: Mining Leases

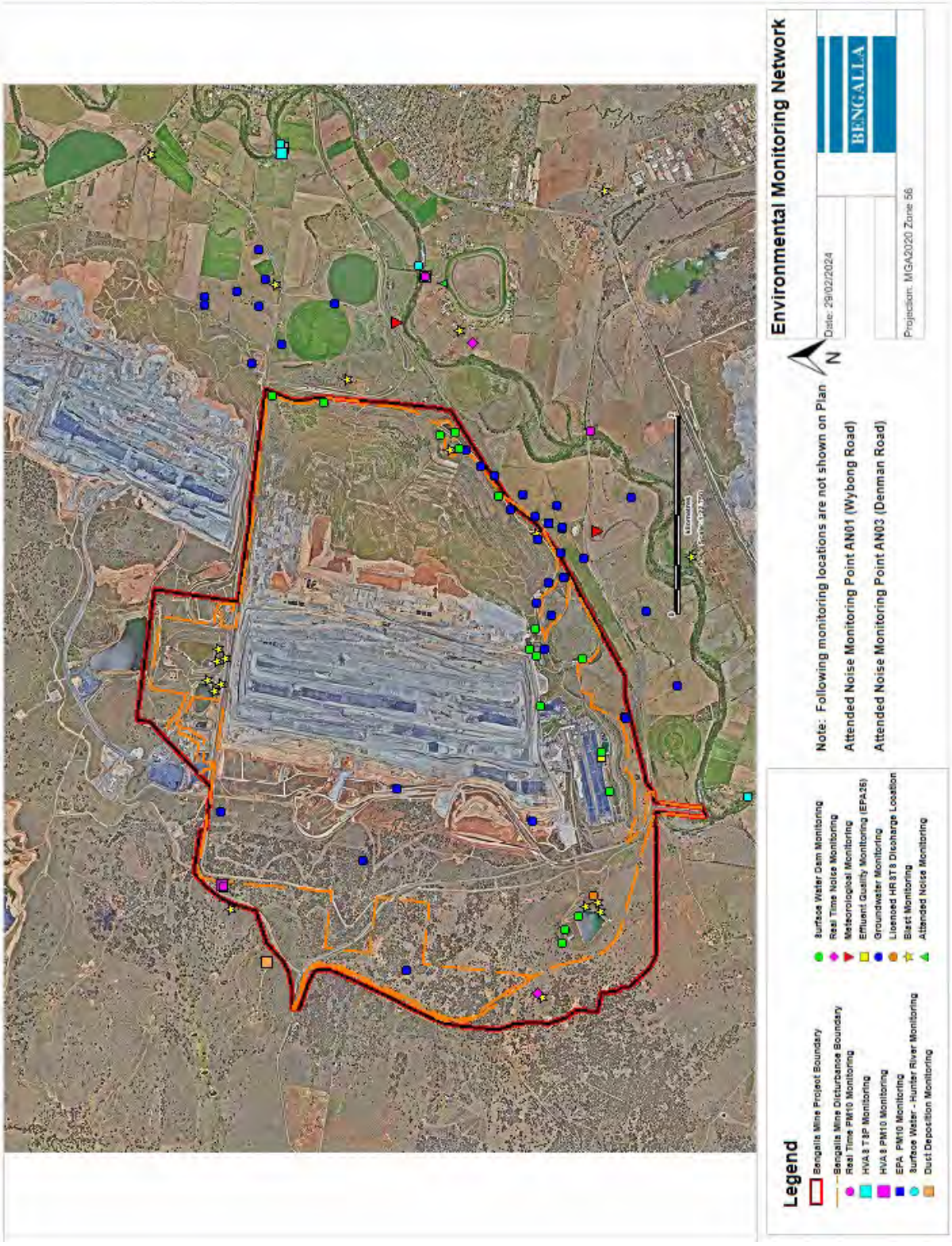

Figure 5: Environmental Monitoring Network[1]

[1] ***Figure 5*** *shows HVAS – PM10, HVAS – TSP and Dust Deposition Monitoring locations as shown in AQMP 2022. A new air quality monitoring network is in the process of being installed in accordance with AQMP 2022 (approved on14 December 2022).*

3 APPROVALS

This section provides a summary of leases, licences and approvals that regulate operations at Bengalla.

3.1 OVERVIEW

A summary of the key mining leases, licences and approvals for activities at Bengalla during the Reporting Period is provided in **Table 6**. Copies of the Bengalla approvals and supporting documentation are available on the BMC website: https://newhopegroup.com.au/

Table 6: Bengalla Approvals Summary

Document	Approval Period(s)	Authority
Development Consent SSD-5170 (as modified)	03/03/2015 – 28/02/2039*	DPHI
Development Consent SSD-5170 MOD 1 – approved 16 December 2015	03/03/2015 – 28/02/2039	DPHI
Development Consent SSD-5170 MOD 2 – approved 1 July 2016	03/03/2015 – 28/02/2039	DPHI
Development Consent SSD-5170 MOD 3 – approved 23 December 2016	03/03/2015 – 28/02/2039	DPHI
Development Consent SSD-5170 MOD 4 – approved 19 December 2018 (Note: MOD 5 application lodged on 28 November 2021 and approved after end of Reporting Period on 24 February 2023)	03/03/2015 – 28/02/2039	DPHI
Development Consent SSD-5170 MOD 5 – approved 24 February 2023	03/03/2015 – 28/02/2039	DPHI
DA 273/2006 – Explosives Facility	06/09/2006 – Perpetuity	Muswellbrook Shire Council (MSC)
EPBC Act 1999 Cth Approval 2012/6378	27/05/2015 – 31/12/2050	Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Mining Lease (ML) 1397	27/06/1996 – 27/06/2038	Department of Regional NSW, Mining Exploration and Geoscience (MEG)
ML 1450	10/06/1999 – 09/06/2043	MEG
ML 1469	05/06/2000 – 04/06/2042	MEG
ML 1711	29/09/2015 – 17/12/2031	MEG
ML 1728	10/02/2016 – 10/02/2037	MEG
ML 1729	10/02/2016 – 10/02/2037	MEG
ML 1796	30/03/2021 – 17/12/2031	MEG
Exploration Licence (EL) 9431	04/07/2022 – 04/07/2028	MEG
EPL 6538	Anniversary Date 11 September	NSW Environment Protection Authority (EPA)
Water Access Licence (WAL) 1106**	Tenure Continuing	Water NSW

Document	Approval Period(s)	Authority
WAL 41547 (formerly 20BL169798)***	Tenure Continuing	Water NSW
20PE001354 (Hunter Pump River Permit)	01/05/1997 – Annual Renewal	Water NSW
XSTR200130 (Licence to Store Explosives)	10/08/2022 – 07/08/2027	SafeWork NSW
5061036 (Radiation Management Licence)	Expiry date: 08/08/2024	NSWEPA

** Schedule 2, Condition 5 of SSD-5170 provides that mining operations may be carried out until 28 February 2039. The consent continues to apply in all other respects other than the right to conduct mining operations until rehabilitation and other relevant obligations have been carried out satisfactorily.*

*** WAL 1106 is for the Hunter Regulated River Water Source (High Security with 1,449 units).*

**** WAL 41547 is for the Sydney Basin-North Coast Groundwater Source (category aquifer with 365 units) authorising extraction of groundwater from the pit. These are the main WALs used in connection with take of water for mining operations at Bengalla. The Bengalla Joint Venturers (BJV) and BMC also hold other WALs for various water sources.*

3.2 PENDING APPLICATIONS AT END OF REPORTING PERIOD

The following applications were made during the Reporting Period and were pending as at 31 December 2023:

(a) application for Minister's approval for sublease of ML 1711 from BMC to MACH Energy Australia Pty Ltd (MACH) and J.C.D. Australia Pty Ltd (JCDA) registered 22 August 2023; and

(b) application to vary the Bengalla Colliery Holding for various reasons regarding tenements ML 1711, ML 1729, ML 1796 and addition of freehold land approved 25 January 2024.

3.3 VARIATIONS

The following new or varied approvals were issued during the Reporting Period:

(a) application for part transfer of ML 1728 from BMC to MACH and JCDA registered 20 July 2023; and

(b) ML 1450 renewal granted 28 April 2023 and ML 1469 renewal granted 15 May 2023.

3.4 STATUS OF MANAGEMENT PLANS

Table 7 outlines the environmental management plans and the approval status of each at the end of the Reporting Period.

Table 7: Status of BMC Management Plans

Management Strategy / Plan	Regulatory Approval
Aboriginal Cultural Heritage Management Plan (ACHMP)	18 August 2017
Air Quality Management Plan (AQMP)	14 December 2022
Biodiversity Management Plan (BDMP)	18 August 2017
Biodiversity Offset Management Plan (BOMP)	18 August 2017
Blast Management Plan (BMP)	22 August 2023
Environmental Management Strategy (EMS)	24 August 2023
Historic Heritage Management Plan (HHMP)	18 August 2017
Rehabilitation Management Plan (RMP)	30 March 2023
Forward Program	31 March 2023*
Noise Management Plan (NMP)	10 August 2023
Visual Impact Mitigation Plan (VMP)	14 June 2016
Water Management Plan (WMP)	21 December 2023

** Forward Program is not subject to approval of the Secretary.*

4 OPERATIONS SUMMARY

This section provides a summary of exploration, mining and other activities undertaken at Bengalla during the Reporting Period. It also includes a summary of operations proposed for 2024.

4.1 MINING OPERATIONS

During 2023, mining operations at Bengalla continued to progress to the west as approved by SSD-5170.

Table 8 provides actual waste rock, ROM coal, reject material and saleable product volumes for 2022 and 2023 and forecast volumes for 2024.

Table 8: Production and Waste Summary

Material	Unit	Approved Limit	Previous Reporting Period (2022 Actual)	This Reporting Period (2023 Actual)	Next Reporting Period (2024 Plan)
Waste Rock / Overburden	Mbcm	-	48.20	60.40	60.02
ROM Coal	Mt	15	10.72	12.01	13.87
Reject Material	Mt	-	2.79	3.17	4.39
Saleable Product	Mt	-	8.30	9.67	11.27

Notes:
1. Forecast data sourced from Forecast Plans.
2. Waste Rock/Overburden is prime waste.
3. Reject material includes fine and coarse material.

4.2 OTHER OPERATIONS

Mining operations at Bengalla occur 24 hours a day except Christmas Day and Boxing Day. Rail activities operate 24 hours a day dependent upon rail schedules.

Other operations at Bengalla during the Reporting Period included:

- ***Exploration*** (in ML areas): During the calendar year of 2023, in ML 1729 and ML 1796 a total of 64 boreholes were drilled. 7 were cored and sampled for gas content and composition for fugitive gas emissions modelling, another 5 were cored for coal quality testing, 4 were cored for geotechnical testing and 48 holes were rotary open holes for structure definition. Five of the holes had vibrating wire piezometers and TDR sensors installed for groundwater monitoring.

  The majority of the boreholes were drilled to the base of the Edderton Coal seam, with 5 holes drilled to the base of the Edinglassie seam.

- ***Coal Transport***: During the Reporting Period, 9,518,179 tonnes (t) of product coal were transported via rail to the Port of Newcastle.

  The total number of train movements during the Reporting Period was 1,237 with a maximum of 7 train movements per day.

- ***Infrastructure, Construction and Management***: The following projects were commenced, progressed or completed during the Reporting Period:
  - Bengalla Link Rd Refurbishment – largely completed. Scheduled to be completed in Q1 2024;
  - In Pit Water Cart Fill Point – Scheduled for completion Feb 2024
  - West Diversion Levee – Scheduled for completion January 2024
  - Tyre Bay – Completed
  - In pit crushing plant facility – Completed
  - Old reload facility – decommissioned

4.3 EMPLOYMENT AND OTHER DETAILS

As at the 31 December 2023, BMC employed 701 permanent employees and 262 full-time equivalent contactors. Approximately 86 per cent of BMC employees resided in the local government areas of Muswellbrook, Upper Hunter and Singleton.

4.4 NEXT REPORTING PERIOD

Forecast mining operations and related activities for the next reporting period include:

- Continue mining westward.
- Pre-production drilling.
- Rehabilitation according to the RMP and Forward Program.
- CHPP upgrades.

A summary of key environmental approval and management activities proposed for 2024 is provided in **Section 12**.

5 ACTION REQUIRED FROM PREVIOUS ANNUAL REVIEW

BMC received correspondence from the NSW Department of Planning and Environment on 1st November 2023, stating that the Department had reviewed the 2022 Annual Review and considered it satisfied the requirements of the consent and the NSW Planning Annual Review Guideline (October 2015).

6 ENVIRONMENTAL MANAGEMENT AND PERFORMANCE

This section describes BMC's environmental monitoring, management and performance during the Reporting Period. Environmental management actions planned to be implemented in 2024 are also described.

Surface water and groundwater environmental management and performance are discussed in ***Section 7.2*** *and* ***Section 7.3****, respectively. Rehabilitation is discussed in* ***Section 8.***

6.1 METEOROLOGY

6.1.1 Environmental Management

BMC operates a meteorological station and inversion tower in accordance with the requirements of SSD-5170 and EPL 6538 (see **Figure 5**).

Maintenance and calibration activities were completed on the meteorological station on 7/03/2023, 27/06/2023, 25/08/2023 and 18/12/2023.

6.1.2 Environmental Performance

Wind speed, wind direction, air temperature, relative humidity, solar radiation, rainfall are recorded at the meteorological station. A summary of monthly rainfall, temperatures and wind roses being part of the 2023 meteorological data is included as **Appendix A**.

6.1.3 Further Actions

There are no additional actions planned for 2024 regarding meteorological monitoring.

6.2 NOISE

6.2.1 Environmental Management

BMC manages noise in accordance with the approved NMP, which describes measures for monitoring and managing noise from Bengalla.

Three methods of noise monitoring are utilised at Bengalla being:

- compliance attended noise monitoring;
- supplementary attended monitoring; and
- unattended (real-time) monitoring.

6.2.2 Environmental Performance

Compliance Attended Noise Monitoring

During the Reporting Period, compliance attended monitoring was undertaken by an appropriately qualified acoustic consultant nominally once per calendar month (but at least two weeks apart) during the night period (10 pm to 7 am) at three locations representative of the nearest private residences being AN01, AN03 and AN04 (see **Figure 6**).

The NMP outlines the applicable criterion for each of the three monitoring locations. Bengalla noise was measured at each monitoring location and assessed against the applicable criterion (see **Appendix B**).

Supplementary Attended Monitoring

Supplementary attended monitoring continued to be undertaken during the Reporting Period for night periods. Measurements are recorded by BMC personnel at the same locations as for compliance attended monitoring.

Results from the supplementary attended monitoring are not used to determine compliance.

Unattended (Real-time) Monitoring

BMC operates two continuous, unattended real-time noise monitoring units as a management tool. The locations of the two real-time noise monitoring units are shown on **Figure 6**.

The noise levels recorded at the real-time monitors are not used to determine compliance.

Noise Monitoring Results

Compliance with noise criteria in SSD-5170 was assessed via the compliance attended noise monitoring program. No exceedances of the noise monitoring criteria were recorded during the Reporting Period. A summary of the compliance criteria and compliance attended noise monitoring results for 2022 is provided in **Appendix B**.

Trend over Life of Project

Average noise levels at AN01, AN03 and AN04 during the Reporting Period had generally remained similar to the previous two years and continue to remain within the noise compliance criteria (see **Table 9**).

Table 9: 2021-2023 Noise Trends

Location	Noise Criteria dBA	BMC Only LAeq dBA		
		2023	2022	2021
AN01	35	29.0[1]	30.4[4]	28.6[7]
AN03	40	32.7[2]	IA[5]	36.0[8]
AN04	35	30.8[3]	32.0[6]	32.7[9]

1 Seven readings within meteorological range averaged.
2 Three readings within meteorological range averaged.
3 Seven readings within meteorological range averaged.
4 Seven readings within meteorological range averaged.
5 Seven readings within meteorological range with seven inaudible.
6 Seven readings within metrological range averaged with five readings inaudible.
7 Five readings within meteorological range averaged.
8 One reading within meteorological range with four readings inaudible.
9 Three readings within meteorological range averaged with three readings inaudible.

Comparison to Assessment Predictions

Noise monitoring results recorded during the Reporting Period were generally consistent with the predictions in the Environmental Impact Statement for the Bengalla Continuation of Mining Project (EIS).

Private Residence Mitigation

In accordance with Schedule 3, Condition 3 of SSD-5170, BMC is required to implement reasonable and feasible noise mitigation measures upon receiving a written request from the owner of relevant residences listed in SSD-5170. No such noise mitigation requests were received during the Reporting Period.

6.2.3 Further Actions

BMC will continue to implement the NMP in accordance with SSD-5170. If amendments to the NMP are required, BMC will lodge the revised NMP with relevant regulatory agencies for comment and then with the DPE for approval.

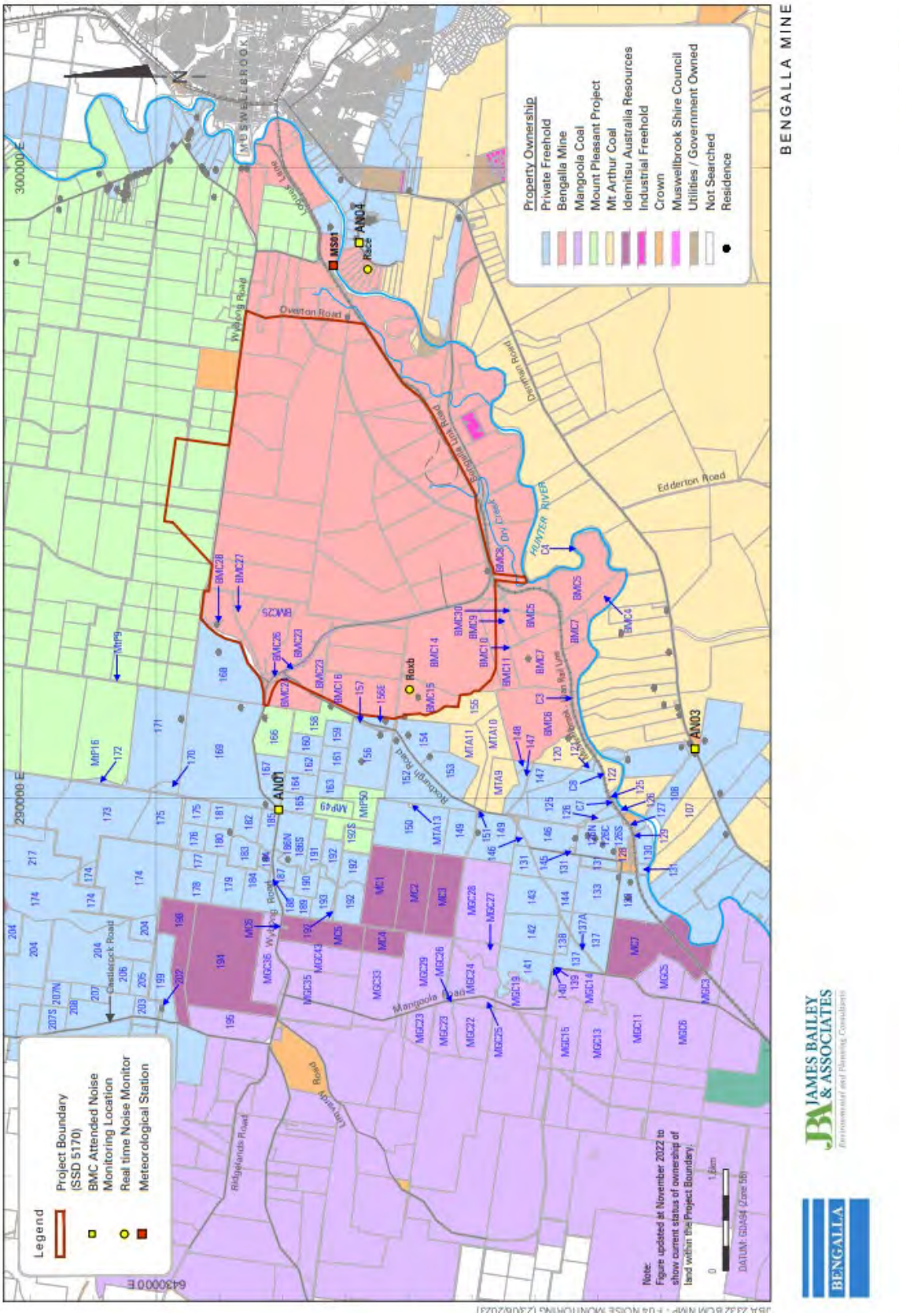

Figure 6: Noise Monitoring Network

6.3 BLASTING

6.3.1 Environmental Management

BMC manages blasting according to the approved BMP, which describes measures for blast monitoring and management at Bengalla. Fume generation is managed in accordance with BMC's Post Blast Fume Generation Mitigation and Management Plan.

6.3.2 Environmental Performance

Blast Monitoring Program

Schedule 3, Condition 10 of SSD-5170 allows a maximum of 2 blasts per day and 6 blasts per week, averaged over a calendar year (except in certain circumstances). A blast refers to a single blast event, which may contain a number of individual blasts.

A total of 175 blast events comprising 169 individual blasts occurred during the Reporting Period with no more than 2 blasts per day and 6 blasts per week when averaged over a calendar year. Blast overpressure and vibration criteria are presented in **Table 10**, with monitoring locations shown on **Figure 7**.

In accordance with the BMP, blast monitoring is now undertaken at 10 blast monitors that record the following data for each blast event:

- Time and date;
- Peak vector sum (mm/s);
- Air overpressure peak (dB Linear Peak); and
- Waveform trace, where applicable.

Assessment of compliance with blast criteria for privately owned residences and public infrastructure is undertaken at one blast monitor located on non-mine owned land being MRE. During 2023, two previous compliance monitors (SCH and BLK) were removed from the blast monitoring network. The SCH monitor was removed on 12 April 2023 and the BLK monitor was removed from the BMP following the approval of Modification 5. (see **Table 10**)**.**

Blast Monitoring Results

A summary of performance against the applicable blasting criteria for the Reporting Period is provided in **Table 11** with monitoring results for locations representative of private receivers included in **Appendix C**. During the Reporting Period, results from the compliance blast monitors in EPL 6538 on non-mine owned land (MRE, SCH and BLK) did not exceed relevant criteria for overpressure or ground vibration.

During 2023, one fume event in relation to blasting was reported to the NSW Environment Protection Authority (EPA).

Trend and Comparison to Assessment Predictions

Table 11 details the 2023 blast performance as compared to 2022 and 2021. A review of blast monitoring measurements over the period 2021 – 2023 indicates that results have remained generally consistent throughout that period.

The EIS predicted that blasting at Bengalla is unlikely to exceed relevant ground vibration and overpressure criteria. The blasting results in **Appendix C** show no exceedances of the blast criteria for compliance monitors.

Table 10: Blast Monitoring Locations and Criteria

Location	Blast Monitoring ID	Criteria	
		Vibration	Overpressure
Private Receivers			
Moore	MRE	10 mm/s and 5% ≥ 5mm/s	120 dB (linear Peak) and 5% ≥ 115dB (linear Peak)
St James School #1	SCH		
Blake #2	BLK		
Mine Owned Historic Heritage Site Monitoring Locations			
Edinglassie Homestead	EGL	10 mm/s	120 dB (linear Peak) and 5% ≥ 115 dB (linear Peak)
Bengalla Homestead	BHS		
ARTC Infrastructure			
Wantana	WAN	100 mm/s	-

#1 – St James School monitor was removed on 12 April 2023.

#2 – Blake monitor was removed as a compliance blast monitor on 23 August 2023

Table 11: Blast Performance Summary 2021-2023

	2023		2022		2021	
Blast Summary	**Number of Blasts**	**% of Blasts**	**Number of Blasts**	**% of Blasts**	**Number of Blasts**	**% of Blasts**
Total blasts	175		172		198	
Average number of blasts per week	3.4		3.2		3.8	
Days with 2 blast events	29	16	25	15	21	10.6
Days with 3 blast events	0	0	0	0	Not reported	
Number of road closures – Wybong Road	45	26	40	23	37	18.7
Number of road closures – Bengalla Road	2	1	0	0	0	0
Number of rail loop closures	0	0	0	0	1	0.5
Number of blast events within Stage Discharge Dam (SDD) Notification Area (1)	0	0	0	0	0	0
Number of blast events within Clean Water Dam 1 (CW1) Notification Area	71	41	60	35	55	27.8
Number of blast events within Mt Pleasant Environmental Dam 3 (ED3) Notification Area (2)	71	41	60	35	55	27.8
Number of blast events within Dirty Water Dam (DW1) Notification Area (4)	2	1	60	35	55	27.8
Exceedances of applicable vibration and overpressure criteria						
• Private Receivers Monitoring Locations Vibration (10 mm/sec)	0	0	0	0	0	0
• Private Receivers Monitoring Locations Vibration (5 % ≥5mm/sec)) (3)	0	0	0	0	1	0.5
• Private Receivers Monitoring Locations Overpressure (120dB)	0	0	0	0	0	0
• Private Receivers Monitoring Locations Overpressure (5% ≥115dB) (3)	1	0.6	5	3	4	2
• Historic Heritage Site Monitoring Locations Vibration (10 mm/sec)	0	0	0	0	0	0

Blast Summary	2023		2022		2021	
	Number of Blasts	% of Blasts	Number of Blasts	% of Blasts	Number of Blasts	% of Blasts
• Historic Heritage Site Monitoring Locations Vibration (5% ≥5 mm/sec))	0	0	0	0	0	0
• Historic Heritage Site Monitoring Locations Overpressure (120 dB)	0	0	0	0	0	0
• Historic Heritage Site Monitoring Locations Overpressure (5% ≥115dB) (3)	0	0	1	1	1	0.5
• ARTC Infrastructure (100 mm/sec)	0	0	0	0	0	0
Blast result capture rate, all non-mine owned monitors	175	100	172	100	198	100
Fume events (≥ Rating 3)	4	2	8	5	5	2.5

(1) SDD was decommissioned in June 2020.

(2) Monitoring of ED3 commenced on 11 March 2020.

(3) The blasting criteria in Schedule 3, Condition 8 of SSD-5170 are 0% allowable exceedance for 120 dB (Lin Peak) overpressure and 10 mm/s ground vibration and 5% allowable exceedance (of the total number of blasts over a period of 12 months) for 115 dB (Lin Peak) overpressure and 5 mm/s ground vibration at any residence on privately owned land.

(4) Monitoring of DW1 commenced on 1 December 2023.

Property Investigation Report

Schedule 3, Condition 12 of SSD-5170 requires a property investigation to be commissioned within 2 months of receiving a claim by the owner of privately-owned land that buildings and/or structures on the land have been damaged as a result of blasting on site.

BMC did not receive a written request for a property investigation from any property owners during 2023.

6.3.3 Further Actions

Any additional blasting actions planned for implementation in 2024 will be in accordance with the BMP and interactions with other mines.

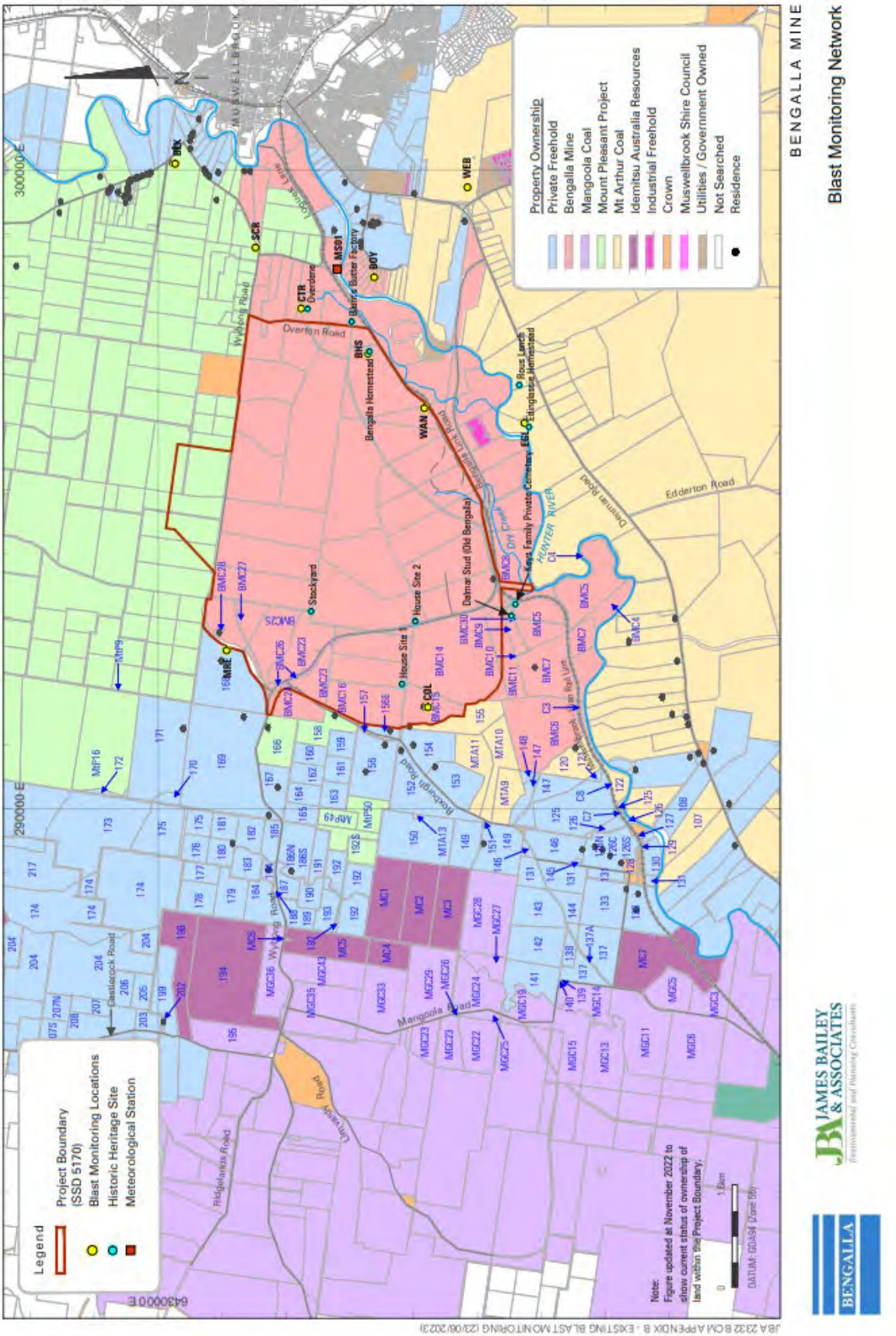

Figure 7: Blast Monitoring Network

6.4 AIR QUALITY

6.4.1 Environmental Management

BMC manages air quality according to the approved AQMP, which sets out procedures for the management of odour, dust and greenhouse gas emissions at Bengalla.

6.4.2 Environmental Performance

Air Quality Monitoring Program

SSD-5170 sets out air quality criteria for Particulate Matter less than 10 microns (PM_{10}), Particulate Matter less than 2.5 microns ($PM_{2.5}$), Total Suspended Particulates (TSP) and deposited dust. Compliance with these criteria is assessed via BMC's air quality monitoring network approved under the AQMP. As described further below, EPL 6538 also requires air quality monitoring for PM_{10} at certain locations.

The Secretary of DPE approved a new AQMP near the end of the 2022 Reporting Period. Upon approval of the new AQMP, redundant monitors in the existing air quality monitoring network were decommissioned or changed status from compliance monitors to real-time monitors (i.e. used as a management tool) in accordance with section 6.2.2 of the AQMP during 2023. The description of air quality management during this Reporting Period is detailed in **Section 6.4.**

This review contained a revised air quality monitoring network consisting of:

- the current meteorological station and inversion tower;
- eight Tapered Element Oscillating Microbalance (TEOMs) (or other suitable monitor) continuously measuring PM10;
- two TEOMs continuously measuring PM2.5;
- five HVAS measuring TSP; and
- five depositional dust gauges.

During the Reporting Period, Bengalla's air quality monitoring network as shown in **Figure 8,** was being modified to meet the new criteria and currently comprises of:

- One meteorological station and an inversion tower.
- Six real-time air quality monitors (four E-Bam monitors and two DustTrak monitors), linked to the Real Time Environment Management System (RTEMS). These monitors are used as a management tool.
- Six High Volume Air Samplers (HVAS) with three measuring TSP and three measuring PM_{10}. One HVAS (PM3) is located on land owned by Hunter Valley Energy Coal Pty Limited, the operator of Mt Arthur Coal (MAC). The HVAS monitors are used to measure compliance against the relevant criteria in SSD-5170 (as modified). Measurements are sampled every six days for a continuous 24-hour period.

- 3 Deposition Dust Gauges were used to measure compliance against the relevant criteria in SSD-5170.

$PM_{2.5}$ is currently monitored through the Upper Hunter Air Quality Monitoring Network – Muswellbrook monitor.

BMC is also required to monitor PM_{10} at EPA22 and EPA24 in accordance with EPL 6538. Monitoring points EPA22 and EPA24 remain in place and are located on the primary wind axis relative to Bengalla.

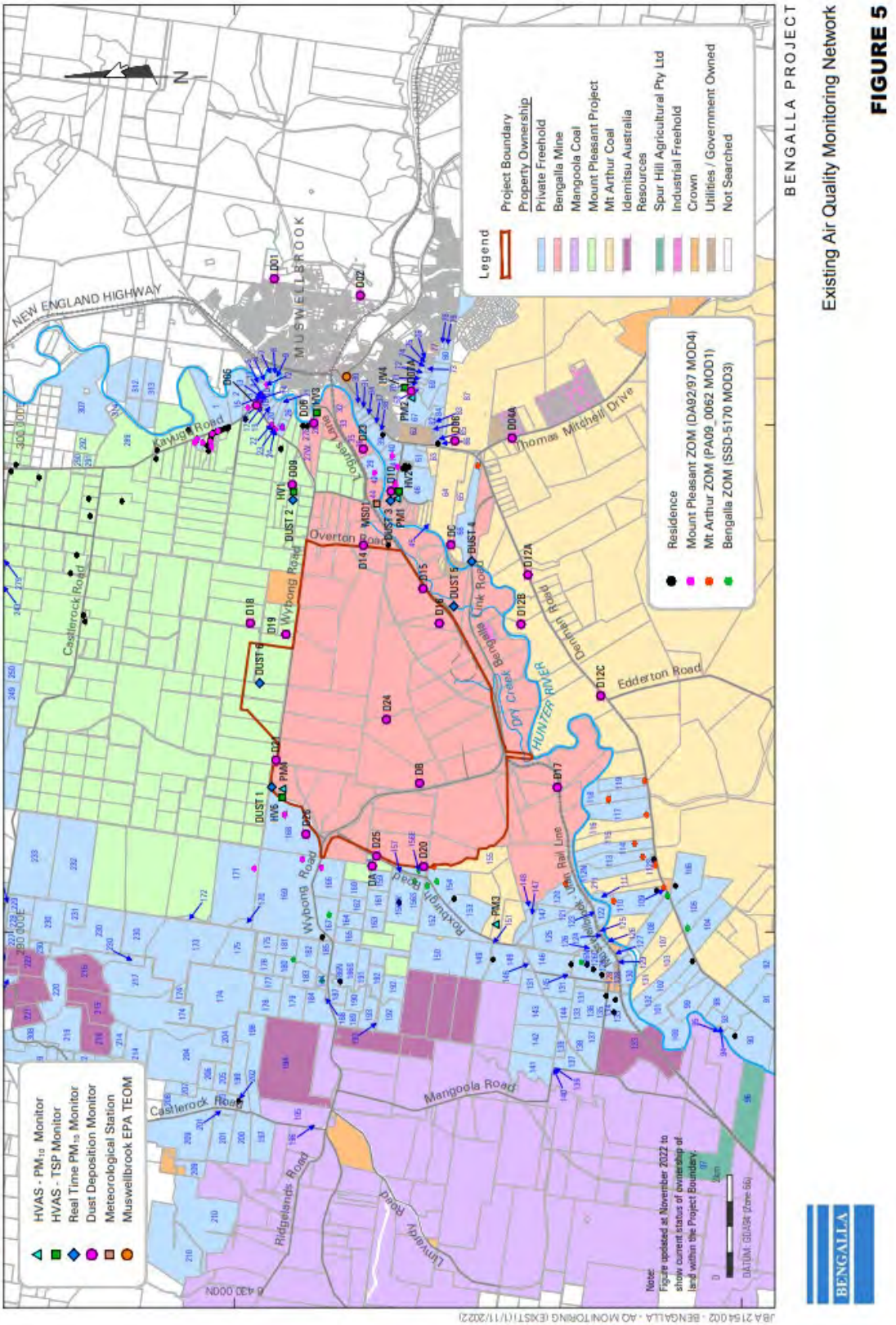

Figure 8: Air Quality Monitoring Locations

Figure source: AQMP (2022)

Air Quality Monitoring Results

There were no exceedances of the annual average air quality criteria for TSP, PM_{10}, $PM_{2.5}$ or deposited dust under Schedule 3, Condition 16 of SSD-5170 for calendar year 2023.

Elevated PM_{10} 24 hour all source measurements were recorded at PM-1 and PM-3 on various dates during the Reporting Period. DPE was notified on each occasion and an air quality expert was engaged to prepare an investigation report. In all cases, the expert concluded that BMC had complied with Schedule 3, Condition 16. Further details about the PM_{10} 24 hour investigation reports are provided in **Section 11.2**.

Detailed air quality monitoring results for 2023 are included in **Appendix D**.

- Deposited Dust

Table 12 details annual average deposited dust monitoring results for the Reporting Period (and for the previous two years). All compliance dust gauges recorded results for 2023 that are compliant with the applicable criteria for annual average total deposited dust (4g/m^2/month). The annual increase in deposited dust levels were 2.0 g/m²/month for D06, 1.5 g/m²/month for D10 and 0.3 g/m²/month for D26 indicating compliance with the maximum annual increase in deposited dust levels (2g/m^2/month).

Table 12: Summary of Deposited Dust Annual Average Monitoring Results

Site	Annual Average Deposited Dust Criteria (g/m²/month)	2023 Annual Average Deposited Dust (g/m²/month)	2022 Annual Average Deposited Dust (g/m²/month)	2021 Annual Average Deposited Dust (g/m²/month)
D06	4.0	3.4	1.4	2.8
D10	4.0	3.1	1.6	2.8
D26	4.0	1.8	1.5	1.4

- TSP

Table 13 details annual average TSP monitoring results for the Reporting Period (and for the previous two years). All TSP compliance monitors recorded results for 2023 that are compliant with the applicable criterion for annual average TSP (90 µg/m³). This criterion excludes extraordinary events, however the occurrence of extraordinary events was not examined for the Reporting Period as the monitoring results were already below 90 µg/m³.

Table 13: Summary of Annual Average TSP Monitoring Results

Site	Annual Average TSP Criteria (µg/m³)	Period	2023 Annual Average TSP (µg/m³)	2022 Annual Average TSP (µg/m³)	2021 Annual Average TSP (µg/m³)
HV2	90	All run days	85.1	48.2	55.3
		Excluding extraordinary events	-	-	-
HV3	90	All run days	51.5	34.5	41.7
		Excluding extraordinary events	-	-	-

- PM_{10}

Table 14 presents PM_{10} annual average monitoring results for the Reporting Period and the previous two years. The cumulative annual average PM_{10} concentration for the Reporting Period was below the annual average criterion (25 µg/m³) at all compliance monitoring sites.

The annual average criteria for PM_{10} excludes extraordinary events. One extraordinary event was experienced on the 18 December 2023 whereby it was examined that BMC contribution was below 25 µg/m³ and consistent with the modelled projections within the BMC EIS.

Table 14: Summary of Annual Average PM_{10} Monitoring Results

Site	Annual Average PM10 Criteria (µg/m³)	Period	2023 Annual Average PM_{10} (µg/m³)	2022 Annual Average PM_{10} (µg/m³)	2021 Annual Average PM_{10} (µg/m³)
PM-1	25	All Run days	28.5*	16.5	20.1
		Excluding extraordinary events		-	-
PM-3	25	All Run days	26.1*	16.0	15.6
		Excluding extraordinary events		-	-

* Value represents monitored results. Further investigation indicated results below criterion as described in Section 11.2

- $PM_{2.5}$

As detailed in the approved AQMP (2023), during the Reporting Period BMC relied upon the Upper Hunter Air Quality Monitoring Network to record and monitor $PM_{2.5}$ concentrations. The monitor utilised by BMC is the Muswellbrook monitor located approximately 5 km east of Bengalla. The cumulative annual average $PM_{2.5}$ concentration for the Reporting Period at the Muswellbrook monitor was 7.5 µg/m³, below the criterion of 8 µg/m³.

The annual average criteria for $PM_{2.5}$ excludes extraordinary events, however the occurrence of extraordinary events was not examined for the Reporting Period as the monitoring results were already below 8 µg/m³.

The trend for $PM_{2.5}$ is increased over the 2023 Reporting Period, mainly attributable to increasingly drier conditions then experienced in recent years.

Trend and Comparison to Assessment Predictions

Table 12, Table 13 and **Table 14** present the annual average air quality monitoring results for deposited dust, TSP and PM_{10} progressively against the respective criteria over the 2021 – 2023 period. The cumulative measurements increased over the 2023 reporting period compared to the preceding years. This can be attributed to a drier than previously experienced reporting periods of 2021 and 2022 and cycle from La Nina to El Nino events.

Private Residence Mitigation

In accordance with Schedule 3, Condition 3 of SSD-5170, BMC is required to implement reasonable and feasible air quality mitigation measures upon receiving a written request from the owner of relevant residences listed in SSD-5170.

BMC did not receive a written mitigation request for implementation of air quality control measures during 2023.

Independent Review

Schedule 4, Condition 4 of SSD-5170 provides for an independent review of impacts from the development on privately-owned land to be carried out where requested by a landowner and agreed to by the Secretary of DPE.

There were no requests made for an independent review of impacts from Bengalla (for air quality or otherwise) during 2023.

6.4.3 Further Actions

BMC will continue the implementation of the revised air quality monitoring network during 2023 (as described in the 2022 AQMP). Until it is fully commissioned and operational, BMC will implement the interim monitoring network described in the 2022 AQMP.

6.5 SPONTANEOUS COMBUSTION

Occurrences of spontaneous combustion are relatively infrequent at Bengalla.

6.5.1 Environmental Management

If spontaneous combustion occurs in the pit, the affected area is capped with inert material where reasonable and feasible to minimise smoke or odour generation. If spontaneous combustion occurs on the Coal Handling Preparation Plant coal stockpiles sprays can be activated and the affected material can be removed and capped where reasonable and feasible.

6.5.2 Environmental Performance

No spontaneous combustion incidents were recorded at Bengalla during the Reporting Period in the mining area however one small instance occurred in the coal stockpiles within the CHPP in January 2023. This was addressed and controlled at the time and no further instances occurred.

6.5.3 Further Actions

There are no additional actions planned for 2024 regarding the management of spontaneous combustion.

6.6 GREENHOUSE GAS

6.6.1 Environmental Management

SSD-5170 requires BMC to implement reasonable and feasible measures to minimise the release of greenhouse gas (GHG) emissions from Bengalla.

BMC contributes to research and development initiatives that investigate GHG minimisation (see **Table 15**).

Table 15: Greenhouse Gas Emission Reduction Research and Development Initiatives

Program	Outcomes
Low Emissions Technology Australia (LETA)	Certain Australian black coal producers contribute a voluntary levy on a quarterly basis to the LETA Fund to support the development of low emission coal technology in Australia.
Australian Coal Association Research Programme (ACARP)	Certain Australian black coal producers contribute five cents per tonne of product coal to fund research and the development of technologies that lead to the safe, sustainable production and utilisation of coal.

6.6.2 Environmental Performance

At the end of each Financial Year (FY) BMC reports on the emissions of certain substances to the National Pollutant Inventory (NPI). GHG emissions, energy consumption and production data are also reported under the National Greenhouse and Energy Reporting (NGER) Scheme requirements. The *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* Cth (Safeguard Mechanism) also applies to emissions at Bengalla.

National Pollutant Inventory

For the 2022 – 2023 FY reporting period BMC reported on 28 of the 31 reportable substances.

National Greenhouse and Energy Reporting

During the 2022 – 2023 FY reporting period Bengalla reported total emissions of 628,795 t Carbon Dioxide Equivalent (CO_2-e) (Scope 1 and Scope 2).

The results for FYs 2021 – 2023 are presented in **Table 16** and **Table 17**.

Table 16: Energy Consumed and Produced FY 2021 to 2023

Energy	FY 2022-2023	FY 2021-2022	FY 2020-2021
Consumed Gigajoule (GJ)	2,870,837	2,636,980	2,808,053
Produced (GJ)	241,384,833	259,316,316	260,612,775

Table 17: GHG Emissions FY 2021 to 2023

Greenhouse Gas Emissions	FY 2022-2023	FY 2021-2022	FY 2020-2021
Scope 1 (t CO_2-e)	573,941	725,774	449,399
Scope 2 (t CO_2-e)	54,854	61,521	53,694
Total (t CO_2-e)	**628,795**	**787,295**	**503,093**

GHG Emissions for Calendar Years 2021-2023 and Comparison to Predictions

Annual GHG emissions (Scope 1 and Scope 2) for calendar years 2021, 2022 and 2023 are presented in **Table 18,** with a comparison against the predictions in the *Air Quality and Greenhouse Gas Impact Assessment Continuation of Bengalla Mine* (AQIA) being Appendix G to the EIS. The method used to calculate Scope 1 and Scope 2 emissions is the method that was used in the EIS.

Overall, the annual Scope 1 and Scope 2 GHG emissions estimated for the 2021, 2022 and 2023 calendar years are generally lower than the AQIA predictions for Years 4 to 13 primarily due to reduced materials movement compared to the EIS.

Table 18: Summary of Scope 1 and Scope 2 GHG Emissions (CO2-e t/yr)

Year	Fugitive Emissions	Diesel Fuel	Electricity	Explosives	Total
	Scope 1	Scope 1	Scope 2	Scope 1	Scope 1 + 2
AQIA Years 4 to 13	486,000	212,291	82,885	4,317	785,493
2021	416,909	163,903	69,515	5,375	655,703
2022	347,409	161,082	64,662	5,201	578,354
2023	387,067	195,672	66,667	6,634	656,010

NOTES

1. *AQIA Years 4 to 13 means for each of Years 4 to 13 of the Project (Bengalla).*
2. *As required, Table 18 calculates actual greenhouse gas emissions using the same methodology for calculating estimated emissions in the AQIA. This methodology is different to that required for reporting under the NGER Scheme and Safeguard Mechanism.*

Reasonable and feasible steps undertaken during the Reporting Period to improve energy efficiency and reduce greenhouse gas emissions generated by the mine

BMC has continued to undertake activities to reduce greenhouse gas emissions from Bengalla being:

- Use of fuel efficient machinery, electric motors and energy efficient lighting systems.

- Efficient fuel use by optimising mine design, for example, haul road distances and optimisation of resource extraction.

6.6.3 Further Actions

BMC will review its emissions against its Production Adjusted and determine next steps as required by the revised Safeguard Mechanism.

6.7 NON-MINERAL WASTE

6.7.1 Environmental Management

Non-mineral waste generated at Bengalla during 2023 was 2,775t. A total of 2,226t was recycled, representing 80% of the total waste. These figures generally increased from 2022 and 2021. **Table 19** details non-mineral waste tonnes for the period 2020 to 2022.

Table 19: Non-mineral Waste Management

	2023	2022	2021
Total (t)	2,775	1,916	1,827
Recycled (t)	2,226	1,474	1,422

6.7.2 Environmental Performance

A total of 2,775t of non-mineral waste was disposed of in 2023 being predominantly scrap metal, oil and general waste.

The major waste streams recycled at Bengalla in 2023 were 582t waste oil, 22t grease, 19t batteries, 26t oil filters, 15t coolant, 1,392t scrap metal and 120t timber.

1,852t of effluent from field crib facilities was disposed of through Bengalla's waste water treatment plant.

Some filters and batteries are also recycled where possible, however are not returned to Bengalla.

Comparison to Assessment Predictions and Trends

The EIS Volume 1 **Table** 84 contains predictions for waste streams. Relative to the two major waste streams:

- the waste oil volume of 582t is slightly above the EIS prediction of 526t; and
- the scrap metal volume of 1,392t is slightly below the EIS prediction of 1902t.

6.7.3 Further Actions

There are no additional actions planned for 2024 regarding the management of non-mineral waste. Normal waste management practice will continue.

6.8 MINERAL WASTE

6.8.1 Environmental Management

Management of mineral waste at Bengalla in 2023 was undertaken in accordance with the BMC Acid Rock Drainage (ARD) and Mineral Waste Management Plan.

6.8.2 Environmental Performance

In accordance with the BMC ARD and Mineral Waste Management Plan, BMC maintains a mineral waste inventory of the volumes of inert and potentially acid forming waste disposed of on site and the disposal locations.

The volumes of total mineral waste generated and stored at Bengalla in 2023 (and the previous calendar year) are summarised in **Table 8**.

Comparisons to Assessment Predictions and Trends

The trends for waste rock are influenced by operational decisions. It is anticipated that increased volumes will occur for 2024 relative to 2023.

The EIS predicted at Year 8 overburden removal of 55 Million Bank Cubic Meters[1].

The waste rock/overburden volume referenced in **Table 8** for 2023 was above the EIS prediction.

6.8.3 Further Actions

There are no additional actions other than normal practices planned for 2024 regarding the management of mineral waste.

[1] *Bengalla EIS Volume 1, Table 10.*

6.9 ABORIGINAL ARCHAEOLOGY AND CULTURAL HERITAGE

6.9.1 Environmental Management

The management of Aboriginal archaeology and cultural heritage at Bengalla is undertaken in accordance with the approved Aboriginal Cultural Heritage Management Plan (ACHMP).

6.9.2 Environmental Performance

All relevant Aboriginal heritage artefacts within the Bengalla Disturbance Boundary were salvaged in 2016.

Activities involving ground disturbance in 2023 were subject to desktop assessment for potential impacts to Aboriginal archaeology as part of Bengalla's Ground Disturbance Permit (GDP) process.

During the Reporting Period, no additional Aboriginal artefacts were discovered within the Bengalla Project Boundary.

Previously identified Aboriginal sites located in ML 1728 and EL 9431 were inspected and some perimeter fences were repaired.

6.9.3 Further Actions

Should any amendments to the ACHMP be required, BMC will lodge the revised plan with the relevant regulatory agencies and stakeholders for comment and then for approval by DPE.

6.10 NON-ABORIGINAL HERITAGE

6.10.1 Environmental Management

BMC has developed and implements the approved Historic Heritage Management Plan (HHMP), which describes the requirements for ongoing management and conservation of the existing non-Aboriginal heritage sites identified in the EIS. Four sites are located within the Project Boundary and five are located adjacent to the Project Boundary. Photos of the sites are presented in **Appendix J**.

6.10.2 Environmental Performance

Annual inspections are undertaken at each site. Annual dilapidation surveys and structural assessments were conducted at the two most significant heritage sites, Bengalla Homestead and Overdene Homestead. These were conducted on 7 November 2023. The results of the inspections and surveys are summarised below.

Bengalla Homestead

The 2023 dilapidation survey of Bengalla Homestead and associated buildings concluded that there appeared to be no further major degradation since the 2022 survey.

Following our 2023 inspection of Bengalla Homestead and associated buildings there appears to be no further major degradation from the 2018 to2023 inspection.

Externally, the condition of the homestead and service wing remained stable, and the building is generally in good repair. Minor cracks were observed in the wall plaster and the ceiling in both the main building and the service wing at isolated locations.

Full renovation of the interior of the cottage services building has been undertaken and externally the building is generally in a good state of repair.

Full renovation of the interior of the book keepers cottage has been undertaken and externally the building is generally in a good state of repair.

The garden shed was in a good state of repair and has not deteriorated since the previous inspection.

The condition of the other remaining structures are consistent with previous inspections including the tool shed, and steel water tower.

All buildings and their repair work should continue to be monitored for any signs of cracks caused by foundation movement or mine workings nearby. Regular inspections should be carried out to ensure there is no termite activity in the vicinity of the buildings.

Overdene Homestead

The 2023 dilapidation survey of Overdene Homestead concluded that there appeared to be no further major degradation since the 2022 inspection.

The works carried out in the previous years have been successful. The replacement of the roof sheeting and diversion of stormwater away from the building and the previous restoration of the sandstone and brickwork has stabilised the deterioration.

The remaining outstanding items for the external part of the building included the replacement of missing pipe props from the tie rod ends to assist in continually stabilising the structure. The verandah flooring and roof framing, sheeting and flashings still require reinstatement.

Internally, the condition of the cottage appeared to be stable. Installation of a new floor system, restoration of all windows, doors and internal walls was still outstanding. The external downpipe next to entry door is dislodged and the water is seeping into the soil and moistening the foundation soil and progressing internally.

A summary of the 2023 maintenance and preservation works completed by BMC at the Bengalla and Overdene Homesteads is presented in **Table 20**.

Appendix J contains photos from the 2023 inspections at Bengalla and Overdene Homesteads.

Keys Family Private Cemetery

An annual inspection was undertaken on the Keys Family Private cemetery in May and December 2023. The cemetery was in good condition with headstones remaining in good condition with no evidence of vandalism or deterioration. New perimeter fencing was constructed in 2023.

The Key's family added another headstone to the cemetery in 2023.

Stockyards

An annual inspection was undertaken of the Stockyards in December 2023. The area was in good repair with a maintenance program being implemented for ongoing ground maintenance. The stockyards remain in good condition.

Old Bengalla

An annual inspection was undertaken of Old Bengalla in December 2023. The existing sandstone wall remains in good condition. The area remains fenced and signage still present.

House Site 1

An annual inspection was undertaken of House Site 1 in May 2023. The site was fenced and signage erected. This remains within Appendix J for this reporting period.

This site is now located within a new Mining Lease ML1829, which was granted to MACH Energy Australia Pty Ltd in 2023.

House Site 2

An annual inspection was undertaken of House Site 2 in December 2023. The site remained fenced and signage erected. No further work was required.

Blunts Butter Factory

An annual inspection was undertaken of Blunts Butter Factory in December 2023. Fencing around the site remained in good condition. Signage was erected. No further works were required.

Table 20: Medium Term Maintenance of the Bengalla and Overdene Homesteads 2023

Reference	Maintenance	Response	Status
OVERDENE HOMESTEAD			
HHMP Appendix D, Section 6.5	Repair internal render all rooms	Being quoted to repair in 2024	Upcoming
HHMP Appendix D, Section 6.5	Repair remaining damage caused by termites (i.e. that determined not to be integral to structural integrity).	Bait station system installed around house and maintained as per termite management plan Damage is being quoted to repair in 2024	Ongoing
HHMP Appendix D, Section 6.5	Reinstate verandah.	Restoration is being designed and planned 2024	Upcoming
HHMP Appendix D, Section 6.5	Reinstate veranda flooring, including repair of sandstone dwarf wall supporting veranda joists and eastern veranda slab.	Restoration is being designed and planned 2024	Upcoming
HHMP Appendix D, Section 6.5	Restore or replace woodwork around external openings and paint.	Restoration is being designed and planned 2024	Upcoming
HHMP Appendix D, Section 6.5	Replace steel vent grate or block from under Door 7.	This was carried out in 2018 repair works	Completed
HHMP Appendix D, Section 6.5	Replace floor boards with like for like.	Restoration is being designed and planned 2024	Upcoming
HHMP Appendix D, Section 6.5	Replace ceiling boards with like for like.	Restoration is being designed and planned 2024	Upcoming
HHMP Appendix D, Section 6.5	Repair remaining cracks in brick and stonework (D7).	This was carried out in 2018 repair works	Completed

HHMP Appendix D, Section 6.5	External - Raked cracking in mortar about sandstone lintels above doorways D1, D3 and D5, and Doorway D7 with erosion of sandstone blocks - Eastern chimney: brickwork collapsed - Steel vent under W3 dislodged	This was carried out in 2018 repair works	Completed
HHMP Appendix D, Section 6.5	Internal - Room R1 – large amount of cracking to render in walls, worst above fireplace - Room R2 – render cracking adjacent fireplace, doors D1 and D2 to ceiling and corners of room - Room R3 – cracks at W3, previous termite damage, concrete hearth dropped further since last inspection (2014) to 40 mm, crack in brickwork of northern wall at 15 mm, doorway cracking at D12, ceiling loose at D6 and above fireplace - Room R4 – old water damage, cracking at W2 and separation of ceiling, some mortar fallen down - Room R5 – cracking of render, loose in various areas, south-western corner full height of wall with separating at the corner, and above window W1; and mortar missing in bottom 3 courses - Hallway – extensive cracking to render in walls, and at #8 and D9, render at D3 and D9 leaning out and should be removed, erosion of mortar with cracks above D12 and skirting board at D7	Restoration is being designed and planned 2024	Upcoming
BENGALLA HOMESTEAD			
HHMP Appendix C, Section 7.4	**Building 1** – Homestead and Service Wing		
HHMP Appendix C, Section 7.4	Maintain Homestead to ensure stability and prevent further damage to all features	All works carried out in 2019	Completed

HHMP Appendix C, Section 7.4	Remediate external faults to service wing including, but not limited to the following: - Repoint/repair mortar in lower courses of brickwork to northern face of service wing. - Repoint/repair mortar between Window 19 and Door 30; - Fix gap on northern side of Window 18 between window frame and brickwork; - Loss of mortar and brickwork to single lead brick projections on eastern side; - Damaged air vent grate on eastern elevation; - Loose mortar joints above Window 17; - Address D30 frame deterioration; - Replace missing brickwork on high window on the southern side of service wing; - Minor cracking to brickwork in various locations; and - Remove earthen bund from western wall adjacent to Window 7 as this is preventing water drainage and has caused damage to the plinth. Fix damage to plinth.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Investigate the cause of separation, splitting and warping of ceiling planks in Rooms 3 and 4. Repair or replace, if necessary, ceiling planks	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate external damage caused by footing defects, including, but not limited to the following: - Cracking above Door 14; - Cracking above Window 10; - Cracking above Window 7; - Cracking above and below Window 17.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 1, including, but not limited to the following: - Repair cracking in brickwork where exposed by missing plaster; - Repair plaster missing or removed; - Reinstate/replace tiles in fireplace; and - Repair crack in metal plinth.	All works carried out in 2019	Completed

HHMP Appendix C, Section 7.4	Remediate internal damage to Room 2, including, but not limited to the following: - Cracking in render above archway between Rooms 2 and 3; - Cracking in render above Door 4 and above and below W3; - Cracking in render in southern wall; and - Cracking in brickwork where exposed by removed plaster	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 3, including, but not limited to the following: - Cracking in render above Door 3; - Cracked brickwork in south eastern corner; - Cracking below Window 2.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 4, including, but not limited to the following: - Render on southern side of Window 1; - Refix skirting board; and - Cracking between ceiling cornice and western wall.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 5, including, but not limited to the following: - Cracking in render above Doors 2,3,4,5,7 and 8; - Cracking of archway and cracking of ceiling between archway and ceiling; - Cracking between Doors 7 and 8; and - Cracking around air vent	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 7, including, but not limited to the following: - Cracking below Window 12; and - Cracking above and adjacent to Door 10.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 9, including, but not limited to the following:	All works carried out in 2019	Completed

	- Cracking above Door 9		
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 25, including, but not limited to the following: - Active moisture erosion of brick work, possibly rising damp; - Mortar loss to southern wall; and - Loose brickwork below Window 18.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 26, including, but not limited to the following: - Cracks in brickwork above Door 33 and 34; - Ceiling vent dropped; and - Cracking above Window 14, Window 20 and below 14.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 27, including, but not limited to the following: - Cracks in brickwork on southern and eastern walls; - Loss of mortar in western wall, investigate active moisture erosion and possible rising damp; - Replace missing brick adjacent to Door 28; and - Repair/replace damp floor boards, if not already remediated as part of rising damp assessment.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 28, including, but not limited to the following: - Thinning mortar on western wall; - Missing brickwork adjacent to Door 33; - Cracking in brickwork above Doors 32 and 33; - Investigate cause and remediate of concrete floor crack; - Cracking above Window 15.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 29, including, but not limited to the following: - Cracking above Doors 31 and 32 and western wall; - Replace missing doorframe; and	All works carried out in 2019	Completed

	- Cracking in brickwork above and below Window 16.		
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 30, including, but not limited to the following: - Cracking above Door 31 and extending to western wall; - Cracking above Window 17 and 18; - Replace removed skirting boards; - Termite damage in northern wall and Door 31 woodwork, if not already remediated.	All works carried out in 2019	Completed
HHMP Appendix C, Section 7.4	**Building 2 – 1960 addition** Remove if this addition is impacting on integrity of the 1895 section of the Homestead, with due care that potential archaeological deposits relating to an earlier timber structure are not impacted or are archaeologically investigated	Garage maintained and refurbished for storage and toilet amenities	Completed
HHMP Appendix C, Section 7.4	**Building 3 – Underground cistern** Maintain as required to ensure cistern does not deteriorate	Maintained as per maintenance schedule	Ongoing
HHMP Appendix C, Section 7.4	**Building 4 – Garden Lodge** The Garden Lodge has been assessed as being unsafe and is recommended for removal (Archaeology Australia, 2009)	Restored to original condition 2019	Completed
HHMP Appendix C, Section 7.4	**Building 5 – Toilet/Shower** Undertake required maintenance to ensure long-term stability of building	Repointed and roofed to maintain building integrity	Completed
HHMP Appendix C, Section 7.4	**Building 6 - Gazebo** Undertake on-going maintenance	Repointed and roofed to maintain building integrity	Completed
HHMP Appendix C, Section 7.4	**Building 7 – Laundry** The current structure has been archivally recorded and is earmarked for demolition due to termite damage (Archaeology Australia, 2009)	Restored to original condition 2019	Completed

HHMP Appendix C, Section 7.4	**Building 8 – Book-keeper's Cottage** Maintain Book-keeper's Cottage to ensure stability and prevent further damage to all features	Restored and improved to liveable condition 2022	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 6, including, but not limited to the following: - termite damage to northern walls; - loss of mortar to fireplace brickwork; - ceiling collapse in south-west corner; and - remove wallpaper, using non damaging techniques, if impacting on the integrity of the walls.	Restored and improved to liveable condition 2022	Completed
HHMP Appendix C, Section 7.4	Remediate internal damage to Room 7, including, but not limited to the following: - buckling of ceiling lining.	Restored and improved to liveable condition 2022	Completed
HHMP Appendix C, Section 7.4	**Building 9 – Tennis Court** Maintain in current condition	Maintained as per maintenance schedule	Ongoing
HHMP Appendix C, Section 7.4	**Building 10 – Water-tower** The water tower has been slated for removal (Archaeology Australia, 2009)	Fell over in 2018 storm and was removed because of safety concerns	Completed
HHMP Appendix C, Section 7.4	**Building 11 – Machinery shed** Undertake on-going maintenance.	Maintained as per maintenance schedule	Ongoing
HHMP Appendix C, Section 7.4	**Building 12 – Modern Water-Tower** Undertake on-going maintenance.	Maintained as per maintenance schedule	Ongoing
HHMP Appendix C, Section 7.4	**Building 13 – Stockyards** Maintain in current condition	Maintained as per maintenance schedule	Ongoing
HHMP Appendix C, Section 7.4	**Building 14 – Stables (archaeological site)**	Removed in 2022 because of safety concerns	Completed

	No works required. Ensure the area is not impacted by works – fence if necessary.		
HHMP Appendix C, Section 7.4	**Building 15 – Hay-shed** The hay-shed has been earmarked for removal and an archival recording has been completed (Archaeology Australia, 2009)	Removed in 2022 because of safety concerns	Completed
HHMP Appendix C, Section 7.4	**Building 16 – Shed and Yard** The shed has been earmarked for removal and an archival recording has been completed (Archaeology Australia, 2009).	Removed in 2022 because of safety concerns	Completed

6.10.3 Further Actions

Should any amendments to the HHMP be required, BMC will lodge the revised HHMP with relevant regulatory agencies for comment and then with DPHI for approval.

BMC will continue to implement the program of inspections, maintenance and preservation works as identified by the HHMP in the next Reporting Period.

6.11 BIODIVERSITY

6.11.1 Environmental Management

SSD-5170 and EPBC Approval 2012/6378 (the EPBC Approval) require BMC to manage biodiversity at Bengalla and its Biodiversity Offset Areas (BOAs).

Appendix E includes an annual compliance report for 2023 against the conditions of EPBC Approval 2012/6378 (EPBC Compliance Report).

During the Reporting Period, there were two non-compliance with EPBC Approval conditions reported to DCCEEW. The first related to Condition 3 (which relates to the use of part of Kenalea in a manner that is inconsistent with the approved Biodiversity Offset Management Plan (BOMP) by a tenant of the property for cattle grazing and horses (in breach of the Residential Tenancy Agreement (RTA) between BMC and the tenant). As a result of this non-compliance the tenancy agreement was cancelled and all stock were removed from the offset.

A report was submitted to DECCEW on 4/9/2023 outlining inconsistencies with the BMC Biodiversity Offset Management Plan and outlining recommendations to be implemented.

The second related to Condition 4 (provision of long-term security for offset properties). Refer to **Appendix E** for details regarding the continued dialogue on this matter. **Section 1.1** and **Section 11** further details compliance matters associated with EPBC 2012/6378.

6.11.2 Environmental Performance

Onsite Biodiversity Management and Mitigation

Biodiversity management at Bengalla is undertaken in accordance with the approved Biodiversity Management Plan (BDMP).

The EPBC Compliance Report contains a summary of commitments from the BDMP against activities undertaken during the Reporting Period. There were no non-compliances with these commitments.

The management, monitoring and performance of rehabilitation at Bengalla during the Reporting Period is described in **Section 8**.

During 2022, the presence of an isolated Cymbidium canaliculatum (species of Tiger Orchid) was identified during Stage 1 pre-clearing surveys. During late 2023, the relocation of this orchid was in preparation to occur in early 2024.

Offsite Biodiversity Management and Mitigation

Biodiversity management at the offset properties is undertaken in accordance with the approved Biodiversity Offset Management Plan (BOMP).

The EPBC Compliance Report includes a summary of commitments from the BOMP against activities undertaken during the Reporting Period. There were no non-compliances with these commitments.

BMC manages approximately 6,215 ha of offset land. There are three distinct BOAs being Kenalea, Black Mountain and Merriwa River. The location of the BOAs in relation to Bengalla is illustrated on **Figure 9.**

During the Reporting Period, BMC undertook management programs on the BOAs including but not limited to:

- weed inspections and weed spraying;
- dog baiting and trapping;
- feral pig management;
- hazard reduction burns across all BOAs;
- fire trail maintenance in all BOAs; and
- summer and winter ecological surveys.

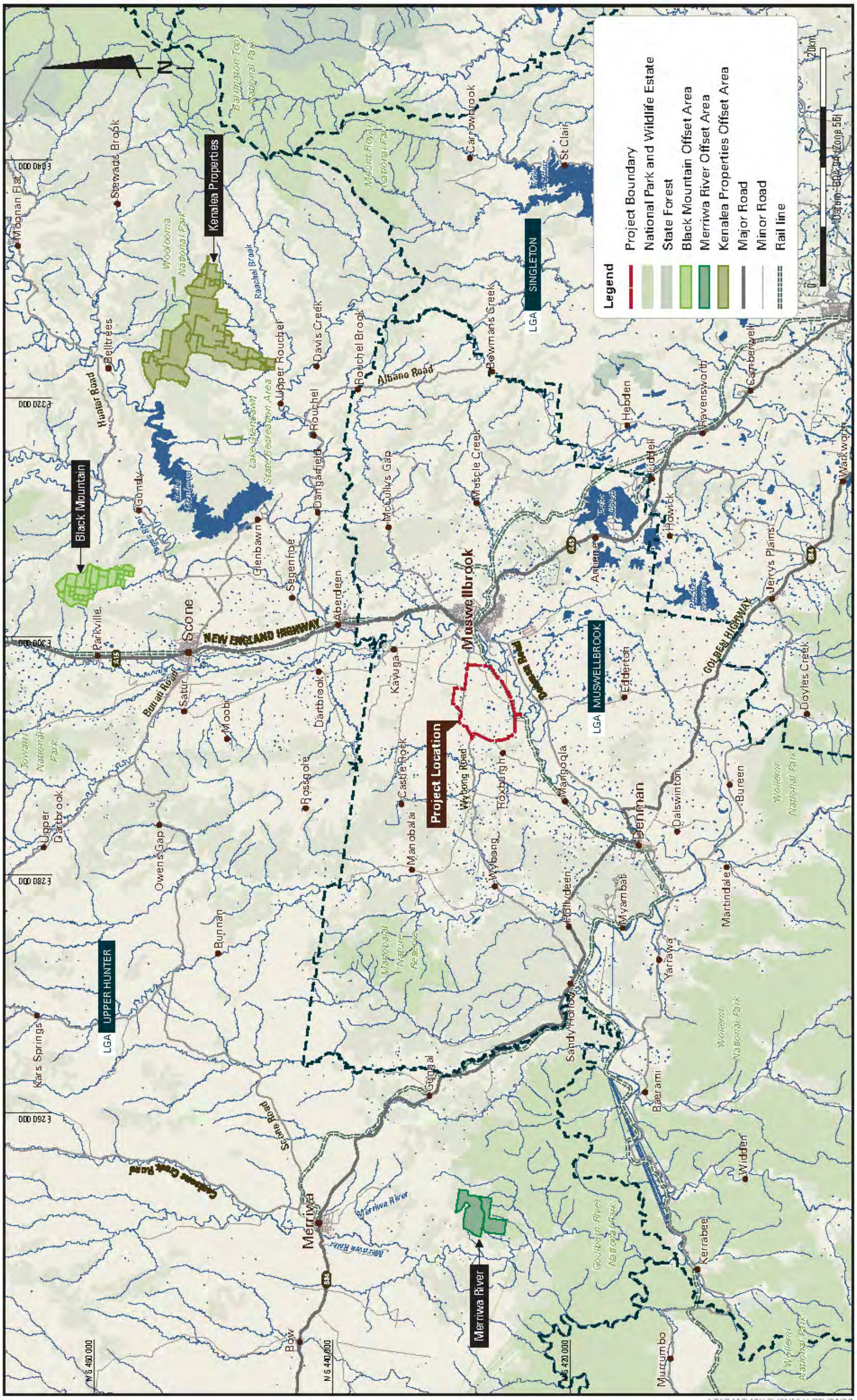

Figure 9: Biodiversity Offset Areas

Biodiversity Offset Area Ecological Surveys

A total of 28 permanent flora monitoring sites were surveyed. A suite of additional surveys by a suitably qualified expert were undertaken, including bird census, terrestrial infra-red (IR) camera surveys for the Spotted-tailed Quoll and feral animals, arboreal IR camera surveys for the Squirrel Glider, ultrasonic bat detection and opportunistic observations.

The BOMP contains measurable indicators and completion criteria for Years 5, 10 and 20 of the Project. **Table 21** compares the measurable indicators and performance criteria for Year 10 against the results of Year 7 (2023) annual monitoring.

Table 21: Assessment Against Performance Criteria

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
Vegetation Management Zones		
Zone 1 - Existing Forest and Woodland (Maintain condition of vegetation within benchmark)		
Total native species richness (NPS)	Maintenance or increase in native species richness	Nine (9) of 19 monitoring sites recorded an equal or greater native plant species richness compared to baseline. Of the ten sites where native species richness was below baseline numbers, none are below benchmark values.
% Native over-store cover (NOS)	Increase to at least 20% of lower benchmark	Five (5) of 19 monitoring sites recorded an equal or greater native over storey cover compared to baseline. Of the 14 sites where native over storey was below baseline numbers, two (2) were below benchmark values.
% Native mid-storey cover (NMS)	Increase to at least 20% of lower benchmark	Eleven (11) of 19 monitoring sites recorded an equal or greater native mid-storey cover compared to baseline. Of the eight monitoring sites below benchmark values, all were also below benchmark values.
% Native ground cover (grasses) (NGCG)	Maintenance of cover above lower benchmark	Five (5) of 19 monitoring sites recorded an equal or greater native ground cover (grasses) compared to baseline. Of the 14 sites where native ground cover (grasses) was below baseline, none were below benchmark values.
% Native ground cover (shrubs) (NGCS)	Increase to at least lower benchmark	Seven (7) of 19 monitoring sites recorded an equal or greater native ground cover (shrubs) compared to baseline. Of the twelve sites where native ground cover (shrubs) was below baseline numbers, four are also below benchmark values.
% Native ground cover (other natives) (NGCO)	Maintenance of current cover above lower benchmark	Eight (8) of 19 monitoring sites recorded an equal or greater native ground cover (other natives) compared to baseline. All 19 monitoring sites are above lower benchmark for native ground cover (other natives).
% Exotic plant cover	Weed cover not increased above baseline	Twelve (12) of 19 monitoring sites recorded an equal or lower exotic plant cover compared to baseline.
% overstorey regeneration (OR)	100%	Nine (9) of 19 monitoring sites have 100% regeneration of all canopy species present, and 15 of

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
		19 monitoring sites have the same or higher levels of regeneration compared to baseline.
Number of trees with hollows (NTH)	Maintenance of number of trees with hollows	Sixteen (16) of 19 monitoring sites recorded an equal or greater number of trees with hollows compared to baseline.
Total length (m) of fallen logs (FL)	Maintenance of length (m) of fallen logs	Twelve (12) of 19 monitoring sites recorded an equal or greater length of fallen logs compared to baseline.
Zone 2 - Derived Native Grasslands (Maintain and improve through assisted natural regeneration. Aim to increase to benchmark condition)		
Total native species richness (NPS)	Increase to at least 80% of lower benchmark.	One (1) of six monitoring sites recorded native species richness at least 80% of lower benchmark.
% Native over-storey cover (NOS)	Increase to at least 20% of lower benchmark	Native over-storey cover absent from monitoring sites.
% Native mid-storey cover (NMS)	Increase to at least 80% of lower benchmark.	Native mid-storey cover absent from monitoring sites.
% Native ground cover (grasses) (NGCG)	Maintenance of cover within benchmark range.	All six monitoring sites are within benchmark range for native ground cover (grasses), and five of the six also exceed the upper benchmark.
% Native ground cover (shrubs) (NGCS)	Increase to at least 80% of lower benchmark.	One (1) of six monitoring sites with native ground cover (shrubs) at least 80% of lower benchmark.
% Native ground cover (other natives) (NGCO)	Increase to at least 80% of lower benchmark.	Four (4) of six monitoring sites with native ground cover (other natives) at least 80% of lower benchmark.
% Exotic plant cover	50% reduction in baseline EPC value	Five (5) of six monitoring sites recorded an equal or decreased weed cover compared to baseline, and these five monitoring sites also recorded a 50% reduction in EPC compared to baseline.
% overstorey regeneration (OR)	Increase to 50%	Overstorey regeneration occurring in two of six monitoring sites for the first time.
Number of trees with hollows (NTH)	No change expected in 10 years. Maintenance of trees with hollows and increase in trees that can eventually produce hollows	No significant change observed. No trees with hollows recorded during baseline or in year seven (2023) monitoring.
Total length (m) of fallen logs (FL)	Maintenance or increase in length (m) of fallen logs	Four (4) of six monitoring sites recorded a greater or equal length of fallen logs compared to baseline.
Zone 3 – Riparian (Rebuild/improve riparian corridors; protect waterways. Aim to increase to benchmark condition)		
Total native species richness (NPS)	Increase to at least 80% of lower benchmark	All three monitoring sites below 80% of lower benchmark for native species richness.

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
% Native over-storey cover (NOS)	Increase to at least 20% of lower benchmark	All three monitoring sites at least 20% of lower benchmark range for native overstorey cover.
% Native mid-storey cover (NMS)	Increase to at least 80% of lower benchmark	None of the three monitoring sites at least 80% of lower benchmark for native mid-storey cover. All three monitoring sites maintained native mid-storey cover compared to baseline.
% Native ground cover (grasses) (NGCG)	Increase to at least 80% of lower benchmark	All monitoring sites at least 80% of lower benchmark for native ground cover (grasses).
% Native ground cover (shrubs) (NGCS)	Increase to at least 80% of lower benchmark	Two (2) of three monitoring sites at least 80% of lower benchmark for native ground cover (shrubs).
% Native ground cover (other natives) (NGCO)	Increase to at least 80% of lower benchmark	Two (2) of three monitoring sites at least 80% of lower benchmark for native ground cover (other natives).
% Exotic plant cover	50% reduction in baseline EPC value	Three (3) of three monitoring sites recorded a 50% reduction in EPC compared to baseline. Two (2) of three monitoring sites decreased weed cover compared to baseline.
% overstorey regeneration (OR)	Increase to 50%	Two (2) of three monitoring sites recorded at least 50% overstorey regeneration.
Number of trees with hollows (NTH)	No change expected in 10 years. Maintenance of trees with hollows, and increase in trees that can eventually produce hollows	All three of three monitoring sites maintained or increased number of trees with hollows and all are above benchmark values.
Total length (m) of fallen logs (FL)	Maintenance or increase in length (m) of fallen logs	All three monitoring sites recorded an equal or increased total length of fallen logs compared to baseline.
Box Gum Woodland and Derived Native Grassland		
Box Gum Woodland		
Increase in site condition value	Native over-storey cover to increase to at least 20% of lower benchmark	All monitoring sites recorded native over-storey cover of at least 20% of lower benchmark.
	Native mid-storey cover to increase to at least 20% of lower benchmark	Four (4) of 14 monitoring sites recorded native mid-storey cover of at least 20% of lower benchmark.
	Native ground cover (shrubs) to increase to at least lower benchmark	Nine (9) of 14 monitoring sites recorded native ground cover (shrubs) meeting lower benchmark.
Increase in site context value	Connectivity within biodiversity offset areas increased as a result of management activities	No significant change observed. Changes expected over a longer timeframe.

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
	Increased security of biodiversity offset areas through formal conservation arrangement	Refer to comments at Section 1.1 and Section 11.
Derived Native Grassland		
Increase in site condition value	Native species richness to increase to at least 80% of lower benchmark.	One (1) of six monitoring sites with native species richness at least 80% of lower benchmark.
	Native over-storey cover to increase to at least 20% of lower benchmark	Native over-storey cover absent from monitoring sites.
	Native mid-storey cover to increase to at least 50% of lower benchmark	Native over-storey cover absent from monitoring sites.
	Native ground cover (shrubs) to increase to at least 80% of lower benchmark.	One of six monitoring sites with native ground cover (shrubs) at least 80% of lower benchmark.
	Native ground cover (other natives) to increase to at least 80% of lower benchmark.	Four (4) of six monitoring sites with native ground cover (other natives) at least 80% of lower benchmark.
	Reduction in exotic plant cover by 50%	Five (5) of six monitoring sites recorded a 50% reduction in EPC compared to baseline.
	Over-storey regeneration increased to 50%	Over-storey regeneration present in two (2) of six monitoring sites for the first time since baseline.
	Potential increase in total length of fallen logs	Three (3) of six monitoring sites increased length of fallen logs compared to baseline, while one more maintained the length of fallen logs.
Increase in site context value	Connectivity within biodiversity offset areas increased as a result of management actions	No significant change observed. Changes expected over a longer timeframe.
	Increased security of biodiversity offset areas through formal conservation arrangement	Refer to comments at Section 1.1 and Section 11.
Threatened Species		
Tiger Orchid: - Maintenance of resident species populations and existing habitat for species.	Increase in the extent and condition of habitat	Species not detected during surveys. No obvious increase in area and condition. Changes expected over a longer timeframe.

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
- Increase in suitable habitat and increase in species populations and area of occupancy.		
Squirrel Glider: - Maintenance of resident species populations and existing habitat for species. - Increase in suitable habitat and increase in species populations and area of occupancy.	- Increase in the extent and condition of habitat - Continued detection of the species	No obvious increase in area and condition. Changes expected over a longer timeframe.
Spotted-tailed Quoll: - Maintenance of resident species populations and existing habitat for species. - Increase in suitable habitat and increase in species populations and area of occupancy.	- Increase in the extent and condition of habitat - Continued detection of the species	Species recorded at three locations within the Kenalea Properties on numerous occasions. No obvious increase in area and condition. Changes expected over a longer timeframe.
Threatened Microbats: - Maintenance of resident species populations and existing habitat for species. - Increase in suitable habitat and increase in species populations and area of occupancy.	- Increase in the extent and condition of habitat - Continued detection of the species	Threatened microbat species were recorded within Kenalea, Black Mountain and Merriwa, with further threatened species possibly occurring. No obvious increase in area and condition. Changes expected over a longer timeframe.
Woodland Birds: - Maintenance of resident species populations and existing habitat for species. - Increase in suitable habitat and increase in species populations and area of occupancy.	- Increase in the extent and condition of habitat - Continued detection of the species	Four (4) threatened woodland birds recorded during year seven monitoring surveys. No obvious increase in area and condition, although the occurrences of the Speckled Warbler do appear to have consistently increased in recent years. Changes expected over a longer timeframe.
Regent Honeyeater and Swift Parrot: - Maintenance of resident species populations and existing habitat for species. - Increase in suitable habitat and increase in species populations and area of occupancy.	Increase in the extent and condition of habitat	Species not detected during surveys. No obvious increase in area and condition. Changes expected over a longer timeframe.
Weeds		

KPI / Measurable Indicators	Year 10 Performance Criteria	Results of Year 6 (2022) Monitoring
Weed density and distribution	50% reduction in baseline EPC value	Changes to exotic species richness variable across the Biodiversity Offset Areas. Primarily an increase in weed density was observed compared to baseline.
Weed diversity	Downward trend in weed diversity	No significant changes to weed species diversity observed.
Significant target weed infestations	Downward trend in abundance and distribution of significant target weed infestations	Significant weed infestations not mapped as part of annual monitoring. Some changes in occurrences of target species at monitoring sites observed.
Feral Animals		
Feral animal abundance	Downward trend in feral animal abundance	Changes in species occurrences observed, including detections of some previously recorded species and absence of previously recorded species at specific sites. Changes expected over a longer timeframe. However, impacts likely to persist as animals move from adjoining areas into the Biodiversity Offset Areas. A significant increase in Pigs (Sus scrofa), particularly at Black Mountain, was observed in year seven (2023).
Habitat disturbance by feral animals	Downward trend in habitat disturbance by feral animals	No significant disturbance observed at the monitoring sites.

The data collected in 2023 represented the seventh year of annual monitoring.

This assessment is intended to continue the annual monitoring program of the Biodiversity Offset Areas. Given that the monitoring program is still in its early stages, few measurable changes in survey results were detected in year seven annual monitoring surveys. Nevertheless, it is notable that most woodland sites are within or above benchmark for most values and the majority of Performance Criteria have consistently been met by many of the monitoring sites. It is expected that greater changes will be observed over time due to a combination of the implementation of management activities and natural regeneration.

The results of monitoring undertaken in Year 7 has been assessed based on the Year 10 performance criteria outlined in the BOMP. Currently insufficient canopy species regeneration is occurring within the derived native grasslands sites that comprise Zone 2. A plan will be developed and implemented to address increasing the presence of canopy species.

Additionally, an increase in the abundance of Pigs (Sus scrofa) was observed in year seven monitoring. Additional pig control measures will be undertaken where practicable to prevent further increases.

Bushfire Hazard Reduction Burns

During 2023, hazard reduction burns were undertaken across all Biodiversity Offset properties.

Black Mountain hazard reduction burn occurred on 17 – 19th January, Kenalea (Echo) burn occurred on 29 – 31st May, Kenalea property occurred on 25 – 27th June and Merriwa River occurred on 24th August.

Overall, a total area of approximately 490ha was control burned.

6.11.3 Further Actions

Should any amendments to the BDMP or BOMP be required, BMC will review and submit a revised version of the BDMP or BOMP to the relevant regulatory agencies and stakeholders for comment and then approval to DPE and DCCEEW.

A study will be commenced on assessing actions required to meet the Year 10 Performance Criteria.

6.12 WEEDS AND PEST MANAGEMENT

6.12.1 Environmental Management

Weed and pest management at Bengalla and its BOA's is undertaken in accordance with the BDMP and BOMP, respectively.

Inspections are undertaken for weeds and pests, as required. Weed and pest control at Bengalla and on the BOA's is undertaken through targeted chemical, baiting and shooting applications.

6.12.2 Environmental Performance

Weed Management

Weed management is undertaken using boom spray, spot spraying or stem application dependent upon the specific weed and the terrain.

- ***Bengalla***

During 2023, approximately 211 ha was treated for the management of weeds. Target weed species primarily included African boxthorn, African olive, St John's Wort, Galenia and other environmental weeds. Priority areas for treatment included the pre-clearing areas and rehabilitation areas. Chemicals used during 2023 include Glyphosate with metsulfuron, Grazon Extra, Starane, Tordon, Amicide advanced, Lontrel and Garlon 600.

Observations during the weed treatment program and follow up inspections indicate that treatment methods used during the Reporting Period have generally been effective in reducing the presence of weeds in target areas.

Weed management areas at Bengalla are shown on **Figure** 10.

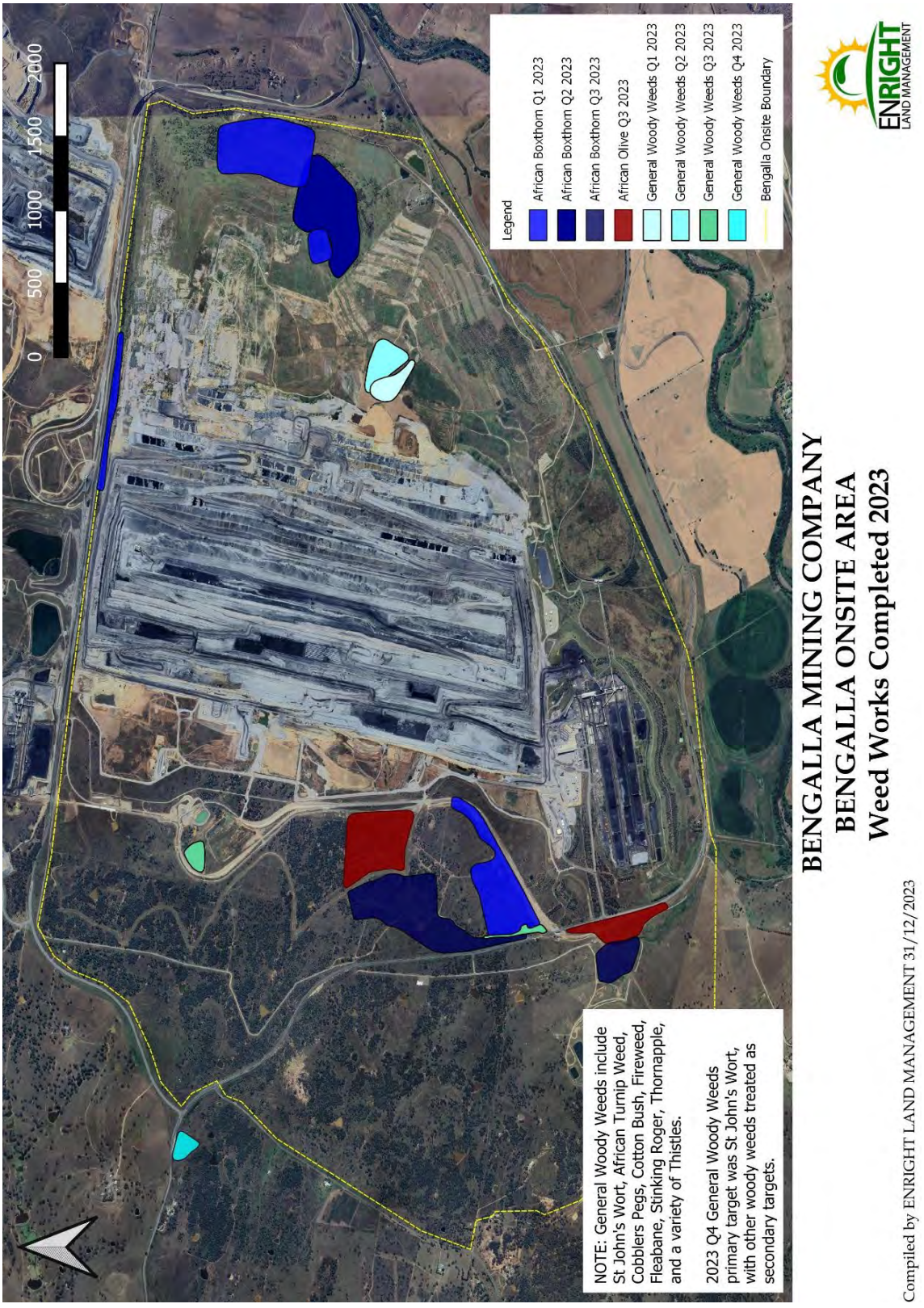

Figure 10: Bengalla Weed Management Locations 2023

- ***Biodiversity Offset Areas***

Weed management across the BOA's involves quarterly inspections and weed control programs.

Quarterly inspections are undertaken to determine weed control required for each quarter in each of the offset areas. Following identification, weed control commences and quarterly work records of site attendance are submitted which detail the sites treated, area (ha) treated, techniques and chemicals utilised and rates of application.

The chemicals to be utilised are based on their effectiveness depending on the type of weeds present. Chemicals used during 2023 include Glyphosate with metsulfuron, Grazon Extra, Roundup Bi-active, Starane advanced, Lontrel Advanced and Garlon 600.

The weeds controlled during the Reporting Period included prickly pear, fire weed, spear thistle, African boxthorn, lantana and several environmental weeds across each BOA.

Particularly higher infestations of seasonal weeds were found in Kenalea and Echo, specifically in disturbed areas, riparian zones, gullies, and grasslands while minimal seasonal weeds were observed in Merriwa and Black Mountain.

Regional rainfall was well below the long-term average for 2023 which contributed to the decrease of several weed populations such as St Johns Wort.

Figure 11 - Figure 12 show locations of weed control in 2023 at the Black Mountain and Kenalea BOA's. The Merriwa River BOA had minimal weed control undertaken.

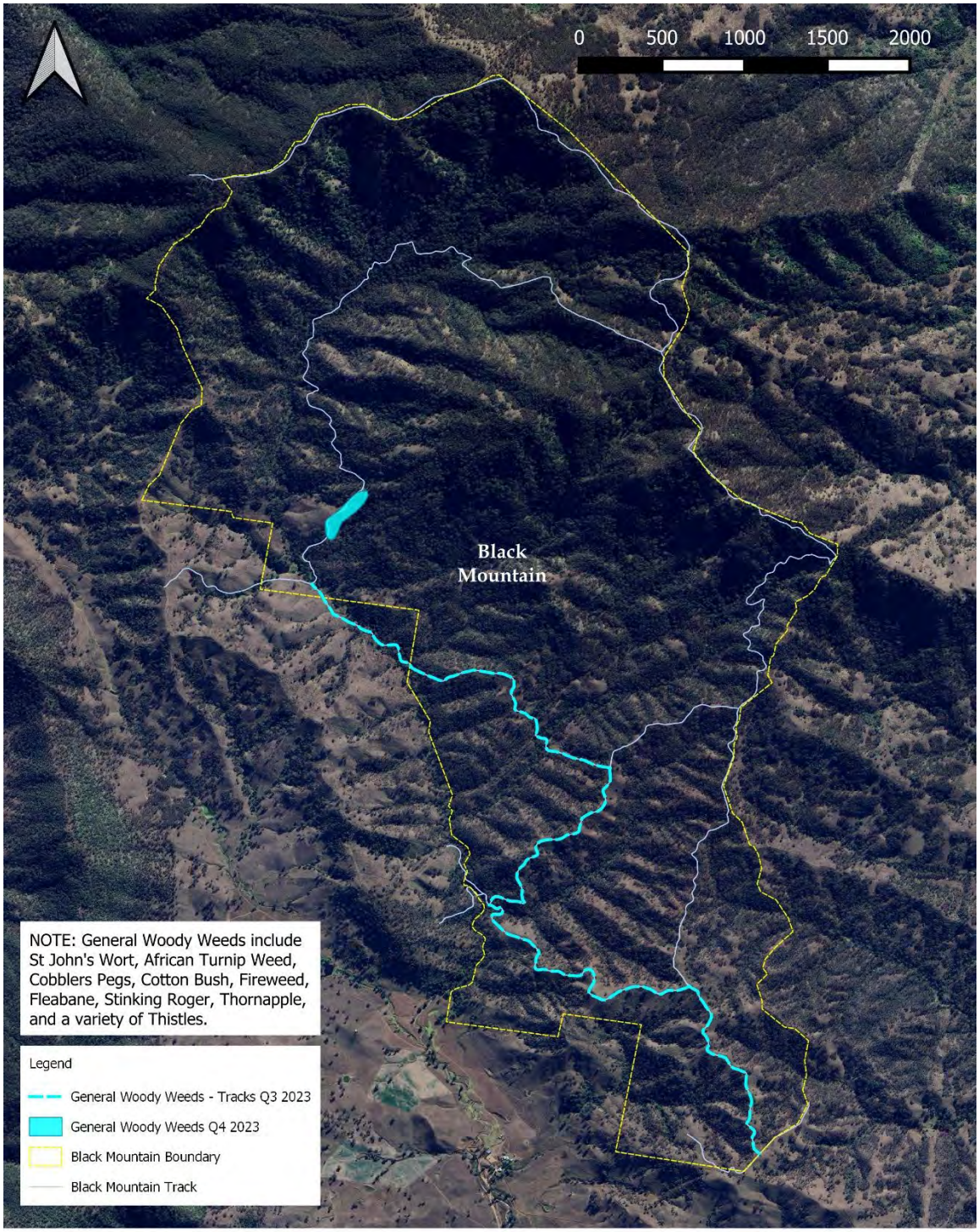

Figure 11: Black Mountain Offset Weed Management Locations 2023

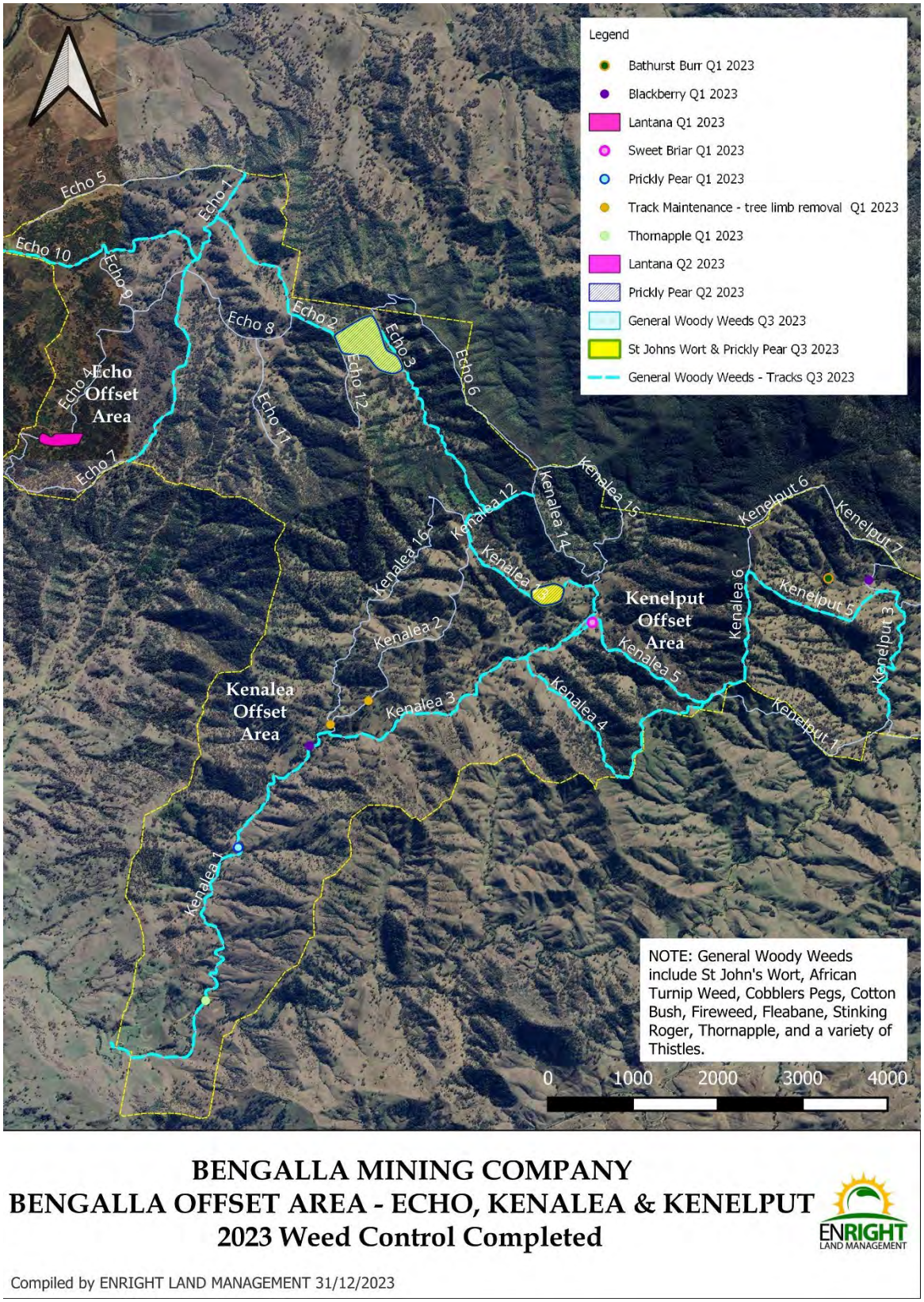

Figure 12: Kenalea Offset Weed Management Locations 2023

Pest Management

- ***Bengalla***

A pig control program was conducted throughout 2023 at various locations across Bengalla. A total of 29 pigs were trapped and culled in 2023.

Feral pigs were trapped utilising a penning system using grain and molasses as the main attractant. Once trapped, all pigs were disposed of humanely.

The culling program will continue into 2024 across Bengalla.

Dog baiting programs at Bengalla occurred in the Autumn and Spring 2023. Each program was undertaken in conjunction with Local Land Services and local wild dog associations and additionally forms part of a broader scale baiting program targeting foxes and wild dogs in the Hunter Valley. Baiting included utilising 1080 poison baits in addition to ejector capsule baits and each baiting program extended for three weeks during each period.

Figure 13 and **Figure 14** shows the location of wild dog bait stations utilised at Bengalla. The distribution of bait locations covered both buffer land west of the mine site and rehabilitation areas.

During the autumn baiting program, 29 bait stations were laid over a three week period with a total of 87 baits. Results indicate 49 takes of which 32 takes were by target species being foxes and 3 wild dogs. Bait shyness was detected at all locations.

During the spring baiting program, 29 stations were laid over a three week period with a total of 87 baits. Results indicate 17 takes were by target species being foxes. No wild dog takes were recorded. Evidence of bait shyness was also detected. Trail cameras were used in conjunction with the baiting program to record species taking the baits.

- ***Offset Properties***

During the Reporting Period, BMC undertook two 4-week dog ground baiting programs across the BOA's, including aerial dog baiting in Autumn and Spring in consultation with Local Land Services. **Figure 15**, **Figure 16** and **Figure 17** show locations of wild dog baiting locations on each BOA in 2023.

A total of 687 baits were placed during the 2023 ground baiting program targeting foxes and wild dogs. A total of 136 baits were taken during the program by the targeted species. Results indicated that 26% of baits were taken by wild dogs and 64% by foxes. Trends over the previous 3 years indicate that wild dog takes have varied from 28 in 2021, 39 in 2022 and 36 in 2023. This suggests that dog numbers have remained relatively stable throughout the period however may also be now increasing due to an increase in available in food supply.

Opportunistic feral animal control was also undertaken during weed control works targeting 34 pigs and 5 deer utilising open range opportunistic shooting.

Further Actions

Ongoing management of weeds and feral animals at Bengalla and BOA's will continue during 2024.

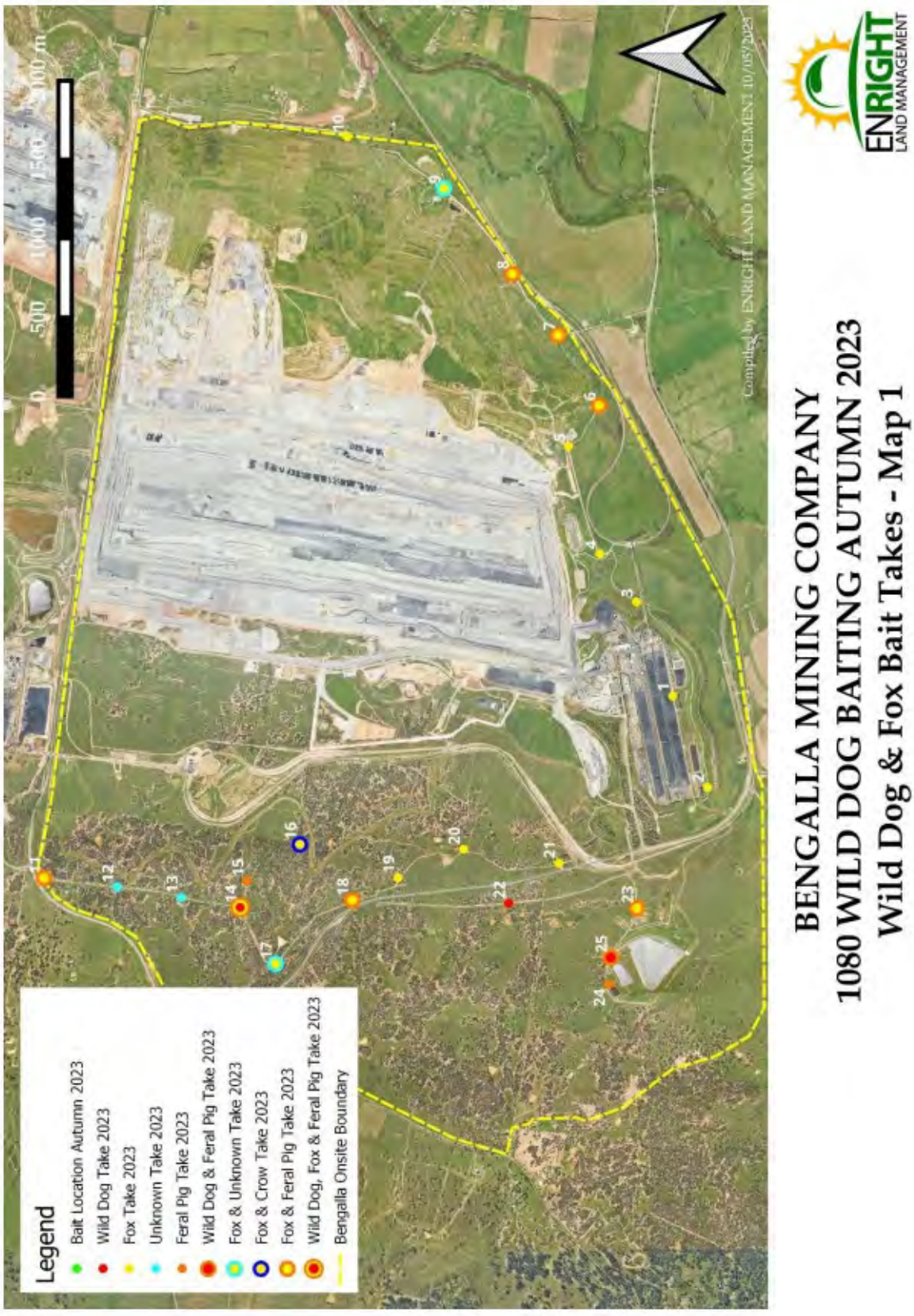

Figure 13: 1080 Wild Dog Baiting Locations at Bengalla Mine (Autumn)

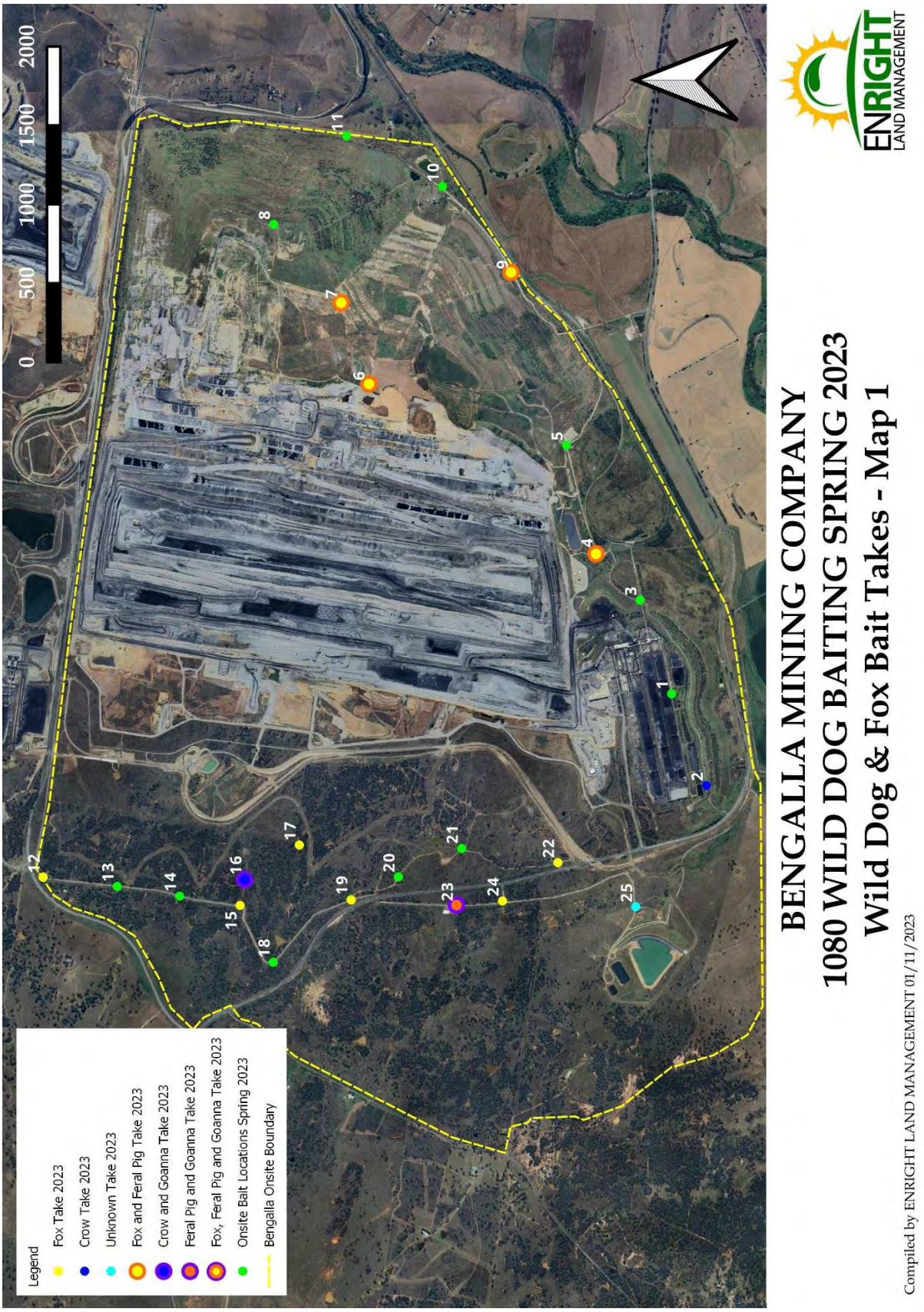

Figure 14: 1080 Wild Dog Baiting Locations at Bengalla Mine (Spring)

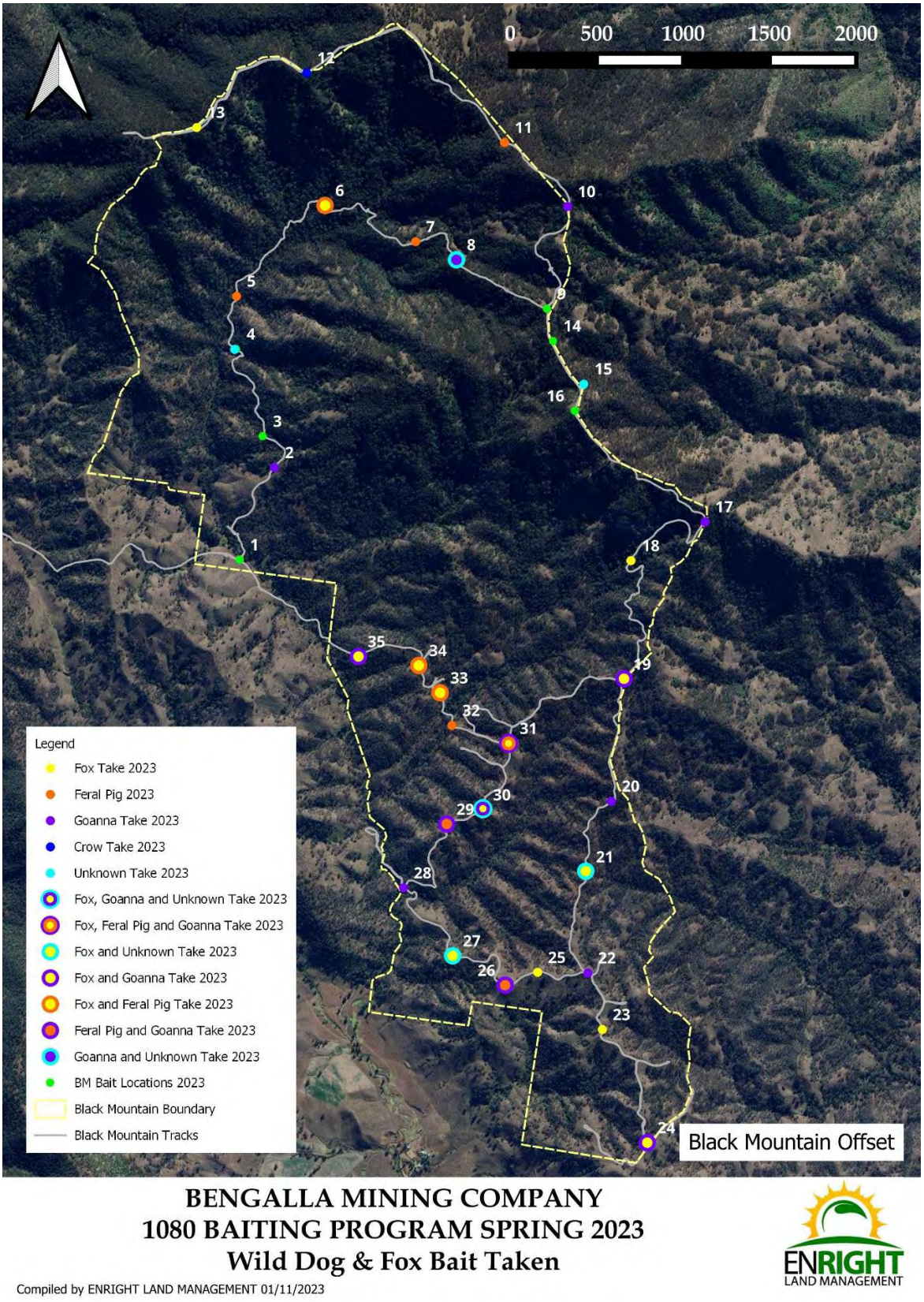

Figure 15: 1080 Wild Dog Baiting Locations at Black Mountain Offset

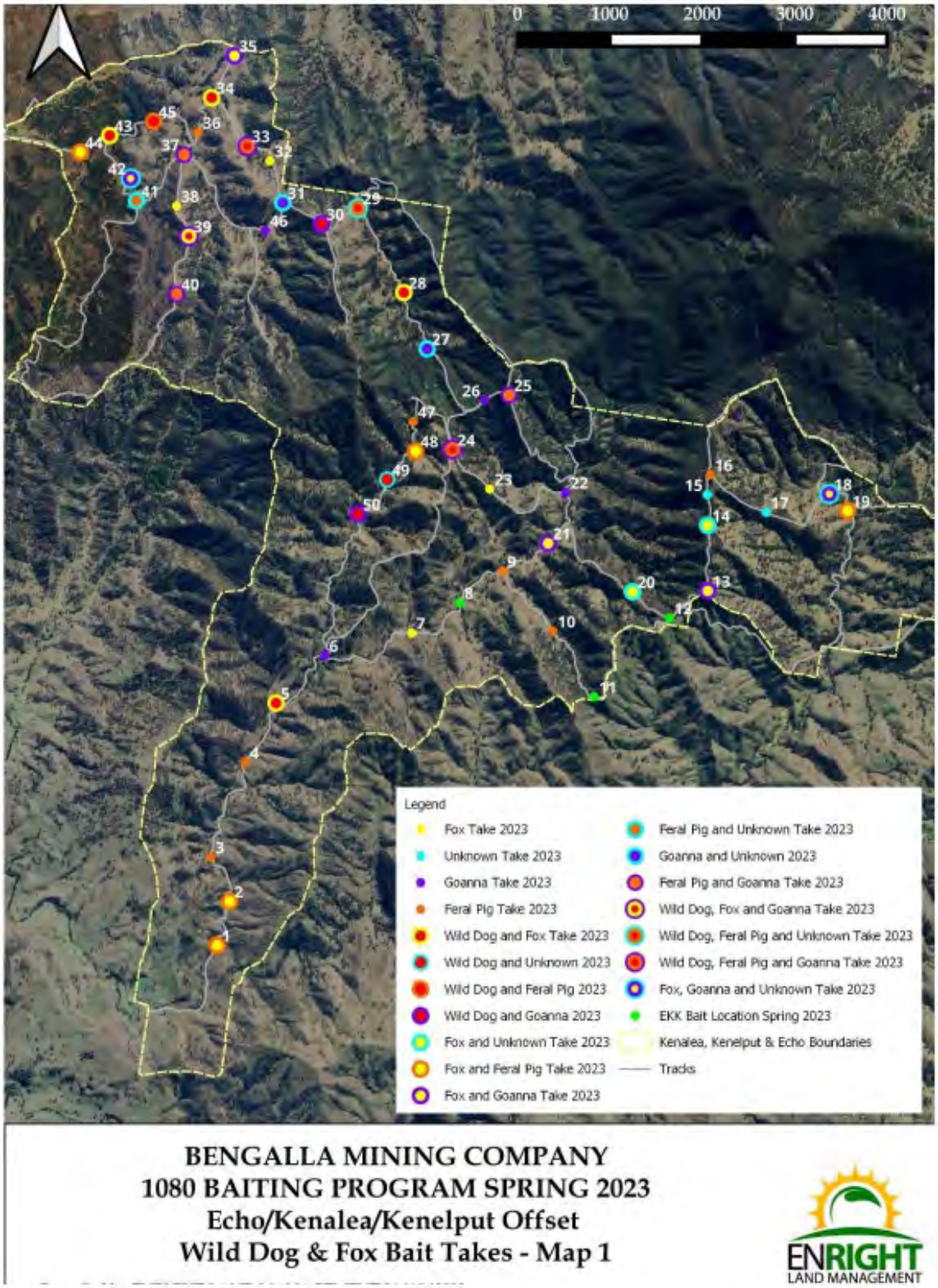

Figure 16: 1080 Wild Dog Baiting Locations at Kenalea Properties Offset

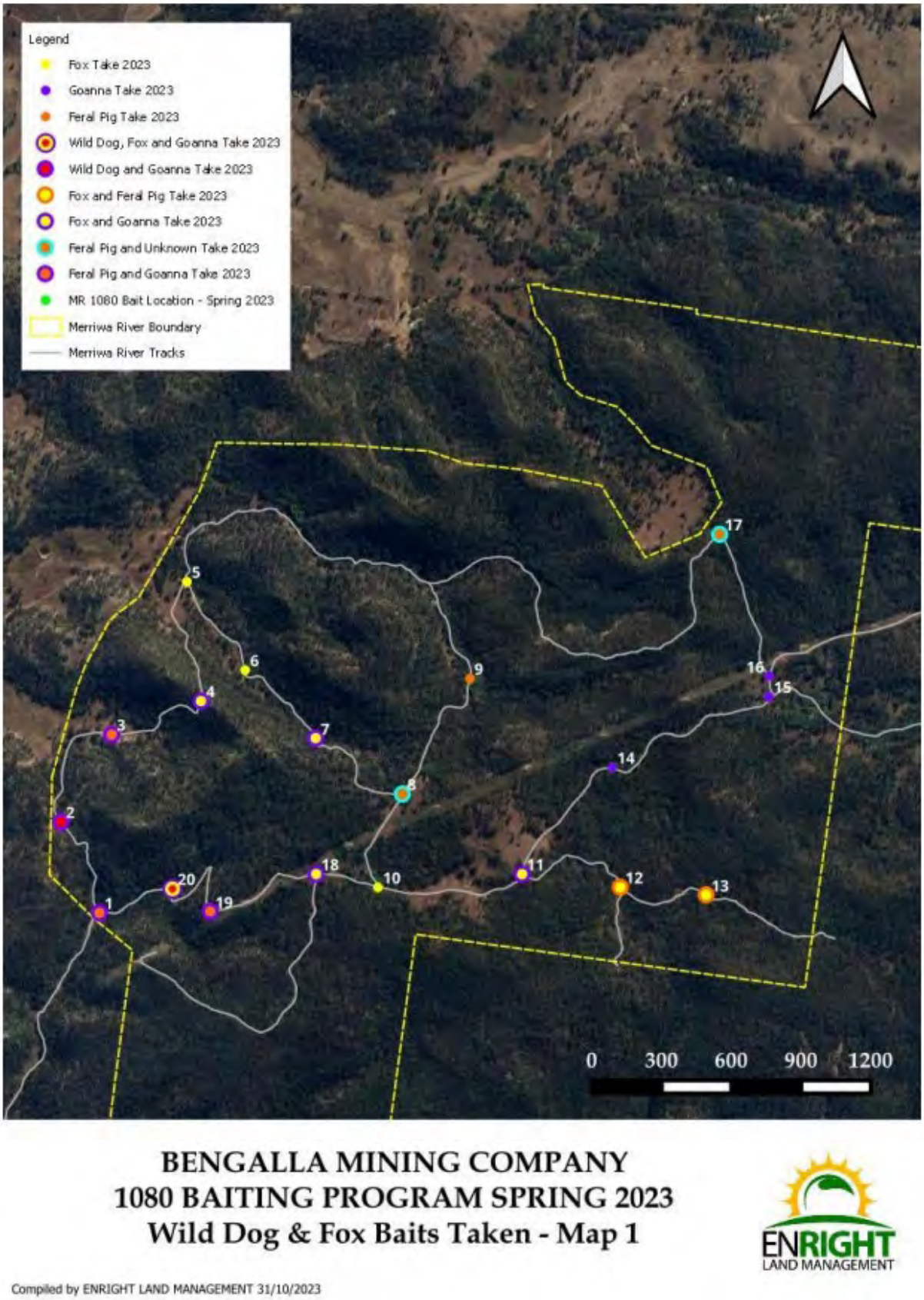

Figure 17: 1080 Wild Dog Baiting Locations at Merriwa River Offset

6.13 VISUAL AMENITY AND LIGHTING

6.13.1 Environmental Management

BMC is required to implement reasonable and feasible measures to mitigate the visual and offsite lighting impacts of the development in accordance with SSD-5170.

6.13.2 Environmental Performance

Tree Screening Along Public Roads

Schedule 3, Condition 40 of SSD-5170 requires BMC to plant trees along sections of Denman Road, Roxburgh Road and Wybong Road that will have direct views of Bengalla in consultation with Council (and where relevant the RMS (now TfNSW)). This condition was modified on 24 February 2023 (Mod 5) so as to require the tree screening (or alternative visual screening measure such as visual bunding) to be completed within 12 months of approval of Mod 5. Condition 41A of Schedule 3 (inserted by Mod 5) provides that tree screening may not be required where BMC can demonstrate, to the satisfaction of the Planning Secretary, that the screening works are not possible due to constraints.

BMC had undertaken tree screen planting on Wybong Road (in September 2019) and Roxburgh Road (in March 2019 and July 2020). Ongoing maintenance work on the trees will consist of replacement of failed plantings where significant and replacement of guards.

During the reporting period, BMC completed consultation with relevant private residences and Transport for New South Wales (TfNSW) to identify opportunities for visual screening measures along Denman Road. Following this consultation, no stakeholders permitted the installation of visual screening measures along areas of Denman Road that provided visual mitigations to mine activity.

6.13.3 Further Actions

The detail design for the realigned Bengalla Link Road is in progress. Upon completion of the detailed design, an assessment regarding plantings that can be undertaken in locations that have direct views of mining operations will be made.

6.14 EMERGENCY RESPONSE PREPAREDNESS

BMC has an Emergency Response Team which is trained to respond to emergencies and conducts simulated emergency exercises. BMC have developed a Pollution Incident Response Management Plan (PIRMP) as required under the *Protection of the Environment Operations Act 1997* NSW (POEO Act).

The BMC Environment Department conducted a pollution incident response test exercise on 7 December 2023. The simulated scenario was a derailment of a coal train within the Bengalla Mine Rail Loop.

The exercise confirmed that the response procedure included in the PIRMP was appropriate and that the required response from BMC was effective.

7 WATER MANAGEMENT

This section describes the Bengalla water management objectives and performance during the Reporting Period.

7.1 WATER BALANCE

The take of water associated with mining operations at Bengalla during the Reporting Period is summarised in **Table 22**. An overview of the site water balance is presented in **Table 23**.

A discussion of surface water and groundwater monitoring and management during the Reporting Period is provided in **Section 7.2** and **Section 7.3**, respectively.

Table 22: Site Water Take 2023

Water Licence	Water Sharing Plan, Source and Management Zone	Entitlement	Passive Take / Inflows (ML)	Active Pumping (ML)	Total (ML)
WAL1106 (High Security)	Hunter Regulated River Water Source (Zone 1A) *Water Sharing Plan for the Hunter Regulated River Water Source 2016* NSW	1449 units[1]	-	1,718[4]	1,718
WAL41547 (Aquifer)	Sydney Basin-North Coast Groundwater Source *Water Sharing Plan for the North Coast Fractured and Porous Rock Groundwater Sources 2016* NSW	365 units	175	-	175
Harvestable Rights	Muswellbrook Water Source *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2009* NSW	109 ML[2]	0	-	0
Total					**1893**

[1] Permanent entitlement to a share of the water source per water year (1 July to 30 June) which generates water allocation based on available water determinations made by the Minister for Water (generally at the start of each water year).

[2] Harvestable rights entitlement calculation (EIS).

[3] Groundwater inflow to open cut pit estimated by WSP Report for 2023.

[4] This value includes portions from period from 2 reporting periods

Table 23: Site Water Balance 2023

Aspect	Volume (ML)
Water Inputs	
Raw water sourced from Hunter River (ML/yr)	1718
Rainfall and catchment runoff (ML/yr)	849
Groundwater inflow to open cut pits (ML/yr)	175
Water entrained in ROM coal processed (ML/yr)	1076
Total Inputs	***3818***
Outputs	
Water entrained in product coal	1998
Other CHPP plant losses	5
Dust suppression (stockpiles and haul roads)	1079
Vehicle wash-down losses	140
Hunter River Salinity Trading Scheme (HRSTS) discharge	0
Other offsite discharges from mine water management system	0
Evaporation from dams	387
Total outputs	**3608**
Water Balance for 2023	**+210 ML**

During the Reporting Period, no water discharges occurred under the Hunter River Salinity Trading Scheme (HRSTS).

7.2 SURFACE WATER

7.2.1 Environmental Management

BMC has an approved Water Management Plan (WMP) which describes the surface water management infrastructure and procedures in place at Bengalla.

7.2.2 Environmental Performance

Surface Water Use

During the Reporting Period, BMC pumped 1,718ML from the Hunter River. This value accounts for 587ML during the period 1 January 2023 – 30 June 2023 and 1131ML during the period 1 July 2023 – 31 December 2023. The Bengalla site water balance for 2023 is provided in **Section 7.1**.

Surface Water Monitoring Program

Surface water monitoring is undertaken in accordance with the approved WMP. Surface water monitoring locations are shown on **Figure 18.**

Surface Water Monitoring Results

A comparison of the 2023 surface water monitoring results with the results for previous years for the Hunter River is presented in **Table 24**.

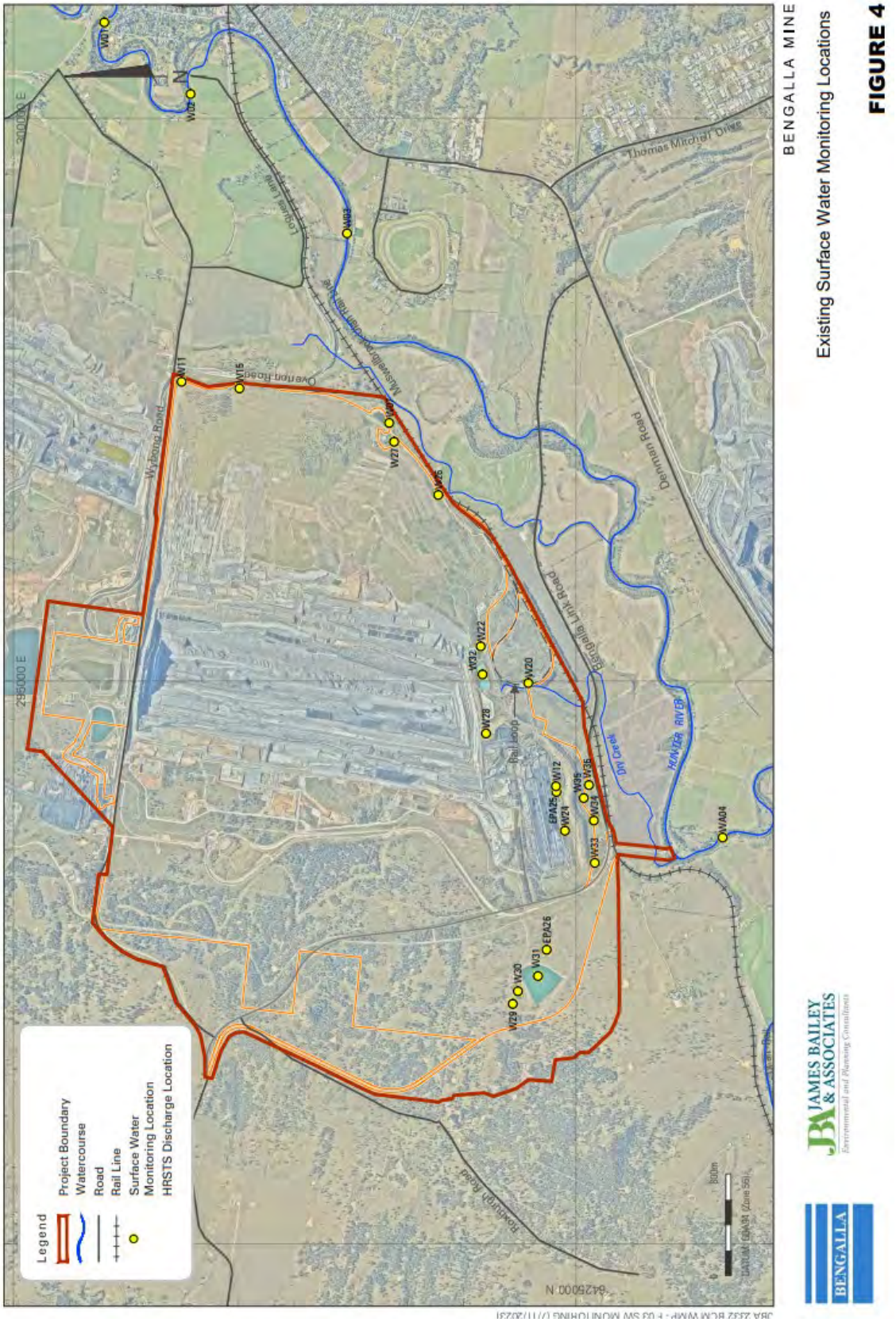

Figure 18: Existing Surface Water Monitoring Locations

Table 24: Summary of Surface Water Monitoring Results (2020 – 2023)

Year	Site W01 Average			Site W02 Average			Site W03 Average			Site W04 Average		
	pH	TSS	EC	pH	TSS	EC	pH	TSS	EC	pH	TSS	EC
2021	7.9	110	503	8.1	60	635	8.0	76	574	7.9	47	552
2022*	8.0	177	487	8.1	180	530	8.1	104	487	8.0	97	592
2023	8.0	14	731	8.1	14	739	8.0	19	813	8.0	21	829

** 15 sampling events*

Trends Over the Life of the Project

The Hunter River water quality trigger values in the WMP are used to investigate potential surface water impacts from operations at Bengalla. Trigger values for the surface water parameters monitored monthly include:

- pH: 6.5 – 8.1;
- Total Suspended Solids (TSS): 40 mg/L; and
- Electrical Conductivity (EC): 650 µS/cm.

Bengalla only recorded one rain event[1] during 2023 which occurred on 20 December 2023.

Water quality results reflected increasing dry conditions throughout 2023 with average pH levels for each site remaining within criteria with a maximum monthly level being 8.3 which occurred at during May for W01 and W04 and June in W02. All months for W03 were within criteria levels.

All TSS results were below the criteria for all sites and all months.

Average Electrical Conductivity (EC) levels were above criteria however this would reflect the increasing dry conditions prevailing during 2023.

Appendix F details monthly data collected from the four Hunter River water monitoring sites.

Comparison to Assessment Predictions

Surface water monitoring of pH, TSS and EC at the four Hunter River water monitoring sites in 2023 confirmed that water quality remains generally within the relevant WMP impact criteria for pH and TDS however there were elevated results for EC due to prevailing dry conditions experienced during 2023.

An overview of the Bengalla site water balance for 2023 is provided in **Section 7.1**. In comparing the 2023 water balance results to the EIS, Year 8 average results were selected as the most appropriate. It should be noted that the Year 8 water balance also assumed a production rate of up to 15 Million tonnes per annum of product coal.

[1] *Rain Event is defined as 25mm rainfall in 24-hour period in the WMP.*

The EIS predicted a gross water balance deficit of 89 ML for Year 8[1] however a surplus of approximately 210 ML occurred in 2023. The discrepancy between the EIS prediction and the measured and modelled 2023 water balance is likely due to below average rainfall for the Reporting Period and previously existing water storages.

7.2.3 Further Actions

Should any amendments to the WMP be required, BMC will lodge the revised plan with relevant regulatory agencies for comment and then with DPE for approval.

7.3 GROUNDWATER

7.3.1 Environmental Management

BMC has an approved WMP which describes groundwater management at Bengalla.

Groundwater Monitoring

The groundwater monitoring network (shown on **Figure 19**) targets two aquifers being an alluvial aquifer associated with the Hunter River floodplain and a Permian aquifer system.

The alluvium, shallow bedrock and deep bedrock bores are all sampled for Standing Water Level, pH, EC, and Total Dissolved Solids at various frequencies. A chemical analysis including sulphate and metals is also undertaken on several bores annually according to the WMP.

Monitoring Results for Groundwater Levels, Quality and Baseline Data

During 2023, BMC undertook investigations into groundwater triggers as per Appendix E of WMP, of which all investigations concluded natural fluctuations and as a result of mining activities. BMC also previously undertook a Groundwater Validation Review (AGE, 2022) in accordance with Condition 25 of Schedule 3 of SSD-5170 in 2022.

Appendix G (see **Section 9**) reviews the trends via a summary of the 2023 groundwater monitoring results and comparison with EIS predictions for selected bore groundwater levels and EC in certain locations.

7.3.2 Further Actions

BMC updated the groundwater monitoring and management recommendations identified in 2023 and will look to update the management plan following the implementation of revised triggers in 2024 actions where reasonable.

The WMP will be reviewed and updated as required in 2023 according to SSD-5170, including the new trigger levels recommended from the Groundwater Validation Review (AGE, 2022). BMC will lodge the revised plan with relevant regulatory agencies for comment and then with DPHI for approval.

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[1] *Bengalla EIS Volume 1 Table 51.*

Figure 19: Existing Groundwater Monitoring Locations

8 REHABILITATION

This section describes the Bengalla rehabilitation objectives and performance during 2023. Rehabilitation activities planned for the next Reporting Period are also discussed.

8.1 REHABILITATION OBJECTIVES AND FINAL LAND USE

The rehabilitation objectives for Bengalla are as described in Schedule 3 Condition 44 of SSD-5170 and the status of each is provided in **Table 25**.

Table 25: Bengalla Rehabilitation Objectives (from SSD-5170 (as modified))

Feature	Objective	Status
Mine site (as a whole)	• Safe, stable and non-polluting	• Ongoing. See **Section 6.8.1** for a description of Bengalla mineral waste management during 2023.
	• Final landforms designed to incorporate natural micro-relief and natural drainage lines, which, where reasonable and feasible, further avoid straight run drainage drop structures, to integrate with surrounding landforms	• Overburden emplacement and rehabilitation activities are undertaken with the objective of achieving the conceptual final landform approved under SSD-5170 (as modified), Forward Program and Rehabilitation Management Plan.
Overburden Emplacement Area – exposed to Muswellbrook and Denman	• Rehabilitate the entire face with high density woody vegetation as soon as practicable following the completion of mining operations[1]	• Ongoing. Rehabilitation Management Plan describes implementation of HDWV.
Final void	• Designed as a long-term groundwater sink and to maximise groundwater flows across back-filled pits to the final void • Minimise to the greatest extent practicable: o the size and depth of the final void; o the drainage catchment of the final void; o any high wall instability risk; and o risk of flood interaction (flows in and out of the void) • Maximise to the greatest extent practicable the final void landform to be in keeping with the natural terrain features of the surrounding landscape	• Final void designs approved under SSD-5170 to be reviewed at least five years from closure of Bengalla.
Agricultural land	• Restore or maintain land capability generally as described in the EIS and	• Ongoing. Rehabilitation activities are undertaken with the objective of

[1] This part of Schedule 3 Condition 44 was modified in February 2023 by Mod 5 to state "*Rehabilitate the entire face with high density woody vegetation comprising of species commensurate with the surrounding native vegetation communities as soon as practicable following the completion of mining operations*".

Feature	Objective	Status
	shown conceptually in Appendix 9 of SSD-5170.	achieving the land capability approved under SSD-5170 and the Rehabilitation Management Plan.
Revegetation areas	• Restore a minimum 10% treed coverage at the mine site • Higher density planting along the riparian zone of the Dry Creek reinstatement, and around the final void	• Noted per Appendix 9 of SSD-5170. • The rehabilitation of riparian areas along Dry Creek and the final void are not within the current Forward Program period.
Dry Creek reinstatement	• No net loss of creek length; • Restore, maintain and/or improve hydrological and ecological function, quality and geomorphic stability; • Incorporate erosion control measures based on vegetation and engineering revetments; and • Revegetate with suitable native species	• Dry Creek reinstatement planned to commence from around 2030 subject to operational progress.
Surface infrastructure	• To be decommissioned and removed, unless RR agrees otherwise	• A new area of the existing western diversion levee was under construction during 2023. This section of the existing western diversion levee will be commissioned in early 2024.
Community	• Ensure public safety; • Minimise the adverse socio-economic effects associated with mine closure	• Mining areas restricted to BMC personnel and contractors; • Socio-economic impacts to be reviewed at least five years from closure of Bengalla.

As described in Section 8.21.5 of the EIS, a mixture of native bushland and cattle grazing have been identified as the most suitable post-mining land uses for most of the land within the Project Boundary except for the eastern face of the OEA (which will be re-vegetated to contain higher density natural woodland). Grazing and native bushland regeneration has therefore been adopted as the preferred post-mining land use in suitable areas of the site.

8.2 REHABILITATION MANAGEMENT

Rehabilitation Status

Rehabilitation at Bengalla is undertaken in accordance with SSD-5170, the current Bengalla Mine Forward Program (1 January 2023 – 31 December 2025) and the Rehabilitation Management Plan (RMP).

The proposed area for new rehabilitation in 2023 was approximately 20ha consisting of Class IV pasture rehabilitation (8.7ha) and High Density Woody Vegetation (HDWV) 11.3ha, focussing on the southern face and crest of the Overburden Emplacement Area (OEA). Additionally, approximately 59ha of retrofitted HDWV tubestock was proposed on the eastern face of the OEA.

During the Reporting Period, BMC continued retrofitting of HDWV tubestock over previously rehabilitated lands. During June 2023, 59ha of tubestock, comprising of 64,000 trees were planted on the eastern face of the OEA.

The rehabilitation completed for 2022 (previous reporting period), 2023 (this Reporting Period) and the predicted rehabilitation activities for 2024 is summarised in **Table 26**.

Table 26: Bengalla Rehabilitation Status Summary

Mine Area Type	Previous Reporting Period 2022 (ha)	This Reporting Period 2023 (ha)	Next Reporting Period 2024 (ha)6
A. Total mine footprint[1]	1,355	1,443	1562
B. Total Active Disturbance[2]	1,047	1,115	1227
C. Land being prepared for rehabilitation[3]	0	0	10
D. Land Under Active Rehabilitation[4]	307	327	337
E. Completed Rehabilitation[5]	0	0	0

Notes:

1. Total mine footprint includes all areas within a mining lease that either have at some point in time or continue to pose a rehabilitation liability due to mining and associated activities. As such it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands.

2. Includes all areas ultimately requiring rehabilitation including exploration areas, stripped areas ahead of mining, infrastructure and water management areas, sewage treatment facilities, access tracks and haul roads, topsoil stockpiles, active mining areas, overburden emplacements, tailings dams, etc.

3. Disturbed land that is under decommissioning, landform establishment and growth medium development.

4. Areas under rehabilitation that are being managed to achieve relinquishment.

5. Areas of rehabilitation that have been formally signed off by the RR as having successfully met agreed land use objectives and rehabilitation completion criteria.

6 Data presented for "Next Reporting Period 2023" is consistent with Bengalla Mine Forward Program and RMP.

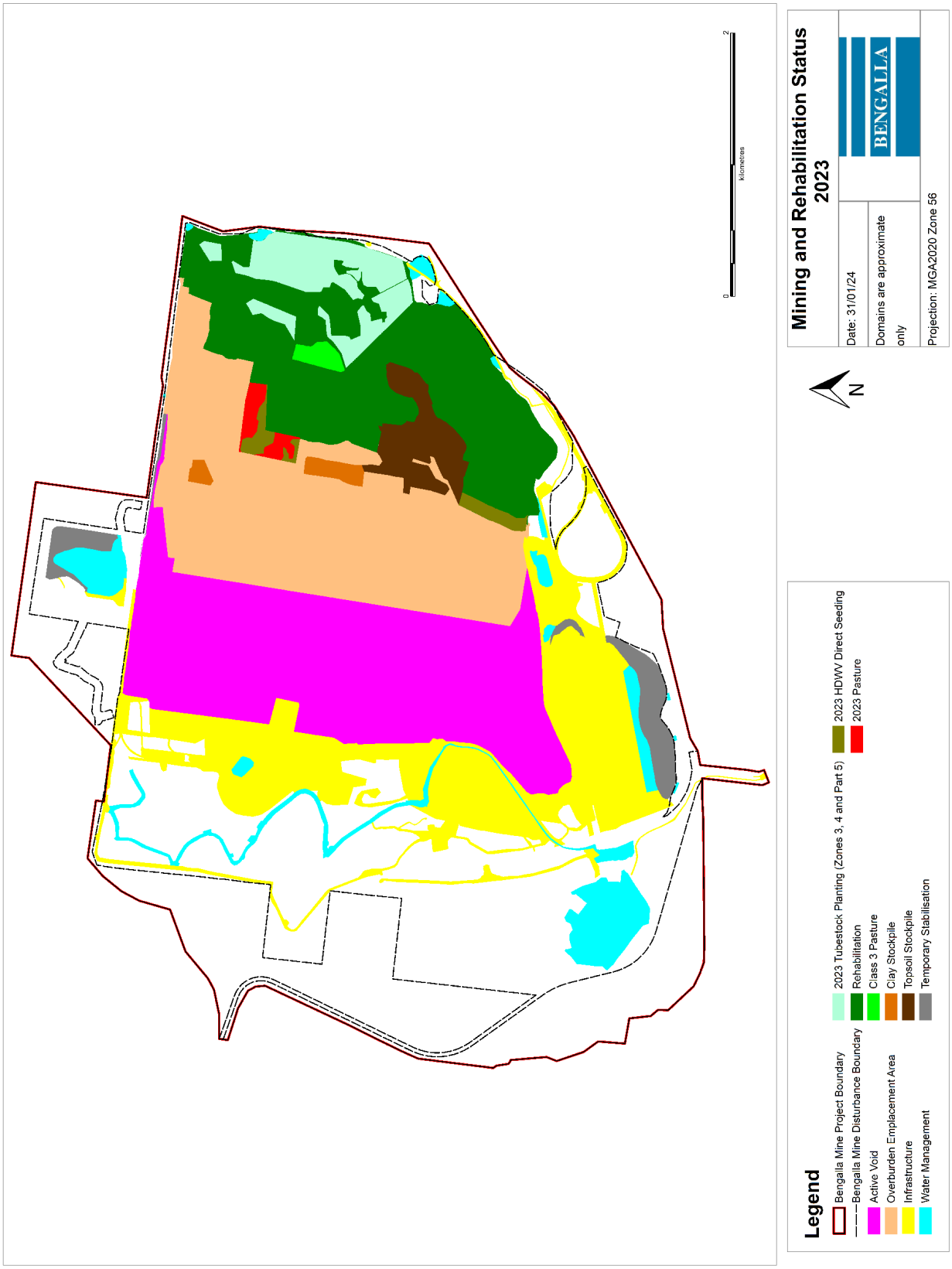


Figure 20: Mining and Rehabilitation Status 2023

8.3 REHABILITATION MONITORING PROGRAM

Rehabilitation monitoring at Bengalla is undertaken annually through the implementation of the following:

- a transect-based monitoring program; and
- a rehabilitation audit.

During the Reporting Period, rehabilitation monitoring was undertaken during January 2024 and assessed 43 existing rehabilitation sites.

The transect based monitoring conducted for 2023 is presented in **Table 27**, with the locations of each transect shown on **Figure 2** of Appendix H. HDWV 43 – 44 and P4 were established and monitored following progressive installation of HDWV and pasture establishment during the Reporting Period.

Table 27: Bengalla Rehabilitation Monitoring Program Transects (2023)

Transect Name	Description	Rehabilitation Established	Monitoring Established
Class III	Grazing Pasture	2012	2014
NW1 (HDWV 1)	High density woodland on Class IV or V land	2005	2011
NW2 (HDWV 2)	High density woodland on Class IV or V land	2004	2011
NW3 (HDWV 3)	High density woodland on Class IV or V land	2008	2012
NW4 (HDWV 4)	High density woodland on Class IV or V land	2007	2017
NW6 (HDWV 6)	High density woodland on Class IV or V land	2014	2017
NW7 (HDWV 7)	High density woodland on Class IV or V land	2015	2017
NW8 (HDWV 8)	High density woodland on Class IV or V land	2016	2016
NW9 (HDWV 9)	High density woodland on Class IV or V land	2016	2016
NW10 (HDWV 10)	High density woodland on Class IV or V land	2006	2018
NW11 (HDWV 11)	High density woodland on Class IV or V land	2004	2018
NW14 (HDWV 14)	High density woodland on Class IV or V land	2020	2020
NW15 (HDWV 15)	High density woodland on Class IV or V land	2020	2020
HDWV16	High density woodland on Class IV or V land	2020	2020
HDWV17	High density woodland on Class IV or V land	2020	2020
HDWV18	High density woodland on Class IV or V land	2020	2020
HDWV19	High density woodland on Class IV or V land	2020	2020
HDWV20	High density woodland on Class IV or V land	2020	2020
HDWV21	High density woodland on Class IV or V land	2020	2020
HDWV22	High density woodland on Class IV or V land	2020	2021
HDWV23	High density woodland on Class IV or V land	2020	2021
HDWV24	High density woodland on Class IV or V land	2020	2021
HDWV25	High density woodland on Class IV or V land	2020	2021
HDWV26	High density woodland on Class IV or V land	2020	2021
HDWV27	High density woodland on Class IV or V land	2020	2021
HDWV28	High density woodland on Class IV or V land	2020	2021

Transect Name	Description	Rehabilitation Established	Monitoring Established
HDWV29	High density woodland on Class IV or V land	2021	2022
HDWV30	High density woodland on Class IV or V land	2021	2022
HDWV31	High density woodland on Class IV or V land	2021	2022
HDWV32	High density woodland on Class IV or V land	2021	2022
HDWV33	High density woodland on Class IV or V land	2021	2022
HDWV34	High density woodland on Class IV or V land	2021	2022
HDWV35	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV36	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV37	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV38	High density woodland on Class IV or V land (Direct seeding)	2021	2022
HDWV39	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV40	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV41	High density woodland on Class IV or V land (tubestock)	2022	2022
HDWV42	High density woodland on Class IV or V land (Aerial seeding)	2021	2022
HDWV43	High density woodland on Class IV or V land (Direct seeding)	2023	2023
HDWV44	High density woodland on Class IV or V land (Direct seeding)	2023	2023
P4	Pasture	2023	2023

Source: Moss Environmental Pty Limited, 2023

8.3.1 Rehabilitation Monitoring Results

Following three years of above average rainfall was received during 2020, 2021 and 2022, 2023 returned to dry conditions once again.

During 2023 rehabilitation monitoring continued to focus on rehabilitated areas of the OEA.

The Class III pasture rehabilitation continued to show satisfactory performance in 2023, with high vegetative cover dominated by productive and palatable tropical pasture grasses, high biomass and feed quality, and minimal weed incidence. Pasture in its current condition was reported as having a productivity exceeding regional averages.

Areas of historic HDWV rehabilitation are well established and showed minimal change from the last few years. Soil and slope stability were excellent at most monitoring sites with limited active erosion processes recorded. A few instances of moderately severe rill, tunnel, gully and sheet erosion were recorded and are likely to require ongoing management.

Protective ground cover dropped in 2023 likely a result of less favourable climatic conditions in the latter half of 2023 and the delayed time in which the monitoring took place. Protective cover remained above the 70% minimum cover benchmark at all but one historic rehabilitation area where one site fell just below benchmark.

The Floristics species richness results indicate that native species in the establishing vegetation communities across the rehabilitation zones have increased in proportion to exotics in 2023. In contrast to 2022, the drier conditions have resulted in a disproportionate reduction in exotic ground covers recorded which may indicate a resilience to the variation in weather conditions by native species. Nevertheless, ground cover species continue to be dominated by introduced/exotic species.

Areas of historic HDWV rehabilitation are well established and have shown minimal change in condition in the past couple of years (i.e. since the end of the drought). Consistent with previous years and the well-established nature of the rehabilitation across historic areas, shrubs and trees diversity remained constant at all historic monitoring sites in 2023.

Overall, it is considered that there is adequate potential for the established communities to be self-sustainable. It is an acceptable outcome for the rehabilitation to include both densely treed areas of sparser stem densities, provided that the average for the zone is within target benchmarks.

Shrub and tree species diversity continue to be, on average, higher in areas planted with tubestock than in all seeded areas (irrespective of the substrate); indicating variable and inconsistent strike rates and germination success where seeding was undertaken.

The 2023 results continue to show woody species assemblage performance was generally better in areas of new rehabilitation.

Soil sampling and analysis was undertaken at all sites monitored in 2023. Testing results generally indicated no key deficiencies in the various growth media, with the exception of pH at the majority of sites and salinity at one site. This site is on newly established on overburden material and salinity levels are expected to normalise over time.

Weed incursion remained a key issue in 2023, with most problematic species including Galenia, fireweed and African boxthorn. For all these species ongoing management will continue.

Erosion on part of the rehabilitation area was identified including breached contour banks, localised gully erosion and an eroded rock-lined drainage channel. Erosion repairs will be undertaken in some key areas in 2024 on identified eroded areas.

Key observations and actions of the rehabilitation monitoring program are detailed in **Appendix H**.

8.3.2 ACTIONS FOR THE NEXT REPORTING PERIOD

Rehabilitation activities for 2024 will be carried out generally in accordance with the Forward Program and Rehabilitation Management Plan subject to operational progress.

Weed control measures will be implemented prior to HDWV establishment in previously rehabilitated land and weed management will continue over the remaining areas of previous rehabilitation.

Remediation works identified in geofluv structures are scheduled for 2024.

BMC will undertake the recommended actions detailed in **Appendix H** for 2024 where reasonable and feasible that have been identified as part of the 2023 rehabilitation monitoring program.

BMC is considering a modification application of SSD-5170 partly related to the landform. If that modification application is progressed long term stability of the landform will be examined.

9 COMMUNITY RELATIONS

This section includes a summary of the environmental complaints received at Bengalla and community engagement and support activities undertaken during the Reporting Period.

9.1 COMMUNITY ENGAGEMENT

BMC undertook a range of community engagement activities during 2023:

- Bengalla Community Consultative Committee (CCC) meetings. The meetings were held in February, May, August, and November 2023. Minutes of each of these meetings are available at the Muswellbrook Library, Denman Library and on the BMC website. The CCC provides a forum for constructive dialogue and discussion enhancing the relationship between the community and Bengalla. The CCC representatives act as a point of contact to provide feedback between Bengalla and the community.
- Near neighbour consultation regarding impacts, sale of land and other interactions.

During 2023, three Upper Hunter Mining Dialogue School Mines Tours were held with a total of 75 students from Muswellbrook High School, St Joseph's Primary School Denman, and Pacific Brook Christian School participating.

9.2 COMMUNITY CONTRIBUTIONS

BMC contributes to programs identified by, and preferably in partnership with, the local community. The BMC Community Support Team (CST) meets regularly to assess requests from the local community for donations, sponsorship, and in-kind contributions. Many projects and events have been developed and supported through sponsorship funding and assistance from the BMC CST who provide their time and expertise towards these initiatives. During the Reporting Period some of the groups, schools and clubs supported through the CST include:

- Muswellbrook CATS AFL Club
- Muswellbrook Polocrosse
- Aberdeen Highland Games
- Muswellbrook Lions Club
- Edinglassie Rural Fire Brigade
- Upper Hunter Conservatorium of Music
- Murrurundi King of the Ranges
- Muswellbrook High School
- Scone Netball Club
- Aberdeen Junior Rugby League Club
- Muswellbrook Netball Club

- Muswellbrook Cricket Club

During 2023, BMC contributed to the education and career development of students from Muswellbrook, Aberdeen, and Scone High Schools with the provision of undergraduate scholarships. BMC awarded eight (8) scholarships valued at $5,000 each to local students pursuing an undergraduate degree. Bengalla will also continue to award the Bengalla Scholarship for students pursuing a career in Engineering, Human Relations, Accounting, Health and Safety, Surveying, Information Technology and Geology which includes paid vacation work at Bengalla. BMC will continue to support local students with scholarship programs again in 2024. In addition, each year in partnership with MIGAS, BMC takes on local apprentices so that at any one time there are a minimum 16 apprentices employed by BMC. In 2023, eleven apprentices were employed, and they will be undertaking their diesel mechanic, fitter machinist and electrical studies whilst also working onsite.

The work experience/placement program with local High Schools and TAFE continued in 2023, offering 21 placements to local students and the opportunity to experience the various careers in the mining industry.

The BMC Community Development Fund (CDF) provides funding that is allocated by BMC to support the local community to build community capacity, address development challenges and to take advantage of emerging opportunities. Some of the organisations and projects funded from the CDF in 2023 included:

- Gundy Crown Reserves
- Murrurundi King of the Ranges
- St James Primary School- Indigenous didgeridoo program
- National Horse Cutting Association
- Power FM Christmas Spectacular

BMC will continue to focus on ensuring the long-term sustainability of the community and target issues, needs and opportunities which are a priority to the local community through the CDF.

In 2023, BMC sponsored and partnered with local community groups including:

- Muswellbrook Shire Council (MSC) for the Blue Heeler Film Festival, Muswellbrook Art Prize and the Easter Family Fun Day
- The Bengalla Upper Hunter Show
- Muswellbrook Race Club Bengalla Race Day
- Muswellbrook PCYC Health and Fitness Resource
- Upper Hunter Conservatorium of Music
- Upper Hunter Education Fund
- Group 21 Rugby League Competition Naming Rights

- Muswellbrook Chamber of Commerce and Industry Business Awards
- Muswellbrook Netball Association Major Sponsor
- Muswellbrook Touch Football Association Major Sponsor
- Sponsorship of School Presentation Days in Muswellbrook, Aberdeen, Scone, and Denman

BMC provides funds to MSC according to the Voluntary Planning Agreement (VPA). A total of $726,285 was provided under the VPA to MSC during the Reporting Period.

In addition, BMC provides funds towards events, organisations, clubs, and charities in the local community. The following funds were allocated/provided during the Reporting Period:

- Community Development Fund: $55,640
- Scholarships: $99,500
- CST and Sponsorships: $404,073

9.3 COMMUNITY COMPLAINTS

BMC maintains a register of complaints and a complaints hotline (1800 178 984) which operates 24 hours, 7 days per week. BMC received 46 complaints during the Reporting Period, a decrease compared to the 36 complaints in 2022 and 68 complaints received in 2021.

During the Reporting Period, the most common environmental complaints raised by complainants related to blasting 28, air quality 12, noise 2 and non mining related 5. A summary of complaints received during the Reporting Period is provided in **Figure 21**.

The environmental complaints for 2023 were greater than complaints received during 2022. One complainant accounted for 61% of all complaints during 2023.

BMC responds to complaints by assessing whether any action is required. If action is undertaken those actions are generally recorded and displayed in the complaints register displayed on the BMC website.

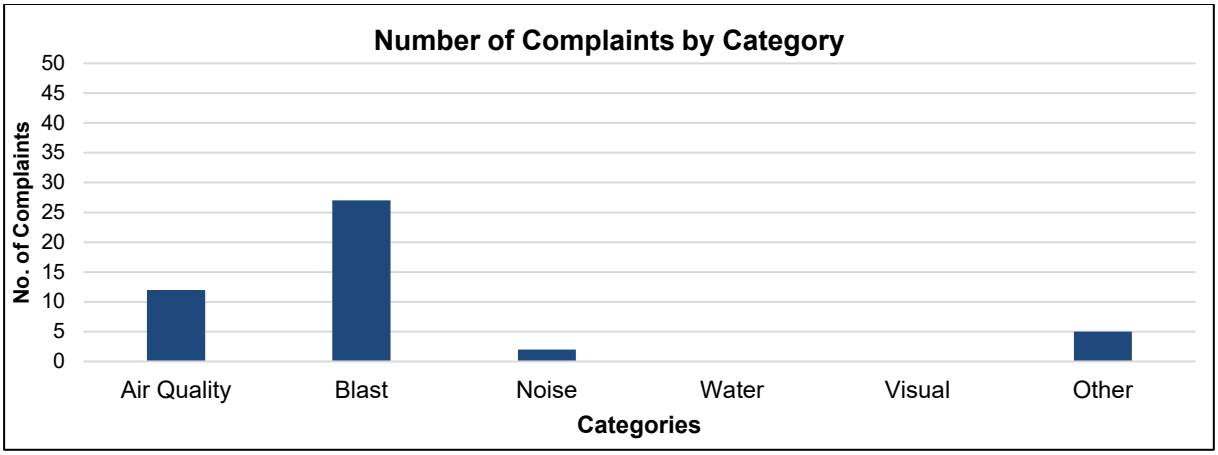


Figure 21: Environmental Complaints Received 2023

10 INDEPENDENT ENVIRONMENTAL AUDIT

This section discusses the requirement for an Independent Environmental Audit (IEA) of the development the subject of SSD-5170 and Dams Safety NSW audit of Dams Safety Regulation 2019 and Mining Approvals 1-3.

10.1 SSD-5170

In accordance with Schedule 5, Condition 9 of SSD-5170, BMC is required to commission an IEA of Bengalla within 1 year of the commencement of SSD-5170 (i.e. 2016) and every 3 years thereafter.

The most recent IEA was conducted in August 2023. Actions arising from this audit are being addressed and are detailed in **Appendix K**.

Two non-compliance actions identified in the IEA were being actioned as of 31 December 2023 and were finalised in March 2024. These include a review of waste procedures and training of relevant staff and a review of the ROM hopper dust suppression system and commissioning of any identified works required.

The next IEA is scheduled to be completed in 2025.

10.2 DAMS SAFETY REGULATION 2019 AND MINING APPROVALS 1-3

Dams Safety Regulation 2019 commenced on 1 November 2019. As of 1 November 2021, any transitional arrangements and savings provisions have concluded, and all clauses of the regulation has commenced.

During 2023, BMC received approval to amended conditions for BENGALLA-2, BENGALLA-3 and BENGALLA-4. BMC have updated the Dam Safety Management Plan to reflect these changes.

The conditions amended included the following:

- BENGALLA-2 (CW1) approves mining within the CW1 Notification Area to 30 June 2040.
- BENGALLA-3 (ED3) approves mining within the ED3 (operated by MACH Energy Australia Pty Ltd) Notification Area to 30 June 2040.
- BENGALLA-4 (DW1) is approved to 30 June 2040.
- From 1 December 2023, Dam safety inspections were revised to occur once per week per Declared Dam regardless of blasting within the notification areas.

11 INCIDENTS AND NON-COMPLIANCES

*This section provides further information about the non-compliances identified in **Section 1** and describes the reportable incidents and exceedances that occurred at Bengalla during the Reporting Period.*

11.1 FURTHER INFORMATION ABOUT NON-COMPLIANCES

11.1.1 Item 1: EPBC Approval 2012/6378 Condition 4

During the Reporting Period communication continued between BMC and the DPHI and the Biodiversity Conservation Trust (BCT) being:

- BMC letter dated 6 April 2023 to what is now the NSW Department of Planning, Housing and Infrastructure (DPHI) where BMC confirmed the 'Department's [DPHI] advice that it considers that the establishment of a BSA to be the
-
- appropriate mechanism for securing the required offset areas. Based on that advice, BMC has instructed its consultants to proceed with preparing the relevant BSAs ….'
- Meeting 20 July 2023 with BMC and its advisors presented to the DPHI and the BCT, discussion occurred regarding:
    - o Background and Biodiversity Stewardship Agreement Site Overview;
    - o Long Term Security Process;
    - o Biodiversity Stewardship Agreement Applications;
    - o Consultation with Local Land Services and Council; and
    - o Future Land Management.

    Actions:

    - o Create an Action Plan outlining specific dates in which key project milestones are completed.
    - o Organise a pre-submission meeting to discuss the draft BSA Applications and supporting documentation.
- BMC Action Plan dated 18 August 2023 provided by email to DPHI and BCT outlining steps to establishment of BSA's for each offset property.
- The BSA's applications continue to be prepared for each offset property during the Reporting Period.

In the meantime, the offset areas will continue to be owned by the BJV and managed by BMC in accordance with the BOMP.

11.1.2 Item 3: Condition 3 of EPBC Approval 2012/6378 and Condition 29 of Schedule 3 of SSD 5170

The non-compliance involved the use of part of 'Kenalea' in a manner that is inconsistent with the approved Biodiversity Offset Management Plan (BOMP) by a tenant of the property, for stock, (that is also inconsistent with the Residential Tenancy Agreement (RTA) between BMC and the tenant).

Under the terms of the RTA, the tenant was not permitted to keep stock on the property (other than up to 12 dogs) however stock had been kept on part of 'Kenalea', on approximately 97 hectares at the southern end of the 'Kenalea' property. The total area of 'Kenalea' is approximately 4,097 hectares with the overall biodiversity offset area being approximately 6,215 hectares.

BMC contacted the tenant to remove the stock as soon as possible and will investigate whether the presence of the stock. The tenant removed all animals by the 2 July 2023 and then vacated the property in August 2023BMC engaged Cumberland Ecology to undertake an ecological assessment of the area where grazing occurred for the purpose of determining whether grazing had resulted in any ecological damage. Cumberland Ecology provided a report that was subsequently forwarded to DPHI and DCCEEW. This report indicated higher levels of degradation had occurred when compared to areas of non-grazing and had delayed regeneration within the subject land. It was also reported that the area is likely to regenerate to a similar condition to remaining areas in Kenalea once all stock had been excluded.

Monitoring of these areas is now incorporated into annual ecological monitoring with the establishment of 4 permanent monitoring plots on the grazing area.

Correspondence was received on 20 December 2023 from DECCW that no further action would be taken provided the actions described above are implemented.

11.2 REPORTABLE INCIDENTS OR EXCEEDANCES

There were no "*incidents*" (as that term is defined in SSD-5170) during the Reporting Period.

Table 28 provides details of matters or exceedances during the Reporting Period that were reported by BMC to regulatory authorities. Matters addressed at **Section 11.1** are not reproduced in **Table 28.**

Table 28: Reportable Matters or Exceedances 2023

No	Date	Reported To	Nature	Details	Action Taken	Matter Status
1.	6 March 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.

No	Date	Reported To	Nature	Details	Action Taken	Matter Status
2.	29 May 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
3.	20 September 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
4.	4 November 2023	EPA	Blast Fume	Potential Blast Fume	NSW EPA have issued a s191 (under the Protection of the Environment Operations Act 1997) Notice to Provide Information and Records.	BMC have responded to this matter and is still with the Environment Protection Authority.
5.	2 October 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI.	No further action required. Completed and closed.

No	Date	Reported To	Nature	Details	Action Taken	Matter Status
					BMC also supplied operations summary for relevant date to DPHI.	
6.	2 October 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-3	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
7.	7 December 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-3	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
8.	13 December 2023	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.

No	Date	Reported To	Nature	Details	Action Taken	Matter Status
9.	19 December	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-1	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
10.	19 December	DPHI	Air Quality	Potential exceedance of 24-hour air quality criteria at PM10-3	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.
11.	**2023**	**DPHI**	**Air Quality**	Potential exceedance of annual air quality criteria at PM10-1 and PM-3	Expert report (concluding BMC did not exceed criteria) supplied to DPHI. BMC also supplied operations summary for relevant date to DPHI.	No further action required. Completed and closed.

ACTIONS TO BE TAKEN TO PREVENT ENVIRONMENTAL INCIDENTS

BMC seeks to improve environmental and community performance through training of employees and contractors and implementation of the BMC environmental management system.

12 ACTIVITIES PROPOSED IN THE NEXT REPORTING PERIOD

This section summarises the operational and environmental management activities proposed to be undertaken during 2024.

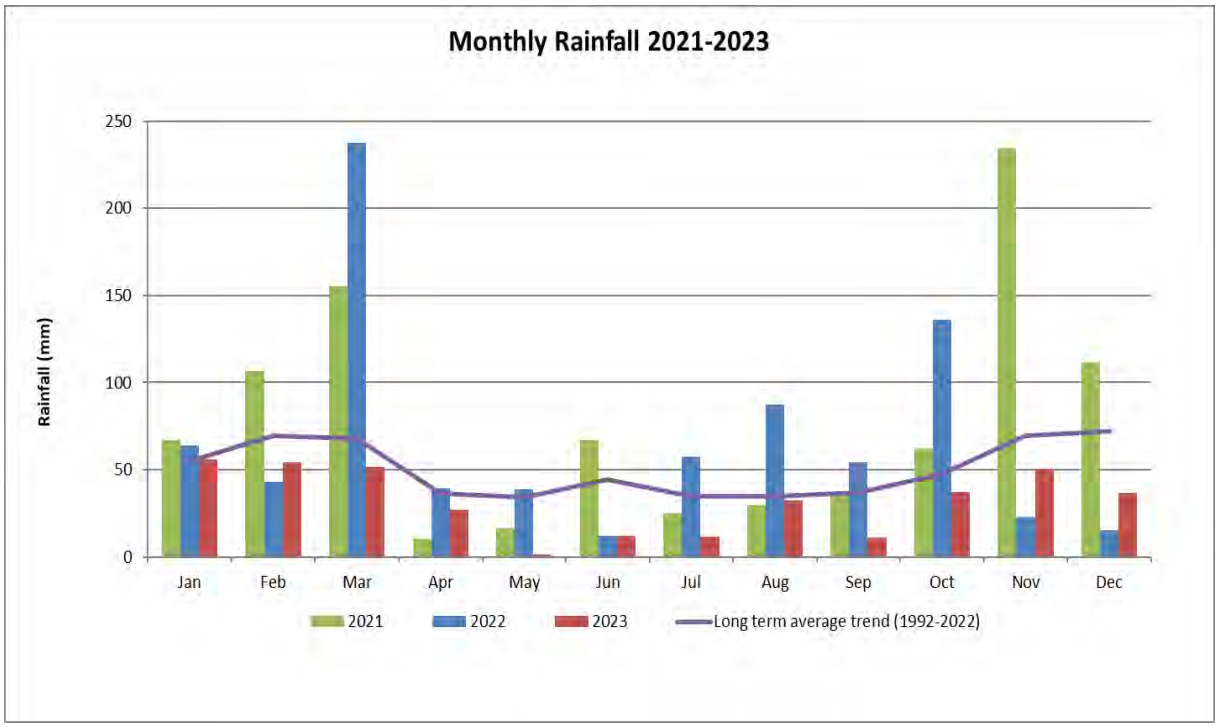
A summary of key environmental management activities proposed for 2024 is presented in **Table 29**. Progress against these activities will be reported in the 2024 Annual Review.

Table 29: Environmental Management Activities Proposed for 2024

Area / Issue	Actions Proposed	Timeline for Implementation
Air quality	Installation and commissioning of updated Air Quality monitoring network.	December 2024 (subject to change due to delivery time of monitors and mains power supply to monitor site).
Regulatory	Continued assessment and preparation of SSD-5170 Modification Application 6.	Q1 2024
Audit	Complete actions identified in 2023 Independent Environmental Audit.	To be progressed during 2024.
Management Plans	Undertake reviews of management plans in accordance with SSD-5170 (if required)	Following approval of Mod 6.
Tree Screening	Progress Denman Road tree screening (Schedule 3, Condition 40 and 41A of SSD-5170).	To be progressed during 2024.
Offsets	Progress long-term security of biodiversity offset areas (Schedule 3, Condition 28 of SSD-5170).	To be progressed during 2024.
Rehabilitation	Undertake new rehabilitation and installation of HDWV into existing rehabilitation according to the Rehabilitation Management Plan and Forward Program. Continue implementation of Rehabilitation Strategy (Schedule 3, Condition 47 of SSD-5170).	To be progressed during 2024.
Noise	Integrate updated Roxburgh real time noise monitor into SCADA system	Q1 2024

Appendix A

Meteorological Monitoring Summary



Graph A1
Bengalla Monthly Rainfall 2021 to 2023

Table A1
Monthly Temperatures 2023

Month	Minimum Daily Temperature (°C)	Maximum Daily Temperature (°C)
January	11.0	38.0
February	8.9	39.1
March	8.3	40.0
April	5.6	28.0
May	-2.9	24.9
June	-5.1	24.2
July	-4.6	24.6
August	-0.1	26.2
September	-0.7	32.9
October	3.8	35.5
November	8.4	37.2
December	12.2	40.9

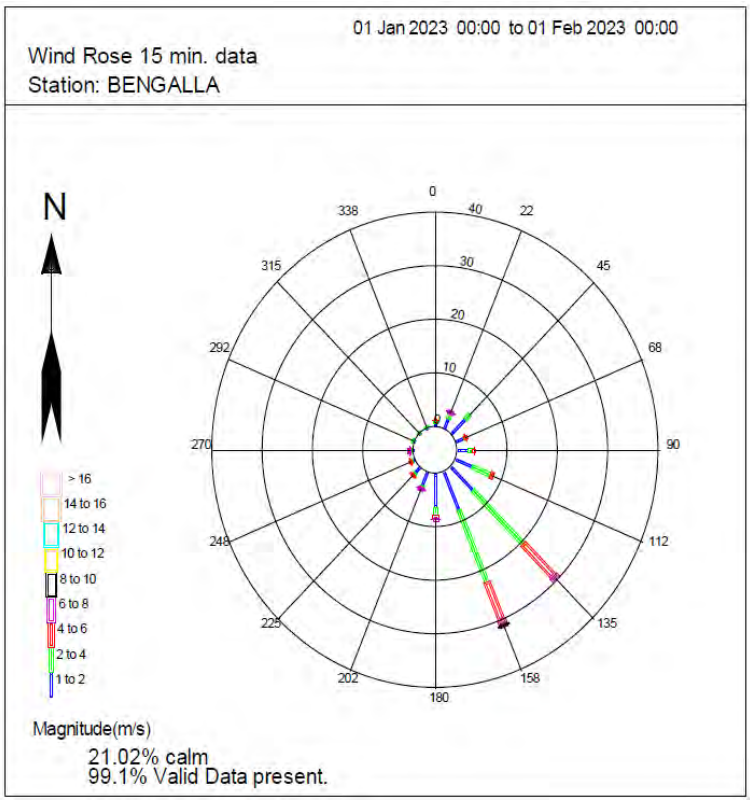


Figure A1
Bengalla January 2023 Windrose

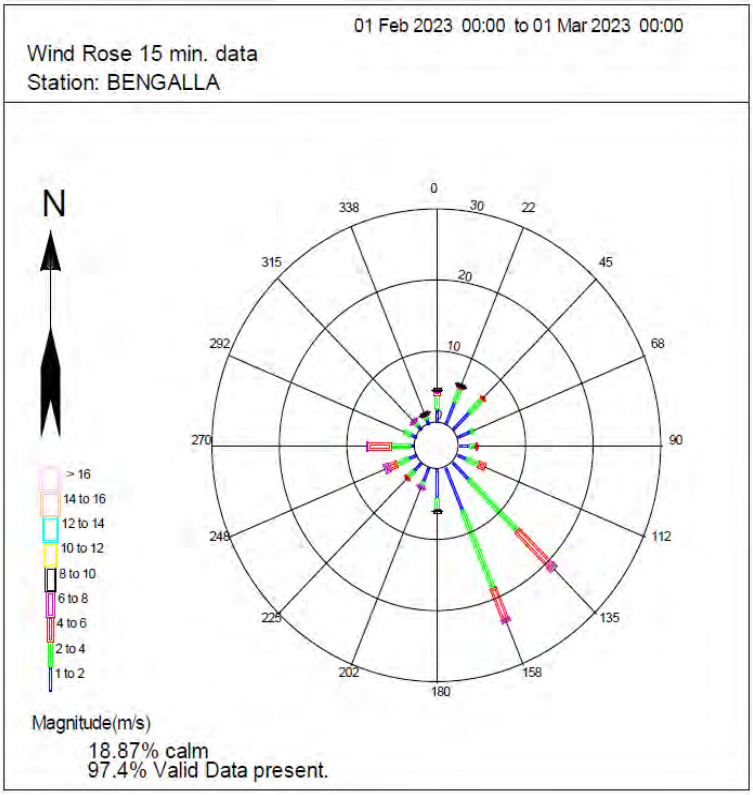


Figure A2
Bengalla February 2023 Windrose

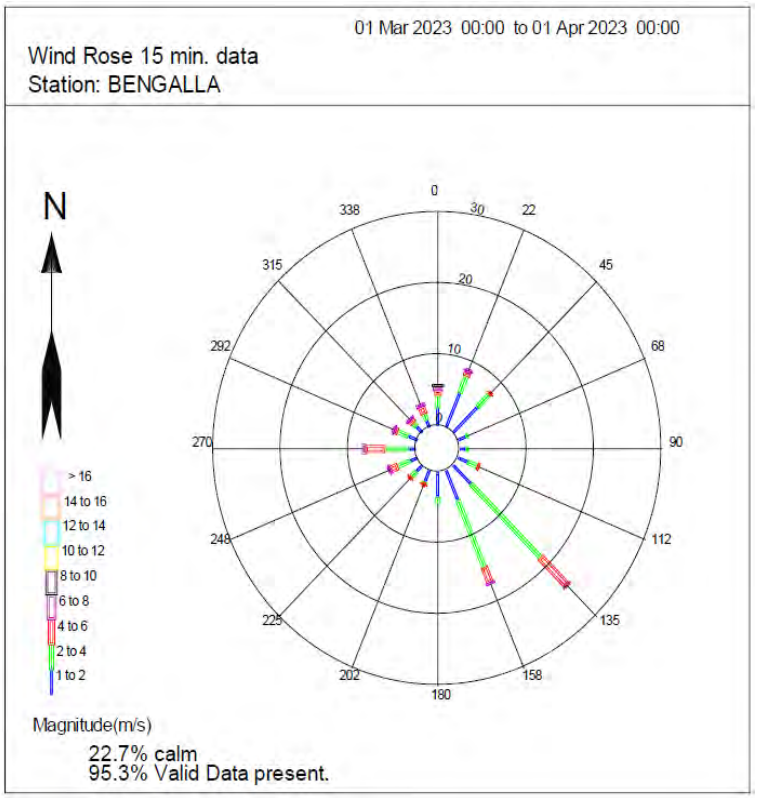


Figure A3
Bengalla March 2023 Windrose

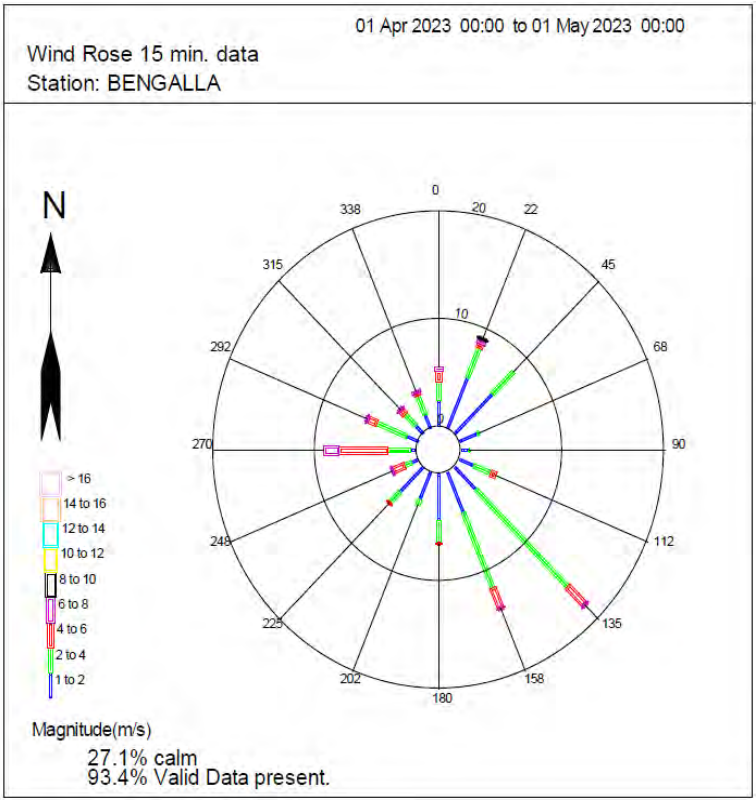


Figure A4
Bengalla April 2023 Windrose

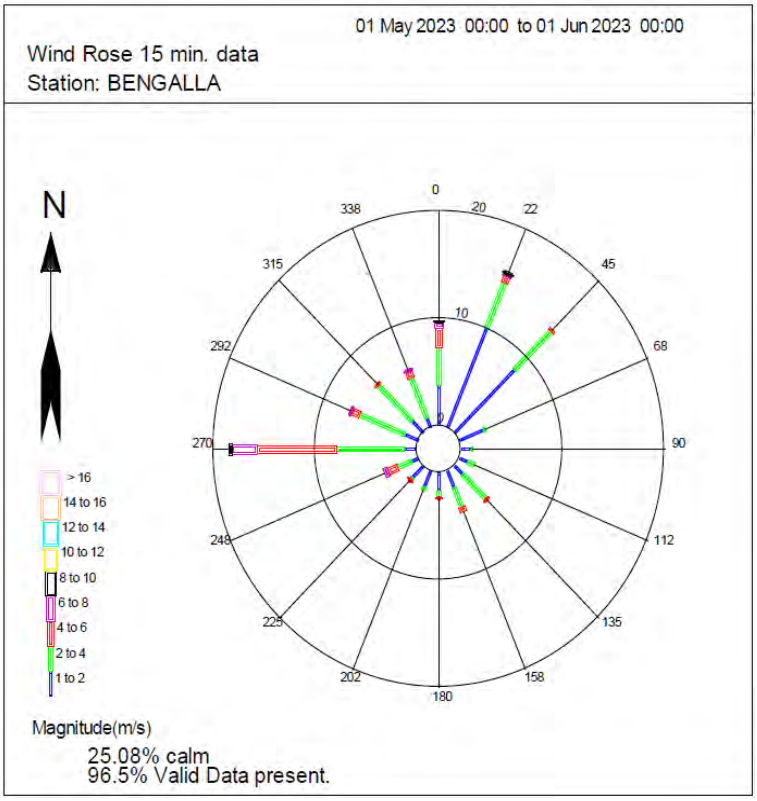


Figure A5
Bengalla May 2023 Windrose

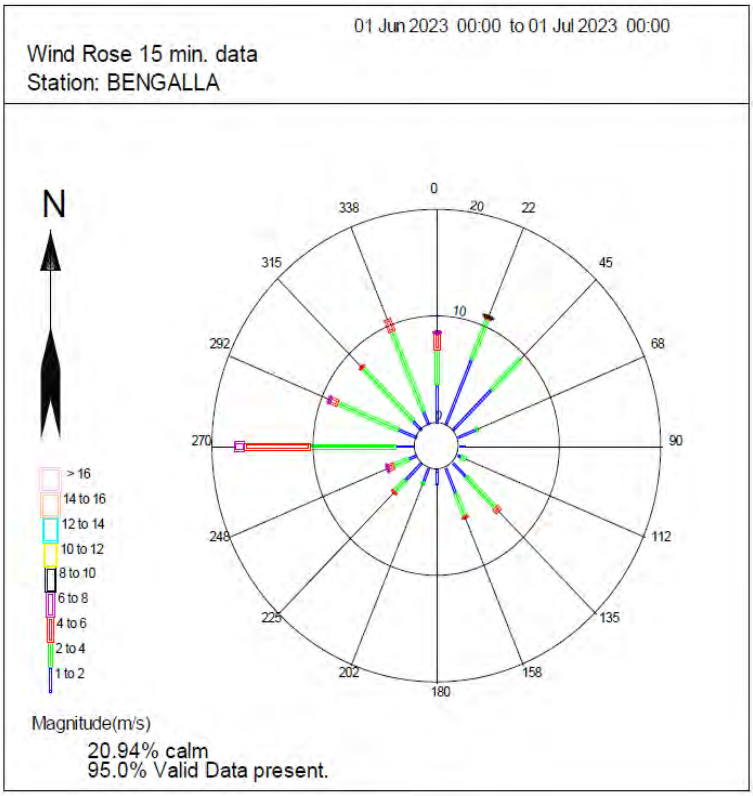


Figure A6
Bengalla June 2023 Windrose

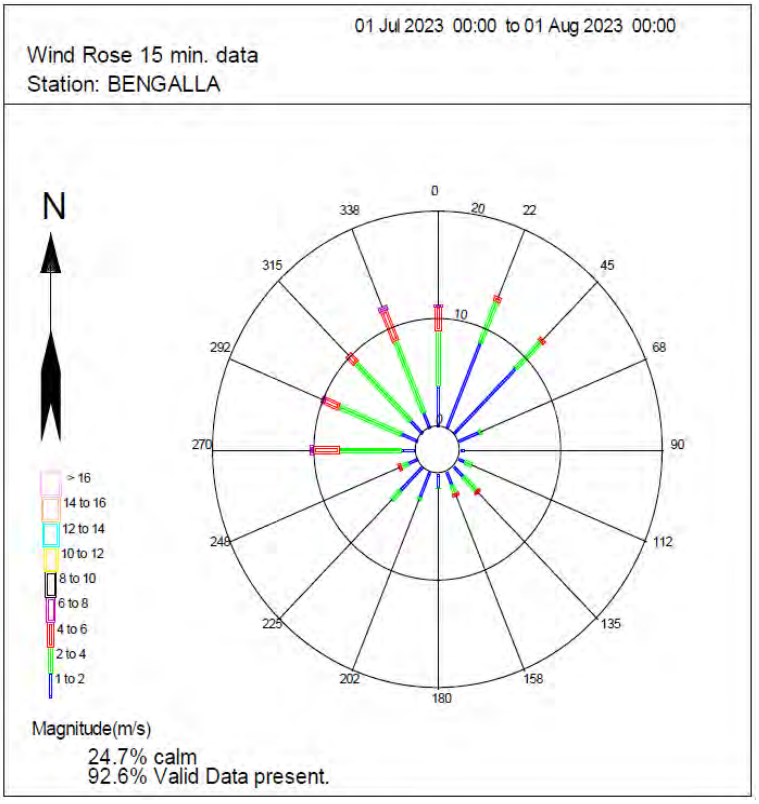


Figure A7
Bengalla July 2023 Windrose

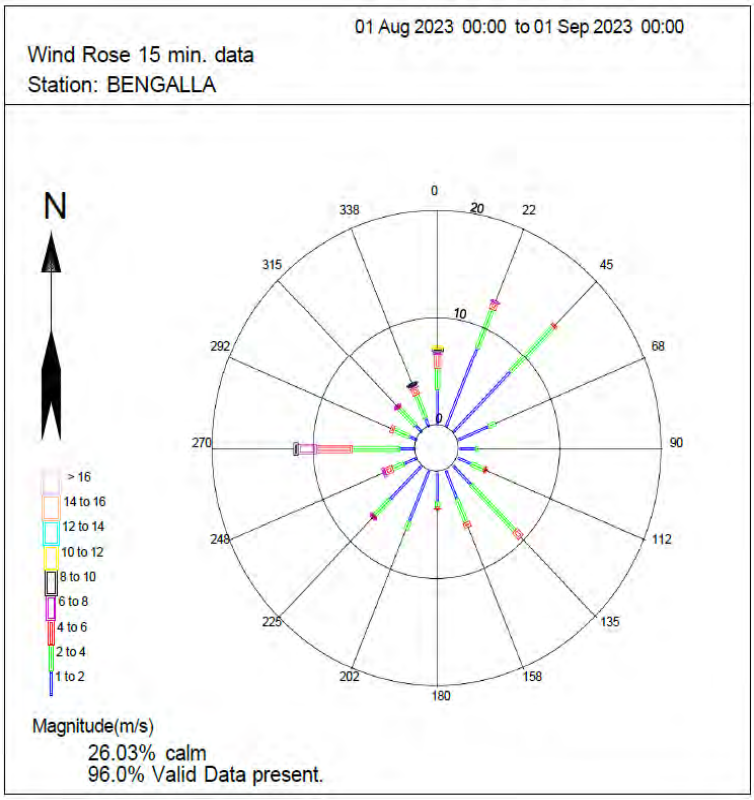


Figure A8
Bengalla August 2023 Windrose

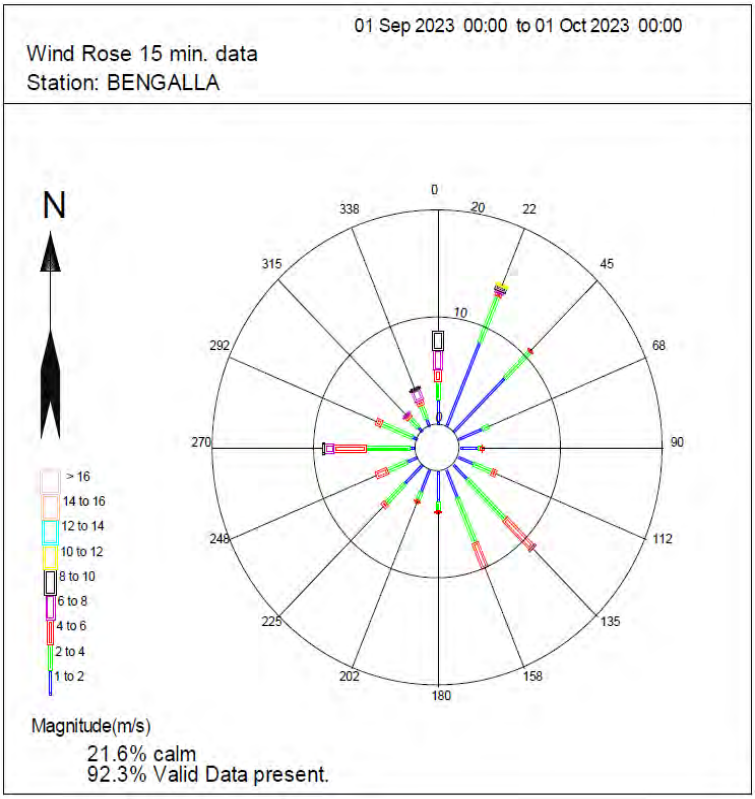


Figure A9
Bengalla September 2023 Windrose

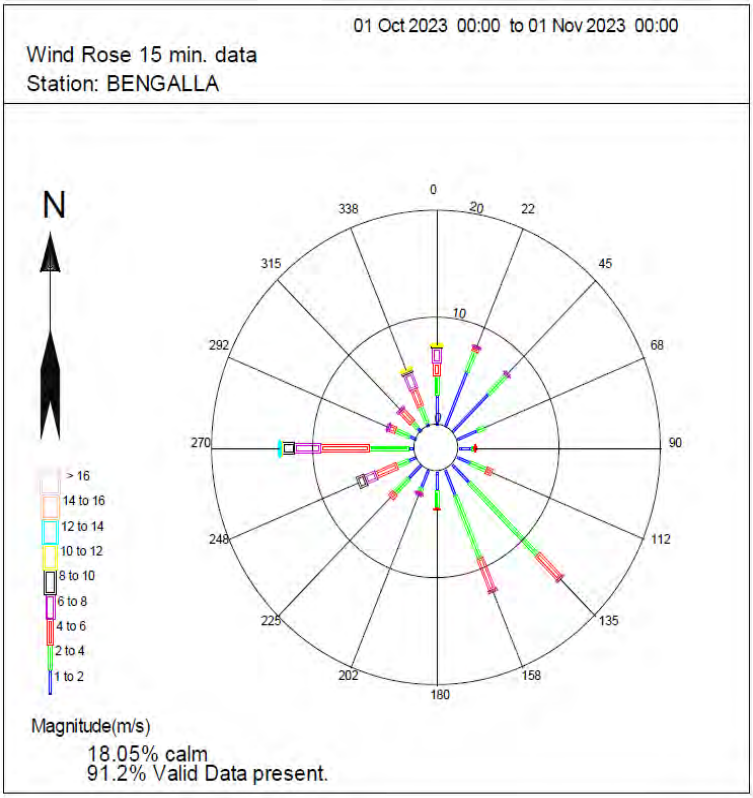


Figure A10
Bengalla October 2023 Windrose

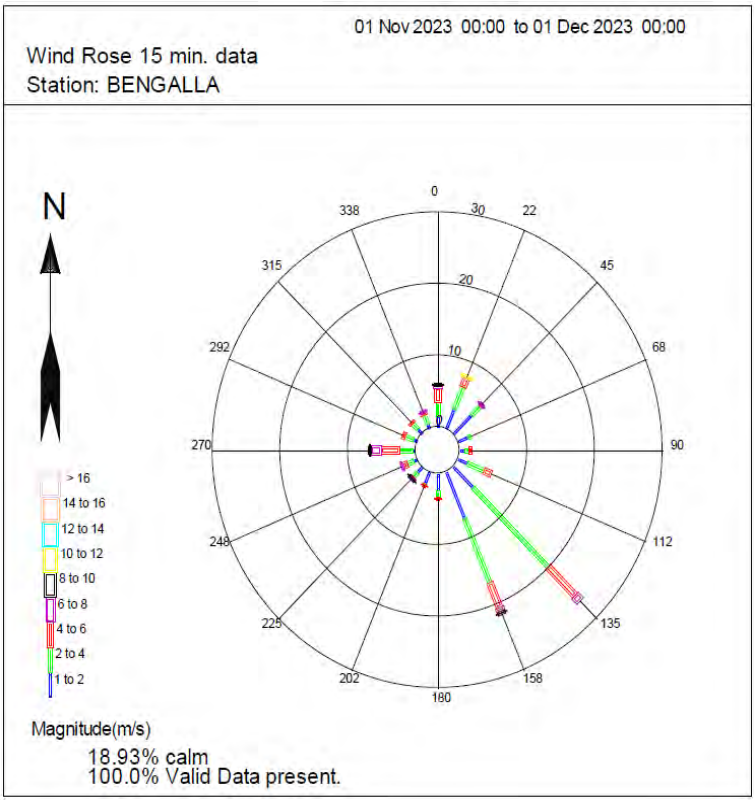


Figure A11
Bengalla November 2023 Windrose

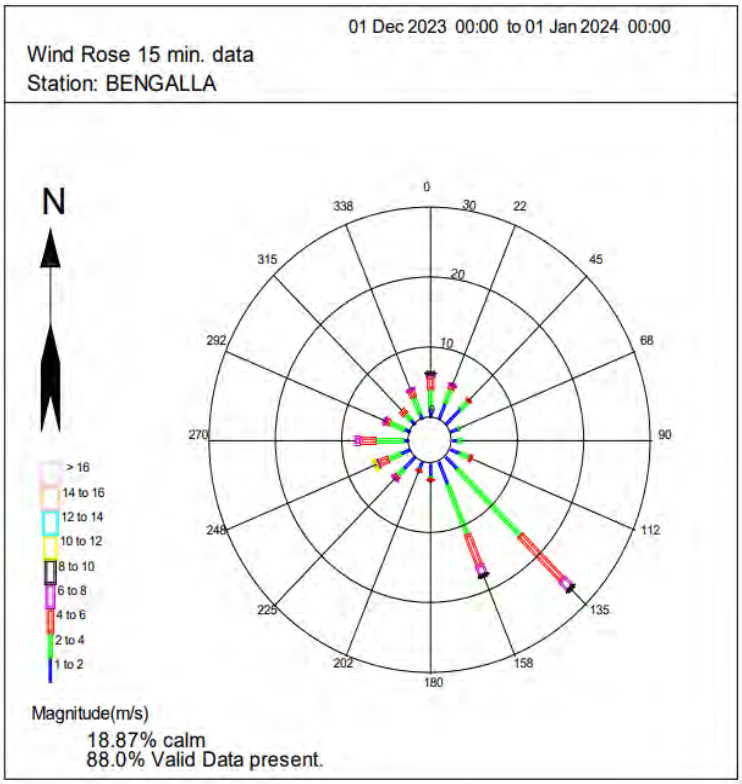


Figure A12
Bengalla December 2023 Windrose

Notes:
Sourced from Benchmark Monitoring.

Appendix B

Noise Monitoring Summary

Table B1
Summary of Compliance Attended Noise Monitoring Results 2023

Site	Month	Met Conditions within Range? [3]	BMC only LA_{eq} dB [1]	BMC Impact Assessment LA_{eq} criterion [1, 4]	BMC only LC_{eq} dB [2]	BMC Impact Assessment LC_{eq} criterion [2, 4]	BMC only $LA_{1,1\ min}$ dB [5]	BMC $LA_{1,1\ min}$ criterion [4]	Exceedance dB
AN01	Jan-23	Yes	27	35	47	60	31	45	No
	Feb-23	Yes	23	35	44	60	37	45	No
	Mar-23	Yes	30	35	50	60	39	45	No
	Apr-23	No	32	35	50	60	40[#8]	45	No
	May-23	No	32	35	52	60	35	45	No
	Jun-23	Yes	IA	35	IA	60	IA	45	No
	Jul-23	No	38	35	55	60	44[#6]	45	N/A
	Aug-23	Yes	34	35	54	60	43[#6]	45	No
	Sep-23	Yes	24	35	45	60	33[#6]	45	No
	Oct-23	No	25	35	48	60	32[#6]	45	No
	Nov-23	Yes	32	35	59	60	43[#6]	45	No
	Dec-23	Yes	33	35	49	60	35	45	No

Site	Month	Met Conditions within Range? [3]	BMC only LA_{eq} dB [1]	BMC Impact Assessment LA_{eq} criterion [1, 4]	BMC only LC_{eq} dB [2]	BMC Impact Assessment LC_{eq} criterion [2, 4]	BMC only $LA_{1,1\ min}$ dB [5]	BMC $LA_{1,1\ min}$ criterion [4]	Exceedance dB
AN03	Jan-23	Yes	IA	40	IA	60	IA	45	No
	Feb-23	No	29	40	51	60	31	45	No
	Mar-23	Yes	IA	40	IA	60	IA	45	No
	Apr-23	Yes	34	40	54	60	36	45	No
	May-23	No	IA	40	IA	60	IA	45	No
	Jun-23	Yes	IA	40	IA	60	IA	45	No
	Jul-23	No	IA	40	IA	60	IA	45	N/A
	Aug-23	Yes	<30	40	<60	60	<30	45	No
	Sep-23	Yes	34	40	57	60	39	45	No
	Oct-23	No	IA	40	IA	60	IA	45	No
	Nov-23	Yes	IA	40	IA	60	IA	45	No
	Dec-23	Yes	IA	40	IA	60	IA	45	No

Site	Month	Met Conditions within Range? [3]	BMC only LA_{eq} dB [1]	BMC Impact Assessment LA_{eq} criterion [1, 4]	BMC only LC_{eq} dB [2]	BMC Impact Assessment LC_{eq} criterion [2, 4]	BMC only $LA_{1,1\ min}$ dB [5]	BMC $LA_{1,1\ min}$ criterion [4]	Exceedance dB
AN04	Jan-23	Yes	IA	35	IA	60	IA	45	No
	Feb-23	Yes	36	35	56	60	44	45	No (within 2 dBA)
	Mar-23	Yes	22	35	Est 50	60	23	45	No
	Apr-23	Yes	35	35	56	60	37	45	No
	May-23	No	<35	35	<58	60	39	45	No
	Jun-23	Yes	32	35	50	60	46[#7]	45	No (within 2 dBA)
	Jul-23	No	37	35	56	60	46[#6]	45	N/A
	Aug-23	Yes	30	35	50	60	32	45	No
	Sep-23	Yes	Est 25	35	IA	60	IA	45	No
	Oct-23	No	36	35	57	60	43[#6]	45	Invalid weather conditions
	Nov-23	Yes	36[#7]	35	57	60	43[#6]	45	No (within 2 dBA)
	Dec-23	Yes	IA	35	IA	60	IA	45	No

Source: Bridges Acoustics (2023)

***Notes** (modified from Bridges Acoustics, 2023)*

1. LAeq,15minute operational noise levels for BMC in the absence of all other noise sources;

2. LCeq,15minute operational noise levels for BMC in the absence of all other noise sources.

3. 'Yes' denotes meteorological conditions result in relevant criteria being applicable. 'No' denotes meteorological conditions are outside those specified in NSW Industrial Noise Policy;

4. From SSD-5170 (as modified) and EPL 6538. Monitoring locations AN02 and AN03 are closer to mining operations than the nearest private receiver. A correction factor has been applied based on noise modelling for the continuation of Bengalla Mine EIS (Hanson Bailey, 2013) as outlined in the approved NMP;

5. LA1,1minute operational noise levels for BMC in the absence of all other noise source;

6. The reported LA1,1min level includes a +5 dBA correction to periods of tonal noise

7. The estimated noise level of LAeq,15min is within 2 dBA of the criterion and is therefore considered compliant with the relevant conditions of SSD-5170.

8. The tonal-corrected noise level of LA1,1min is within 2 dBA above the criterion and occurred under invalid weather conditions and therefore compliant with relevant conditions of SSD-5170.

9. N/A – Noise criteria do not apply due to a strong temperature inversion at the time of the survey (Bridges Acoustics – July 2023.

IA = inaudible

Appendix C

Blast Monitoring Summary

Table C1

Blast Monitoring Summary – 2023

BLAST DETAILS				GROUND VIBRATION (mm/s)			OVERPRESSURE (dBL)		
Event No.	Date	Time of Blast	Blast Code	Blake[2]	Moore	School[1]	Blake[2]	Moore	School[1]
1	03/01/23	11:00:58 AM	S40-10-IB-PF2	0.11	1.15	0.04	92.6	97.5	87.7
2	03/01/23	11:02:08 AM	S41-05-IB-WW3	0.14	0.78	0.04	93.4	103.3	88.8
3	07/01/23	11:23:00 AM	S40-03-CI-MAPF	0.13	0.62	0.04	90.2	108.6	85.4
4	07/01/23	11:23:00 AM	S41-03-IB-WW3	0.17	0.95	0.04	94.4	108.6	100.7
5	09/01/23	11:25:48 AM	S43-04-IB-RL181	0.09	1.36	0.03	82.1	108.0	89.0
6	11/01/23	12:37:50 PM	S39-25-IB-WN	0.13	0.72	0.09	101.4	113.4	97.7
7	11/01/23	12:39:56 PM	S41-25-CI-MAPF	0.04	0.42	0.03	100.6	98.2	86.8
8	13/01/23	11:52:28 AM	S40-15-IB-VARL	0.35	2.97	0.11	98.7	104.9	89.5
9	16/01/23	9:01:49 AM	S40-02-CI-MAPF	0.29	0.72	0.06	102.8	92.9	95.2
10	17/01/23	11:02:52 AM	S39-23-IB-WN	0.08	0.46	0.07	91.0	97.7	93.7
11	19/01/23	11:59:07 AM	S40-27-IB-VA1	0.11	0.84	0.10	92.6	98.4	93.0
12	21/01/23	11:34:00 AM	S39-12-IB-WN	0.05	0.31	0.03	99.5	109.3	92.9
13	24/01/23	11:54:52 AM	S39-15-IB-WN	0.06	0.54	0.04	92.0	101.1	107.1
14	27/01/23	11:29:36 AM	S39-11-IB-WN	0.02	0.09	0.01	94.8	87.4	77.6
15	27/01/23	11:27:37 AM	S39-18-IB-WN	0.18	0.58	0.05	99.3	107.0	93.3
16	28/01/23	2:28:00 PM	S40-14-IB-VA1	0.31	2.05	0.09	92.5	97.1	91.6
17	30/01/23	1:32:36 PM	S40-06-IB-PF2	0.20	1.73	0.08	91.1	100.5	90.3
18	01/02/23	3:09:44 PM	S40-12-IB-VA1	0.17	2.71	0.08	93.4	101.0	92.6
19	03/02/23	11:26:45 AM	S40-03-IB-PF2	0.21	1.21	0.05	96.5	106.7	109.5
20	03/02/23	3:32:24 PM	S43-26-IB-WW2	0.02	0.24	0.01	103.2	110.9	106.8
21	06/02/23	10:59:29 AM	S39-03-IB-WN	0.09	0.33	0.03	94.7	102.7	97.0
22	08/02/23	11:00:52 AM	S40-29-IB-VA1	0.04	0.22	0.03	101.9	101.2	91.1
23	08/02/23	4:25:24 PM	S39-09-IB-WN	0.09	0.43	0.05	108.8	103.2	90.6
24	11/02/23	2:52:30 PM	S39-06-IB0-WN	0.05	0.22	0.02	89.3	98.8	95.7
25	14/02/23	11:02:43 AM	S41-07-IB-WW4	0.18	1.77	0.07	104.1	107.6	88.3
26	16/02/23	11:33:45 AM	S41-04-IB-WW4	0.14	1.40	0.06	94.5	105.6	89.2
27	18/02/23	10:05:51 AM	S40-11-IB-VA1	0.33	3.11	0.17	93.7	101.2	96.3
28	21/02/23	10:59:34 AM	S40-08-IB-VA1	0.25	3.47	0.12	88.9	101.0	93.1
29	24/02/23	12:06:28 PM	S41-01-IB-WW2	0.07	0.66	0.05	94.0	108.6	101.7
30	24/02/23	12:07:26 PM	S40-00-IB-RL181	0.04	0.79	0.02	101.0	100.9	104.9
31	27/02/23	10:58:43 AM	S40-15-IB-VA1	0.05	0.73	0.07	90.7	91.7	92.2
32	02/03/23	10:58:28 AM	S40-19-IB-VA1	0.02	1.08	0.08	104.4	98.6	87.4
33	04/03/23	2:22:32 PM	S40-23-IB-VA1	0.03	0.86	0.09	106.3	109.8	89.9

34	06/03/23	3:03:28 PM	S40-06-IB-VA1	0.02	2.94	0.12	108.2	96.5	106.4
35	10/03/23	2:59:55 PM	S40-02-IB-PF2 & S40-04-IB-VA1	0.30	3.30	0.08	92.1	100.3	88.9
36	10/03/23	3:00:55 PM	S41-01-IB-WW3 & S41-01-PS-MA2	0.21	0.12	0.05	93.9	99.4	88.8
37	13/03/23	11:33:01 AM	S43-05-IB-WW2	0.12	1.29	0.05	102.2	111.1	84.2
38	16/03/23	3:30:40 PM	S41-14-CI-MAPF	0.11	0.90	0.05	99.6	101.0	106.3
39	17/03/23	3:26:04 PM	S40-22-IB-BY1	0.05	0.45	0.05	93.4	98.4	92.4
40	18/03/23	11:02:13 AM	S40-26-IB-VA1	0.07	0.48	0.06	96.9	94.5	95.8
41	22/03/23	11:16:40 AM	S40-03-IB-VA1	0.30	2.88	0.08	99.5	100.2	89.6
42	22/03/23	11:17:35 AM	S41-03-IB-WW4	0.09	0.62	0.02	96.0	103.9	90.7
43	24/03/23	9:35:09 AM	S43-06-IB-WW2	0.18	4.15	0.07	89.2	101.2	88.5
44	30/03/23	4:05:38 PM	S41-29-IB-WW2	0.02	0.64	0.07	105.6	101.7	104.8
45	31/03/23	10:57:00 AM	S40-16-IB-BR1	0.05	0.48	0.05	94.2	97.9	90.7
46	03/04/23	11:27:40 AM	S40-12-IB-BR1	0.19	2.73	0.07	105.0	108.5	89.9
47	04/04/23	12:00:05 PM	S43-26-IB-WW3	0.05	0.67	0.06	101.9	108.2	93.3
48	05/04/23	10:58:03 AM	S40-01-IB-PF2	0.19	0.86	0.05	92.2	95.8	90.6
49	11/04/23	11:35:56 AM	S41-12-CI-MAPF	0.09	1.30	0.04	89.3	101.6	91.4
50	11/04/23	11:36:32 AM	S43-04-IB-WW1	0.22	4.26	0.09	104.9	115.3	99.0
51	13/04/23	12:28:18 PM	S40-09-IB-BR1	0.30	1.57		97.0	101.0	
52	15/04/23	3:22:20 PM	S40-02-IB-VA1	0.59	4.76		86.2	99.6	
53	17/04/23	10:52:43 AM	S43-22-IB-WW4	0.14	2.33		91.8	103.9	
54	19/04/23	4:05:34 PM	S44-00-OB-RL181	0.23	4.59		92.7	107.6	
55	21/04/23	12:02:29 PM	S43-26-IB-WW4	0.18	5.46		97.0	106.2	
56	24/04/23	2:55:45 PM	S40-07-IB-BR1	0.19	2.20		96.2	104.0	
57	26/04/23	11:10:43 AM	S43-03-IB-RL181	0.15	5.73		90.2	114.1	
58	27/04/23	4:03:20 PM	S40-19-PS-BYWN	0.54	1.84		90.9	100.8	
59	27/04/23	4:04:35 PM	S41-29-IB-WW3	0.09	0.53		86.4	102.2	
60	01/05/23	3:57:47 PM	S41-09-IB-MA1	0.05	0.65		103.8	99.7	
61	04/05/23	2:57:13 PM	S40-19-IB-BR2C	0.06	0.28		99.3	105.4	
62	06/05/23	3:54:18 PM	S40-05-IB-BR1	0.34	3.38		93.4	98.6	
63	09/05/23	3:54:19 PM	S40-02-IB-BR1	0.42	2.30		92.1	98.7	
64	12/05/23	3:59:24 PM	S40-11-PS-BYWN	0.27	1.96		88.1	97.2	
65	12/05/23	4:01:19 PM	S43-18-IB-WW4	0.14	2.23		89.4	105.4	
66	15/05/23	2:51:45 AM	S41-05-IB-MA1	0.14	1.92		96.9	105.6	
67	17/05/23	11:55:16 AM	S41-18-IB-PF2	0.05	0.53		99.8	109.4	
68	19/05/23	3:31:21 PM	S41-09-CI-MAPF	0.11	1.71		98.7	107.2	
69	23/05/23	3:05:55 PM	S40-25-PS-BYWN	0.29	1.67		87.0	93.2	
70	23/05/23	3:07:08 PM	S43-16-IB-WW4	0.19	4.21		88.9	103.3	
71	24/05/23	3:29:02 PM	S41-01-IB-WW4 & S41-03-IB-MA1	0.41	2.18		93.9	100.2	
72	29/05/23	3:58:34 PM	S43-01-IB-WW1	0.27	5.90		88.6	100.2	

73	31/05/23	3:01:27 PM	S40-11-IB-BY1	0.19	2.14		91.1	93.7	
74	01/06/23	3:02:58 PM	S40-24-IB-BR2C	0.38	0.65		102.1	96.4	
75	03/06/23	4:00:59 PM	S40-18-IB-BR2A	0.12	0.35		93.6	105.4	
76	06/06/23	3:57:03 PM	S41-26-CI-MAPF	0.08	0.73		97.8	112.4	
77	09/06/23	4:03:39 PM	S40-03-PS-BYWN	0.33	2.47		95.7	97.0	
78	10/06/23	4:10:25 PM	S44-06-IB-WW1	0.14	5.18		91.0	101.9	
79	13/06/23	4:01:53 PM	S40-07-PS-BYWN	0.29	1.86		96.5	93.0	
80	13/06/23	4:03:10 PM	S41-07-CI-MAPF	0.09	0.90		105.9	104.8	
81	14/06/23	3:30:24 PM	S40-16-IB-BY1	0.13	1.48		94.2	100.1	
82	17/06/23	1:27:10 PM	S40-17-IB-BY1	0.04	0.26		90.0	100.8	
83	17/06/23	1:27:47 PM	S40-21-IB-BR2A	0.15	1.35		91.0	91.3	
84	19/06/23	12:23:27 PM	S41-23-IB-VARL	0.25	1.81		94.9	101.7	
85	22/06/23	4:29:09 PM	S41-20-IB-VARL	0.60	3.58		94.2	103.6	
86	22/06/23	4:29:09 PM	S41-21-IB-VARL	0.60	3.58		94.2	103.6	
87	24/06/23	3:53:33 PM	S41-01-IB-MA1	0.16	1.70		101.8	101.9	
88	26/06/23	3:58:10 PM	S40-19-IB-BY1	0.14	1.06		100.0	106.8	
89	26/06/23	3:58:10 PM	S40-21-RA-BY1	0.14	1.06		100.0	106.8	
90	28/06/23	4:06:42 PM	S41-27-IB-WWRL	0.11	0.77		87.5	92.3	
91	30/06/23	4:22:40 PM	S40-08-IB-BY1	0.39	2.47		97.1	101.0	
92	04/07/23	2:33:19 PM	S41-13-IB-PF2	0.05	0.57		91.3	103.3	
93	05/07/23	4:04:04 PM	S41-27-IB-PF2	0.13	1.69		87.6	96.6	
94	10/07/23	3:28:48 AM	S40-24-IB-BR2A	0.05	0.34		94.1	103.4	
95	11/07/23	12:05:35 PM	S41-03-CI-MAPF	0.14	1.07		84.8	100.0	
96	12/07/23	3:25:19 PM	S43-09-IB-WW3	0.13	1.53		92.9	107.8	
97	14/07/23	1:27:30 PM	S43-03-IB-WW3	0.12	1.86		94.6	105.1	
98	17/07/23	3:59:01 PM	S41-25-IB-PF2	0.09	1.39		85.5	100.2	
99	17/07/23	4:00:08 PM	S41-29-IB-WW4	0.08	0.95		83.3	93.9	
100	18/07/23	3:51:26 PM	S40-05-IB-BY1	0.46	1.63		102.1	96.6	
101	21/07/23	4:05:30 PM	S43-12-IB-WW4	0.13	2.02		93.6	104.4	
102	22/07/23	3:26:25 PM	S40-03-IB-BY1	0.34	1.91		83.9	101.1	
103	25/07/23	11:39:37 AM	S41-16-IB-VARL	0.35	3.28		86.1	99.9	
104	28/07/23	11:02:29 AM	S40-23-IB-BY1	0.13	0.87		105.1	103.3	
105	31/07/23	12:41:49 PM	S41-02-CI-MAPF	0.20	1.19		85.5	96.8	
106	31/07/23	12:43:29 PM	S41-14-IB-VARL	0.32	2.58		96.9	98.9	
107	01/08/23	3:55:33 PM	S41-29-IB-VARL	0.21	1.53		84.8	98.4	
108	01/08/23	3:55:33 PM	S41-30-CI-MAPF	0.21	1.53		84.8	98.4	
109	05/08/23	10:54:55 AM	S44-09-IB-WW2	0.14	2.50		91.4	110.5	
110	7/08/2023	4:01:08 PM	S44-29-IB-WW2	0.15	1.27		94.1	105.4	
111	9/08/2023	3:31:28 PM	S40-11-IB-WN	0.06	0.32		90.6	98.9	

112	9/08/2023	3:32:49 PM	S41-10-IB-PF2	0.11	2.06		88.9	99.3	
113	11/08/2023	4:05:17 PM	S44-31-IB-WW2	0.15	0.96		86.4	100.6	
114	14/08/2023	11:01:01 AM	S44-18-IB-WW4	0.18	3.38		93.5	99.3	
115	16/08/2023	11:28:22 AM	S41-24-IB-VARL	0.19	2.44		88.3	105.3	
116	19/08/2023	4:03:26 PM	S41-26-IB-VARL	0.24	2.38		103.4	107.1	
117	22/08/2023	3:31:57 PM	S43-08-IB-WW4	0.15	2.82		88.0	99.9	
118	23/08/2023	3:59:57 PM	S41-03-IB-PF2		1.59			103.6	
119	25/08/2023	3:00:34 PM	S41-06-IB-PF2		1.94			100.9	
120	28/08/2023	2:57:27 PM	S44-20-IB-WW4		1.44			104.2	
121	30/08/2023	3:01:23 PM	S41-11-IB-VA1		3.30			96.2	
122	4/09/2023	10:57:44 AM	S46-09-IB-WW2		3.36			105.4	
123	6/09/2023	3:07:31 PM	S40-06-IB-WN		0.50			107.0	
124	7/09/2023	3:09:44 PM	S40-10-IB-WN		0.14			105.1	
125	8/09/2023	12:09:00 PM	S43-22-CI-MAPF		1.26			105.6	
126	11/09/2023	2:23:46 PM	S40-12-IB-WN		0.65			104.0	
127	15/09/2023	12:31:22 PM	S43-04-IB-WW4		2.74			101.8	
128	15/09/2023	12:32:08 PM	S43-01-IB-WW2		0.93			100.1	
129	18/09/2023	12:07:38 PM	S43-17-CI-MAPF		1.43			101.7	
130	20/09/2023	15:52:18 PM	S41-07-IB-VA1		3.21			99.5	
131	22/09/2023	3:57:34 PM	S41-29-IB-PF2		0.89			102.6	
132	22/09/2023	3:58:36 PM	S43-29-IB-WW2		0.98			110.5	
133	26/09/2023	4:14:32 PM	S41-04-IB-VA1		2.91			100.6	
134	26/09/2023	4:17:03 PM	S43-04-IB-WW3		2.34			99.9	
135	28/09/2023	4:00:52 PM	S40-18-IB-WN		0.51			112.3	
136	30/09/2023	2:54:29 PM	S41-23-IB-VA1		1.45			97.7	
137	6/10/2023	4:02:12 PM	S46-14-IB-WW3		1.75			111.0	
138	6/10/2023	4:03:00 PM	S44-32-IB-WW2		1.78			104.2	
139	7/10/2023	3:28:31 PM	S41-27-IB-VA1		0.79			102.5	
140	9/10/2023	11:58:47 PM	S41-02-IB-PF2		0.81			96.4	
141	11/10/2023	11:31:02 AM	S41-18-IB-VA1		1.48			99.0	
142	13/10/2023	4:11:42 PM	S43-15-CI-MAPF		1.07			104.9	
143	13/10/2023	4:13:47 PM	S43-29-IB-WW3		0.73			98.4	
144	16/10/2023	9:57:46 AM	S41-03-IB-VA1		2.57			102.9	
145	17/10/2023	12:06:07 PM	S41-18-IB-VA1		1.13			100.2	
146	19/10/2023	10:55:38 AM	S40-25-IB-WN		0.69			109.6	
147	21/10/2023	11:32:22 AM	S40-22-IB-WN		0.52			111.1	
148	21/10/2023	11:33:06 AM	S43-14-CI-MAPF		1.66			80.4	
149	24/10/2023	4:14:12 PM	S41-29-IB-VA1		0.21			96.9	
150	24/10/2023	4:15:31 PM	S47-28-IB-WW2		1.66			96.7	

151	26/10/2023	4:16:42 PM	S40-12-IB-WN		0.25			113.1	
152	30/10/2023	11:56:32 AM	S44-04-IB-WW1		4.88			104.0	
153	31/10/2023	11:57:55 AM	S41-02-IB-VA1		2.49			113.2	
154	4/11/2023	10:29:31 AM	S44-26-IB-WW2		2.01			105.6	
155	7/11/2023	10:54:57 AM	S41-12-IB-BR1		2.54			98.5	
156	10/11/2023	12:07:32 PM	S44-17-IB-WW4		2.84			97.7	
157	13/11/2023	4:05:56 PM	S43-29-IB-WWRL & S43-26-CI-MAPF		0.67			101.4	
158	14/11/2023	12:02:16 PM	S56-25-IB-WW1		0.09			102.9	
159	16/11/2023	1:02:46 PM	S44-15-IB-WW4		3.67			103.8	
160	20/11/2023	12:27:09 PM	S40-03-IBN-WN		0.59			103.1	
161	20/11/2023	12:27:52 PM	S43-01-IB-WW4		1.85			105.7	
162	23/11/2023	11:03:00 AM	S40-05-IB-WN		0.01			94.8	
163	24/11/2023	12:16:39 PM	S47-30-IB-WW2		1.41			100.2	
164	27/11/2023	4:09:59 PM	S44-01-IB-WW1		4.88			109.9	
165	1/12/2023	3:11:57 PM	S44-05-IB-WW1		7.29			103.0	
166	6/12/2023	12:04:02 PM	S44-07-IB-WW1		4.55			102.2	
167	8/12/2023	11:57:54 AM	S43-03-IB-MA1 & S43-05-IB-MA1		1.88			101.4	
168	11/12/2023	12:21:58 PM	S47-31-IB-WW2		1.41			95.6	
169	12/12/2023	11:35:54 AM	S40-21-IB-BY1		0.50			102.2	
170	15/12/2023	2:01:00 PM	S43-30-IB-WW4		1.84			102.0	
171	18/12/2023	12:06:43 PM	S44-24-IB-WW4 & S44-22-IB-WW4		1.67			102.4	
172	19/12/2023	2:24:10 PM	S44-26-IB-WW3		1.19			106.6	
173	23/12/2023	1:58:12 PM	S43-09-IB-MA1		0.58			104.5	
174	28/12/2023	3:24:48 PM	S43-07-IB-MA1		0.93			106.6	
175	30/12/2023	11:27:16 AM	S41-16-IB-BR1		0.55			114.4	

[1] St James School monitor was removed on 12 April 2023 at the request of the school.

[2] Blake monitor was removed as a compliance blast monitor on 23 August 2023 following property purchase and subsequent update to the Bengalla BMP.

Appendix D

Air Quality Monitoring Summary

Table D1
Particulate Matter <10µm (PM_{10}) Summary (Compliance Monitors Only)

Run Date	PM_{10}-1		PM_{10}-3		24-hour Assessment Criteria (µg/m^3)	Annual Assessment Criteria (µg/m^3)
	Run Date Reading (µg/m^3)	Annual Rolling Average (µg/m^3)	Run Date Reading (µg/m^3)	Annual Rolling Average (µg/m^3)		
05/01/2023	31.1	16.6	9.1	15.6	*50*	*25*
11/01/2023	22.4	16.6	37.8	15.8	*50*	*25*
17/01/2023	18.3	16.5	35.5	15.9	*50*	*25*
23/01/2023	19.5	16.5	23.0	15.9	*50*	*25*
29/01/2023	29.1	16.6	28.4	15.8	*50*	*25*
04/02/2023	41.2	17.0	41.6	16.2	*50*	*25*
10/02/2023	16.8	16.9	16.2	16.1	*50*	*25*
16/02/2023	34.0	17.1	35.6	16.0	*50*	*25*
22/02/2023	15.6	16.7	4.8	15.9	*50*	*25*
28/02/2023	29.1	16.9	26.2	16.0	*50*	*25*
06/03/2023	72.0	17.8	23.4	16.0	*50*	*25*
12/03/2023	38.2	18.1	28.5	16.1	*50*	*25*
18/03/2023	38.8	18.4	40.7	16.4	*50*	*25*
24/03/2023	19.9	18.2	21.4	16.3	*50*	*25*
30/03/2023	24.4	18.4	8.6	16.3	*50*	*25*
05/04/2023	18.0	18.4	17.0	16.3	*50*	*25*
11/04/2023	16.3	18.3	6.7	16.2	*50*	*25*
17/04/2023	16.9	18.4	26.8	16.3	*50*	*25*
23/04/2023	14.4	18.4	12.2	16.4	*50*	*25*
29/04/2023	11.9	18.4	17.4	16.6	*50*	*25*
05/05/2023	23.4	18.5	22.7	16.6	*50*	*25*
11/05/2023	16.1	18.5	24.3	16.6	*50*	*25*
17/05/2023	18.7	18.6	13.5	16.7	*50*	*25*

Run Date	PM_{10}-1		PM_{10}-3		24-hour Assessment Criteria ($\mu g/m^3$)	Annual Assessment Criteria ($\mu g/m^3$)
	Run Date Reading ($\mu g/m^3$)	Annual Rolling Average ($\mu g/m^3$)	Run Date Reading ($\mu g/m^3$)	Annual Rolling Average ($\mu g/m^3$)		
23/05/2023	40.1	19.1	44.3	17.3	*50*	*25*
29/05/2023	56.6	19.9	11.4	17.5	*50*	*25*
04/06/2023	20.4	20.1	26.2	17.8	*50*	*25*
10/06/2023	17.8	20.2	10.4	18.0	*50*	*25*
16/06/2023	21.0	20.2	6.2	18.0	*50*	*25*
22/06/2023	27.5	20.5	46.1	18.8	*50*	*25*
28/06/2023	24.7	20.6	4.5	18.7	*50*	*25*
04/07/2023	11.1	20.7	11.0	18.8	*50*	*25*
10/07/2023	27.9	21.1	4.3	18.9	*50*	*25*
16/07/2023	31.9	21.5	19.0	19.1	*50*	*25*
22/07/2023	19.5	21.7	18.9	19.1	*50*	*25*
28/07/2023	35.2	22.1	13.1	19.0	*50*	*25*
03/08/2023	27.2	22.4	42.2	19.7	*50*	*25*
09/08/2023	24.6	22.7	28.6	20.1	*50*	*25*
15/08/2023	8.6	22.8	14.1	20.3	*50*	*25*
21/08/2023	18.0	23.0	5.5	20.1	*50*	*25*
27/08/2023	19.9	23.1	30.4	20.4	*50*	*25*
02/09/2023	31.8	23.3	35.3	20.5	*50*	*25*
08/09/2023	11.4	23.2	4.8	20.2	*50*	*25*
14/09/2023	25.7	23.4	45.6	20.8	*50*	*25*
20/09/2023	71.9	24.3	24.8	21.1	*50*	*25*
26/09/2023	35.7	24.7	33.4	21.6	*50*	*25*
02/10/2023	57.5	25.4	70.3	22.5	*50*	*25*
08/10/2023	22.5	25.7	32.5	22.9	*50*	*25*
14/10/2023	41.9	26.1	14.2	22.8	*50*	*25*
20/10/2023	40.8	26.5	38.9	23.2	*50*	*25*

Run Date	PM_{10}-1		PM_{10}-3		24-hour Assessment Criteria ($\mu g/m^3$)	Annual Assessment Criteria ($\mu g/m^3$)
	Run Date Reading ($\mu g/m^3$)	Annual Rolling Average ($\mu g/m^3$)	Run Date Reading ($\mu g/m^3$)	Annual Rolling Average ($\mu g/m^3$)		
26/10/2023	23.2	26.7	16.7	23.4	*50*	*25*
01/11/2023	28.1	26.7	44.6	23.9	*50*	*25*
07/11/2023	30	26.9	28.1	24.0	*50*	*25*
13/11/2023	33	27.2	48.4	24.6	*50*	*25*
19/11/2023	26.5	27.2	45.4	24.9	*50*	*25*
25/11/2023	6.6	27.0	4.6	24.7	*50*	*25*
1/12/2023	36.5	27.1	15	24.4	50	25
7/12/2023	48.5	27.3	63.8	24.8	50	25
13/12/2023	54	27.7	35.3	25.2	50	25
19/12/2023	61.8	28.4	81.3	26.2	50	25
25/12/2023	16.2	28.4	14.5	26.1	50	25
31/12/2023	16.9	28.5	34.8	26.1	50	25

Source: AECOM (2023)

Table D2
Total Suspended Particulates (TSP) Summary

Run Date	HV2		HV3		Annual Assessment Criteria (<90 µg/m^3)
	Run Date Reading (µg/m3)	Annual Rolling Average (µg/m3)	Run Date Reading (µg/m^3)	Annual Rolling Average (µg/m^3)	
05/01/2023	38.0	47.8	28.9	34.1	90
11/01/2023	77.9	48.2	53.8	34.2	90
17/01/2023	56.9	48.2	29.8	33.9	90
23/01/2023	58.4	48.5	46.1	34.2	90
29/01/2023	82.0	48.6	56.9	34.4	90
04/02/2023	148.0	50.3	110.0	35.7	90
10/02/2023	49.8	50.1	38.3	35.7	90
16/02/2023	83.0	50.4	57.0	35.8	90
22/02/2023	42.0	49.3	28.4	35.4	90
28/02/2023	85.1	50.0	40.9	35.6	90
06/03/2023	192.0	52.7	76.2	36.5	90
12/03/2023	120.0	54.1	69.3	37.2	90
18/03/2023	113.0	55.1	79.6	37.9	90
24/03/2023	58.1	54.6	39.3	37.6	90
30/03/2023	43.2	55.0	65.9	38.4	90
05/04/2023	51.2	54.7	35.9	38.4	90
11/04/2023	75.9	55.2	45.1	38.6	90
17/04/2023	63.0	55.5	40.4	39.0	90
23/04/2023	40.5	55.7	31.1	39.3	90
29/04/2023	102.0	57.0	60.8	39.9	90
05/05/2023	80.3	57.7	49.5	40.3	90
11/05/2023	40.2	57.7	26.2	40.2	90
17/05/2023	63.9	58.0	33.3	40.1	90

Run Date	HV2		HV3		Annual Assessment Criteria (<90 µg/m^3)
	Run Date Reading (µg/m3)	Annual Rolling Average (µg/m3)	Run Date Reading (µg/m^3)	Annual Rolling Average (µg/m^3)	
23/05/2023	134.0	59.8	62.0	40.8	90
29/05/2023	201.0	62.6	56.6	41.7	90
04/06/2023	84.6	63.5	34.9	41.9	90
10/06/2023	74.8	64.2	60.3	42.4	90
16/06/2023	54.9	64.2	25.3	42.3	90
22/06/2023	77.1	64.7	48.6	42.5	90
28/06/2023	132.0	66.0	44.1	42.6	90
04/07/2023	41.4	66.5	24.0	42.9	90
10/07/2023	158.0	68.8	45.5	43.5	90
16/07/2023	87.8	69.9	48.2	44.0	90
22/07/2023	84.2	70.9	54.1	44.6	90
28/07/2023	102.0	71.7	42.2	44.7	90
03/08/2023	84.6	72.8	63.9	45.5	90
09/08/2023	65.7	73.5	46.4	46.0	90
15/08/2023	43.6	73.9	35.8	46.5	90
21/08/2023	72.5	74.7	28.6	46.3	90
27/08/2023	53.8	75.1	38.5	46.5	90
02/09/2023	47.4	75.1	38.7	46.7	90
08/09/2023	51.2	74.1	42.8	47.0	90
14/09/2023	54.4	74.1	45.7	47.2	90
20/09/2023	153	75.2	70.4	47.5	90
26/09/2023	99.7	75.9	60.9	48.1	90
02/10/2023	124	77.4	83.4	48.8	90
08/10/2023	45.2	77.9	25.5	48.9	90
14/10/2023	111	78.9	75.6	49.4	90
20/10/2023	103	80.0	73	49.7	90

Run Date	HV2		HV3		Annual Assessment Criteria (<90 µg/m^3)
	Run Date Reading (µg/m3)	Annual Rolling Average (µg/m3)	Run Date Reading (µg/m^3)	Annual Rolling Average (µg/m^3)	
26/10/2023	73.8	80.6	44.5	49.9	90
01/11/2023	76.1	80.5	98	50.5	90
07/11/2023	85.3	81.2	62.7	50.9	90
13/11/2023	100	81.9	57.3	51.2	90
19/11/2023	105	82.8	51	51.3	90
25/11/2023	23.8	81.8	17	50.2	90
1/12/2023	110	82.6	88.1	50.8	90
7/12/2023	109	82.8	68.5	50.6	90
13/12/2023	165	84.1	91.6	50.8	90
19/12/2023	138	85.5	85	51.7	90
25/12/2023	27.5	85.3	23	51.6	90
31/12/2023	73.8	85.1	36.1	51.5	90

Source: AECOM (2023)

Table D3
Total Deposited Dust Summary

Month	D06	D10	D26
January	1.9	2.0	2.5
February	5.3	2.2	1.3
March	2.2	2.3	1.8
April	2.5	1.3	2.3
May	5.5	4.9	1.3
June	4.8	5.3	1.6
July	1.7	3.6	1.0
August	4.5	3.4	2.0
September	1.8	3.7	2.5
October	3.7	4.0	2.9
November	3.7	2.1	1.4
December	3.4	2.2	1.2
Annual Average	**3.4**	**3.1**	**1.8**
Criteria (g/m^2/month)	**4**	**4**	**4**

c = contaminated sample

Table D4
Increase in Deposited Dust

Month	D06	D10	D26
January	-1.5	-1.1	0.3
February	-1.1	-1.0	0.2
March	-1.0	-0.9	0
April	-0.9	-0.7	-0.1
May	-0.4	-0.1	0.2
June	-0.1	0.3	0.2
July	0	0.6	0.2
August	0.4	0.9	0.4
September	0.7	1.5	0.4
October	1.0	1.9	0.4
November	1.3	2.0	0.4
December	3.4	3.1	1.8
Annual Increase	**2.0**	**1.5**	**0.3**
Criteria (g/m^2/month)	**2**	**2**	**2**

Table D5
Particulate Matter <2.5µm ($PM_{2.5}$) Summary

$PM_{2.5}$ ($\mu g/m^3$)		
Monitor	**Annual Assessment Criteria**	**Result**
DPIE Upper hunter Air Quality Monitoring Network "Muswellbrook" Monitor	8.0	7.5

Note: BMC currently relies upon the Upper Hunter Air Quality Monitoring Network managed by the DPIE to record and monitor particulate matter less than 2.5 microns ($PM_{2.5}$) levels. The monitor adopted by BMC is the Muswellbrook monitor located approximately 5 km to the east of Bengalla.

Table D6
Continuous PM_{10} Monitoring (EPA22 and EPA24) 24 Hour Average Summary

Date	EPA-22 PM10 Avg (ug/m3)	EPA-24 PM10 Avg (ug/m3)
1/01/2023	6.5	9.4
2/01/2023	11	13.7
3/01/2023	10.4	13.4
4/01/2023	12.1	-
5/01/2023	4.2	-
6/01/2023	2.9	0.9
7/01/2023	4.4	4.4
8/01/2023	5.6	8.2
9/01/2023	8.7	10.0
10/01/2023	6	10.8
11/01/2023	6.4	8.5
12/01/2023	9.7	-
13/01/2023	10.4	14.0
14/01/2023	5.5	10.6
15/01/2023	7.3	-
16/01/2023	4.1	7.1
17/01/2023	5.9	9.5
18/01/2023	7.6	11.1
19/01/2023	5.9	6.8
20/01/2023	5.2	8.6
21/01/2023	3.9	7.9
22/01/2023	3.4	5.5
23/01/2023	10.5	11.2
24/01/2023	12.7	15.0
25/01/2023	19.7	19.4
26/01/2023	23.3	17.0
27/01/2023	21.3	21.8
28/01/2023	18.3	18.2
29/01/2023	12	13.9
30/01/2023	25.3	22.7
31/01/2023	6.7	8.5
1/02/2023	7.9	10.4
2/02/2023	11.3	8.2
3/02/2023	8.7	3.4
4/02/2023	9.5	1.8
5/02/2023	4	4.3
6/02/2023	7.8	10.9
7/02/2023	7.5	10.6
8/02/2023	9.1	10.3
9/02/2023	10.8	8.4
10/02/2023	15.6	15.8
11/02/2023	13.4	12.9
12/02/2023	12.6	9.1
13/02/2023	14.5	15.9
14/02/2023	7.9	10.1
15/02/2023	5	8.0
16/02/2023	7	15.0
17/02/2023	10.2	13.7
18/02/2023	12.3	11.0
19/02/2023	14.9	12.7
20/02/2023	22.5	21.4
21/02/2023	14.3	15.7
22/02/2023	2.9	2.8
23/02/2023	5.2	6.0
24/02/2023	4	5.3
25/02/2023	4	7.2
26/02/2023	5.6	5.1
27/02/2023	7.6	4.9
28/02/2023	12.1	12.6
1/03/2023	14.4	12.3
2/03/2023	5.2	6.8
3/03/2023	8.3	10.2
4/03/2023	7.5	8.4
5/03/2023	7.4	9.9
6/03/2023	13	6.9
7/03/2023	15.6	5.3
8/03/2023	18.2	-
9/03/2023	17.5	-
10/03/2023	8.8	-
11/03/2023	10.3	-
12/03/2023	17.8	-
13/03/2023	10.7	-
14/03/2023	8	9.4
15/03/2023	16.1	16.9
16/03/2023	16.4	12.6
17/03/2023	9.9	10.2
18/03/2023	21.9	22.9
19/03/2023	12.8	20.6
20/03/2023	17.2	25.9
21/03/2023	6.5	8.2
22/03/2023	6.1	9.8
23/03/2023	7.1	6.3
24/03/2023	7.8	8.6
25/03/2023	7.6	11.0
26/03/2023	5.2	8.2
27/03/2023	10.8	8.8
28/03/2023	15	15.4

29/03/2023	7.5	7.2
30/03/2023	3.8	3.1
31/03/2023	3.1	3.1
1/04/2023	3.8	6.4
2/04/2023	2.7	7.0
3/04/2023	4.4	8.7
4/04/2023	2.8	6.6
5/04/2023	3.3	6.0
6/04/2023	3.4	13.8
7/04/2023	4.2	8.0
8/04/2023	5.8	5.6
9/04/2023	4.6	2.8
10/04/2023	4	2.3
11/04/2023	3.7	3.2
12/04/2023	4.4	3.6
13/04/2023	3.9	3.2
14/04/2023	2.5	4.7
15/04/2023	4.8	6.6
16/04/2023	3.7	3.9
17/04/2023	2.8	13.8
18/04/2023	4.6	-
19/04/2023	6	-
20/04/2023	6	-
21/04/2023	5	-
22/04/2023	6.3	-
23/04/2023	5.5	-
24/04/2023	5.1	-
25/04/2023	5.9	-
26/04/2023	2.6	-
27/04/2023	4	-
28/04/2023	7.2	-
29/04/2023	7.8	-
30/04/2023	3.1	-
1/05/2023	4.2	-
2/05/2023	5.2	-
3/05/2023	4	-
4/05/2023	3.7	-
5/05/2023	7.9	-
6/05/2023	14.7	-
7/05/2023	11.1	-
8/05/2023	6	-
9/05/2023	8	7.5
10/05/2023	11.5	17.0
11/05/2023	11.2	15.8
12/05/2023	16.7	17.8
13/05/2023	22.5	26.3
14/05/2023	23.4	18.5
15/05/2023	18	13.6
16/05/2023	24.5	18.0
17/05/2023	18.8	8.8
18/05/2023	12.7	14.1
19/05/2023	16.2	16.7
20/05/2023	14.1	6.0
21/05/2023	6.5	8.7
22/05/2023	11.8	3.1
23/05/2023	16	12.3
24/05/2023	24.6	30.3
25/05/2023	32.7	24.6
26/05/2023	68.2	13.0
27/05/2023	14.9	6.7
28/05/2023	16	5.0
29/05/2023	11.8	1.1
30/05/2023	9.8	2.1
31/05/2023	16.9	2.6
1/06/2023	13.3	1.9
2/06/2023	7.8	17.5
3/06/2023	10.8	15.7
4/06/2023	5.5	10.6
5/06/2023	1.1	7.2
6/06/2023	4.7	14.5
7/06/2023	7	25.1
8/06/2023	8.7	7.9
9/06/2023	3.5	1.8
10/06/2023	5.4	6.4
11/06/2023	8.8	19.4
12/06/2023	10.2	11.2
13/06/2023	5.2	3.4
14/06/2023	3	1.8
15/06/2023	3.8	2.3
16/06/2023	6.7	3.8
17/06/2023	9.6	9.7
18/06/2023	11.3	4.6
19/06/2023	4.6	0.9
20/06/2023	2.6	2.9
21/06/2023	7.4	12.7
22/06/2023	14.6	30.3
23/06/2023	6.2	5.5
24/06/2023	3.4	0.3
25/06/2023	2.4	2.3
26/06/2023	2.2	1.1
27/06/2023	3.9	2.4
28/06/2023	3.5	1.6
29/06/2023	3.2	0.9
30/06/2023	1.3	0.2

1/07/2023	1.5	0.1
2/07/2023	12	16.7
3/07/2023	10.3	19.3
4/07/2023	16	22.0
5/07/2023	13.8	1.4
6/07/2023	4.6	0.4
7/07/2023	2.3	0.5
8/07/2023	2.9	1.1
9/07/2023	3.7	4.9
10/07/2023	4.8	2.6
11/07/2023	6.7	8.0
12/07/2023	11.8	32.4
13/07/2023	18	15.1
14/07/2023	14.5	9.8
15/07/2023	13.2	5.7
16/07/2023	11.4	14.6
17/07/2023	14.1	18.7
18/07/2023	13	9.7
19/07/2023	9	8.6
20/07/2023	13.1	11.4
21/07/2023	11.7	7.0
22/07/2023	13.4	34.9
23/07/2023	17.2	18.7
24/07/2023	7	9.8
25/07/2023	12.8	18.8
26/07/2023	15	14.5
27/07/2023	16.1	16.4
28/07/2023	12	5.0
29/07/2023	11.4	8.3
30/07/2023	11.7	5.2
31/07/2023	5.8	2.1
1/08/2023	8.2	5.7
2/08/2023	8.3	16.0
3/08/2023	14.3	20.7
4/08/2023	19.9	17.3
5/08/2023	16.8	10.2
6/08/2023	9.6	15.5
7/08/2023	6.4	12.6
8/08/2023	7.4	13.0
9/08/2023	8.9	13.4
10/08/2023	13.4	6.4
11/08/2023	9.1	6.1
12/08/2023	12.9	10.0
13/08/2023	10.4	12.6
14/08/2023	10.6	7.8
15/08/2023	4	4.7
16/08/2023	6.9	12.8
17/08/2023	14.9	19.8
18/08/2023	4.7	2.9
19/08/2023	3.5	1.8
20/08/2023	4.3	1.3
21/08/2023	9.3	11.5
22/08/2023	15.2	14.2
23/08/2023	5	4.0
24/08/2023	4.4	9.4
25/08/2023	12.2	22.7
26/08/2023	13.7	22.0
27/08/2023	20.9	24.7
28/08/2023	18.3	25.7
29/08/2023	22	24.4
30/08/2023	14.8	11.3
31/08/2023	8.3	9.3
1/09/2023	5.7	5.2
2/09/2023	3.7	16.9
3/09/2023	5.8	17.3
4/09/2023	11.9	18.8
5/09/2023	10.3	8.6
6/09/2023	7.9	13.6
7/09/2023	16.5	25.8
8/09/2023	9.3	10.1
9/09/2023	5.9	-
10/09/2023	9.4	-
11/09/2023	11.7	-
12/09/2023	18.2	-
13/09/2023	26	-
14/09/2023	24.4	-
15/09/2023	19.1	-
16/09/2023	13.3	-
17/09/2023	16.9	-
18/09/2023	20.4	20.5
19/09/2023	21.3	22.5
20/09/2023	19.2	13.7
21/09/2023	10.2	7.7
22/09/2023	3.6	6.9
23/09/2023	4.3	13.1
24/09/2023	3.8	9.1
25/09/2023	9.5	11.6
26/09/2023	11	12.0
27/09/2023	26.7	25.0
28/09/2023	12.5	13.5
29/09/2023	15.3	12.6
30/09/2023	21	20.9
1/10/2023	16.7	13.6
2/10/2023	22.2	23.4

3/10/2023	26.3	28.1
4/10/2023	11.8	10.7
5/10/2023	5	1.6
6/10/2023	3.5	3.3
7/10/2023	5	7.2
8/10/2023	3.4	8.7
9/10/2023	6.1	14.1
10/10/2023	7.8	16.5
11/10/2023	9.7	11.0
12/10/2023	13.5	10.9
13/10/2023	3.6	1.3
14/10/2023	7.4	2.5
15/10/2023	12.5	5.7
16/10/2023	11.8	12.9
17/10/2023	4.1	6.8
18/10/2023	4.2	6.9
19/10/2023	4	6.9
20/10/2023	12.9	17.7
21/10/2023	23.5	28.6
22/10/2023	18	14.4
23/10/2023	7.2	2.9
24/10/2023	11.3	22.6
25/10/2023	34.1	32.0
26/10/2023	9.4	11.6
27/10/2023	3.1	4.0
28/10/2023	3.4	6.3
29/10/2023	6.6	7.1
30/10/2023	21.9	14.2
31/10/2023	15.3	9.8
1/11/2023	7.5	9.7
2/11/2023	6.1	8.2
3/11/2023	14.7	18.5
4/11/2023	9.8	13.5
5/11/2023	4.7	6.8
6/11/2023	3.8	5.3
7/11/2023	6.6	10.0
8/11/2023	6.7	9.0
9/11/2023	8.7	11.2
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13/11/2023	13.1	-
14/11/2023	9.2	-
15/11/2023	11.2	-
16/11/2023	15.2	-
17/11/2023	4	-
18/11/2023	2.3	-
19/11/2023	4.1	-
20/11/2023	10.3	-
21/11/2023	5.2	5.8
22/11/2023	7.6	11.9
23/11/2023	4.6	8.7
24/11/2023	2.9	6.2
25/11/2023	6.1	6.2
26/11/2023	7.7	2.4
27/11/2023	11.6	15.8
28/11/2023	6.1	16.0
29/11/2023	3.3	11.9
30/11/2023	1.9	2.7
1/12/2023	2.2	2.1
2/12/2023	1.2	-
3/12/2023	1.6	-
4/12/2023	2	-
5/12/2023	3.9	7.3
6/12/2023	5.1	11.3
7/12/2023	8.9	25.2
8/12/2023	6.8	15.5
9/12/2023	20.4	-
10/12/2023	8.9	-
11/12/2023	22.4	49.6
12/12/2023	7.3	20.1
13/12/2023	16.2	-
14/12/2023	10.7	-
15/12/2023	10.9	-
16/12/2023	9.2	-
17/12/2023	7.6	-
18/12/2023	23.1	73.5
19/12/2023	57.9	117.2
20/12/2023	36	36.6
21/12/2023	2.2	5.5
22/12/2023	4	9.6
23/12/2023	5.4	10.0
24/12/2023	9.2	14.0
25/12/2023	12.6	14.4
26/12/2023	17.3	18.9
27/12/2023	11.8	14.5
28/12/2023	9.7	2.7
29/12/2023	11.5	-
30/12/2023	8.2	-
31/12/2023	5.3	-

Appendix E

Annual Compliance Report for EPBC Approval 2012/6378

BENGALLA MINING COMPANY

Bengalla Mine (EPBC APPROVAL 2012/6378)

2023 ANNUAL COMPLIANCE REPORT

Prepared by:
BENGALLA MINING COMPANY PTY LIMITED
Locked Bag 5
MUSWELLBROOK NSW 2333
March 2023

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

BENGALLA MINE

ANNUAL COMPLIANCE REPORT FOR EPBC APPROVAL 2012/6378

1 INTRODUCTION

1.1 Background

Bengalla Mining Company Pty Limited (BMC) operates the Bengalla Mine (Bengalla) on behalf of the Bengalla Joint Venture (comprising New Hope Bengalla Pty Ltd as to 8/10 share and Taipower Bengalla Pty Limited as to 2/10 share). Bengalla is located 130 km north-west of Newcastle and 4 km west of the township of Muswellbrook.

Bengalla commenced operations in 1998 and is approved to extract up to 15 Million tonnes per annum of run of mine coal until 2039.

On 3 March 2015, State Significant Development Consent (SSD-5170) for the Bengalla Continuation of Mining Project was granted by the Secretary of the NSW Department of Planning and Environment (DPE) under the *Environmental Planning and Assessment Act 1979* NSW. SSD-5170 has since been modified on various occasions.

On 27 May 2015, BMC was granted *Environment Protection and Biodiversity Conservation Act 1999* Cth (EPBC Act) Approval 2012/6378 (the EPBC Approval).

Both the EPBC Approval and SSD-5170 (as originally granted) are supported by (relevantly) the '*Continuation of Bengalla Mine Environmental Impact Statement*' (Hansen Bailey, 2013) (EIS) and *Continuation of Bengalla Mine Response to Submissions* (Hansen Bailey, 2014) (RTS).

The Biodiversity Offset Management Plan (BOMP) has been developed to meet relevant requirements under the EPBC Approval and SSD-5170. The current version of the BOMP was approved by what was then the Commonwealth Department of Environment and Energy (DoEE)[1] on 8 March 2017 and by DPE on 18 August 2017.

The Biodiversity Management Plan (BDMP) has also been developed to meet relevant requirements under the EPBC Approval and SSD-5170. The current version of the BDMP was approved by DPE on 18 August 2017 and by DoEE on 20 September 2017. The BDMP incorporates the Vegetation Clearance Protocol and Landscape Management Plan (VCPLMP) referred to in the EPBC Approval.

1.2 Purpose and Scope

This report has been prepared in accordance with Condition 12 of the EPBC Approval which states:

> *"By the end of March each year, the approval holder must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of the BOMP and VCLMP as specified in the conditions. Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published.*
>
> *Note: The Annual Review required under NSW Approval condition 4 (of Schedule 5) may be used to satisfy this condition if it meets the above content and submission requirements)."*

This report applies to the period 1 January 2023 to 31 December 2023 (Reporting Period).

[1] Now the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

This report is published as a stand-alone report and will also form an Appendix to the 2023 Annual Review for Bengalla required under SSD-5170 Schedule 5 Condition 4.

1.3 Clearing Activities in 2023

Table 1 is a reproduction of Figure 6 from the BDMP. It provides details of the staged clearing approach undertaken at Bengalla.

Table 1
Staged Clearing Approach

Stage	Actions
Pre-Clearing Survey	• Performed within one month of clearing • All fauna, flora and *Cymbidium canaliculatum* recorded • Vegetation health assessed and documented • Habitat features marked and flagged • Fauna captured and relocated
Clearing – Stage 1	• Removal of all vegetation other than habitat trees • Habitat features left standing overnight
Clearing – Stage 2	• A final pre-clearing inspection will be conducted to identify and capture any fauna • Habitat trees lightly shaken by machinery prior to felling • Appropriate machinery used to fell the tree • Any *Cymbidium canaliculatum* (Tiger Orchid) translocated • Remaining fauna captured and relocated • Felled habitat trees left overnight and then appropriate sections are removed and relocated to a storage location, rehabilitation areas or disposed

The Bengalla Mine Annual Clearing Report for 2023 (Clearing Report) is presented in **Appendix C** and contains details about the procedures and results for all pre-clearing and clearing activities completed at Bengalla during the Reporting Period.

Clearing works in 2023 were undertaken in relation to, but not limited to the following:

- General pit progression and relocation of infrastructure,
- Construction of new infrastructure, and
- Maintenance works.

The Clearing Report summarises the 2023 pre-clearance and clearance surveys, which included:

- Identification of 297 hollow-bearing / habitat trees, of which 134 were felled;
- 46 animals were relocated or captured during pre-clearance and clearance surveys;
- Observation of 54 animals that evaded capture during clearing;
- Nine animals were killed as a result of tree felling;
- Two animals required euthanasia following tree felling;

- One *Cymbidium canaliculatum* (listed as endangered under the EPBC Act) was identified during Stage 1 pre-clearance surveys in 2022. This individual was translocated to a donor tree in 2023.

Figure 1 is a reproduction of Figure 3 from the approved BOMP and has been updated to illustrate areas cleared during the Reporting Period, including Critically Endangered Ecological Communities (CEEC) listed under the EPBC Act.

CEEC identified in environmental assessments completed for the EIS and RTS included the following four communities identified as conforming to Upper Hunter White Box-Ironbark Grassy Woodland (Box Gum Woodland):

- Grey Box/White Box Intergrade Grassy Woodland;
- Upper Hunter White Box -Ironbark Grassy Woodland;
- Central Hunter Ironbark – Spotted Gum Forest; and
- Derived Native Grassland.

1.4 Weed and Pest Management in 2023

Information about the weed and pest management programs implemented at Bengalla and the offset areas during the Reporting Period is presented in **Appendix D**.

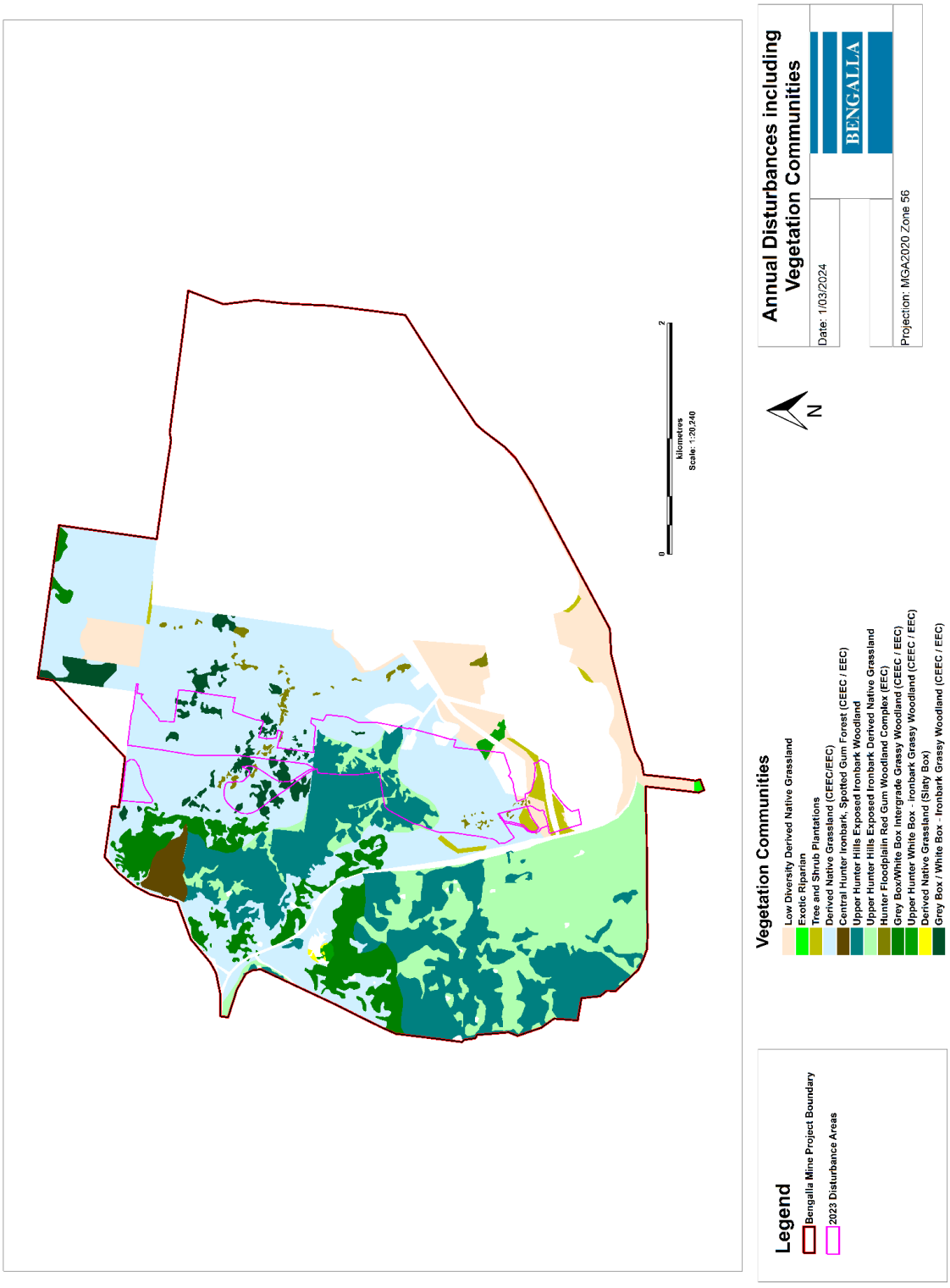

Figure 1 - Vegetation Communities

1.5 Compliance Report

The commitments made in the approved BDMP and BOMP, along with the compliance status of each for the Reporting Period, are presented in **Appendix A** and **Appendix B** respectively with comments provided against each where required.

Table 2 lists the conditions of the EPBC Approval and indicates the compliance status of each for the Reporting Period as 'compliant', 'not compliant' or 'not triggered'. Comments are provided against each condition, where required.

Table 2
BMC Compliance Status against Conditions of EPBC Approval for 2023

Ref	Condition	Status	Comment
1	The approval holder must not clear more than 535 hectares of *White Box-Yellow Box Blakely's Red Gum Grassy Woodland and Derived Native Grassland* ecological community (Box Gum Woodland) and must limit clearing to within the project disturbance boundary defined at Schedule 1.	Compliant	In 2023 clearing was undertaken within the Project Disturbance Boundary shown on the plan at Schedule 1 of the EPBC Approval. BMC has not cleared more than 535 hectares of Box Gum Woodland (see **Figure 1**).
2	To mitigate impacts of the action on Box Gum Woodland, the Grey Headed Flying Fox, Large-eared Pied Bat, South-eastern Long-eared Bat, Regent Honeyeater, Swift Parrot and Spotted-tail Quoll, the approval holder must prepare and submit, prior to the proposed date of commencement of the action, a mine site Vegetation Clearance Protocol and Landscape Management Plan (VCPLMP) for the Minister's written approval. The VCPLMP must: a. Delineate areas to be cleared, describe pre-clearance survey methods, specify actions to minimise fauna impacts and detail vegetation clearance procedures b. Require collection and stockpiling of habitat features important to threatened fauna species for reinstatement in rehabilitation areas c. Require use of native, locally sourced seed for propagation for rehabilitation activities d. Include measures to avoid, suppress and control the spread of plant pathogens (such as *Phytophthora cinnamomi*) e. Specify a two stage clearing protocol where non-habitat trees are cleared 24 hours prior to any habitat trees being cleared, to encourage fauna to move out of an area. The approval holder must not commence the action until the VCPLMP is approved by the	Compliant	A BMP was developed to meet this requirement and is implemented at Bengalla. **Appendix A** sets out the commitments from the BMP and the compliance status of each for the Reporting Period. The original BMP was approved by each of (then) DPE and DoEE on 14 August 2015. BMC commenced implementation of the BMP from that date (before operations commenced under SSD-5170). The current (revised) version of the BMP was approved by DPE on 18 August 2017 and DoEE on 20 September 2017. The BMP addresses each of the requirements in Condition 2(a)-(e) of the EPBC Approval (refer to Table 1 of the BMP).

Ref	Condition	Status	Comment
	Minister. The approved VCPLMP must be implemented. Note: The Biodiversity Management Plan required under NSW Approval condition 29 may be used to satisfy this condition if it meets the above content and submission requirements.		
3	To compensate for the loss of 535 hectares of Box Gum Woodland ecological community and 272 hectares of habitat for the Grey Headed Flying Fox, Large-eared Pied Bat, South-eastern Long-eared Bat, Regent Honeyeater, Swift Parrot and the Spotted-tail Quoll, the approval holder must prepare and submit, by 3 September 2015, a Biodiversity Offset Management Plan (BOMP) for the Minister's written approval. The BOMP must: a. Identify those lands described as the Offset Areas at Schedule 2 (Figures 1- 6) of this notice. This must include offset attributes, shape files, textual descriptions and maps to clearly define the location and boundaries of the offset area(s) b. Provide a survey and description of the current condition (prior to any management activities) of the offset areas identified in Condition 3a c. Detail management actions and regeneration and revegetation strategies to be undertaken on the offset areas to improve the ecological quality of these areas, including: (i) a description and timeframe of measures that would be implemented to improve the condition of Box Gum Woodland and habitat for the Grey Headed Flying Fox, Large-eared Pied Bat, South-eastern Long-eared Bat, Regent Honeyeater, Swift Parrot and the Spotted-tail Quoll on the offsets sites; (ii) performance and completion criteria for evaluating the management of the offset areas, and criteria for triggering remedial action; (iii) a program to monitor and report on the effectiveness of these measures, and progress	Non-Compliant	A BOMP was developed to meet this requirement and is implemented at Bengalla. Appendix B sets out the commitments from the BOMP and the compliance status of each for the Reporting Period. The draft BOMP was submitted to then DoEE and DPE on 2 September 2015. Following an extensive consultation process (see Appendix A of the BOMP), the BOMP was approved by DoEE on 8 March 2017 and by DPE on 18 August 2017. The BOMP addresses each of the requirements in Condition 3(a)-(c) of the EPBC Approval (refer to Table 1 of the BOMP). The approved BOMP was published on Bengalla's website within 1 month after being approved and continues to be available on the website. As noted in last year's report, BMC has taken preliminary steps towards entering into a Biodiversity Stewardship Agreement for each of the three offset properties (refer to Condition 4 below). The currently approved BOMP continues to be implemented in the interim. All Biodiversity Offset Areas identified in Schedule 2 (Figures 1-6) of the EPBC Approval are owned by the Bengalla Joint Venturers (BJV) and managed by BMC. All Biodiversity Offset Areas are managed in accordance with the BOMP. One non-compliance with the BOMP was identified in the reporting period. By email and the Planning Portal 9 June 2023, BMC notified what is now known as the DPHI of a non-compliance with Condition 29 of Schedule 3 of SSD 5170 under Condition 7A of Schedule 5 of SSD 5170. By email on 6 June 2023 BMC notified the Department of Climate Change, Energy, the Environment and Water (DCCEEW) regarding a non-compliance with Condition 3 of EPBC Approval 2012/6378 under Condition 13 of EPBC Approval 2012/6378. The non-compliance involved the use of part of 'Kenalea' in a manner that is inconsistent with the approved Biodiversity Offset Management Plan (BOMP) by a tenant of the property, for stock, (that is also inconsistent with the Residential Tenancy Agreement (RTA) between BMC and the tenant).

Ref	Condition	Status	Comment
	against the performance and completion criteria; (iv) a description of potential risks to the successful implementation of the plan, a description of the measures that will be implemented to mitigate against these risks and a description of the contingency measures that will be implemented if defined triggers arise; and (v) details of who would be responsible for monitoring, reviewing, and implementing the plan. The approved BOMP must be implemented. The approved BOMP must be published on the approval holder's internet web site within 1 month of being approved. The most recently approved version of the BOMP must be published on the approval holder's internet web site for a period of 5 years after it is approved. Note: The Biodiversity Management Plan required under NSW Approval condition 29 may be used to satisfy this condition if it meets the above content and submission requirements.		Under the terms of the RTA, the tenant was not permitted to keep stock on the property (other than up to 12 dogs) however stock had been kept on part of 'Kenalea', on approximately 97 hectares at the southern end of the 'Kenalea' property. The total area of 'Kenalea' is approximately 4,097 hectares with the overall biodiversity offset area being approximately 6,215 hectares. BMC contacted the tenant to remove the stock as soon as possible and will investigate whether the presence of the stock. The tenant removed all animals by the 2 July 2023 and then vacated the property in August 2023BMC engaged Cumberland Ecology to undertake an ecological assessment of the area where grazing occurred for the purpose of determining whether grazing had resulted in any ecological damage. Cumberland Ecology provided a report that was subsequently forwarded to DPHI and DCCEEW. This report indicated higher levels of degradation had occurred when compared to areas of non-grazing and had delayed regeneration within the subject land. It was also reported that the area is likely to regenerate to a similar condition to remaining areas in Kenalea once all stock had been excluded. Monitoring of these areas is now incorporated into annual ecological monitoring with the establishment of 4 permanent monitoring plots on the grazing area. Correspondence was received on 20 December 2023 from DECCW that no further action would be taken provided the actions described above are implemented.
4	The approval holder must secure the lands identified as the *Offset Areas* at Schedule 2 (Figures 1- 6) of this notice as a biodiversity offset, in accordance with NSW Approval condition 28.	DCCEEW concluded not compliant with Condition 4 – no further action taken	All Biodiversity Offset Areas identified in Schedule 2 (Figures 1-6) of the EPBC Approval are owned by the Bengalla Joint Venturers (BJV) and managed by BMC. All Biodiversity Offset Areas are managed in accordance with the BOMP. By letter dated 6 October 2020, the Secretary agreed to an extension of time until 30 June 2022 to finalise the long-term security of the Biodiversity Offset Areas under Schedule 3 Condition 28 of SSD-5170 (Condition 28). At this stage, the DPE has not granted a further extension in which to comply with Condition 28. BMC corresponded with the relevant NSW government departments during 2022 to determine the appropriate long-term mechanism for securing the offsets. Following that correspondence, BMC has taken steps to progress Biodiversity Stewardship Agreements (BSAs) for the offset areas. BMC notified the non-compliance with Condition 28 to DCCEEW on 7 September 2022. By letter dated 12 October 2022, DCCEEW advised that it had reviewed the matter and "*concluded that the issuing of an infringement notice would not be an appropriate*

Ref	Condition	Status	Comment
			course of action in this case. Consequently, no further action will be taken regarding this matter". During the Reporting Period communication continued between BMC and the DPHI and the Biodiversity Conservation Trust (BCT) being: - BMC letter dated 6 April 2023 to what is now the NSW Department of Planning, Housing and Infrastructure (DPHI) where BMC confirmed the 'Department's [DPHI] advice that it considers that the establishment of a BSA to be the - - appropriate mechanism for securing the required offset areas. Based on that advice, BMC has instructed its consultants to proceed with preparing the relevant BSAs ….' - Meeting 20 July 2023 with BMC and its advisors presented to the DPHI and the BCT, discussion occurred regarding: o Background and Biodiversity Stewardship Agreement Site Overview; o Long Term Security Process; o Biodiversity Stewardship Agreement Applications; o Consultation with Local Land Services and Council; and o Future Land Management. Actions: o Create an Action Plan outlining specific dates in which key project milestones are completed. o Organise a pre-submission meeting to discuss the draft BSA Applications and supporting documentation. - BMC Action Plan dated 18 August 2023 provided by email to DPHI and BCT outlining steps to establishment of BSA's for each offset property. - The BSA's applications continue to be prepared for each offset property during the Reporting Period. In the meantime, the offset areas will continue to be owned by the BJV and managed by BMC in accordance with the BOMP

Ref	Condition	Status	Comment
5	In order to protect listed threatened species and listed threatened ecological communities, the approval holder must undertake rehabilitation activities in accordance with NSW approval conditions 44, 45 and 46.	Compliant	**Condition 44** • Requirement Schedule 3 Condition 44 of SSD-5170 (Condition 44) requires BMC to rehabilitate the site to the satisfaction of what is now the Resources Regulator.[2] The rehabilitation must comply with the objectives in Table 15 of SSD-5170 and be consistent with the conceptual final landform shown in Appendix 9 of SSD-5170. • Status Rehabilitation at Bengalla is ongoing. It is undertaken in accordance with SSD-5170 (as modified) and the current Forward Program and Rehabilitation Management Plan. The current Forward Program covers a period from 27 June 2022 to 26 June 2025. The proposed rehabilitation activities for Year 2 (July 2023 to July 202) include development of approx. 47.7 ha of retrofitted High Density Woody Vegetation (HDWV) on the eastern face of the Overburden Emplacement Area (OEA) and reshaping of approximately 20 ha of land of overburden for rehabilitation to Class IV pasture 8.7 ha and HDWV 11.3 ha on the landform of the OEA. During the Reporting Period, no areas of new rehabilitation were undertaken. BMC installed 64,000 HDWV tubestock into previously rehabilitated land according to the current Forward Plan. Further detail about the rehabilitation carried out at Bengalla during the Reporting Period will be available in Section 8 of the Annual Review for 2023. **Condition 45** • Requirement Schedule 3 Condition 45 of SSD-5170 requires BMC to carry out progressive rehabilitation. Interim stabilisation measures are to be used where reasonable and feasible to control dust emissions in disturbed areas that are not active but not ready for final rehabilitation. • Status Rehabilitation is carried out progressively at Bengalla, as soon as reasonably practicable following disturbance. Interim stabilisation measures are used where required. **Condition 46** • Requirement

[2] This requirement was modified slightly as a result of Mod 5 to SSD-5170 (approved on 24 February 2023, after the end of the Reporting Period). The first part of Schedule 3 Condition 44 of SSD-5170 now requires BMC to "*rehabilitate the site in accordance with the provisions under the Mining Act 1992*".

Ref	Condition	Status	Comment
			During the Reporting Period, Schedule 3 Condition 46 of SSD-5170 (Condition 46) required BMC to prepare a Rehabilitation Management Plan to the satisfaction of what is now the Resources Regulator. The plan was to be prepared in accordance with and incorporate the elements specified in Condition 46. BMC was required to implement the plan as approved by the Resources Regulator.[3] • Status BMC was required to develop and implement a new Rehabilitation Management Plan and Forward Program (among other actions) from 1 July 2022 due to reforms to the Mining Act 1992. The Rehabilitation Management Plan and Forward Program were updated in 2023 and are implemented at Bengalla as part of mining operations.
6	The approval holder must undertake management and monitoring of water resources in accordance with NSW approval conditions 23 to 25.	Compliant	**Condition 24** • Requirement Schedule 3 Condition 24 of SSD-5170 requires BMC to ensure that mining operations comply with the performance measures in Table 12 of SSD-5170 to the satisfaction of the Secretary. • Status Water management at Bengalla during the Reporting Period was undertaken in accordance with the performance measures in Table 12 of SSD-5170. The approved Water Management Plan (WMP) also addresses the performance measures (see Table 1 of the WMP). Further detail about the site water balance and results of surface water monitoring and groundwater monitoring during the Reporting Period will be available in the Annual Review for 2023. **Condition 25** • Requirement Schedule 3 Condition 25 of SSD-5170 requires BMC to prepare a Water Management Plan to the satisfaction of the Secretary. The plan must be prepared in accordance with and incorporate the elements specified in Condition 25. BMC must implement the plan as approved by the Secretary. • Status The WMP was developed to meet this requirement and is implemented at Bengalla.

[3] Schedule 3 Condition 46 of SSD-5170 was modified on 24 February 2023, after the end of the Reporting Period. It now requires BMC to "*prepare a Rehabilitation Management Plan for the development in accordance with the provisions under the Mining Act 1992 and carry out the development in accordance with this plan*."

Ref	Condition	Status	Comment
			The current WMP was updated in 2023 and was approved by the Secretary on 8 August 2023. The WMP was prepared in consultation with the relevant authorities and addresses each of the requirements of Schedule 3 Condition 25 of SSD-5170 (see Table 2 of the WMP).
7	In order to protect water resources, the approval holder must undertake rehabilitation activities in accordance with NSW approval conditions 44 and 46.	Compliant	Refer to comments at Conditions 5 and 6 above.
8	Upon request, the approval holder shall supply the groundwater monitoring data for the Bengalla Mine to the Department, NSW Government agencies, operators of the Mt Arthur and/or Mount Pleasant mines or other adjacent mine operators. A protocol for the supply of the data must be included in the approval holder's Water Management Plan.	Not Triggered	No request was made during the Reporting Period. In accordance with Schedule 5 Condition 11 of SSD-5170 and BMC's approved Water Management Plan, groundwater monitoring results are published as part of the Annual Review on Bengalla's website each year.
9	The approval holder must make available to the Minister on request, all plans or programs and any review of plans or programs required under the Project Approval issued for the project under the Environmental Planning and Assessment Act, 1979 (NSW), including the Biodiversity Management Plan, the Rehabilitation Management Plan and the Water Management Plan, which must include a Site Water Balance, Surface Water Management Plan and Groundwater Management Plan.	Not Triggered	No request was made during the Reporting Period. Approved Bengalla management plans are available on Bengalla's website. BMC's approved Water Management Plan includes a Site Water Balance, Surface Water Management Plan and Groundwater Management Plan.
10	Within 30 days after the commencement of the action, the approval holder must advise the Department in writing of the actual date of commencement.	Compliant	By email dated 30 October 2015, BMC advised the then DoEE that the action the subject of the EPBC Approval commenced on 1 October 2015.
11	The approval holder must maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement the BOMP and VCPLMP, 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. Summaries of audits will be posted on the Department's website. The results of audits may also be publicised through the general media.	Not Triggered	BMC maintains accurate records substantiating all activities associated with or relevant to the EPBC Approval conditions, including measures to implement the BOMP and the BDMP (which incorporates the VCPLMP). No request was made during the Reporting Period to make any records available to DCCEEW. **Appendix A** describes the commitments made in the approved BDMP and how each has been addressed in the Reporting Period. **Appendix B** describes the commitments made in the approved BOMP and how each has been addressed in the Reporting Period. **Appendix C** describes pre-clearing and clearing activities implemented in accordance with the BDMP during the Reporting Period.

Ref	Condition	Status	Comment
12	By the end of March each year, the approval holder must publish a report on their website addressing compliance with each of the conditions of this approval, including implementation of the BOMP and VCPLMP as specified in the conditions. Documentary evidence providing proof of the date of publication must be provided to the Department at the same time as the compliance report is published. Note: The Annual Review required under NSW Approval condition 4 (of Schedule 5) may be used to satisfy this condition if it meets the above content and submission requirements.	Compliant	This report addresses compliance with each of the conditions of the EPBC Approval for the Reporting Period. **Appendix A** describes the commitments made in the approved BDMP and how each has been addressed in the Reporting Period. **Appendix B** describes the commitments made in the approved BOMP and how each has been addressed in the Reporting Period. **Appendix C** describes pre-clearing and clearing activities implemented in accordance with the BDMP during the Reporting Period. This report will be uploaded to Bengalla's website by the end of March 2024 and documentary evidence of publication will be provided to DCCEEW at the same time.
13	Non-compliance with any of the conditions of this approval must be reported to the Department within 2 business days of the approval holder becoming aware of the non-compliance.	Compliant	
14	Upon the direction of the Minister, the approval holder 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 must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.	Not Triggered	No direction was made during the Reporting Period.
15	If the approval holder wishes to carry out any activity other than in accordance with a Plan as specified in the conditions, the approval holder must submit to the Department for the Minister's written approval a revised version of that Plan. The approval holder must not commence the varied activity until the Minister has approved the varied Plan in writing. The Minister will not approve a varied Plan unless the revised Plan would result in an equivalent or improved environmental outcome over time. If the Minister approves the revised Plan, that Plan must be implemented in place of the Plan originally approved.	Not Triggered	No relevant activities other than those described in the BMP or BOMP were required during the Reporting Period.
16	If the Minister believes that it is necessary or convenient for the better protection of listed threatened species and ecological communities to do so, the Minister may request that the approval holder make specified revisions to a Plan specified in the conditions and submit the revised Plan for the	Not Triggered	No request was made during the Reporting Period.

Ref	Condition	Status	Comment
	Minister's written approval. The approval holder must comply with any such request. The revised approved Plan must be implemented. Unless the Minister has approved the revised Plan then the approval holder must continue to implement the Plan originally approved, as specified in the conditions.		
17	If, at any time after 5 years from the date of this approval, the approval holder has not commenced the action, then the approval holder must not commence the action without the written agreement of the Minister.	Not Triggered	By email dated 30 October 2015, BMC advised the then DoEE that the action the subject of the EPBC Approval commenced on 1 October 2015.

1.6 Conclusion

During the Reporting Period, there were two non-compliances with EPBC Approval conditions reported to DCCEEW. These related to Condition 3 (implementation and Compliance of the Biodiversity Offset Management Plan (BOMP)) and Condition 4 (provision of long-term security for offset properties in respect of which DCCEEW has advised that no further action will be taken).

BMC will continue to review and document all relevant activities at Bengalla during the 2024 reporting period to assist in maintaining compliance with the EPBC Approval conditions.

Appendix A and **Appendix B** provide comments about the implementation of the BMP and BOMP commitments respectively during the Reporting Period. In summary, BMC has generally complied with the BMP and BOMP commitments for the Reporting Period.

Appendix A Biodiversity Management Plan Commitments

BDMP Section	Control / Action	Timing / Trigger	Responsibility	Monitoring	Reporting	Status	Comment
4.1	Marking Limits of Clearing	Prior to clearing	Environment Superintendent / Mining Manager / Surveyors	Inspection to be undertaken throughout duration of clearing.	Documented in Ground Disturbance Permit (GDP) form and signed off.	Compliant	GDP boundaries are demarcated prior to clearing, where required. Refer section 2.2 of **Appendix C.**
4.2	Identification of suitable fauna relocation sites	Prior to clearing	Environment Superintendent / Mining Manager	N/A	Documented in GDP form and/or pre-clearing report.	Compliant	Refer Section 2.2.6 of **Appendix C**.
4.2	Pre-clearing surveys	Within one month prior to clearing	Suitably qualified person	Monitoring of fauna and flora (including Tiger Orchid, pest and weed species), habitat features and plant pathogens.	Documented and signed off in the pre-clearing report. Results are reported in Annual Review. OEH notified if new threatened species identified.	Compliant	Refer Section 3.1 of **Appendix C**.
4.2	Clearing Surveys	Within one month of the pre-clearing survey	Suitably qualified person	Monitoring of fauna and flora (including Tiger Orchid, pest and weed species), habitat features and plant pathogens.	Documented and signed off in the clearing report. Results are reported in Annual Review. OEH notified if new threatened species identified.	Compliant	Refer Section 3.2 of **Appendix C**.
4.3	Pre-clearing weed management	Prior to clearing and during clearing	Suitably qualified person and Environment Superintendent	Inspection to be undertaken prior to clearing.	Documented and signed off in the GDP. Results are reported in Annual Review.	Compliant	Refer Section 3.1.7 of **Appendix C**.

BDMP Section	Control / Action	Timing / Trigger	Responsibility	Monitoring	Reporting	Status	Comment
4.2.3	Relocation of habitat features to rehabilitation areas, adjacent vegetation or storage location.	During and/or after clearing	Environment Superintendent	N/A	Documented and signed off in the GDP. Results are reported in Annual Review.	Compliant	Refer Section 3.1.8 and Section 3.2 of **Appendix C**.
4.1	Inductions and Staff Education	Ongoing as part of the existing induction process or as part of toolbox talks prior to commencement of ground disturbance works.	Environment Superintendent	N/A	As per BMC Induction procedure	Compliant	Inductions provided to BMC staff and contractors include a component on biodiversity management.
4.2	Vehicle Driving Policy and Signage	Ongoing or when wildlife crossing areas are identified	Mining Manager / Environment Superintendent	N/A	N/A	Compliant	No wildlife crossing areas were identified by the suitably qualified expert (WSP) during 2023. Site access tracks and controls are included in site procedures.
4.2.5	Seed collection	Targeted throughout year and opportunistically before and immediately after clearing	Environment Superintendent	Observations to be made throughout year to check flowering / seeding development of key species. Ensure correct licences are held by any contractors.	To be documented and reported in Annual Review.	Compliant	Refer Section 3.1.6 of **Appendix C**.
4.3	Weed control	Ongoing over life of mine	Environment Superintendent	Routine field observations and management undertaken in Weed Control Zones, including rehabilitation areas.	Results to be reported in Annual Review.	Compliant	Refer **Appendix D.**
4.4	Feral animal control	Ongoing over life of mine	Environment Superintendent	Routine field observations undertaken and management undertaken	Results to be reported in Annual Review.	Compliant	Refer **Appendix D.**

BDMP Section	Control / Action	Timing / Trigger	Responsibility	Monitoring	Reporting	Status	Comment
				including rehabilitation areas.			
5.0	Ecological Monitoring and Inspections	Ongoing over life of mine	Ecologist	N/A	Results to be reported in Annual Review.	Compliant	The purpose of the ecological monitoring program is primarily to monitor the risks posed by plant pathogens, exotic weeds and feral animals in biodiversity offsets, residual vegetation and rehabilitation areas and to indicate where management actions are required. For weed and feral animal monitoring programs for Bengalla and the biodiversity offset areas refer to **Appendix D.** Rehabilitation monitoring was completed during January 2024 for 2023. Details of results are presented in Section 8 of the 2023 Annual Review. As stated at section 5.4 of the BMP, no immediate management actions are required for the management of plant pathogens at Bengalla. However, signs of pathogens outbreaks (e.g. in pre-clearing surveys) may require measures to be taken in the future.

Appendix B Biodiversity Offset Management Plan Commitments

BOMP Section	Commitment	Status	Comment
Notification			
2.3	Following approval, all actions detailed within this BOMP will be implemented. Within one month of receiving approval, this BOMP will be made available to the public on the BMC website.	Compliant	The BOMP is implemented as part of BMC's operations. The BOMP (with regulatory approval letters) (August 2017) is publicly available on Bengalla's website.
Fencing, Gates and Signage			
8.1	Boundary fencing will remain around all BOS Areas and will be inspected annually to identify areas that may require maintenance.	Compliant	An annual inspection of boundary fencing for all biodiversity offset areas (BOS Areas) was undertaken in 2023.
8.1	Internal fencing within Kenalea properties and Black Mountain will be maintained (where appropriate) to allow for the management of controlled grazing in these properties.	Compliant	No internal fence repairs were required in 2023 at Kenalea or Black Mountain.
8.1	Stock proof fencing will be utilised where existing fences are absent to protect sensitive areas.	Not Triggered	Not required during the Reporting Period.
8.1	Current gates for access to BOS Areas will be retained and kept locked.	Compliant	Gates to BOS Areas remained secured and locked during 2023.
8.1	BMC will install signage at the entrances to the BOS Areas to inform the public of restricted access to properties.	Compliant	Restricted access signage at the entrances to the BOS Areas has been installed prior to 2023.
Controlled Activities			
8.2	All contractors, stakeholders and visitors to the BOS Areas will be inducted. The induction will include information on activities prohibited in BOS Areas unless explicitly undertaken for the purposes of ongoing management.	Compliant	BMC has established internal polices which require all staff/contractors, stakeholders and visitors working at Bengalla (or BOS Areas) to be inducted prior to undertaking specified work. The BOS Areas induction identifies relevant compliance obligations including under applicable management plans.

BOMP Section	Commitment	Status	Comment
Control Grazing			
8.3	Control grazing will only be permitted in Zone 1 and Zone 2 management areas.	Not Triggered	No control grazing was undertaken during 2023.
8.3	Best practice for control grazing will be implemented wherever control grazing is employed, including: • Providing adequate rest periods and adjusting rest periods to suit the recovery needs and growth rates of the desirable plants; • Targeting defined areas with high fuel loads or weed infestations; • Cattle stocking numbers kept below 4 dray sheep equivalent; • Pre and post grazing monitoring; • Periods of grazing must be kept as short as practicable; and • Control grazing will not be conducted during declared drought periods.	Not Triggered	No control grazing was undertaken during 2023.
8.3	Control grazing will be monitored against Trigger and Performance Criteria.	Not Triggered	No control grazing was undertaken during 2023.
7.1	Should monitoring results indicate that regeneration is not occurring naturally after Year 5, assisted revegetation will take place in areas that require this management action.	Not Triggered	An assisted regeneration program will be developed and implemented to mid and over storey covers in identified areas as required.
8.3	Stock will be excluded from riparian areas and will access water primarily from farm dams or water troughs.	Not Triggered	No cattle grazing was undertaken during 2023.
8.3	Monitoring will be undertaken pre and post grazing with the use of photo reference points. Areas subject to control grazing will be monitored as part of annual monitoring program.	Not Triggered	No cattle grazing was undertaken during 2023
Bushfire management			
8.4	BMC will take practicable steps to prevent the occurrence of bushfires on the land and minimise the spread of bushfire.	Compliant	Bushfire hazard reduction burns were conducted on all Biodiversity Offset areas in 2023. Black Mountain was conducted in January, Echo in May 23, Kenalea in June 23 and Merriwa River in August 2023.
8.4	BMC will provide maps (including water fill points) and contact details of the properties to the RFS.	Compliant	Maps, keys and relevant contact information have previously been provided to local RFS captains. Locations of water fill points were provided to the RFS in 2018 following the ground truthing of these locations.

BOMP Section	Commitment	Status	Comment
Weed Control			
8.5	Weed management actions will target Weeds of National Significance and Noxious Weeds across BOS Areas.	Compliant	Enright Land Management undertook a weed monitoring and control program in BOS Areas during the Reporting Period. Records of the locations of weed control are detailed in **Appendix D**.
8.5	Weed control will focus on species that exclude or have the potential to exclude native species, disrupt the recruitment of native species or impede ecological progress.	Compliant	A summary of the weed monitoring and control program undertaken during the Reporting Period is provided in **Appendix D**.
8.5	Weed management will be undertaken in accordance with the management principles listed in Section 8.5 of the BOMP.	Compliant	Weed management practices were undertaken during the Reporting Period in accordance with Section 8.5 of the BOMP.
8.5	The results and outcomes of weed management will be documented and analysed for each year in the Annual Review. This will include documentation of areas subject to weeding, techniques used, target species controlled, new species identified, chemicals used and revised approaches to weed control in light of learnings during the previous reporting period.	Compliant	A summary of the weed monitoring and control program for the Reporting Period is provided in **Appendix D**.
8.5	Weed infestation maps will be updated annually and annotated as required with information about previously implemented weed controls.	Compliant	A weed monitoring and control program was undertaken during the Reporting Period. The location of weeds identified during the program were recorded for GIS input and is presented in **Appendix D**.
Feral Animal Control			
8.6	BMC will conduct an annual feral animal control program in conjunction with current Local Land Services programs.	Compliant	A feral animal control program was undertaken in 2023. This was undertaken in line with neighbouring properties and the Local Land Services baiting program and is described in **Appendix D**.
8.6	Should any native fauna deaths be recorded during 1080 baiting and if sufficient carcass is available the animal will be sent to a veterinarian to provide a cause of death should there be any evidence of poisoning.	Not triggered	No native fauna deaths were reported during the 2023 feral animal control program.
8.6	The results and outcomes of feral animal management will be documented for each year in the Annual Review. This will include documentation of the techniques used for each feral species, the quantity of bait material purchased and deployed, the areas subject to control, estimate of the numbers of animals culled, new species identified (if any) and any other chemicals used.	Compliant	A summary of the 2023 feral animal control program is provided in **Appendix D**.

BOMP Section	Commitment	Status	Comment
8.6	All personnel involved in feral animal management must hold relevant and valid licences/permits, including any relevant chemical licences for pesticide use or a firearms licence for shooting.	Compliant	Staff and/or contractors involved in feral animal management held all relevant licences and accreditations to undertake the feral animal control works in 2023.
Maintenance Track Improvement and Additional Infrastructure			
8.7	Maintenance of existing tracks and installation of additional infrastructure may be required to provide safe access to BOS Areas. Maintenance or construction works may result in minor/localised disturbance. BMC will ensure compliance with all legal and environmental protection measures prior to any significant disturbance.	Compliant	All existing access tracks in all offsets were assessed and regraded in 2023.
8.7	BMC will record and store all relevant GIS information related to the improvement or installation of additional infrastructure.	Compliant	BMC has recorded and stored GIS information for all improvements and installation of additional infrastructure on the BMC GIS database.
8.7	BMC will undertake routine inspections and maintenance of BOS infrastructure (eg. tracks, fence lines, gates)	Compliant	Inspections and maintenance of tracks was undertaken in 2023. Fence lines and gates were also inspected.
Contingency Measures			
8.8	Contingency measures will be utilised should monitoring indicate that performance measures or contingency measures are not being met.	Not Triggered	No contingency measures were required during the Reporting Period.

Appendix C Annual Clearing Report 2023

Design
for a better
future /

Bengalla Mining Company

Bengalla Coal Mine

2023 Annual Clearing Report

March 2024

Question today
Imagine tomorrow
Create for the future

Bengalla Coal Mine
2023 Annual Clearing Report

Bengalla Mining Company

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Rev	Date	Details
A	6/02/2024	Draft
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	Name	Date	Signature
Prepared by:	Gavin Shelley Nathan Cooper	26/03/2024	Nathan C
Reviewed by:	Nathan Cooper	26/03/2024	Nathan C
Approved by:	Nathan Cooper	26/03/2024	Nathan C

WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

Table of contents

List of tables

List of figures

List of photographs

Contents (continued)

List of appendices

Abbreviations

BMC	Bengalla Mining Company Pty Ltd
Bengalla	Bengalla Mine
BMP	Biodiversity Management Plan
EEC	Endangered Ecological Community
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDP	Ground Disturbance Permit
BC Act	*Biodiversity Conservation Act 2016*

1 Project background

1.1 Existing operation

The Bengalla Mining Company (BMC) operates Bengalla Mine (Bengalla), an open cut coal mine located approximately four kilometres (km) west of Muswellbrook in the Upper Hunter Valley, NSW.

Activities associated with clearing operations during the reporting period relate to the construction of new infrastructure, the relocation and maintenance of infrastructure and service roads, in addition to an extension of the open cut mining pit towards the west.

1.2 Aims and objectives

The aims of this annual clearing report are to detail the procedures and results for all pre-clearing and clearing operations completed at Bengalla in 2023, inclusive of:

- ecology pre-clearing surveys
- Stage 1 and Stage 2 clearing operations
- fauna handling and relocation
- habitat salvage and procedures.

2 Methods

2.1 Personnel

The contributors to the delivery of clearing operations and reporting, their qualifications and roles are listed in Table 2.1 and Table 2.2.

Table 2.1 Contributors and their role (WSP)

Name	Qualification	Role
Gavin Shelley	B.Env Sc. Mgmt	Ecologist – pre-clearing surveys, spotter catcher and reporting
Sebastian Miller	B.Sc.	Ecologist – pre-clearing surveys, spotter catcher and reporting
Allan Richardson	B Env Sc (Hons)	Associate Ecologist – pre-clearing surveys, spotter catcher and reporting
Nathan Cooper	B.Env.Sc. Grad Dip Ornithology	Principal Ecologist – project manager, pre-clearing surveys, spotter catcher and technical review

All work was carried out under the appropriate licenses, including a scientific licence as required under Part 2 of the NSW *Biodiversity Conservation Act 2016* (BC Act) (License Number: SL100630), and an Animal Research Authority issued by the Department of Primary Industries (Agriculture).

Table 2.2 Contributors and their role (SLR)

Name	Role
Josh Drane	Ecologist – pre-clearing surveys, spotter catcher
Hannah Centra	Ecologist – pre-clearing surveys, spotter catcher
David Conder	Ecologist – pre-clearing surveys, spotter catcher
Jeremy Pepper	Ecologist – pre-clearing surveys, spotter catcher

2.2 Pre-clearing survey procedure

Ecology pre-clearance surveys were conducted throughout 2023 and were completed in accordance with Section 4.2.1 of the BMP (Hansen Bailey, 2017), which outlines management actions for vegetation pre-clearance procedures. The aims and objectives of the ecology pre-clearing survey include:

- detecting the presence/absence of threatened species and their habitat, including *Cymbidium canaliculatum* (Tiger Orchid)
- recording the presence of any fauna or flora species
- identification and demarcation of habitat trees, large logs, and boulders
- identification and demarcation of salvageable material including hollow bearing trees, debris, and boulders
- searching for evidence of plant pathogen *Phytophthora cinnamomi*
- identification of appropriate fauna relocation sites for captured fauna species
- identification of plants suitable for seed collection
- identification of weed and pest species infestations.

Clearing boundaries were initially marked by a surveyor with survey pegs, generally incorporating spacing commensurate with visible line of sight. A hard copy map of the GDP area was also used as a reference when in the field.

It should be noted that throughout the year some GDP areas were assessed more than once due to only part of the GDP area being disturbed or an extended time frame between the initial pre-clearance inspection and commencement of works (Section 3).

2.2.1 Fauna habitat identification

Each clearing area was traversed by a field ecologist to identify important fauna habitat values, including:

- habitat trees – identified as any substantial non hollow-bearing tree that either provided significant canopy cover and thus significant potential foraging resources, or was observed to contain nesting material
- hollow-bearing trees – which include any tree that was observed to contain a visible hollow or fissure that may support microhabitat values for native fauna.

All identified habitat and hollow-bearing trees were marked with "H" (habitat tree) in high visibility paint as well as pink flagging tape to ensure dark trees, such as *Eucalyptus crebra* (Narrow-leaved Ironbark), were clearly marked prior to the commencement of clearing activities. The number of habitat, hollow-bearing or significant trees were recorded on field proformas.

2.2.2 Species inventory

All flora and fauna species identified during the ecology pre-clearance surveys and clearing surveys were recorded and are presented in Appendix A and Appendix B.

2.2.3 Surveys for Cymbidium canaliculatum

Trees within the clearing area were visually examined for the presence of *Cymbidium canaliculatum*, which is listed as an Endangered Population in the Hunter Catchment under the NSW BC Act.

2.2.4 Salvageable habitat material

In accordance with the BMP (Hansen Bailey, 2017), selected salvageable hollow logs and rocks were identified for later reuse in rehabilitation areas. Since materials vary in abundance and quality throughout Bengalla, ecologists are guided by the selection criteria for salvageable materials (as outlined in Table 5 of the BMP) when identifying logs and rocks for re-use.

2.2.5 Surveys for Phytophthora cinnamomi

Vegetation health assessments were undertaken to detect the presence of the plant pathogen *Phytophthora cinnamomi*. This involved assessing vegetation for any visible signs of disease.

2.2.6 Fauna relocation sites

Sites suitable for the relocation of displaced native fauna were assessed prior to the commencement of the ecology pre-clearance survey. Relocation sites were assessed for habitat attributes that represent similar or commensurate habitat attributes as those within the clearing areas. All relocation sites are located outside of the clearing area and consist of the same vegetation community. Fauna relocation sites are illustrated on Figure 3.1.

2.2.7 Collection of seeds for rehabilitation purposes

In accordance with the BMP (Hansen Bailey, 2017), native trees and shrubs suitable for the harvesting and propagation of native seed for use in rehabilitation activities are required to be identified. Any areas of particularly high seed yield were marked on maps for future reference. During pre-clearing surveys throughout 2023. there was a lack of seed availability and as such, no seed was collected for use in rehabilitation areas.

2.2.8 *Identification of weed and pest species infestations*

Significant infestations of Weeds of National Significance (WONS) and noxious weeds identified during the field surveys were recorded and notified to BMC Environmental Department.

2.3 Clearing procedure

In accordance with Section 4.2.2 of the BMP (Hansen Bailey, 2017), clearing activities in 2023 were undertaken as a two-stage process as follows:

- **Stage 1 clearing** – removal of understory vegetation other than marked/flagged habitat features. Habitat trees, marked with an 'H', were left to stand overnight to enable any resident fauna to self-relocate into adjacent habitat.
- **Stage 2 clearing** – commenced no less than 24 hours following the completion of Stage 1 clearing. Felled habitat trees were left undisturbed over night to allow any undetected fauna further opportunity to relocate.

2.3.1 *Fauna handling and relocation*

The following information was recorded in relation to fauna species observed during the clearing activities:

- details of animals sighted, captured, relocated, injured, or killed as a result of vegetation clearing activities
- the relocation of fauna within designated relocation areas
- tree species used for breeding or roosting by fauna
- micro-habitat features of where the species was found on the tree.

Uninjured adult fauna will be relocated into suitable habitat within designated relocation sites. Juvenile and injured fauna will be passed on to the Muswellbrook Satur Vets, local Wildlife Aid carers or euthanised in accordance with the Animal Research Authority Code of Practice (National Health and Medical Research Council, 2013).

3 Results

3.1 Stage 1 pre-clearance surveys

Pre-clearing surveys completed by or on behalf of BMC in 2023 are summarised in Table 3.1 and illustrated in Figure 3.1. It should be noted that throughout 2023 the GDP area was assessed on more than one occasion due to only part of the GDP area being disturbed, or an extended time frame between the initial pre-clearance inspection and commencement of works.

Table 3.1 Pre-clearing surveys completed in 2023 – BMC

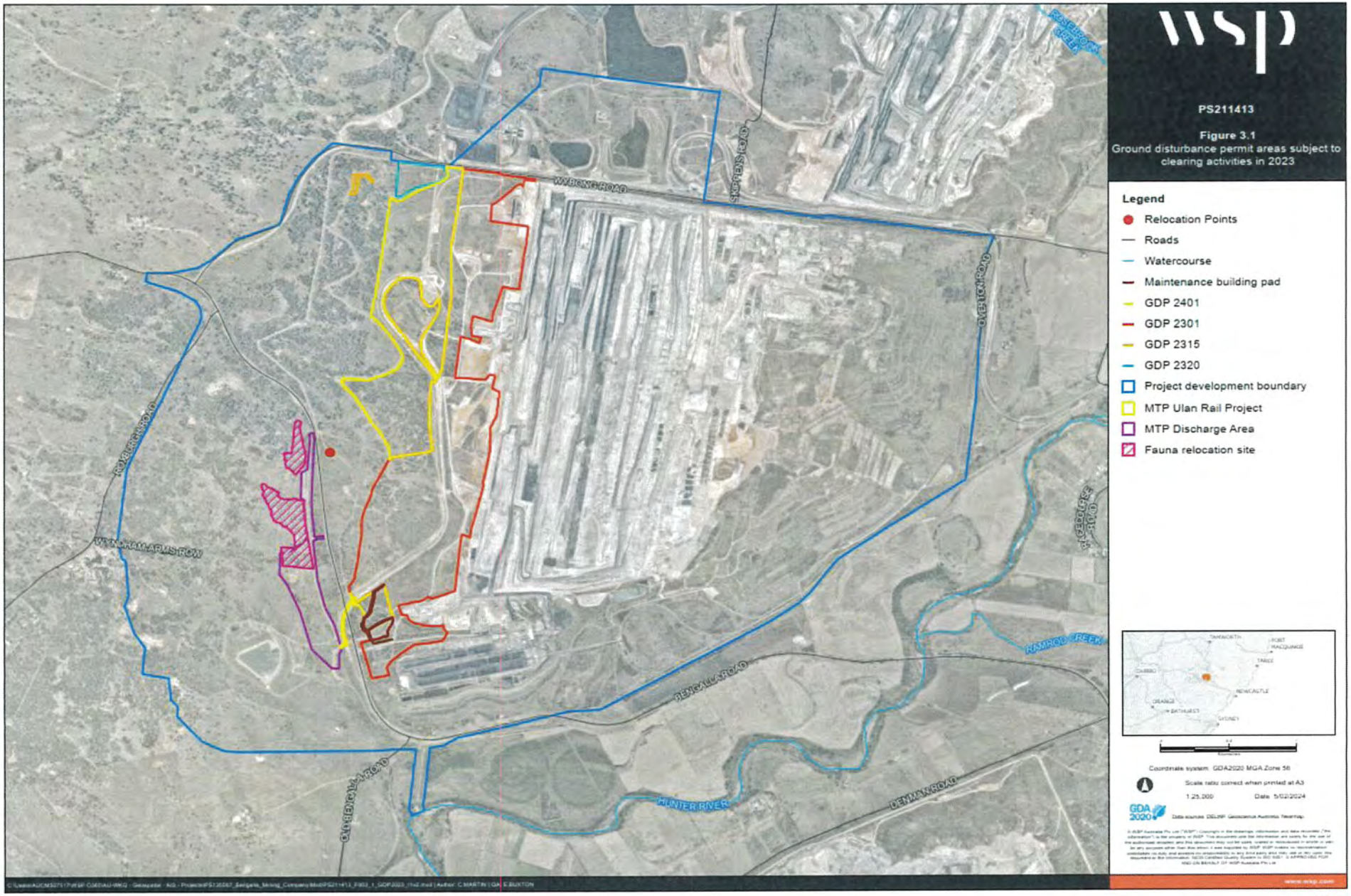
Ground disturbance permit area (GDP)	Date pre-clearance undertaken	Vegetation community
GDP 2301	31 January 2023	Grey Box/White Box Intergrade Grassy Woodland and Derived Native Grassland (CEEC/EEC)
GDP 2301	1-2 February 2023	Derived Native Grassland (CEEC/EEC), Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland Grey Box/White Box Intergrade Grassy Woodland and Derived Native Grassland (CEEC/EEC)
Maintenance Building Pad	27 February 2023	Tree and shrub plantations commensurate with *Eucalyptus crebra*, *Eucalyptus tereticornis*, *Eucalyptus moluccana*, *Allocasuarina luehmannii* and *Acacia implexa*
GDP 2301	1 March 2023	Grey Box/White Box Intergrade Grassy Woodland and Derived Native Grassland (CEEC/EEC)
GDP 2301	7 September 2023	Low Derived Native Grassland/Exotic Grassland
GDP 2401	13-14 December 2023	Derived Native Grassland (CEEC/EEC) Hunter Floodplain Red Gum Woodland Complex (EEC)

In addition to the works completed for BMC, a pre-clearance survey for Mount Pleasant Operations was undertaken for water discharge pipeline that occurred in BMC project boundary (Table 3.2).

Table 3.2 Pre-clearing surveys completed in 2023 – Mount Pleasant Operations

Ground disturbance permit area (GDP)	Date pre-clearance undertaken	Vegetation community
MTP Discharge Area	15 February 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland

Figure 3.1 GDP area subject to pre-clearing or clearing activities in 2023



3.1.1 Vegetation community structure

The following vegetation communities were identified in the areas pre-cleared in 2023:

- Grey Box/White Box Intergrade Grassy Woodland and Derived Native Grassland (CEEC/EEC)
- Derived Native Grassland (CEEC/EEC)
- Hunter Floodplain Red Gum Woodland Complex (EEC)
- Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland
- Low Derived Native Grassland
- Exotic Grassland.
- Tree and shrub plantations.

3.1.2 Habitat, hollow-bearing and significant trees

A total of 297 hollow-bearing/habitat trees were identified within the GDP areas subject to pre-clearing surveys in 2023.

3.1.3 Species inventory

3.1.3.1 Flora

A total of 31 flora species were recorded during pre-clearing surveys completed in 2023. Of these, 15 were introduced species (Appendix A).

3.1.3.2 Fauna

A total of 36 fauna species were recorded during pre-clearing surveys completed in 2023. Of these, two were introduced species, including Common Starling and European Rabbit (Appendix B).

Two Geckos were captured during pre-clearing surveys completed in November 2023 and transported to Bengalla Coal Mine Environment personnel for relocation.

3.1.4 Cymbidium canaliculatum surveys

One *Cymbidium canaliculatum* was identified during pre-clearing surveys in 2023 in association with the former Mount Pleasant Operations Rail Loop (Latitude: -32.26699 Longitude: 150.80649) (Photo 3.1). The orchid was observed growing in a *Eucalyptus molucanna*. This orchid was not translocated or cleared during the 2023 clearing operations and remains extant.

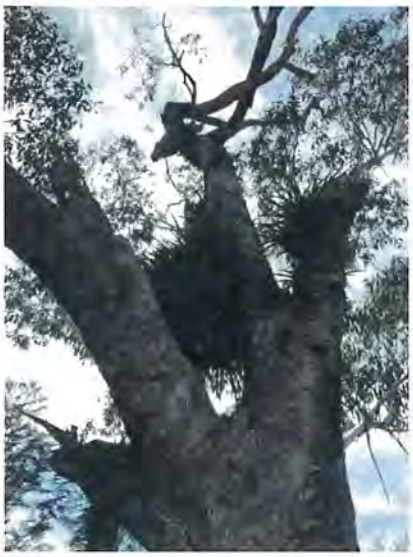


Photo 3.1 *Cymbidium canaliculatum* recorded in the former Mount Pleasant Operations Rail Loop

3.1.5 Phytophthora cinnamomi surveys

No evidence of disease or plant dieback was identified within the GDP area subject to pre-clearing surveys in 2023.

3.1.6 Collection of seeds for rehabilitation purposes

During pre-clearing surveys throughout 2023, no seed was identified within survey areas deemed suitable to be collected for use in rehabilitation. Overall, due to clearing times and large areas of derived native and exotic grasslands limiting the number of canopy species, no suitable native flora seeding opportunities were present and no seed collection was conducted.

3.1.7 Weed species

Table 3.3 Noxious weeds recorded during pre-clearance surveys

Species	Class	Legal requirements
Lycium ferocissimum (African Boxthorn)	3	This plant must be continually suppressed and destroyed, and the plant must not be sold propagated or knowingly distributed.
Opuntia stricta (Prickly Pear)	4	The growth of the plant must be managed that reduces its numbers, spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed.
Senecio madagascariensis (Fireweed)	4	The growth of the plant must be managed that reduces its numbers, spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed.

3.1.8 Salvageable material

A total of 503 lineal metres of hollow ground timber was identified during Stage 1 pre-clearance surveys in 2023. A further 19 log piles and 121 logs were identified in pre-clearing areas in November and December 2023.

3.2 Stage 2 tree clearing

The GDP areas cleared in part in 2023 are summarised in Table 3.4 and illustrated on Figure 3.1. The removal of understory vegetation surrounding habitat trees was undertaken a minimum of 24 hours prior to habitat tree removal. Stage 2 clearing of habitat trees was undertaken in January, February, September, and November in 2023, with a total of 134 habitat trees felled (Table 3.4).

Table 3.4 Stage 2 clearing completed in 2023

Ground disturbance permit area	Stage 2 clearing completed (date)	Vegetation community
GDP 2301	31 January 2023	Central Hunter *Eucalyptus crebra* and *Eucalyptus moluccana* grassy woodland.
GDP 2301	31 January 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland
MTP Discharge Area	24 February 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland
GDP 2301	27 February 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland
GDP 2301	28 February 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland
GDP 2301 Maintenance Building Pad	1 March 2023	Upper Hunter Hills Exposed Ironbark Woodland and Derived Native Grassland Tree and shrub plantations
GDP 2301	7 September 2023	Low Derived Native Grassland/Exotic Grassland
GDP 2401	13-14 December 2023	Derived Native Grassland (CEEC/ EEC) Hunter Floodplain Red Gum Woodland Complex (EEC)

Prior to the habitat trees being felled, the trees were visually inspected to identify signs of fauna utilisation. Habitat trees were gently shaken prior to felling to encourage any resident fauna to vacate any fissure and/ or hollow. Habitat trees were then felled sequentially when directed by the supervising ecologist.

Immediately following the felling of each habitat tree, the supervising ecologist inspected the trees for remaining fauna. Tree hollows were inspected using a hand-held torch. Felled habitat trees were left undisturbed over night to allow any undetected fauna further opportunity to relocate. The habitat trees were then stockpiled for mulching or utilisation in rehabilitation areas.

3.2.1 Fauna recorded and relocated

A total of 50 species of animal were observed whilst on site at Bengalla during Stage 1 and Stage 2 clearing activities (Appendix B). Of the 50 species observed on site, a minimum of 114 individual animals were recorded using habitat trees impacted within GDP areas subject to Stage 2 tree clearing activities. This comprised of two species of bird, six mammals, five reptiles and two species of frog. Animals handled for purpose of relocation or euthanasia were handled in accordance with the Animal Research Authority Code of Practice (National Health and Medical Research Council, 2013). During the 2023 Stage 2 tree clearing operations:

- 46 animals were successfully relocated
- 54 animals were displaced but evaded capture

- nine animals died as a result of tree felling
- three animals were euthanised following tree felling
- two animals required assistance from wildlife rehabilitation agencies.

Table 3.5 Species of animal recorded during Stage 2 tree clearing operations in 2023.

Common name	Scientific name	Notes	Number of individuals
Animals relocated during Stage 2 tree clearing operations			
Eastern Bearded Dragon	*Pogona barbata*	–	3
Elegant Snake-eyed Skink	*Cryptoblepharus pulcher*	–	4
Robust Velvet Gecko	*Nebulifera robusta*	–	8
Tree Skink	*Egernia striolata*	–	11
Common Brushtail Possum	*Trichosurus vulpecula*	–	2
Gould's Wattled Bat	*Chalinolbus gouldii*	–	9
Ride's Free-tailed Bat	*Ozimops ridei*	–	2
Green Tree Frog	*Litoria caerulea*	–	5
Peron's Tree Frog	*Litoria peroni*	–	2
Total			**46**
Animals displaced but evaded capture			
Elegant Snake-eyed Skink	*Cryptoblepharus pulcher*	–	12
Lace Monitor	*Varanus varius*	–	4
Tree Skink	*Egernia striolata*	–	13
Robust Velvet Gecko	*Nebulifera robusta*	–	3
Common Brushtail Possum	*Trichosurus vulpecula*	–	2
Gould's Wattled Bat	*Chalinolbus gouldii*	Self-relocated	6
Ride's Free-tailed Bat	*Ozimops ridei*	Self-relocated	1
Unidentified microbat	–	Roost limb. Hollow entrance observed but bats were not accessible. Trunk could not be sectioned and relocated, and individuals remained in hollow to self-relocate at nightfall.	1 (minimum)
Unidentified microbat	–	Self-relocated	5
Unidentified microbat	–	–	4
House Mouse	*Mus Musculus*	–	2
Australian Owlet Nightjar		Self-relocated	1
Total			**54**

Common name	Scientific name	Notes	Number of individuals
Animals that died during Stage 2 tree clearing operations			
Gould's Wattled Bat	*Chalinolobus gouldii*	–	7
Ride's Free-tailed Bat	*Ozimops ridei*	–	2
Total			**9**
Animals euthanised following Stage 2 tree clearing operations			
Common Brushtail Possum	*Trichosurus vulpecula*	–	1
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	–	1
Black Rat	*Rattus rattus*	–	1
Total			**3**
Animals requiring assistance from wildlife rehabilitation agencies			
Sulphur-crested Cockatoo	*Cacatua galerita*	Delivered to Muswellbrook Satur Vets for collection by wildlife rehabilitation agencies	2
Total			**2**

Table 3.6 Fauna guilds recorded during Stage 2 clearing operations in 2023

Guild	Number of individuals recorded				
	Relocated	Observed	Injured	Dead/ Euthanised	Taken to Wildlife carer
Reptiles	26	32	0	0	0
Microchiropteran bats/mammals	13	21	0	12	0
Amphibians	7	0	0	0	0
Birds	0	1	0	0	2
Total	**46**	**54**	**0**	**12**	**2**

In mid-December 2022, a Noisy Friarbird nest was observed in an *Allocasuarina luehmanii* (Buloke) during clearing works with adults attending and sitting on the nest (Photo 3.2). It was envisaged that nest might be vacated in a 5–6-week window, so a strip of trees associated with the nest tree was left in situ for the purpose of allowing the adults to raise and fledge their young (Photo 3.3), after which the nest would be inspected by an ecologist to gauge activity and guide clearing of the remaining trees in accordance with the BMP. On 31 January 2023, the Noisy Friarbird nest was inspected, and no activity was observed. Accordingly, the nest tree and remaining support trees were then cleared without incident.

Photo 3.2 Active Noisy Friarbird nest, December 2022

Photo 3.3 Vegetation strip reserved to assist Noisy Friarbird breeding attempt, December 2022

3.2.2 *Salvage of habitat resources*

Stage 1 clearing operations identified approximately A total 503 lineal metres of new salvageable material potentially suitable for re-use in rehabilitation works in 2023. A further 19 existing log piles and another 121 logs (presumably from existing log piles) were identified from pre-clearing areas in November and December 2023.

An additional 78 lineal metres of suitable salvageable material was identified from hollow-bearing trees felled during Stage 2 tree clearing activities (Photo 3.4 and Photo 3.5). Salvaged habitat items were to be stockpiled with the intention to relocate within rehabilitation areas as work progresses.

Photo 3.4 An example of salvageable material identified during Stage 2 tree clearing

Photo 3.5 An example of salvageable material identified during Stage 2 tree clearing

3.2.3 *Stage 2 clearing works completed outside approved clearing time*

In accordance with Bengalla's BMP, clearing of woodland areas will be avoided during May to November, in order to avoid impacting hibernating bats and important growth and flowering periods for *Cymbidium canaliculatum* (Hansen Bailey, 2017). If clearing is to occur during this period, an assessment by a suitably qualified ecologist justifying clearing activities must be recorded.

New light vehicle road/pipeline relocation (September 2023)

In September 2023, Bengalla were progressing the construction of a new light vehicle road, including a pipeline relocation, associated with standard open cut mine progression. One habitat tree immediately adjacent to the alignment was observed to have previously been cut with a chainsaw (Photo 3.6) and posed a significant safety issue to construction personnel and machinery (Photo 3.7). An ecologist from WSP attended Bengalla on 7 September 2023 to undertake a pre-clearing inspection of the tree and immediate area for biodiversity values, and the habitat tree was felled with caution with the ecologist present.

One Gould's Wattled Bat (*Chalinolobus gouldii*) escaped the tree unharmed and self-relocated to nearby remnant vegetation. No other microchiropteran bats or fauna were found following thorough inspection of all hollows and the trunk with a torch. The tree was left in place overnight to allow any undetected fauna further opportunity to escape.

Photo 3.6 Dangerous habitat tree detail

Photo 3.7 Dangerous habitat tree

4 Conclusions

This report documents the pre-clearing and clearing activities completed at Bengalla Mine in 2023. Pre-clearing and clearing surveys were undertaken by appropriately qualified WSP ecologists to allow for the safe removal and relocation of native flora and fauna, where practicable.

A total of 297 hollow-bearing/ habitat trees were identified within GDP areas, 134 of which were felled in 2023. In total, approximately 503 lineal metres of salvageable material potentially suitable for reuse in rehabilitation programs was identified, with the intention to relocate within rehabilitation areas as work progresses.

During Stage 2 clearing operations, 46 animals were captured and relocated, nine animals died as a result of tree felling activities, and a further three animals were euthanised post tree felling. Two juvenile birds were also captured post-felling and passed on to wildlife rehabilitation agencies for additional care. In addition, 54 animals were observed using habitat trees but evaded capture once the tree was felled.

One large *Cymbidium canaliculatum* was identified during Stage 1 pre-clearing surveys in 2023. This individual was left in place during Stage 2 tree clearing activities in February 2023.

One habitat tree was felled during the May to November avoidance period in 2023. Due to the unsafe nature of the tree observed, and its proximity to construction activities and personnel, it was considered that the tree could be safely felled with appropriate ecological supervision to ensure that any arising ecological matters were appropriately addressed and handled to ensure protection of important biodiversity. The tree was felled successfully, with no animals injured or requiring veterinary assistance. No animals were captured and relocated during these works.

Clearing activities undertaken in 2024 will continue to follow the methodology outlined within the BMP.

5 Limitations

This Report is provided by WSP Australia Pty Limited (*WSP*) for Bengalla Mining Company (*Client*) in response to specific instructions from the Client and in accordance with WSP's proposal dated 13 December 2023 (*Agreement*).

5.1 Permitted purpose

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (*Permitted Purpose*).

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- NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL 2013. Australian code for the care and use of animals for scientific purposes, 8th edition. Canberra: National Health and Medical Research Council.

Appendix A

Recorded flora

Table A.1 Recorded flora

Scientific name	Common name	Introduced	EPBC Act[1]	BC Act[2]
Acacia implexa	Hickory Wattle			
Allocasuarina luehmannii	Buloke			
Angophora floribunda	Rough-barked Apple			
Austrostipa verticillata	Bamboo Grass			
Aster subulatus	Wild Aster	*		
Bidens pilosa	Cobblers Pegs	*		
Bidens subalternans	Greater Beggar's Ticks	*		
Bothrichloa macra	Red Grass			
Brachychiton populneus	Kurrajong			
Cirsium vulgare	Spear Thistle	*		
Chrysocephalum apiculatum	Golden Buttons			
Conyza bonariensis	Flaxleaf Fleabane	*		
Corymbia maculata	Spotted Gum			
Cymbidium canaliculatum	Tiger Orchid			EP
Cynodon sp.	Couch	*		
Daviesia ulicifolia	Gorse Bitter Pea			
Dichondra repens	Kidney Weed			
Einada hastata	Berry Saltbush			
Eragrostis curvula	African Lovegrass	*		
Eucalyptus crebra	Narrow-leaved Ironbark			
Eucalyptus moluccana	Grey Box			
Eucalyptus tereticornis	Forest Red Gum			
Lycium ferocissimum	African Boxthorn	*		
Melinis repens	Red-natal Grass	*		
Onopordum acanthium	Scotch Thistle	*		
Opuntia stricta	Prickly Pear	*		
Phyla canescens	–	*		
Rytidosperma caespitosum	Wallaby Grass			
Senecio madagascariensis	Fireweed	*		
Sida rhombifolia	Paddys Lucerne	*		
Verbena bonariensis	Purpletop	*		

(1) Environment Protection and Biodiversity Conservation Act 1999

(2) Biodiversity Conservation Act 2016 – EP = Endangered Population.

Appendix B

Recorded fauna

Table B.1 Recorded fauna

Scientific name	Common name	Introduced	EPBC Act[1]	BC Act[2]
Amphibians (2)				
Litoria caerulea	Green Tree Frog			
Litoria peroni	Peron's Tree Frog			
Birds (32)				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			
Acanthiza nana	Yellow Thornbill			
Acridotheres tristis	Common Myna	*		
Aegotheles cristatus	Australian Owlet-nightjar			
Alisterus scapularis	Australian King-Parrot			
Aquila audax	Wedge-tailed Eagle			
Cacatua galerita	Sulphur-crested Cockatoo			
Coracina novaehollandiae	Black-faced Cuckoo-shrike			
Corcorax melanorhamphos	White-winged Chough			
Corvus coronoides	Australian Raven			
Coturnix ypsilophora	Brown Quail			
Cracticus tibicen	Australian Magpie			
Cracticus nigrogularis	Pied Butcherbird			
Cracticus torquatus	Grey Butcherbird			
Dicaeum hirundinaceum	Mistletoebird			
Elanus axillaris	Black-shouldered Kite			
Eolophus roseicapilla	Galah			
Falco cenchroides	Nankeen Kestrel			
Grallina cyanoleuca	Magpie Lark			
Malurus cyaneus	Superb Fairywren			
Manorina melanocephala	Noisy Miner			
Ocyphaps lophotes	Crested Pigeon			
Pardalotus striatus	Striated Pardalote			
Petrochelidon nigricans	Tree Martin			
Platycerus elegans	Crimson Rosella			
Platycerus eximius	Eastern Rosella			
Pomatostomus temporalis	Grey-crowned Babbler			Vulnerable
Rhipidura leucophrys	Willie Wagtail			

Sericornis frontalis	White-browed Scrubwren			
Smicrornis brevirostris	Weebill			
Sturnus vulgaris	Common Starling	*		
Taeniopygia guttata	Zebra Finch			
Mammals (9)				
Chalinolobus gouldii	Gould's Wattled Bat			
Macropus giganteus	Eastern Grey Kangaroo			
Mus musculus	House Mouse	*		
Nyctophilus geoffroyi	Lesser-long-eared Bat			
Oryctolagus cuniculus	Rabbit	*		
Ozimops ridei	Ride's Free-tailed Bat			
Rattus rattus	Black Rat	*		
Trichosurus vulpecula	Common Brushtail Possum			
Vombatus Ursinus	Common Wombat			
Reptiles (7)				
Cryptoblepharus pulcher	Elegant Snake-eyed Skink			
Ctenotus robustus	Robust Ctenotus			
Ergernia striolata	Tree Skink			
Nebulifera robusta	Robust Velvet Gecko			
Pogona barbata	Eastern Bearded Dragon			
Pseudonaja textilis	Eastern Brown Snake			
Varanus varius	Lace Monitor			

(1) *Environment Protection and Biodiversity Conservation Act 1999;* (2) *Biodiversity Conservation Act 2016*

Appendix C

Scientific licence

Department of Planning, Industry and Environment

Scientific Licence

Biodiversity Conservation Act 2016

Name and postal address of principal licensee

Mr Alex Cockerill
WSP Australia
Se 1 L 3 51-55 Bolton St
NEWCASTLE NSW 2300

Nominated premises (where appropriate)

Your licence number is: SL100630

This licence is valid from: 01 September 2022

This licence will expire on: 31 March 2024

Additional authorisations:

Project Title: General flora and fauna surveys for environmental impact assessments

This class of biodiversity conservation licence granted under Part 2 of the *Biodiversity Conservation Act 2016* authorises the following activities: Harm, by means of capture, deal in (possess), and liberate protected and threatened animals for survey purposes; Pick and deal in (possess) protected and threatened plants for identification purposes.

This licence authorises the principal licensee and any associates named in **Attachment A** to conduct those activities authorised above, to those species, communities or materials listed in **Attachment B**, at the locations specified in **Attachment C** of this licence.

This licence also authorises the principal licensee to conduct research on National Park estate under clause 26 of the National Parks and Wildlife Regulation 2019 (NPW Reg), where this forms part of a project approved by a delegated officer of the *Biodiversity Conservation Act 2016*.

This licence is granted subject to the provisions of *Biodiversity Conservation Act 2016*, Biodiversity Conservation Regulation 2017, the general conditions listed below, any special conditions as may be notified in writing to the licensee by the Environment Agency Head of the Department of Planning, Industry and Environment (the Department) or a 'delegated officer' of the *Biodiversity Conservation Act 2016* and the Department's "Scientific Licensing Policy".

.....

Signature of Delegated Officer

Date: 21 March 2023

.....

Signature of Principal Licensee*

Date: 5 5 2023

* This licence is not valid unless it is signed by the principal licensee. By signing this licence, the licensee agrees that they have read, understood and agree to comply with all of the conditions listed on the licence.

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Appendix D Weed and Pest Management

WEED AND PEST MANAGEMENT

1 Environmental Management

Weed and pest management at Bengalla and on the offset properties is undertaken in accordance with the BMP and BOMP, respectively.

Inspections are undertaken for weeds and pests, as required. Weed and pest control at Bengalla and on the offset properties is undertaken through targeted chemical and baiting applications.

2 Environmental Performance

Weed Management

Weeding is undertaken using boom spray, spot spraying or stem application dependent upon the specific weed and the terrain.

- *Bengalla*

During 2023, approximately 211 ha was treated for the management of weeds. Target weed species included African boxthorn, Galenia, St John's wort, African olive and other environmental weeds. Priority areas for treatment included the pre-clearance areas and rehabilitation areas. Chemicals used during 2023 included Glyphosate with metsulfuron, Grazon Extra, Starane, Tordon, Amicide advanced, Lontrel and Garlon 600.

Observations during the weed treatment program and follow up inspections indicate that treatment methods used during the Reporting Period have generally been effective in reducing the presence of weeds in target areas.

Weed management areas at Bengalla are shown on **Figure 2** below.

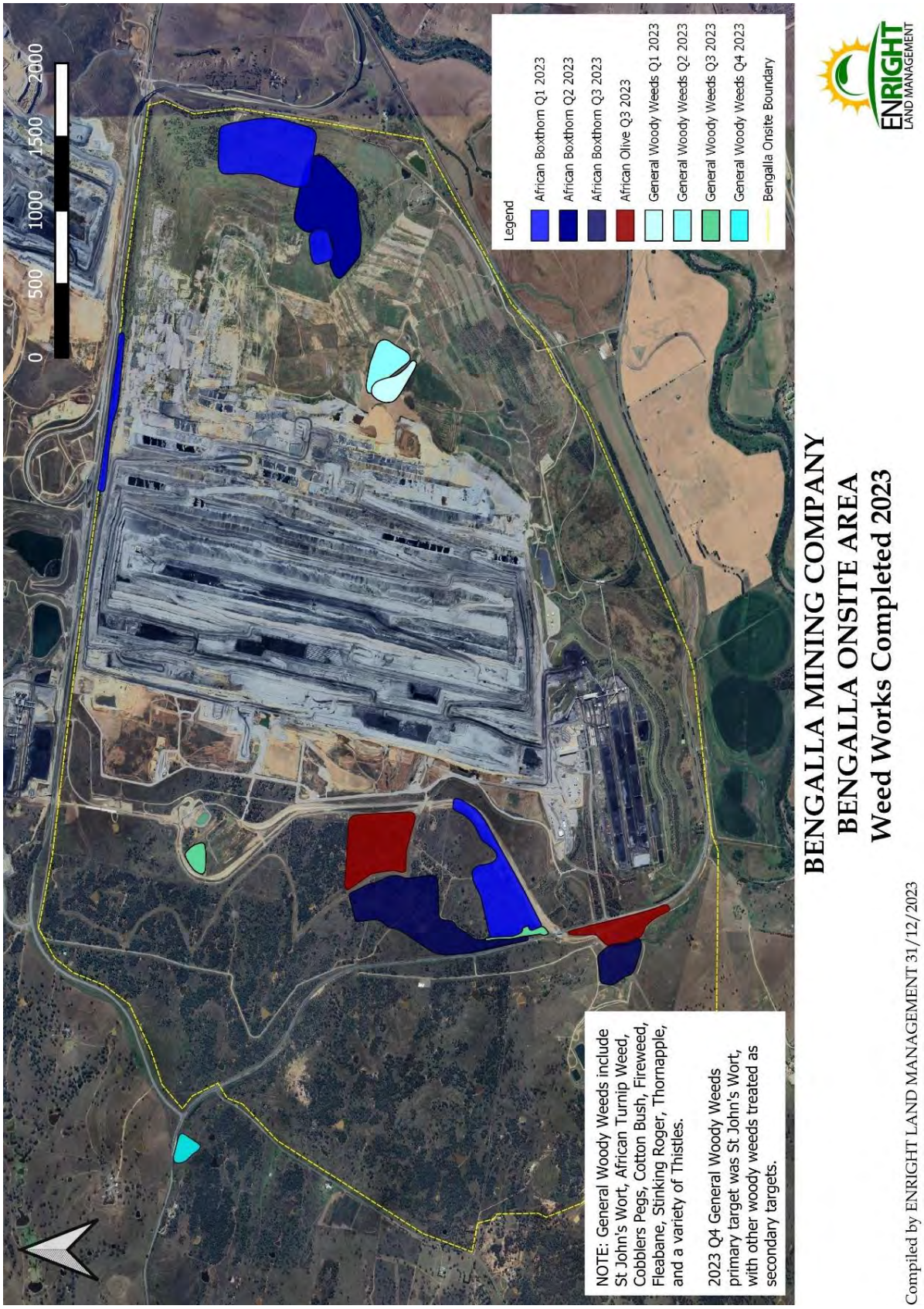


Figure 2 - Bengalla Mine Weed Management Areas 2023

- *Biodiversity Offset Areas*

Weed management across the biodiversity offset areas involves quarterly inspections and weed control programs.

Quarterly inspections are undertaken to determine weed control required for each quarter in each of the offset areas. Following identification, weed control commences and quarterly work records of site attendance are submitted which detail the sites treated, area (ha) treated, techniques and chemicals utilised and rates of application.

The chemicals to be utilised are based on their effectiveness depending on the type of weeds present. Chemicals used during 2023 include Glyphosate with metsulfuron, Grazon Extra, Roundup Bi-active, Starane advanced, Lontrel Advanced and Garlon 600.

The weeds controlled during the Reporting Period included prickly pear, fire weed, spear thistle, African boxthorn, lantana and several environmental weeds across each BOA.

Application of chemicals was primarily via vehicle mounted spray rigs however backpacks were also used in some areas inaccessible by vehicle.

Particularly higher infestations of seasonal weeds were found in Kenalea and Echo, specifically in disturbed areas, riparian zones, gullies, and grasslands while minimal seasonal weeds were observed in Merriwa and Black Mountain.

Regional rainfall was well below the long-term average for 2023 which contributed to the decrease of several weed populations such as St Johns Wort.

Figures 3 to 4 below show locations of weed control in 2023 at the Black Mountain, Kenalea and Merriwa offset properties.

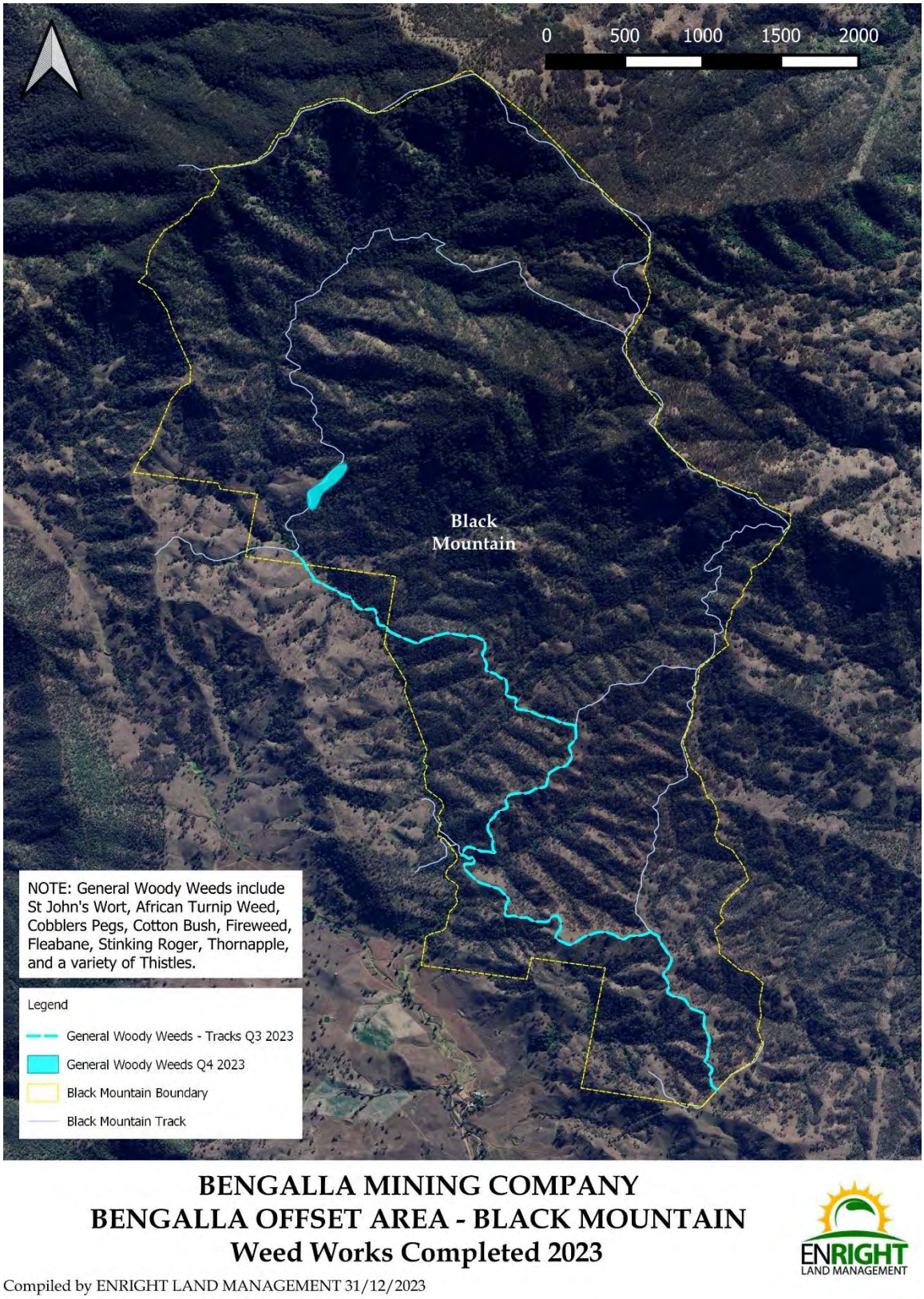


Figure 3 – Black Mountain Weed Management Locations 2023

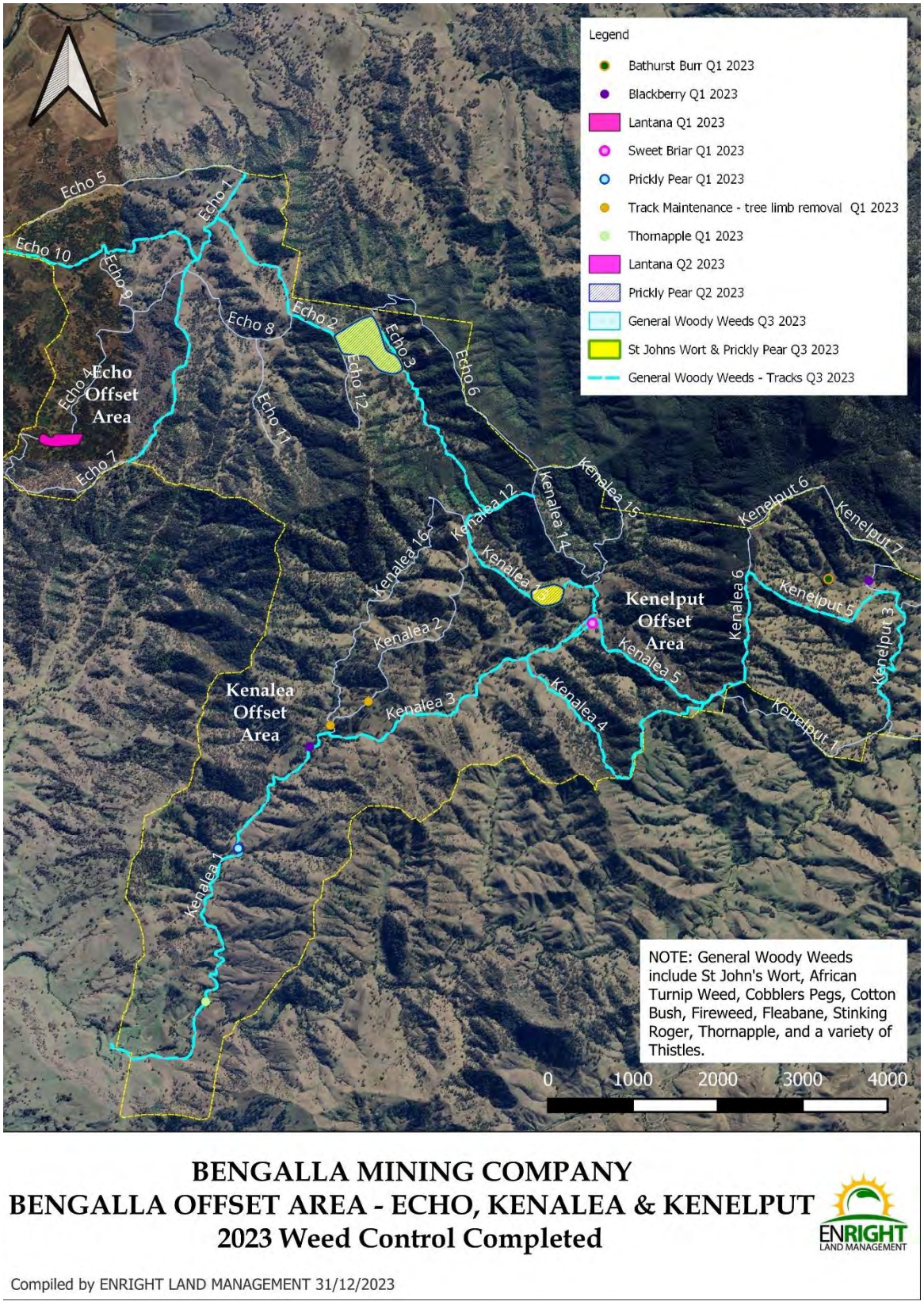


Figure 4 – Kenalea Weed Management Locations 2023

Pest Management

- *Bengalla*

A pig control program was conducted throughout 2023 at various locations across Bengalla. A total of 29 pigs were trapped and culled in 2023.

Feral pigs were trapped utilising a penning system using grain and molasses as the main attractant. Once trapped, all pigs were disposed of humanely.

The culling program will continue into 2024 across Bengalla.

Dog baiting programs at Bengalla occurred in the Autumn and Spring 2023. Each program was undertaken in conjunction with Local Land Services and local wild dog associations and additionally forms part of a broader scale baiting program targeting foxes and wild dogs in the Hunter Valley. Baiting included utilising 1080 poison baits in addition to ejector capsule baits and each baiting program extended for three weeks during each period.

Both buffer lands and rehabilitation areas were utilised in the programs. **Figure 5** and **Figure 6** shows the location of wild dog bait stations utilised at Bengalla. The distribution of bait locations covered both buffer land west of the mine site and rehabilitation areas.

During the autumn baiting program, 29 bait stations were laid over a three week period with a total of 87 baits. Results indicate 49 takes of which 32 takes were by target species being foxes and 3 wild dogs. Bait shyness was detected at all locations.

During the spring baiting program, 29 stations were laid over a three week period with a total of 87 baits. Results indicate 17 takes were by target species being foxes. No wild dog takes were recorded. Evidence of bait shyness was also detected. Trail cameras were used in conjunction with the baiting program to record species taking the baits.

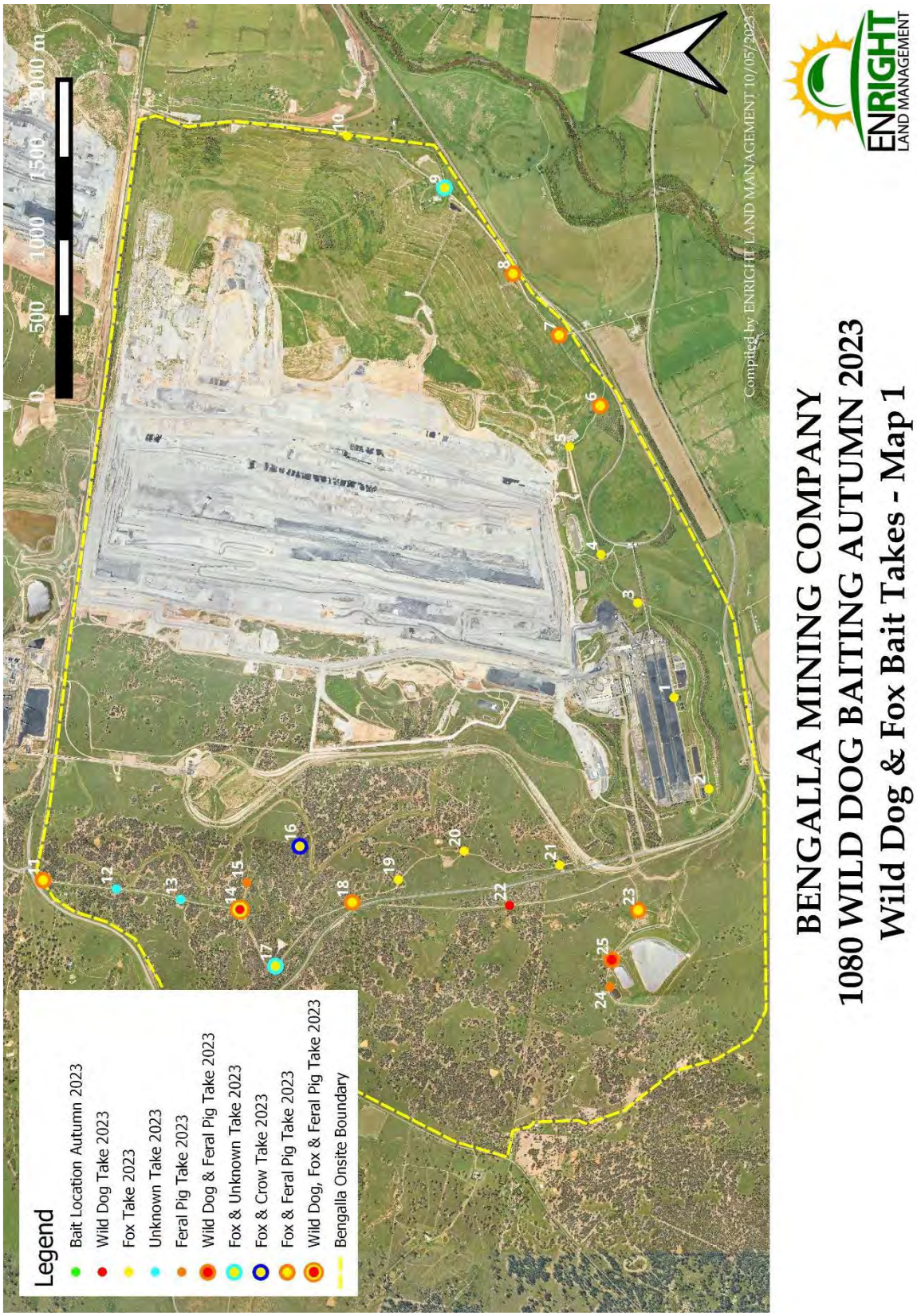


Figure 5 – Bengalla Mine Wild Dog Bait Locations Autumn 2023

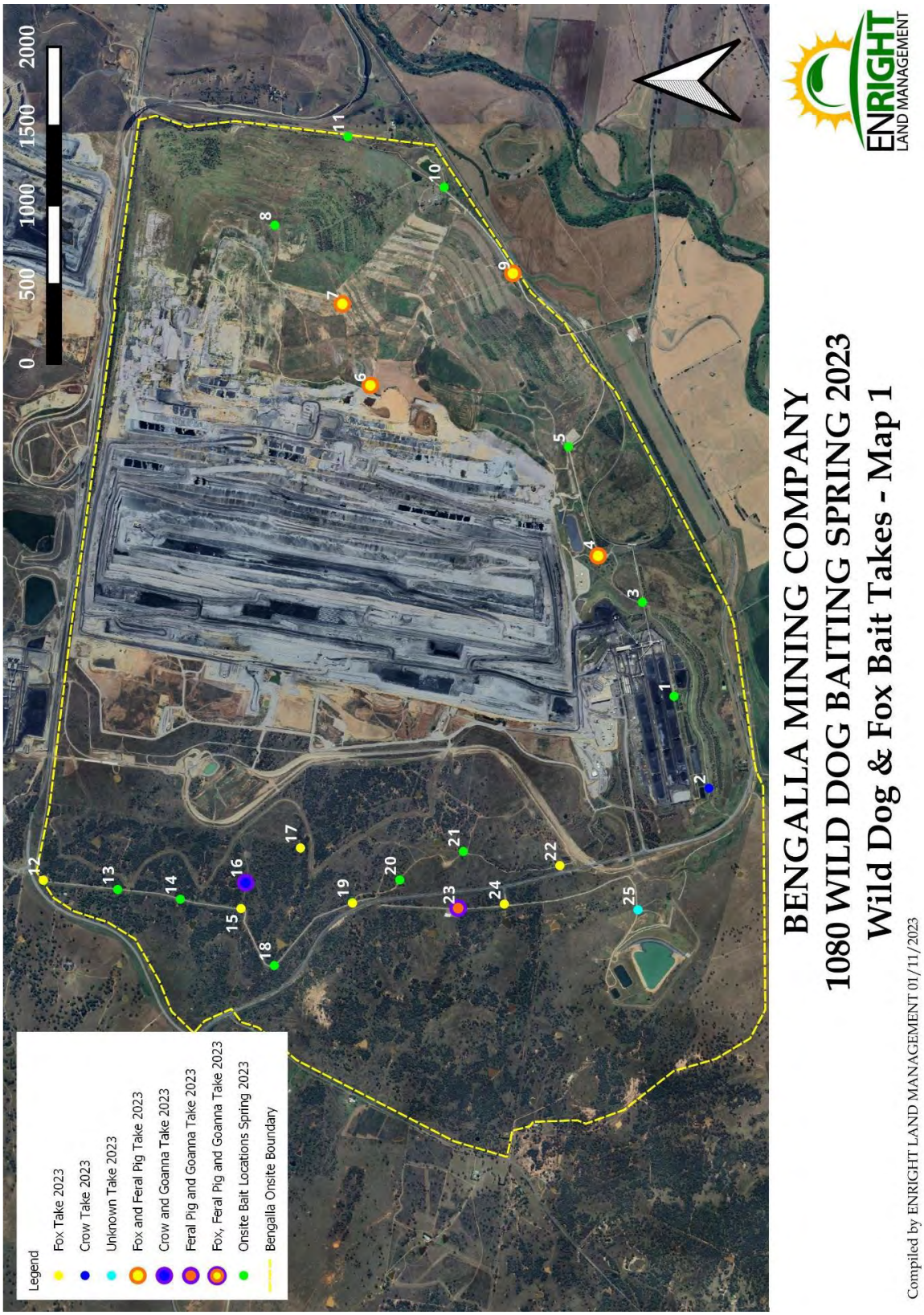


Figure 6 – Bengalla Mine Wild Dog Bait Locations Spring 2023

- *Offset Properties*

During the Reporting Period, BMC undertook two 4-week dog ground baiting programs across all offset properties, including aerial dog baiting in Autumn and Spring in consultation with Local Land Services.

Figure 7 to **Figure 12** show locations of wild dog baiting locations on each BOA for each baiting period in 2023.

A total of 687 baits were placed during the 2023 ground baiting program targeting foxes and wild dogs. A total of 136 baits were taken during the program by the targeted species. Results indicated that 26% of baits were taken by wild dogs and 64% by foxes. Trends over the previous 3 years indicate that wild dog takes have varied from 28 in 2021, 39 in 2022 and 36 in 2023. This suggests that dog numbers have remained relatively stable throughout the period however may also be now increasing due to an increase in available in food supply.

Opportunistic feral animal control was also undertaken during weed control works targeting 34 pigs and 5 deer utilising open range opportunistic shooting.

Further Actions

Ongoing management of weeds and feral animals at Bengalla and BOA's will continue during 2024.

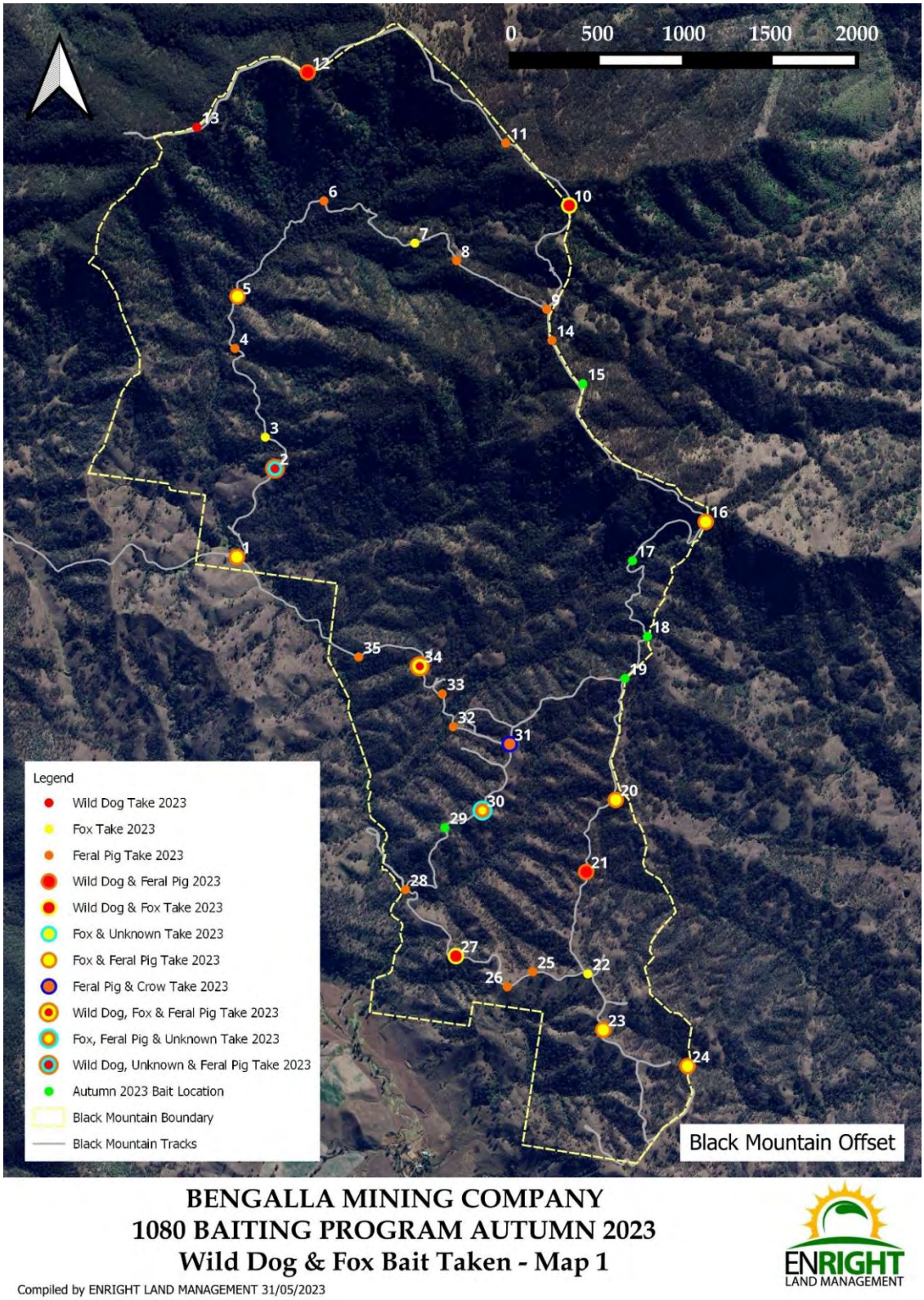


Figure 7 – Black Mountain Wild Dog Bait Locations Autumn 2023

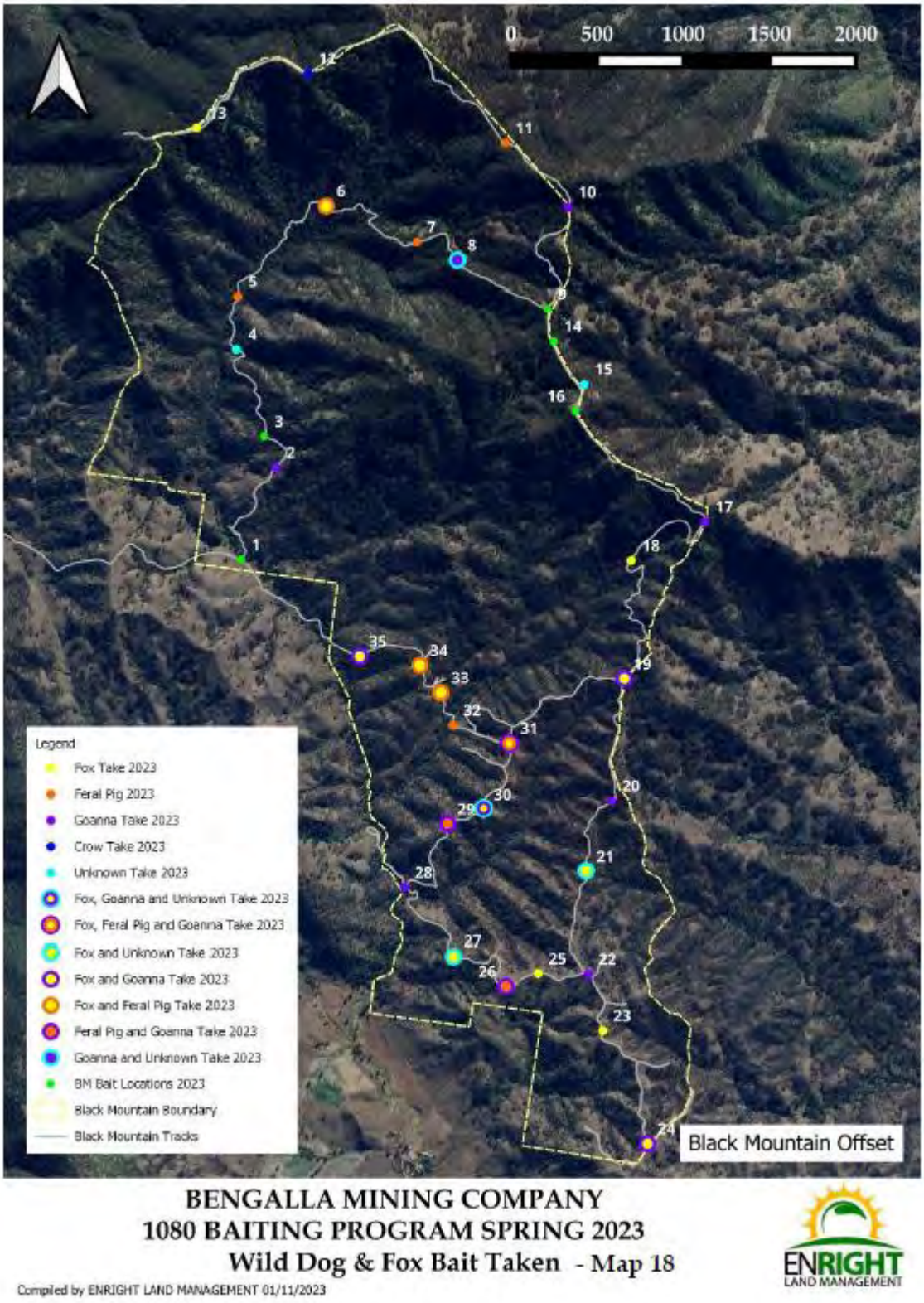


Figure 8 – Black Mountain Wild Dog Bait Locations Spring 2023

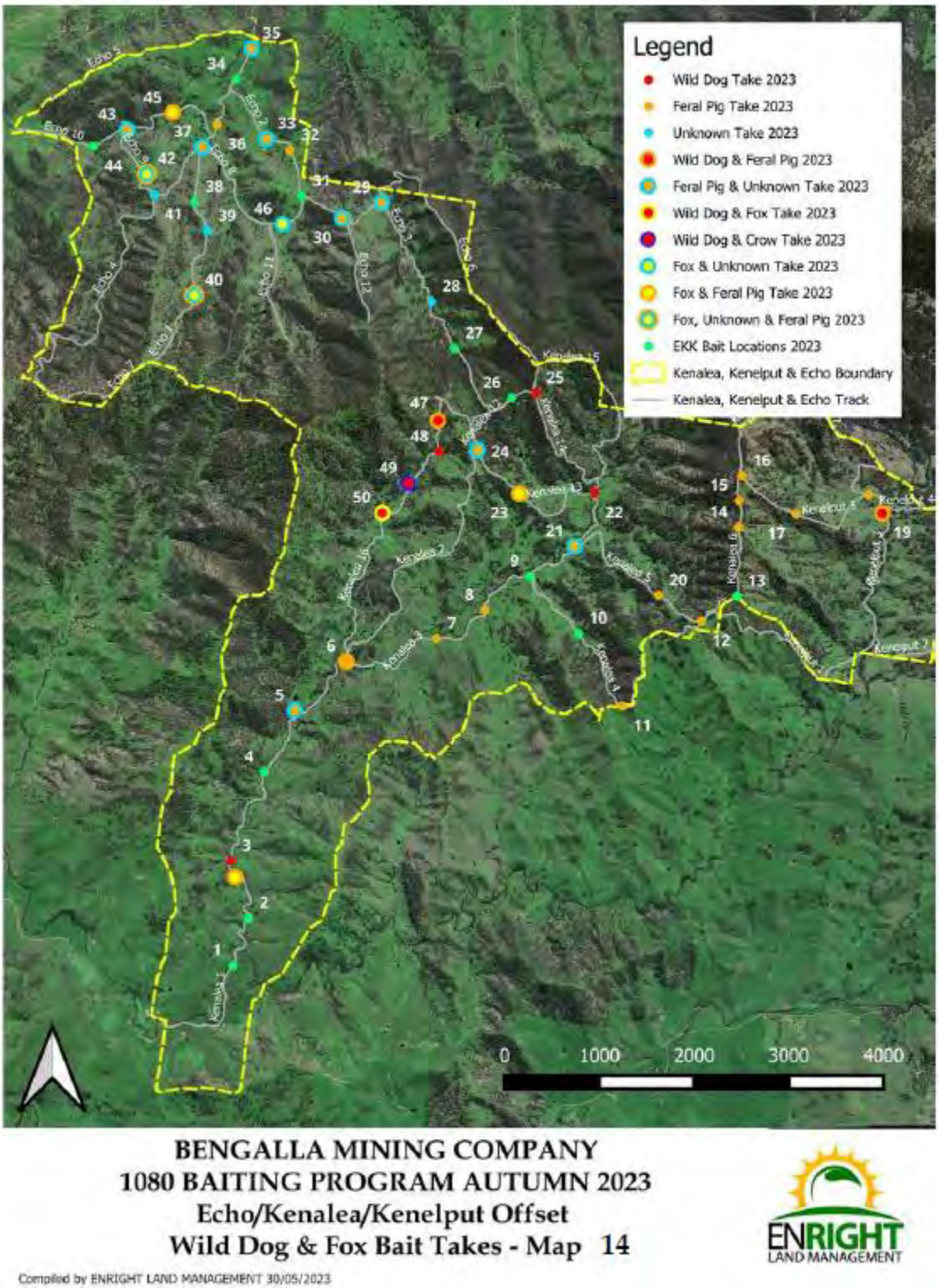


Figure 9 – Kenalea Wild Dog Bait Locations Autumn 2023

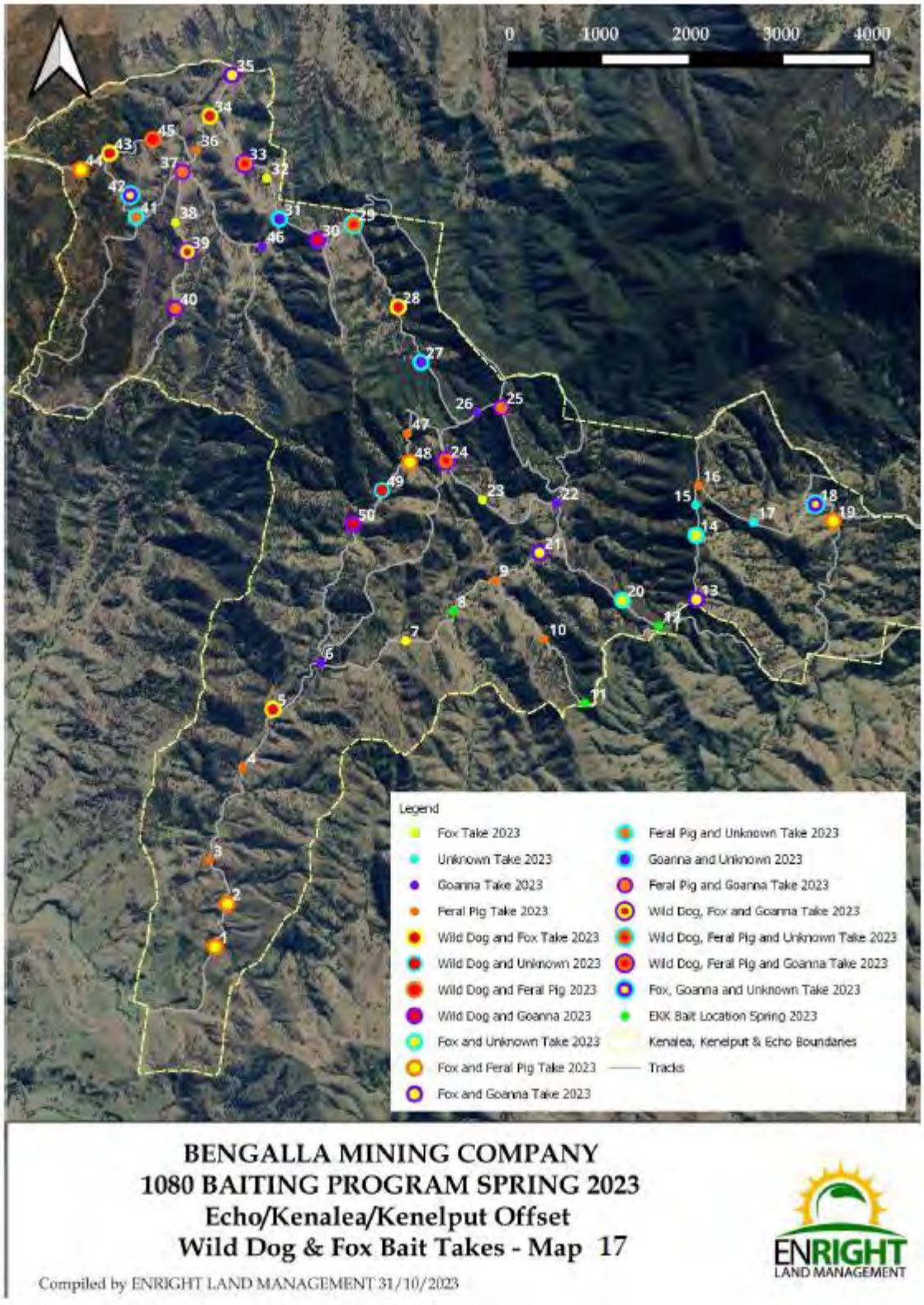


Figure 10 – Kenalea Wild Dog Bait Locations Spring 2023

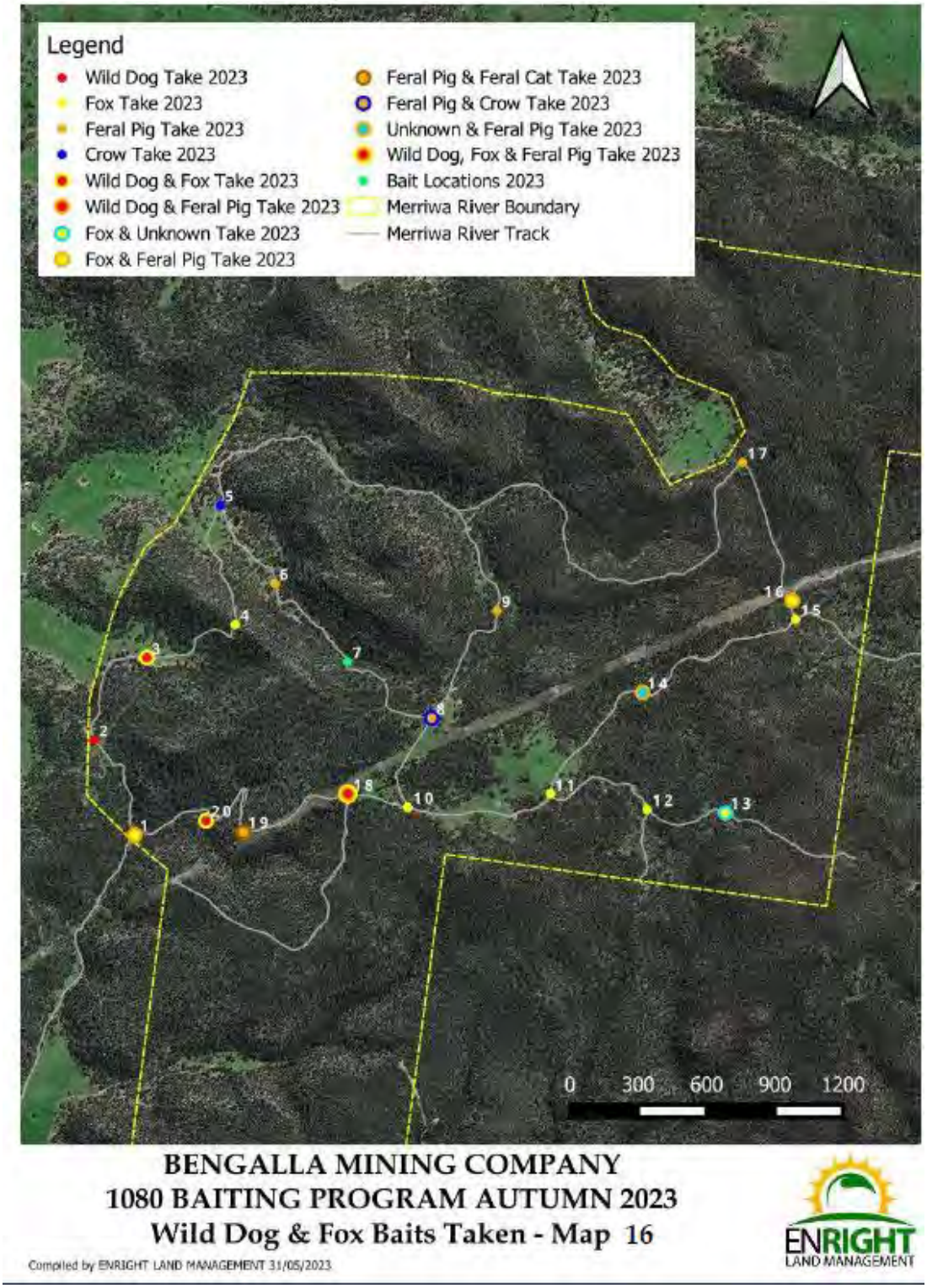


Figure 11 – Merriwa River Wild Dog Bait Locations Autumn 2023

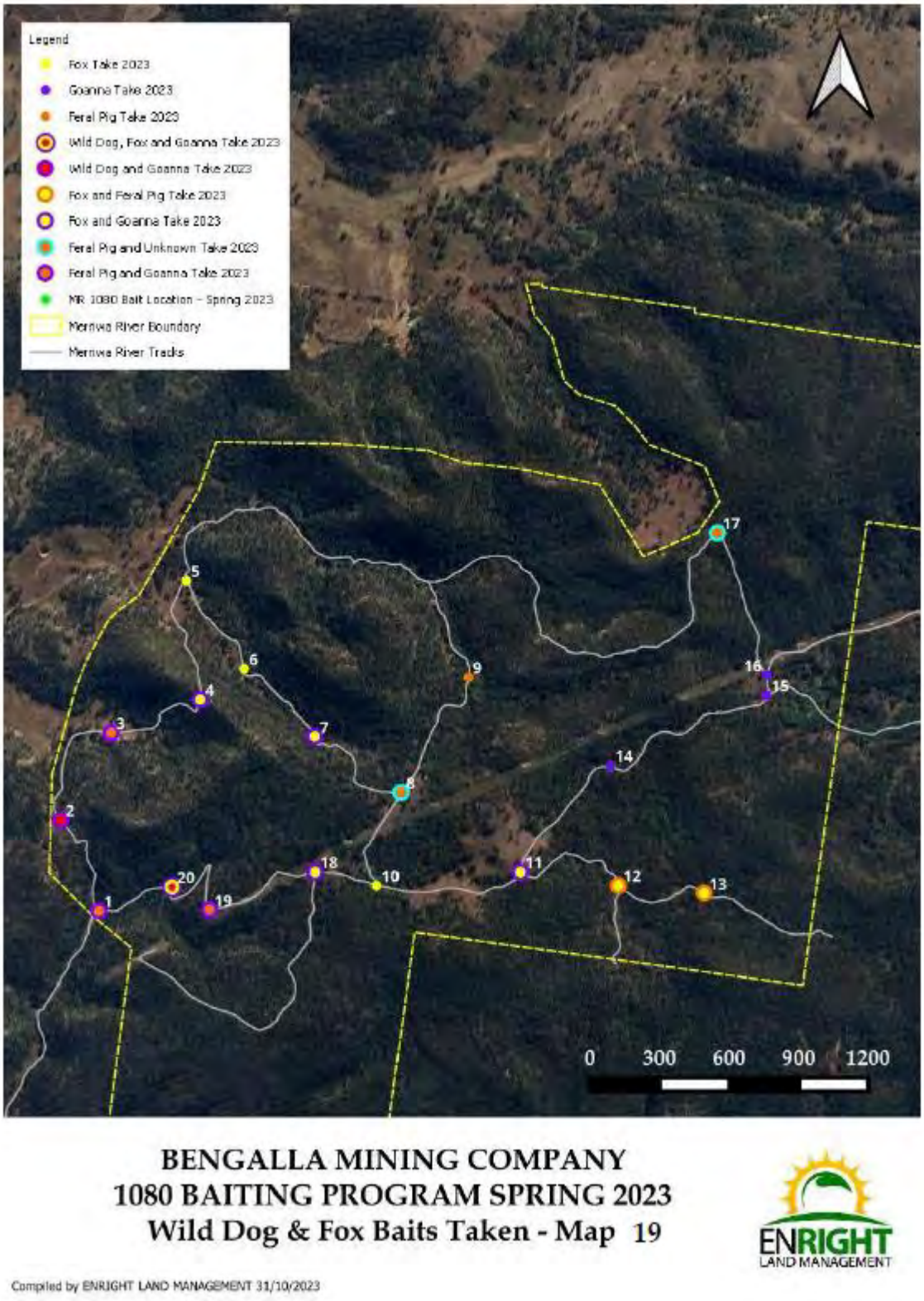


Figure 12 – Merriwa River Wild Dog Bait Locations Spring 2023

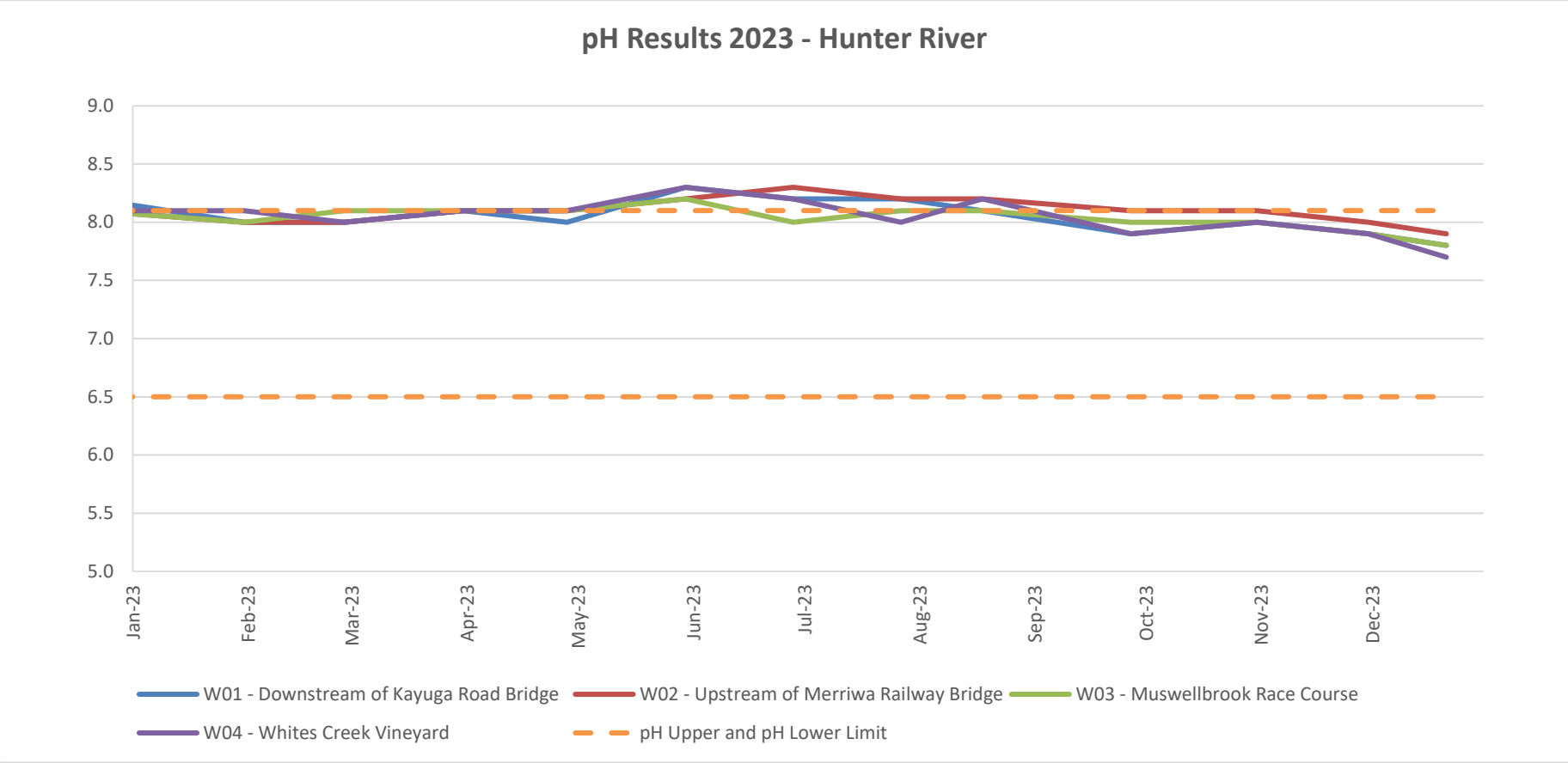
Appendix F

Surface Water Monitoring Summary

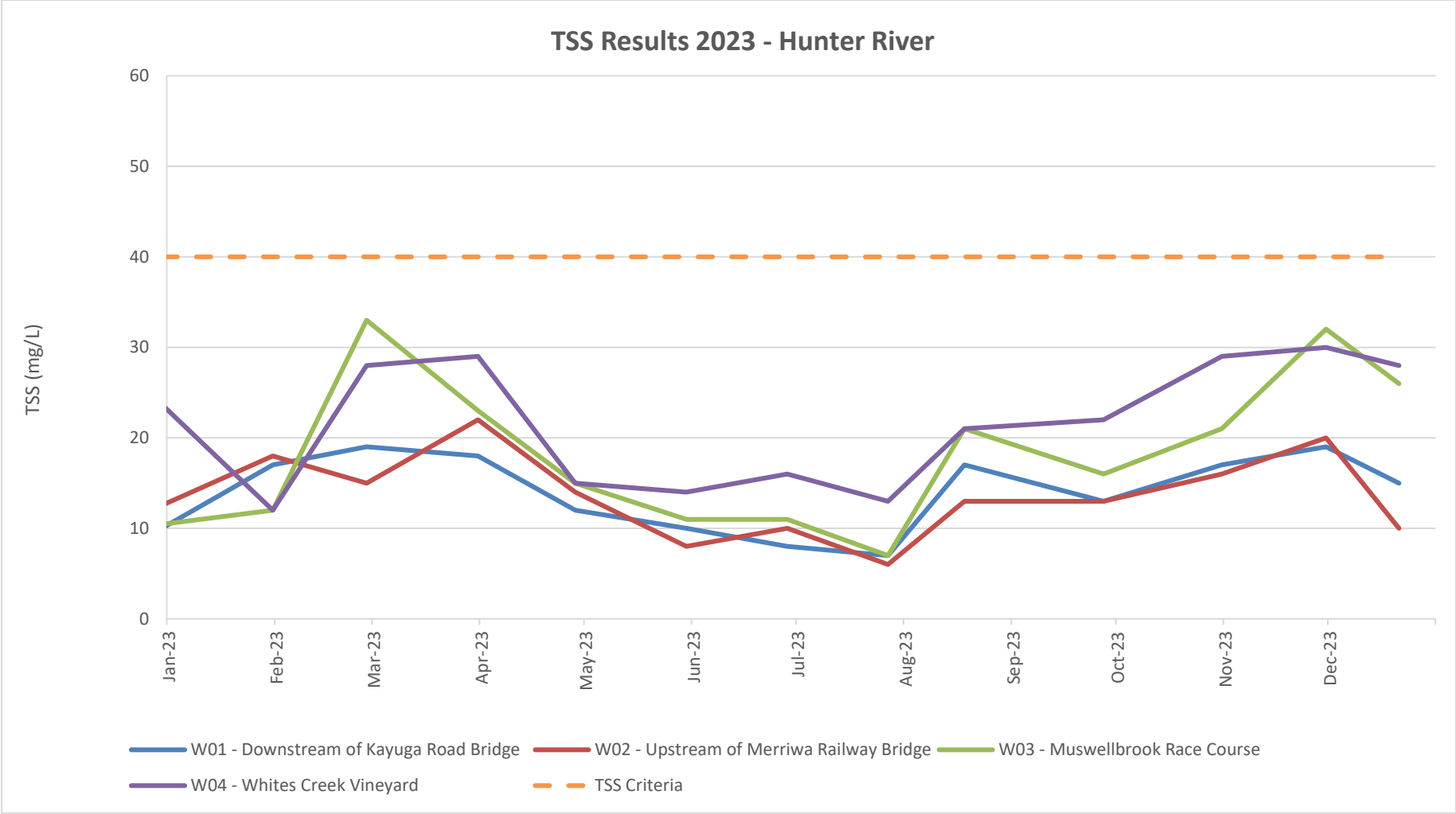
Table F1
Hunter River (W01 – W04) Surface Water Monitoring Results 2023

Criteria		31-Jan-23	27-Feb-23	31-Mar-23	28-Apr-23	30-May-23	28-Jun-23	27-Jul-23	18-Aug-23	27-Sep-23	31-Oct-23	30-Nov-23	21-Dec-23
W01													
pH	6.5 – 8.1	8.0	8.0	8.1	8.0	8.3	8.2	8.2	8.1	7.9	8.0	7.9	7.8
TSS (mg/L)	40	17	19	18	12	10	8	7	17	13	17	19	15
EC (µS/cm)	650	733	870	831	1027	920	692	736	698	641	498	628	496
W02													
pH	6.5 – 8.1	8.0	8.0	8.1	8.1	8.2	8.3	8.2	8.2	8.1	8.1	8.0	7.9
TSS (mg/L)	40	18	15	22	14	8	10	6	13	13	16	20	10
EC (µS/cm)	650	726	911	843	1031	958	760	740	658	644	509	605	487
W03													
pH	6.5 – 8.1	8.0	8.1	8.1	8.1	8.2	8.0	8.1	8.1	8.0	8.0	7.9	7.8
TSS (mg/L)	40	12	33	23	15	11	11	7	21	16	21	32	26
EC (µS/cm)	650	789	899	875	1100	1070	774	802	1022	698	529	660	532
W04													
pH	6.5 – 8.1	8.1	8.0	8.1	8.1	8.3	8.2	8.0	8.2	7.9	8.0	7.9	7.7
TSS (mg/L)	40	12	28	29	15	14	16	13	21	22	29	30	28
EC (µS/cm)	650	791	895	961	1146	1137	770	860	790	768	564	695	571

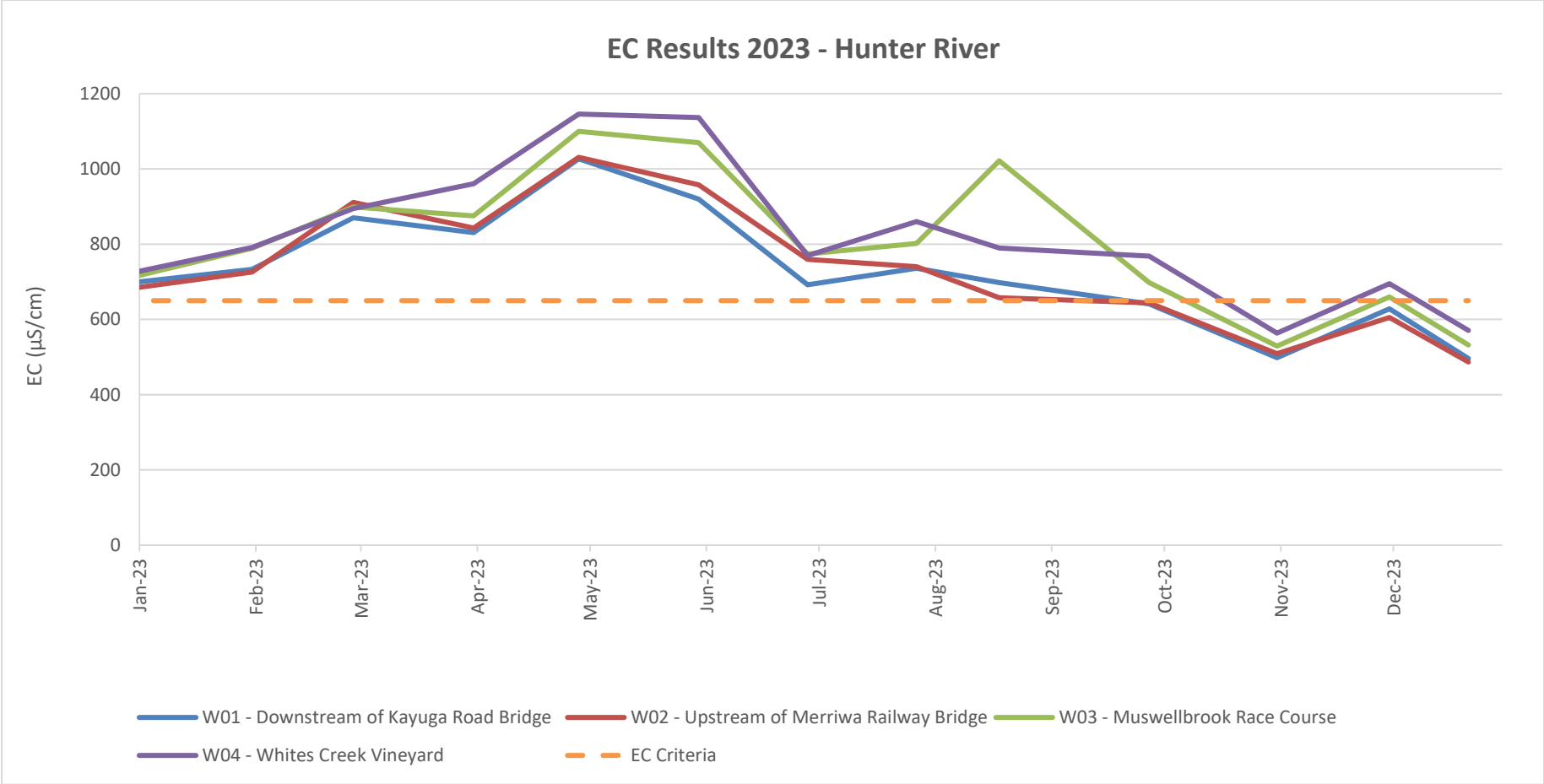
Data sourced from AECOM.



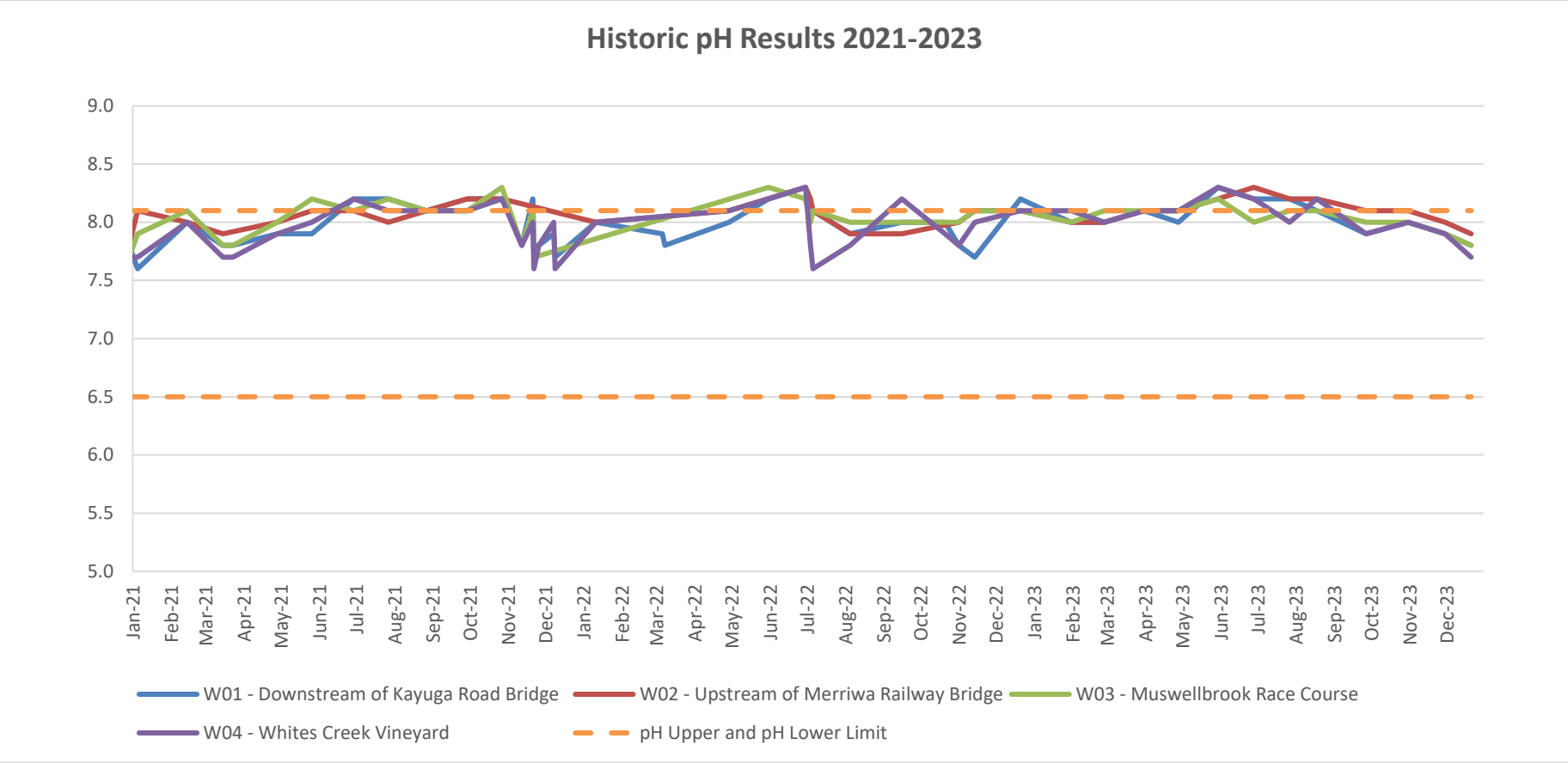
Graph F1
Hunter River pH Results 2023



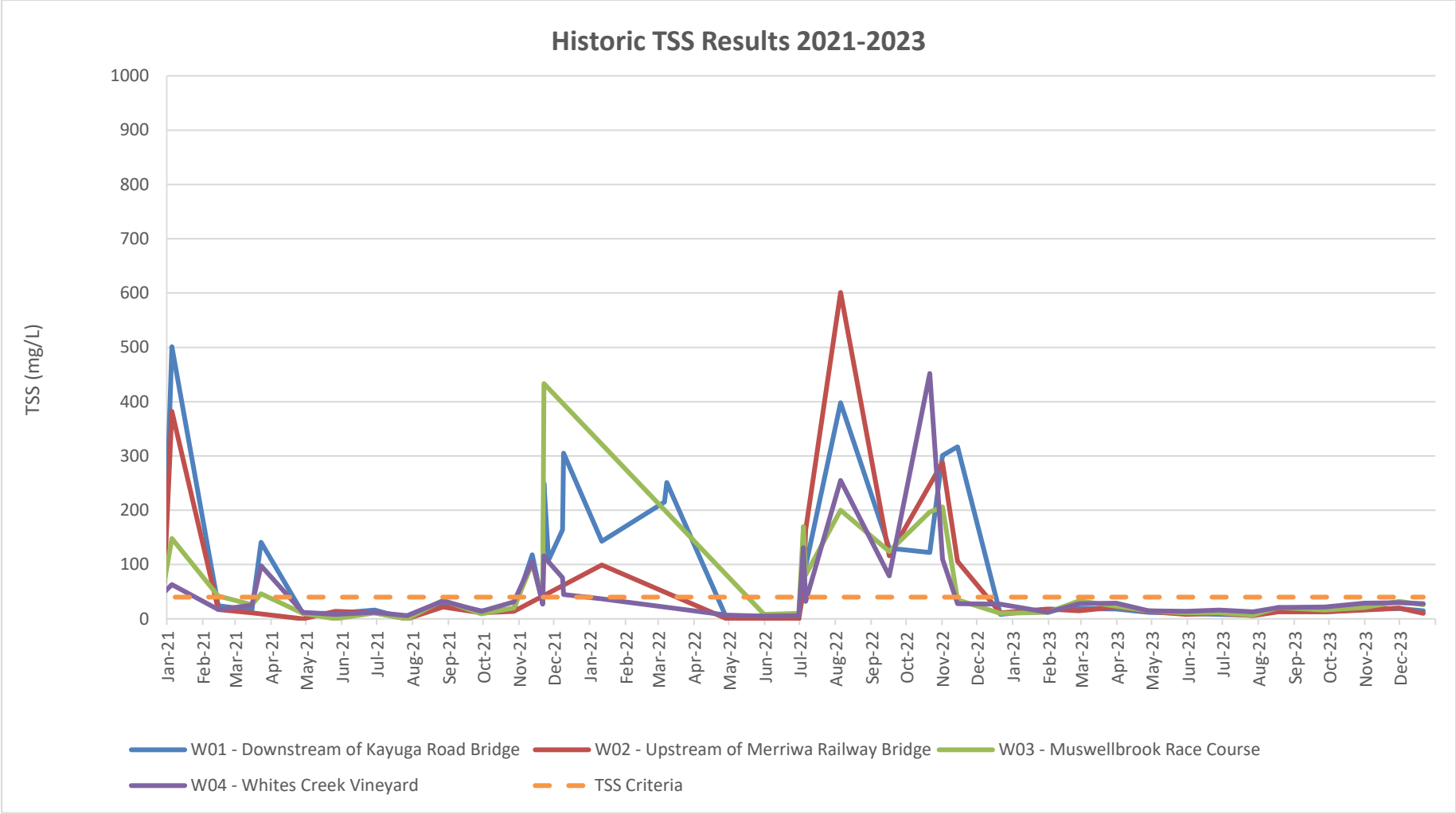
Graph F2
Hunter River TSS Results 2023



Graph F3
Hunter River EC Results 2023

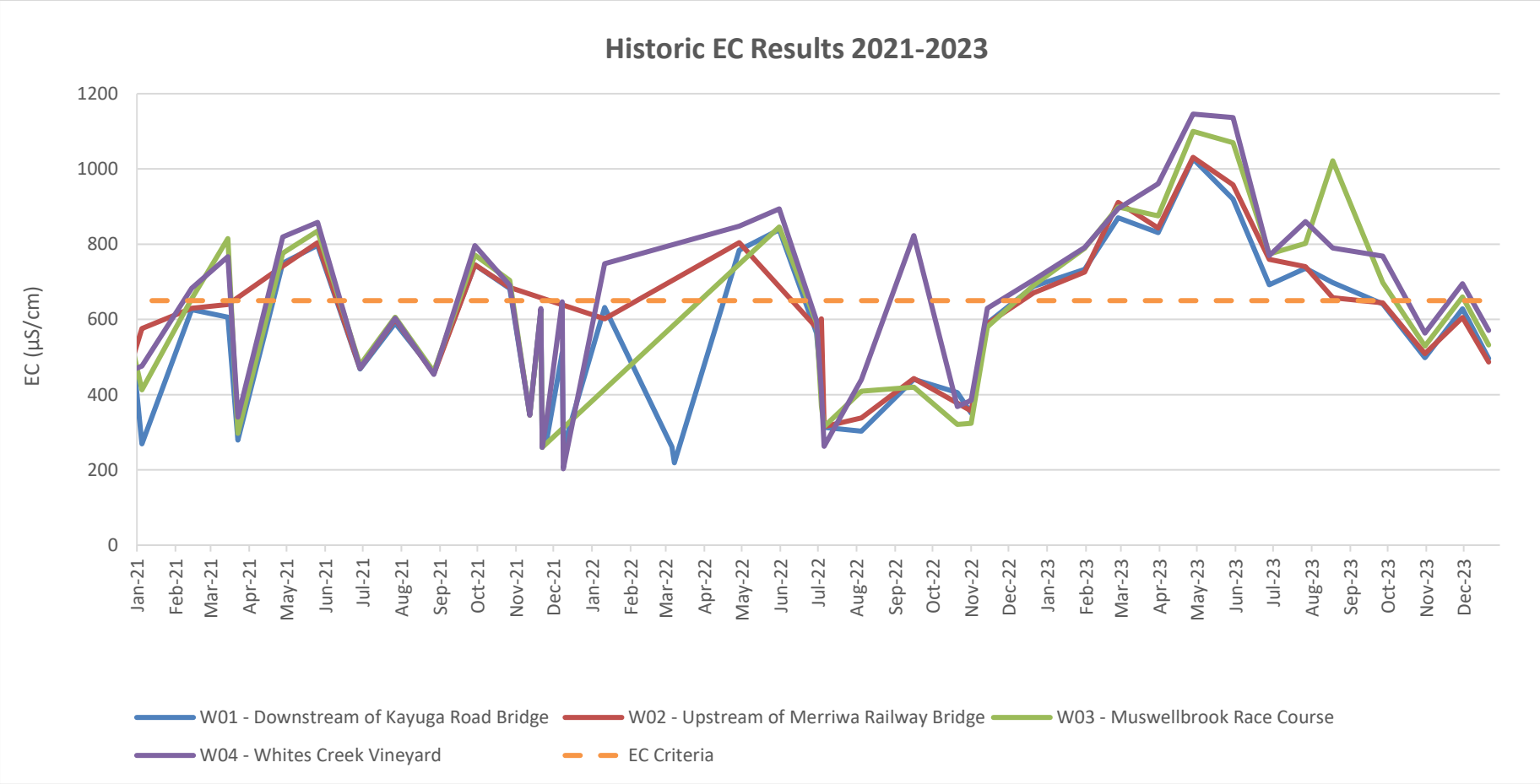


Graph F4
Hunter River pH Results 2021 - 2023



Graph F5
Hunter River TSS Results 2021 – 2023

(Note Elevated TSS levels have been recorded due to Hunter River flooding and La Nina conditions increasing ongoing flows into the Hunter River during 2020, 2021 and 2022).



Graph F6
Hunter River EC Results 2021 – 2023

Appendix G

Annual Groundwater Monitoring Report 2023

Australasian Groundwater & Environmental Consultants

Report on

Bengalla Mine Annual Groundwater Monitoring Report for 2023

Prepared for
Bengalla Mining Company Pty Ltd

Project No. BEN5017.001
March 2024

ageconsultants.com.au

ABN 64 080 238 642

Document details and history

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Table of contents

Table of contents

List of figures

Table of contents

List of tables

List of appendices

Bengalla Mine
Annual Groundwater Monitoring Report for 2023

1 Introduction and scope of works

The Bengalla Mining Company Pty Ltd (BMC) is a joint venture ownership between New Hope Group (80%) and Taipower (20%). BMC operate the Bengalla open cut coal mine (Bengalla), which was officially opened in 1999. Bengalla is located approximately 4 km west of Muswellbrook in the Upper Hunter Valley of New South Wales (NSW). Mining operations target coal from the Warkworth to Edderton Seams of the Permian Wittingham Coal Measures.

This report is a review of groundwater monitoring data collected during the one-year monitoring period 1 January 2023 to 31 December 2023. Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) were commissioned by BMC to undertake the following scope of work:

- update all groundwater monitoring hydrographs;
- discuss how groundwater levels respond to rainfall and mining over the reporting period;
- discuss groundwater chemistry trend analyses;
- identify any changes/observations made during the past 12 months;
- assess the adequacy of the existing monitoring bore network and monitoring program; and
- provide recommendations if necessary.

The review shall also address the additional scope:

- fulfil the requirements of Schedule 5, Condition 4 of SSD-5170 (as modified) which states:

  "*By the end of March each year (or as otherwise agreed by the Secretary), the Applicant must review the environmental performance of the development for the previous calendar year to the satisfaction of the Secretary. This review must:*

  a) describe the development (including any rehabilitation) that was carried out in the past 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 past year, which includes a comparison of these results against the:

  - *relevant statutory requirements, limits or performance measures/criteria;*
  - *monitoring results of previous years; and*
  - *relevant predictions in the EIS;*

  c) identify any non-compliance over the last year, and describe what actions were (or are being) taken to ensure compliance;

  d) identify any trends in the monitoring data over the life of the development;

  e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and

  f) describe what measures will be implemented over the next year to improve the environmental performance of the development."

AGE will report on the above with regards to groundwater issues, for all items except item (a).

2 Climate

The climate at Bengalla is temperate and is characterised by hot, wet summers and mild, dry winters. Temperature data for 2023 were sourced from the Bureau of Meteorology weather station at Scone (061363), 25 km from Bengalla. The maximum monthly mean temperature for the year was recorded in November 2023 (33.4°C), whilst a minimum monthly mean temperature of 18.9°C was recorded in June 2023.

Long-term rainfall data covering the period 1992 to 2023 were obtained from the onsite Bengalla weather station and are summarised in Table 2.1.

The total annual rainfall recorded at the Bengalla meteorological station for 2023 was 402 mm. December was the wettest month, with 67 mm of recorded rain, and May the driest with 1.5 mm of rain recorded. A comparison of the total annual 2023 rainfall (402 mm) at Bengalla with the longer-term 1992 to 2023 average (596.2 mm) illustrates a below average rainfall trend for the year (Table 2.1).

Table 2.1 Rainfall data 2023 – Bengalla weather station

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bengalla Monthly Total Rainfall (mm) 2023	56.0	54.5	51.5	27.0	1.5	12.0	11.5	32.5	11.0	37.0	40.5	67.0	402.0
Bengalla long term monthly average rainfall (mm) 1992 - 2023	54.9	69.0	67.0	36.0	33.3	43.3	34.3	34.2	35.9	47.3	69.7	71.4	596.2

Historical rainfall was contextualised using the Cumulative Rainfall Departure (CRD) method (Figure 2.1). This method is a summation of the monthly departure of rainfall from the long-term average monthly rainfall. A rising trend in the CRD plot indicates periods of above average rainfall, whilst a falling slope indicates periods when rainfall is below average. The Hunter River water level was also plotted with rainfall (Figure 2.1) using data from the Muswellbrook Bridge monitoring station (210002), which is located approximately 5 km up-stream of Bengalla.

The CRD (Figure 2.1) has displayed a decreasing trend throughout 2022 and 2023, following a period of high rainfall from mid-2019 to mid-2022. The Hunter River water level data indicates that, whilst periods of higher rainfall correlate with elevated river levels, the Hunter River generally displays relatively stable water levels due to being regulated by the Glenbawn Dam.

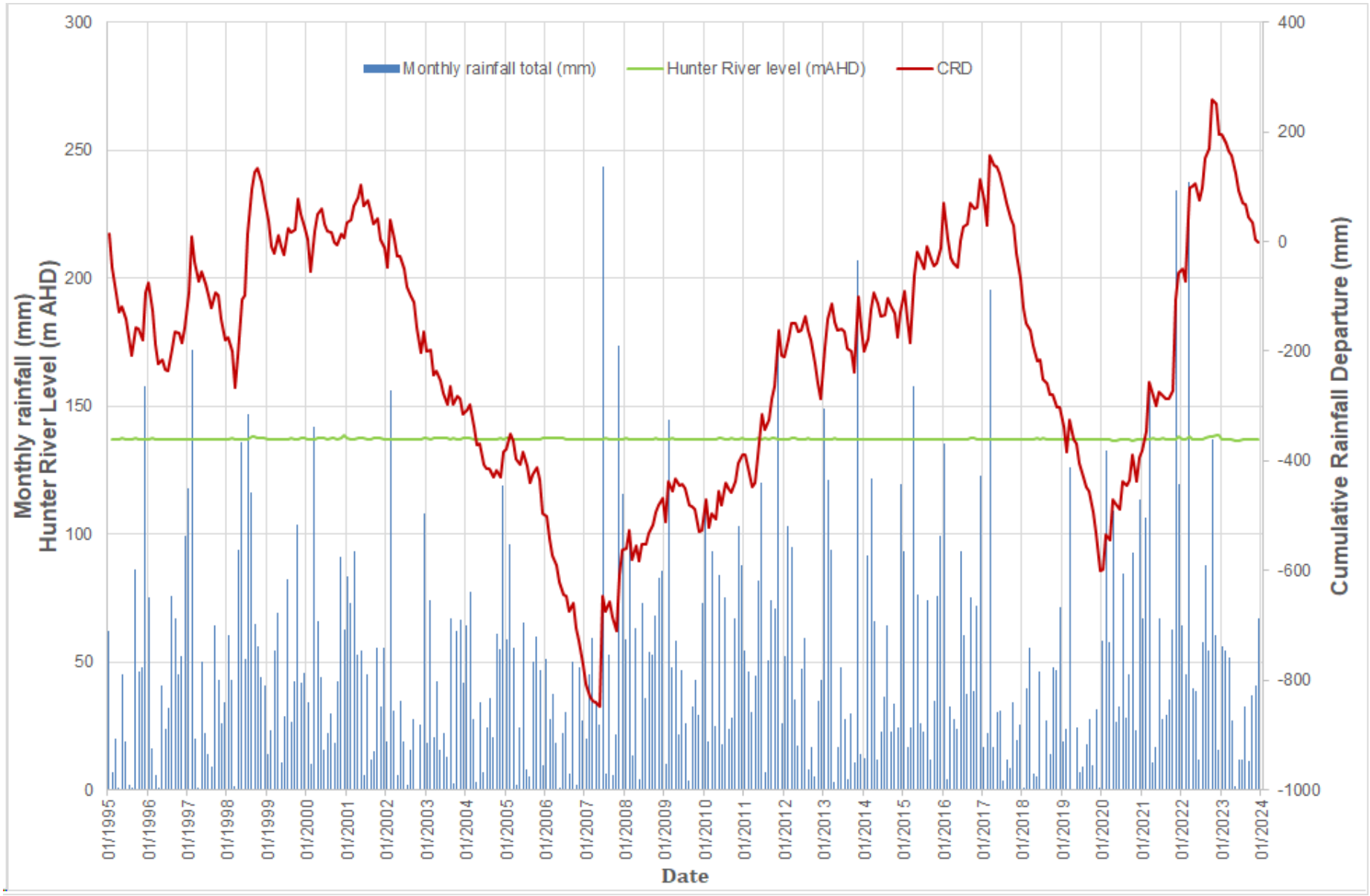


Figure 2.1 Cumulative rainfall departure (1995 to 2023) for Bengalla weather monitoring station

3 Groundwater regime

The groundwater regime at Bengalla consists primarily of two systems:

- the porous-medium aquifer of the Hunter River alluvial deposits, which is up to 14 m thick and consists of a silty clay layer overlying a basal gravel; and
- the Permian coal measures, comprising a multi-layered bedrock aquifer in which the coal seams are the prime water bearing strata and the interburden is hydrogeologically "tight" and very low yielding to essentially dry.

The coal seams strike in a generally north-south direction, and dip westward at approximately 5 degrees. The coal seams subcrop beneath the Hunter River alluvium to the south of Bengalla. Table 3.1 summarises the approximate thicknesses of coal seam and interburden units at Bengalla.

Table 3.1 Coal seams and interburden at Bengalla Mine

	Seam name	Average seam thickness (m)	Average thickness of overlying interburden (m)
Mined at Bengalla	Warkworth	1	35
	Mount Arthur	4.5	5
	Piercefield	2.3	12
	Vaux	4	35
	Broonie	1.3	13
	Bayswater	2.5	10
	Wynn	2.5	5
	Edderton	2	10
Not mined at Bengalla	Clanricard	1.8	10
	Bengalla	2.5	10
	Edinglassie	3.9	30
	Ramrod Creek	6.5	-

Generally, in undisturbed conditions, the potentiometric surface (pressure head) of groundwater in the coal seams is higher than the alluvial water table (i.e. an upward hydraulic gradient). Therefore, in areas where the coal seams subcrop beneath the alluvium, there is potential for groundwater from the coal measures to discharge to the Hunter River alluvium. Depressurisation of the coal seams by open cut mining has the following potential impacts on the Hunter River alluvial aquifer:

- reduced discharge rate from the coal seams to the alluvium; and
- reversed hydraulic gradients, resulting in leakage from the Hunter River alluvial aquifer to the coal seams where they subcrop beneath the alluvium to the south of Bengalla, and eventual discharge of this alluvial water to the Bengalla pit.

Generally, the Hunter River level is above the water table in the Hunter River alluvium, and near Bengalla the river is losing water to the alluvium. The level of the Hunter River is relatively constant under normal conditions due to the regulation of water discharge from Glenbawn Dam (refer Figure 2.1).

The objective of the groundwater monitoring program at Bengalla is to assess these potential impacts.

4 Bengalla groundwater monitoring network

BMC has established a groundwater monitoring network around Bengalla with data from 1992 onwards. Table 4.1 summarises the monitoring bore network and the Vibrating Wire Piezometer (VWP) locations. Figure 4.1 shows the bore and VWP locations. The following text provides a chronological summation of monitoring bore network upgrades.

In March 2009 and June 2010, nine bores were installed in the alluvial fringe area as part of a commitment from the Wantana Extension Statement of Environmental Effects (SEE; March 2009). Three of these were bore clusters, with one bore screened in the alluvium and one in an underlying coal seam at each monitoring location (e.g. WAN8A/B, WAN9A/B and WAN10A/B). A bedrock bore (REPI7) was installed to replace bore I7. Two alluvial monitoring bores – SMB1 and SMB2 – were installed in June 2010 to the east of Wantana Extension as part of investigations to obtain approval for spoil placement on an alluvial embayment adjacent to the mine.

Monitoring bore A10 was mined out in 2014. This was the sole bore monitored for potential effects to the north of the Bengalla pit. The removal of A10 left an absence of coverage in this area.

In 2017, two new VWPs, BE4 and BE5, were installed between ML 1645 and the westward advancing pit. The BE4 and BE5 VWPs are positioned to replace the A10 and E12 bores (E12 was mined out in 2017) and to complement the existing BE1 and BE3 VWPs further to the west.

In 2018, a downhole bore survey was undertaken by AGE on WAN2, WAN5, WAN7 and WAN8 bore clusters. The construction details of these bores are included in Table 4.1. Note these updated construction details for WAN8A/B differ from those shown in the WMP. The locations WAN5A and WAN5B have historically been mistakenly interchanged. Following the downhole investigation, it was found that WAN5A targets the deep Permian and WAN5B targets the alluvium (now rectified in Table 4.1).

In late 2018 BMC commenced drilling five new monitoring bores that target both alluvial and shallow Permian strata (GW01A, GW01B, WAN11A, WAN11B and WAN12). These bores have been included in the monitoring bore network summary (Appendix A) for record completeness however do not form part of this compliance review.

As the neighbouring Mount Pleasant Project progresses, 64092 has been covered by a visual bund and access to groundwater monitoring sites 11953 has become restricted. No data have been recorded for these bores in 2023. Monitoring bore E12 was mined through in May 2017. VWP BE4 was removed 27 October 2021 due to blasting operations. VWP BE3 was decommissioned in October 2023.

In December 2021, BMC commenced drilling a nested monitoring site that target both alluvial (211GW001) and shallow Permian (211GW002) strata south of Bengalla, along strike to the actively mined seams in the region nearby to BG3 (approximately 1 km), as recommended in Bengalla Mine Groundwater Annual Report 2020 (AGE, 2021). The purpose of these bores is to provide a control point that enables a comparison of the two sites. The monitoring bores were installed in a ‘nested’ configuration (i.e., in proximity at a single site), with one shallow monitoring bore targeting shallow strata (211GW002) and another deeper bore installed into subcropping Permian strata (211GW001). These bores have been included in the monitoring bore network summary (Appendix A) for record completeness however are not part of this compliance review.

Table 4.1 Current Bengalla groundwater monitoring network

Bore ID	Easting MGA94 z56	Northing MGA94 z56	Ground level (mAHD)	Top of casing (mAHD)	Stick - up (m)	Screen Interval/ Sensor Depth (mbGL)	Total depth (mBGL)	Bore base elevation (mAHD)	Geology/ Target Seam
11953 [a]	298129	6428693	148.0	148.0	0.97	-	-	-	Deep Permian
18298 [b]	294375	6423521	132.86	133.47	0.61	-	-	-	Alluvium
19116 [b]	296078	6425589	135.6	136.43	0.82	-	-	-	Alluvium
28510 [b]	298649	6429105	142.7	144	1.3	-	-	-	Deep Permian
37774 [b]	298488	6428998	145.6	146	0.4	-	-	-	Deep Permian
42701 [b]	298586	6428632	144	144.91	0.97	-	-	-	Deep Permian
42927 [b]	298843	6428570	144.26	145.36	1.1	-	-	-	Alluvium
46737 [b]	291862	6427143	227.69	227.9	0.21	-	-	-	Shallow Permian
47277 [b]	299145	6428643	143.54	144.59	1.06	-	-	-	Alluvium
53007 [b]	298720	6428857	143.97	144.01	0.04	-	-	-	Deep Permian
BE1 (bore)	293469	6429033	241.48	242.67	1.19	69-75	75	166.48	Permian Sandstone
BE2 (bore)	293374	6425866	204.22	205.38	1.16	45-48	48	156.22	Permian Sandstone
BE3 (bore)	292977	6427587	175.21	176.39	1.18	48-54	54	121.21	Permian Sandstone
BG1 [b]	296656	6426003	138.2	138.78	0.58	-	-	-	Alluvium
BG3 [b]	294731	6424413	133.60	133.76	0.16	-	-	-	Alluvium
BG5 [b]	298609	6427874	142.2	142.51	0.31	-	-	-	Alluvium
REPI7	295575	6425832	135.47	136.38	0.91	49-52	52	83.47	Vaux Seam
SMB1	296955	6426391	141.2	142.47	1.27	13-19	19	122.2	Alluvium
SMB2	297124	6426549	141.69	142.61	0.92	15-21	21	120.69	Alluvium
WAN10A	295828	6425571	135.07	136.13	1.06	10-13	13.83	121.24	Alluvium
WAN10B	295825	6425578	135.04	136.1	1.06	44-47	47	88.04	Vaux Seam
WAN1A	296519	6426099	140.6	141.35	0.75	16-20	20	120.6	Alluvium/ Wynn seam
WAN1B	296519	6426099	140.6	141.35	0.75	29-33	33	107.6	Edderton Seam
WAN2A	296217	6425824	137.7	138.4	0.7	13-16	16	121.7	Alluvium/ Vaux seam
WAN2B	296217	6425824	137.7	138.44	0.74	36-39	39	98.7	Wynn Seam
WAN2C	296217	6425824	137.7	138.43	0.73	51-54	55	83.7	Edderton Seam
WAN3 [b]	295772	6425713	136.4	136.7	0.3	2.5-87	87	49.4	Deep Permian
WAN4A	295442	6425690	135.1	135.93	0.83	11.5-14.5	14.5	120.6	Alluvium
WAN4B	295442	6425690	135.1	135.89	0.79	21-24	24	111.1	Deep Permian
WAN5A [b]	296019	6425360	135.9	136.78	0.88	26-29	28.98	107.8	Deep Permian
WAN5B [bc]	296019	6425360	135.9	136.74	0.84	10.5-13.5	15.57	121.17	Alluvium

Bore ID	Easting MGA94 z56	Northing MGA94 z56	Ground level (mAHD)	Top of casing (mAHD)	Stick - up (m)	Screen Interval/ Sensor Depth (mbGL)	Total depth (mBGL)	Bore base elevation (mAHD)	Geology/ Target Seam
WAN6A	296553	6425634	136.9	137.67	0.77	7.5-10.5	10.5	126.4	Alluvium
WAN6B	296553	6425634	136.9	137.66	0.76	30-33	33	103.9	Edderton Seam
WAN7A	296856	6426254	138.1	138.86	0.76	12.0-15.0	15	123.1	Alluvium
WAN7B	296856	6426254	138.1	138.89	0.79	80-83	83	55.1	Edinglassie Seam
WAN8A	296457	6425854	136.41	137.47	1.07	10.7-11.9	12.94	124.53	Alluvium
WAN8B	296450	6425855	136.33	137.42	1.09	15-18.6	19.6	117.82	Wynn Seam
WAN9A2 [c]	296326	6425582	136.88	137.98	1.1	8.5-10.5	10.5	126.38	Alluvium
WAN9B	296328	6425576	136.93	137.88	0.95	21-24	24	112.93	Wynn Seam
BE1 (VWP)	293475	6429036	241.48	-	-	120	120	121.48	Warkworth/Mt Arthur
BE1 (VWP)	293475	6429036	241.48	-	-	264.5	264.5	-23.02	Edderton Seam
BE2 (VWP)	293374	6425866	204.22	-	-	97.8	97.8	106.42	Warkworth/Mt Arthur
BE2 (VWP)	293374	6425866	204.22	-	-	212.5	212.5	-8.28	Edderton Seam
BE3 (VWP)	292977	6427587	175.21	-	-	80.6	80.6	94.61	Warkworth/Mt Arthur
BE3 (VWP)	292977	6427587	175.21	-	-	154.6	154.6	20.61	Edderton Seam
BE4 (VWP)	294313	6428784	191.4	-	-	82	228.2	-36.8	Mt Arthur
BE4 (VWP)	294313	6428784	191.4	-	-	213	228.2	-36.8	Edderton Seam
BE5 (VWP)	293696	6427245	181.3	-	-	74	210.15	-28.85	Mt Arthur
BE5 (VWP)	293696	6427245	181.3	-	-	197.5	210.15	-28.85	Edderton Seam
GW01A [c]	298190	6428409	TBC	TBC	TBC	9-12	12	TBC	Alluvium
GW01B [c]	298190	6428409	TBC	TBC	TBC	24-27	27	TBC	Shallow Permian
WAN11A [c]	296649	6424875	135.4	136.44	1.05	9-12	12	123.4	Alluvium
WAN11B [c]	296645	6424876	135.5	136.45	0.95	24-27	27	108.5	Shallow Permian
WAN12A [b c]	295491	6424725	135.3	136.06	0.76	11-14	14	121.3	Alluvium
211GW001 [c d]	294301	6424930	138.33	139.20	0.87	49.4-55.4	55.4	83.8	Shallow Permian
211GW002 [c d]	294294	6424927	138.30	139.20	0.90	14.8-20.8	20.8	118.4	Alluvium

Notes: [a] no access or mined through for 2022 monitoring.

[b] recommended camera survey on bores to determine screened interval and bore depth.

[c] survey data to be added to WMP.

[d] not included in groundwater management plan to date.

LEGEND

Monitoring bore network

- Monitoring bore network
- Drainage
- 2023 Void boundary

Bengalla annual review 2023 (BEN5017.001)

Monitoring bore network

NOTE:
Aerial Image Capture Date : September 2021
Source: BMC

AGE

DATE
28/02/2024

FIGURE No:
4.1

G:\Projects\BEN5017.001 Bengalla Annual Review 2023\3_GIS\Workspaces\Figure 4.1 - Monitoring Bore Network\Figure 4.1 - Monitoring Bore Network.qgs.qgz

5 Water management plan

Bengalla manages its water resources as per the Bengalla Water Management Plan (WMP), which was approved February 2019.

The current WMP (February 2019) groundwater quality triggers are summarised in Table 5.1 and the water level triggers are summarised in Table 5.2. The 2023 monitoring data are compared to these triggers.

Table 5.1 Bengalla WMP water quality triggers (February 2019)

Site	Easting	Northing	Min pH trigger	Max pH trigger	Stage 1 EC Trigger – 95th Percentile (µS/cm)	Stage 2 EC Trigger – Maximum EC (µS/cm)	Target aquifer
11953	298192	6428693	6	8.5	7,121	8,540	Deep Permian
18298	294375	6423521	6	8.5	1,484	1,990	Alluvium
19116	296078	6425589	6	8.5	2,297	2,650	Alluvium
28510	298649	6429105	6	8.5	1,479	1,480	Deep Permian
37774	298488	6428998	6	8.5	2,901	3,060	Deep Permian
42701	298586	6428632	6	8.5	1,232	1,340	Deep Permian
42927	298843	6428570	6	8.5	1,260	1,380	Alluvium
46737	291862	6427143	6	8.5	9,092	9,290	Shallow Permian
47277	299145	6428643	6	8.5	1,325	1,340	Alluvium
53007	298720	6428857	6	8.5	1,240	1,350	Deep Permian
BE1	293469	6429033	6	8.5	7,186	7,190	Permian Sandstone
BE2	293375	6425866	6	8.5	8,335	8,370	Permian Sandstone
BE3	292977	6427587	6	8.5	8,738	8,740	Permian Sandstone
BG1	296656	6426003	6	8.5	1,021	1,580	Alluvium
BG3	294731	6424413	6	8.5	3,540	4,850	Alluvium
BG5	298609	6427874	6	8.5	1,330	1,670	Alluvium
REPI7	295575	6425832	6	8.5	4,280	4,310	Vaux Seam
SMB1	296955	6426392	6	8.5	2,159	2,790	Alluvium
SMB2	297125	6426550	6	8.5	2,439	2,460	Alluvium
WAN1A	296519	6426099	6	8.5	2,099	2,280	Alluvium
WAN1B	296519	6426099	6	8.5	1,909	3,790	Shallow Permian
WAN2A	296217	6425824	6	8.5	1,389	1,780	Alluvium
WAN2B	296217	6425824	6	8.5	3,856	3,930	Edderton Seam
WAN2C	296217	6425824	6	8.5	3,619	3,840	Edderton Seam
WAN3	295772	6425713	6	8.5	4,365	4,550	Deep Permian
WAN4A	295442	6425690	6	8.5	3,965	4,170	Alluvium

Site	Easting	Northing	Min pH trigger	Max pH trigger	Stage 1 EC Trigger – 95th Percentile (µS/cm)	Stage 2 EC Trigger – Maximum EC (µS/cm)	Target aquifer
WAN4B	295442	6425690	6	8.5	3,507	3,570	Deep Permian
WAN5A	296019	6425360	6	8.5	6,001	6,180	Alluvium
WAN5B	296019	6425360	6	8.5	1,641	1,900	Deep Permian
WAN6A	296553	6425634	6	8.5	1,055	1,280	Alluvium
WAN6B	296553	6425634	6	8.5	1,297	1,461	Edderton Seam
WAN7A	296856	6426254	6	8.5	2,258	2,300	Alluvium
WAN7B	296856	6426254	6	8.5	3,160	3,220	Edinglassie Seam
WAN8A	296457	6425855	6	8.5	-	7,720	Alluvium
WAN8B	296450	6425855	6	8.5	2,780	2,820	Wynn Seam
WAN9A2	296320	6425583	6	8.5	936	937	Alluvium
WAN9B	296328	6425576	6	8.5	1,915	1,930	Wynn Seam
WAN10A	295828	6425571	6	8.5	1,253	1,367	Alluvium
WAN10B	295825	6425578	6	8.5	5,068	5,090	Vaux Seam

Note: - Indicates insufficient data for statistical analysis.

Table 5.2 Bengalla WMP water level triggers (February 2019)

Bore ID	Geology / Target Seam	Max. drawdown (m)	Trigger water level (mAHD)
SMB1	Alluvium	1.5	127.2
SMB2	Alluvium	1.6	127.3
WAN1A	Alluvium	4.2	117.5
WAN2A	Alluvium	6.8	118.5
WAN4A	Alluvium	5.5	121.2
WAN5A	Alluvium	2.4	124.3
WAN6A	Alluvium	1.1	126.9
WAN7A	Alluvium	1.4	125.4
WAN8A	Alluvium	2.4	123.3
WAN9A	Alluvium	2.6	123.7
WAN10A	Alluvium	4.6	122.2
18298	Alluvium	0.3	123.2
19116	Alluvium	4.2	123.2
42927	Alluvium	1.2	131.1
47277	Alluvium	0.8	132.8
BG1	Alluvium	1.4	126.8

Bore ID	Geology / Target Seam	Max. drawdown (m)	Trigger water level (mAHD)
BG3	Alluvium	0.2	126.3
BG5	Alluvium	0.9	132.4
37774	Deep Permian	5.4	128.7
42701	Deep Permian	1.9	131.3
46737	Shallow Permian	0.7	185.3
53007	Deep Permian	1.8	131.9
BE1	Permian Sandstone	15.5	156.8
BE2	Permian Sandstone	148.9	18.8
BE3	Permian Sandstone	32.5	113.2
WAN2B	Wynn Seam	25.4	86.4
11953	Deep Permian	7.1	129.3
28510	Deep Permian	3.3	129
REPI7	Vaux Seam	39	63.1
WAN1B	Edderton Seam	15.8	100.1
WAN2C	Edderton Seam	25.4	75
WAN3	Deep Permian	26.3	100.3
WAN9B	Wynn Seam	8.1	111.4
WAN10B	Vaux Seam	20.9	98.3
WAN4B	Deep Permian	26.3	98.2
WAN5B	Deep Permian	10.7	116
WAN6B	Edderton Seam	4.1	123.8
WAN7B	Edinglassie Seam	2.3	126.4
WAN8B	Wynn Seam	9.5	108.5

6 Water levels assessment

6.1 Alluvium aquifer water levels

The hydrographs for the bores monitoring groundwater levels in the Hunter River alluvium were analysed in two sub-sets, as follows:

- bores to the immediate south of the current pit and in the approved Wantana Extension; these bores are referred to here-in as the Wantana Extension Bores; and
- bores located in the alluvium at a greater distance from Bengalla, which are unlikely to be impacted by mining; referred to as Regional Hunter River alluvial bores.

6.1.1 Wantana Extension Bores

No Wantana Extension bore water levels were recorded below their respective trigger levels in 2023 (Appendix A).

Figure 6.1 shows the alluvial groundwater level trends in the Wantana Extension area overlain with the CRD trend and Hunter River level. The water level trends for the Wantana Extension bores increased during 2023, coincident with below average rainfall and decreasing CRD.

The increasing trends in groundwater levels in Figure 6.1 show a strong correlation between the CRD and Hunter River level (at Station 210002, Muswellbrook Bridge).

Groundwater elevations in WAN8A demonstrate an inconsistent rate of decline when compared to Hunter River level, the CRD, or the other Wantana Extension bores. This may be due to this bore being located on the fringe of the alluvium, with the screened interval not being completely representative of the Hunter River alluvium.

Groundwater monitoring bores SMB1S, WAN8A and WAN9A contained insufficient water for sampling on numerous occasions in 2023. SMB1S contained insufficient water from November to December 2023, while WAN8A was dry during February 2023 and WAN9A was dry from January to February, and September to December 2023.

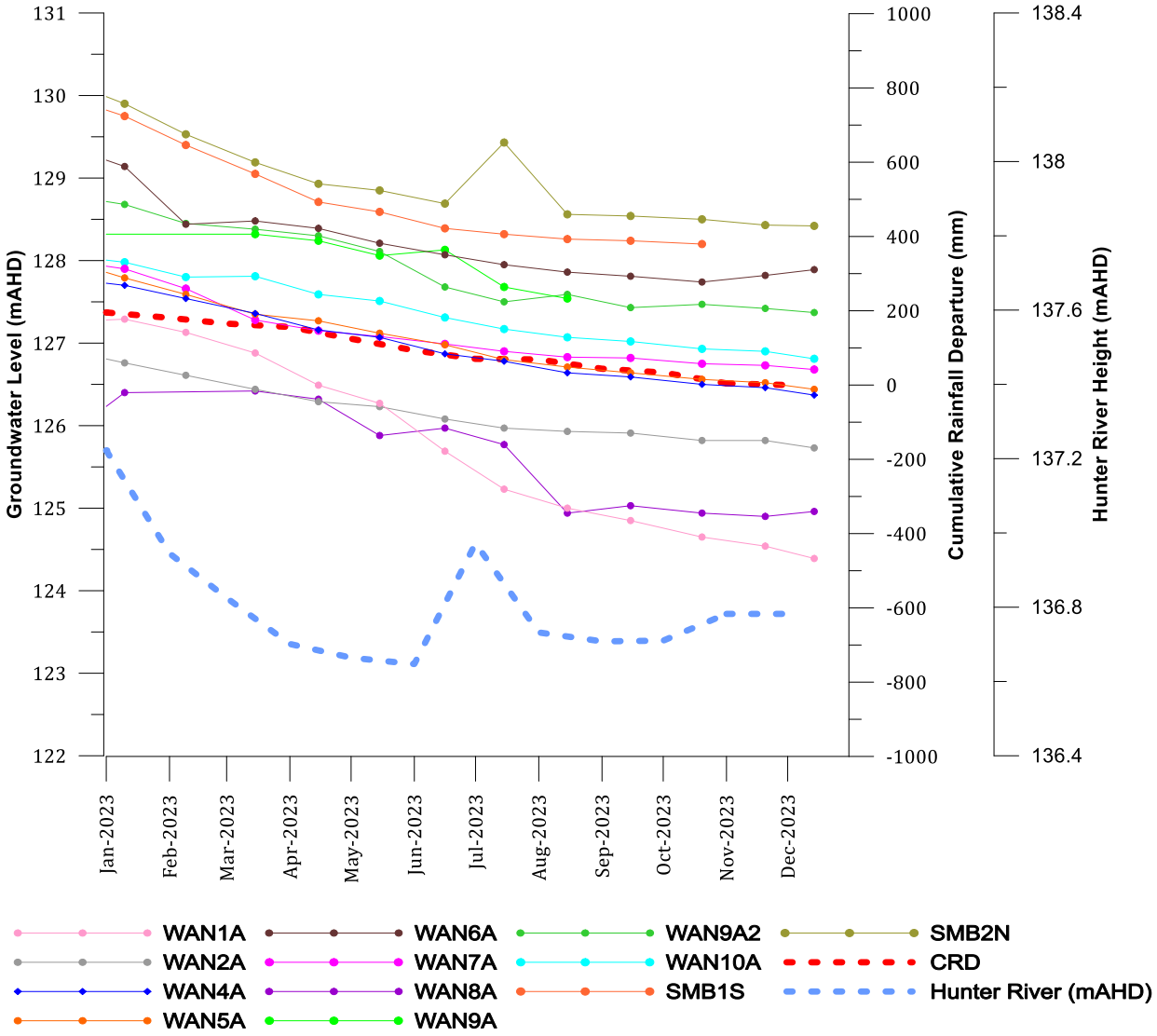


Figure 6.1 Hydrographs of alluvial bores - Wantana extension area

6.1.2 Regional Hunter River alluvial bores

Figure 6.2 shows groundwater levels measured in the Regional Hunter River alluvial monitoring bores. Groundwater levels in BG1 and BG5 remained above established triggers during 2023. Groundwater levels in BG5 have remained above the trigger value since April 2018.

Groundwater levels in BG3 dropped below the derived trigger value in October 2023. The groundwater elevation in October was 126.26 mAHD, while the trigger is 126.30 mAHD.

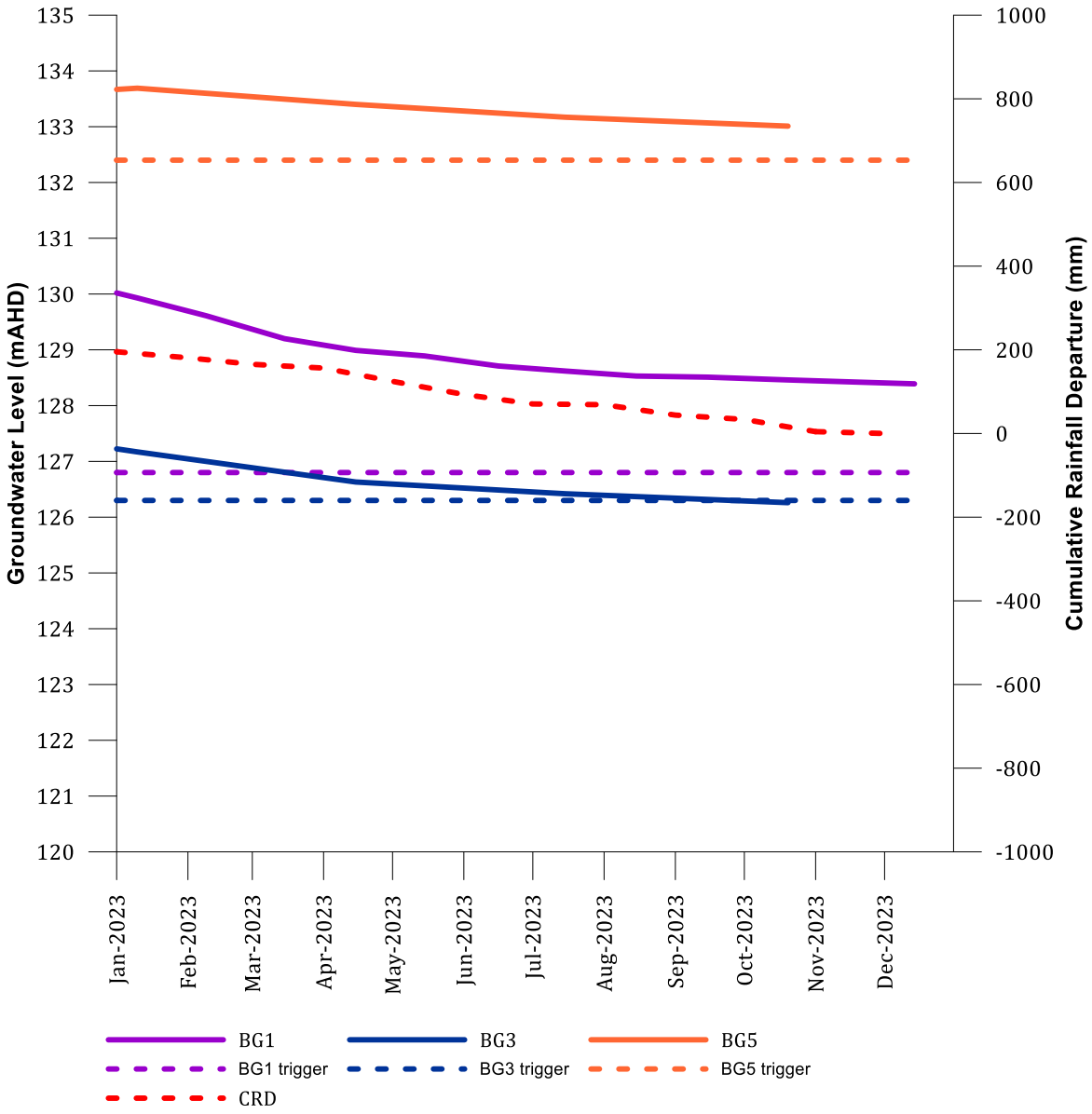
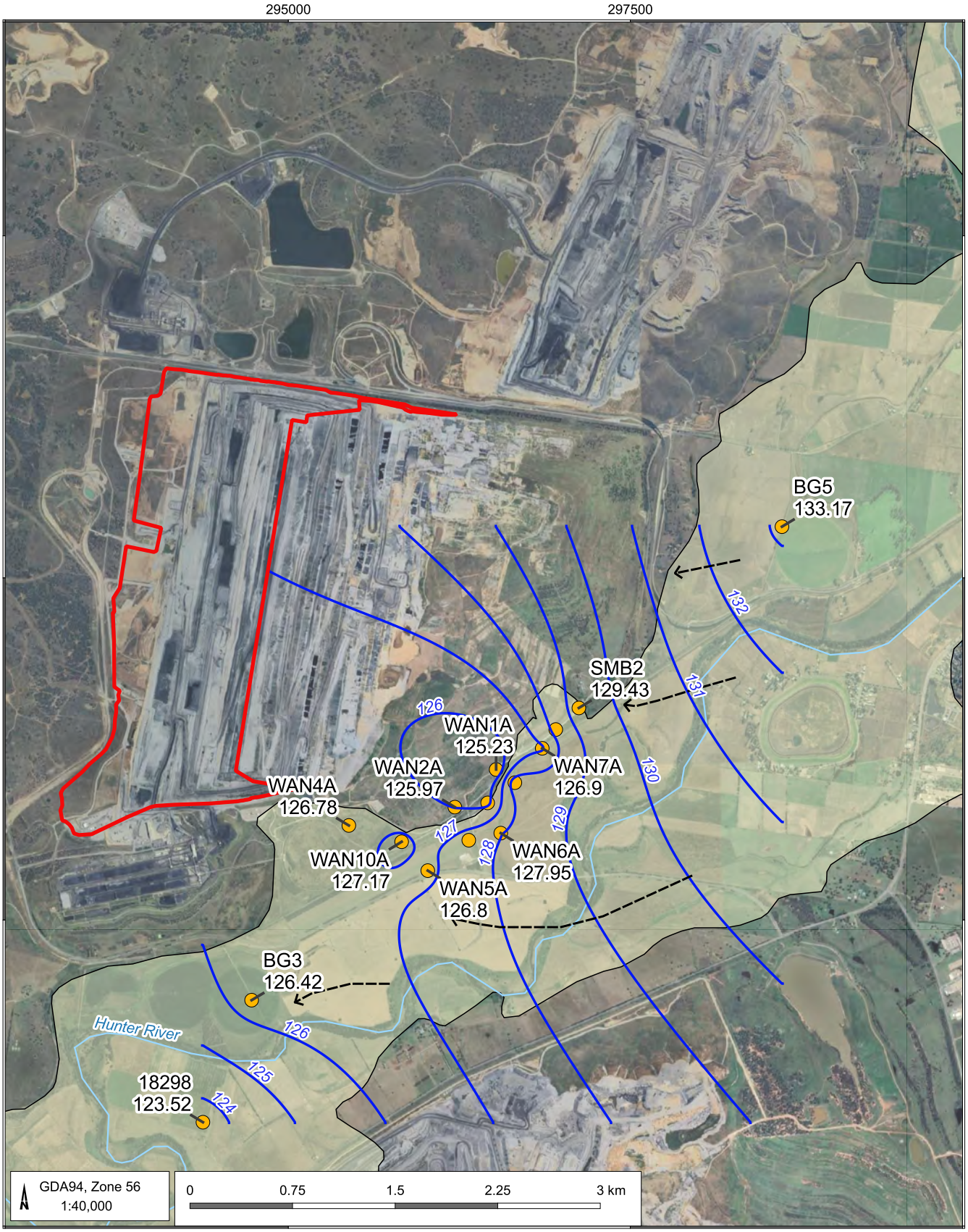


Figure 6.2 Hydrographs of Regional alluvial bores

6.1.3 Alluvial groundwater level contours

Figure 6.3 shows the water table within the Hunter River alluvium interpolated from water elevation measurements observed during July 2023. The water level contours, and flow directions remain consistent with those of previous years.

As was the case in previous years, a steep hydraulic gradient is present adjacent to WAN8A and BG1 (Figure 6.3). This is likely due to a combination of the proximity of bore WAN8A to the open cut and to the edge of the alluvium (refer Figure 6.3). It is likely that mining related depressurisation of shallow Permian strata at the southern margin of the pit continues to cause movement of alluvial water towards Bengalla Mine. This would explain the decline of water levels to below the screened interval of the bore in WAN8B (screened in the shallow Permian/Wynn Seam; refer Section 6.2.1). Indeed, the groundwater level in WAN8A is also very close to the base of the bore, and it may be stagnant water in the bore sump. The latest 2023 groundwater elevation in WAN8A was 125.0 mAHD, whereas the base of the screened interval is 124.51 mAHD (ground level minus 11.9 m; Appendix A). Therefore, there was only 0.49 m of screened casing below the water level; a decrease of 0.05 m from the previous year. Regardless of the degree of saturation at WAN8, any loss of water to the pit from the alluvium fringe is likely to be masked by both the regulated nature of the Hunter River and the Hunter River recharge to the alluvium (the river is considered a losing stream at this point).



LEGEND

- Alluvium Bores (July 2023)
- Drainage
- Alluvium groundwater contours (1m)
- Groundwater flow direction
- Alluvium boundary
- 2023 Void Boundary

NOTE:
Aerial Image Capture Date : September 2021
Source: BMC

Bengalla annual review 2023 (BEN5017.001)

Alluvial groundwater levels (July 2023)

AGE

DATE 28/02/2024

FIGURE No: **6.3**

Source: Hunter Coalfield Regional 1:100 000 Geology Map*
G:\Projects\BEN5017.001 Bengalla Annual Review 2023\3_GIS\Workspaces\Figure 6.3 - Alluvium Groundwater Contours\Figure 6.3 - Alluvium groundwater contours.qgs.qgz

6.2 Coal seam/interburden water levels

6.2.1 Permian monitoring bore hydrographs

Groundwater levels in all Permian monitoring bores remained above established trigger values throughout 2023. Figure 6.4 shows long-term shallow Permian groundwater levels monitored in the Wantana Extension area to the south of Bengalla. Key observations are outlined below:

- The mined seams have been depressurised to a varying extent, depending on their stratigraphic position and the proximity of the bore to the pit.
- Pressure head in a number of seams has stabilised as the pit progresses westward after a prolonged period of above average rainfall recharges groundwater in shallower strata (WAN1A, WAN1B, WAN2A, WAN5A, WAN6B and WAN7B).
- The Edinglassie Seam is not mined at Bengalla and therefore the water elevation in this seam is considered most representative of the pre-mining potentiometric surface in the Wantana Extension area. Monitoring bore WAN7B screens the Edinglassie Seam. Groundwater elevation in WAN7B decreased approximately 1 m in 2023 (~129.54 mAHD groundwater elevation).
- The measured water level in WAN8B has been below the base of the screened interval in this bore since 2016, indicating that the bore is dry. The downhole camera survey showed that this bore has a 1 m sump at the base of the bore.
- Groundwater levels in bore WAN1A (screened in the Wynn Coal seam) decreased overall throughout 2023 after being relatively static since 2007. After being recorded as almost dry in April 2020, the observed water level at WAN1A is now 2.99 m above the base of the casing.
- WAN3 was found to contain insufficient water for sampling throughout 2023. The last recorded groundwater measurement was taken in December 2021, which was one of only three measurements recorded at this bore in six years.
- Monitoring bore WAN2C was blocked prior to October 2019. Measurements for 2023 show consistent groundwater levels of approximately 100 mAHD.
- Monitoring bore WAN2B displayed a gradual but steady recovery in water level from mid-2013. As with WAN1B, the recovery noted in WAN2B may represent a gradual recovery in pressure as mining operations move further away from this bore.
- Monitoring bore REPI7 groundwater levels were relatively static, following an initial recovery as mining operations progressed away from the monitoring bore.

Figure 6.5 and Figure 6.6 show the groundwater levels for the Permian monitoring bores (WAN4B, WAN5A, and WAN1B). Key observations can be summarised as follows:

- Groundwater levels in WAN4B and WAN5A have remained stable in 2023, in line with below-average rainfall and decreasing CRD;
- Figure 6.6 shows a coal seam (Edderton Seam) monitoring bore (WAN1B) plotted against the CRD. Groundwater elevation in WAN1B has remained stable overall in 2023, compared to an increase of approximately 2 m in 2022 and is likely due to the westward progression of mining operations (i.e. away from WAN1B); and
- WAN4B, WAN5A, and WAN1B remained above established triggers throughout 2023.

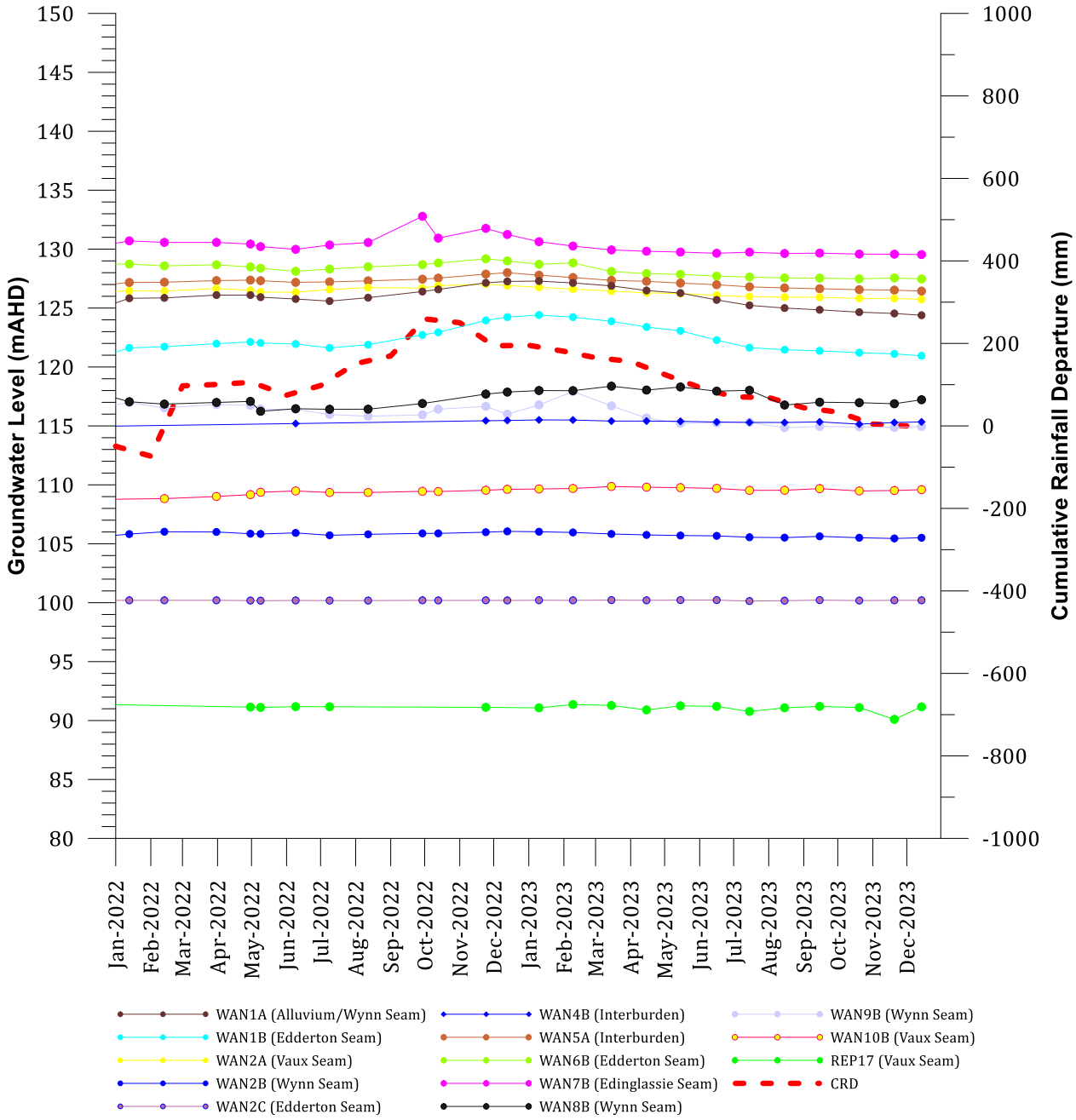


Figure 6.4 Hydrographs of coal seam/interburden bores – Wantana extension area

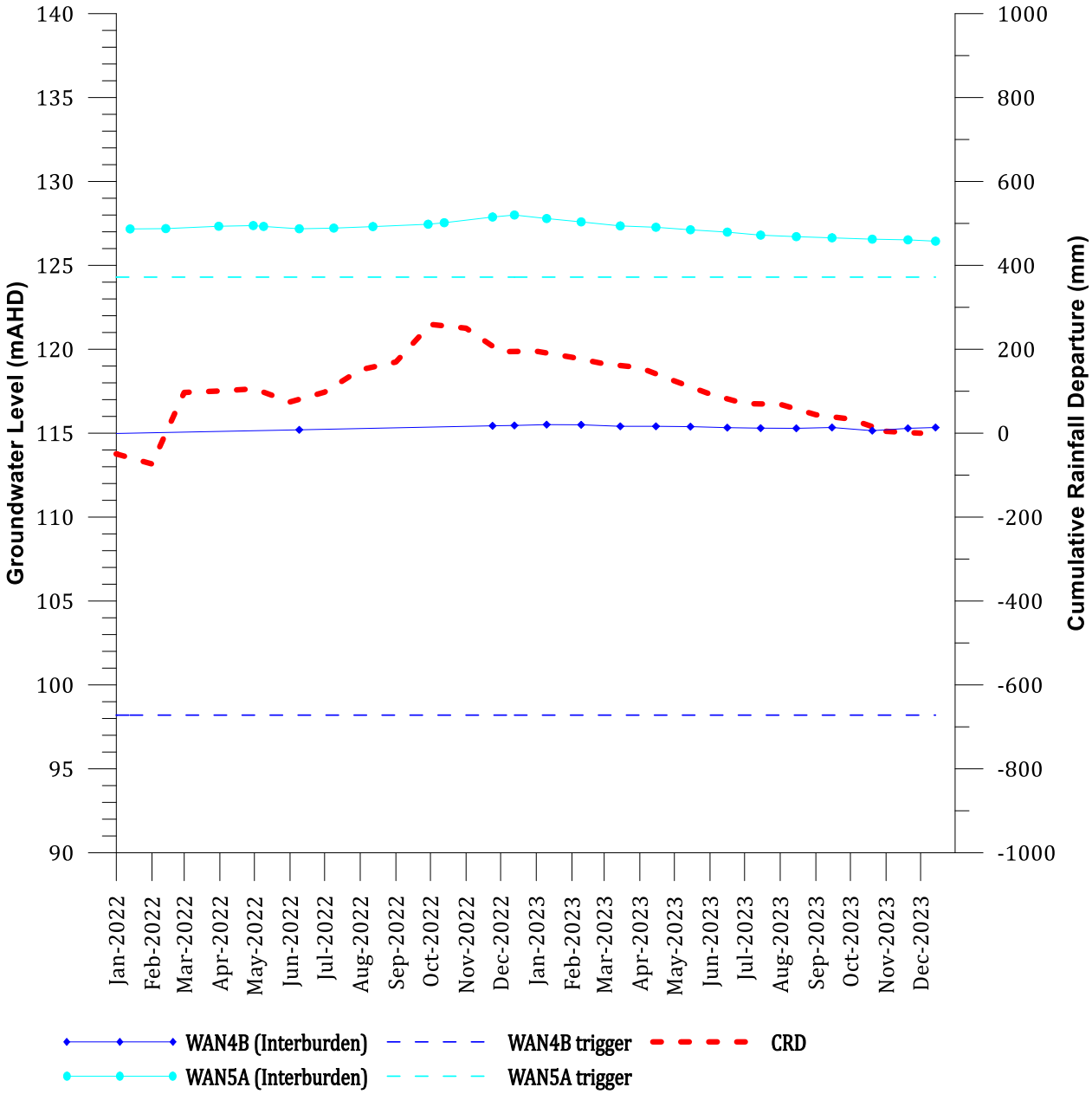


Figure 6.5 Hydrographs of deep Permian monitoring bores

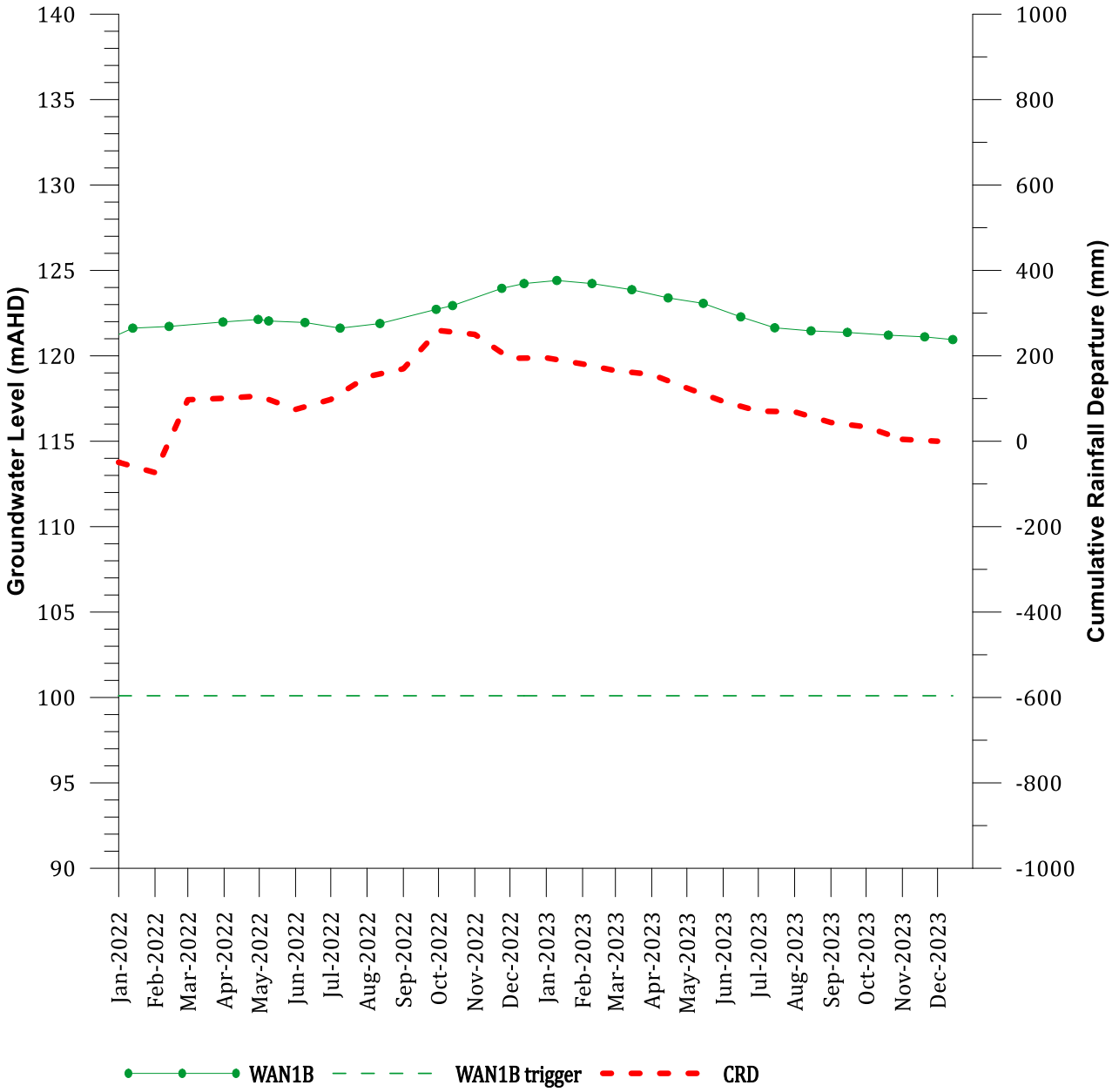


Figure 6.6 Hydrograph of shallow Permian monitoring bores

6.2.2 Nested monitoring bore hydrographs

Nested/clustered monitoring bore installations in the Wantana Extension are used to monitor water levels in several aquifers at the one location. Each nested installation generally comprises one alluvium bore, and one (or more) coal seam bore(s). Groundwater levels in all nested monitoring bores remained above the trigger level for 2023. The hydrographs of the clustered bores (Figure 6.9 to Figure 6.15) are discussed in the following sections. WMP trigger levels for the Wantana bores are summarised in Section 5, and are based on groundwater modelling for Bengalla (AGE 2013b – G1505). The trigger levels were further revised in 2017 to avoid false exceedances and to reflect potential mining related impacts (AGE, 2017). The trigger values are also displayed in the hydrographs.

Figure 6.7 shows the WAN1 nested site water levels. WAN1 bores retained levels above the trigger levels throughout 2023. WAN1A is screened in the Wynn seam and possibly also over part of the alluvium. At this location, the Wynn seam subcrops close to the base of the alluvium. WAN1A recorded an overall decrease in water level throughout the year, decreasing from 127.29 mAHD to 124.39 mAHD (2.90 m decrease). WAN1B (Edderton seam) also recorded an overall decrease in groundwater elevation in 2023 (3.46 m decrease in pressure head), following a period of re-pressurisation from 2019 to 2023. The water level of 120.95 mAHD (December 2023) has recovered to above the pre-mining level of 115.87 mAHD, demonstrating that water levels in depressurised coal seams can recover in a post-mining phase.

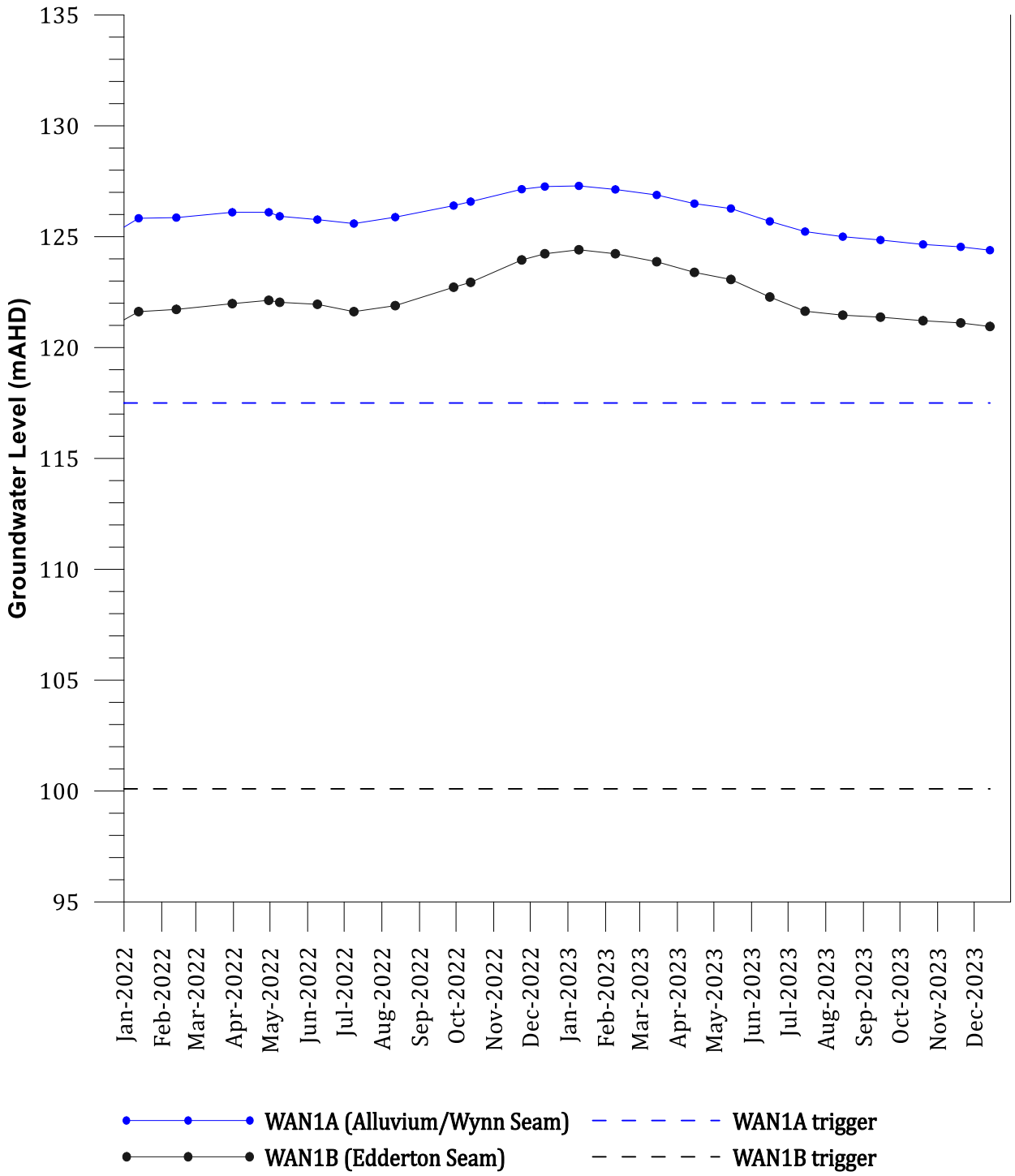


Figure 6.7 Alluvium and coal seam hydrographs – WAN1

Figure 6.8 shows the WAN2 nested site water levels. All WAN2 bores retained levels above the trigger levels throughout 2023. Water levels in WAN2A (Vaux Seam) remained stable during the 2023 monitoring period. Levels in WAN2B (Wynn Seam) steadily declined from 2005 to December 2013 as a result of mining, remaining relatively stable thereafter (i.e. to December 2023). Monitoring bore WAN2C recorded a steady water level throughout 2023.

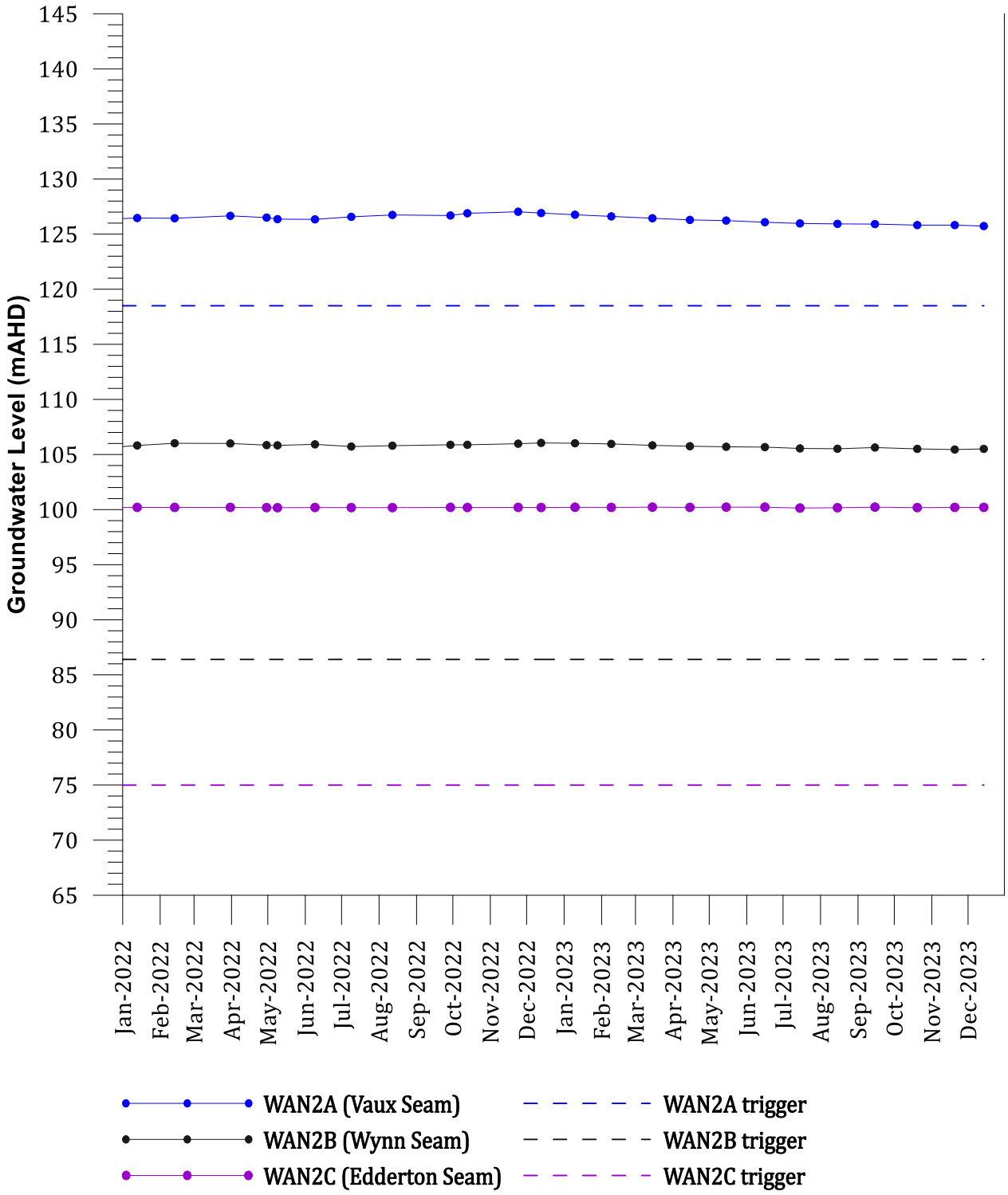


Figure 6.8 Alluvium and coal seam hydrographs – WAN2

WAN4 bores retained groundwater levels above the trigger values throughout 2023 (Figure 6.9). At WAN4B, the groundwater level in the interburden prior to 2011 was 2 m lower than the water level observed in the alluvium (WAN4A). Since December 2011, the water level in the interburden bore – WAN4B – declined by 9.32 m. This rate of decline appears to have stabilised to an elevation approximately 115.4 mAHD (115.34 mAHD - December 2023). WAN4A water level in the alluvium remained stable overall throughout 2023. While this is in conjunction with below-average rainfall, this relatively minor response indicates little local connection between the alluvium and the interburden, or suggests the alluvium is constantly recharged by the Hunter River. Access to WAN4 bores was impeded by rainfall on multiple occasions in 2023, leading to gaps in the data.

WAN4A/B is located closer to the pit than WAN5A/B and WAN6A/B (Figure 4.1). WAN5A/B and WAN6A/B have coal seam/interburden and alluvium water levels at similar elevations to each other (Figure 6.10 and Figure 6.11), whereas those from WAN4A/B are separated by >10 m (Figure 6.9). This suggests that either the water levels in the interburden and Edderton Seam at WAN5A/B and WAN6A/B show minimal response to mining (refer Figure 6.10 and Figure 6.11), or that the rate of recharge from the alluvium to the interburden is greater than the rate of seepage to the pit at this location. In December 2021, WAN5A and WAN6A/B groundwater levels increased significantly in response to rainfall recharge. WAN5B was unblocked in October 2022 and sampling resumed after being damaged by cattle in September 2020.

Data from 2023 (Figure 6.12) show the groundwater level in the Edinglassie Seam is approximately 2 m above the groundwater level in the alluvium, indicating that the Edinglassie Seam is pressurised. The Edinglassie Seam is not mined at Bengalla and hence has not been impacted by mining related drawdown. The water level in WAN7A decreased overall during 2023. WAN7A and WAN7B were above established trigger levels throughout the entirety of 2023 (Figure 6.12).

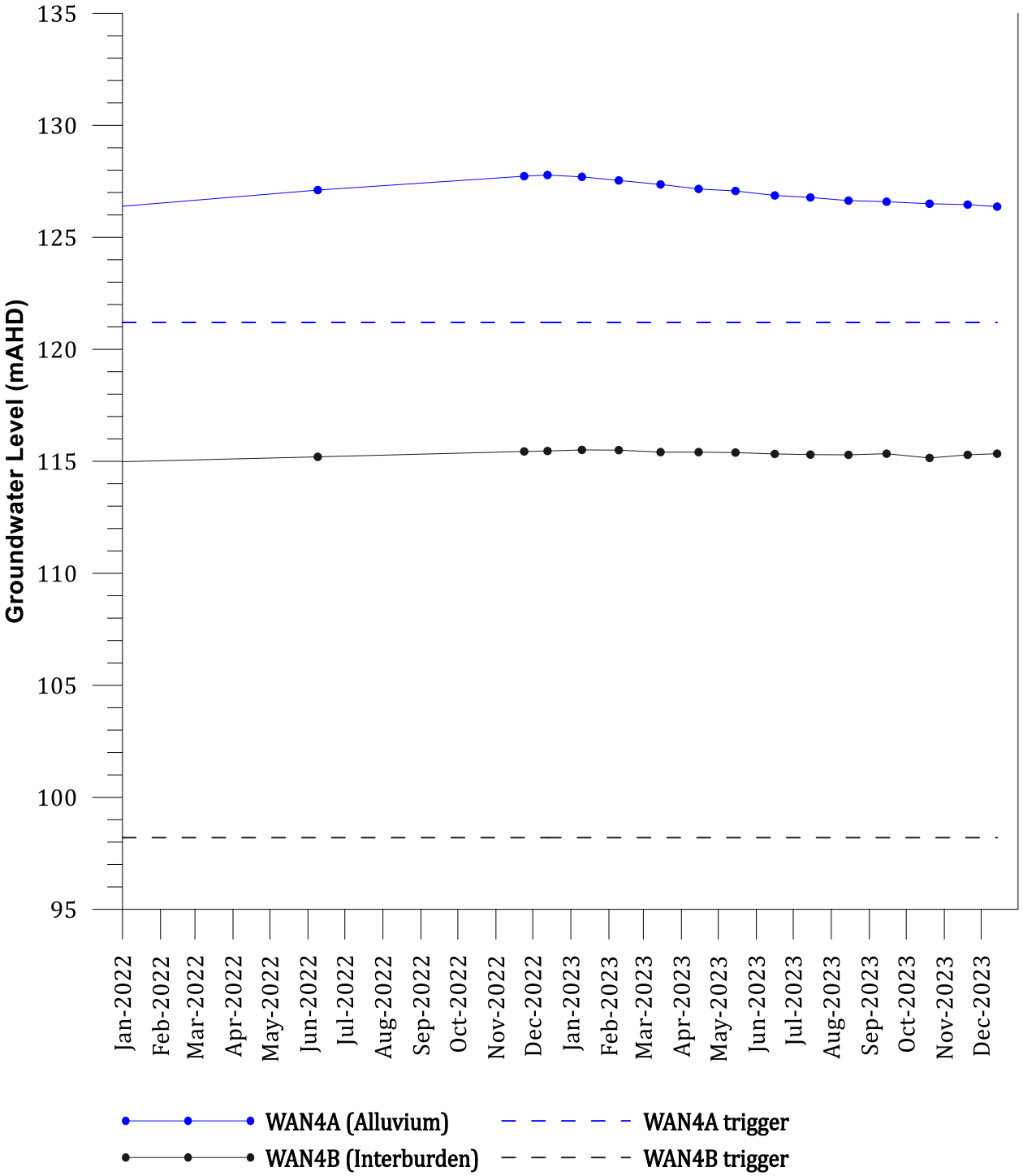


Figure 6.9 Alluvium and interburden hydrographs – WAN4

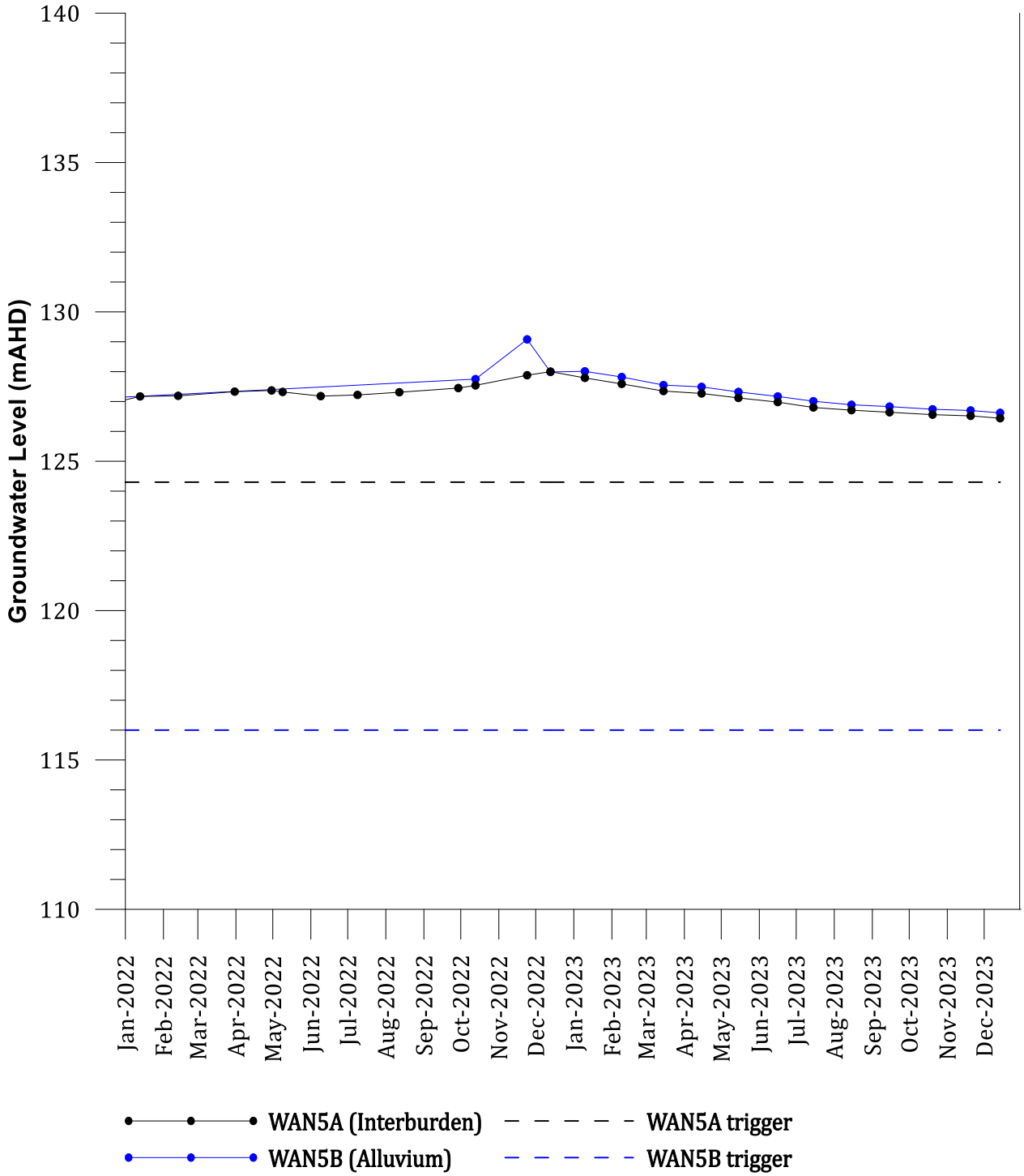


Figure 6.10 Alluvium and interburden hydrographs – WAN5

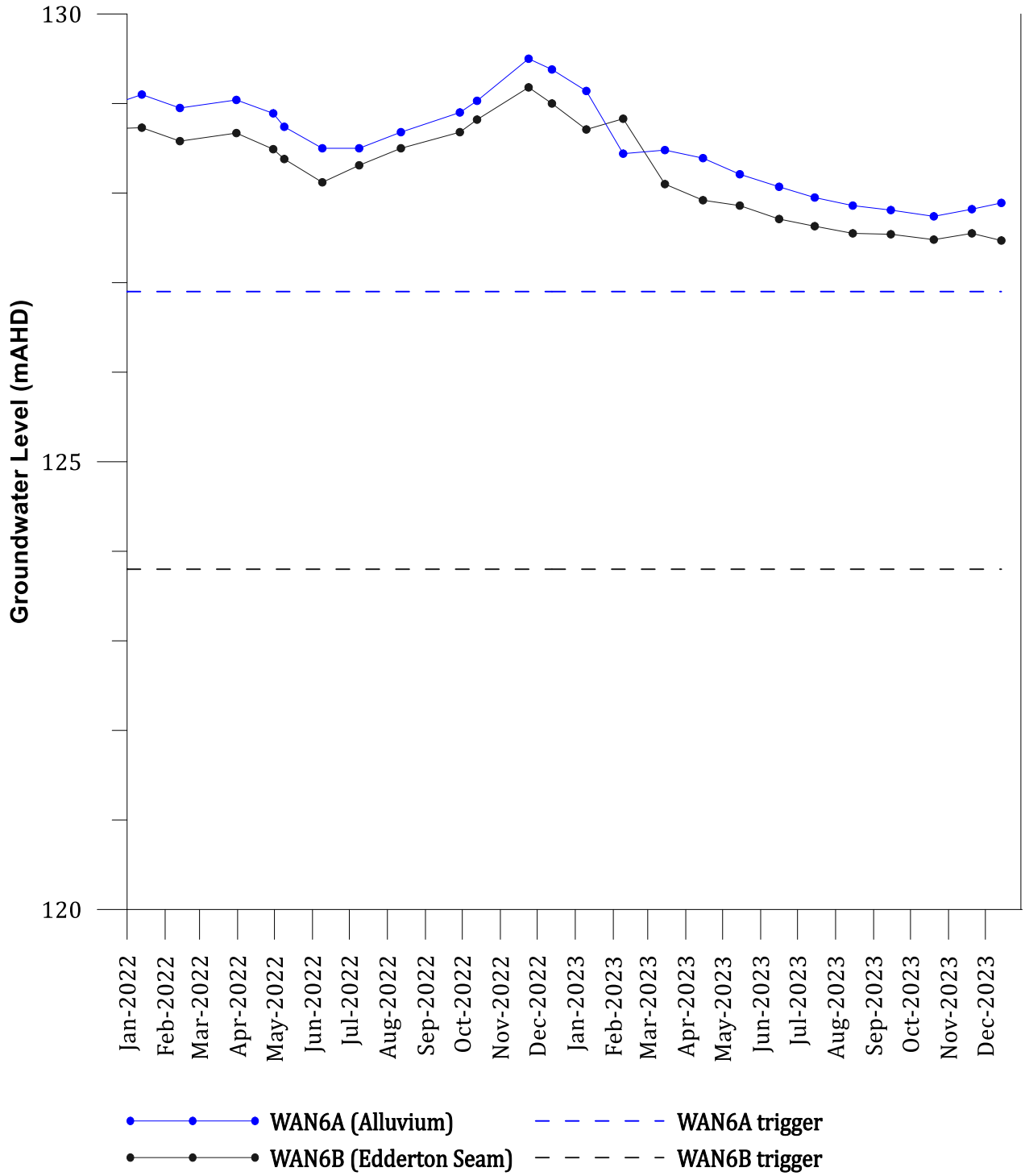


Figure 6.11 Alluvium and interburden hydrographs – WAN6

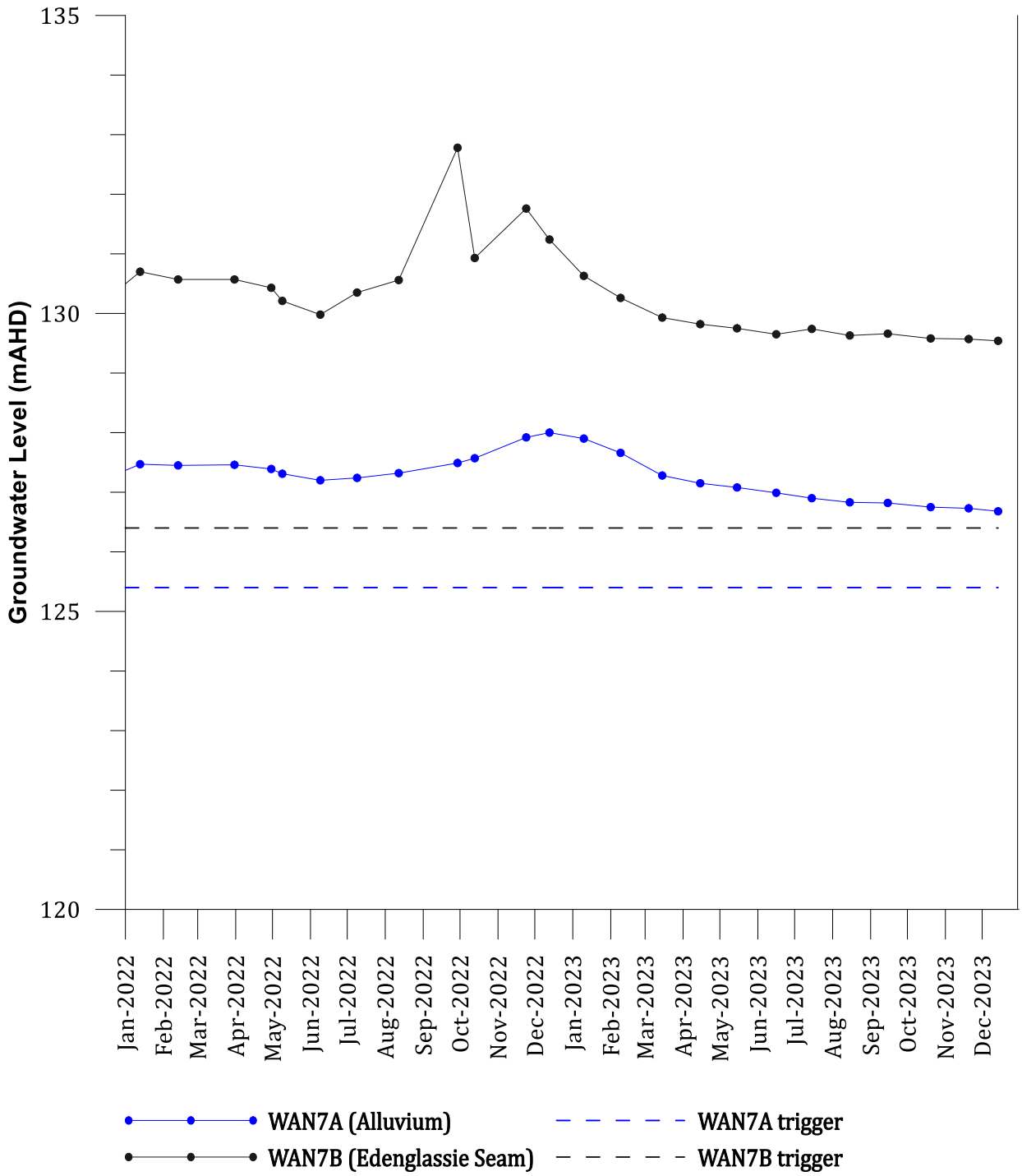


Figure 6.12 Alluvium and coal seam hydrographs – WAN7

Figure 6.13, Figure 6.14 and Figure 6.15 show groundwater levels at nested sites WAN8, WAN9 and WAN10. Monitoring bore WAN9A2 has replaced the previously dry WAN9A bore.

Figure 6.13 shows the water levels at the nested site WAN8. The water levels are approximately 125 mAHD and 117 mAHD for the alluvium and the Wynn seam, respectively. The alluvium is approximately 8 m higher than the Wynn seam head, potentially demonstrating a separation of the aquifers. The head trends are relatively constant for the monitoring period, indicating that there has been no mining induced change to groundwater water levels through 2023. WAN8 groundwater levels were above established triggers in 2023.

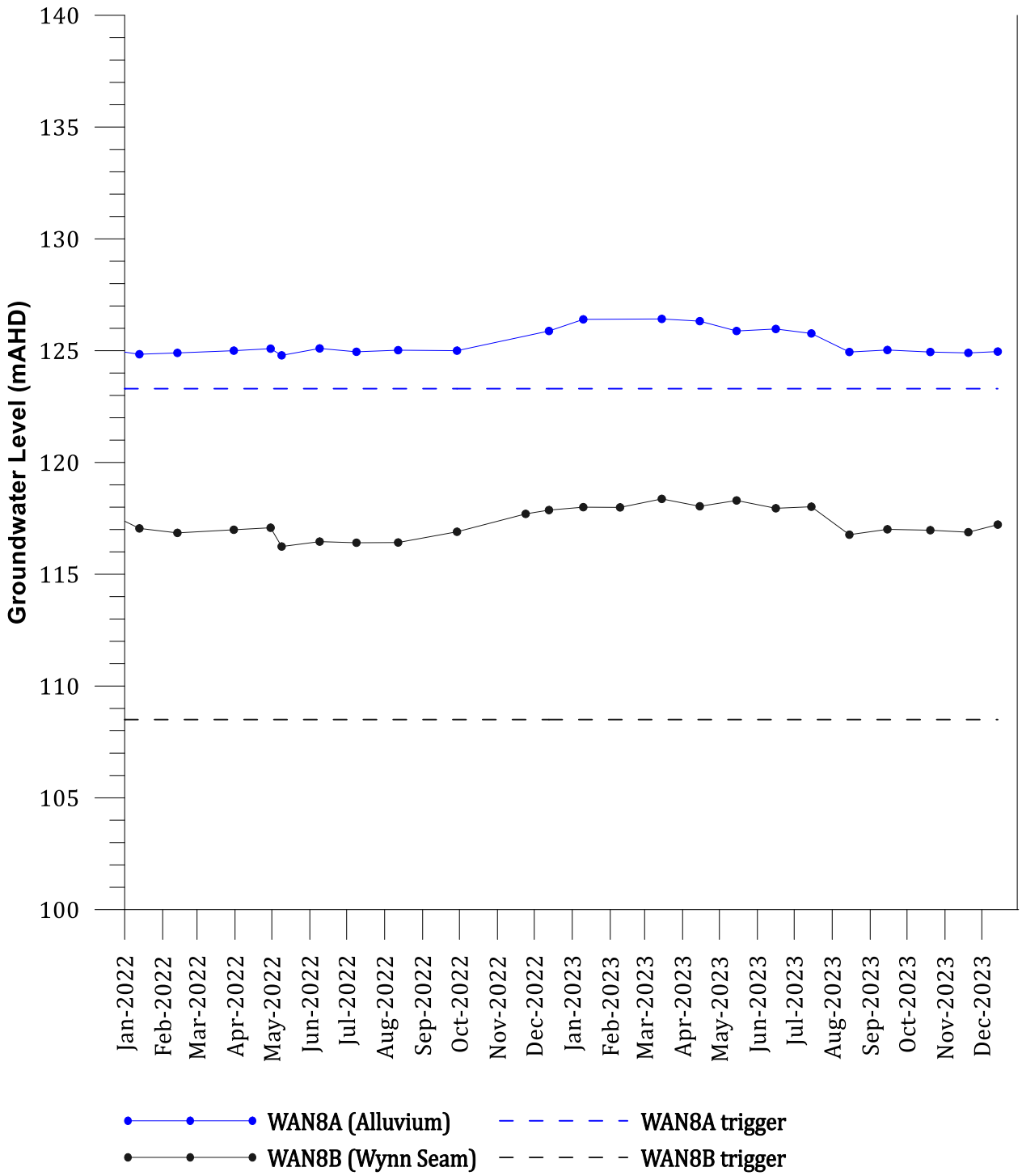


Figure 6.13 Alluvium and coal seam hydrographs – WAN8

Groundwater levels in WAN9A2 (refer Figure 6.14) decreased overall during the monitoring period. The groundwater level in WAN9B gradually declined throughout 2023. The final recorded groundwater level at WAN9B in 2023 was 114.95 mAHD (December 2023), 1 m lower than the groundwater level recorded at this bore in January 2023. All WAN9 monitoring bores continued to remain above established trigger values.

WAN10 monitoring bores (Figure 6.15) remained above trigger values for 2023. WAN10B shows the groundwater level in the Vaux Seam remaining relatively stable during 2023, whilst WAN10A alluvial water levels remained stable. Since September 2012, the water level in the Vaux Seam (WAN10B) has been steadily declining. The head differential between the bores at WAN10 has now increased to approximately 18.4 m, indicating potential for alluvial groundwater to leak to the coal seams, where they subcrop below the alluvium.

The initial groundwater level at WAN10B (119.2 mAHD, May 2009) has declined to 109.59 mAHD by December 2023 (a change of 9.52 m). This represents a decline in groundwater level of approximately 50% of the range above the adopted trigger level (Figure 6.15). Despite this, the decline is still within the limits of predicted impacts.

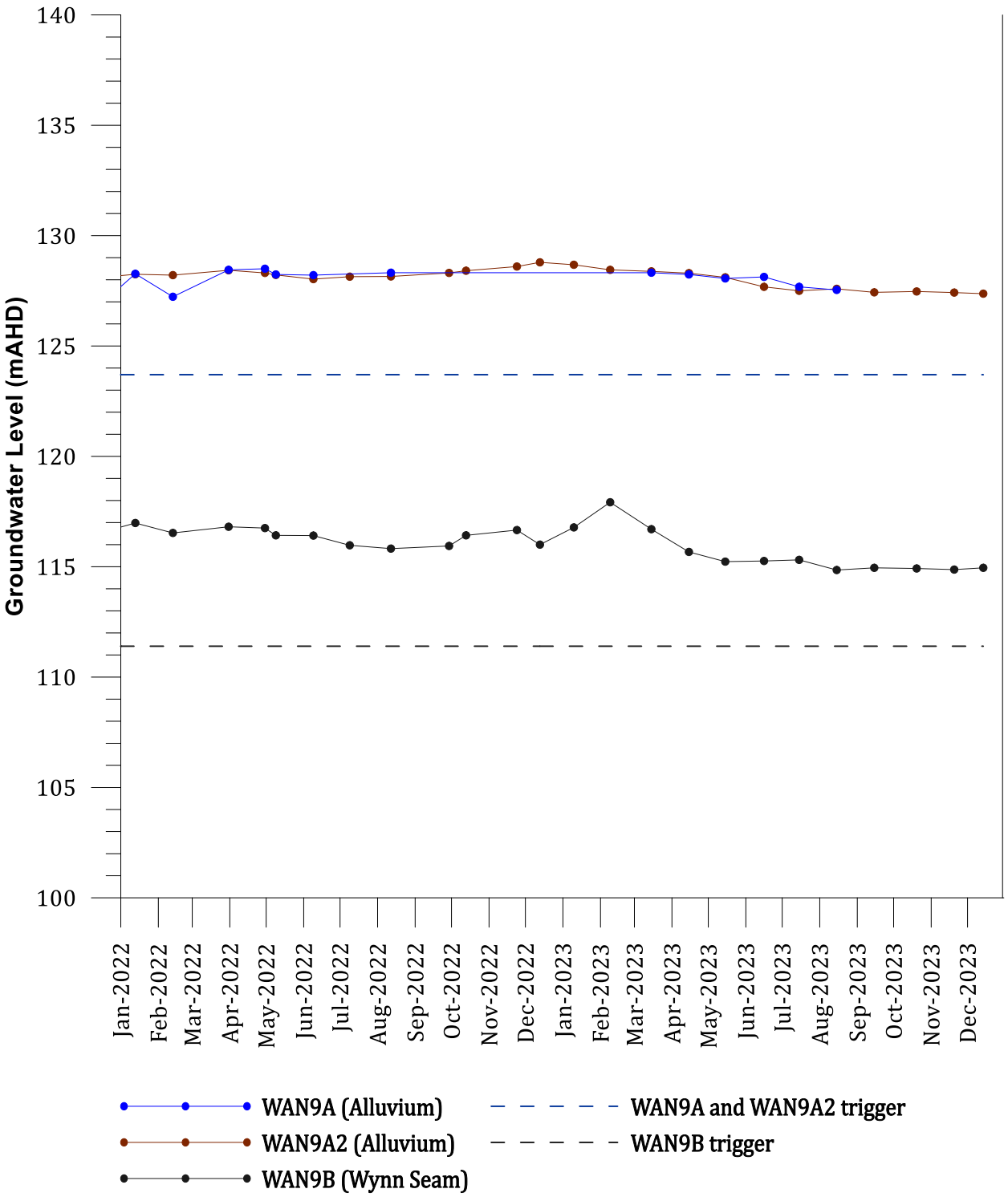


Figure 6.14 Alluvium and coal seam hydrographs – WAN9

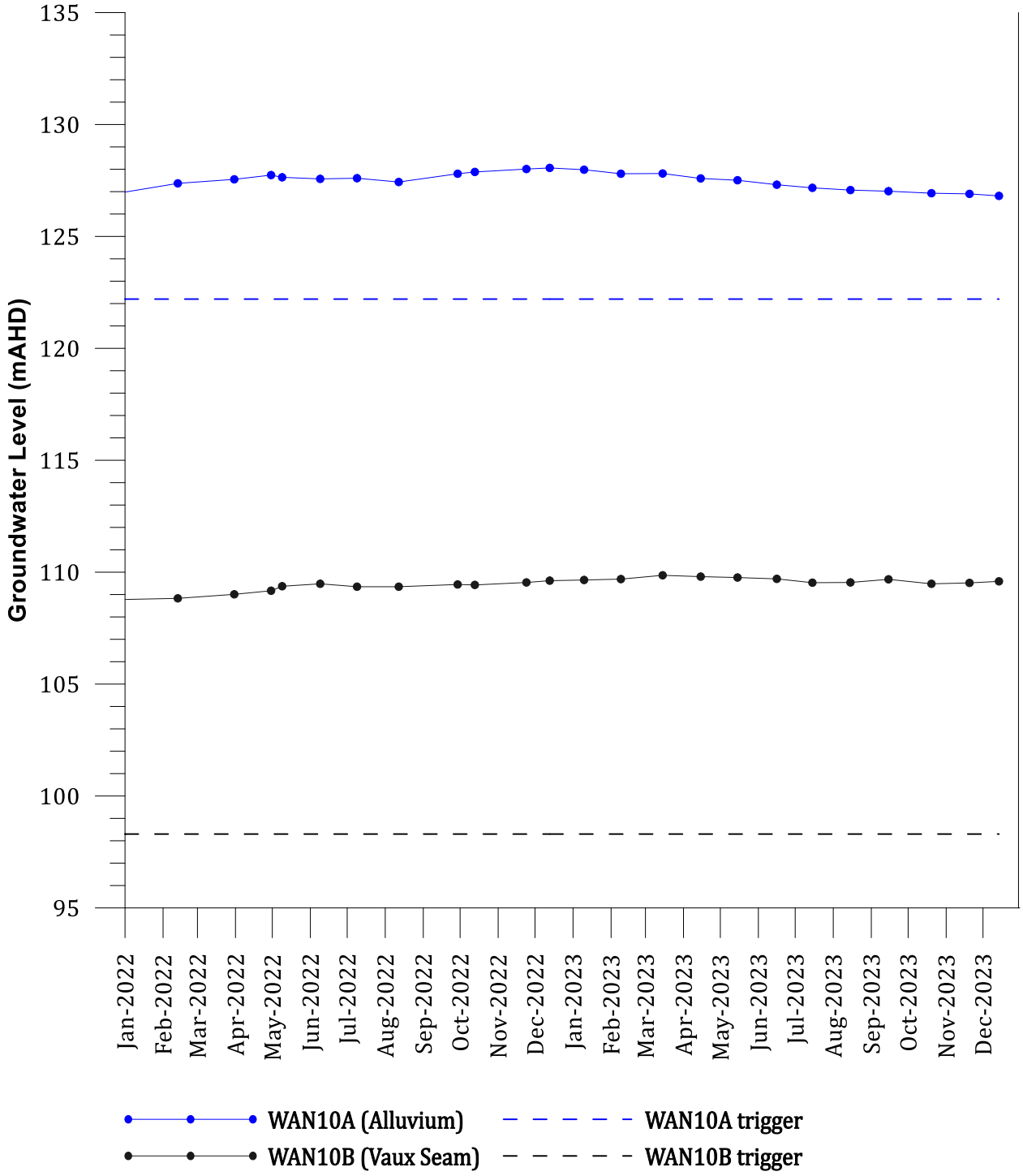


Figure 6.15 Alluvium and coal seam hydrographs – WAN10

6.2.3 Permian groundwater level contours

Figure 6.16 and Figure 6.17 show the interpreted groundwater flow contours for the shallow Permian units (Wynn and Vaux Seams and interburden) and deeper Permian units (Edderton and Edinglassie Seams and interburden), respectively. The depressurisation of the coal seams by open cut mining and the hydraulic gradient towards the mine is evident in the water level contours of both layers. Whilst the impact of the coal seam depressurisation is evident in the Permian units, the impact to the alluvial aquifer is minimal (refer Figure 6.3 and Section 6.1.3).

When compared to the previous year (2022), shallow Permian groundwater levels as monitored to the west (BE1, BE2, BE3) can be seen to be relatively stable (BE1, BE2) to slightly depressurised (BE3) depending on their proximity to the encroaching pit, whilst equivalent monitoring sites to the east have slightly increased groundwater levels reflective of increased rainfall recharge and more distal mining operations (Figure 6.16). Alternatively, the deeper Permian strata displays a greater comparative reduction in pressure head due to the higher hydraulic conductivity enabling enhanced lateral propagation of drawdown in these seams.

The water level contours, and flow directions are consistent with historic data and the drawdown is within predicted and approved ranges.

LEGEND

- Shallow Permian bores (July 2023)
  BoreID : WAN10B
  Groundwater level : 109.53 mAHD
- Drainage
- Shallow permian groundwater contours (5m)
- Groundwater flow direction
- Alluvium boundary
- 2023 Void boundary

Bengalla annual review 2023 (BEN5017.001)

Shallow Permian groundwater levels (July 2023)

AGE

DATE 20/03/2024

FIGURE No: **6.16**

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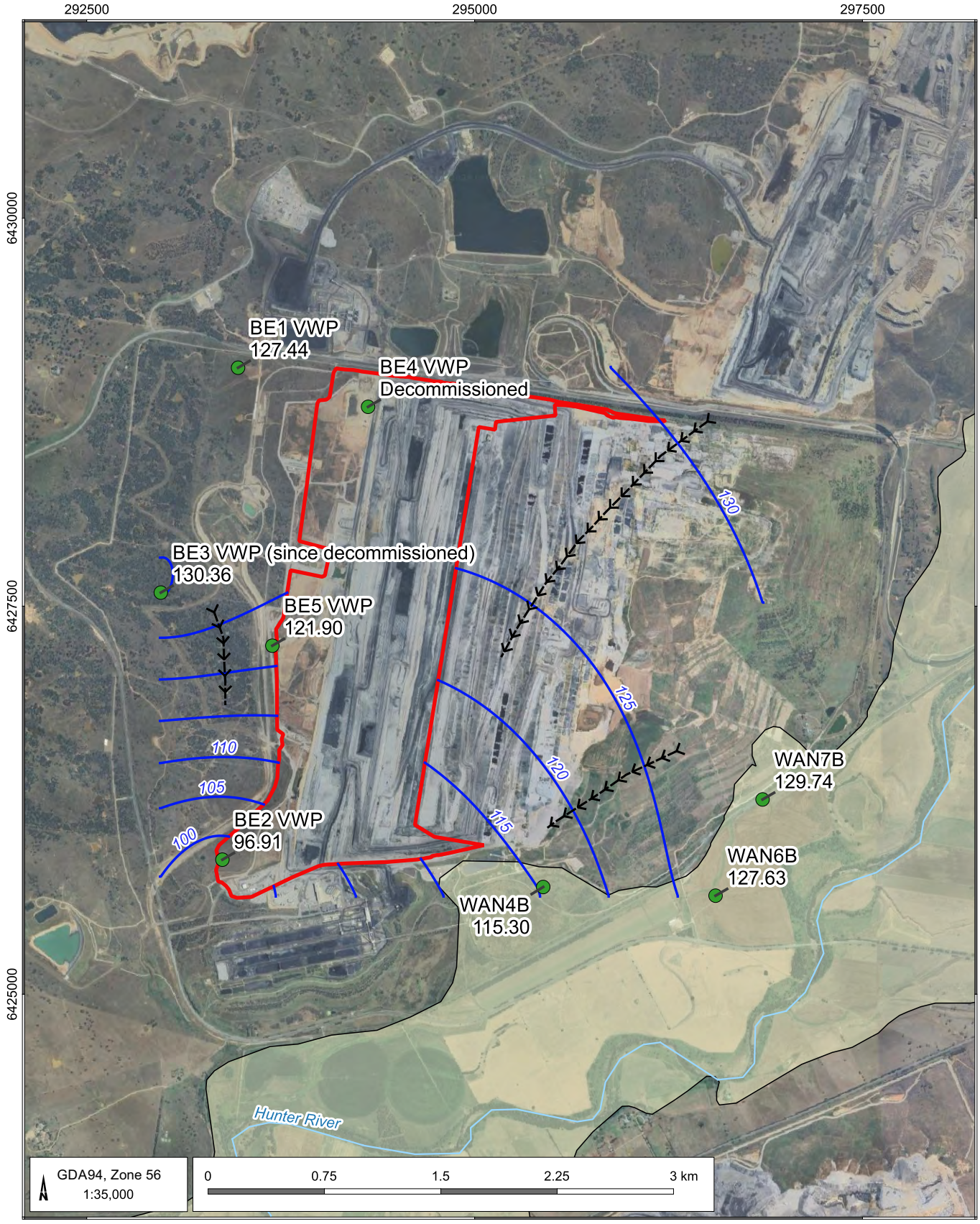

LEGEND

- Deep Permian bores (July 2023)
  BoreID: WAN4B
  Groundwater level : 115.30 mAHD
- Drainage
- Deep Permian groundwater contours (5m)
- Groundwater flow direction
- Alluvium boundary
- 2023 Void boundary

Bengalla annual review 2023 (BEN5017.001)

Deep Permian groundwater levels (July 2023)

AGE

DATE
20/03/2024

FIGURE No:
6.17

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6.3 Permian groundwater level – northwest of active mining

Figure 6.18 to Figure 6.22 below show the groundwater level hydrographs for those bores and VWPs located to the northwest of the active mining area, including:

- 46737;
- BE1 (overburden monitoring bore);
- BE2 (overburden monitoring bore);
- BE3 (overburden monitoring bore);
- BE1 (Mt Arthur Seam VWP);
- BE1 (Edderton Seam VWP);
- BE2 (Mt Arthur Seam VWP);
- BE2 (Edderton Seam VWP);
- BE3 (Mt Arthur Seam VWP);
- BE3 (Edderton Seam VWP);
- BE4 (Mt Arthur Seam VWP);
- BE4 (Edderton Seam VWP);
- BE5 (Mt Arthur Seam VWP); and
- BE5 (Edderton Seam VWP).

Little change is evident in the groundwater level in the monitoring bore sites to the northwest of the active mining area over 2023 (BE1, BE2 and BE3). Groundwater level in 46737 increased overall in response to historical rainfall recharge. These bores are all above their relative water level triggers.

Figure 6.19 to Figure 6.22 show the potentiometric heads measured in VWP installations at BE1, BE2, BE3, BE4 and BE5. Each of these installations has one VWP sensor in the Mt Arthur Seam, and another sensor in the Edderton Seam. BE4 was removed 27 October 2021 due to blasting operations. The water levels from monitoring bores BE1 through BE3 have also been plotted for comparison. Observations include:

- VWPs and bore at BE1 (Figure 6.19):
  - head pressure in both the Mt Arthur Seam and the Edderton Seam have continued trends from 2022, gradually declining throughout 2023; and
  - A brief increase in pressure head can be seen at the sensor at 264.5 mBGL, likely associated with rainfall. Afterwards, pressure head at this sensor continued to decline.
- VWPs and bore at BE2 (Figure 6.20):
  - the Mt Arthur Seam VWP sensor registered a gradual rate of decline throughout 2023; and
  - the head in the Edderton Seam VWP is declining at a greater rate than that of the Mt Arthur Seam VWP.
- VWPs and bore at BE3 (Figure 6.21):
  - the Mt Arthur Seam VWP sensor recorded an overall decrease in 2023; and
  - the Edderton Seam VWP recorded a stable pressure head in 2023. Overall pressure head is expected to decline in this seam as the pit progression approaches.
- VWPs at BE4:
  - BE4 was removed in October 2021 due to blasting operations. It is recommended that a replacement VWP be installed to continue monitoring in the area, or VWP BE4 be removed from future versions of the WMP.
- VWPs at BE5 (Figure 6.22):
  - Mt Arthur VWP sensor recorded a decline in pressure head in 2023.
  - Erroneous data has been recorded in sensor one (BE5-1) since September 2021. To continue monitoring pressure head in the Edderton seam a replacement VWP installation should be installed.

The declining water levels are most likely attributable to the advancing mine and coal seams are expected to depressurise ahead of the mine highwall.

The reason for the discrepancy in groundwater level trends between the VWP sensors and the monitoring bores is that pressure dissipation is greatest in the deeper coal seams, as they are more permeable than the shallow coal overburden. Additionally, the 'BE' series monitoring bores are screened in Permian sandstone/overburden, which may not yet be intersected by the pit, and is continuing to receive recharge via seepage from overlying strata and lateral groundwater flow from the north and west.

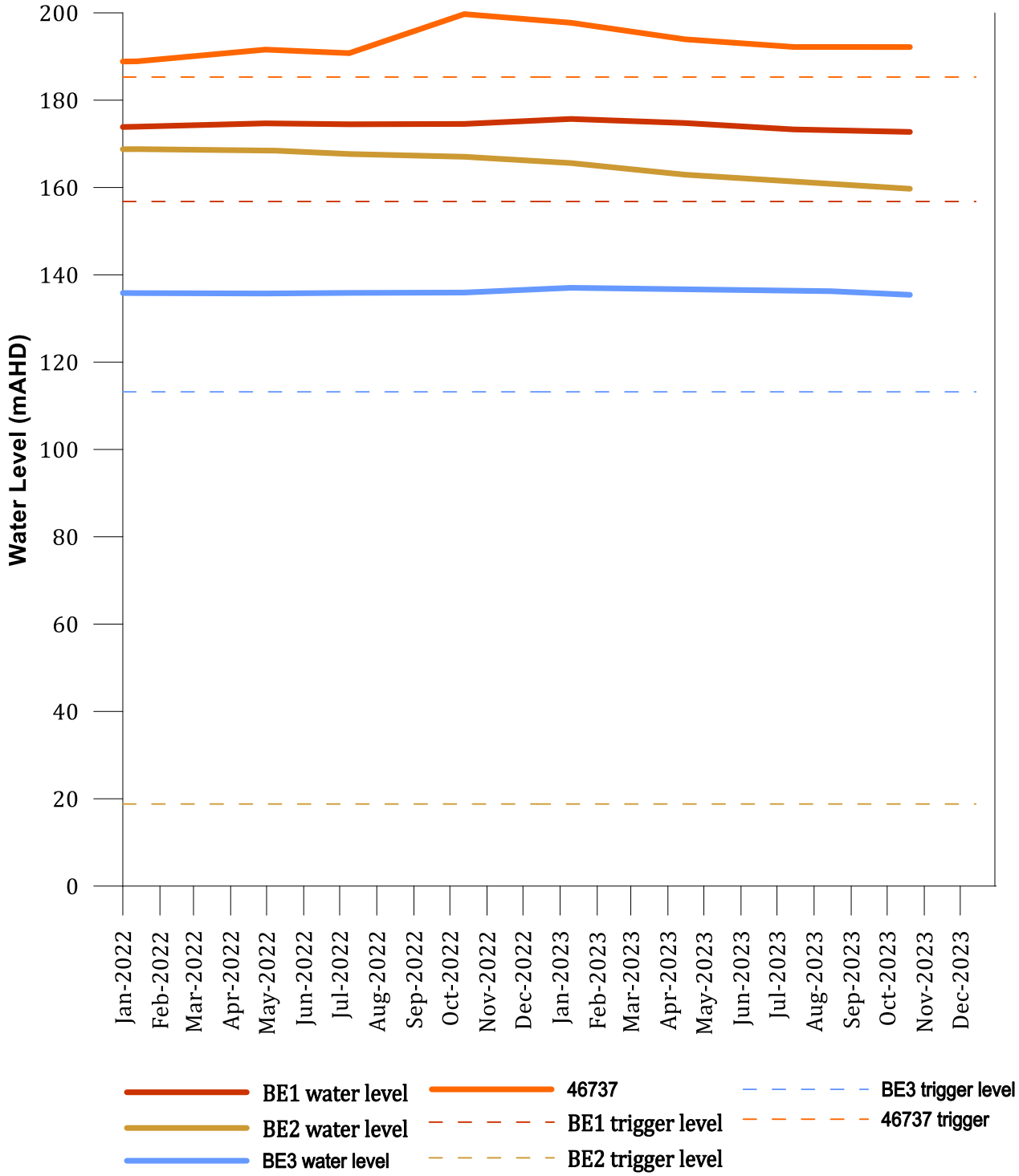

Figure 6.18 Northwest Permian monitoring bore groundwater levels

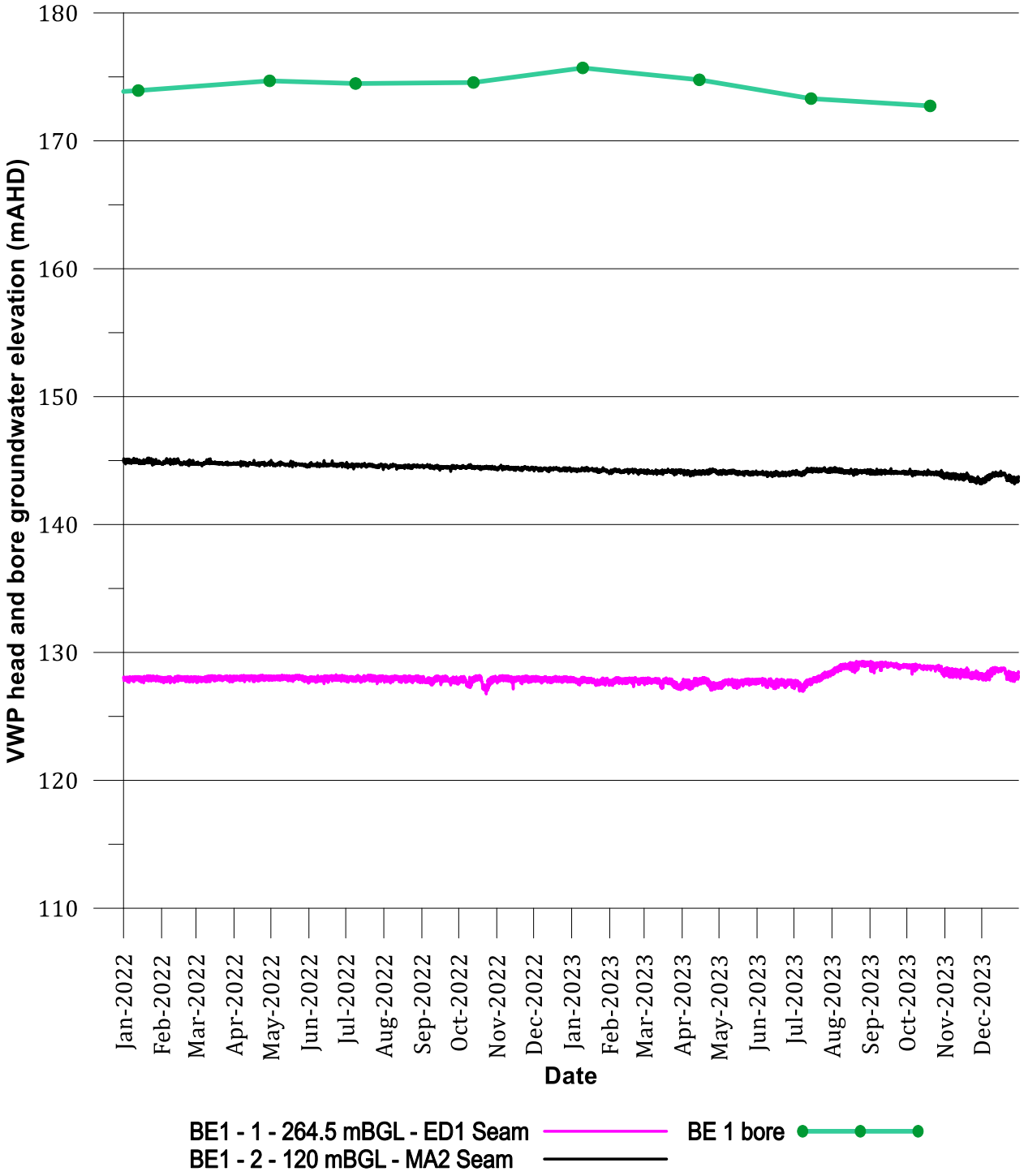

Figure 6.19 Northwest Permian VWP potentiometric heads – BE1

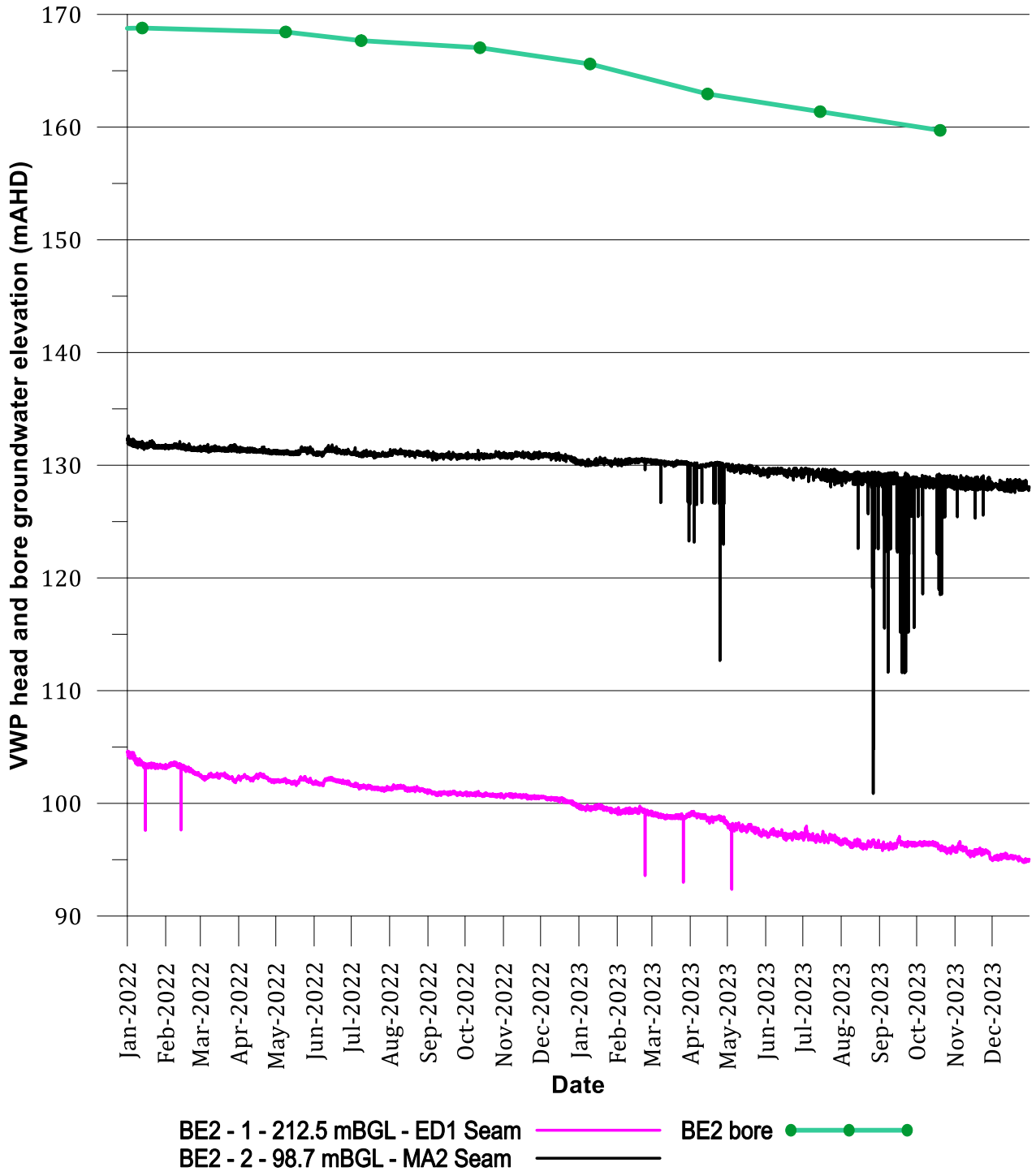

Figure 6.20 Northwest Permian VWP potentiometric heads – BE2

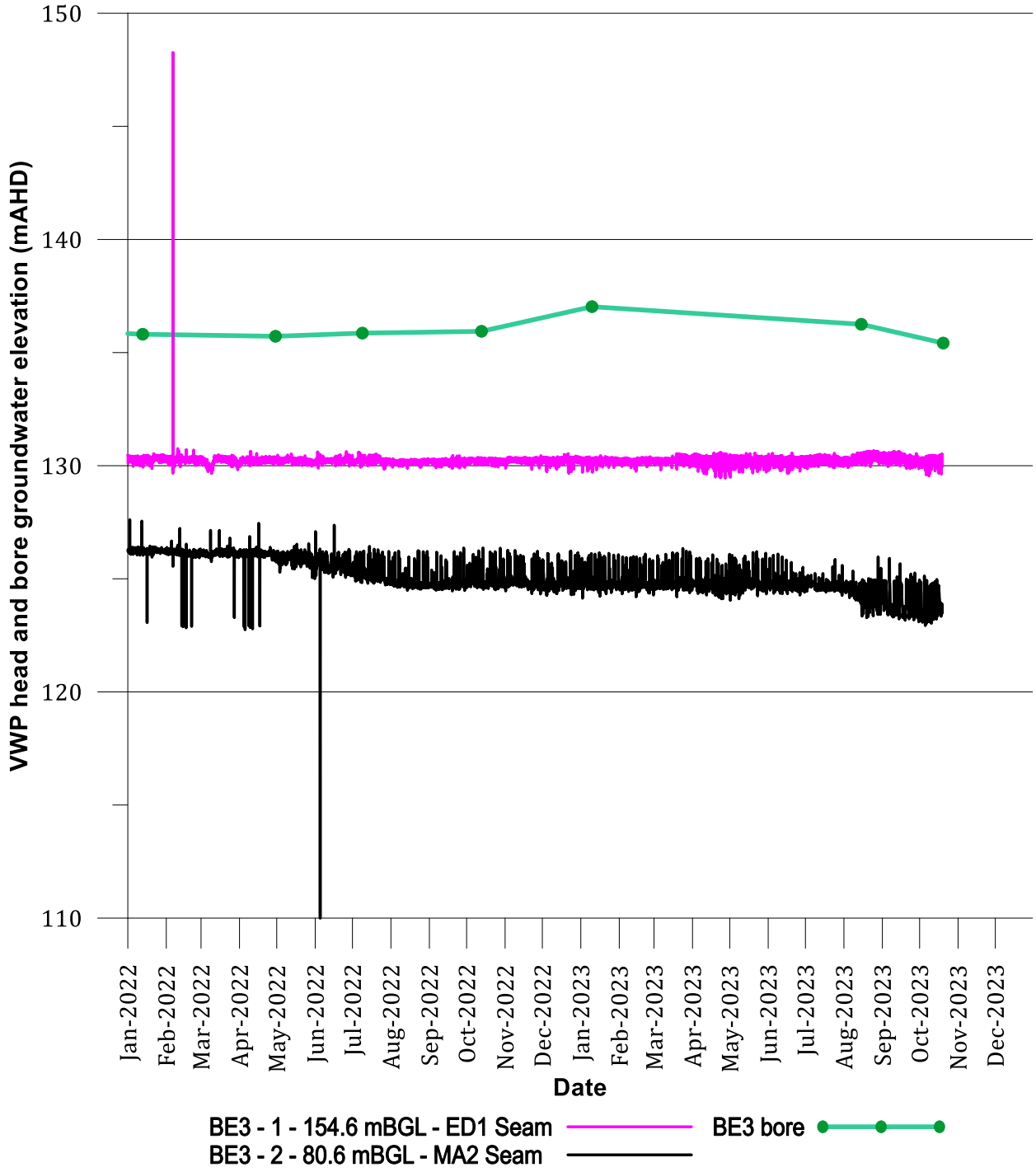

Figure 6.21 Northwest Permian VWP potentiometric heads – BE3

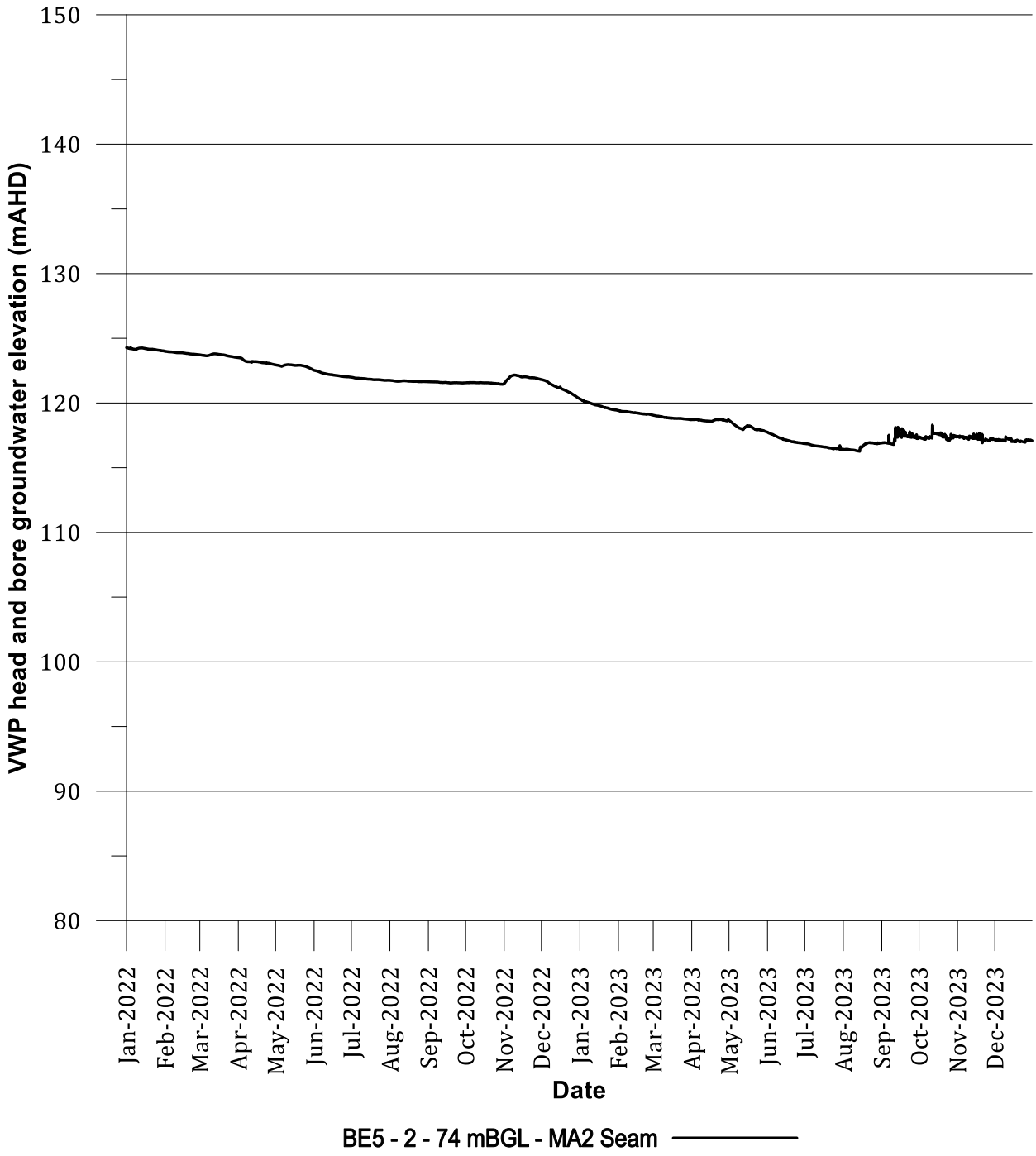

Figure 6.22 Northwest Permian VWP potentiometric heads – BE5

6.4 Groundwater level assessment against baseline data

Groundwater level data recorded over the 2023 reporting period has been compared against baseline data. Maximum predicted drawdown (trigger level) data is also reviewed, as set out in the Bengalla WMP (February 2019). A summary of the data is presented in Appendix A.

6.4.1 Baseline assessment

Appendix A shows the difference between the last measured groundwater level for the 2023 reporting period and the baseline data for each monitoring bore.

During the 2023 reporting period, monitoring bores 18298, 19116, BE2, BE3, BG5, REP17, SMB1, WAN2B, WAN2C, WAN3, WAN4B, WAN6B, WAN8B, WAN9B, and WAN10B had groundwater levels below their respective baseline water levels, see Appendix A – column 'Difference baseline vs. 2023 groundwater level'. Of the bores with groundwater levels below their respective baselines; BE2, BE3, REP17, WAN2B, WAN3, WAN4B, WAN9B, and WAN10B had groundwater levels of more than one metre below their respective baseline water level, due to drawdown from the mine. Monitoring bore REPI7 showed the greatest negative difference (-11.29 m) compared to its baseline, whereas 46737 showed the greatest positive difference (6.15 m).

6.4.2 Trigger level assessment

Groundwater trigger levels have been developed based on the maximum drawdown from the groundwater model. The trigger level is equal to: the most applicable pre-mining groundwater level (sourced from historic data), minus the predicted drawdown.

Appendix A shows the difference between the last measured groundwater level for the 2023 reporting period and the trigger level for each monitoring bore. There were no bores with a groundwater level below the maximum expected drawdown in 2023.

Water level triggers are considered to have triggered a response when:

- three or more alluvial bore levels fall below the trigger levels in one round of monitoring; and/or
- water levels in any bores fall below the trigger levels for three consecutive readings.

The groundwater level for bore BG3 has fluctuated around its trigger level throughout 2023 and had a water level exceedance in October 2023 (Figure 6.23). No other monitoring bores detected a groundwater elevation exceedance in 2023.

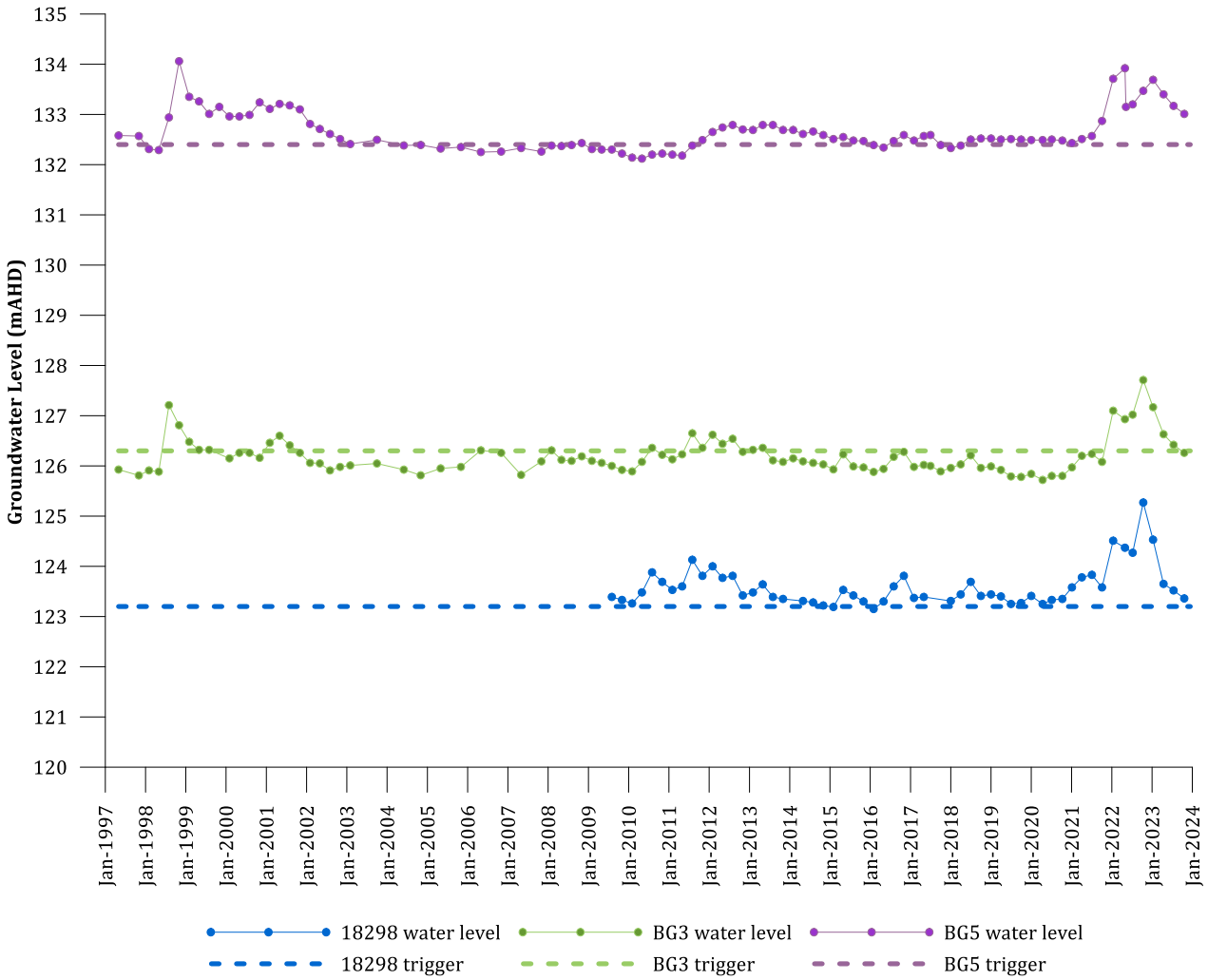

Figure 6.23 Hydrograph of bores with groundwater levels near maximum predicted drawdown

7 Groundwater quality and monitoring

7.1 Quality monitoring overview

Groundwater quality monitoring at Bengalla has included the following analyses:

- Electrical Conductivity (EC);
- Total Dissolved Solids (TDS);
- pH;
- sulphate; and
- dissolved metals (Al, As, Be, B, Cd, Cr, Co, Cu, F, Fe, Pb, Li, Hg, Mo, Ni, Se, V, and Zn).

EC, TDS and pH have been monitored in the Wantana Extension sites – WAN1, WAN2, WAN3, WAN4, WAN5, WAN6 and WAN7 since September 2005, and in the Regional bores since 1999. SMB1 and SMB2 were added to the monitoring program in 2010.

Sulphate and metals have been monitored in the Wantana Extension bores WAN8, WAN9 and WAN10 since May 2009, and in all Wantana bores from August 2009. Monitoring of sulphate and metals commenced in eleven of the Regional monitoring bores in 2003, and in the remaining eight Regional monitoring bores in August 2009.

7.2 Alluvial water quality

7.2.1 pH

Figure 7.1, Figure 7.2 and Figure 7.3 show pH trends in alluvial bores. Groundwater pH trends for Hunter River alluvial bores have remained consistent across 2023 with some minor fluctuations evident.

Groundwater pH in WAN8A remained anomalously high. The bore has historically contained insufficient water to sample. Throughout 2023, there was less than 0.6 m of water in the bore for both pH readings from WAN8A, below the bore screen. These observations of water level and water quality together indicate that the water being sampled from WAN8A is stagnant water from the bore sump, rather than a representative sample of the screened formation. The monitoring procedure for this bore should be redressed to exclude sampling if there is insufficient water to provide a representative sample. The high pH values at this site do not pose an environmental risk.

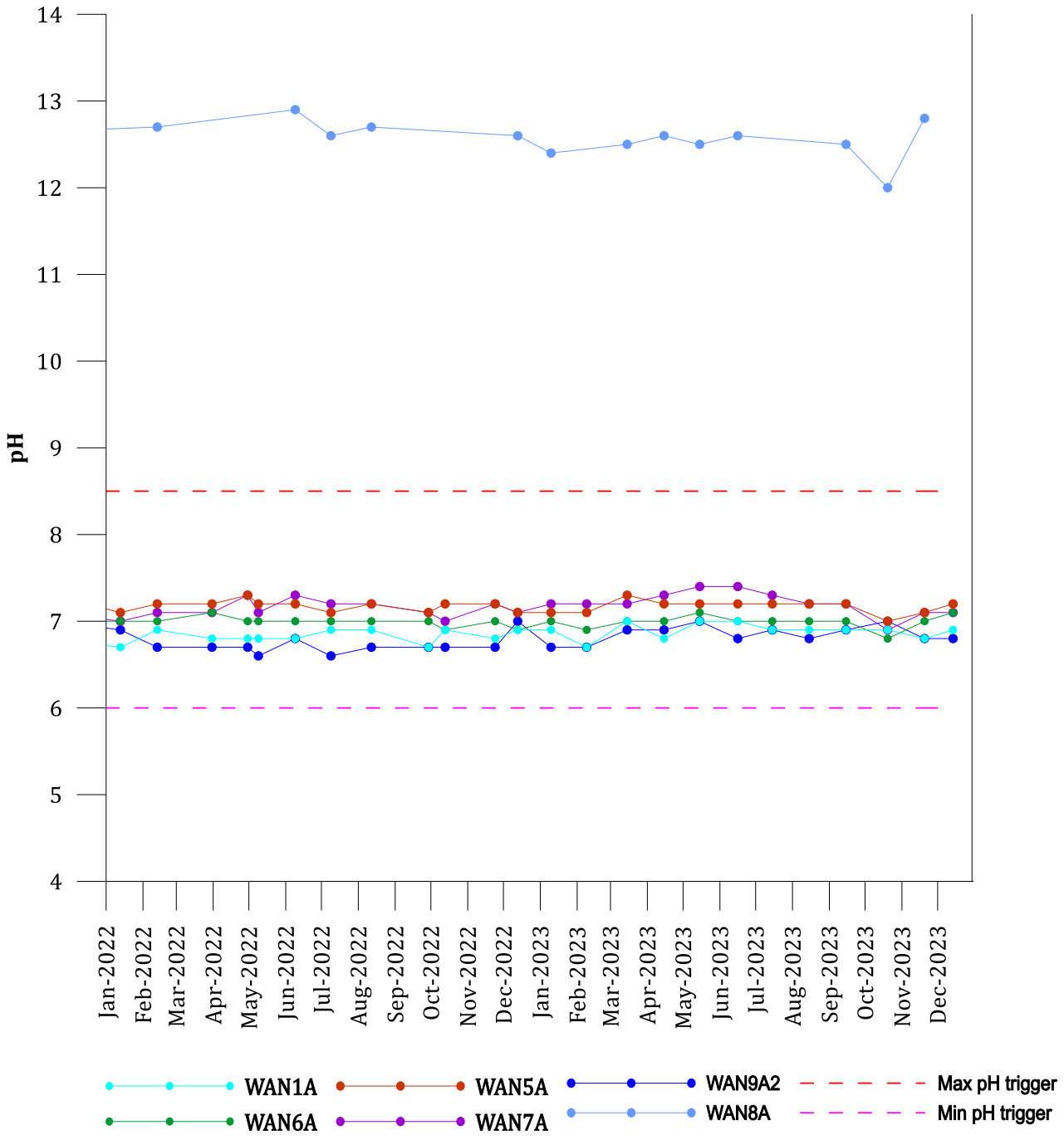

Figure 7.1 pH trends – Hunter River alluvial bores

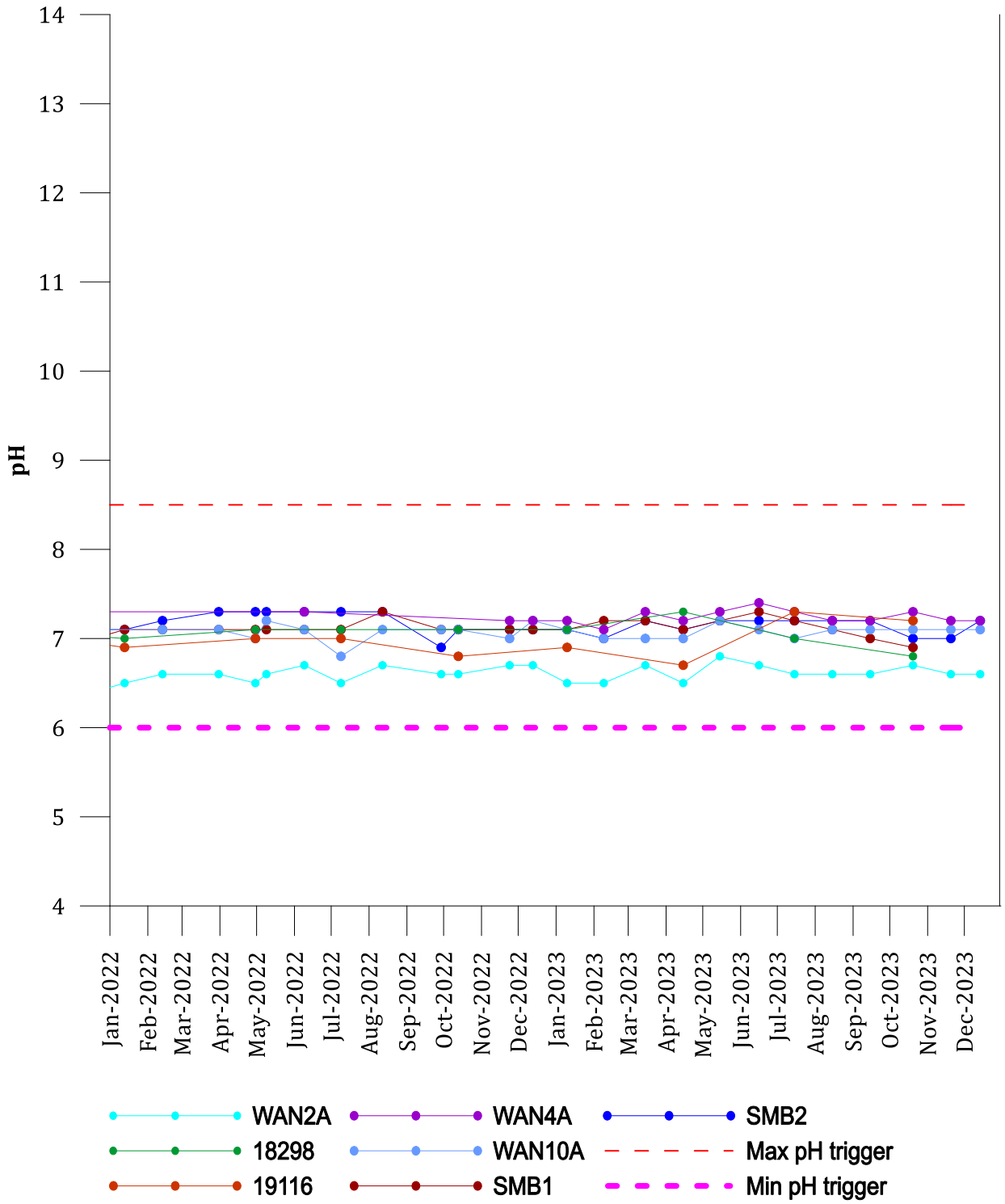

Figure 7.2 pH trends – other alluvial bores

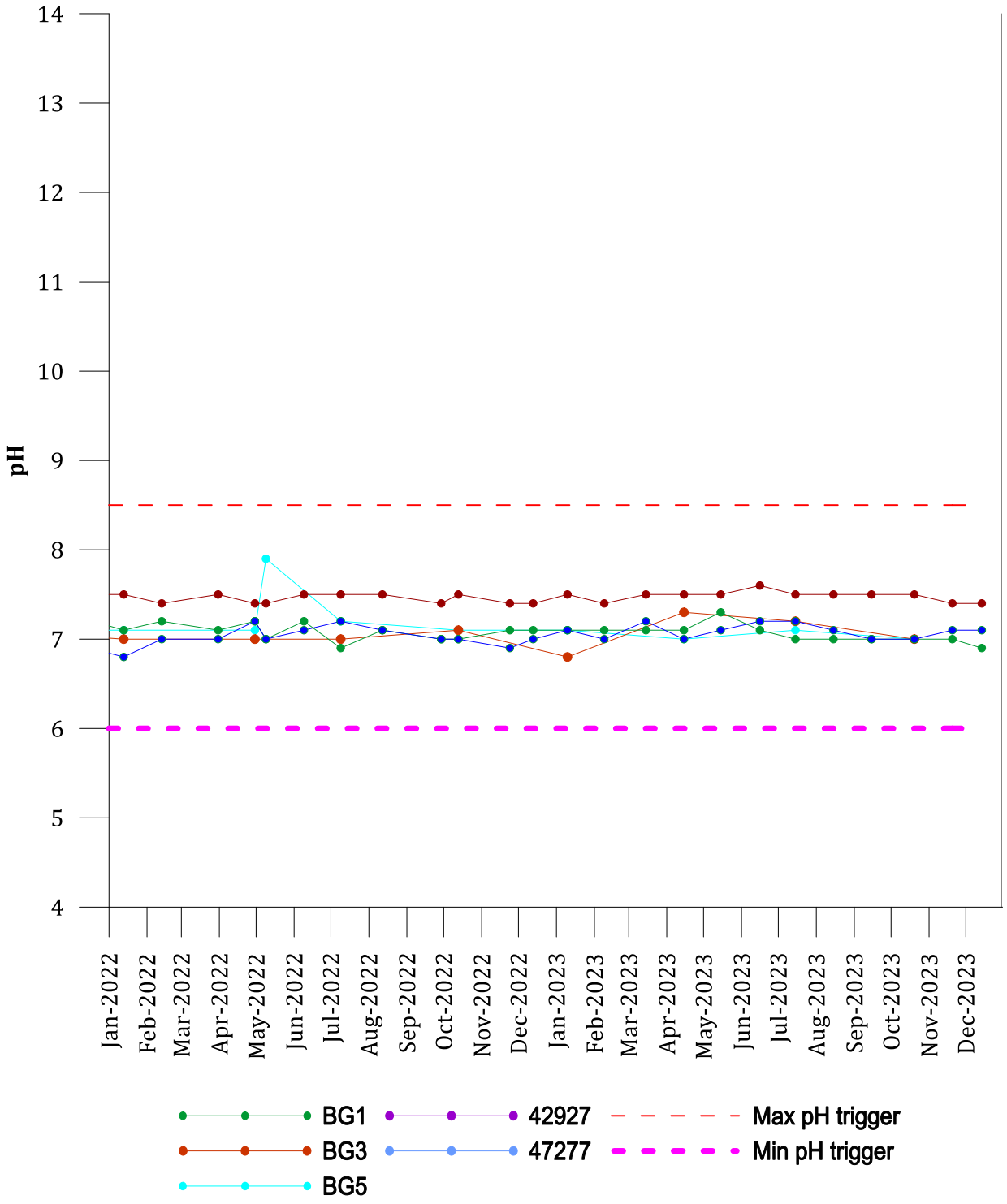

Figure 7.3 pH trends – regional alluvial bores

7.2.2 EC

Figure 7.4 and Figure 7.5 show EC trends in alluvial bores in the Wantana Extension Area and Regional alluvial monitoring bores, respectively.

Generally, the EC in the alluvium is less than 1,500 µS/cm, indicating that the alluvial groundwater in the Wantana Extension area is similar to groundwater in the regional alluvial bores. The exceptions to this were SMB1 and SMB2 in which groundwater EC was around 2,000 µS/cm, and WAN9A2 in which groundwater EC was around 7,500 µS/cm.

Water quality trigger events in 2023 are described in Section 7.5.

WAN4A has been recording a gentle decline in EC since early 2015 with the last recorded value 1,271 µS/cm (December 2023). WAN4A is on a “spur” of alluvium to the south of Bengalla’s southern endwall. The coal seams in this area have depressurised due to mining and the decrease in pressure has allowed local infiltration of less saline river water in the alluvium, causing a decrease in EC. The water level in this bore does not appear to be impacted. The EC values in this bore should continue to be monitored.

The EC values for WAN8A, which is screened in the alluvium, have historically ranged between 1,282 µS/cm (Nov 2007) and 8,870 µS/cm (May 2010). Groundwater EC values in 2023 continue to be elevated, likely representing stagnant water accumulated in the sump of WAN8A, rather than a representative sample of the screened formation. Groundwater levels (Section 6.1.3) and pH (Section 7.2.1) also support this conclusion.

Throughout 2023, monitoring bores WAN7A, SMB1 and SMB2 presented EC values between 1,500 µS/cm and 2,500 µS/cm. Although these results are above 1,500 µS/cm, these bores have generally remained consistent throughout 2023 and are comparable to historical values (Figure 7.4). Monitoring bore WAN10A recorded anomalously high EC values above 1,422 µS/cm from November 2021 to June 2022, however all other values ranged between 820 µS/cm and 1,045 µS/cm, consistent with historic values.

Regional monitoring bore BG3 is situated along strike to seams currently being mined at Bengalla (and north of Mt Arthur where the same geological profile is mined), and has historically shown significant variation in EC, following a generally decreasing trend since 2015. EC values have increased in 2023, recording an average EC of 1,017.25 µS/cm in 2022 and an average of 1,825.75 µS/cm in 2023 (Figure 7.5).

EC values in alluvial bores generally remained stable between 2022 and 2023, with fluctuations coincident with increased rainfall over 2023. It does not appear that there are mine related impacts on groundwater EC within these bores.

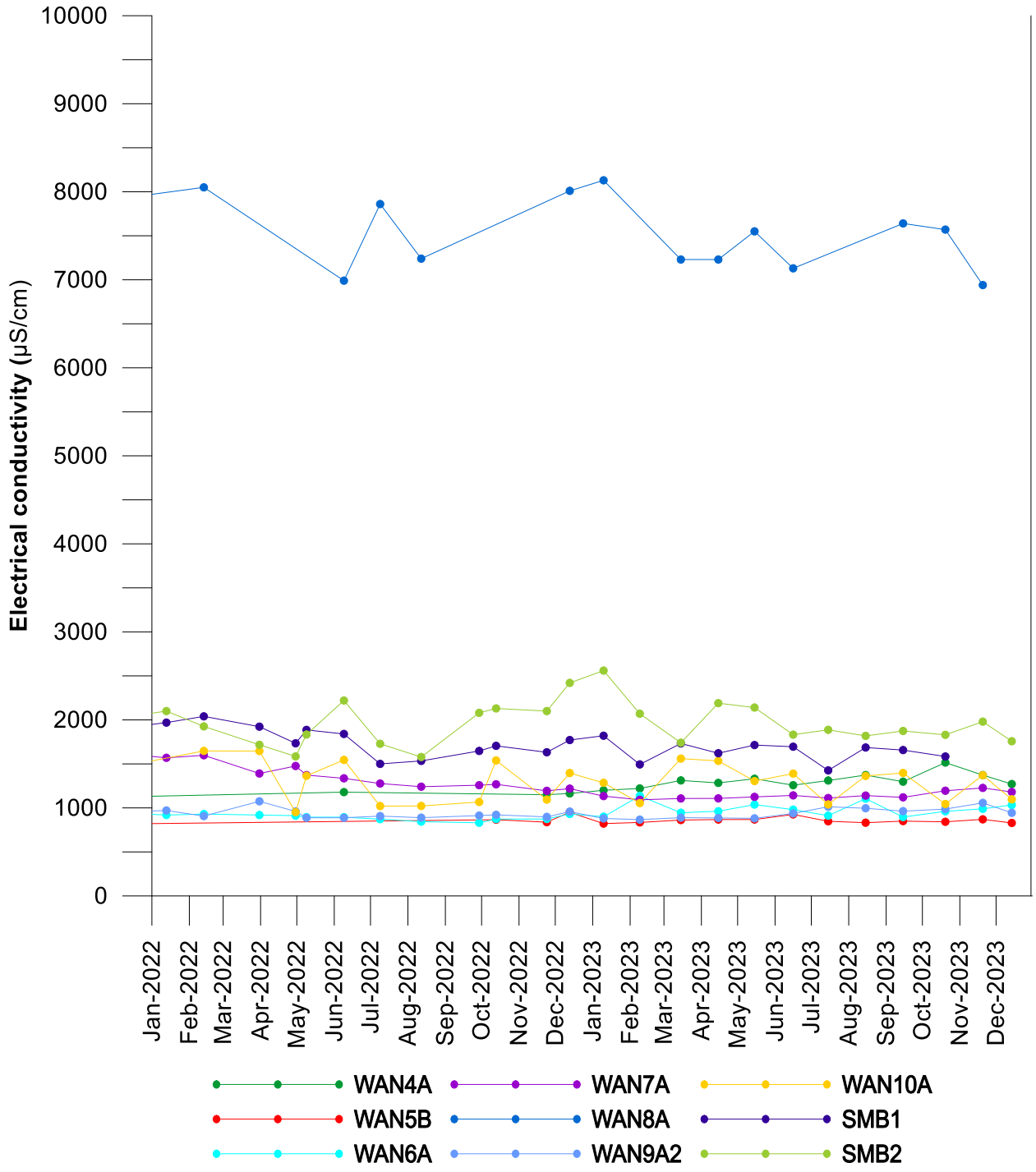

Figure 7.4 EC trends – Hunter River Alluvium (Wantana Extension)

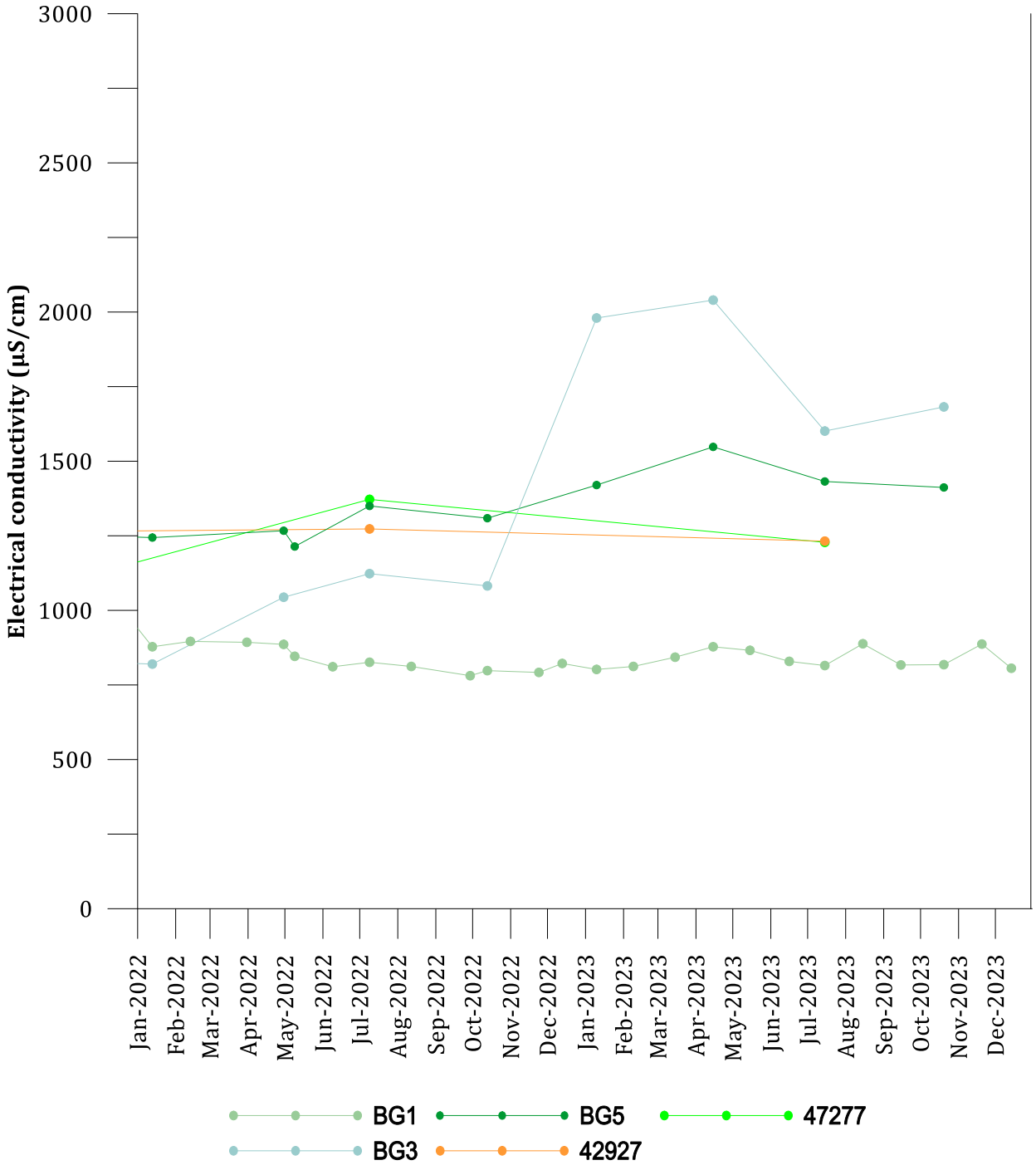

Figure 7.5 EC trends – Hunter River Alluvium (Regional)

7.3 Coal seam and interburden water quality

7.3.1 pH

Figure 7.6 and Figure 7.7 show pH trends for coal seam units and interburden bores in the Wantana area, respectively. Groundwater pH trends in coal seams and interburden have remained circumneutral and stable, and generally share the same trends over 2023. Excepting conditions in WAN8B which exceeded the upper pH trigger in February 2023 (pH of 8.6 – first exceedance), no coal seam/interburden bores have exceeded pH trigger values throughout 2023.

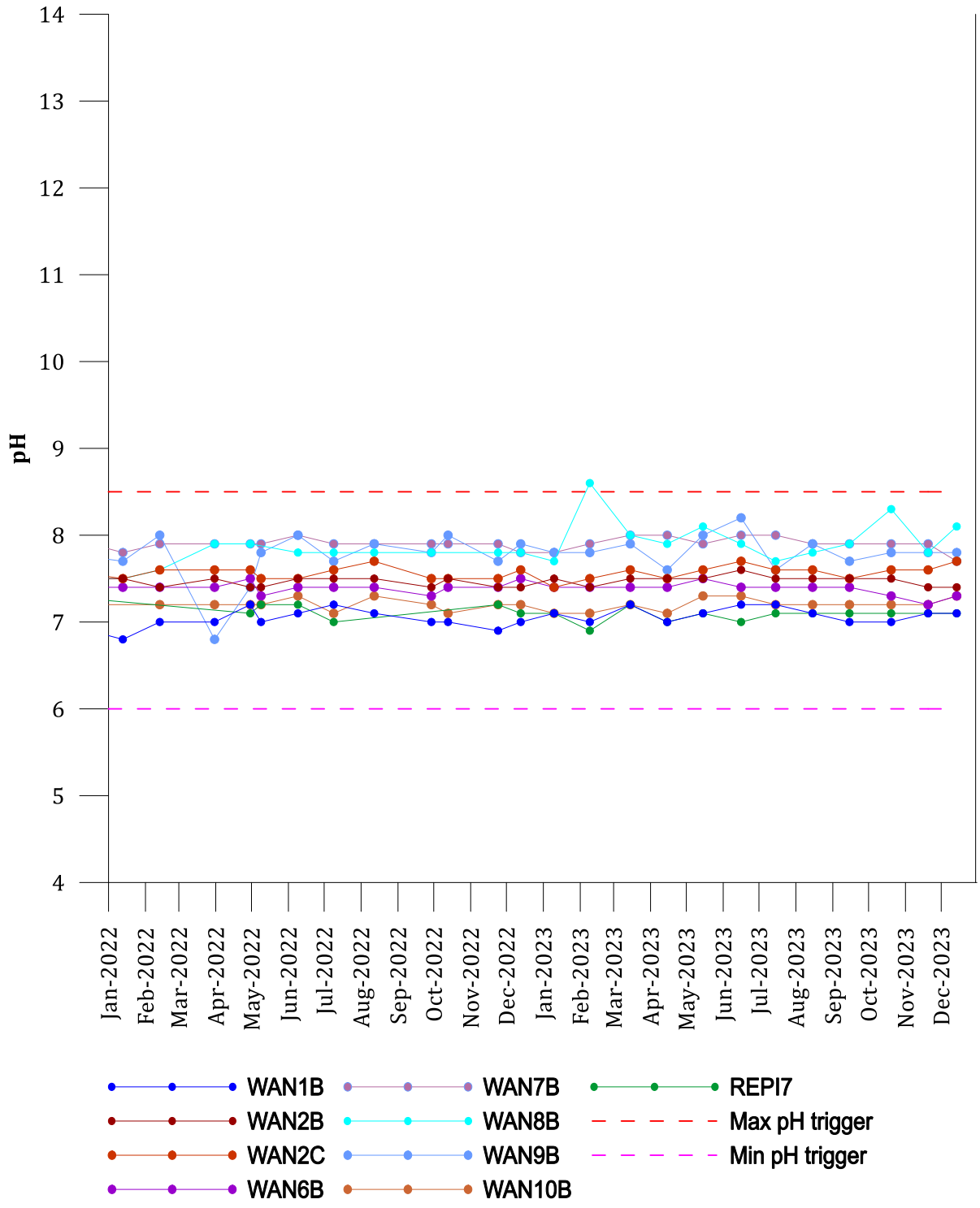

Figure 7.6 pH tends – coal seam aquifers

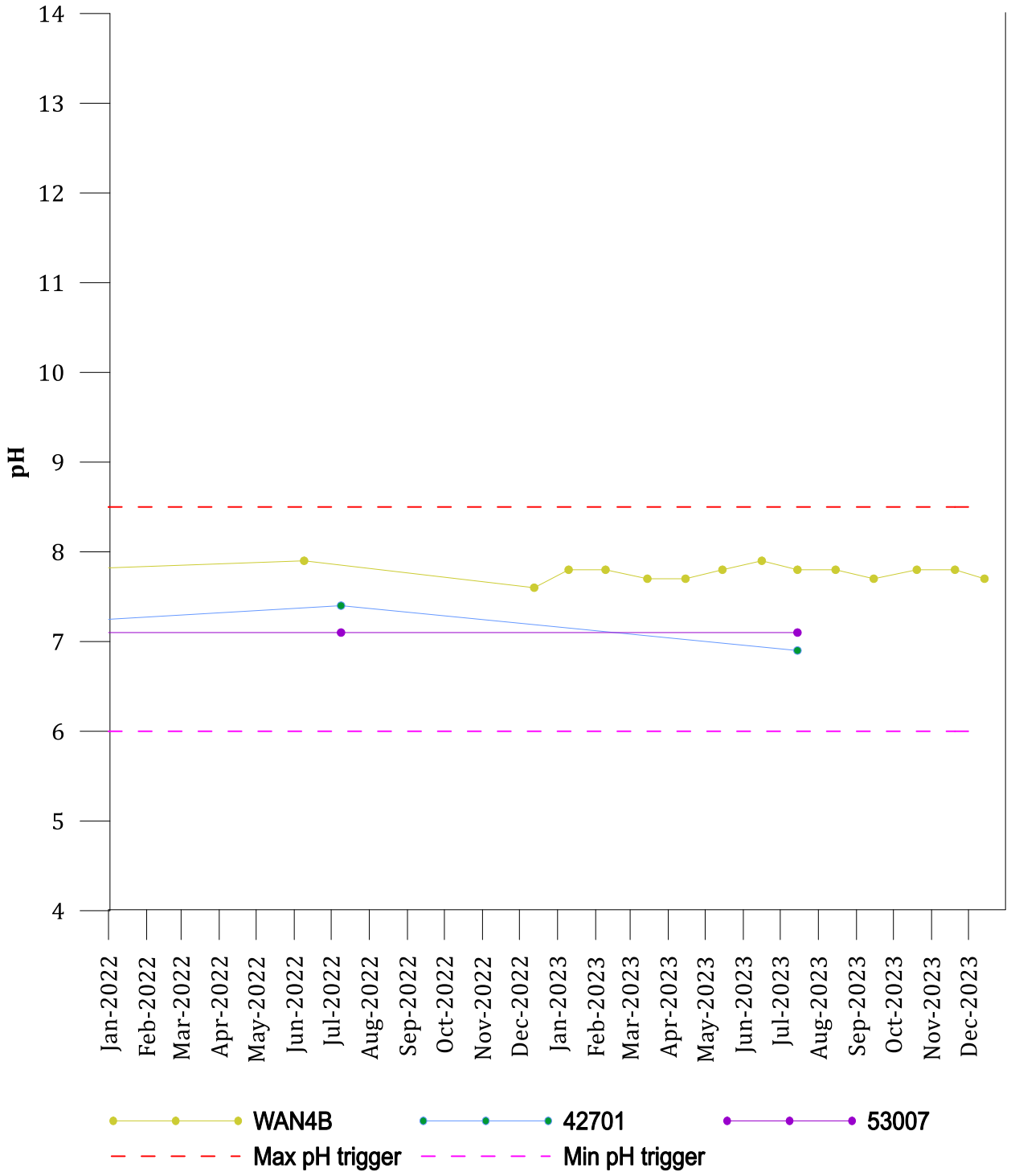

Figure 7.7 pH trends – coal seam aquifers (Wantana Area)

7.3.2 EC

Figure 7.8 and Figure 7.9 show EC trends for coal seam units and interburden bores in the Wantana area and regional monitoring bores, respectively. Water quality trigger events in 2023 are described in Section 7.5.

The coal seam and interburden bores can be separated into three distinct groups by groundwater EC:

- bores that have EC measurements generally less than 2,000 µS/cm, including WAN1A, WAN1B, WAN6B, and REP17 (lower EC group; Figure 7.8);
- bores that have EC measurements between 2,000 µS/cm and 3,000 µS/cm, including WAN2A, WAN2B, WAN2C, WAN4B, WAN7B and WAN8B; and
- bores that have EC measurements between 3,000 µS/cm and 9,000 µS/cm, including WAN5B, WAN9B and WAN10B that are within the expected range for coal seam bores (Figure 7.8 and Figure 7.9).

The lower EC group may reflect seepage from the alluvium.

Groundwater EC in nine coal seam monitoring bores exceeded their derived triggers in 2023 (Table 7.1):

- REP17.
- WAN1B.
- WAN2A.
- WAN2C.
- WAN6A.
- WAN8A.
- WAN9A2.
- WAN10A.
- WAN10B.

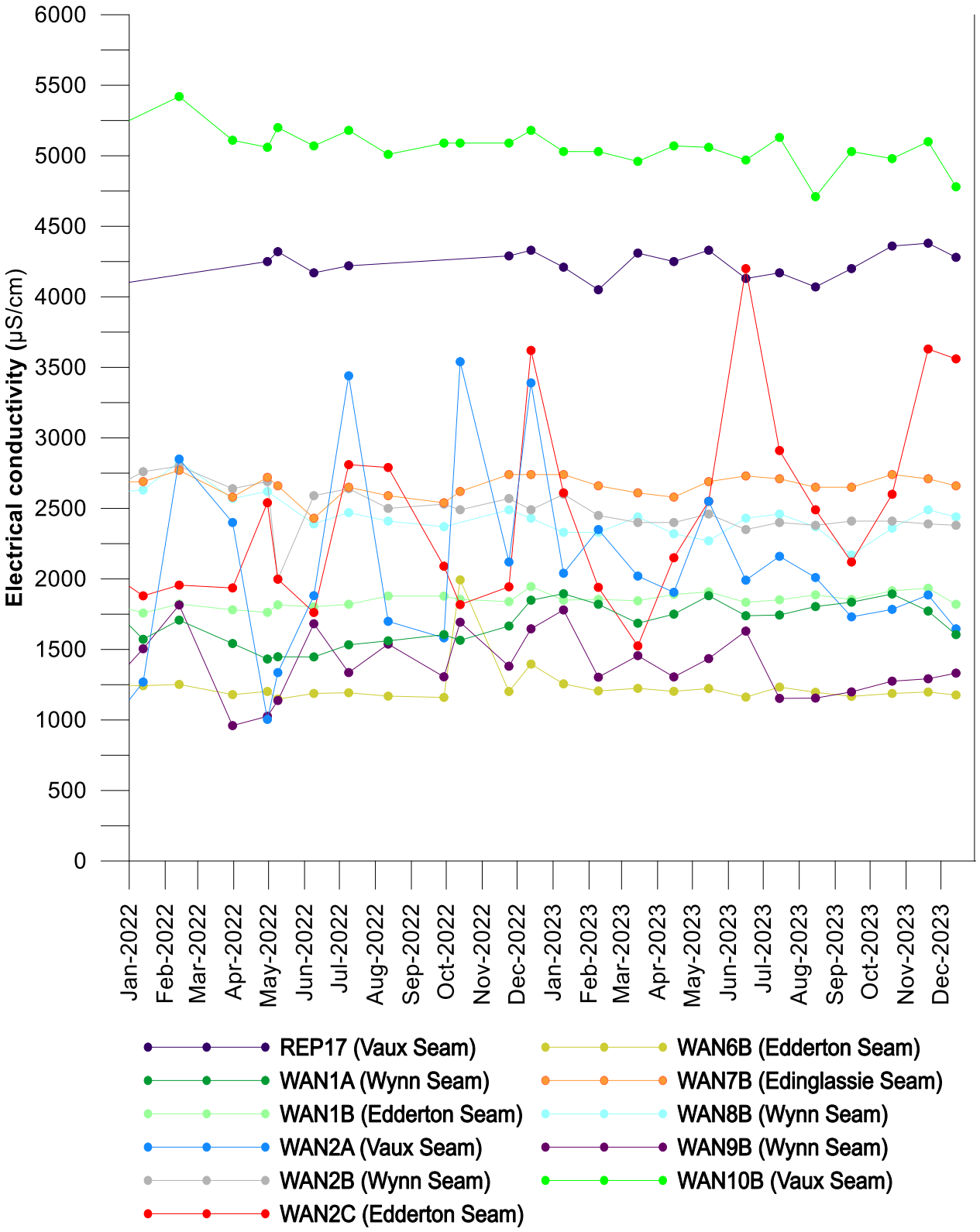

Figure 7.8 Electrical conductivity trends – Coal seam aquifers (Wantana Area)

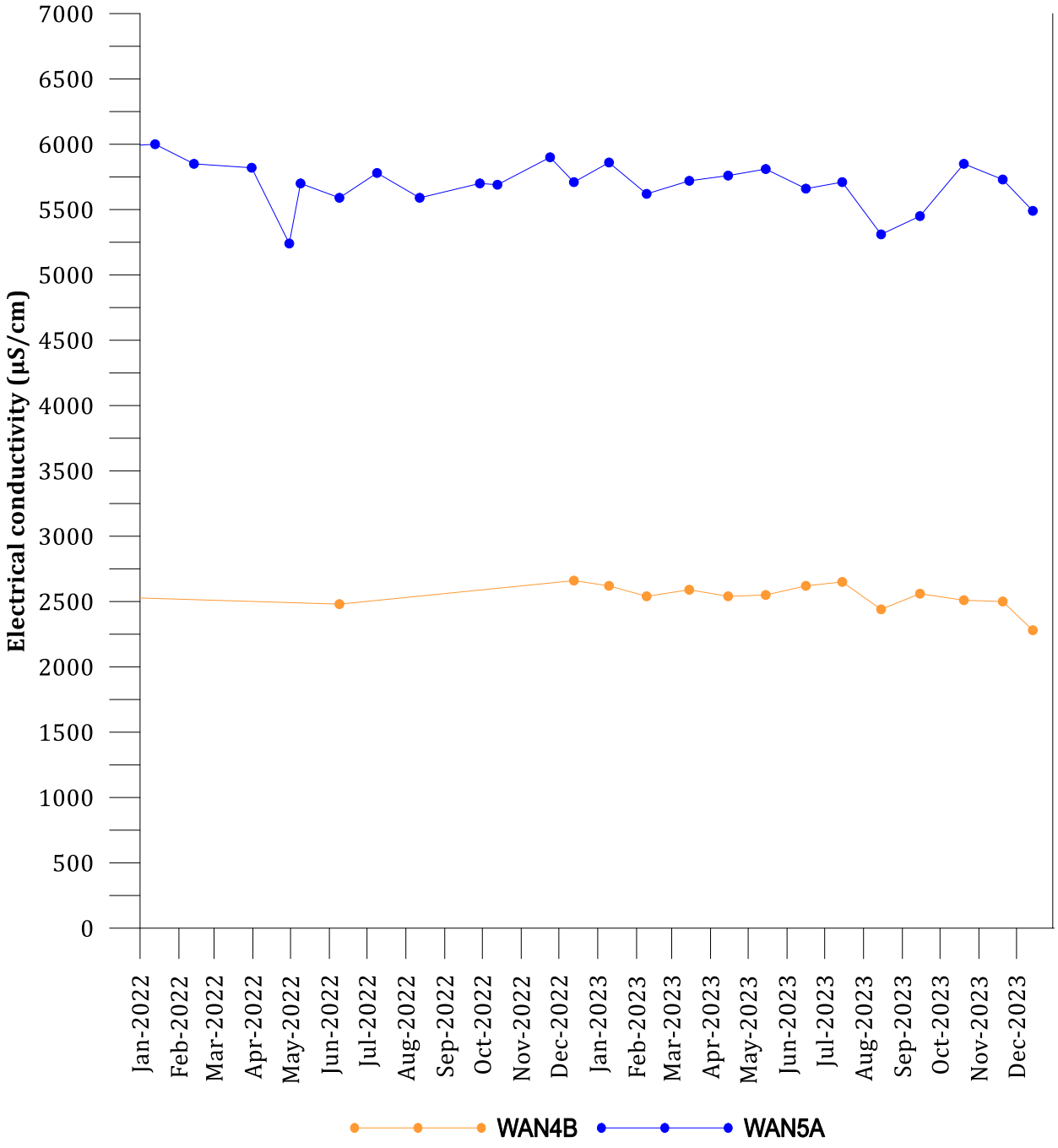

Figure 7.9 Electrical conductivity trends – Deep Permian bores

7.4 Permian groundwater quality – northwest of active mining

Figure 7.10 and Figure 7.11 show the EC and pH, respectively, for bores to the northwest of active mining. These bores include:

- BE1;
- BE2; and
- BE3.

Figure 7.10 showed similar trends for bores BE2 and BE3, wherein EC decreased between January 2022 and October 2022, then increased until the end of 2023. BE1 increased throughout 2022, then decreased from January 2023 onward. These bores are ahead of the mine highwall and there is no apparent depressurisation. The changes in EC, which is naturally elevated, are likely due to natural variation.

Figure 7.11 shows pH values have remained circum-neutral and stable in 2023. Groundwater pH values for all monitoring bores are within historic ranges.

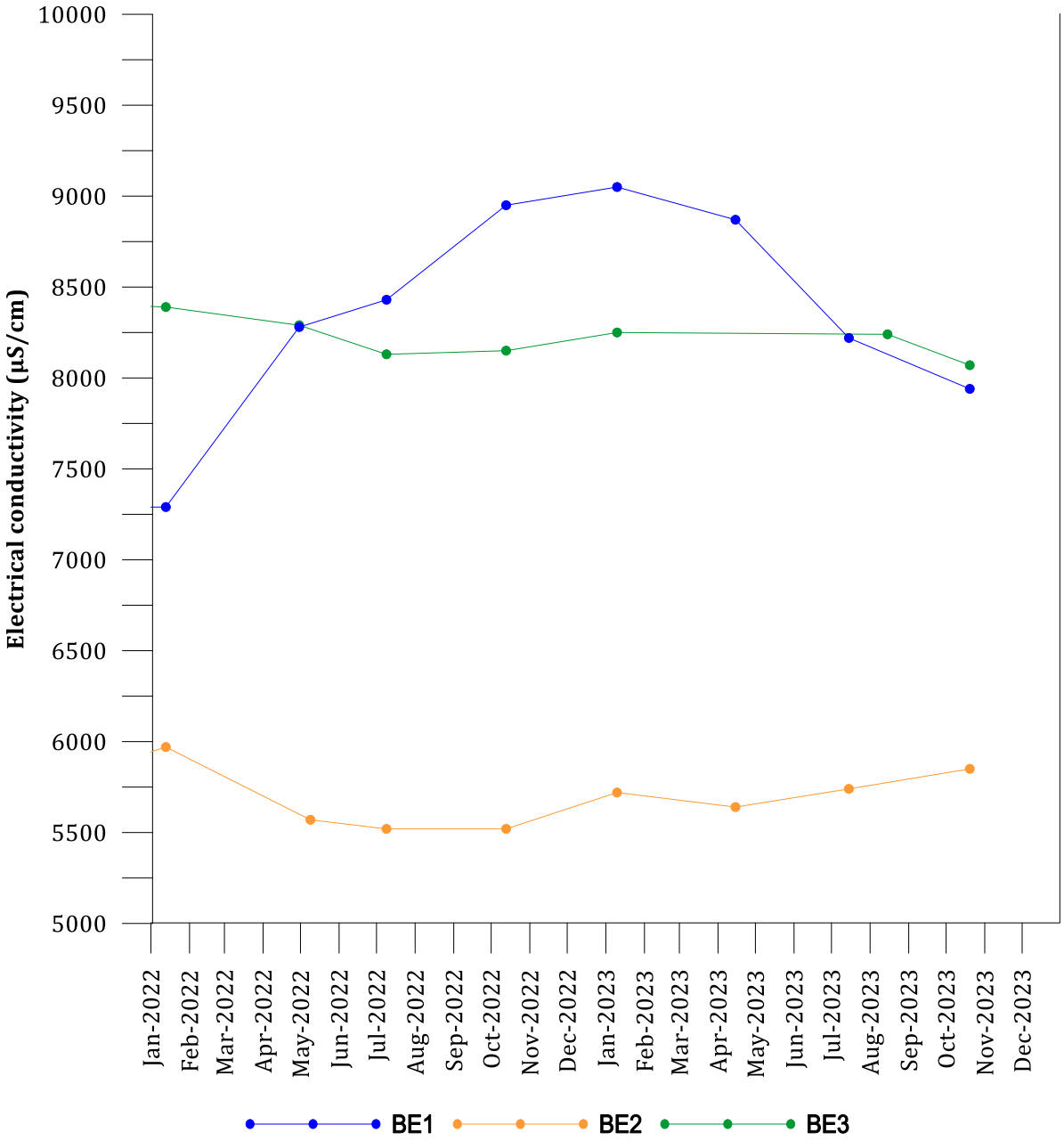

Figure 7.10 Electrical conductivity of Permian bores to the northwest of active mining

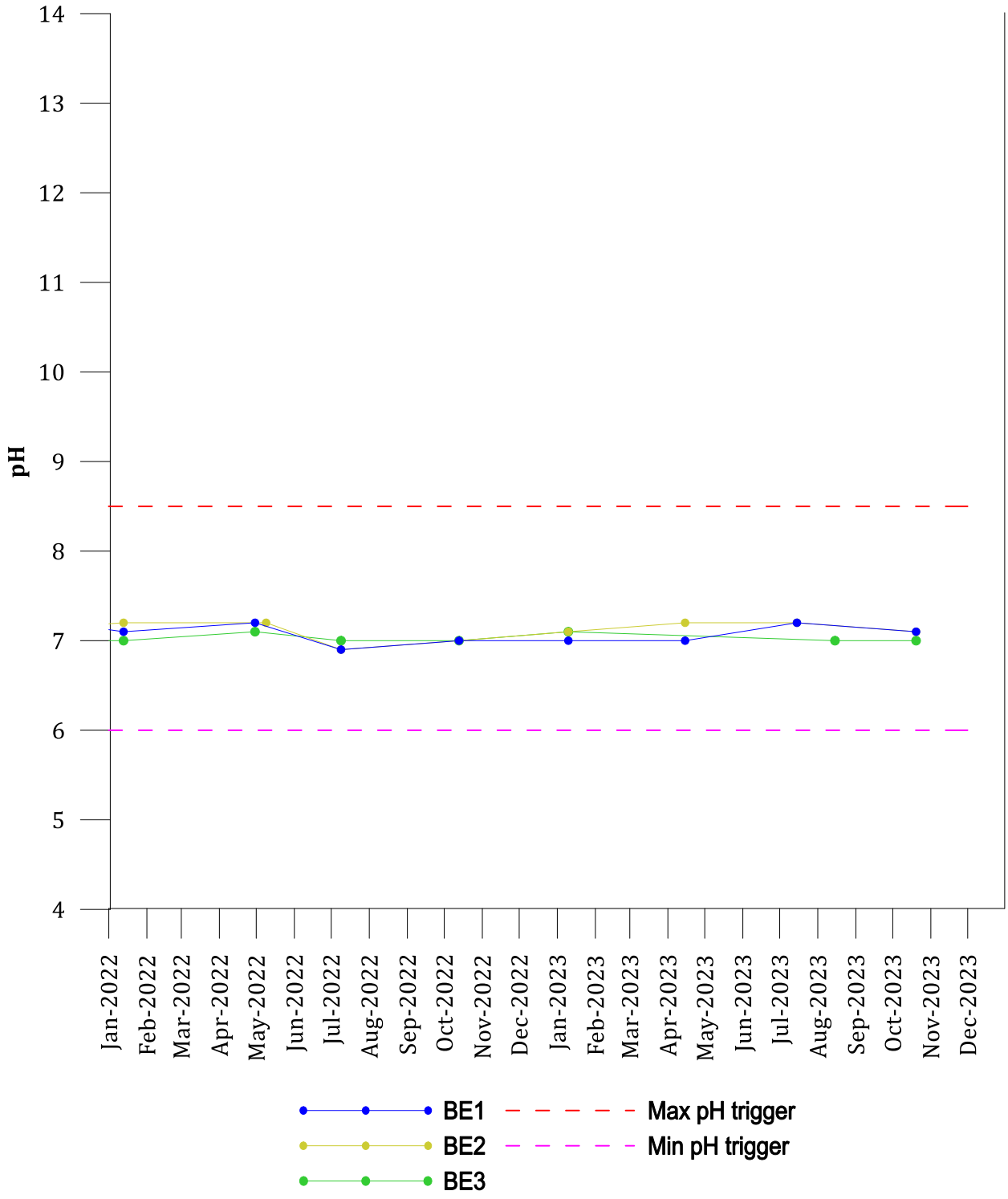

Figure 7.11 pH of Permian bores to the northwest of active mining

7.5 Water quality trigger events

Water quality monitoring data was compared to trigger values in the current WMP (Version 7, February 2019). Twelve sites had groundwater quality trigger events in 2023.

7.5.1 pH

With the exception of WAN8A, which recorded eight consecutive exceedances for pH in 2023, all groundwater monitoring bores in the network have recorded values within the assigned trigger range. Elevated pH values for WAN8A were investigated in 2017 and were found to be unrelated to mining (refer Section 7.2.1). Results from this reporting period indicate that the water in this bore is stagnant, and not representative of the target formation in which the bore is screened.

7.5.2 EC

A comparison of monitoring results to EC triggers revealed that twelve monitoring bores exceeded their respective EC triggers during the monitoring period (refer Table 5.1). Eleven of these exceedances trigger the response protocol as outlined in the WMP. The relevant monitoring data and trigger events are summarised in Table 7.1. Groundwater EC in WAN6A does not trigger the response protocol, as two consecutive Stage 1 exceedances are required.

Groundwater in Permian sandstone bore BE1 exceeded its derived trigger for EC throughout 2023, and is monitored on a quarterly basis. While historically the groundwater in this bore has been stable at or above the trigger threshold, a comparison of trends in 2023 to 2022 and prior suggest the EC has been increasing. EC values have begun to decrease from April 2023 onward. BE1 should be closely monitored for and further changes to EC at this site. As of December 2023, no risk of environmental harm has been identified.

Groundwater in alluvial monitoring bores BG5, SMB2N, WAN8A, WAN9A2 and WAN10A exceeded their derived triggers for EC throughout 2023. Groundwater in BG5 exceeded its derived trigger threshold during all quarterly monitoring events. Historically, groundwater EC in BG5 has remained below the Stage 1 trigger threshold however recent trends suggest that values have increased above the trigger from July 2022 to April 2023, decreasing afterward. EC values recorded in BG5 in 2023 remain within the historical range. Groundwater EC in both SMB2N and WAN8A recorded a single Stage 2 EC exceedance in January 2023. Following this exceedance, values have remained below their respective Stage 1 thresholds and remain within their historical ranges. EC values in WAN9A2 remained just above the Stage 2 trigger threshold from July 2023-onward but has remained stable and within historical ranges. Groundwater EC in WAN10A has intermittently exceeded Stage 1 and Stage 2 trigger thresholds throughout 2023 but remains within historical ranges. EC trends in alluvial bores BE1, BG5, SMB2N and WAN8A indicate a temporary rise in groundwater EC early in the year but recovered shortly afterward. These are most likely the result of evaporative effects resulting in an accumulation of salts in the surrounding formation, owing to a reduction in rainfall in the region. No risk of environmental harm has been identified.

Groundwater in Edderton Seam monitoring bores WAN1B and WAN2C have recorded a single reportable event each, with WAN1B recording two consecutive Stage 1 exceedances and WAN2C recording a single Stage 2 exceedance event. In both cases, the EC values considered an exceedance event were just above the derived trigger thresholds for WAN1B and WAN2C while remaining within historical ranges. As such, no risk of environmental harm has been identified.

Vaux Seam monitoring bores REP17, WAN2A and WAN10B recorded multiple EC exceedance events throughout the year. Groundwater EC in REP17 intermittently exceeded the Stage 1 and Stage 2 thresholds, however remained overall stable and within historical EC ranges. EC values in WAN2A, which screens both alluvium and the Vaux Seam, recorded an increase in groundwater EC at the beginning of the year at a similar time to the alluvial bores. Values have begun to decline to within the expected range towards the end of the year. WAN10B recorded two Stage 2 exceedances in July and November 2023, but has remained relatively stable throughout the year. No risk of environmental harm has been identified.

Table 7.1 Summary of EC trigger exceedances for 2023

Site	BE1	BG5	REPI7	SMB2N	WAN1B	WAN2A	WAN2C	WAN6A	WAN8A	WAN9A2	WAN10A	WAN10B
Lithology	**Permian Sandstone**	**Alluvium**	**Vaux Seam**	**Alluvium**	**Edderton Seam**	**Alluvium/ Vaux Seam**	**Edderton Seam**	**Alluvium**	**Alluvium**	**Alluvium**	**Alluvium**	**Vaux Seam**
Stage 1 EC Trigger - 95th Percentile (µS/cm)	7186	1330	4280	2439	1909	1389	3619	1055	-	936	1253	5068
Stage 2 EC Trigger - Maximum EC (µS/cm)	7190	1670	4310	2460	3790	1780	3840	1280	7720	937	1367	5090
Jan-23	9050	1420	4210	2560	1850	2040	2610	900	8130	880	1285	5030
Feb-23	-	-	4050	2070	1855	2350	1940	1137	-	867	1055	5030
Mar-23	-	-	4310	1740	1845	2020	1525	945	7230	889	1560	4960
Apr-23	8870	1548	4250	2190	1890	1905	2150	962	7230	886	1534	5070
May-23	-	-	4330	2140	1908	2550	2550	1038	7550	881	1305	5060
Jun-23	-	-	4130	1832	1834	1991	4200	980	7130	937	1390	4970
Jul-23	8220	1432	4170	1887	1852	2160	2910	912	-	1013	1039	5130
Aug-23	-	-	4070	1818	1887	2010	2490	1105	-	996	1363	4710
Sep-23	-	-	4200	1874	1854	1731	2120	896	7640	963	1397	5030
Oct-23	7940	1412	4360	1830	1916	1784	2600	961	7570	987	1044	4980
Nov-23	-	-	4380	1980	1934	1886	3630	990	6940	1057	1372	5100
Dec-23	-	-	4280	1757	1820	1646	3560	1033	-	944	1097	4780

Notes: - indicates no Stage 1 trigger is noted in the WMP.
underscore signifies that notification should be undertaken.

8 Comparison to ANZECC guidelines

Groundwater is used for livestock watering on properties in the region as well as for irrigation purposes. Guidelines exist for the protection of these environmental values and are outlined in the Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) guidelines.

Annual speciation results as required by the WMP have been compared to the ANZECC guidelines and are shown in Table 8.1. WAN8A was found to contain insufficient water to sample. Has previously been found to be blocked or damaged. Exceedances of guideline values in 2023 were recorded for iron, fluoride, TDS, and Sodium (Table 8.1).

Table 8.1 2023 ANZECC Exceedances

Site	Long term irrigation	Stock water	Stock water - pigs and poultry	Stock water - sheep and dairy cows	Long term irrigation
Analyte in exceedance	**Iron (mg/L)**	**Fluoride (mg/L)**	**TDS (mg/L)**	**TDS (mg/L)**	**Sodium (mg/L)**
Exceedance value	**0.20 mg/L**	**2.0 mg/L**	**3000 mg/L**	**4000 mg/L**	**115**
28510	<0.05	0.2	749	-	63
37774	<0.05	0.2	1120	-	220
42701	<0.05	0.2	739	-	57
42927	<0.05	0.2	747	-	64
46737	<0.05	0.9	-	4560	980
47277	<0.05	0.2	779	-	69
53007	<0.05	0.2	685	-	57
BE1	3.5	3.4	-	4770	1840
BE2	1.12	2.1	-	3720	1320
BE3	4.53	2.5	-	5090	1950
BG1	<0.05	0.2	474	-	56
BG3	<0.05	0.3	899	-	150
BG5	<0.05	0.2	881	-	89
REP17	1.71	0.8	2370	-	758
SMB1S	<0.05	0.3	913	-	147
SMB2N	0.24	0.3	1130	-	216
WAN1A	1.75	0.7	1,050	-	226
WAN1B	<0.05	0.6	1090	-	298
WAN2A	0.87	0.8	1,330	-	228
WAN2B	0.76	3.6	1360	-	608
WAN2C	1.26	2.9	1,770	-	652
WAN4A	<0.05	0.4	812	-	148
WAN4B	0.06	1.1	1,350	-	485
WAN5A	3.2	1.1	-	3440	1300
WAN6A	<0.05	0.2	571	-	52
WAN6B	0.1	1.1	683	-	205
WAN7A	<0.05	0.4	635	-	122

Site	Long term irrigation	Stock water	Stock water - pigs and poultry	Stock water - sheep and dairy cows	Long term irrigation
Analyte in exceedance	Iron (mg/L)	Fluoride (mg/L)	TDS (mg/L)	TDS (mg/L)	Sodium (mg/L)
Exceedance value	0.20 mg/L	2.0 mg/L	3000 mg/L	4000 mg/L	115
WAN7B	<0.05	1.7	1470	-	623
WAN8B	0.65	3.1	1,400	-	529
WAN9A	<0.05	0.2	581	-	75
WAN9B	0.25	4	661	-	273
WAN10A	<0.05	0.2	614	-	96
WAN10B	0.18	1	2840	-	926

9 Summary

9.1 Groundwater levels

A review of groundwater level trends indicates the following:

- Alluvium groundwater levels have decreased in comparison to recent years. Water level contours and flow directions are generally consistent with previous years.
- Compared to previous years, the height of the Hunter River has decreased due to lower-than-average rainfall during 2023.
- On a regional scale, groundwater in the alluvium flows south-west, generally parallel to the flow of the Hunter River. However, close to the Wantana Extension, alluvial groundwater flows towards the pit, likely due to the depressurisation of coal seams subcropping beneath the alluvium. This is consistent with the 2013 EIS (AGE, 2013a) that states "*The groundwater model predicts that mining associated with the Project will induce flow from the alluvium to the Permian. This is a reversal of the flow direction under pre-mining conditions*", and "*The model predicts mining will continue to depressurise and lower groundwater levels in the Permian sequence, but this will not result in drawdown extending a significant degree into the alluvial aquifer system, with model drawdown calculated to be less than 1 m*."
- A number of bores/sites could not be accessed on multiple occasions in 2023 due insufficient water in the bore (SMB1S, WAN8A and WAN9A).
- The coal seams and interburden in the Wantana Extension appear to have been depressurised because of mining, and there is potential in this area for leakage from the alluvium to the coal seams. A pressure head differential of up to 18 m (WAN4, WAN9 and WAN10) is evident between the alluvium and the coal seams. In 2023, as compared to 2022, this differential remained stable due to below average rainfall. This depressurisation is in line with the EIS groundwater model predictions that state "*The water level in the deep aquifer is expected to fall reducing the availability of water in this aquifer*". Bengalla's target coal seams are included in the "*deep aquifer*" layer of the groundwater model.
- WAN1B (Edderton seam), has shown mining induced depressurisation from mid-2010 to late-2011 and subsequent water level recovery. The water level appears to have recovered to above the pre-mining level. This demonstrates that water levels in depressurised coal seams can recover post-mining.
- WAN2C declined approximately 6 m between September 2005 and December 2006 but has remained relatively unchanged thereafter. The bore was blocked with an obstruction in September 2016, which was cleared in October 2019, and has since recorded groundwater levels of approximately 100 mAHD.
- A steep hydraulic gradient exists nearby to WAN8A and BG1. It appears likely that water is flowing from the edge of the alluvium, which is recharged via the regulated Hunter River, into the depressurised Wynn Seam in this location.
- Regional alluvium bore, BG3, did not trigger the Trigger Event Response Protocol in 2023, following historically low water levels.
- Bores to the northwest of the active mining area (i.e. future mining area) showed very little change in groundwater level across the monitoring period. Groundwater elevation in 46737 is no longer increasing following a sharp incline from August 2022 to October 2022 and has remained stable throughout 2023 at levels prior to this incline. This is in line with the EIS groundwater model predictions. The eventual removal of those seams and overburden will completely depressurise the whole profile at that location and an area outside of the highwall location.
- The Edderton Seam at VWP installations BE1, BE2 and BE3 shows signs of seam depressurisation. Pressure head in BE1 declined from January 2023-onward as predicted. The sensor in BE5 targeting the Edderton Seam ceased functioning in 2021 and is considered to have failed.
- The Mt Arthur Seam at VWP installations BE1, BE2, BE3 and BE5 also shows signs of seam depressurisation. Pressure heads in BE1 remained stable or slightly decreased in 2023. It is expected pressure head at these locations will continue to decline as the pit progresses westward.

9.2 Groundwater quality

A review of pH monitoring data indicates the following:

- All monitoring bores recorded groundwater pH values within triggers and share similar pH trends, with the exception of WAN8A.
- WAN8A has historically presented elevated pH measurements and exceeded the trigger value in August 2017. During the eight out of twelve months of 2023, pH values in WAN8A were consistently high (around 12.7). For the remaining four months WAN8A did not contain sufficient water for sampling. WAN8A likely contains stagnant water and the elevated pH in this bore should not be considered representative of the screened formation.

A review of EC monitoring data indicates the following:

- EC values in alluvium monitoring bores are less than 1,500 µS/cm, except for SMB1, SMB2 and WAN9A2. This is likely to be a natural phenomenon associated with proximity to coal seam subcrop and their influence on the water quality locally.
- WAN4A EC values remained stable during 2023, recording a measurement of 1,271 µS/cm in December 2023. The bore is likely impacted by underlying coal seam depressurisation due to mining. The decrease in pressure has allowed local infiltration of less saline river water into the alluvium, causing a decrease in EC. The water level in this bore does not appear to be impacted. The water quality appears to be returning to a level in line with the pre-2008 water quality in this bore. The EC values in this bore should continue to be monitored.
- The EC values for WAN8A have historically ranged between 1,282 µS/cm (Nov 2007) and 8,870 µS/cm (May 2010). A single exceedance was recorded in 2023 for this bore. This bore is suspected to contain stagnant water contained in a sump below the screened interval. Variable EC is likely due to this bore's location on the alluvial fringe.
- Monitoring bore WAN2C recorded a Stage 2 EC exceedance in June 2023 and a Stage 1 EC exceedance in November 2023. EC values have otherwise remained below the derived trigger threshold during 2023.
- SMB1-South and SMB2-North present EC values that have generally remained consistent throughout 2023 and recent years. It is unlikely that these bores have been impacted by mining.
- BG3 displayed an increase in EC during 2023, with average EC values increasing from 1,017 µS/cm in 2022 to 1,826 µS/cm in 2023. BG3 EC values sharply increased at the beginning of 2023, then decreased in the middle of the year. This bore is situated to the south of Bengalla (and north of Mt Arthur where the same geological profile is mined), along strike from actively mined coal seams which are known to be depressurising. The surge in EC in BG3 was most likely brought on by localised infiltration of mobilised salts in the unsaturated zone above the alluvium because of increased alluvial groundwater levels in 2022. Groundwater EC in BG3 is already showing signs of recovery towards the end of 2023.
- EC data within the coal measures and interburden is generally between 2,500 µS/cm and 9,000 µS/cm, which is the expected EC for coal measures and interburden.
- Four bores in the coal seams (WAN1A, WAN1B, WAN6B, and REP17) show EC less than 2,000 µS/cm, suggesting leakage from the alluvium due to depressurisation of the coal seams. WAN9B has historically recorded EC at or above 2,000 µS/cm. EC values in WAN9B remained stable throughout 2023, with the latest recorded measurement in December being 1,332 µS/cm. It should be noted that WAN1A and WAN2A are screened nearby the contact of a coal seam and alluvial material and are not considered to be screened wholly within coal. This freshening of the alluvium, coal measures and interburden was predicted in the EIS groundwater model, which states "*Water quality in the alluvial sediments will improve as a result of decreased discharge of water from hardrock aquifers to the alluvial aquifer due to aquifer depressurisation*."
- WAN10B has historically presented elevated EC values between 3,790 µS/cm and 5,440 µS/cm, and generally above the Stage 2 EC trigger. The EC trigger events in 2018 (to month ending October 2018) were investigated as per the Trigger Event Response Protocol. The investigation found that changes in rainfall/recharge are likely to be the main influencing factor in these trigger events (AGE, 2018). Groundwater EC in WAN10B exceeded the Stage 2 trigger threshold during June and November 2023, but remained below the Stage 1 trigger for all remaining months of the year, despite below average rainfall and decreasing CRD. Further investigation is required to determine the cause of EC exceedances in WAN10B. Trigger values for WAN10B and other bores were scheduled to be reviewed in 2023.

- Monitoring bore REP17, screening the Vaux Seam, recorded EC trigger exceedances March, May, and October to December 2023. EC values in 2023 remained consistent with values from the previous year, which are generally recorded at or above the Stage 2 EC trigger. The water quality in this bore should continue to be monitored to establish the cause of increasing EC.
- Groundwater quality within the bores to the northwest of the active mining area (BE1, BE2 and BE3 - future mining area) showed little change in pH (7.0 – 7.6) and moderate change in EC (range: 5,500 µS/cm – 9,000 µS/cm) over the reporting period. Groundwater EC in BE1 was consistently above the Stage 2 trigger threshold in 2023. Comparison of trends in 2019 to 2023 suggest the EC values have been increasing and have only now just begun to return to pre-2021 levels at the beginning of 2023. The water quality in this bore should continue to be monitored for any major, steady EC increases in the future and determine the cause.
- When speciation results are compared to the ANZECC guidelines, multiple locations exceed the ANZECC guidelines for iron (long term irrigation), fluoride (stock water), TDS (stock water), and sodium (long term irrigation).

10 Recommendations

Recommendations based on the information provided in this (and previous) annual reports include:

- Continue to monitor water levels in bores where access allows. The water levels should be investigated if the respective water levels drop below the trigger criteria.
- Continue to monitor the water levels and water quality in bores WAN8A and WAN8B, with an awareness that very low water levels (< 0.5 m water column) are likely not representative of the aquifer.
- Update the WMP to include nested monitoring bores installed in December 2021 (211GW001 and 211GW002). Groundwater quality analysis should align with sampling undertaken throughout the remainder of the Bengalla groundwater monitoring network (refer Section 7.1).
- Continue to monitor groundwater level at WAN3 to determine if the December 2021 measurement was erroneous.
- At present the spatial coverage of monitoring installations to the west of the pit is limited
  - install new VWP array further to the west to replace the decommissioned BE3 and BE4 monitoring installations.
  - install new VWP array to replace BE5 following the failure of the Edderton seam sensor.

11 References

Australasian Groundwater and Environmental Consultants Pty Ltd (2013a), “Continuation of Bengalla Mine Groundwater Impact Assessment”, prepared for Hansen Bailey Pty Ltd, June 2013 (G1505).

Australasian Groundwater and Environmental Consultants Pty Ltd (2013b), “Continuation of Bengalla Mine Groundwater Impact Assessment – Appendix K Groundwater Impact Assessment”, June 2013.

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Australasian Groundwater and Environmental Consultants Pty Ltd (2021), “Bengalla Mine Annual Groundwater Report”, March 2021 (G1543Y).

Australasian Groundwater and Environmental Consultants Pty Ltd (2021), “Bengalla Exceedance Review WAN10B”, Draft report, October 2021 (BEN5003.001).

BMC (2019), “Bengalla Mine. Water Management Plan. Revision 4” Bengalla Mining Company. February 2019.

Appendix A

Monitoring bore summary data

Bore ID	Easting MGA94 z56	Northing MGA94 z56	Ground level (mAHD)	Top of casing (mAHD)	Stick- up (m)	Screen Interval/Sensor Depth (mbGL)	Total depth (mBGL)	Bore base elevation (mAHD)	Geology/ Target Seam	Standard WQ/SWL	Installa-tion date	Full suite WQ	Data since	Baseline water level (mAHD)	Baseline measurement date	Max predicted drawdown (mAHD)	Maximum predicted drawdown (m)	WMP bore	Trigger levels (mAHD)	2023 GWL (mAHD)	Measured date	Difference baseline vs. 2023 GWL (m)	Max drawdown vs. 2023 GWL (m) [Available drawdown]	Trigger vs. 2023 GWL (m)
11953 [a]	298192	6428693	147	147.97	0.97	-	-	-	Deep Permian	Quarterly	Jan-97	Annually	Oct-03	136.46	1-Feb-00	129.33	7.13	Yes	129.3	-	-	-	-	-
18298 [b]	294375	6423521	132.86	133.47	0.61	-	-	-	Alluvium	Quarterly	Jan-97	Annually	Sep-09	123.53	1-Feb-11	123.19	0.34	Yes	123.2	123.5	Jul-23	-0.03	0.31	0.30
19116 [b]	296078	6425589	135.6	136.43	0.82	-	-	-	Alluvium	Quarterly	Jan-97	Annually	Oct-03	127.46	1-May-97	123.24	4.22	Yes	123.2	127.1	Jul-23	-0.36	3.86	3.90
28510 [b]	298649	6429105	142.7	144	1.3	-	-	-	Deep Permian	Quarterly	Jan-97	Annually	Aug-09	132.22	1-Feb-00	128.97	3.25	Yes	129	133.3	Jul-23	1.08	4.33	4.30
37774 [b]	298488	6428998	145.6	146	0.4	-	-	-	Deep Permian	Quarterly	Jan-97	Annually	Aug-09	134.14	1-Feb-00	128.74	5.4	Yes	128.7	135.1	Jul-23	0.96	6.36	6.40
42701 [b]	298586	6428632	144	144.91	0.97	-	-	-	Deep Permian	Quarterly	Jan-97	Annually	Oct-03	133.18	1-Feb-00	131.26	1.92	Yes	131.3	134.3	Jul-23	1.12	3.04	3.00
42927 [b]	298843	6428570	144.26	145.36	1.1	-	-	-	Alluvium	Quarterly	Jan-97	Annually	Oct-03	132.29	1-Feb-00	131.11	1.18	Yes	131.1	133.7	Jul-23	1.41	2.59	2.60
46737 [b]	291862	6427143	227.69	227.9	0.21	-	-	-	Shallow Permian	Quarterly	Jan-97	Annually	Sep-09	186.05	1-Feb-01	185.31	0.74	Yes	185.3	192.2	Jul-23	6.15	6.89	6.90
47277 [b c]	299145	6428643	143.54	144.59	1.06	-	-	-	Alluvium	Quarterly	Jan-97	Annually	Aug-09	133.65	1-Aug-02	132.81	0.84	Yes	132.8	134.4	Jul-23	0.75	1.59	1.60
53007 [b]	298720	6428857	143.97	144.01	0.04	-	-	-	Deep Permian	Quarterly	Jan-97	Annually	Aug-09	133.67	1-Feb-01	131.91	1.76	Yes	131.9	134.4	Jul-23	0.73	2.49	2.50
64092 b	297762	6428813	151.27	151.35	0.09	-	-	-	Shallow Permian	Quarterly	Jan-97	Annually	Oct-03	143.98	1-Feb-99	124.96	19.02	Yes	125	-	-	-	-	-
A10 b	295445	6428834	199.33	199.33	0	-	-	-	Shallow Permian	Quarterly	Jan-97	Annually	Oct-03	184.45	1-Feb-99	151.94	32.51	No	-	-	-	-	-	-
BE1 (bore)	293469	6429033	241.48	242.67	1.19	69-75	75	166.48	Permian Sandstone	Quarterly	Jun-12	Annually	Jun-12	172.04	1-Sep-12	156.83	15.21	Yes	156.8	173.3	Jul-23	1.26	16.47	16.50
BE2 (bore)	293374	6425866	204.22	205.38	1.16	45-48	48	156.22	Permian Sandstone	Quarterly	Jun-12	Annually	Jun-12	167.67	1-Sep-12	18.81	148.86	Yes	18.8	161.4	Jul-23	-6.27	142.59	142.60
BE3 (bore)	292977	6427587	175.21	176.39	1.18	48-54	54	121.21	Permian Sandstone	Quarterly	Jun-12	Annually	Jun-12	145.69	1-Sep-12	113.18	32.51	Yes	113.2	136.3	Aug-23	-9.39	23.12	23.10
BG1 [b]	296656	6426003	138.2	138.78	0.58	-	-	-	Alluvium	Quarterly SWL 8hr logger	Jan-97	Annually	Oct-03	128.24	1-Nov-00	126.84	1.4	Yes	126.8	128.6	Jul-23	0.36	1.76	1.80
BG3 [b]	294731	6424413	133.6	133.76	0.16	-	-	-	Alluvium	Quarterly SWL 8hr logger	Jan-97	Annually	Oct-03	126.48	1-Feb-99	126.25	0.23	Yes	126.3	126.4	Jul-23	-0.08	0.15	0.10
BG45 [b]	291570	6424648	166.04	166.36	0.32	-	-	-	Shallow Permian	Quarterly SWL 8hr logger	Jan-97	Annually	Sep-09	152.74	1-May-01	149.92	2.82	No	-	-	-	-	-	-
BG5 [b]	298609	6427874	142.2	142.51	0.31	-	-	-	Alluvium	Quarterly	Jan-97	Annually	Oct-03	133.35	1-Feb-99	132.4	0.95	Yes	-	133.2	Jul-23	-0.15	0.8	-
E12 [b]	294808	6427576	197.06	197.17	0.11	-	-	-	Shallow Permian	Quarterly	Jan-97	Annually	Oct-03	157.4	1-Feb-99	-6.57	163.97	Yes	-	-	-	-	-	-
REPI7	295575	6425832	135.47	136.38	0.91	49-52	52	83.47	Vaux Seam	Quarterly	Jan-97	Annually	Jan-97	102.09	1-Jun-10	63.07	39.02	Yes	63.1	90.8	Jul-23	-11.29	27.73	27.70
SMB1	296955	6426391	141.2	142.47	1.27	13-19	19	122.2	Alluvium	Monthly	Jun-10	Biannually	Aug-10	128.66	1-Aug-11	127.17	1.49	Yes	127.2	128.3	Jul-23	-0.36	1.13	1.10
SMB2	297124	6426549	141.69	142.61	0.92	15-21	21	120.69	Alluvium	Monthly	Jun-10	Biannually	Aug-10	128.83	1-Aug-11	127.28	1.55	Yes	117.5	129.4	Jul-23	0.57	2.12	11.9
WAN10A	295828	6425571	135.07	136.13	1.06	8-13	13.83	121.24	Alluvium	Monthly	May-09	Biannually	Apr-09	126.74	1-May-09	122.16	4.58	Yes	122.2	127.2	Jul-23	0.46	5.04	5.00
WAN10B	295825	6425578	135.04	136.1	1.06	44-47	47	88.04	Vaux Seam	Monthly	May-09	Biannually	Apr-09	119.2	1-May-09	98.32	20.88	Yes	98.3	109.5	Jul-23	-9.70	11.18	11.20
WAN1A	296519	6426099	140.6	141.35	0.75	16-20	20	120.6	Alluvium/ Wynn seam	Monthly	Sep-05	Annually	Aug-09	121.72	1-Sep-05	117.53	4.19	Yes	117.5	125.2	Jul-23	3.48	7.67	7.70
WAN1B	296519	6426099	140.6	141.35	0.75	29-33	33	107.6	Edderton Seam	Monthly	Sep-05	Annually	Aug-09	115.87	1-Sep-05	100.09	15.78	Yes	100.1	121.6	Jul-23	5.73	21.51	21.50

Bore ID	Easting MGA94 z56	Northing MGA94 z56	Ground level (mAHD)	Top of casing (mAHD)	Stick- up (m)	Screen Interval/Sensor Depth (mbGL)	Total depth (mBGL)	Bore base elevation (mAHD)	Geology/ Target Seam	Standard WQ/SWL	Installation date	Full suite WQ	Data since	Baseline water level (mAHD)	Baseline measurement date	Max predicted drawdown (mAHD)	Maximum predicted drawdown (m)	WMP bore	Trigger levels (mAHD)	2023 GWL (mAHD)	Measured date	Difference baseline vs. 2023 GWL (m)	Max drawdown vs. 2023 GWL (m) [Available drawdown]	Trigger vs. 2023 GWL (m)
WAN2A	296217	6425824	137.7	138.4	0.7	13-16	16	121.7	Alluvium/Vaux seam	Monthly	Sep-05	Annually	Aug-09	125.23	1-Feb-07	118.47	6.76	Yes	118.5	126.0	Jul-23	0.77	7.53	7.50
WAN2B	296217	6425824	137.7	138.44	0.74	36-39	39	98.7	Wynn Seam	Monthly	Sep-05	Annually	Aug-09	111.8	1-Feb-07	86.38	25.42	Yes	86.4	105.6	Jul-23	-6.20	19.22	19.20
WAN2C	296217	6425824	137.7	138.43	0.73	51-54	55	83.7	Edderton Seam	Monthly	Sep-05	Annually	Aug-09	100.44	1-Feb-07	75.02	25.42	Yes	75	100.1	Jul-23	-0.34	25.08	25.10
WAN3 [d]	295772	6425713	136.4	136.7	0.3	2.5-87	87	49.4	Deep Permian	Monthly	Sep-05	Annually	Aug-09	126.64	1-Sep-05	100.32	26.32	Yes	100.3	101.7	Jul-23	-24.94	1.38	1.40
WAN4A	295442	6425690	135.1	135.93	0.83	11.5-14.5	14.5	120.6	Alluvium	Monthly	Sep-05	Annually	Aug-09	126.64	1-Sep-05	121.16	5.48	Yes	121.2	126.8	Jul-23	0.16	5.64	5.60
WAN4B	295442	6425690	135.1	135.89	0.79	21-24	24	111.1	Deep Permian	Monthly	Sep-05	Annually	Aug-09	124.51	1-Sep-05	98.19	26.32	Yes	98.2	115.3	Jul-23	-9.21	17.11	17.10
WAN5A	296019	6425360	135.9	136.74	0.84	10.5-13.5	15.57	121.17	Alluvium	Monthly	Sep-05	Annually	Aug-09	126.74	1-Sep-05	124.31	2.43	Yes	124.3	126.8	Jul-23	0.06	2.49	2.50
WAN5B [e]	296019	6425360	135.9	136.78	0.88	26-29	28.98	107.8	Deep Permian	Monthly	Sep-05	Annually	Aug-09	126.74	1-Sep-05	116.03	10.71	Yes	116	127.0	Jul-23	0.26	10.97	11.00
WAN6A	296553	6425634	136.9	137.67	0.77	7.5-10.5	10.5	126.4	Alluvium	Monthly	Sep-05	Annually	Aug-09	128	1-Aug-07	126.9	1.1	Yes	126.9	128.0	Jul-23	0.00	1.10	1.10
WAN6B	296553	6425634	136.9	137.66	0.76	30-33	33	103.9	Edderton Seam	Monthly	Sep-05	Annually	Aug-09	127.92	1-Aug-07	123.82	4.1	Yes	123.8	127.6	Jul-23	-0.32	3.78	3.80
WAN7A	296856	6426254	138.1	138.86	0.76	12.0-15.0	15	123.1	Alluvium	Monthly	Sep-05	Annually	Aug-09	126.8	1-Feb-09	125.4	1.4	Yes	125.4	126.9	Jul-23	0.10	1.50	1.50
WAN7B	296856	6426254	138.1	138.89	0.79	80-83	83	55.1	Edinglassie Seam	Monthly	Sep-05	Annually	Aug-09	128.7	1-Feb-08	126.41	2.29	Yes	126.4	129.7	Jul-23	1.00	3.29	3.30
WAN8A	296457	6425854	136.41	137.47	1.07	10.7-11.9	12.94	124.53	Alluvium	Monthly	May-09	One off sample	Apr-09	125.64	1-Sep-09	123.29	2.35	Yes	123.3	125.8	Jul-23	0.16	2.51	2.50
WAN8B	296450	6425855	136.33	137.42	1.09	15-18.6	19.6	117.82	Wynn Seam	Monthly	May-09	One off sample	Apr-09	118.03	1-Oct-09	108.51	9.52	Yes	108.5	118.0	Jul-23	-0.03	9.49	9.50
WAN9A2	296326	6425582	136.88	137.98	1.1	8.5-10.5	10.5	126.38	Alluvium	Monthly	May-09	One off sample	Apr-09	126.25	1-Sep-09	123.68	2.57	Yes	123.7	127.5	Jul-23	1.25	3.82	3.80
WAN9B	296328	6425576	136.93	137.88	0.95	21-24	24	112.93	Wynn Seam	Monthly	May-09	Biannually	Apr-09	119.44	1-Sep-09	111.39	8.05	Yes	111.4	115.3	Jul-23	-4.14	3.91	3.90
BE1 (VWP)	293475	6429036	241.48	-	-	120	120	121.48	Warkworth /Mt Arthur	Quarterly	Oct-11	NA	2011	-	-	-	-	-	-	127.4	Jul-23	-	-	-
BE1 (VWP)	293475	6429036	241.48	-	-	264.5	264.5	-23.02	Edderton Seam	Quarterly	Nov-11	NA	2011	-	-	-	-	-	-	144.0	Jul-23	-	-	-
BE2 (VWP)	293374	6425866	204.22	-	-	97.8	97.8	106.42	Warkworth /Mt Arthur	Quarterly	Dec-11	NA	2011	-	-	-	-	-	-	96.9	Jul-23	-	-	-
BE2 (VWP)	293374	6425866	204.22	-	-	212.5	212.5	-8.28	Edderton Seam	Quarterly	Jan-12	NA	2011	-	-	-	-	-	-	129.4	Jul-23	-	-	-
BE3 (VWP)	292977	6427587	175.21	-	-	80.6	80.6	94.61	Warkworth /Mt Arthur	Quarterly	Feb-12	NA	2011	-	-	-	-	-	-	130.4	Jul-23	-	-	-
BE3 (VWP)	292977	6427587	175.21	-	-	154.6	154.6	20.61	Edderton Seam	Quarterly	Mar-12	NA	2011	-	-	-	-	-	-	124.9	Jul-23	-	-	-
BE4 (VWP)	294313	6428784	191.4	-	-	82	228.2	-36.8	Mt Arthur	Quarterly	Mar-17	NA	2017	-	-	-	-	-	-	-	-	-	-	-
BE4 (VWP)	294313	6428784	191.4	-	-	213	228.2	-36.8	Edderton Seam	Quarterly	Mar-17	NA	2017	-	-	-	-	-	-	-	-	-	-	-
BE5 (VWP)	293696	6427245	181.3	-	-	74	210.15	-28.85	Mt Arthur	Quarterly	Apr-17	NA	2017	-	-	-	-	-	-	-	-	-	-	-
BE5 (VWP)	293696	6427245	181.3	-	-	197.5	210.15	-28.85	Edderton Seam	Quarterly	Apr-17	NA	2017	-	-	-	-	-	-	-	-	-	-	-
GW01A	298190	6428409	TBC	TBC	TBC	9-12	12	TBC	Alluvium	Monthly	Dec-18	Annually	2019	-	-	-	-	No	-	-	-	-	-	-
GW01B	298190	6428409	TBC	TBC	TBC	24-27	27	TBC	Shallow Permian	Monthly	Dec-18	Annually	2019	-	-	-	-	No	-	-	-	-	-	-

Bore ID	Easting MGA94 z56	Northing MGA94 z56	Ground level (mAHD)	Top of casing (mAHD)	Stick- up (m)	Screen Interval/Sensor Depth (mbGL)	Total depth (mBGL)	Bore base elevation (mAHD)	Geology/ Target Seam	Standard WQ/SWL	Installa-tion date	Full suite WQ	Data since	Baseline water level (mAHD)	Baseline measurement date	Max predicted drawdown (mAHD)	Maximum predicted drawdown (m)	WMP bore	Trigger levels (mAHD)	2023 GWL (mAHD)	Measured date	Difference baseline vs. 2023 GWL (m)	Max drawdown vs. 2023 GWL (m) [Available drawdown]	Trigger vs. 2023 GWL (m)
WAN11A	296649	6424875	135.4	136.44	1.05	9-12	123.4	12	Alluvium	Monthly	Jan-19	Annually	Feb-19	-	-	-	-	No	-	-	-	-	-	-
WAN11B	296645	6424876	135.5	136.45	0.95	24-27	108.5	27	Shallow Permian	Monthly	Jan-19	Annually	Feb-19	-	-	-	-	No	-	-	-	-	-	-
WAN12	295491	6424725	135.3	136.06	0.76	11-14	121.3	14	Alluvium	Monthly	Feb-19	Annually	Feb-19	-	-	-	-	No	-	-	-	-	-	-
211GW001 [d]	294301	6424930	139.2	140.07	0.87	49.4-55.4	55.4	83.8	Permian	TBC	Nov-21	-	-	-	-	-	-	No	-	-	-	-	-	-
211GW002 [d]	294294	6424927	139.2	140.1	0.9	15.8-21.8	20.8	118.4	Alluvium	TBC	Nov-21	-	-	-	-	-	-	No	-	-	-	-	-	-

Notes: [a] no access or mined through for 2022 monitoring.

[b] recommended camera survey on bores to determine screened interval and bore depth.

[c] survey data to be added to WMP.

[d] not included in groundwater management plan to date.

Appendix H

Rehabilitation Monitoring Findings

Rehabilitation Monitoring and Audit 2023

Bengalla Mine

Rehabilitation Monitoring and Audit 2023 – Bengalla Mine

Prepared for

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Table of Content

List of Figures

List of Tables

List of Graphs

Executive Summary

This report presents the findings of the 2023 rehabilitation monitoring program conducted at Bengalla Mine by Moss Environmental on behalf of Bengalla Mining Operations Pty Ltd.

Large-scale remediation, rehabilitation and revegetation works were completed in 2023 at Bengalla to establish high density woody vegetation (**HDWV**) across the eastern overburden emplacement area (**OEA**) following the approved rehabilitation reforms. Works are driven by the Rehabilitation Management Plan (**RMP**) and the Forward Work Plan (**FWP**) developed by BMC. Works under the FWP continued in 2023 with 11.3ha to HDWV via direct seeding, 8.7ha of Pasture rehabilitation and 59ha of the planting of around 64,000 HDWV tubestock into areas previously rehabilitated.

The 2023 monitoring campaign focussed on all rehabilitation completed under the RMP by the time of monitoring, as well as historic rehabilitation areas of the OEA where the long-term monitoring program was continued (and including pasture and HDWV rehabilitation). Monitoring approaches and methods strictly adhered to those defined in the RMP and included a combination of scientific transect-based data collection (a total of 43 transects were monitored) and a rehabilitation walkover audit. The intent of the audit is to complement the transect-based monitoring by collecting opportunistic observations of rehabilitation performance at the larger scale, particularly focussing on key deficiencies and issues impacting the rehabilitation that may require management inputs.

Field surveys were completed over a one-week period in January 2024, used to represent the 2023 monitoring period, and followed approximately one year of below average rainfall. The preceding three years (2020-2022) exhibited good growing conditions in the locality with above average rainfall (which in turn followed three years of severe state drought between 2016-2019).

Two areas of pasture rehabilitation were assessed for the 2023 monitoring round, Class III and a newly seeded' Unclassified Pasture Rehabilitation' area (PR4). PR4 will be classified in future years as either Class IV or V. For the purposes of this monitoring year PR4 rehabilitation objectives and assessment against completion criteria will align with Appendix B of the RMP only where feasible due to the area being in the very early stages of establishment.

The Class III pasture rehabilitation continued to display a satisfactory performance in 2023, with high vegetative cover dominated by productive and palatable tropical pasture grasses, high biomass and feed quality. Pasture composition recorded at P3 (Class III) in 2023 small changes from 2022 with a. a total of nine species being recorded. These consisted of two desirable pasture species (two grasses), three non-invasive exotic forbs and two priority weeds. Pasture composition in PR4 in 2023 recorded a total of 11 species including four desirable pasture species and seven exotic species. It should be noted that PR4 was sown in 2023.

Across all areas of HDWV rehabilitation, consistent with previous years, soil and slope stability were excellent at most monitoring sites with limited active erosion processes recorded. A few instances of moderately severe rill, tunnel, gully, and sheet erosion were recorded and are likely to require ongoing management.

Protective ground cover dropped in 2023 likely a result of less favourable climatic conditions in the latter half of 2023 and the delayed time in which the monitoring took place. Protective cover remained above the 70% minimum cover benchmark at all but one historic rehabilitation area where HDWV03 fell just below benchmark.

The Floristics species richness results indicate that native species in the establishing vegetation communities across the rehabilitation zones have increased in proportion to exotics in 2023, however, this is not via an increase in native diversity. In contrast to 2022, the drier conditions have resulted in a disproportionate reduction in exotic ground covers recorded which may indicate a resilience to the variation in weather conditions by native species. Nevertheless, ground cover species continue to be dominated by introduced/exotic species.

Areas of historic HDWV rehabilitation are well established and have shown minimal change in condition in the past couple of years (i.e. since the end of the drought). Consistent with previous years and the well-

established nature of the rehabilitation across historic areas, shrubs and trees diversity remained constant at all historic monitoring sites in 2023. Tree stems densities have shown minimal change from 2022 results, which as noted in last year's report is largely due to the well-established nature of the historic rehabilitation sites. Consistent with 2022, annual variations were largely due to the dieback and/or recruitment in acacia trees which were undoubtedly influenced by inherent variability in observer's interpretation when recording tree stems in the field. Tree densities in these areas (a key objective and requirement of the HDWV final land use) remain below acceptable targets. Particularly, the density of canopy eucalypts remained unsatisfactory and will need to be increased through supplementary infill tree plantings. It should however be noted that over the past 4 years, HDWV trees has been progressively established and this density will improve significantly as these trees grow and mature.

Establishment success continues to be inconsistent across the new rehabilitation areas with variances between sites and rehabilitation methods being extremely wide ranging.

Overall and irrespective of their 2023 performance in terms of species composition and tree densities and taking into account the recruitment capability shown in wetter years, it is considered that there is adequate potential for the established communities to be self-sustainable.

Recent HDWV rehabilitation (established since 2020 under the RMP) was highly variable in condition, influenced by the different revegetation techniques and approaches implemented:

- Areas dressed with topsoil and direct seeded showed high protective ground cover levels, high weed cover levels and vastly variable but satisfactory tree stem densities (i.e. limited germination strike rates).
- Areas direct-seeded in a subsoil substrate showed moderate to poor ground cover establishment, moderately low weed cover levels and very low tree stem densities (indicating poor germination strike rates and potential deficiencies in the growth medium) with the exception of HDWV18 which made a remarkable recovery from the 2022 drop largely due to a flush in Hopbush germination.
- Areas seeded directly into overburden showed moderate to poor ground cover establishment, low weed cover levels and variable tree stem densities, reducing from 2022 counts.
- Areas planted with tubestock into in situ topsoil showed very high protective ground cover, high weed cover levels and variable but on average satisfactory tree stem densities.

Total species richness recorded in 2023 at the monitoring sites was highly variable. Even if the recently created HDWV43 and HDWV44 sites were not considered in the analysis, species richness was down in the 2023 reporting period. This indicates that floristic composition across the rehabilitation zones has experienced some seasonal fluctuation (predominantly in the ground cover stratum) likely reflecting the change in weather conditions in the latter half of 2023. In addition to seasonal fluctuation, the variable germination rate among the RMP compositional mix of species used for direct seeding is influencing the species richness results across the site. It is expected that overall species richness will continue to increase over time as germination potential is realised over the coming reporting periods. The 2023 results continue to show woody species assemblage performance was generally better in areas of new rehabilitation.

The lower percentage of species characteristic of the CHGBIW or CHSGIGBF communities in 2023 can be explained by an increase in natural regeneration of native species that are not characteristic of the target communities, rather than a reduction in species that are. No additional exotic species were recorded in 2023 and so exotics had little effect on the change in the 2023 results. It is expected that germination of seed and supplementary plantings will increase the percentage of characteristic species going forward.

Shrub and tree species diversity continue to be, on average, higher in areas planted with tubestock than in all seeded areas (irrespective of the substrate); indicating variable and inconsistent strike rates and germination success where seeding was undertaken.

The 2023 results continue to show woody species assemblage performance was generally better in areas of new rehabilitation.

Tree establishment success continues to be inconsistent across the new rehabilitation areas with variances between sites and rehabilitation methods being extremely wide ranging.

In total, only 13 of the 31 monitoring sites met the defined tree density benchmark which is an improvement on the previous year's results.

Of note, HDWV18 made a remarkable recovery from 2022 due to a flush in Hopbush germination.

Total stem densities recorded in 2023 averaged ~402 stems/ha in the historic rehabilitation sites, which is marginally above the defined target benchmark of 400 stem/ha. Stem densities averaged ~371 stems/ha in the recent rehabilitation sites which is acceptable considering germination of seeded areas is yet to take place or reach full potential for sites rehabilitated in the last two years.

Soil sampling and analysis was undertaken at all sites monitored in 2023. Testing results generally indicated no key deficiencies in the various growth media, except for pH at the majority of sites and salinity at one site. The results from the 2023 monitoring are currently outside completion criteria for pH however these are likely to reduce over time. pH could, be assessed for appropriate ameliorants since current levels have the potential to impact on establishment and growth of native vegetation as.

pH of all sites is trending upwards towards higher alkalinity and should be assessed for appropriate management measures to reduce the pH levels.

HDWV43 returned a very high salinity level. This site is newly established on overburden material and salinity levels are expected to normalise over time.

Organic material analysis returned generally moderate to high levels at all sites and at least doubled at nine of the sites. This correlates to an increase in soil pH and Cation Exchange Capacity at many of these sites indicating an increased decomposition rate of plant residues.

Additional issues observed during the walkover audit and requiring management inputs included weed infestations (particularly of Galenia, fireweed and African Boxthorn), local failure in water management structures (e.g. drains and contour banks), locally severe gully and tunnel erosion on slopes, insufficient incorporation of artificial habitat features.

1. Introduction

1.1 Background

Bengalla Mine (**Bengalla**) is located approximately 4 kilometres (**km**) west of the township of Muswellbrook in the Upper Hunter Valley of New South Wales (**NSW**). The mine is managed and operated by Bengalla Mining Company Pty Limited (**BMC**), a joint venture ownership with New Hope Group and Taipower. BMC is responsible for all facets of the operation including coal extraction, final landform development and rehabilitation works.

BMC presently operates under Development Consent for State Significant Development (**SSD**) 5170 (as modified) which was granted by the NSW Department of Planning and Environment on 3rd March 2015 for the Continuation of Bengalla project. The approval allows for the extraction of up to 15 million tonnes per annum of run of mine coal until 2039.

As required by SDD-5170, post-mined land rehabilitation at Bengalla is carried out progressively and as soon as reasonably practicable following disturbance. Once initial rehabilitation works are complete rehabilitation monitoring and inspections begin to ensure successful progression towards defined goals and objectives. The annual rehabilitation monitoring program at Bengalla commenced in 2009 and has been successively implemented by AECOM (2009-2017), Koru Environmental (2018-2022) and Moss Environmental (2023). Monitoring is implemented to satisfy the requirements of:

- Relevant conditions contained in SDD 5170 Consolidated consent; and
- The current Rehabilitation Management Plan (**RMP**) (BMC, 2023).

1.2 Report Scope and Structure

This report provides a brief overview of rehabilitation requirements and objectives at Bengalla, outlines the monitoring methods and presents the results of the ensuing 2023 rehabilitation monitoring works conducted in January 2024 by Moss Environmental Pty Ltd on behalf of BMC. Rehabilitation monitoring has in the past been conducted in November for the preceding year. Due to staff change overs the 2023 monitoring was conducted in January 2024. The report is structured as follows:

- **Section 2**– highlights rehabilitation requirements and objectives for Bengalla, and the monitoring approach adopted to assess and report on performance condition.
- **Section 3** – details the rehabilitation monitoring methodology, as defined in the current RMP.
- **Section 4** – presents and discusses the 2023 monitoring results for the Class III, and V pasture rehabilitation, including an assessment of rehabilitation progress against the defined completion criteria.
- **Section 5** – presents and discusses the 2023 monitoring results for areas of HDWV rehabilitation, including an assessment of rehabilitation progress against the defined completion criteria.
- **Section 6** – provides high-level generic recommendations suggested to improve rehabilitation condition, based on the 2023 monitoring results and observations.
- **Section 7** – includes the bibliography of references cited throughout this report.

2. Land Rehabilitation at Bengalla

2.1 Post-Mining Landscape and Land Use Goals

The overarching objective of the Bengalla rehabilitation program is to develop a safe, stable, and non-polluting landscape that is consistent with rehabilitation requirements stated in relevant project approvals and SSD-5170 Development Consent, Consolidated Consent for the Bengalla Continuation Project. This will be achieved by the development of an undulating, free draining post mining landform (excluding final void) that is consistent with the surrounding environment.

Pasture Class IV and V, revegetation areas with a minimum 10% treed coverage will cover the majority of the post-mining landform, however the face of the overburden emplacement area (**OEA**) that is exposed to Muswellbrook and Denman will be rehabilitated with high density woody vegetation (**HDWV**) comprising of species commensurate with the surrounding native vegetation.

The ephemeral watercourse known as Dry Creek (which has been diverted to facilitate mining operations at Bengalla) will be re-instated after the relevant area has been mined through.

2.2 Rehabilitation Objectives

In order to achieve the final land use objectives defined for Bengalla, 'domains' (including 'final land use' domains and 'mining' domains) have been defined in the RMP which are used to divide the site into small, more manageable areas. Domains are usually defined based on the consideration of specific requirements of the mining location and the local environment. Each domain will generally require specific decommissioning and rehabilitation methods to successfully achieve the intended post-mining land use.

A total of five mining domains (i.e. active areas) and seven final land use domains have been defined for the site as per the RMP. Currently relevant to the rehabilitation monitoring program are the final land use domains defined as 'Native Ecosystem (HDWV)-Domain A', 'Agricultural – Grazing'-Domain B, and 'Water Management Areas'-Domain F. which have been re-established on overburden emplacement areas (i.e. mining Domain 4)'.

- Domain A (Native Ecosystem – HDWV) relates to the eastern and southern faces of the OEA which are exposed to Muswellbrook and Denman and will consist of HDWV with pasture. This design will allow for both visual amenity of the landform from external viewing locations and a native vegetation corridor over part of the OEA. The vegetation to be established will consist of high-density woodland vegetation with pasture along the contour banks (swales). There is no requirement to re-create a specific native vegetation community profile, however shrub and tree species targeted for re-establishment will generally come from the local Central Hunter Grey Box – Ironbark Woodland (**GBIW**) and Central Hunter Spotted Gum - Ironbark – Grey Box Forest (**SGIGBF**) vegetation communities.
- Domain B (Agricultural – Grazing) will comprise areas of:
  - Class III pasture: a small sub-domain on the top of the eastern OEA where class III land capability was re-established. This domain has minimal slopes and was created from soils recovered from the Southern OEA (prior to emplacement).
  - Class IV and V pasture: Class IV and V land capability pastoral lands will cover the majority of the post-mining landform. These pasture areas will be reconstructed using a mix of native grasses and improved pasture species. Throughout the domain, native vegetation will be introduced as scattered tree plots to create windbreaks and wood lots for stock shelter, as well as improve overall landscape connectivity.

2.3 Existing Rehabilitation

2.3.1 Background

To date, rehabilitation works have been undertaken on the northern, central, and southern overburden dumps, which are collectively referred to as the eastern OEA. In accordance with BMC's previous development consent (DA 211/93), areas of pre-2016 rehabilitation across the eastern OEA were revegetated with a mosaic of pasture and woodland rehabilitation (with no specific species selection).

However, the new approval (SDD-5170) was granted under the condition that the entire eastern face of the OEA is to be entirely revegetated using HDWV. As a result, BMC is converting historic rehabilitation areas of the eastern OEA not presently achieving adequate tree densities (i.e. areas of pasture rehabilitation and areas of low-density woody vegetation) to HDWV i.e. effectively implementing a change in final land-use type.

2.3.2 HDWV Establishment

As part of the eastern face woodland rehabilitation strategy, BMC engaged Global Soil Systems (**GSS**) in 2020 to assist in establishing HDWV across the eastern OEA.

The RMP defines the management zones based on existing condition, revegetation strategies and/or timing for works implementation. These management zones include areas of new rehabilitation yet to be established and areas of historic rehabilitation requiring to be converted to HDWV. During the 2023 rehabilitation monitoring, three new transects were established in new areas of rehabilitation identified as Zone 8. Two transects are in areas of High-Density Woody Vegetation (HDWV43 and HDWV44) and one in Pasture (PR4). The management zones are listed in **Table 1** and their location and extent shown in **Figure 1**.

Table 1 Bengalla HDWV rehabilitation management zones

Zone	Area (ha)	Details and condition	Estimated timing
Zone 1	41.4	Located on the southern dump and includes areas of rehabilitation established between 2013 and 2018. Initial rehabilitation works across the zone have been only partially successful with some woody vegetation (shrubs + trees) established over only ~14.6 ha (or 35% of the zone). Under the PRP, broadscale plantings of native trees and shrubs tubestock were implemented throughout all poorly treed sections of the zone in 2022, at indicative densities of ~1,000 plants/ha.	Completed 2022
Zone 2	59.9	Located on the central dump and includes areas of rehabilitation established between 2013 and 2016 where woody vegetation establishment had been largely unsuccessful; as well as new rehabilitation areas at the top of the emplacement shaped and dressed in 2019 but seeded with cover crop only (for stabilisation). HDWV revegetation works were completed under the PRP across 2021 and 2022. All areas east of the existing rock-lined drop structure were completed in 2021. Historic areas (i.e. established 2013-2016) were scalped of the surface 100-200mm topsoil in an attempt to remove the in-situ seed bank of weeds and exotic pasture grasses. The original landform design (i.e. linear slope with contour banks) was retained. All areas (i.e. including the 2019 area) were recultivated (i.e. deep ripped to ~300mm deep) and seeded with a native woodland mix in late 2021. All areas west of the existing rock-lined drop structure were completed in 2022, and consisted of broadscale plantings of native trees/shrubs tubestock at indicative densities of ~1,000 plants/ha.	Completed 2021 + 2022

Zone	Area (ha)	Details and condition	Estimated timing
Zone 3	48.4	Located on the central dump and includes areas of rehabilitation established between 2003 and 2013. Existing rehabilitation condition across the zone reflects the previous final land use definition for the site and comprises areas of pasture as well as partially treed areas. Woody vegetation (shrubs + trees) is currently established over approximately ~17.2 ha (or 36% of the zone). Pasture areas present were planted during 2023, with HDWV tubestock. Future monitoring will report on progressive development of Zone 3.	Completed June 2023
Zone 4	44.9	Located on the northern dump and includes areas of rehabilitation established between 2009 and 2011 where woody vegetation establishment was largely unsuccessful. HDWV revegetation works were fully completed under the Rehabilitation execution plan during the second half of 2020. The zone received three different treatments (intended to act as a trial to determine the most successful method moving forward): • Zone 4A (~12.9ha): high density tubestock plantings. Area preparation included slashing of existing vegetation followed by blanket spraying of regrowth using a non-selective herbicide, and surface ripping to 300-400mm. Following planting, a six-week maintenance watering regime was implemented. • Zone 4B (~11.4ha): direct seeding into in-situ topsoil. Area preparation included slashing and removal of existing vegetation followed by blanket spraying of regrowth using a non-selective herbicide, and surface ripping to 300-400mm. • Zone4C (~18.3ha): direct seeding into a clay-based subsoil substrate. Area preparation included scalping and discarding of existing topsoil layer (leaving the clay-based subsoil layer) followed by surface ripping to 300-400mm. During 2023, this area was again reviewed and subsequently had HDWV tubestock replanted across the area referred to as Zones 4B and 4C. This area will be assessed again in future monitoring programs.	Completed 2023
Zone 5	31.3	Located on the northern dump and includes areas of rehabilitation established between 2004 and 2011. Rehabilitation across the zone has been only partially successful with some woody vegetation (shrubs + trees) established over only ~10.1 ha (or 32% of the zone). During June 2023, a small area of Zone 5 was planted with HDWV tubestock. This area will be assessed in future monitoring programs. The area remaining in Zone 5 will be addressed at a later date.	Completed 2023
Zone 6	29.9	Comprises three separate areas in the southern dump and top of the eastern emplacement. Landforms were created between 2019-2020 using natural undulating design (areas completed in 2019 were stabilised with a temporary cover crop). Under the RMP, all areas were direct seeded with a native woodland mix in late 2020. Most of the rehabilitation was dressed with native topsoil prior to seeding, however the south-west corner of the southern area was revegetated directly into fine overburden material (intended to act as a trial to determine the potential efficacy of the method)	Completed 2020
Zone 7	33.1	Comprises a number of separate areas generally corresponding the westernmost boundaries where HDWV needs to be re-established. All rehabilitation works were completed during 2021 under the PRP. Landforms were constructed using undulating design, not dressed with any growth medium (i.e. seeding directly into overburden material) and all areas aerial-seeded (using a helicopter) in late 2021 using a native woodland mix.	Completed 2021

Zone	Area (ha)	Details and condition	Estimated timing
Zone 8	20	comprises HDWV (a portion on Wybong Side and another on Wantana side for a total of 11ha) and unclassified pasture (9ha). Bengalla completed area shaping and topsoil placement for pasture establishment. HDWV installation was conducted into overburden with gypsum placement prior to direct seeding over areas of deep ripping. .	Completed 2023

2.3.3 Current Rehabilitation Extent

At the time of the 2023 monitoring campaign, a total of approximately 377.6 ha of post-mined lands had been rehabilitated at Bengalla, comprising:

- ~6.5 ha of pasture rehabilitation on Class III land capability.
- ~9 ha of pasture rehabilitation on Class IV and V land capability.
- ~327 ha of completed HDWV rehabilitation on class IV and V land capability (including areas completed in the past three years, as well as partially treed areas in historic rehabilitation); and
- ~52.4 ha of historic rehabilitation on class IV and V land capability not currently achieving the HDWV land use objectives, and requiring additional revegetation or improvement works (i.e. remediation works not yet completed).

2.4 Rehabilitation Monitoring

2.4.1 Approach

Rehabilitation monitoring at Bengalla is undertaken to satisfy the requirements of the RMP, with the monitoring results being reported in the Annual Review. The objective of the annual monitoring program is to assess rehabilitation progress against relevant performance indicators and completion criteria.

The approach adopted to that effect includes a combination of transect-based monitoring and a rehabilitation audit:

- The transect-based monitoring relies on quantitative data that is collected in a consistent and repeatable manner to allow multi-year comparison of data and assessment of changes and trends occurring over time. The results of this monitoring indicate whether the rehabilitation meets the relevant objectives particularly pertaining to vegetation attributes and metrics (e.g. tree densities, floristic assemblages, vegetation structure, etc.), whilst highlighting potential deficiencies requiring improvement and management interventions.
- The rehabilitation audit is intended as a complement to the transect-based monitoring, and consists of a broad-scale, high-level walkthrough inspection of rehabilitated lands across the site with the main objective to identify any potential issues / deficiencies requiring maintenance treatments (e.g. slope stability or drainage issues, weed infestations, etc.).

2.4.2 2023 Monitoring Scope of Works

The scope of works for the 2023 monitoring campaign included the implementation of the field data collection program followed by processing, analysis and interpretation of monitoring results and associated reporting. The following were undertaken:

1. Step 1 – Field monitoring and assessments, consisting of:

    a. Transect-based monitoring of rehabilitated areas to measure slope stability (i.e. erosion), ground cover protection, species diversity, community structure and function, and soil characteristics – a total of 43 monitoring sites were assessed; and

b. Rehabilitation audit – with inspection areas focussing on the management zones where monitoring transects are located.

2. Step 2 – Preparation of a rehabilitation monitoring report (this report): covering all aspects of the field work and site assessments, including an assessment of rehabilitation progress against relevant RMP completion criteria, and provision of recommendations for improvement where rehabilitation is underperforming.

3. Methodology

3.1 Transect-based Monitoring

3.1.1 Monitoring Sites

A total of 43 monitoring sites were monitored in 2023, comprising one Class III, one unclassified pasture site and 41 HDWV sites. Of the 41 HDWV sites:

- Ten sites were historic monitoring sites established in sections of the OEA where original rehabilitation works have been at least partially successful (i.e. trees/shrubs present), and located within zones 1, 3 and 5. Sites 3 and 5 subsequently underwent rehabilitation criteria reform with the physical works to reform these sites completed in June 2023. For these sites several years of monitoring data are available to analyse long-term trends in vegetation condition.
- Fifteen sites were located within management zones 4 and 6 (i.e. Zone 6 rehabilitation works were completed in 2019, Zone 4 revegetation reform works completed in June 2023). These sites were established during the two past monitoring campaigns, and this 2023 monitoring event represented the third or fourth year of data collection.
- Fourteen sites were located within management zones 1, 2 and 7 (i.e. revegetation works completed between 2021 and 2022). These were monitored for the first time in 2022, i.e. with this year's results representing the first year of comparable data collection.
- Two sites were located within management zone 8 (i.e. revegetation works completed in 2023). These were monitored for the first time in 2023, i.e. with this year's results representing pre baseline data.

The locations of all new monitoring sites established since 2019 across zones 1, 2, 4, 6, 7 and 8 were selected to adequately capture and represent the various revegetation methods implemented in each zone (as defined in **Table 1**), so that the efficacy of each method can be assessed independently.

Details on the monitoring sites are listed in **Table 2**, and shown in **Figure 1**.

Table 2 Bengalla rehabilitation monitoring program – Monitoring sites

Location / PRP zone	Site code	Monitoring started	Revegetation method	Coordinates (GDA94 Zone 56)	
				Easting	Northing
Class III area	P3	2014	Black cracking clay + direct seeded	296710	6427664
Zone 1	HDWV 06	2017	Topsoil + direct seeded	296362	6426364
	HDWV 07	2017	Topsoil + direct seeded	296381	6426121
	HDWV 08	2017	Topsoil + direct seeded	296102	6426010
	HDWV 09	2017	Topsoil + direct seeded	295982	6425838
	HDWV 35	2022	Topsoil + tubestock	296222	6426531
	HDWV 36	2022	Topsoil + tubestock	296076	6426277
	HDWV 37	2022	Topsoil + tubestock	296047	6426403
Zone 2	HDWV 29	2022	Topsoil + tubestock	296262	6427151
	HDWV 30	2022	Subsoil + direct seeded	296675	6427115
	HDWV 31	2022	Subsoil + direct seeded	296851	6426955
	HDWV 38	2022	Subsoil + direct seeded	296988	6426789
	HDWV 39	2022	Topsoil + tubestock	296723	6426616

Location / PRP zone	Site code	Monitoring started	Revegetation method	Coordinates (GDA94 Zone 56)	
				Easting	Northing
	HDWV 40	2022	Topsoil + tubestock	296902	6426453
	HDWV 41	2022	Topsoil + tubestock	296688	6426462
Zone 3	HDWV 01	2011	Topsoil + direct seeded	297166	6427208
	HDWV 03	2012	Topsoil + direct seeded	296895	6427456
	HDWV 04	2017	Topsoil + direct seeded	297078	6427375
	HDWV 10	2018	Topsoil + direct seeded	296939	6427274
Zone 4A	HDWV 14	2020	Topsoil + tubestock	297013	6427653
	HDWV 15	2020	Topsoil + tubestock	297147	6427905
	HDWV 16	2020	Topsoil + tubestock	297230	6428081
Zone 4B	HDWV 17	2020	Subsoil + direct seeded	296911	6427633
	HDWV 18	2020	Subsoil + direct seeded	297015	6427977
Zone 4C	HDWV 19	2020	Topsoil + direct seeded	297340	6427767
	HDWV 20	2020	Topsoil + direct seeded	297462	6427928
	HDWV 21	2020	Topsoil + direct seeded	297432	6427611
Zone 5	HDWV 02	2011	Topsoil + direct seeded	297401	6428141
	HDWV 11	2018	Topsoil + direct seeded	297501	6428270
Zone 6	HDWV 22	2021	Topsoil + direct seeded	296380	6427604
	HDWV 23	2021	Topsoil + direct seeded	296352	6427401
	HDWV 24	2021	Topsoil + direct seeded	296244	6427006
	HDWV 25	2021	Topsoil + direct seeded	295883	6426309
	HDWV 26	2021	Topsoil + direct seeded	295886	6425949
	HDWV 27	2021	Topsoil + direct seeded	295859	6425835
	HDWV 28	2021	Overburden + direct seeded	295619	6425988
Zone 7	HDWV 32	2022	Overburden + aerial seeded	296314	6427853
	HDWV 33	2022	Overburden + aerial seeded	296728	6427867
	HDWV 34	2022	Overburden + aerial seeded	296765	6428083
	HDWV 42	2022	Overburden + aerial seeded	295637	6426310
Zone 8	HDWV 43	2023	Overburden + aerial seeded	296092	6427978
	HDWV 44	2023	Overburden + aerial seeded	295584	6426436
Zone 8 and pasture rehabilitation area	PR4	2023	Topsoil + direct seeded	296225	6428019

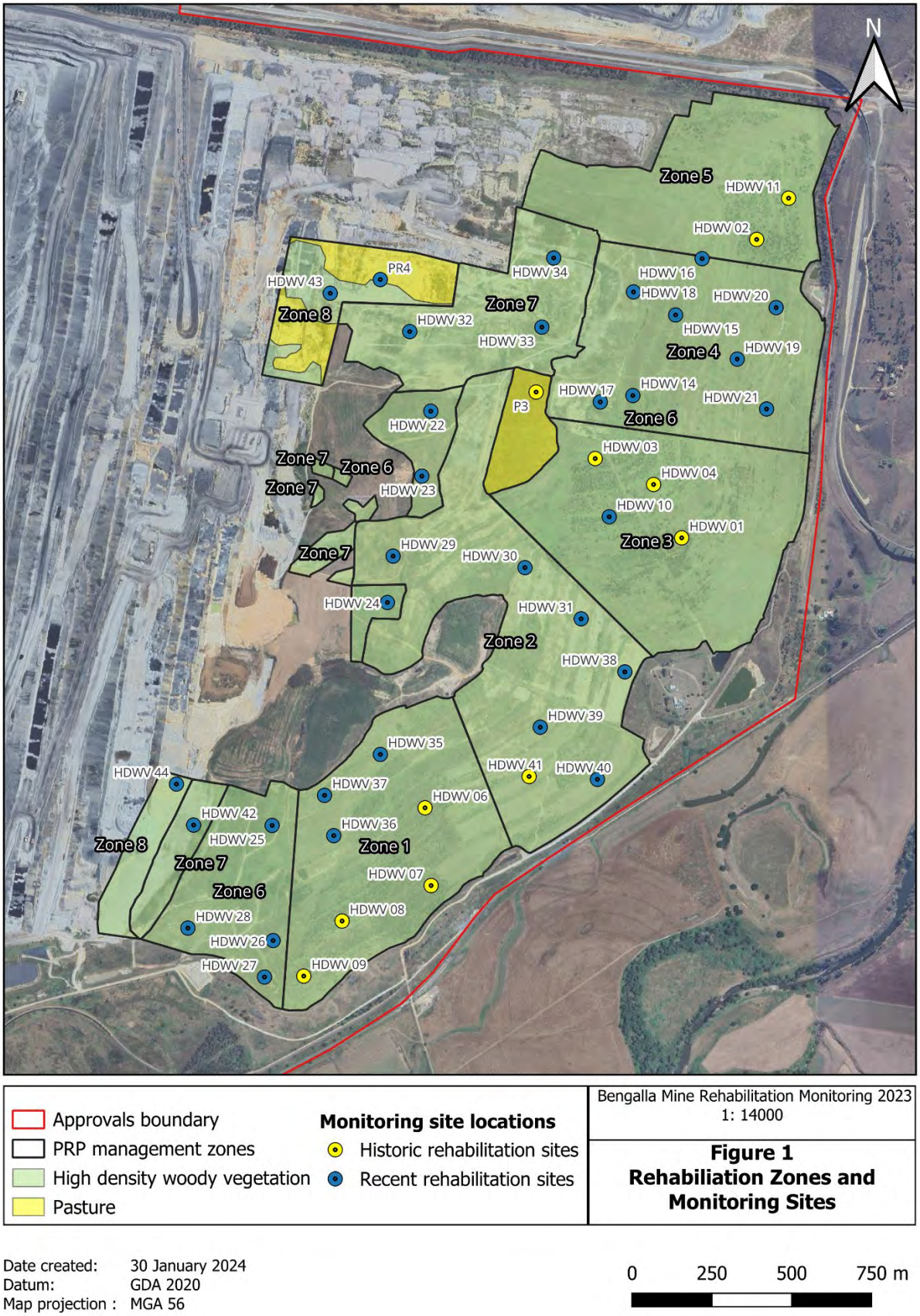


Figure 1 Rehabilitation zones and monitoring sites locations

3.1.2 Site Layout

Each monitoring site consists of a standardised 50 m long transect, with nested 1 m x 1 m and 2 m x 2 m plots, in the configuration depicted in **Figure 2**. Monitoring transects are established as follows:

- Transects are located along the contour i.e. across the slope (with some exceptions for historical monitoring sites established under previous monitoring methods).
- Transects are permanently established using metal star pickets at the start and end points to facilitate repeated measurements over time. This is essential for long-term monitoring to be meaningful; and
- Transects are located by GPS readings of the start and end points (±3m accuracy).

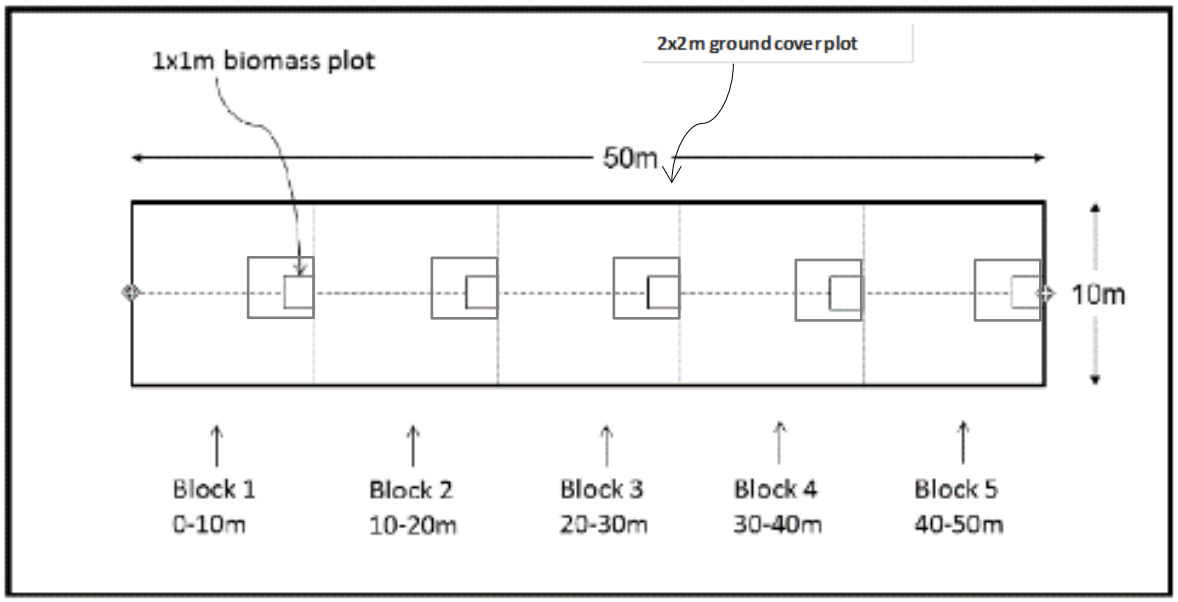


Figure 2 Monitoring sites layout

3.1.3 Monitoring Metrics and Methods

At each of the monitoring sites, the metrics presented in **Table 3** were assessed and recorded (differing based on the target final land use).

Table 3 Monitoring metrics and assessment methods

Metric	Sampling area	Methods
All monitoring sites		
Slope	50m transect line	• The slope gradient at the transect line is measured using a digital clinometer for accurate results.
Erosion	10m x 50m transect area	• Erosion is assessed in accordance with the guidelines in the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009) for sheet, rill, gully and tunnel erosion. • Where rills or gully features were present, their location, depth and width are recorded as they intercept the transect line.
Ground cover protection	2m x 2m quadrats	• The percentage cover live vegetation (projected), organic litter, rocks >200mm and bare ground are visually estimated.
Ground cover composition	2m x 2m quadrats	• All ground cover species (grasses, herbs and sub-shrubs) are identified (where possible) and recorded and assigned a foliage percent cover (**FPC**) score.

Soil properties	10m x 50m area	• A composite soil sample (made up of 5-6 x sub-samples) is collected and sent to a NATA-accredited laboratory for analysis of soil chemistry.
Pasture rehabilitation		
Pasture biomass	1m x 1m quadrats	• All standing herbage is cut to ground level using hand shears and the clipped material weighed on site using a digital scale to determine the standing herbage biomass.
Feed quality	10m x 50m transect area	• A sample of available forage material is collected (in accordance with the guidelines provided by NSW DPI (2017) and sent to a NATA-accredited laboratory for feed quality testing including.
HDWV rehabilitation		
Vegetation community composition and structure	10m x 50m transect area	• All trees and shrub species are identified and recorded. • A count is undertaken of all shrubs and trees to determine the overall stem densities. • Each recorded individual is categorised within a height category using the following classes: <1m, 1-3m, 3-5m, 5-8m, 8-12m, >12m.
	50m transect line	• FPC provided by shrub species and by tree species is measured using a line intercept method, with native species and exotic species assessed separately.
Habitat potential	10m x 50m transect area	• The presence and abundance of a litter layer, ground logs/woody debris, large rocks or other artificial habitat features were quantified and recorded.
Ecosystem resilience	10m x 50m transect area	• Results of the woody species height stratification are used to determine the occurrence of second-generation seedlings. • The presence of reproductive material (buds/flowers/fruits) on established shrubs and trees is recorded.

3.2 Audit Inspection

The audit consisted of a rapid-style assessment of rehabilitation areas whilst walking the site in cross-sections, covering an area as comprehensive as possible within the available time allocation. The 2023 monitoring included a reduced walk-over due to time constraints. Opportunistic sightings and assessments were made identifying the following where relevant:

- Stability of slopes and landforms – including presence and severity of active erosion areas (e.g. rill, gully and tunnel erosion).
- Function and condition of existing erosion and sediment control structures and landform features, including water management structures (e.g. spine drains, contour banks), water ponding areas, etc. (where applicable).
- Visual assessment of ground protection and vegetation cover, vegetation health and growth rates.
- Presence of artificial habitat structures incorporated into the rehabilitation (e.g. nest boxes, logs, rock piles or large boulders, erect habitat trees, etc).
- Areas of significant weed incursion (with a particular focus on high threat exotics and priority weed species).
- Evidence of presence/impact of vertebrate pests; and
- Any other disturbance factors or features, such as presence of mine waste, track disturbance, damaged fences, etc.

GPS points (±3m accuracy) and geo-located photographs were taken of all observations made during the assessment. By collecting geo-located photos, areas can be re-visited in the future and photo-monitoring continued to demonstrate the evolution of the site condition over time.

3.3 Works Implementation

3.3.1 Monitoring Dates

Field data collection took place over one week during the second week of January 2024, and was conducted by Shonelle Gleeson-Willey (Principal Rehabilitation Scientist / Erosion Specialist) and Jakub Juszczak (Ecologist) from Moss Environmental. Monitoring activities were supervised by Seydou Cisse (Senior Environmental Specialist) from BMC.

3.3.2 Weather Conditions

Interrogating local rainfall data in the context of an ongoing monitoring program is important as the amount of rain received during the months or even weeks preceding floristic surveys can strongly influence the species diversity observed in the ground layer (especially shorter-lived species of grass, forb, fern, twiner, etc.). Wet conditions tend to favour the emergence and flowering of many species (including weeds), whereas drier periods will often lead to lower recorded species diversity (often compounded by desiccated plants making positive species identification difficult). Consequently, cross-year comparisons of total species richness and abundance of vegetation typically requires careful interpretation.

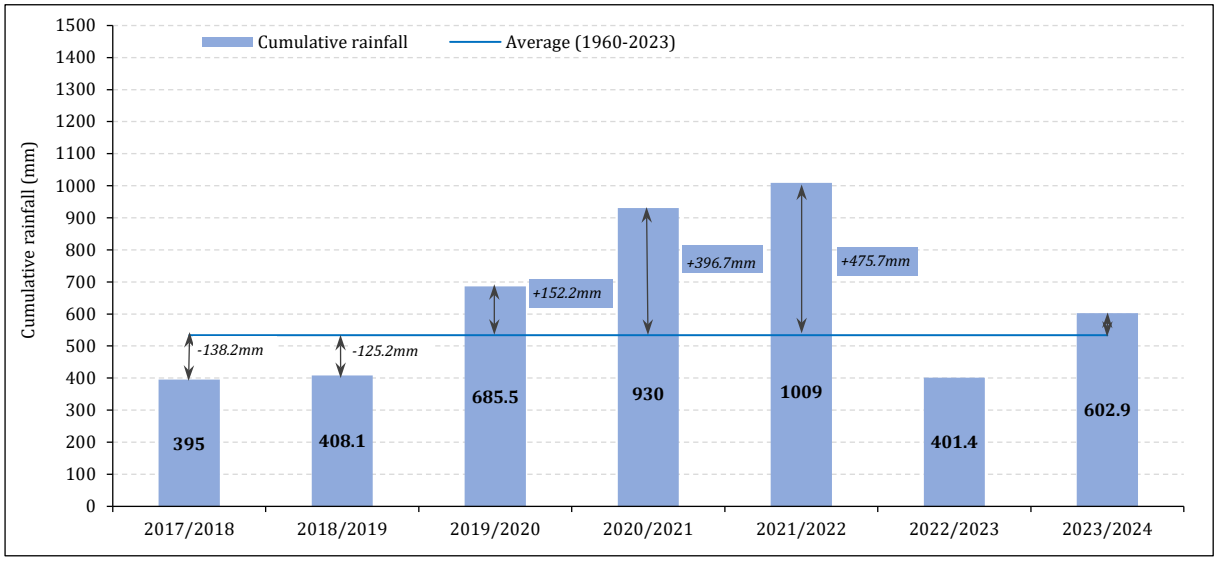
For rehabilitated lands on unconsolidated soil profiles, the amount (and intensity) of rainfall can also have repercussions on landform stability and surface erosion processes, especially in areas of steeper slope gradients and/or where a vegetative cover has not yet fully established (e.g. recent rehabilitation). In particular, heavy rainfall events (i.e. ≥25 mm in 24-hour) generate high surface-flow velocities associated with greater erosive forces.

Rainfall data received in the locality over the past 5 years are illustrated in **Graph 1** (cumulative 12-month rainfall calculated over the December-to-November period) and **Graph 2** (monthly rainfall) (data from Muswellbrook (Lindisfarne) BoM Station No. 61168) and Muswellbrook (Spring Creek (Castle Vale) BoM Station No. 61192 (-32.2092 °S, 150.7365 ° E). The Spring Creek Met Station data was used during this monitoring due to Station 61168 presenting no data from March 2023.

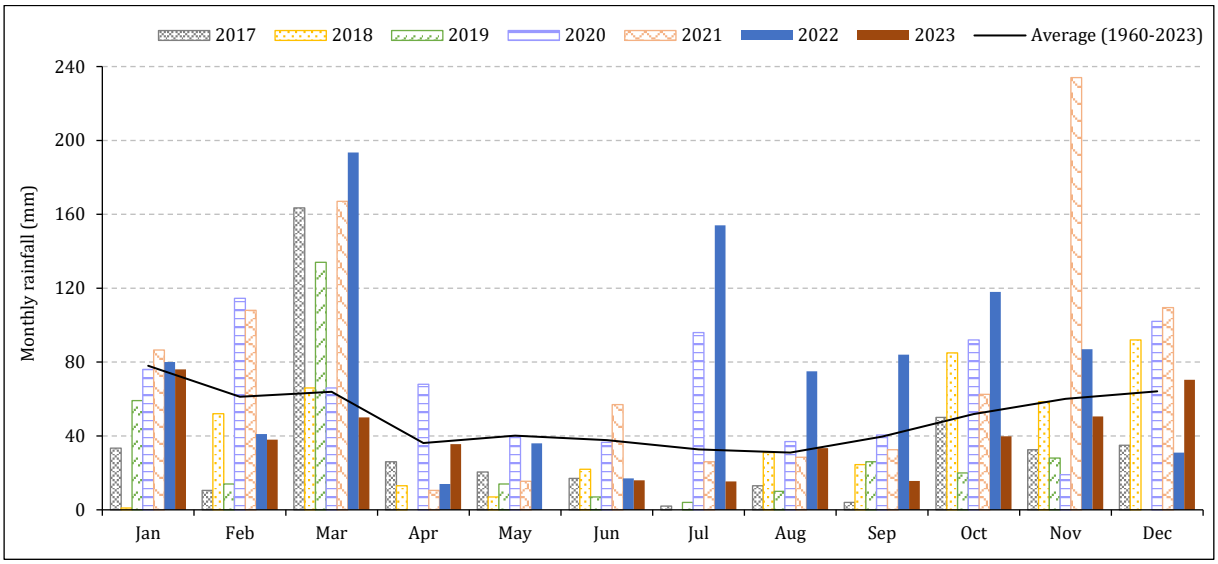
Following the severe three-year state wide drought which impacted the region between 2016 and 2019 and placed a significant amount of stress on local vegetation and biophysical systems (including rehabilitated lands), conditions significantly eased off starting early 2020 and the locality received well-above average annual rainfall between 2019 and 2022. The 2023 year shows a marked difference in rainfall, with a significant decrease to below average measurements, commensurate with the 2017-2019 rainfall. As shown in **Graph 1**, cumulative rainfall during the two years preceding this 2023 monitoring campaign was respectively ~189% (1,009 mm) and ~75% (401.4 mm) of the long-term (62-year) annual average (533 mm).

Compared to long-term seasonal averages, the four-month period directly preceding the 2023 field survey received slightly below average rainfall. Total rainfall received during the months of July (15.4mm), August (33.4 mm), September (15.6 mm), October (39.8 mm), November (50.6 mm) and December (70.4 mm) was slightly below their long-term monthly average (**Graph 2**).

Finally, the locality experienced a total of 6 heavy rainfall events (>20mm) during the 12 months preceding the survey, three of which occurring during the four months leading up to the field surveys.



Graph 1 Local annual rainfall 2017-2023 (cumulative December to November)



Graph 2 Local monthly rainfall data 2017-2023 (cumulative)

3.4 Results Interpretation

3.4.1 Transect-based Data

Results from the transect-based monitoring were analysed, tabulated, and presented graphically to provide a summary of key monitoring results for each area monitored. Where relevant, data from previous monitoring events were also included for comparison purposes and trend analyses (note that a change in monitoring methods was adopted in 2018, limiting cross-year comparisons with historical monitoring data for a number of attributes).

The following data analyses and interpretation were undertaken:

- **Soil properties**: soil chemical properties of pH, salinity[1], sodicity and fertility were assessed against values documented in relevant literature (particularly Hazelton and Murphy, 2007) and as pertaining to value ranges known to be suitable and conducive to vegetation growth.
- **Ground cover:** ground cover was defined as including live vegetative cover, litter cover and other perennial and immovable ground features (such as logs or rocks >10 cm), and rehabilitation performance assessed against the previous MOP target of 70 % total protective cover.
- **Weed incidence:** data were interrogated for the presence and abundance of weed species[2]. Weeds were categorised as either 'non-invasive exotics' (i.e. low risk and generally requiring no active control except in severe cases) or 'priority weeds'[3] (i.e. problematic species requiring active and ongoing control). Weed cover was assessed as acceptable where ≤10 % cumulative Foliage Projective Cover (FPC).
- **Pasture composition[4]:** data were interrogated for the presence and proportion of suitable pasture species, as per the approved pasture species list in the RMP (Table 10) making up the pasture composition. These were defined to include: palatable and productive grasses, legumes, and other native species.
- **Pasture biomass:** satisfactory performance was defined where herbage biomass was ≥ 1,500 kg DM/ha (dry matter per hectare), which has been reported as the minimum herbage mass required to maintain satisfactory production in a dry cow cattle enterprise in the region (NSW DPI, 2006a).
- **Pasture productivity:** using the herbage biomass and feed testing results, potential carrying capacities and stocking rates of the rehabilitated pastures were calculated in accordance with the NSW DPI's '*Beef stocking rates and farm size – Hunter Region*' (NSW DPI, 2006b).
- **Woody vegetation composition:** shrub and tree species establishing in the HDWV rehabilitation domain were assessed against species assemblage's characteristic of the local CHGBIW and CHSGIGBF communities to determine levels of resemblance. Performance was assessed as satisfactory where ≥75% of trees and shrubs were representative of the target communities. Assessment against these communities is a requirement for HDWV, as per Table 4, point A. The species are assessed in groups using the same groupings each monitoring year, as per Appendix C.
- **Woody vegetation density:** stem counts and densities were considered and reported for tree species only (tree species as defined in the BAM), which is believed to be the intent of the relevant RMP completion criteria. As defined in the RMP tree densities were assessed as satisfactory where greater than 400 stems/ha equivalent.
- **Natural regeneration:** in areas of mature woodland rehabilitation, regeneration was assessed as 'active' (i.e. second-generation seedlings present), 'potential' (i.e. no seedlings but reproductive material present on plants) or 'absent' (i.e. no seedlings nor reproductive material present).

3.4.2 Walkover Audit Observations

All observations made during the walkover audit inspection were assigned a priority ranking based on the categories and guideline defined in **Table 4**.

This approach (including performance categories) was adopted with the view to prioritise current rehabilitation issues impacting the site at the time of the monitoring, thereby providing BMC a record of

[1] Note that the electrical conductivity (EC) values reported in the laboratory report were converted to account for soil types (as per Hazelton & Murphy, 2007).

[2] Having regards to the component of grazing land use defined for most of Bengalla's rehabilitation (including in areas of HDWV), introduced species suitable for grazing (i.e. pasture grasses and legumes) were not considered as weeds for the purpose of this monitoring program.

[3] Priority weeds were defined to include species listed as: priority weeds under the NSW *Biosecurity Act 2015* (NSW WeedWise), Weeds of National Significance (**WoNS**), and/or High Threat Exotics (**HTE**) under the NSW BAM (NSW OEH, 2017). Additionally, and although not falling in either of these categories, *Acacia saligna* was also defined as a priority weed as the species is a known issue on mine sites locally.

[4] Note Pasture refers to both Class III and unclassified pasture areas. Unclassified pastures areas are assessed as per the rehabilitation objectives and closure criteria in the RMP. Class III pasture is assessed based on a unique set of criteria approved solely for the purpose of Class III pasture.

what issues should be prioritised for maintenance / remedial actions (while also highlighting those areas of acceptable performance / practice).

Table 4 Rehabilitation performance criteria guidelines

Priority	Type	Description
1	Urgent immediate action required	• Issues threatening the fundamental objectives of safe, stable and vegetated landforms (e.g. severe erosion issues compromising land capability, large bare areas, spontaneous combustion impacts, etc). • Unattended issues will prevent successful lease relinquishment. • Repair/remediation costs likely to increase rapidly if issue is left unattended.
2	Major maintenance works required	• Rehabilitation success compromised and does not meet completion criteria. • Issue processes and impacts may deteriorate if left unattended for a long period of time. • Significant management inputs required to address the issue and progress the rehabilitation towards defined objectives and criteria (e.g. repairs of minor/localised erosion, severe widespread weed infestations, large-scale revegetation or tree plantings, etc.)
3	Regular inspections, minor maintenance works, or improvement interventions required	• Does not meet completion criteria but future rehabilitation success unlikely to be compromised. • Localised or routine land management actions required to improve rehabilitation condition (e.g. localised weed control, supplementary infill tree plantings, fertiliser applications, incorporation of artificial habitat features, etc.) • Careful monitoring or regular inspections of area/issue required to confirm area/issue is not degrading further.
4	Observations of good practices or rehabilitation performance.	• Satisfactory rehabilitation performance (relative to the age of the rehabilitation) or example of good practice. • Meets or on trajectory to meet completion criteria (e.g. ecologically young areas). • Routine land management and monitoring should be continued to maintain status until relinquishment process is sought.

3.4.3 Compliance Assessment

Using the analysed field monitoring data together with the observations made during the audit, an assessment was undertaken of current rehabilitation performance against associated completion criteria defined in the RMP (2023).

For reference, these criteria have been reproduced in **Table 5**, as relevant to the scope of this rehabilitation monitoring program (some criteria have been reworded, re-organised or grouped to remove duplicates or improve legibility).

Where no clear benchmark values are defined in the RMP for a specific indicator, pre-defined target benchmarks were used to provide an assessment of performance condition. These were based on review of published literature and studies, historical monitoring results, benchmarks in previous MOPs, and other relevant standards and guidelines.

It is further noted that several completion criteria require an assessment of rehabilitation condition against corresponding analogue sites (for both pasture and HDWV final land uses). The Bengalla rehabilitation monitoring program currently does not include relevant analogue sites, therefore progress against those criteria cannot be assessed.

Table 5 Bengalla rehabilitation objectives and completion criteria

Rehabilitation objectives	Completion criteria
Domain A (Native Ecosystem – HDWV) and Domain B (Agricultural – Grazing)	
Safe, stable and non-polluting	No uncontrolled access and demarcations present Adoption of standad fire prevention measures including firebreaks and minimising fire hazards, access maintained for fire fighting
	No visible signs of instability (slumping/cracks) requiring ongoing maintenance
	No erosion rills, gullies or tunnel erosion requiring ongoing maintenance
	No erosion in water/sediment management structures requiring ongoing maintenance
	No evidence of contamination
	Water quality of surface runoff within parameters suitable for relevant land use
	Surface runoff diverted to neighbouring drainage lines
Slope / macro-relief	Landform compliant with approved final landform
Incorporation of natural drainage lines	Water / sediment management structures installed as per design
Domain A (Native Ecosystem – HDWV)	
Soils suitability	Soil properties are appropriate for native vegetation growth
Sustainable vegetation cover	Species establishing are aligned to those included in the species mix for the domain
	Species diversity comparable to similar native woodland in the region
HDWV established	Tree stem densities maintained at ≥400 stems/ha
Ecosystem structure and function	Surface organic litter present
	Weed coverage comparable to similar native woodland in the region
	Evidence of reproductive material on shrubs/trees and/or presence of second-generation seedlings
	Recruitment rates are equal to or exceed mortality rates
Habitat augmentation	Habitat features (e.g. nest boxes, boulders, logs, etc) present on rehabilitated areas
	Presence of native animal activity
Feral pests incidence	No increasing trends in feral pests populations and species diversity
Domain B (Agricultural – Grazing)	
Landform suitable to establish Class III pasture	No surface rocks present that impede the post-mining land use
Soils suitability	Soil properties are appropriate for pasture growth
Vegetation cover suitable for pasture land use	Vegetative cover comparable to similar native woodland in the region
	Presence of a diversity of grasses and legumes from the species mix
	Pasture composition comparable to similar pasture areas within the region
	Weed coverage comparable to similar pasture area within in the region
	No species with known toxicity to grazing stock
	Pasture productivity comparable to regional averages

Rehabilitation objectives	Completion criteria
	Surface organic litter present
Feral pests incidence	No increasing trends in feral pest populations and species diversity

4. Results – Class III Pasture and unclassified Pasture Rehabilitation

4.1 Transect-based Monitoring

4.1.1 Photographic Monitoring

For reference, photographs taken in January 2024 for the 2023 annual monitoring from the permanent photo points at the start and end of the 50 m transect line are provided in **Appendix A**.

The photographs depict the visual condition of the monitoring site at the time of the 2023 monitoring, which can be compared with previous monitoring years (supplied in previous annual monitoring reports) to determine evolution and changes in vegetation establishment and condition over time.

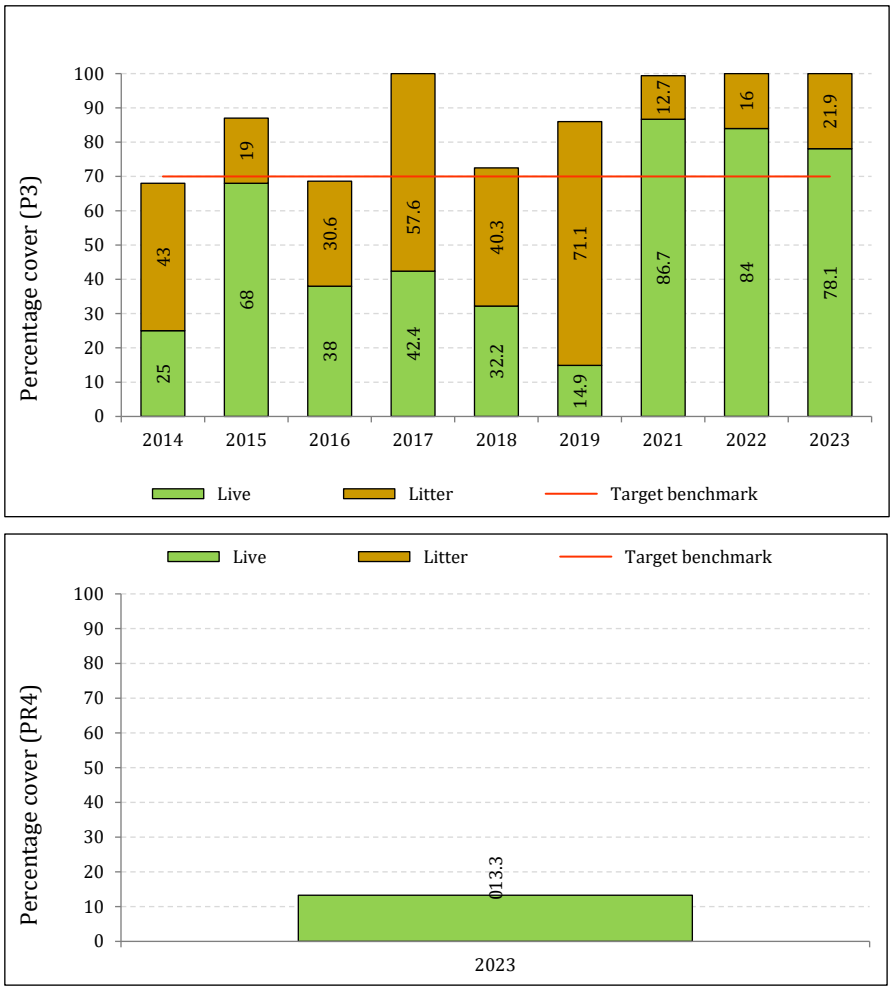
4.1.2 Erosion

As a function of the very gentle to flat topography established to re-create Class III land capability, as well as the good soil and vegetative cover, soil and landform stability remained excellent across the area with no active erosion processes recorded. Pasture areas Class V land capability, recently rehabilitated have been roughened suitably to prevent erosion during the establishment phase.

4.1.3 Ground Cover Protection

Total protective cover at the 'P3' monitoring site remained excellent in 2023 with no exposed bare ground recorded, and well exceeding the benchmark of 70% minimum cover (**Graph 3**). Although levels of vegetative cover remained high, it is down approximately 6% on 2022 cover levels reflecting the above average maximum temperatures and below average rainfall in the second half of 2023.

An additional Pasture monitoring transect was established in the 2023 survey period (PR4) located in Zone 8. Pasture establishment is in its infancy at 13.3% live cover and no litter. It is expected that future monitoring events will find this transect has greatly matured in live cover and species composition.



Graph 3 Ground cover protection (2023) – Unclassified Pasture

4.1.4 Soil Properties

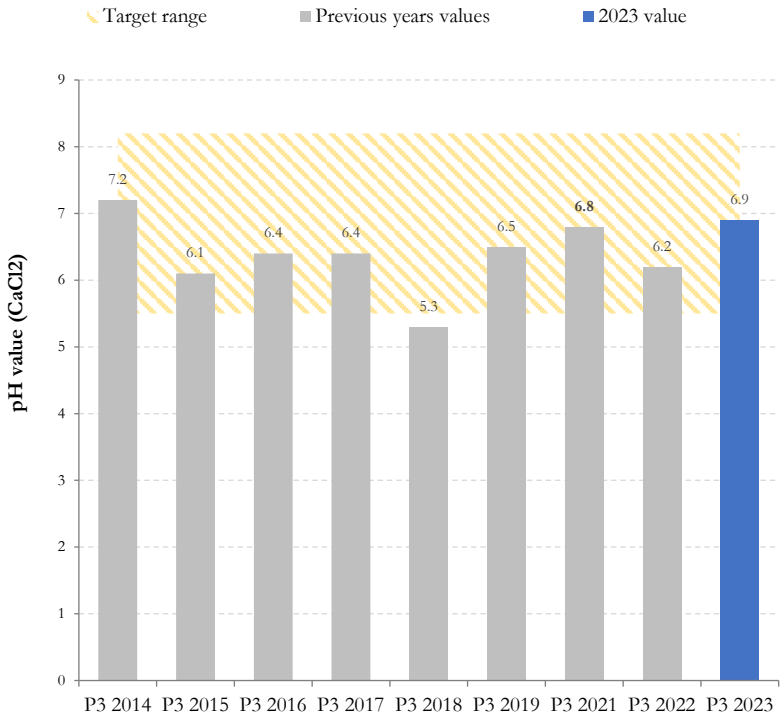
Testing results for key soil chemical properties (i.e. those most influencing and regulating plant establishment and growth) are presented in **Graph 4 and Graph 5**; including pH, salinity converted from electrical conductivity (**EC**), sodicity, cation exchange capacity (**CEC**) and organic matter content (**OM**). For further reference, the detailed laboratory analysis report is provided in **Appendix B**.

The 2023 results for P3 were generally within range of previous years and only displayed minor seasonal variations. The tested soil sample at P3 was slightly acidic, non-saline and non-sodic, and continued to show high levels of OM and CEC.

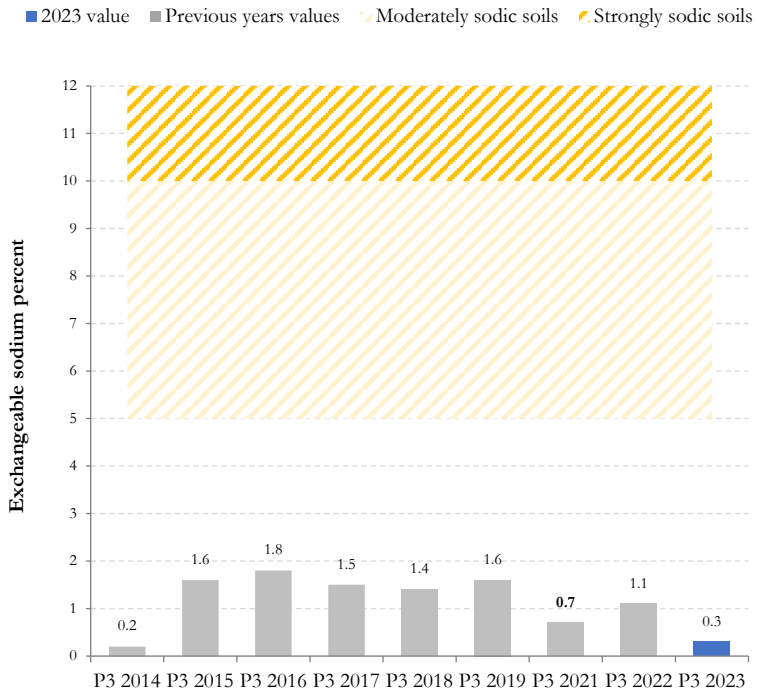
The 2023 results for PR4 are not compared to previous years due to this being the first year of testing. The tested soil sample was slightly alkaline, slightly saline and non-sodic, and showed very high levels of OM and CEC levels slightly exceeding the target range.

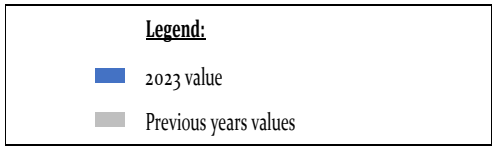
Overall, except for pH and CEC at PR4 all key soil parameters remained within ranges conducive to the establishment and growth of pasture species, with no key limitations noted. It is anticipated that as the material placed across the newly establish pasture area PR4 settle, level will stablise. This should be monitored in future years.

Soil acidity - pH

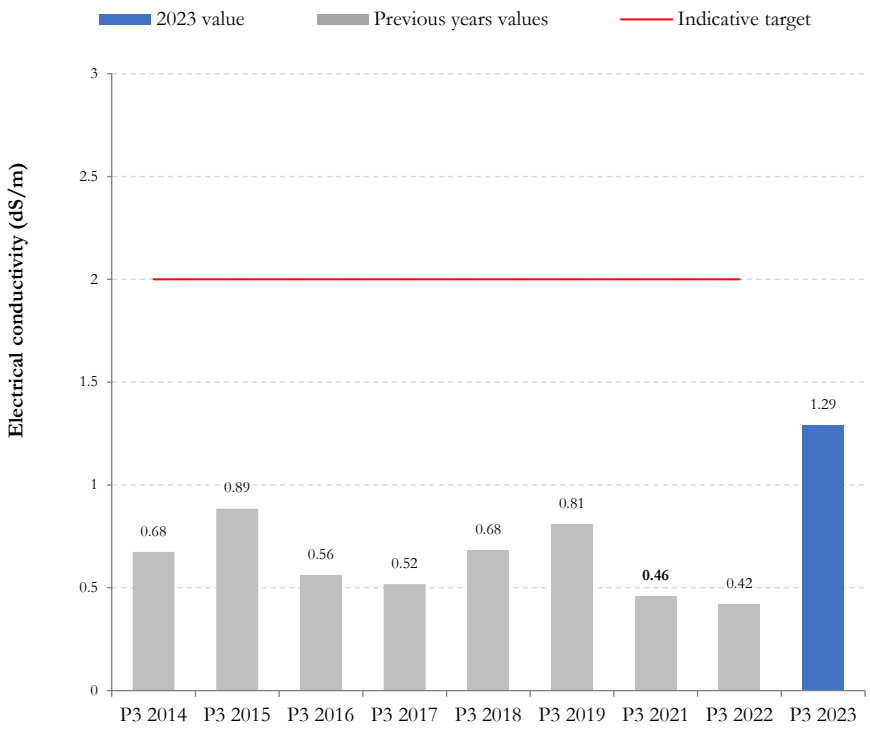


Soil sodicity – Exchangeable Sodium Percent (ESP)





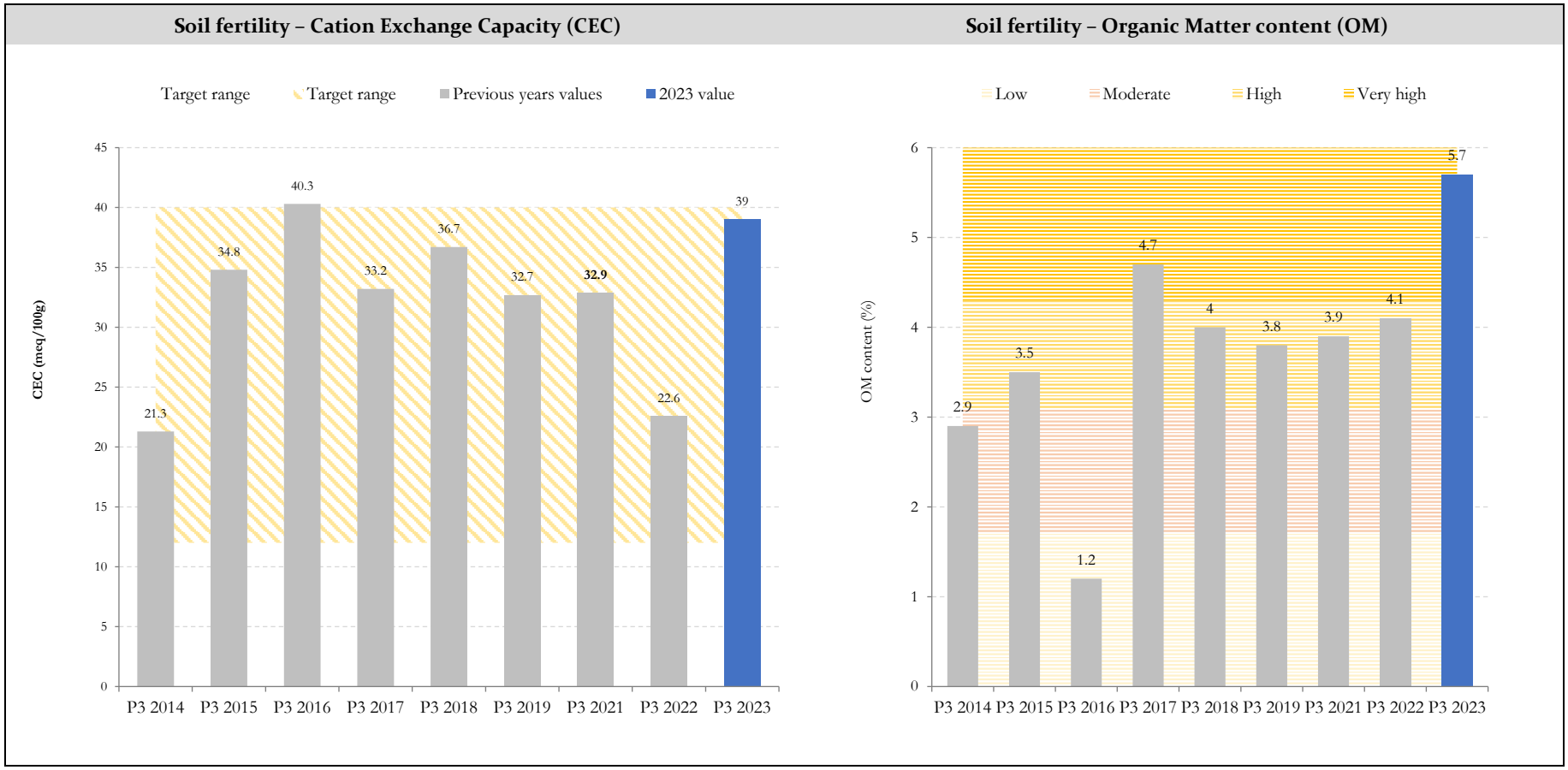
Soil salinity – Electrical Conductivity (EC)[5]



Legend:

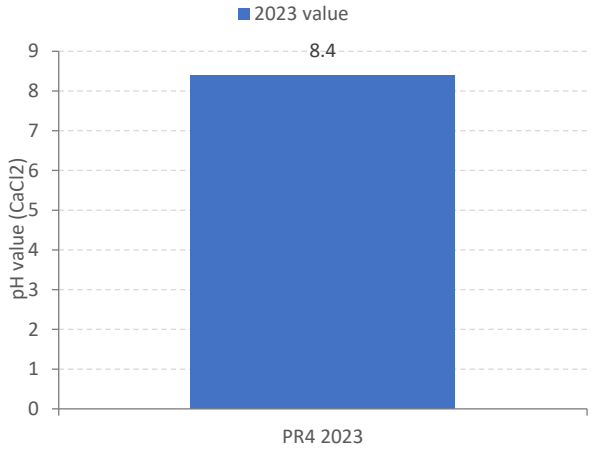
- 2023 value
- Previous years values

[5] Note that the EC values reported in the laboratory report (**Appendix B**) were converted to account for soil types (as per Hazelton & Murphy, 2007).

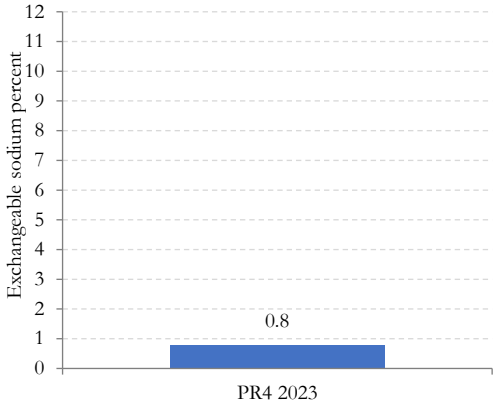


Graph 4 Soil properties monitoring results (2014-2023) – Class III Pasture

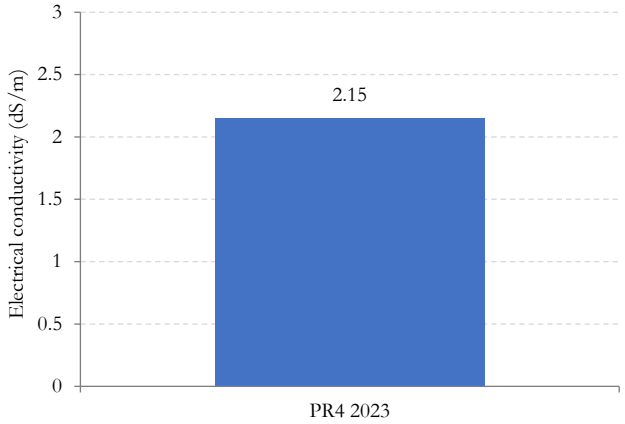
Soil acidity - pH



Soil sodicity – Exchangeable Sodium Percent (ESP)



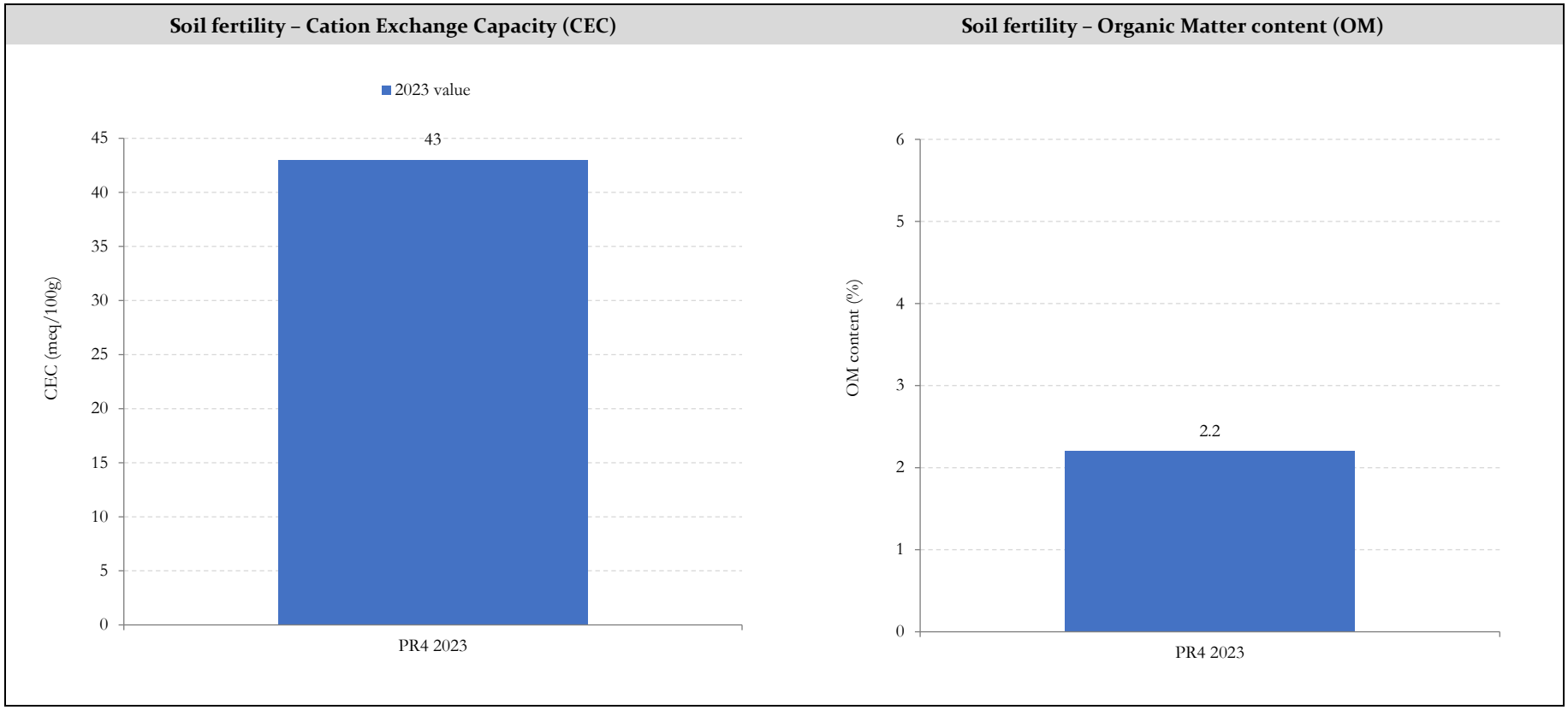
Soil salinity – Electrical Conductivity (EC)[6]



Legend:

- 2023 value
- Previous years values

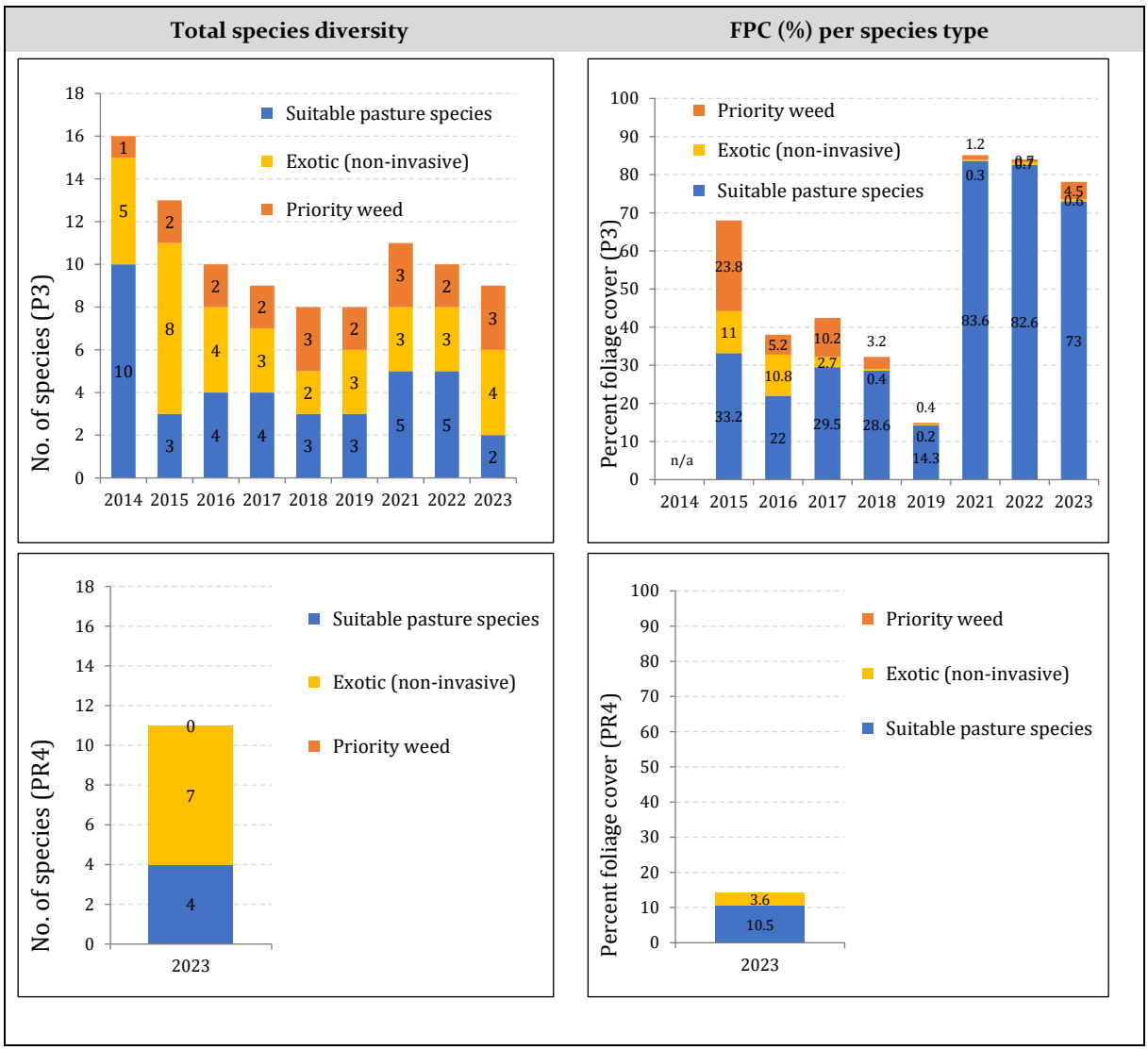
[6] Note that the EC values reported in the laboratory report (**Appendix B**) were converted to account for soil types (as per Hazelton & Murphy, 2007).



Graph 5 Soil properties monitoring results (2023) – Unclassified Pasture

4.1.5 Pasture Composition

An additional pasture monitoring transect (PR4) was created during the 2023 monitoring and is in a newly rehabilitated Zone 8 (refer **Figure 1**). Trends in pasture composition performance in (including weeds) since 2014 are shown in **Graph 6**, with the detailed 2023 floristics monitoring results included in **Appendix C** for further reference. (Note that due to changes in monitoring methods FPC score were not recorded in 2014 and could not be graphed and PR4 only has its first year of data illustrated).



Graph 6 Species composition monitoring results (2014-2023) – Class III, unclassified Pasture.

Pasture composition recorded in P3 in 2023 showed considerable change from last year. A total of nine species were recorded which comprised only two desirable pasture species (two grasses), three non-invasive exotic forbs and two priority weeds. Pasture composition in PR4 in 2023 recorded a total of nine species including three desirable pasture species (as per the RMP) and six exotic species.

Consistent with last year in P3, total live herbage in 2023 remained very largely dominated by *Megathyrsus maximus* (Guinea grass) and *Cenchrus clandestinus* (Kikuyu) which combinedly represented ~98% of the total live herbage cover. These are highly productive and palatable pasture grasses. The abundance of

legumes remained negligible (0% cover within the monitoring subplots but was observed outside the transect area), which is not uncommon in unmanaged and non-grazed rehabilitated pastures and can easily be improved under an adequate management regime.

Similarly in PR4, total live herbage in 2023 was dominated by *Megathyrsus maximus* (Guinea grass) which represented approximately 75% of the total live herbage cover. Unlike in P3, one legume was recorded (*Medicago truncatula* Barrel Medic) though its abundance at this stage was also negligible.

With the high cover and biomass of vigorous pasture grasses, weed diversity and abundance was an acceptable level in 2023 at ~5.1% cumulative cover (0.6% non-invasive exotics + 4.5% priority weeds), for a continued acceptable performance in terms of weed incursion. However, without significant improvement in climatic conditions over the following year, the lowered pasture biomass is likely to allow an increased in exotic weed abundance and cover.

However, one species remained which has a known potential toxicity to stock, being *Sorghum halepense* (Johnson Grass). Johnson's Grass has the potential to cause prussic acid poisoning – severe cases of which can lead to death of the animals (NSW DPI, 2007). Although occurring at very low abundance (~0.4% cover), the species has consistently been recorded over the last few monitoring events, and it is unknown how it will respond to the introduction of stock (e.g. the species could further establish from in situ seed bank as the cover of palatable grasses reduces under grazing pressures). As noted in previous year's reports, the presence of the species will need to be considered (i.e. advice from qualified agronomist sought) before livestock is introduced.

As in 2022, *Urochloa panicoides* (Liverseed grass) was not recorded at P3 however a small amount was recorded in PR4 (0.1% cover) and has been observed at other locations throughout the project site. Liverseed grass has the potential to cause nitrate poisoning to sheep and cattle though it is not likely to be hazardous under normal conditions. Liverseed grass can be toxic if large amounts of nitrate are accumulated in the plant, especially to animals under stress. The species is an annual grass with strong seed dormancy which typically germinates and establishes in a single flush following rain (Walker et al, non-dated); it is therefore likely that a viable seed load of the species occurs in the soil.

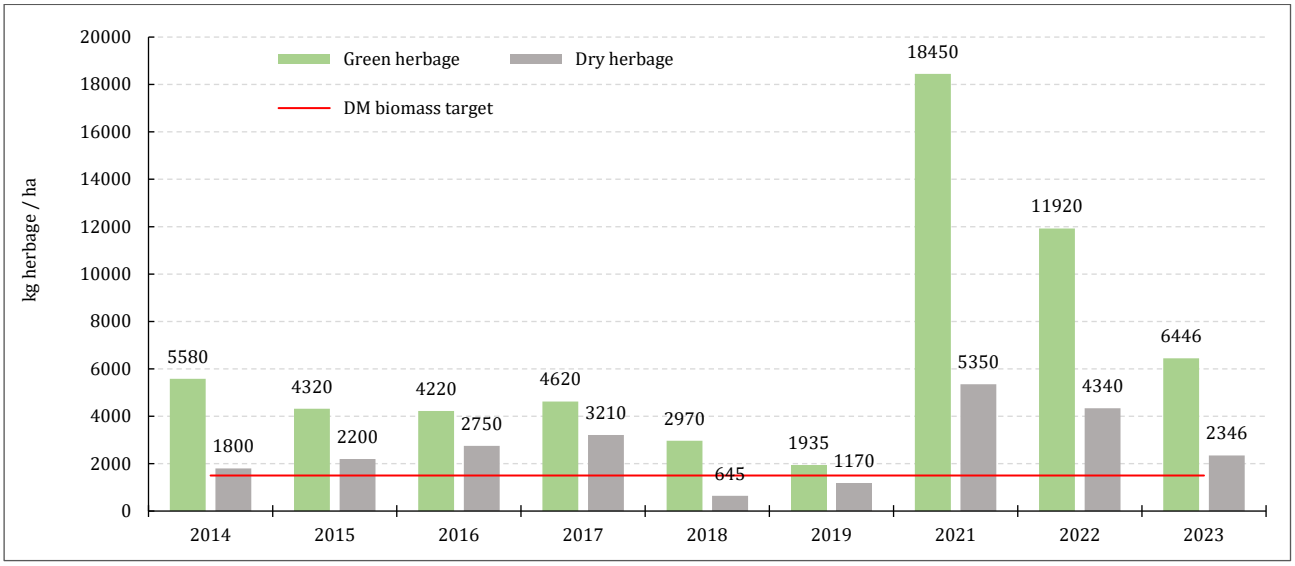
4.1.6 Pasture Productivity

4.1.6.1 Herbage Biomass

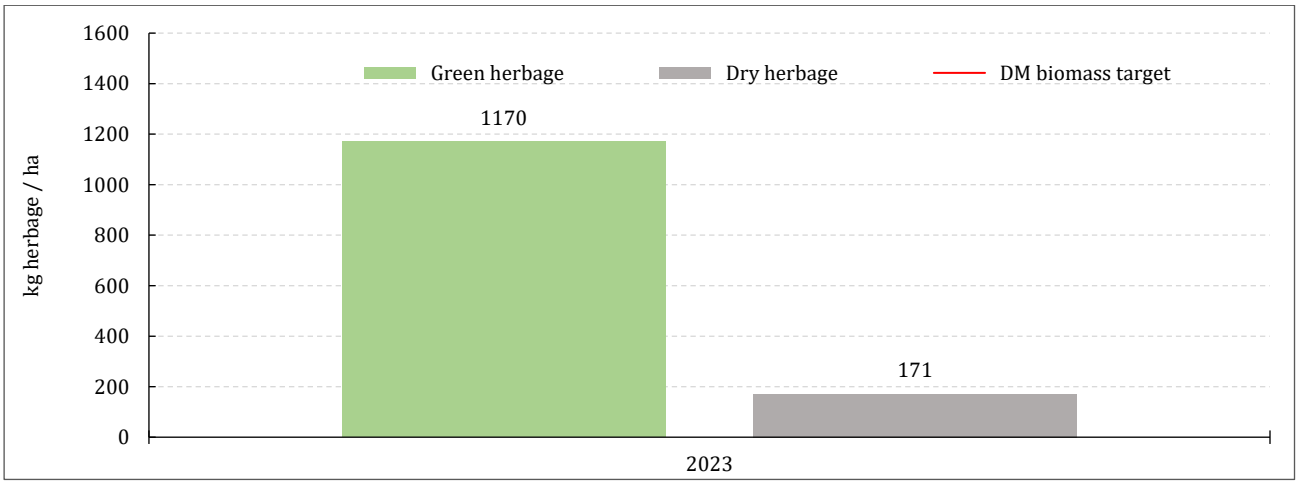
Reflecting the decrease in rainfall compared to 2022, herbage biomass at P3 decreased in 2023 to approximately ~2,346 kg DM/ha, i.e. maintained its exceedance of the minimum productivity benchmark of 1,500 kg DM/ha (**Graph 7**). Results of the past few years testified of the excellence resilience of the Class III pasture system, especially following the 2016-2019 drought where very low productivity levels were recorded.

A new unclassified pasture plot was established in Zone 8 during 2023. The herbage biomass target in 2023 is approximately ~1,170 kg DM/ha. The result for biomass achieved in Zone 8 (**Graph 7 & Graph 8**) are consistent with the area being direct seeded in December 2023, one month prior to sample collection, and is currently within the establishment phase. Since this is the first year of data collection no comparisons are available currently.

Consistent with last year, the sampled herbage from P3 and PR4 in 2023 showed a high moisture content (66.6% and 85.3% respectively), as showed by the difference between the green and dry biomass levels. The herbage from P3 showed a much lower moisture content than PR4 due to its later growth stage. The results for PR4 indicate that the herbage at the time of monitoring was at the early vegetative stage with a high leaf-to-stem ratio. This is consistent with the December 2023 ripping and direct seeding for this new rehabilitation zone. The bulk of the biomass having likely established in response to recent rainfall received during the weeks preceding the monitoring.



Graph 7 Pasture biomass monitoring results P3 (2014-2023)



Graph 8 Pasture biomass monitoring results PR4 (2023)

4.1.6.2 Feed quality and carrying capacity

The feed quality testing results are summarised in **Table 6**, which also includes calculations of potential carrying capacities for a 450kg dry stock cattle enterprise[7]. For further reference, the detailed laboratory report is provided in **Appendix D**. (Note that monitoring for feed quality only started in 2018).

[7] NB: the calculations of stocking rates were made with due consideration to the following:

- Stocking rates were calculated using the amount of feed available, the ME content of the feed and the average monthly feed requirement of dry cow livestock.
- In the Hunter Valley, the average energy requirements for dry stock are approximately 54.0 MJ/day (from NSW DPI, 2006b), which equates to 1,620 MJ/month.
- Adjustments were made to the recorded amount of herbage biomass to account for pasture residue (cattle don't graze to ground level) as well as inevitable herbage wastage associated with trampling, animal manure, etc. Wastage of ~25% can reasonably be expected and that amount was therefore deducted from the total available herbage biomass.

Table 6 Feed quality testing results and potential pasture carrying capacity (2018-2023)

Metric		2018	2019	2021	2022	2023
Dry matter digestibility (%)	P3	72	55	56	45	42.9
	PR4	-	-	-	-	67.9
Crude protein content (%)	P3	22.2	12.8	6.6	6.8	6.3
	PR4	-	-	-	-	26.6
Metabolisable energy (MJ/kg DM)	P3	11.7	7.9	7.8	6.1	5.9
	PR4	-	-	-	-	9.9
Feed available (kg DM/ha)	P3	650	1,170	5,350	4,340	2,346
	PR4	-	-	-	-	1,170
Potential stocking rate (animal / ha)	P3	3.5	4.3	19.3	12.3	10.7
	PR4	-	-	-	-	4.1
Phosphorus	P3	-	-	-	-	980
	PR4	-	-	-	-	20

The potential carrying capacity of the Class III pasture in 2023 was calculated at ~10.7 dry cow/ha for P3 and 4.1 dry cow/ha for PR4. This is less than last year at P3 (~12.3 dry cow/ha) due to the lower amount of feed available and the slightly lower metabolizable energy contained in the sampled forage; however this remains much greater than the average carrying capacity of a similar pasture in the Hunter region (NSW DPI, 2006b).

However, it must be noted that the productivity levels and stocking rates reported here only apply to the pasture under no active grazing regime or pressure. If the pasture was actively grazed, available herbage biomass would rapidly reduce and accordingly so would stocking rates.

4.2 Walkover Audit Inspection

No specific observations were made within the Class III or unclassified pasture areas during the walkover inspection.

No issues of stability, drainage or weed incursions were recorded; and vegetative performance was generally uniform throughout and consistent with the data collected at the monitoring transect.

4.3 Compliance Assessment

Based on the 2023 monitoring results and observations as presented in the previous sections, **Table 7** provides an assessment of rehabilitation progress against the relevant completion criteria defined in the RMP (2023) for the 'Class III Pasture' domain and 'unclassified Pasture' domain.

Table 7 Progress against RMP completion criteria – Class III, unclassified Pasture

Completion criteria	Progress as of 2023	Compliant
No uncontrolled access and demarcations present	No uncontrolled access evidenced. The Class III area remains fully fenced (since grazing trials were implemented) and all fences/gates are in good condition	Yes
No visible signs of instability (slumping/cracks) requiring maintenance	Area stable with no signs of instability	Yes
No erosion rills, gullies or tunnel erosion requiring maintenance	Area stable with no signs of active erosion	Yes
No active erosion within water management structures requiring maintenance	Not applicable – no water management structure in the Class III domain	Yes
No evidence of contamination	No hazardous or problematic materials were observed or recorded during the walkover inspection	Yes
Surface runoff diverted to neighbouring drainage lines	No surface runoff from the Class III pasture area leaves the site, i.e. all surface flows report to adjoining rehabilitation area and water management structures downslope.	Yes
Water quality of surface runoff within parameters suitable for pasture land use	Not assessed – outside the scope of this monitoring program	n/a
Landform compliant with approved final landform	Not assessed – outside the scope of this monitoring program	n/a
Water / sediment management structures installed as per design	Not assessed – outside the scope of this monitoring program	n/a
No surface rocks present that impede the post-mining land use	No large surface rocks present	Yes
Soil properties are appropriate for pasture growth	Soil tests results show minor exceedances of the target range for the following parameters at PR4. • pH • EC • CEC	Trending (newly established)
Vegetative cover comparable to similar native woodland in the region	P3 - Good vegetative cover with no bare ground recorded in 2023 (78% projected live cover + 22% projected litter cover) PR4 – Pasture is in the establishment phase with 13% projected live cover	Yes
Presence of a diversity of grasses and legumes from the species mix	Eight suitable species present, including five C4 perennial grasses and three legumes. Pasture biomass largely dominated by Guinea Grass and Kikuyu	Yes
Pasture composition comparable to similar pasture areas within the region	Not assessed – the monitoring program currently does not include corresponding analogue sites against which this criterion can be assessed. Suitable comparable analogue	n/a

Completion criteria	Progress as of 2023	Compliant
	sites unlikely to exist in the region where grazing lands are dominated by unimproved native pastures	
Weed coverage comparable to similar pasture area within in the region	The monitoring program currently does not include corresponding analogue sites against which this criterion can be assessed. However, recorded weed cover levels were very low in 2023 (~5.1% at P3 and 3.6% at PR4) and deemed acceptable / satisfactory.	Yes
No species with known toxicity to grazing stock	One species recorded with known potential toxicities to livestock (Johnson grass).	No
Pasture productivity comparable to regional averages	Pasture in its current (un-grazed) condition has a productivity exceeding regional averages.	Yes
Surface organic litter present	Yes – organic litter is present across the soil surface in P3 (grass litter and mulch). PR4 currently has no organic litter present due to being seeded in December 2023.	Yes
No increasing trends in feral pest populations and species diversity	Rabbit digging and pellets were observed in P3.	No

5. Results – HDWV

Notes:

Wherever possible, a differentiation is made throughout the following section between 'historic' rehabilitation and 'new' rehabilitation (i.e. areas recently reworked under the RMP).

In addition, and for practicality in reporting and legibility purposes, monitoring results from the past three to four monitoring events only have been included in the graphed results and data.

Where older monitoring data exist for monitoring sites, previous years reports can be referred to for longer-term trends in rehabilitation condition.

5.1 Transect-based Monitoring

5.1.1 Photographic Monitoring

For reference, photographs taken in 2023 from the permanent photo points at the start and end of the 50 m transect line are provided in **Appendix A**.

The photographs depict the visual condition of the monitoring site at the time of the 2023 monitoring, which can be compared with previous monitoring years (supplied in previous annual monitoring reports) to determine evolution and changes in vegetation establishment and condition over time.

5.1.2 Erosion

Consistently with previous years, soil and slope stability were excellent at most monitoring sites with limited active erosion processes recorded. A few instances of rill, tunnel, and sheet erosion were recorded and are likely to require ongoing management.

Erosion was recorded at the following locations of the following type.

HDWV 37 – tunnel, HDWV 42 – rill, HDWV 32 – rill, HDWV 22 – tunnel, HDWV 30 – rill, HDWV 31 – rill, HDWV 38 – rill, HDWV 35 – rill, HDWV 28 – rill, HDWV 08 – sheet.

Tunnel erosion was recorded at two monitoring sites (HDWV 37 and HDWV 22) the extent was minor and attributed to the recent change from wet to dry conditions resulting in soil cracking. Tunnel erosion can be a result of soil chemistry, particularly soils with greater than 6% exchangeable sodium which can be prone to dispersion. The soils recorded during the 2023 monitoring, where tunnel erosion was noted do not have high exchangeable sodium and are limited to areas of topsoil spreading. Therefore, it is believe that the tunnel erosion is linked to physical transport of clay particles rather than chemical dispersion. All tunnel erosion was localised and relatively minor in nature, however the occurrences should be monitored regularly and assessed for repairs, since this is a trend from previous monitoring reports in these same areas.

Superficial rill erosion (channels <30 cm deep) was recorded at seven recently reworked monitoring sites (HDWV 42, HDWV 32, HDWV 30, HDWV 31, HDWV 38, HDWV 35 and HDWV 28). Three of these sites (HDWV 32, HDWV 38 and HDWV 42) were recorded in 2022 as also exhibiting minor erosion These consistently occurred in locations where no topsoil was applied and where vegetative ground cover levels remained very limited at the time of monitoring. All the rill erosion occurrences are classified as stabilised due to the establishment of minor groundcover vegetation. With further establishment this may continue to self-stabilise over time as vegetation in all strata further establishes, which will need to be confirmed during the next monitoring events.

The site audit walkover returns opportunistic findings of gully erosion as presented in **Table 11**.

5.1.3 Ground Cover Protection

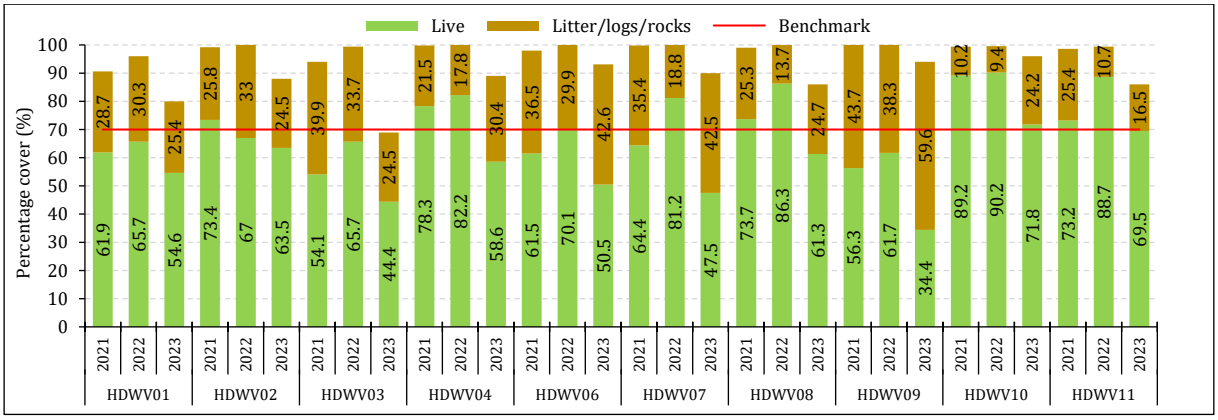
Trends in ground cover protection since 2021 are depicted in **Graph 9** (historic rehabilitation areas) and **Graph 10** (new rehabilitation areas).

Protective ground cover dropped in 2023 likely a result of less favourable climatic conditions in the latter half of 2023 and the delayed time in which the monitoring took place. Protective cover remained above the 70% minimum cover benchmark at all but one historic rehabilitation area where HDWV03 fell just below benchmark to ~68.9%. The remainder of the historic sites ranged between 80-96% with an average across all historic rehabilitation areas of 79.2%, significantly lower than the 2022 average of 99.4%.

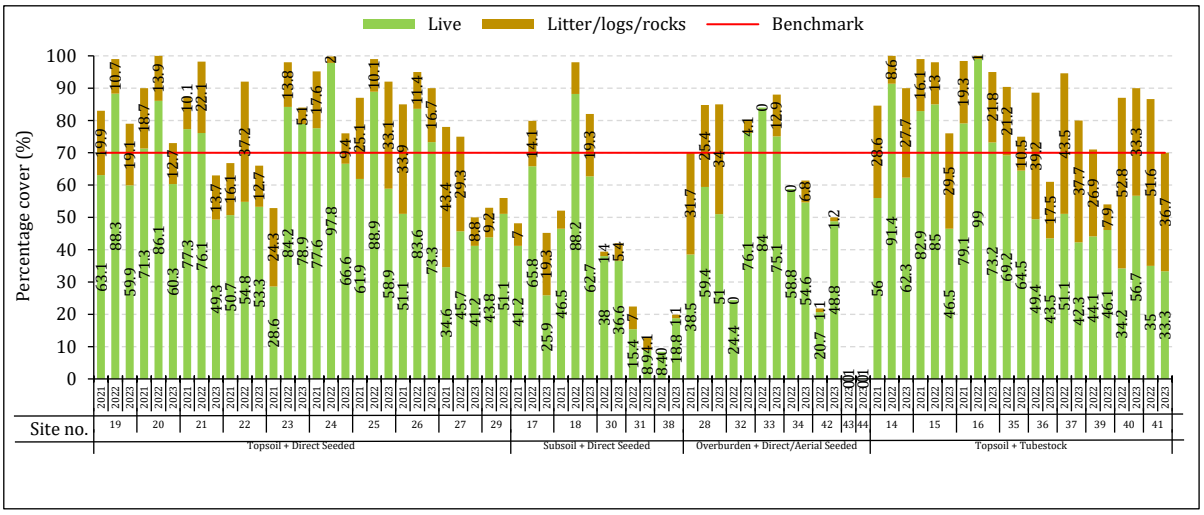
Ground cover levels across new rehabilitation areas were more variable which reflected both the various revegetation techniques and the age since revegetation. In total, the 70% cover benchmark was met at 17 of the 31 monitoring sites at the time of monitoring (as opposed to 19 of 29 sites in 2022). The following variations were observed between the monitoring sites in 2023:

- 'Topsoil + direct seeded' areas: protective cover ranged between 50-92% (average ~72.9% for all sites), with four in ten sites not meeting the target benchmark.
- 'Subsoil + direct seeded' areas: protective cover ranged between 13-82% (average ~40.4% for all sites), with four of five sites not meeting the target benchmark.
- 'Overburden + direct/aerial seeded' areas: protective cover ranged between 0.1-88% (average ~52.1% for all sites), with four of seven sites not meeting the target benchmark. Consideration must be given here to two sites being recently established and seeded just prior to the monitoring period resulting in a reduced average.
- 'Topsoil + tubestock' areas: protective cover ranged between 54.0-95.0% (average ~76.8% for all sites), with all two of eleven sites failing to meet the target benchmark.

Overall, results continue to show that cover levels appeared more variable and inconsistent in areas seeded in overburden or subsoil substrates, where vegetative ground cover establishment is likely inhibited by the lack of topsoil. These areas will need to be closely monitored in coming years.



Graph 9 Ground cover protection (2020-2023) – HDWV (historic rehabilitation)



Graph 10 Ground cover protection (2020-2023) – HDWV (new rehabilitation)

5.1.4 Soil Properties

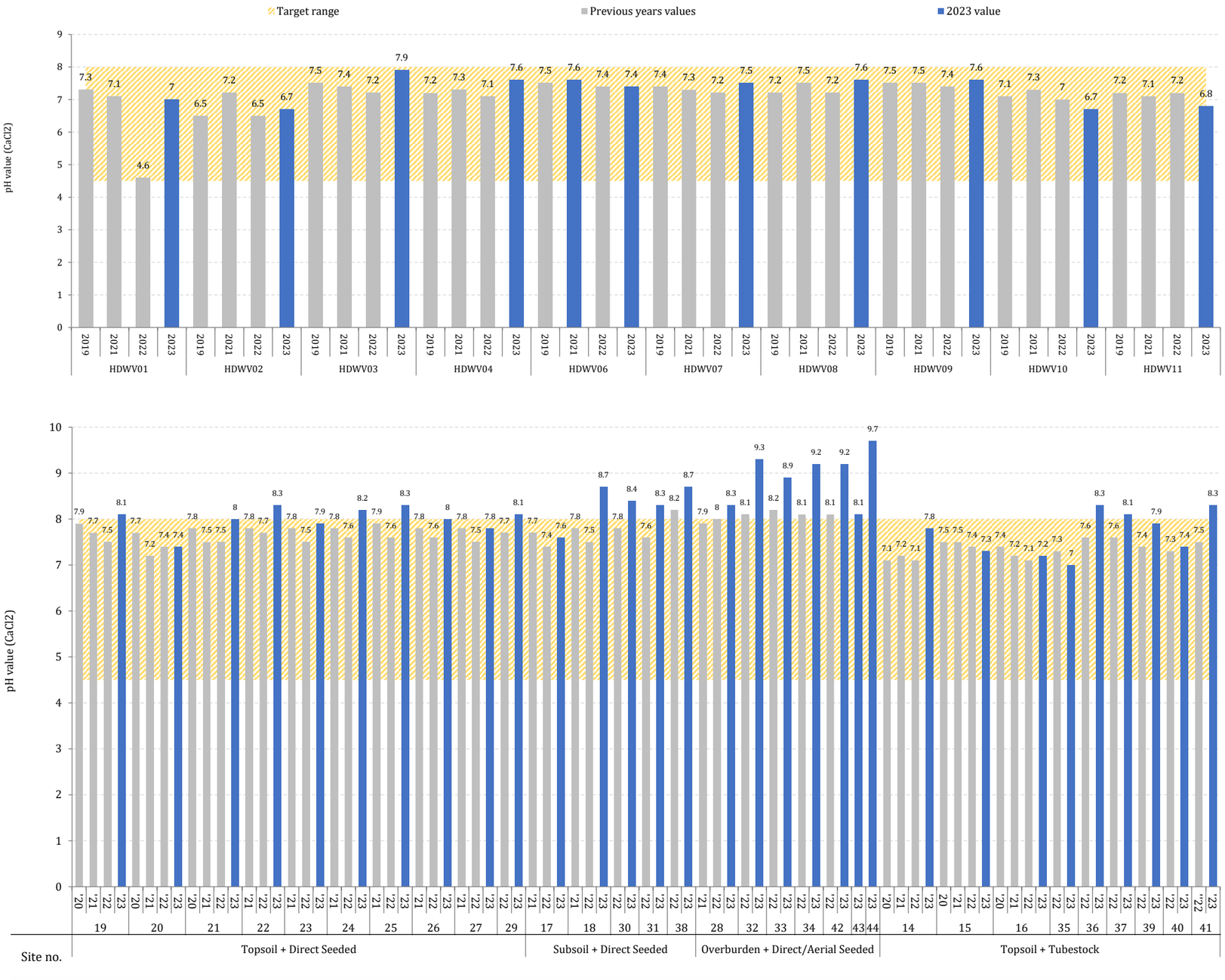
Soil testing results for pH, salinity, sodicity and cation exchange capacity are presented in **Graph 10** (detailed laboratory analysis report is provided in **Appendix B**). Note that soil sampling was not consistently implemented across historic monitoring sites in 2020, therefore results from 2019 have been included in their stead.

Key findings from the soil testing program are highlighted in the following table.

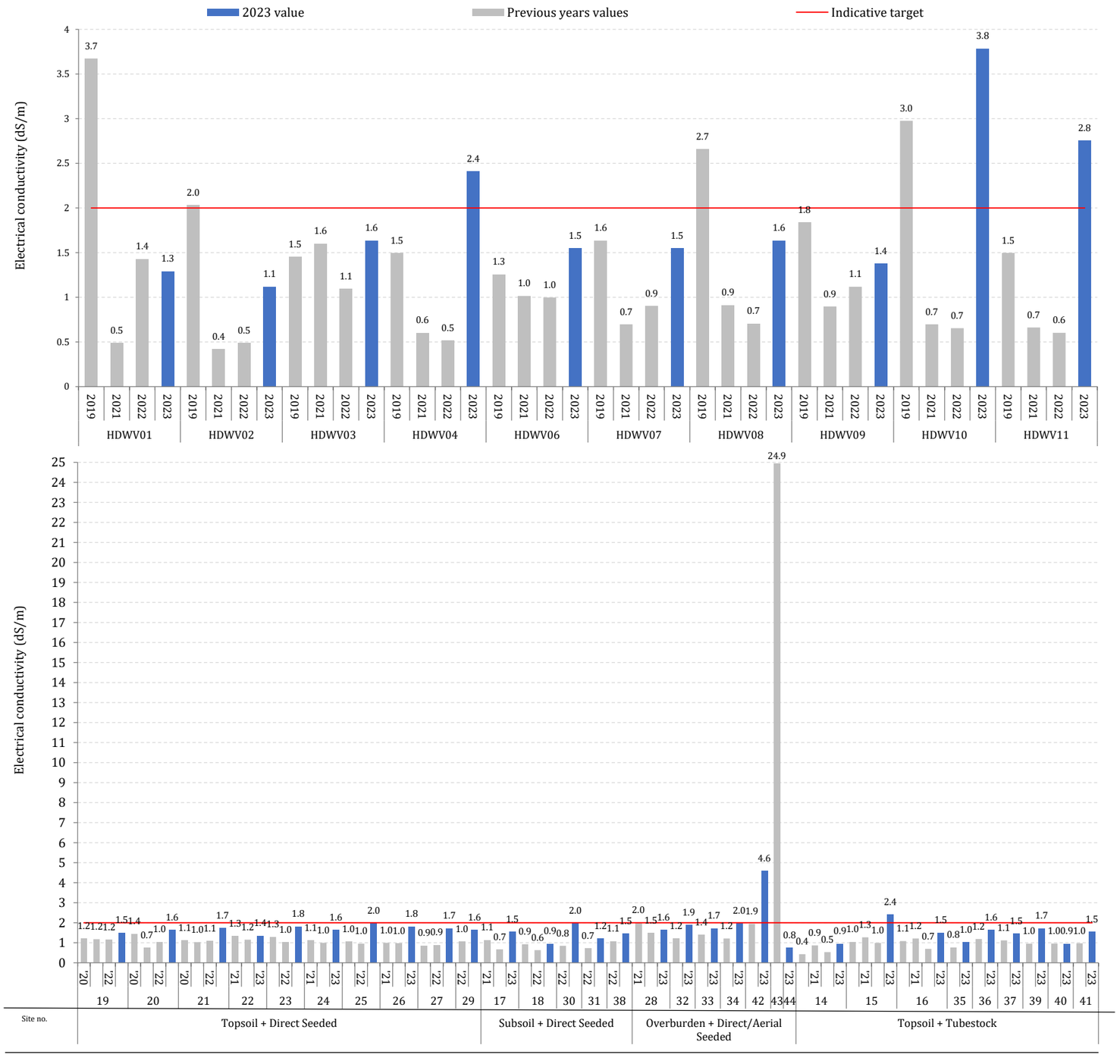
Soil acidity – pH	Soil pH levels recorded in 2023 ranged between 6.7-9.7 (i.e. moderately acidic to moderately alkaline), with 27 of the 41 sites being within acceptable range for native vegetation growth (i.e. 4.5-8.0). Most sites falling marginally outside the upper target range were in areas seeded in subsoil or overburden due to the alkalinity of these substrates – however none of the pH levels were highly alkaline to the point that plant growth would be affected with the exception of 44 with a pH of 9.7. Sites 19, 22, 24, 25, 29 and 41 are all seeded in topsoil, and are at or marginally above the upper target limit for pH. None of the pH levels were highly alkaline to the point that plant growth would be expected to be affected. Most previously monitored sites showed only minor seasonal variations since last year, except for HDWV01, HDWV32, HDWV42, HDWV36 and HDWV41. HDWV01 shows a sudden increase in alkalinity in 2023 (from 4.6 in 2022 to 7 in 2023). This is close to the 2021 results of 7.1. HDWV32 shows a sudden increase in alkalinity in 2023 (from 8.1 in 2022 to 9.3 in 2023) HDWV42 shows a sudden increase in alkalinity in 2023 (from 8.1 in 2022 to 9.2 in 2023). HDWV36 shows a sudden increase in alkalinity in 2023 (from 7.6 in 2022 to 8.3 in 2023). HDWV41 shows a sudden increase in alkalinity in 2023 (from 7.5 in 2022 to 8.3 in 2023) None of these sites is currently within acceptable range, the reasons for this change are uncertain and this will have to be monitored in the next monitoring events. All other sites generally returned a neutral to slightly alkaline pH levels, which is higher than typical soil profiles in the region (which are moderately acidic) but within acceptable range for plant establishment and growth.
Soil salinity – electrical conductivity (**EC**)	Consistent with last year, soil salinity levels in 2023 were low at most locations and comprised between 0.8-2.0 dS/m, i.e. within values considered as non-saline and unlikely to restrict vegetation establishment and growth. However there were six sites with highly elevated levels above the target criteria of salinity ranging from 2.4 to 24.9 dS/m. Five of the six a minor exceedances not considered likely to impact plant establishment or growth. HDWV43 had a very high salinity level of 24.9 dS/m. This site is newly established on overburden material and salinity levels are expected to normalise over time. The reason for past rehabilitation areas on overburden not returning results this elevated is unknown. This will have to be monitored in the next monitoring events, and downslope vegetation and surface water monitored for impacts from high levels of salinity.
Soil sodicity – exchangeable sodium percentage (**ESP**)	All sites were non-sodic and returned very low ESP (exchangeable sodium percentage) levels in 2023 – for a satisfactory performance. Potential sodicity issues discussed in 2022 recorded for all areas seeded in overburden (five sites) and at one site (of five) seeded in subsoil substrate (HDWV38) no longer present elevated levels.
Soil fertility – cation exchange capacity (**CEC**)	Soils CEC showed natural seasonal variations at most sites in 2023 (CEC levels are influenced by clay content and organic matter levels, and seasonal fluctuations are common), and ranged from slightly high 7.4 meq/100g to a very high 48 meq/100g. The indicative target of >6 meq/100g (which is deemed adequate for areas being returned to native vegetation where land productivity is not a concern) was achieved by all 41 of the monitoring sites. Of these, 4 sites returned a moderately low CEC (6.0-12 meq/100g) and 14 sites a moderate CEC (12.0-20.0 meq/100g). The remaining 24 sites returned a good CEC (>20 meq/100g). Site HDWV07 has achieve the completion criteria of 28 meq/100g. CEC levels on average appeared somewhat lower in areas seeded in overburden and old rehabilitation areas, reflecting the lower fertility of the overburden substrate and declining fertility of older rehabilitation areas, albeit still well within the target range. However, CEC levels in all other locations showed no evident differences based on substrate (topsoil vs subsoil. Finally, the extremely low value recorded at the topsoiled HDWV39 monitoring site (0.6 meq/100g) during the 2022 monitoring has rebounded to 25 meq/100g and is now within the target range.

Soil fertility – organic matter content (**OM**)	Soil OM (Organic Matter) levels were highly variable between all samples in 2023, ranging from 1% to a very high 6.8% and generally reflecting the varying levels of vegetation establishment across locations. Soil OM levels are greatly influenced by the rate of plant material being returned to the ground (i.e. litter) and should progressively increase as vegetation further establishes across the rehabilitation. Of the 43 monitoring sites tested in 2023, 7 returned OM content considered as low (<1.7%), 19 sites as moderate (1.7-3.1%), 7 sites as high (3.1-4.3%) and 8 sites as very high (>4.3%). Most sites only showed minor seasonal variations in results from last year, however OM levels at least doubled at nine of the sites. This correlates to an increase in soil pH and CEC at many of these sites indicating an increased decomposition rate of plant residues.

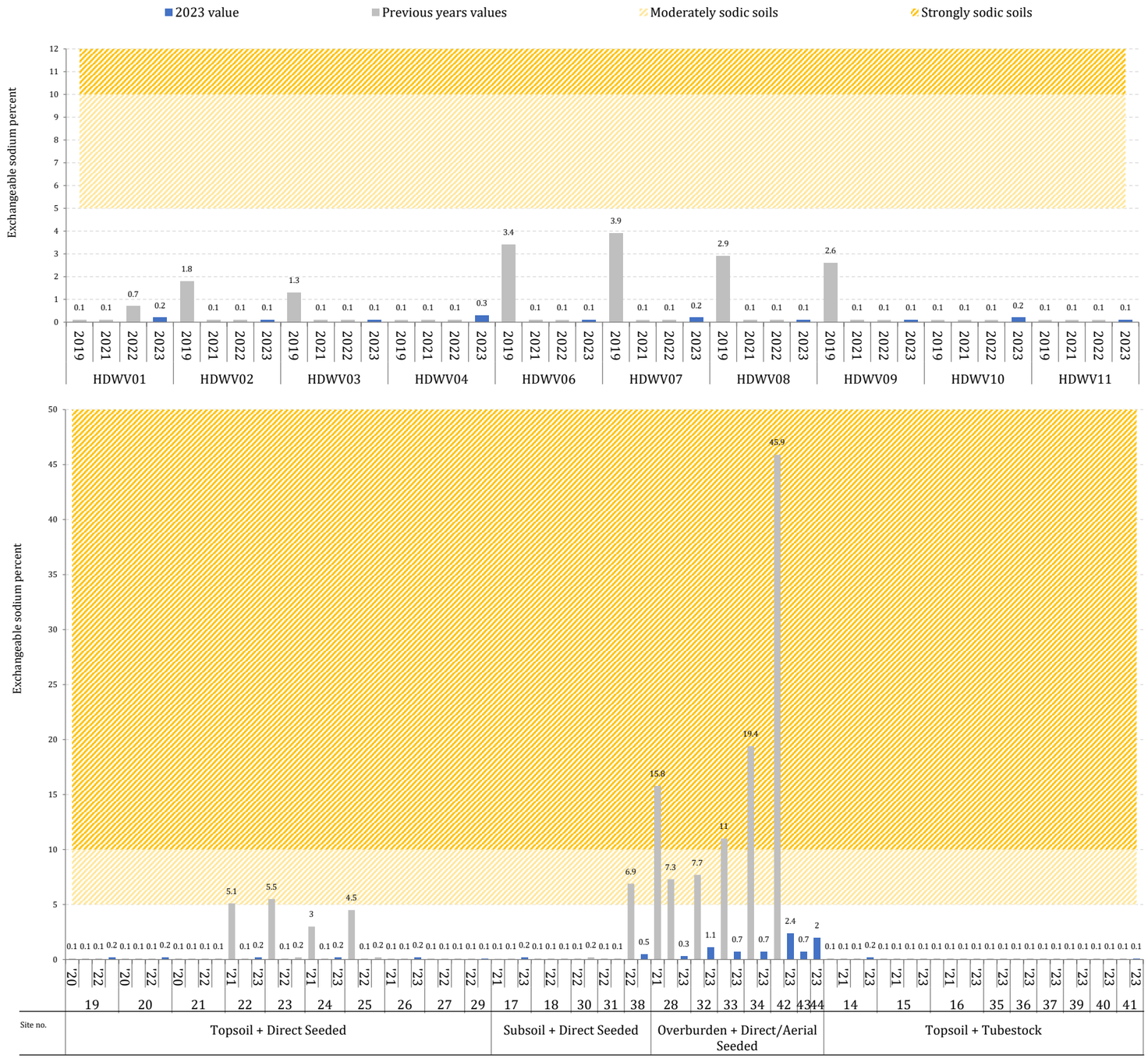
Soil acidity – pH



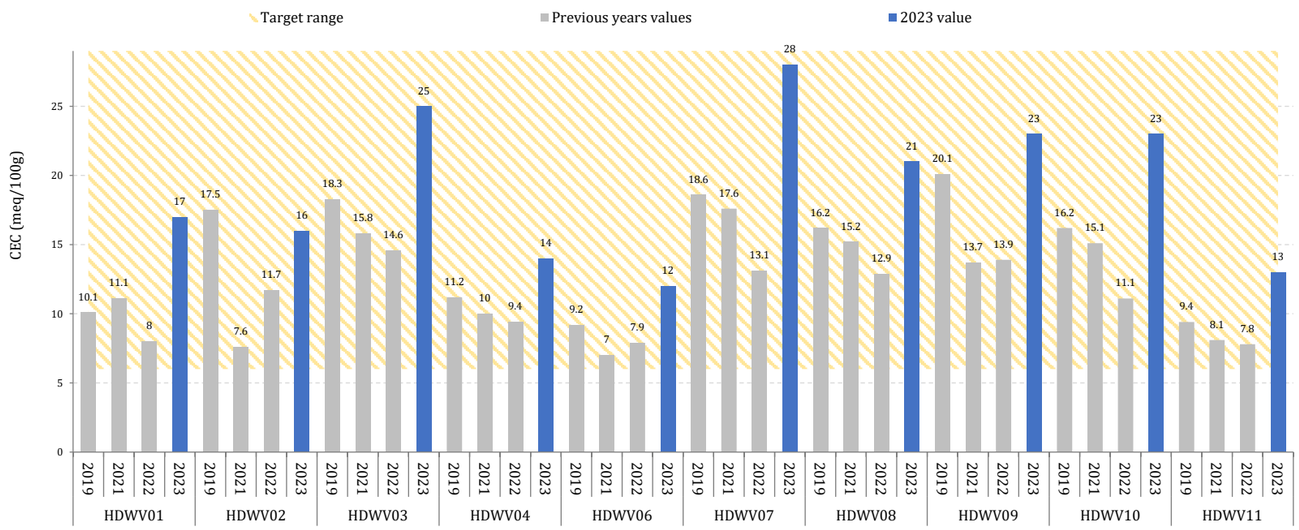
Soil salinity – Electrical conductivity

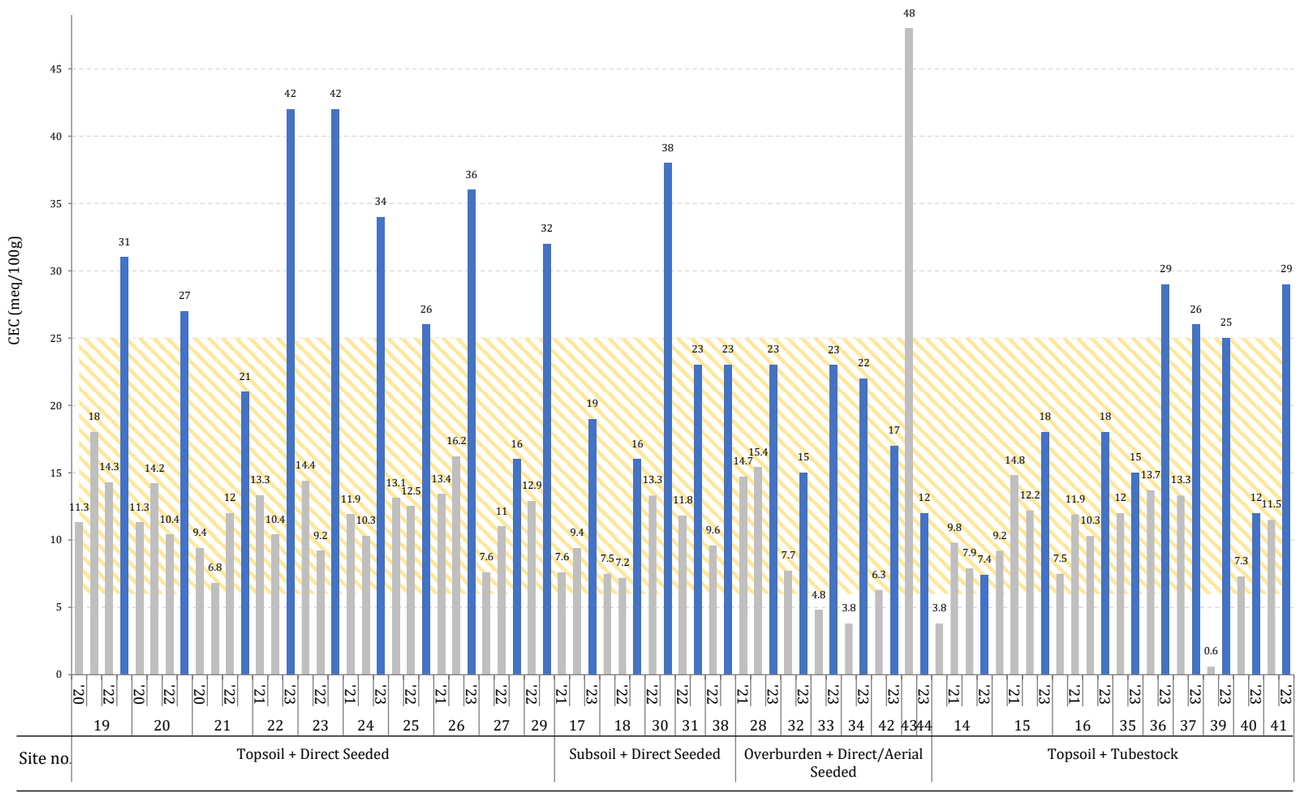


Soil sodicity – Exchangeable Sodium Percent

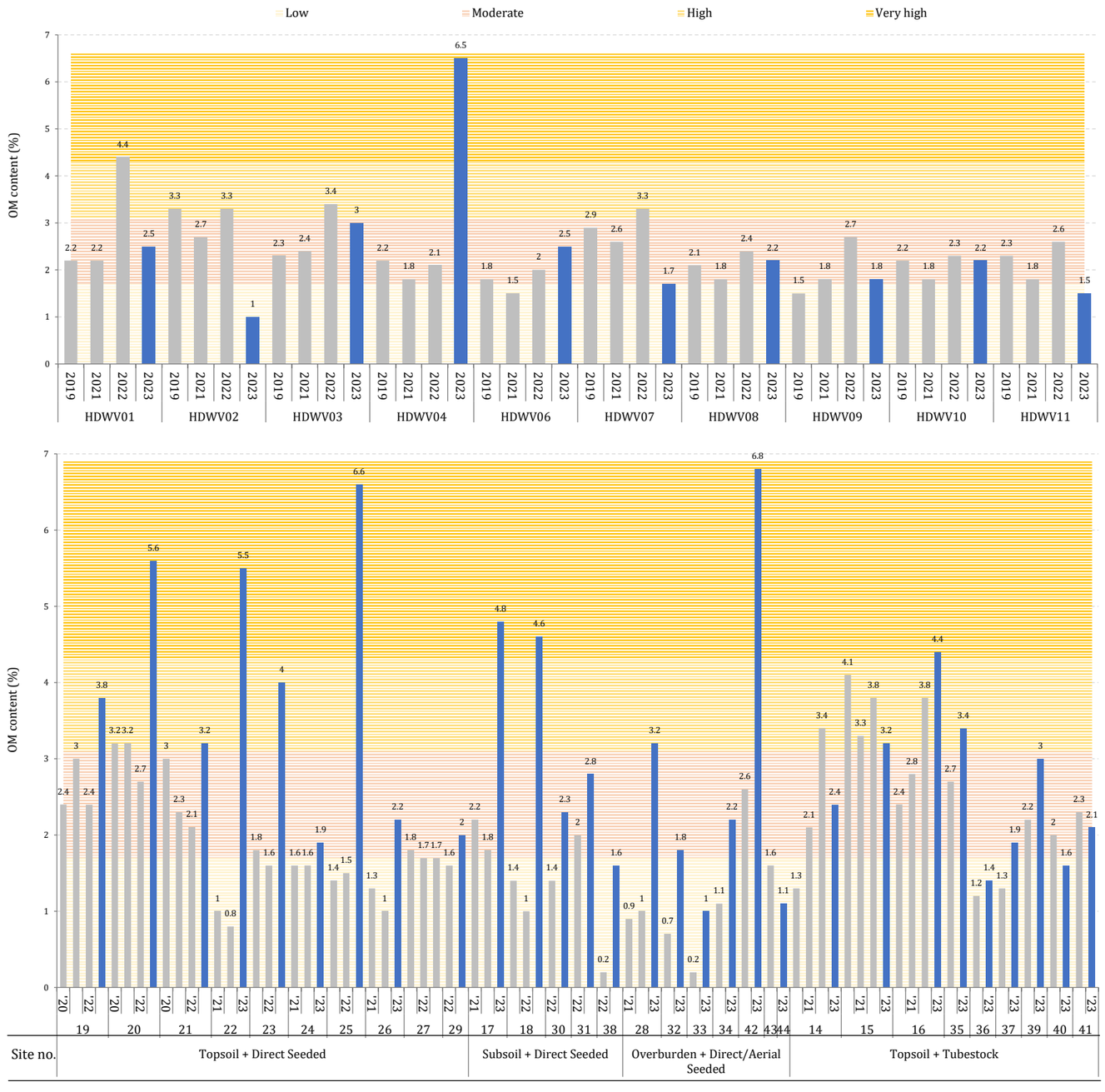


Soil fertility – Cation Exchange Capacity





Soil fertility – Organic Matter Content



Graph 11 Soil properties monitoring results (2020-2023) – HDWV.

5.1.5 Floristics

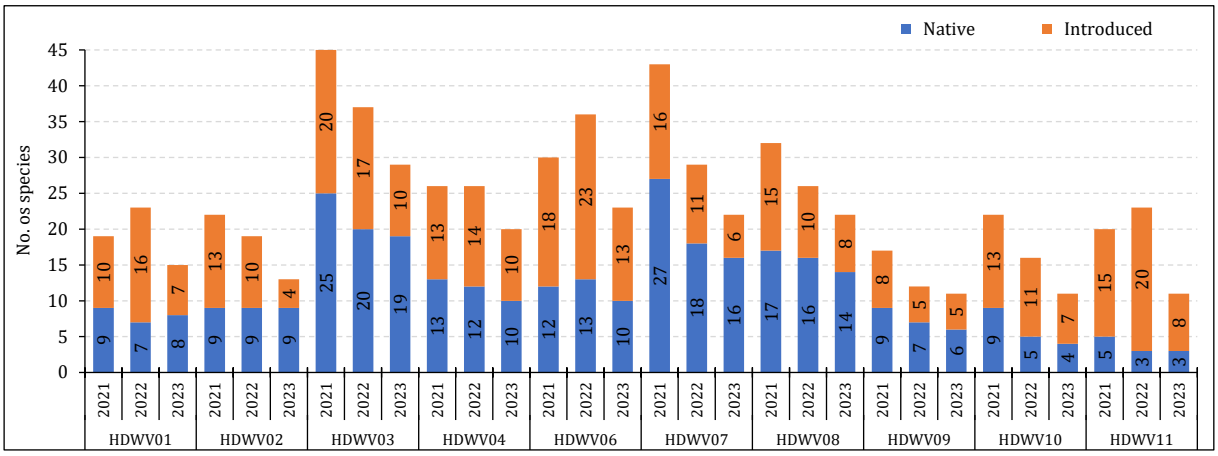
Trends in total species richness since 2021 are depicted in **Graph 12** (historic rehabilitation areas) and **Graph 13** (new rehabilitation areas), with detailed 2023 floristic monitoring results included in **Appendix C** for further reference.

Total species richness recorded in 2023 at the monitoring sites was highly variable and ranged between 1-31 species for an average of ~18.7 species per site. Even when considering that recently created HDWV43 and HDWV 44 sites consisted of sprouting seedlings, this was considerably down in 2023's results (range 11-43 species, average ~27.5 species/sites), and indicates that floristic composition across the rehabilitation zones has experienced significant seasonal fluctuation in the past 12 months likely reflecting the change in weather conditions in the latter half of 2023. Furthermore, the survey was undertaken in the second fortnight of January, approximately 2 months later than previous monitoring periods in late spring which would have compounded the effects of a drier and warmer than average season with the heat of mid-summer resulting in many species of herbs and legumes dying off prior to the survey.

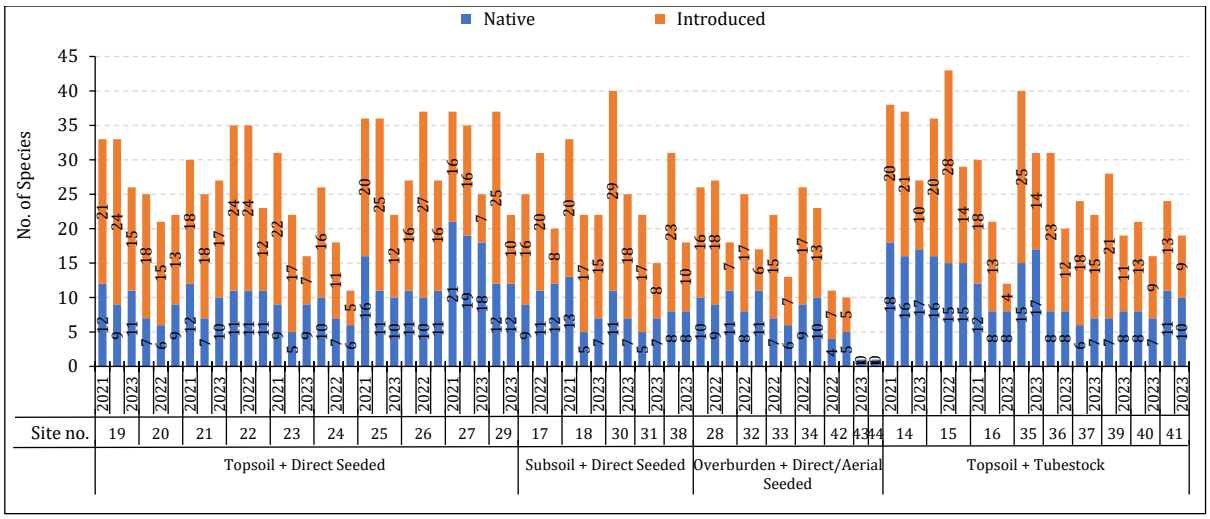
The representation of native species (in proportion of total species richness) has increased to an average of ~51.8% across all sites (compared to an average of ~35.3% in 2022) and ranged between 27.3-100% (100% being recently seeded sites 43 and 44 where seedlings of a single native grass species were the only species present). These results indicate that native species in the establishing vegetation communities across the rehabilitation zones have increased in proportion to exotics in 2023, however, this is not via an increase in native diversity. In contrast to 2022, the drier conditions have resulted in a disproportionate reduction in exotic ground covers recorded which may indicate a resilience to the variation in weather conditions by native species. Nevertheless, ground cover species continue to be dominated by introduced/exotic species.

The following variations were observed in 2023 based on revegetation techniques and age of rehabilitation:

- 'Topsoil + direct seeded' areas (historic rehabilitation): range 11-29 species (average 17.7 species/site), average proportion native species ~53.6%.
- 'Topsoil + direct seeded' areas (new rehabilitation): range 11-27 species (average 22.1 species/site), average proportion native species ~49.2%.
- 'Subsoil + direct seeded' areas (new rehabilitation): range 15-25 species (average 20 species/site), average proportion native species ~42.2%.
- 'Overburden + direct/aerial seeded' areas (new rehabilitation): range 1-23 species (average 11.9 species/site), average proportion native species ~66.5%.
- 'Topsoil + tubestock' areas (new rehabilitation): range 12-31 species (average 21.7 species/site), average proportion native species ~49.6%.



Graph 12 Total species richness (2020-2023) – HDWV (historic rehabilitation)



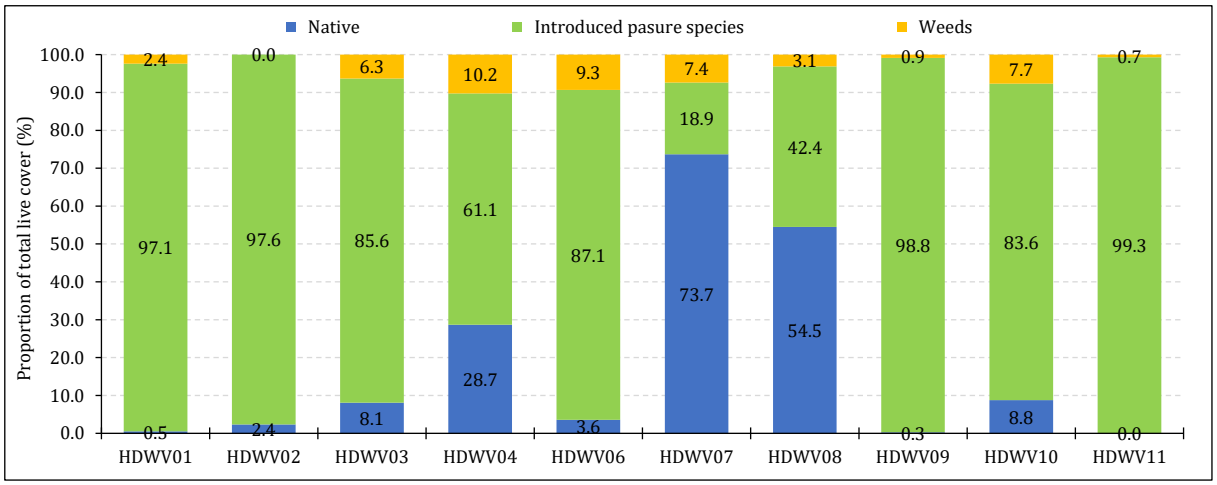
Graph 13 Total species richness (2020-2023) – HDWV (new rehabilitation)

5.1.5.1 Ground Layer

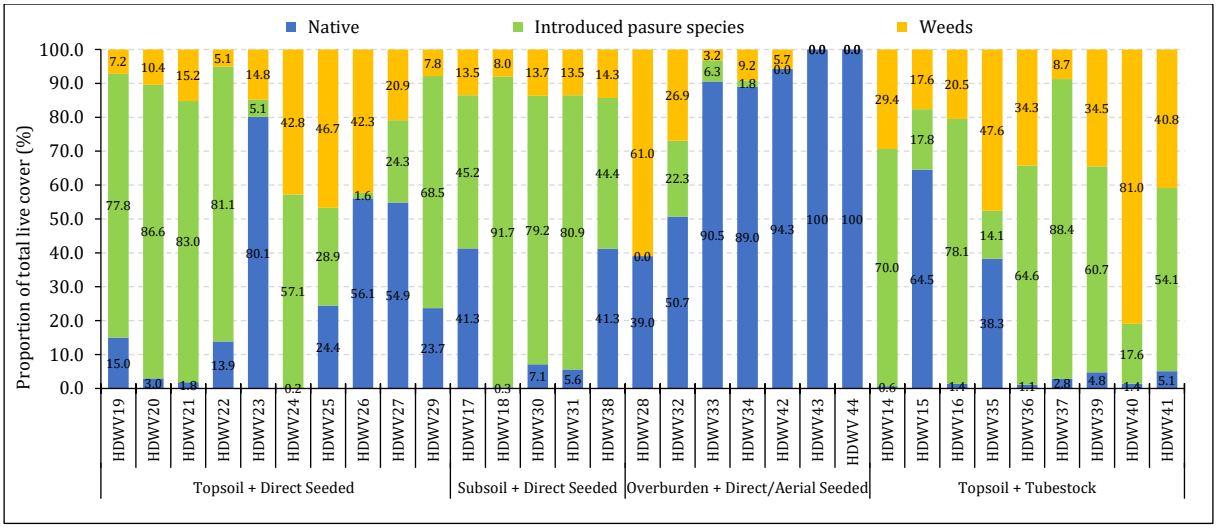
A total of 99 ground cover species were recorded in 2023 across the older rehabilitation areas, comprising:

- 27 grasses – including 17 native species, 5 introduced pasture grasses and 5 weeds.
- 59 forbs – including 14 native species, 5 introduced legumes and 40 weeds.
- 8 sub-shrubs – including 6 native species and 2 weeds; and
- 6 'other' species (twiners, sedges, ferns, etc) – including 5 native species and one weed.

Graph 13 (historic rehabilitation) and **Graph 14** (new rehabilitation) represent the contribution of native species, introduced pasture species and weeds in proportion of the total live cover in the ground layer, as measured in 2023.



Graph 14 Contribution of species types to total live ground cover – HDWV (historic rehabilitation)



Graph 15 Contribution of species types to total live ground cover – HDWV (new rehabilitation)

Consistent with previous years, the ground layer remained very largely dominated by exotic pasture grasses at most sites, representing much of the total live cover at 25 of the 41 monitoring sites. *Megathyrsus maximus* (Guinea grass) continues to be by far the most common and abundant species across the site, with *Chloris gayana* (Rhodes Grass) and *Cenchrus clandestinus* (Kikuyu) also being locally dominant.

Four sites had a predominantly weedy ground cover, with a similar composition of common and locally abundant weed species including *Galenia pubescens* (Galenia), *Lysimachia arvensis* (Scarlet Pimpernel), *Conyza spp.* (Fleabanes), *Plantago lanceolata* (Ribwort Plantain) or *Sida rhombifolia* (Paddy's Lucerne).

Twelve sites displayed a predominantly native ground layer, typically consisting of *Cynodon dactylon* (Common Couch) though other native grasses *Chloris truncata* (Windmill grass) and *Bothriochloa decipiens* (Red grass) also appear to have increased in coverage. Consistent with last year, many of these sites are in areas seeded directly in overburden, where exotic grass seed loads were not imported with topsoil (nor is the nutrient-poor overburden substrate conducive to the establishment of pasture grasses).

Finally, it is important to reiterate that there are currently no approval requirements to re-establish a native ground layer throughout the HDWV rehabilitation. This final land use domain contains a component of grazing and is intended to be accessible to cattle. Productive exotic pasture species suitable for grazing are therefore not regarded as weeds for the purpose of this monitoring program.

5.1.5.2 Mid and Canopy Layers

Mid-storey species (shrubs + small trees) and canopy species (trees) recorded at the monitoring sites in 2022 are presented in **Table 8** (historic rehabilitation) and **Table 9** (new rehabilitation), which also indicate which species are representative of (i.e. naturally found in) the CHGBIW and CHSGIGBF local native communities.

Historic Rehabilitation

Consistent with previous years and the well-established nature of the rehabilitation across historic areas, shrubs and trees diversity remained constant at all historic monitoring sites in 2023 and ranged from two to eleven species (average 7.0 species per site).

A total of 24 mid and upper storey species were recorded across the historic sites comprising 20 NSW native species (8 shrubs, 4 small trees and 8 canopy trees) and 4 exotic species (2 shrubs and 2 canopy trees). Of the 20 native species, 11 species (or 55.0%) were characteristic of the CHGBIW or CHSGIGBF communities.

Overall, six of the ten historic monitoring sites displayed woody species assemblages dominated by species characteristic of CHGBIW and CHSGIGBF (i.e. representing ≥50% of total shrub/tree richness).

As reported in previous years, shrub and tree species assemblages are particularly stochastic across older rehabilitation areas of the OEA, with no evident consistency in established vegetation communities across all areas. This has likely been influenced by different seeding mixes, different topsoil provenance and quality, and different rehabilitation and revegetation methods over time.

New Rehabilitation

The 2023 results continue to show woody species assemblage performance was generally better in areas of new rehabilitation with average preferred species representation between 67.2-87.6%. Consistent with 2022, a total of 25 mid and upper storey species were recorded in 2023, comprising 23 NSW native species (11 shrubs, 2 small trees and 10 canopy trees) and 2 exotic species (all shrubs). Of the 23 native species, 19 species (or 78.3%) were characteristic of the CHGBIW or CHSGIGBF communities.

All 29 monitoring sites displayed woody species assemblages dominated by species characteristic of CHGBIW and CHSGIGBF (i.e. representing ≥50% of total shrub/tree richness). However, woody species diversity and abundance remained highly variable between the monitoring sites based on revegetation techniques employed, as follows:

- 'Topsoil + direct seeded' areas: range 4-10 species (average 6.2 species/site), average species representativeness ~74.3%.
- 'Subsoil + direct seeded' areas: range 4-8 species (average 6.2 species/site), average species representativeness ~67.2%.
- 'Overburden + direct/aerial seeded' areas: range 0-7 species (average 4.0 species/site), average species representativeness ~87.6%.
- 'Topsoil + tubestock' areas: range 4-15 species (average 8.0 species/site), average species representativeness ~78.8%.

The lower percentage of species characteristic of the CHGBIW or CHSGIGBF communities in 2023 can be explained by an increase in regeneration of native species that are not characteristic of the target communities, rather than a reduction in species that are. No additional exotic species were recorded in 2023 and so exotics had little effect on the change in the 2023 results.

Shrub and tree species diversity continue to be, on average, higher in areas planted with tubestock than in all seeded areas (irrespective of the substrate); indicating variable and inconsistent strike rates and germination success where seeding was undertaken.

Table 8 Mid and canopy species composition (2023) – HDWV (historic rehabilitation)

Species (* introduced, ^ priority weed)	Type	GBIW / SGIGBF species?	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11
Acacia concurrens	Small tree	No					X					
Acacia decora	Shrub	Yes						X	X	X		
Acacia decurrens	Small tree	No			X				X			
Acacia implexa	Shrub	Yes		X	X	X		X	X			
Acacia ligulata	Shrub	No					X					
Acacia linifolia	Shrub	No				X						X
Acacia parvipinnula	Shrub	Yes						X				
Acacia salicina	Small tree	Yes	X	X	X	X	X	X	X	X	X	X
Acacia saligna^	Shrub	No	X	X	X							X
*Corymbia citriodora**	Canopy tree	No		X								X
Corymbia maculata	Canopy tree	Yes	X	X	X	X		X	X	X		X
Dodonea viscosa subsp. cuneatea	Shrub	Yes						X		X		
Eucalyptus albens	Canopy tree	No			X				X			
Eucalyptus camaldulensis	Canopy tree	No	X	X	X	X						
*Eucalyptus cladocalyx**	Canopy tree	No	X	X								
Eucalyptus crebra	Canopy tree	Yes	X	X	X				X			
Eucalyptus melliodora	Canopy tree	No	X				X					
Eucalyptus microcarpa	Canopy tree	No				X						
Eucalyptus moluccana	Canopy tree	Yes	X	X	X				X	X		
Eucalyptus tereticornis	Canopy tree	Yes							X			
Hardenbergia violaceae	Shrub	Yes							X			
Lycium ferocissimum^	Shrub	No			X	X		X	X	X	X	
Melaleuca styphelioides	Small tree	No	X									
Solanum cinereum	Shrub	Yes										
Total species		**24**	**9**	**9**	**10**	**7**	**4**	**7**	**11**	**6**	**2**	**5**
Proportion of characteristic species (%)		**45.8**	**44.4**	**60.0**	**50.0**	**42.8**	**25.0**	**87.5**	**72.7**	**83.3**	**50.0**	**40.0**

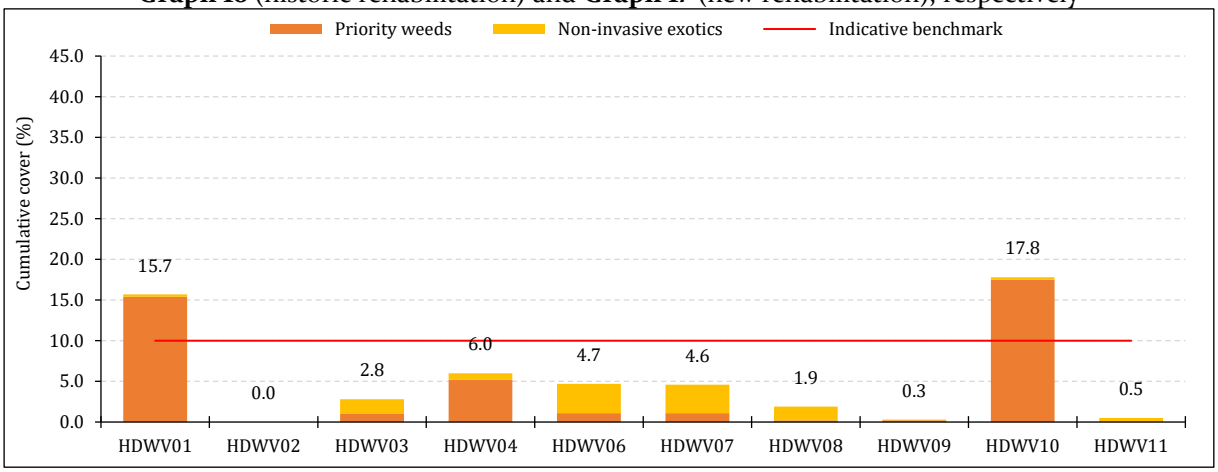
Table 9 Mid and canopy species composition (2023) – HDWV (new rehabilitation)

Species (* introduced, ^ priority weed)	Type	GBIW / SGIGBF species?	Topsoil + Direct Seeded										Subsoil + Direct Seeded					Overburden + Aerial/Direct Seeded							Topsoil + Tubestock								
			HDWV 19	HDWV 20	HDWV 21	HDWV 22	HDWV 23	HDWV 24	HDWV 25	HDWV 26	HDWV 27	HDWV 29	HDWV 17	HDWV 18	HDWV 30	HDWV 31	HDWV 38	HDWV 28	HDWV 32	HDWV 33	HDWV 34	HDWV 42	HDWV 43	HDWV 44	HDWV 14	HDWV 15	HDWV 16	HDWV 35	HDWV 36	HDWV 37	HDWV 39	HDWV 40	HDWV 41
Acacia decora	Shrub	Yes			X				X	X	X		X				X										X					
Acacia decurrens	Small tree	No	X						X		X										X				X	X	X	X		X	X	X	X
Acacia falcata	Shrub	Yes											X												X	X	X						X
Acacia implexa	Shrub	Yes		X	X	X	X	X	X	X	X	X	X	X				X	X	X		X			X	X		X			X		
Acacia linifolia	Shrub	No			X	X	X	X	X	X	X	X	X	X				X	X														
Acacia parvipinnula	Shrub	Yes						X	X	X	X		X	X				X	X		X				X	X							
Acacia salicina	Small tree	Yes	X	X	X						X	X	X	X				X	X		X	X			X			X					
*Acacia saligna^*	Shrub	No		X										X	X	X	X								X								
Corymbia maculata	Canopy tree	Yes		X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X			X	X	X	X	X			X	X
Daviesia genistifolia	Shrub	No																							X								
Dodonaea viscosa subsp. augustifolia	Shrub	Yes																								X		X			X		
Dodonaea viscosa subsp. cuneata	Shrub	Yes																				X			X	X		X	X	X	X		X
Dodonaea viscosa subsp. spatulata	Shrub	Yes	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X				X			X	
Eucalyptus albens	Canopy tree	Yes																							X	X							
Eucalyptus blakelyi	Canopy tree	Yes	X		X		X			X																X	X	X	X				
Eucalyptus camaldulensis	Canopy tree	No		X												X	X											X					
Eucalyptus crebra	Canopy tree	Yes									X				X	X	X			X					X	X	X	X					
Eucalyptus fibrosa	Canopy tree	Yes																							X	X	X						
Eucalyptus moluccana	Canopy tree	Yes																							X	X	X			X		X	
Eucalyptus moluccana x albens	Canopy tree	Yes																													X	X	X
Eucaluptus sp.	Canopy tree	No	X											X																			
Eucalyptus tereticornis	Canopy tree	Yes									X							X								X							
Hardenbergia violacea	Shrub	Yes																											X		X		
*Lycium ferocissimum^*	Shrub	No	X	X											X						X							X		X			X
Solanum cinereum	Shrub	Yes															X		X														
Total species		**25**	**6**	**7**	**6**	**4**	**5**	**5**	**7**	**7**	**10**	**5**	**8**	**7**	**5**	**5**	**7**	**7**	**7**	**4**	**6**	**4**	**0**	**0**	**14**	**13**	**7**	**11**	**5**	**4**	**6**	**5**	**6**
Proportion of characteristic species (%)		**76.0**	**50**	**57.1**	**83.3**	**75**	**80**	**80**	**71.4**	**85.7**	**80**	**80**	**87.5**	**57.1**	**60**	**60**	**71.4**	**85.7**	**85.7**	**100**	**66.7**	**100**	**0**	**0**	**78.6**	**92.3**	**85.7**	**72.7**	**100**	**50**	**83.3**	**80**	**66.7**

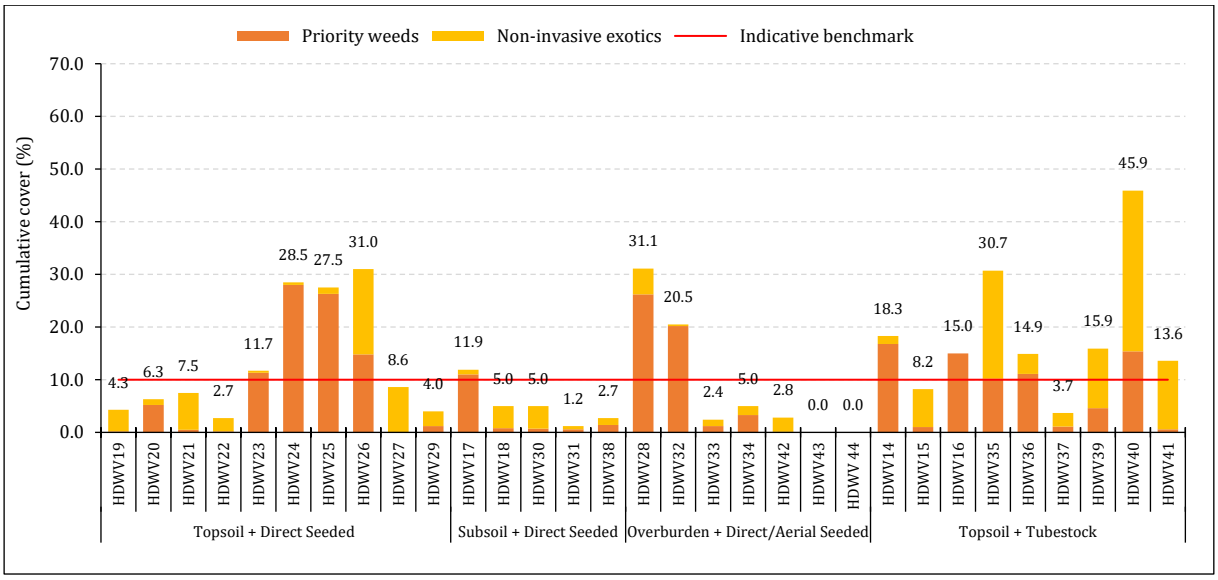
5.1.5.3 Weeds

A total of 52 weed species (i.e. exotic species excluding introduced pasture species) were recorded across all sites in 2023, comprising 44 non-invasive exotics (2 trees, 2 sub-shrubs, 3 grasses and 35 forbs) and nine priority weeds (2 shrubs, 2 grasses and 5 forbs). Priority weeds include *Lycium ferocissimum* (African Boxthorn), *Acacia saligna* (Golden Wreath Wattle), *Sorghum halepense* (Johnson Grass), *Paspalum dilatatum* (Paspalum), *Bidens pilosa* (Cobblers Peg), *Bidens subalternans* (Greater Beggars Tick), *Carthamus lanatus* (Saffron Thistle), *Galenia pubescens* (Galenia), and *Senecio madagascariensis* (Fireweed).

Total cumulative weed cover levels recorded in 2023 (i.e. ground + mid + upper storey[8]) are presented in **Graph 16** (historic rehabilitation) and **Graph 17** (new rehabilitation), respectively



Graph 16 Cumulative weed cover levels 2023 – HDWV (historic rehabilitation)



Graph 17 Cumulative weed cover levels 2023 – HDWV (new rehabilitation)

[8] Ground layer weeds FPC = average weed cover in the 2 m x 2 m quadrats. Mid and upper storey weeds FPC = assessed through the 50 m line intercept method (refer to monitoring methods in **Section 3.1.3**).

The 2023 weed monitoring results indicate a significant reduction in weed population levels with 14 of 41 sites registering weed cover levels between 11.7-45.9% (compared to 24 of 39 sites and range of 10.3-65.8% in 2022) and in exceedance of the 'allowable' 10% cumulative weed cover benchmark. The timing of field monitoring and the direr than average season are likely to account for some of the variation though some sites have had weed control undertaken and would also have influenced the result. As noted in 2022, areas not dressed with topsoil displayed lower weed abundance, as follows:

- 'Topsoil + direct seeded' areas (historic rehabilitation): weed cover range 0-17.8%, average ~5.3%.
- 'Topsoil + direct seeded' areas (new rehabilitation): weed cover range 2.7-31%, average ~13.2%.
- 'Subsoil + direct seeded' areas (new rehabilitation): weed cover range 1.2-11.9%, average ~5.2%.
- 'Overburden + direct/aerial seeded' areas (new rehabilitation): weed cover range 0.0-31.1%, average ~8.8%.
- 'Topsoil + tubestock' areas (new rehabilitation): weed cover range 3.7-45.9%, average ~18.4%.

Fourteen monitoring sites had high levels of priority weeds alone (i.e. those most problematic species) exceeding the 10% target, including:

- HDWV01 (15.4% priority weeds cover) – where Golden Wreath Wattle will need to be controlled;
- HDWV10 (17.5% priority weeds cover) – where Galenia will need to be controlled;
- HDWV14 (16.8% priority weeds cover) – where Galenia will need to be controlled;
- HDWV16 (15.0% priority weeds cover) – where Galenia will need to be controlled;
- HDWV17 (11.0% priority weeds cover) – where Galenia and Golden Wreath Wattle will need to be controlled;
- HDWV23 (11.3% priority weeds cover) – where Galenia will need to be controlled;
- HDWV24 (28.0% priority weeds cover) – where Galenia will need to be controlled;
- HDWV25 (26.3% priority weeds cover) – where Galenia will need to be controlled;
- HDWV26 (14.8% priority weeds cover) – where Galenia will need to be controlled;
- HDWV28 (26.2% priority weeds cover) – where Galenia will need to be controlled;
- HDWV32(20.2% priority weeds cover) – where Galenia will need to be controlled;
- HDWV35 (10.2% priority weeds cover) – where Galenia and African Boxthorn will need to be controlled.
- HDWV36 (11.1% priority weeds cover) – where Galenia will need to be controlled; and
- HDWV40 (15.4% priority weeds cover) – where Greater Beggars Ticks need to be controlled.

Golden Wreath Wattle and Galenia typically respond well to conventional treatments and can successfully be controlled provided adequate resources and control effort.

The prevalence of African Boxthorn was not adequately captured by the line-intercept scores across the monitoring sites due to their location within the 10 m x 50 m sampling zone and subsequently were not included in the graphs and cumulative weed cover figures. They were captured by stem counts and as such should be targeted in vicinity of the following monitoring sites in addition to the opportunistic locations mapped in Figure 2:

- HDWV07
- HDWV10
- HDWV34
- HDWV37; and
- HDWV41.

Only two were exceeding the allowable target due to a high prevalence of non-invasive exotics, mostly annual forbs which have persisted despite the drier conditions. Weed management at these locations are unlikely to be warranted. The abundance of non-invasive exotics will likely continue to reduce naturally over time as canopy foliage cover establishes.

5.1.6 Tree Stems Densities

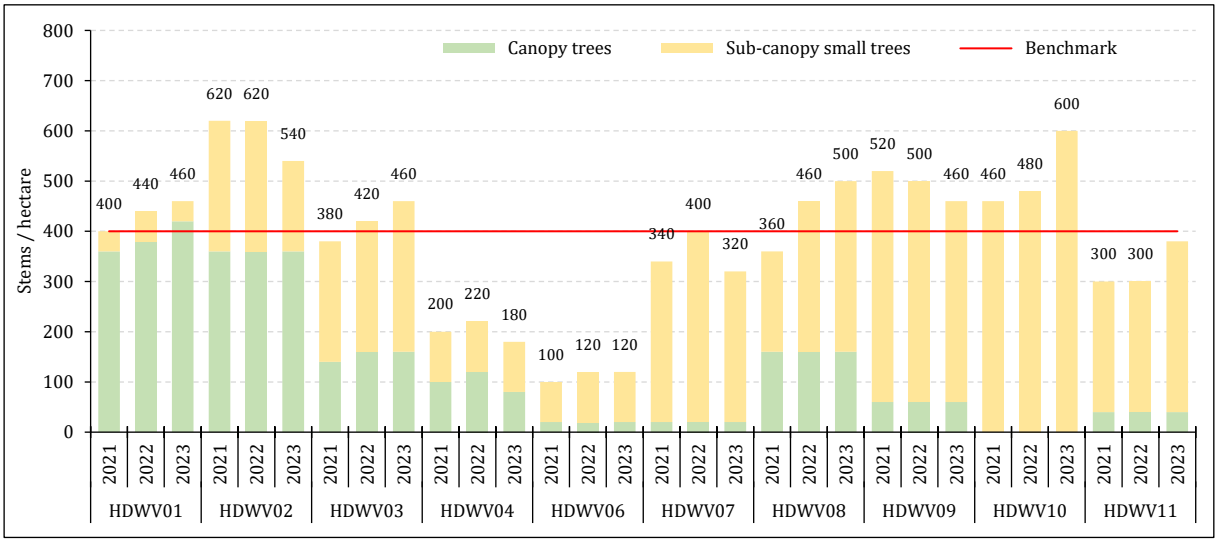
Trends in recorded tree stems densities are presented in **Graph 18** (historic rehabilitation) and **Graph 19** (new rehabilitation).

Historic Rehabilitation

Tree stems densities have shown minimal change from 2022 results, which as noted in last year's report is largely due to the well-established nature of the historic rehabilitation sites. Consistent with 2022, annual variations were largely due to the dieback and/or recruitment in acacia trees which were undoubtedly influenced by inherent variability in observer's interpretation when recording tree stems in the field.

Total stem densities recorded in 2023 ranged from 100 stems/ha at HDWV06 to 620 stems/ha at HDWV02, with an average of ~402 stems/ha which is marginally above the defined target benchmark of 400 stem/ha.

Acacia species continue to dominate the stem count at all but two monitoring sites (HDWV01 and HDWV02) total stem counts continue to the be largely comprised of *Acacia salicina* (Cooba) and not preferred long-lived canopy eucalypt species. As mentioned in the 2022 report, this is not a satisfactory outcome as the species is shorter-lived (~50 years) and will unlikely provide adequate vegetation structure and complexity in the long-term. Supplementary infill tree plantings should be undertaken in other locations, particularly HDWV 04, 06, 07 and 10 to establish eucalypt species commensurate with CHGBIW and CHSGIGBF.



Graph 18 Tree stem densities (2020-2023) – HDWV (historic rehabilitation)

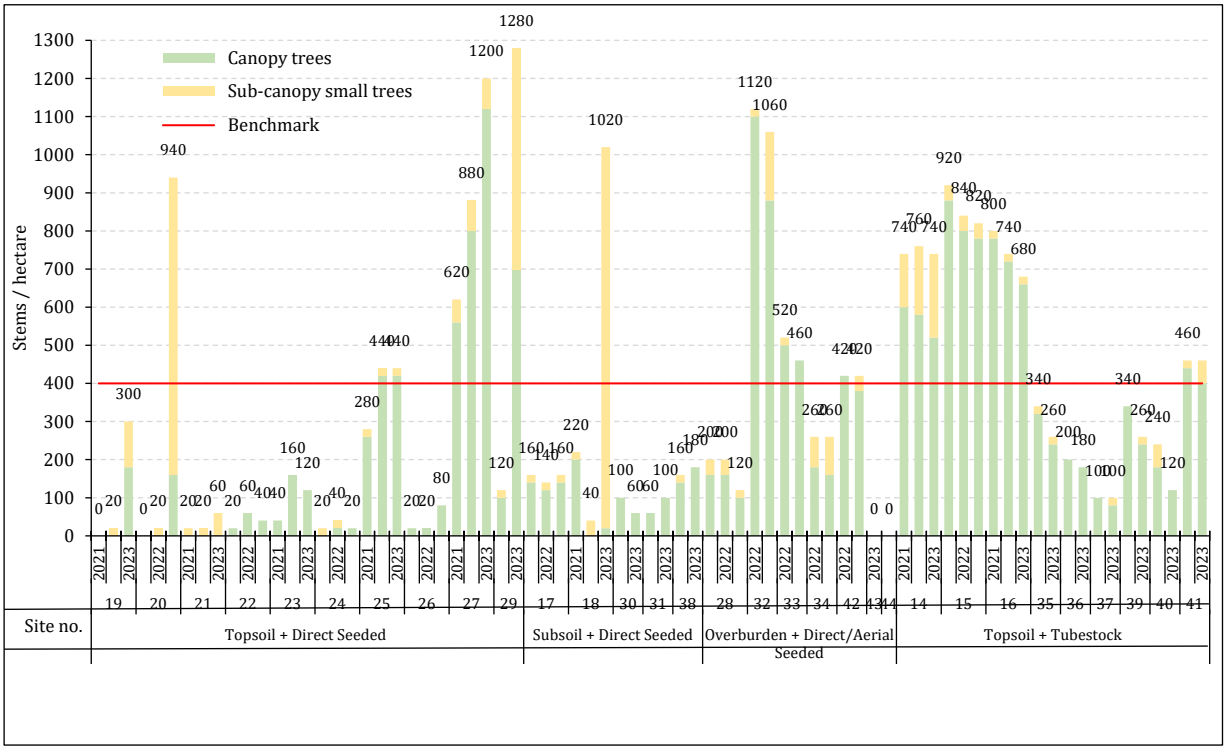
New Rehabilitation

As shown in **Graph 18**, tree establishment success continues to be inconsistent across the new rehabilitation areas with variances between sites and rehabilitation methods being extremely wide ranging. The following are variations observed based on revegetation methods:

- 'Topsoil + direct seeded' areas: range 20-1280 stems/ha (average ~448 stems/ha), extremely high variance between monitoring sites (i.e. very variable strike rates).
- 'Subsoil + direct seeded' areas: range 60-1020 stems/ha (average ~304 stems/ha), a disparity between monitoring sites is beginning to emerge due to the emergence of shrubs at HDWV18.
- 'Overburden + direct/aerial seeded' areas: range 0-1060 stems/ha (average ~331 stems/ha), high variance between monitoring sites continues (i.e. variable strike rates) however the average stem count has reduced due to the establishment of two new monitoring areas devoid of vegetation at the time of survey.
- 'Topsoil + tube stock' areas: range 100-820 stems/ha (average ~402 stems/ha), relatively high variance between monitoring sites though the most consistent with 2022 results. The 2022 report suggested the variation was due to plantings being biased towards shrub species in some sections, and/or uneven tube stock survival rates and the 2023 results would continue to support this reasoning.

In total, only 13 of the 31 monitoring sites met the defined tree density benchmark of ≥400 stems/ha which is an improvement on the previous year's results (only 9 sites met the benchmark in 2022). This is despite the average stem count dropping among the different rehabilitation sites and is largely due to the following sites substantial increase in tree density: HDWV18; HDWV20; HDWV26; and HDWV29 (all direct seeded in topsoil) all showed a marked increase in tree densities, indicating that further germination occurred.

Of note, HDWV18 made a remarkable recovery from the 2022 drop largely due to a flush in Hopbush germination.



Graph 19 Tree stem densities (2020-2023) – HDWV (new rehabilitation)

When considering the averages as an indicator of performance at the larger scale, it needs to incorporate acceptable levels of variability within a zone. Provided that no extreme values occur, it is an acceptable outcome for the rehabilitation to include both densely treed areas of sparser stem densities, provided that the average for the zone is within target benchmarks. This is point is evidenced by the 'Overburden' zone, as its average of ~331 stems/ha falls below the benchmark of 400 stems/ha, however, when the newly established transects (HDWV43 and HDWV44) are removed from consideration, the average is ~464 stems/ha and clearly exceeding the benchmark.

Along with 'Topsoil + tube stock' (~402 stems/ha) and 'Topsoil + direct seed' (~448 stems/ha) these three methods have produced a satisfactory result and are out-performing sub-soil direct seeding in recent years.

5.1.7 Regeneration

Having regard to the age of different rehabilitation areas at the site, regeneration assessments were only undertaken for sites located within older historic rehabilitation areas. Results for 2023 are presented in **Table 10**.

Consistent with 2022, active natural tree regeneration (i.e. recruitment of second-generation tree seedlings) was observed at six of the eleven historic sites. Furthermore, most recruitment consisted of *Acacia salicina* (Cooba) seedlings with only two other Acacia species being recorded namely *Acacia ligulata* and *Acacia linifolia* saplings occurring at HDWV06 and HDWV11 respectively. Only one site (HDWV01) recorded young saplings of canopy eucalypt species.

Between 0.0-100.0% of shrub species and between 12.5-100.0% of tree species were recorded with evidence of flowering/fruiting structures across the historic monitoring sites in 2023. As noted in the 2022 report, this metric should be taken as indicative only and not representative, as shrubs and trees may be flowering/fruiting at different times of the year, while some individuals of a specific species may only produce flower/fruits in response to conditions and not necessarily on a seasonal or annual basis. The drier seasonal conditions occurring in late 2023 are likely to have affected reproductive processes during the 2023 survey as evidenced by the relatively poor recruitment and lower overall percentage of flowering/fruiting species.

Of note, *Dodonaea viscosa subsp. cuneata* was observed to be fruiting abundantly across historic area (occasionally in newer rehabilitation areas) and considerably more than the two other subspecies present across the entire site.

Overall and irrespective of their 2023 performance in terms of species composition and tree densities, and taking into account the recruitment capability shown in wetter years, it is considered that there is adequate potential for the established communities to be self-sustainable.

Table 10 Natural regeneration 2023 – HDWV (historic rehabilitation)

Metric	HDWV 01	HDWV 02	HDWV 03	HDWV 04	HDWV 06	HDWV 07	HDWV 08	HDWV 09	HDWV 10	HDWV 11
% of shrubs with flower/fruit (1)	n/a[2]	0.0	0.0	33.3	100.0	75.0	25.0	100.0	n/a[2]	0.0
% of trees species with flower/fruit	12.5	28.6	28.6	25.0	0	50.0	28.6	0	100.0	100.0
No. tree species with seedlings	1	0	1	0	0	1	1	1	0	1

(1) Excludes shrubby weeds i.e. Acacia saligna and Lycium ferocissimum.
(2) No native shrub species present at these locations

5.2 Walkover Audit Inspection

Key observations made during the 2023 walkover inspection are summarised in **Table 11** (which includes reference links to example photographs provided in **Appendix E**), with their locations shown in **Figure 3**.

Table 11 Walkover audit key findings 2023 – HDWV rehabilitation

Category	Details	Photo ref.	Priority
Drainage structures – Rock-lined drains	All rock-lined drainage channels across the OEA were assessed as stable and well-functioning, with drain in older historic areas well vegetated.	NA	4
Drainage structure – Contour banks	Two locations (in PRP Zone 1) were noted where surface ponding occurs in the trough of the structure. Remediation action is required due to tunnel erosion resulting from this surface ponding noted in the 2022 monitoring report.	Photo 1	2
Slope erosion – Rilling	A total of 9 rills were recorded ranging in severity from 5-25cm in depth and which may exceed 'allowable' limits for safe and stable landform. These included 1 channel in Zone 1, 5 channels in PRP Zone 2, 1 channel in PRP Zone 6 and 3 channels in PRP Zone 7. All rills were classified as stabilised except for 1 in Zone 2 close to HDWV30 monitoring point which was classified as active. The rills should be closely monitored and remediation requirements considered on a case-by-case basis (e.g. channels of lower severity which are assessed as fully stabilised and occur in areas of good vegetative performance may not necessarily need to be repaired).	Photo 2 and 3	3
Slope erosion - Gully	A total of 3 gully channel was recorded with a severity of 25-100cm in depth and which may exceed 'allowable' limits for safe and stable landform. The gully channels are in Zone 2 close to HDWV38 and HDWV29 monitoring points and are classified as active, and in Zone 7 near HDWV33 monitoring point and is classified as active. Locations are displayed in Figure 3. The gully should be closely monitored and remediation requirements considered on a case-by-case basis (e.g. channels of lower severity which are assessed as fully stabilised and occur in areas of good vegetative performance may not necessarily need to be repaired).	Photo 4	1
Slope erosion - tunnel	A total of 2 tunnel erosion locations were recorded ranging in severity from 10-25cm in depth and which exceed the 'allowable' limits for safe and stable landform. These included 2 tunnels in Zone 6 (close to HDWV22). Tunnel erosion is evident in the topsoil layer and may cause slumping if not repaired.	Photo 1	1
Erosion - slumping	Localised slumping was recorded in Zone 1 near HDWV36 at the location of tunnel erosion where the area around older tunnels had collapsed and slumped.	Photo 1	2
Weeds – Galenia	Galenia has been suppressed as evidenced by control efforts leaving large patches of dead plant material over obvious previous infestations. However, although survey results show a reduced cover in monitoring plots, it remains prevalent and widely distributed across the entire site including severe infestations and localised patches scattered throughout.	Photo 5 and 7	2

	The species is known to be problematic at the site, and a systematic and ongoing management strategy will be required to manage population levels in the long term.		
Weeds – Golden Wreath Wattle	The species remains common across the site and locally problematic as evidenced by the majority of recruitment observed belonging to this species. The severe infestations mapped in 2022 in PRP Zone 3 remain, and many small patches / scattered individuals occur throughout the slopes	NA	2
Weeds – African Boxthorn	The species is common across the site and based on previous year's results, appears to be expanding. Some areas are at risk of severe infestations and should be the target of greater control efforts	NA	3
Weeds – Coolatai Grass	One localised and relatively small patch of the species was observed as establishing on the lower slope in PRP Zone 4. The species can be highly invasive and can rapidly become problematic, Photo particularly in times of below-average rainfall (the species is drought-tolerant and tends to spread during dry spell whilst other grasses see their growth slowed down). Pro-active control is recommended to ensure the species is not left to establish further.	NA	3
Habitat augmentation	Fourteen artificial habitat features (log piles) were created in 2023 in the newly created Zone 8. These have been mapped in Figure 3. In their current configuration they are more likely to harbour vertebrate pests such as rabbits and foxes and regular monitoring should be undertaken to determine if targeted pest control is required.	Photo 6	4
Animal pests	Although no vertebrate pest animals were sighted, rabbit and feral pig sign such as diggings and scats were recorded at low abundance in the rehabilitation areas during the 2023 surveys. Pigs are difficult to control as they travel great distances daily unless there is a constant resource and opportunistic observations should be mapped to check if numbers may be increasing. Evidence of rabbits occurred in and around the pasture areas though no warrens were discovered. Nocturnal transect spotlight surveys are recommended to establish a baseline count to better understand rabbit abundance going forward..	Photo 7	3
Access tracks	Internal tracks maintenance has been very limited within the rehabilitation, and several tracks were overgrown with vegetation and/or actively eroding at the time of monitoring, making access to some locations difficult. Internal access tracks should be regularly maintained and maintained in serviceable condition to ensure adequate access to all rehabilitation areas.	N/A	3

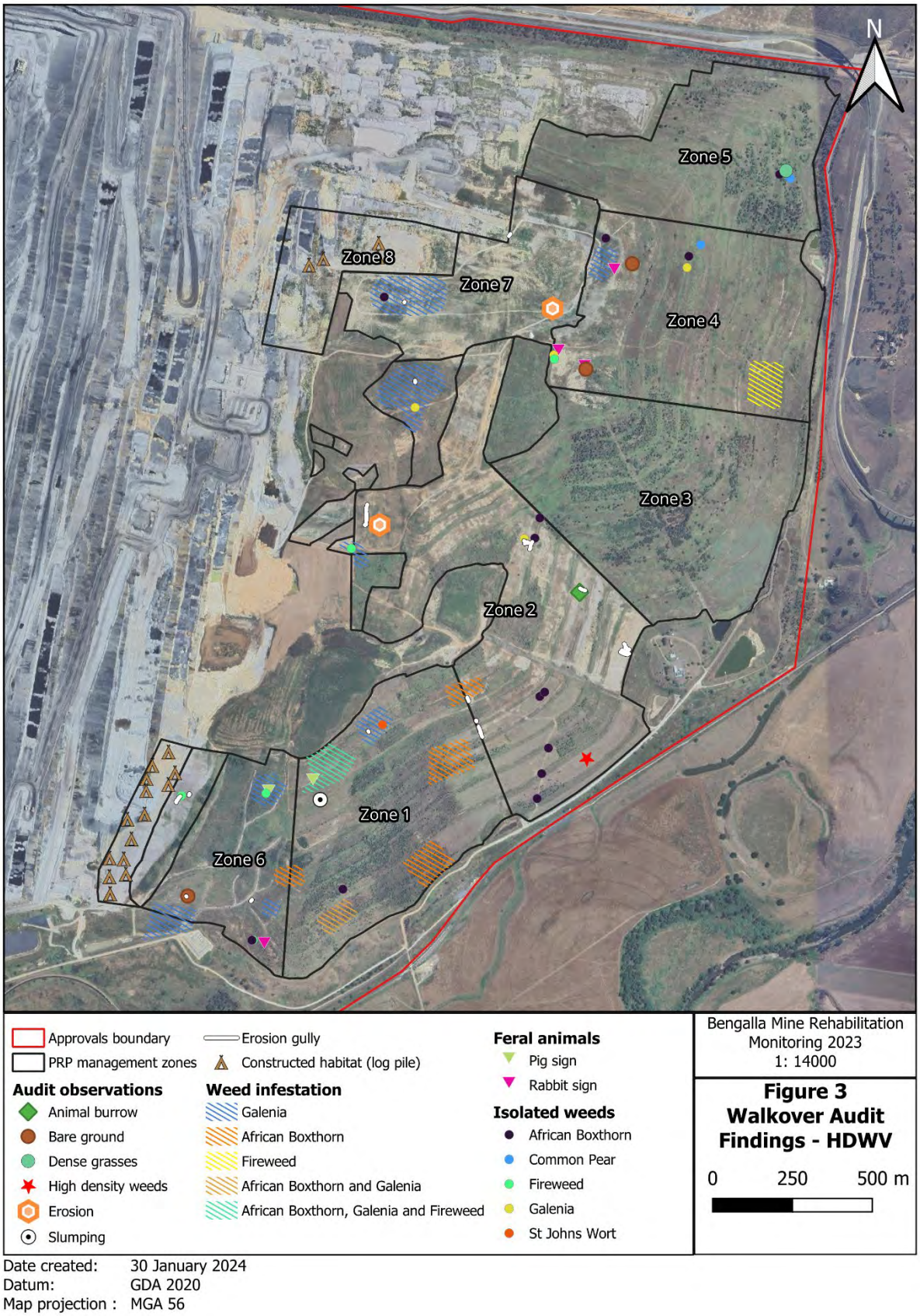


Figure 3 Walkover audit key findings 2023 – HDWV rehabilitation

5.3 Compliance Assessment

Based on the 2023 monitoring results and observations as presented in the previous sections, this section provides an assessment of rehabilitation progress against the relevant completion criteria defined in the RMP (2023) for areas of HDWV rehabilitation.

Criteria pertaining to landform establishment, landform stability, drainage, habitat augmentation and feral pests have been assessed at the scale of the entire dump/emplacement (**Table 12**).

For criteria pertaining to vegetative performance and soils, a separate assessment has been undertaken based on rehabilitation age and revegetation method (consistent with the rest of this report) (**Table 13**).

Table 12 Progress against RMP completion criteria (HDWV) 2023 – landform, erosion, habitat and feral pests

Completion criteria	Progress as of 2023	Compliant
No uncontrolled access and demarcations present	No uncontrolled access was evidenced, and rehabilitation areas at the site are typically well demarcated. Sites not demarcated were re-staked during the 2023 monitoring period.	Yes
No visible signs of instability (slumping/cracks) requiring maintenance	Minor Slumping and cracking, as shown on Fig 3, was observed which could compromise the integrity and long-term stability of the landform. These areas will need to be assessed for repair requirements.	No
No erosion rills, gullies or tunnel erosion requiring maintenance	Several gully channels of moderate to high severity (25-100 cm deep), tunnel erosion of moderate severity (10-25cm deep) and rills of minor severity (occur across the slopes, which will need to be assessed for repair requirements.	No
No active erosion within water management structures requiring maintenance	Channel erosion is impacting the main rock-lined drainage channel in the area of natural landform (PRP Zone 6) – straw bales have previously been installed as part of rectification works from severe erosion noted in 2022 monitoring. These are in need of replacement and an assessment for on-going repair requirements is needed. 4 x contour bank breaches recorded.	No
No evidence of contamination	No hazardous or problematic materials were observed or recorded during the walkover inspection.	Yes
Surface runoff diverted to neighbouring drainage lines	All surface drainage from rehabilitation areas is currently contained internally into sediment basins, with no surface water leaving the site.	n/a
Water quality of surface runoff within parameters suitable for pasture land use	Not assessed – outside the scope of this monitoring program.	n/a
Landform compliant with approved final landform	Not assessed – outside the scope of this monitoring program.	n/a
Water / sediment management structures installed as per design	Not assessed – outside the scope of this monitoring program.	n/a
No increasing trends in feral pest populations and species diversity	Foxes, rabbits/hares and pigs utilise the rehabilitation. An ongoing culling program is in place to reduce population levels. Active and regular monitoring focusing on rabbits and pigs should be undertaken to better inform population status.	Trending

Completion criteria	Progress as of 2023	Compliant
Habitat features (e.g. nest boxes, boulders, logs, etc) present on rehabilitated areas	Additional habitat features (log piles) have been installed in 2023 (Zone 8) building on the artificial habitat features incorporated in sections of PRP Zones 1, 3 and 4 where some logs/fallen trees have been spread onto the surface. No nest boxes or rocky areas have been incorporated as yet and present opportunity to improve wild life habitat connectivity across the site. Nest boxes to be installed in existing mature areas in 2024.	No / Insufficient
Presence of native animal activity	As in 2022, macropods and several species of woodland birds were observed as utilising the rehabilitation areas. A potential wombat scat was also located in Zone 2.	Yes

Table 13 Progress against RMP completion criteria (HDWV) – Soils and vegetation

Completion criteria	Progress as of 2023	Compliance status				
		Topsoiled + Direct Seeded (historic rehabilitation)	Topsoil + Direct Seeded (new rehabilitation)	Subsoil + Direct Seeded (new rehabilitation)	Overburden + Aerial/Direct Seeded (new rehabilitation)	Topsoil + Tubestock (new rehabilitation)
Soil properties are appropriate for native vegetation growth	Soil fertility levels variable but overall deemed within suitable range for native vegetation growth across all areas. Soil salinity levels exceeded the target at five sites. Three of these sites are old rehabilitation areas (HDWV04, HDWV10 and HDWV11) and presented minor exceedances which will need to be monitored closely in future monitoring periods. The other two sites (HDWV42 and HDWV43) are newly established on overburden and returned very high levels. The areas have recently been spread with gypsum, explaining the increase in salinity levels as the gypsum dissolves subsequently increasing the ionic strength of the soil solution. The increased levels will help supress dispersion and improve soil structure at the surface which will assist in vegetation establishment. Very high soil pH levels were recorded for many areas with an increase in pH across all sites. This trend towards more alkaline soils is thought to be a result of the die back of vegetative growth from previous wetter than normal season between 2019-2022, subsequent decomposing of the organic material in the soil resulting in an increase of pH. High soil sodicity levels were recorded for one area seeded in overburden (HDWV28) (but no sodicity issues in all other areas), with potential to limit vegetation establishment and growth. Vegetative performance observed in 2023 has declined from previous monitoring periods but was mostly satisfactory, and the decline is expected due to seasonal variations.	No	No	N/A no topsoil present	Trending	No
Species establishing are aligned to those included in the species mix for the domain	Average proportions of shrubs and trees species representative of the local communities CHGBIW and CHSGIGBF measured at the monitoring sites were as follow: • 'Topsoil + direct seeded' (historic rehabilitation): ~55.2% characteristic species. • 'Topsoil + direct seeded' (new rehabilitation): ~74.3% characteristic species. • 'Subsoil + direct seeded' (new rehabilitation): ~67.2% characteristic species. • 'Overburden + direct/aerial seeded' (new rehab.): ~87.6% characteristic species. • 'Topsoil + tubestock' areas (new rehabilitation): ~78.8% characteristic species.	No	Yes	Yes	Yes	Yes

Completion criteria	Progress as of 2023	Compliance status				
		Topsoiled + Direct Seeded (historic rehabilitation)	Topsoil + Direct Seeded (new rehabilitation)	Subsoil + Direct Seeded (new rehabilitation)	Overburden + Aerial/Direct Seeded (new rehabilitation)	Topsoil + Tubestock (new rehabilitation)
Species diversity comparable to similar native woodland in the region	The monitoring program currently includes no relevant analogue/reference sites in areas of native woodland against which rehabilitation performance can be compared. However, native woodland ecosystems in the region typically show much greater levels of native biodiversity than rehabilitated lands at Bengalla, particularly in the ground layer. Species diversity is being addressed through the installation of HDWV across OEA and throughout future rehabilitation works.	No	No	No	No	No
Tree stem densities maintained at ≥400 stems/ha	Average tree stems densities measured as: • 'Topsoil + direct seeded' (historic rehabilitation): ~402 stems/ha. • 'Topsoil + direct seeded' (new rehabilitation): ~448 stems/ha. • 'Subsoil + direct seeded' (new rehabilitation): ~304 stems/ha. • 'Overburden + direct/aerial seeded' (new rehab.): ~331 stems/ha. • 'Topsoil + tubestock' areas (new rehabilitation): ~402 stems/ha. Tree stem counts will increase as tubestock and direct seeded trees which are currently immature continue to grow and become more evident in the rehabiltiation areas.	Yes	Yes	No	No	Yes
Surface organic litter present	Surface organic litter has decreased generally in 2023 likely a result of reduced live vegetation growth and a drier than normal season. Additionally, the establishment of new rehabilitation areas has also lowered average scores in the overburden areas. As noted in 2022, litter should naturally accumulate with time assuming satisfactory vegetation establishment and growth.	Yes	Yes	Trending	Trending	Yes
Weed coverage comparable to similar native woodland in the region	The monitoring program currently includes no relevant analogue/reference sites in areas of native woodland against which rehabilitation performance can be compared. However, native woodland ecosystems in the region typically show very low levels of weed coverage (often <1%). When assessed again the nominal and indicative 10% weed cover target, performance in 2023 was measured was as: • 'Topsoil + direct seeded' (historic rehabilitation): average ~5.3% weed cover. • 'Topsoil + direct seeded' (new rehabilitation): average ~13.2% weed cover.	Yes	No	Yes	Yes	No

Completion criteria	Progress as of 2023	Compliance status				
		Topsoiled + Direct Seeded (historic rehabilitation)	Topsoil + Direct Seeded (new rehabilitation)	Subsoil + Direct Seeded (new rehabilitation)	Overburden + Aerial/Direct Seeded (new rehabilitation)	Topsoil + Tubestock (new rehabilitation)
	• 'Subsoil + direct seeded' (new rehabilitation): average ~5.2% weed cover. • 'Overburden + direct/aerial seeded' (new rehab.): average ~8.8% weed cover. • 'Topsoil + tubestock' areas (new rehabilitation): average ~18.4% weed cover.					
Evidence of reproductive material on shrubs/trees and/or presence of second-generation seedlings	Criteria not applicable to recent rehabilitation areas where vegetation remains immature. In areas of older-established rehabilitation, active natural regeneration (i.e. recruitment of second-generation tree seedlings) was evidenced at six of the eleven historic sites. On average for all monitoring sites, 33.3% of shrubs and 34.7% of trees were observed as bearing reproductive material at the time of the 2023 monitoring.	Yes	n/a	n/a	n/a	n/a
Recruitment rates are equal to or exceed mortality rates	Criteria not applicable to recent rehabilitation areas where vegetation remains immature. This criterion is difficult or impractical to accurately measure or assess. However, as in the previous year's report, woody species diversity and counts of tree stem densities have remained generally stable over the evaluation period in areas of historic rehabilitation, with only a minor net reduction in shrub/tree populations largely attributed acacia dieback.	Yes	n/a	n/a	n/a	n/a

6. Recommendations

6.1 Erosion Repairs

Erosion issues identified during this 2023 round of monitoring and recommended for remediation included:

- One location in Zone 2 close to HDWV30 monitoring point with an active erosion rill recorded.
- Superficial rill erosion (channels <30 cm deep) was recorded at seven recently reworked monitoring sites (HDWV 42, HDWV 32, HDWV 30, HDWV 31, HDWV 38, HDWV 35 and HDWV 28). Three of these sites (HDWV 32, HDWV 38 and HDWV 42) were recorded in 2022 as also exhibiting minor erosion.
- Three locations with identified gully erosion channels of moderate to very high severity (25-100cm deep) located in Zone 2 close to HDWV38 and HDWV29 monitoring points and are classified as active, and in Zone 7 near HDWV33 monitoring point and is classified as active. The more severe channels (>50cm deep) should be repaired (if accessible without impacting adversely on newly established HDWV), whilst the necessity to repair the less severe channels (<50cm deep) should be assessed in context of the status of erosion processes (i.e. active vs stabilised) as well as vegetative performance in the surrounding area.
- Tunnel erosion was recorded at and near two monitoring sites (HDWV 37 and HDWV 22) the extent was minor to moderate and attributed to the recent change from wet to dry conditions resulting in soil cracking.
- One location of localised slumping recorded in Zone 1 near HDWV36.
- The main drainage channel in the southern Zone 6 previously repaired requires additional maintenance of control structures and assessment for repairs to minor subsequent erosion.

6.2 Weeds

Weed incursion remains one of the main issues inhibiting rehabilitation progress across the site and will require significant, systematic and ongoing management inputs.

Similarly to previous years, of the priority weeds recorded at the site in 2023, the most problematic include Galenia, Golden Wreath Wattle and African Boxthorn – which typically respond well to conventional treatments (i.e. herbicide applications, mulching, etc) and should continue to be systematically targeted for treatment. Treatment should be timed prior to seasonal reproduction (where the species allow) to reduce the presence of seed in the soil.

African Boxthorn particularly should be targeted in vicinity of the following monitoring sites in addition to the opportunistic locations mapped in Figure 2:

- HDWV07
- HDWV10
- HDWV34
- HDWV37; and
- HDWV41.

Coolatai Grass identified in the 2022 report was not evident at the time of survey though monitoring of previously identified locations should be maintained, and appropriate management implemented in the event it is found to be actively growing.

Fireweed and Greater Beggars Tick were observed commonly during the 2023 monitoring, with Fireweed in particular becoming well established in certain areas (refer Figure 2) in conjunction with other weeds. It is recommended that Fireweed be controlled opportunistically during any weed control operations being undertaken going forward.

Other recorded priority weeds (e.g. Cobblers Peg, Saffron Thistle, etc) occur more sparsely and generally do not represent an immediate threat to the successful establishment of the targeted land use.

Areas of broadleaf (non-listed) environmental weeds identified at the time of the 2022 monitoring, proliferation of which was a result of high rainfall, have reduced naturally through seasonal and climatic variation. As stated in the previous report, these species are generally not recommended for treatment as they tend to naturally reduce once canopy foliage establishes. Continued long-term monitoring will confirm that this natural reduction is occurring, and active management may need to be considered otherwise.

Acknowledging the strong component of grazing in the agreed final land use for most of the site (including areas of HDWV), exotic pasture grasses including Guinea grass, Kikuyu and Rhodes Grass have not been regarded as weeds under this monitoring program and thus control is not deemed required. It is however noted that these species are defined as 'high threat exotics' for the purpose of biodiversity conservation under the *NSW Biodiversity Conservation Act 2016*, and may be problematic and counteract any effort to establish a native component in the ground layer in future monitoring.

6.3 Feral Pests

High levels of feral pig activity were not recorded during the 2023 monitoring. Although some diggings were observed, they were small and more akin to solitary animals passing through searching for preferable food resources or water. Continued monitoring collecting opportunistic observations such as scats, diggings and live animals should be undertaken in conjunction with active monitoring using camera traps placed in areas of higher use.

Fresh Rabbit/Hare signs were also observed, and these species pose a significant threat to rehabilitation. High Rabbit densities can have severe impacts on live ground cover resulting in large bare patches at risk of erosion and Hare are known to browse shrub and tree seedlings to the extent that survival rates of germinated seedlings and tube stock are severely impacted. As Rabbit and Hare populations are difficult to determine, active nocturnal monitoring using the Transect Spotlight method should be considered to establish a baseline count. Seasonal monitoring would then allow future fluctuations of these pests to be detected and managed before impacts on vegetation rehabilitation occur.

6.4 HDWV Establishment

In the RMP zones identified in 2022 where revegetation plantings were observed, indications suggest that mid-storey shrub species and canopy eucalypt species appear to have been incorporated with supplementary planting resulting in a more even shrub to canopy species ratio. Future planting should continue to ensure a relatively even distribution of the canopy tree species so as not to result in areas being dominated by short lived shrub species.

The continued implementation of the HDWV installation over the coming years should be adaptive and take into considerations the findings presented in this and previous reports and subsequent rehabilitation monitoring events (to determine which revegetation methods is generating the best outcomes).

6.5 Habitat Augmentation

Artificial habitat sites created in 2023 focused on log piles concentrated in new rehabilitation areas. These provide native fauna habitat, and whilst thought to favour introduced species such as rabbits and foxes in other landforms, BMC have previously sought and received guidance from an Ecologist, who advised that the site specific recommendation is to provide log piles since they provide higher ecological benefit,

especially for closure criteria, when laid in piles rather than spread across the rehabilitation area in isolation. Visual monitoring during the 2023 rehabilitation monitoring period found a small number of small reptiles (lizards) utilising some of the piles. This is consistent with the advice provided to BMC, and anecdotal evidence from the BMC Senior Environmental Advisor, who advised that small reptiles such as snake, bees and other small mammals have been sighted utilising these piles. As in previous reports, it continues to be a recommendation that future construction of artificial habitat features include rock piles, large boulders, and nest boxes.

7. References

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Appendix A

2023 Photographic Monitoring Record

Monitoring Site: P3

View from start of transect	View from end of transect
	

Monitoring Site: PR4

View from start of transect	View from end of transect
	

Monitoring Site: HDWV01

View from start of transect	View from end of transect
	

Monitoring Site: HDWV02

View from start of transect	View from end of transect
	

Monitoring Site: HDWV03

View from start of transect	View from end of transect
	

Monitoring Site: HDWV04

View from start of transect	View from end of transect
	

Monitoring Site: HDWV06

View from start of transect	View from end of transect
	

Monitoring Site: HDWV07

View from start of transect	View from end of transect
	

Monitoring Site: HDWV08

View from start of transect	View from end of transect
	

Monitoring Site: HDWV09

View from start of transect	View from end of transect
	

Monitoring Site: HDWV10

View from start of transect	View from end of transect
	

Monitoring Site: HDWV011

View from start of transect	View from end of transect
	

Monitoring Site: HDWV14

View from start of transect	View from end of transect
	

Monitoring Site: HDWV15

View from start of transect	View from end of transect
	

Monitoring Site: HDWV16

View from start of transect	View from end of transect
	

Monitoring Site: HDWV17

View from start of transect	View from end of transect
	

Monitoring Site: HDWV18

View from start of transect	View from end of transect
	

Monitoring Site: HDWV19

View from start of transect	View from end of transect
	

Monitoring Site: HDWV20

View from start of transect	View from end of transect
	

Monitoring Site: HDWV21

View from start of transect	View from end of transect
	

Monitoring Site: HDWV022

View from start of transect	View from end of transect
	

Monitoring Site: HDWV23

View from start of transect	View from end of transect
	

Monitoring Site: HDWV24

View from start of transect	View from end of transect
	

Monitoring Site: HDWV25

View from start of transect	View from end of transect
	

Monitoring Site: HDWV26

View from start of transect	View from end of transect
	

Monitoring Site: HDWV27

View from start of transect	View from end of transect
	

Monitoring Site: HDWV28

View from start of transect	View from end of transect
	

Monitoring Site: HDWV29

View from start of transect	View from end of transect
	

Monitoring Site: HDWV30

View from start of transect	View from end of transect
	

Monitoring Site: HDWV31

View from start of transect	View from end of transect
	

Monitoring Site: HDWV32

View from start of transect	View from end of transect
	

Monitoring Site: HDWV33

View from start of transect	View from end of transect
	

Monitoring Site: HDWV34

View from start of transect	View from end of transect
	

Monitoring Site: HDWV35

View from start of transect	View from end of transect
	

Monitoring Site: HDWV36

View from start of transect	View from end of transect
	

Monitoring Site: HDWV37

View from start of transect	View from end of transect
	

Monitoring Site: HDWV38

View from start of transect	View from end of transect
	

Monitoring Site: HDWV39

View from start of transect	View from end of transect
	

Monitoring Site: HDWV40

View from start of transect	View from end of transect
	

Monitoring Site: HDWV41

View from start of transect	View from end of transect
	

Monitoring Site: HDWV42

View from start of transect	View from end of transect
	

Monitoring Site: HDWV43

View from start of transect	View from end of transect
	

Monitoring Site: HDWV44

View from start of transect	View from end of transect
	

Appendix B

2023 Soil Laboratory Analyses Report

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CERTIFICATE OF ANALYSIS 342289

Client Details

Client	Moss Enviro
Attention	S Gleeson-Willey
Address	1/342 Peel st, Tamworth

Sample Details

Your Reference	**Moss Enviro-Bengalla Mining Company**
Number of Samples	43 Soil
Date samples received	24/01/2024
Date completed instructions received	24/01/2024

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Please refer to the last page of this report for any comments relating to the results.

Report Details

Date results requested by	16/02/2024
Date of Issue	15/02/2024

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Diego Bigolin, Inorganics Supervisor
Giovanni Agosti, Group Technical Manager
Jenny He, Senior Chemist
Loren Bardwell, Development Chemist

Authorised By
Nancy Zhang, Laboratory Manager

CEC						
Our Reference		342289-1	342289-2	342289-3	342289-4	342289-5
Your Reference	UNITS	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06
Depth		0.1	0.05	0.05	0.05	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	18/01/2024	21/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	9.8	10	18	9.4	8.6
Exchangeable K	meq/100g	1.3	1.1	1.1	0.9	0.6
Exchangeable Mg	meq/100g	6.0	4.5	6.5	3.9	3.1
Exchangeable Na	meq/100g	0.2	0.1	<0.1	0.3	<0.1
Cation Exchange Capacity	meq/100g	17	16	25	14	12

CEC						
Our Reference		342289-6	342289-7	342289-8	342289-9	342289-10
Your Reference	UNITS	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11
Depth		0.05	0.05	0.1	0.1	0.1
Date Sampled		21/01/2024	22/01/2024	22/01/2024	18/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	18	13	14	16	9.0
Exchangeable K	meq/100g	1.3	1.5	1.2	1.6	1
Exchangeable Mg	meq/100g	8.5	6.0	7.2	5.4	2.7
Exchangeable Na	meq/100g	0.2	<0.1	0.1	0.2	<0.1
Cation Exchange Capacity	meq/100g	28	21	23	23	13

CEC						
Our Reference		342289-11	342289-12	342289-13	342289-14	342289-15
Your Reference	UNITS	HDWV14	HDWV15	HDWV16	HDWV17	HDWV18
Depth		0.1	0.1	0.1	0.05	0.07
Date Sampled		18/01/2024	19/01/2024	19/01/2024	22/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	4.5	12	11	13	9.8
Exchangeable K	meq/100g	0.6	1.4	1.4	0.5	0.3
Exchangeable Mg	meq/100g	2.1	4.6	4.7	5.2	6.1
Exchangeable Na	meq/100g	0.2	<0.1	<0.1	0.2	0.1
Cation Exchange Capacity	meq/100g	7.4	18	18	19	16

CEC						
Our Reference		342289-16	342289-17	342289-18	342289-19	342289-20
Your Reference	UNITS	HDWV19	HDWV20	HDWV21	HDWV22	HDWV23
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	20/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	20	20	14	28	35
Exchangeable K	meq/100g	1.0	1.4	1	0.9	0.8
Exchangeable Mg	meq/100g	8.9	5.5	5.7	13	6.8
Exchangeable Na	meq/100g	0.2	0.2	0.1	0.2	0.2
Cation Exchange Capacity	meq/100g	31	27	21	42	42

CEC						
Our Reference		342289-21	342289-22	342289-23	342289-24	342289-25
Your Reference	UNITS	HDWV24	HDWV25	HDWV26	HDWV27	HDWV28
Depth		0.05	0.02	0.1	0.05	0.05
Date Sampled		20/01/2024	17/01/2024	21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	26	17	25	12	15
Exchangeable K	meq/100g	0.7	0.8	1.2	0.6	0.6
Exchangeable Mg	meq/100g	7.3	8.5	9.5	3.1	8.8
Exchangeable Na	meq/100g	0.2	0.2	0.2	<0.1	0.3
Cation Exchange Capacity	meq/100g	34	26	36	16	25

CEC						
Our Reference		342289-26	342289-27	342289-28	342289-29	342289-30
Your Reference	UNITS	HDWV29	HDWV30	HDWV31	HDWV32	HDWV33
Depth		0.05	0.1	0.1	0.08	0.05
Date Sampled		20/01/2024	20/01/2024	20/01/2024	19/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	25	28	16	14	13
Exchangeable K	meq/100g	0.8	1.0	0.5	0.4	0.5
Exchangeable Mg	meq/100g	5.9	8.1	6.0	11	8.8
Exchangeable Na	meq/100g	0.1	0.2	<0.1	1.1	0.7
Cation Exchange Capacity	meq/100g	32	38	23	26	23

CEC						
Our Reference		342289-31	342289-32	342289-33	342289-34	342289-35
Your Reference	UNITS	HDWV34	HDWV35	HDWV36	HDWV37	HDWV38
Depth		0.1	0.1	0.1	0.1	0.08
Date Sampled		19/01/2024	21/01/2024	17/01/2024	17/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	12	7.3	20	22	13
Exchangeable K	meq/100g	0.5	0.6	0.9	0.4	0.4
Exchangeable Mg	meq/100g	8.0	6.7	8.3	3.5	8.7
Exchangeable Na	meq/100g	0.7	0.1	0.3	<0.1	0.5
Cation Exchange Capacity	meq/100g	22	15	29	26	23

CEC						
Our Reference		342289-36	342289-37	342289-38	342289-39	342289-40
Your Reference	UNITS	HDWV39	HDWV40	HDWV41	HDWV42	HDWV43
Depth		0.05	0.1	0.05	0.1	0.1
Date Sampled		20/01/2024	20/01/2024	20/01/2024	17/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	17	8.9	21	5.4	42
Exchangeable K	meq/100g	0.8	0.6	0.9	0.5	0.4
Exchangeable Mg	meq/100g	7.3	2.7	6.8	8.4	4.9
Exchangeable Na	meq/100g	<0.1	<0.1	<0.1	2.4	0.7
Cation Exchange Capacity	meq/100g	25	12	29	17	48

CEC				
Our Reference		342289-41	342289-42	342289-43
Your Reference	UNITS	HDWV44	P3	P4
Depth		0.1	0.05	0.05
Date Sampled		21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil
Date prepared	-	02/02/2024	02/02/2024	02/02/2024
Date analysed	-	02/02/2024	02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	6.6	22	30
Exchangeable K	meq/100g	0.2	2.0	0.8
Exchangeable Mg	meq/100g	2.9	15	11
Exchangeable Na	meq/100g	2.0	0.3	0.8
Cation Exchange Capacity	meq/100g	12	39	43

Acid Extractable metals in soil						
Our Reference		342289-1	342289-2	342289-3	342289-4	342289-5
Your Reference	UNITS	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06
Depth		0.1	0.05	0.05	0.05	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	18/01/2024	21/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	210	200	200	330	190

Acid Extractable metals in soil						
Our Reference		342289-6	342289-7	342289-8	342289-9	342289-10
Your Reference	UNITS	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11
Depth		0.05	0.05	0.1	0.1	0.1
Date Sampled		21/01/2024	22/01/2024	22/01/2024	18/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	190	280	240	430	310

Acid Extractable metals in soil						
Our Reference		342289-11	342289-12	342289-13	342289-14	342289-15
Your Reference	UNITS	HDWV14	HDWV15	HDWV16	HDWV17	HDWV18
Depth		0.1	0.1	0.1	0.05	0.07
Date Sampled		18/01/2024	19/01/2024	19/01/2024	22/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	200	630	410	350	460

Acid Extractable metals in soil						
Our Reference		342289-16	342289-17	342289-18	342289-19	342289-20
Your Reference	UNITS	HDWV19	HDWV20	HDWV21	HDWV22	HDWV23
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	20/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	230	510	190	210	260

Acid Extractable metals in soil						
Our Reference		342289-21	342289-22	342289-23	342289-24	342289-25
Your Reference	UNITS	HDWV24	HDWV25	HDWV26	HDWV27	HDWV28
Depth		0.05	0.02	0.1	0.05	0.05
Date Sampled		20/01/2024	17/01/2024	21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	190	170	450	160	240

Acid Extractable metals in soil						
Our Reference		342289-26	342289-27	342289-28	342289-29	342289-30
Your Reference	UNITS	HDWV29	HDWV30	HDWV31	HDWV32	HDWV33
Depth		0.05	0.1	0.1	0.08	0.05
Date Sampled		20/01/2024	20/01/2024	20/01/2024	19/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	250	240	240	410	380

Acid Extractable metals in soil						
Our Reference		342289-31	342289-32	342289-33	342289-34	342289-35
Your Reference	UNITS	HDWV34	HDWV35	HDWV36	HDWV37	HDWV38
Depth		0.1	0.1	0.1	0.1	0.08
Date Sampled		19/01/2024	21/01/2024	17/01/2024	17/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	410	230	230	350	340

Acid Extractable metals in soil						
Our Reference		342289-36	342289-37	342289-38	342289-39	342289-40
Your Reference	UNITS	HDWV39	HDWV40	HDWV41	HDWV42	HDWV43
Depth		0.05	0.1	0.05	0.1	0.1
Date Sampled		20/01/2024	20/01/2024	20/01/2024	17/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	220	180	280	280	330

Acid Extractable metals in soil				
Our Reference		342289-41	342289-42	342289-43
Your Reference	UNITS	HDWV44	P3	P4
Depth		0.1	0.05	0.05
Date Sampled		21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil
Date prepared	-	31/01/2024	31/01/2024	31/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024
Phosphorus	mg/kg	280	980	20

Misc Inorg - Soil						
Our Reference		342289-1	342289-2	342289-3	342289-4	342289-5
Your Reference	UNITS	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06
Depth		0.1	0.05	0.05	0.05	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	18/01/2024	21/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	7.0	6.7	7.9	7.6	7.4
Electrical Conductivity 1:5 soil:water	µS/cm	150	130	190	280	180
Ammonia as N in soil	mg/kg	8.5	9.0	3.7	15	2.3
Nitrate as N in soil	mg/kg	<0.5	<0.5	1	<0.5	<0.5
Nitrite as N in soil	mg/kg	1.3	0.4	0.7	<0.1	1.0
NOx as N in soil	mg/kg	1.5	<0.5	1.7	<0.5	1.1
TKN in soil	mg/kg	1,800	1,600	1,600	2,800	1,100
Total Nitrogen in soil	mg/kg	1,800	1,600	1,600	2,800	1,100
Phosphate as P in soil	mg/kg	<0.5	<0.5	<0.5	2	<0.5
Total Organic Matter in soil/solids	mg/kg	37,000	10,000	30,000	65,000	25,000

Misc Inorg - Soil						
Our Reference		342289-6	342289-7	342289-8	342289-9	342289-10
Your Reference	UNITS	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11
Depth		0.05	0.05	0.1	0.1	0.1
Date Sampled		21/01/2024	22/01/2024	22/01/2024	18/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	7.5	7.6	7.6	6.7	6.8
Electrical Conductivity 1:5 soil:water	µS/cm	180	190	160	440	290
Ammonia as N in soil	mg/kg	3.4	2.8	2.5	19	11
Nitrate as N in soil	mg/kg	<0.5	6.5	1	<0.5	<0.5
Nitrite as N in soil	mg/kg	1	5.8	1.7	42	0.8
NOx as N in soil	mg/kg	1.4	12	2.9	42	0.77
TKN in soil	mg/kg	1,900	2,100	1,700	7,200	2,200
Total Nitrogen in soil	mg/kg	1,900	2,100	1,700	7,200	2,200
Phosphate as P in soil	mg/kg	<0.5	0.8	<0.5	1	<0.5
Total Organic Matter in soil/solids	mg/kg	17,000	22,000	18,000	22,000	15,000

Misc Inorg - Soil						
Our Reference		342289-11	342289-12	342289-13	342289-14	342289-15
Your Reference	UNITS	HDWV14	HDWV15	HDWV16	HDWV17	HDWV18
Depth		0.1	0.1	0.1	0.05	0.07
Date Sampled		18/01/2024	19/01/2024	19/01/2024	22/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	7.8	7.3	7.2	7.6	8.7
Electrical Conductivity 1:5 soil:water	µS/cm	110	320	200	180	110
Ammonia as N in soil	mg/kg	8.6	8.4	10	2.2	1.4
Nitrate as N in soil	mg/kg	<0.5	<0.5	0.7	<0.5	<0.5
Nitrite as N in soil	mg/kg	0.1	11	7.2	0.2	0.1
NOx as N in soil	mg/kg	<0.5	11	7.9	<0.5	<0.5
TKN in soil	mg/kg	830	4,400	2,600	1,800	600
Total Nitrogen in soil	mg/kg	830	4,400	2,600	1,800	600
Phosphate as P in soil	mg/kg	2	7.5	6.0	0.9	<0.5
Total Organic Matter in soil/solids	mg/kg	24,000	32,000	44,000	48,000	46,000

Misc Inorg - Soil						
Our Reference		342289-16	342289-17	342289-18	342289-19	342289-20
Your Reference	UNITS	HDWV19	HDWV20	HDWV21	HDWV22	HDWV23
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	20/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	8.1	7.4	8.0	8.3	7.9
Electrical Conductivity 1:5 soil:water	µS/cm	200	190	230	180	210
Ammonia as N in soil	mg/kg	6.6	3.6	3.3	2.3	3.1
Nitrate as N in soil	mg/kg	0.6	<0.5	22	6.3	5.8
Nitrite as N in soil	mg/kg	0.2	0.7	0.6	0.2	0.3
NOx as N in soil	mg/kg	0.78	0.85	23	6.5	6.2
TKN in soil	mg/kg	1,300	2,400	1,200	890	880
Total Nitrogen in soil	mg/kg	1,300	2,400	1,300	900	890
Phosphate as P in soil	mg/kg	<0.5	3	<0.5	<0.5	<0.5
Total Organic Matter in soil/solids	mg/kg	38,000	56,000	32,000	55,000	40,000

Misc Inorg - Soil						
Our Reference		342289-21	342289-22	342289-23	342289-24	342289-25
Your Reference	UNITS	HDWV24	HDWV25	HDWV26	HDWV27	HDWV28
Depth		0.05	0.02	0.1	0.05	0.05
Date Sampled		20/01/2024	17/01/2024	21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	8.2	8.3	8.0	7.8	8.6
Electrical Conductivity 1:5 soil:water	µS/cm	190	230	210	200	190
Ammonia as N in soil	mg/kg	2.5	29	2.6	2.8	1.4
Nitrate as N in soil	mg/kg	0.8	14	<0.5	<0.5	5.8
Nitrite as N in soil	mg/kg	0.3	1.1	0.7	0.2	0.6
NOx as N in soil	mg/kg	1.0	16	1.0	<0.5	6.4
TKN in soil	mg/kg	1,000	760	1,400	1,000	970
Total Nitrogen in soil	mg/kg	1,000	770	1,400	1,000	980
Phosphate as P in soil	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Organic Matter in soil/solids	mg/kg	19,000	66,000	22,000	17,000	32,000

Misc Inorg - Soil						
Our Reference		342289-26	342289-27	342289-28	342289-29	342289-30
Your Reference	UNITS	HDWV29	HDWV30	HDWV31	HDWV32	HDWV33
Depth		0.05	0.1	0.1	0.08	0.05
Date Sampled		20/01/2024	20/01/2024	20/01/2024	19/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	8.1	8.4	8.3	9.3	8.9
Electrical Conductivity 1:5 soil:water	µS/cm	190	230	140	220	200
Ammonia as N in soil	mg/kg	2.7	26	1.9	1.4	1.5
Nitrate as N in soil	mg/kg	1	10	1	0.6	2
Nitrite as N in soil	mg/kg	0.4	0.8	0.1	<0.1	0.2
NOx as N in soil	mg/kg	1.4	11	1.1	0.64	2.4
TKN in soil	mg/kg	1,000	1,100	960	720	480
Total Nitrogen in soil	mg/kg	1,000	1,100	970	730	480
Phosphate as P in soil	mg/kg	<0.5	<0.5	<0.5	0.8	0.7
Total Organic Matter in soil/solids	mg/kg	20,000	23,000	28,000	18,000	10,000

Misc Inorg - Soil						
Our Reference		342289-31	342289-32	342289-33	342289-34	342289-35
Your Reference	UNITS	HDWV34	HDWV35	HDWV36	HDWV37	HDWV38
Depth		0.1	0.1	0.1	0.1	0.08
Date Sampled		19/01/2024	21/01/2024	17/01/2024	17/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	9.2	7.0	8.3	8.1	8.7
Electrical Conductivity 1:5 soil:water	µS/cm	230	120	190	170	170
Ammonia as N in soil	mg/kg	1.9	2.8	2.2	1.5	1.3
Nitrate as N in soil	mg/kg	<0.5	15	1	<0.5	<0.5
Nitrite as N in soil	mg/kg	0.2	1.9	0.4	<0.1	<0.1
NOx as N in soil	mg/kg	0.72	17	1.7	<0.5	<0.5
TKN in soil	mg/kg	700	1,400	840	840	750
Total Nitrogen in soil	mg/kg	700	1,400	840	840	750
Phosphate as P in soil	mg/kg	0.9	<0.5	<0.5	<0.5	<0.5
Total Organic Matter in soil/solids	mg/kg	22,000	34,000	14,000	19,000	16,000

Misc Inorg - Soil						
Our Reference		342289-36	342289-37	342289-38	342289-39	342289-40
Your Reference	UNITS	HDWV39	HDWV40	HDWV41	HDWV42	HDWV43
Depth		0.05	0.1	0.05	0.1	0.1
Date Sampled		20/01/2024	20/01/2024	20/01/2024	17/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	7.9	7.4	8.3	9.2	8.1
Electrical Conductivity 1:5 soil:water	µS/cm	200	110	180	730	2,900
Ammonia as N in soil	mg/kg	6.7	2.7	3.3	3.2	3.0
Nitrate as N in soil	mg/kg	<0.5	9.3	0.8	11	7.3
Nitrite as N in soil	mg/kg	5.4	<0.1	0.1	<0.1	<0.1
NOx as N in soil	mg/kg	5.4	9.4	0.96	11	7.3
TKN in soil	mg/kg	1,300	810	950	1,500	570
Total Nitrogen in soil	mg/kg	1,300	820	950	1,500	580
Phosphate as P in soil	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Total Organic Matter in soil/solids	mg/kg	30,000	17,000	21,000	68,000	16,000

Misc Inorg - Soil				
Our Reference		342289-41	342289-42	342289-43
Your Reference	UNITS	HDWV44	P3	P4
Depth		0.1	0.05	0.05
Date Sampled		21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil
Date prepared	-	24/01/2024	24/01/2024	24/01/2024
Date analysed	-	01/02/2024	01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units	9.7	6.9	8.4
Electrical Conductivity 1:5 soil:water	µS/cm	760	150	250
Ammonia as N in soil	mg/kg	1.9	7.0	5.2
Nitrate as N in soil	mg/kg	13	<0.5	16
Nitrite as N in soil	mg/kg	<0.1	<0.1	0.6
NOx as N in soil	mg/kg	13	<0.5	16
TKN in soil	mg/kg	390	2,400	990
Total Nitrogen in soil	mg/kg	410	2,400	1,000
Phosphate as P in soil	mg/kg	<0.5	6.9	<0.5
Total Organic Matter in soil/solids	mg/kg	11,000	57,000	22,000

Particle Size Distribution in Soils						
Our Reference		342289-1	342289-2	342289-3	342289-4	342289-5
Your Reference	UNITS	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06
Depth		0.1	0.05	0.05	0.05	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	18/01/2024	21/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	<1	<1	<1
Medium Gravel 9.5-13.2mm	%	2	<1	<1	<1	1
Medium Gravel 6.7-9.5mm	%	1	1	<1	<1	1
Medium Gravel 4.75-6.7mm	%	<1	<1	<1	<1	<1
Fine Gravel 2.36-4.75mm	%	1	1	1	3	2
Very Coarse Sand 1.18-2.36mm	%	<1	2	2	3	2
Coarse Sand 0.6-1.18mm	%	1	7	6	10	13
Medium Sand 0.425-0.6mm	%	3	5	6	7	10
Medium Sand 0.3-0.425mm	%	5	13	9	13	14
Fine Sand 0.15-0.3mm	%	42	39	44	33	29
Very Fine Sand 0.075-0.15mm	%	20	14	15	16	14
Coarse Silt 0.020-0.075mm	%	11	9	6	9	7
Fine Silt 0.002-0.020mm	%	5	3	4	2	3
Clay <0.002mm	%	9	5	6	4	4

Particle Size Distribution in Soils						
Our Reference		342289-6	342289-7	342289-8	342289-9	342289-10
Your Reference	UNITS	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11
Depth		0.05	0.05	0.1	0.1	0.1
Date Sampled		21/01/2024	22/01/2024	22/01/2024	18/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	<1	<1	<1
Medium Gravel 9.5-13.2mm	%	<1	<1	<1	<1	<1
Medium Gravel 6.7-9.5mm	%	1	<1	1	2	<1
Medium Gravel 4.75-6.7mm	%	1	<1	<1	1	1
Fine Gravel 2.36-4.75mm	%	1	1	1	2	2
Very Coarse Sand 1.18-2.36mm	%	4	<1	1	2	1
Coarse Sand 0.6-1.18mm	%	10	<1	6	5	4
Medium Sand 0.425-0.6mm	%	6	1	4	6	6
Medium Sand 0.3-0.425mm	%	11	7	15	9	12
Fine Sand 0.15-0.3mm	%	24	38	34	25	33
Very Fine Sand 0.075-0.15mm	%	13	18	16	16	19
Coarse Silt 0.020-0.075mm	%	10	13	8	13	15
Fine Silt 0.002-0.020mm	%	7	7	5	8	3
Clay <0.002mm	%	11	13	9	10	5

Particle Size Distribution in Soils						
Our Reference		342289-11	342289-12	342289-13	342289-14	342289-15
Your Reference	UNITS	HDWV14	HDWV15	HDWV16	HDWV17	HDWV18
Depth		0.1	0.1	0.1	0.05	0.07
Date Sampled		18/01/2024	19/01/2024	19/01/2024	22/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	<1	5	6
Medium Gravel 9.5-13.2mm	%	1	<1	<1	1	<1
Medium Gravel 6.7-9.5mm	%	<1	<1	<1	1	<1
Medium Gravel 4.75-6.7mm	%	<1	1	<1	<1	<1
Fine Gravel 2.36-4.75mm	%	1	6	1	2	1
Very Coarse Sand 1.18-2.36mm	%	2	11	3	1	2
Coarse Sand 0.6-1.18mm	%	8	13	10	2	<1
Medium Sand 0.425-0.6mm	%	11	9	5	2	1
Medium Sand 0.3-0.425mm	%	19	10	7	7	2
Fine Sand 0.15-0.3mm	%	34	20	30	41	38
Very Fine Sand 0.075-0.15mm	%	12	12	18	22	25
Coarse Silt 0.020-0.075mm	%	7	7	12	7	11
Fine Silt 0.002-0.020mm	%	2	5	6	3	6
Clay <0.002mm	%	2	6	8	5	8

Particle Size Distribution in Soils						
Our Reference		342289-16	342289-17	342289-18	342289-19	342289-20
Your Reference	UNITS	HDWV19	HDWV20	HDWV21	HDWV22	HDWV23
Depth		0.1	0.1	0.1	0.1	0.1
Date Sampled		18/01/2024	20/01/2024	18/01/2024	20/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	9	13	<1	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	<1	<1	<1
Medium Gravel 9.5-13.2mm	%	1	1	<1	5	<1
Medium Gravel 6.7-9.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 4.75-6.7mm	%	<1	1	2	<1	<1
Fine Gravel 2.36-4.75mm	%	3	3	3	2	10
Very Coarse Sand 1.18-2.36mm	%	1	6	<1	3	5
Coarse Sand 0.6-1.18mm	%	3	6	7	11	12
Medium Sand 0.425-0.6mm	%	3	4	9	10	10
Medium Sand 0.3-0.425mm	%	6	5	13	12	11
Fine Sand 0.15-0.3mm	%	31	28	27	28	25
Very Fine Sand 0.075-0.15mm	%	25	14	23	17	15
Coarse Silt 0.020-0.075mm	%	6	7	8	4	5
Fine Silt 0.002-0.020mm	%	4	3	3	3	2
Clay <0.002mm	%	8	7	5	4	4

Particle Size Distribution in Soils						
Our Reference		342289-21	342289-22	342289-23	342289-24	342289-25
Your Reference	UNITS	HDWV24	HDWV25	HDWV26	HDWV27	HDWV28
Depth		0.05	0.02	0.1	0.05	0.05
Date Sampled		20/01/2024	17/01/2024	21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	5	<1	<1
Medium Gravel 9.5-13.2mm	%	<1	<1	3	<1	<1
Medium Gravel 6.7-9.5mm	%	<1	1	<1	<1	<1
Medium Gravel 4.75-6.7mm	%	<1	<1	1	<1	<1
Fine Gravel 2.36-4.75mm	%	1	3	4	1	<1
Very Coarse Sand 1.18-2.36mm	%	2	4	7	1	<1
Coarse Sand 0.6-1.18mm	%	6	12	13	2	1
Medium Sand 0.425-0.6mm	%	8	10	10	10	1
Medium Sand 0.3-0.425mm	%	11	14	9	13	7
Fine Sand 0.15-0.3mm	%	36	29	22	27	51
Very Fine Sand 0.075-0.15mm	%	13	17	16	20	24
Coarse Silt 0.020-0.075mm	%	10	5	5	13	6
Fine Silt 0.002-0.020mm	%	5	2	3	5	5
Clay <0.002mm	%	7	4	4	7	5

Particle Size Distribution in Soils						
Our Reference		342289-26	342289-27	342289-28	342289-29	342289-30
Your Reference	UNITS	HDWV29	HDWV30	HDWV31	HDWV32	HDWV33
Depth		0.05	0.1	0.1	0.08	0.05
Date Sampled		20/01/2024	20/01/2024	20/01/2024	19/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	9	<1
Coarse Gravel 19-26.5mm	%	<1	<1	7	<1	<1
Medium Gravel 13.2-19mm	%	<1	<1	6	4	6
Medium Gravel 9.5-13.2mm	%	<1	<1	<1	<1	3
Medium Gravel 6.7-9.5mm	%	<1	<1	<1	1	1
Medium Gravel 4.75-6.7mm	%	<1	<1	2	1	4
Fine Gravel 2.36-4.75mm	%	3	3	9	5	9
Very Coarse Sand 1.18-2.36mm	%	4	4	6	7	12
Coarse Sand 0.6-1.18mm	%	7	6	9	8	12
Medium Sand 0.425-0.6mm	%	8	4	4	4	6
Medium Sand 0.3-0.425mm	%	13	6	6	7	5
Fine Sand 0.15-0.3mm	%	29	37	23	21	12
Very Fine Sand 0.075-0.15mm	%	18	24	14	15	11
Coarse Silt 0.020-0.075mm	%	10	6	7	8	9
Fine Silt 0.002-0.020mm	%	4	4	3	4	4
Clay <0.002mm	%	6	7	4	7	6

Particle Size Distribution in Soils						
Our Reference		342289-31	342289-32	342289-33	342289-34	342289-35
Your Reference	UNITS	HDWV34	HDWV35	HDWV36	HDWV37	HDWV38
Depth		0.1	0.1	0.1	0.1	0.08
Date Sampled		19/01/2024	21/01/2024	17/01/2024	17/01/2024	20/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	4
Medium Gravel 13.2-19mm	%	<1	<1	<1	<1	3
Medium Gravel 9.5-13.2mm	%	4	<1	<1	<1	<1
Medium Gravel 6.7-9.5mm	%	2	<1	<1	<1	<1
Medium Gravel 4.75-6.7mm	%	<1	<1	<1	<1	<1
Fine Gravel 2.36-4.75mm	%	2	2	2	4	3
Very Coarse Sand 1.18-2.36mm	%	4	2	5	8	5
Coarse Sand 0.6-1.18mm	%	11	13	8	12	6
Medium Sand 0.425-0.6mm	%	9	5	7	8	4
Medium Sand 0.3-0.425mm	%	10	4	11	11	7
Fine Sand 0.15-0.3mm	%	15	30	33	23	30
Very Fine Sand 0.075-0.15mm	%	15	20	18	16	17
Coarse Silt 0.020-0.075mm	%	14	9	7	9	9
Fine Silt 0.002-0.020mm	%	7	7	3	3	4
Clay <0.002mm	%	8	8	6	7	8

Particle Size Distribution in Soils						
Our Reference		342289-36	342289-37	342289-38	342289-39	342289-40
Your Reference	UNITS	HDWV39	HDWV40	HDWV41	HDWV42	HDWV43
Depth		0.05	0.1	0.05	0.1	0.1
Date Sampled		20/01/2024	20/01/2024	20/01/2024	17/01/2024	19/01/2024
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1	<1	25
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1	<1	<1
Coarse Gravel 19-26.5mm	%	<1	<1	<1	<1	6
Medium Gravel 13.2-19mm	%	<1	<1	<1	4	8
Medium Gravel 9.5-13.2mm	%	<1	<1	<1	1	<1
Medium Gravel 6.7-9.5mm	%	<1	<1	<1	<1	<1
Medium Gravel 4.75-6.7mm	%	<1	<1	<1	1	<1
Fine Gravel 2.36-4.75mm	%	3	3	2	6	4
Very Coarse Sand 1.18-2.36mm	%	5	3	3	2	6
Coarse Sand 0.6-1.18mm	%	13	4	4	6	9
Medium Sand 0.425-0.6mm	%	8	3	2	6	5
Medium Sand 0.3-0.425mm	%	8	9	6	5	6
Fine Sand 0.15-0.3mm	%	28	39	33	26	14
Very Fine Sand 0.075-0.15mm	%	19	21	24	21	11
Coarse Silt 0.020-0.075mm	%	6	9	10	9	4
Fine Silt 0.002-0.020mm	%	3	2	8	7	2
Clay <0.002mm	%	6	6	8	6	1

Particle Size Distribution in Soils				
Our Reference		342289-41	342289-42	342289-43
Your Reference	UNITS	HDWV44	P3	P4
Depth		0.1	0.05	0.05
Date Sampled		21/01/2024	22/01/2024	22/01/2024
Type of sample		Soil	Soil	Soil
Date prepared	-	05/02/2024	05/02/2024	05/02/2024
Date analysed	-	06/02/2024	06/02/2024	06/02/2024
Cobbles >75mm	%	<1	<1	<1
Cobbles/Coarse Gravel 63-75mm	%	<1	<1	<1
Coarse Gravel 37.5-63mm	%	<1	<1	<1
Coarse Gravel 26.5-37.5mm	%	<1	<1	<1
Coarse Gravel 19-26.5mm	%	5	<1	<1
Medium Gravel 13.2-19mm	%	7	<1	<1
Medium Gravel 9.5-13.2mm	%	4	<1	<1
Medium Gravel 6.7-9.5mm	%	2	<1	<1
Medium Gravel 4.75-6.7mm	%	3	<1	<1
Fine Gravel 2.36-4.75mm	%	6	<1	1
Very Coarse Sand 1.18-2.36mm	%	3	<1	5
Coarse Sand 0.6-1.18mm	%	10	<1	13
Medium Sand 0.425-0.6mm	%	11	<1	9
Medium Sand 0.3-0.425mm	%	11	<1	13
Fine Sand 0.15-0.3mm	%	16	41	24
Very Fine Sand 0.075-0.15mm	%	10	25	17
Coarse Silt 0.020-0.075mm	%	8	10	9
Fine Silt 0.002-0.020mm	%	2	13	3
Clay <0.002mm	%	3	11	6

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell.
Inorg-055	Nitrate - determined colourimetrically. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-055	Nitrite - determined colourimetrically based on APHA latest edition NO2- B. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-055/062/127	Total Nitrogen - Calculation sum of TKN and oxidised Nitrogen. Alternatively analysed by combustion and chemiluminescence.
Inorg-057	Ammonia - determined colourimetrically, based on APHA latest edition 4500-NH3 F. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a KCl extraction.
Inorg-060	Phosphate determined colourimetrically based on EPA365.1 and APHA latest edition 4500 P E. Waters samples are filtered on receipt prior to analysis. Soils are analysed following a water extraction.
Inorg-062	TKN - determined colourimetrically based on APHA latest edition 4500 Norg. Alternatively, TKN can be derived from calculation (Total N - NOx).
Inorg-107	Particle Size Distribution using in house method INORG-107 by way of sieving and/or hydrometer sedimentation testing.
INORG-137	Total Carbon Nitrogen Sulfur by high temperature catalytic combustion with IR detection.
Metals-020	Determination of various metals by ICP-AES.
Metals-020	Determination of exchangeable cations and cation exchange capacity in soils using 1M Ammonium Chloride exchange and ICP-OES analytical finish.

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W1	342289-2
Date prepared	-			02/02/2024	1	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Date analysed	-			02/02/2024	1	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	0.1	Metals-020	<0.1	1	9.8	9.2	6	120	125
Exchangeable K	meq/100g	0.1	Metals-020	<0.1	1	1.3	1.4	7	120	101
Exchangeable Mg	meq/100g	0.1	Metals-020	<0.1	1	6.0	6.2	3	118	112
Exchangeable Na	meq/100g	0.1	Metals-020	<0.1	1	0.2	0.2	0	106	106

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W2	342289-22
Date prepared	-			[NT]	11	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Date analysed	-			[NT]	11	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	0.1	Metals-020	[NT]	11	4.5	4.9	9	129	#
Exchangeable K	meq/100g	0.1	Metals-020	[NT]	11	0.6	0.6	0	122	110
Exchangeable Mg	meq/100g	0.1	Metals-020	[NT]	11	2.1	2.6	21	127	##
Exchangeable Na	meq/100g	0.1	Metals-020	[NT]	11	0.2	0.2	0	98	98

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-W3	342289-42
Date prepared	-			[NT]	21	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Date analysed	-			[NT]	21	02/02/2024	02/02/2024		02/02/2024	02/02/2024
Exchangeable Ca	meq/100g	0.1	Metals-020	[NT]	21	26	23	12	117	#
Exchangeable K	meq/100g	0.1	Metals-020	[NT]	21	0.7	0.7	0	114	108
Exchangeable Mg	meq/100g	0.1	Metals-020	[NT]	21	7.3	7.4	1	115	#
Exchangeable Na	meq/100g	0.1	Metals-020	[NT]	21	0.2	0.2	0	100	101

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	02/02/2024	02/02/2024		[NT]	[NT]
Date analysed	-			[NT]	31	02/02/2024	02/02/2024		[NT]	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	[NT]	31	12	11	9	[NT]	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	[NT]	31	0.5	0.5	0	[NT]	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	[NT]	31	8.0	7.0	13	[NT]	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	[NT]	31	0.7	0.7	0	[NT]	[NT]

QUALITY CONTROL: CEC						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	02/02/2024	02/02/2024		[NT]	[NT]
Date analysed	-			[NT]	41	02/02/2024	02/02/2024		[NT]	[NT]
Exchangeable Ca	meq/100g	0.1	Metals-020	[NT]	41	6.6	6.2	6	[NT]	[NT]
Exchangeable K	meq/100g	0.1	Metals-020	[NT]	41	0.2	0.2	0	[NT]	[NT]
Exchangeable Mg	meq/100g	0.1	Metals-020	[NT]	41	2.9	2.8	4	[NT]	[NT]
Exchangeable Na	meq/100g	0.1	Metals-020	[NT]	41	2.0	1.9	5	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	342289-2
Date prepared	-			31/01/2024	1	31/01/2024	31/01/2024		31/01/2024	31/01/2024
Date analysed	-			01/02/2024	1	01/02/2024	01/02/2024		01/02/2024	01/02/2024
Phosphorus	mg/kg	10	Metals-020	<10	1	210	220	5	94	94

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	342289-22
Date prepared	-			[NT]	11	31/01/2024	31/01/2024		31/01/2024	31/01/2024
Date analysed	-			[NT]	11	01/02/2024	01/02/2024		01/02/2024	01/02/2024
Phosphorus	mg/kg	10	Metals-020	[NT]	11	200	220	10	94	103

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	342289-42
Date prepared	-			[NT]	21	31/01/2024	31/01/2024		31/01/2024	31/01/2024
Date analysed	-			[NT]	21	01/02/2024	01/02/2024		01/02/2024	01/02/2024
Phosphorus	mg/kg	10	Metals-020	[NT]	21	190	200	5	103	111

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	31	31/01/2024	31/01/2024		[NT]	[NT]
Date analysed	-			[NT]	31	01/02/2024	01/02/2024		[NT]	[NT]
Phosphorus	mg/kg	10	Metals-020	[NT]	31	410	420	2	[NT]	[NT]

QUALITY CONTROL: Acid Extractable metals in soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	31/01/2024	31/01/2024		[NT]	[NT]
Date analysed	-			[NT]	41	01/02/2024	01/02/2024		[NT]	[NT]
Phosphorus	mg/kg	10	Metals-020	[NT]	41	280	300	7	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	342289-2
Date prepared	-			24/01/2024	1	24/01/2024	24/01/2024		24/01/2024	24/01/2024
Date analysed	-			01/02/2024	1	01/02/2024	01/02/2024		01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	7.0	7.1	1	100	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	<1	1	150	160	6	102	[NT]
Ammonia as N in soil	mg/kg	0.5	Inorg-057	<0.5	1	8.5	8.4	1	93	#
Nitrate as N in soil	mg/kg	0.5	Inorg-055	<0.5	1	<0.5	<0.5	0	99	82
Nitrite as N in soil	mg/kg	0.1	Inorg-055	<0.1	1	1.3	1.3	0	103	86
NOx as N in soil	mg/kg	0.5	Inorg-055	<0.5	1	1.5	1.4	7	99	82
TKN in soil	mg/kg	10	Inorg-062	<10	1	1800	1800	0	[NT]	[NT]
Total Nitrogen in soil	mg/kg	10	Inorg-055/062/127	<10	1	1800	1800	0	102	[NT]
Phosphate as P in soil	mg/kg	0.5	Inorg-060	<0.5	1	<0.5	<0.5	0	117	89
Total Organic Matter in soil/solids	mg/kg	1000	INORG-137	<1000	1	37000	35000	6	98	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-2	342289-22
Date prepared	-			[NT]	11	24/01/2024	24/01/2024		24/01/2024	24/01/2024
Date analysed	-			[NT]	11	01/02/2024	01/02/2024		01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	11	7.8	7.7	1	100	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	11	110	110	0	102	[NT]
Ammonia as N in soil	mg/kg	0.5	Inorg-057	[NT]	11	8.6	8.6	0	85	#
Nitrate as N in soil	mg/kg	0.5	Inorg-055	[NT]	11	<0.5	<0.5	0	99	#
Nitrite as N in soil	mg/kg	0.1	Inorg-055	[NT]	11	0.1	0.1	0	103	101
NOx as N in soil	mg/kg	0.5	Inorg-055	[NT]	11	<0.5	<0.5	0	99	#
TKN in soil	mg/kg	10	Inorg-062	[NT]	11	830	880	6	[NT]	[NT]
Total Nitrogen in soil	mg/kg	10	Inorg-055/062/127	[NT]	11	830	880	6	103	[NT]
Phosphate as P in soil	mg/kg	0.5	Inorg-060	[NT]	11	2	2	0	113	96
Total Organic Matter in soil/solids	mg/kg	1000	INORG-137	[NT]	11	24000	25000	4	98	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-3	342289-40
Date prepared	-			[NT]	21	24/01/2024	24/01/2024		24/01/2024	24/01/2024
Date analysed	-			[NT]	21	01/02/2024	01/02/2024		01/02/2024	01/02/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	21	8.2	8.1	1	100	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	21	190	200	5	102	[NT]
Ammonia as N in soil	mg/kg	0.5	Inorg-057	[NT]	21	2.5	2.4	4	91	[NT]
Nitrate as N in soil	mg/kg	0.5	Inorg-055	[NT]	21	0.8	0.7	13	99	106
Nitrite as N in soil	mg/kg	0.1	Inorg-055	[NT]	21	0.3	0.3	0	103	101
NOx as N in soil	mg/kg	0.5	Inorg-055	[NT]	21	1.0	1.0	0	99	106
TKN in soil	mg/kg	10	Inorg-062	[NT]	21	1000	1000	0	[NT]	[NT]
Total Nitrogen in soil	mg/kg	10	Inorg-055/062/127	[NT]	21	1000	1000	0	103	[NT]
Phosphate as P in soil	mg/kg	0.5	Inorg-060	[NT]	21	<0.5	<0.5	0	119	124
Total Organic Matter in soil/solids	mg/kg	1000	INORG-137	[NT]	21	19000	22000	15	98	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	342289-42
Date prepared	-			[NT]	31	24/01/2024	24/01/2024		[NT]	24/01/2024
Date analysed	-			[NT]	31	01/02/2024	01/02/2024		[NT]	01/02/2024
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	31	9.2	9.1	1	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	31	230	220	4	[NT]	[NT]
Ammonia as N in soil	mg/kg	0.5	Inorg-057	[NT]	31	1.9	2.2	15	[NT]	75
Nitrate as N in soil	mg/kg	0.5	Inorg-055	[NT]	31	<0.5	0.5	0	[NT]	[NT]
Nitrite as N in soil	mg/kg	0.1	Inorg-055	[NT]	31	0.2	0.1	67	[NT]	[NT]
NOx as N in soil	mg/kg	0.5	Inorg-055	[NT]	31	0.72	0.65	10	[NT]	[NT]
TKN in soil	mg/kg	10	Inorg-062	[NT]	31	700	710	1	[NT]	[NT]
Total Nitrogen in soil	mg/kg	10	Inorg-055/062/127	[NT]	31	700	710	1	[NT]	[NT]
Phosphate as P in soil	mg/kg	0.5	Inorg-060	[NT]	31	0.9	0.9	0	[NT]	[NT]
Total Organic Matter in soil/solids	mg/kg	1000	INORG-137	[NT]	31	22000	23000	4	[NT]	[NT]

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	[NT]	[NT]
Date prepared	-			[NT]	41	24/01/2024	24/01/2024		[NT]	[NT]
Date analysed	-			[NT]	41	01/02/2024	01/02/2024		[NT]	[NT]
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	41	9.7	9.7	0	[NT]	[NT]
Electrical Conductivity 1:5 soil:water	µS/cm	1	Inorg-002	[NT]	41	760	770	1	[NT]	[NT]
Ammonia as N in soil	mg/kg	0.5	Inorg-057	[NT]	41	1.9	2.2	15	[NT]	[NT]
Nitrate as N in soil	mg/kg	0.5	Inorg-055	[NT]	41	13	13	0	[NT]	[NT]
Nitrite as N in soil	mg/kg	0.1	Inorg-055	[NT]	41	<0.1	<0.1	0	[NT]	[NT]
NOx as N in soil	mg/kg	0.5	Inorg-055	[NT]	41	13	13	0	[NT]	[NT]
TKN in soil	mg/kg	10	Inorg-062	[NT]	41	390	420	7	[NT]	[NT]
Total Nitrogen in soil	mg/kg	10	Inorg-055/062/127	[NT]	41	410	430	5	[NT]	[NT]
Phosphate as P in soil	mg/kg	0.5	Inorg-060	[NT]	41	<0.5	<0.5	0	[NT]	[NT]
Total Organic Matter in soil/solids	mg/kg	1000	INORG-137	[NT]	41	11000	10000	10	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

The recommended maximums for analytes in urine are taken from “2018 TLVs and BEIs”, as published by ACGIH (where available). Limit provided for Nickel is a precautionary guideline as per Position Paper prepared by AIOH Exposure Standards Committee, 2016.

Guideline limits for Rinse Water Quality reported as per analytical requirements and specifications of AS 4187, Amdt 2 2019, Table 7.2

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals (not SPOCAS); 60-140% for organics/SPOCAS (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Where matrix spike recoveries fall below the lower limit of the acceptance criteria (e.g. for non-labile or standard Organics <60%), positive result(s) in the parent sample will subsequently have a higher than typical estimated uncertainty (MU estimates supplied on request) and in these circumstances the sample result is likely biased significantly low.

Measurement Uncertainty estimates are available for most tests upon request.

Analysis of aqueous samples typically involves the extraction/digestion and/or analysis of the liquid phase only (i.e. NOT any settled sediment phase but inclusive of suspended particles if present), unless stipulated on the Envirolab COC and/or by correspondence. Notable exceptions include certain Physical Tests (pH/EC/BOD/COD/Apparent Colour etc.), Solids testing, total recoverable metals and PFAS where solids are included by default.

Samples for Microbiological analysis (not Amoeba forms) received outside of the 2-8°C temperature range do not meet the ideal cooling conditions as stated in AS2031-2012.

Report Comments

8 metals in soil - The results are reported on the sample as received due to limited sample i.e. no moisture correction has been applied.

MISC_INORG_DRY:# Percent recovery is not applicable due to the high concentration of the analyte/s in the sample/s. However an acceptable recovery was obtained for the LCS.

CEC:
- # Percent recovery is not applicable due to the high concentration of the element/s in the sample/s. However an acceptable recovery was obtained for the LCS.
- ## poor spike recovery was obtained for this sample. The sample was re-extracted and re-spiked and the poor recovery was confirmed. This is due to matrix interferences.
However, an acceptable recovery was obtained for the LCS.

Appendix C

2023 Floristics Monitoring Results

Ground Cover Floristics (1 of 2)

Species	Common name	Life form	Type	P3	PR4	HDWV01	HDWV02	HDWV03	HDWV04	HDWV06	HDWV07	HDWV08	HDWV09	HDWV10	HDWV11	HDWV14	HDWV15	HDWV16	HDWV17	HDWV18	HDWV19	HDWV20	HDWV21	HDWV22
Anthosachne scabra	Common Wheatgrass	Grass	Native								0.1													
Aristida ramosa	Purple Wiregrass	Grass	Native																					
Asphodelus fistulosus	Onion Weed	Forb	Exotic (non-invasive)																					
Aster subulatus	Wild Aster	Forb	Exotic (non-invasive)																					
Atriplex semibaccata	Creeping Saltbush	Sub-shrub	Native					0.6																
Austrostipa scabra	Speargrass	Grass	Native					0.2																
Austrostipe verticillata	Slender Bamboo Grass	Grass	Native					0.2																
Avena barbata	Bearded Oats	Grass	Exotic (non-invasive)																					
Bidens pilosa	Cobblers Peg	Forb	Exotic (priority weed)									0.2											0.1	0.1
Bidens subalternans	Greater Beggars Tick	Forb	Exotic (priority weed)	0.1													0.4				0.2		0.2	
Bothriochloa decipiens	Red Grass	Grass	Native								4.2								0.1					
Bromus catharticus	Prairie Grass	Grass	Introduced (pasture grass)													0.1								
Bromus hordeaceus	Soft Brome	Grass	Introduced (pasture grass)																					
Calotis lappulacea	Yellow Burr-daisy	Forb	Native				0.1																	
Carex inversa	Knob Sedge	Sedge	Native											2										
Carthamus lanatus	Saffron Thistle	Forb	Exotic (priority weed)																					
Cenchrus clandestinus	Kikuyu	Grass	Introduced (pasture grass)	31				21								43		49	0.1	1.2	12	14.2	1	
Centaurea melitensis	Maltese Cockspur	Forb	Exotic (non-invasive)																			0.2		
Centaurium tenuiflorum	Slender Centaury	Forb	Exotic (non-invasive)							0.4					0.2									
Chenopodium album	Fat Hen	Forb	Exotic (non-invasive)																					
Chloris divaricata	Slender Chloris	Grass	Native																					
Chloris gayana	Rhodes Grass	Grass	Introduced (pasture grass)					13	1					8	1	0.1	0.2	6.2	4.4	56	18.2		33	16
Chloris truncata	Windmill Grass	Grass	Native					0.4		1	9.4													
Cirsium vulgare	Spear Thistle	Forb	Exotic (non-invasive)	0.2																0.1			0.2	
Conyza bonariensis	Flaxleaf Fleabane	Forb	Exotic (non-invasive)							0.1										0.2	0.1			1.3
Conyza sumatrensis	Tall Fleabane	Forb	Exotic (non-invasive)							0.6			0.1							0.2	0.1			0.1
Convolvulus erubescens	Blushing Bindweed	Vine	Native																					
Cullen tenax	Emu-foot	Forb	Native (legume)													0.2					0.1			
Cyclospermum leptophyllum	Slender Celery	Forb	Exotic (non-invasive)							0.4						0.1							0.4	
Cynodon dactylon	Common Couch	Grass	Native		0.1				16.2		19.4	33		4.2		0.1	29		10.4	0.2	8.2			5
Datura stramonium	Common Thornapple	Forb	Exotic (non-invasive)		0.1												1.4					0.2		
Dichanthium sericeum	Queensland Bluegrass	Grass	Native								0.2	0.2										0.1		

Dichondra repens	Kidney Weed	Forb	Native			0.1		0.2																1
Digitaria brownii	Cotton Panic Grass	Grass	Native																					
Einadia hastata	Berry Saltbush	Forb	Native								1													
Einadia nutans subsp. linifolia	Climbing Saltbush	Forb	Native					0.6																
Enchylaena tomentosa	Ruby Saltbush	Sub-shrub	Native					0.6																
Eriochloa pseudoacrotricha	Early Spring Grass	Grass	Native		0.1			0.2	0.2								1	1						
Erodium crinitum	Blue Storksbill	Forb	Native																0.1					0.1
Euchiton sphaericus	Star Cudweed	Forb	Native							0.1														
Euphorbia dallachyana	Mat Spurge	Forb	Native					0.2			0.1	0.1												0.1
Facelis retusa	Annual Trampweed	Forb	Exotic (non-invasive)												0.1									
Galenia pubescens	Galenia	Forb	Exotic (priority weed)	4		1		1	4.2	1			0.1	5.2		16.8	0.2	15	2.2			5		0.1
Galium aparine	Cleavers	Vine	Exotic (non-invasive)						0.1			0.1												
Gamochaeta americana	Cudweed	Forb	Exotic (non-invasive)							0.1														
Geranium solanderi	Native Geranium	Forb	Native							0.1											0.2	1.4	0.4	0.1
Glycine tabacina	Variable Glycine	Vine	Native (legume)					0.1			0.1												0.1	0.1
Gomphocarpus fruticosus	Narrow-leaved Cotton Bush	Forb	Exotic (non-invasive)																					
Lachnagrostis filiformis	Blown Grass	Grass	Native													0.1								
Lactuca saligna	Willow-leaved Lettuce	Forb	Exotic (non-invasive)									0.1											0.1	
Lactuca serriola	Prickly Lettuce	Forb	Exotic (non-invasive)								0.1													
Lepidium bonariense	Argentine Peppercress	Forb	Exotic (non-invasive)							0.1														
Lysimachia arvensis	Scarlet Pimpernel	Forb	Exotic (non-invasive)			0.1			0.1						0.1		0.1				0.2		0.4	0.2
Malva parviflora	Small-flowered Mallow	Forb	Exotic (non-invasive)											0.1										
Medicago polymorpha	Burr Medic	Forb	Introduced (legume)						0.2												0.4		0.8	
Medicago truncatula	Barrel Medic	Forb	Introduced (legume)		0.8												0.1			0.2				
Megathyrsus maximus	Guinea Grass	Grass	Introduced (pasture grass)	42	9.7	53	62	4	34.6	44	8	26	34	52	68	0.4	8	2	7.2		16	38	6	27
Melilotus indicus	Hexham Scent	Forb	Introduced (legume)																	0.1			0.1	
Modiola caroliniana	Red-flowered Mallow	Forb	Exotic (non-invasive)						0.4							0.1					0.1			
Neptunia gracilis	Sensitive Plant	Forb	Native																		0.2			
Oxalis perennans	Grassland Wood-sorrel	Forb	Native						0.1			0.1							0.1		0.2		0.3	
Panicum effusum	Hairy Panic	Grass	Native																					
Panicum queenslandicum	Coolibah Grass	Grass	Native								0.1										0.1	0.1		1
Paspalidium distans	Shotgrass	Grass	Native						0.2					0.1										
Paspalum dilatatum	Paspalum	Grass	Exotic (priority weed)						1															
Plantago lanceolata	Ribwort Plantain	Forb	Exotic (non-invasive)	0.2				1.2			3.2	1.2					2			2.4	0.8	0.2	1.8	
Polygonum aviculare	Wireweed	Forb	Exotic (non-invasive)														0.1							
Portulaca oleracea	Purslane	Forb	Native																					
Rapistrum rugosum	Turnip Weed	Forb	Exotic (non-invasive)		2.6				0.2	0.6				0.1			1.4			0.2		0.1		0.1
Rhynchosia minima	Rhynchosia	Vine	Native (legume)								0.4		0.1											

Rumex crispus	Curled Dock	Forb	Exotic (non-invasive)																					
Rytidosperma racemosum	Wallaby Grass	Grass	Native				0.4																	
Salsola australis	Rolypoly	Shrub	Native																					
Salvia reflexa	Mintweed	Forb	Exotic (non-invasive)			0.1														0.6	2.2	0.2		0.4
Sclerolaena muricata	Black Roly Poly	Shrub	Native						0.1															
Senecio madagascariensis	Fireweed	Forb	Exotic (priority weed)							0.1			0.1				0.4		0.4	0.8		0.2	0.2	
Senecio quadridentatus	Cotton Fireweed	Forb	Native							0.1														
Setaria parviflora	Slender Pigeon Grass	Grass	Exotic (non-invasive)														1							
Sida corrugata	Corrugated Sida	Sub-shrub	Native					0.1																
Sida hackettiana	Golden Rod	Sub-shrub	Native																					
Sida rhombifolia	Paddy's Lucerne	Sub-shrub	Exotic (non-invasive)	0.1	0.6	0.1		0.4		0.2	0.2	0.2				1.2	0.2		0.2	0.1	0.2		0.6	0.4
Sida spinosa	Arrow-leaf Sida	Sub-shrub	Exotic (non-invasive)																					
Solanum nigrum	Black-berry Nightshade	Forb	Exotic (non-invasive)											0.1										
Sonchus oleraceus	Common Sowthistle	Forb	Exotic (non-invasive)													0.1			0.1			0.1	0.2	
Sorghum halepense	Johnson Grass	Grass	Exotic (priority weed)	0.4																				
Sporobolus creber	Slender Rat's Tail Grass	Grass	Native			0.2	1	0.2		0.4												0.2		
Stachys arvensis	Stagger Weed	Forb	Exotic (non-invasive)									0.1												
Trifolium arvense	Haresfoot Clover	Forb	Introduced (legume)																					0.1
Trifolium repens	White Clover	Forb	Introduced (legume)								1													0.1
Urochloa panicoides	Liverseed Grass	Grass	Exotic (non-invasive)		0.1					1							1			0.2		0.1		
Verbascum virgatum	Twiggy Mullein	Forb	Exotic (non-invasive)							0.1														
Verbena bonariensis	Purpltop	Forb	Exotic (non-invasive)												0.1				0.6		0.2		3.2	
Verbena incompta	Purpltop	Forb	Exotic (non-invasive)																	0.2			0.1	
Verbena quadrangularis	A Verbena	Forb	Exotic (non-invasive)					0.2													0.2			
Verbena rigida	Veined Verbena	Forb	Exotic (non-invasive)	0.1																				
Veronica persica	Creeping Speedwell	Forb	Exotic (non-invasive)																					
Vicia villosa	Woolly Pod Vetch	Forb	Exotic (non-invasive)		0.3																			
Wahlenbergia gracilis	Australian Bluebell	Forb	Native							0.1													0.1	
Xanthium spinosum	Bathurst Burr	Forb	Exotic (non-invasive)																					

Ground Cover Floristics (2 of 2)

Species	Common name	Life form	Type	HDWV23	HDWV24	HDWV25	HDWV26	HDWV27	HDWV28	HDWV29	HDWV30	HDWV31	HDWV32	HDWV33	HDWV34	HDWV35	HDWV36	HDWV37	HDWV38	HDWV39	HDWV40	HDWV41	HDWV42	HDWV43	HDWV44
Anthosachne scabra	Common Wheatgrass	Grass	Native													1									
Aristida ramosa	Purple Wiregrass	Grass	Native														0.2								
Asphodelus fistulosus	Onion Weed	Forb	Exotic (non-invasive)			0.1	0.2										0.1								
Aster subulatus	Wild Aster	Forb	Exotic (non-invasive)			0.1				0.2															
Atriplex semibaccata	Creeping Saltbush	Sub-shrub	Native	1													0.2								
Austrostipa scabra	Speargrass	Grass	Native																						
Austrostipe verticillata	Slender Bamboo Grass	Grass	Native																						
Avena barbata	Bearded Oats	Grass	Exotic (non-invasive)													1		0.1							
Bidens pilosa	Cobblers Peg	Forb	Exotic (priority weed)	0.1					0.2																
Bidens subalternans	Greater Beggars Tick	Forb	Exotic (priority weed)				0.4				0.2									4.4	15.2				
Bothriochloa decipiens	Red Grass	Grass	Native					0.2			0.2					10									
Bromus catharticus	Prairie Grass	Grass	Introduced (pasture grass)													1									
Bromus hordeaceus	Soft Brome	Grass	Introduced (pasture grass)													0.1									
Calotis lappulacea	Yellow Burr-daisy	Forb	Native																						
Carex inversa	Knob Sedge	Sedge	Native												0.1										
Carthamus lanatus	Saffron Thistle	Forb	Exotic (priority weed)												0.1										
Cenchrus clandestinus	Kikuyu	Grass	Introduced (pasture grass)								14	0.2		0.2					6						
Centaurea melitensis	Maltese Cockspur	Forb	Exotic (non-invasive)				0.1																		
Centaurium tenuiflorum	Slender Centaury	Forb	Exotic (non-invasive)					0.1										0.1			0.1				
Chenopodium album	Fat Hen	Forb	Exotic (non-invasive)							0.2	0.1														
Chloris divaricata	Slender Chloris	Grass	Native					0.1																	
Chloris gayana	Rhodes Grass	Grass	Introduced (pasture grass)	2						16			17	4.2	1	8			0.4	28	10				
Chloris truncata	Windmill Grass	Grass	Native					3.2					1	0.2	0.2	4.1						0.2			
Cirsium vulgare	Spear Thistle	Forb	Exotic (non-invasive)			0.2									0.2			0.1		1.2	0.2				
Conyza bonariensis	Flaxleaf Fleabane	Forb	Exotic (non-invasive)								0.1	0.2	0.1		0.4			0.2	0.2		6		0.4		
Conyza sumatrensis	Tall Fleabane	Forb	Exotic (non-invasive)		0.2						2	0.2	0.1		0.1	0.2	0.1	0.6		1.2		2.4	0.1		
Convolvulus erubescens	Blushing Bindweed	Vine	Native	0.1							0.2		0.2												
Cullen tenax	Emu-foot	Forb	Native (legume)		0.1					0.1								0.2							
Cyclospermum leptophyllum	Slender Celery	Forb	Exotic (non-invasive)			0.1	0.2				0.1											0.2			
Cynodon dactylon	Common Couch	Grass	Native	62		14.2	39	18.4	17.2	10.4	2	0.1	37	67.8	48	2.2			3			0.2	46	0.1	0.1
Datura stramonium	Common Thornapple	Forb	Exotic (non-invasive)						0.2																
Dichanthium sericeum	Queensland Bluegrass	Grass	Native																						
Dichondra repens	Kidney Weed	Forb	Native			0.1	1			0.2	0.1						0.1	0.6							
Digitaria brownii	Cotton Panic Grass	Grass	Native					0.2																	
Einadia hastata	Berry Saltbush	Forb	Native																						
Einadia nutans subsp. linifolia	Climbing Saltbush	Forb	Native																						
Enchylaena tomentosa	Ruby Saltbush	Sub-shrub	Native																						
Eriochloa pseudoacrotricha	Early Spring Grass	Grass	Native						0.4	0.1					0.2	7		0.1							
Erodium crinitum	Blue Storksbill	Forb	Native				1		0.1	0.1	0.1	0.2						0.1				1			

Euchiton sphaericus	Star Cudweed	Forb	Native																					
Euphorbia dallachyana	Mat Spurge	Forb	Native					0.2		1								4.8						
Facelis retusa	Annual Trampweed	Forb	Exotic (non-invasive)																					
Galenia pubescens	Galenia	Forb	Exotic (priority weed)	11	28	26	14.2		26	1	0.1	0.2	20.1	1.2	3.2	10	11	1	1.2					
Galium aparine	Cleavers	Vine	Exotic (non-invasive)																					
Gamochaeta americana	Cudweed	Forb	Exotic (non-invasive)						0.1															
Geranium solanderi	Native Geranium	Forb	Native						2.2			0.2			0.1	0.2		0.2				0.2		
Glycine tabacina	Variable Glycine	Vine	Native (legume)	0.1																				
Gomphocarpus fruticosus	Narrow-leaved Cotton Bush	Forb	Exotic (non-invasive)				0.2								0.1									
Lachnagrostis filiformis	Blown Grass	Grass	Native																					
Lactuca saligna	Willow-leaved Lettuce	Forb	Exotic (non-invasive)				0.2			0.1					0.2	0.2		0.4	0.8	0.4		0.2		
Lactuca serriola	Prickly Lettuce	Forb	Exotic (non-invasive)			0.1	0.6				0.1					0.2				0.8	0.2	4.2		
Lepidium bonariense	Argentine Peppercress	Forb	Exotic (non-invasive)																					
Lysimachia arvensis	Scarlet Pimpernel	Forb	Exotic (non-invasive)				0.2			0.2	0.1			0.2	0.2						10			
Malva parviflora	Small-flowered Mallow	Forb	Exotic (non-invasive)																					
Medicago polymorpha	Burr Medic	Forb	Introduced (legume)															0.2						
Medicago truncatula	Barrel Medic	Forb	Introduced (legume)				0.2																	
Megathyrsus maximus	Guinea Grass	Grass	Introduced (pasture grass)	2	38	17	1	10		19	15	7					28	37	2			18		
Melilotus indicus	Hexham Scent	Forb	Introduced (legume)											0.1			0.1	0.2						
Modiola caroliniana	Red-flowered Mallow	Forb	Exotic (non-invasive)		0.1		0.1	0.1		2					0.1		0.1							
Neptunia gracilis	Sensitive Plant	Forb	Native																					
Oxalis perennans	Grassland Wood-sorrel	Forb	Native																	2	0.4			
Panicum effusum	Hairy Panic	Grass	Native					0.1																
Panicum queenslandicum	Coolibah Grass	Grass	Native					0.2								0.2								
Paspalidium distans	Shotgrass	Grass	Native																					
Paspalum dilatatum	Paspalum	Grass	Exotic (priority weed)			0.2																		
Plantago lanceolata	Ribwort Plantain	Forb	Exotic (non-invasive)			0.2					0.4				0.2	16.6	0.5	0.4		5		3		
Polygonum aviculare	Wireweed	Forb	Exotic (non-invasive)																					
Portulaca oleracea	Purslane	Forb	Native																	0.2				
Rapistrum rugosum	Turnip Weed	Forb	Exotic (non-invasive)				0.6	0.2							0.2	1.1	0.1			2.4	14	3		
Rhynchosia minima	Rhynchosia	Vine	Native (legume)																					
Rumex crispus	Curled Dock	Forb	Exotic (non-invasive)										0.1											
Rytidosperma racemosum	Wallaby Grass	Grass	Native																					
Salsola australis	Rolypoly	Shrub	Native										0.4											
Salvia reflexa	Mintweed	Forb	Exotic (non-invasive)								0.4													
Sclerolaena muricata	Black Roly Poly	Shrub	Native																					
Senecio madagascariensis	Fireweed	Forb	Exotic (priority weed)	0.2		0.1	0.2			0.2	0.4	0.4	0.1			0.2	0.1	0.1	0.2	0.2	0.2	0.6	0.1	
Senecio quadridentatus	Cotton Fireweed	Forb	Native																			0.1		
Setaria parviflora	Slender Pigeon Grass	Grass	Exotic (non-invasive)					7	1.2					1		1		0.6					2.1	
Sida corrugata	Corrugated Sida	Sub-shrub	Native																					
Sida hackettiana	Golden Rod	Sub-shrub	Native			0.1	0.1																	
Sida rhombifolia	Paddy's Lucerne	Sub-shrub	Exotic (non-invasive)	0.2	0.2	0.2	0.8	0.6	0.2		0.2	0.2				0.2	2.6			0.2				
Sida spinosa	Arrow-leaf Sida	Sub-shrub	Exotic (non-invasive)								0.6													
Solanum nigrum	Black-berry Nightshade	Forb	Exotic (non-invasive)																					
Sonchus oleraceus	Common Sowthistle	Forb	Exotic (non-invasive)														0.1						0.1	
Sorghum halepense	Johnson Grass	Grass	Exotic (priority weed)																					
Sporobolus creber	Slender Rat's Tail Grass	Grass	Native							0.2											0.4			
Stachys arvensis	Stagger Weed	Forb	Exotic (non-invasive)																					
Trifolium arvense	Haresfoot Clover	Forb	Introduced (legume)																					

Trifolium repens	White Clover	Forb	Introduced (legume)											0.2										
Urochloa panicoides	Liverseed Grass	Grass	Exotic (non-invasive)	0.2			13	0.6	3.2	0.1														
Verbascum virgatum	Twiggy Mullein	Forb	Exotic (non-invasive)																					
Verbena bonariensis	Purpltop	Forb	Exotic (non-invasive)															0.1						
Verbena incompta	Purpltop	Forb	Exotic (non-invasive)			0.2										0.2	0.1	0.2						
Verbena quadrangularis	A Verbena	Forb	Exotic (non-invasive)																					
Verbena rigida	Veined Verbena	Forb	Exotic (non-invasive)																					
Veronica persica	Creeping Speedwell	Forb	Exotic (non-invasive)								0.2													
Vicia villosa	Woolly Pod Vetch	Forb	Exotic (non-invasive)																					
Wahlenbergia gracilis	Australian Bluebell	Forb	Native																					
Xanthium spinosum	Bathurst Burr	Forb	Exotic (non-invasive)																0.1					

Mid and Upper Storey Floristics

Site Code	Species	Type	Growth form	Height Class (m)						Reproductive material present	Average repro. score
				< 1m	1-3m	3-5m	5-8m	8-12m	>12m		
HDWV1	Acacia saligna	Priority weed	Shrub	4	2	6	3			Yes	1
HDWV1	Melaleuca styphelioides	Native	Small tree				1			Yes	3
HDWV1	Acacia salicina	Native	Small tree			1				No	0
HDWV1	Eucalyptus cladocalyx	Exotic	Tree						1	No	0
HDWV1	Eucalyptus camaldulensis	Native	Tree				1	2		Yes	3
HDWV1	Eucalyptus melliodora	Native	Tree				1	3	1	No	0
HDWV1	Eucalyptus moluccana	Native	Tree	2			1	1		Yes	3
HDWV1	Corymbia maculata	Native	Tree		1		1	1	1	No	0
HDWV1	Eucalyptus crebra	Native	Tree					3	1	No	0
HDWV2	Acacia implexa	Native	Shrub		1	4				No	0
HDWV2	Acacia saligna	Priority weed	Shrub		5	1				No	0
HDWV2	Acacia salicina	Native	Small tree		1	5	3			Yes	3
HDWV2	Eucalyptus cladocalyx	Exotic	Tree				2		1	No	0
HDWV2	Eucalyptus moluccana	Native	Tree						1	No	0
HDWV2	Corymbia maculata	Native	Tree			1	3	2	3	Yes	4
HDWV2	Eucalyptus crebra	Native	Tree					2		No	0
HDWV2	Eucalyptus camaldulensis	Native	Tree					1		Yes	1
HDWV2	Corymbia citriodora	Exotic	Tree					1	1	Yes	3
HDWV3	Lycium ferocissimum	Priority weed	Shrub	3	3					Yes	4
HDWV3	Acacia implexa	Native	Shrub				1			No	0
HDWV3	Acacia saligna	Priority weed	Shrub		1					No	0
HDWV3	Acacia salicina	Native	Small tree	7	2	4	1			Yes	1
HDWV3	Acacia decurrens	Native	Small tree		1					No	0
HDWV3	Eucalyptus albens	Native	Tree					2		Yes	2

HDWV3	Eucalyptus moluccana	Native	Tree				1			No	0
HDWV3	Eucalyptus camaldulensis	Native	Tree				1			No	0
HDWV3	Corymbia maculata	Native	Tree					2		No	0
HDWV3	Eucalyptus crebra	Native	Tree		1	1				No	0
HDWV4	Acacia implexa	Native	Shrub			2				Yes	3
HDWV4	Lycium ferocissimum	Priority weed	Shrub	1						No	0
HDWV4	Acacia linifolia	Native	Shrub		1					No	0
HDWV4	Acacia salicina	Native	Small tree			3	1	1		Yes	4
HDWV4	Eucalyptus camaldulensis	Native	Tree				1			No	0
HDWV4	Eucalyptus microcarpa	Native	Tree				1			No	0
HDWV4	Corymbia maculata	Native	Tree			1		1		Yes	4
HDWV6	Acacia ligulata	Native	Shrub	1	2	44				Yes	4
HDWV6	Acacia concurrens	Native	Small tree			1	1			No	0
HDWV6	Acacia salicina	Native	Small tree		1	1	1			No	0
HDWV6	Eucalyptus melliodora	Native	Tree			1				No	0
HDWV7	Acacia decora	Native	Shrub		36	8				Yes	3
HDWV7	Lycium ferocissimum	Priority weed	Shrub		7					Yes	4
HDWV7	Dodonaea viscosa subsp. cuneata	Native	Shrub		4					Yes	2.5
HDWV7	Acacia implexa	Native	Shrub		0	2	3			No	0
HDWV7	Acacia parvipinnula	Native	Shrub			2	1			Yes	4
HDWV7	Acacia salicina	Native	Small tree	1	1	12	1			No	0
HDWV7	Corymbia maculata	Native	Tree				1			Yes	4
HDWV8	Hardenbergia violaceae	Native	Shrub		1					No	0
HDWV8	Acacia decora	Native	Shrub		5					Yes	3
HDWV8	Lycium ferocissimum	Priority weed	Shrub		1					No	0
HDWV8	Acacia implexa	Native	Shrub		1					No	0
HDWV8	Acacia salicina	Native	Small tree	2	2	8	4			Yes	3.5
HDWV8	Acacia decurrens	Native	Small tree				1			Yes	3
HDWV8	Eucalyptus moluccana	Native	Tree				4			No	0
HDWV8	Corymbia maculata	Native	Tree				1			No	0
HDWV8	Eucalyptus albens x moluccana	Native	Tree			1				No	0
HDWV8	Eucalyptus tereticornis	Native	Tree			1				No	0
HDWV8	Eucalyptus crebra	Native	Tree		1					No	0
HDWV9	Acacia decora	Native	Shrub		7					Yes	4
HDWV9	Dodonaea viscosa subsp. cuneata	Native	Shrub		1					Yes	5
HDWV9	Lycium ferocissimum	Priority weed	Shrub		1					No	0
HDWV9	Acacia salicina	Native	Small tree	1	3	13	3			No	0
HDWV9	Corymbia maculata	Native	Tree				1			No	0
HDWV9	Eucalyptus moluccana	Native	Tree			2				No	0

HDWV10	Lycium ferocissimum	Priority weed	Shrub	7	1					No	0
HDWV10	Acacia salicina	Native	Small tree		5	19	6			Yes	4
HDWV11	Acacia saligna	Priority weed	Shrub	1	1					No	0
HDWV11	Acacia linifolia	Native	Shrub	5	5					No	0
HDWV11	Acacia salicina	Native	Small tree	4	1	3	6	3		Yes	3
HDWV11	Corymbia maculata	Native	Tree					1		Yes	4
HDWV11	Corymbia citriodora	Exotic	Tree						1	Yes	5
HDWV14	Acacia falcata	Native	Shrub		2	3				No	0
HDWV14	Acacia saligna	Priority weed	Shrub	1	2					No	0
HDWV14	Acacia parvipinnula	Native	Shrub		1	3				No	0
HDWV14	Acacia implexa	Native	Shrub				2			Yes	3
HDWV14	Dodonaea viscosa subsp. cuneata	Native	Shrub	2	1					Yes	4
HDWV14	Dodonaea viscosa subsp. spatulata	Native	Shrub		2					Yes	3
HDWV14	Daviesia genistifolia	Native	Shrub	1						No	0
HDWV14	Acacia decurrens	Native	Small tree		3	3	4			Yes	4
HDWV14	Acacia salicina	Native	Small tree	1						No	0
HDWV14	Corymbia maculata	Native	Tree		2					No	0
HDWV14	Eucalyptus albens	Native	Tree		6					No	0
HDWV14	Eucalyptus crebra	Native	Tree	1	1					No	0
HDWV14	Eucalyptus moluccana	Native	Tree	1	3					No	0
HDWV14	Eucalyptus fibrosa	Native	Tree	3	9					No	0
HDWV15	Dodonaea viscosa subsp. augustifolia	Native	Shrub		1					Yes	4
HDWV15	Dodonaea viscosa subsp. cuneata	Native	Shrub		11					Yes	4
HDWV15	Acacia falcata	Native	Shrub			3				Yes	3
HDWV15	Acacia implexa	Native	Shrub		4					No	0
HDWV15	Acacia parvipinnula	Native	Shrub				1			No	0
HDWV15	Acacia decurrens	Native	Small tree			2				No	0
HDWV15	Eucalyptus crebra	Native	Tree	1	1					No	0
HDWV15	Eucalyptus fibrosa	Native	Tree	3	6					No	0
HDWV15	Eucalyptus blakelyi	Native	Tree		3					Yes	3
HDWV15	Eucalyptus moluccana	Native	Tree	2	2					No	0
HDWV15	Eucalyptus albens	Native	Tree	1	2					No	0
HDWV15	Eucalyptus tereticornis	Native	Tree		13					No	0
HDWV15	Corymbia maculata	Native	Tree	3		2				No	0
HDWV16	Acacia falcata	Native	Shrub	2	3	2				No	0
HDWV16	Acacia decurrens	Native	Small tree			1				No	0
HDWV16	Eucalyptus moluccana	Native	Tree	2	6					No	0
HDWV16	Eucalyptus blakelyi	Native	Tree	2	2					No	0
HDWV16	Eucalyptus fibrosa	Native	Tree	1	3					No	0

HDWV16	Eucalyptus crebra	Native	Tree	6	3					No	0
HDWV16	Corymbia maculata	Native	Tree	4	4					No	0
HDWV17	Dodonaea viscosa subsp. spatulata	Native	Shrub	115	11					No	0
HDWV17	Acacia parvipinnula	Native	Shrub	1	2	13	11			No	0
HDWV17	Acacia falcata	Native	Shrub		1					No	0
HDWV17	Acacia linifolia	Native	Shrub		9	3				No	0
HDWV17	Acacia decora	Native	Shrub	2						No	0
HDWV17	Acacia implexa	Native	Shrub			2				No	0
HDWV17	Acacia salicina	Native	Small tree		1					No	0
HDWV17	Corymbia maculata	Native	Tree	6	1					No	0
HDWV18	Acacia saligna	Priority weed	Shrub		1					No	0
HDWV18	Dodonaea viscosa subsp. spatulata	Native	Shrub	41	1					No	0
HDWV18	Acacia parvipinnula	Native	Shrub		2	2				No	0
HDWV18	Acacia implexa	Native	Shrub	1	1					No	0
HDWV18	Acacia linifolia	Native	Shrub		1					No	0
HDWV18	Acacia salicina	Native	Small tree		1					No	0
HDWV18	Eucalyptus sp.	Native	Tree	1						No	0
HDWV19	Dodonaea viscosa subsp. spatulata	Native	Shrub	45						No	0
HDWV19	Lycium ferocissimum	Priority weed	Shrub	1						No	0
HDWV19	Acacia decurrens	Native	Small tree	5						No	0
HDWV19	Acacia salicina	Native	Small tree		1					No	0
HDWV19	Eucalyptus blakelyi	Native	Tree	7						No	0
HDWV19	Eucalyptus sp.	Native	Tree	2						No	0
HDWV20	Dodonaea viscosa subsp. spatulata	Native	Shrub	36						No	0
HDWV20	Acacia implexa	Native	Shrub			1				No	0
HDWV20	Lycium ferocissimum	Priority weed	Shrub	1						No	0
HDWV20	Acacia saligna	Priority weed	Shrub		1					No	0
HDWV20	Acacia salicina	Native	Small tree	1	1					No	0
HDWV20	Corymbia maculata	Native	Tree	2						No	0
HDWV20	Eucalyptus camaldulensis	Native	Tree	6						No	0
HDWV21	Dodonaea viscosa subsp. spatulata	Native	Shrub	23						No	0
HDWV21	Acacia decora	Native	Shrub	5						No	0
HDWV21	Acacia linifolia	Native	Shrub		5					No	0
HDWV21	Acacia implexa	Native	Shrub	1	1					No	0
HDWV21	Eucalyptus blakelyi	Native	Shrub	6						No	0
HDWV21	Acacia salicina	Native	Small tree	2	1					No	0
HDWV22	Acacia implexa	Native	Shrub	1						No	0
HDWV22	Acacia linifolia	Native	Shrub	1	2					No	0
HDWV22	Dodonaea viscosa subsp. spatulata	Native	Shrub	10						No	0

HDWV22	Corymbia maculata	Native	Tree		1	1				No	0
HDWV23	Dodonaea viscosa subsp. spatulata	Native	Shrub	43						No	0
HDWV23	Acacia linifolia	Native	Shrub	1						No	0
HDWV23	Acacia implexa	Native	Shrub	1						No	0
HDWV23	Corymbia maculata	Native	Tree	3	2					No	0
HDWV23	Eucalyptus blakelyi	Native	Tree	1						No	0
HDWV24	Acacia implexa	Native	Shrub		2					No	0
HDWV24	Acacia parvipinnula	Native	Shrub	1	2	5				No	0
HDWV24	Acacia linifolia	Native	Shrub		11					No	0
HDWV24	Dodonaea viscosa subsp. spatulata	Native	Shrub	9						No	0
HDWV24	Corymbia maculata	Native	Tree	1						No	0
HDWV25	Dodonaea viscosa subsp. spatulata	Native	Shrub	16	1					No	0
HDWV25	Acacia decora	Native	Shrub		1					No	0
HDWV25	Acacia implexa	Native	Shrub	1						No	0
HDWV25	Acacia linifolia	Native	Shrub	2	7					No	0
HDWV25	Acacia parvipinnula	Native	Shrub		5	15				No	0
HDWV25	Acacia decurrens	Native	Small tree		1					No	0
HDWV25	Corymbia maculata	Native	Tree	7	12	2				No	0
HDWV26	Dodonaea viscosa subsp. spatulata	Native	Shrub	5	8					No	0
HDWV26	Acacia implexa	Native	Shrub			1				No	0
HDWV26	Acacia parvipinnula	Native	Shrub			1				No	0
HDWV26	Acacia decora	Native	Shrub		1					No	0
HDWV26	Acacia linifolia	Native	Shrub	2	5					No	0
HDWV26	Corymbia maculata	Native	Tree		2	1				No	0
HDWV26	Eucalyptus blakelyi	Native	Tree	1						No	0
HDWV27	Acacia parvipinnula	Native	Shrub		9	20	11			No	0
HDWV27	Acacia linifolia	Native	Shrub		43	1				No	0
HDWV27	Dodonaea viscosa subsp. spatulata	Native	Shrub	50	8					No	0
HDWV27	Acacia implexa	Native	Shrub		1					No	0
HDWV27	Acacia decora	Native	Shrub	4	4					No	0
HDWV27	Acacia salicina	Native	Small tree		1	1				Yes	3
HDWV27	Acacia decurrens	Native	Small tree		1	1				Yes	3
HDWV27	Corymbia maculata	Native	Tree	28	8					No	0
HDWV27	Eucalyptus crebra	Native	Tree	1						No	0
HDWV27	Eucalyptus tereticornis	Native	Tree	14	5					No	0
HDWV28	Dodonaea viscosa subsp. spatulata	Native	Shrub	17	4					Yes	4
HDWV28	Acacia parvipinnula	Native	Shrub		1					No	0
HDWV28	Acacia implexa	Native	Shrub		1					No	0
HDWV28	Acacia linifolia	Native	Shrub	1	2					No	0

HDWV28	Acacia salicina	Native	Small tree		1					No	0
HDWV28	Corymbia maculata	Native	Tree	1	3					Yes	3
HDWV28	Eucalyptus tereticornis	Native	Tree		1					No	0
HDWV29	Acacia implexa	Native	Shrub		4					No	0
HDWV29	Acacia linifolia	Native	Shrub	1						No	0
HDWV29	Dodonaea viscosa subsp. spatulata	Native	Shrub	19						No	0
HDWV29	Acacia salicina	Native	Small tree	2	3					No	0
HDWV29	Corymbia maculata	Native	Tree	5	1					No	0
HDWV30	Dodonaea viscosa subsp. spatulata	Native	Shrub	35	1					No	0
HDWV30	Acacia saligna	Priority weed	Shrub	1	5					No	0
HDWV30	Lycium ferocissimum	Priority weed	Shrub		1					No	0
HDWV30	Eucalyptus crebra	Native	Tree	1						No	0
HDWV30	Corymbia maculata	Native	Tree	2						No	0
HDWV31	Acacia saligna	Priority weed	Shrub	2						No	0
HDWV31	Dodonaea viscosa subsp. spatulata	Native	Shrub	26						No	0
HDWV31	Corymbia maculata	Native	Tree	3						No	0
HDWV31	Eucalyptus camaldulensis	Native	Tree	1						No	0
HDWV31	Eucalyptus crebra	Native	Tree	1						No	0
HDWV32	Dodonaea viscosa subsp. spatulata	Native	Shrub	30						No	0
HDWV32	Solanum cinereum	Native	Shrub	1						No	0
HDWV32	Acacia implexa	Native	Shrub	2						No	0
HDWV32	Acacia parvipinnula	Native	Shrub	1						No	0
HDWV32	Acacia linifolia	Native	Shrub	1	3					No	0
HDWV32	Acacia salicina	Native	Small tree	4	5					No	0
HDWV32	Corymbia maculata	Native	Tree	26	18					No	0
HDWV33	Dodonaea viscosa subsp. spatulata	Native	Shrub	10						No	0
HDWV33	Acacia implexa	Native	Shrub	1						No	0
HDWV33	Corymbia maculata	Native	Tree	21						No	0
HDWV33	Eucalyptus crebra	Native	Tree	2						No	0
HDWV34	Acacia parvipinnula	Native	Shrub	1						No	0
HDWV34	Dodonaea viscosa subsp. spatulata	Native	Shrub	15						No	0
HDWV34	Lycium ferocissimum	Priority weed	Shrub	4						No	0
HDWV34	Acacia salicina	Native	Small tree	3	1					No	0
HDWV34	Acacia decurrens	Native	Small tree	1						No	0
HDWV34	Corymbia maculata	Native	Tree	6	2					No	0
HDWV35	Dodonaea viscosa subsp. cuneata	Native	Shrub	5						No	0
HDWV35	Dodonaea viscosa subsp. augustifolia	Native	Shrub	2						No	0
HDWV35	Acacia salicina	Native	Shrub	1						No	0
HDWV35	Acacia implexa	Native	Shrub	1						No	0

HDWV35	Acacia decora	Native	Shrub	1						No	0
HDWV35	Lycium ferocissimum	Priority weed	Shrub	1						No	0
HDWV35	Acacia decurrens	Native	Small tree	1						No	0
HDWV35	Corymbia maculata	Native	Tree	2						No	0
HDWV35	Eucalyptus camaldulensis	Native	Tree	6						No	0
HDWV35	Eucalyptus crebra	Native	Tree	1						No	0
HDWV35	Eucalyptus blakelyi	Native	Tree	3						No	0
HDWV36	Dodonaea viscosa subsp. spatulata	Native	Shrub	4						No	0
HDWV36	Dodonaea viscosa subsp. cuneata	Native	Shrub	2						No	0
HDWV36	Hardenbergia violaceae	Native	Shrub	2						No	0
HDWV36	Corymbia maculata	Native	Tree	8						No	0
HDWV36	Eucalyptus blakelyi	Native	Tree	1						No	0
HDWV37	Dodonaea viscosa subsp. cuneata	Native	Shrub	8						No	0
HDWV37	Lycium ferocissimum	Priority weed	Shrub	5						No	0
HDWV37	Acacia decurrens	Native	Small tree	4						No	0
HDWV37	Eucalyptus moluccana	Native	Tree	1						No	0
HDWV38	Acacia saligna	Priority weed	Shrub		7					No	0
HDWV38	Solanum cinereum	Native	Shrub	1						No	0
HDWV38	Acacia decora	Native	Shrub	1						No	0
HDWV38	Dodonaea viscosa subsp. spatulata	Native	Shrub	7						No	0
HDWV38	Corymbia maculata	Native	Tree	6						No	0
HDWV38	Eucalyptus camaldulensis	Native	Tree	1						No	0
HDWV38	Eucalyptus crebra	Native	Tree	2						No	0
HDWV39	Dodonaea viscosa subsp. cuneata	Native	Shrub	15	6					Yes	3
HDWV39	Hardenbergia violaceae	Native	Shrub							No	0
HDWV39	Acacia implexa	Native	Shrub	1						No	0
HDWV39	Dodonaea viscosa subsp. augustifolia	Native	Shrub		2					No	0
HDWV39	Acacia decurrens	Native	Small tree	1						No	0
HDWV39	Eucalyptus moluccana x albens	Native	Tree	12						No	0
HDWV40	Dodonaea viscosa subsp. spatulata	Native	Shrub	8	1					No	0
HDWV40	Acacia decurrens	Native	Small tree	1	2					No	0
HDWV40	Eucalyptus moluccana x albens	Native	Tree	2	2					No	0
HDWV40	Eucalyptus moluccana	Native	Tree	1						No	0
HDWV40	Corymbia maculata	Native	Tree		1					No	0
HDWV41	Lycium ferocissimum	Priority weed	Shrub		4					Yes	3
HDWV41	Dodonaea viscosa subsp. cuneata	Native	Shrub	6	18					Yes	4
HDWV41	Acacia falcata	Native	Shrub		1					No	0
HDWV41	Acacia decurrens	Native	Small tree	3						No	0
HDWV41	Eucalyptus moluccana x albens	Native	Tree	13	3					No	0

HDWV41	Corymbia maculata	Native	Tree	4						No	0
HDWV42	Acacia implexa	Native	Shrub	2						No	0
HDWV42	Dodonaea viscosa subsp. cuneata	Native	Shrub	2						No	0
HDWV42	Acacia salicina	Native	Small tree	2						No	0
HDWV42	Corymbia maculata	Native	Tree	11	2					No	0
HDWV43	Nil	NA	NA							No	0
HDWV44	Nil	NA	NA							No	0

Appendix D

2023 Pasture Feed Quality Testing Report

Department of Primary Industries
Department of Regional NSW

NSW GOVERNMENT

LABORATORY REPORT

AgEnviro Labs - South

DATE OF ISSUE:	**29/01/24**	**REPORT NO:**	**R24-00115-[R00]**
DATE RECEIVED:	25/01/2024	**SAMPLES RECEIVED:**	2 X PASTURE
LABORATORY:	**FEED QUALITY SERVICE**	**LABORATORY REF:**	R24-00115
JOB MANAGER:	RICHARD MEYER	**PURCHASE ORDER:**	

SUBMITTER:	**SHONELLE GLEESON-WILLEY**	**COMPANY:**	**MOSS ENVIROMENTAL**
ADDRESS:	1/342 PEEL STREET TAMWORTH	NSW , 2340 AUSTRALIA	

PIC:

SUBMITTED ON BEHALF OF:

METHOD ID	ANALYSIS METHOD	COMPLETION DATE
Reuter & Robinson 2.E.3; 2.E.4	Dry & Grind inc Dry Matter & Moisture	29/01/24
LMOP_2-1129	Forage Quality Parameters by NIR	29/01/24
LMOP_2-1124	Calculation of Metabolisable Energy	29/01/24
AFIA GRADING	*AFIA Hay & Silage Grade	29/01/24

***NATA Accreditation does not cover the performances of this service**

Results Finalised By:

Patrick Yates

Patrick Yates
Technical Officer
Feed Quality Service

NATA Accreditation No. 14949
Accredited for compliance with ISO/IEC 17025 - Testing

Wagga Wagga Agricultural Institute (WWAI)
PMB Pine Gully Road
Wagga Wagga NSW 2650
T: 02 6938 1957
E: wagga.labs@dpi.nsw.gov.au
W: www.dpi.nsw.gov.au

DATE OF ISSUE: 29/01/24 **REPORT NO:** R24-00115-[R00]

ANALYSIS RESULTS

Dry & Grind inc Dry Matter & Moisture	LOR	UNITS	1 P3	2 P4
Dry Matter (DM)	0.5	%	33.4	14.7
Moisture	0.5	%	66.6	85.3

Approved by:

Patrick Yates
Technical Officer
Feed Quality Service

Standard Forage Package - NIR	LOR	UNITS	1 P3	2 P4
Neutral Detergent Fibre (NDF) - NIR	10	%	72.2	52.4
Acid Detergent Fibre (ADF) - NIR	4.0	%	38.3	23.6
Crude Protein (CP) - NIR	2	%	6.3	26.6
Inorganic Ash - NIR	3.0	%	10.4	15.7
Organic Matter (OM) - NIR		%	89.6	84.3
Dry Matter Digestibility (DMD) - NIR	39	%	42.9	67.9
DOMD - NIR	38	%	44.0	63.8
Calculation of Metabolisable Energy (ME) - NIR	4.3	MJ/kg DM	5.9	9.9
Water Soluble Carbohydrates (WSC) - NIR	4	%	<4.0	6.3

DATE OF ISSUE: 29/01/24 **REPORT NO:** R24-00115-[R00]

Standard Forage Package - NIR			1	2
	LOR	UNITS	P3	P4
AFIA Hay and Silage Grade			NO GRADE	NO GRADE

Approved by:

Patrick Yates
Technical Officer
Feed Quality Service

DATE OF ISSUE: 29/01/24 **REPORT NO:** R24-00115-[R00]

ATTACHMENTS

SubmissionForm2024-01-25_091137_R24-00115_25-01-2024-091218.pdf, 1. 22 December attachment.pdf, Red Imported Fire Ants Advice + FAQ.pdf, R24-00115 SUMMARY V1.xlsx

LABORATORY COMMENTS

This is the final report.
All pages of this report have been checked and approved for release.

This report is version 00, 29/01/24 and replaces any previous reports.

NOTE

I. AFIA Grading is calculated using the 95% coverage probability for the expanded uncertainty of the measurement of results for crude protein (CP) and metabolisable energy (ME). Where there is sufficient doubt that a test sample has complied with a particular grade, then a range of grades are quoted to ensure sufficient accuracy in the reporting.
II. All results are reported on a dry matter basis unless otherwise stated. All units of % are g/100g equivalent.
III. The results apply to the samples as provided to the laboratory.
IV. LOR = Limit of Reporting, the minimum quantity that can be reported with confidence.
V. Information supplied by the submitter may be transcribed from the Submission Form attached to this report. Validity of results is dependent on supplied information being correct.
VI. The laboratory report shall not be reproduced except in full without approval of the laboratory

Appendix E

2023 Walkover Audit Photographs

Photo 1 –Example of tunnel erosion

Photo 2 – Example of stabilising Moderate rill erosion in in Zone 2

Photo 3 – Moderate rill erosion in Zone 2

Photo 4 – Example of Gully erosion

Photo 5 – Example of weed infestation along transect line, not presenting in the surrounding area in Zone 2

Photo 6 – Example of log piles

Photo 7 – Example of animal diggings (possible wombat) in Zone 2

Photo 8 – Example of bare area in Zone 4B

END OF REPORT

Appendix I

Summary of Cumulative Elevated PM_{10} Monitoring Results and Bengalla Increment

APPENDIX I

Summary of Cumulative Elevated Dust Monitoring Results and Bengalla Increment

Date of elevated result	Result (µg/m^3)	Monitor	Description
24 HOUR EXCEEDANCES			
6 March 2023	72.0	PM_{10}-1	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 20.9µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day.
29 May 2023	56.6	PM_{10}-1	BMC engaged TAS to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it is estimated that Bengalla's operations contributed 33.2µg/m3 to the elevated reading at PM_{10}-1. BMC provided DPE with the investigation report and a summary of operations undertaken at Bengalla on the day.
20 September 2023	71.9	PM_{10}-1	BMC engaged TAS to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it is estimated that Bengalla's operations contributed 4.6 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day.
2 October 2023	57.5	PM_{10}-1	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 2.5 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day.
2 October 2023	70.3	PM_{10}-3	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-3. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 12.0 µg/m^3 to the elevated reading at PM_{10}-3. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day
7 December 2023	63.8	PM_{10}-3	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-3. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 15.3 µg/m^3 to the elevated reading at PM_{10}-4. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day
13 December 2023	54	PM_{10}-1	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 3.7 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day
19 December	61.8	PM_{10}-1	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 7.1 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day

Date of elevated result	Result (µg/m^3)	Monitor	Description
19 December	81.3	PM_{10}-3	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 26.6 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day on
Annual Criterion	28.5	PM_{10}-1	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-1. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 24.4 µg/m^3 to the elevated reading at PM_{10}-1. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day
Annual Criterion	26.1	PM_{10}-3	BMC engaged Todoroski Air Sciences (TAS) to investigate the elevated PM_{10} levels recorded at PM_{10}-3. Based on the prevailing wind directions it was estimated that Bengalla's operations contributed 23.8 µg/m^3 to the elevated reading at PM_{10}-3. BMC provided DPIE with the investigation report and a summary of operations undertaken at Bengalla on the day

Appendix J

Non- Aboriginal Heritage Sites

Bengalla Mining Company Non Aboriginal Heritage Sites

Keys Family Cemetery

Stockyards


Bengalla Mining Company
HERITAGE SITE
STOCKYARDS
DO NOT DISTURB

Old Bengalla

House Site 1

House Site 2

Blunts Butter Factory

Bengalla Homestead

External Views

Main homestead, northern aspect

Internal views of fire places

Example of brick and mortar repairs needed

Garden Shed

Out building

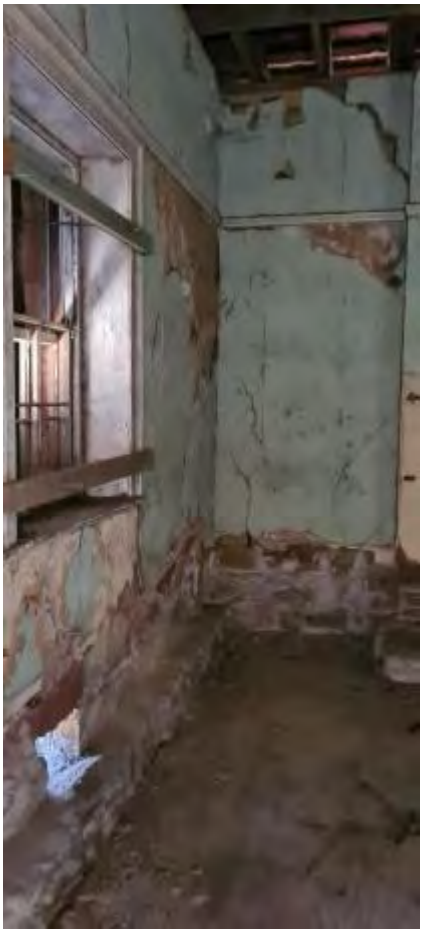
Book Keepers Cottage

Images of internal repairs of book keepers cottage

Overdene Homestead

External view

External view of exposed verandah area



Internal views of Overdene Cottage

Appendix K

2023 Independent Environmental Audit Actions

INDEPENDENT ENVIRONMENTAL AUDIT FINDINGS - BENGALLA MINING COMPANY PTY LIMITED (BMC) RESPONSE

Date: 25 August 2023

Identified Non-Compliances and Recommendations

Non-Compliances identified against SSD-5170 have been summarised in **Table 1** below including the independent audit finding, recommendation, and BMC response.

Table 1 Non-compliances SSD-5170

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
S2 C1	2022	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development and any rehabilitation required under this consent.	BMC implemented some reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development and any rehabilitation required under this consent during the audit period. However, there were some identified non-compliances and opportunities for improvement regarding management of air quality/dust impacts, rehabilitation, and surface water. See non-compliances listed on this checklist and throughout the audit report.	Follow recommendations provided throughout this checklist and the audit report to remediate non-compliances as soon as possible.
Response this reporting period: BMC will continue to implement management plans approved under SSD-5170. Date: Ongoing.				
S2 C2	2022	The Applicant must: a. carry out the development generally in accordance with the EIS, SEE (Mod 1), SEE (Mod 2), SEE (Mod 3) and SEE (Mod 4); and b. comply with the conditions of this consent and the Development Layout. Note: The Development Layout is shown in Appendix 2.	BMC was observed to be carrying out the development in general accordance with the EIS and Mods during the audit period. However, the auditor's report a number of non-compliances against SSD5170 including: - S2C1 - S3C12 - S3C19 - S3C23 - S3C28 - S3C45	Follow recommendations provided throughout this checklist and the audit report to remediate non-compliances as soon as possible.

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
			- S3C46 -S5C7A -S5C10 And therefore, this condition.	
Response this reporting period: BMC will continue to implement management plans approved under SSD-5170. Date: Ongoing.				
S3 C12	2020	**Property Investigations** If the owner of any privately-owned land claims that buildings and/or structures on his/her land have been damaged as a result of blasting on the site, then within 2 months of receiving this claim the Applicant must: a. commission a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties to investigate the claim; and b. give the landowner a copy of the property investigation report. If this independent property investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant must repair the damage to the satisfaction of the Secretary. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the independent property investigation, then either party may refer the matter to the Secretary for resolution.	Warning Letter dated 22 October 2020 issued by DPIE regarding an alleged breach of section 4.2 of the EPA Act involving failure to comply with Schedule 3, Condition 12 of SSD-5170. This condition relevantly requires a property investigation to be commissioned within 2 months of receiving a claim by the owner of privately-owned land that buildings and/or structures have been damaged as a result of blasting on site. On 3 June 2020, an owner of privately-owned land in the vicinity of Bengalla Mine requested a property investigation. DPIE determined that the required response was provided after the 2-month timeframe (on 14 August 2020). A suitably qualified, experienced and independent expert was commissioned to complete the property investigation. The report concluded that damage to buildings and/or structures was not attributable to blasting at Bengalla Mine. No other property investigations were required during the audit period.	In future, make further effort to respond to any requests for property investigations within the required 2-month timeframe.
Response this reporting period: BMC will respond within SSD-5170 time requirement or seek an extension of time from the Department of Planning and Environment (DPE). No requests received during 2023. Date: Ongoing.				
S3 C23	2022	**Water Pollution** Unless an EPL or the EPA authorises otherwise, the Applicant must comply with section 120 of the POEO Act and the Protection	Incident on 16 August 2022, where elevated TSS discharged during authorised HRSTS event, and an incident on the 6-7 July 2022 when the hourly volume discharge limit was exceeded.	Ensure evidence of EPA notification and official Caution letter to close out the non-compliance are included in the Independent Environmental Audit Report.

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
		of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.	During the Reporting Period BMC notified the EPA of a potential breach of Conditions L1 and E1.3 of EPL 6538 regarding hourly volume discharge limits under the Hunter River Salinity Trading Scheme (HRSTS) on 6-7 July 2022.	Ensure desilting of DW1 is undertaken. BMC has taken steps to monitor the river registers for the entirety of Block periods. EPA has closed out investigation.
Response this reporting period: DW1 dam desilting completed. Date: Completed.				
S3 C28	2022	**Long Term Security of Offsets** Within 2 years of the commencement of development under this consent, unless otherwise agreed with the Secretary, the Applicant must make suitable arrangements to provide appropriate long-term security for the land within the Biodiversity Offset Strategy identified in Table 13 through a Biobanking Agreement under the Threatened Species Conservation Act 1995 (or an alternative mechanism agreed with OEH), to the satisfaction of the Secretary.	Taken from 2022 Annual Review: DPE granted an extension to 30 June 2022. BMC corresponded with relevant NSW government departments during 2022 about this matter. Following that correspondence, BMC is taking steps to progress Biodiversity Stewardship Agreements. In the meantime, offset areas remain owned by BJV and managed by BMC in accordance with the approved BOMP. BMC provided evidence of correspondence with BCT regarding requests for extension on this condition. A letter dated 23 December 2022 showed BMC had still not received a response from the BCT from their previous letter dated 26 September 2022. The letter requested an extension until 30 June 2023.BMC also supplied a number of Progress Reports they have sent to DPIE within the audit period, noting a number of complex issues had been identified, including dedication of the properties to the National Estate, Biodiversity Stewardship Agreement or alternate mechanism and environmental targets and measures.	It is noted that the arrangement of a solution for long term security of offsets is complex and Bengalla is making efforts to determine an appropriate long-term mechanism for security. At the time of inspection BMC was still exploring options and corresponding with BCT about the issue.
Response this reporting period: BMC is continuing to consult with the DPE and to progress the establishment of the long term security. Date: Ongoing				
S3 C43	2022	The Applicant must: a. implement all reasonable and feasible measures to minimise the waste (including coal reject) generated by the development;	Of all non-mineral waste generated by the development in the audit period, an average of 77% per year was recycled according to the annual reviews for the audit period.	Implement further staff training to raise awareness around waste management, specifically waste sorting and storage on site.

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
		b. ensure that the waste generated by the development is appropriately stored, handled and disposed of; c. manage on-site sewage treatment and disposal in accordance with the requirements of Council; and d. monitor and report on effectiveness of the waste minimisation and management measures each calendar year, to the satisfaction of the Secretary.	Auditors sighted BMC's 'PRO-0069 Tipping and Dumping Materials' as well as 'PORO-0459 ARD and Mineral Waste Management' which were deemed to lay adequate framework for waste management procedures. Auditors also sighted Bengalla WWTP certification 2022 dated 28 October 2022 by SLR. The document confirmed on-site sewage management was adequate and infrastructure was well maintained. BMC also reuses some waste streams such as intermediate bulk containers, according to the yearly Annual Reviews. Onsite sewage treatment was observed to be effective. BMC reports on the effectiveness of waste minimisation yearly in the Annual Reviews which are available on the New Hope Group website. The effectiveness of waste minimisation is monitored throughout the year and reported in Annual Reviews. However, it was noted during site inspection that some waste was not being appropriately stored, with lids missing from a number of waste storage bins and contamination present in some bins, such as the oily rags only bin.	
Response this reporting period: BMC reviewed the PORO-0459 ARD and Mineral Waste Management plan in March 2024. BMC also conducted targeted training across all staff members as part of planned staff engagement sessions. In these sessions waste observations as detailed in the audit and waste allocation expectations across BMC were communicated. The training occurred in February 2024 to align with already scheduled whole of site engagement sessions.				
S3 C45	2022	**Progressive Rehabilitation** The Applicant must carry out rehabilitation progressively, that is, as soon as reasonably practicable following disturbance (particularly on the face of emplacements that are visible off-site). Interim stabilisation measures must be implemented where reasonable and feasible to control dust emissions in disturbed areas that are not active, and which are not ready for final rehabilitation.	While the majority of the site fulfills this condition and is considered either active mining area or undergoing the stages of rehabilitation. There is an area on the northern face of the overburden emplacement area which has not been part of active mining for approximately 10 years and has not undergone any form of temporary or permanent rehabilitation. The site is visible from Wybong Road. There is no evidence that this area was included in the forward work plan. This site was raised as an observation in the previous	Ensure plans are progressed for rehabilitation of the northern face and appropriate rehabilitation commences as soon as reasonably possible.

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
		Note: It is accepted that parts of the site that are progressively rehabilitated may be subject to further disturbance in future.	audit. It is understood that over the years the site has developed a surface armouring and currently may not contribute significantly to dust generation from the site. It is also noted that across Wybong Road is current active mining from Mt Pleasant mine and therefore may not be considered a high visual impact area relative to the surrounds. In discussions with Bengalla representatives it was noted that there is a plan for the Northern Area to be designed as a geomorphic landform which will require approval as a change to the final landform.	
Response this reporting period: BMC has completed rehabilitation according to the Forward Program and Rehabilitation Management Plan. BMC are preparing an application to modify SSD-5170 that modify the final landform which will meet the rehabilitation objectives on the area identified in the audit adjacent to Wybong Road. Date: BMC anticipate lodging a modification application in the 2024 reporting period				
S3 C46	2021	**Rehabilitation Management Plan** The Applicant must prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRG. This plan must: e. be submitted to the DRG for approval within 6 months of the date of this consent; f. be prepared in consultation with the Department, DoI, OEH, Council and the CCC; g. be prepared in accordance with relevant DRG guidelines; h. describe how the rehabilitation of the site would be integrated with the implementation of the biodiversity offset strategy; i. include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, including over the long-term following completion of mining operations, and triggering remedial action (if necessary); j. describe the design specifications and measures that would be implemented to	Topsoil Management and Rehabilitation under MOP Official Caution dated 15 May 2020 issued by the Resources Regulator regarding an alleged failure to comply with mining lease conditions requiring compliance with an approved MOP (topsoil management procedure and progressive rehabilitation schedule for 2017 and 2018). Following a site inspection on 29 August 2019, the Resources Regulator determined that BMC did not comply with the MOP as follows: 1. Failure to fulfil commitments with respect to topsoil management procedure as referenced in Section 2.3.3.6 (Topsoil Stockpiles) of the approved MOP (including topsoil stockpile size, inactive stockpile management, prevention of sediment water runoff leaving site, weed control management for topsoil stockpiles, topsoil storage processes and maintaining an inventory of available topsoil). 2. Failure to comply with the progressive rehabilitation schedule for 2017 and 2018 in line with commitments made in Table 27 of the approved MOP.	Corrective actions have been taken by BMC. No further action required.

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
		ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including mine closure, final landform including final voids, and final land use; k. include interim rehabilitation where necessary to minimise the area exposed for dust generation; l. include a research program that seeks to improve the understanding and application of rehabilitation techniques and methods in the Hunter Valley; m. include a schedule for establishment of native vegetation corridors and habitat linkages across the site; n. include a landscape management plan for the proposed Bengalla Link Road realignment; o. include a plan for the reinstatement of Dry Creek including: • detailed design specifications for the reinstatement of the creek; • a schedule of works describing how the reinstatement work would be staged and integrated with mining operations and the final landform; • a revegetation program; • hydrological, ecological and geomorphic performance and completion criteria for the reinstated creek based on the assessment of baseline conditions; and • a program to monitor, maintain and/or improve the hydrological and ecological function, quality and geomorphic stability of the reinstated creek; p. include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed	BMC has taken corrective action regarding the identified matters in accordance with the requirements of notices issued by the Resources Regulator under section 240 of the Mining Act (NTCE0003914, NTCE0003917 and NTCE0003919). In December 2021, BMC notified the NSW Resources Regulator (RR) that proposed installation of High-Density Woody Vegetation over previously rehabilitated lands would not be fully completed during 2021 due to difficult meteorological and ground conditions.	

Condition Ref	Date	Requirement	Independent Audit Finding	Recommendation
		performance and completion criteria; and q. build to the maximum extent practicable on other management plans required under this consent. The Applicant must implement the management plan as approved by the Secretary.		
Response this reporting period: BMC will continue to implement the Rehabilitation Management Plan. Date: Completed				

1.1 Summary of Audit Recommendations

Table 2 below outlines the general recommendations identified during the audit. The recommendations detailed below are based around continuous improvement opportunities identified during the audit and do not all represent immediate non-compliance issues. BMC has provided a response to the recommendations.

Table 2 Summary of Recommendations

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
S2C1	In addition to meeting the specific performance measures and criteria established under this consent, the Applicant must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development and any rehabilitation required under this consent.	BMC implemented some reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the development and any rehabilitation required under this consent during the audit period. However, there were some identified non-compliances and opportunities for improvement regarding management of air quality/dust impacts, rehabilitation and surface water. See non-compliances listed on this checklist and throughout the audit report.	Follow recommendations provided throughout this checklist and the audit report to remediate non-compliances as soon as possible.	BMC will continue to implement management plans approved under SSD-5170. Date: Ongoing.
S2C2	The Applicant must: a. carry out the development generally in accordance with the EIS, SEE (Mod 1), SEE (Mod 2), SEE (Mod 3) and SEE (Mod 4); and b. comply with the conditions of this consent and the Development Layout. Note: The Development Layout is shown in Appendix 2.	BMC was observed to be carrying out the development in general accordance with the EIS and Mods during the audit period. Auditors report a number of non-compliances against SSD5170 including: -S2C1 - S3C12 - S3C19 - S3C20* - S3C23 - S3C28* - S3C45 - S3C46* - S5C7A -S5C10 And therefore, this condition.	Follow recommendations provided throughout this checklist and the audit report to remediate non-compliances as soon as possible.	BMC will continue to implement management plans approved under SSD-5170. Date: Ongoing.
S3C12	**Property Investigations** If the owner of any privately-owned land claims that buildings and/or structures on his/her land have been	Warning Letter dated 22 October 2020 issued by DPIE regarding an alleged breach of section 4.2 of the EPA Act involving failure to comply with Schedule 3, Condition 12 of SSD-5170.	Ensure that future requests for property investigations occur within the required 2-month timeframe.	BMC will respond within SSD-5170 time requirement or seek an extension of time from

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
	damaged as a result of blasting on the site, then within 2 months of receiving this claim the Applicant must: a. commission a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties to investigate the claim; and b. give the landowner a copy of the property investigation report. If this independent property investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant must repair the damage to the satisfaction of the Secretary. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the independent property investigation, then either party may refer the matter to the Secretary for resolution.	This condition requires a property investigation to be commissioned within 2 months of receiving a claim by the owner of privately-owned land that buildings and/or structures have been damaged as a result of blasting on site. On 3 June 2020, an owner of privately-owned land in the vicinity of Bengalla Mine requested a property investigation. DPIE determined that the required response was provided after the 2-month timeframe (on 14 August 2020). A suitably qualified, experienced and independent expert was commissioned to complete the property investigation. The report concluded that damage to buildings and/or structures was not attributable to blasting at Bengalla Mine. No other property investigations were required during the audit period.		the Department of Planning and Environment (DPE). Date: Ongoing
S3C19	**Operating Conditions** The Applicant must: a. implement all reasonable and feasible measures to minimise the: ○ odour, fume and dust emissions of the development; and ○ release of greenhouse gas emissions from the site; minimise any visible air pollution generated by the development; minimise the surface disturbance of the site; operate a comprehensive air quality management system that uses a combination of predictive meteorological forecasting, predictive air dispersion modelling and real-time air quality monitoring data to guide the day-to-day planning of mining operations and implementation of both proactive and reactive air quality mitigation measures to ensure compliance with the relevant conditions of this consent;	BMC was observed to be employing some dust mitigation measures during the site inspection, such as water truck spraying of tracks in the pit. BMC's air quality monitoring system was observed to be comprehensive and adequate, using a combination of eight real time air quality monitors, nine high volume air samplers, 27 dust deposition gauges, as well as a meteorological station and inversion tower. The air quality monitoring system feeds into managerial decision and risk assessments, such as blasting risk assessments, to minimise visible air pollution and surface disturbance on site. Blasting events, etc would not be undertaken during adverse meteorological conditions according to interview with Environment employee Ben Simpson. However, during site inspection it was observed that dust mitigation measures were not in place on BMC's ROM hopper, contradictory to part a) of S3C19, as the applicant was not implementing all feasible measures to minimise dust emissions.	Review the ROM hopper dust suppression system and ensure it is operating effectively to mitigate dust emissions.	BMC will review the ROM hopper dust suppression system and ensure it is operating effectively to mitigate dust emissions. Upon completion of the review if works are required those works will be commissioned. Date Review by 31 December 2023. Any works as soon as reasonable and feasible after the review.

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
	minimise the air quality impacts of the development during adverse meteorological conditions and extraordinary events (see note d to Tables 6-8 above); implement all reasonable and feasible measures to co-ordinate the air quality management at the Bengalla mine with the air quality management at the Mt Arthur and Mount Pleasant mines to minimise any cumulative air quality impacts; and monitor and report on compliance with the relevant air quality conditions in this consent, to the satisfaction of the Secretary.			
S3C23	**Water Pollution** Unless an EPL or the EPA authorises otherwise, the Applicant must comply with section 120 of the POEO Act and the Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002.	Incident on 16 August 2022, where elevated TSS discharged during authorised HRSTS event, and an incident on the 6-7 July 2022 when the hourly volume discharge limit was exceeded. During the Reporting Period BMC notified the EPA of a potential breach of Conditions L1 and E1.3 of EPL 6538 regarding hourly volume discharge limits under the Hunter River Salinity Trading Scheme (HRSTS) on 6-7 July 2022.	The recommendations from the surface water specialist are as follows: • Ensure evidence of EPA notification and official Caution letter to close out the noncompliance are included in the Independent Environmental Audit Report. • Ensure desilting of DW1 is undertaken. BMC has taken steps to monitor the river registers for the entirety of Block periods. EPA has closed out investigation. BMC provided the EPA notification and official caution letter to auditors	BMC has commenced desilting of certain dams at Bengalla Mine that will include DW1. Date: As required.
S3C28	**Long Term Security of Offsets** Within 2 years of the commencement of development under this consent, unless otherwise agreed with the Secretary, the Applicant must make suitable arrangements to provide appropriate long-term security for the land within the Biodiversity Offset Strategy identified in Table 13 through a Biobanking Agreement under the Threatened Species Conservation Act 1995 (or an alternative mechanism agreed with OEH), to the satisfaction of the Secretary.	Taken from 2022 Annual Review: DPE granted an extension to 30 June 2022. BMC corresponded with relevant NSW government departments during 2022 about this matter. Following that correspondence, BMC is taking steps to progress Biodiversity Stewardship Agreements. In the meantime, offset areas remain owned by BJV and managed by BMC in accordance with the approved BOMP .	It is noted that the arrangement of a solution for long term security of offsets is complex and Bengalla is making efforts to determine an appropriate long-term mechanism for security. At the time of inspection BMC was still exploring options and	BMC is continuing to consult with the DPE and to progress the establishment of the long term security. Date: Ongoing.

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
		BMC provided evidence of correspondence with BCT regarding requests for extension on this condition. A letter dated 23 December 2022 showed BMC had still not received a response from the BCT from their previous letter dated 26 September 2022. The letter requested an extension until 30 June 2023 .BMC also supplied a number of Progress Reports they have sent to the Department within the audit period, noting a number of complex issues had been identified, including dedication of the properties to the National Estate, Biodiversity Stewardship Agreement or alternate mechanism and environmental targets and measures.	corresponding with BCT about the issue.	
S3C43	The Applicant must: a. implement all reasonable and feasible measures to minimise the waste (including coal reject) generated by the development; b. ensure that the waste generated by the development is appropriately stored, handled and disposed of; c. manage on-site sewage treatment and disposal in accordance with the requirements of Council; and d. monitor and report on effectiveness of the waste minimisation and management measures each calendar year, to the satisfaction of the Secretary.	Of all non-mineral waste generated by the development in the audit period, an average of 77% per year was recycled according to the annual reviews for the audit period. Auditors sighted BMC's 'PRO-0069 Tipping and Dumping Materials' as well as 'PORO-0459 ARD and Mineral Waste Management' which were deemed to lay adequate framework for waste management procedures. Auditors also sighted Bengalla WWTP certification 2022 dated 28 October 2022 by SLR. The document confirmed on-site sewage management was adequate and infrastructure was well maintained. BMC also reuses some waste streams such as intermediate bulk containers, according to the yearly Annual Reviews. Onsite sewage treatment was observed to be effective. BMC reports on the effectiveness of waste minimisation yearly in the Annual Reviews which are available on the New Hope Group website. The effectiveness of waste minimisation is monitored throughout the year and reported in Annual Reviews. However, it was noted during site inspection that some waste was not being appropriately stored, with lids missing from a number of waste	Ensure that regular inspections consider maintenance of waste segregation, and that staff training is undertaken to ensure awareness of waste management, specifically waste segregation and storage on site.	BMC will review relevant waste procedures and conduct training with relevant staff. Date: Review of procedures and training to be completed by 31 December 2023.

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
		storage bins and contamination present in some bins, such as the oily rags only bin.		
S3C45	**Progressive Rehabilitation** The Applicant must carry out rehabilitation progressively, that is, as soon as reasonably practicable following disturbance (particularly on the face of emplacements that are visible off-site). Interim stabilisation measures must be implemented where reasonable and feasible to control dust emissions in disturbed areas that are not active, and which are not ready for final rehabilitation. Note: It is accepted that parts of the site that are progressively rehabilitated may be subject to further disturbance in future.	While the majority of the site fulfills this condition and is considered either active mining area or undergoing the stages of rehabilitation. There is an area on the northern face of the overburden emplacement area which has not been part of active mining for approximately 10 years and has not undergone any form of temporary or permanent rehabilitation. The site is visible from Wybong Road. There is no evidence that this area was included in the forward work plan. This site was raised as an observation in the previous audit. It is understood that over the years the site has developed a surface armouring and currently may not contribute significantly to dust generation from the site. It is also noted that across Wybong Road is current active mining from Mt Pleasant mine and therefore may not be considered a high visual impact area relative to the surrounds. In discussions with Bengalla representatives it was noted that there is a plan for the Northern Area to be designed as a geomorphic landform which will require approval as a change to the final landform.	Ensure plans are progressed for rehabilitation of the northern face and appropriate rehabilitation commences as soon as reasonably possible.	BMC has completed rehabilitation according to the Mining Operations Plan and now the Forward Program and Rehabilitation Management Plan. BMC are preparing an application to modify SSD-5170 that will likely include installation of geomorphic features on the northern face adjacent to Wybong Road. Date: BMC anticipate lodging a modification application around end of first quarter 2024.
S3C46	**Rehabilitation Management Plan** The Applicant must prepare a Rehabilitation Management Plan for the development to the satisfaction of the DRG. This plan must: a. be submitted to the DRG for approval within 6 months of the date of this consent; b. be prepared in consultation with the Department, DoI, OEH, Council and the CCC; c. be prepared in accordance with relevant DRG guidelines; d. describe how the rehabilitation of the site would be integrated with the implementation of the biodiversity offset strategy; e. include detailed performance and completion criteria for evaluating the performance of the	Topsoil Management and Rehabilitation under MOP Official Caution dated 15 May 2020 issued by the Resources Regulator regarding an alleged failure to comply with mining lease conditions requiring compliance with an approved MOP (topsoil management procedure and progressive rehabilitation schedule for 2017 and 2018). Following a site inspection on 29 August 2019, the Resources Regulator determined that BMC did not comply with the MOP as follows: 1. Failure to fulfil commitments with respect to topsoil management procedure as referenced in Section 2.3.3.6 (Topsoil Stockpiles) of the approved MOP (including topsoil stockpile size,	Corrective actions have been taken by BMC. No further action required.	BMC will continue to implement the Rehabilitation Management Plan. Date: Ongoing.

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
	rehabilitation of the site, including over the long-term following completion of mining operations, and triggering remedial action (if necessary); f. describe the design specifications and measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including mine closure, final landform including final voids, and final land use; g. include interim rehabilitation where necessary to minimise the area exposed for dust generation; h. include a research program that seeks to improve the understanding and application of rehabilitation techniques and methods in the Hunter Valley; i. include a schedule for establishment of native vegetation corridors and habitat linkages across the site; j. include a landscape management plan for the proposed Bengalla Link Road realignment; k. include a plan for the reinstatement of Dry Creek including: • detailed design specifications for the reinstatement of the creek; • a schedule of works describing how the reinstatement work would be staged and integrated with mining operations and the final landform; • a revegetation program; • hydrological, ecological and geomorphic performance and completion criteria for the reinstated creek based on the assessment of baseline conditions; and • a program to monitor, maintain and/or improve the hydrological and ecological function, quality and geomorphic stability of the reinstated creek; l. include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and	inactive stockpile management, prevention of sediment water runoff leaving site, weed control management for topsoil stockpiles, topsoil storage processes and maintaining an inventory of available topsoil). 2. Failure to comply with the progressive rehabilitation schedule for 2017 and 2018 in line with commitments made in Table 27 of the approved MOP. BMC has taken corrective action regarding the identified matters in accordance with the requirements of notices issued by the Resources Regulator under section 240 of the Mining Act (NTCE0003914, NTCE0003917 and NTCE0003919). In December 2021, BMC notified the NSW Resources Regulator (RR) that proposed installation of High-Density Woody Vegetation over previously rehabilitated lands would not be fully completed during 2021 due to difficult meteorological and ground conditions.		

Condition Ref	Requirement	Independent Audit Finding	Recommendation	BMC Response
	m. build to the maximum extent practicable on other management plans required under this consent. The Applicant must implement the management plan as approved by the Secretary.			