PINE DALE MINE
ANNUAL REVIEW 2021

Prepared by Enhance Place Pty Ltd

18 February 2022

TITLE BLOCK

Name of Operation:	Pine Dale Mine
Name of Operator:	Enhance Place Pty Limited
Project Approval Number:	10_0041
Project Approval Holder:	Enhance Place Pty Limited
Mining Lease Numbers:	ML1569, ML1578, ML1664, ML1637
Mining Lease Holder:	Enhance Place Pty Limited
Water Licence Number:	10WA118780
Water Licence Holder:	Enhance Place Pty Ltd
Mining Operations Plan Commencement Date:	15 April 2014
Mining Operations Plan Completion Date:	2 July 2022[1]
Annual Review Start Date:	1 January 2021
Annual Review End Date:	31 December 2021
Annual Review Report Author:	Fiona Brooker (RCA Australia)

I, Graham Goodwin, certify that this audit report is a true and accurate record of the compliance status of Pine Dale Mine, for the period 1 January 2021 to 31 December 2021 and that I am authorised to make this statement on behalf of Enhance Place Pty ltd.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 9.39 of the Environmental Planning and Assessment Act 1979. Section 9.42 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 Tier 3 monetary penalty.

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 a fine of 200 penalty units or both).

Authorised Reporting Officer:	Graham Goodwin
Title:	Mining Engineering Manager
Signature:	
Date:	18.February.2022

[1] A 12-month extension to the Pine Dale Mine Care and Maintenance MOP term was approved by the Resources Regulator on 10 December 2020. A second extension was granted on 2nd February 2022.

STATEMENT OF COMPLIANCE

The Pine Dale Mine (PDM) Annual Review has been prepared to provide a summary of the performance of PDM operations over the period 1 January 2021 – 31 December 2021 (the reporting period).

This Annual Review has been prepared pursuant to Schedule 5, Condition 3 of the Project Approval 10_0041, and in accordance with the Annual Review Guideline developed by the NSW Department of Planning and Environment (Ref [1]).

A summary of the PDM compliance status during this reporting period is provided in **Table 1**. There was one (1) non-compliance during the 2021 reporting period relating to groundwater monitoring as detailed in the Pine Dale Mine Water Management Plan which is a requirement under PA 10_0041. A description of the administrative non-compliance is provided in **Table 2**. There was also one non-compliance associated with the PDM Environment Protection Licence (EPL) 4911 relating to loss of meteorological data from the weather station. The non-compliance status recorded during the reporting period has been ranked according to the risk included in **Table 3**.

Table 1 *Statement of compliance*

Approval No.	Were all conditions of the approval complied with?
PA 10_0041	No
EPL 4911	No
ML1569	Yes
ML1578	Yes
ML1664	Yes
ML1637	Yes
10WA118780	Yes

Table 2 *Non-Compliances*

Relevant Approval	Condition #	Condition Description Summary	Compliance Status	Comment	Where Addressed in Annual Review
PA 10_0041	27 (c) Groundwater Management Plan	Groundwater monitoring requirements of Groundwater Management Plan.	Non-compliant	Yarraboldy Groundwater monitoring schedule unable to be adhered to due to the State Forest closure and safety risks accessing bores caused by bushfire damage.	**Section 6.5**
EPL 4901	M4.1 Weather monitoring	Monitoring requirements for meteorological station	Non-compliant	Data lost on 3 occasions from meteorological station malfunction / flat battery	**Section 5.3**

Table 3 *Compliance status Key for Table 2*

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

An acceptable standard of environmental performance was achieved during the reporting period as evidenced by the following:

- Air quality monitoring results recorded during the reporting period for depositional dust were below the air quality criteria stipulated in the Project Approval 10_0041 at all monitoring locations.
- There were no noise exceedances from mining activities recorded at privately owned properties during the reporting period.
- There were no surface water discharge events during the reporting period.

- There were some intermittent exceedances of surface water trigger values during the reporting period; however, these are considered to be due to activities upstream of PDM and / or natural variation and not associated with activities undertaken by PDM during the reporting period.
- There were some intermittent exceedances of groundwater trigger values during the reporting period; however, these are considered to be primarily due to climatic influences (increased rainfall) and potential ingress of water into the underground workings outside of the control and influence of PDM.

During the reporting period, an assessment of rehabilitation areas was completed. Rehabilitation areas are generally stable in both the pasture and treed revegetation areas, whilst weed presence continues to be adequately controlled. It is recommended to continue weed management and monitoring of performance indicators over the 2022 reporting period. Installation of nesting boxes has also been recommended as per previous years, subject to trees being suitable for the installation.

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1 INTRODUCTION

EnergyAustralia owns Enhance Place Pty Ltd (Enhance Place) which operates PDM having acquired PDM in June 2012.

PDM is located at Blackmans Flat in NSW, 17km north of Lithgow off the Castlereagh Highway. The site is approximately 3km via the Castlereagh Highway from the Mt. Piper Power Station (MPPS). A locality plan is provided in **Plan 1**, **Appendix A**.

PDM is authorised by Project Approval (PA) 10_0041, dated 20 February 2011, granted by the former Department of Planning and Infrastructure, currently the Department of Planning, Industry and the Environment (DPIE) under section 75J of the Environmental Planning & Assessment Act 1979 (EP&A Act). The Project Approval provided for the extraction of up to 800,000 tonnes of Run of Mine (ROM) coal from the Yarraboldy Extension at PDM up to 31 December 2014 at a maximum rate of 350,000 tonnes per annum. Approved mining resources at PDM were exhausted in March 2014. From April 2014 the mine was placed under care and maintenance, with only rehabilitation activities undertaken intermittently at the site from this time.

This Annual Review (AR) has been generated to meet:

- The requirements of the NSW DPIE (Ref [1]), formerly the NSW Department of Planning and Environment under the conditions of a development consent and/ or project approval.
- The routine reporting expectations of the NSW Resources Regulator.
- The annual reporting requirements of the Environment Protection Authority (EPA) under the conditions of the site Environmental Protection Licence 4911.

This Annual Review will be distributed to the following stakeholders:

- NSW DPIE – Compliance.
- NSW DPIE – Resources Regulator.
- NSW DPIE – Natural Resources Access Regulator.
- NSW Environment Protection Authority.
- Lithgow City Council.
- Community Consultative Committee (CCC) via the EnergyAustralia website.

1.1 KEY PERSONNEL

The key personnel for environmental management at the PDM are listed in **Table 1-1**.

Table 1-1 *Key Personnel and contact information*

Contact Person	Position	Telephone	Email
Mr Graham Goodwin	Mining Engineering Manager	(02) 6355 7893	Graham.Goodwin2@energyaustralia.com.au
Mr Mark Frewin	Coal Supply Lead	0438 338 176	Mark.Frewin@energyaustralia.com.au
Mr Ben Eastwood	NSW Environment Leader	(02) 6354 8350	Ben.Eastwood@energyaustralia.com.au

2 APPROVALS, LEASES AND LICENCES

PDM operates in accordance with a number of relevant licenses and approvals which are summarised in **Table 2-1**. The mining and exploration lease boundaries are shown in **Plan 2**, **Appendix A**.

Table 2-1 *Pine Dale Mine Consents, Leases and Licences*

Permit Type	Permit Number	Relevant Dates	Description
Project Approval	PA 10_0041	Granted 20 Feb 2011 Expired 31 Dec 2014	Granted by Minister of DP&I, Section 75J of the EP&A Act. A modification to PA 10_0041 was granted in March 2012.
Referral Decision	2011/6016	Date of Decision 20 October 2011	Issued by Department of Sustainability, Environment, Water, Population and Communities under section 75 & 77A of the EPBC Act 1999; to avoid impact on Purple Copper Butterfly & Austral toadflax (*Thesium australe*).
Environment Protection Licence	EPL 4911	Review Due Date 13 August 2024	EPL held by Enhance Place Pty Ltd.
Mining Lease	ML1578	Granted 5 November 2013	ML 1578 incorporates 69.4ha of land within the boundary of the Pine Dale Mine site.
Mining Lease	ML1664	Grouped under ML1578, 5 Nov 2013	ML 1664 incorporates 4.1 Hectares of land within the boundary of the Pine Dale Mine site.
Mining Lease	ML1569	Grouped under ML1578, 5 Nov 2013	ML1569 incorporates 161 hectares of land with which the Yarraboldy Extension and a portion of PDM.

Permit Type	Permit Number	Relevant Dates	Description
Mining Lease	ML1637	Grouped under ML1578, 5 Nov 2013	ML1637 covers an area to the south of PDM for the purpose of proposed rail infrastructure.
Exploration Mining Lease	EL7621	Granted 1 October 2010	EL 7621 incorporates 312 Hectares of land within the north western and central parts of the Wallerawang Colliery.
Bore Licence	10BL165933	Issued 22 December 2005	Issued by the Department of Natural Resources (DNR) under Part 5 of the Water Act 1912 for the use of (6) six piezometers for monitoring groundwater levels and quality on the Pine Dale Mine site.
Bore Licence	10BL603588	Issued 17 December 2010	Issued by the DNR under Part 5 of the Water Act 1912 for the use of eight (8) piezometers for monitoring groundwater levels and quality on the Yarraboldy Extension.
Water Access Licence	WAL36480 (approval no 10WA118780)	Dated 1 July 2013 Expires 30 June 2026	This licence was issued by the former Department of Environment, Climate Change and Water, which was superseded by DPIE under Part 5 of the Water Act 1912 for interception and use of up to 200ML of groundwater per year from The Bong.
Flood Control Works Licence	10CW801601 (approval no 10FW119292)	Dated 21 Sept 2015 Expires 21 Sep 2017	Issued by the DNR under Part 8 of the Water Act 1912 for the construction of noise/flood bunding along the boundaries of Mining Areas A, B and C.

3 OPERATIONS SUMMARY

PDM was in care and maintenance during the reporting period, as such, no extractive mining operations were undertaken.

3.1 EXPLORATION

There were no exploration drilling activities carried out at PDM during the reporting period.

3.2 LAND PREPARATION

There were no land preparation activities carried out at PDM during the reporting period.

3.3 CONSTRUCTION

No construction work was undertaken at PDM during the reporting period.

3.4 MINING OPERATIONS

There were no mining activities undertaken at PDM during the reporting period: PDM is currently in care and maintenance. The production and waste summary for 2020, 2021 and forecast for 2022 is provided in **Table 3-1**.

Table 3-1 *Production Summary*

	Approved Limit	Previous Reporting Period (2020 actual)	Current Reporting Period (2021 actual)	Next Reporting Period (2022 forecast)
Waste Rock / Overburden	NA	0	0	0
ROM Coal	800,000tonne (over life of mine)	0	0	0
Coarse Reject	NA	0	0	0
Fine Reject (Tailings)	NA	0	0	0
Saleable product	350,000tonne per annum	0	0	0

3.5 COAL PROCESSING

Due to the care and maintenance status of PDM, no coal was processed during the reporting period: the coal crushing plant was decommissioned at the completion of mining extraction in April 2014.

3.6 COAL TRANSPORTING

Due to the care and maintenance status of PDM, no product coal was required to be transported during the reporting period.

3.7 WASTE MANAGEMENT

General waste bins are kept at the site office for the collection of putrescible waste. These bins are inspected and emptied as part of the regular inspection and maintenance programme. Minimal general waste is generated at PDM as the mine in care and maintenance.

Sewage management facilities associated with personnel offices were maintained at the site during the reporting period with regular inspections and pump outs undertaken as required.

3.8 PRODUCT STOCKPILES

All product stockpiles were decommissioned prior to the reporting period.

3.9 HAZARDOUS MATERIAL MANAGEMENT

There are no bulk oils stored on site and none were brought onto site during the reporting period. In the event hazardous materials are to be brought on site, they are to be accompanied by Safety Data Sheets (SDS).

3.10 FORECAST OPERATIONS

There are no operations forecast for PDM during 2022. The mine will continue to remain under care and maintenance.

4 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The 2020 Annual Review recommended weed spraying and the installation of nesting boxes once the treed area contains adequate structure to support nesting birds, noting that the bushfires in the area (late 2019 to early 2020) were considered likely to delay this action. Weed spraying has been undertaken (refer **Section 5.7**) however nesting boxes have not been installed as trees remain too small to accommodate them.

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [2]) noted that rehabilitation had been successfully completed in Areas B, C and 8 and all completion criteria defined in the Pine Dale Mine Care and Maintenance Mining Operations Plan (PDM MOP, Ref [3]) had been successfully achieved. As such PDM intended to seek to relinquish rehabilitation responsibilities of Areas B, C and 8 in 2021 however at time of writing this has not been completed.

There were no further specific actions (other than maintenance requirements) from the 2020 Annual Review.

5 ENVIRONMENTAL PERFORMANCE

PDM regards sound environmental performance and community liaison as integral components of its operations.

Environmental monitoring and management at PDM are governed by the requirements of PA 10_0041 and the supporting environmental assessment. The following management plans have been developed for PDM to minimise the potential risk to the surrounding environment.

- PDM MOP, Ref [3])
- Aboriginal Heritage Management Plan.
- Air Quality and Greenhouse Gas Management Plan.
- Blast Management Plan.
- Bushfire Management Plan.
- Waste Management Plan.
- Water Management Plan.
- Noise Management Plan.
- Pollution Incident Response Management Plan.
- Pine Dale Mine Environmental Management Strategy.

These management plans are available on the EnergyAustralia website: https://www.energyaustralia.com.au/about-us/energy-generation/pine-dale-coal-mine/yarraboldy-stage-1

A summary of the environmental performance for noise and air quality monitoring is provided in **Table 5-1**. Applicable approval and Environmental Assessment criteria are also provided in **Table 5-1**. Detailed discussions of the environmental performance are presented further in this section.

It is noted that monitoring of dust via a High Volume Air Sampler (HVAS) was ceased after 29 October 2020 following an EPL amendment. Furthermore, meteorological data is now collected from the existing Mt Piper Power Station (MPPS) weather station following an EPL amendment in November 2021.

Table 5-1 *Summary of Environmental Performance and assessment criteria*

Aspect	Approval Criteria	Energy Australia[a] Prediction	Performance during 2021	Trends /Management Implications	Management Actions
Noise	NM1 – NM3 Daytime Criterion 42dB(A) $L_{Aeq(15minute)}$[b]	NM1 41 NM2 32 NM3 39 dB(A) $L_{Aeq(15minute)}$	NM1 Nil detected NM2 Nil detected NM3 Nil detected dB(A) $L_{Aeq(15minute)}$	NA – no operational noise generated	Nil management actions required
	NM4 – NM6 Daytime Criterion 35dB(A) $L_{Aeq(15minute)}$[b]	NM4 34 NM6 <30 dB(A) $L_{Aeq(15minute)}$	NM4 Nil detected NM5 Nil detected NM6 Nil detected dB(A) $L_{Aeq(15minute)}$	NA – no operational noise generated	Nil management actions required
Air Quality: Depositional Dust	Maximum total deposited dust 4g/m^2/month	Annual average of 3.2g/m^2/month deposited dust	Annual average range of 0.2 to 1.0g/m^2/month deposited dust	Concentrations during previous five years are considered consistent noting that there has been impact to the results from external factors (climate and bushfires)	Maintain dust suppression measures as required
	Maximum increase in deposited dust 2g/m^2/month	Annual average increase of deposited dust 1.2g/m^2/month	Annual average change of -1.3 to -0.2g/m^2/month deposited dust	Annual average dust levels are slightly lower than 2020 generally consistent with 2017 and 2018 data (prior to significant impact from bushfires).	Ensure dust suppression measures are efficiently utilised during extended dry periods, otherwise maintain current measures as required.

[a] Environmental Assessment prediction
[b] The A-weighted, equivalent continuous sound level in decibels measured across 15-minutes

5.1 NOISE

Mining related noise impacts at PDM are managed in accordance with Schedule 3, Condition 1 of PA 10_0041, EPL 4911 and the Noise Management Plan. Noise emissions from PDM operations were monitored on a quarterly basis at six (6) locations surrounding PDM. Although PDM is currently in care and maintenance, rehabilitation maintenance activities and inspections were undertaken on the site during the 2021 reporting period. The noise monitoring locations are described as:

- NM1 – Noon Street, Blackman's Flat.
- NM2 – the Cherry residence, Blackman's Flat.

- NM3 – front of Barnes residence, east of Blackman's Flat along the Castlereagh Highway.
- NM4 – North of View Street, Blackman's Flat.
- NM5 – Wolgan Road, Lidsdale.
- NM6 – Wolgan Road, Lidsdale.

The locations of these noise monitoring locations are shown in **Plan 3a**, located in **Appendix A**.

The operational noise assessment criteria are summarised in **Table 5-2**.

Table 5-2 *Noise Impact Assessment Criteria*

Location	Day[a] Period $L_{Aeq\ (15min)}$, dB	Evening[b] Period $L_{Aeq\ (15min)}$, dB
NM1	42	39
NM2	42	35
NM3	42	35
NM4	35	35
NM5	35	35
NM6	35	35

[a] Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and public holidays.

[b] Evening is defined as the period between 6pm and 10pm.

Attended noise monitoring was undertaken quarterly during the reporting period to assess any noise impacts from PDM against the relevant criteria detailed within EPL 4911 and PA 10_0041 (**Table 5-2)** on the following dates:

- Quarter 1 – January to March, monitoring conducted 25 March 2021.
- Quarter 2 – April to June, monitoring conducted 20 May 2021.
- Quarter 3 – July to September, monitoring conducted on 8 September 2021.
- Quarter 4 – October to December, monitoring conducted on 13 December 2021.

The measured L_{Aeq} 15 minutes noise contribution from PDM was below the noise assessment criteria for all 15-minute surveys at all noise monitoring locations measured during the reporting period. Similarly, the measured noise contribution from PDM was below the noise levels predicted in the Environmental Assessment (refer **Table 5-1**). Audible noise emanating from PDM operations have not been detected during noise surveys since the cessation of mining operations in April 2014.

Results for each noise monitoring survey during the 2021 reporting period are presented in full in **Appendix B**.

During the reporting period, no environmental performance or management measures were required to be implemented at the site in respect to noise generation by PDM.

5.2 AIR QUALITY

During care and maintenance, water for dust suppression is to be sourced from the onsite sediment basins.

Air quality at PDM is managed in accordance with Schedule 3, Condition 18 of PA 10_0041, EPL 4911 and the approved Air Quality and Greenhouse Gas Management Plan (AQGGMP).

The scope of air quality comprises five (5) depositional dust gauges (D1, D3, D4, D5 & D6) as shown on **Plan 3a**, **Appendix A**.

Four (4) additional dust gauges associated with the Purple Copper Butterfly (PCB) Monitoring Programme are located surrounding the Yarraboldy Extension. The PCB Monitoring Programme was prepared to address concerns raised by the then Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (now Department of Agriculture, Water and the Environment, DAWE).

Monitoring is undertaken by RCA Australia; a summary report data collected throughout the monitoring period is available in **Appendix B**.

5.2.1 DEPOSITIONAL DUST

All deposited dust results have been compared to the nominated annual average assessment criterion of 4.0g/m^2/month, as stipulated in PA 10_0041. Depositional dust results for the reporting period showed an annual average insoluble solids range of 0.2g/m^2/month to 1.0g/m^2/month across the nine (9) dust gauges.

Comparative annual average depositional data for the previous five-year period is presented in **Table 5-3**. Depositional dust data are presented graphically in **Figure 5-1**.

Table 5-3 *Depositional dust monitoring results*

Total insoluble solids (g/m^2/month)									
Date	**D1**	**D3**	**D4**	**D5**	**D6**	**PCB1**	**PCB2**	**PCB3**	**PCB7**
Jan-21	0.6	*0.05*	0.1	*0.05*	0.1	0.4	0.6	0.1	0.4
Feb-21	0.5	0.4	0.3	0.3	0.5	0.7	0.3	0.4	0.3
Mar-21	1.2	0.6	0.2	0.1	0.2	0.6	0.6	0.2	0.4
Apr-21	0.6	0.5	0.3	0.2	0.5	0.6	0.1	0.2	0.2
May-21	1.0	1.1	0.8	0.9	0.4	0.9	0.3	0.7	0.5
Jun-21	0.3	0.9	0.1	0.2	0.2	0.3	0.1	0.1	0.2
Jul-21	0.2	0.3	0.2	0.2	0.1	0.4	0.4	0.9	0.1
Aug-21	0.4	0.5	0.1	0.2	0.1	0.7	0.4	0.3	0.1
Sep-21	0.1	0.4	0.4	0.6	0.2	0.4	0.2	0.2	0.1
Oct-21	0.4	0.8	0.5	1.3	2.6	0.9	0.5	0.6	0.1
Nov-21	*0.05*	0.3	0.1	0.4	0.2	0.7	0.4	0.2	0.2
Dec-21	0.3	6.6	0.1	0.1	1.8	1.8	0.4	0.4	0.1
Annual Averages									
2017	0.6	0.5	0.5	0.5	0.8	0.9	0.6	0.8	0.8
2018	1.3	1.0	1.0	1.3	0.9	1.3	1.2	0.9	1.3
2019	1.3	1.5	1.6	1.3	1.2	1.6	1.4	1.1	1.4
2020	1.2	1.2	1.2	1.6	1.1	1.9	1.1	1.1	1.1
2021	0.5	1.0	0.3	0.4	0.6	0.7	0.4	0.4	0.2
Annual average assessment criterion: 4.0g/m^2/month									

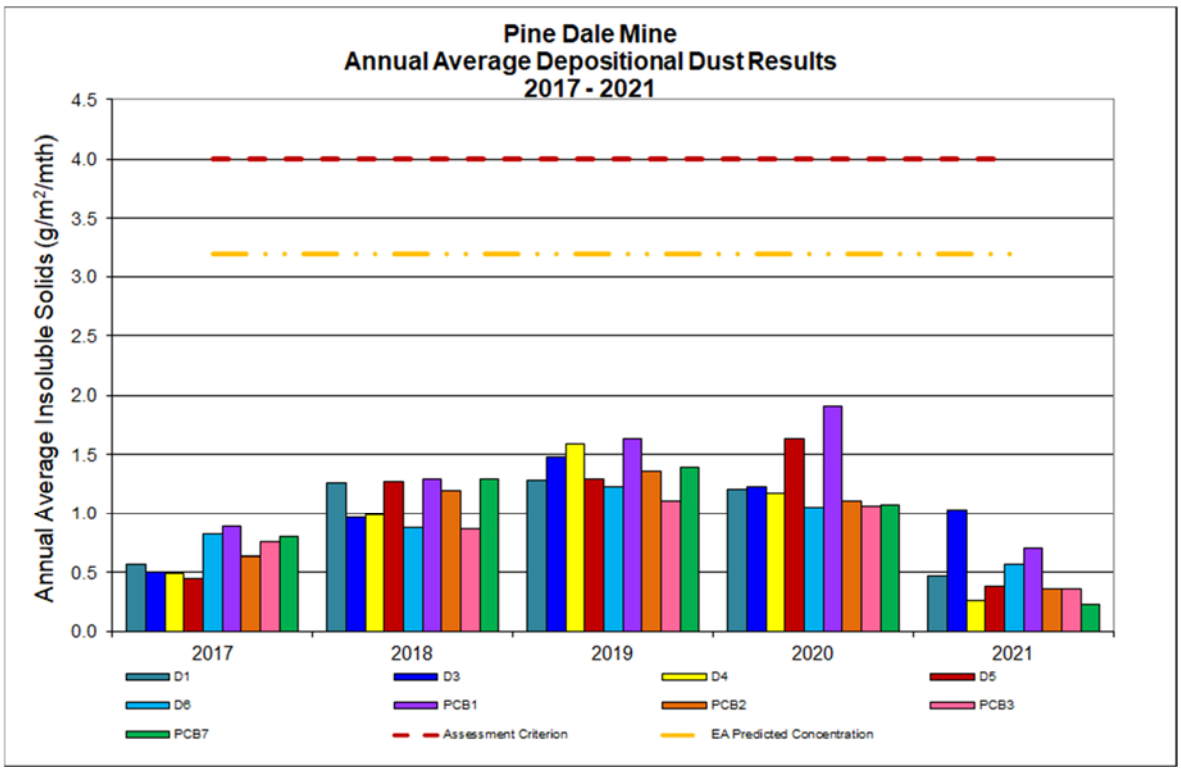


Figure 5-1 *Depositional dust data: 2017 – 2021*

An examination of the historical data (refer **Table 5-3**) indicates most dust monitoring locations show a substantial decrease in the 2021 annual averages deposited dust concentrations when compared to the 2020 annual averages. Dust monitoring location D3 showed a slight decrease. Annual average deposited dust concentrations are shown to be generally consistent with the 2017 results (refer **Figure 5-1**) with the exception of D3. The decrease in concentrations is not considered to be due to a change in site activities at PDM as the mine has been in care and maintenance since 2014, rather it is considered to be influenced by the increased rainfall over the reporting period (refer **Section 5.3.1**) following prolonged dry conditions and associated correlation with dust storms (observed during 2018, 2019 and early 2020), and bushfires (observed during late 2019 and early 2020).

The 2021 annual average deposited dust concentrations are shown to be lower than the concentrations predicted in the site Environmental Assessment annual average criterion of 3.2g/m^2/month annual average (refer **Table 5-1**).

5.3 METEOROLOGICAL MONITORING

In accordance with Schedule 3, Condition 22 of PA 10_0041 and EPL 4911, PDM operates a meteorological monitoring station which measures air temperature, wind direction, wind speed, solar radiation, sigma theta, rainfall, evapotranspiration and relative humidity.

Between the period 1 January 2021 – 9 November 2021, the meteorological station was located near the PDM site offices. Throughout the 2021 reporting period, there were three (3) occasions where the PDM meteorological station failed to collect data:

- 16 April: loss of half a day of data due to a malfunction.
- 1 – 30 June: rainfall data collected was anomalous (due to a malfunction) and the data was discarded.
- 7 July – 19 August: weather station failed due to flat battery

During these periods of data loss, the Mt Piper Power Station (MPPS) meteorological station (located 3.2km to the west of PDM) weather data was used as an alternate record.

As PDM remains on care and maintenance with minimal mining related activities occurring at the site. The on site weather data is no longer required for operational decision making and operational monitoring until such times as the mine recommences operations. However, weather data from a meteorological station in the near vicinity of the licenced premises is required to monitor conditions relating to revegetation and rehabilitation progress. The MPPS, approximately 3.2km from the PDM, maintains a meteorological station to monitor weather conditions. The use of the MPPS meteorological station to collect weather data is a more efficient and consistent use of EAs existing infrastructure. To this end, as of the 10 November 2021, weather data has been collected from the existing meteorological station located at the MPPS in accordance with an amendment of the EPL 4911.

A summary of monthly meteorological conditions recorded during the 2021 reporting period are presented in the following sections and **Appendix B**. Data presented in this section are based on that sourced from the PDM meteorological station for the majority of the monitoring period with data sourced from the MPPS meteorological station in July 2021, August 2021 and December 2021.

The total annual rainfall and the minimum and maximum temperature at 2m is shown graphically in **Figure 5-2**.

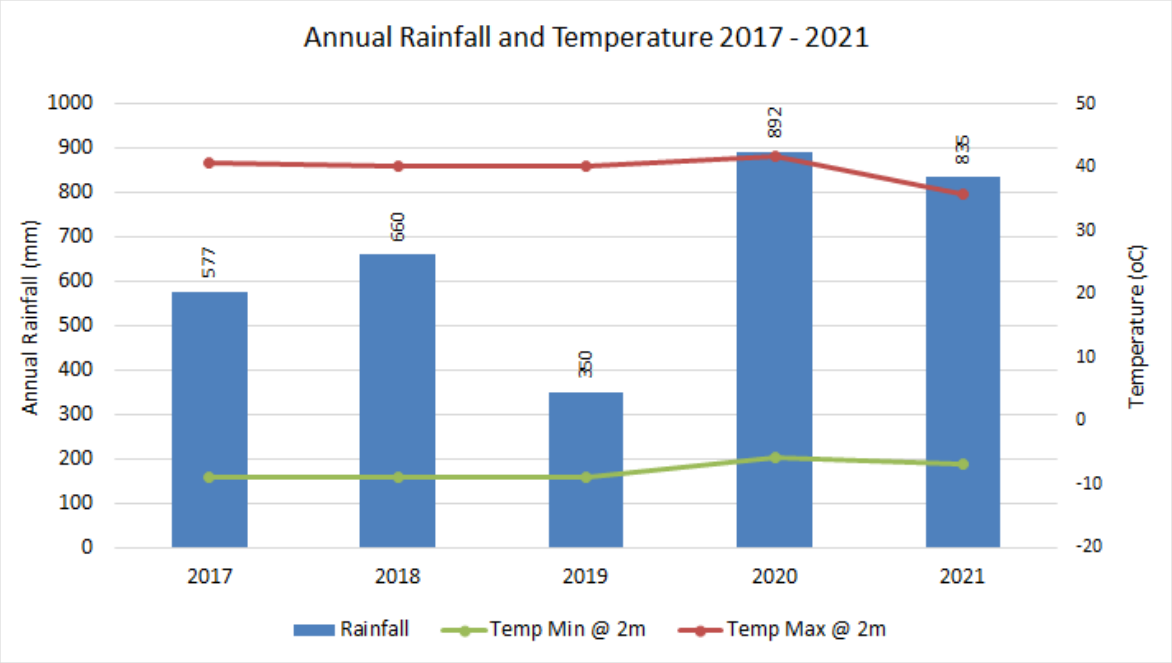


Figure 5-2 *Annual Temperature and Rainfall Summary: 2017 – 2021*

5.3.1 RAINFALL

PDM received 835mm of rainfall across 173 rainfall days during the 2021 reporting period.

Rainfall during this reporting period was observed to be greater than the annual rainfall recorded during 2019 (350mm), 2018 (660mm) and 2017 (577mm) and generally consistent with that recorded during 2020 (892mm).

The Bureau of Meteorology (BoM) weather station located at Lithgow[2] (Birdwood Street) (approximately 16km from PDM), reported a long-term median[3] annual rainfall total (years 1889 – 2006) of 858.6mm and an average annual rainfall total of 861.8mm. During the previous five (5) years (refer **Figure 5-2**), 2020 was the only year that reported total rainfalls greater than the median (and the average). The total annual rainfall for 2017 – 2019 was below the median, with 2019 reporting 42% of the median.

The monthly rainfall data for 2021 is summarised in **Table 5-4**.

5.3.2 TEMPERATURE

Temperature is monitored at two (2) heights (2 metres and 10 metres above the ground surface) to account for temperature inversions. The maximum temperatures recorded during the reporting period were 35.8°C at the 2m sensor and 34.4°C at the 10m sensor, during January 2021. The lowest temperatures occurred in July at 2m (-6.8°C) and in May at 10m (-5.8°C). A summary of monthly temperatures for 2021 is included in **Table 5-4**. A graphical presentation of annual temperature variations at 2m during the previous five (5) years is presented in **Figure 5-2**.

[2] Data for the Cooerwull Station (14km from PDM) was not available at date of access (22/1/2022)

[3] The use of median value is specified as the preferred measure for 'typical' rainfall from a meteorological perspective as it reduces bias from extreme rainfall events.

5.3.3 WIND SPEED AND DIRECTION

Predominant wind direction at PDM during 2021 was observed to be primarily from the north-westerly quadrant. Wind directions were also observed from an easterly / south easterly direction during the February – May and from the south-west quadrant in July – August and December 2021 (refer **Table 5-4**).

The maximum wind speed measured at the site was 18.5m/s during December 2021 from a west-south-west direction. Sigma theta data was measured continuously throughout the entire 2021 monitoring period. A summary of monthly wind speed, predominant directions and sigma theta recordings in 2021 is included in **Table 5-4**.

5.3.4 RELATIVE HUMIDITY

Relative humidity was measured during the reporting period. The minimum humidity recorded was 0%[4] recorded during December. The maximum humidity recorded at the PDM meteorological monitoring was 101.9% during the periods of January – June 2021 and September to November 2021. It is noted that a relative humidity greater than 100% is not technically feasible and readings in the range of 100-103% are considered due to condensation forming on the weather station humidity sensor during low wind conditions and do not represent uncertainty with regards to the readings. A summary of monthly humidity variations for 2021 is included in **Table 5-4**.

[4] Negative readings were presented in the data however are not considered viable data

Table 5-4 *Pine Dale Mine Meteorological Monitoring Summary 2021*

Month	Rainfall (mm)	Cumulative Rainfall (mm)	No of Rain Days/ Month	Air Temp. @ 2m (°C)			Air Temp. @ 10m (°C)			Sigma theta (º)			Relative Humidity (%)			Wind Speed (m/s)			Modal Wind Direction
				Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Jan	84.2	84.2	11	18.3	6.9	35.8	17.8	7.1	34.4	38.5	3.4	103.0	73.2	15.1	101.9	1.6	0.0	16.1	ESE
Feb	77.0	161.2	17	17.7	7.3	30.5	17.2	7.5	28.6	38.3	4.6	100.5	81.1	25.1	101.9	1.6	0.0	12.1	ESE
Mar	143.2	304.4	16	15.7	2.9	30.1	15.4	2.9	28.6	41.2	6.8	103.3	81.6	15.4	101.9	1.6	0.0	12.0	ESE
April	1.6	306.0	7	10.9	-2.8	29.7	10.8	-2.8	28.6	40.5	2.2	102.1	76.1	18.6	101.9	1.3	0.0	12.3	W
May	23.2	329.2	12	8.2	-5.8	22.3	8.1	-5.8	21.4	38.5	2.6	103.0	83.8	22.1	101.9	1.3	0.0	14.9	SE
June	50.0	379.2	14	5.8	-4.9	18.6	5.8	-4.9	17.6	34.2	5.1	102.1	87.1	23.5	101.9	1.8	0.0	12.5	WNW
July*	60.6	439.8	22	5.1	-6.8	17.0	5.2	-4.8	16.7	23.9	0.0	100.0	82.6	5.8	99.9	2.2	0.0	15.1	W
Aug*	80.8	520.6	22	5.1	-4.5	20.0	5.2	-2.7	19.6	20.3	0.0	100.0	82.6	3.6	99.8	2.3	0.0	11.2	SW
Sept	52.6	573.2	7	9.0	-4.5	23.5	8.9	-4.4	22.0	33.7	1.0	102.5	73.1	6.8	101.9	2.0	0.0	17.0	WNW
Oct	32.6	605.8	12	12.0	-0.4	29.7	11.6	-0.6	28.2	36.2	4.6	102.1	74.3	11.7	101.9	1.9	0.0	16.2	WNW
Nov	158.8	764.6	18	14.0	2.4	26.4	13.5	2.4	24.1	35.9	6.6	103.8	81.9	27.7	101.9	1.9	0.0	15.3	WNW
Dec*	70.1	834.7	15	16.5	4.1	29.9	16.7	5.0	29	24.2	0.0	100.0	73.7	0.0*	101.4	1.9	0.0	18.5	SW
TOTAL	834.7		173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minimum	1.6		7	-	*-6.8*	-	-	*-5.8*	-	-	*0.0*	-	-	*0.0**	-	-	*0.0*	-	-
Maximum	158.8		22	-	-	*35.8*	-	-	*34.4*	-	-	*103.8*	-	-	*101.9*	-	-	*18.5*	-

Note that data was missing for approximately twelve (12) hours on 16th April

Note that June rainfall was recorded as 1911mL however considered to be a weather station malfunction. The 50mm assigned based on manual review of data and Lithgow BOM records

* July and August data from MPPS records due to Pinedale weather station malfunction

*December data from MPPS records following EPL amendment. Negative humidity numbers were presented however are not considered viable data and have been ascribed a value of 0

5.4 EROSION AND SEDIMENT

The erosion and sediment controls for PDM have been implemented to safeguard against soil loss and minimise potential water quality impacts. Erosion control structures have been installed around PDM with the principle aim of containing sediment at its source. All runoff from disturbed areas is contained in temporary pollution control ponds within the open cut mine and surrounding hardstand areas.

Exposed areas which have been disturbed by previous mining operations are controlled though the use of windrows constructed by subsoil and/or clay material. Once vegetation has been cleared and topsoil removed, subsoil and clay material are pushed against the interface between the disturbed and undisturbed area creating a windrow where the potential for erosion impacts exist. Exposed areas are also managed through the use of temporary measures, such as silt fencing, to avoid sedimentation impacts on downstream waterways until the area has been rehabilitated. Additionally, temporary sediment ponds are constructed downslope of disturbed areas to ensure the capture of 'dirty' water and enable treatment prior to discharge into the underground workings. The management measures for the control of erosion described above are also put in place to increase batter and bench stability prior to establishment of permanent rehabilitation measures, where possible.

Erosion control structures at PDM are inspected on a monthly basis by the Mining Engineering Manager, particularly after significant rainfall events and repaired where necessary. Erosion and sediment control works which were undertaken during the reporting period comprised the inspection and maintenance of windrows and silt fencing to prevent potential surface water impacts and sediment entering Wangcol Creek.

5.5 CONTAMINATED AND POLLUTED LAND

There was no land identified as being contaminated or polluted during the reporting period. In the unlikely event that contaminated material is identified at the site, the remedial actions taken shall be those outlined in the PDM MOP (Ref [3]), whereby the affected material is either treated on-site or disposed of offsite by a licenced contractor.

5.6 THREATENED FLORA AND FAUNA

Measures for the management and mitigation of flora and fauna impacts at PDM and in the surrounding area are provided in the PDM MOP (Ref [3]).

5.6.1 PURPLE COPPER BUTTERFLY

The Purple Copper Butterfly (PCB), also known as the Bathurst Copper Butterfly, is listed as an endangered species under the *Biodiversity Conservation Act 2016* and vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. The PCB and larvae have been identified adjacent to the eastern boundary of the PDM Yarraboldy Extension within an area of its habitat of native Blackthorn (*Bursaria spinosa subsp. Lasiophylla*). Native Blackthorn vegetation is found throughout the local area, which provides suitable habitat for the PCB noting that they will only reside where there are native Blackthorn vegetation.

To minimise the potential direct and indirect impacts of dust and vibration from the PDM on the PCB, the following mitigation measures have been implemented:

- Maintenance of fencing and earth bunds around the known PCB habitat.

- Mining activity not occurring within 200m of the main habitat area between September through to the end of February, when the flying season of the adult larvae stages of the PCB are apparent (as determined by an independent ecologist).
- Implementation of further management and mitigation measures in accordance with PA 10_0041 and Particular Manner Decision 2011/2016 made under Sections 75 and 77a of the *Environment Protection and Biodiversity Conservation Act 1999*.

A PCB monitoring programme has previously been implemented to monitor potential indirect impacts from extractive mining activities (particularity blasting and vibration) on the known populations of the butterfly. The field survey monitoring was conducted to coincide with the adult and larvae stages of the PCB with monitoring being undertaken by ecologists in a 30m radius of the PCB dust gauge locations PCB1, PCB2 and PCB4 (refer **Plan 3a** in **Appendix A**). The results of the surveys undertaken in March, September and October 2020 identified that the habitat area had been subject to bushfire and had likely perished as a result.

A summary of the survey data and results recorded during the period 2015 to 2020 indicates PDM has had minimal impact upon the life cycles of the Purple Copper Butterfly. A summary of the survey results for the previous five years is provided in **Table 5-5**.

Data collected from dust gauges located within the butterfly habitat area is provided in **Table 5-3**.

Table 5-5 *Purple Copper Butterfly Field Survey Summary*

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2015-2016	To confirm commencement of PCB larval feeding season	4 September 2015	No larvae identified; five (5) adult PCB identified	Lack of active larvae observed on the plants inspected suggests that the PCB breeding season had only recently commenced, and the adult individuals observed had only recently emerged.	No mining activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening 22/23 February 2016	No larvae identified; no attendant ants observed near targeted plants.	No larvae detected indicate PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to reappear until Aug / Sep.	Mining activities can recommence within 200m of PCB main habitat area.

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2016-2017	To confirm commencement of PCB larval feeding season	29 August 2016	Numerous adult PCB observed; no larvae observed.	Lack of active larvae observed indicates PCB breeding season had only recently commenced.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening of 27 February 2017	No larvae identified on any plants; attendant ants were observed on two (2) plants at site PCB1 and PCB2.	No larvae detected in survey area indicating PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to re-appear until late August / early September.	Mining activities can recommence within 200m of PCB main habitat area.
2017-2018	To confirm commencement of PCB larval feeding season	31 August 2017	Abundant adult PCB observed; no larvae observed.	Absence of larvae observed indicates PCB breeding season had only recently commenced.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area	Evening of 1 March 2018.	No larvae identified on any plants. No attendant ants observed.	Absence of larvae during seasonally mild conditions indicates that PCB have commenced pupation and are no longer active. Larvae stage is complete. PCB not expected to re-appear until late August / early September.	Mining activities can recommence within 200m of PCB main habitat area.

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2018 – 2019	To confirm commencement of PCB larval feeding season	5 September 2018.	Seven (7) PCB (flying stage) identified at PCB1; no larvae observed.	Absence of larvae indicates PCB feeding season has commenced, no further monitoring required.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area.	28 February 2019	No larvae identified on any plants. No attendant ants observed.	Absence of larvae during seasonally mild conditions indicates that PCB larvae have commenced pupation and are no longer active.	Mining activities can recommence within 200m of PCB main habitat area.
2019 – 2020	To confirm commencement of PCB larval feeding season.	5 September 2019	Eight (8) adult PCB (flying stage) identified at PCB1. PCB feeding season has commenced. PCB survey to be undertaken March 2020 to confirm completion of larvae stage.	PCB feeding season has commenced, no further monitoring required.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. No earthwork activities to occur within 200m of PCB main habitat area.
	To confirm completion of larval stage i.e., larvae not actively foraging above ground, within habitat area.	3 March 2020	No larvae identified on any plants. Attendant ants recorded on eight (8) live Blackthorn plants.	Absence of larvae indicates pupation has commenced and larvae are no longer active. Damage sustained to Blackthorn plants during December 2019 bushfires.	Mining activities can recommence within 200m of PCB main habitat area.

Season	Purpose of field survey	Date of field surveys	Survey results	Conclusion	Response
2020 – 2021	To confirm commencement of PCB larval feeding season	7 and 8 September 2020 2 October 2020	No adult (flying stage) PCB identified.	As no adult PCB were identified it was likely that the PDM PCB population perished during the December 2019 bushfire.	As PDM is in care and maintenance, mining activities have ceased, and no foreseeable impacts would be noted. PCB monitoring should be undertaken if mining or earthwork activities to occur within 200m of PCB main habitat area.

On 30th October 2020, Enhance Place Pty Ltd notified the DAWE (formerly SEWPAC) of the intention to temporarily cease the annual PCB monitoring until such times as when mining (or the "proposed action" as set out in the Referral 2011/6016) recommences. This strategy was accepted in reply correspondence of 5 November 2020 with DAWE to be notified at time of recommencement of mining activities.

As PDM has remained in care and maintenance throughout 2021, there have been no ecological surveys undertaken in relation to the PCB. Dust monitoring has continued for due diligence and to maintain the long term data set.

5.6.2 AUSTRAL TOADFLAX (THESIUM AUSTRALE)

Austral Toadflax is listed as vulnerable under the *Biodiversity Conservation Act 2016* and the *Environment Protection and Biodiversity Conservation Act 1999*. An erect to scrambling perennial herb, it occurs in small populations, parasitising a range of grass species, which at PDM is Kangaroo Grass. At subalpine and tableland climates the species dies back to rootstock during winter and re-sprouts in spring.

Surveys conducted by Eco Logical Australia in March 2011 identified a total of 260 individual Austral Toadflax plants in three (3) patches located beyond the north-west crest of the Yarraboldy Stage 1 Extension pit.

A Species Management Plan completed in consultation with the Department of Planning and Environment was developed to mitigate the impact of open cut mining on the host habitat within the Austral Toadflax buffer area. This includes:

- Inclusion of a buffer zone from known specimens referred to as the Austral Toadflax buffer area.
- Installation and maintenance of fencing and signage between the open cut boundary and known location of specimens.
- Installation of additional signage and barriers (e.g., tape) when operating in close proximity to the Austral toadflax buffer area.
- Control of priority weed infestations and feral animals.

The Gospers Mountain bushfire which spread through Ben Bullen State Forest and PDM during December 2019 and January 2020, had burnt out the Austral Toadflax during the 2020 reporting period.

During the reporting period, care and maintenance operations did not encroach within the habitat area. Details regarding control of noxious weeds within and surrounding the habitat area for the reporting period is presented in **Section 5.7** and will continue to be undertaken in the next reporting period.

5.7 WEEDS AND FERAL ANIMALS

Weed and feral animal control activities at PDM are undertaken in accordance with the PDM MOP (Ref [3]). Weed control methods target four (4) priority weeds previously identified within PDM and the Yarraboldy Extension area, namely:

- African lovegrass (*Eragrostis curvula*).
- Blackberry (*Rubus fruticosus* aggregate species).
- Briar Rose (*Rosa rubiginosa*).
- St John's Wort (*Hypericum perforatum*).

Weed inspections were undertaken on a regular basis during the reporting period: spraying for the four (4) target species was undertaken during summer (January and December 2021) in areas of PDM.

No feral animal control methods were undertaken in the reporting period.

The PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix C**) identified African lovegrass (*Eragrostis curvula*) within the pasture rehabilitation areas (Area 8, Area B and Area C). The presence of all weeds, including African lovegrass, comprised of <10% of the pasture area and was considered to be controlled in accordance with legislation.

The PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix C**) identified indications of the presence of rabbits (European rabbit *Oryctolagus cuniculus*) across PDM however density was considered to be low. No holes, burrows or dens were observed along the transects.

The control of weeds and feral animals will be undertaken on an ongoing basis as required and consistent with the PDM MOP (Ref [3]) to ensure species are managed accordingly.

5.8 BLASTING

As PDM is currently in care and maintenance, there were no blasting activities undertaken during the reporting period.

5.9 VISUAL AND STRAY LIGHT

There were no adverse impacts associated with stray light or visual disturbance identified during the reporting period. There were no complaints received during the reporting period regarding visual and stray light impacts.

5.10 ABORIGINAL HERITAGE

There were no artefacts of Aboriginal cultural heritage found at PDM during the reporting period.

5.11 NATURAL HERITAGE

No items or areas of natural heritage significance have been recorded or are considered to occur within the approved disturbance area at PDM.

5.12 SPONTANEOUS COMBUSTION

There were no incidences of spontaneous combustion in or overburden material during the reporting period. The Lithgow Seam is known to have a low propensity for spontaneous combustion. All coal stockpiles have been decommissioned.

5.13 MINE SUBSIDENCE

There were no issues identified regarding mine subsidence during the reporting period.

5.14 BUSHFIRE

Bush fire control strategies for PDM are managed in accordance with Project Approval PA 10_0041 and the approved PDM Bush Fire Management Plan. These strategies are employed for preventing the occurrence and spread of any fire events that may impact on the site or in surrounding lands (i.e., Ben Bullen State Forest). As such, measures are taken at PDM to prevent the occurrence and spread of fire through proper maintenance of machinery and equipment, and the maintenance of access roads.

The PDM 2021 Rehabilitation Monitoring Report (Ref [4]), determined fuel loads within rehabilitation areas A, B, C and 8 were low and fuel hazard mitigation activities were not required. The internal access road within PDM provides a firebreak between Area A, and the PDM office and infrastructure to the south. The haul road provides a firebreak to the north of area A, and to the north and west of Areas B, C and 8. Fire-fighting access roads were also considered to be adequate, with all access roads within rehabilitated areas maintained in good condition and suitable for the passage of Category 1 (vertical clearance of >4m and width of >2.8m) tankers.

During the 2021 reporting period there were no bush fire events at or in close proximity to PDM.

5.15 METHANE DRAINAGE AND VENTILATION

The underground workings at the PDM site were closed in 1986 and decommissioned over a period from 1987 to 1990. Methane levels are considered to be negligible at PDM.

5.16 PUBLIC SAFETY

No issues of public safety occurred during the reporting period. The entire perimeter of PDM is fenced, with “No Trespassing” signs displayed at various intervals. “Do Not Enter” and “Danger” signs are also displayed along the fence of the private sealed haul road. Continuation of the control of trespassing during the reporting period has occurred through routine inspection, monitoring, upgrades and repairs of fencing structures. During the care and maintenance term, PDM has continued to be regularly monitored by mine personnel.

6 WATER MANAGEMENT

PDM lies within the Wangcol Creek (also known, and formerly referred to as, Neubeck’s Creek) catchment which is a sub-catchment of the Upper Coxs River catchment, which in turn is part of the Warragamba Catchment, administered by WaterNSW.

The runoff from the surrounding area flows to the Coxs River via Wangcol Creek (a perennial tributary) which runs into Blue Lake, a former open cut mining void. Wangcol Creek is understood to flow intermittently (noting that many of its tributaries are temporary), with flows influenced by water discharges from other upstream industrial land uses and/or natural seepage.

Water resources at PDM are managed in accordance with the Water Management Plan (WMP) which was developed under the requirements of project approval PA 10_0041, EPL 4911, respective groundwater bore licences, the water access licence (WAL 36480) and Water Supply Works Approval 10WA118780.

The water management system has been designed as a closed loop system, with all clean water diverted around the mining site where practicable. It is also designed not to discharge any water from PDM into Wangcol Creek unless required to under an emergency. Drainage of surface water within the site's disturbed areas is generally to the south and southeast following the natural topography for treatment prior to free draining into the underground workings (see **Plan 2**, **Appendix A**). The runoff from the north is captured in temporary sumps and used as dust suppression when required.

Potable water for use in the offices and amenities is sourced from town water mains supply.

6.1 STORED WATER

There are no permanent water storage structures at the PDM. Clean water diversion structures are utilised at the site in conjunction with temporary sediment ponds. Temporary sediment ponds are constructed downslope of disturbed areas to ensure the capture of 'dirty' water and enable treatment prior to draining into the underground workings.

6.2 SURFACE WATER MONITORING

Surface water quality at PDM is managed in accordance with the WMP and EPL 4911. At the end of the reporting period, sampling was conducted at a total of twelve (12) surface water locations within and surrounding the mine site (see **Plan 3a**, **Appendix A**). Surface water field data and samples are collected by RCA Australia and analysed at a NATA registered laboratory.

In accordance with EPL 4911 the following locations are required to be monitored at PDM on a quarterly basis for total suspended solids (TSS), sulphate and dissolved iron:

- Point 2 – Upstream of EnergyAustralia flow gauge and upstream of confluence with Lamberts Gully.
- Point 3 – 100m downstream of open cut area of PDM.
- Point 14 – Cox's River downstream of Blue Lake.

A further ambient surface water monitoring point, EPL Point 16 (Wallerawang Underground), was added to EPL 4911 on 10 November 2021. This point comprises a seep of underground water emanating from an adit associated with the historic Wallerawang Underground Mine which then enters the surface water system. The seep was first observed in March 2021 and sampled for due diligence. The NSW EPA were informally made aware of the seep in late March 2021. This was followed by an inspection of the area by EPA Officers on 31 March 2021 as a part of the regular five (5) year inspection programme. The NSW EPA and the NSW Resources Regulator were formally informed via letter of the presence of the seep in April 2021.

In accordance with EPL 4911 and in the event of a discharge to water, via licence discharge point (EPL Point 13), samples are required to be collected daily during discharge for electrical conductivity (EC), pH, and turbidity and weekly for dissolved iron, oil and grease, sulphate and total suspended solids. EPL Points 2, 3 and 14 are also required to be sampled daily for EC, pH and turbidity. No discharge was made via the licenced discharge point (LDP13) during the reporting period.

The WMP also details monitoring of a further six (6) locations, S1 and S3[5] to S7, on a monthly basis for pH, temperature, EC and turbidity plus a quarterly analysis suite comprising major ions, anions and filtered metals. The description of surface water monitoring sites S1 and S3 to S7 is as follows:

- S1 located within Wangcol Creek upstream of PDM operations.
- S3 and S6 are located within Wangcol Creek downstream of S1 and any PDM operations.
- S4 is located on Coxs River, upstream of the confluence of Wangcol Creek and does not receive water from PDM operations.
- S5 is located within Blue Lake which receives flow from Wangcol Creek and Coxs River.
- S7 located within Coxs River, downstream of Wangcol Creek.

The water level of Wangcol Creek is measured at S2 on a monthly frequency.

The surface water monitoring locations are shown in **Plan 3a**, **Appendix A**.

During the reporting period, all surface water monitoring at PDM was undertaken in accordance with the surface water monitoring programme documented in the PDM WMP, and EPL 4911. Results of surface water monitoring are discussed in **Section 7.3.2** and also provided in **Appendix B**.

6.2.1 SURFACE WATER ASSESSMENT CRITERIA

Concentration limits are specified in EPL 4911 for the licenced discharge point LDP13, whilst the remaining water monitoring locations only have water quality trigger values stipulated in the site WMP – surface water section in accordance with Schedule 3, Condition 27(b) of the Project Approval (PA 10_0041). The current approved WMP trigger values are presented in **Table 6-1**.

The WMP details the protocol for the investigation, notification, and mitigation of any identified adverse impacts on surface water quality. The surface water component of the WMP also provides impact assessment criteria, including trigger values for investigating any potentially adverse surface water impacts.

[5] Surface location S3 is the same location as EPL Point 3

Table 6-1 *PDM Approved Surface Water Trigger Values*

Surface Water Site	pH (range)	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Oil and Grease (mg/L)
S1	6.2 – 8.0	2325	30	10
S2	NA	NA	NA	NA
S3	6.4 – 8.0	2223	30	10
S4	7.3 – 8.0	957	30	10
S5	7.0 – 8.0	1013	30	10
S6	6.7 – 8.0	1941	30	10
S7	6.8 – 8.0	1007	30	10
EPL Point 2	7.1 – 8.0	2055	30	NA
EPL Point 3	6.4 – 8.0	2223	30	NA
EPL Point 13	6.5 – 8.0[a]	NA	30*	10*
EPL Point 14	7.5 – 8.0	1166	30	NA
EPL Point 16	NA	NA	NA	NA

[a] EPL concentration limit only applicable during discharge events.

EnergyAustralia commissioned an investigation of surface water quality at PDM which included identification of factors that influence surface water quality. This investigation was concluded in 2018 and, as a result, new surface water trigger values were proposed. The investigation (Ref [5]) concluded that water quality monitored at EPL Point 2 and S1, which are located within Wangcol Creek, to be primarily influenced by a licence discharge point (not associated with PDM) located between EPL Point 2 and S1. The revised surface water trigger values (Ref [5]) are shown in **Table 6-2**.

Table 6-2 *Revised Surface Water Trigger Values (Ref [5])*

pH trigger level[a]	6.5 – 8.0
Electrical conductivity (µS/cm)	5592
Total suspended solids (mg/L)	25

[a] pH trigger level is exceeded if the pH is outside the nominated range.

The trigger values presented in **Table 6-2** are applicable to all PDM surface water monitoring sites, noting that EPL Point 2, S1 and S4 are not influenced by activities at PDM. At the time of writing this report, the revised trigger values detailed in **Table 6-2** have been utilised alongside the approved trigger values presented in **Table 6-1**.

6.2.2 SURFACE WATER QUALITY

6.2.2.1 EPA SURFACE WATER MONITORING

During the monitoring period, four (4) quarterly surface water monitoring events were conducted in February, May, August and November 2021 in accordance with the requirements of EPL 4911. These events included EPA specified monitoring Point 2 and Point 3, which are both ambient surface water monitoring locations on Wangcol Creek and Point 14 which is an ambient surface water monitoring point located on the Coxs River and assesses the water quality downstream of PDM. Point 16 was included in the November 2021 round. There are no concentration limits stipulated in EPL 4911 for monitoring points 2, 3, 14 and 16. The EPL surface water monitoring locations are shown in **Plan 3a**, **Appendix A**.

Surface water samples collected during the 2021 period are compared against the approved surface water trigger values (**Table 6-1**) and the revised surface water trigger values (**Table 6-2**) in **Appendix B**. Results of water quality monitoring were generally compliant with the water quality trigger levels.

pH was within the respective approved site-specific trigger value ranges with the exception of EPL Point 2 which was below the approved lower pH trigger value on one (1) of the four (4) water quality monitoring events (May, August and November) and EPL Point 14 which was below the approved lower pH trigger value during two (2) of the four (4) events. The pH were within the specified pH range of the revised surface water trigger values (Ref [5]).

EC was less than the approved trigger value, and the revised surface water quality trigger value (Ref [5]), at all locations during the water quality monitoring events.

Total suspended solids (TSS) concentrations were all below the approved trigger values.

The electrical conductivity and pH for the period 2017 – 2021 is shown in **Figure 6-1**; electrical conductivity and rainfall for the same period is shown in **Figure 6-3**.

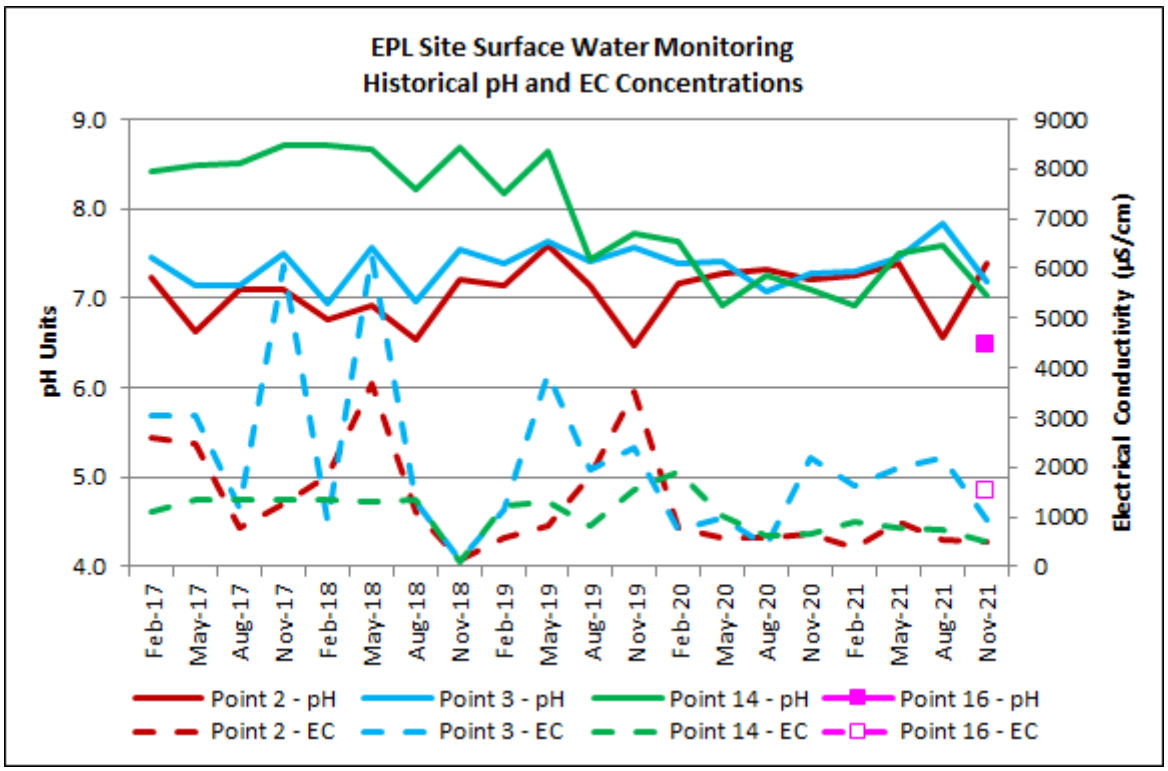


Figure 6-1 *Surface water at EPL monitoring points: pH and Electrical Conductivity*

During the 2017 – 2021 monitoring period, pH has remained generally stable with a decreasing trend observable at EPL Point 14 during the period August 2019 – November 2020 which fluctuated upwards in May and August 2021 however had stabilised in November 2021.

During the 2017 – 2021 monitoring period, electrical conductivity during the previous five (5) years is generally shown to fluctuate; however the overall trend is generally stable at EPL Point 2, EPL Point 3 and EPL Point 14 (refer **Figure 6-1**). There is currently insufficient data available to determine any water quality trending associated with EPL Point 16.

Electrical conductivity within Wangcol Creek is predominantly influenced by a licenced discharge flow entering the drainage line immediately downstream of EPL Point 2. This licence discharge point is not associated with PDM, as such increase in electrical conductivity within Wangcol Creek is considered due to the influence of the licenced discharge flows and not due to activities associated with PDM.

EPL Point 3 is located downstream of EPL Point 2 and the licence discharge point. Monitoring results from EPL Point 3 are also influenced by the above-mentioned licenced discharge water quality. It is considered that there is some influence of electrical conductivity at EPL Point 2 from the discharge point due to mixing and the close proximity of the licence discharge point (approximately 50m upstream). The influence of the water quality at the licenced discharge point is minimal at EPL Point 14, as this monitoring location is located 2km from the discharge point and receives water from both Wangcol Creek and Coxs River, as such, significant dilution and mixing has occurred.

The pH of EPL Point 14 has been plotted against that of S4 to S7 in **Figure 6-2** and appears to have the most correlation with S6 and there is correlation with S7, which is downgradient of the confluence of Coxs River and Wangcol Creek and of Blue Lake, in the later part of the year. As such it is considered that the water quality of Wangcol Creek has been the predominant influence to the water quality of EPL Point 14 however given the pH at EPL Point 14 is higher than all other results (except for the November 2021 result) there are other influences within the catchment. In the absence of any activities except those regarding care and maintenance the water quality impacts are not considered to be related to PDM.

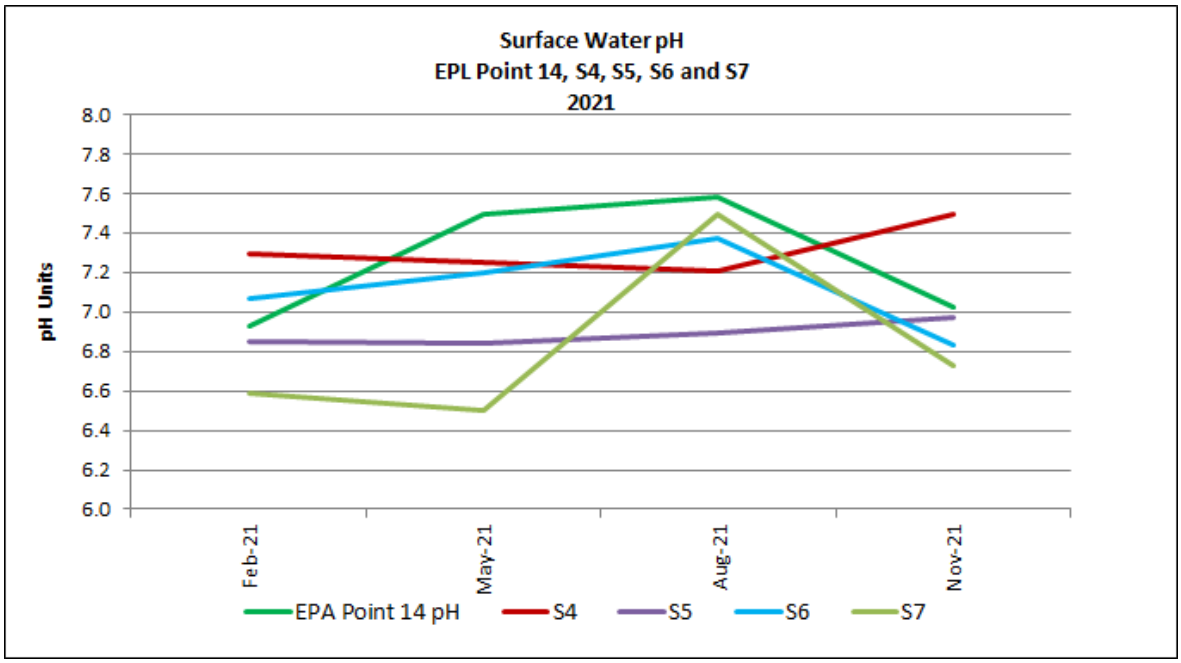


Figure 6-2 *Surface Water pH: 2021*

Monthly rainfall totals greater than 50mm appear to influence lower electrical conductivity results at EPL Points 2 and 3 presumably through dilution from runoff. (refer **Figure 6-3**). The association between electrical conductivity and rainfall is not as apparent for EPL Point 14; the results decrease with some high rainfall quantities however also increase or are unchanged such that there is considered to be some other factor which influences the changes in electrical conductivity. There is insufficient data to comment on trends for EPL Point 16 with relation to rainfall.

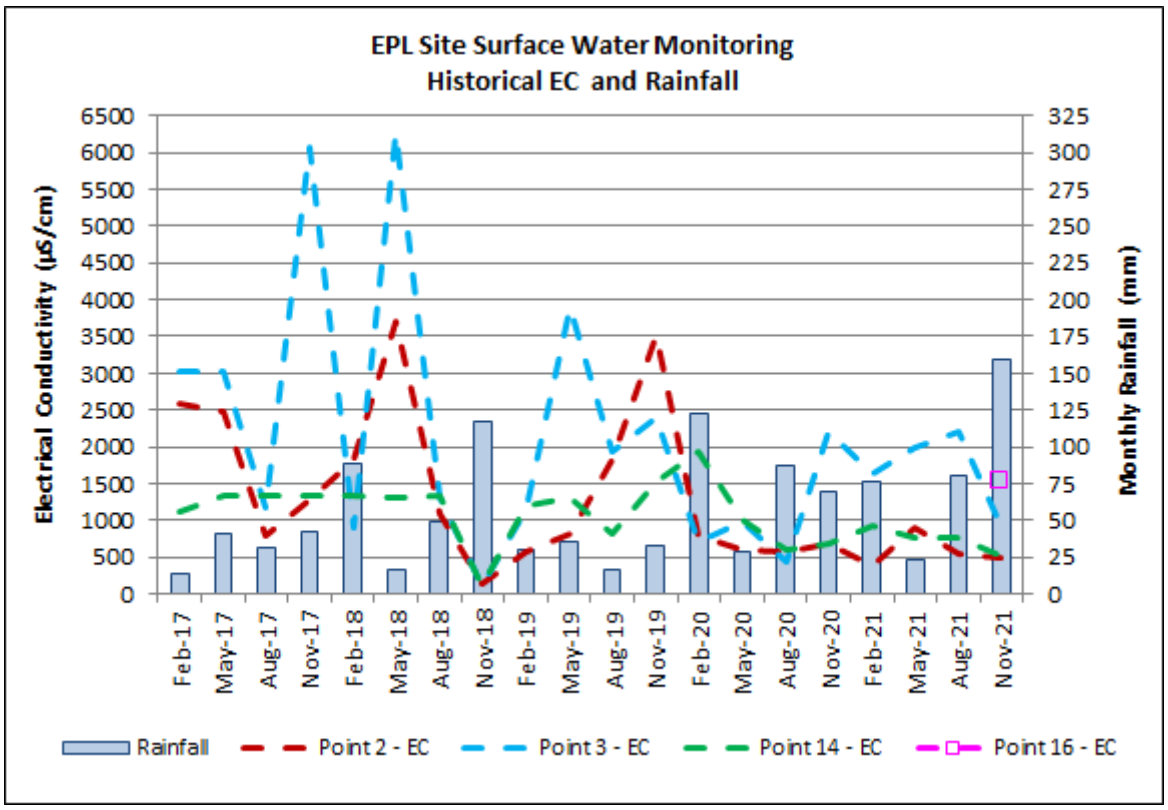


Figure 6-3 *Surface water at EPL monitoring points: Rainfall and Electrical Conductivity*

6.2.2.2 GENERAL SURFACE WATER MONITORING

Surface water monitoring was undertaken on a monthly frequency at six (6) locations during the reporting period at locations S1 and S3 – S7, as per the requirements of the PDM WMP. It is noted that surface water site S3 and EPL Point 3 are the same monitoring location. Results for pH over the period 2017 – 2021 are shown graphically in **Figure 6-4** and **Figure 6-5**. The results for electrical conductivity and rainfall for the same period are shown in **Figure 6-6** and **Figure 6-7**.

The complete suite of monitoring results is shown in **Appendix B**. Monitoring locations are shown in **Plan 3a**, **Appendix A**.

During the reporting period, pH was generally within the approved trigger values (refer **Table 6-1**) with the exception of the following:

- S4 was above the upper pH trigger value during one (1) of the twelve (12) monitoring events (July 2021) and below the lower pH trigger value during five (5) of the twelve (12) monitoring events. The lowest value (pH of 6.69) was observed during the September 2021 monitoring event.
- S5 was below the lower pH trigger value during ten (10) of the twelve (12) monitoring events. The lowest value (pH of 6.32) was observed during the September 2021 monitoring event.
- S6 was below the lower pH trigger value during two (2) of the twelve (12) monitoring events. The lowest value (pH of 6.38) was observed during the September 2021 monitoring event.
- S7 was below the lower pH trigger value during seven (7) of the twelve (12) monitoring events. The lowest value (pH of 6.32) was observed during September 2021.

The pH values were generally more compliant with the revised trigger values (refer **Table 6-2**) with the following pH values noted outside the revised trigger value range:

- S1 was below the lower pH trigger value during the September and December 2021 monitoring events.
- S4 was above the upper pH trigger value during the July 2021 monitoring event.
- S5 was below the lower pH trigger value for two (2) of the twelve (12) monitoring events (June and September 2021).
- S6 was below the lower pH trigger value for one (1) of the twelve (12) monitoring events (September 2021)
- S7 was below the lower pH trigger value for four (4) of the twelve (12) monitoring events (January, April, July and September 2021).

Generally, over the last five (5) years (refer to **Figure 6-4**) pH in Wangcol Creek is consistent between the upstream (S1) location and the downstream locations (S3 and S6). S1 is generally slightly more acidic in historical monitoring from 2017 -2021 and was similarly observed in January 2021 and July to October 2021. The pH of S1 and S6 were near identical between March to June 2021. Overall, the pH trend is stable (noting some large fluctuations) for S1 and a slight decrease for S3 and S6.

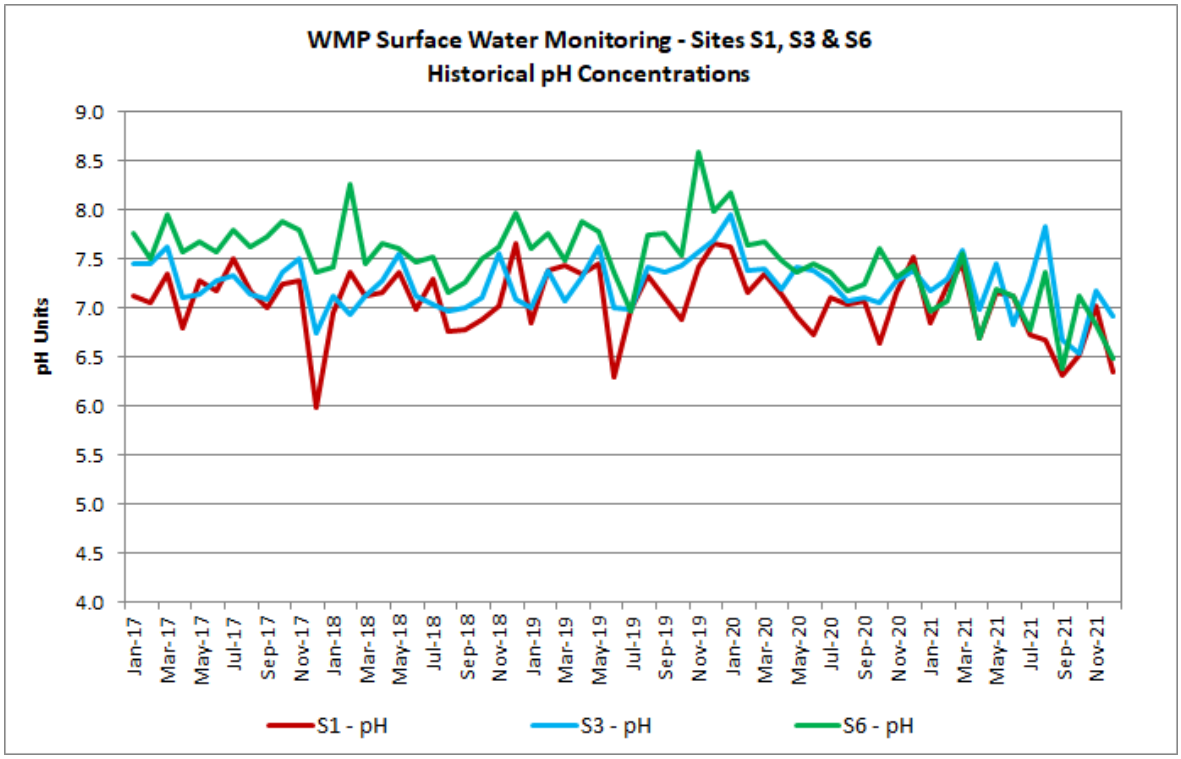


Figure 6-4 *S1, S3 and S6 Historical pH results*

Generally, over the last five (5) years (refer **Figure 6-5**) pH in Coxs River is higher (more alkaline) upstream of Blue Lake (and the confluence with Wangcol Creek) however the changes in pH indicate good correlation between the three (3) sampling locations along the River. Overall, the pH trend is a slight decrease for all locations.

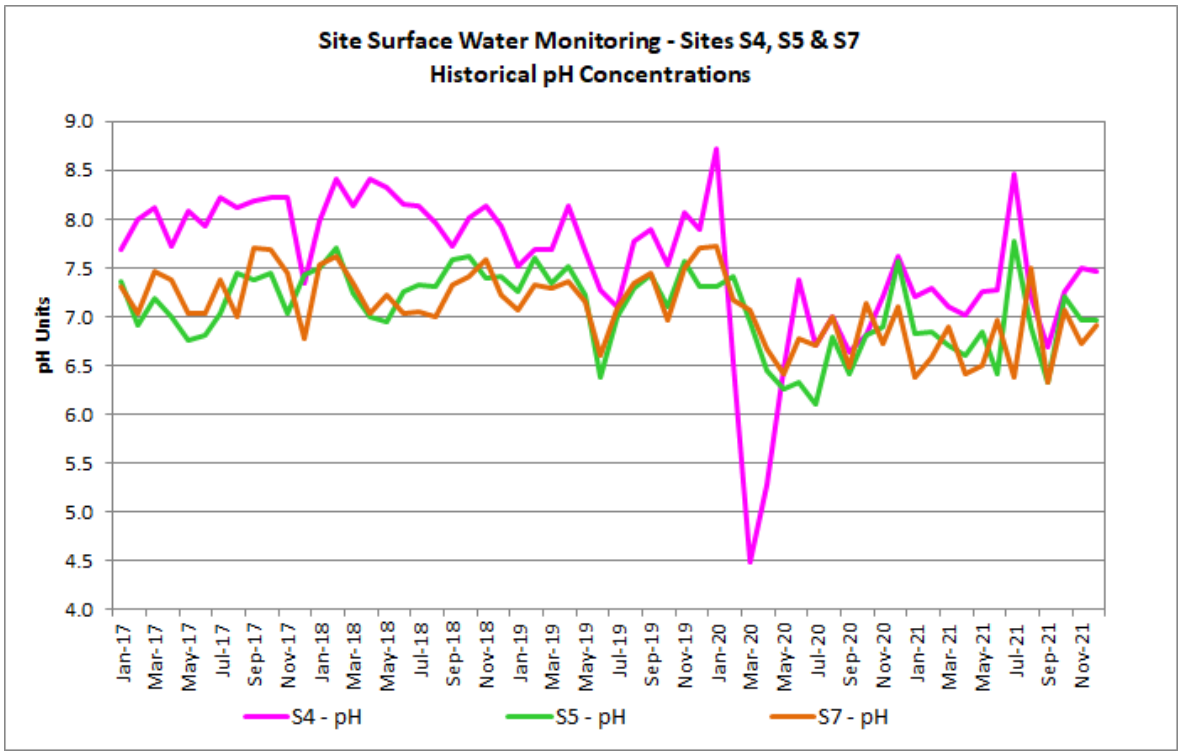


Figure 6-5 *S4, S5 & S6 Historical pH Results*

During the reporting period, electrical conductivity was intermittently above the approved trigger values (refer **Table 6-1**) as presented below:

- S1 was in excess of the trigger value during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2710µS/cm, observed during March 2021.
- S3 was in excess of the trigger value during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2510µS/cm, observed during March 2021.
- S5 was in excess of the trigger value during one (1) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1480µS/cm, observed during March 2021.
- S6 was in excess of the site-specific trigger value during four (4) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2660µS/cm, observed during October 2021.
- S7 was in excess of the trigger value during one (1) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1350µS/cm, observed during March 2021.

Electrical conductivity concentrations were below the revised trigger values (refer **Table 6-2**) at all locations during the monitoring period.

Electrical conductivity levels during the previous five (5) years shows fluctuations, with the greatest increases generally observable during periods of low rainfall (refer **Figure 6-6** and **Figure 6-7**). However, there are months of high rainfall in which electrical conductivity concentrations are also high, indicating that there are other contributions to the salinity of the water. Wangcol Creek (S1, S3 and S6) is considered to be impacted by saline discharges at a licence discharge point upstream of PDM which then potentially impacts, at a lesser extent, within Blue Lake and downstream within Coxs River. Another potential contributor to salinity during high rainfall months is sediment from the catchment. It is noted that the electrical conductivity of S4 has been on a decreasing trend for the previous five (5) years, such that salinity impacts not associated with the discharge point / Wangcol Creek appear to be reducing; the large spike in February and March 2020 is considered to be likely due to erosion of land burnt in the 2019 / 2020 bushfires and the decreasing trend from that point is considered likely due to revegetation of the catchment.

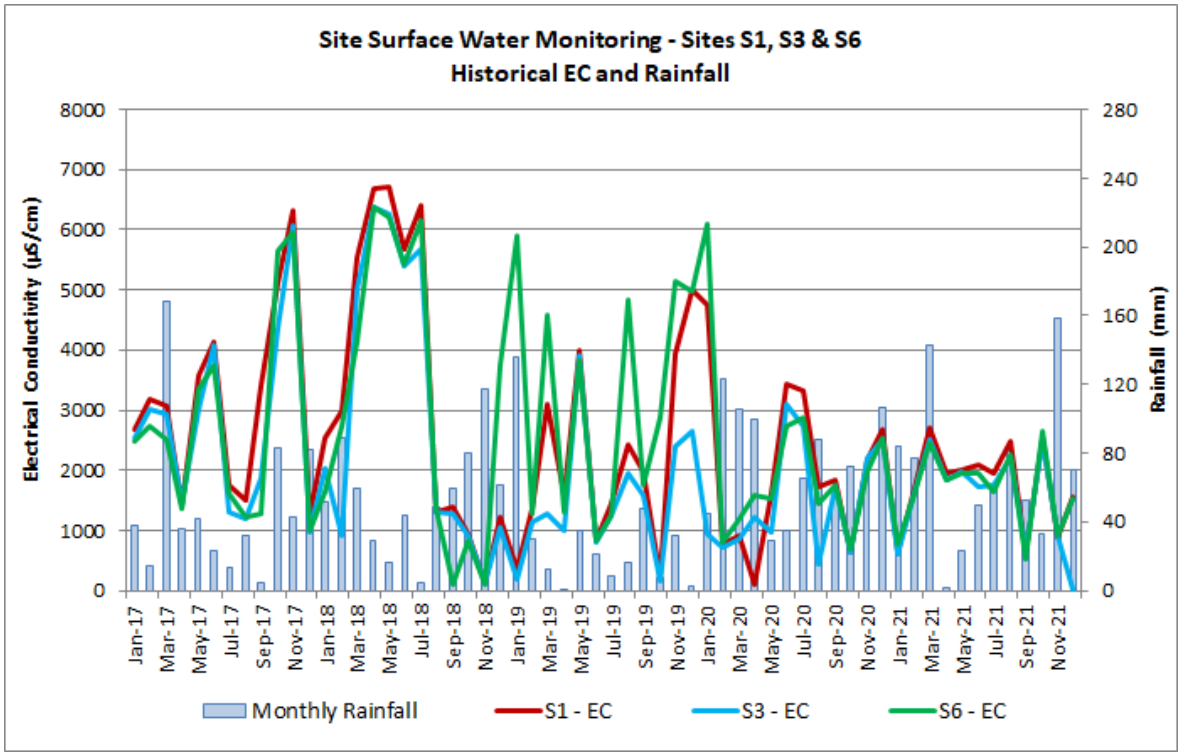


Figure 6-6 *S1, S3 & S6 Historical EC Results & Rainfall*

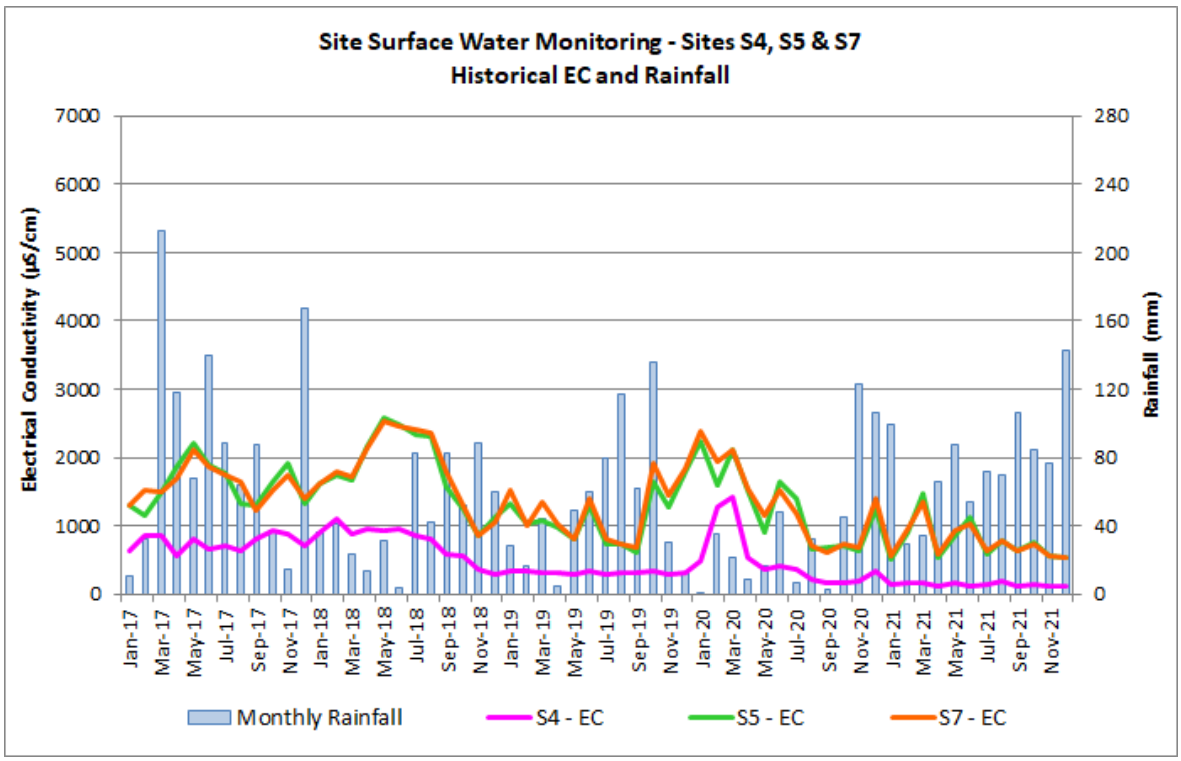


Figure 6-7 *S4, S5 & S6 Historical EC Results & Rainfall*

The water quality entering Wangcol Creek from the PDM discharge line (EPL Point 13) is monitored voluntarily, as there was no discharge during the reporting period, for the purposes of assessing trends within Wangcol Creek; samples are collected from the drainage line prior to the water entering Wangcol Creek within the PDM boundary. The electrical conductivity of the discharge drainage line is shown compared to the electrical conductivity of the Wangcol Creek monitoring locations (S1, S3 and S6) during 2021 in **Figure 6-8**. Generally, the electrical conductivity is shown to be greater within the discharge drainage line as compared to the Wangcol Creek downstream monitoring locations; in the absence of discharge the changes to electrical conductivity within the drainage channel are considered to be associated with natural variations due to rainfall.

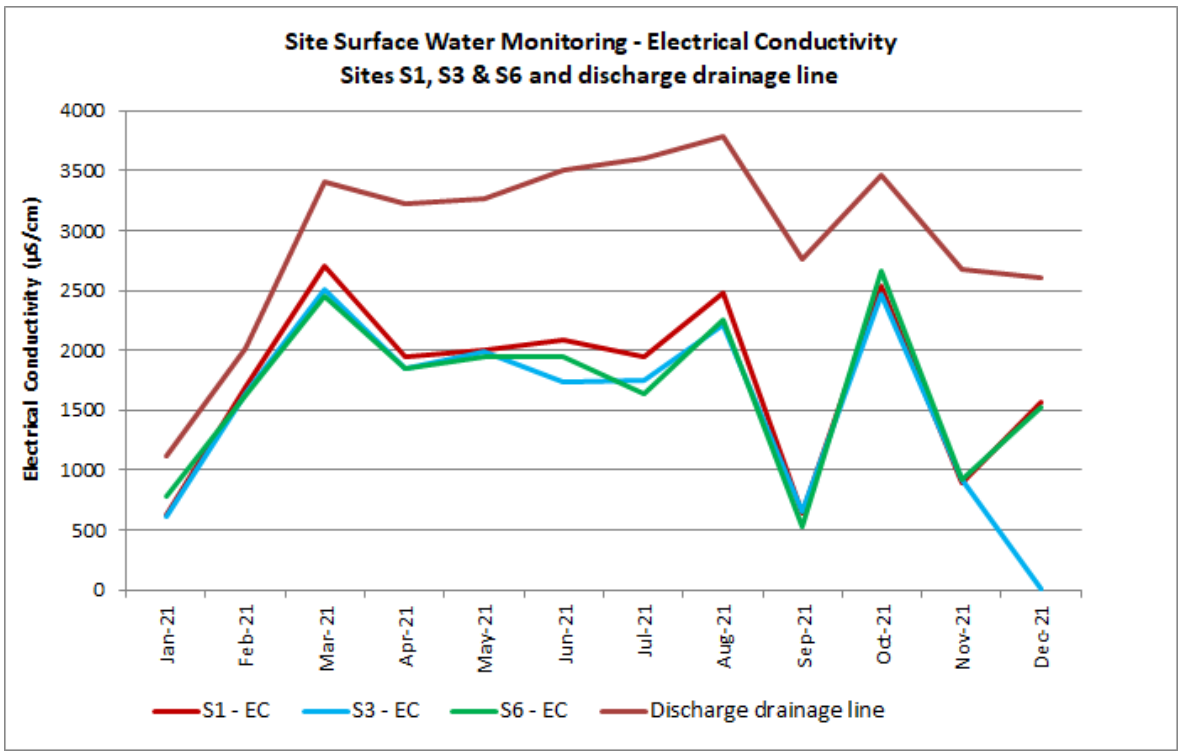


Figure 6-8 *Electrical conductivity (EC): discharge point, S1, S3 and S6*

6.3 CHANNEL STABILITY AND STREAM HEALTH MONITORING

Channel stability and stream health monitoring of Wangcol Creek is conducted on a six-monthly basis in accordance with project approval PA 10_0041 and the WMP. Monitoring was conducted in March and September 2021. It is noted that additional inspections are undertaken on a voluntary basis each month.

Monitoring is conducted at four (4) monitoring points along Wangcol Creek (SH1, SH2, SH3 & SH3A) and one location at Coxs River (SH5), downstream of Blue Lake (refer **Plan 3b**, **Appendix A**). An additional location at Blue Lake (SH4) is also included to allow for visual observation of the condition of the water bodies.

The monitoring involves an observational survey which provides a description of the locations and dimensions of erosive features. Indicators then produce a rating based on a scoring system. The combined total score of the indicators then ranks each monitoring location from very actively eroding through to very stable. This assessment enables determinations to be made as to whether the section of creek has changed over time from the classification derived during the original baseline survey. The criteria and scoring methodology are based on the CSIRO Ephemeral Stream Assessment protocol (Ref [6]).

A baseline assessment of channel stability, stream health and vegetation health of Wangcol Creek and Coxs River undertaken in 2013 indicated the drainage lines were classified as ‘potentially stabilising.’

Follow-up (six-monthly) assessments were conducted at the same monitoring locations, results of which indicated there had been no major change to the Wangcol Creek and Coxs River drainage lines, with each monitoring location classified as 'potentially stabilising'. During the 2017 assessment, the classification of Wangcol Creek did not change, however the particle size of the material on the Coxs River drainage line floor (site SH5) improved and the site was classified as 'stable'; these classifications continued throughout 2018 and March 2019 (refer **Figure 6-9**). During October 2019, there was a loss in vegetation in the drainage line walls which is considered to be due to below average rainfall (drought conditions), as such the classification was decreased to 'potentially stabilising.' During the March and October 2020 assessment, vegetation growth was observed; however, not to the density observed during March 2019 and as such the classification remained.

During the March and September 2021 assessments, each location with the exception of SH3A was classified as 'potentially stabilising'. SH3A was considered 'stable' due to the presence of spray-concrete lining.

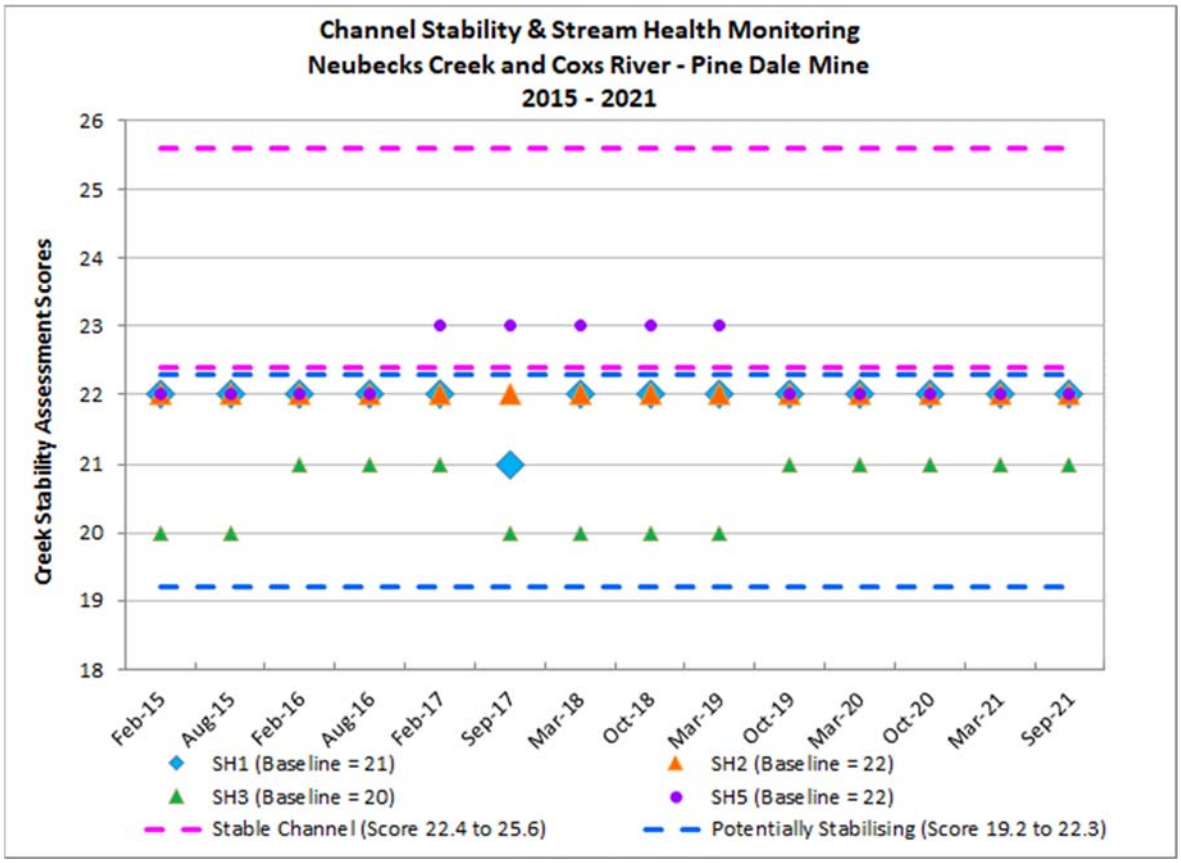


Figure 6-9 *Channel Stability and Stream Health Scores*

Detailed results are presented in **Appendix B**.

6.4 GROUNDWATER

Management of groundwater at PDM is undertaken in accordance with project approval PA 10_0041 and the PDM WMP. PDM has a water access licence (WAL36480) for the extraction and use of groundwater from the underground mine workings; and Bore Licences (10BL165933 & 10BL603588) for the monitoring of groundwater levels and quality. Results of groundwater monitoring are discussed in **Section 6.5**, with the complete results for the reporting period provided in **Appendix B**.

Review of groundwater extraction data is required to be undertaken by a qualified groundwater consultant in accordance with WAL36480 to validate the recorded data against groundwater predictions. As there was no measurable groundwater intercepted from the underground workings during the 2021 reporting period, no review was required.

6.5 GROUNDWATER MONITORING

The Groundwater Management Plan detailed within the WMP includes the sampling of four (4) locations within PDM and seven (7) locations offsite. The offsite locations include five (5) monitoring locations surrounding the Yarraboldy Extension and two (2) locations at the former Enhance Place mine site. Monitoring locations are shown in **Plan 3a**, **Appendix A**.

Monitoring during the reporting period was generally in accordance with the WMP except as detailed below.

Sampling was conducted monthly at the onsite PDM bores (P6, P7) for standing water level and physical water quality parameters, and on a quarterly basis for cations, anions and dissolved metals.

Groundwater from the Bong was historically sampled by pumping water from the underground opening into the Water Cart Dam at PDM (location of Water Cart Dam is shown in **Plan 3a**). The Bong is an opening to the old underground workings; groundwater can no longer be accessed from the Bong as it is under pressure. Water is not pumped into the Water Cart Dam during the care and maintenance period; thus, water quality within The Bong (sampled at the Water Cart Dam) is now considered to be representative of surface water runoff rather than groundwater quality from within the Old Wallerawang underground workings. Thus, any results in excess of the trigger values at the Bong are not considered indicative of impacts to groundwater.

Sampling from Old Shaft was discontinued after the February 2021 sampling round when an internal audit identified that the sampling posed a fall risk due to the requirement for an elevated position to collect samples and the absence of any formal attachment points for a harness required for working at heights.

Sampling from bores within the Yarraboldy extension (Bores A, B, C, D and E) has been limited since the bushfire of November 2019 – January 2020, initially due to access restrictions and then following a risk assessment which concluded that access to Bores A, C, D and E was not safe and no further attempts were to be made to sample. Access to Bore B was able to be undertaken and the data logger was downloaded on a quarterly basis (February, May, August, November 2021).

Access to the Enhance Place bores (EP PDH3/GW and EP PDH4/GW), intended to be sampled monthly for standing water level only, was undertaken in January 2021 – February 2021 only as following the February 2021 sampling round the access gates were locked by the landowner. Access has remained closed for the remainder of the monitoring period.

6.5.1 GROUNDWATER ASSESSMENT CRITERIA

The approved groundwater trigger values developed for PDM are detailed in the WMP in accordance with Schedule 3, Condition 27(c) of the Project Approval (PA 10_0041). The approved trigger level values are detailed in **Table 6-3**.

Table 6-3 *Approved Groundwater Assessment Criteria*

Groundwater Site	pH (range)	Electrical Conductivity (µS/cm)	SWL[a] Trigger (m, AHD)
P6	6.2 - 8.0	1180	887.90
P7	6.3 - 8.0	852	883.28
EP DDH4/GW (Bore D)	*6.8 - 8.0*	*608*	*940.61*
EP DDH7/GW (Bore A)	*6.5 - 8.0*	*326*	*954.40*
EP PDH1/GW Bore C)	*6.9 - 8.0*	*490*	*889.25*
EP PDH3/GW (Enhance)	*NA*	*NA*	*891.06*
EP PDH4/GW (Enhance)	*NA*	*NA*	*890.95*
EP PDH7/GW (Bore E)	5.5 - 8.0	151	938.43
Old Shaft	6.3 - 8.0	908	888.46
The Bong (at SW location)	5.8 - 8.0	1157	NA

[a] SWL: standing water level

NA: No trigger value required for these locations

Small, italicised text is not relevant to the 2021 reporting period due to access restrictions / change of scope as detailed in this Section

Vibrating wire piezometers are installed within bores B, C, and E at various target aquifers. A summary of the target aquifers and corresponding trigger values for each bore location is shown in **Table 6-4**.

Table 6-4 *Approved Groundwater Trigger Values (vibrating piezometers)*

Groundwater Site	Aquifer	SWL Trigger (m AHD)
Bore B (EP DDH5)	Sandstone	921.23
	Irondale	NA
	Lidsdale	899.23
	Lithgow	No trigger value
Bore C (EP HHD3)	Irondale	909.40
	Lithgow	No trigger value
	Lidsdale	891.78
	Marangaroo	889.76
Bore E (EP DDH6)	Irondale	884.67
	Lithgow	No trigger value

NA: no data, bore is depressurised (water level has dropped below sensor installation height)

Small text is not relevant to the 2021 reporting period due to access restrictions / change of scope as detailed in this Section

The current approved assessment criteria detailed in **Table 6-3** was developed from groundwater quality data collected during the period January 2011 – December 2014. During the 2017 monitoring period, it was observed that intermittent exceedances of the approved trigger values occurred. During the scheduled review of the WMP in 2017 revised trigger levels were proposed which were developed using the entire groundwater quality data set (2005 – 2017), as it was considered that using all available data would provide a robust data set which incorporated diverse climatic influences. These revised trigger values were submitted to the DPIE – Natural Resources Access Regulator (NRAR) (formerly Department of Industries – Water) for approval. DPIE recommended that an investigation be undertaken to determine the cause of the exceedances as a basis for the revision of trigger values.

An investigation was undertaken and the findings indicated that the likely cause of the decreasing pH trend observed in bore P6 and Old Shaft was acid mine drainage from historical underground workings (Ref [5]). The investigation recommended revised trigger values which are summarised in **Table 6-5**.

Table 6-5 *Revised Groundwater Trigger Values*

Monitoring location	P6	P7	Old Shaft
pH trigger level[a]	5.6	6.3	5.4
Water Level (AHD)[b]	--	--	891.54

[a] pH trigger level is exceeded if the pH drops below the nominated value.

[b] Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

At the time of writing of this report, the recommended revised trigger values shown in **Table 6-5** have been utilised alongside the approved trigger values in **Table 6-3**.

6.5.2 GROUNDWATER QUALITY AND SWL

6.5.2.1 ONSITE GROUNDWATER

Groundwater bores P6, Old Shaft and The Bong are located within the old Wallerawang underground workings; whilst P7 is located within the Lithgow seam. The full suite of groundwater results for the 2021 reporting period is presented in **Appendix B**.

The onsite groundwater standing water level (SWL) and rainfall for the period 2017 – 2021 is shown in **Figure 6-10** and are compared against the approved groundwater trigger values.

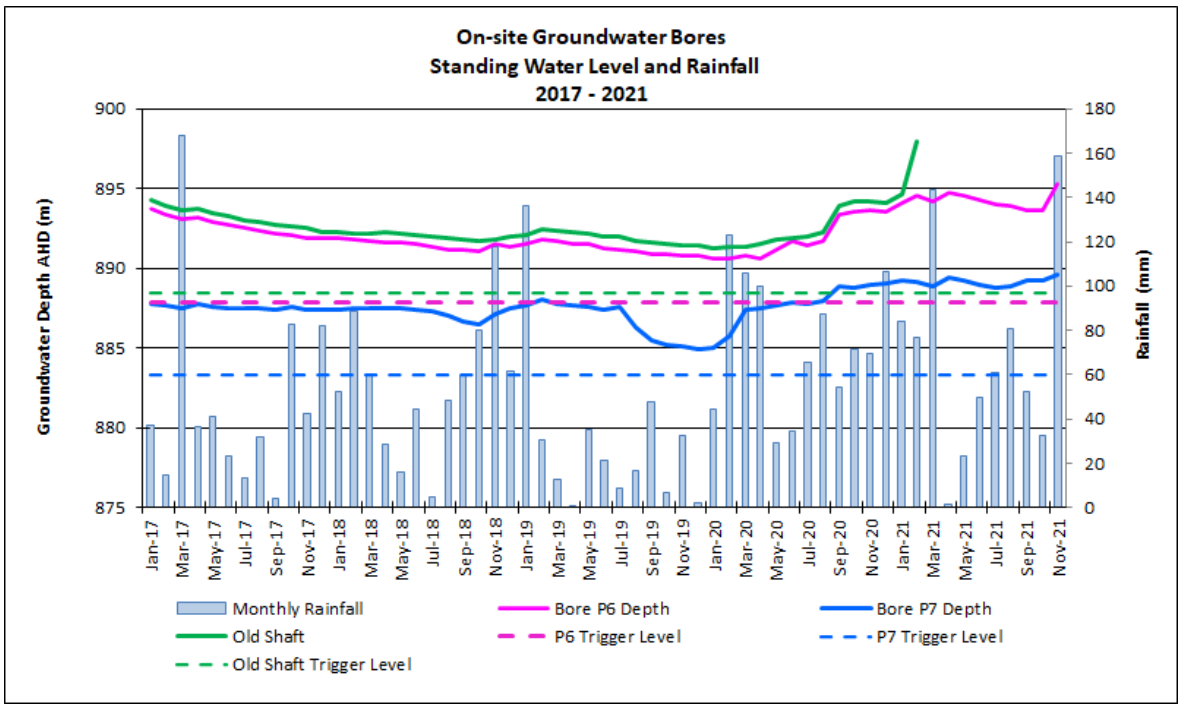


Figure 6-10 *Onsite Groundwater Bores SWL and Rainfall 2017 – 2021*

During the 2021 reporting period there were no instances where the SWL dropped below the respective approved trigger values (refer **Table 6-3**) or the revised trigger values (refer **Table 6-5**).

Review of the previous five (5) years of monitoring data (refer **Figure 6-10**) indicates that the SWL within bore P6 and P7 decreased for the period December 2016 – October 2018 with a marginal increase / stabilisation to February 2019 upon which water levels further decreased to March / April 2020. P7 had a sharp decrease in water level between July 2019 and January 2020 upon which it recovered to a level consistent with the July 2019 level by March 2020. Water levels increased at variable amounts in both P6 and P7 until the end of the monitoring. The water level in both P6 and P7 is higher than at December 2016.

Review of the previous five (5) years of monitoring data (refer **Figure 6-10**) indicates that the SWL within Old Shaft was consistent with the water level in P6 up until January 2020 when there was a significant increase in the water level within Old Shaft which was not presented in P6 (or P7).

There is an overall trend of increasing rainfall during 2020 and to a lesser extent 2021, which is considered to be the cause of the increasing SWL rather than any activities (which have not included any groundwater extraction or injection and have been restricted to surficial care and maintenance tasks) being undertaken at PDM. Furthermore, there is evidence of surface water ingress entering the old workings of the historic Wallerawang underground mine which are likely influencing the water level within Old Shaft. This is supported by the development of a seep coming from an old adit of the historic Wallerawang underground mine (refer **Section 6.2**) which was first identified in March 2021.

The pH of the onsite groundwater monitoring bores for the period 2017 – 2021 is shown in **Figure 6-11**. Periods of no data (gaps in **Figure 6-11**) are due to The Bong (Water Cart Dam) being dry and therefore no sample being collected.

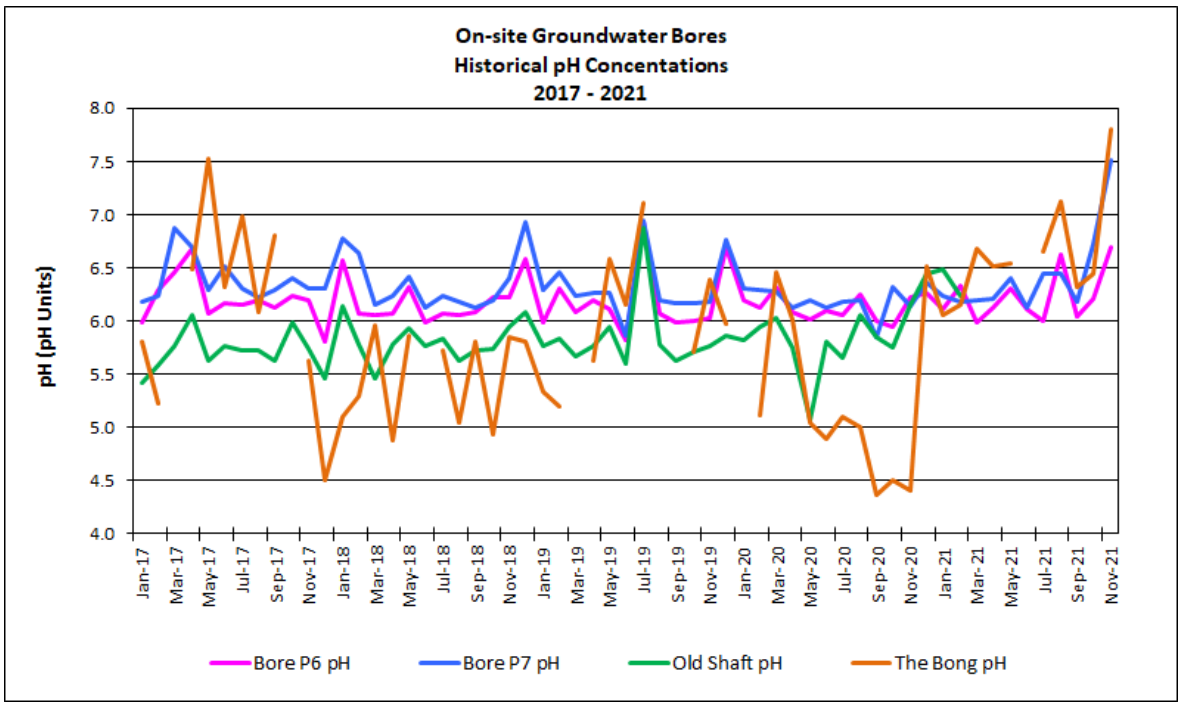


Figure 6-11 *Onsite Groundwater Bores pH: 2017 – 2021*

During the period 2017 – 2021 (refer **Figure 6-11**), fluctuations in pH are observable across all three (3) onsite groundwater sampling locations as well as The Bong. The pH at bores P6 and P7 are generally stable with fluctuations between 6 and 7 pH units until the November 2021 round during which the pH of P7 has increased to above 7pH units. The pH at Old Shaft was generally stable, with a spike in July 2019 which stabilised in August 2019, until a marked decrease during May 2020 at which time the pH increased to the completion of monitoring. The pH within The Bong, noting that it is considered to be representative of rainfall runoff for the period presented within **Figure 6-11**, indicated significant variations however overall does not indicate an increasing or decreasing trend.

During the 2021 reporting period, the pH within the bores were generally shown to be below the lower pH approved groundwater trigger values (refer **Table 6-3**), or just above, noting that reported concentrations are rounded to one decimal place when comparing to the trigger values. The pH was below the lower approved trigger value during:

- Six (6) of the twelve (12) monitoring events at groundwater bore P6. The lowest reported pH was 5.99 during the March 2021 monitoring event.
- Six (6) of the twelve (12) monitoring events at Bore P7. The lowest reported pH was 6.13 during the June 2021 monitoring event.
- One (1) of the two (2) monitoring events at Old Shaft. The lowest reported pH was 6.23 during the February 2021 monitoring event.

During the 2021 reporting period, there were no instances where the upper pH trigger value was exceeded.

Comparison of the pH with the revised trigger values (refer **Table 6-5**) indicates the following:

- The pH at Bore P6 is compliant for all twelve (12) monitoring events.

- The pH trigger value for Bore P7 remains unchanged, thus the pH remained below the lower pH trigger value for seven (7) of the twelve (12) monitoring events.
- The pH at Old Shaft is compliant for the two (2) monitoring events.

The Bong revised trigger value has not been presented nor used for comparison as this location is no longer considered representative of water within the Old Wallerawang underground workings.

Although the pH at Bore P7 is intermittently below the revised trigger level value, current activities undertaken at PDM during care and maintenance are not considered to be the cause of the low pH value. It is noted that the pH at P7 is not trending downwards and is relatively stable, potentially increasing throughout 2021. It is considered that the increase in rainfall observed during 2020, and to a lesser extent 2021, following a prolonged dry period has resulted in an increased flow which has the potential to mobilise stagnant low pH water may have accumulated during drought conditions.

The electrical conductivity of the onsite groundwater monitoring bores for the period 2017 – 2021 is shown in **Figure 6-12**. Periods of no data (gaps in **Figure 6-12**) are due to The Bong being dry and therefore no sample being collected.

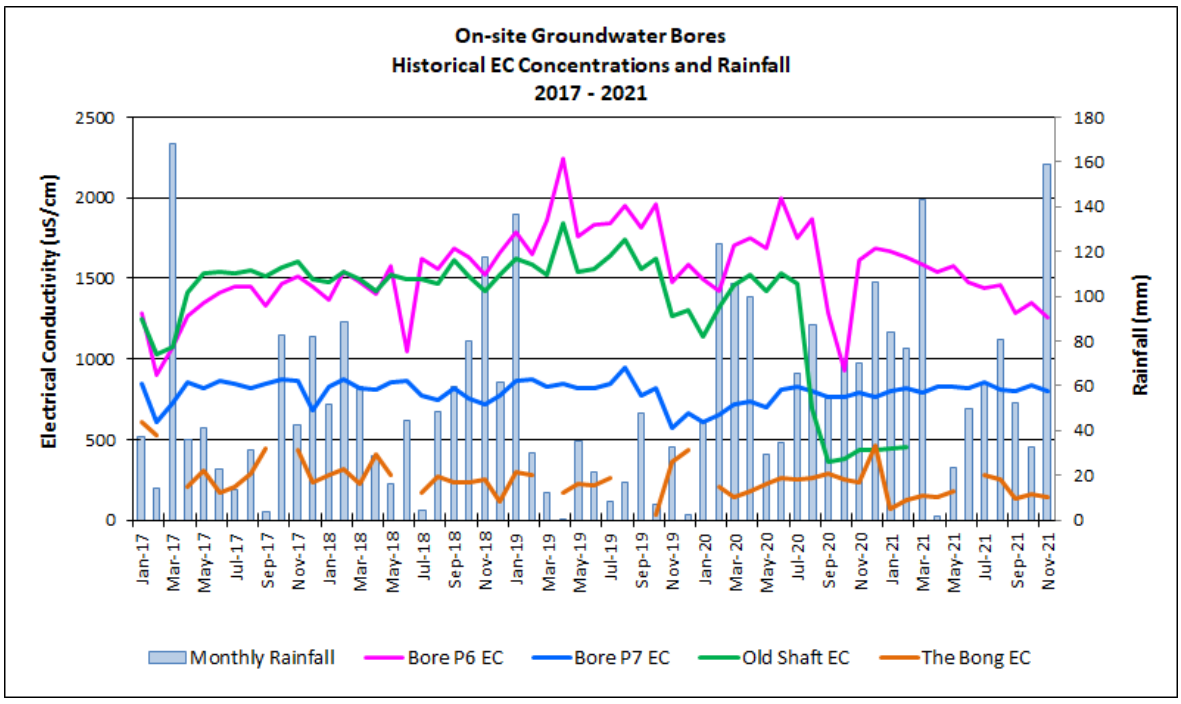


Figure 6-12 *Onsite Groundwater Bores Electrical Conductivity: 2017 – 2021*

During the 2017 – 2021 period (refer **Figure 6-12**) the electrical conductivity within Bore P6 and Old Shaft follow a similar trend: increasing (with some fluctuations) during the period January 2016 – December 2019 and then decreasing through to November 2021 with a period between February / March 2020 – July / August 2020 in which concentration increased. The increases in electrical conductivity within bore P6 and Old Shaft generally correspond to periods of decreased rainfall, while the decreases correspond to increased rainfall up until January 2021; from that period the decrease in P6 does not appear to be affected by rainfall. There were no activities undertaken at PDM which extracted or discharged water into the Old Wallerawang underground workings, as such, the factors causing the increase or decrease of the electrical conductivity are considered outside the control of PDM.

The electrical conductivity within bore P7 is generally stable over the five (5) year monitoring period (refer **Figure 6-12**) with a significant decrease and subsequent partial recovery from August 2019 through to June 2020.

The electrical conductivity within the Bong is generally low and overall indicating a slightly decreasing trend.

During the 2021 reporting period, the electrical conductivity exceeded the approved trigger values (refer **Table 6-3**) during:

- All of the twelve (12) monitoring events at bore P6: a maximum electrical conductivity of 1670µS/cm was recorded in January 2021.
- One (1) of the twelve (12) monitoring events at P7 with a concentration of 853µS/cm in July 2021.

The two (2) results at Old Shaft were below the approved trigger value.

6.5.2.2 YARRABOLDY GROUNDWATER (OFFSITE)

Groundwater bores located offsite and associated with the Yarraboldy Extension include Bores A, B, C, D and E. Bore B is not a groundwater quality monitoring location and consists of a vibrating piezometer for the purposes of monitoring groundwater levels only. Monitoring bores A, D and E are located within the Middle River seam and bore C within the Lithgow seam.

As discussed in **Section 6.5** only Bore B was monitored in the 2021 reporting period however for completeness the monthly standing water level measurements compared with rainfall for the period 2017 – 2021 are shown in **Figure 6-13** and the quarterly pH and electrical conductivity measurements for the same period are shown in **Figure 6-14** and **Figure 6-15**. The gaps in the graphs indicate that the bore was unable to be sampled because it was dry, or it was inaccessible.

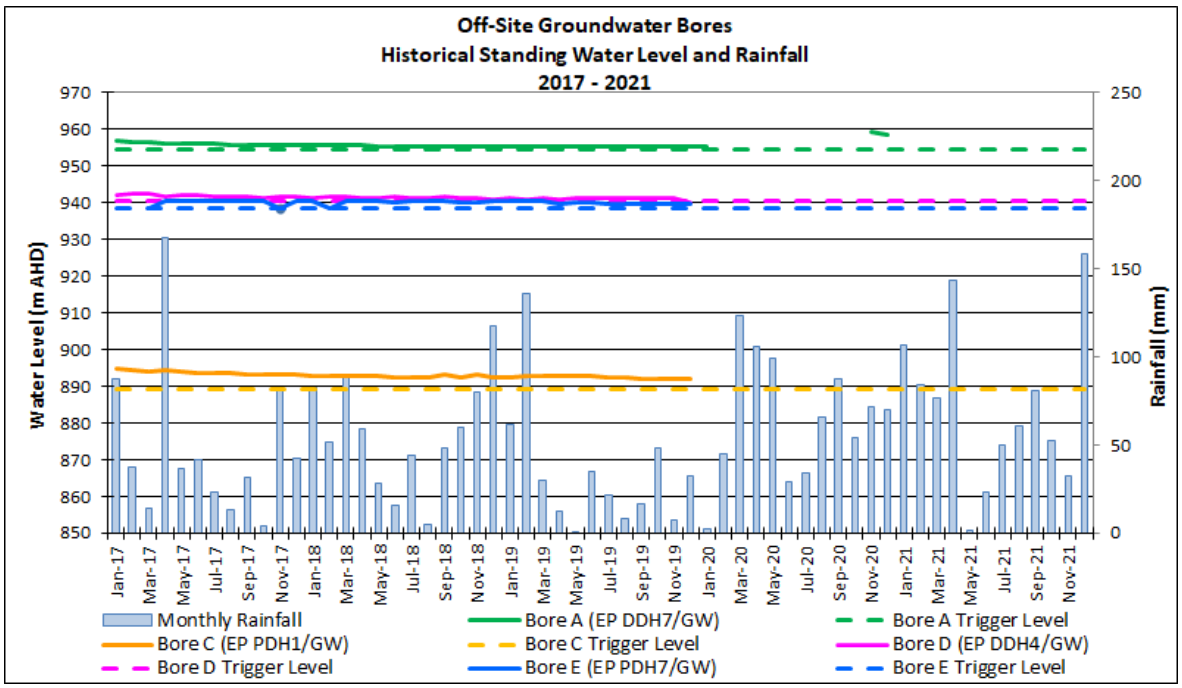


Figure 6-13 *Yarraboldy Groundwater Bores Standing Water Level: 2017 – 2021*

During the 2017 – 2019 monitoring period, the standing water levels within the Yarraboldy groundwater bores show varying levels of response to rainfall fluctuations, with a slight decreasing trend observed from November 2016 – December 2019. The standing water level recorded at Bore A during October and November 2020, has increased when compared to the 2019 levels.

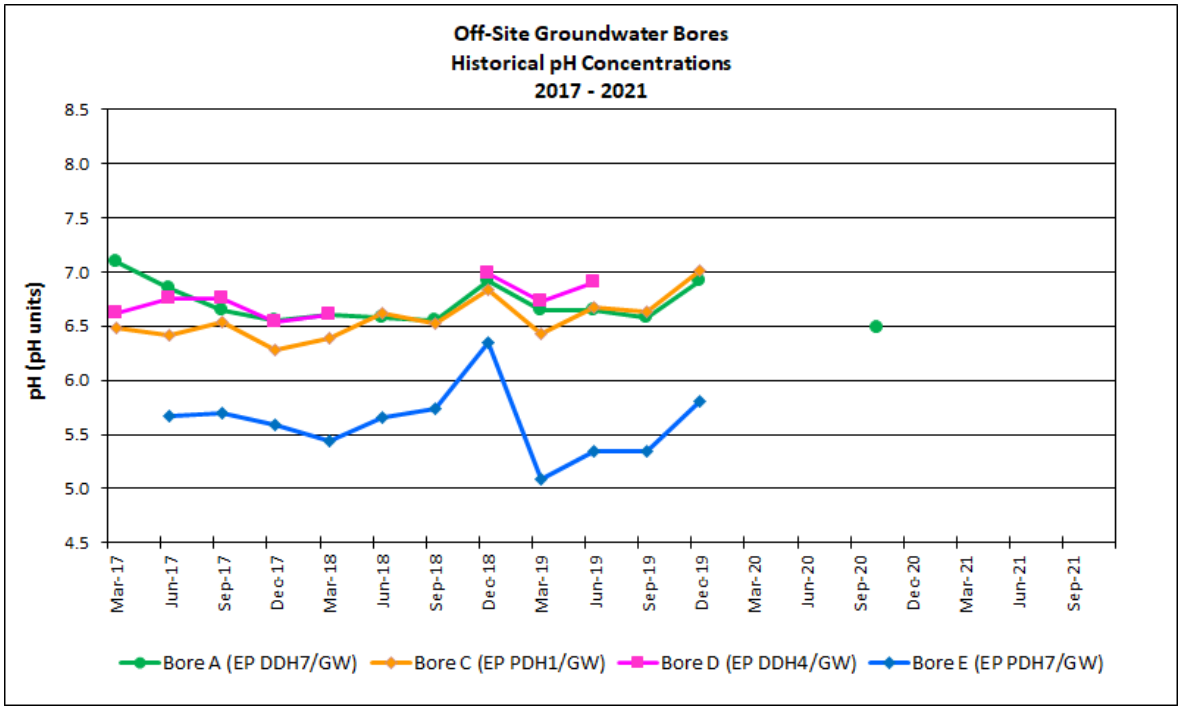


Figure 6-14 *Yarraboldy Groundwater Bores pH: 2017 – 2021*

During the 2017 – 2021 monitoring period, the pH indicates a slight increasing trend in all bores except Bore E which overall in stable however with significant variation. It is noted that concentrations of sulphate and iron are generally low within Bores A, C and D and as such it is considered unlikely that pyrite oxidation and acid mine drainage are influencing pH, noting that an increasing pH would not be considered representative of the effect of acid mine drainage. There are some elevated levels of iron and low pH values within bore E during the 2019 monitoring period; however, this is unaccompanied by sulphate concentrations. As such, it remains unclear if the impacts of acid mine drainage from the Wallerawang underground workings are impacting the results from Bore E (Middle River seam).

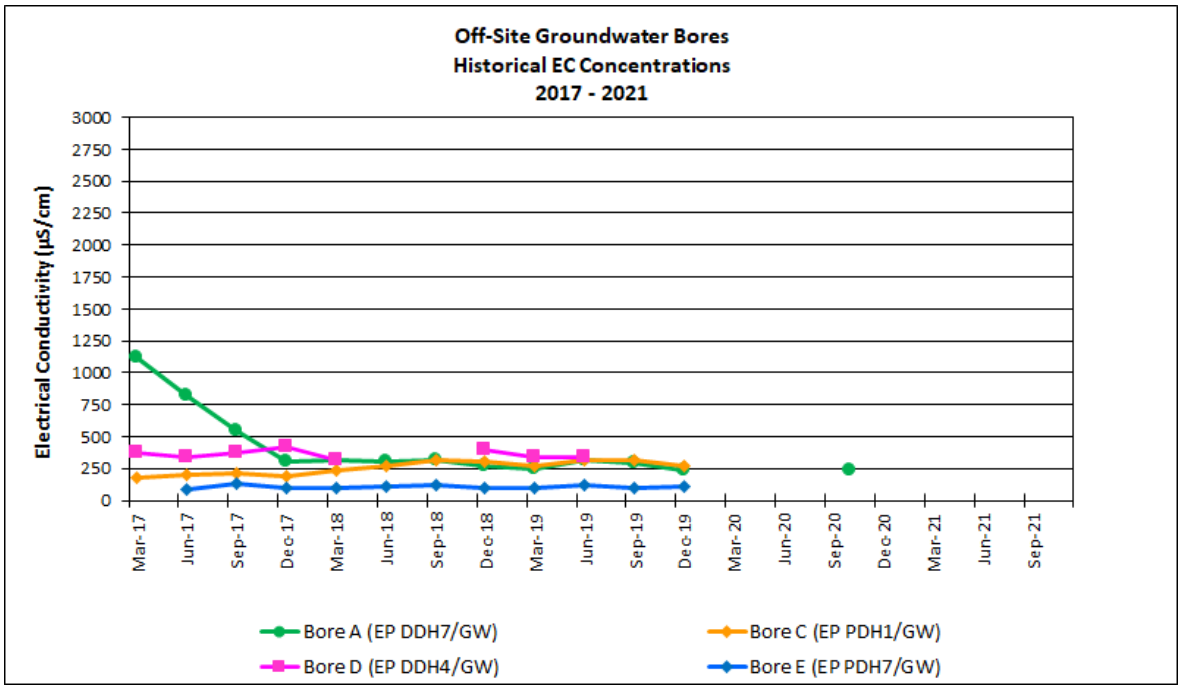


Figure 6-15 *Yarraboldy Groundwater Bores Electrical Conductivity: 2017 – 2021*

During the 2017 – 2021 monitoring period, electrical conductivity is generally shown to be stable within bores A, C, D and E.

Groundwater level hydrographs for Bore B, Bore C and Bore E along with rainfall from 2015 are shown in **Figure 6-16** to **Figure 6-18**. There was no data available at Bore B for the period 19/10/2017 – 1/2/2018 and Bore C for the period 11/5/2017 – 1/2/2018 due to connectivity issues with the vibrating wire piezometer loggers. The loggers were removed from site and new loggers installed on 2/2/2018.

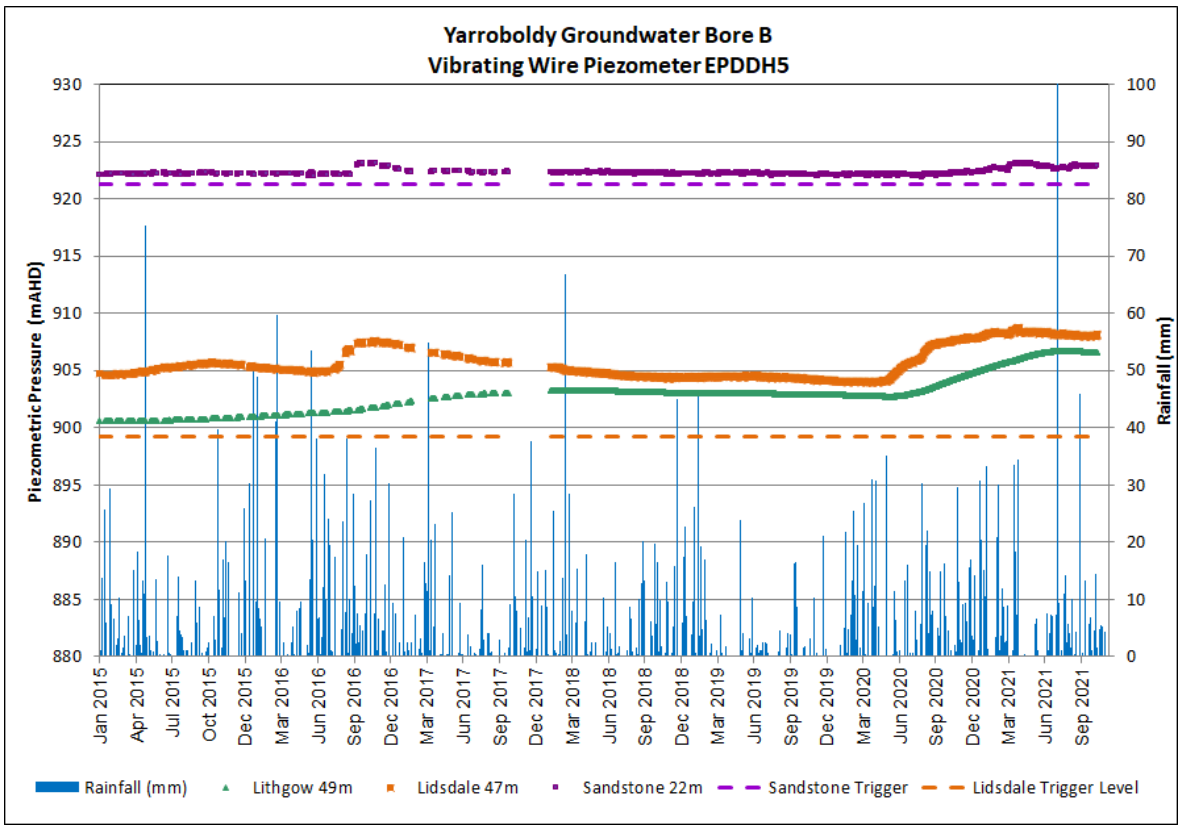


Figure 6-16 *Yarraboldy Bore B Hydrograph and Rainfall*

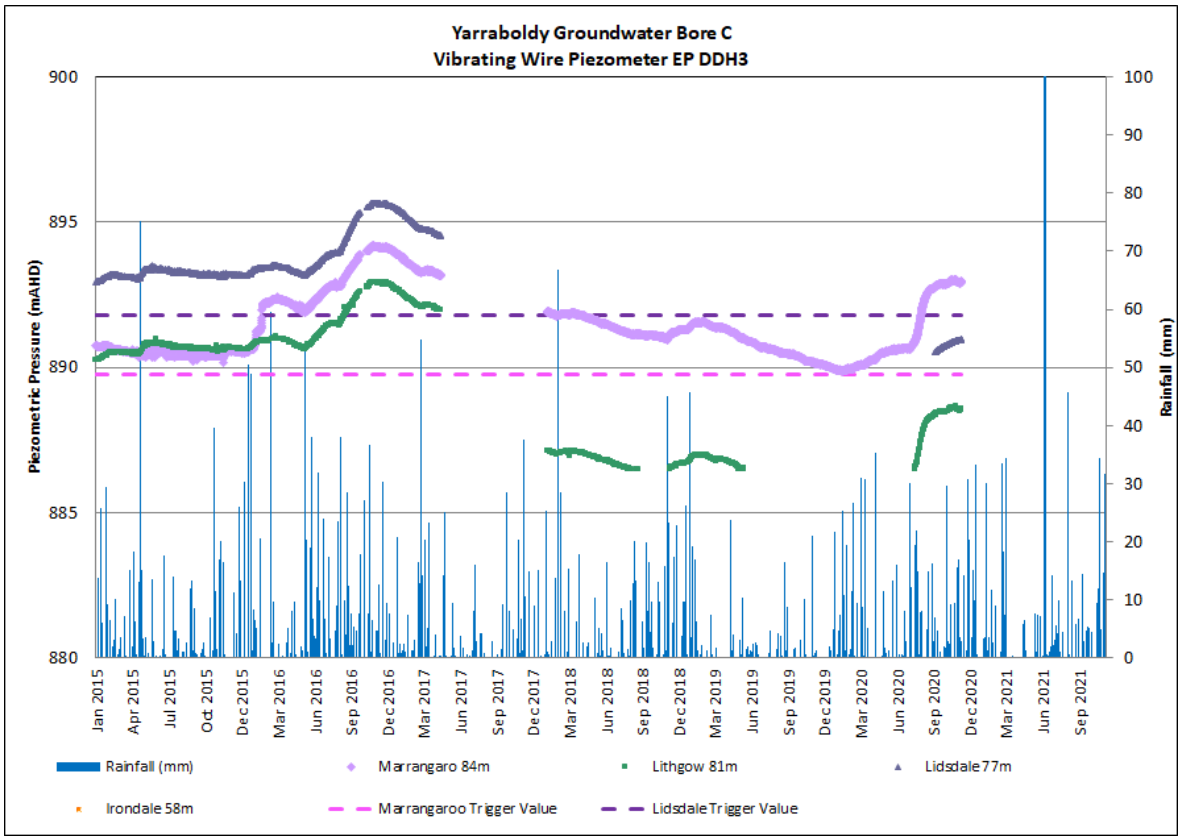


Figure 6-17 *Yarraboldy Bore C Hydrograph and Rainfall*

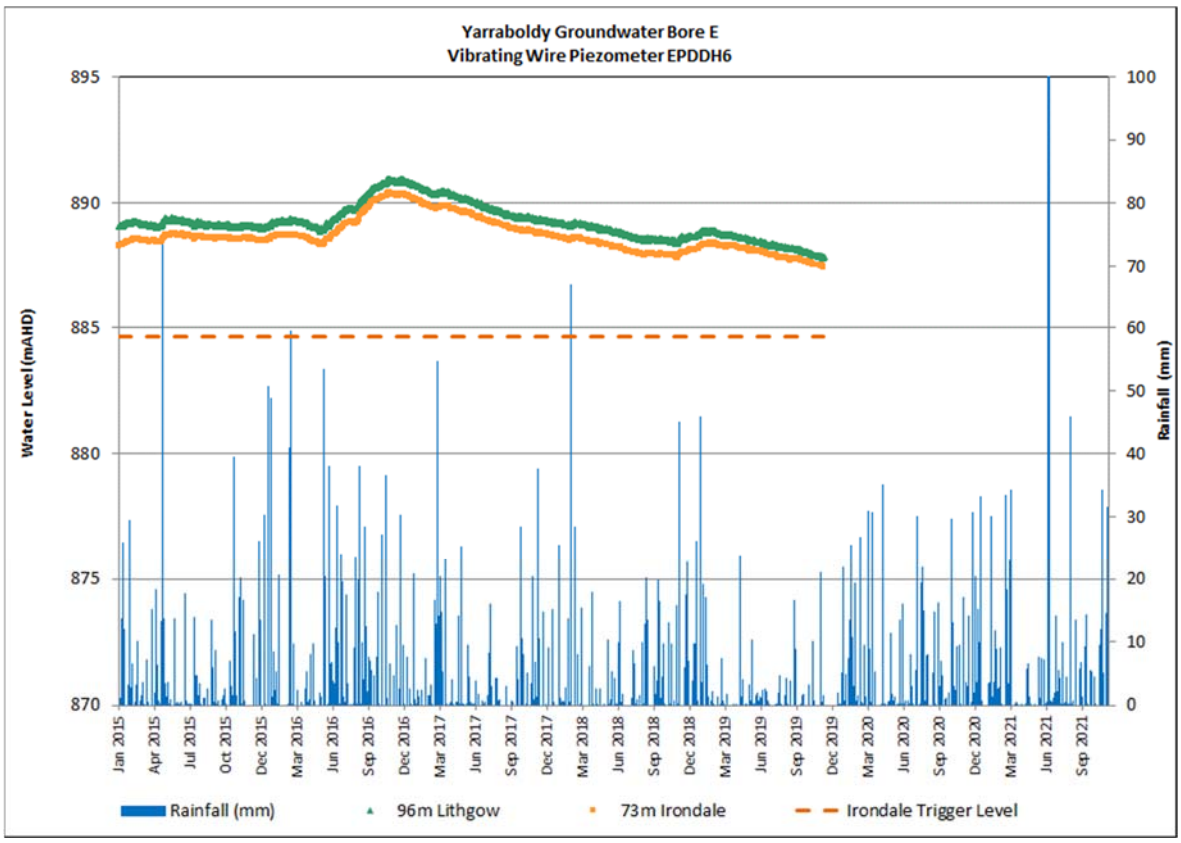


Figure 6-18 *Yarraboldy Bore E Hydrograph and Rainfall*

The groundwater levels at Bore B at the various aquifers have shown some variation in response to rainfall trends, however the response is generally minimal during the period January 2015 – March 2020. Following increased rainfall during the 2020 reporting period, the Lidsdale and Lithgow seam show an increase in water level and have stabilised in 2021. The water levels have not fallen below the groundwater trigger levels (refer **Figure 6-16**). There is no data available for the Irondale seam as the water level has fallen below the sensor height.

The groundwater levels at Bore C show a general decreasing trend since January 2017 which is considered likely due to decreased rainfall during 2017 and 2019. There is no data available for the Lidsdale seam from February 2018 as the water level has fallen below the sensor height. Similarly, there is no data available for the Lithgow seam from June 2019 as the water level has fallen below the sensor height. An increase in water level is evident during August 2020, with a sharp increase noted at the Marrangaroo seam and the water level increasing to above the sensor height with an increasing trend noted for the remainder of 2020. The water level within the Lidsdale seam has also increased to above the sensor height during September 2020 and continues to show an increasing trend to the end of monitoring (refer **Figure 6-17**). This increase in groundwater levels is considered to be due to increased rainfall during the 2020 reporting period, when compared to the rainfall during 2017 – 2019.

The groundwater levels at Bore E also show a general decreasing trend from January 2017 – December 2019 which is attributed to the decreased rainfall since early 2017. The water level within the Irondale aquifer remains above the trigger level during the 2015 – 2019 period. As Bore E was unable to be accessed during 2020 and 2021, it is unknown if the water level has responded to rainfall in a similar manner to Bores B and C.

6.5.2.3 ENHANCE PLACE GROUNDWATER

Two (2) monitoring bores are located within the former Enhance Place Mine and are measured monthly for standing water level.

As discussed in **Section 6.5** neither location was able to be accessed following the February 2021.

The standing water level for the period 2017 – 2021 is shown in **Figure 6-19**.

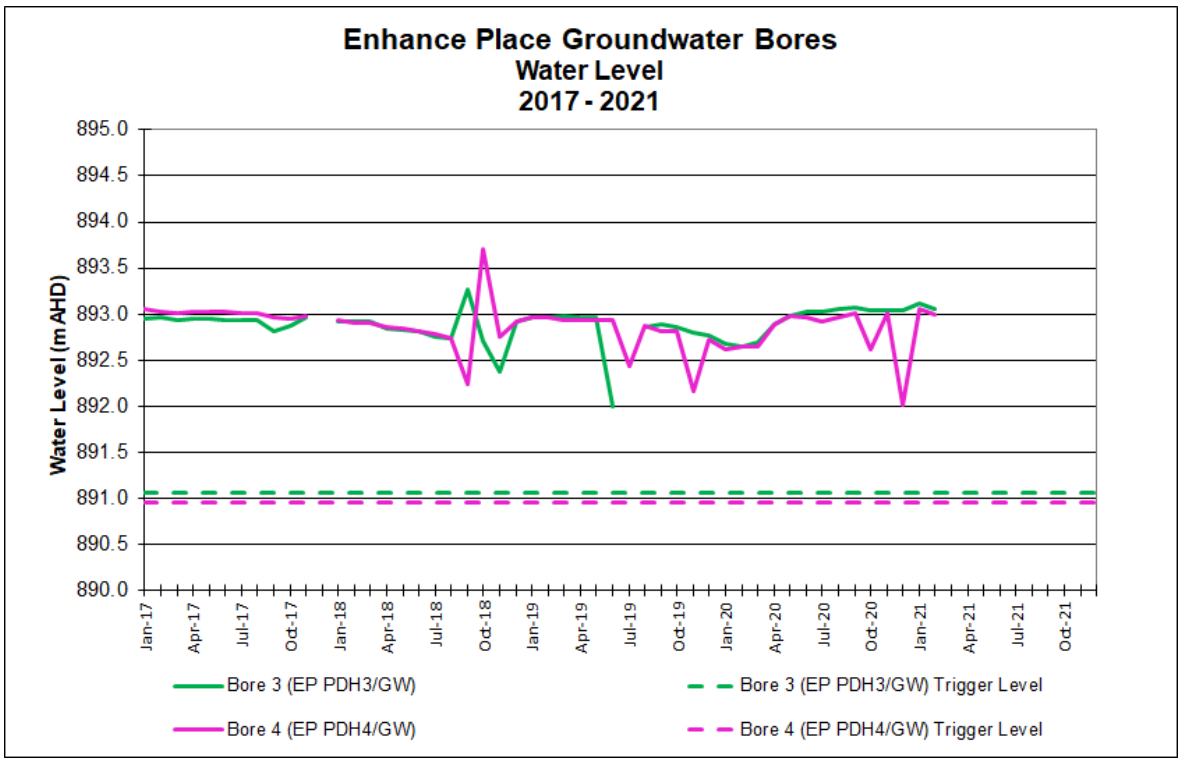


Figure 6-19 *Enhance Place Standing water levels 2017 – 2021*

There are some fluctuations in water level observed at the Enhance Place bores during 2018, late 2019 and late 2020. Otherwise, water levels are generally consistent within only a slight decreasing trend until March 2020 upon which the water levels increase, with fluctuations, to the last monitoring undertaken in February 2021. The overall trends are considered to be associated with rainfall. The groundwater level at both bores has remained above the water level trigger values during the 2017 – 2021 monitoring periods.

A detailed summary of the Enhance Place groundwater bore standing water levels can be found in **Appendix B**.

7 REHABILITATION

Rehabilitation works at PDM are conducted in accordance with rehabilitation objectives in the approved PDM MOP (Ref [3]). Rehabilitation performance criteria documented in the PDM MOP (Ref [3]) define the performance indicators, measuring criteria, status and progress of rehabilitation at PDM.

PDM is made up of a series of rehabilitation areas, comprising a series of parcels of land which are at various stages of being progressively rehabilitated back to the agreed post rehabilitation land use (acceptable post-mining land use and capability). This includes Areas A, B, C and 8. As the Yarraboldy Extension may form part of future mining operations, only temporary maintenance activities have and will be undertaken within this area until such time as mining recommences. The location of each rehabilitation domain is depicted in **Plan 4**, **Appendix A**.

The principal revegetation technique currently employed is direct seeding using native tree and shrub species for areas intended as woodland communities and pasture species for areas intended for agricultural activities.

The proposed final landform aims to emulate the pre-mining environment and to enhance local and regional ecological linkages across the site and surrounding areas.

A soil assessment and revised rehabilitation strategy was developed in 2014 by an agronomist (Ref [7])) and the recommendations were incorporated into the PDM MOP (Ref [3]).

7.1 REHABILITATION PERFORMANCE DURING THE REPORTING PERIOD

7.1.1 AGREED POST REHABILITATION LAND USE

Areas of privately owned land within PDM (Area B, C & 8) have been returned to pasture for agricultural purposes, including grazing, as per the approved rehabilitation strategy and landholder preferences.

The principal aim for the final land use of the Yarraboldy Extension rehabilitation area (including Area A) is for native vegetation conservation and for the use of Forests NSW. The Rehabilitation domains are shown in **Plan 4**, **Appendix A**.

7.1.2 REHABILITATION STATUS SUMMARY

A summary of the rehabilitation status for the previous (2020), current (2021) and future (2022) reporting periods are presented in **Table 7-1**.

Table 7-1 *Rehabilitation Area Summary*

Mine Area Type	Area Affected/Rehabilitated (ha)		
	2020 reporting period (Actual)	2021 reporting period (Actual)	2022 reporting period (Forecast)
A. Total Mine Footprint	98.1	98.1	98.1
B. Total active disturbance	56.8	56.8	56.8
C. Land being prepared for rehabilitation	0	0	0
D. Land under active rehabilitation	7	7	7
E. Completed Rehabilitation	25.4	25.4	25.4

A rehabilitation status survey is undertaken annually, and the monitoring report provides an overview of the rehabilitation status of PDM and recommendations for the improvement of rehabilitation outcomes in reference to the approved completion criteria. The survey comprises six (6) previously established monitoring transects: four (4) transects are located within rehabilitated pastures and two (2) transects are within treed rehabilitation areas. An additional two (2) transects exist as analogue sites in grazed pasture and undisturbed naturally vegetative areas to provide benchmarks against the pasture and treed rehabilitation areas.

The PDM 2021 Rehabilitation Monitoring Report (Ref [4]) is attached in **Appendix C** and Figure 1 of that report shows the location of the transects along with the results of the survey and comparative photographs. It is noted that neither of the analogue sites could be surveyed in 2021 due to the presence of livestock (in the grazed pasture analogue site) and accessibility issues associated with the late 2019 / early 2020 bushfire in the treed analogue site.

The 2021 rehabilitation status as compared against the performance indicators and completion criteria as defined in the PDM MOP (Ref [3]) is reproduced from the PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix C**) in **Table 7-2**.

Table 7-2 *Rehabilitation Status Summary: 2021*

Performance indicator	Completion Criteria	Current Status (2021 Reporting Period)
Feral animal and priority weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.	**Satisfactory** – continue to monitor.
Feral animal and priority weed control	Feral animals and priority weeds are controlled in accordance with legislation.	**Satisfactory** – continue to monitor.
Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	**Satisfactory** – continue to monitor.
Access	Adequate access for firefighting is maintained on rehabilitation areas.	**Satisfactory** – continue to monitor.
Habitat features	Habitat features are installed on native forest rehabilitation areas including: • Nesting boxes and salvaged hollows • Crushed timber spread over native forest rehab areas • Rock pile clusters.	**Ongoing** - nesting boxes to be installed once trees are established.
Vegetation health	More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	**Complete**.
	Native forest indicator species tree height and girth is within the range of analogue sites.	**Ongoing** – continue to monitor.

Performance indicator	Completion Criteria	Current Status (2021 Reporting Period)
Soil loss	Net annual soil loss is comparable to analogue sites at year 10.	**Complete**.
Erosion	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunnelling).	**Complete**.
Woodland birds present	Evidence of woodland birds utilising rehabilitation areas.	**Complete**.
Evidence of mammals	Evidence of target mammal species present in rehabilitation areas.	**Complete**.
Natural regeneration	Evidence of second generation of native forest indicator species from desired vegetation community.	**Ongoing** – continue to monitor.
	Evidence of natural regeneration of at least four (4) pasture species at year 5.	**Complete**.
Structure	Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.	**Ongoing** – continue to monitor.
Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	**Satisfactory** – continue to monitor.
Rural land capability	Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	**Complete**.
Species composition	Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites.	**Complete**.
	Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix.	**Complete**.
	Approved pasture species mix is sown at the specified rate per hectare.	**Complete**.
Weed presence	Weeds including African Lovegrass to comprise <10% of the pasture sward.	**Satisfactory** – continue to monitor.
Ground cover	Ground cover (vegetation, leaf litter, mulch) >70% at year 5.	**Complete**.

7.1.3 YARRABOLDY EXTENSION REHABILITATION PERFORMANCE

To minimise dust dispersion and soil erosion, overburden stockpiles located within the northern area of the Yarraboldy Extension have been re-contoured and seeded with pasture species.

The amenity bund located along the southern boundary of the Yarraboldy Extension was re-profiled in 2014, with the southern batter having a gradient of 18° to minimise erosion and enhance establishment of seedlings. Following the application and tilling of topsoil, a native species grass and tree species seed mix was applied followed by mulch (refer **Photograph 7-1**).

Photograph 7-1 *Amenity Bund looking east following application of mulch and native mix 2015*

During the reporting period, maintenance works was not required to be undertaken in the Yarraboldy Extension. No rehabilitation maintenance activities were undertaken. Current vegetative cover on the bund (photo taken February 2022) is shown in **Photograph 7-2**.

Photograph 7-2 *Amenity Bund looking north east, February 2022*

7.1.4 AREA A REHABILITATION PERFORMANCE

Area A is a treed rehabilitation area located in the southern area of PDM, south-east of the Yarraboldy Extension (refer to **Plan 4**, **Appendix A**). During 2008, seeding was commenced in Area A (8 ha) and 1500 trees were planted. In 2010, an additional 400 trees were planted. Further direct seeding and application of an organic mulch layer and lime occurred in October 2013; however, drought conditions late in 2013 limited the outcomes of this work.

Historical rehabilitation activities undertaken in Area A are presented in **Table 7-3**, along with the actions recommended in 2014 (Ref [7]) for improved rehabilitation and recommendations from the 2016 – 2020 annual rehabilitation surveys. Rehabilitation activities undertaken within the reporting period are also presented in **Table 7-3**.

Table 7-3 *Recommended and Completed Rehabilitation Actions in Area A*

Recommended Rehabilitation Actions - Area A		Actions Completed (2014 – 2020)	Undertaken in 2021
SLR Soil Assessment Report (Ref [7])	Continue control of Biddy Bush with current spot spraying regime.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Continue with further application of mushroom compost, lime & gypsum (10:3:2 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required
	Increase potassium by application of Muriate of Potash or similar (0.25tonnes/ha).	Application of Muriate of Potash at recommended rate.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [8])	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Coarse woody debris placed along contours above rills to reduce runoff rate and volume.	No – not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed surfaces ripped and re-sown with locally sourced seed mix.	No – not required
	Install nesting boxes in close proximity treed rehabilitation area.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
2015 Rehabilitation Monitoring Report (Ref [9])	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
	Re-apply a mixture of mushroom compost, lime and gypsum to treed rehabilitation areas as per the recommendations of SLR (2014) report.	Application of fertiliser and compost at recommended rates.	No – not required
	Increase canopy cover of tall herbs and shrubs at treed rehabilitation Area A to 75% with 80% groundcover of grasses and broadleaf herbs.	Exposed surfaces ripped and re-sown with fast growing herbs and grasses.	No – not required
	Concentrate tube stock planting in benches of treed rehabilitation areas to take advantage of run-on from banks.	Tree planting undertaken in addition to direct seeding.	No – not required
	Place additional coarse woody debris along contours above rills to reduce runoff rate and volume at treed rehabilitation areas.	Woody mulch placed along contours above rills to reduce runoff rate and volume.	No – not required
	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Coarse woody debris placed along contours above rills to reduce runoff rate and volume.	No – not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed surfaces ripped and re-sown with locally sourced seed mix.	No – not required

Recommended Rehabilitation Actions - Area A		Actions Completed (2014 – 2020)	Undertaken in 2021
2016 Rehabilitation Monitoring Report (Ref [10])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
	Place additional coarse woody debris along contours above rills to reduce runoff rate and volume at treed rehabilitation areas.	Woody mulch placed along contours above rills to reduce runoff rate and volume.	No – not required
2017 – 2020 Rehabilitation Monitoring Reports (Ref [11-14])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Install nesting boxes in or adjacent to treed rehabilitation areas.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.

The PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix C**) indicated that the total living groundcover within the monitoring transects in Area A (transect 5 and transect 6) was the same or had increased compared to that observed during the 2020 survey. Total living cover within the transect 5 had maintained at 80%; there was an increase in annual living cover however a corresponding decrease of litter cover. The total living cover at transect 6 had increased to >90% due to an increase in annual living cover and a decrease in litter cover and bare surface.

There remains evidence of bushfire affecting the treed rehabilitation areas however regeneration has continued from that first observed in October 2020.

Comparative photographs are presented in **Appendix C**.

7.1.5 AREA B AND C REHABILITATION PERFORMANCE

Rehabilitation Areas B and C are located in the eastern area of PDM; the locations are shown in **Plan 4**, **Appendix A**. Area B and C cover an area of approximately 25ha in total and have been rehabilitated as pasture. The final landform and water management structures have been completed and the areas seeded for pasture in accordance with Planning Approval 10_0041 and the requirements of the landowner.

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [2]) indicated that rehabilitation has been successfully completed in Area B and C and all completion criteria defined in the PDM MOP (Ref [3]) had been met.

Historical rehabilitation activities undertaken in Areas B and C are presented in **Table 7-4**, along with the actions recommended in 2014 (Ref [7]) for improved rehabilitation and recommendations from the 2016 – 2020 annual rehabilitation surveys. Rehabilitation activities undertaken within the reporting period are also presented in **Table 7-4**.

Table 7-4 *Recommended and Completed Rehabilitation Actions in Area B and C*

Recommended Rehabilitation Actions Area B & C		Actions Completed (2014 to 2020)	Undertaken in 2021
SLR Soil Assessment. Report, 2014 (Ref [7])	Control of African Lovegrass prior to pasture establishment works.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Ripping with a plough to create furrows, followed by application of pasture seed mix.	Furrows created along pasture poor areas and contour banks, seed, fertiliser & compost applied.	No – not required
	Application of Muriate of Potash (0.25tonnes/ha) and Di-ammonium phosphate 0.20 tonnes/ha).	MAP and DAP applied at recommended rates.	No – not required.
	Application of mushroom compost, lime & gypsum (10:4:1 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [8])	Continue to implement integrated weed management control methods for noxious weeds.	Weed spraying as per Weed Management Schedule (**Section 6.7**).	Yes
2015 Rehabilitation Monitoring Report (Ref [9])	Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Cover with a mixture of mushroom compost, lime and gypsum as per the recommendations of SLR (2014) report.	Poorly established pasture areas and drainage lines mechanically ripped prior to re-sowing with pasture species.	No – not required
	Increase and maintain groundcover in pasture rehabilitation Areas B and C and in Area 8 to at least 95%.	Application of fertiliser and compost at recommended rates.	No – not required.
2016 Rehabilitation Monitoring Report (Ref [10])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Continue to monitor pest animal numbers.	Pest and animal monitoring not required to be undertaken.	No – not required
2017 Rehabilitation Monitoring Report (Ref [11])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes

Recommended Rehabilitation Actions Area B & C		Actions Completed (2014 to 2020)	Undertaken in 2021
2018 Rehabilitation. Monitoring Report (Ref [12])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Repair soil cracking along contours in Area B (transect 3).	Cracking occurred in 2018; repair works undertaken in 2018.	No – not required
2019 Rehabilitation Monitoring Report (Ref [13])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
2020 Rehabilitation Monitoring Report (Ref [14])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes

The PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix C**) documented the following findings for Area B and C (transects 1, 2 and 3):

- Rehabilitated pasture surfaces in the three (3) transect areas support living groundcover of greater than 90%.
- Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.
- Target weed presence comprises African lovegrass at <10% of the pasture sward.

Comparative photographs are presented in **Appendix C**.

7.1.6 AREA 8 REHABILITATION PERFORMANCE

Area 8 is a pasture rehabilitation area located in the south-eastern area of PDM, immediately south of Area B. The location of Area 8 is shown in **Plan 4**, **Appendix A**. The vegetation communities prior to mining include a mixture of cleared land, pasture, pines and eucalyptus. Seeding of Area 8 (10 ha) commenced in 2008, with a pasture mixture known as 'Coxs River Mix'.

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [2]) indicated that rehabilitation has been successfully completed in Area 8 and all completion criteria defined in the PDM MOP (Ref [3]) have been met.

Historical rehabilitation activities undertaken in Area 8 are presented in **Table 7-5**, along with the actions recommended in 2014 (Ref [7]) for improved rehabilitation and recommendations from the 2016 – 2020 annual rehabilitation surveys. Rehabilitation activities undertaken within the reporting period are also presented in **Table 7-5**.

Table 7-5 *Recommended and Completed Rehabilitation Actions in Area 8*

Recommended Rehabilitation Actions – Area 8		Actions Completed (2014 to 2020)	Undertaken in 2021
SLR Soil Assessment. Report, 2014 (Ref [7])	Control of African Lovegrass prior to pasture establishment works.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Ripping with a plough to create furrows, followed by application of pasture seed mix.	Furrows created along poorly vegetated areas followed by direct seeding.	No – not required
	Application of Muriate of Potash (0.25tonnes/ha) and Di-ammonium phosphate 0.20 tonnes/ha).	MAP and DAP applied at recommended rates.	No – not required.
	Application of mushroom compost, lime & gypsum (10:4:1 tonnes/ha).	Fertiliser and compost applied at recommended rates.	No – not required.
2014 Rehabilitation Monitoring Report (Ref [8])	Treat surface soil erosion on slopes via placement of cut vegetation or rocks in erosion channels.	Drainage lines re-shaped with rock placement in erosion channels.	No, not required
	Re-sow exposed surfaces with fast-growing groundcover herbs and grasses.	Exposed areas re-sown with pasture seed mix.	No – not required
	Install nesting boxes in close proximity treed rehabilitation area.	Installation will be undertaken when the native tree species are of a suitable size to support the nesting boxes.	No – trees unable to support boxes.
2015 Rehabilitation Monitoring Report (Ref [9])	Rip along contours of poorly established pasture rehabilitation areas and re-sow pasture mix and fertiliser. Cover with a mixture of mushroom compost, lime and gypsum as per the recommendations (Ref [7]).	Furrows created over the land, pasture seed mix applied, followed by fertiliser and compost.	No – not required.
	Increase and maintain groundcover in pasture rehabilitation Areas B and C and in Area 8 to at least 95%.	Application of fertiliser and compost at recommended rates.	No – not required
2016 Rehabilitation Monitoring Report (Ref [10])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes
	Continue to monitor pest animal numbers.	Pest and animal monitoring not required to be undertaken.	No – not required
2017 – 2020 Rehab Monitoring Reports (Ref [11-14])	Continue to spot spray African Lovegrass outbreaks.	Weed spraying as per Weed Management Schedule (**Section 5.7**).	Yes

The PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix D**) indicates that transect 4 had greater than 90% of total living cover consistent with the previous year. There was a slight decrease in bare ground. African lovegrass was noted to comprise <10% of the pasture sward.

Comparative photographs are presented in **Appendix D**.

7.1.7 ADDITIONAL REHABILITATION MAINTENANCE WORKS

There were no additional rehabilitation or maintenance works undertaken or required to be undertaken during the reporting period.

7.1.8 RENOVATION/REMOVAL OF BUILDINGS

A hired demountable was removed in July 2021 and four (4) work shop containers owned by contractor were also removed from PDM during the reporting period

7.1.9 REHABILITATION FORMAL SIGN OFF

There were no areas of rehabilitation which acquired formal sign of from the Resources Regulator during the reporting period.

7.1.10 REHABILITATION TRIALS AND RESEARCH

There were no rehabilitation trials or research undertaken during the reporting period.

7.1.11 THREATS TO REHABILITATION SUCCESS

Significant threats to rehabilitation at PDM have been identified in the PDM MOP (Ref [3]). These threats and mitigation measures have been reproduced in **Table 7-6**. PDM successfully maintained the mitigation and management measures during the 2021 reporting period.

Table 7-6 *Threats to Rehabilitation Success*

Secondary Domains (Post Mining Land Use)	Potential Threat(s)	Mitigation & Management Measures
Infrastructure (A)	Engineering design failure	Any infrastructure remaining in place post mining would be inspected and approved by a suitably qualified person (if required) and agreed by relevant stakeholders.
Water Management Structure (B)	Water damage (erosion, flooding etc.)	Infrastructure and water management structures would be constructed in accordance with relevant guidelines and to ensure erosion and damage from floods is minimised.
Rehabilitation - Pasture (C) Rehabilitation - Native Forest (D) Rehabilitation – Pine Plantation (E)	Adverse soil chemistry	Soil testing and amelioration
	Erosion	Design to relevant guidelines, regular maintenance as required
	Seed germination failure	Seed treatment, soil amelioration, annual monitoring
	Species diversity and density	Annual monitoring and supplementary tree planting and seeding as required
	Weed presence	Inspections and weed control (herbicide application).
	Drought	Drought tolerant species selection, timing seeding to coincide with appropriate soil moisture.
	Grazing	Restrict grazing particularly in early years to rehabilitated areas
	Bushfire	Maintain low fuel loads, emergency preparedness and response

Bushfire was the dominant threat during late 2019 and early January 2020; the PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix D**) indicated that fuel loads within all rehabilitation areas were low and fuel hazard mitigation activities were not required. Details regarding firefighting access tracks, fire breaks and emergency response measures are detailed in **Section 5.14**.

7.2 ACTIONS FOR THE 2022 REPORTING PERIOD

Maintenance and rehabilitation activities recommended in the PDM MOP (Ref [3]) will continue on areas not directly impacted by future mining operations throughout 2022 (sediment fences, fertilising, re-seeding, weed control etc), where required and as conditions allow.

As per the recommendations made in the PDM 2021 Rehabilitation Monitoring Report (Ref [4], **Appendix D**), further weed spraying is proposed in addition to the installation of nesting boxes once the treed area contains adequate structure to support nesting birds. It is noted that due to the bushfires it is not considered likely that nesting boxes will be able to be installed during the 2022 period.

The 2018 SLR Rehabilitation and Completion Assessment report (Ref [2]) confirms that rehabilitation has been successfully completed in Areas B, C and 8 and all completion criteria defined in the PDM MOP (Ref [3]) has been successfully achieved. As such PDM intends to seek to relinquish rehabilitation responsibilities of Areas B, C and 8 during the 2022 reporting period.

8 COMMUNITY RELATIONS

8.1 ENVIRONMENTAL COMPLAINTS

All stakeholder and community complaints, enquiries and notifications regarding PDM are documented, with appropriate actions taken as soon as possible to determine the likely cause of the incident and all possible corrective actions to resolve the problem and prevent its recurrence. Complaints, enquiries and notifications are recorded and retained at the site office in addition to monthly publication on the EnergyAustralia website. During the 2021 reporting period, there were no complaints received, enquiries or notifications received as summarised by **Table 8-1**.

Table 8-1 *Community Complaints, Incidents and Notifications*

Incident Type	Incidents Received 2021
Noise	0
Air Quality	0
Blasting	0
Traffic	0
Water	0
Other	0
Total Complaints Received	**0**
Enquiries/Notifications Received	**0**

Details of the complaints, enquiries and notifications received during the previous 5 years (2016 – 2020) are presented in **Table 8-2**.

Table 8-2 *Historical Community Complaints, Incidents and Notifications*

Complainant[a]	Item No.	Date Received	Nature (Enquiry / Notification or Complaint)	Issue(s)	Comment on nature of complaint in relation to approved parametric limits	Corrective Action Required? Y/N	Response / Action	
							Y/N	Date Completed
7	001-18	22/05/18	Notification	White residue observed within Neubecks[b] Creek	An inspection of Neubecks[b] Creek at Pine Dale Mine conducted on the 22nd May 2018. White residue was observed to have originated upstream outside of the Pine Dale Mine boundary. Investigation completed; white residue considered to be an ionic compound (salt).	Yes	Yes	22/06/18
7	002-17	26/05/17	Notification	Operations adjacent to Private Property	Notification from neighbouring resident that he did not want remediation activities occurring near his residential boundary.	Yes	Yes	10/11/17
6	001-17	28/02/17	Complaint	CCC Minutes on Energy Australia Website	Minutes of December 2015 CCC meeting were not able to be viewed on the website due to a problem with the link. The June and December 2016 minutes and the December 2015 minutes (when visible) were still shown in Draft format.	Yes	Yes	1/03/17
7	002-16	23/12/16	Complaint	Operations adjacent to Private Property	Energy Australia received an email from the office of the Member for Bathurst regarding a complaint they had received from a neighbouring PDM resident regarding rehabilitation activities undertaken at the mine during December within close proximity to the residential boundary without prior notification to the resident.	No	Yes	12/01/17

[a] complainants are referred to with a number to maintain anonymity

[b] Now known as Wangcol Creek

8.2 COMMUNITY

8.2.1 COMMUNITY CONSULTIVE COMMITTEE

PDM Community Consultative Committee commenced in January 2012 and comprises representatives from the local community and PDM. During 2017, the DPIE (formerly DPE) approved an amalgamation of the PDM CCC and the regional EnergyAustralia CCC into one. The amalgamated CCC meets three (3) times per year to discuss matters relating to PDM and meeting minutes are made publicly available via the EnergyAustralia website. During the 2021 reporting period the CCC meetings were held on 1 March, 17 August, 18 October and 6 December 2021.

8.2.2 WEBSITE INFORMATION

A website has been established to keep the broader community up to date with recent activities at the Pine Dale Mine in accordance with Schedule 5, Condition 10 of the PA 10_0041; and EPL 4911. Copies of the following documents are made publicly available on the EnergyAustralia Website:

- EPL 4911.
- Environmental Assessment.
- Project Approval 10_0041.
- Environment Protection and Biodiversity Conservation Act 1999 Referral Decision 2011/6016.
- The Care and Maintenance Mining Operation Plan.
- Environmental Management Plans for Pine Dale Mine.
- AEMR Reports / Annual Review.
- Pollution Incident Response Management Plan.
- Independent Environmental Audits (refer **Section 9**).
- Community Consultative Committee minutes.
- Community Complaints (Enquiries & Notifications).
- Blasting information.
- Monthly Environmental Performance reports.

8.2.3 SOCIAL AND ECONOMIC CONTRIBUTIONS

PDM has contributed to the economy of the district and NSW by providing direct employment and indirect employment through the purchase of services and materials from regional suppliers. Coal supplies to Mount Piper Power Station provide competitively priced energy for the NSW electricity market which ultimately flows through to provide economic benefit to electricity consumers.

Additionally, EnergyAustralia undertakes a community grants programme which provides funding for local initiatives that will deliver sustainable benefits for the Lithgow region. The two (2) priority areas for funding are education and social inclusion. Details of the community grants programme is provided on the EnergyAustralia website.

9 INDEPENDENT ENVIRONMENTAL AUDIT

There was no requirement within the Project Approval 10_0041 for an Independent Environmental Audit (IEA) to be conducted at PDM while PDM is in care and maintenance: as such none was undertaken during the 2021 reporting period.

The last IEA was undertaken in August 2014. Copies of the audit report, the audit Action Plan and the auditor's recommendations and proposed actions by PDM are provided on the company website.

As per the conditions of Project Approval 10_0041, no further IEA are required at PDM providing the care and maintenance status is maintained.

10 INCIDENTS AND NON-COMPLIANCES

During the 2021 reporting period, there was one instance of non-compliance in relation to the requirements of the Groundwater Management Plan and one non-compliance relating to the loss of data from the onsite meteorological station.

There were no reportable incidents, official cautions, warning letters, penalty notices or prosecution proceedings by any regulatory body during the reporting period.

There were several exceedances of the water quality triggers for surface water and groundwater during the reporting period. As discussed in **Section 6.2** exceedances of surface water triggers are considered to be due to upstream influences in Wangcol Creek and Coxs River outside of the control of PDM. As discussed in **Section 6.5.2** intermittent exceedances of the groundwater trigger values are not considered to be due to activities undertaken by PDM, rather external factors such as climate.

11 PROPOSED ACTIVITIES IN THE NEXT REPORTING PERIOD

The activities proposed for the 2022 reporting period are consistent with the PDM MOP (Ref [3]). Rehabilitation activities set out in the PDM MOP will be transitioned across into a new Rehabilitation Management Plan inclusive of Rehabilitation Objectives, Completion Criteria and Final Landform Plan. These will remain substantially consistent with that already set out in the PDM MOP. General maintenance will be undertaken at the site in addition to rehabilitation activities including weed management and fertilising as required.

11.1 MINING

All recoverable coal within the approved mining area was extracted during early 2014. No mining activities are proposed during 2022.

11.2 FUTURE MINING DEVELOPMENT

Subject to market conditions, in order to maintain supply of commercial coal to Mount Piper Power Station, Enhance Place may consider lodging an application with the DPIE to extend the existing mining operations. This will be subject to ongoing feasibility assessments associated with coal extraction within the existing authorisations.

11.3 DOCUMENT REVIEWS

The Pine Dale Mine Water Management Plan is intended to be reviewed during the 2022 reporting period.

REFERENCES

[1] NSW Government, *Annual Review Guideline,* October 2015.

[2] SLR, *Pine Dale Mine Rehabilitation Completion Assessment*, SLR ref 630.12362-R01, 2018.

[3] EnergyAustralia, *Pine Dale Mine Care and Maintenance Mining Operations Plan,* February 2019.

[4] FirstField Environmental, *Pine Dale Mine 2021 Rehabilitation Monitoring Report*, January 2022.

[5] GHD, *Pine Dale Groundwater and Surface Water Investigation Trigger Value Review Report*, September 2018.

[6] CSIRO, Ecosystem Function Analysis – Ephemeral Stream Assessment Protocol.

[7] SLR, *Soil Assessment and Recommendations for Rehabilitated Areas: Pine Dale Mine and Enhance Place,* November 2014.

[8] FirstField Environmental, *Pine Dale Mine 2014 Rehabilitation Monitoring Report*, June 2014.

[9] FirstField Environmental, *Pine Dale Mine 2015 Rehabilitation Monitoring Report*, November 2015.

[10] FirstField Environmental, *Pine Dale Mine 2016 Rehabilitation Monitoring Report*, November 2016.

[11] FirstField Environmental, *Pine Dale Mine 2017 Rehabilitation Monitoring Report*, October 2017.

[12] FirstField Environmental, *Pine Dale Mine 2018 Rehabilitation Monitoring Report*, October 2018.

[13] FirstField Environmental, *Pine Dale Mine 2019 Rehabilitation Monitoring Report*, October 2019.

[14] FirstField Environmental, *Pine Dale Mine 2020 Rehabilitation Monitoring Report*, November 2020.

Appendix A

Site Plans

Locality Plan (NSW)

LEGEND

Pine Dale Mine

Mine Lease Numbers

1569 1664

1578 1637

Note: Aerial taken from ArcGis Base Map, September 10 2018
Coordinate System MGA Zone 56

EnergyAustralia LIGHT THE WAY

PINE DALE MINE
REGIONAL LOCALITY PLAN

PLAN: 1

DRAWN BY : F.Brooker

SCALE: 1:24,000 (A3)

DATE: 17/02/2022

EL7621

EL7621

ML 6

ML 5

ML 19

Pt Por.55

POR.53

POR.
15

LOT 1
D.P.597541

MT. PIPER

49

47

44

ANGUS

PLACE

POR.41

POR.38

DP400022

ML1664

ML 1569

BEN BULLEN
STATE FOREST

POR.39

Pt. Pt. 291

BEN BULLEN
STATE FOREST

POR.35

ML 1578

POR.29

ML 29

BEN BULLEN
STATE FOREST

BEN BULLEN
STATE FOREST

ML 1569

POR.37

ML1578

POR.38

30

31

HAUL ROAD

CASTLEREAGH

35

34

Pt. Por.20

33

POR.27

POR.21

25

23

20

24

23

21

26

27

29

HIGHWAY

WALLERAWANG COLLIERY
RAILWAY

PML 11

ML1637

LEGEND

Limit of underground workings

ML1569

ML1578

ML1637

ML1664

EL7621

NOTE: Drawing adapted from plan supplied by
Craven, Ellistion & Hayes (Lithgow) Pty Ltd
Drawing No.3-1656
Dated 6/7/2011

N

0 200 300 400 500

metres

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE
MINING AND EXPLORATION LEASES

PLAN:
2

DRAWN BY : F.Brooker

SCALE : 1 : 2000 (A3)

DATE : 17/02/2022

CDT-DWG-A3H-001/1

LEGEND

- Noise monitoring location
- Depositional dust monitoring location
- Groundwater monitoring location
- Surface water monitoring location
- Historic High Volume Air Sampling Location
- Meteorological monitoring location (up until 10 November 2021)
- Meteorological monitoring location (from 10 November 2021)

Note: Aerial taken from ArcGis Base Map, September 10 2018
Coordinate System MGA Zone 56

0 175 350 700 1,050 1,400
metres

N

EnergyAustralia LIGHT THE WAY

PINE DALE MINE ENVIRONMENTAL MONITORING LOCATION PLAN

PLAN: 3a

DRAWN BY : F. Brooker

SCALE: 1:24,000 (A3)

DATE: 18/02/2022

LEGEND

- Monitoring location
- Licence discharge point location
- Clean water diversion location

Note: Aerial taken from ArcGis Base Map,
September 10 2018
Coordinate System MGA Zone 56

0 37.5 75 150 225 300
metres

N

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE ENVIRONMENTAL MONITORING CHANNEL STABILITY, STREAM AND VEGETATIVE HEALTH MONITORING SITES

PLAN: 3b

DRAWN BY : F. Brooker

SCALE: 1:5,000 (A3)

DATE: 17/02/2022

LEGEND

- Yarraboldy Extension Area (21.9ha)
- Rehabilitation Area - Native Forest (7.1ha)
- Rehabilitation Area - Pasture (25.4ha)
- Dams
- Bund Wall
- Road

NOTE: Drawing adapted from plan supplied by
Craven, Ellistion & Hayes (Lithgow) Pty Ltd
Drawing No. PINE AEMR13
Dated 31/12/2013

0 100 200 300 400 500
metres

N

EnergyAustralia
LIGHT THE WAY

PINE DALE MINE
REHABILITATION DOMAINS
DECEMBER 2018

PLAN: 4

DRAWN BY : F. Brooker

SCALE: 1 : 8000 (A3)

DATE: 24/01/2022

CDT-DWG-A3H-001/1

Appendix B

Environmental Monitoring Summary Report

ANNUAL REVIEW ENVIRONMENTAL SUMMARY 2021

PINE DALE MINE

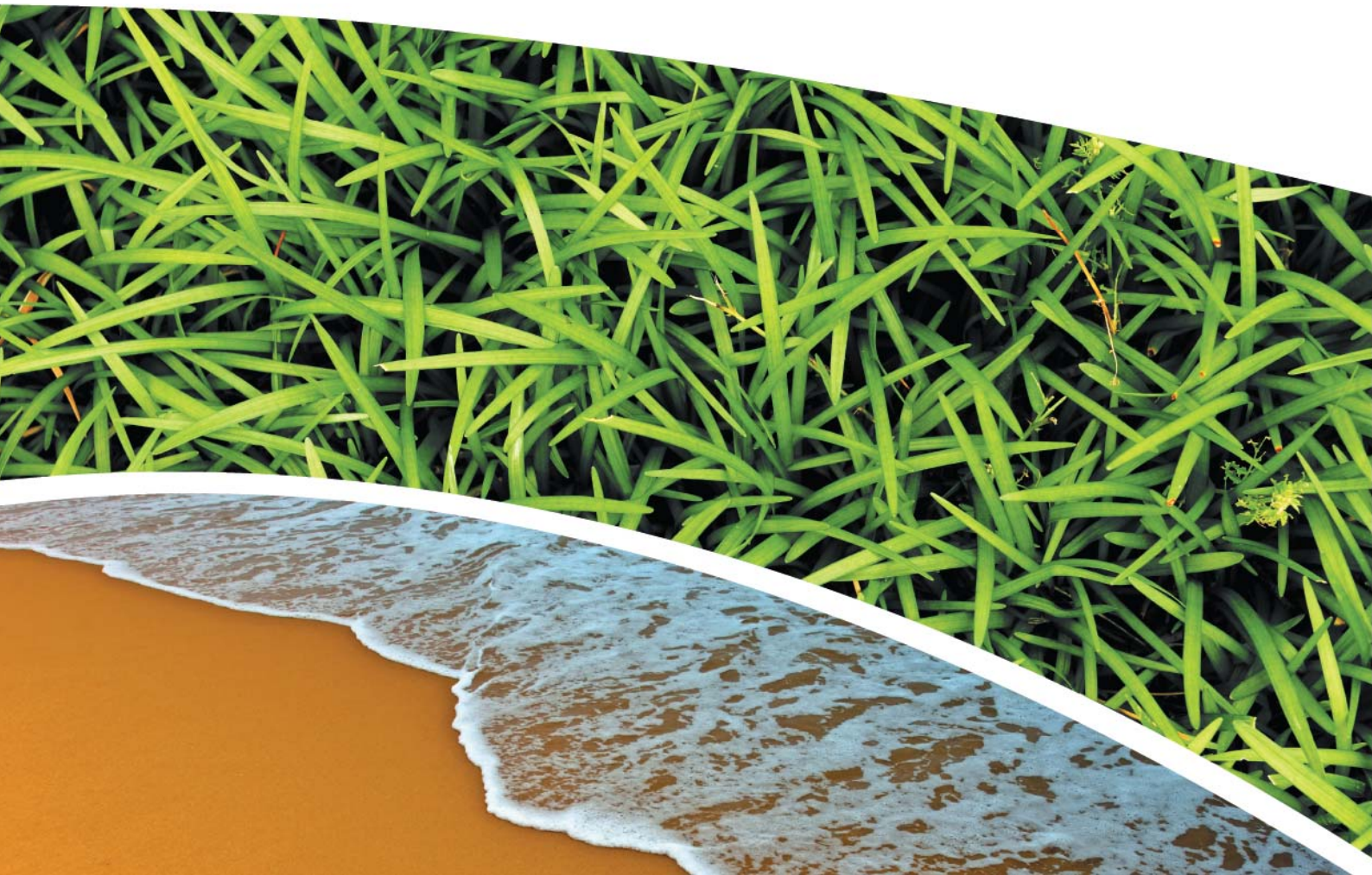
Prepared for ENHANCE PLACE PTY Limited

Prepared by RCA Australia

RCA ref 6880-1869/1 APPENDIX B

FEBRUARY 2022

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL



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DOCUMENT STATUS						
Rev No	**Comment**	**Author**	**Reviewer**	**Approved for Issue (Project Manager)**		
				Name	**Signature**	**Date**
/0	Final provided as Appendix B to Pine Dale Mine Annual Review 2021 report	F Brooker	K. Davies	F Brooker		18.02.2022
/1	Minor revisions to appendices	F Brooker	K. Davies	F Brooker		18.02/22

DOCUMENT DISTRIBUTION				
Rev No	**Copies**	**Format**	**Issued to**	**Date**
/0	1	Electronic (email)	Pine Dale Mine – Graham Goodwin – graham.goodwin2@energyaustralia.com.au	18.02.2022
/0	1	Electronic (email)	Energy Australia – Mark Frewin mark.frewin@energyaustralia.com.au	18.02.2022
/0	1	Electronic report	RCA – job archive	18.02.2022
/1	1	Electronic (email)	Pine Dale Mine – Graham Goodwin – graham.goodwin2@energyaustralia.com.au	18.02.2022
/1	1	Electronic (email)	Energy Australia – Mark Frewin mark.frewin@energyaustralia.com.au	18.02.2022
/1	1	Electronic report	RCA – job archive	18.02.2022

RCA ref 6880-1869/1 Appendix B

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
Engineering Geology
Environmental Engineering
Hydrogeology
Construction Materials Testing
Environmental Monitoring
Noise & Vibration
Occupational Hygiene

18 February 2022

Enhance Place Pty Limited
PO Box 202
WALLERAWANG NSW 2845

Attention: Mr Graham Goodwin

ANNUAL REVIEW ENVIRONMENTAL SUMMARY 2021
COMPILED FOR PINE DALE MINE
JANUARY – DECEMBER 2021

EXECUTIVE SUMMARY

Pine Dale Mine achieved an acceptable standard of environmental performance during the 2021 reporting period, as evidenced by the following:

- Air quality monitoring results recorded during the reporting period for depositional dust were below the Project Approval (PA 10_0041) and Environment Protection Licence limits in Blackmans Flat and other privately owned properties adjacent to the Mining Leases.
- There were no noise exceedances from mining activities recorded at privately owned properties recorded during the reporting period.
- There were no surface water discharge events during the reporting period; and monitoring was conducted in accordance with EPL 4911 and the site Water Management Plan.
- Surface water and groundwater quality were assessed against the respective trigger values that showed varied results which was generally consistent with previous years.
- There were no community complaints throughout the 2021 reporting period.

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Attachments

ATTACHMENT 1

1 INTRODUCTION

The following report provides a summary of monthly environmental monitoring data for Pine Dale Mine (PDM) for the period January – December 2021. The 2021 environmental summary data includes:

- Depositional dust.
- Surface water.
- Groundwater.
- Channel stability and stream health monitoring.
- Noise monitoring.

This report satisfies the requirements to monitor environmental parameters as presented in the PDM Environment Protection Licence (EPL 4911, Ref [1]) and Project Approval (PA 10_0041, (Ref [2]). Monitoring is also undertaken in general accordance with the PDM: Water Management Plan (Ref [3]); Air Quality and Greenhouse Gas Management Plan (Ref [4]; Purple Copper Butterfly Monitoring Programme (Ref [5]); and Noise Management Plan (Ref [6]).

A compliance assessment of each environmental monitoring parameter is made in accordance with the relevant assessment criteria outlined in EPL 4911 (Ref [1]), Project Approval (Ref [2]) and the PDM Management Plans (Ref [3] to [6]).

2 AIR QUALITY MONITORING

2.1 ASSESSMENT CRITERIA

The PDM Project Approval (Schedule 3 Condition 18, Ref [2]) and Air Quality and Greenhouse Gas Management Plan (Ref [4]) stipulates that dust emissions generated by the project must not cause additional exceedances of the long-term impact assessment criteria listed in **Table 1**.

Table 1 *Air Quality Assessment Criteria*

Pollutant	Average Period	Assessment Criteria	
[c] Deposited dust	Annual	**Maximum increase in deposited dust level**	**Maximum total deposited dust level**
		[b] 2 g/m^2.month	[a] 4g/m^2.month

[a] Total impact (incremental increase in concentrations due to the project plus background concentrations due to other sources)

[b] Incremental impact (incremental increase in concentrations due to the project on its own);

[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS3580.10.1 (Ref [7])

Criteria excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed to by the Director-General in consultation with Department of Planning, Industry and Environment (DPIE).

2.2 AIR MONITORING RESULTS

Depositional dust monitoring is undertaken at nine (9) locations across PDM.

A total of five (5) depositional dust gauges are monitored in accordance with EPL 4911 (Ref [1]) and the Air Quality and Greenhouse Gas Management Plan (Ref [4]). One (1) dust gauge is located within the settlement of Blackmans Flat (gauge D1) and one (1) is located to the east of Blackmans Flat (gauge D3). The remaining three (3) gauges (D4, D5 & D6) were installed in November 2006 to coincide with the commencement of mining in Areas B & C. Gauge D4 is located to the north of View St, Blackmans Flat. Gauges D5 & D6 are located to the east of Mining Areas B & C, along Wolgan Road, Lidsdale (refer **Drawing 1**, **Appendix 1**).

The remaining four (4) depositional dust gauges are monitored in accordance with the Purple Copper Butterfly Monitoring Programme (Ref [5]) assessing the level of dust present at each location to aid in the study of the Purple Copper Butterfly population. These gauges are: PCB1, PCB2, PCB3 and PCB7. Three (3) of the dust gauges are located within the major butterfly population to the east of the mine workings in the Yarraboldy Extension (PCB1, PCB2 and PCB3); whilst the fourth dust gauge (PCB7) is located to the south west of the butterfly habitat area (refer **Drawing 1**, **Appendix 1**).

Depositional dust summary results for the period January – December 2021 are shown in **Table 2** to **Table 10**. Graphical presentations are shown in **Figures 1** and **2**. A discussion of results is presented in **Section 2.3**.

Table 2 *Depositional Dust Data Summary Dust Gauge D1 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.6	0.1	0.5
Feb-21	0.5	<0.1	0.5
Mar-21	1.2	0.7	0.5
Apr-21	0.6	<0.1	0.6
May-21	1.0	0.4	0.6
Jun-21	0.3	<0.1	0.3
Jul-21	0.2	<0.1	0.2
Aug-21	0.4	0.2	0.2
Sep-21	0.1	<0.1	0.1
Oct-21	0.4	<0.1	0.4
Nov-21	<0.1	<0.1	<0.1
Dec-21	0.3	<0.1	0.3
Annual Average	*0.5*	*0.2*	*0.4*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 3 *Depositional Dust Data Summary Dust Gauge D3 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	<0.1	<0.1	<0.1
Feb-21	0.4	0.1	0.3
Mar-21	0.6	0.4	0.2
Apr-21	0.5	0.1	0.4
May-21	1.1	0.8	0.3
Jun-21	0.9	0.5	0.4
Jul-21	0.3	0.2	0.1
Aug-21	0.5	0.3	0.2
Sep-21	0.4	0.2	0.2
Oct-21	0.8	0.3	0.5
Nov-21	0.3	0.1	0.2
Dec-21	6.6	0.1	6.5
Annual Average	*1.0*	*0.3*	*0.8*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Refer **Section 2.3** for discussion regarding December sampling result

Table 4 *Depositional Dust Data Summary Gauge D4 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.1	<0.1	0.1
Feb-21	0.3	0.1	0.2
Mar-21	0.2	<0.1	0.2
Apr-21	0.3	<0.1	0.3
May-21	0.8	0.4	0.4
Jun-21	0.1	<0.1	0.1
Jul-21	0.2	<0.1	0.2
Aug-21	0.1	<0.1	0.1
Sep-21	0.4	0.3	0.1
Oct-21	0.5	<0.1	0.5
Nov-21	0.1	<0.1	0.1
Dec-21	0.1	0.1	<0.1
Annual Average	*0.3*	*0.1*	*0.2*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 5 *Depositional Dust Data Summary Gauge D5 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	<0.1	<0.1	<0.1
Feb-21	0.3	0.1	0.2
Mar-21	0.1	0.1	<0.1
Apr-21	0.2	<0.1	0.2
May-21	0.9	0.3	0.6
Jun-21	0.2	<0.1	0.2
Jul-21	0.2	<0.1	0.2
Aug-21	0.2	<0.1	0.2
Sep-21	0.6	0.1	0.5
Oct-21	1.3	0.7	0.6
Nov-21	0.4	0.1	0.3
Dec-21	0.1	<0.1	0.1
Annual Average	*0.4*	*0.1*	*0.3*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 6 *Depositional Dust Data Summary Gauge D6 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.1	<0.1	0.1
Feb-21	0.5	0.2	0.3
Mar-21	0.2	0.1	0.1
Apr-21	0.5	0.1	0.4
May-21	0.4	0.1	0.3
Jun-21	0.2	<0.1	0.2
Jul-21	0.1	<0.1	0.1
Aug-21	0.1	0.1	<0.1
Sep-21	0.2	<0.1	0.2
Oct-21	2.6	2.1	0.5
Nov-21	0.2	<0.1	0.2
Dec-21	1.8	1.1	0.7
Annual Average	*0.6*	*0.3*	*0.3*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 7 *Depositional Dust Data Summary Gauge PCB1 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.4	<0.1	0.4
Feb-21	0.7	<0.1	0.7
Mar-21	0.6	0.2	0.4
Apr-21	0.6	0.1	0.5
May-21	0.9	0.3	0.6
Jun-21	0.3	<0.1	0.3
Jul-21	0.4	<0.1	0.4
Aug-21	0.7	0.1	0.6
Sep-21	0.4	<0.1	0.4
Oct-21	0.9	0.3	0.6
Nov-21	0.7	0.2	0.5
Dec-21	1.8	0.8	1.0
Annual Average	*0.7*	*0.2*	*0.5*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 8 *Depositional Dust Data Summary Gauge PCB2 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.6	0.1	0.5
Feb-21	0.3	<0.1	0.3
Mar-21	0.6	0.2	0.4
Apr-21	0.1	<0.1	0.1
May-21	0.3	0.1	0.2
Jun-21	0.1	<0.1	0.1
Jul-21	0.4	<0.1	0.4
Aug-21	0.4	<0.1	0.4
Sep-21	0.2	<0.1	0.2
Oct-21	0.5	<0.1	0.5
Nov-21	0.4	0.1	0.3
Dec-21	0.4	0.1	0.3
Annual Average	*0.4*	*0.1*	*0.3*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 9 *Depositional Dust Data Summary Gauge PCB3 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.1	<0.1	0.1
Feb-21	0.4	<0.1	0.4
Mar-21	0.2	<0.1	0.2
Apr-21	0.2	<0.1	0.2
May-21	0.7	0.2	0.5
Jun-21	0.1	<0.1	0.1
Jul-21	0.9	0.1	0.8
Aug-21	0.3	<0.1	0.3
Sep-21	0.2	<0.1	0.2
Oct-21	0.6	0.1	0.5
Nov-21	0.2	<0.1	0.2
Dec-21	0.4	<0.1	0.3
Annual Average	*0.4*	*0.1*	*0.3*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

Table 10 *Depositional Dust Data Summary Gauge PCB7 January – December 2021*

Month	Insoluble Solids (g/m^2.month)	Ash Residue (g/m^2.month)	Combustible Matter (g/m^2.month)
Jan-21	0.4	0.2	0.2
Feb-21	0.3	<0.1	0.3
Mar-21	0.4	0.1	0.3
Apr-21	0.2	<0.1	0.2
May-21	0.5	0.2	0.3
Jun-21	0.2	0.1	0.1
Jul-21	0.1	0.1	0.1
Aug-21	0.1	<0.1	0.1
Sep-21	0.1	<0.1	0.1
Oct-21	0.1	<0.1	0.1
Nov-21	0.2	<0.1	0.2
Dec-21	0.1	<0.1	0.1
Annual Average	*0.2*	*0.1*	*0.2*

Where results are less than the detection limit, half of the detection limit has been used in statistical calculations.

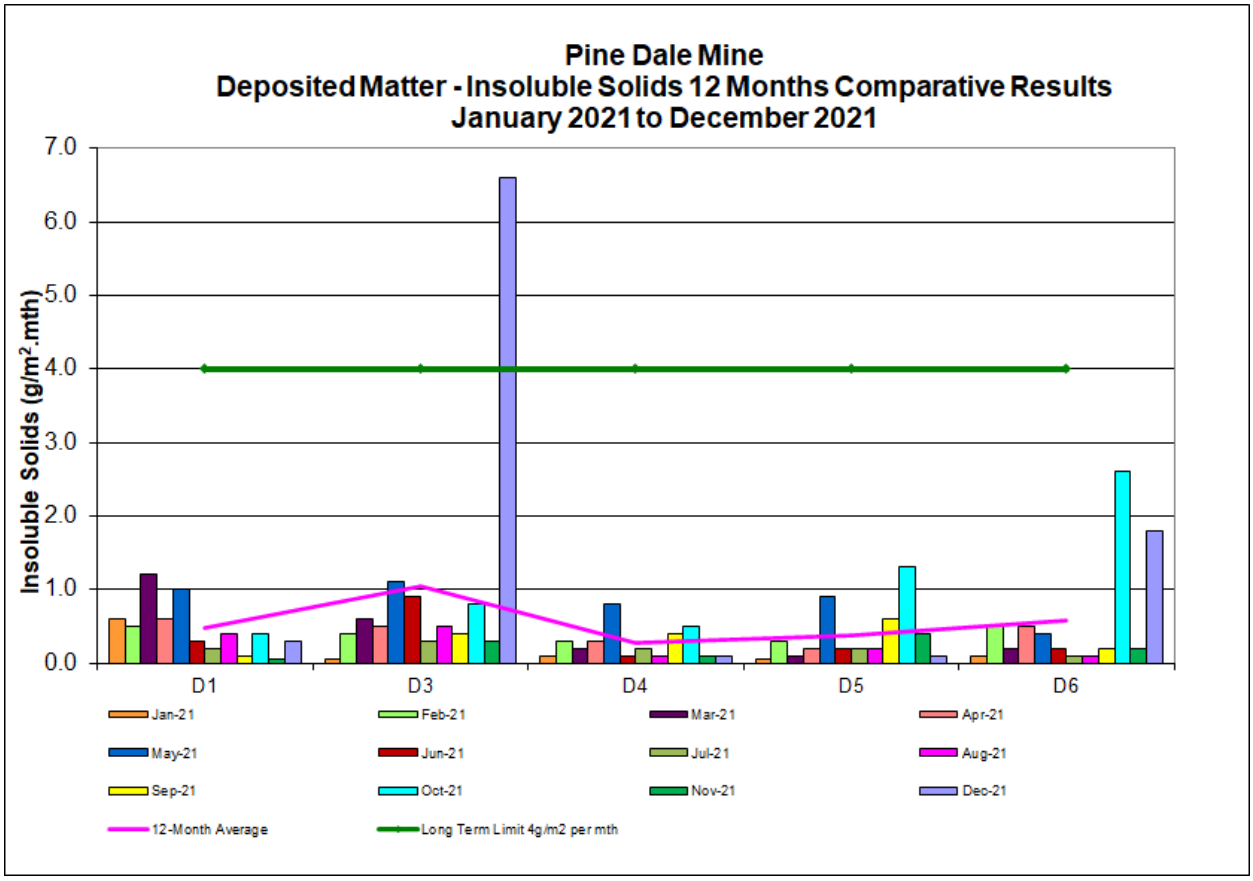

Figure 1 *Depositional Dust Results - Gauges D1, D3 to D6 (refer **Section 2.3** for D3 discussion)*

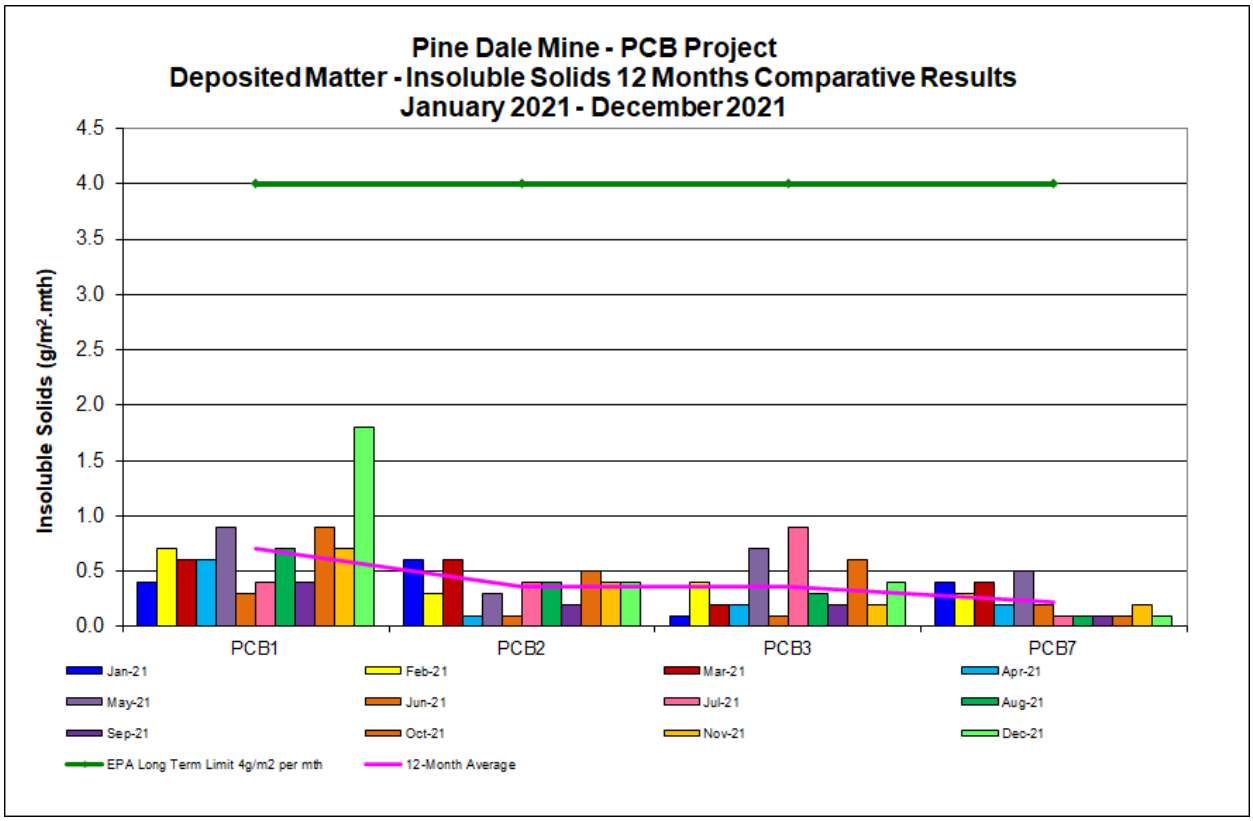

Figure 2 *Depositional Dust Results – Gauges PCB1 to PCB3 & PCB7*

2.3 REVIEW & INTERPRETATION OF AIR MONITORING RESULTS

The average insoluble solids within depositional dust results for the period January – December 2021 range from 0.3g/m^2 per month to 1.0g/m^2 per month for dust gauges D1 and D3 to D6. These results are well below the long-term assessment criteria detailed in **Table 1**.

The highest result is for the December period at D3. Consideration of the results, refer **Table 3**, indicates that the majority (98.5%) of the insoluble solids concentrations are due to combustible matter and may not be related to dust particles. This is supported by the field notes which stated the presence of insects and organic matter. It is further noted that were no reported physical activities undertaken at Pine Dale Mine which may have generated high dust levels.

The average insoluble solids within depositional dust results for the period January – December 2021 range from 0.2g/m^2 per month to 1.1g/m^2 per month for dust gauges PCB1, PCB2, PCB3 and PCB7. These results are well below the long-term assessment criteria detailed in **Table** 1, noting that as the dust gauges are located in a bushland setting under the canopy of tall trees and therefore do not conform to the siting requirements of AS/NZS 3580.1.1 (Ref [8]) the criteria are not strictly applicable.

A review of historical data captured over the previous five (5) years including the 2021 monitoring period indicate there were no instances where the dust gauges showed results which were greater than the allowable maximum annual average increase of 2g/m^2 per month deposited matter **Table 1**.

3 GROUNDWATER QUALITY MONITORING

Groundwater monitoring is undertaken at PDM to monitor for any potential impacts on local groundwater due to past mining operations. The intended monitoring scope in accordance with the Water Management Plan (Ref [3]) comprises:

- Four (4) locations within the mine site; seven (7) locations surrounding the Yarraboldy Extension area (four (4) sampling wells and three (3) vibrating wire piezometer wells).
- Two (2) locations at the former Enhance Place Mine site.

Groundwater monitoring is not a requirement of EPL 4911 (refer **Drawing 1**, **Appendix 1**).

It is noted that one of the on-site locations is an underground opening known as The Bong: groundwater from The Bong was historically pumped into the Water Cart Dam at PDM and the sample collected from the Dam. During care and maintenance activities water is no longer pumped into the Water Cart Dam and therefore water quality from the Water Cart Dam is now considered to be representative of surface water runoff rather than groundwater quality from within the Old Wallerawang underground workings. Thus, any results reported in excess of the trigger values at the Bong are not considered indicative of impacts to groundwater.

The scope of sampling at the Yarraboldy bores has been reduced to a quarterly download of Bore B only following the Gospers Mountain bushfire during late 2019 / early 2020 as detailed in the 2020 Annual Review Environmental Summary Report.

3.1 GROUNDWATER ASSESSMENT CRITERIA

Site specific trigger values for standing water level (SWL) and water quality parameters pH and electrical conductivity were developed for PDM are stipulated in the Water Management Plan (Ref [3]) which is in accordance with Schedule 3, Condition 27(c) of the Project Approval (PA 10_0041). The groundwater trigger values (Ref [3]) are shown in **Table 11**.

Table 11 *Groundwater Trigger Values*

Bore	pH (range)	Electrical Conductivity (µS/cm)	SWL Trigger (m, AHD)
P6	6.2 - 8.0	1,180	887.90
P7	6.3 - 8.0	852	883.28
Old Shaft	6.3 - 8.0	908	888.46
The Bong (at SW location)	5.8 - 8.0	1,157	NA
EP DDH4/GW (Bore D)	6.8 - 8.0	608	940.61
EP DDH7/GW (Bore A)	6.5 - 8.0	326	954.40
EP PDH1/GW Bore C)	6.9 - 8.0	490	889.25
EP PDH7/GW (Bore E)	5.5 - 8.0	151	938.43
EP PDH3/GW (Enhance)	NA	NA	891.06
EP P H4/GW (Enhance)	NA	NA	890.95

NA – no trigger value required for these locations.

3.2 GROUNDWATER MONITORING DATA SUMMARY

Samples were collected from P6 and P7 each month during the January – December 2021 monitoring period.

Sampling from Old Shaft was discontinued after the January and February 2021 sampling rounds when an internal audit identified that the sampling posed a fall risk due to the requirement for an elevated position to collect samples and the absence of any formal attachment points for a harness required for working at heights.

Samples were collected from The Bong / Water Cart Dam on eleven (11) occasions during the January – December 2021 monitoring period: the sampling location was dry in June 2021.

Download of Yarraboldy Bore B was undertaken in February, May, August and November 2021.

The scope of sampling at the former Enhance Place Mine Site has not been able to be fulfilled since the February 2021 monitoring round: the landowner locked the gates (presumably as part of the process of selling the property) and access has not yet been granted by the new owners.

Groundwater summary results for the period January – December 2021 are shown in **Table 12** to **Table 17**. Graphical presentations of standing water levels are shown in **Figure 3** and **Figure 4**.

Table 12 *Groundwater Monitoring Bore P6 Results January - December 2021*

Location	Site Bore P6												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	06/01/21	05/02/21	09/03/21	08/04/21	06/05/21	01/06/21	01/07/21	02/08/21	02/09/21	05/10/21	22/11/21	06/12/21	
Time Sampled	6:40	6:45	7:29	7:39	12:30	15:00	15:25	15:00	16:14	16:05	9:25	16:28	
Standing Water Level (m)	23.47	23.08	23.41	22.87	23.02	23.29	23.56	23.71	23.99	23.94	22.31	22.82	
Standpipe Height (m)	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	
Relative Water Level (m)	22.81	22.42	22.75	22.21	22.36	22.63	22.90	23.05	23.33	23.28	21.65	22.16	
Water Level AHD (m)	894.14	894.53	894.20	894.74	894.59	894.32	894.05	893.90	893.62	893.67	895.30	894.79	**887.90#**
Temperature (°C)	16.4	16.9	14.6	15.9	15.5	14.7	14.5	14.2	16.3	14.5	15.0	16.0	
pH	6.11	6.33	5.99	6.12	6.31	6.11	6.00	6.63	6.04	6.21	6.70	6.53	**6.2 to 8.0***
Conductivity (µS/cm)	1670	1630	1590	1539	1580	1480	1440	1460	1280	1350	1260	1370	**1180**
Turbidity (NTU)	19	19	19	12	18	53	52	66	64	77	27	12	
Dissolved Oxygen (mg/L)	1.5	<1	6.2	2.5	6.4	6.5	4.2	2.6	2.0	3.2	1.9	2.1	
TSS (mg/L)	20.0	49.0	32.0	69.0	24.0	53.0	35.0	54.0	33.0	75.0	58.0	24.0	
Oil & Grease (mg/L)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	
Bicarbonate Alkalinity (mg/L)	104	112	68	94	98	103	<1	103	72	94	74	120	
Total Alkalinity (mg/L)	104	112	68	94	98	103	<1	103	72	94	74	120	
Sulphate (mg/L)	702	686	621	770	736	685	601	624	454	560	548	576	
Chloride (mg/L)	53	57	54	50	55	51	50	44	40	44	51	42	
Calcium (mg/L)	150	138	166	140	160	128	129	126	95	130	117	146	
Magnesium (mg/L)	72	68	70	66	70	60	57	58	44	54	53	59	
Sodium (mg/L)	84	79	80	75	79	67	60	60	50	57	57	59	
Potassium (mg/L)	22	19	22	21	22	21	19	20	16	23	20	21	
Cobalt (dissolved) (mg/L)	0.042	0.045	0.049	0.045	0.049	0.047	0.049	0.046	0.04	0.054	0.05	0.05	
Manganese (dissolved) (mg/L)	2.68	2.59	2.8	2.72	2.76	2.37	2.5	2.24	1.9	1.78	2.18	2.2	
Nickel (dissolved) (mg/L)	0.083	0.091	0.1	0.091	0.096	0.088	0.088	0.084	0.073	0.09	0.089	0.095	
Zinc (dissolved) (mg/L)	0.008	0.014	0.034	0.032	0.015	0.02	0.031	0.028	0.024	0.031	0.072	0.03	
Iron (dissolved) (mg/L)	38.2	39.4	35.9	37.9	40.1	37	31.4	28.4	11.3	17.8	18.1	26.5	

Shaded Cells - Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 13 *Groundwater Monitoring Bore P7 Results January - December 2021*

Location	Site Bore P7												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	06/01/21	05/02/21	09/03/21	08/04/21	06/05/21	01/06/21	01/07/21	02/08/21	02/09/21	06/10/21	22/11/21	06/12/21	
Time Sampled	7:40	8:50	10:08	8:46	13:31	15:48	16:16	15:57	16:52	8:37	10:26	17:11	
Standing Water Level (m)	6.14	6.22	6.50	5.90	6.16	6.43	6.58	6.45	6.08	6.12	5.72	5.55	
Standpipe Height (m)	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	
Relative Water Level (m)	5.18	5.26	5.54	4.94	5.20	5.47	5.62	5.49	5.12	5.16	4.76	4.59	
Water Level AHD (m)	889.22	889.14	888.86	889.46	889.20	888.93	888.78	888.91	889.28	889.24	889.64	889.81	**883.28#**
Temperature (°C)	15.8	16.4	17.4	15.9	15.4	13.9	13.4	13.7	14.9	13.0	14.0	14.4	
pH (pH units)	6.24	6.18	6.19	6.21	6.40	6.13	6.44	6.44	6.18	6.72	7.51	6.90	**6.3 to 8.0***
Conductivity (µS/cm)	799	821	791	830	828	819	853	812	802	840	796	826	**852**
Bicarbonate Alkalinity (mg/L)	--	253	--	--	252	--	--	230	--	--	245	--	
Total Alkalinity (mg/L)	--	253	--	--	252	--	--	230	--	--	245	--	
Sulphate (mg/L)	--	75	--	--	75	--	--	73	--	--	76	--	
Chloride (mg/L)	--	84	--	--	89	--	--	85	--	--	90	--	
Calcium (mg/L)	--	46	--	--	53	--	--	44	--	--	45	--	
Magnesium (mg/L)	--	50	--	--	53	--	--	46	--	--	46	--	
Sodium (mg/L)	--	50	--	--	53	--	--	46	--	--	47	--	
Potassium (mg/L)	--	7	--	--	8	--	--	7	--	--	8	--	
Iron (dissolved) (mg/L)	--	0.06	--	--	0.13	--	--	0.12	--	--	<0.05	--	

Shaded Cells - Indicates results are outside of the nominated trigger level.

* results are rounded to 1 decimal place when comparing to trigger value

-- Indicates no analysis for compound required.

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 14 *Groundwater Monitoring Bore Old Shaft Results January - December 2021*

Location	Site Bore 'Old Shaft'												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	5/01/2021	4/02/2021	X	X	X	X	X	X	X	X	X	X	
Time Sampled	15:43	15:20	X	X	X	X	X	x	X	X	x	X	
Standing Water Level (m)	10.12	6.79	X	X	X	X	X	X	X	X	X	X	
Standpipe Height (m)	1.72	1.72	X	X	X	X	X	X	X	X	X	X	
Relative Water Level (m)	8.40	5.07	X	X	X	X	X	X	X	X	X	X	
Water Level AHD (m)	894.64	897.97	X	X	X	X	X	X	X	X	X	X	**888.46#**
Temperature (°C)	20.0	21.1	X	X	X	X	X	X	X	X	X	X	
pH	6.48	6.23	X	X	X	X	X	X	X	X	X	X	**6.3 to 8.0***
Conductivity (µS/cm)	448	457	X	X	X	X	X	X	X	X	X	X	**908**
Turbidity (NTU)	208	71	X	X	X	X	X	X	X	X	X	X	
Dissolved Oxygen (mg/L)	--	1.2	--	--	X	--	--	X	--	--	X	--	
TSS (mg/L)	--	28	--	--	X	--	--	X	--	--	X	--	
Oil & Grease (mg/L)	--	<5	--	--	X	--	--	X	--	--	X	--	
Bicarbonate Alkalinity (mg/L)	--	74	--	--	X	--	--	X	--	--	X	--	
Total Alkalinity (mg/L)	--	74	--	--	X	--	--	X	--	--	X	--	
Sulphate (mg/L)	--	123	--	--	X	--	--	X	--	--	X	--	
Chloride (mg/L)	--	29	--	--	X	--	--	X	--	--	X	--	
Calcium (mg/L)	--	27	--	--	X	--	--	X	--	--	X	--	
Magnesium (mg/L)	--	18	--	--	X	--	--	X	--	--	X	--	
Sodium (mg/L)	--	21	--	--	X	--	--	X	--	--	X	--	
Potassium (mg/L)	--	6	--	--	X	--	--	X	--	--	X	--	
Cobalt (dissolved) (mg/L)	--	0.013	--	--	X	--	--	X	--	--	X	--	
Manganese (dissolved) (mg/L)	--	0.922	--	--	X	--	--	X	--	--	X	--	
Nickel (dissolved) (mg/L)	--	0.024	--	--	X	--	--	X	--	--	X	--	
Zinc (dissolved) (mg/L)	--	0.041	--	--	X	--	--	X	--	--	X	--	
Iron (dissolved) (mg/L)	--	12.1	--	--	X	--	--	X	--	--	X	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required X indicates sampling not undertaken

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 15 *Groundwater Monitoring Location 'The Bong' Results January – December 2021*

Location	Site Bore 'The Bong'												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	5/1/21	4/2/21	8/3/21	7/4/21	6/5/21	2/6/21	1/7/21	2/8/21	2/9/21	5/10/21	22/11/21	22/11/21	
Time Sampled	15:55	15:55	16:50	14:42	11:50		16:27	14:20	15:50	15:34	8:37	8:37	
Temperature (°C)	26.8	23.3	20.5	18.6	13.8		9.7	10.5	15.7	16.2	13.0	13.0	
pH	6.06	6.15	6.68	6.51	6.54		6.65	7.12	6.32	6.45	7.80	7.80	**5.8 – 8.0***
Conductivity (µS/cm)	73	121	149	147	179		280	257	134	164	140	140	**1157**
Turbidity (NTU)	459	58	4	3	5		12	4	38	26	<1	<1	
Bicarbonate Alkalinity (mg/L)	--	6	--	--	5		--	2	--	--	4	4	
Total Alkalinity (mg/L)	--	6	--	--	5		--	2	--	--	4	4	
Sulphate (mg/L)	--	39	--	--	65		--	104	--	--	53	53	
Chloride (mg/L)	--	<1	--	--	1		--	5	--	--	<1	<1	
Calcium (mg/L)	--	10	--	--	17		--	23	--	--	14	14	
Magnesium (mg/L)	--	4	--	--	6	Dry	--	8	--	--	5	5	
Sodium (mg/L)	--	2	--	--	3		--	3	--	--	5	5	
Potassium (mg/L)	--	3	--	--	4		--	9	--	--	2	2	
Arsenic (dissolved) (mg/L)	--	<0.001	--	--	<0.001		--	<0.001	--	--	<0.001	<0.001	
Cadmium (dissolved) (mg/L)	--	<0.0001	--	--	<0.0001		--	<0.0001	--	--	<0.0001	<0.0001	
Chromium (dissolved) (mg/L)	--	<0.001	--	--	<0.001		--	<0.001	--	--	<0.001	<0.001	
Copper (dissolved) (mg/L)	--	<0.001	--	--	<0.001		--	<0.001	--	--	<0.001	<0.001	
Lead (dissolved) (mg/L)	--	<0.001	--	--	<0.001		--	<0.001	--	--	<0.001	<0.001	
Nickel (dissolved) (mg/L)	--	0.005	--	--	0.004		--	0.012	--	--	0.008	0.008	
Zinc (dissolved) (mg/L)	--	<0.005	--	--	0.006		--	0.026	--	--	0.014	0.014	
Iron (dissolved) (mg/L)	--	0.07	--	--	<0.05		--	<0.05	--	--	0.14	0.14	

Shaded Cells - Indicates results are outside of the nominated trigger level. * results are rounded to 1 decimal place when comparing to trigger value

--- Indicates no analysis for compound required

Table 16 *Groundwater Monitoring Bore - EP PDH3/GW Results January - December 2021*

Location	Enhance Place Bore EP PDH3/GW												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	5/01/2021	4/02/2021	X	X	X	X	X	X	X	X	X	X	
Standing Water Level (m)	23.65	23.71	X	X	X	X	X	X	X	X	X	X	
Standpipe Height	0.77	0.77	X	X	X	X	X	X	X	X	X	X	
Relative Water Level (m)	22.88	22.94	X	X	X	X	X	X	X	X	X	X	
Water Level AHD (m)#	893.12	893.06	X	X	X	X	X	X	X	X	X	X	**891.06**

Shaded Cells - Indicates results are outside of the nominated Trigger Level. X indicates sampling not undertaken

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

Table 17 *Groundwater Monitoring Bore - EP PDH4/GW Results January – December 2021*

Location	Enhance Place Bore EP PDH4/GW												Trigger Value
Sampling Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Date Sampled	5/01/2021	4/02/2021	X	X	X	X	X	X	X	X	X	X	
Standing Water Level (m)	23.19	23.24	X	X	X	X	X	X	X	X	X	X	
Standpipe Height	0.16	0.16	X	X	X	X	X	X	X	X	X	X	
Relative Water Level (m)	23.03	23.08	X	X	X	X	X	X	X	X	X	X	
Water Level AHD (m)#	893.05	893.00	X	X	X	X	X	X	X	X	X	X	**890.95**

Shaded Cells - Indicates results are outside of the nominated Trigger Level. X indicates sampling not undertaken

Water Level trigger is exceeded if the AHD water level drops below the nominated trigger level.

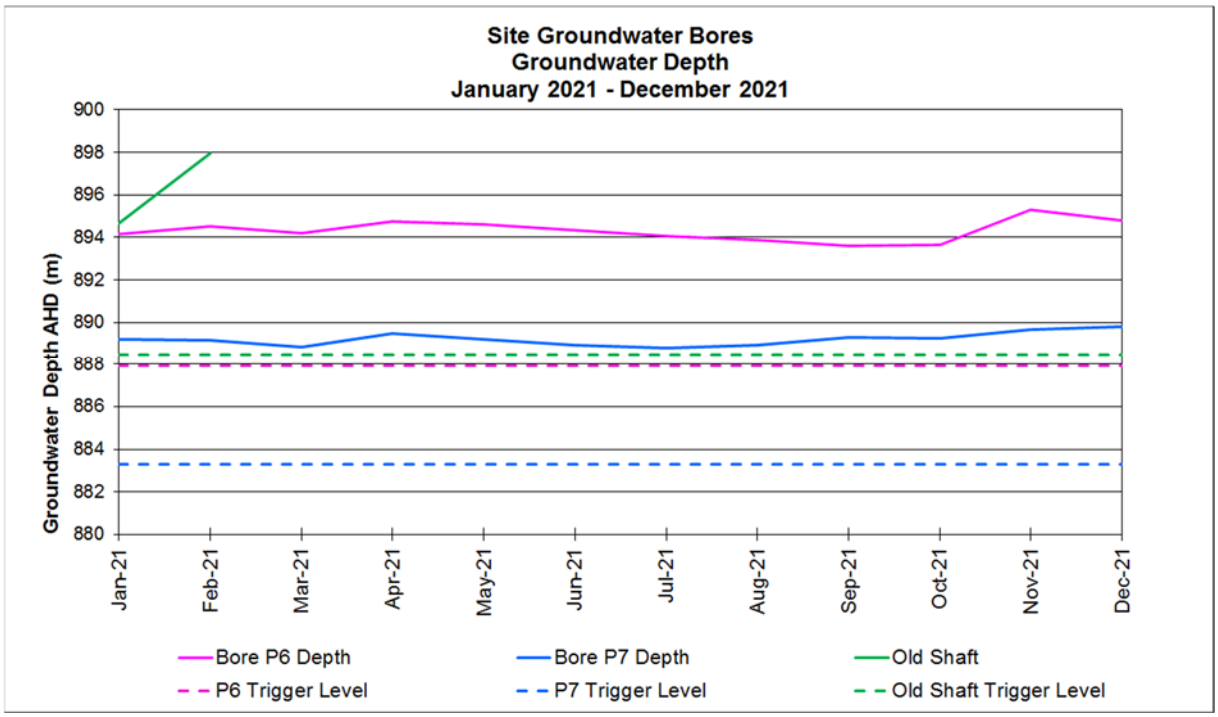

Figure 3 *Onsite Groundwater Standing Water Level 2021*

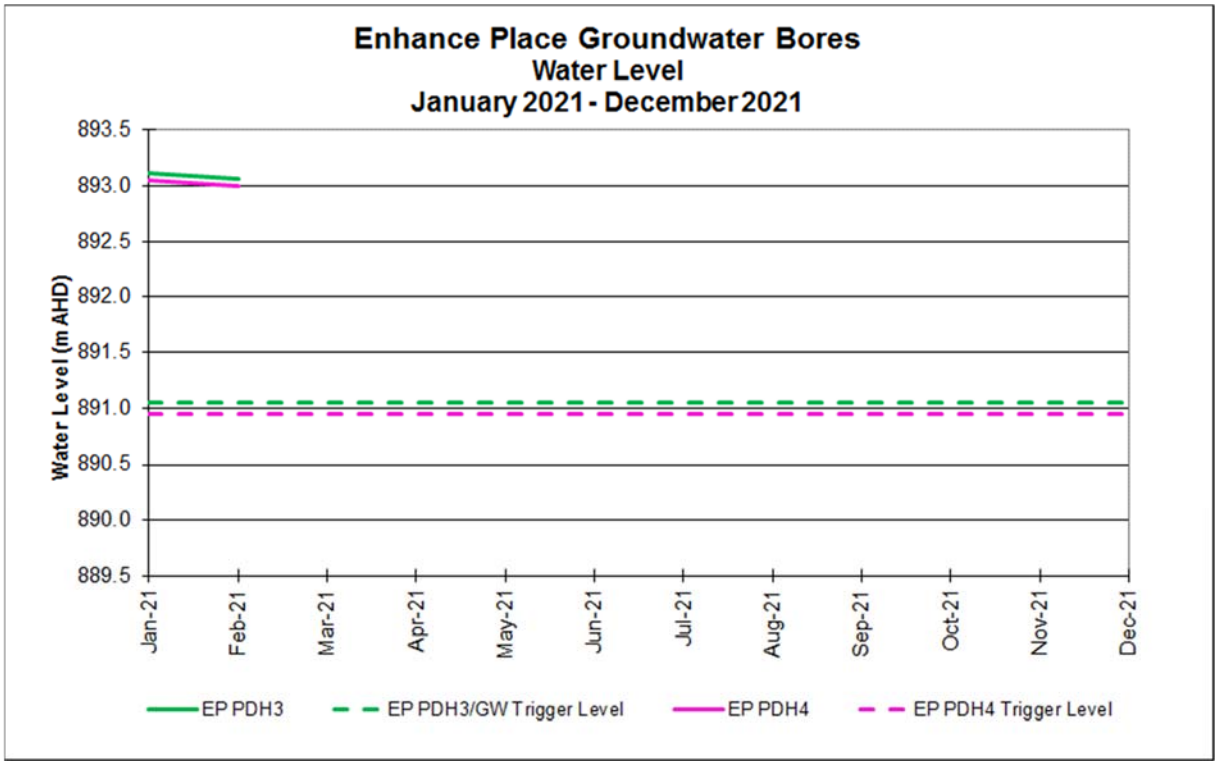

Figure 4 *Enhance Place Groundwater Standing Water Level 2021*

3.3 REVIEW & INTERPRETATION OF GROUND WATER MONITORING

3.3.1 SITE GROUNDWATER BORES

Groundwater samples collected from the on-site groundwater bores during the January – December 2021 period generally indicate water quality results which are consistent throughout the 2021 monitoring period with the exception of the following:

- pH in P6, and P7 to a lesser extent, has shown an increasing trend in late 2021. It is noted that this appears to have normalised in December 2021, however the trend will not be apparent until 2022 results are reviewed.
- Electrical conductivity in P6 indicated a decreasing trend throughout 2021; the December result was higher than the November result and may be the commencement of a rebound or may be a minor variation within the overall trend.
- Dissolved iron within Bore P7 were detected in the first three (3) monitoring rounds in 2021, continuing the decreasing trend from the August 2020 high: concentrations were not detected in November 2021, consistent with the majority of the historical results.
- Dissolved iron concentration within Old Shaft during February 2021 had increased slightly to 12.1mg/L from the low recorded in November 2020.

There were no instances during the 2021 monitoring period where the standing water level dropped below the respective water level triggers (refer **Figure 3**). The water level within bores P6, P7 and Old Shaft all show a slightly increasing trend during the period January 2021 to December 2021. There are relatively sharp increases at both P6 and P7 between March 2021 and April 2021 following a period of very high rainfall. Groundwater at P6 had been gradually falling since April until October 2021 sampling round; at which time there was another sharp increase which has declined as of December 2021. The groundwater level at P7 gradually fell between April and June 2021 until a relatively sharp increase occurred between August and September 2021 and again between October and November 2021.

The pH within the on-site bores were generally below the site-specific lower pH trigger values, noting that reported concentrations are rounded to one decimal place when comparing to the site-specific trigger values. The pH was outside of the approved trigger range during six (6) of the twelve (12) monitoring events at groundwater bore P6 and P7, and at one (1) of the two (2) monitoring events at Old Shaft. The lowest reported pH was 5.99 during the March 2021 monitoring event which was observed at P6.

During 2021, there were no instances where the upper pH trigger level (8.0 pH units) was exceeded.

The electrical conductivity within the on-site bores have variably exceeded the respective conductivity trigger values throughout the 2021 monitoring period. Bore P6 exceeded the conductivity trigger value during all twelve (12) monitoring events with a maximum concentration of 1670µS/cm recorded in January 2021. The July 2021 result at P7 (853µS/cm) was the only instance in which the trigger value was exceeded at this location; whilst none of the results from The Old Shaft exceeded the trigger value.

3.3.1.1 REVIEW OF SITE-SPECIFIC TRIGGER VALUES

The current approved site-specific trigger values detailed in the Water Management Plan (Ref [3]) and as presented in **Table 11** are derived from monitoring data collected in the period January 2011 – December 2014. Electrical conductivity and pH intermittently exceeded the site-specific trigger values during the 2017 monitoring period; these were attributed to the below average rainfall observed during that year. A scheduled review of the groundwater monitoring data undertaken in accordance with the Water Management Plan (Ref [3]) recommended that the entire monitoring data set should be utilised in the derivation of the trigger values, which includes up to 12 years of data (2005 – 2017) for some monitoring locations, rather than be restricted to 2011-2014. The rationale for including all available data was that it provided robust data sets which were more representative of site conditions including varying climatic influences. Revised trigger values based on all available monitoring data were derived and submitted to the DPIE – Natural Resources Access Regulator (NRAR) (formerly Department of Industries – Water) for approval. In March 2018, DPIE – NRAR recommended an investigation to be undertaken to determine the cause of the exceedances as a basis for the revision of the trigger values.

An investigation (Ref [9]) was undertaken by an external consultant and indicated that the likely cause of the decreasing pH trend observed in bore P6 and Old Shaft was likely due to acid mine drainage associated with historic underground mine workings. A decrease in groundwater levels at P6 and Old Shaft was observed from early 2010, with groundwater levels recovering in 2012. The increasing groundwater level interacted with exposed pyrite, generating acid. Increasing trends in dissolved cobalt, manganese, iron, nickel and zinc at Old Shaft and dissolved iron at P6 commenced in conjunction with recovering water levels in 2012 (Ref [9]). Revised site-specific trigger values were also provided and are summarised in **Table 18**. It is noted that the investigation recommended the removal of electrical conductivity as a trigger value.

Table 18 *Revised Groundwater Trigger Values (Ref [9])*

Monitoring location	P6	P7	Old Shaft
pH trigger level[a]	5.6	6.3	5.4
Water Level (AHD)[b]	--	--	891.54

Comparison of the groundwater quality of the onsite bores to the trigger values presented in **Table 18** indicates the following:

- The pH at Bore P6 is compliant for all twelve (12) monitoring events.
- The pH trigger value for Bore P7 remains unchanged, thus the pH remained outside the pH trigger value range for six (6) of the twelve (12) monitoring events.
- The pH at Old Shaft is compliant for the two (2) monitoring events conducted.

Although the pH at Bore P7 is intermittently below the revised trigger level value, current activities undertaken at PDM during care and maintenance are not considered to be the cause of the low pH value. It is noted that the pH at P7 is not trending downwards and is relatively stable; and potentially increasing throughout 2021. It has previously been considered that the increase in rainfall observed during 2020 following a prolonged dry period has resulted in an increased flow which has the potential to mobilise stagnant low pH water that may have accumulated during drought conditions; **Figure 3** illustrates the stabilisation / slight increase in standing water level during 2021 (refer **Section 5** for a review of the rainfall during the 2021 monitoring period).

3.3.2 OFF-SITE GROUNDWATER BORES

Bore B exhibited standing water levels which were generally consistent throughout the 2021 monitoring period; the water level within the Lithgow seam increased by <2mAHD. All levels within Bore B were compliant with their respective trigger levels.

3.3.3 ENHANCE PLACE GROUNDWATER BORES

Standing water level measurements at the two (2) monitoring bores located at the former Enhance Place Mine were within 0.06m of each other during the two (2) events they were accessible during the reporting period: these levels are generally consistent with historical data. The water levels remained compliant with the water trigger level value at both bores.

4 SURFACE WATER QUALITY MONITORING

The purpose of surface water monitoring is to ensure that any impact of the mining operations on surface water bodies and streams can be identified, and to demonstrate compliance with relevant legislative requirements.

Surface water monitoring for the Pine Dale Mine is undertaken in accordance with the EPL 4911 (Ref [1]) and the Water Management Plan (Ref [3]) at twelve (12) monitoring locations within and surrounding the mine site (refer **Drawing 1**, **Appendix 1**). Frequency is on a quarterly and monthly basis for routine samples depending on location and in accordance with the EPL 4911 (Ref [1]) and Water Management Plan (Ref [3]).

EPL 4911 (Ref [1]) specifies sampling to be undertaken daily or weekly from EPL Point 13 during discharge with daily samples analysed for pH, electrical conductivity and turbidity, and weekly samples analysed for filterable (dissolved) iron, oil and grease, sulphate and total suspended solids.

EPL 4911 (Ref [1]) specifies quarterly surface water monitoring is to be undertaken at four (4) surface water monitoring locations:

- EPL Point 2: ambient water monitoring point.
- EPL Point 3: ambient water monitoring point.
- EPL Point 14: ambient water monitoring point.
- EPL Point 16: ambient water monitoring point

The PDM Water Management Plan (Ref [3]) stipulates quarterly monitoring of EPL Point 2, 3, 14 is to include analysis for pH, electrical conductivity, turbidity, total suspended solids, sulphate and filterable (dissolved) iron. Trigger values for these quarterly monitoring events are detailed in the Water Management Plan (Ref [3]); however, compliance with these trigger values are not an EPL requirement.

The PDM Water Management Plan (Ref [3]) also stipulates the water level of Neubecks Creek (also known as Wangcol Creek and referred to as such herein) is measured at S2 on a monthly frequency, and monthly monitoring of a further six (6) monitoring locations:

- S1 located within Wangcol Creek upstream of PDM operations.
- S4 is located on Coxs River, upstream of the confluence of Wangcol Creek and does not receive water from PDM operations.
- S5 is located within Blue Lake which receives flow from Wangcol Creek and Coxs River.
- S6 is located within Wangcol Creek; downstream of S1 and any PDM operations.
- S7 located within Coxs River, downstream of Wangcol Creek.

Analysis at locations S1, EPA Point 3 and locations S4-S7 is stipulated in the PDM Water Quality Management Plan (Ref [3]) to include pH electrical conductivity, turbidity, dissolved oxygen, total suspended solids, oil & grease, bicarbonate and total alkalinity, sulphate, chloride, calcium, magnesium, sodium, potassium and filterable (dissolved) metals (cobalt, manganese, nickel, zinc, iron).

4.1 SURFACE WATER ASSESSMENT CRITERIA

EPL 4911 stipulates maximum concentrations limits applicable to EPL Point 13 discharge events. No concentration limits are detailed in EPL 4911 for any other locations.

Site specific trigger values for pH and electrical conductivity are stipulated in the PDM Water Management Plan (Ref [3]) in accordance with Schedule 3, Condition 27(c) of the Project Approval (Pa 10_0041) except for EPL Point 16 which was added to the EPL in November 2021: this site has not yet had site specific triggers derived. Trigger values for oil and grease and total suspended solids are not site specific and are uniform across all surface water sites.

Surface water assessment criteria (Ref [3]) are presented in **Table 19**.

Table 19 *Surface Water Trigger Values*

Surface Water Site	pH (range)	Electrical Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Oil and Grease (mg/L)
S1	6.2 – 8.0	2325	30	10
S2	NA	NA	NA	NA
S3	6.4 – 8.0	2223	30	10
S4	7.3 – 8.0	957	30	10
S5	7.0 – 8.0	1013	30	10
S6	6.7 – 8.0	1941	30	10
S7	6.8 – 8.0	1007	30	10
EPL Point 2	7.1 – 8.0	2055	30	NA
EPL Point 3	6.4 – 8.0	2223	30	NA
EPL Point 13	6.5 – 8.0^	NA	30^	NA
EPL Point 14	7.5 – 8.0	1166	30	NA
EPL Point 16	NA	NA	30	NA

NA – no trigger value required for these locations.

^refers to maximum concentration limits applicable during discharge events as detailed in EPL 4911 section L2.

4.2 SURFACE WATER MONITORING DATA SUMMARY

No monitoring was undertaken at EPL Point 13 during the reporting period in the absence of discharge during the 2021 monitoring period.

Four (4) quarterly surface water monitoring events were conducted at EPL Point 2, 3 and 14, and one (1) monitoring event was conducted for EPL Point 16. These events were conducted during February, May, August and November 2021.

Twelve (12) monthly surface water monitoring events were conducted at S1-S7 during the January to December 2021 monitoring period.

Surface water summary results for the period January – December 2021 are shown in **Table 20** to **Table 30**. Graphical presentations are shown in **Figure 5** to **Figure 10**.

Table 20 *Surface Water Monitoring Location EPL Point 2 Results 2021*

Location	EPL Point 2				Trigger Value
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	4/02/2021	6/05/2021	2/08/2021	22/11/2021	
Time Sampled	16:15	12:01	14:30	08:50	
pH (pH units)	7.25	7.39	6.56	7.39	**7.1 – 8.0**
Conductivity (µS/cm)	375	905	537	482	**2055**
Sulphate (mg/L)	102	248	168	130	
Iron filterable (mg/L)	0.06	0.05	<0.05	0.1	
TSS (mg/L)	<5	<5	<5	<5	**30**
Turbidity (NTU)	6.6	4.6	2.0	<1	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 21 *Surface Water Monitoring Location EPL Point 3 Results 2021*

Location	EPL Point 3				Trigger Value
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	4/02/2021	6/05/2021	2/08/2021	22/11/2021	
Time Sampled	16:25	13:46	16:15	10:40	
pH (pH units)	7.29	7.45	7.83	7.18	**6.4 – 8.0**
Conductivity (µS/cm)	1640	1990	2210	925	**2223**
Sulphate (mg/L)	676	775	998	326	
Iron filterable (mg/L)	0.08	0.18	0.34	0.19	
TSS (mg/L)	5	<5	<5	<5	**30**
Turbidity (NTU)	9.0	2.3	3.9	<1	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 22 *Surface Water Monitoring Location EPL Point 14 Results 2021*

Location	EPL Point 14				Trigger Value
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	5/02/2021	6/05/2021	2/08/2021	22/11/2021	
Time Sampled	08:12	14:00	16:25	10:55	
pH (pH units)	6.93	7.49	7.58	7.02	**7.45 – 8.0**
Conductivity (µS/cm)	922	764	759	514	**1166**
Sulphate (mg/L)	348	277	283	163	
Iron filterable (mg/L)	0.07	<0.05	0.06	0.21	
TSS (mg/L)	<5	<5	<5	<5	**30**
Turbidity (NTU)	5.1	3.0	2.7	<1	

Shaded Cells - Indicates results are outside of the nominated Trigger Value

Table 23 *Surface Water Monitoring Location EPL Point 16 Results 2021*

Location	EPL Point 14				Trigger Value
Sampling Month	Feb	May	Aug	Nov	
Date Sampled	X	X	X	22/11/2021	
Time Sampled	X	X	X	09:15	
pH (pH units)	X	X	X	6.47	
Conductivity (µS/cm)	X	X	X	1520	
Sulphate (mg/L)	X	X	X	706	
Iron filterable (mg/L)	X	X	X	20.2	
TSS (mg/L)	X	X	X	6	
Turbidity (NTU)	X	X	X	<1	

X – sampling not required by licence

Table 24 *Surface Water Monitoring Location S1 Results 2021*

Location	Surface Water S1												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**5/01/21**	**4/02/21**	**9/03/21**	**7/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	16:12	16:25	10:21	14:32	13:46	15:56	16:52	16:15	15:02	16:21	10:40	17:23	
Temperature (°C)	23.2	24.0	20.3	18.4	13.8	7.0	9.5	10.2	13.7	15.0	13.7	16.9	
pH	6.84	7.22	7.45	6.70	7.15	7.13	6.72	6.67	6.31	6.52	7.02	6.35	**6.2 – 8.0**
Conductivity (µS/cm)	627	1690	2710	1945	2000	2080	1940	2480	644	2540	893	1570	**2325**
Turbidity (NTU)	206	9	3	2	3	1	2	3	3	9	<1	<1	
Dissolved Oxygen (mg/L)	--	3.9	--	--	7.4	--	--	7.5	--	--	8.8	--	
TSS (mg/L)	--	<5	--	--	7	--	--	<5	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	76	--	--	82	--	--	84	--	--	72	--	
Total Alkalinity (mg/L)	--	76	--	--	82	--	--	84	--	--	72	--	
Sulphate (mg/L)	--	681	--	--	786	--	--	1030	--	--	326	--	
Chloride (mg/L)	--	104	--	--	123	--	--	158	--	--	57	--	
Calcium (mg/L)	--	64	--	--	95	--	--	96	--	--	41	--	
Magnesium (mg/L)	--	50	--	--	67	--	--	74	--	--	31	--	
Sodium (mg/L)	--	231	--	--	272	--	--	323	--	--	100	--	
Potassium (mg/L)	--	18	--	--	26	--	--	27	--	--	10	--	
Cobalt (dissolved) (mg/L)	--	0.002	--	--	0.008	--	--	0.008	--	--	0.003	--	
Manganese(dissolved) (mg/L)	--	0.296	--	--	0.722	--	--	0.362	--	--	0.259	--	
Nickel (dissolved) (mg/L)	--	0.079	--	--	0.117	--	--	0.135	--	--	0.048	--	
Zinc (dissolved) (mg/L)	--	0.023	--	--	0.031	--	--	0.02	--	--	0.01	--	
Iron (dissolved) (mg/L)	--	<0.05	--	--	0.05	--	--	<0.05	--	--	0.10	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period. Additional analysis was undertaken in April 2021 as part of an investigation into the water quality associated with a seep of groundwater (which became EPL Point 16).

Table 25 *Surface Water Monitoring Location S2 Results 2021*

Location	Surface Water Site S2											
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Date Sampled	**5/01/2021**	**4/02/2021**	**8/03/2021**	**7/04/2021**	**6/05/2021**	**1/06/2021**	**1/07/2021**	**2/08/2021**	**2/09/2021**	**5/10/2021**	**22/11/2021**	**6/12/2021**
Time Sampled	15:08	14:13	16:11	13:37	16:12	14:47	15:07	14:15	15:20	15:10	15:53	17:20
Depth to Surface from Top of Rail Bridge (m)	3.57	3.70	3.72	3.69	3.69	3.72	3.72	3.71	3.70	3.65	3.71	3.65

Table 26 *Surface Water Monitoring Location S3 Results 2021*

Location	Surface Water S3												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**5/01/21**	**4/02/21**	**9/03/21**	**7/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	16:12	16:25	10:21	14:32	13:46	15:56	16:52	16:15	15:02	16:21	10:40	17:23	
Temperature (°C)	22.8	23.6	19.0	18.0	14.6	9.6	9.5	10.7	12.9	14.2	14.0	16.0	
pH	7.17	7.29	7.59	6.99	7.45	6.83	7.28	7.83	6.68	6.54	7.18	6.91	**6.4 – 8.0**
Conductivity (µS/cm)	609	1640	2510	1842	1990	1730	1750	2210	655	2470	925	1560	**2223**
Turbidity (NTU)	197	9	4	3	2	2	3	4	7	11	<1	1	
Dissolved Oxygen (mg/L)	--	3.8	--	--	8.2	--	--	7.2	--	--	6.5	--	
TSS (mg/L)	--	5	--	7	<5	--	--	<5	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	<5	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	76	--	92	82	--	--	77	--	--	69	--	
Total Alkalinity (mg/L)	--	76	--	92	82	--	--	77	--	--	69	--	
Sulphate (mg/L)	--	676	--	799	775	--	--	998	--	--	326	--	
Chloride (mg/L)	--	101	--	116	121	--	--	150	--	--	57	--	
Calcium (mg/L)	--	63	--	76	93	--	--	92	--	--	41	--	
Magnesium (mg/L)	--	48	--	57	66	--	--	71	--	--	30	--	
Sodium (mg/L)	--	224	--	255	266	--	--	306	--	--	97	--	
Potassium (mg/L)	--	18	--	22	25	--	--	26	--	--	10	--	
Cobalt (dissolved) (mg/L)	--	0.005	--	0.014	0.01	--	--	0.011	--	--	0.005	--	
Manganese(dissolved) (mg/L)	--	0.578	--	1.09	0.858	--	--	0.666	--	--	0.5	--	
Nickel (dissolved) (mg/L)	--	0.078	--	0.127	0.116	--	--	0.132	--	--	0.051	--	
Zinc (dissolved) (mg/L)	--	0.016	--	0.041	0.03	--	--	0.026	--	--	0.02	--	
Iron (dissolved) (mg/L)	--	0.08	--	0.12	0.18	--	--	0.34	--	--	0.19	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period. Additional analysis was undertaken in April 2021 as part of an investigation into the water quality associated with a seep of groundwater (which became EPL Point 16).

Table 27 *Surface Water Monitoring Location S4 Results 2021*

Location	Surface Water S4												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**6/01/21**	**5/02/21**	**9/03/21**	**8/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	7:30	7:33	10:03	8:24	13:18	15:38	16:05	15:52	16:45	8:30	10:16	17:08	
Temperature (°C)	17.4	18.5	19.1	16.4	13.4	6.8	8.9	8.5	12.0	10.5	13.7	15.9	
pH	7.2	7.29	7.11	7.02	7.25	7.27	8.46	7.21	6.69	7.25	7.49	7.47	**7.3 – 8.0**
Conductivity (µS/cm)	141	172	170	125	154	128	135	189	110	133	106	122	**957**
Turbidity (NTU)	10.8	9	7.8	5.3	5.8	3.8	3.2	1.8	13.3	9.3	<1	4.1	
Dissolved Oxygen (mg/L)	--	9.1	--	--	7.5	--	--	7.2	--	--	5.2	--	
TSS (mg/L)	--	<5	--	--	7	--	--	<5	--	--	7	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	58	--	--	30	--	--	30	--	--	35	--	
Total Alkalinity (mg/L)	--	58	--	--	30	--	--	30	--	--	35	--	
Sulphate (mg/L)	--	6	--	--	16	--	--	19	--	--	6	--	
Chloride (mg/L)	--	12	--	--	16	--	--	13	--	--	7	--	
Calcium (mg/L)	--	8	--	--	7	--	--	6	--	--	6	--	
Magnesium (mg/L)	--	4	--	--	4	--	--	4	--	--	3	--	
Sodium (mg/L)	--	14	--	--	12	--	--	12	--	--	8	--	
Potassium (mg/L)	--	5	--	--	8	--	--	5	--	--	4	--	
Cobalt (dissolved) (mg/L)	--	<0.001	--	--	<0.001	--	--	<0.001	--	--	<0.001	--	
Manganese(dissolved) (mg/L)	--	0.039	--	--	0.009	--	--	0.008	--	--	0.01	--	
Nickel (dissolved) (mg/L)	--	<0.001	--	--	<0.001	--	--	0.001	--	--	<0.001	--	
Zinc (dissolved) (mg/L)	--	0.01	--	--	0.013	--	--	0.016	--	--	<0.005	--	
Iron (dissolved) (mg/L)	--	0.19	--	--	0.1	--	--	0.06	--	--	0.25	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period. Additional analysis was undertaken in April 2021 as part of an investigation into the water quality associated with a seep of groundwater (which became EPL Point 16).

Table 28 *Surface Water Monitoring Location S5 Results 2021*

Location	Surface Water S5												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**6/01/21**	**5/02/21**	**9/03/21**	**8/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	7:34	7:33	10:00	8:40	13:25	15:40	16:08	15:55	16:50	8:27	10:13	17:05	
Temperature (°C)	17.9	20.0	21.0	16.3	14.6	9.4	9.1	9.1	13.4	11.9	14.4	18.0	
pH	6.82	6.85	6.70	6.61	6.84	6.41	7.77	6.89	6.32	7.20	6.97	6.97	**7.0 – 8.0**
Conductivity (µS/cm)	506	914	1480	547	864	1120	579	776	626	761	567	544	**1013**
Turbidity (NTU)	141	15	3	8	9	25	6.5	6.3	19.9	16.1	8.2	10.5	
Dissolved Oxygen (mg/L)	--	4.6	--	--	8.5	--	--	7.2	--	--	4.6	--	
TSS (mg/L)	--	7	--	--	<5	--	--	<5	--	--	11	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	66	--	--	49	--	--	40	--	--	40	--	
Total Alkalinity (mg/L)	--	66	--	--	49	--	--	40	--	--	40	--	
Sulphate (mg/L)	--	359	--	--	336	--	--	282	--	--	186	--	
Chloride (mg/L)	--	51	--	--	41	--	--	42	--	--	27	--	
Calcium (mg/L)	--	41	--	--	49	--	--	35	--	--	26	--	
Magnesium (mg/L)	--	30	--	--	31	--	--	25	--	--	17	--	
Sodium (mg/L)	--	104	--	--	91	--	--	74	--	--	52	--	
Potassium (mg/L)	--	11	--	--	12	--	--	10	--	--	8	--	
Cobalt (dissolved) (mg/L)	--	0.008	--	--	0.015	--	--	0.01	--	--	0.003	--	
Manganese(dissolved) (mg/L)	--	0.675	--	--	0.903	--	--	0.562	--	--	0.231	--	
Nickel (dissolved) (mg/L)	--	0.053	--	--	0.06	--	--	0.044	--	--	0.031	--	
Zinc (dissolved) (mg/L)	--	0.03	--	--	0.051	--	--	0.034	--	--	0.025	--	
Iron (dissolved) (mg/L)	--	0.08	--	--	<0.05	--	--	<0.05	--	--	0.18	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

Table 29 *Surface Water Monitoring Location S6 Results 2021*

Location	Surface Water S6												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**6/01/21**	**5/02/21**	**9/03/21**	**8/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	7:25	7:29	9:48	8:27	13:12	15:36	16:01	15:42	16:39	8:16	10:03	17:01	
Temperature (°C)	17.6	18.6	17.9	16.4	14.6	10.0	10.2	10.5	14.4	10.6	13.9	17.1	
pH	6.96	7.07	7.55	6.70	7.20	7.12	6.77	7.37	6.38	7.12	6.83	6.48	**6.7 – 8.0**
Conductivity (µS/cm)	781	1620	2450	1848	1940	1950	1640	2260	533	2660	925	1530	**1941**
Turbidity (NTU)	99	5	4	4	22	<1	1.6	2.7	4.4	7.0	<1	1.1	
Dissolved Oxygen (mg/L)	--	4.4	--	--	9.3	--	--	8.94	--	--	5.5	--	
TSS (mg/L)	--	<5	--	9	10	--	--	<5	--	--	<5	--	**30**
Oil & Grease (mg/L)	--	<5	--	<5	<5	--	--	<5	--	--	<5	--	**10**
Bicarbonate Alkalinity (mg/L)	--	71	--	104	76	--	--	70	--	--	68	--	
Total Alkalinity (mg/L)	--	71	--	104	76	--	--	70	--	--	68	--	
Sulphate (mg/L)	--	666	--	796	765	--	--	954	--	--	339	--	
Chloride (mg/L)	--	82	--	110	115	--	--	142	--	--	57	--	
Calcium (mg/L)	--	69	--	83	95	--	--	93	--	--	43	--	
Magnesium (mg/L)	--	50	--	60	66	--	--	70	--	--	31	--	
Sodium (mg/L)	--	208	--	240	254	--	--	287	--	--	95	--	
Potassium (mg/L)	--	17	--	21	24	--	--	25	--	--	10	--	
Cobalt (dissolved) (mg/L)	--	0.008	--	0.021	0.01	--	--	0.012	--	--	0.006	--	
Manganese(dissolved) (mg/L)	--	0.661	--	1.31	0.776	--	--	0.741	--	--	0.504	--	
Nickel (dissolved) (mg/L)	--	0.077	--	0.131	0.112	--	--	0.126	--	--	0.052	--	
Zinc (dissolved) (mg/L)	--	0.027	--	0.091	0.038	--	--	0.041	--	--	0.022	--	
Iron (dissolved) (mg/L)	--	<0.05	--	0.06	<0.05	--	--	0.05	--	--	0.06	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period. Additional analysis was undertaken in April 2021 as part of an investigation into the water quality associated with a seep of groundwater (which became EPL Point 16).

Table 30 *Surface Water Monitoring Location S7 Results 2021*

Location	Surface Water S7												Trigger Value
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
Date Sampled	**6/01/21**	**5/02/21**	**9/03/21**	**8/04/21**	**6/05/21**	**1/06/21**	**1/07/21**	**2/08/21**	**2/09/21**	**5/10/21**	**22/11/21**	**6/12/21**	
Time Sampled	7:15	7:13	9:36	8:19	13:00	15:28	15:54	15:30	16:30	8:03	9:51	16:55	
Temperature (°C)	17.3	20.2	19.4	16.3	14.1	11.0	10.6	10.6	15.5	12.6	14.5	17.9	
pH	6.37	6.59	6.90	6.42	6.50	6.97	6.37	7.49	6.32	7.06	6.73	6.91	**6.8 – 8.0**
Conductivity (µS/cm)	566	956	1350	574	922	1030	622	778	622	731	550	527	**1007**
Turbidity (NTU)	74	8	2	7	7	17	3.7	5	17	10	2	6	
Dissolved Oxygen (mg/L)	--	3.6	--	--	6.4	--	--	8.17	--	--	3.6	--	**10**
TSS (mg/L)	--	5	--	--	<5	--	--	<5	--	--	6	--	**30**
Oil & Grease (mg/L)	--	<5	--	--	<5	--	--	<5	--	--	<5	--	
Bicarbonate Alkalinity (mg/L)	--	74	--	--	52	--	--	42	--	--	42	--	
Total Alkalinity (mg/L)	--	74	--	--	52	--	--	42	--	--	42	--	
Sulphate (mg/L)	--	368	--	--	361	--	--	294	--	--	188	--	
Chloride (mg/L)	--	52	--	--	42	--	--	43	--	--	27	--	
Calcium (mg/L)	--	47	--	--	54	--	--	38	--	--	26	--	
Magnesium (mg/L)	--	31	--	--	34	--	--	26	--	--	17	--	
Sodium (mg/L)	--	102	--	--	99	--	--	78	--	--	51	--	
Potassium (mg/L)	--	13	--	--	13	--	--	10	--	--	8	--	
Cobalt (dissolved) (mg/L)	--	0.002	--	--	0.008	--	--	0.004	--	--	0.004	--	
Manganese(dissolved) (mg/L)	--	0.429	--	--	0.762	--	--	0.365	--	--	0.577	--	
Nickel (dissolved) (mg/L)	--	0.048	--	--	0.062	--	--	0.04	--	--	0.036	--	
Zinc (dissolved) (mg/L)	--	0.017	--	--	0.05	--	--	0.027	--	--	0.024	--	
Iron (dissolved) (mg/L)	--	0.18	--	--	0.14	--	--	0.22	--	--	0.32	--	

Shaded Cells - Indicates results are outside of the nominated Trigger Value.

--- Indicates no analysis for compound required during particular period.

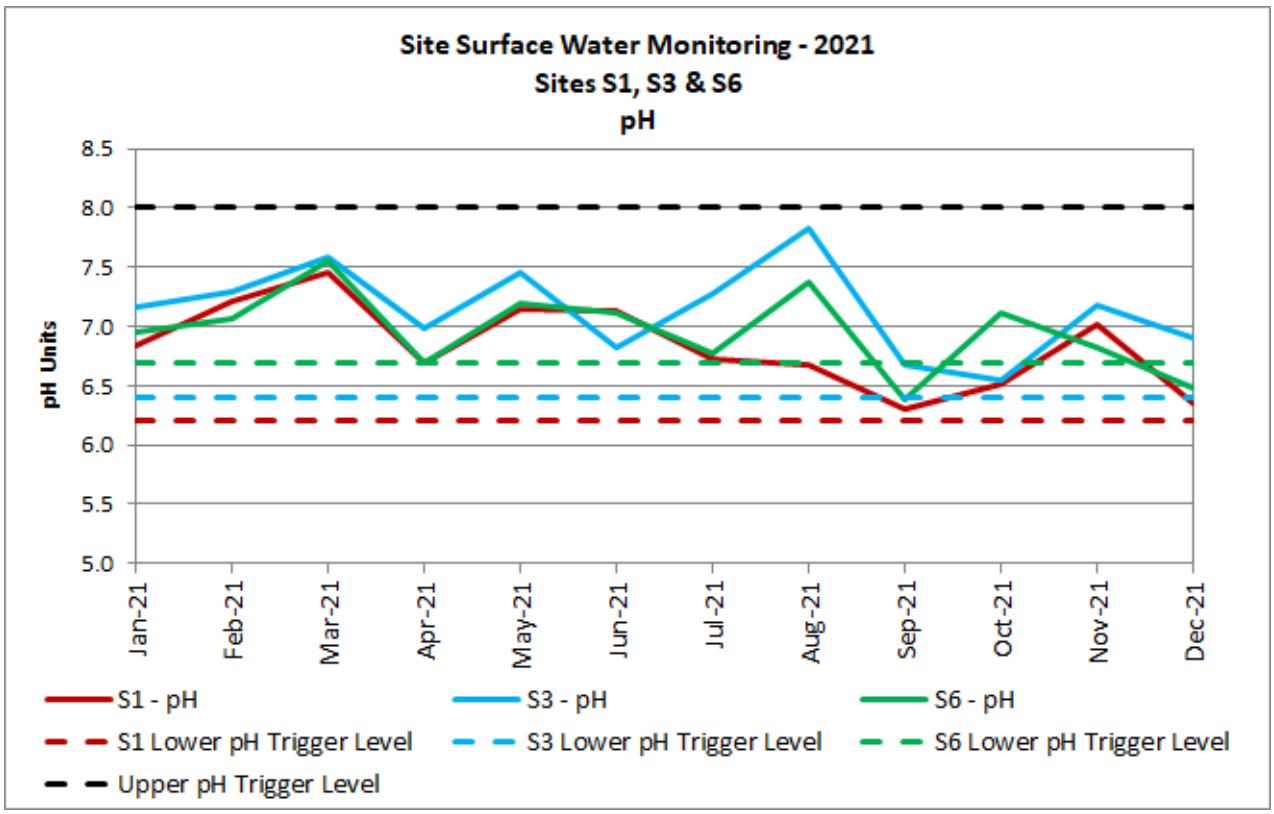

Figure 5 *Site Surface Water S1, S3 & S6 pH Results 2021*

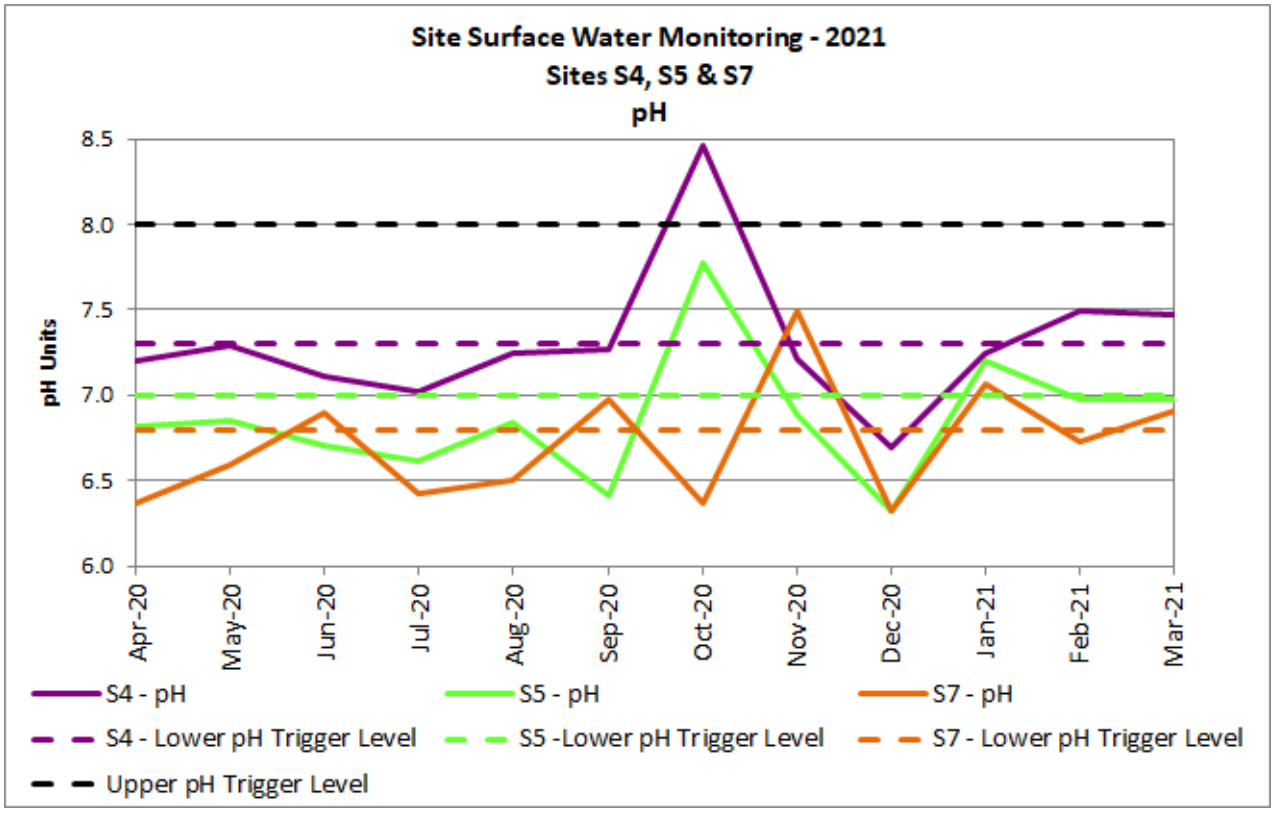

Figure 6 *Site Surface Water S4, S5 & S7 pH Results 2021*

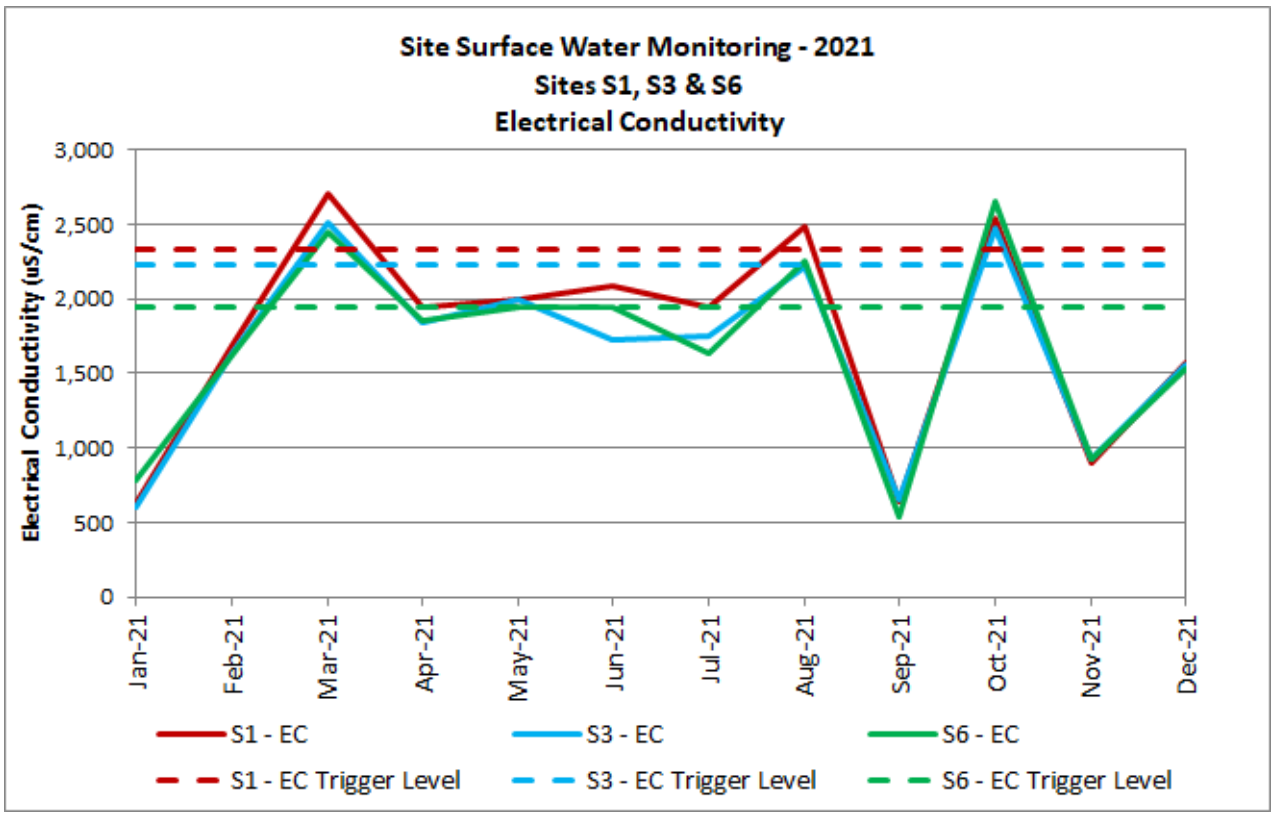

Figure 7 *Site Surface Water S1, S3 & S6 Electrical Conductivity Results 2021*

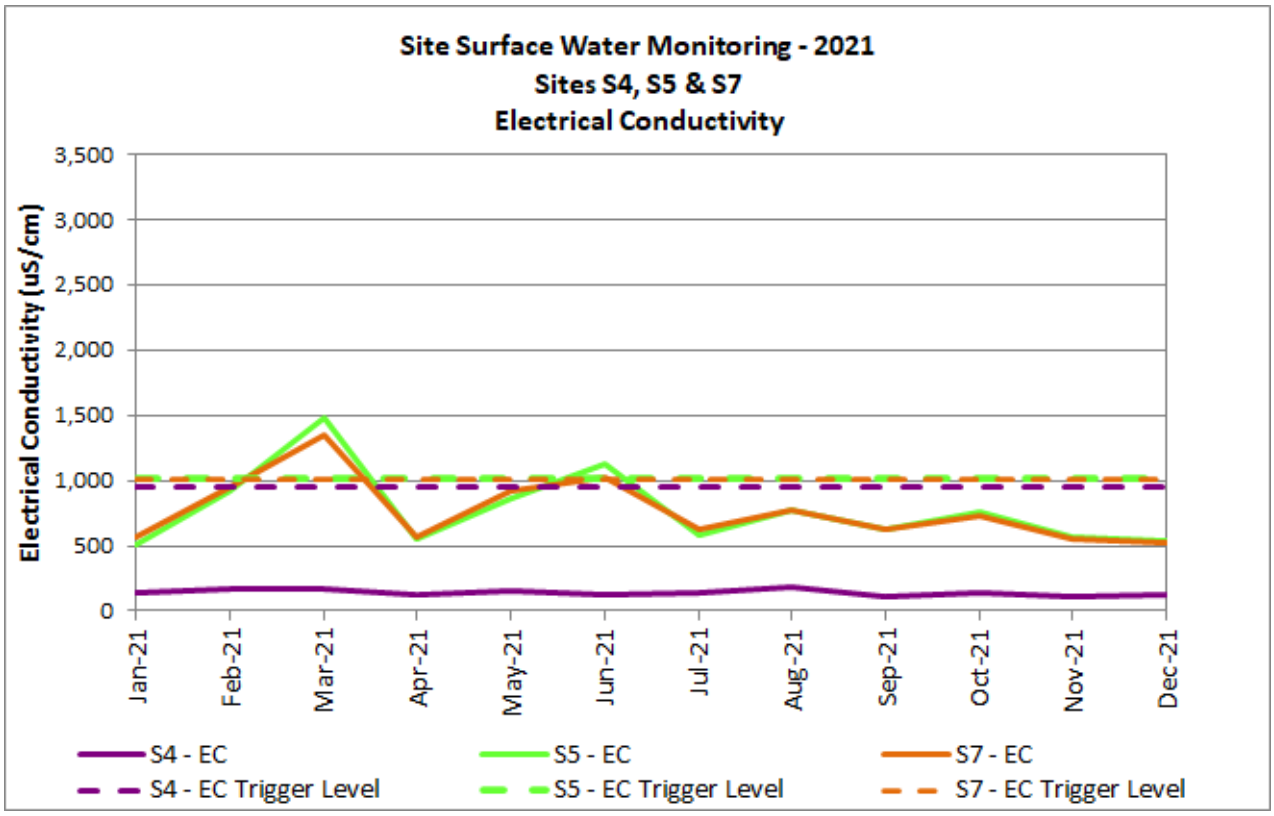

Figure 8 *Site Surface Water S4, S5 & S7 Electrical Conductivity Results 2021*

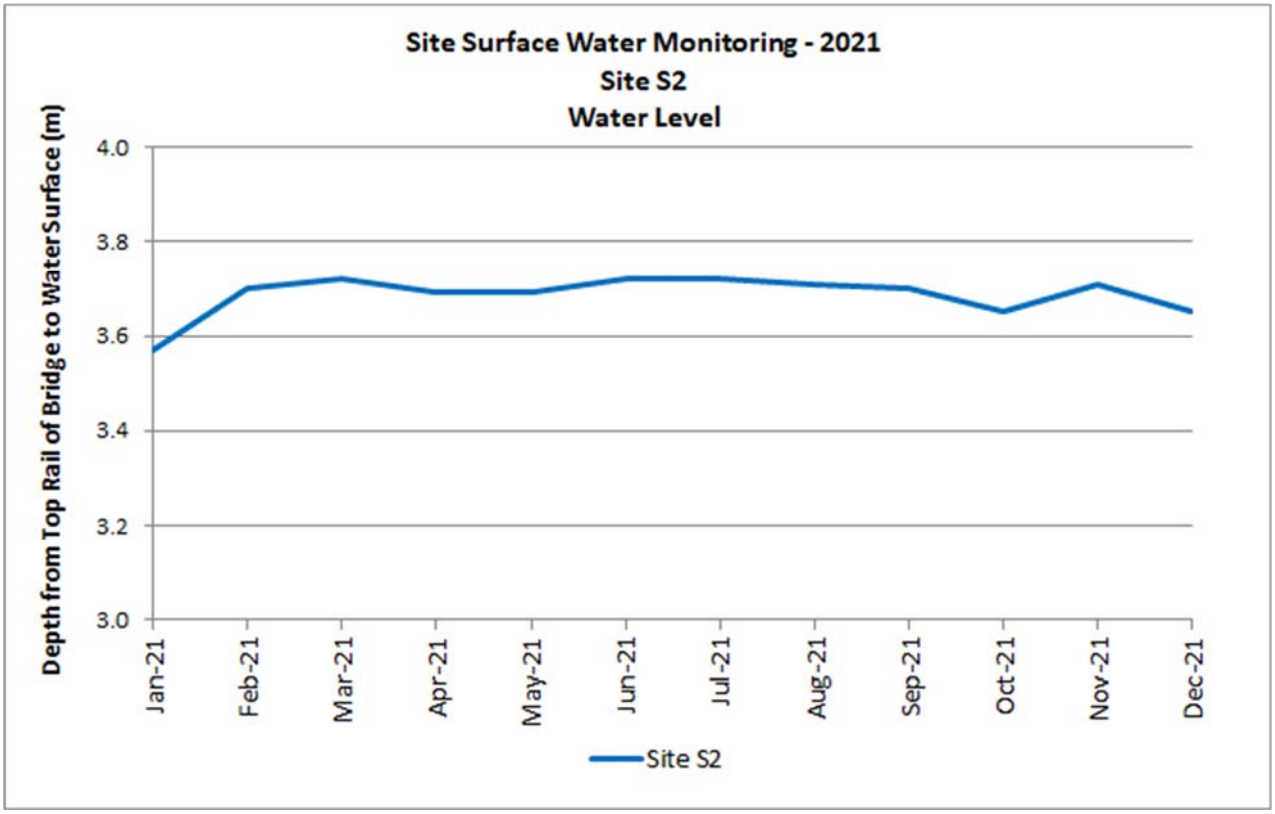

Figure 9 *Site Surface Water S2 – 2021 Water Level*

4.3 REVIEW & INTERPRETATION OF SURFACE WATER MONITORING RESULTS

4.3.1 EPL SURFACE WATER

The results of the water quality monitoring were generally compliant with respective water quality trigger levels. pH was compliant with the respective site-specific trigger values with the exception of the following:

- EPL Point 2 was below the lower pH trigger level value during the August 2021 monitoring event only.
- EPL Point 14 was below the lower pH trigger level value during two (2) of the three (3) water quality monitoring events.

Electrical conductivity was compliant with the respective trigger values at all locations during all monitoring events.

All EPL locations exhibited total suspended solids (TSS) concentrations below the trigger value during all monitoring events.

4.3.2 SITE SURFACE WATER

During the 2021 monitoring period, pH was intermittently outside the site-specific trigger value ranges at:

- S4 during six (6) of the twelve (12) monitoring events: the pH was above the upper trigger value in July 2021 and below the lower pH trigger value during five (5) of the twelve (12) monitoring events.
- S5 was below the lower pH trigger value during ten (10) of the twelve (12) monitoring events.

- S6 was below the lower pH trigger value during two (2) of the twelve (12) monitoring events.
- S7 was below the lower pH trigger value during seven (7) of the twelve (12) monitoring events.

During the 2021 monitoring period, electrical conductivity intermittently exceeded the site-specific trigger values at:

- S1 during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2710µS/cm, observed during March 2021.
- S3 during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2510µS/cm, observed during March 2021.
- S5 during one (1) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1480µS/cm, observed during March 2021.
- S6 during four (4) of the twelve (12) monitoring events. The greatest electrical conductivity level was 2660µS/cm, observed during October 2021.
- S7 during two (2) of the twelve (12) monitoring events. The greatest electrical conductivity level was 1350µS/cm, observed during March 2021.

Total suspended solids, and oil and grease concentrations were below the trigger values in all sampling locations throughout the 2021 monitoring period.

The variation of electrical conductivity with rainfall is presented in **Figure 10**: while historically conductivity generally increases in response to decreased rainfall, the March 2021 results were significantly higher than the majority of results in a month of significant rainfall. As such it is considered that that there are other contributions to the salinity of the water, potentially including sediment which is eroded by rainfall from the catchment.

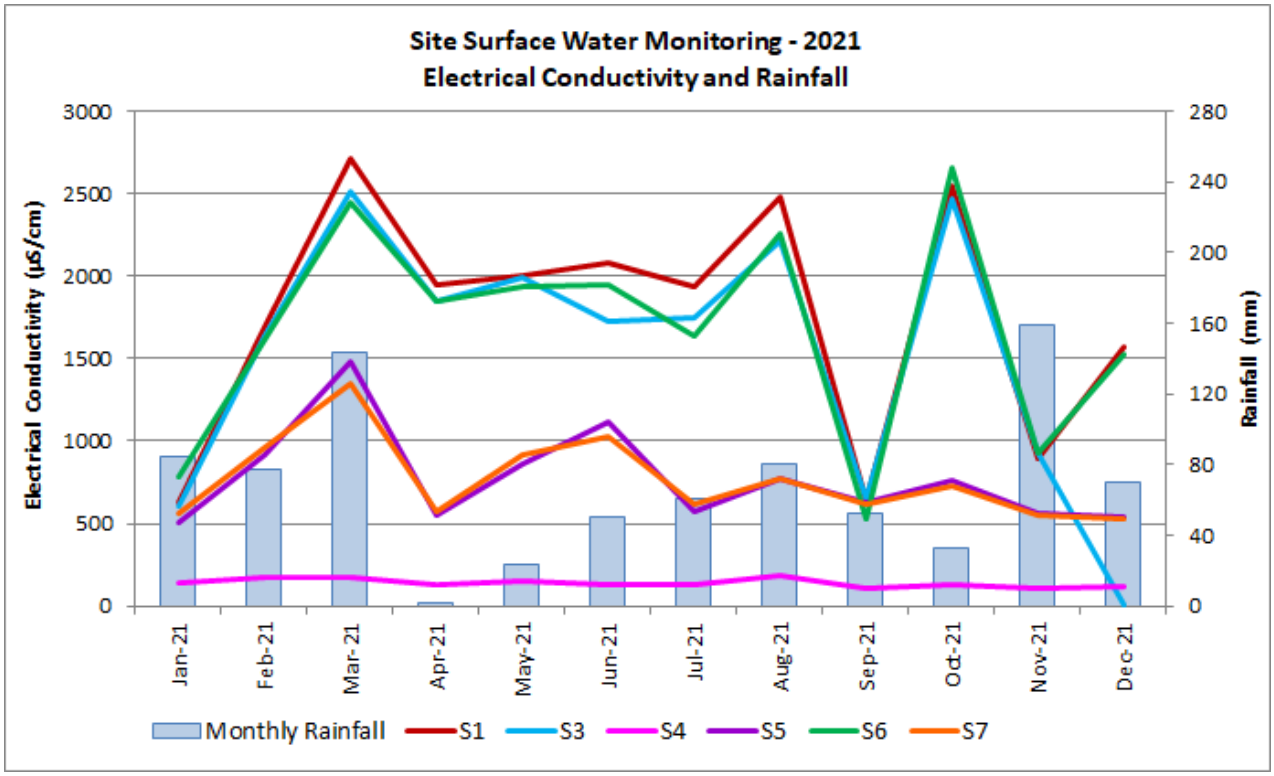

Figure 10 *Site Surface Water Electrical Conductivity and Monthly Rainfall*

An assessment undertaken by GHD (Ref [9]) proposed revised trigger levels for surface water. The investigation indicated that surface water sites EPL Point 2, S1 are considered appropriate background sites for the purpose of assessing influences of PDM on water quality. Surface water site S4 is located within Coxs River, upstream of the confluence of Wangcol Creek and also does not receive any water from PDM. The revised trigger values (Ref [9]) are shown in **Table 31**.

Table 31 *Revised Surface Water Trigger Values (Ref [9])*

pH trigger level[a]	6.5 – 8.0
Electrical conductivity (µs/cm)	5592
TSS (mg/L)	25

[a] pH trigger level is exceeded if the pH is outside the nominated range.

The trigger values presented in **Table 31** are applicable to all PDM surface water monitoring sites, noting that EPL Point 2, S1 and S4 are not influenced by activities at PDM.

At the time of writing of this report, the revised trigger values shown in **Table 31** have been utilised alongside the approved trigger values in **Table 19**.

Water quality within Wangcol Creek and Coxs River was generally within the revised surface water trigger values (refer **Table 31**) with the exception of the following:

- S1 was outside of the pH trigger range during the September and December 2021 monitoring events.
- S4 outside of the pH trigger range during the July 2021 monitoring event.
- S5 was outside of the pH trigger range for two (2) of the twelve (12) monitoring events (June and September 2021).
- S6 was outside of the pH trigger range for one (1) of the twelve (12) monitoring events (September 2021).
- S7 was outside of the pH trigger range for four (4) of the twelve (12) monitoring events (January, April, July and September 2021).

Electrical conductivity was below the revised trigger value at all locations during the 2021 reporting period.

5 METEOROLOGICAL MONITORING

The meteorological monitoring requirements of EPL 4911 (Ref [1]) are presented in **Table 32**.

Table 32 *EPL Meteorological Monitoring Requirements*

Parameter	Units of Measure	Frequency	Averaging Period
Air temperature	°C	Continuous	1 hour
Wind direction	°	Continuous	15 minute
Wind speed	m/s	Continuous	15 minute
Sigma theta	°	Continuous	15 minute
Rainfall	mm	Continuous	15 minute
Relative humidity	%	Continuous	1 hour

5.1 METEOROLOGICAL MONITORING DATA SUMMARY

Meteorological monitoring was undertaken for the majority of the year from a meteorological monitoring station situated at PDM. From the 10th November 2021 the EPL 4911 (Ref [1]) was amended to change the location of the monitoring station to Mt Piper Power Station. Data from this station was also used for July and August 2021 due to malfunctions with the PDM meteorological station.

Each station presents data for wind speed, wind direction, temperature at 10m height, temperature at 2m height, rainfall, humidity, solar radiation, sigma theta and evapotranspiration. There are some differences in the time intervals and grouping of data between the weather stations however the requirements in **Table 32** are satisfied with either station.

Details of weather data recorded for the period January to December 2021 are summarised in **Table 33**.

Table 33 *Meteorological Monitoring Summary Data 2021*

Month	Rainfall (mm)	Cumulative Rainfall (mm)	No of Rain Days/ Month	Air Temp. @ 2m (°C)			Air Temp. @ 10m (°C)			Sigma theta (°)			Relative Humidity (%)			Wind Speed (m/s)			Modal Wind Direction
				Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	
Jan	84.2	84.2	11	18.3	6.9	35.8	17.8	7.1	34.4	38.5	3.4	103.0	73.2	15.1	101.9	1.6	0.0	16.1	ESE
Feb	77.0	161.2	17	17.7	7.3	30.5	17.2	7.5	28.6	38.3	4.6	100.5	81.1	25.1	101.9	1.6	0.0	12.1	ESE
Mar	143.2	304.4	16	15.7	2.9	30.1	15.4	2.9	28.6	41.2	6.8	103.3	81.6	15.4	101.9	1.6	0.0	12.0	ESE
April	1.6	306.0	7	10.9	-2.8	29.7	10.8	-2.8	28.6	40.5	2.2	102.1	76.1	18.6	101.9	1.3	0.0	12.3	W
May	23.2	329.2	12	8.2	-5.8	22.3	8.1	-5.8	21.4	38.5	2.6	103.0	83.8	22.1	101.9	1.3	0.0	14.9	SE
June	50.0	379.2	14	5.8	-4.9	18.6	5.8	-4.9	17.6	34.2	5.1	102.1	87.1	23.5	101.9	1.8	0.0	12.5	WNW
July*	60.6	439.8	22	5.1	-6.8	17.0	5.2	-4.8	16.7	23.9	0.0	100.0	82.6	5.8	99.9	2.2	0.0	15.1	W
Aug*	80.8	520.6	22	5.1	-4.5	20.0	5.2	-2.7	19.6	20.3	0.0	100.0	82.6	3.6	99.8	2.3	0.0	11.2	SW
Sept	52.6	573.2	7	9.0	-4.5	23.5	8.9	-4.4	22.0	33.7	1.0	102.5	73.1	6.8	101.9	2.0	0.0	17.0	WNW
Oct	32.6	605.8	12	12.0	-0.4	29.7	11.6	-0.6	28.2	36.2	4.6	102.1	74.3	11.7	101.9	1.9	0.0	16.2	WNW
Nov	158.8	764.6	18	14.0	2.4	26.4	13.5	2.4	24.1	35.9	6.6	103.8	81.9	27.7	101.9	1.9	0.0	15.3	WNW
Dec*	70.1	834.7	15	16.5	4.1	29.9	16.7	5.0	29	24.2	0.0	100.0	73.7	0.0*	101.4	1.9	0.0	18.5	SW
TOTAL	834.7	173	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Minimum	1.6	7	-	*-6.8*	-	-	*-5.8*	-	-	*0.0*	-	-	*0.0**	-	-	*0.0*	-	-	-
Maximum	158.8	22	-	-	*35.8*	-	-	*34.4*	-	-	*103.8*	-	-	*101.9*	-	-	*18.5*	-	-

Note that data was missing for approximately twelve (12) hours on 16th April

Note that June rainfall were manually adjusted: refer **Section 5.2**.

* July and August data from Mt Piper Power Station records due to Pinedale weather station malfunction

* December data from Mt Piper Power Station records following EPL amendment. Negative humidity numbers were presented however are not considered viable data and have been ascribed a value of 0.

5.2 REVIEW OF METEOROLOGICAL MONITORING RESULTS

Rainfall was recorded across 173 days during the 2021 monitoring period.

The total rainfall recorded by the meteorological monitoring was 2,695.7mm, of which 1,911mm was recorded by the PDM meteorological station in June 2021. Examination of the data identified that the rainfall was significantly skewed by two (2) days of approximately 700mm each. This was considered erroneous and the data reviewed and manually corrected to 50mm consistent with the BOM data from the Lithgow meteorological station.

The 2021 rainfall was observed to be greater than the annual rainfall recorded during 2019 (350mm), 2018 (660mm) and 2017 (577mm) and generally consistent with the volume that was recorded during 2020 (892mm).

The maximum temperatures recorded during the reporting period were 35.8°C at the 2m sensor and 34.4°C at the 10m sensor, during January 2021. The lowest temperatures occurred in July at 2m (-6.8˚C) and in May at 10m (-5.8˚C).

Predominant wind directions at the PDM during 2021 was observed to be primarily from the north-westerly quadrant.

6 STREAM HEALTH & CHANNEL STABILITY MONITORING

6.1 STREAM HEALTH & CHANNEL STABILITY MONITORING SUMMARY

Schedule 3 Condition 27(b) of Project Approval PA 10_0041 requires performance criteria and a programme to monitor the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially be affected by the PDM. As defined in Schedule 3 Condition 27(b) of the Project Approval, the creeks and other water bodies that could potentially be affected by the project include Wangcol Creek, the Blue Lake and Coxs River.

A Channel Stability and Stream Health Monitoring programme is outlined in Section 4.6.5 of the PDM Water Management Plan (Ref [3]) for the purpose of monitoring channel stability and stream health and vegetation health of Wangcol Creek. In addition to the requirements of the Channel Stability and Stream Health Monitoring programme, the water bodies of Blue Lake and Coxs River have also been included in the monitoring programme, to satisfy the conditions outlined in the Project Approval (Ref [2]).

In accordance with the Channel Stability and Stream Health Monitoring programme, routine six-monthly assessments of Wangcol Creek, Blue Lake and Coxs River were undertaken in March and September 2021. The performance criteria utilised for the stream health assessment of each monitoring point is derived from the CSIRO Ephemeral Stream Assessment protocol (Ref [10]) which is reproduced in **Table 34**.

Results of the routine six-monthly assessments are presented in **Table 35** to **Table 39**. The locations of stream health monitoring sites are presented in **Drawing 2**, **Appendix 1**.

Visual assessments and photographic documentation of each site are also undertaken on a monthly basis detailing evidence of erosion, newly exposed soils, and vegetation disturbance. Results of this monthly monitoring indicate no evidence of erosion, newly exposed soils, or vegetation disturbance.

A stream health assessment of the Blue Lake site was not undertaken, as the site does not fit the requirements of the Ephemeral Stream Assessment protocol (Ref [10]), which has been developed for streams and drainage lines. Nevertheless, the Blue Lake is still included in monthly erosion and vegetation disturbance observation inspections.

Table 34 *Classification of Different Drainage Line States (CSIRO)*

Activity Rating (%)	Classification	Discussion of Classification
80 +	Very Stable	Drainage line is very stable and likely to be in original form. It is able to withstand all flow velocities that have previously occurred in this area and only minimal monitoring is required, predominantly after high flow events, to ensure condition does not deteriorate.
70-80	Stable	Drainage line is stable. It is important to assess this zone in relation to the other classifications and define whether this zone is moving from potentially stabilising to a more stable form, or if it is deteriorating from a very stable form. The nature of this relationship will identify the type of monitoring required.
60-69	Potentially Stabilising	Drainage line is potentially stabilising. Ongoing monitoring is required while rehabilitation works are not needed in the immediate future.
50-59	Active	Drainage line is actively eroding and remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.
< 50	Very Active	Drainage line is very actively eroding and immediate remedial actions are required. It is important to classify if erosion is caused primarily by upstream flows, lateral flows or unstable wall materials so that appropriate rehabilitation can be carried out.

Table Source: CSIRO Ephemeral Stream Assessment (CSIRO, undated)

Table 35 *Classification of Different Drainage Line State – Site SH1*

Location:		SH1	
Assessment Date:		**9 March 2021 & 3 September 2021**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake and/or disperse are exposed on less than 0.3m of wall height.
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland: low inflow rate, mostly diffuse.
2021 Overall Scores			
Classification of Drainage Line		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 36 *Classification of Different Drainage Line State – Site SH2*

Location:		SH2	
Assessment Date:		**9 March 2021 & 3 September 2021**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/ riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake and/or disperse are exposed on less than 0.3m of wall height.
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
2021 Overall Scores			
Classification of Drainage Line		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 37 *Classification of Different Drainage Line State – Site SH3*

Location:		SH3	
Assessment Date:		**9 March 2021 & 3 September 2021**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	3	Dense perennial plant cover, similar to vegetation on floodplain/ riparian zone. Characteristic wetland species composition. No observable plant burial by sediment.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	2	Actively eroding: slight undercutting, near vertical walls fans also eroding: depth = width
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	3	Materials that slake or disperse are exposed on greater than 0.3m and less than 1m of vertical height (the sum of multiple layers if present).
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
2021 Overall Score			
Classification of Drainage Line		21/32 **65%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

Table 38 *Classification of Different Drainage Line State – Site SH3A*

Location:		SH3A	
Assessment Date:		**9 March 2021 & 2 September 2021**	
Activity		**Rating**	**Explanation of Rating**
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	1	Little or no vegetation growing on drainage line walls.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	NA	This section of drainage line coated with spray-concrete.
	Longitudinal Morphology of Drainage Line	NA	
	Particle Size of Materials on Drainage Line Floor	NA	
Wall Materials	Nature of Drainage Line Materials	NA	
Bank Edge	Shape of Stream Bordering Slopes	2	Steep bank, 10-30º, permitting moderate to high velocity flows.
	Nature of Lateral Flow Regulation	4	Dense grassland. Low inflow rate, mostly diffuse.
2021 Overall Score			
Classification of Drainage Line		NA	Drainage line is considered stabile due to spray-concrete lining.

Table 39 *Classification of Different Drainage Line State – Site SH5*

Location:		SH5	
Assessment Date:		9 March 2021 & 2 September 2021	
Activity		Rating	Explanation of Rating
Vegetation	On Drainage Line Floor	1	Little or no vegetation growing on drainage line floor.
	On Drainage Line Walls	2	Any vegetation present is annual or short-lived: partial burial of plants by recently deposited sediment is evident.
Profile of D/L	Shape and Aspect of Drainage Line Cross Section	3	Potentially stabilising. Side walls become rounded and crusted alluvial fan at foot of side walls. Width > depth.
	Longitudinal Morphology of Drainage Line	3	Flat with a cohesive fine textured 'soil-like' bed.
	Particle Size of Materials on Drainage Line Floor	3	Material on floor is much larger in particle size and/ or denser than material on walls. Surface armouring (e.g., cobbles, competent country rock).
Wall Materials	Nature of Drainage Line Materials	4	Materials that do not slake or disperse are exposed on wall surface.
Bank Edge	Shape of Stream Bordering Slopes	3	Moderately sloped bank, 5- 10°.
	Nature of Lateral Flow Regulation	3	Sparse grassland / woodland with bare soil bank lip. Moderate flow rate, some highly focused inflow locations.
September 2021 Overall Score			
Classification of Drainage Line		22/32 **69%**	Drainage line is potentially stabilising. Ongoing monitoring is required however rehabilitation works are not needed in the immediate future.

6.2 REVIEW & INTERPRETATION OF STREAM HEALTH MONITORING RESULTS

The routine six-monthly assessment of channel stability, stream health and vegetation health of the Wangcol Creek monitoring locations (SH1, SH2, SH3 and SH3A) at PDM indicates the drainage line classification is potentially stabilising at locations SH1, SH2 and SH3. The drainage line at location SH3a is considered stable as this section of the creek is lined with spray concrete.

An assessment of the Coxs River monitoring site (SH5) indicated the drainage line is also considered to be potentially stabilising. It is noted that previously the Coxs River monitoring site was classified as stable however a loss of vegetation observed in October 2019 (attributed to the drought conditions during 2019) resulted in the downgrading of the classification.

The CSIRO Ephemeral Stream Assessment protocol Ref [10]) indicates ongoing monitoring of Wangcol Creek drainage line and Coxs River is required; however, rehabilitation works are not required in the immediate future.

7 NOISE MONITORING

Noise monitoring is undertaken in accordance with Project Approval (Ref [2]) conditions and the PDM Noise Management Plan (Ref [6]) on a quarterly basis. There is no specific requirement for monitoring in the EPL 4911 (Ref [1]) although limits are set (refer **Section 7.1**).

The purpose of noise monitoring is to ensure that any impact of operations on the surrounding sensitive receivers can be identified; and to show compliance with relevant legislative requirements.

As PDM is currently in care and maintenance, rehabilitation activities are considered to be the primary noise source.

7.1 NOISE ASSESSMENT CRITERIA

The conditional requirements within EPL 4911 (Ref [1]), Project Approval 10_0041 (Schedule 3, Condition 1, Ref [2]) are presented in **Table 40**.

Table 40 *Noise Assessment Criteria (Ref [1] and [2])*

Location		Noise Monitoring Location	Day LAeq (15 min) dBA	Evening LAeq (15 min) dBA
Residences 18, 32 and 33		NM1 - (EPL Ref No.33)	42	39
Residences 20-23, 25 and 27-29		N/A	42	36
Residences 8, 10-12 and14		NM2 - (EPL Ref No.14) NM3 - (EPL Ref No.10)	42	35
Residences 2, 5-7 and 35		NM4 - (EPL Ref No.5) NM6 - (EPL Ref No.2)	35	35
All other residences		NM5 - (EPL Ref No.4)	35	35
During construction and removal of the amenity bund	Residences 8, 10-12, 14, 18, 20-23, 25, 27-29 and 32 - 33	N/A	46	N/A

Noise generated by the project should not exceed the above criteria at any residence on privately-owned land or on more than 25% of any privately-owned land.

Day: The period from 7:00am to 6:00pm Monday to Saturday and 8:00am to 6:00pm Sundays and Public Holidays

Evening: The period from 6:00pm to 10:00pm Monday to Sunday

Noise survey locations are presented in **Drawing 1**, **Appendix 1**.

7.2 NOISE MONITORING DATA SUMMARY

Quarterly attended noise surveys of PDM for the 2021 monitoring period were undertaken during the care and maintenance stage of the site on the following dates:

- Quarter 1 – January to March, monitoring conducted 25 March 2021.
- Quarter 2 – April to June, monitoring conducted 20 May 2021.
- Quarter 3 – July to September, monitoring conducted on 8 September 2021.
- Quarter 4 – October to December, monitoring conducted on 13 December 2021.

The conditions and operations during noise surveys were considered to be representative of those undertaken on a normal daily basis.

Monitoring comprised two (2) consecutive 15-minute surveys conducted at each of the six (6) monitoring locations. Measurements were recorded in free field conditions with a Class 1 sound level meter (SLM) attached to a tripod at a height of 1.5 metres above the ground. A handheld calibrator was used to check the calibration of the SLM in between all measurement locations. All calibration checks were within the acceptable range of 94 dB±0.5.

Time based source coding was used during the attended noise surveys to record the overall noise levels and identify the sound sources that contributed to the sound environment at each of the six (6) noise monitoring locations. Sound sources audible during the attended surveys were classified as mine noise (from PDM) or from sources in up to four (4) categories. Contributions from these sources were determined by analysis of the time coded survey data using the SLM manufacturer's proprietary software. The software analysis determines the overall L_{Aeq} and L_n statistical values for the entire survey, as well as identifying the individual sound sources that were coded during the attended surveys and shows the energy average contribution and L_{min} and L_{max} values, for each source, for each of the 15 minute survey periods.

Results of attended noise surveys carried out during the 2021 monitoring period are presented in **Tables 48** to **51**. Meteorological conditions recorded during each noise survey are presented in **Table 52**; the 10m data has been sourced from the meteorological data (refer **Section 5**) subsequent to the completion of the noise surveys.

Table 41 *Attended Noise Survey – Quarter 1, March 2021*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road traffic, birds & other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
25/03/21	12:45	NM 1	54	57	50	NIL	42	54	Road Traffic 52 to 62 dB Birds & Other 45 to 50 dB
25/03/21	13:00	NM 1	54	57	50	NIL	42	54	Road Traffic 52 to 67 dB Birds & Other 45 to 50 dB
25/03/21	13:30	NM 2	51	54	45	NIL	42	51	Road Traffic 50 to 86 dB Birds & Other 40 to 54 dB
25/03/21	13:45	NM 2	49	52	43	NIL	42	49	Road Traffic 50 to 86 dB Birds & Other 40 to 54 dB
25/03/21	14:15	NM 3	59	63	44	NIL	42	59	Road Traffic 55 to 72 dB Birds & Other 45 to 55dB
25/03/21	14:30	NM 3	59	64	48	NIL	42	59	Road Traffic 55 to 72 dB Birds & Other 45 to 55dB
26/03/21	10:00	NM 4	38	39	32	NIL	35	38	Distant Road Traffic 33 to 43 dB Birds & Other 33 to 38 dB Loud Birds 43 to 53 dB
26/03/21	10:15	NM 4	45	39	32	NIL	35	45	Distant Road Traffic 33 to 43 dB Birds & Other 33 to 38 dB Loud Birds 48 to 65 dB
26/03/21	08:30	NM 5	56	48	33	NIL	35	56	Distant Road Traffic 33 to 40 dB Cars pass by 54 to 80 dB Birds 43 to 54 dB
26/03/21	08:45	NM 5	54	50	32	NIL	35	54	Distant Road Traffic 33 to 40 dB Car pass by 54 to 79 dB Birds & Other 46 to 68 dB
26/03/21	09:15	NM 6	53	47	31	NIL	35	53	Distant Road Traffic 33 to 38 dB Car & truck pass by 54 to 77 dB Birds & Other 37 to 55 dB
26/03/21	09:30	NM 6	53	46	33	NIL	35	53	Distant Road Traffic 33 to 38 dB Car & truck pass by 54 to 78 dB Birds & Other 37 to 48

* Nil – Noise source not audible during survey session

Table 42 *Attended Noise Survey – Quarter 2, May 2021*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
20/05/21	12:30	NM 1	57	62	34	NIL	42	57	Road Traffic 47 to 70 dB Distant traffic 36 to 38 dB
20/05/21	12:45	NM 1	58	63	37	NIL	42	58	Road Traffic 43 to 70 dB Distant traffic 36 to 38 dB
20/05/21	13:15	NM 2	47	51	36	NIL	42	47	Road Traffic 41 to 60 dB Birds 36 dB
20/05/21	13:30	NM 2	46	50	36	NIL	42	46	Road Traffic 42 to 60 dB Birds 41 to 43 dB
20/05/21	14:00	NM 3	61	65	41	NIL	42	61	Road Traffic 51 to 82 dB Wind on trees 41 to 43 dB
20/05/21	14:15	NM 3	63	66	44	NIL	42	63	Road Traffic 44 to 80 dB Birds 44 to 48 dB
20/05/21	14:45	NM 4	35	37	32	NIL	35	35	Distant Traffic 34 to 36 dB Birds 27 to 33 dB
20/05/21	15:00	NM 4	42	39	33	NIL	35	42	Distant Traffic 33 to 43 dB Birds 37 to 52 dB
20/05/21	16:13	NM 5	61	50	32	NIL	35	61	Distant Traffic 35 dB Cars pass by 80 to 83 dB Birds 41 to 43 dB
20/05/21	16:29	NM 5	63	57	34	NIL	35	63	Distant Traffic 35 to 37 dB Car pass by 85 dB Birds 50 dB
20/05/21	15:31	NM 6	53	46	36	NIL	35	53	Distant Traffic 45 to 80 dB Airplane 44 to 48 dB Birds 46 dB
20/05/21	15:47	NM 6	59	51	33	NIL	35	59	Car pass by 70 to 80 dB Distant Traffic 37 dB Wind on trees by 34 dB Birds 38 to 45

Nil – Noise source not audible during survey session

Table 43 *Attended Noise Survey – Quarter 3, September 2021*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			$L_{Aeq\ 15min}$	$L_{A10\ 15min}$	$L_{A90\ 15min}$				
08/09/21	08:00	NM 1	59	63	42	NIL	42	59	Road Traffic 65 to 73 dBA Distant traffic 39 to 45 dBA
08/09/21	08:15	NM 1	59	63	43	NIL	42	59	Road Traffic 63 to 75 dBA Distant traffic 39 to 45 dBA
08/09/21	08:40	NM 2	50	53	35	NIL	42	50	Road Traffic 48 to 66 dBA Birds 50 dBA Distant traffic 31 to 44 dBA
08/09/21	08:55	NM 2	49	53	33	NIL	42	49	Road Traffic 47 to 63 dBA Birds 50 dBA Distant traffic 31 to 44 dBA
08/09/21	09:20	NM 3	58	59	32	NIL	42	58	Road Traffic 48 to 78 dBA Birds 45 dBA Distant traffic 32 to 42 dBA
08/09/21	09:35	NM 3	57	60	35	NIL	42	57	Road Traffic 54 to 75 dBA Birds 48 dBA Distant traffic 35 to 42 dBA
08/09/21	10:00	NM 4	40	45	28	NIL	35	40	Barking Dog 42 – 49 dBA Distant Traffic 28 to 32 dBA
08/09/21	10:15	NM 4	42	47	30	NIL	35	42	Barking Dog 42 – 48 dBA Flock of birds 47 – 55 dBA Distant Traffic 28 to 32 dBA
08/09/21	11:25	NM 5	55	52	28	NIL	35	55	Cars pass by 78 to 80 dBA Residence noise 62 to 71 dB Distant Traffic 27 - 33 dBA
08/09/21	11:40	NM 5	60	45	27	NIL	35	60	Cars pass by 73 to 87 dBA Distant Traffic 27 - 33 dBA
08/09/21	10:45	NM 6	49	40	27	NIL	35	49	Cars pass by 76 to 77 dBA Birds 43 - 53 dBA Distant Traffic 27 to 33 dBA
08/09/21	11:00	NM 6	56	49	30	NIL	35	56	Cars pass by 71 to 81 dBA Distant Traffic 29 to 33 dBA

Nil – Noise source not audible during survey session

Table 44 *Attended Noise Survey – Quarter 4, December 2021*

Survey Date	Survey Start Time	Location	Overall			Pine Dale Mine $L_{Aeq\ 15min}$ Contribution	Pine Dale Mine $L_{Aeq\ 15min}$ Limit	Road Traffic, birds and other $L_{Aeq\ 15min}$ Contribution	Noise Sources & Level Ranges (Min to Max) dB(A)
			L_{Aeq} 15min	L_{A10} 15min	L_{A90} 15min				
13/12/21	08:11	NM 1	57	60	40	NIL	42	57	Road Traffic 55 to 67 dBA Birds 55 to 63 dBA Distant traffic 39 to 45 dBA
13/12/21	08:27	NM 1	55	59	40	NIL	42	55	Road Traffic 64 to 67 dBA Birds and Insects 36 to 52 dBA Distant traffic 39 to 45 dBA
13/12/21	08:48	NM 2	50	54	38	NIL	42	50	Road Traffic 46 to 60 dBA Birds 50 to 57 dBA Distant traffic 33 to 44 dBA
13/12/21	09:03	NM 2	49	53	37	NIL	42	49	Road Traffic 46 to 60 dBA Birds 50 to 57 dBA Distant traffic 33 to 44 dBA
13/12/21	09:23	NM 3	57	59	37	NIL	42	57	Road Traffic 58 to 78 dBA Birds 45 to 50 dBA Distant traffic 32 to 40 dBA
13/12/21	09:38	NM 3	57	60	40	NIL	42	57	Road Traffic 58 to 78 dBA Birds 45 to 50 dBA Distant traffic 32 to 40 dBA
13/12/21	10:00	NM 4	45	48	28	NIL	35	45	Birds 35 to 54 dBA Barking Dog 39 – 45 dBA Distant Traffic 30 to 35 dBA
13/12/21	10:15	NM 4	43	46	30	NIL	35	43	Birds 35 to 54 dBA Barking Dog 39 – 45 dBA Distant Traffic 30 to 35 dBA
13/12/21	11:20	NM 5	59	54	30	NIL	35	59	Cars pass by 45 to 75 dBA Birds 35 to 50 dBA Distant Traffic 27 - 33 dBA
13/12/21	11:35	NM 5	52	41	29	NIL	35	52	Cars pass by 45 to 75 dBA Birds 35 to 50 dBA Distant Traffic 27 - 33 dBA
13/12/21	10:44	NM 6	60	49	31	NIL	35	60	Cars pass by 45 to 79 dBA Birds 35 - 43 dBA Distant Traffic 27 to 35 dBA
13/12/21	10:59	NM 6	61	55	32	NIL	35	61	Cars pass by 45 to 83 dBA Birds 35 - 43 dBA Distant Traffic 27 to 35 dBA

Nil – Noise source not audible during survey session

Table 45 *Meteorological Conditions during Attended Noise Surveys*

Survey Date	Start Time	Location	Temp at 10m (°C)	Average Wind Speed (m/s)	Average Wind Direction (degrees)
25/03/21	12:45	NM 1	20	4.0	247
25/03/21	13:00	NM 1	19	3.6	235
25/03/21	13:30	NM 2	21	3.3	238
25/03/21	13:45	NM 2	20	5.0	275
25/03/21	14:15	NM 3	19	4.5	238
25/03/21	14:30	NM 3	19	3.3	225
26/03/21	10:00	NM 4	16	2.0	233
26/03/21	10:15	NM4	17	1.0	146
26/03/21	08:30	NM 5	14	1.0	292
26/03/21	08:45	NM 5	15	1.0	215
26/03/21	09:15	NM 6	16	1.3	207
26/03/21	09:30	NM 6	16	1.5	202
20/05/21	12:30	NM 1	15	2.0	235
20/05/21	12:45	NM 1	16	1.8	224
20/05/21	13:15	NM 2	17	2.8	241
20/05/21	13:30	NM 2	16	2.7	234
20/05/21	14:00	NM 3	17	1.7	199
20/05/21	14:15	NM 3	17	1.6	205
20/05/21	14:45	NM 4	16	1.8	195
20/05/21	15:00	NM4	15	1.4	225
20/05/21	16:13	NM 5	15	1.8	228
20/05/21	16:29	NM 5	14	1.1	201
20/05/21	15:31	NM 6	16	2.1	219
20/05/21	15:47	NM 6	15	1.1	205
08/09/21	08:00	NM 1	3	0.7	78
08/09/21	08:15	NM 1	6	0.5	91
08/09/21	08:40	NM 2	8	0.7	53
08/09/21	08:55	NM 2	10	0.7	64
08/09/21	09:20	NM 3	11	1.2	301
08/09/21	09:35	NM 3	13	1.2	357
08/09/21	10:00	NM 4	14	1.3	346
08/09/21	10:15	NM4	14	1.7	7
08/09/21	11:25	NM 5	14	1.6	219
08/09/21	11:40	NM 5	15	1.9	288
08/09/21	10:45	NM 6	16	1.5	335
08/09/21	11:00	NM 6	16	1.7	17

Survey Date	Start Time	Location	Temp at 10m (°C)	Average Wind Speed (m/s)	Average Wind Direction (degrees)
13/12/21	08:11	NM 1	15	0.6	18
13/12/21	08:27	NM 1	16	1.7	19
13/12/21	08:48	NM 2	17	1.5	24
13/12/21	09:03	NM 2	18	1.7	40
13/12/21	09:23	NM 3	18	1.1	74
13/12/21	09:38	NM 3	18	1.6	135
13/12/21	10:00	NM 4	19	0.4	35
13/12/21	10:15	NM4	18	1.8	292
13/12/21	11:20	NM 5	21	1.7	168
13/12/21	11:35	NM 5	21	1.9	235
13/12/21	10:44	NM 6	20	2.5	248
13/12/21	10:59	NM 6	20	1.0	147

The Industrial Noise Policy states “Wind can also create extraneous noise on noise-monitoring equipment; an upper limit of 5 m/s at the microphone position is commonly applied during noise measurement to reduce this effect”

7.3 REVIEW & INTERPRETATION OF OPERATIONAL NOISE MONITORING RESULTS

7.3.1 FIRST QUARTER 2021

Attended noise surveys for the January to March 2021 quarter were undertaken on 25 and 26 March at six (6) PDM noise monitoring locations. During the surveys, no activities were observed at the mine, with no traffic observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys showed that road traffic along Castlereagh Highway was typically the dominant noise source with bird calls, wind, and cars/ trucks contributing to the acoustic climate.

There were no audible noise contributions from PDM at the six (6) noise monitoring locations.

7.3.2 SECOND QUARTER 2021

Attended noise surveys for the April to June 2021 quarter were undertaken on the 20 May. During the surveys, no activities were observed at the mine, with no traffic observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys showed that road traffic along Castlereagh Highway was typically the dominant noise source with bird calls, wind, and cars/ trucks contributing to the acoustic climate.

There were no audible noise contributions from PDM at the six (6) noise monitoring locations.

7.3.3 THIRD QUARTER 2021

Attended noise surveys for the July to September 2021 quarter were undertaken on the 8 September. During the surveys, no activities were observed at the mine, with no traffic observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys showed that road traffic along Castlereagh Highway was typically the dominant noise source with bird calls and distant traffic contributing to the acoustic climate.

There were no audible noise contributions from PDM at the six (6) noise monitoring locations.

7.3.4 FOURTH QUARTER 2021

Attended noise surveys for the October to December 2021 quarter were undertaken on the 13 December. During the surveys, no activities were observed at the mine, with no traffic observed to be using the privately-owned Angus Place haul road located within PDM.

The surveys showed that road traffic along Castlereagh Highway was typically the dominant noise source with bird calls and distant traffic contributing to the acoustic environment.

There were no audible noise contributions from PDM at the six (6) noise monitoring locations.

7.3.5 OVERALL ASSESSMENT FOR 2021

The assessable sound levels from PDM were below the assessment criteria at the six (6) locations during the 2021 monitoring period.

It is a requirement under AS 1055 that the noise surveys also document levels of ambient sound resulting from non PDM sources; these are represented by the "Overall" $L_{Aeq\ 15\ minute}$ noise levels (refer **Table 41** to **Table 44**). In the surveys conducted for PDM, traffic from the Castlereagh Highway was observed to be the dominant noise source with natural sounds and more distant traffic significant contributors to the acoustic climate.

8 BLAST MONITORING

8.1 BLASTING OPERATIONS ASSESSMENT CRITERIA

The purpose of blast monitoring is to ensure that any impact of blasting operations on the surrounding land and nearby sensitive locations can be identified, and to show compliance with relevant legislative requirements. Conditional requirements within Project Approval 10_0041 (Schedule 3, Condition 8) and Environment Protection License (EPL 4911) are presented in **Table 46**.

Table 46 *Blasting Operations: Compliance Requirements*

Location	Airblast overpressure (dB (Lin Peak))	Ground vibration (mm/s)	Allowable exceedance
Residence on privately-owned land	115	5	5% of the total number of blasts over a period of 12 months
	120	10	0%

8.2 BLASTING OPERATIONS MONITORING DATA SUMMARY

Throughout the 2021 monitoring period there were no blast events conducted at the site as a result of the mine being in care and maintenance.

9 LIMITATIONS

This report has been prepared for Enhance Place Pty Limited in accordance with an agreement with RCA Australia (RCA). The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

This report has been prepared for the sole use of Enhance Place Pty Limited. The report may not contain sufficient information for purposes of other uses or for parties other than Enhance Place Pty Limited. This report shall only be presented in full and may not be used to support objectives other than those stated in the report without written permission from RCA Australia.

The information in this report is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation.

Environmental conditions including analyte concentrations can change in a limited period of time. This should be considered if the report is used following a significant period of time after the date of issue.

Yours faithfully

RCA AUSTRALIA

Fiona Brooker
Manager of Environmental Services

REFERENCES

[1] NSW EPA, *Environment Protection Licence 4911,* 22 March 2013 updated 10 November 2021.

[2] NSW Department of Planning, *Project Approval Application Number 10_0041.*

[3] Enhance Place Pty Ltd, *Water Management Plan for the Pine Dale Coal Mine,* August 2015.

[4] Enhance Place Pty Ltd, *Air Quality and Greenhouse Gas Management Plan for the Pine Dale Coal Mine,* November 2020.

[5] Enhance Place Pty Ltd, *Purple Copper Butterfly Monitoring Program for the Pine Dale Coal Mine,* August 2015.

[6] Enhance Place Pty Ltd, *Noise Management Plan for the Pine Dale Coal Mine,* August 2015.

[7] Standards Australia, *AS/NZS 3580.10.1:2016: Methods for sampling and analysis of ambient air: Determination of particulate matter – Deposited matter – Gravimetric Method*, 2016.

[8] Standards Australia, *AS/NZS 3580.1.1:2007: Methods for sampling and analysis of ambient air: Guide to siting air monitoring equipment*, 2007.

[9] GHD, *Pine Dale Groundwater and Surface Water Investigation Trigger Value Review Report,* September 2018.

[10] CSIRO, *Ecosystem Function Analysis – Ephemeral Stream Assessment*.

GLOSSARY

AHD	Australian height datum, based on a mean sea level.
dB	Unit of sound pressure level
DPIE	Department of Planning, Industry and Environment – formerly known as Department of Planning and Environment (2014 – 2019), Department of Industry (2015 – 2019) and the Office of Environment and Heritage (OEH, 2011 – 2019).
EPL	Environment Protection Licence
kg	kilogram, 1000 gram.
L_{A90}	Average A-weighted minimum noise level in a measurement period
L_{Aeq}	Average acoustic energy over the duration of the measurement, represented using the A-weighting filter.
L_{Aeqmax}	Maximum A-weighted noise level in a measurement period.
mg	milligram, 1/1000 gram.
NSW EPA	NSW Environment Protection Authority.
NTU	Nephelometric Turbidity Units: unit for the measurement of turbidity.
PDM	Pine Dale Mine
µg	microgram, 1/1000 milligram.

Chemical Compounds

EC	Electrical conductivity: a measure of the ability of a solution to conduct electricity.
PM_{10}	particulate matter less than or equal to 10 micrometres.
TSP	Total suspended Particulates
TSS	Total suspended solids.
Turbidity	Cloudiness of fluid

Attachment 1

Drawing 1 - Environmental Monitoring Locations

Drawing 2 - Stream Health & Channel Stability Monitoring Locations

EP PDH7/GW Site E

EP DDH7/GW Site A

EP DDH5/GW Site B

EP PDH1/GW Site C

EP DDH4/GW Site D

COXS RIVER

WANGCOL CREEK

Mount Piper Power Station

Water Cart Dam

PCB1

EPL Point 2

S1

PCB7

Weather Station

S2

HVAS

PCB2

PCB3

D1

EPL Point 3 (33)

Old Shaft

NM1

EPL Point 16

NM2

Wallerawang D/S

P6

D6

NM6

S4

S5

S6

EPL Point 13

P7

Blue Lake

D4

NM4

D3

NM3

S7

EP PDH4/GW

EP PDH3/GW

View Street

D5

NM5

Karawatha Drive

Castlereagh Highway

EPL Site 14

Cullen Bullen

State Forest

Portland

Pine Dale Mine

Newnes State Forest

1209 m

Wallerawang

Falnash State Forest

A32

Mount Lambie

Lidsdale State Forest

Rydal

Marrangaroo

Lithgow

Locality Plan
N.T.S.

LEGEND

- Noise monitoring location
- Depositional dust monitoring location
- Groundwater monitoring location
- Surface water monitoring location
- Historic High Volume Air Sampling Location
- Meteorological monitoring location (up until 10 November 2021)
- Meteorological monitoring location (from 10 November 2021)

Note: Aerial taken from ArcGis Base Map, September 10 2018

0 175 350 700 1,050 1,400
metres

N

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PINE DALE MINE
ENVIRONMENTAL MONITORING LOCATION PLAN

CLIENT	Enhance Place			RCA Ref	6880-1869-App B
DRAWN BY	FB	SCALE	1:24,000 (A3)	DRAWING 1	REV 1
APPROVED BY	FB	DATE	18/02/2022	OFFICE	NEWCASTLE

LEGEND

- Monitoring location
- Licence discharge point location
- Clean water diversion location

Note: Aerial taken from ArcGis Base Map, September 10 2018

0 37.5 75 150 225 300
metres

N

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

PINE DALE MINE
CHANNEL STABILITY, STREAM AND VEGETATIVE HEALTH MONITORING SITES

CLIENT	Enhance Place			RCA Ref	6880-1869-App B
DRAWN BY	FB	SCALE	1:5,000 (A3)	DRAWING 2	REV 0
APPROVED BY	FB	DATE	17/02/2022	OFFICE	NEWCASTLE

Appendix C

PDM 2021 Rehabilitation Monitoring Report
(Ref [4])

Pine Dale Mine

Rehabilitation Monitoring Report 2021

Report prepared by First Field Environmental
on behalf of EnergyAustralia

19 January 2022

Revision history		
Version	Date	Author
Draft	10 January 2022	Myrna Calumpong Michelle Evans
Final	19 January 2022	Michelle Evans

Cover image: Pasture

This report has been prepared by First Field Environmental for EnergyAustralia. The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report.

First Field Environmental

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1. Introduction

Pine Dale Mine is located in the Western Coalfields of NSW at Blackmans Flat, 15 km north of Lithgow on the northern side of Castlereagh Highway. The property is approximately 3 km east of Mount Piper Power Station.

Pine Dale Mine is managed in accordance with Project Approval 10_0041 and relevant subsidiary licenses and approvals. The *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2019) has been prepared in accordance with the above approval documentation and describes the following rehabilitation objectives:

- *"The rehabilitated landform is safe, stable, non-polluting and sustainable;*
- *Rehabilitation maintains or improves species diversity and habitat values of the Yarraboldy Extension Area, particularly the former Yarraboldy Open Cut Mine; and*
- *The agreed post mining land use is compatible with the surrounding land fabric and land use requirements."*

The preparation of this Rehabilitation Monitoring Report has been prepared to satisfy Schedule 3, Condition 55 of Project Approval 10_0041.

This report aims to identify successes and failures in rehabilitation in regard to agreed performance indicators and completion criteria. Recommendations are made in areas that could be improved.

2. Performance indicators

Table 1 identifies the performance indicators and completion criteria for Pine Dale Mine as determined by the *Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd, 2019).

Table 1 Performance indicators and completion criteria

Performance indicator	Completion criteria
Feral animal and priority weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.
Feral animal and priority weed control	Feral animals and priority weeds are controlled in accordance with legislation.
Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.
Access	Adequate access for fire-fighting is maintained on rehabilitation areas.
Habitat features	Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.
Vegetation health	More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.
	Native forest indicator species tree height and girth is within the range of analogue sites.
Soil loss	Net annual soil loss is comparable to analogue sites at year 10.

Performance indicator	Completion criteria
Erosion	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).
Woodland birds present	Evidence of woodland birds utilising rehabilitation areas.
Evidence of mammals	Evidence of target mammal species presence in rehabilitation areas.
Natural regeneration	Evidence of second generation of native forest indicator species from desired vegetation community. Evidence of natural regeneration of at least four pasture species at year 5.
Structure	Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.
Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.
Rural land capability	Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).
Species composition	Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites. Vegetation within the treed rehabilitation areas are established in accordance with the approved species mix. Approved pasture species mix is sown at the specified rate per hectare.
Weed presence	Weeds including African Lovegrass to comprise <10% of the pasture sward.
Ground cover	Ground cover (vegetation, leaf litter, mulch) >70% at year 5.

Source: Care and Maintenance Mining Operations Plan for Pine Dale Mine (Enhance Place Pty Ltd, 2019)

3. Weather conditions

The three months leading up to the survey were consistent with average temperatures (over a 15-year period of observations). The area received significantly higher than average rainfall in the three months leading up to the survey with winter rainfall of 220.6 mm compared with the average of 162.5 mm in the months of June – August (Bureau of Meteorology 2020). Table 2 presents regional rainfall data for the period commencing 2013.

Table 2 Rainfall (in mm) recorded January 2013 - September 2021

Year	Average	2013	2014	2015	2016	2017	2018	2019	2020	2021
January	85.0	87.4	9.2	156.2	142.0	37.2	49.0	154.6	46.8	82.8
February	63.2	149	85	21.2	28.8	12.2	65.2	21.4	131.6	87.4
March	91.9	43.2	155	39.4	69.6	141.4	56.6	84.2	115.0	154.0
April	42.9	26.8	63	158.2	6.2	21.2	13.6	1.0	93.6	0.6
May	22.6	23.6	14	25.2	26.0	32.6	12.6	37.2	47.8	25.2
June	62.4	87	43.2	24.8	173.4	19.6	34.6	16.2	39.0	51.8
July	35.3	19.6	25.6	44.6	91.4	6.6	5.4	10.8	77.8	60.6
August	46.7	22.4	56.4	43.8	52.2	41.8	38.0	18.0	103.8	81.4
September	42.4	44	35.2	9.8	118.6	4.2	67.6	52.0	57.0	43.2

Year	Average	2013	2014	2015	2016	2017	2018	2019	2020	2021
October	60.6	20.8	51.6	58.0	71.4	106.0	79.8	9.4	68.6	53.2
November	64.6	68.6	36.8	63.6	58.4	28.8	124.6	35.8	76.4	172.4
December	83.8	38.4	160.4	58.6	86.4	75.2	80.6	2.8	125.0	-
Annual	**696.77**	**630.8**	**735.4**	**703.4**	**924.4**	**526.8**	**627.6**	**443.4**	**982.4**	-

Source: Bureau of Meteorology (2021)

4. Survey methodology

4.1 Rehabilitation monitoring

Monitoring locations - Previous studies have seen the establishment of six monitoring transects; four transects are located within rehabilitated pastures while the remaining two transects are within treed rehabilitation areas. Additional transects exist as analogue sites in grazed pasture and an undisturbed naturally vegetated area of the property to provide benchmarks against which the pasture and treed rehabilitation areas are assessed. Monitoring locations are shown in Figure 1.

Photopoint monitoring - Coordinates for each transect and analogue site are provided in Appendix A. Each transect area contains previously established photo monitoring points. Photos taken from these points enable a visual comparison to photos from previous surveys and are provided in Appendix E.

4.2 Erosion and sedimentation

Evidence of erosion and sedimentation along and within the vicinity of each transect has been determined in accordance with *Best Practice Erosion and Sediment Control* (IECA 2006).

4.3 Soil loss

The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2019) recommends that net soil loss be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method has been found to be inadequate for determining soil loss in comparison with the widely used *RUSLE* (IEAC Australasia 2012). An estimation of soil loss at each transect site has been calculated using the *Revised Universal Soil Loss Equation* (RUSLE) (IEAC Australasia 2012). Values used for these calculations are presented in Appendix C.

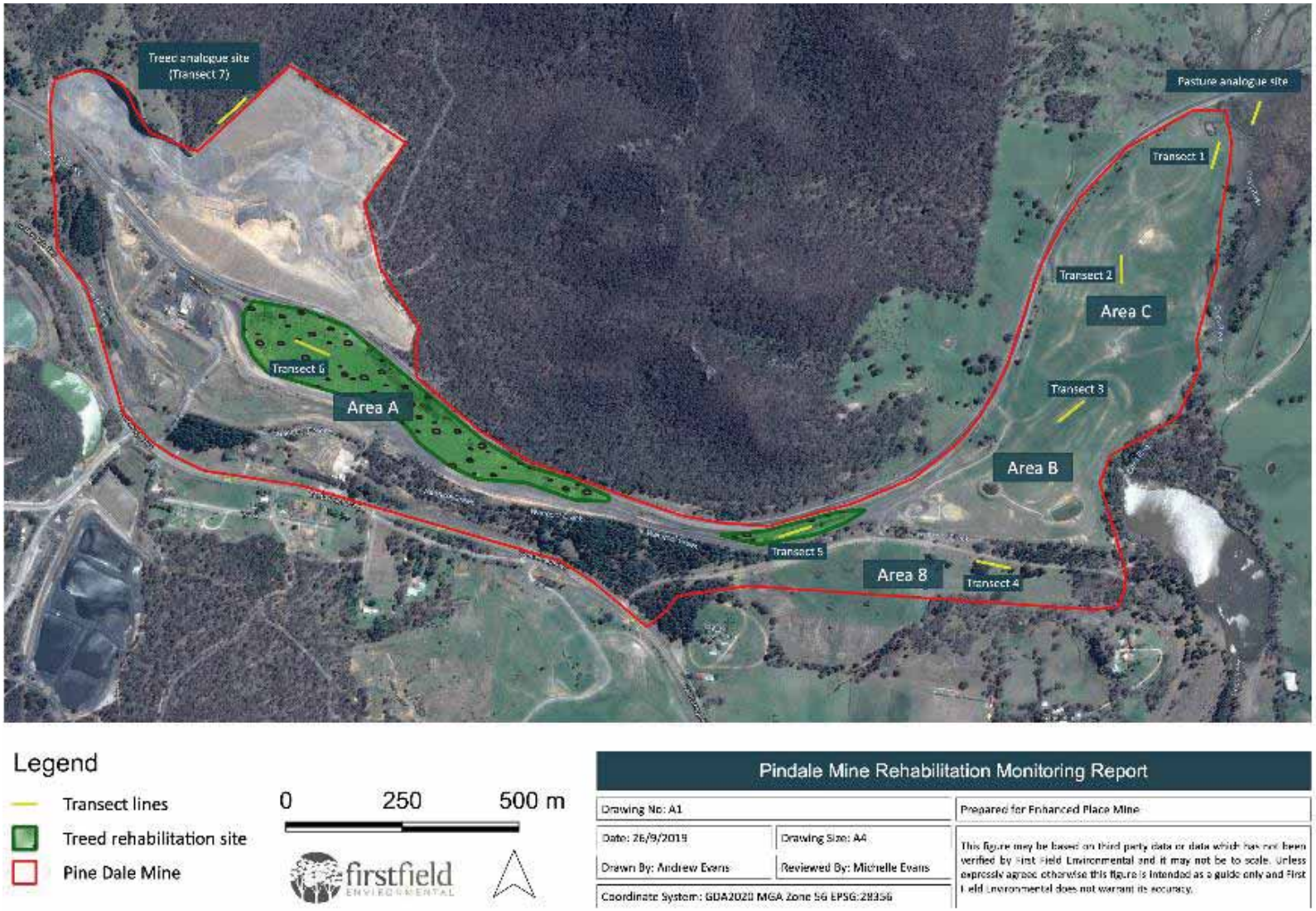

Figure 1 Monitoring locations

4.4 Vegetation assessment

Pasture rehabilitation areas – Cox's River seed mix was sown in 2010-2011 at Areas B, C and Area 8 at the following rates:

- 40% Fescue *(Festuca spp.)*
- 25% Cocksfoot *(Dactylis glomerata)*
- 20% Subterranean clover *(Trifolium subterranean)*
- 6% Perennial rye grass *(Lolium perene)*
- 5% White clover *(Trifolium repens)*
- 4% Phalaris *(Phalaris aquatica)*

The proportion of perennial grasses and annual legumes currently in evidence at pasture transects has been recorded and compared with the proportion at which these species were initially sown.

Tree rehabilitation areas – The *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2019) recommends that vegetation structure be determined in accordance with the *Ecosystem Function Analysis* (CSIRO 2008). This method does not adequately enable the identification of all completion criteria as required by the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2019). Vegetation health, natural regeneration, structure and species composition have instead been determined in accordance with the *Australian Soil and Land Survey Field Handbook* (CSIRO 2009).

4.5 Evidence of fauna and habitat features

Fauna - Evidence of woodland birds and native fauna utilising rehabilitated areas has been recorded through the observation of scats and tracks and sightings.

Habitat features - The presence of nesting boxes, crushed timber piles and rock pile clusters within the rehabilitation areas is noted.

4.6 Pest animal and weed survey

Pest animal presence - Evidence of feral animal presence across the rehabilitation areas has been determined through scat and trail identification.

Priority weeds - The location and extent of priority weeds as declared for the Central Tablelands Region (Central Tablelands Local Land Services 2019) have been recorded. Target weed species, particularly African Lovegrass were identified in accordance with field guides and botanical keys.

4.7 Fuel loads and fire-fighting access

Fuel loads - Fuel loads within and adjacent to rehabilitation areas have been assessed in accordance with the *Overall Fuel Hazard Assessment Guide* (Department of Sustainability 2010).

Fire-fighting access - Access trails within rehabilitated areas have been assessed in accordance with *Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007).

4.8 Rural land capability assessment

Pasture rehabilitation areas have been assessed in accordance with the *Land and Soil Capability Assessment* (OEH 2007).

4.9 Management input assessment

Land management activities - Land management and soil amelioration activities conducted in the past year have been identified through discussions with the land manager.

Feral animal and weed management - Evidence of feral animal and priority weed control activities have been sought from the land manager and audited against relevant legislative requirements.

5. Field survey results

Field survey was conducted on 29 November 2021 by a qualified ecologist. The survey revisited six transects representing rehabilitated pasture and treed areas as well as pasture and treed analogue sites.

5.1 Erosion and sedimentation

There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling) within the rehabilitation areas. The presence and extent of active surface erosion within transect areas is recorded in Appendix A.

Pasture rehabilitation areas - The pasture rehabilitation areas support evidence of minor wind erosion where groundcover is poorly established or absent.

Treed rehabilitation areas - Minor wind and rill erosion is occurring at treed rehabilitation areas.

Analogue sites - No active erosion was evident at the pasture analogue site in 2020. Minor surface erosion is occurring within the treed analogue site.

5.2 Soil loss

Estimated annual soil loss at rehabilitated transects is summarised in Table 3. Note that soil loss in transect 3 is affected by increased slope. Current tonnes per hectare soil loss in transect 3 is considered acceptable. Full calculations are provided in Appendix C.

Table 3 Estimated soil loss due to erosion

Estimated annual soil loss t/ha	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
	0.09 t/ha	0.09 t/ha	0.09 t/ha	0.18 t/ha	0.03 t/ha	0.36 t/ha	0.36 t/ha	1.10 t/ha

5.3 Vegetation assessment

Flora species identified along and within the vicinity of transects are listed in Appendix D.

Species composition at pasture rehabilitation areas – Pasture rehabilitation areas were established with a mix of ~70% perennial grasses and ~20% annual legumes consistent with species composition at the analogue pasture site. Examples of analogue pasture and Transect 2 pasture are shown in Figure 2 and Figure 3.

Figure 2 Pasture composition at the Pasture analogue site (2020)

Figure 3 Typical pasture composition at Transect 2

Groundcover at pasture rehabilitation areas – Rehabilitated pasture surfaces in each of the transect areas support living groundcover of >90%.

Areas currently exist within each pasture rehabilitation area where groundcover is sparse or absent. It is estimated that these areas account for less than 10% of each pasture area.

Natural regeneration at pasture rehabilitation areas – Natural regeneration of groundcover species is evident across all the pasture rehabilitation areas.

Species composition at treed rehabilitation areas – Treed rehabilitation areas were established in accordance with an approved species mix representing local native species.

Structure of vegetation at treed rehabilitation areas – Structural layers of vegetation at treed rehabilitation areas are not comparable to those of the treed analogue site.

In 2019 the treed analogue site was characterised by a canopy to 14 m height with 20% canopy cover over a sparse shrubby mid-storey to 3 m height and isolated shrubs to 1.5 m height in the understorey. Groundcover consisted of grasses and herbs with a cover of >95% (Figure 4).

The treed analogue site was affected by fire in 2020 which resulted in the loss of groundcover, shrubby understorey and canopy.

The tree analogue site was not surveyed in 2021 due to inaccessibility. Treed rehabilitation areas have therefore been compared to 2019 data from the treed analogue site.

Figure 4 Vegetation structure of treed analogue site (Transect 7) in 2019

Canopy cover is sparse in treed rehabilitation areas. A sparse mid-storey of isolated juvenile trees and shrubs exists over a sparse, low, shrubby understorey. Groundcover is a mix of broadleaf herbs and grasses. Changes in vegetation structure over time (as shown in Appendix B) are not considered significant.

Groundcover at treed rehabilitation areas – Annual living cover at transect 5 has increased since 2020, while litter cover was apparently absent. Total living cover remains at 80% however bare surface has increased to 20%. Transect 6 shows an increase of total living cover to >90%. Annual living cover has increased while litter cover has decreased. Bare surface has decreased to less than 10%.

Vegetation health at treed rehabilitation areas – Native forest indicator species are those that occur both in treed rehabilitation areas and the treed analogue site and provide an opportunity for comparison of growth between natural and rehabilitation conditions. Indicator species include native trees, shrubs and groundcovers.

More than 20% of native species recorded within the treed analogue site in 2019 are actively growing in the treed rehabilitation areas. These species are dominated by trees and shrubs and it is expected that groundcovers and herbaceous species will be able to colonise the treed rehabilitation areas once sufficient canopy cover is established. Trees and shrubs at transects 5 and 6 continue to increase in height and spread.

Natural regeneration of treed rehabilitation areas - There is no evidence of second-generation native forest indicator tree or shrub species on treed rehabilitation areas.

5.4 Evidence of fauna and habitat features

Habitat features – Nesting boxes have not been installed in treed rehabilitation areas. Habitat features were previously installed and were evident in treed rehabilitation areas prior to 2020. These included timber and rock pile clusters. The 2020 bushfire has reduced the amount of mulch and fallen timber at transects 5 and 6.

Fauna – Macropod and rabbit scats and tracks were evident throughout the property. Native woodland birds were observed landing within the treed vegetation areas. Magpies were observed on the ground within pasture areas A, B and C. Crimson Rosellas were observed in treed rehabilitation areas.

5.5 Feral animals and weeds

Feral animal and weed species presence and abundance is not considered likely to adversely impact the intended final land use. Feral animals and priority weeds are controlled in accordance with legislation. Weeds including African Lovegrass comprise <10% of the pasture sward. The presence or evidence of pests and weeds within and in the vicinity of each transect is recorded in Appendix A.

Pest animal presence – Rabbit scats were observed across the property. Rabbit density is considered low, with some evidence of shallow soil scraping and scats across each of the monitoring locations. No holes, burrows or dens were observed.

Priority and targeted weed species – Priority weeds observed during field survey are listed in Table 4.

Table 4 Feral animal and priority weed presence

Common name *Species name*	Location	Treatment
European rabbit *Oryctolagus cuniculus*	All locations	Landholders are obliged to control populations on their land.
African lovegrass *Eragrostis curvula*	All pasture locations	All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.

The presence of African lovegrass was noted at all rehabilitated pasture locations and occurred across less than 10% of the pasture area. These outbreaks have been subjected to ongoing chemical control.

5.6 Fuel loads and fire-fighting access

Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan, and adequate access for firefighting is maintained on rehabilitation areas.

Fuel loads – Fuel loads within Areas A, B and C and Area 8 are low and fuel hazard mitigation activities are not required at this time.

Firebreaks - The internal road provides a mineral earth firebreak between Area A and Pine Dale Mine infrastructure to the south, while the Coal Haul Road provides a mineral earth firebreak immediately to the north of Area A. The Coal Haul Road and internal road provide a mineral earth firebreak to the north and west of Areas B and C and Area 8. Private grazing land is located immediately adjacent to the east and south of Areas B and C and Area 8. The majority of this interface supports mature Pine and Eucalypt trees which would provide a barrier to wind-borne embers spreading to private grazing land during a fire event.

Fire-fighting access - Access to each of the rehabilitation areas is considered to be adequate. The Coal Haul Road is a private road located immediately to the north of Areas A, B and C and Area 8 and allows movement from within the former Wallerawang Power Station site, through Pine Dale Mine and to Mount Piper Power Station. An internal road is located immediately to the south of Areas A and B and to the north of Area 8. This road connects to Castlereagh Highway through the administration area of Pine Dale Mine. Area C is accessible by following the internal road through Area B. All access roads within rehabilitated areas are maintained in good condition and are suitable for the passage of Category 1 tankers, having a vertical clearance of >4 m and a width of >2.8 m (*Policy No. 2/2007 Fire Trails* (Bush Fire Coordinating Committee 2007)).

5.7 Rural land capability assessment

Pasture rehabilitation areas are assessed as being Land and Soil Capability Class V and are suitable for grazing. The limiting factors for land use are generally related to wind erosion hazard. Note that the area of Transect 4 is also subject to soil acidification hazard due to soil texture (Table 5).

Table 5 Rural land capability assessment of pasture areas

Class	Transect 1	Transect 2	Transect 3	Transect 4
Water erosion hazard class	2 1 - <3% slope	3 3 - <10% slope	4 10 - <20% slope, no gully erosion present	2 1 - <3% slope
Wind erosion hazard class	5 Moderate wind erodibility class of surface soil, high winds erosive power, high exposure to wind, average annual rainfall >500 mm			
Soil structural decline class	4 Fragile light textured soil - hardsetting			
Soil acidification hazard class	4 Very low texture /buffering capacity, pH 6.7 – 7.5 ($CaCl_2$)			5 Very low texture /buffering capacity, pH 4.0 – 4.7 ($CaCl_2$)
Salinity hazard class	1 Moderate to high recharge potential, low discharge potential, low salt store			
Waterlogging hazard class	2 0 – 0.25 months typical waterlogging duration, moderately well drained soils			
Shallow soils and rockiness hazard class	1 Nil rocky outcrop, soil depth >100 cm			
Mass movement hazard class	1 No mass movement present			

5.8 Management input assessment

Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.

Control of priority and targeted weed species has been undertaken across all rehabilitation areas as required and in accordance with the recommendations of the *Pine Dale Mine Rehabilitation Monitoring Report 2014* (First Field Environmental 2014).

6. Rehabilitation status

The status of performance indicators and completion criteria are summarised in Table 6.

Table 6 Status of completion criteria

Performance indicator	Completion criteria	Status
Feral animal and priority weed presence	Feral animal and weed species presence and abundance is not considered to adversely impact the intended final land use.	**Satisfactory – Continue to monitor**
Feral animal and priority weed control	Feral animals and priority weeds are controlled in accordance with legislation.	**Satisfactory – Continue to monitor**
Fuel loads	Fuel loads and fire breaks in and surrounding rehabilitation areas are assessed and maintained in accordance with the Bushfire Management Plan.	**Satisfactory – Continue to monitor**
Access	Adequate access for firefighting is maintained on rehabilitation areas.	**Satisfactory – Continue to monitor**
Habitat features	Habitat features are installed on native forest rehabilitation areas including: - Nesting boxes and salvaged hollows - Crushed timber spread over native forest rehabilitation areas - Rock pile clusters.	**Ongoing** - nesting boxes to be installed once trees are established.
Vegetation health	More than 75% of native forest indicator species are assessed to be healthy and growing at year 5.	**Complete**
	Native forest indicator species tree height and girth is within the range of analogue sites.	**Ongoing** – continue to monitor
Soil loss	Net annual soil loss is comparable to analogue sites at year 10.	**Complete**
Erosion	There are no significant erosion features that compromise landform stability or public safety (including gullying or tunneling).	**Complete**
Woodland birds present	Evidence of woodland birds utilising rehabilitation areas.	**Complete**
Evidence of mammals	Evidence of target mammal species presence in rehabilitation areas.	**Complete**
Natural regeneration	Evidence of second generation of native forest indicator species from desired vegetation community.	**Ongoing** – continue to monitor
	Evidence of natural regeneration of at least four pasture species at year 5.	**Complete**

Performance indicator	Completion criteria	Status
Structure	Structural layers (canopy, mid-storey, understorey and ground cover) are comparable to analogue sites.	**Ongoing** – continue to monitor
Management inputs	Management inputs (ameliorants, fertilisers, weed treatments) are within the range of analogue sites.	**Satisfactory – Continue to monitor**
Rural land capability	Pasture rehabilitation areas are assessed to have a Rural Land Capability Class VI or better (suitable for grazing).	**Complete**
Species composition	Establishment of pasture comprising approximately 70% perennial grass and 20% annual legume, representative of species at analogue sites.	**Complete**
	Vegetation within the treed rehabilitation areas is established in accordance with the approved species mix.	**Complete**
	Approved pasture species mix is sown at the specified rate per hectare.	**Complete**
Weed presence	Weeds including African lovegrass to comprise <10% of the pasture sward.	**Satisfactory – Continue to monitor**
Ground cover	Ground cover (vegetation, leaf litter, mulch) >70% at year 5.	**Complete**

7. Key findings

- Rainfall preceding the November survey was higher than the mean annual rainfall for the area and free water was observed on the surface of internal trails and in isolated patches across the pastures.
- Feral animal and weed control are satisfactory and are to continue to be monitored to ensure that the criteria remain satisfactorily met prior to completion of rehabilitation requirements.
- Fuel loads and access are satisfactory and are to continue to be monitored to ensure that the criteria remain satisfactorily met prior to completion of rehabilitation requirements.
- Nesting boxes are not installed in or adjacent to the treed rehabilitation areas.
- Vegetation health in treed areas is satisfactory and is to continue to be monitored to ensure that the criteria remain satisfactorily met prior to completion of rehabilitation requirements.
- African Lovegrass is present. The extent of establishment is to be monitored and the species is to be controlled to within less than 10% of the pasture sward.
- The pasture analogue site was not accessible during the 2021 survey due to the presence of livestock. 2020 survey data was utilised as a comparison to 2021 quadrat conditions.
- The treed analogue area located near Pine Dale Mine was affected by bushfire in 2020. The treed analogue area was not accessible during the 2021 survey due to hazardous conditions. 2019 survey data was utilised as a comparison to 2021 treed rehabilitation conditions.

8. Recommendations

The following recommendations for mitigation and management are consistent with intervention and adaptive management measures contained within the *Pine Dale Mine Care and Maintenance Mining Operations Plan* (Enhance Place Pty Ltd 2019).

- Continue to monitor performance indicators;
- Continue to spot-spray outbreaks of African Lovegrass; and
- Install nesting boxes once the treed rehabilitation areas contain adequate structure to support nesting woodland birds.

9. References

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OEH (2007) *Land and Soil Capability Assessment*, Office of Environment and Heritage, NSW

SLR (2014) *Soil Assessment and Recommendations for Rehabilitation Areas*, NSW

Appendix A
Survey data 2021

Pasture analogue site (Pine Dale Mine) 2020	
Easting	Northing
228300	6304880
228317	6304925
Landform and soils	
Slope	1 - <3% slope inclining to the northwest.
Erosion	Not observed.
Cracking soils	Not observed.
Surface drainage impediments	No significant drainage impediments.
Vegetation	
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.
Species richness	>30 herb and 15 grass species identified.
Cover classification	
Total living cover	90%
Annual living cover	20%
Perennial living cover	70%
Litter cover	-
Bare surface	10%

Transect 1 Pasture rehabilitation area								
Easting	Northing							
228621	6305093							
228594	6305048							
Landform and soils								
Slope	Transect located along a contour. 1 - <3% slope inclining to the northwest.							
Erosion	Minor wind erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.							
Species richness	>30 herbs and grasses identified, dominated by exotic species.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	80%	95%	90%	90%	90%	90%	>90%
Annual living cover	-	40%	47.5%	40%	40%	40%	20%	20%
Perennial living cover	-	50%	47.5%	50%	50%	50%	70%	70%
Litter cover	10%	-	-	<10%	10%	-	-	-
Bare surface	-	20%	5%	<10%	10%	10%	10%	<10%
Target weed presence								
African Lovegrass (*Eragrostis curvula)*	<10%							

Transect 2 Pasture rehabilitation area								
Easting	Northing							
228454	6304718							
228400	6304744							
Landform and soils								
Slope	Transect located along a contour. 3 - <10% slope inclining to the west.							
Erosion	Minor wind erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.							
Species richness	>30 herbs and grasses identified, dominated by exotic species.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	80%	90%	90%	90%	90%	90%	>90%
Annual living cover	-	40%	42%	40%	40%	40%	20%	20%
Perennial living cover	-	50%	48%	50%	50%	50%	70%	70%
Litter cover	10%	-	-	<10%	10%	-	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%	<10%
Target weed presence								
African Lovegrass (*Eragrostis curvula)*	<10%							

Transect 3 Pasture rehabilitation area								
Easting	Northing							
228267	6304532							
228306	6304560							
Landform and soils								
Slope	Transect located along a contour. 10 - <20% slope declining to the northwest.							
Erosion	Minor wind erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Groundcover of mixed native and exotic grasses and broadleaf herbs.							
Species richness	>30 herbs and grasses recorded, dominated by exotic species.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	80%	90%	90%	90%	90%	90%	>90%
Annual living cover	-	40%	46%	40%	40%	40%	20%	20%
Perennial living cover	-	50%	44%	50%	50%	50%	70%	70%
Litter cover	10%	-	-	<10%	10%	-	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%	<10%
Target weed presence								
African Lovegrass (*Eragrostis curvula)*	<10%							

Transect 4 Pasture rehabilitation area								
Easting			Northing					
228318			6304224					
228249			6304227					
Landform and soils								
Slope	Transect located along a contour. 1 - <3% slope declining to the west.							
Erosion	Minor wind erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Groundcover of mixed native exotic grasses and broadleaf herbs.							
Species richness	Diverse groundcover with >35 exotic herb and grass species recorded.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	80%	90%	90%	90%	90%	>90%	>90%
Annual living cover	-	40%	42%	30%	30%	40%	20%	20%
Perennial living cover	-	50%	48%	60%	60%	50%	70%	70%
Litter cover	10%	-	-	<10%	10%	-	-	-
Bare surface	-	20%	10%	<10%	10%	10%	10%	<10%
Target weed presence								
African Lovegrass (*Eragrostis curvula)*	<10%							

Transect 5 Treed rehabilitation area								
Easting	Northing							
227846	6304272							
227787	6304251							
Landform and soils								
Slope	Transect located along contour of mid slope inclining 10-20% to the north.							
Erosion	Minor wind and rill erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Sparse tree layer to 3 m height with isolated juvenile trees and sparse mixed native shrub species. Moderately dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.							
Species richness	Shrub layer consists of native species and juvenile trees. Groundcover dominated by exotic grasses. >15 species recorded.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	50%	75%	70%	70%	70%	80%	80%
Annual living cover	-	20%	12%	10%	10%	10%	10%	20%
Perennial living cover	-	30%	63%	60%	60%	60%	60%	60%
Litter cover	10%	10%	10%	10%	10%	15%	10%	-
Bare surface	-	40%	15%	20%	20%	15%	10%	20%
Target weed presence								
None observed.								

Transect 6 Treed rehabilitation area								
Easting	Northing							
226604	6304724							
226647	6304706							
Landform and soils								
Slope	Transect located along contour of mid slope inclining 10-20% to the northeast.							
Erosion	Minor wind and rill erosion observed on exposed soils.							
Cracking soils	Not observed.							
Surface drainage impediments	No significant drainage impediments.							
Vegetation								
Vegetation structure	Sparse tree layer to 5 m height with isolated juvenile trees and sparse mixed native shrub species. Moderately dense groundcover dominated by native and exotic grasses with scattered mixed native and exotic herbs.							
Species richness	Shrub layer consists of native species and juvenile trees. Groundcover dominated by exotic grasses. >20 species recorded.							
Cover classification	% cover at each observation							
	April 2014	September 2015	September 2016	September 2017	September 2018	September 2019	September 2020	November 2021
Total living cover	90%	70%	80%	80%	70%	70%	80%	>90%
Annual living cover	-	10%	12%	10%	10%	10%	10%	20%
Perennial living cover	-	60%	68%	70%	60%	60%	70%	70%
Litter cover	10%	10%	10%	10%	10%	15%	10%	-
Bare surface	-	20%	10%	10%	20%	15%	10%	<10%
Target weed presence								
None observed.								

Treed analogue site (transect 7)	
Easting	Northing
226801	6305097
226838	6305039
Landform and soils	
Slope	Transect located along contour of mid slope gently inclining to the north.
Erosion	Minor wind and rill erosion observed on exposed soils.
Cracking soils	Not observed.
Surface drainage impediments	No drainage impediments.
Vegetation	
Vegetation structure	Eucalyptus dominated canopy to 14 m high. No appreciable canopy cover due to recent fire. Very sparse shrub layer to 3 m height. 70% groundcover to 0.5 m height, dominated by native grasses with mixed native herbs.
Species richness	More than 10 tree species, dominated by *Eucalyptus* spp. Shrub layer of >14 native species. Diverse groundcover dominated by *Poa* spp. with mixed native herbs.
Cover classification	
Total living cover	70%
Annual living cover	10%
Perennial living cover	60%
Litter cover	20%
Bare surface	10
Target weed presence	
None observed.	

Appendix B
Vegetation assessment of treed areas

Vegetation assessment treed areas 2021

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>5	>10	>20
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. No significant canopy cover not assessable due to recent fire.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse. <10 species, 1-3 m height, No significant cover due to recent fire.
Groundcover	80% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. >90% cover.	70% cover. Mixed native herbs and grasses.
Non-native species	>5	>10	<5
Recruitment	Observed.	Observed.	Regeneration observed.
Organic litter	Thin, sparse.	Thin, sparse.	Thin, sparse.
Logs	Large logs placed along contours on upper slope. Some burned.	Large logs placed along contours on upper slope.	Sparse fallen timber from burned trees.

Vegetation assessment treed areas 2020

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>5	>10	>20
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. No significant canopy cover not assessable due to recent fire.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse. <10 species, 1-3 m height, No significant cover due to recent fire.
Groundcover	90% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 90% cover.	70% cover. Mixed native herbs and grasses.
Non-native species	>5	>10	<5
Recruitment	Observed.	Observed.	Regeneration observed.
Organic litter	Thin, sparse.	Thin, sparse.	Thin, sparse.
Logs	Large logs placed along contours on upper slope. Some burned.	Large logs placed along contours on upper slope.	Sparse fallen timber from burned trees.

Vegetation assessment treed areas 2019

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>10	>15	>25
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>14 species, 1-3 m height, 10% cover
Groundcover	80% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	>10 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2018

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>14 species, 1-3 m height, 10% cover
Groundcover	70% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	>10 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2017

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Includes juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Includes juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	70% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10	>10	<5
Recruitment	Not observed.	Not observed.	Observed.
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2016

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>10 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species.	Sparse, to 3 m height. Juvenile Eucalyptus and Acacia species.	>9 species, 1-2 m height, 10% cover
Groundcover	75% cover. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 80% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>15	>13, including *Senecio madagascariensis.*	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Very sparse layer of mulch remaining.	Very sparse layer of mulch remaining.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2015

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3 m height.	Sparse. To 3 m height.	>5 species, 12-14 m height. 20% canopy cover.
Understorey	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	Sparse, to 2 m height. Juvenile Eucalyptus and Acacia species. *Cassinia arcuata.*	>7 species, 1-2 m height, 10% cover
Groundcover	<40%. Mix of exotic grasses, native and exotic herbs.	Dominated by exotic grasses and herbs. Some native herbs present. 20% cover.	Dominated by *Poa* spp. >95% cover. Mixed herbs and grasses also present.
Non-native species	>10, including *Rubus fruticosus.*	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to 2 cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Vegetation assessment treed areas 2014

Transect	Treed rehabilitation area (transect 5)	Treed rehabilitation area (transect 6)	Treed analogue site (transect 7)
Vegetation type	Rehabilitated	Rehabilitated	Dry Sclerophyll Forest (grassy)
Native plant species richness	>30	>30	>50
Trees	Sparse. To 3m height.	Sparse. To 3m height.	>5 species, 12-14 m height. 40% canopy cover.
Understorey	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	Sparse. Juvenile Eucalyptus spp. present with Acacia shrubs.	>7 species, 1.5 - 3 m height, 35% cover
Groundcover	Sparse. Mix of exotic grasses, native and exotic herbs.	Sparse. Mix of exotic grasses, native and exotic herbs.	70% cover. Dominated by *Poa* spp. with mixed native herbs.
Non-native species	>10	>10	<10
Recruitment	Not observed.	Not observed.	Present
Organic litter	Thin mulch present.	Thin mulch present.	Well-developed to >2cm depth.
Logs	Large logs placed along contours on upper slope.	Large logs placed along contours on upper slope.	8 fallen logs of >20 cm diameter present along transect.

Appendix C
Estimation of annual soil loss

Annual soil loss factors	Pasture analogue site	Transect 1 (pasture)	Transect 2 (pasture)	Transect 3 (pasture)	Transect 4 (pasture)	Transect 5 (treed)	Transect 6 (treed)	Treed analogue site (transect 7)
Annual rainfall erosivity factor **(R)**	**1365** Bathurst							
Soil erodibility factor **(K)**	**0.03** Sandy loam /fine sandy loam				**0.025** Sandy clay-loam			**0.03** Sandy loam /fine sandy loam
Topographic factor **(LS)**	**0.17** 3% gradient, 5 m slope length			**0.34** 8% gradient, 5 m slope length	**0.09** 1% gradient, 5 m slope length	**0.89** 20% gradient, 5 m slope length		**0.52** 12% gradient, 5 m slope length
Cover and management factor **(C)**	**0.01** No appreciable canopy cover, 80-95% grassy groundcover					**0.01** 25% canopy cover of tall weeds or short brush, 80-95% grassy groundcover	**0.01** 25% canopy cover of tall weeds or short brush, 80-95% grassy groundcover	**0.04** No appreciable cover, 60-80% grassy groundcover
Erosion control practice factor **(P)**	**1.3** Compacted					**1.2** Consistent with trackwalking along contour		**1.3** Compacted
Annual soil loss due to erosion **(A)**	**0.09 t/ha**	**0.09 t/ha**	**0.09 t/ha**	**0.18 t/ha**	**0.03 t/ha**	**0.36 t/ha**	**0.36 t/ha**	**1.10 t/ha**

Appendix D
Species list

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Acacia dealbata subsp. *dealbata*					✓	✓	✓
Acacia nana					✓	✓	
Acacia parramattensis						✓	
Acacia rubida					✓	✓	✓
Acacia sp.					✓	✓	✓
Acacia spectabilis						✓	
Acacia ulcifolia							✓
Acaena novae-zelandiae							✓
Amaranthus sp.	✓	✓	✓	✓			
Anagalis arvensis	✓	✓	✓	✓			
Brassica spp.	✓	✓	✓	✓	✓	✓	
Bursaria spinosa subsp. *lasiophylla*					✓	✓	✓
Cassinia arcuata						✓	
Chenopodium sp.						✓	
Chloris truncata	✓	✓	✓	✓			
Cirsium vulgare	✓	✓	✓	✓	✓	✓	
Conyza bonariensis	✓	✓	✓	✓	✓	✓	
Cortaderia sp.						✓	
Cymbonotis lawsonianus				✓	✓	✓	
Cyperus eragrostis		✓					
Dactylis glomerata	✓	✓	✓	✓			
Eragrostis sp.	✓	✓	✓	✓			
Erodium cicutarium				✓			
Eucalyptus bensonii							✓

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Eucalyptus cypellocarpa						✓	
Eucalyptus dalrympleana subsp. *dalrympleana*							✓
Eucalyptus dealbata						✓	
Eucalyptus dives					✓	✓	✓
Eucalyptus machrorhyncha subsp. *cannonii*							✓
Eucalyptus mannifera subsp. *mannifera*							✓
Eucalyptus melliodora						✓	
Eucalyptus pulverulenta						✓	
Eucalyptus radiata subsp. *radiata*						✓	✓
Eucalyptus rubida subsp. *rubida*							✓
Eucalyptus sp.					✓	✓	✓
Euphorbia sp.	✓	✓	✓	✓			
Exocarpos cuppressiformis							✓
Festuca sp.	✓	✓	✓	✓			
Gamochaeta sp.	✓	✓	✓	✓	✓	✓	
Geranium molle var. *molle*	✓	✓	✓	✓			
Gnaphalium sphaericum	✓	✓	✓	✓			
Helminthotheca echioides				✓	✓		
Hypochaeris radicata	✓	✓	✓	✓	✓	✓	
Juncus spp.		✓					
Lepidium sp.	✓	✓	✓	✓			
Leptorhynchos sp.				✓			
Leucopogon sp.							✓

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Lissanthe strigose subsp. *subulata*							✓
Lolium perenne	✓	✓	✓	✓			
Lysimachia arvensis							✓
Malva neglecta	✓	✓	✓	✓			
Malva sp.	✓	✓	✓	✓	✓	✓	
Marrubium vulgare							✓
Medicago sp.	✓	✓	✓	✓			
Modiola carolina	✓	✓	✓	✓			
Oxalis corniculata	✓	✓	✓	✓			
Oxalis sp.	✓	✓	✓	✓	✓	✓	
Paspalum sp.	✓	✓	✓	✓			
Pattersonia sp.	✓	✓	✓	✓			
Persoonia laurina							✓
Persoonia mollis subsp. mollis							✓
Persoonia spp.							✓
Phalaris sp.	✓	✓	✓	✓			
Plantago lanceolata	✓	✓	✓	✓	✓	✓	
Poa annua	✓	✓	✓	✓			
Poa labillardierei							✓
Poa spp.	✓	✓	✓	✓			✓
Portulaca oleracea				✓	✓	✓	
Ranunculus sp.	✓	✓	✓	✓			
Romulea minutiflora	✓	✓	✓	✓			
Rorippa sp.	✓	✓	✓	✓			

Scientific name	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5	Transect 6	Treed analogue site (Pine Dale Mine transect 7)
Rumex acetosella	✓	✓	✓	✓			
Secale sp.	✓	✓	✓	✓			
Sida sp.	✓	✓	✓	✓	✓	✓	
Solanum sp.	✓	✓	✓	✓	✓	✓	
Sonchus oleraceus	✓	✓	✓	✓			
Stellaria media	✓	✓	✓	✓			
Taraxacum officinale	✓	✓	✓	✓			
Themeda australis	✓	✓	✓	✓			✓
Trifolium arvense	✓	✓	✓	✓			
Trifolium arvense	✓	✓	✓	✓			
Trifolium campestre	✓	✓	✓	✓			
Trifolium repens	✓	✓	✓	✓			
Trifolium subterraneum	✓	✓	✓	✓			
Vulpia sp.	✓	✓	✓	✓			

Appendix E
Photopoint monitoring to 2021

Transect 1 looking south 2014

Transect 1 looking south 2015

Transect 1 looking south 2016

Transect 1 looking south 2017

Transect 1 looking south 2018

Transect 1 looking south 2019

Transect 1 looking south 2020

Transect 1 looking east 2021 note that the transect 1 photo-monitoring point was inaccessible to the presence of livestock

Transect 2 looking southeast 2014

Transect 2 looking southeast 2015

Transect 2 looking southeast 2016

Transect 2 looking southeast 2017

Transect 2 looking southeast 2018

Transect 2 looking southeast 2019

Transect 2 looking southeast 2020

Transect 2 looking southeast 2021

Transect 3 looking southwest 2014

Transect 3 looking southwest 2015

Transect 3 looking southwest 2016

Transect 3 looking southwest 2017

Transect 3 looking southwest 2018

Transect 3 looking southwest 2019

Transect 3 looking southwest 2020

Transect 3 looking south 2021

Transect 4 looking west 2014

Transect 4 looking west 2015

Transect 4 looking west 2016

Transect 4 looking west 2017

Transect 4 looking west 2018

Transect 4 looking west 2019

Transect 4 looking west 2020

Transect 4 looking west 2021

Transect 5 looking west 2014

Transect 5 looking west 2015

Transect 5 looking west 2016

Transect 5 looking west 2017

Transect 5 looking west 2018

Transect 5 looking west 2019

Transect 5 looking west 2020

Transect 5 looking west 2021

Transect 6 looking east 2014

Transect 6 looking east 2015

Transect 6 looking east 2016

Transect 6 looking east 2017

Transect 6 looking east 2018

Transect 6 looking east 2019

Transect 6 looking east 2020

Transect 6 looking east 2021

Transect 7 looking east 2014

Transect 7 looking east 2015

Transect 7 looking east 2016

Transect 7 looking east 2017

Transect 7 looking east 2018

Transect 7 looking east 2019

Transect 7 looking east 2020

Quadrat 1 February 2010 (Cunningham 2012)

Quadrat 1 September 2011 (Cunningham 2012)

Quadrat 1 November 2012 (Cunningham 2012)

Quadrat 1 April 2014

Quadrat 1 September 2015

Quadrat 1 September 2016

Quadrat 1 September 2017

Quadrat 1 September 2018

Quadrat 1 September 2019

Quadrat 1 September 2020

Quadrat 1 November 2021