# CULLEN VALLEY MINE
# ANNUAL REVIEW

1 January – 31 December 2020

## FINAL

**March 2021**

# CULLEN VALLEY MINE
# ANNUAL REVIEW

1 January – 31 December 2020

## FINAL

**Document Status**

| Rev No. | Reviewer | | Approved for Issue | |
|---|---|---|---|---|
| | Name | Date | Name | Date |
| 1 | Rod Williams | 17/03/2021 | Graham Goodwin | 25/03/2021 |

# Annual Review Title Block

| | |
|---|---|
| Name of operation: | Cullen Valley Mine |
| Name of operator: | Shoalhaven Coal Pty Ltd (trading as Castlereagh Coal) |
| Development consent: | DA-200-5-2003 (as modified) |
| Name of holder of development consent: | Shoalhaven Coal Pty Ltd |
| Mining leases: | EL 5712, EL 6007, EL 8618, EL 8619, ML 1455, ML 1488, ML 1556, ML 1557 |
| Name of holder of mining leases: | Shoalhaven Coal Pty Ltd |
| Water licence: | 80WA706148 |
| Name of holder of water licence: | Shoalhaven Coal Pty Ltd |
| MOP start date: | 12 February 2021 |
| MOP end date: | 19 August 2025 |
| Annual Review start date: | 1 January 2020 |
| Annual Review end date: | 31 December 2020 |

**I, Graham Goodwin, certify that this audit report is a true and accurate record of the compliance status of Cullen Valley Mine for the period 1 January 2020 to 31 December 2020, and that I am authorised to make this statement on behalf of Shoalhaven Coal Company Pty Limited.**

Note.

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

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

| | |
|---|---|
| Name of authorised report officer: | Graham Goodwin |
| Title of authorised report officer: | Mining Engineering Manager |
| Signature of authorised report officer: |  |
| Date: | 25/03/2021 |

# Table of Contents

# Figures



# Plates



# Tables

# 1.0 Statement of Compliance

This Annual Review provides a summary of the Cullen Valley Mine (CVM) operations environmental performance over the period 1 January to 31 December 2020 (referred to hereafter as the report period).

It is noted that an Independent Environmental Audit (IEA) was undertaken during the 2016 reporting period. In accordance with Schedule 6, Condition 6 of the Development Consent, CVM is required to undertake an Independent Environmental Audit (IEA) every 5 years. The next IEA will be completed during the 2021 annual reporting period.

The IEA identified non-compliances with the EPL, Development Approval and the 2003 Environmental Impact Statement mitigation measure commitments. Further details regarding the status of the non-compliances identified by the IEA are located in **Appendix 1**. Actions to address non-compliances which were completed prior to the 2020 reporting period and are no longer active have been removed from the table as they are no longer relevant. A copy of the 2016 IEA is located on the CVM website.

The compliance status for the report period is summarised in **Table 1.1**. A total of four non-compliances occurred during the report period. The non-compliances recorded during the report period have been ranked according to the risk matrix included in **Table 1.2** and a brief description of each is provided in **Table 1.3**.

**Table 1.1 Statement of Compliance**

| Relevant approval | All conditions complied with? |
|---|---|
| Development Approval DA-200-5-2003 | No – Refer to **Table 1.3** |
| Environmental Protection Licence EPL 10341 | No – Refer to **Table 1.3** |
| Exploration Licence (EL) 5712 | Yes |
| EL 6007 | Yes |
| EL 8618 | Yes |
| EL 8619 | Yes |
| Mining Lease (ML) 1455 | Yes |
| ML 1488 | Yes |
| ML 1556 | Yes |
| ML 1557 | Yes |
| Water Access Licence 27898 | Yes |
| Water Supply Work Approval (80WA 706148) | Yes |

**Table 1.2 Compliance Status Key for Table 1.3**

| 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:<br>• Potential for serious environmental consequences, but is unlikely to occur; or<br>• Potential for moderate environmental consequences, but is likely to occur |
| **Low** | **Non-compliant** | Non-compliance with:<br>• Potential for moderate environmental consequences, but is unlikely to occur; or<br>• 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) |

*Source: Annual Review Guideline (NSW Government, 2015).*

**Table 1.3 Non-Compliances During the 2020 Report Period**

| Relevant Approval | Condition No. | Description (Summary) | Compliance Status | Comment and Proposed Action | Where Addressed in Annual Review |
|---|---|---|---|---|---|
| Development Approval DA-200-5-2003 EPL 10341 | Schedule 4 Condition 27 L6.1 | Two odour complaints associated with sub-surface heating areas at CVM. | **Non-compliant** | Two subsurface heating complaints were received by CVM during the report period (refer to **Section 9.2**). Shoalhaven Coal has implemented a number of management measures and undertake regular inspections of the area. Remediation works were completed during 2020 to manage and treat sub-surface heating. An updated Plan of Works to manage and further investigate subsurface heating at CVM has been submitted to the NSW Resources Regulator (NSW RR) for approval and will be implemented during 2021, if approved. | **Section 6.9** and **Section 9.2** |
| Development Approval DA-200-5-2003 | Schedule 4 Condition 25 | Failure to monitor $PM_{10}$ and TSP in accordance with the required sampling period. | **Non-compliant** | On 1, 7, 19 and 31 July 2020, the CVM high volume air sampler (HVAS) unit failed to monitor $PM_{10}$ levels for the required monitoring period (24hr +/- 1hr). The HVAS unit ran without issue on 13 and 25 July 2020.<br>An investigation into the cause identified the unit's timer mechanism was faulty. The HVAS unit was repaired and reinstalled in August 2020. The non-compliance was reported to the Department of Planning, Industry and Environment (DPIE) on 17 September 2020. | **Section 6.3.3.2** |
| Development Approval DA-200-5-2003 | Schedule 4 Condition 43 | Failure to undertake groundwater monitoring as outlined in the Water Management Plan (Umwelt, 2017). | **Non-compliant** | Groundwater monitoring was not undertaken at bores CP 131 and LD001 during the report period due to access restrictions and damage to the bore caused by the 2019-20 bushfires. Both CP 131 and LD001 are required to be sampled annually in accordance with the Water Management Plan (Umwelt, 2017). | **Section 6.4.2.3** |
| Development Approval DA-200-5-2003 | Schedule 6 Condition 8 | Only one Community Consultative Committee (CCC) meeting was held. | **Non-compliant** | During the 2018 CCC meeting it was agreed that only one CCC meeting would be held annually while CVM remains on care and maintenance. As such only one of the required two CCC meetings for CVM were held by Shoalhaven Coal during the reporting period.<br>As part of DPIE's review of the 2019 Annual Review and subsequent correspondence DPIE advised Shoalhaven Coal that:<br>• the matter to be a technical non-compliance<br>• noted as such in the Annual Review and<br>• expects the CCC to resume bi-annual meetings in the event of changes to the operational status of the mine or other extenuating circumstances. | **Section 9.1** |

# 2.0 Introduction

The CVM is located near the village of Cullen Bullen and approximately 30 kilometres (km) north-west of Lithgow in New South Wales (NSW) (refer to **Figure 2.1**).

Underground mining commenced at CVM formerly Tyldesley Colliery around 1904 and continued up until the 1960s when the workings were abandoned. Open cut operations were conducted on the site between 1948 and 1953. Modern open cut operations began at CVM after 19 August 1999 when the Lithgow Coal Company was granted Mining Lease (ML) 1455 by the then Minister for Mineral Resources. Mining commenced on site in May 2000 following a four month construction phase.

Following the identification of additional open cut coal reserves, a further Environmental Assessment and Development Application was lodged for an extension of the mine in April 2003 (i.e. DA-200-5-2003). The lease extension area lies along the western side of Tyldesley Hill adjacent to the main western railway line. Approval of the Development Application was granted by the then Department of Planning and Infrastructure (DPI) on 19 August 2004.

CVM has previously supplied coal under contract to the Mount Piper Power Station. However, with the failure of the mine to secure a supply contract in 2007, it was proposed to place the operation on a care and maintenance program until such time as sufficient contracts were awarded that would make the operation of the mine viable once again. Coalpac Pty Ltd purchased the Lithgow Coal Company Pty Ltd, which owned the CVM, in January 2008 and the previous plans to place the mine on care and maintenance were discarded. Recommencement of the open cut mining operations occurred in February 2008. Mining of the available approved area at CVM was completed in early December 2012. Any remaining stockpiled ROM coal was transported to the Invincible Colliery during February 2013 and processed through the Invincible Coal Crushing Plant. The CVM was then placed under care and maintenance.

Shoalhaven Coal purchased the mine from Coalpac's administrators in May 2015 and continues to operate the mine under a care and maintenance arrangement.

## 2.1 Mine Contacts

The Mining Engineering Manager is responsible to the regulatory authorities for all aspects of environmental management and compliance. The Mining Engineering Manager's contact details are included in **Table 2.1** below.

**Table 2.1 Key Personnel Responsible for Environmental Management of CVM During 2020 Report Period**

| Name | Contact details |
|---|---|
| Graham Goodwin<br>Mining Engineering Manager | Based at Invincible Colliery<br>Castlereagh Highway<br>Cullen Bullen, NSW 2790<br>0418 830 598<br>Graham.Goodwin@manildra.com.au |
| Cullen Valley Mine Website<br>(Copies of approvals, licences, management plans, monitoring and other information relating to the operation) | http://www.castlereaghcoal.com.au/ |

## 2.2 Annual Review Requirements

Condition 5 of Schedule 6 of the CVM Development Approval-200-5-2003 (as modified) requires an Annual Review (AR) to be prepared and submitted to the Director General of the Department of Planning, Infrastructure and Environment (DPIE) and relevant agencies. This report has been prepared in accordance with the *NSW Government Annual Review Guidelines* (NSW Government, 2015) and details the operational and environmental management activities at CVM during the report period. The reporting obligations contained in the Development Approval along with an explanation of where each requirement is addressed within this document are provided in **Table 2.2**.

**Table 2.2 Development Approval (200-5-2003) Conditions for the Annual Review**

| Conditions | | Addressed in Section |
|---|---|---|
| **Schedule 6 – Environmental Management, Monitoring, Auditing and Reporting: Annual Report** | | |
| **5.** | The Proponent shall submit an AEMR to the Director- General and relevant agencies. This report must: | This document |
| | a) identify the standards and performance measures that apply to the project; | Relevant sections throughout **Section 6.0** |
| | b) include a detailed summary of the complaints received during the past year, and compare this to the complaints received in the previous 5 years; | **Section 9.2** |
| | c) include a detailed summary of the monitoring results for the project during the past year; | Relevant sections throughout **Section 6.0** |
| | d) include a detailed analysis of these monitoring results against the relevant:<br>• impact assessment criteria/limits;<br>• monitoring results from previous years; and<br>• predictions in the EA; | Relevant sections throughout **Section 6.0** |
| | e) identify any trends in the monitoring results over the life of the development; | Relevant sections throughout **Section 6.0** |
| | f) identify any non-compliance during the previous year; | **Section 11.0** |
| | g) describe what actions were, or are being, taken to ensure compliance. | **Section 6.0, Section 11.0** |

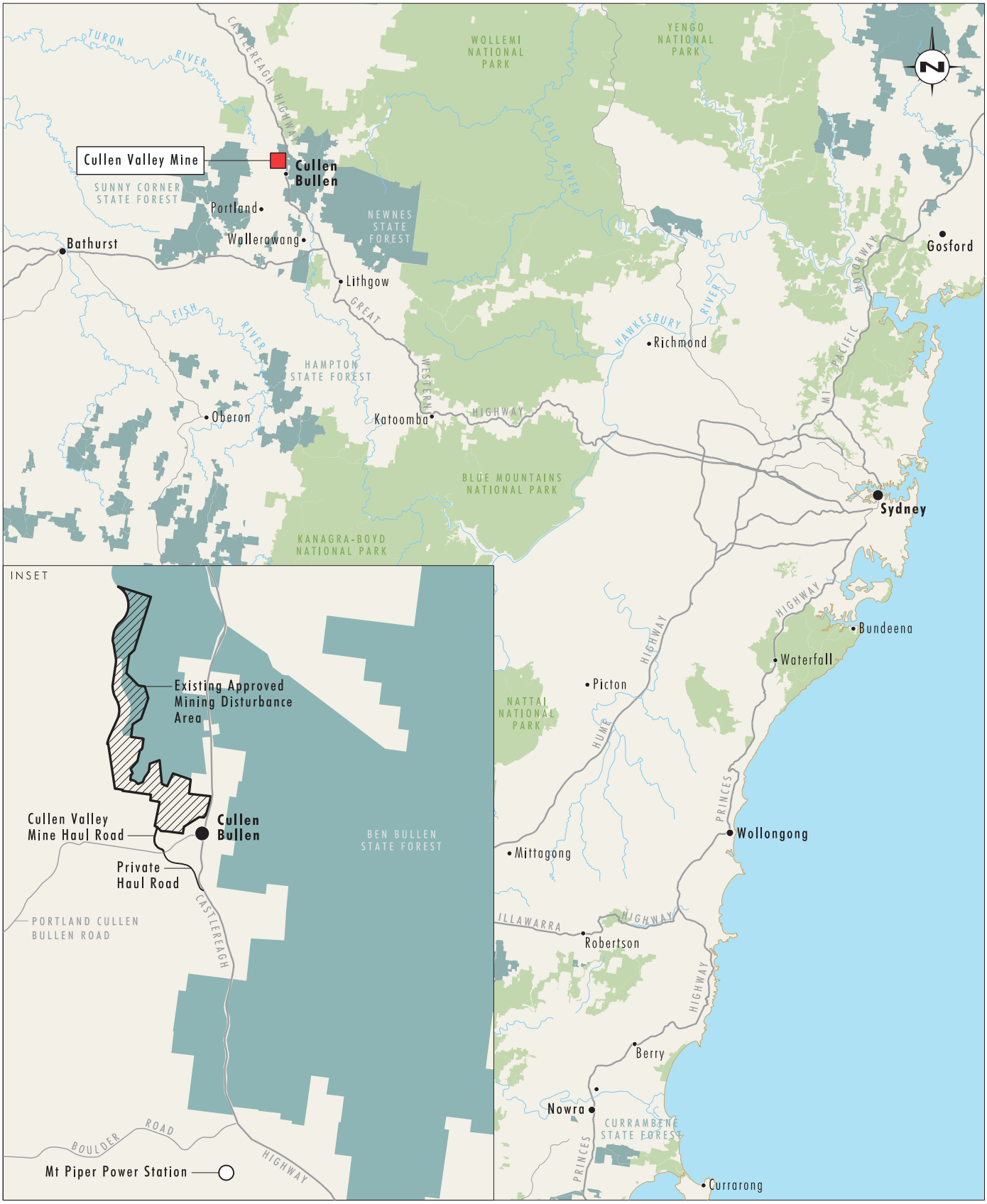



FIGURE 2.1

Locality Plan
Cullen Valley Mine

# 3.0 Approvals

The operations at CVM during 2020 were regulated by a range of leases, licences and approvals from various State government authorities as listed in **Table 3.1**.

**Table 3.1 Environmental Approvals Held by CVM**

| Approval | Date Granted | Expiry Date | Status |
|---|---|---|---|
| Development Approval (DA-200-5-2003) | 19 August 2004 | 19 August 2025 | Current |
| Environment Protection Licence (EPL) 10341 | 10 December (anniversary date) | Annually | Current |
| Exploration Licence (EL) 5712 | 10 April 2000 | 10 April 2019 | Renewal application submitted – determination pending. |
| EL 6007 | 8 October 2002 | 8 October 2024 | Current |
| EL 8618 | 12 July 2017 | 12 July 2023 | Current |
| EL 8619 | 12 July 2017 | 12 July 2023 | Current |
| ML 1455 | 19 August 1999 | 18 August 2020 | Renewal application submitted – determination pending |
| ML 1488 | 21 June 2001 | 20 June 2022 | Current |
| ML 1556 | 20 September 2004 | 19 September 2025 | Current |
| ML 1557 | 20 September 2004 | 19 September 2025 | Current |
| Water Supply Work Approval 80WA 706148 | 16 January 2012 | 5 July 2025 | Current |

## 3.1 Status of Management Plans

In accordance with the DA-200-5-2003, CVM is required to implement a range of environmental management plans. **Table 3.2** identifies the environmental management plans and the approval status of each plan at the end of the report period.

In accordance with the requirements of the *Protection of the Environment Operations Act 1997*, CVM also reviewed and updated the Pollution Incident Response Management Plan (PIRMP) during December 2020. The updated PIRMP has been placed on the Castlereagh Coal website.

**Table 3.2 Status of DA-200-5-2003 Management Plans**

| Management Strategy/Plan | Approved | Modified Plan Submitted | Approved | Approval Agency |
|---|---|---|---|---|
| Care and Maintenance MOP (Umwelt, 2020) (NB approved in early 2021) | Yes | 13 November 2020 | Yes | NSW RR |
| Environmental Management Plan (Coalpac, 2012c) | Yes | N/A | N/A | DPE |
| Flora and Fauna Management Plan (Coalpac 2012a) | Yes | N/A | N/A | DPE |
| Flora and Fauna Management Plan (Umwelt, 2017b) | N/A | 29 June 2017 | Yes | DPE |
| Species Management Plan (Clandulla Geebung) (Coalpac, 2012f) | N/A | 31 August 2017 | Yes | DPE |
| Environmental Monitoring Program (Coalpac, 2009) | Yes | N/A | N/A | DPE |
| Blast Management Plan (Coalpac, 2012d) | Yes | N/A | N/A | DPE |
| Fire Management Plan (Coalpac, 2012e) | Yes | N/A | N/A | DPE |
| CVM and Invincible Colliery Pollution Incident Response Management Plan (PIRMP), (Umwelt, 2020) | N/A | N/A | N/A | EPA |

Care and maintenance activities at CVM are undertaken in accordance with an approved Care and Maintenance (C&M) MOP (Umwelt, 2020). The CVM MOP was updated and submitted to the NSW Resources Regulator for approval on 13 November 2020 and was approved in early 2021.

# 4.0 Operations Summary

## 4.1 Mining Operations

CVM remained in care and maintenance and as such no production occurred during the report period. A summary of the production figures and mining activity for 2020 and the forecast production for 2021 is provided in **Table 4.1**.

**Table 4.1 Production Summary**

| Material | Approved Limit (specify source) | 2019 Previous reporting period (Actual) | 2020 This reporting period (Actual) | 2021 Next reporting period (forecast) |
|---|---|---|---|---|
| Waste rock/overburden | Not specified | 0 | 0 | 0 |
| Coal works/Coal mining | 0-2 Mtpa Coalworks (EPL)<br>0.5-2 Mtpa Mining for Coal (EPL)<br>1 Mtpa (DA) | 0 | 0 | 0 |
| Coarse reject | Not specified | 0 | 0 | 0 |
| Fine reject | Not specified | 0 | 0 | 0 |
| Saleable coal | Not specified | 0 | 0 | 0 |

### 4.1.1 Waste Rock/Overburden

As the site has been in care and maintenance during the report period, with no mining activities undertaken. Therefore, no waste rock or overburden was produced.

### 4.1.2 ROM Coal

As the site has been in care and maintenance during the report period with no mining activities undertaken. Therefore, no coal was handled or produced.

### 4.1.3 Coarse Reject

As the site has been in care and maintenance during the report period with no mining activities undertaken. Therefore, no coal reject material was produced.

### 4.1.4 Fine Reject (tailings)

As the site has been in care and maintenance during the report period with no mining activities undertaken. Therefore, no tailings were produced.

### 4.1.5 Saleable coal

As the site has been in care and maintenance during the report period with no mining activities undertaken. Therefore, no tailings were produced.

## 4.2 Other Operations

During the report period, other works undertaken included works to treat subsurface heating which included the excavation and compaction of surface material (refer to **Section 6.9**).

## 4.3 Section 240 Notice and Updated MOP

On 4 February 2020, the NSW Resource Regulator issued Shoalhaven Coal with a Section 240 notice, which was updated and reissued on 15 May 2020. Shoalhaven Coal received direction from the Section 240 notice to submit an updated MOP, including an updated Plan of Works for the containment and extinguishing of subsurface heating and an updated Rehabilitation Cost Estimate (RCE) to the NSW Resources Regulator. Additionally, the Section 240 notice directed CVM to address rehabilitation of subsurface heating areas, issues related to steep batters and slopes, control of surface water and prevention and management of gully erosion in the MOP.

The updated MOP and Plan of Works were submitted to the NSW RR for approval on 13 November 2020 and was approved in February 2021. The approved MOP period covers 2021-2025 and provides a framework for the investigation and treatment of subsurface heating areas, continued rehabilitation of areas impacted by subsurface heating and management of erosion areas associated with subsurface heating impacts. Works undertaken as part of the approved MOP will be reported in the 2021 Annual Review.

## 4.4 Next Report Period

Shoalhaven Coal will continue to investigate opportunities to recommence mining at CVM. Currently there are no coal mining operations proposed during 2021 and it is envisaged that the operation will remain in care and maintenance.

# 5.0 Actions Required from Previous Annual Review

Following submission of the 2019 Annual Review to DPIE on 31 March 2020, DPIE advised in correspondence dated 14 April 2020, that the Annual Review was considered to generally satisfy the requirement of the Approval in relation to Annual Reviews. Additionally, DPIE requested that the Annual Review be made publicly available on the company website. A copy of the 2019 Annual Review is available on the Castlereagh Coal website.

DPIE did not request any further action in relation to the 2019 Annual Review or future Annual Reviews, however, DPIE advised Shoalhaven that if operational activities change, Shoalhaven are required to recommence biannual CCC meetings.

# 6.0 Environmental Performance

In accordance with the Annual Review Guidelines (DPE, 2015), this section describes the environmental monitoring and management measures undertaken at CVM during the report period. **Section 3.1** details the environmental management plans which have been prepared for the operation.

A range of environmental monitoring is required to be undertaken by the Development Consent, EPL and CVM management plans. **Figure 6.1** shows the CVM environmental monitoring locations.

## 6.1 Summary of Performance Against EIS Predictions

CVM has been the subject of two Environmental Impact Statements (EIS) in the last 20 years of operations. The results of environmental monitoring conducted during the report period are compared to the predictions of these EIS's.

The Feldmast Coal Project for open cut and underground operations to the north-east and north-west of Cullen Bullen was assessed in the EIS dated February 1997 (International Environmental Consultants, 1997). The CVM Lease Extension Project involved expanded operations further to the north-west of the original mining area adjacent to the Wallerawang-Gwabegar Railway line and was assessed in the EIS dated April 2003 (International Environmental Consultants, 2003).

Environmental monitoring undertaken includes noise, air quality, surface water and groundwater quality, and biodiversity. Below is a summary of predictions from the two EIS's completed for the site. **Table 6.1** provides a summary of CVM environmental performance against the EIS predictions for the report period. It is noted that modelling undertaken for the respective EIS's assumed mining operations were being undertaken. As noted previously, CVM is in care and maintenance and there were no mining operations during the report period.

### 6.1.1 Noise Predictions

The Feldmast EIS (1997) predicted that with construction of the noise bund, noise from open cut operations was expected to result in an increase in existing background levels measured at the Hillcroft property (Hillcroft) of no more than 5 dB(A). The construction of a private access road between the mine and Mudgee Road to bypass Cullen Bullen was completed during the construction phase and was expected to minimise truck noise. The bypass around Cullen Bullen and noise bund were constructed, significantly reducing traffic and noise impacts on the town and nearby properties.

In the 2003 EIS and approved extension to mining operations, noise exceedances of 2-4 dB(A) were predicted to occur at Red Springs during temperature inversion conditions. Noise exceedances of 4-7 dB(A) were also predicted at Hillcroft during temperature inversion conditions. At Forest Lodge, exceedances of 1 dB(A) (calm), 5dB(A) (south wind) and 5dB(A) (temperature inversion) were predicted in Years 9 and 10 of the extension operations. Exceedances of 3 dB(A) (calm), 10dB(A) (south wind) and 5dB(A) (temperature inversion) were also predicted during years 9 and 10 at the 25 acre allotments to the north of the mine. *NB: These are exceedances of the 35 dB(A) criteria.*

### 6.1.2 Air Quality Predictions

The Feldmast EIS (1997) predicted annual average TSP concentrations from background levels plus mine emissions to be 48 µg/m$^3$ at the closest residences to the mine, which is well below the 90 µg/m$^3$ annual average goal. Predicted $PM_{10}$ concentrations were 24 µg/m$^3$ (background plus mine emissions) and this is well below the annual average goal of 30 µg/m$^3$. $PM_{2.5}$ concentrations from mine emissions were predicted to be 0.5 µg/m$^3$ at the closest residence.

Modelling of dust deposition in the worst case scenario predicted that no long-term adverse air quality impacts at the closest residential area as a result of mine operations.

The 2003 EIS predicted that nearby residences and those in Cullen Bullen were unlikely to experience unacceptable long-term impacts on air quality from the mine extension operations. It was predicted that short-term impacts could occur if emissions from the mine extension operations were combined with elevated levels from other sources.

### 6.1.3 Water Quality Predictions

Given the water management system contains and treats water within storage ponds prior to discharge, the Feldmast EIS (1997) predicted that EPA discharge criteria would be met. All water within the Lithgow Seam was proposed to be drained within the mining area. Groundwater systems below the Lithgow Seam were expected to be unaffected by the project.

The 2003 EIS predicted that the water management system for containment and reuse of all runoff from disturbed areas would ensure that EPA licence criteria for surface water quality would be met. The project was expected to use underground water within the old Tyldesley underground workings which collects subsurface water contained within the coal measures. Groundwater systems below the Lithgow Seam were expected to be unaffected by the project.

### 6.1.4 Groundwater Predictions

During the 2017 report period, a review of the groundwater regime in the vicinity of CVM was undertaken which resulted in the development of a standalone CVM Water Management Plan (Umwelt, 2017b).
For the purposes of this report, the results of the 2020 groundwater monitoring have been compared to the groundwater trigger levels contained in the CVM Water Management Plan (Umwelt, 2017b).

### 6.1.5 Biodiversity Predictions

Only one threatened plant species, Capertee Stringybark, was found to occur in the study area during the Feldmast EIS (1997). The EIS predicted that no local population of Capertee Stringybark would be placed at risk of extinction as a result of the proposed mining operations. The 2003 EIS made similar predictions and concluded that there would not be a significant effect on Capertee Stringybark as a result of the expansion.

The 1997 EIS predicted that the mining operations were unlikely to cause a significant impact on threatened fauna species found in the study area. Similarly, the 2003 EIS predicted that the expansion was unlikely to have a significant impact on threatened fauna.

A summary of the environmental performance of CVM during the report period as compared to predictions made in the EIS's is provided in **Table 6.1**.

**Table 6.1 Summary of Environmental Performance During 2020**

| Aspect | Development Approval criteria/ EA prediction | Performance during the report period | Trend/key management implications |
|---|---|---|---|
| **Noise** | Refer to **Section 6.1.1** | Noise performance is compliant with Development Approval criteria and conforms to EIS predictions.<br>Refer to **Section 6.5**. | No noise exceedance recorded during 2020.<br>Historic trends are shown in **Section 6.5**. |
| **Air Quality** | Refer to **Section 6.1.2** | Air Quality monitoring conforms to EIS predictions. All results complied with the air quality performance criteria.<br>Refer to **Section 6.3**. | A comparison to historic trends for air quality are shown in **Section 6.3** and **Appendix 2**. |
| **Water Quality** | Refer to **Sections 6.1.3** and **6.1.4** | Surface water quality performance is compliant with Development Approval criteria and conforms to EIS predictions.<br>Refer to **Section 6.4.2**.<br>Groundwater monitoring has been compared to trigger levels developed during 2017 in **Section 6.4.2**. | Groundwater monitoring was undertaken and is discussed in **Section 6.4.2** and **Appendix 3**. |
| **Biodiversity** | Refer to **Section 6.1.5** | Rehabilitation areas are generally progressing towards satisfactory completion. | The Biodiversity Monitoring Program continued during 2020 |

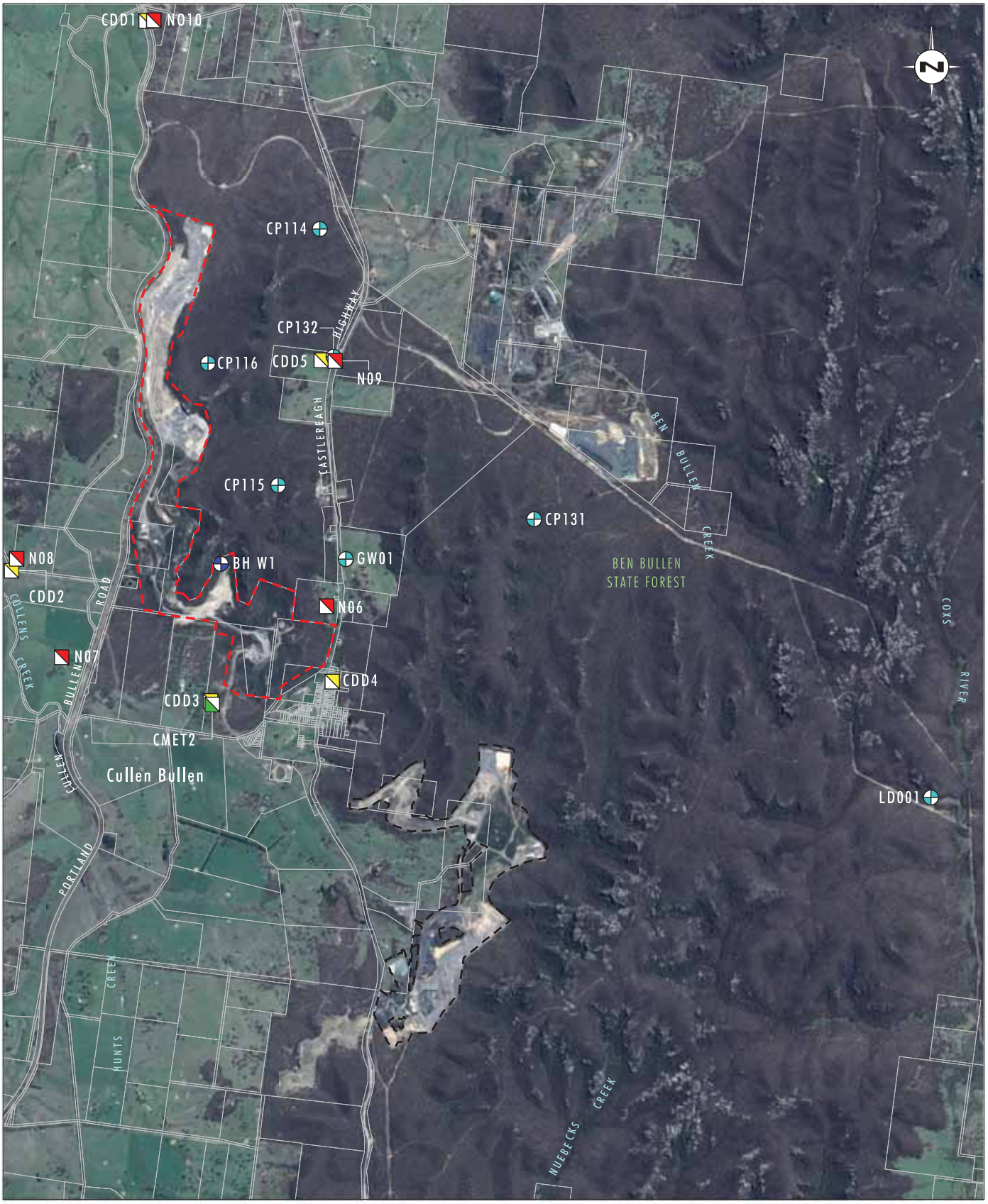



Image Source: Google Earth - CNES/Astrim (2016)

## Legend

- Existing Approved Mining Disturbance Area - Cullen Valley
- Existing Approved Mining Disturbance Area - Invincible
- Depositional Dust Monitoring Point
- Meteorological Station
- Noise Monitoring Point
- Surface Water Monitoring Point
- Groundwater Monitoring Point

FIGURE 6.1

# Environmental Monitoring Locations Cullen Valley Mine

## 6.2 Meteorological Monitoring

Meteorological monitoring is undertaken at CVM. The CVM weather station (CMET2) is located at the training centre adjacent to the compensatory habitat area (**Figure 6.1**). A summary of monthly meteorological monitoring results is provided in **Table 6.3**.

### 6.2.1 Rainfall

CVM received 776.4 mm of rainfall over 156 rain days during the report period. The highest rainfall occurred during February (115.4 mm), while the lowest rainfall was recorded during April (14.2mm). A summary of monthly rainfall data is provided in **Table 6.3**.

### 6.2.2 Temperature

Air temperature is measured at 2 m and 10 m above ground level. The maximum temperature recorded during the report period was in January (41.04°C @ 2 m, 39.01°C @10m) and the lowest temperatures occurred in June (-5.31°C @ 2 m) and August (-4.51°C @ 10 m). The minimum and maximum monthly temperature data is provided in **Table 6.3.**

### 6.2.3 Humidity

The lowest humidity recorded during the report period at CVM occurred during March (4.75%) and the highest was during December (149.9%) as shown in **Table 6.3**. The receipt of humidity results above 100% from June to December 2020 is likely the result of an error associated with humidity sensor of CMET2. This error may have been caused during cleaning of the CMET2 humidity sensor during the report period. Shoalhaven will explore the possibility of repairing the sensor during 2021.

## 6.3 Air Quality

### 6.3.1 Environmental Management Measures

CVM's Environmental Management Plan (Coalpac, 2012c), includes an Air Quality Management Plan (AQMP), which defines mitigation measures and monitoring procedures for the management of dust.

The air quality monitoring network at CVM consists of five dust deposition gauges (i.e. CDD1 to CDD5) and one High Volume Air Sampler (HVAS) measuring particulate matter <10 µm ($PM_{10}$) (**Figure 6.1**).

### 6.3.2 Performance Criteria

The air quality performance criteria specified in DA 200-5-2003 are reproduced in **Table 6.2**.

**Table 6.2 Air Quality Performance Criteria**

| Pollutant | Averaging Period | Criterion |
|---|---|---|
| **Total suspended particulate (TSP) matter** | Annual average | 90 µg/$m^3$ |
| **Particulate matter <10µm ($PM_{10}$)** | Annual average | 30 µg/$m^3$ |
| | 24-hour average | 50 µg/$m^3$ |
| **Deposited dust** | Annual average (maximum total) | 4 g/$m^2$/month |
| | Annual average (maximum increase) | 2 g/$m^2$/month |

**Table 6.3 CVM Weather Station Summary**

| Month | Rainfall (mm) | Cumulative Rainfall (mm) | No of rain days | Air temp @ 2m | | Air temp @ 10m | | Humidity (%) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |
| **January 2020** | 51.8 | 51.8 | 9 | 9.72 | 41.04 | 10.37 | 39.01 | 10.37 | 39.01 |
| **February 2020** | 115.4 | 167.2 | 17 | 4.76 | 39.48 | 6.26 | 38.96 | 12.43 | 96.60 |
| **March 2020** | 97.6 | 264.8 | 14 | 4.08 | 31.21 | 4.75 | 30.64 | 4.75 | 30.64 |
| **April 2020** | 98.8 | 363.6 | 8 | -0.98 | 26.28 | -0.98 | 26.28 | 17.11 | 100.00 |
| **May 2020** | 14.2 | 377.8 | 12 | -4.09 | 20.24 | -3.53 | 19.83 | 24.66 | 100.00 |
| **June 2020** | 28.6 | 406.4 | 14 | -5.31 | 17.08 | -4.21 | 17.72 | 33.47 | 121.00 |
| **July 2020** | 57.4 | 463.8 | 15 | -5.17 | 16.55 | -4.34 | 17.15 | 23.28 | 122.90 |
| **August 2020** | 70.6 | 534.4 | 15 | -5.28 | 20.29 | -4.51 | 19.23 | 9.42 | 121.90 |
| **September 2020** | 53.2 | 587.6 | 11 | -2.61 | 24.38 | -2.02 | 23.68 | 23.07 | 130.60 |
| **October 2020** | 56.2 | 643.8 | 16 | -0.88 | 26.49 | 0.23 | 25.98 | 14.25 | 132.90 |
| **November 2020** | 51.4 | 695.2 | 10 | 1.34 | 33.91 | 1.88 | 32.96 | 14.85 | 143.00 |
| **December 2020** | 81.2 | 776.4 | 15 | 1.51 | 36.57 | 2.31 | 35.82 | 11.87 | 149.90 |
| **Total** | **776.4** | - | **156** | - | - | - | - | - | - |

## 6.3.3 Environmental Outcomes

### 6.3.3.1 Dust Deposition

Deposited dust is monitored on a 30 ±2 day cycle. The annual average criterion for deposited dust (4 $g/m^2$/month) was not exceeded at any of the dust deposition gauges during the report period. The annual average dust levels for all locations was less than 2 $g/m^2$/month and therefore complied with air quality performance criteria. It is noted that the January 2020 results were considered to be significantly influenced by regional bushfire events. The exclusion of the January 2020 results from the annual average calculations represents a maximum change of approximately 0.5 g/m2/month.

The monthly deposited dust monitoring results for 2020 are shown in **Table 6.4** and is compared with historical results in **Appendix 2**.

**Table 6.4 Deposited Dust Monitoring Results**

| Date | Total Insoluble Solids ($g/m^2$/month) | | | | |
|---|---|---|---|---|---|
| | CDD1 | CDD2 | CDD3 | CDD4 | CDD5 |
| **January 2020** | 4.7 | 5.5 | 5.3^ | 7.0 | 8.1^ |
| **February 2020** | 0.8 | 1.4 | 1.6 | 1.0 | 1.8^ |
| **March 2020** | 0.3 | 0.1 | 0.3 | 0.5 | 0.9^ |
| **April 2020** | 0.2 | 0.4 | 0.7 | 0.6 | 0.8 |
| **May 2020** | 0.8 | 0.3 | 0.5 | 0.5 | 0.1 |
| **June 2020** | <0.1 | 0.1 | 0.1 | 0.1 | <0.1 |
| **July 2020** | 0.8 | 0.2 | 0.1 | 0.2 | 0.2 |
| **August 2020** | 0.5 | 1.1 | 0.7 | 0.4 | 1.2^ |
| **September 2020** | 0.6 | 0.6 | 0.6 | 0.7 | 7.4 |
| **October 2020** | 0.5 | 0.5 | 0.5 | 1.2 | 1.5 |
| **November 2020** | 0.6 | 0.6 | 0.8 | 0.8 | 0.8 |
| **December 2020** | 0.1^ | 0.1^ | 0.7 | 0.3 | 0.4^ |
| **Annual Average 2020** | **0.8** | **0.9** | **1.0** | **1.1** | **1.9** |
| **Annual Average 2020** (Excluding January 2020 result) | **0.5** | **0.5** | **0.6** | **0.6** | **1.4** |

*^ Result contained insects and tree bark*

### 6.3.3.2 Particulate Matter

Monitoring of particulate matter was conducted during 2020. Total suspended particulates are estimated from the $PM_{10}$ concentrations. The annual average criteria for $PM_{10}$ (30 $\mu g/m^3$) and TSP (90 $\mu g/m^3$) were not exceeded during the report period.

The $PM_{10}$ monitoring results for the report period are shown in **Table 6.5**.

**Table 6.5 Particulate matter ($PM_{10}$) and Total Suspended Particulates (TSP) Results**

| Annual Average | $PM_{10}$ (µg/m$^3$) | TSP (µg/m$^3$)* |
|---|---|---|
| **Criterion** | 30 | 90 |
| **All data** | 11.0 | 27.5 |
| Excluding results influenced by extraordinary events | 9.0 | 22.0 |

** Total suspended particulates are estimated from the $PM_{10}$ concentrations.*

During the report period, the sample duration for the following dates exceeded the 24 (± 1) hour period, as required by the relevant Australian Standard (AS/NZS 3580.9.6:2015):

- 7 July
- 31 July

Exceedances of the 24 (± 1) hour period were also recorded on scheduled run dates 1 July and 19 July, however re-runs were successfully undertaken on 3 July and 27 July (respectively) to achieve a compliant run time.

CVM investigated the cause of these run time anomalies. The issue was diagnosed as an intermittent fault with the HVAS unit's timer, which controls the duration of the HVAS run time and date (i.e. when the unit will collect a sample). Once this issue was diagnosed, the faulty HVAS unit was replaced with a function, calibrated hire unit in August 2020.

A graph of the $PM_{10}$ and TSP monitoring data for 2020, as well as historical data trends, is shown in **Appendix 2**.

#### 6.3.3.3 Exceedances Influenced by Extraordinary Events

On 3 January 2020, a result in excess of the 24-hour maximum allowable limit for $PM_{10}$ (50 µg/m$^3$) was recorded (55 µg/m$^3$).

This elevated result appears to have been influenced by an exceptional event, being large-scale bushfires within the Lithgow Local Government Area (LGA), Blue Mountains region and Australian east coast in general.

This exceedance is not considered as a non-compliance with the respective criterion as the results were attributed to localised bushfire events and were considered to be "exceptional events" according to the National Environment Protection (Ambient Air Quality) Measure (NEPM). The NEPM defines an exceptional event as:

> *"… a fire or dust occurrence that adversely affects air quality at a particular location, and causes an exceedance of 1 day average standard in excess of normal historical fluctuations and background levels, and is directly related to: bushfire, jurisdiction authorised hazard reduction burning; or continental scale windblow dust"*

It is noted $PM_{10}$ results as high as 280 µg/m$^3$ were recorded during December 2019 monitoring at CVM as bushfires burnt within the vicinity of the mine site. There were no further exceedances of the 24-hour maximum allowable limit for $PM_{10}$ recorded at CVM during 2020 following the receipt of the 3 January 2020 result.

## 6.3.4 Trends in Data

### 6.3.4.1 Dust Deposition

**Table 6.6** presents the dust deposition annual averages from 2015 to 2020. Graphs of the long-term dust deposition levels are included in **Appendix 2**. The annual averages for depositional dust recorded at CVM during 2020 are well below the performance criteria.

**Table 6.6 Annual Averages for Dust Deposition 2015-2020**

| Reporting period | Total Insoluble Solids ($g/m^2$/month) | | | | |
|---|---|---|---|---|---|
| | CDD1 | CDD2 | CDD3 | CDD4 | CDD5 |
| **Criteria** | 4 | 4 | 4 | 4 | 4 |
| **2015** | 0.2 | 2.7 | 0.4 | 0.8 | 0.6 |
| **2016** | 0.2 | 0.6 | 0.4 | 0.6 | 0.8 |
| **2017** | 0.5 | 1.3 | 0.5 | 0.6 | 1.3 |
| **2018** | 0.8 | 0.9 | 1.0 | 1.2 | 1.5 |
| **2019** | 1.3 | 1.1 | 1.3 | 1.7 | 1.9 |
| **2020** | 0.8 | 0.9 | 1.0 | 1.1 | 1.9 |
| **Annual Average 2020** (Excluding January 2020 result) | 0.5 | 0.5 | 0.6 | 0.6 | 1.4 |

The 2020 annual average dust deposition levels were consistent with the range of averages since 2015. The 2020 annual averages were generally comparable to the 2018 annual averages. Excluding the results influenced by bushfire events during 2020 (January 2020), the 2020 annual averages at all monitoring locations would be at the lower end of the historical range over the previous five years.

### 6.3.4.2 Particulate Matter

**Table 6.7** presents the particulate matter annual averages from 2015 to 2020. The raw $PM_{10}$ and TSP 2020 annual averages are within the range of results over the previous five years, despite including results influenced by an exceptional event (i.e. January 2020 results). The 2020 annual average for $PM_{10}$ is the lowest since 2017, while the 2020 annual average for TSP is the lowest since 2016. The 2020 annual average for both $PM_{10}$ and TSP, excluding the January results, are at the lower end of the previous annual averages since 2015 (see **Table 6.7** note).

**Table 6.7 Annual Averages for $PM_{10}$ and TSP 2015-2020**

| Annual Average | $PM_{10}$ ($\mu g/m^3$) | TSP ($\mu g/m^3$)* |
|---|---|---|
| **2015** | 8.4 | 21.0 |
| **2016** | 8.5 | 21.2 |
| **2017** | 7.8 | 24.5 |
| **2018** | 13.7 | 34.3 |
| **2019*** | 23.4 | 58.5 |
| **2020** | 11.0 | 27.5 |
| **2020^** | 9.0 | 22.0 |

* Annual average significantly influenced by bushfire activity (refer 2019 Cullen Valley Annual Review)

^ Excluding results influenced by extraordinary events

### 6.3.5 Proposed Improvements

No additional mitigation measures or monitoring procedures are proposed to be implemented which are outside that detailed in the CVM EMP (Coalpac, 2012c).

## 6.4 Water Management

During 2017 a standalone Water Management Plan (WMP) (Umwelt, 2017b) for the CVM was submitted to DPE for approval (refer to **Section 3.1**). The WMP sets out water quality criteria, mitigation measures and monitoring procedures for the management of surface water and groundwater. The approval status of the revised WMP remained pending during the 2020 annual reporting period. In 2021, Shoalhaven Coal will continue to seek clarification of the status of the 2017 CVM WMP.

### 6.4.1 Surface Water Quality

#### 6.4.1.1 Environmental Management Measures

The surface water management system at CVM utilises a series of settlement dams. The system is primarily operated as a closed loop system. The CVM Water Management System (WMS) incorporates a range of infrastructure to manage clean water runoff from upslope undisturbed catchments, dirty water runoff from disturbed catchments and mine water (i.e. groundwater extracted from former underground workings or water that has come into contact with coal). Whilst CVM is on care and maintenance, mine water is only utilised for dust suppression. Where mine water is utilised for dust suppression it is captured and managed within the dirty water management system. The fundamental principle of the WMS is to minimise interaction of clean, dirty and mine waters and to capture dirty water for re-use and provide controls to treat captured dirty water to a standard suitable for discharge off-site.

The Tyldesley Mine underground workings are also used to store excess water from the WMS. The primary source of water for site use (when required) is from the abandoned and flooded Tyldesley Mine underground workings via the Tilley's Bore (GW01) in accordance with Water Access Licence WAL27898. When required, water is pumped from the workings via the Tilley's Bore to two 500,000 L tanks at CVM. Site water is transferred between site dams through gravity fed water mains.

CVM operates under EPL 10341. The EPL provides water quality criteria and water quality monitoring requirements for water discharges from the two CVM Licensed Discharge Points (LDP's) being LDP 001 and LDP 004, refer to **Figure 6.1**. Further discussion regarding water management and erosion and sediment control measures is included in **Section 7.0**.

#### 6.4.1.2 Performance Criteria

Water may be discharged from LDP 001 and LDP 004 at CVM in accordance with EPL and Development Approval requirements. **Table 6.8** presents the EPL discharge criteria for these discharge points.

**Table 6.8 Water Quality Concentration Limits for LDP 001 and LDP 004 During Discharge**

| Pollutant | Concentration Limit |
|---|---|
| **Oil & Grease** | 10 mg/L |
| **pH** | 6.5 – 8.5 |
| **Total suspended solids** | 30 mg/L |

#### 6.4.1.3 Environmental Outcomes/Trends in Data

There were no discharge events from LDP 001 and LDP 004 during the 2020 report period.

#### 6.4.1.4 Proposed Improvements

No additional mitigation measures or monitoring procedures are proposed to be implemented which are outside that detailed in the WMP (Umwelt, 2017b).

### 6.4.2 Groundwater Quality

#### 6.4.2.1 Environmental Management Measures

CVM is located on the western escarpment of the Sydney Basin. Aquifers in this area are typically limited to the Lithgow Seam and the Marangaroo Sandstone which underlies the Lithgow Seam. Despite their proximity, there is little observed movement between these aquifers in the Marangaroo Sandstone and the Lithgow Seam (AGE, 2012).

Past open cut and highwall mining at CVM has targeted the Irondale, Lidsdale and Lithgow seams. Underground mining in the area has been largely limited to the Lithgow seam. The Lithgow Seam can be seen in the highwalls faces at CVM (some of which are now covered by overburden). Outcrop areas north of the open cut workings represent local recharge points for the Lithgow seam.

**Figure 6.2** shows the general dip in the strata of the Lithgow seam to the east - northeast and the location of underground workings in the Lithgow seam in the area. The open cut workings in the southern parts of the CVM are hydraulically connected to the former Tyldesley Colliery workings which extend to the east of the southern part of CVM (refer to **Figure 6.2**). The water in the Tyldesley Colliery workings is sourced from groundwater inflows (i.e. recharge areas) located up-dip, ingress from areas at CVM where the open cut operations are hydraulically connected to the Tyldesley workings, and infiltration through subsidence cracking associated with pillar extraction and pillar failure in the former workings. Water quality in these workings is monitored at GW01 (East Tyldesley Bore) (refer to **Figure 6.2**).

As can be seen from **Figure 6.2**, the CVM is located up-dip of the Lithgow seam groundwater monitoring bores of CP 116, CP 115 and CP 132 and operates as a recharge point for the Lithgow seam in this area. As mining at CVM extended to the base of the Lithgow Seam and as CVM represents an up-dip recharge point of this aquifer, the open cut at CVM do not intercept any natural groundwater aquifers. Therefore, there are limited depressurisation impacts associated with the CVM open cut pits and any impacts would be associated with interactions with the recharge regime; these impacts are expected to be limited due to the low recharge rates and the generally benign nature of the overburden emplaced adjacent to the outcropping coal seams (Umwelt, 2017b).

#### 6.4.2.2 Performance Criteria

There are no pollutant concentration limits for groundwater specified in the Development Approval or EPL for CVM. The CVM WMP (Umwelt, 2017b) includes trigger values against which groundwater monitoring results are compared. For the purposes of this Annual Review, the groundwater results obtained during the report period have been compared to these trigger values.

The CVM WMP (Umwelt, 2017b) has reviewed the location and target seam for each groundwater monitoring bore and considers the CP115, CP116 and GW01 groundwater monitoring bores are suitable to assess any potential offsite groundwater impacts associated with the operation of CVM. These bores are located down dip of CVM and are also located within appropriate seams. **Table 6.9** shows the trigger level/range for key groundwater monitoring parameters that are specific to bores CP115, CP116 and GW01. Results outside of these ranges are triggers for further investigation. The results of CP115, CP116 and GW01 are also compared to reference bores which are bores that are considered to be representative of background groundwater quality (refer to **Section 6.4.2.4**).

**Table 6.9 Groundwater Quality and Level Triggers as Defined in CVM WMP (Umwelt, 2017b)**

| Bore | Groundwater Level (mAHD) Trigger Range | Analyte | | | |
|---|---|---|---|---|---|
| | | pH | EC (us/cm) | Sulphate (mg/L) | Hardness (mg of $CaCO_3$/L) |
| **CP116** | 890 - 894 | Range 5.82 - 7.2 | Upper limit 840 | Upper limit 140 | Upper limit 210 |
| **CP115** | 892 - 896 | Range 6.26 - 7.3 | Upper limit 970 | Upper limit 380 | Upper limit 376 |
| **GW01**[1] | N/A as bore is located in workings | Range 6.14 - 6.82 | Upper limit 939 | Upper limit 338 | Total Alkalinity[2] Upper limit 100 mg of $CaCO_3$ |

[1] Baseline data for GW01 has been obtained from 11 groundwater monitoring events over an 11 month period from 2016-2017 for the trigger levels. The groundwater triggers will be reviewed considering the additional data now available, with any update included in the MOP and Water Management Plan during 2020.

[2] GW01 has not been monitored for Hardness as part of groundwater quality baseline monitoring. Total Alkalinity has been used as a proxy for Hardness and will be utilised as a trigger for this bore until sufficient baseline data for hardness has been obtained for this bore to develop a trigger value.

Baseline groundwater monitoring programs and associated trigger levels when developed in accordance with ANZECC recommendations require the utilisation of 24 contiguous monthly samples (ANZECC, 2000). The trigger levels for groundwater monitoring at CVM have been developed utilising the groundwater data set which is a limited data set of between nine and eleven annual groundwater samples at each location between the period 2011 – 2017. It was therefore intended that the groundwater trigger levels for the CVM groundwater bores were to be refined during 2021 to incorporate the additional monitoring data. The trigger action response plan, as detailed in the CVM WMP (Umwelt, 2017b) defines a process for reviewing results which are outside of the groundwater trigger levels as detailed in **Table 6.9**. Section 5.7.1 of the CVM WMP (Umwelt, 2017b) states:

> *'Monitoring results observed outside groundwater quality and level triggers identified in Table 5.3 do not necessarily reflect an environmental impact associated with CVM, as variances within the CVM bores may be influenced by natural environmental variations and/or localised land use activities (not associated with CVM activities).'*

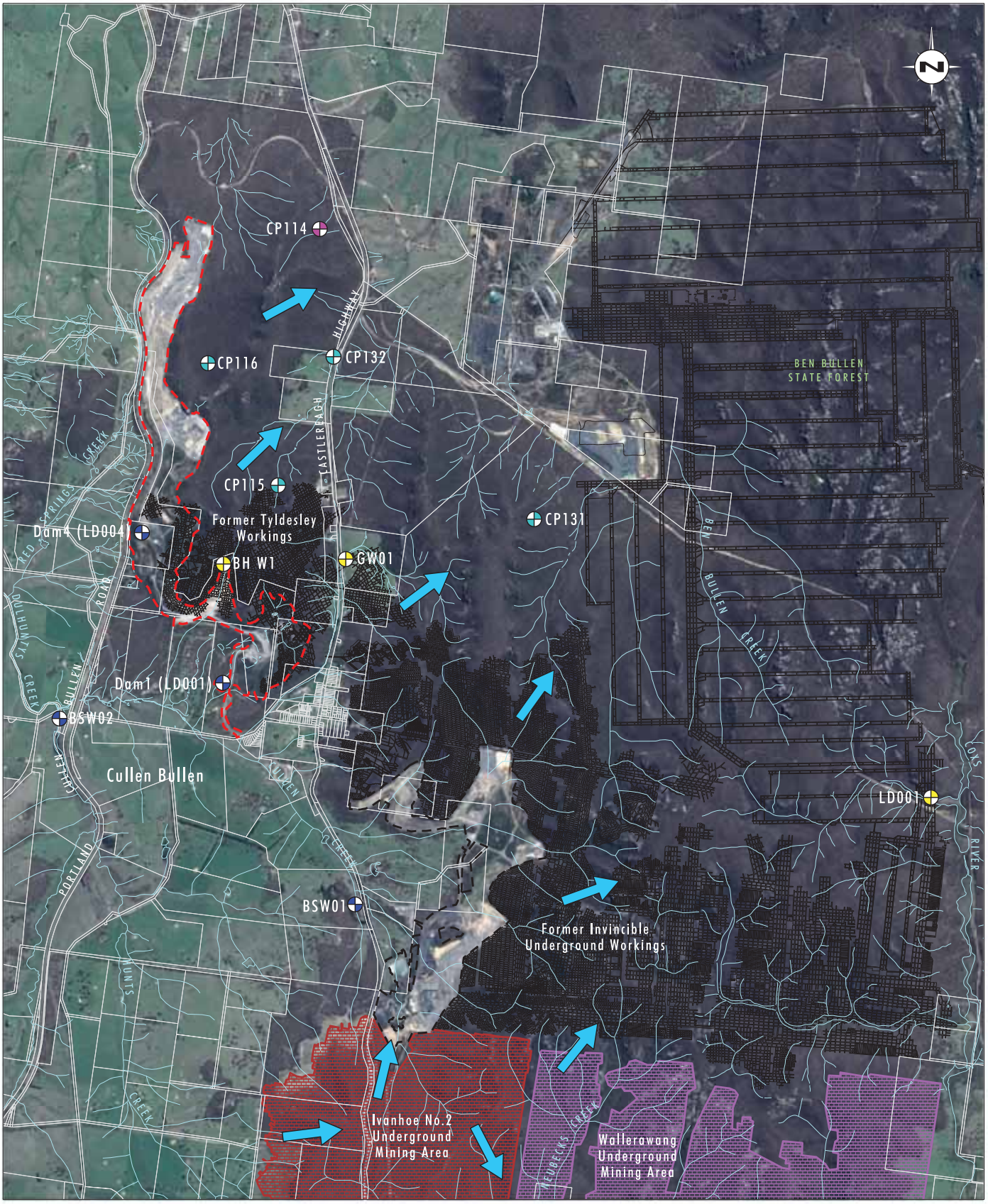



Image Source: Google Earth - CNES/Astrim (2016)
Data Source: LPI (2016), Sedgman (2014)

0 0.5 1.0 2.0km
1:50 000

## Legend

- Open Cut Mining Disturbance Area - Cullen Valley
- Existing Mining Disturbance Area - Invincible
- Direction of Coal Seam Dip
- Former Invincible Underground Workings
- Invincible Project Approval Boundary
- Wallerawang Underground Mining Area
- Groundwater Monitoring Point (Lithgow Seam)
- Groundwater Monitoring Point (Marangaroo Sandstone)
- Groundwater Monitoring Point (Underground Workings)
- Surface Water Monitoring Point (Invincible)

FIGURE 6.2

# Hydrology Context Cullen Valley Mine

File Name (A4): R129/3968_164.dgn
20200311 10.37

### 6.4.2.3 Environmental Outcomes

During the report period, groundwater monitoring was conducted on two occasions (refer to **Table 6.9**). A discussion of the 2020 groundwater monitoring results is included in **Section 6.4.2.4**.

Groundwater monitoring undertaken during the reporting was affected by damage to the Ben Bullen State Forest caused by the 2019-20 bushfire event which burnt in the vicinity of CVM.

During the May 2020 groundwater monitoring round, entry into the Ben Bullen State Forest was prohibited by the Forestry Corporation of NSW due to safety risks posed by damaged and burnt trees. As a result, bores LD001 and CP131 were unable to be accessed by the environmental monitoring contractor and therefore data was not downloaded from the groundwater loggers.

During the November 2020 groundwater monitoring round, access to the Ben Bullen State Forest was restored by the Forestry Corporation of NSW. Bore CP131 was therefore accessible, however the environmental monitoring contractor reported the bore casing was found to be melted to the ground, preventing the cap from being able to be removed for monitoring. Additionally, a bridge which permits access to bore LD001 in the Ben Bullen State Forest was found to be completely removed, most likely due to structural damage caused by the 2019 bushfire event. As a result, the environmental monitoring contractor was unable to access LD001 for monitoring. Consequently, no data was obtained for bores LD001 or CP131 during the 2020 report period.

During 2021, Shoalhaven will undertake a review of the historical monitoring data at both LD001 and CP131. The review will be undertaken to determine whether these monitoring locations are adding value to the existing groundwater monitoring network and assessment of CVM groundwater impacts.

As LD001 is located on land owned by the NSW Forestry Corporation, Shoalhaven will engage with NSW Forestry during 2021 as to whether access to LD001 will be reinstated.

**Table 6.10 2020 Groundwater Monitoring**

| Sampling Date | Overview of Sampling |
|---|---|
| **May 2020** | Monitoring undertaken during May 2020 was applicable only to selected bores and parameters, based on results from November 2019. Bore CP115 is monitored every six months (Umwelt, 2017b) due to proximity to operations. Bores CP131 and LD001 were inaccessible due to bushfire damage in the Ben Bullen State Forest. |
| **November 2020** | Monitoring undertaken during November 2020 was applicable only to selected bores and parameters, based on previous results. Bore LD001 was inaccessible due to bushfire damage in the Ben Bullen State Forest. Bore CP131 was found to be completely destroyed by bushfire. |

### 6.4.2.4 Trends in Data

The groundwater monitoring program at CVM consists of:

- Impact bores – bores with the potential to identify potential groundwater impact from CVM, specifically CP115, CP116 and GW01; and
- Reference bores – bores that are considered to be representative of background groundwater quality (i.e. are unlikely to be impacted by CVM operations), specifically CP114, CP131, CP 132 and LD001. These bores provide a baseline for comparison with the impact bores.

### Standing Water Level

The standing water level in the impact bores during the report period are within the trigger level range, as shown in **Table 6.11**.

**Table 6.11 Impact Bores Standing Water Levels and Triggers**

| Bore | Groundwater Level (mAHD) Trigger Range | May 2020 Groundwater Level (mAHD) | November 2020 Groundwater Level (mAHD) | Complied with Trigger Level? |
|---|---|---|---|---|
| **CP116** | 890 - 894 | 893.04 | 893.29 | Yes |
| **CP115** | 892 - 896 | 894.28 | 894.70 | Yes |
| **GW01** | N/A as bore is located in workings | N/A | N/A | N/A |

The long-term standing water level trend in both impact bores (CP116 and CP 115) has shown little variation since monitoring commenced in February 2012. Since February 2012, the standing water level has gradually increased until November 2016 after which time it has gradually declined and is increasing slightly since May 2019, as shown graphically in **Appendix 3**. The reference bores of LD001, CP132 and CP131show slightly greater variability in the long-term standing water level trends, as shown graphically in **Appendix 3**.

### pH

The pH results for impact bores CP116, CP115 and GW01 during the report period were within the trigger level range, as shown in **Table 6.12**.

A slight increase in pH occurred between May 2020 and November 2020 at CP115, however this increase appears to be consistent with trends observed for this period over the last two years, as shown graphically in **Appendix 3**. Since November 2019, pH levels have generally decreased at CP116, CP115 and GW01, as demonstrated in **Appendix 3**. pH levels of all reference bores have also decreased during this period. As such, these results are considered to be reflective of a wider regional trend and not the result of CVM activities.

The pH trend across both impact and reference bores is generally consistent over time, with isolated spikes and declines observed for individual sampling dates. Since December 2017, all bores have demonstrated an overall increase in pH levels, as shown graphically in **Appendix 3**.

**Table 6.12 Impact Bores pH Levels and Triggers**

| Bore | pH Trigger Range | May 2020 pH Level | November 2020 pH Level | Complied with Trigger Level? |
|---|---|---|---|---|
| **CP116** | 5.82 – 7.2 | No sample required* | 6.58 | Yes |
| **CP115** | 6.26 – 7.3 | 6.31 | 6.52 | Yes |
| **GW01** | 6.14 – 6.82 | No sample required* | 6.67 | Yes |

* CP116 and GW01 Sampled annually.

### Electrical Conductivity

The electrical conductivity (EC) results for the impact bores during the report period are below the trigger level, as shown in **Table 6.13**.

**Table 6.13 Impact Bores Electrical Conductivity Levels and Triggers**

| Bore | Electrical Conductivity (µS/cm) Trigger Level | May 2020 EC Level (µS/cm) | November 2020 EC Level (µS/cm) | Complied with Trigger Level? |
|---|---|---|---|---|
| **CP116** | Upper limit 840 | No sample required* | 428 | Yes |
| **CP115** | Upper limit 970 | 901 | 837 | Yes |
| **GW01** | Upper limit 939 | No sample required* | 805 | Yes |

*CP116 and GW01 Sampled annually.

The long-term trend in EC values across the reference bores is mixed, as shown graphically in **Appendix 3**:

- LD001 was inaccessible for monitoring during 2020 (see **Table 6.9)** and thus no results were obtained during the reporting period. Based on available data from previous year's, LD001 has shown some variability (±20 µS/cm) around 130 µS/cm, increasing to 166 µS/cm in November 2018 and 175 µS/cm in November 2019, which was above previous maximum levels.
- CP114 exhibits a slight decrease since November 2019 from 294 µS/cm to 268 µS/cm, with historical results presenting occasional spikes, stable periods and steady declines.
- CP131 was accessible; however the bore was destroyed by bushfire activity and was unable to be sampled. Its noted that dry conditions have been observed at this location since 2015.
- CP132 monitoring results have increased initially, dropping in 2017 and peaking in November 2018 before continuing to decrease since November 2018.

The long term trend in EC values in the impact bores shows greater variability than reference bores, as shown graphically in **Appendix 3**:

- CP116 monitoring results have continued to increase since April 2014. EC levels remained at 428 µS/cm in both November 2019 and November 2020, representing the third-highest result since November 2015. This result remains well below the historical maximum of 840 µS/cm.
- CP115 monitoring results exhibit greater variability. The results since April 2014 have ranged from 398 µS/cm (April 2018) to 901 µS/cm (May 2020). The May 2020 result is the second highest recorded as shown in **Appendix 3**. EC levels decreased to 837 µS/cm in November 2020.
- GW01 EC levels in November 2020 (805 µS/cm) represents a new maximum EC level recorded at GW01 however, results remain below groundwater trigger levels.

**Sulphate**

The sulphate levels in the impact bores during the report period are below the trigger level, as shown in **Table 6.14**.

**Table 6.14 Impact Bores Sulphate Levels and Triggers**

| Bore | Sulphate (mg/L) Trigger Level | May 2020 Sulphate Level (mg/L) | November 2020 Sulphate Level (mg/L) | Complied with Trigger Level? |
|---|---|---|---|---|
| **CP116** | Upper limit 140 | No sample required* | 87 | Yes |
| **CP115** | Upper limit 380 | 362 | 372 | Yes |
| **GW01** | Upper limit 338 | No sample required* | 298 | Yes |

*CP131 and GW01 Sampled annually

The long-term sulphate values for the reference bores ranges from 11-25 mg/L at LD001 and 12-28 mg/L at CP114. CP132 shows greater variability with results ranging between 5 mg/L - 145 mg/L. There is a variability of up to 70 mg/L between consecutive samples, as shown graphically in **Appendix 3**. The 2020 result at CP132 of 79 mg/L fall within historical range.

As discussed within the groundwater study completed for CVM in 2017 (Umwelt, 2017e), the recorded sulphate levels are all well within the ANZECC criteria for drinking water for domestic stock which provide:

> *No adverse effects to stock are expected if the concentration of sulphate in drinking water does not exceed 1000 mg/L. Adverse effects may occur at sulphate concentrations between 1000 and 2000 mg/L, especially in young or lactating animals or in dry, hot weather when water intake is high. These effects may be temporary and may cease once stock become accustomed to the water. Levels of sulphate greater than 2000 mg/L may cause chronic or acute health problems in stock.*

As the sulphate results from CP115 are relatively stable and within ANZECC guidelines, there is no indication of any environmental harm associated with these results. The long-term sulphate values for impact bore CP115 range from 78 mg/L to 396 mg/L. The CP115 2020 sulphate result (372 mg/L) was within this historical range. In accordance with the CVM WMP (Umwelt, 2017b) Shoalhaven Coal will continue to monitor sulphate levels however no specific investigation of sulphate levels is required to be undertaken.

The long-term sulphate values for impact bores range from 20 mg/L to 140 mg/L at CP116 and 276 to 315 mg/L at GW01. The GW01 2020 sulphate result (298 mg/L) decreased from the historical maximum recorded in November 2019 and appears to indicate a generally stable around 300 ± 20mg/L, as demonstrated in **Appendix 3**.

**Hardness**

The hardness levels in the impact bores during the report period are below the trigger level, with the exception being the November 2020 result for GW01 by 1mg/L, as shown in **Table 6.15**. An analysis of water licenses in the region completed during May 2017 identified that there were no bore users in the area down-dip of CVM and therefore there are no groundwater bores which would be impacted by increased hardness levels if it were to occur.

**Table 6.15 Impact Bores Hardness Levels and Triggers**

| Bore | Hardness (mg/L) Trigger Level | May 2020 Hardness Level (mg/L) | November 2020 Hardness Level (mg/L) | Complied with Trigger Level? |
|---|---|---|---|---|
| **CP116** | Upper limit 210 | No sample required* | 146 | Yes |
| **CP115** | Upper limit 376 | 363 | 368 | Yes |
| **GW01** | Total Alkalinity Upper limit 100 mg of $CaCO_3$ | No sample required* | 101** | No |

*CP131 and GW01 Sampled annually

** GW01 has not been monitored for Hardness as part of groundwater quality baseline monitoring. Total Alkalinity has been used as a proxy for Hardness and will be utilised as a trigger for this bore until sufficient baseline data for hardness has been obtained for this bore to develop a trigger value.

The long-term trend in hardness values for the reference bores is mixed, as shown graphically in **Appendix 3**:

- LD001 was inaccessible for monitoring during 2020 (see **Table 6.9**) and thus no results were obtained for discussion during the reporting period.

- CP114 shows small variability around 100 mg/L before a result of 350 mg/L in December 2017. Since this time, monitoring results have returned to levels that are typical of the pre-December 2017 spike with a result of 103 mg/L observed for November 2020.

- CP131 was dry during November 2020, consistent with previous monitoring events since 2015.

- CP132 initially was consistent around a level of 150 mg/L (April 14 to Nov 15), before spiking at 200 mg/L on November 2016 and declining to 46 mg/L in December 2017. Results increased to 210 mg/L in November 2018 with results in November 2019 (213 mg/L) representing a new historical maximum, slightly above the previous maximum of 210 mg/L. The November 2020 monitoring results have returned to levels that are more typical of pre-2016 levels, declining to 187 mg/L.

The impact bores also show different long-term trends in hardness as shown in **Appendix 3**:

- CP116 has declined from an initial level of 210 mg/L before stabilising in April 2014 to a range of 98 mg/L to 128 mg/L (2017). Concentrations increased during November 2018 (134mg/L) and 2019 monitoring (176 mg/L) with a decrease observed in November 2020 (146 mg/L).

- CP115 shows an overall increasing trend, from 130 mg/L in August 2011, increasing to 350 mg/L in July 2014 after which the results have remained around 375 mg/L ±25 mg/L. During 2018, CP115 decreased in hardness to 338 mg/L in November, before spiking again to 399mg/L in November 2019 which is slightly above the historical maximum. In November 2020, monitoring results returned to pre-2019 levels (368 mg/L). Monitoring will continue to be undertaken at this bore to monitor hardness.

- GW01 increased from 80 mg/L in November 2018 to 101 mg/L in November 2019, which was above the trigger levels and above the historical maximum (based on a sample size of four). Monitoring will continue to be undertaken at this bore to monitor hardness.

Given the restricted baseline dataset, the values for EC and hardness at GW01 were possibly within the range of likely expected values for the bore and are not necessarily indicative of groundwater impact. An analysis of water licences in the region during May 2017 identified that there were no registered bore users in the area down-dip of CVM and thus there are no users which would be impacted by this result.

The 2020 hardness result at GW01 was 101 mg/L, which is 1 mg/L above the trigger level. Given the exceedance of the trigger level minor, CVM is not proposing to initiate a 6 monthly sampling program as per the requirements of the CVM WMP (Umwelt, 2017). CVM will continue to undertake the standard frequency of sampling and review the results of GW01 and take action if needed.

**Other Analytes (not required for trigger level assessment as described in the WMP)**

*Nitrate*

Results for 2020 monitoring together with the long-term trends show that both impact and reference bores have very low levels of nitrate. The levels of nitrate are typically less than the laboratory detection limit (shown graphically at **Appendix 3**).

*Metals*

Results of monitoring undertaken during 2020 for dissolved metals within the impact bores are highly variable. Metals are usually analysed for trends as a group (or groups of metals) rather than on an individual metal basis. This is usually completed where sufficient baseline information is available to analyse potential trends. Given the restricted available dataset, the ability to meaningfully analyse metal results obtained during 2020 and trends in data is therefore limited.

It is noted that in recent years bores CP115, CP116 and CP 132 have been monitored every 6 months, with the remaining bores monitored annually during November. During the reporting period, bore CP116 was monitored for water level only in the May 2020 monitoring round, and therefore only one round of groundwater quality monitoring occurred (i.e. during November 2020). Results are discussed below:

- Monitored every 6 months:
    - Impact bore CP115 - The May 2020 manganese concentration of 920 µg/L was above the historical maximum of 860 µg/L. The November 2020 result of 337 µg/L however, is the lowest since May 2017. Given the limited available dataset, it is difficult to determine whether the May 2020 result is within the historical range of expected results from this bore. The remaining metal analytes (Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Molybdenum, Nickel, Selenium, Zinc and Mercury) levels recorded in May and November 2020 were within the range of previous results. Insufficient data is available to set meaningful trigger levels at this stage, based on ANZECC guidelines.
    - Impact bore CP116 – All metal analytes monitored during the single 2020 monitoring round (Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Zinc and Mercury) were within the historical range of previous results. The iron concentration recorded during the monitoring round was observed to be the second highest recorded for this bore, however still remained within the historical range. Insufficient data is available to set meaningful trigger levels at this stage, based on ANZECC guidelines.

    Reference bore CP132 – No sample was required during May 2020, as sampling was required for selected bores and parameters only. All metal analytes monitored during the single 2020 monitoring round (Aluminium, Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Molybdenum, Nickel, Selenium, Zinc and Mercury) were within the historical range of previous results. The iron concentration recorded during 2020 (6020 µg/L) was comparable to previously obtained results, however was significantly higher than the most recently obtained result of 50 µg/L in May 2019. Insufficient data is available to set meaningful trigger levels at this stage, based on ANZECC guidelines.

- Monitored Annually:

    Impact bore GW01 – No sample was required during May 2020 as sampling was required for selected bores and parameters only. In November 2020, Arsenic, Cadmium, Chromium, Copper, Lead, Molybdenum, Selenium and Mercury all returned results that were below the limit of detection. Results for Manganese, Nickel and Zinc represented historical minimums for each respective metal, while the Aluminium concentration of 10 µg/L was above the limit of detection for the first time. All other results remained within the respective historical ranges. Both the Nickel and Zinc result were in excess of the 95% AZNG freshwater protection criteria. These trends will continue to be monitored during 2021. As monitoring of GW01 only commenced in December 2017, it is difficult to determine whether these results are within historical range of expected results as the dataset is limited.

    - Reference bore LD001 – LD001 was inaccessible for monitoring during 2020 (see **Table 6.9**) and thus no results were obtained for discussion during the reporting period. LD001 will be monitored annually in 2021 provided access to the bore is reinstated.
    - Reference bore CP114 – Results of monitoring completed during November 2019 for Aluminium, Arsenic, Cadmium, Chromium, Copper, Lead, Molybdenum, Selenium and Mercury were below the limit of detection. The remaining metals (Iron, Manganese, Nickel and Zinc) were within the previous historical range of results. The Zinc result was in excess of the 95% AZNG freshwater protection criteria. These trends will continue to be monitored during 2021.

The CVM WMP (Umwelt, 2017b) does not include trigger values for metals, due to the limited data set and variable nature of the dissolved metals in groundwater samples taken to date. In order to develop trigger levels for the metals results obtained from the CVM bores, 24 contiguous monthly samples would be required, as per ANZECC guidelines (ANZECC, 2000). Given the phase of operations at the site (i.e. care and maintenance), there are no proposed changes to the groundwater monitoring regime, however the CVM groundwater triggers will be reviewed considering the additional data now available, with any update included in the MOP and revised Water Management Plan during 2021.

#### 6.4.2.5 Proposed Improvements

No additional mitigation measures or monitoring procedures are proposed to be implemented which are outside that detailed in the CVM WMP (Umwelt, 2017b).

## 6.5 Noise

### 6.5.1 Environmental Management Measures

CVM's Environmental Management Plan (Coalpac, 2012c) includes a Noise Management Plan (NMP), which details mitigation measures and monitoring procedures for noise management. There were no mining operations during the report period; however, quarterly attended monitoring was conducted at five locations around CVM in accordance with the CVM Environmental Management Plan (Coalpac, 2012c). Noise controls and mitigation measures are implemented to ensure compliance with noise impact assessment criteria.

### 6.5.2 Performance Criteria

Noise criteria is specified in the Development Approval and EPL 10341. **Table 6.16** and **Table 6.17** summarises the criteria across the Development Approval and EPL 10341.

**Table 6.16 Noise Criteria in DA 200-5-2003**

| Location | Day – $L_{Aeq}$ (15 minute) (dB) | Evening – $L_{Aeq}$ (15 minute) (dB) | Night – $L_{Aeq}$ (15 minute) (dB) | Night - $L_{A1}$ (1 minute) (dB) |
|---|---|---|---|---|
| **Red Springs (east of rail line)** | 37 | 35 | 35 | 45 |
| **Red Springs (west of rail line)** | 43 | 38 | 35 | 45 |
| **Hillcroft (east of rail line)** | 35 | 35 | 35 | 45 |
| **Hillcroft (west of rail line)** | 43 | 38 | 35 | 45 |
| **Forest Lodge** | 40 | 40 | 38 | 45 |
| **Doble Gate** | 43 | 38 | 35 | 45 |
| **Tilley** | 43 | 38 | 35 | 45 |

**Table 6.17 Noise Criteria in EPL 10341**

| Location | Day – $L_{Aeq}$ (15 minute) (dB) | Evening – $L_{Aeq}$ (15 minute) (dB) | Night – $L_{Aeq}$ (15 minute) (dB) | Night - $L_{A1}$ (1 minute) (dB) |
|---|---|---|---|---|
| **Red Springs (east of rail line)** | 35 | 35 | 35 | 45 |
| **Red Springs (west of rail line)** | 43 | 38 | 35 | 45 |
| **Hillcroft (east of rail line)** | 35 | 35 | 35 | 45 |
| **Hillcroft (west of rail line)** | 43 | 38 | 35 | 45 |
| **Forest Lodge** | 40 | 40 | 40 | 45 |
| **Doble Gate** | 43 | 38 | 35 | 45 |
| **Tilley** | 43 | 38 | 35 | 45 |

### 6.5.3 Environmental Outcomes

There were no exceedances of the Development Approval or EPL criteria during the report period as shown in **Table 6.18**. On all monitoring occasions, the noise from CVM was inaudible. There were no complaints received regarding noise during the reporting period.

**Table 6.18 2020 Quarterly Noise Monitoring Results**

| Location | Consent Criterion (dB) | EPL Criterion (dB) | Quarter 1 ($L_{Aeq\ 15min}$) (dB) | Quarter 2 ($L_{Aeq\ 15min}$) (dB) | Quarter 3 ($L_{Aeq\ 15min}$) (dB) | Quarter 4 ($L_{Aeq\ 15min}$) (dB) |
|---|---|---|---|---|---|---|
| **Red Springs (N07)** | 37 | 35 | IA | IA | IA | IA |
| **Hillcroft (N08)** | 35 | 35 | IA | IA | IA | IA |
| **Forest Lodge (N10)** | 40 | 40 | IA | IA | IA | IA |
| **Doble Gate (N09)** | 43 | 43 | IA | IA | IA | IA |
| **Tilley (N06)** | 43 | 43 | IA | IA | IA | IA |

*IA – noise from CVM was inaudible*

### 6.5.4 Trends in Data

The quarterly noise monitoring results for the period 2011 – 2020 are summarised in **Appendix 4**. The results show CVM has largely been inaudible at each noise monitoring location since CVM entered care and maintenance.

### 6.5.5 Proposed Improvements

No additional mitigation measures or monitoring procedures are proposed to be implemented which are outside that detailed in the CVM EMP (Coalpac, 2012c) in relation to noise management.

## 6.6 Biodiversity

### 6.6.1 Environmental Management Measures

The 2020 Biodiversity Monitoring was undertaken in accordance with the approved CVM Environmental Monitoring Program (Coalpac, 2009), and the CVM Flora and Fauna Management Plan (Coalpac, 2012a).

Biodiversity monitoring commenced at CVM in 2012 (Kleinfelder, 2011-2015) and has been undertaken by Umwelt since 2016 (refer to **Figure 6.2**).

Existing vegetation communities and fauna habitat have been previously characterised during the Ecological Impact Assessment (Cumberland Ecology, 2014). Ongoing monitoring aims to document the condition of vegetation and habitats throughout the CVM Compensatory Habitat Areas and Rehabilitation Zones.

The CVM Compensatory Habitat Areas contains eight monitoring plots located across following three vegetation types:

- Tablelands Dry Woodland – CH1, CH2, CH3, CH5, CH6 and CH8
- Sandstone Dry Ridgetop Woodland – CH7
- Tablelands Sheltered Valley Forest – CH4

The Cullen Valley Rehabilitation Zones contains 15 monitoring plots located across nine rehabilitation areas defined by year:

- 2002 – plot FP5
- 2003 – plots R7, R8, FP9, FP22 and FP10
- 2004 – plot FP10 and FP11
- 2005 – plot FP6
- 2006 – plot 2006NE
- 2009 – plot R5
- 2010 – plot R4
- 2012 – plots R1 and R3
- 2014 – plot 2014NE

## 6.6.2 Monitoring Methodology

The 2020 biodiversity monitoring was undertaken at the CVM Compensatory Habitat Areas and Rehabilitation Zone monitoring sites as shown on **Figure 6.3**. The biodiversity monitoring program for CVM was based on the monitoring requirements documented in the following plans:

- Cullen Valley Mine Flora and Fauna Management Plan (Coalpac, 2012a); and
- Cullen Valley Mine Environmental Monitoring Program (Hansen Bailey, 2009).

In addition to the monitoring requirements stated in the above documents, monitoring undertaken of the Compensatory Habitat Areas and Rehabilitation Zones in 2020 included the following:

- floristic monitoring within fixed plots (20 m x 10 m) every 10 ha;
- fauna surveys to identify the fauna species and habitats quality;
- Clandulla geebung and Capertee stringybark monitoring (biodiversity conservation area);
- vegetation dieback surveys in areas of subsurface heating (further discussed in **Section 6.9**) and
- an assessment against the performance/completion criteria with the CVM C&M MOP (Sedgman, 2015).

A general assessment of compliance of the rehabilitated areas against the biodiversity and rehabilitation performance and completion criteria for CVM is summarised in **Table 8.2**.

## 6.6.3 Environmental Outcomes/Trends in Data

### 6.6.3.1 Environmental Conditions

During the 2020 surveys, the Cullen Bullen region was listed as being in “Non-Drought” according to the Combined Drought Indicator (CDI) (DPI 2021) (Plate 6.1). The CDI uses a combination of factors in making this determination including the rainfall index, soil water index, pasture growth index and drought direction index. This comes off the back of conditions in 2017, 2018 and 2019 (DPI 2021) where:

- The region was listed as “Drought Affected (intensifying) in August 2017.
- The region was listed as in “Drought” and in “Intense Drought” from November 2017 to December 2018 before recovering until late 2019.
- The region was listed as in “Drought” and in “Intense Drought” from December 2019 to January 2020.
- The region was listed as “Non-Drought” since August 2020.

These trends are shown in **Plate 6.1** (DPI 2021) for the Cullen Bullen Parish (Roxburgh County). This plate provides the rainfall index, plant growth index and soul water index for this parish, which combines to provide the CDI. This is then categorised into either Intense Drought, Drought, Drought Affected, Drought Recovery or Non-Drought. Of particular relevance in this plate is the rainfall index ad plant growth index, which are key measures of community condition and can substantially influence the local vegetation and local water sources leading to varying resource availability for fauna species.

The total annual rainfall recorded at Portland (approximately 7 km south east) in 2020 was 916.5 mm which is above average annual rainfall recorded over the last 116 years (703.5 mm) (BOM 2021).

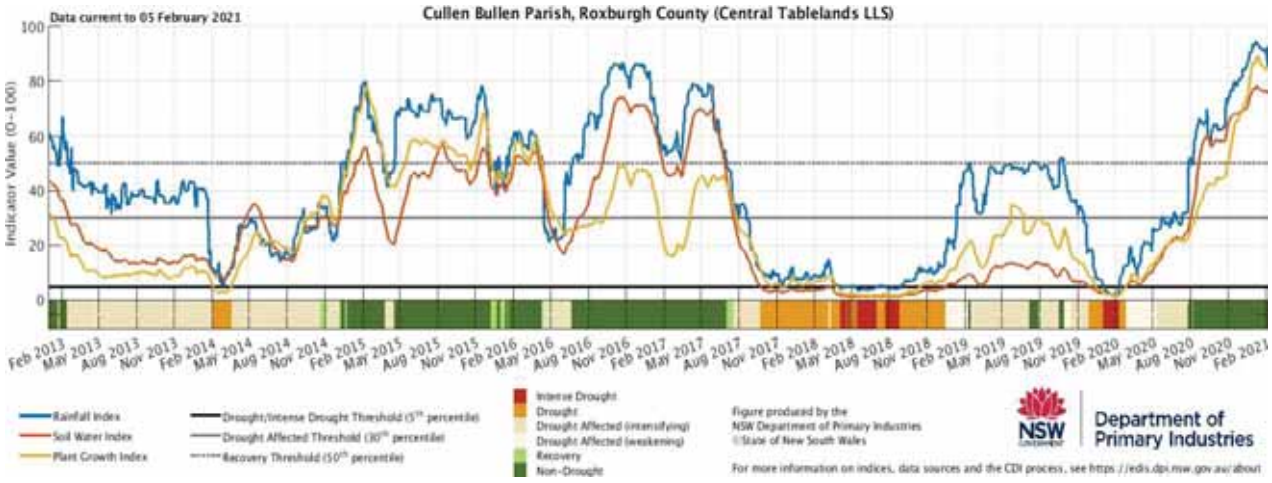



**Plate 6.1** Seasonal environmental conditions recorded at Cullen Bullen



### 6.6.3.2 CVM Compensatory Habitat Areas

Native vegetation within the Compensatory Habitat Areas was considered to be in good condition across all woodland and forest habitats however it was found to be affected by previous drought conditions. Monitoring in 2020 recorded a significant increase in the overall floristic composition and vegetation condition for most Compensatory Habitat Area monitoring locations compared to monitoring in 2019. Woodland and forest habitats demonstrated substantial increase in the vegetative cover throughout the ground stratum (**Plate 6.2**), whereas foliage cover in the canopy while the midstory strata was generally sparse and continues to recover following the drought. In 2020 bare earth was infrequently observed across all Compensatory Habitat Area monitoring locations. Where ground layer vegetation was present an increase in native species diversity was observed, compared to 2019. The vegetation of the Compensatory Habitat Areas demonstrates minimal degradation due to human influences with the exception of vehicle tracks, minor logging and rubbish dumping by others. Given the above information, no flora management activities are recommended at this time. While the 2020 monitoring observed increased cover and abundance of native species it should be noted that the cover and abundance of these species is expected to decrease slightly in subsequent monitoring events as is typical of native flora species following a period of increased growth after a drought.

**Plate 6.2** Condition of CHA monitoring location CH6 (Left - 2019; Right - 2020)

The Compensatory Habitat Areas provides habitat for a range of fauna groups including amphibians, birds, reptiles, as well as arboreal and ground dwelling mammals and marsupials. While the vegetation condition has increased from that recorded in 2019, the Compensatory Habitat Areas continue to provide a number of stable habitats for fauna including woody debris, hollow bearing trees, fallen timber, escarpment and large rocky outcrops. Other habitats previously recorded, such as permanent water sources and patches of dense leaf litter appeared to be in decrease since monitoring was last undertaken in 2019. Dams which were dry in 2019 contained water due to increased rainfall in 2020. These water sources are important for a range of fauna as they provide water for drinking, as well as a range of micro habitats for amphibians and foraging habitat for insectivores such as microbats and birds.

Monitoring in 2020 recorded an increase in overall fauna species diversity throughout the Compensatory Habitat Areas with a total of 88 fauna species recorded compared to 55 species recorded during monitoring in 2019. Approximately 70% of the fauna diversity is represented by birds with 62 species recorded across all Compensatory Habitat Area monitoring sites. The remaining 26 fauna species recorded during 2020 monitoring consisting of 13 mammal species, nine reptile species and four frog species. While most fauna groups experienced an increase in the species diversity, the number of mammal species detected during monitoring increased from 11 species in 2019. Microbat monitoring in 2020 consisted of site stratification to decrease the number of sample sites and increase the detection period of the Anabat ultrasonic recording device from one hour to an entire night of recording. A total of three microbat species were confidently identified in 2020 based on call analysis compared to 10 species recorded in 2019 and two species recorded in 2018. The availability of diverse habitats structures, the proximity of the CHA to Ben Bullen State Forest and rural areas, is the likely reason that the CVM Compensatory Habitat Area retains reasonably high degree of fauna species diversity and the occurrence of threatened species during severe environmental conditions.

Two threatened species were recorded in the CVM Compensatory Habitat Area during 2020 including the greater glider (*Petauroides volans*) and large-eared pied bat (*Chalinolobus dwyeri*). Both species are listed as Vulnerable under the EPBC Act and the large-eared pied bat is also listed as Vulnerable under the BC Act.

**Plate 6.3** A greater glider foraging near CHA monitoring site CH7

### 6.6.3.3 Rehabilitation Zones

The Cullen Valley Rehabilitation Zones are identified by the year each zone was established being, 2002, 2003, 2004, 2005, 2006, 2009, 2010, 2012 and 2014.

During the 2020 monitoring, a significant increase of vegetative cover was observed within the ground strata of the monitoring sites within the Rehabilitation Zones. This is a marked difference to the low ground cover recoded in 2019 indicating that the vegetation within the Rehabilitation Zones is recovering post-drought (**Plate 6.4**). The middle and upper stratums within the Rehabilitation Zones continued to show some form of dieback, likely due to the drought and natural senescence of acacia in particular. However, it is expected that the species within these strata will continue to recover over time. Encouragingly, the presence of the mycorrhizal orchid species (*Calochilus sp*.) recorded at monitoring site R1 is an indication of ecosystem functionality of the Rehabilitation Zones. Approximately 10 mycorrhizal orchids were recorded during the 2020 surveys whereas no records were observed in 2019 and only one record observed in 2018.

While the 2020 monitoring observed increased cover and abundance of native species it should be noted that the cover and abundance of these species is expected to decrease slightly in subsequent monitoring events as is typical of native flora species following a period of increased growth after a drought. This trend is expected for vegetation throughout both the CVM Rehabilitation Zones and Compensatory Habitat Areas.

**Plate 6.4** Condition of CVM Rehabilitation Monitoring Location FP6 (Left – 2019; Right – 2020)



In 2020 evidence of improved ecosystem functionality and developing habitat features was found in most monitoring sites of the CVM Rehabilitation Zones. This has assisted with maintaining the midstory and canopy species as they establish and assisted to develop landscape function. Salvaged woody debris was commonly recorded in younger areas of rehabilitation, however the production of leaf litter and woody debris as a natural process was limited.

Characteristics of ecosystem function, such as the natural accumulation of leaf litter and woody debris were evident in older rehabilitations areas as they continue to progress towards a self-sustaining ecosystem. The production of woody debris through acacia senescence, deterioration of existing woody debris, and the presence of detritivores (such as wood roaches and weevils) were also recorded during 2020. Ants were observed opportunistically throughout most rehabilitation zones and are important for topsoil development, as well as facilitating the transfer of water, oxygen and nutrients within the soil profile. The presence of trees and shrubs bearing seed, and successional acacia saplings in proximity to those individuals recently senesced, indicates how these areas are progressing toward a self-sustaining condition.

Monitoring in 2020 recorded a total of 73 fauna species, comprising 49 bird species, 16 mammal species, six amphibian species and two reptile species. This represents an increase in total fauna species diversity compared to monitoring in 2019 (54 species) and 2018 (60 species). The same method for monitoring microbats was undertaken in both the Compensatory Habitat Areas and rehabilitation areas in 2020 where the number of sites were stratified based on the rehabilitation establishment year. A total of seven microbat species were confidently identified in 2020 based on call analysis compared to nine species recorded during monitoring in 2019.

Fauna species diversity of rehabilitation areas was considered to be influenced by age and structure of rehabilitation areas, as well as the decline in condition within surrounding remnant habitats including the Ben Bullen State Forest as a result of recent bushfires. This was evident during 2020 monitoring where the CVM Rehabilitation Zones were found to support a more fauna species diversity than the Compensatory Habitat Areas with a total of 88 fauna species recorded (refer to **Section 6.6.3.2**). This is particularly the case for highly mobile fauna such as birds, microbats and arboreal mammals that move between habitat patches depending on their condition. It is likely that the CVM Rehabilitation Zones are acting as refuge habitat as they were not affected by bushfires which had a substantial impact on surrounding remnant woodland habitat. In a landscape context flowering acacia within these rehabilitation areas provide important food resources for nectarivorous fauna (birds and arboreal mammals in particular) while adjacent remnant vegetation recovers from the effects of fire.

This was particularly evident where a total of 17 sugar gliders (*Petaurus breviceps*), four common brushtail possum (*Trichosurus vulpecula*), and three common ring tail possums (*Pseudocheirus peregrinus*) were recorded within the CVM Rehabilitation Zones.

Compensatory habitat features such as nest boxes provide an artificial substitute for species including a variety of gliders, birds and microbats, which have consistently used the boxes based on monitoring undertaken 2016 – 2019. Monitoring in 2020 recorded one sugar glider (*Petaurus breviceps*) in a nest box located south rehabilitation monitoring location FP11 (**Plate 6.5**).

**Plate 6.5** Squirrel glider (*Petaurus norfolcensis*) mother with three young recorded in a nest box during monitoring.

A total of four threatened species were recorded in the CVM rehabilitation zones during 2020. These were the gang-gang cockatoo (*Callocephalon fimbriatum*), squirrel glider (*Petaurus norfolcensis*), large-eared pied bat (*Chalinolobus dwyeri*) and yellow-bellied sheath tailed bat (*Saccolaimus flaviventris*). The large-eared pied bat is listed as vulnerable under the BC Act and EPBC Act, while all remaining species are listed as vulnerable under the BC Act. This is the first time that the yellow-bellied sheath tailed bat (*Saccolaimus flaviventris*) has been recorded within the CVM Rehabilitation Zones. The remaining species have been recorded at CVM Rehabilitation Zones during previous monitoring events.

#### 6.6.3.4 Clandulla geebung Monitoring

In 2020 a total of 71 Clandulla geebung (*Persoonia marginata*) plants were recorded within the monitoring site. This demonstrates a slight population decrease since monitoring was undertaken in 2019 (88 plants), and 2017 (100 plants) but a slight increase from the 2018 (60 plants) surveys. Of the 71 plants identified in 2020, 38 individuals were recorded bearing fruit and 19 plants were flowering. No individuals were identified buds. Three new individual plants were identified during the 2020 monitoring event. Fifty-four (76%) of the 71 plants recorded in 2020 were identified as healthy, with the remaining 17 plants (24%) identified as showing slight signs of stress. These observations indicate that this population is healthy and reproducing despite the prevailing drought conditions. Overall, there was no discernible change in this population which suggests that the population is stable and currently not affected by the previous mining activities.

### 6.6.4 Proposed Improvements

Monitoring of rehabilitation and compensatory habitat areas will continue in 2021.

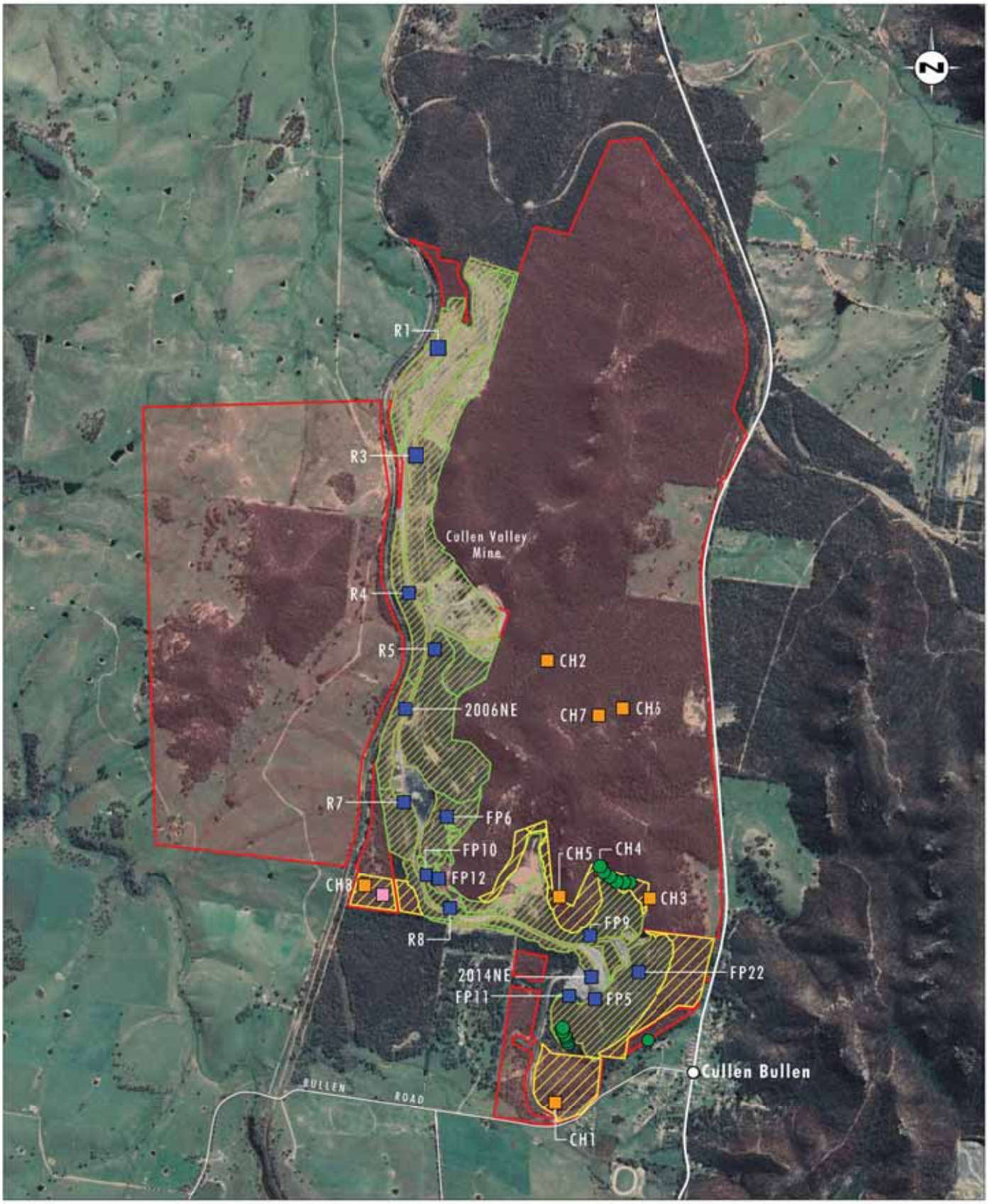



Image Source: Google Earth (Apr 2020)
Data Source: Kleinfelder (2017)

0 0.5 1.0 1.5km
1:30 000

**Legend**

- Study Area
- Compensatory Habitat Area
- Rehabilitation Zones
- Rehabilitation Monitoring Point
- Compensatory Habitat Monitoring Site
- Nest Box Location
- Clandulla Geebung Monitoring Site

FIGURE 6.3

**Cullen Valley Environmental Monitoring Sites**

File Name (A4): R129/3965_165.dgn
20210219 13.03

# 6.7 Weeds and Feral Animals

## 6.7.1 Weeds

### 6.7.1.1 Rehabilitation Zones

In 2020, the CVM Rehabilitation Zones demonstrated a minor continued presence of weeds during monitoring. Weeds were limited to cosmopolitan species such as catsear (*Hypochaeris radicata*), fireweed (*Senecio madagascarensis*), St John's wort (*Hypericum perforatum*), blackberry (*Rubus fruticosus spp*. *aggregate*) or Paterson's curse (*Echium plantagineum*) which were found in relatively low abundances throughout most rehabilitation vegetation. Treatment of St John's wort (*Hypericum perforatum*) was observed in some areas, however follow up treatment and assessment of different areas is recommended for this weed. Given the current low density of blackberry (*Rubus fruticosus spp. aggregate*) within the rehabilitation areas, it is recommended that hand removal and spraying be conducted as this will prevent further infestations and be more cost effective in the long term. No management intervention is required at this time for other weed species given their current cover and abundance throughout the Rehabilitation Zones.

While studies have shown that bare ground favours the establishment of some weed species via colonisation from surrounding areas, this does not appear to be the case considering CVM Rehabilitation Zones have been established for up to 18 years (2002). Small fluctuations are common when monitoring the presence and management of weeds and generally vary in response to a range of natural variables such as rainfall and drought. The likelihood of exotic species further colonising throughout CVM Rehabilitation Zones is low, given the soil structure, absence of topsoil, and the density of tree and shrub species established in the rehabilitation zone.

### 6.7.1.2 Compensatory Habitat Areas

Monitoring in 2020 demonstrated an increase in the presence of weeds across all areas of the CVM Compensatory Habitat Areas, however these also corresponded with increased abundance and cover of native species, which this is likely a product of the suitable environmental conditions following recent drought conditions. The majority of weeds recorded in these areas were typically cosmopolitan weed species that are not expected to have an adverse effect on the integrity and function of the natural ecosystem give their current abundance and cover. However, weed species that were recorded consistently throughout the Compensatory Habitat Areas included catsear (*Hypochaeris radicata*), St John's wort (*Hypericum perforatum*), cotoneaster (*Cotoneaster glaucophyllus*), hawthorn (*Crataegus monogyna*), Paterson's curse (*Echium plantagineum*) and blackberry (*Rubus fruticosus aggregate*). Treatment of St John's wort (*Hypericum perforatum*) was observed in some areas, however continued monitoring of this weed species is recommended. Cotoneaster (*Cotoneaster glaucophyllus*), hawthorn (*Crataegus monogyna*) and low abundance of blackberry (*Rubus fruticosus aggregate*) were recorded again in 2020, however these weed species do not appear to be contributing to any environmental degradation as they are; management of these species is not currently required but continued monitoring is recommended.

## 6.7.2 Feral Animals

### 6.7.2.1 Compensatory Habitat Area

Five introduced species were observed within the CVM Compensatory Habitat Areas during 2020, being the fox (*Vulpes vulpes*), feral cat (*Felis catus*), dog (*Canis lupus familiaris*), brown hare (*Lepus capensis*) and rabbit (*Oryctolagus cuniculus*). No management activities are recommended at the present time given the low impact potential that these species may have on the quality of vegetation throughout the CVM Compensatory Habitat Areas.

#### 6.7.2.2 Rehabilitation Area

Three introduced species were recorded within the CVM Rehabilitation Zones during 2020 being the red fox (*Vulpes vulpes*), dog (*Canis lupus familiaris*) and fallow deer (*Dama dama*). Feral animal management intervention is not recommended at this time for these species given their low numbers observed and low potential to impact rehabilitation progress.

## 6.8 Erosion and Sediment Control

### 6.8.1 Environmental Management Measures

The objective of the CVM water management system is to separate clean water and dirty/mine water. Erosion and sediment control focus on the management of 'dirty' water which is runoff from disturbed areas. The erosion and sediment controls (ESC's) established during mining remains in place whilst the operation is under care and maintenance. These ESC's include dirty water sediment dams, open drainage channels with established vegetation and/or rock armouring and drop structures where required.

### 6.8.2 Performance Criteria

There are no performance criteria for erosion and sediment control specified in either the Development Approval or the EPL.

### 6.8.3 Environmental Outcomes

Visual inspections of the water management system and erosion and sediment controls are monitored by the mine manager with repairs undertaken on an as needs basis.

As part of the Section 240 notice issued to CVM (**Section 4.3**), the NSW RR directed CVM to address erosion issues relating to steep batters, slopes and gullies at the mine site. Recommended actions for the management of these issues are included in the CVM MOP (Umwelt, 2020). The target completion date for some of these works is February and March 2021. It is also noted that the timing of some works is subject to the subsurface heating investigation which is expected to be completed by September 2021.

### 6.8.4 Trends in Data and Proposed Improvements

Visual inspections of the water management system and erosion and sediments controls indicate that both are operating as intended.

## 6.9 Subsurface Heating

In 2011, the former Department of Resources and Energy (DRE) issued the previous mine owner/operator (Coalpac) with a Section 240 direction requiring a concentrated effort to manage and extinguish subsurface heating in a noise bund and in other areas within ML 1488. The direction also required rehabilitation of heating affected areas. Subsequently, a plan of work was developed and included within the Plan of Works MOP Variation (dated 30 January 2013) and the 2011 to 2015 CVM Care and Maintenance (C&M) MOP.

Following the receipt of Section 240 notices during the report period, CVM engaged an independent consultant with extensive subsurface heating experience to review the current management measures being utilised to manage subsurface heating at CVM. This review informed the MOP (Umwelt, 2020) and Plan of Works.

The Plan of Works included in the MOP (Umwelt, 2020) made the following recommendations, being:

- Continue to the implement the current subsurface heating management and monitoring measures (i.e. monitoring via heat gun, visual, smell and recording community complaints) and a minimal earthworks/topsoil disturbance treatment approach (i.e. backfill and compact any areas where surface cracking and evidence of subsurface heating is observed).

- Limiting the extent of earthworks and surface disturbance as far as practicable. This minimises any potential loss of topsoil, maximises the available seed bank in the topsoil and assists with the natural recovery of vegetation in the area.

- Undertake an investigation to inform the containment and extinguishing options for subsurface heating (further details of the scope of the investigation are detailed below) and

The outcomes and results of these investigations will be used to inform the preferred overburden subsurface heating treatment measure/s to be implemented for each area of interest and also any timing constraints with undertaking further targeted rehabilitation works.

Subsurface heating at CVM has been observed in five main areas being area R1, F1, F2, F3 and F4 (refer to **Figure 6.4**). The active extent of the subsurface heating has been mapped for applicable years (**Figure 6.4**).

Mapping of the extent of subsurface heating has occurred since 2016. Previously only hot spots were mapped. In regard to the physical extent of heating areas as shown on **Figure 6.4** it is important to note the following:

- 2015 – showed only hot spots at Area R1

- 2016 – showed the area impacted by sub-surface heating, noting that the area was not necessarily showing active signs of heating at that point in time (i.e. the presence of active subsurface heating smell, smoke and /or surface cracking)

- 2017 (revised mapping methodology commenced) – areas shown are those which showed signs of active heating (i.e. temperature, sulphurous smell, smoke, discoloration of the ground, vegetation die back or stress and /or surface cracking). These areas were observed in F1, F2, F3, R1 and a new area F4)

- 2018 – Areas shown are those showing signs of active heating. During the 2018 report period, area F4 was also cleared of vegetation, excavated and compacted as a treatment measure.

- 2019 – Areas shown are those showing signs of active heating. During the report period, area F3 was cleared of vegetation, excavated and compacted as a treatment measure.

- 2020 - Areas shown are those showing signs of active heating. During the report period, area F3 was cleared of vegetation, excavated and compacted as a treatment measure.

**Table 6.19** shows the area subject to active heating at the time of monitoring.

**Table 6.19 Summary of Subsurface Heating Impact Extent (2016 - 2019)**

| Subsurface Heating Area Name | Area of active subsurface heating(ha) | | | | | 2020 Comment |
|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2018 | 2019 | 2020 | |
| **F1** | 1.05 | 0.26 | 0.03 | 0.78* | 1.35* | |
| **F2** | 0.28 | 0.28 | 0 | 0.76 | 0.96 | |
| **F3** | - | 0.07 | 0.19 | 0.13 | 0.03 | New area of subsurface heating adjoining remediated area of F3 |
| **F4** | - | 0.1 | 0 | 0.78* | 1.35* | |
| **R1** | 1.97 | 0.05 | 0.46 | 0.46 | 0.34 | |

*Subsurface heating areas F1 and F4 combined

Note: **Section 6.9** explains how these mapping areas have been calculated.

Active subsurface heating was recorded across all existing management areas. The 2020 extent of active subsurface heating in each area is detailed in **Table 6.20**. Subsequent monitoring surveys will provide further information regarding how rehabilitation responds to subsurface heating impacts.

**Table 6.20 Details of Vegetation Response to Subsurface Heating during 2020**

| Subsurface Heating Area Name | Extent of Active Heating | Vegetation Response |
|---|---|---|
| **F1** | Extends outside of the previously mapped footprints and continues to be joined with Area F4. | New area of Eucalypt and Acacia dieback in the north-east of F1 area. Substantial dieback of Eucalypts and Acacias and groundcover vegetation in the south of the F1 area outside previous extent of subsurface heating.<br>Acacia and groundcover recovery in the north-west area of F1. |
| **F2** | Includes and extends outside of the 2019 mapped footprint. | Heat impacted Acacia and Eucalypt and groundcover vegetation to the north-east and south-east of the F2 Area.<br>Recovery of groundcover vegetation on the edge of the heating extent in the south-west of the F2 Area. |
| **F3** | New heating area adjacent to remediated F3 area to the eastern side.<br>Areas of warm ground and gas venting. | Significant grass growth around previously remediated area. Some dead and dying Acacias adjacent to remediated area likely due to subsurface heating and recent drought.<br>New active heating adjacent to remediated area of F3 with immature Acacias and grasses dead or dying off. Some healthy vegetation but most likely attributed to drought recovery. |
| **F4** | Includes and extends outside the previously mapped footprint. | Acacias and groundcover vegetation at the edges of existing subsurface heating in the south-east and north-west are recovering.<br>Acacia and Eucalypt dieback in the north-east outside previous extent of subsurface heating. |
| **R1** | Largely remains in the previously mapped footprint. | Acacia recovery in the south west edge of remediation. The north-west to north-east of the mapped area demonstrated continued recovery of Eucalypts and Acacias and groundcover vegetation growth (grasses and forbs).<br>Severe vegetation death in the south-east of the mapped area with active cracking and gas venting and yellow ooze. |

CVM continues to observe variation in the level of vegetation regeneration and erosion issues where different subsurface treatment techniques have been implemented. Where aggressive subsurface management measures are applied erosion issues are more prevalent and natural regeneration of vegetation is slower when compared to areas where targeted remediation works have been undertaken. This is difference is believed to be due to the presence of woody debris and seed back in the soil in areas where targeted remediation works have been undertaken. Recording of this information will inform what treatment techniques will be implemented in the future. The ongoing management of these areas will be undertaken with the management measures as detailed in the CVM C&M MOP (Sedgman, 2015).

### 6.9.1 Environmental Management Measures

The management measures to monitor and treat sub surface heating are detailed in the CVM Care and Maintenance MOP (Sedgman, 2015) and include:

- weekly monitoring of heating areas (temperature/heat gun, sulphurous smell, smoke, discoloration of the ground, vegetation dieback or stress and/or surface cracking)
- capping of surface cracking using cement
- excavation and compaction of material as required.

### 6.9.2 Environmental Outcomes and Further Improvements

During 2019, minor repair works (i.e. localised earthworks – excavation of cracks and backfilling with inert material and compacting and filling cracks with concrete) was undertaken in subsurface heating areas with the exception of Area F3.

During 2021, CVM will continue to monitor for subsurface heating and undertake treatment measures in accordance with the updated Plan of Works (**Section 6.9**). Further investigations into subsurface heating sources and potential treatment methods will also continue (**Section 6.9**).

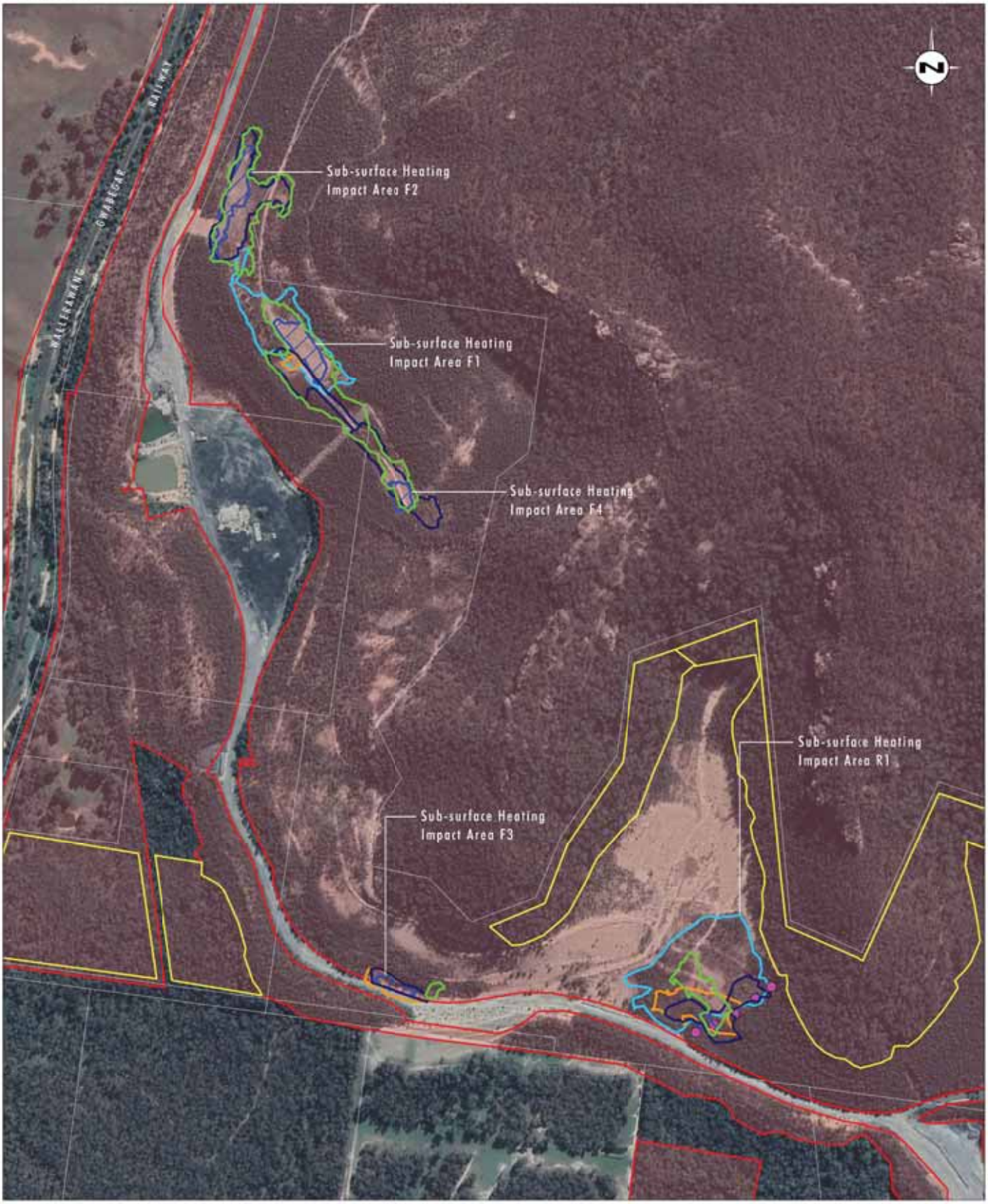



Image Source: Google Earth (Apr 2020)
Data Source: Kleinfelder (2017)

0 100 200 400m
1:7 500

**Legend**

- Study Area
- Compensatory Habitat Area
- Sub-surface Heating Impact Areas 2020
- Sub-surface Heating Impact Areas 2019
- Sub-surface Heating Impact Areas 2018
- Sub-surface Heating Impact Areas 2017
- Sub-surface Heating Impact Areas 2016
- Sub-surface Heating Impact Area - SE Boundary (Kleinfelder 2015)

FIGURE 6.4

## Sub-surface Heating Impact Areas - Cullen Valley Mine

File Name (A4): R129/3968_167.dgn
20210219 13.44

## 6.10 Blasting

There was no blasting conducted at CVM during the report period.

## 6.11 Waste Management

As no mining activities were undertaken during the report period and as there is only one staff member on site, minimal quantities of waste, typically office waste, was generated. Sewage from the workshop areas are directed to a septic system which is pumped out by a licensed waste collection and disposal contractor on an as-needs basis.

During the report period only minimal oil and greases were stored on site. Any maintenance works required on machinery and equipment is undertaken within existing bunded areas. Waste oils and grease are collected by a licensed waste recycling contractor on an as needs basis.

All paper and general wastes from workshop areas is disposed of in garbage bins located adjacent to the workshop areas, which are collected by a licensed contractor on an as needs basis.

## 6.12 Hazardous Material Management

Hazardous material storage tanks containing oils, grease and degreasers have been emptied, isolated and secured. Any excess storage tanks have been removed from the site. Storage tanks remaining onsite have been kept empty during the care and maintenance period.

The above ground self-bunded diesel tank (Transtank) is not currently operational during the care and maintenance period. Up to 35,000L of diesel may be stored in the facility if diesel is required for environmental works on site. Two EPA registered radionuclide fixed radiation gauges (No.s RR20215 and RR21832) have been decommissioned and are stored onsite.

## 6.13 Heritage

### 6.13.1 Indigenous Heritage

Previous archaeological surveys did not locate any Aboriginal artefacts or sites within the approved open cut mining area. However, two sites of significance were recorded in close proximity to the approved mining area. A campsite-stone artefact scatter (C-OS-1) and a rock shelter site (C-S-1). A further two sites where identified in surveys undertaken during 2011 and include 45-1-2542 and RSC-OS-1. These sites are located outside of the existing mining area.

### 6.13.2 Non-Indigenous Heritage

No mining activities were undertaken in proximity of locations of European heritage significance during the report period.

## 6.14 Greenhouse Gas Emissions

As the site was in care and maintenance during the report period, greenhouse gas emissions were minimal. Emissions are limited to a small fleet of vehicles/equipment which are utilised for care and maintenance works and minor earth works associated with erosion and sediment control and sub-surface heating treatment. CVM is below the trigger thresholds for National Greenhouse and Energy Report System (NGERS) report as a single facility, however a consolidated greenhouse gas emissions report is completed by the ownership group which takes into account other business interests, in accordance with NGERS requirements. NGERs reporting was undertaken during the 2020 report period.

## 6.15 Bushfire

A CVM Fire Management Plan (Coalpac, 2012e) has been developed and includes a number of measures to minimise bushfire risk. These measures include:

- fitting fire extinguishers to all earthmoving and mining equipment
- fitting and maintaining efficient exhaust systems and spark arresters to mobile equipment
- advising NSW Rural Fire Service, regulatory authorities and neighbours of any burning-off operations
- facilitating that vehicles with low level exhaust systems do not leave defined tracks in locations and conditions likely to lead to ignition of combustible plant material
- maintaining, at the request of Forestry Corporation NSW, existing fire trails or access roads at the extremities of the lease area, which serve as access for firefighting services as well as establishing a fire break to the limits of operations at the open cut.

## 6.16 Mine Subsidence

Mining operations at CVM ceased in 2012. There have been no subsidence management measures required to be implemented by CVM during the report period.

## 6.17 Public Safety

Access to working areas of the CVM open cut are controlled by locked gates. Access to CVM by members of the public is via contact at the mine office where visitors or contractors can only be escorted by site personnel around the site.

# 7.0 Water Usage

## 7.1 Water Management System

The water management system at CVM is described within the CVM WMP (Umwelt, 2017b) and also within **Section 6.4** of this document.

## 7.2 Water Take

Licence and water take information is summarised in **Table 7.1**. During the report period, there was 2.5 ML extracted from Tyllies Bore.

**Table 7.1 Water Take During 2020 Reporting Period**

| Water Licence No. | Water sharing plan, source and management zone (as applicable) | Entitlement | Passive take/ inflows | Active Pumping | Total (ML) |
|---|---|---|---|---|---|
| **80WA706148** | Sydney Basin MDB Groundwater Source<br>Water Sharing Plan – NSW Murray Darling Basin porous rock groundwater sources | 80 units | 0 | 0 | 0 |

# 8.0 Rehabilitation

## 8.1 Status of Mining and Rehabilitation

CVM has operated on a care and maintenance basis since coal mining ceased in December 2012. Previously established rehabilitation areas included 132.8 ha of land mined since the commencement of open cut mining operations.

There was no tree planting or tree seeding undertaken during the report period. An assessment of the status of the existing CVM rehabilitation against the performance indicators and completion criteria as detailed within the CVM CM MOP (Sedgman, 2015) is detailed in **Section 8.3**.

CVM has identified areas where further rehabilitation can potentially be undertaken. These areas are associated with:

- land that has been previously rehabilitated but requires supplementary works to improve the quality and quantity of this vegetation in line with the agreed completion criteria objectives
- infrastructure areas (e.g. coal stockpile pad) which is larger than that required for any future mining operational needs
- shaped and topsoiled emplacement dumps which have not been seeded/planted
- land which has been affected by subsurface heating and has been confirmed via further subsurface heating investigations to be completed during the MOP term to be capable of to supporting plant growth and unlikely to be subject to further subsurface heating. The viability of and timing of undertaking the rehabilitation work will in part be informed by the subsurface heating investigation as described in **Section 6.9**.

Previous rehabilitation at CVM has seen the successful germination and growth of native and local grass, shrub and tree species which are representative of the vegetation community types found in the area. Recent rehabilitation has proved successful with multiple tree species including *Eucalyptus*, *Acacia* and *Allocasuarina* being heavily represented. During 2021, CVM intends to apply for the relinquishment of rehabilitation areas which are deemed to satisfy the rehabilitation criteria.

The status of rehabilitation at CVM is detailed in **Table 8.1**.

**Table 8.1 CVM Rehabilitation Status**

| Mine Area Type | Previous reporting period (actual) 2019 (ha) | This reporting period (actual) 2020 (ha) | Next reporting period (forecast) 2021 (ha) |
|---|---|---|---|
| A. Total mine footprint (all areas including active disturbance areas and rehabilitation areas) | 193.9 | 193.9 | 193.9 |
| B. Total active disturbance (areas within the footprint still requiring rehabilitation) | 56.7 | 56.7 | 56.7 |
| C. Land being prepared for rehabilitation | 4.4 | 4.4 | 4.4 |
| D. Land under active rehabilitation | 132.8 | 132.8 | 132.8 |
| E. Completed rehabilitation (areas that have achieved completion criteria and have been signed-off by DRE) | 0 | 0 | 0 |

## 8.2 Post Rehabilitation Land Uses

The proposed final land use aims to emulate the pre-mining environment and will enhance local and regional ecological linkages across the site and adjacent areas. The primary objective of site revegetation and regeneration is to create a stable final landform with acceptable post-mining land use and suitability. In the long term, rehabilitation areas will become integrated with adjacent native vegetation communities. Rehabilitation areas will continue to be monitored on an annual basis and will be managed until self-sustaining. Final rehabilitation areas will achieve the rehabilitation completion criteria specified in the approved CVM C&M MOP (Sedgman, 2015) prior to relinquishment.

## 8.3 Completion Criteria Assessment

The results of the 2020 biodiversity monitoring program have been compared against the objectives as defined in the CVM C&M MOP (Sedgman, 2015). Monitoring undertaken during 2020 has indicated that the CHA's within CVM are providing consistent native flora and fauna habitat compared to baseline information and previous annual monitoring results.

## 8.4 Rehabilitation Activities

Although the mine is in care and maintenance, management and monitoring of rehabilitation areas is undertaken in accordance with the approved CVM Flora and Fauna Management Plan (Coalpac, 2012a).

There has been no removal of buildings or other infrastructure and no new rehabilitation areas were established during the 2020 report period as the mine is currently in care and maintenance.

**Table 8.2** provides a general overview of the performance of the rehabilitated area against the biodiversity and rehabilitation performance and completion criteria for CVM. It is noted that there are areas which have been disturbed by mining which are yet to be rehabilitated. These disturbed areas do not form part of the general assessment presented in **Table 8.2**.

**Table 8.2 Assessment of CVM Rehabilitation Against MOP Performance Indicators and Completion Criteria**

| Domain Objectives | Performance indicators | Completion criteria | 2020 Status Against Completion Criteria |
|---|---|---|---|
| Revegetation works are undertaken in accordance with the Flora and Fauna Management Plan. | Plant establishment | Planting/seeding is assessed during annual monitoring as becoming successfully established. | Generally satisfied<br>Planting/seeding of existing rehabilitation areas has generally been successful.<br>Supplementary works are required where rehabilitation has been impacted by subsurface heating. The timing of these works will be informed by further investigations. |
| Established rehabilitation areas to be monitored on an annual basis and managed until self-sustaining. | Species composition | A range of native shrubs, grasses and other understorey species have established through topsoil, seeding or recolonization. | Generally satisfied<br>Exiting rehabilitation areas generally satisfy this criteria.<br>Supplementary works are required where rehabilitation has been impacted by subsurface heating. The timing of these works will be informed by further investigations |
| | Plant health | More than 75% of trees are healthy and growing as indicated by monitoring. | Satisfied<br>The general heath of the trees appears to be heavily influenced by climatic conditions and is mirroring that observed in unmined areas.<br>With the exception of the effect of subsurface heating, more than 75% of the trees are healthy and do not show any abnormal signs of disease, pest impact or ill heath. |
| | Weed establishment | A spraying program for the control of declared plants and other weeds has been implemented on the site. | Satisfied<br>A spraying program for the control of declared plants and other weeds has been implemented on the site where required.<br>No weed management works are required. |
| | Soil conditions | Soil salinity is sufficiently low to allow survival and growth of plant species, soil pH levels are within the range to allow plant growth. | Not monitored as part of the 2020 monitoring report. |

| Domain Objectives | Performance indicators | Completion criteria | 2020 Status Against Completion Criteria |
|---|---|---|---|
| | Fauna habitat structure | Fauna habitat includes a range of vegetation structural habitats, e.g. eucalypts, shrubs, ground cover and a developing litter layer. | The existing rehabilitated areas includes a range of vegetation structural habitats including eucalypts, shrubs, ground cover and a developing litter layer.<br>The individual monitoring sites within the CVM Rehabilitation Area have varying stages and extent of these habitats with some sites meeting the completion criteria while others are progressing towards it. It is suggested that this is a function of the age and the rehabilitation areas would be expected to trend over time to satisfy the completion criteria.<br>Monitoring sites FP11 and FP22 appear to have satisfactorily met the completion criteria. Monitoring sites R4, R5, FP05, FP6, FP9 and FP10 partially satisfy the completion criteria (i.e. leaf litter is still developing and areas of bare ground were observed). Whereas monitoring sites R1, R3, R7, R8 2014NE and 2006NE are progressing toward meeting the completion criteria as the leaf litter was almost absent and the vegetation structure is immature.<br>Overall, the structural habitats of the rehabilitation areas are not comparable to those within the surrounding Compensatory Habitat Areas as the they are not mature enough to contain the range of naturally forming habitats (e.g. hollow-bearing trees) that are present in the surrounding un-mined forests and woodlands. The Rehabilitated Areas are however expected to progress towards the naturally forming habitat features that exist in pre-existing or surrounding landforms over time. |

| Domain Objectives | Performance indicators | Completion criteria | 2020 Status Against Completion Criteria |
|---|---|---|---|
| | Presence of fauna species | Vertebrate surveys demonstrate that bird, mammal, reptile and frog communities are becoming established in rehabilitated sites. | Satisfied<br>The 2020 monitoring demonstrated that bird, mammal, reptile and frog communities are becoming established in the CVM Rehabilitation Area as a whole. However, when comparing the faunal group assemblages among the individual monitoring sites within the CVM Rehabilitation Area, not all sites are meeting the completion criteria. This is attributed to the availability of habitats within each site that are specific faunal groups need.<br>Fauna species diversity increased in 2020 compared with previous monitoring, however the total number of fauna species recorded in the CVM Rehabilitation Areas was less than those recorded in the Compensatory Habitat Areas. This is most likely due to the maturity of the rehabilitated areas and not any other factor. It is expected that faunal communities will continue to establish towards a similar number (i.e. carrying capacity) to those recorded in the surrounding un-mined vegetation as the diversity of habitats progressively improve.<br>Further evidence will be drawn from future monitoring events as remnant vegetation recovers from the effects of bushfire, habitat corridors continue to establish, and permanent habitat features become more frequent. |
| | Biodiversity monitoring | Annual biodiversity monitoring indicates that rehabilitation areas are becoming integrated with adjacent vegetation communities | Generally satisfied<br>The age of the rehabilitation area is the dominate factor for this completion criteria.<br>The older are:<br>• Look visually connected to the unmined land (e.g. landform)<br>• The vegetation on the rehabilitation areas is connected to the un-mined land<br>• Fauna species are using the rehabilitation areas<br>The diversity and structure of all rehabilitated areas is expected to continue to mature over time to be similar to the surrounding un-mined forests and woodlands. |

| Domain Objectives | Performance indicators | Completion criteria | 2020 Status Against Completion Criteria |
|---|---|---|---|
| Final rehabilitation areas to achieve rehabilitation completion criteria | Vegetation cover | No bare areas that have obviously failed and are greater than 0.5 ha in total area. | Progressing towards satisfactory completion.<br>All Rehabilitation Areas inspected were considered to meet this criteria milestone in 2020, with the exception of areas affected by subsurface heating. |
| | Tree cover | No treeless areas greater than 0.5 ha are present. | Generally satisfied<br>No treeless area greater than 0.5 ha were observed during the 2020 monitoring, with the exception of areas affected by subsurface heating. |
| | Shrub/grass cover | Monitoring and visual estimation show grass or shrub cover to be >50%. | Generally satisfied<br>2020 monitoring and visual estimation recorded grass and shrub cover to be >50% on the Rehabilitation Zones. It is noted that these are a mix of native ground cover species and exotic cover crop species.<br>This >50% coverage is due to above average rainfall conditions. It is expected that the ground cover layer will decrease in 2021 and beyond as this is a natural response for native flora after experiencing substantial growth during favourable environmental conditions following severe drought.<br>It is also noted that the acacia species in the older rehabilitation areas rehab are naturally dying back (senescence) and as such their prominence will be less in coming years. Recruitment of acacias species however was recorded in majority of the rehabilitation monitoring sites.<br>Future monitoring will determine how the native species diversity of rehabilitation areas will respond following increased plant growth in response to favourable environmental conditions. |
| Water management system to be maintained and monitored in accordance with the Water Management Plan | Mine affected water | Clean water is diverted around unsealed areas and directed through the water management system. | The separation and management of clean and dirty water continued during the report period in accordance with the water management system. |

| Domain Objectives | Performance indicators | Completion criteria | 2020 Status Against Completion Criteria |
|---|---|---|---|
| Disturbed landform is graded and shaped to reflect natural landforms and is free-draining. | Sediment and erosion control | Monitoring by the Mining Engineering Manager and annual monitoring of rehabilitation areas does not detect any major erosion/washouts that will compromise vegetation establishment or safety of final surfaces. | Progressing towards satisfactory completion. |
| Water management system to be maintained and monitored in accordance with the Water Management Plan. | Water management system | Clean water to be diverted around operational mining areas and directed through the water management system. | The separation and management of clean and dirty water continued during the report period in accordance with the water management system. |
| | | Mine affected water and sediment laden water from bare ground surfaces is captured and diverted to sediment ponds and dams for treatment prior to discharge from the site. | The separation and management of clean and dirty water continued during the report period in accordance with the water management system. |
| Water management structures to be retained in place until rehabilitation is complete and post-mining landforms achieve stability and land use suitability. | Discharge water quality | Water quality at the licenced discharge point is assessed as being within EPL licence release limits prior to discharge | Satisfied<br>There were no discharge events from LDP 001 and LDP 004 during the 2020 report period. |

## 8.5 Actions for the Next Reporting Period

During 2021, CVM will undertake the following works:

- Confirm the additional rehabilitation areas
- Make arrangements for the supply of the required quantity of seed and/or tubestock
- Engage a contractor to undertake these works.

**Rehabilitation Relinquishment Process**

CVM will explore opportunities to be submit relinquishment applications for existing rehabilitation areas which satisfy rehabilitation criteria.

# 9.0 Community

## 9.1 CCC Meetings

One community consultation meeting was held in the reporting period on 2 December 2020.

During the December 2020 meeting, information was presented on environmental monitoring and performance, works undertaken in response to the Section 240 notice (including revised MOP submission and the subsurface heating investigation undertaken by Ian Pankhurst), complaints received, statutory reporting, rehabilitation and land management works undertaken on site.

It was agreed during this meeting that the CCC would meet during 2021 in December only, due to the care and maintenance status of the operations. A CCC meeting could be called, should the status of the operations change.

The outcomes of the CCC meeting are detailed in the meeting minutes available on the Castlereagh Coal website.

## 9.2 Complaints

In accordance with Condition M5 of the EPL, Shoalhaven Coal maintains a complaints register to record and respond to complaints received from the community. The register is included in the Castlereagh Coal website. Two complaints were received from the local community during the report period. These were received on 10 February 2020 and 5 June 2020. The complaints were in relation to steam and odour emanating from a subsurface heating area on site. Following the receipt of the complaints, Shoalhaven Coal undertook prompt repair works to manage the subsurface heating steam and odour. A comparison of complaints received between 2011 and 2020 is outlined in **Table 9.1** below.

**Table 9.1 Comparison of Complaints**

| Complaint Type | 2011 | 2012* | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Noise** | 9 | 9 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **Air quality** | 5 | 5 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **Blasting** | 3 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Traffic** | 4 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Water** | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Subsurface Heating** | 2 | 0 | 0 | 0 | 0 | 4 | 2 | 3 | 2 | 2 |
| **Other** | 2 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **25** | **36** | **5** | **3** | **2** | **4** | **2** | **3** | **2** | **2** |

* CVM was placed on care and maintenance in December 2012

# 10.0 Audit Information

An Independent Environmental Audit (IEA) was conducted during 2016 in accordance with Schedule 6, Condition 6 of the Development Approval DA-200-5-2003. The audit timeframe covered the period from November 2010 to September 2016. The mine was operated by the previous mine owner Coalpac up until May 2015. The current owner, Shoalhaven Coal, was only responsible for operations from May 2015 onwards and therefore many of the non-compliances detected by the audit were outside the control of Shoalhaven Coal. In addition, a large number of the non-compliances that have occurred during Shoalhaven Coal's ownership are as a direct result of historical practices conducted by Coalpac.

An action plan was developed as an outcome of the audit findings and follow up actions have been implemented as required in consultation with DPE. The updated audit action plan is included on the Castlereagh Coal website. In accordance with the Development Approval the next IEA to be undertaken at CVM is required to be conducted by June 2021.

Key actions required to be implemented by Shoalhaven Coal following the 2016 IEA and where these items are discussed in the Annual Review is presented below. Further detail on the status of each action can be found in **Appendix 1.**

- Continued treatment of subsurface heating and repair of erosion control structures (**Sections 6.8** and **6.9**)
- completion of annual biodiversity monitoring (**Sections 6.6** and **8.3**)
- revision and submission of updated Flora and Fauna and Water Management Plans to DPE (**Section 3.1**)
- continued progression of rehabilitation of CVM (**Section 8.0**).

# 11.0 Incidents and Non-Compliances During the Report Period

The CVM PIRMP (Umwelt, 2020) was not activated during the report period. Non-compliances noted during the report period are detailed in **Section 1.0**.

# 12.0 Activities to be Undertaken in the Next Reporting Period

There are no mining activities proposed at CVM in the next report period (1 January – 31 December 2021) as the site is currently managed under a care and maintenance arrangement.

However, during the 2021 report period, Shoalhaven Coal will:

- commission and complete an Independent Environmental Audit
- continue to implement the various approved environmental management plans.
- review the Water Management Plan. This will consider the rational of the current network and the additional groundwater monitoring data obtained as part of updating the groundwater monitoring triggers and outcome of the water management review.
- monitor subsurface heating and continue treatment of subsurface heating via backfilling surface cracks with cement and capping heating areas will be undertaken (as described in **Section 6.9**).
- commence subsurface heating investigations in accordance with the MOP (Umwelt, 2020) and Plan of Works during 2021.
- Undertake the rehabilitation activities as detailed in **Section 8.5**, being:
    - Confirm the additional rehabilitation areas
    - Make arrangements for the supply of the required quantity of seed and/or tubestock
    - Engage a contractor to undertake these works.
- Seek to relinquish rehabilitation areas which satisfy rehabilitation criteria.
- Review the results from GW01 groundwater sampling as pe the CVM WMP.

# 13.0 References


Australian and New Zealand Guidelines for Fresh and Marine Water Quality, 2000. (ANZECC, 2000) An Introduction to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Commonwealth Government.

Castlereagh Coal (2018). Care and Maintenance Mining Operations Plan Cullen Valley Mine.

Coalpac (2009). Environmental Monitoring Program.

Coalpac (2012a). Cullen Valley Mine Flora and Fauna Management Plan.

Coalpac (2012b). Cullen Valley Mine Species Management Plan (Clandulla Geebung).

Coalpac (2012c). Environmental Management Plan.

Coalpac (2012d). Blast Management Plan.

Coalpac (2012e) Fire Management Plan.

Castlereagh Coal (2018). Cullen Valley Mine Care and Maintenance Mining Operations Plan

Global Acoustics Pty Ltd (2017a). Cullen Valley Mine Environmental Noise Monitoring Quarter 1, 2018. Prepared for Shoalhaven Coal.

Global Acoustics Pty Ltd (2017b). Cullen Valley Mine Environmental Noise Monitoring Quarter 2, 2018. Prepared for Shoalhaven Coal.

Global Acoustics Pty Ltd (2017c). Cullen Valley Mine Environmental Noise Monitoring Quarter 3, 2018. Prepared for Shoalhaven Coal.

Global Acoustics Pty Ltd (2017d). Cullen Valley Mine Environmental Noise Monitoring Quarter 4, 2018. Prepared for Shoalhaven Coal.

International Environmental Consultants, 1997. Feldmast Coal Project Environmental Impact Statement.

International Environmental Consultants, 2004. Cullen Valley Mine Open Cut Extension Environmental Impact Statement

NSW Government (2015). Annual Review Guideline.

Sedgman (2015) Cullen Valley Mine Care and Maintenance MOP.

SLR Consulting (2016). Cullen Valley Mine Independent Environmental Audit. Prepared for Shoalhaven Coal Pty Limited

Umwelt (2017a). Flora and Fauna Management Plan.

Umwelt (2017b). Water Management Plan Cullen Valley Mine.

Umwelt (2017d). 2017 Biodiversity Monitoring Report. Cullen Valley Mine and Invincible Colliery, Castlereagh Highway Draft.

Umwelt (2017e). Cullen Valley Mine Groundwater Quality Investigation.

Umwelt (2019). Cullen Valley Mine & Invincible Colliery Pollution Incident Response Management Plan.

# APPENDIX 1

**Status of 2016 Audit Actions**

## Appendix 1 2020 Annual Review IEA Action Plan Update

| Consent Condition | Audit Finding | Compliance identified during audit | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| DA Sch 4, Condition 2 | 2010 AEMR - During the report period, CVM complied with the criteria LAeq(15 minute) noise limits at all locations with the exception of Hillcroft in Q1 and Q3. The noise levels at Hillcroft exceeded the criteria by 5 and 2 dB(A) respectively. This was outside the audit period.<br>2011 AEMR - CVM complied with the daytime LAeq (15 minute) noise criteria at all locations during the report period, with the exception of the Hillcroft property (N08) during Q2.<br>2012 AEMR - CVM complied with the daytime LAeq (15 minute) noise criteria at all locations during the report period, with the exception of the Hillcroft property (N08) which exceeded the noise criteria on one occasion during Q2.<br>2013, 14 and 15 AEMR's - Nil exceedances<br>These noise non - compliances related to when the site was operating and under previous ownership. Noise is a minor issue during care and maintenance, however if mining activities were to recommence there would be a requirement for additional noise controls. | Non-compliant | Noise is a minor issue during care and maintenance, however if mining activities were to recommence there should be a full review of noise mitigation measures to reduce the chance of non - compliances relating to noise. The Noise Management Plan would require to be updated. | Noise exceedances occurred during Coalpac ownership of the mine.<br>The noise management plan would only be updated if and when mining operations recommence at CVM. Noise mitigation measures for mining operations would be reviewed at that time.<br>**2017 Annual Review Update**<br>No further action required. As noted above, if mining operations recommence the Noise Management Plan will be updated.<br>**2018 Annual Review Update**<br>No further action required. As noted above, if mining operations recommence the Noise Management Plan will be updated.<br>**2019 Annual Review Update**<br>No further action required. As noted above, if mining operations recommence the Noise Management Plan will be updated.<br>**2020 Annual Review Update**<br>No further action required. As noted above, if mining operations recommence the Noise Management Plan will be updated. | **Complete** |
| DA Sch 4, Condition 27 | There have been odour complaints in every year of the audit period with this relating to the area of sub surface heating. These have been outlined in the AEMR/Annual Reviews. There has been some works at site (movement of material) to control the fire/odour issue with investigations still continuing.<br>Based on discussions with site this is an ongoing issue that is being managed by Shoalhaven Coal in consultation with experts and the Departments. Shoalhaven Coal are also resolving drainage issues that are directly linked to 2017 heating issues particularly venting, smoke and odour prior to capping. | Non-compliant | Continue to investigate issue and develop a strategy to remediate. Continue to monitor and report on the odour issue. Implement actions where possible. | Sub-surface heating is being managed by Shoalhaven Coal in consultation with specialist consultants and the Departments. Shoalhaven are also undertaking reconstruction of contour and flume drains to direct water away from areas to reduce the incidence of venting, smoke and odour. Stage 1 works will be monitored during Q2 and Q3 2017.<br>**2016 Annual Review Update**<br>In accordance with Section 12.0 of the Annual Review and DRE requirements, during 2017 Shoalhaven Coal will review and manage subsurface heating across the site, and an updated Plan of Works (PoW) for management of subsurface heatings will be developed as part of the updated C&M MOP.<br>**2017 Annual Review Update**<br>During 2017, Shoalhaven Coal undertook repairs to a number of erosion control structures and these are discussed in the 2017 CVM Annual Review. Shoalhaven Coal has continued to implement the PoW as detailed in the approved MOP and liaise with the Division of Resources and Geoscience, during the reporting period.<br>**2018 Annual Review Update**<br>During 2018, Shoalhaven Coal has continued to implement the PoW as detailed in the approved MOP. Subsurface heating management is detailed in Section 6.9 of the Annual Review.<br>**2019 Annual Review Update**<br>During 2019, Shoalhaven Coal has continued to implement the PoW as detailed in the approved MOP. Subsurface heating management is detailed in Section 6.9 of the Annual Review. A further review of subsurface heating management techniques and measures utilised at CVM will be undertaken during the 2020 report period.<br>**2020 Annual Review Update**<br>Ian Pankhurst (Mining Operations Services) was engaged to review the *Plan of Works Variation to the Mining Operations Plan (Coalpac, 2013)* (i.e. Appendix D(i) of the CVM Care and Maintenance MOP 2016-2018), *Cullen Valley Heating Report of Cullen Valley Mine (Olsen Environmental* | **Ongoing** |

| Consent Condition | Audit Finding | Compliance identified during audit | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| | | | | *Consulting Pty Ltd, 2013)* (i.e. Appendix D(ii) of the CVM Care and Maintenance MOP 2016-2018), and the *Cullen Valley Mine Sub-Surface Heating Program of Works (Sedgman, 2015)* (i.e. Appendix E of the CVM Care and Maintenance MOP 2016-2018). Mr Pankhurst also conducted an assessment of the effectiveness of subsurface heating mitigation measures and conducted a site inspection of the affected areas of the Cullen Valley mine site. Following this body of works, Mr Pankhurst provided Shoalhaven Coal with a program of works to investigate and manage subsurface heating areas. | |
| **DA Sch 4, Condition 31** | a) Partially covered under Section 2.2 of the Compensatory Habitat Plan.<br>No differentiation between short term and long term management. There should be goals developed for short term e.g. Year 1, medium term Year 5 and long-term Year 10.<br>b) Covered under Section 2.2.3.1 of the Compensatory Habitat Plan. This section outlines fencing and prohibiting access. Minimal signage was identified at the site illustrating the compensatory habitat area. There has been no evidence of disturbance (from the site inspection) associated with the Cullen Valley project within the compensatory habitat area. A detailed plan within the Flora and Fauna Management Plan outlines the boundaries of these areas.<br>c) Covered under Section 2.2.3.1 including fencing and signage.<br>d) Baseline vegetation communities are shown in Figure 2 of the audit report. Description of existing vegetation within Section 2.2.2.<br>e) Implementation within Section 2.2.3 of the Compensatory Habitat Plan. Details of monitoring are outlined in the Annual Flora, Fauna and Rehabilitation Monitoring Program which is undertaken by Kleinfelder. This monitoring program includes eight survey sites across the compensatory habitat area. A brief methodology relating to the monitoring within the compensatory habitat area is outlined within Section 3.2 of the 2015 Annual Flora, Fauna and Rehabilitation Monitoring Program.<br>f) There is no criteria for the compensatory habitat area within the Compensatory Habitat Plan.<br>SLR recognises that this management plan was completed prior to the site being managed by Shoalhaven Coal. | Administrative non-compliance | There is no differentiation between short term and long term management of compensatory habitat area. To be included in future updates.<br>Completion criteria for the compensatory habitat area should be included in this Management Plan. All management plans would be required to be updated prior to recommencement of operations as agreed with DP&E. The ecological monitoring has been prepared to a high standard, however there are no definitive goals for the compensatory habitat area or other rehabilitation areas. These criteria and goals should be developed as well as being included within the management plan and monitoring reports. Where possible this criteria should be linked with MOP criteria.<br>There should be a more detailed analysis of monitoring results relating to the compensatory habitat area within the Annual Review. Currently there is little detail in the Annual Review regarding the performance and management of the compensatory habitat area, with reference to the very detailed ecological monitoring report. Although the Kleinfelder report is very detailed, a summary section or table within the report would be useful in determining key changes within monitoring locations and proposed actions within specific sections of the compensatory habitat area.<br>The recommendations from the Annual Flora, Fauna and Rehabilitation Monitoring Program should be implemented by Shoalhaven Coal. This includes:<br>• Development of a feral animal control strategy. It should be noted the feral animals identified within the compensatory habitat area are | Annual Biodiversity Monitoring was undertaken in December 2016 and was broadened from the scope of previous biodiversity monitoring. This monitoring included assessment of the compensatory habitat areas.<br>As requested by DPE, the Flora and Fauna Management Plan will be updated by 30 June 2017.<br>**2017 Annual Review Update**<br>The CVM Flora and Fauna management plan was updated and submitted to DPE for review on 29 June 2017. DPE have not provided any comments on the draft management plan to date.<br>**2018 Annual Review Update**<br>The CVM Flora and Fauna management plan was updated and submitted to DPE for review on 29 June 2017. During 2019, Shoalhaven Coal will liaise with DPE regarding the status of the management plan.<br>**2019 Annual Review Update**<br>During 2019, Shoalhaven Coal undertook biodiversity monitoring which included monitoring within compensatory habitat areas on site. This monitoring will continue in 2020 and Shoalhaven Coal will liaise with DPIE regarding the update of the CVM Flora and Fauna Management Plan.<br>**2020 Annual Review Update**<br>During 2020, Shoalhaven Coal undertook biodiversity monitoring which included monitoring within compensatory habitat on site. This monitoring will continue in 2020 and Shoalhaven Coal will liaise with DPIE regarding the update of the CVM Flora and Fauna Management Plan. | **Ongoing** |

| Consent Condition | Audit Finding | Compliance identified during audit | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| | | | consistent with the surrounding landscape.<br>• Dumping has occurred to a minor extent within the compensatory habitat area. During the inspection SLR did not view these areas, but the Ecological Report recommends rubbish is removed. | | |
| **DA Sch 4, Condition 47** | (a) minimal infrastructure visible from offsite<br>(b) noise bunds act as visual screens<br>c) revegetating underway on noise bunds, was rehabilitated previously but had to be re-turned and shaped due to sub - surface heating<br>(d) lots of areas still required for rehabilitation. Pre 2012 rehabilitation appears to be of a good quality with low degree slopes, topsoil used and a mix of grasses, acacias and eucalypts.<br>Poor results in large sections of the post 2012 rehabilitation was observed with erosion in some areas. This is possibly due to steep slopes and lack of topsoil. No rehabilitation has been completed (apart from rehabilitation maintenance) since Shoalhaven Coal commenced managing the site. In 2016 the focus has been to improve existing rehabilitation.<br>Biodiversity monitoring is conducted annually in rehabilitation areas and will be conducted again in December 2016. Based on discussions with Shoalhaven Coal the scope of works for this monitoring has been broadened from the monitoring conducted between 2011-2015 | Non-compliant | SLR recommends engaging a specialist to review the reasons for poor rehabilitation (post 2012 rehabilitation) to improve existing rehabilitation as well as future rehabilitation. Some possible options to improve future rehabilitation include:<br>* soil and material testing.<br>* reducing slope angle and landform design;<br>* application of ameliorates such as gypsum, biosolids; and<br>* review of seed mix (including grass within seed mix).<br>It is acknowledged there is little topsoil available for future rehabilitation. Further rehabilitation/biodiversity monitoring should be compared against completion criteria from the MOP. Local seed should be collected for rehabilitation in accordance with the Flora and Fauna Management Plan. | Biodiversity monitoring is conducted annually in rehabilitation areas by a specialist ecological consultant and was conducted again in December 2016. The scope of works for this monitoring was broadened from the monitoring conducted between 2011-2015.<br>Annual Biodiversity Monitoring was completed during December 2016.<br>**2016 Annual Review Update**<br>Results of 2016 Biodiversity Monitoring are included in the 2016 Annual Review<br>**2017 Annual Review Update**<br>Biodiversity monitoring was undertaken in 2017 with the results included in the CVM 2017 Annual Review.<br>**2018 Annual Review Update**<br>Biodiversity monitoring was undertaken in 2018 with the results included in the CVM 2018 Annual Review.<br>**2019 Annual Review Update**<br>Biodiversity monitoring was undertaken in 2019 with the results included in the CVM 2019 Annual Review.<br>**2020 Annual Review Update**<br>Biodiversity monitoring was undertaken in 2020 with the results included in the CVM 2020 Annual Review. | **Complete** |
| **DA Sch 6, Condition 5** | AEMRs/Annual Reviews sighted for 2011 to 2015.<br>A comparison against the EIS predictions was not been completed in the recent C&M AEMRs/Annual Reviews. SLR understands that most EIS commitments are not relevant to the site as it is under care and maintenance; however some predictions for water should be reviewed and reported against.<br>Monitoring results are compared against monitoring limits/criteria. There was a comparison of dust data across five years with this outlining the long-term trend.<br>Details of complaints are included however there is no comparison over five years which means this is an administrative non-compliance. Details of complainants (names) should not be included in the AEMR/Annual Reviews. | Administrative non-compliance | Ensure key EIS predictions are reviewed in future Annual Reviews.<br>Provide details of complaints across five years. | This Annual Review provides a comparison of EIS predictions in **Section 6.1**. A review of complaints is provided in **Section 9.0**.<br>**2017 Annual Review Update**<br>The CVM reporting period monitoring results and environmental performance have been included in the 2016 and 2017 CVM Annual Reviews.<br>**2018 Annual Review Update**<br>The CVM reporting period monitoring results and environmental performance have been included in the 2018 CVM Annual Review.<br>**2019 Annual Review Update**<br>The CVM reporting period monitoring results and environmental performance have been included in the 2019 CVM Annual Review.<br>**2020 Annual Review Update**<br>The CVM reporting period monitoring results and environmental performance have been included in the 2020 CVM Annual Review. | **Complete** |

| Licence Condition | Audit Finding | Compliance | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| EPL L4.5 | Quarterly noise monitoring reports state the source of the meteorological data utilised for determining meteorological conditions. The data is generally sourced from the Cullen Valley weather station however, it is noted that the noise monitoring reports prepared for 2015 state that meteorological data has been sourced from the Bureau of Meteorology Met station in Bathurst. This is located approximately 45 km from the site and is unlikely to be representative of onsite weather conditions.<br><br>Temperature inversion conditions are reported in the quarterly noise monitoring reports and are calculated from sigma theta data. Where met data is obtained from Bathurst, standard stability class is assumed.<br><br>Shoalhaven Coal informed SLR that the weather station at CVM had been shut down and was inoperable prior to Shoalhaven Coal ownership. Shoalhaven Coal has reinstated and serviced the weather station to allow recording and download of meteorological data during care and maintenance. Prior to recommencement of operations, the weather station will be calibrated according to the Australian Standard to allow data to be used for noise monitoring purposes. | Administrative non-compliance | Ensure that meteorological data is sourced from the onsite meteorological station. If this is not possible due to equipment failure etc., justification for the use of alternative meteorological data and its relevance should be provided. | The noise monitoring requires weather data from an accredited source. The weather station at CVM had been shut down and was inoperable prior to Shoalhaven Coal ownership.<br><br>Shoalhaven Coal has now reinstated and serviced the weather station to allow recording and download of meteorological data during care and maintenance.<br><br>Prior to recommencement of operations, the weather station will be calibrated according to the Australian Standard to allow data to be used for noise monitoring purposes.<br><br>This action will only be required if and when mining operations recommence at CVM.<br><br>**2017 Annual Review Update**<br><br>As noted above, prior to the commencement of any mining operations the weather station will be calibrated to enable its use for noise monitoring purposes.<br><br>**2018 Annual Review Update**<br><br>During the report period the meteorological station was calibrated and has been utilised for noise monitoring purposes as required by this recommendation.<br><br>**2019 Annual Review Update**<br><br>During the report period the meteorological station was calibrated and has been utilised for noise monitoring purposes as required by this recommendation.<br><br>**2020 Annual Review Update**<br><br>During the report period the meteorological station was calibrated and has been utilised for noise monitoring purposes as required by this recommendation. | **Complete** |
| EPL L6.1 | There have been odour complaints in every year of the audit period with relating to the area of sub surface heating. These have been outlined in the AEMR/Annual Reviews. There has been some works at site (movement of material) to control the fire/odour issue with investigations still continuing.<br><br>Based on discussions with site this is an ongoing issue that is being managed by Shoalhaven Coal in consultation with experts and the Departments. Shoalhaven Coal are also resolving drainage issues that are directly linked to sub surface heating issues particularly venting, smoke and odour prior to capping. | Non-compliant | Continue to investigate issue and develop a strategy to remediate. Continue to monitor and report on the odour issue. | Sub-surface heating is being managed by Shoalhaven Coal in consultation with specialist consultants and the Departments.<br><br>Shoalhaven Coal are also undertaking reconstruction of contour and flume drains to direct water away from areas to reduce the incidence of venting, smoke and odour. Stage 1 works will be monitored during Q2 and Q3 2017.<br><br>**2016 Annual Review Update**<br><br>In accordance with Section 12.0 of the Annual Review and DRE requirements, during 2017 Shoalhaven Coal will review and manage subsurface heating across the site, and an updated PoW for management of subsurface heatings will be developed as part of the updated C&M MOP.<br><br>**2017 Annual Review Update**<br><br>During 2017, Shoalhaven Coal undertook repairs to a number of erosion control structures and these are discussed in the 2017 CVM Annual Review. Management measures utilised at CVM to treat sub surface heating are detailed in the CVM C&M MOP (Sedgman, 2015) with the management measures developed in consultation with DRG. Environmental management controls implemented by CVM to monitor and treat subsurface heating include:<br><br>• Weekly hearing monitoring of heating areas;<br><br>• Capping of surface cracking using cement;<br><br>• Excavation and compaction of material as required | **Ongoing** |

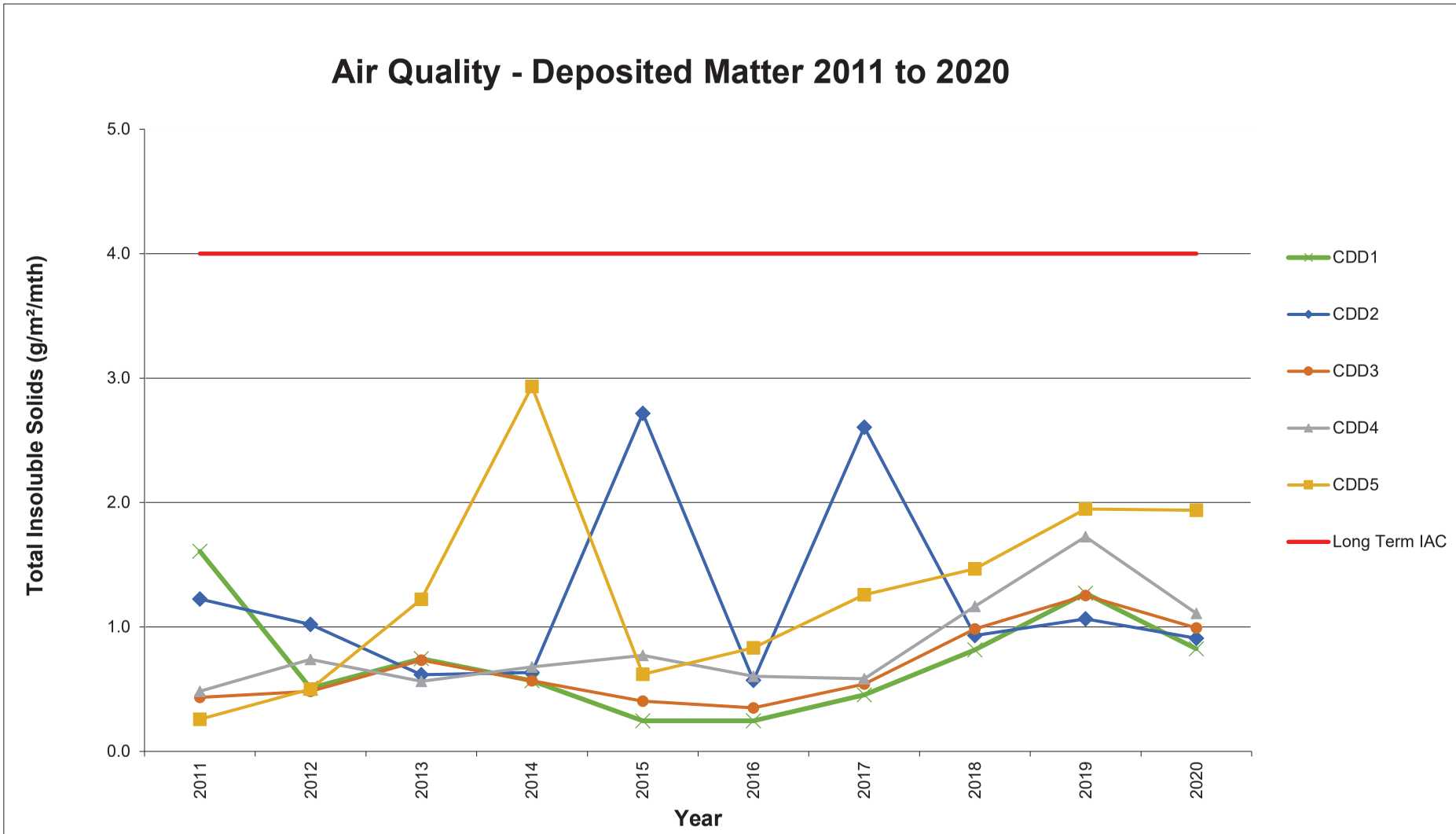
| Licence Condition | Audit Finding | Compliance | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| | | | | **2018 Annual Review Update**<br>Odour complaints have been recorded during the 2018 report period and these complaints are detailed in Section 9 of the Annual Review. Subsurface heating management measures implemented during the report period are consistent with actions identified in the 2017 Annual Review update and are also detailed in Section 6.9 of the Annual Review.<br>**2019 Annual Review Update**<br>Odour complaints have been recorded during the 2019 report period and these complaints are detailed in Section 9 of the Annual Review. Subsurface heating management measures implemented during the report period are consistent with actions identified in the 2017 and 2018 Annual Review update and are also detailed in Section 6.9 of the 2019 Annual Review. A further review of subsurface heating management techniques and measures utilised at CVM will be undertaken during the 2020 report period as detailed in the Annual Review.<br>**2020 Annual Review Update**<br>Odour complaints have been recorded during the 2020 report period and these complaints are detailed in Section 9 of the Annual Review. Subsurface heating management measures implemented during the report period are consistent with actions identified in the 2017, 2018 and 2019 Annual Review update. Additional subsurface heating activities undertaken in 2020, including Ian Pankhurst's investigation and findings, are also detailed in Section 6.9 of the 2020 Annual Review. | |

| EIS Commitments | Audit Finding | Compliance | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| 2003 EIS Section: Flora | Rehabilitation works have attempted to replicate a woodland/forest community. Results have been variable with good results prior to 2012, and average since.<br>No Capertee Stringybark seed has been collected for rehabilitation. | Non-compliant | Recommend engaging a specialist to review reasons for poor rehabilitation (post 2012 rehabilitation) to improve existing rehabilitation as well as future rehabilitation. Some possible options to improve future rehabilitation include:<br>* soil and material testing.<br>* reducing slope angle and landform design;<br>* application of ameliorates such as gypsum, biosolids;<br>* review of seed mix (including grass within seed mix);<br>It is acknowledged there is little topsoil available for future rehabilitation. Further rehabilitation/biodiversity monitoring should be compared against completion criteria from the MOP. Local seed should be collected for rehabilitation in accordance with the Flora and Fauna Management Plan. | Biodiversity monitoring is conducted annually in rehabilitation areas by a specialist ecological consultant and was conducted again in December 2016. The scope of works for this monitoring was broadened from the previous monitoring conducted between 2011-2015.<br>The Annual Biodiversity Monitoring was completed during December 2016.<br>**2016 Annual Review Update**<br>Results of 2016 Biodiversity Monitoring are included in the 2016 Annual Review<br>**2017 Annual Review Update**<br>Results of 2017 Biodiversity Monitoring are included in the 2017 Annual Review. The biodiversity monitoring includes a comparison of CVM rehabilitation to the performance indicators / completion criteria included in the CVM C&M MOP (Sedgman, 2015).<br>**2018 Annual Review Update**<br>Results of 2018 Biodiversity Monitoring are included in the 2018 Annual Review.<br>**2019 Annual Review Update**<br>Results of 2019 Biodiversity Monitoring are included in the 2019 Annual Review.<br>**2020 Annual Review Update**<br>Results of 2020 Biodiversity Monitoring are included in the 2020 Annual Review. | **Ongoing** |

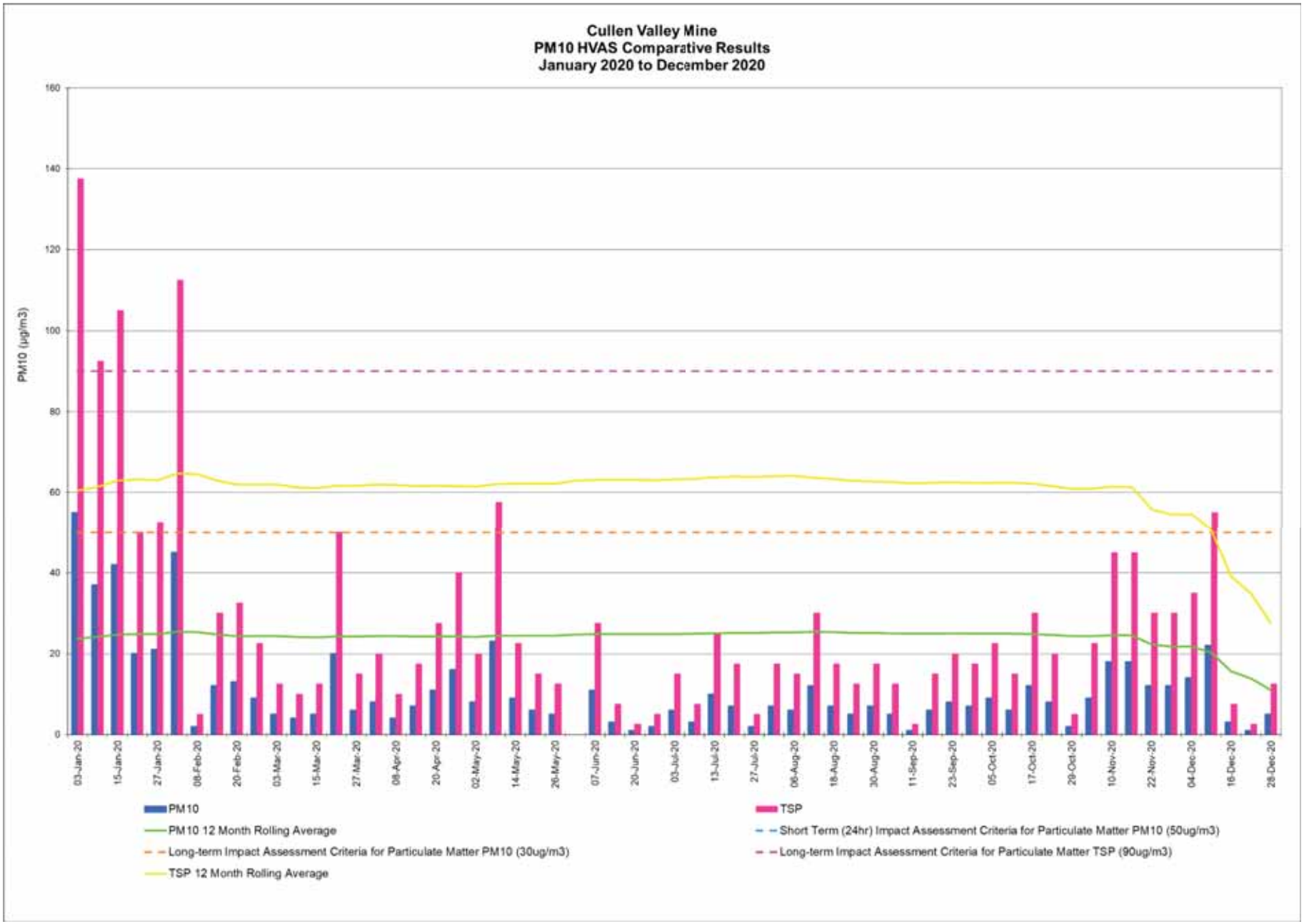
| EIS Commitments | Audit Finding | Compliance | Audit Recommendation | Proposed Action and Timing | Status |
|---|---|---|---|---|---|
| **2003 EIS Section: Rehabilitation** | There are still large sections of disturbed areas that have not been rehabilitated. | Non-compliant | Same as 'Flora' recommendation to improve rehabilitation. | Biodiversity monitoring is conducted annually in rehabilitation areas by a specialist ecological consultant and was conducted again in December 2016. The scope of works for this monitoring was broadened from the previous monitoring conducted between 2011-2015. The Annual Biodiversity Monitoring was completed during December 2016.<br>**2017 Annual Review Update**<br>As detailed within the 2017 CVM Annual Review, during the 2018 Report Period CVM propose to utilise VENM/ENM to fill site voids and progress with the rehabilitation of the mine.<br>**2018 Annual Review Update**<br>As discussed in Section 3.0 of the Annual Review, during the 2018 report period a small volume of VENM and ENM was received by CVM however as a result of discussions between DPE and Shoalhaven Coal, the receipt of VENM / ENM at CVM ceased on 29 March 2018 and no further VENM/ENM has been received since this time. During 2019, Shoalhaven Coal will seek to continue to liaise with DPE regarding the receipt of VENM / ENM at CVM.<br>**2019 Annual Review Update**<br>As discussed in Section 3.0 of the Annual Review, during the 2019 report period, DPIE advised that CVM were not authorised to receive VENM/ENM onsite and as such no further material has been received since March 2018. Shoalhaven Coal will continue to seek to identify opportunities for the progressive rehabilitation of CVM however there was no rehabilitation undertaken during the 2019 report period.<br>**2020 Annual Review Update**<br>As discussed in Section 3.0 of the Annual Review, during the 2019 report period, DPIE advised that CVM were not authorised to receive VENM/ENM onsite and as such no further material has been received since March 2018. Shoalhaven Coal will continue to seek to identify opportunities for the progressive rehabilitation of CVM however there was no rehabilitation undertaken during the 2020 report period. | **Ongoing** |
| **2003 EIS Section: Soil Resources** | Topsoil was used in most of the rehabilitation prior to 2012, however does not appear to be used in post 2012 rehabilitation. | Non-compliant | Same as 'Flora' recommendation to improve rehabilitation. | Biodiversity monitoring is conducted annually in rehabilitation areas by a specialist ecological consultant and was conducted again in December 2016. The scope of works for this monitoring was broadened from the previous monitoring conducted between 2011-2015.<br>The Annual Biodiversity Monitoring was completed during December 2016.<br>**2017 Annual Review Update**<br>Results of 2017 Biodiversity Monitoring are included in the 2017 Annual Review. The biodiversity monitoring includes a comparison of CVM rehabilitation to the performance indicators / completion criteria included in the CVM C&M MOP (Sedgman, 2015).<br>**2018 Annual Review Update**<br>Results of 2018 Biodiversity Monitoring are included in the 2018 Annual Review. The biodiversity monitoring includes a comparison of CVM rehabilitation to the performance indicators / completion criteria included in the CVM C&M MOP (Sedgman, 2015).<br>**2019 Annual Review Update**<br>Results of 2019 Biodiversity Monitoring are included in the 2019 Annual Review. The biodiversity monitoring includes a comparison of CVM rehabilitation to the performance indicators / completion criteria included in the CVM C&M MOP (Sedgman, 2015).<br>**2020 Annual Review Update**<br>Results of 2020 Biodiversity Monitoring are included in the 2020 Annual Review. The biodiversity monitoring includes a comparison of CVM rehabilitation to the performance indicators / completion criteria included in the CVM C&M MOP (Sedgman, 2015). | **Complete** |

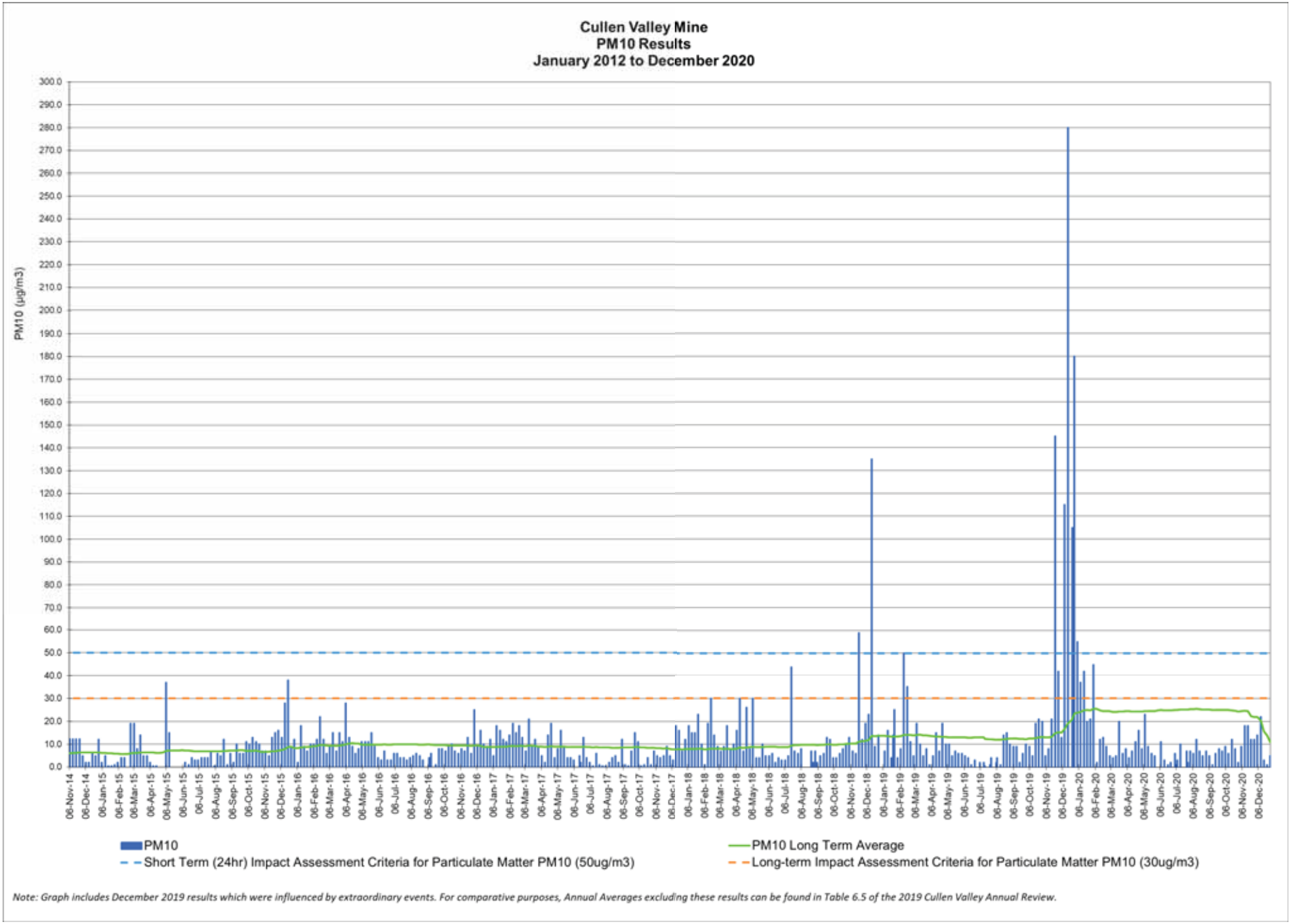
# APPENDIX 2

**Air Quality Monitoring Graphs**

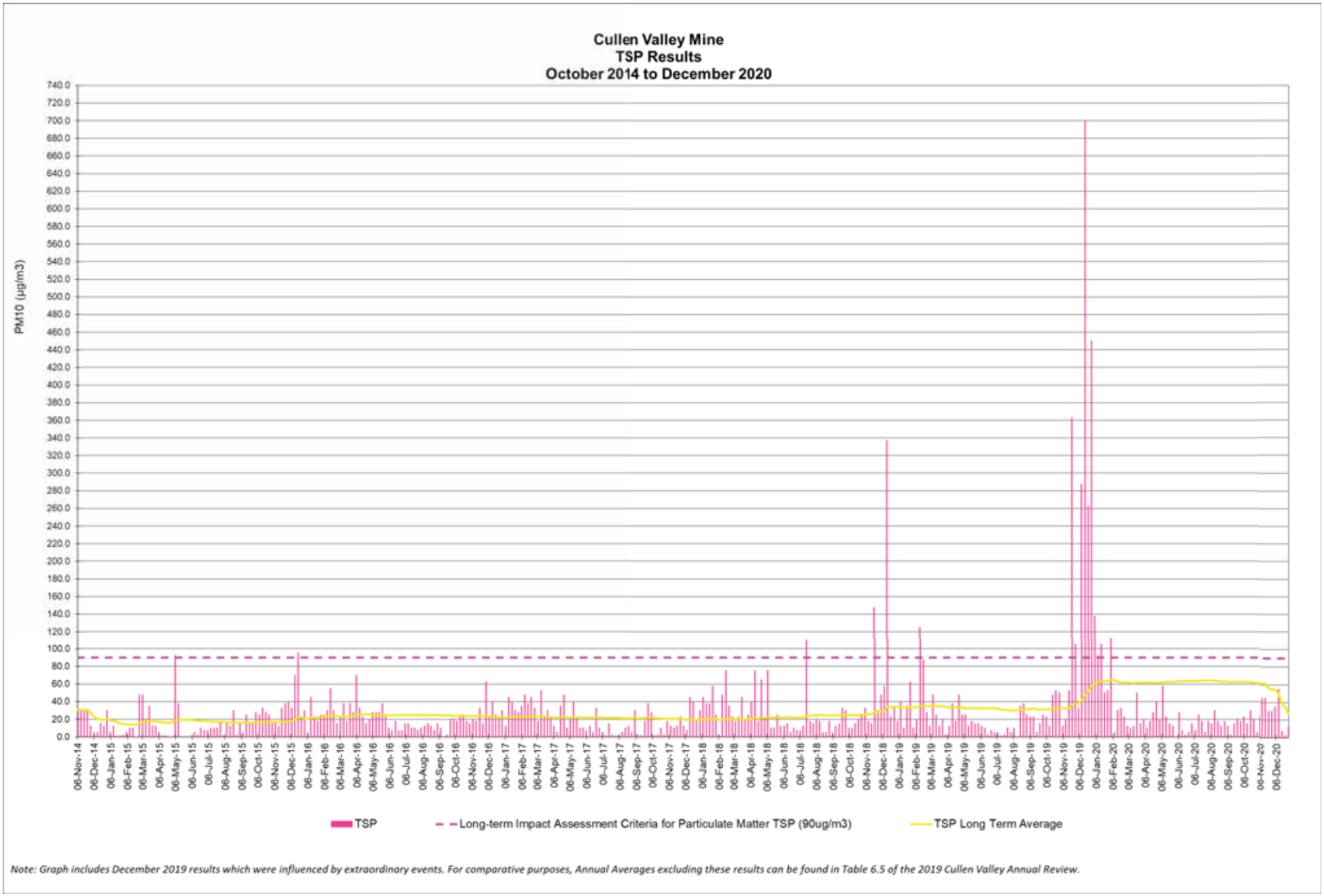



*Note: Graph displays annual average total insoluble solids.*


Cullen Valley Mine
PM10 HVAS Comparative Results
January 2020 to December 2020
PM10 (µg/m3)
160
140
120
100
80
60
40
20
0
03-Jan-20
15-Jan-20
27-Jan-20
08-Feb-20
20-Feb-20
03-Mar-20
15-Mar-20
27-Mar-20
08-Apr-20
20-Apr-20
02-May-20
14-May-20
26-May-20
07-Jun-20
20-Jun-20
03-Jul-20
13-Jul-20
27-Jul-20
06-Aug-20
18-Aug-20
30-Aug-20
11-Sep-20
23-Sep-20
05-Oct-20
17-Oct-20
29-Oct-20
10-Nov-20
22-Nov-20
04-Dec-20
16-Dec-20
28-Dec-20
PM10
TSP
PM10 12 Month Rolling Average
Short Term (24hr) Impact Assessment Criteria for Particulate Matter PM10 (50ug/m3)
Long-term Impact Assessment Criteria for Particulate Matter PM10 (30ug/m3)
Long-term Impact Assessment Criteria for Particulate Matter TSP (90ug/m3)
TSP 12 Month Rolling Average




*Note: Graph includes December 2019 results which were influenced by extraordinary events. For comparative purposes, Annual Averages excluding these results can be found in Table 6.5 of the 2019 Cullen Valley Annual Review.*

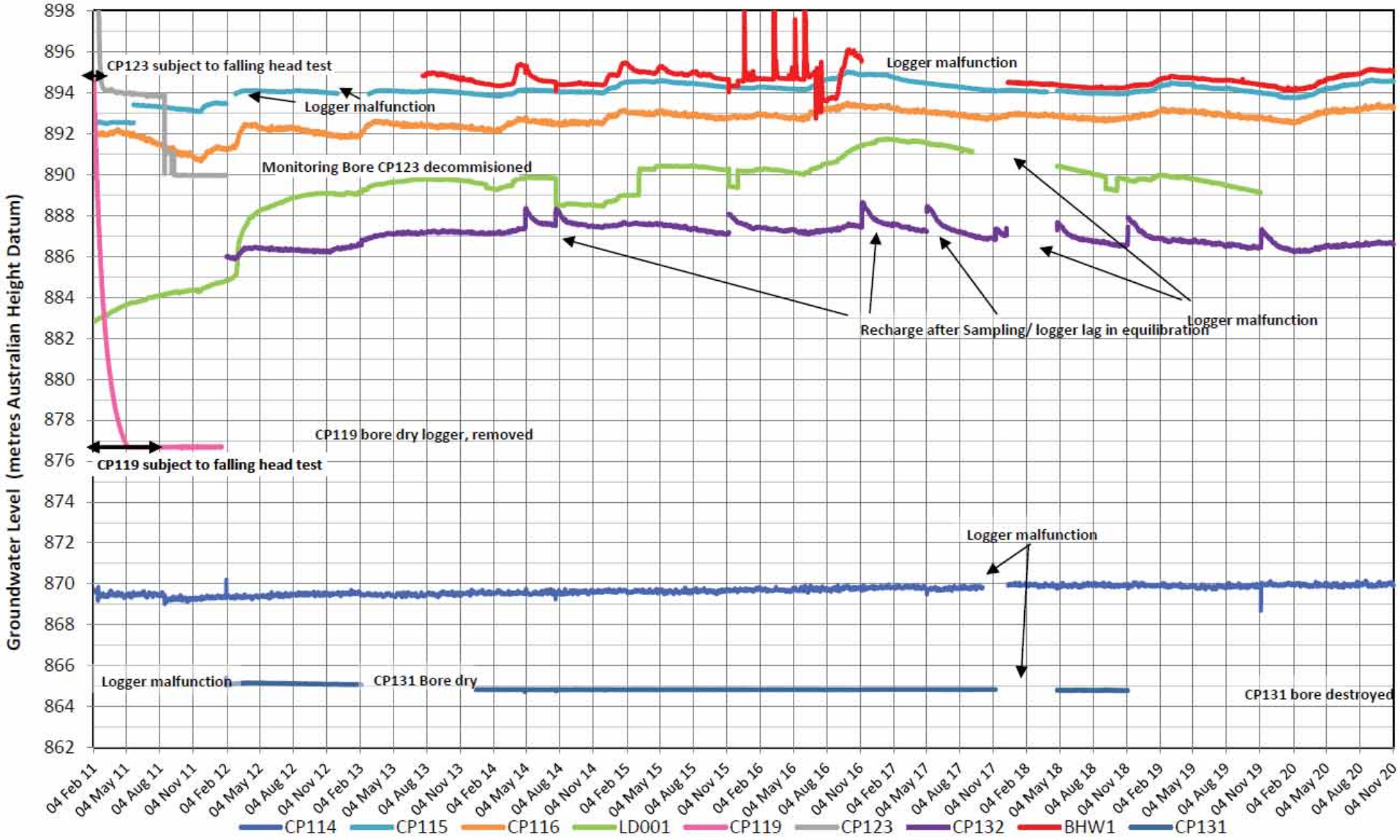


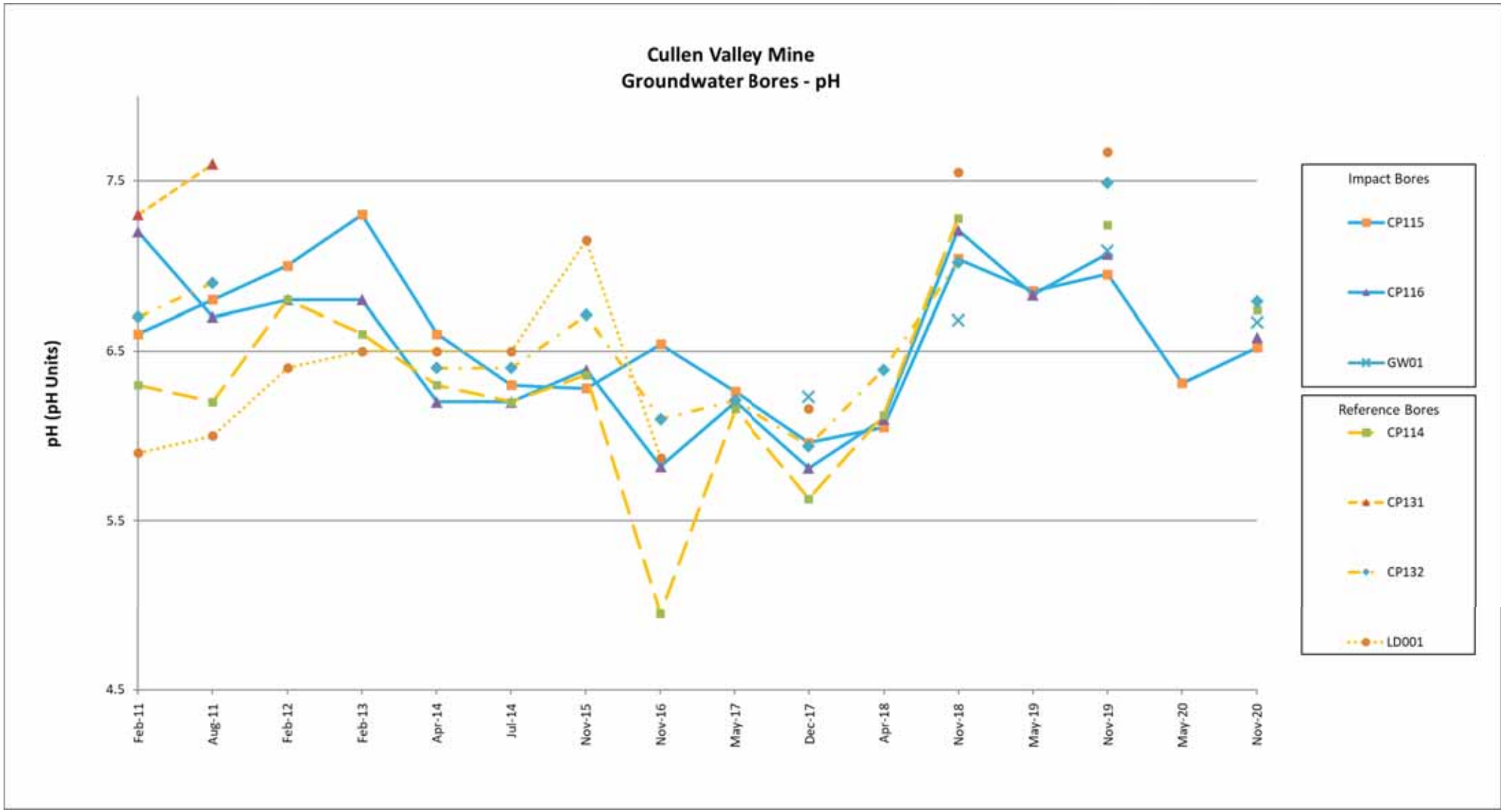

*Note: Graph includes December 2019 results which were influenced by extraordinary events. For comparative purposes, Annual Averages excluding these results can be found in Table 6.5 of the 2019 Cullen Valley Annual Review.*

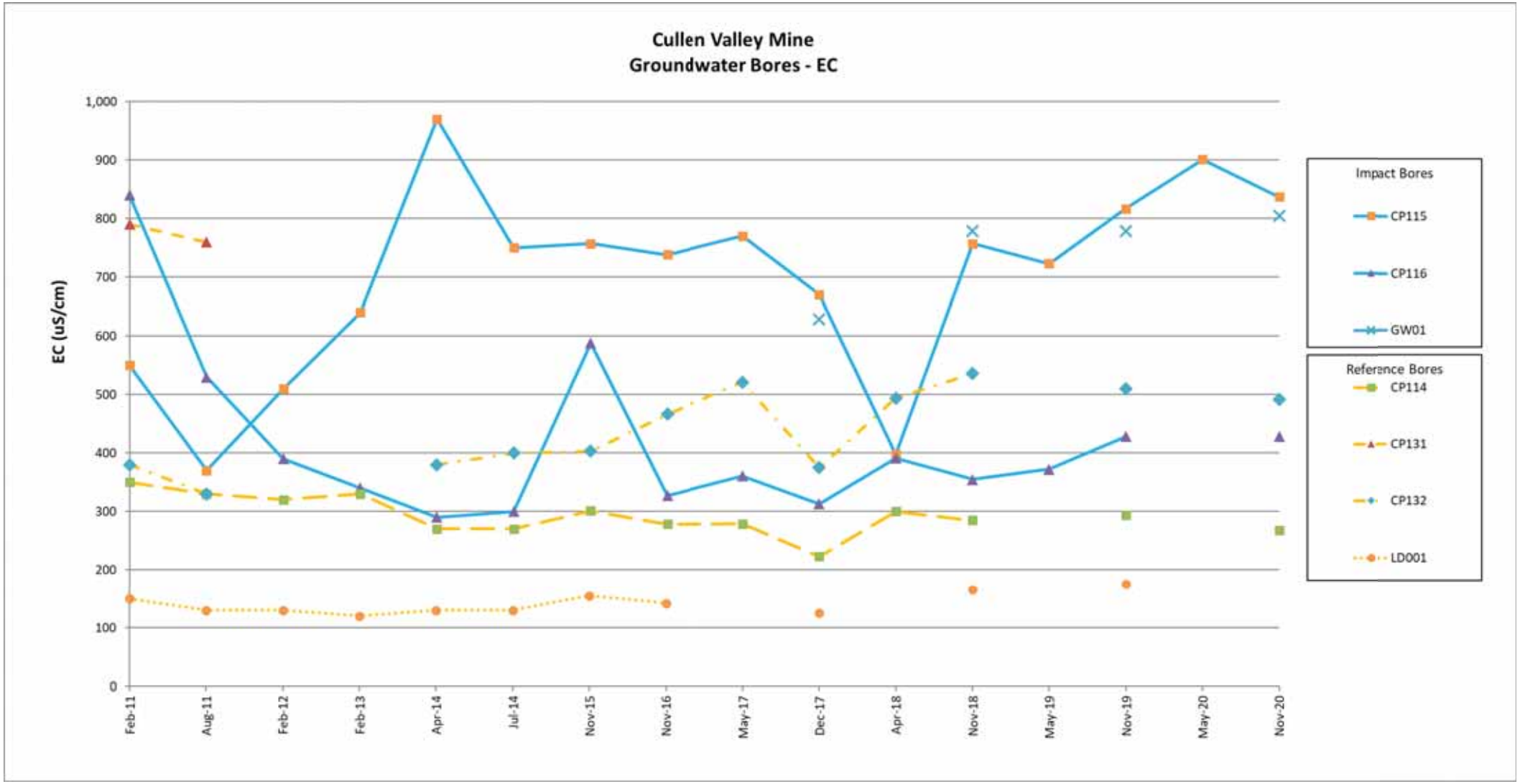
# APPENDIX 3

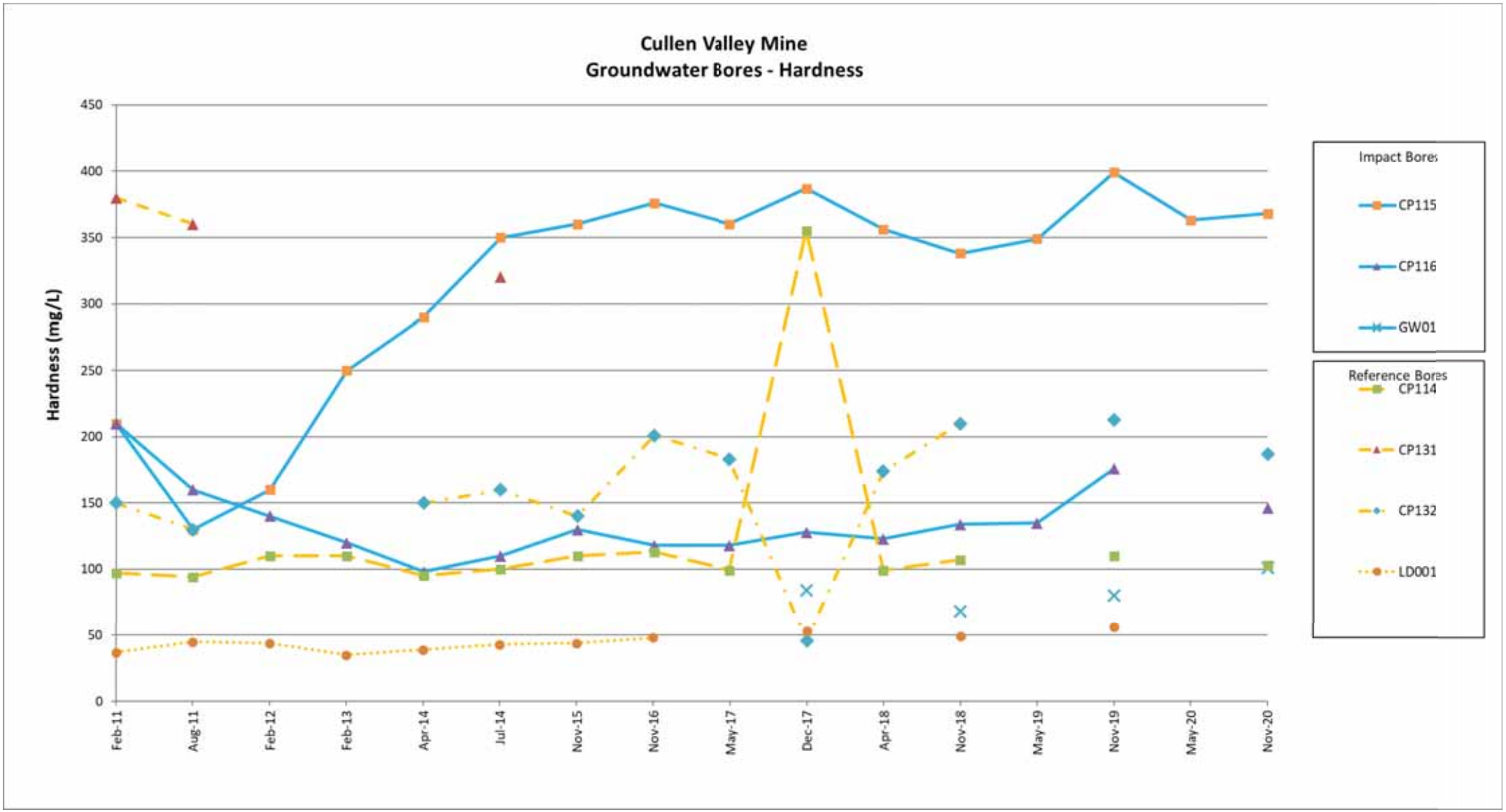
**Groundwater Monitoring Graphs and Tables**

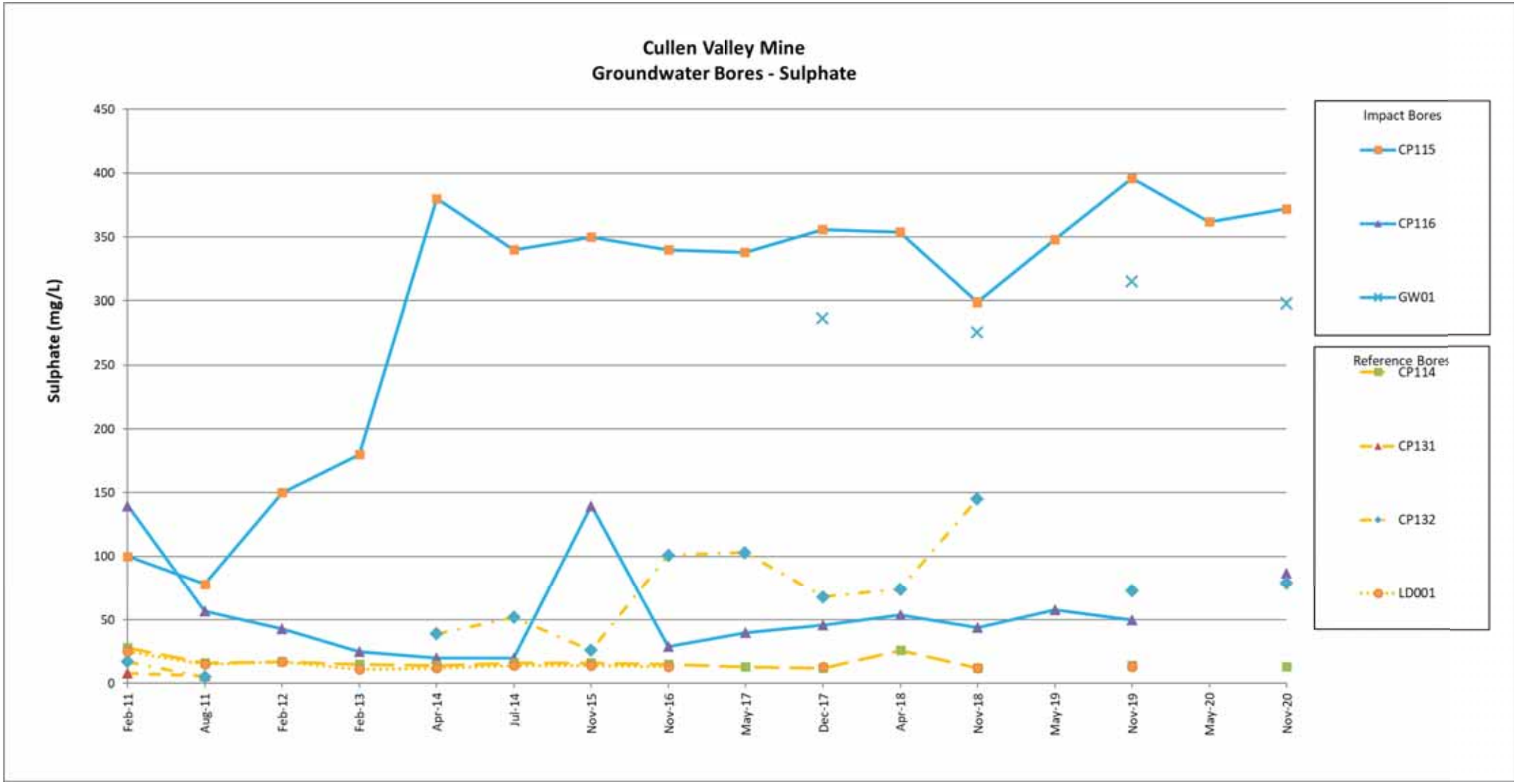
# Groundwater Hydrographs - Cullen Valley (2011-2020)

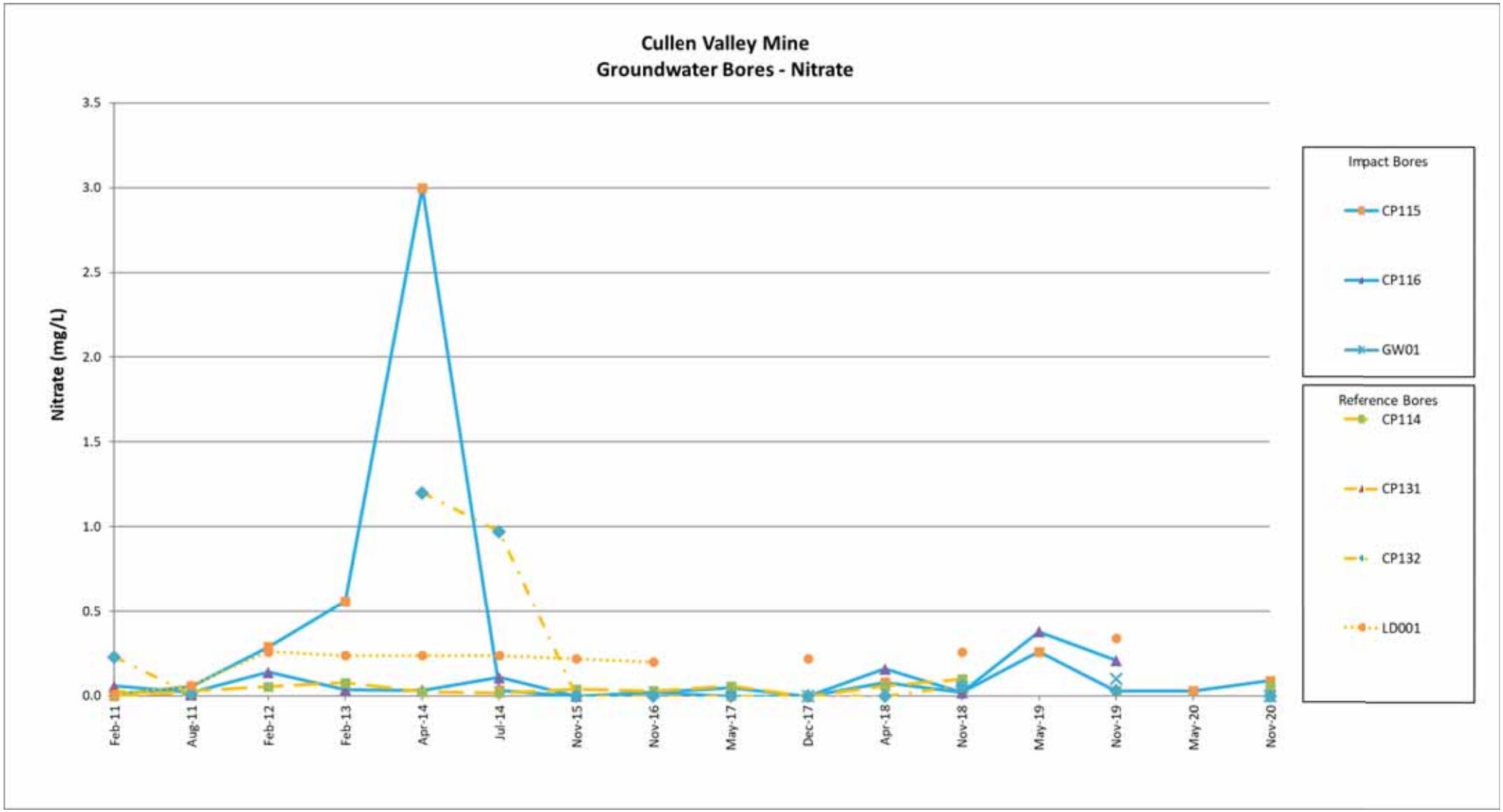



Cullen Valley Mine
Groundwater Bores - pH
pH (pH Units)
7.5
6.5
5.5
4.5
Feb-11
Aug-11
Feb-12
Feb-13
Apr-14
Jul-14
Nov-15
Nov-16
May-17
Dec-17
Apr-18
Nov-18
May-19
Nov-19
May-20
Nov-20
Impact Bores
CP115
CP116
GW01
Reference Bores
CP114
CP131
CP132
LD001


Cullen Valley Mine
Groundwater Bores - EC
EC (uS/cm)
1,000
900
800
700
600
500
400
300
200
100
0
Feb-11
Aug-11
Feb-12
Feb-13
Apr-14
Jul-14
Nov-15
Nov-16
May-17
Dec-17
Apr-18
Nov-18
May-19
Nov-19
May-20
Nov-20
Impact Bores
CP115
CP116
GW01
Reference Bores
CP114
CP131
CP132
LD001


Cullen Valley Mine
Groundwater Bores - Hardness
Hardness (mg/L)
450
400
350
300
250
200
150
100
50
0
Feb-11
Aug-11
Feb-12
Feb-13
Apr-14
Jul-14
Nov-15
Nov-16
May-17
Dec-17
Apr-18
Nov-18
May-19
Nov-19
May-20
Nov-20
Impact Bores
CP115
CP116
GW01
Reference Bores
CP114
CP131
CP132
LD001


Cullen Valley Mine
Groundwater Bores - Sulphate
Sulphate (mg/L)
450
400
350
300
250
200
150
100
50
0
Feb-11
Aug-11
Feb-12
Feb-13
Apr-14
Jul-14
Nov-15
Nov-16
May-17
Dec-17
Apr-18
Nov-18
May-19
Nov-19
May-20
Nov-20
Impact Bores
CP115
CP116
GW01
Reference Bores
CP114
CP131
CP132
LD001


Cullen Valley Mine
Groundwater Bores - Nitrate
Nitrate (mg/L)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Feb-11
Aug-11
Feb-12
Feb-13
Apr-14
Jul-14
Nov-15
Nov-16
May-17
Dec-17
Apr-18
Nov-18
May-19
Nov-19
May-20
Nov-20
Impact Bores
CP115
CP116
GW01
Reference Bores
CP114
CP131
CP132
LD001

| Sample Site | CP114 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | 869.78 | 869.96 | 869.94 | 869.99 | 869.78 | 869.90 | 869.78 | 869.87 |
| Depth to aquifer (m) | 36.18 | 36.00 | 36.02 | 35.97 | 36.19 | 36.07 | 42.10 | 35.22 |
| pH | 6.16 | 5.63 | 6.12 | 7.28 | NS | 7.24 | NS | 6.74 |
| Electrical Conductivity (µS/cm | 279 | 223 | 300 | 285 | | 294 | | 268 |
| Nitrite (mg/L) | <0.05 | <0.05 | 0.06 | <0.01 | | <0.01 | | <0.01 |
| Total Oxidised Nitrogen (mg/L) | 0.060 | <0.05 | 0.12 | 0.1 | | 0.03 | | 0.06 |
| Chloride (mg/L) | 5 | 22 | 8 | 15 | | 13 | | 12 |
| Nitrate (mg/L) | 0.060 | <0.05 | 0.06 | 0.1 | | 0.03 | | 0.06 |
| Sulphate (mg/L) | 13 | 12 | 26 | 12 | | 14 | | 13 |
| Alkalinity (mg/L) | 110 | 100 | 100 | 104 | | 121 | | 126 |
| Calcium (mg/L) | 23 | 86 | 23 | 23 | | 26 | | 23 |
| Magnesium (mg/L) | 10 | 34 | 10 | 12 | | 11 | | 11 |
| Sodium (mg/L) | 8 | 12 | 13 | 12 | | 9 | | 10 |
| Potassium (mg/L) | 5 | 10 | 6 | 6 | | 5 | | 6 |
| Total Hardness (mg CaCO3/L) | 99 | 355 | 99 | 107 | | 110 | | 103 |
| Aluminium (µg/L) | <10 | 280 | 20 | 60 | | 330 | | <10 |
| Arsenic (µg/L) | <1 | <1 | <1 | <1 | | <1 | | <1 |
| Cadmium (µg/L) | <0.1 | <0.1 | <0.1 | <0.1 | | <0.1 | | <0.1 |
| Chromium (µg/L) | <1 | 1 | <1 | <1 | | <1 | | <1 |
| Copper (µg/L) | 1 | 9 | 3 | 2 | | 3 | | <1 |
| Iron (µg/L) | 2240 | 12800 | <50 | 1350 | | 2000 | | 4660 |
| Lead (µg/L) | <1 | 15 | <1 | <1 | | 2 | | <1 |
| Manganese (µg/L) | 964 | 414 | 535 | 635 | | 1170 | | 386 |
| Molybdenum (µg/L) | 8 | <1 | 1 | 1 | | <1 | | <1 |
| Nickel (µg/L) | 6 | 3 | 4 | 27 | | 11 | | 2 |
| Selenium (µg/L) | <10 | <10 | <10 | <10 | | <10 | | <10 |
| Zinc (µg/L) | 48 | 86 | 21 | 16 | | 57 | | 12 |
| Mercury (mg/L) | <0.0001 | <0.0001 | <0.0001 | Removed from monitoring program | | <0.0001 | | <0.0001 |

*NS – No sample required (annual monitoring only)*

| Sample Site | CP115 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | 894.41 | 894.19 | 894.02 | 893.98 | 894.27 | 894.01 | 894.28 | 894.70 |
| Depth to aquifer (m) | 56.87 | 57.09 | 57.21 | 57.30 | 56.96 | 52.27 | 56.10 | 55.68 |
| pH | 6.26 | 5.96 | 6.05 | 7.04 | 6.85 | 6.95 | 6.31 | 6.52 |
| Electrical Conductivity (µS/cm | 770 | 670 | 398 | 757 | 723 | 817 | 901 | 837 |
| Nitrite (mg/L) | <0.05 | <0.05 | 0.05 | <0.01 | <0.01 | <0.01 | <0.01 | <0.01 |
| Total Oxidised Nitrogen (mg/L) | <0.05 | <0.05 | 0.13 | 0.02 | 0.26 | 0.03 | 0.03 | 0.09 |
| Chloride (mg/L) | 5 | 4 | 4 | 3 | 11 | 3 | 3 | 9 |
| Nitrate (mg/L) | <0.05 | <0.05 | 0.08 | 0.02 | 0.26 | 0.03 | 0.03 | 0.09 |
| Sulphate (mg/L) | 338 | 356 | 354 | 299 | 348 | 396 | 362 | 372 |
| Alkalinity (mg/L) | 62 | 62 | 64 | 46 | 62 | 53 | 60 | 62 |
| Calcium (mg/L) | 85 | 94 | 85 | 81 | 82 | 97 | 86 | 88 |
| Magnesium (mg/L) | 36 | 37 | 35 | 33 | 35 | 38 | 36 | 36 |
| Sodium (mg/L) | 11 | 13 | 13 | 16 | 13 | 14 | 13 | 14 |
| Potassium (mg/L) | 10 | 11 | 10 | 10 | 10 | 12 | 11 | 10 |
| Total Hardness (mg CaCO3/L) | 360 | 387 | 356 | 338 | 349 | 399 | 363 | 368 |
| Aluminium (µg/L) | <10 | 490 | 10 | <10 | <10 | <10 | <10 | <10 |
| Arsenic (µg/L) | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| Cadmium (µg/L) | 0.2 | 0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| Chromium (µg/L) | 2 | 2 | <1 | <1 | <1 | <1 | <1 | <1 |
| Copper (µg/L) | <1 | 10 | <1 | <1 | <1 | <1 | <1 | <1 |
| Iron (µg/L) | 9450 | 12300 | 7880 | 7840 | 9090 | 5750 | 7500 | 8560 |
| Lead (µg/L) | <1 | 17 | <1 | <1 | <1 | <1 | 50 | <1 |
| Manganese (µg/L) | 424 | 461 | 448 | 388 | 463 | 543 | 920 | 337 |
| Molybdenum (µg/L) | 2 | <1 | <1 | 5 | 1 | <1 | 2 | <1 |
| Nickel (µg/L) | 16 | 3 | 3 | 49 | 12 | 3 | 15 | <1 |
| Selenium (µg/L) | <10 | <10 | <10 | <10 | <10 | <10 | <10 | <10 |
| Zinc (µg/L) | 317 | 86 | 115 | 78 | 87 | 62 | 183 | 44 |
| Mercury (mg/L) | <0.0001 | <0.0001 | <0.0001 | Removed from monitoring program | Removed from monitoring program | <0.0001 | <0.0001 | <0.0001 |

| Sample Site | CP116 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | 892.98 | 892.86 | 892.82 | 892.76 | 893.05 | 892.75 | 893.04 | 893.29 |
| Depth to aquifer (m) | 49.62 | 49.74 | 49.75 | 49.81 | 49.52 | 49.82 | 67.40 | 48.53 |
| pH | 6.20 | 5.81 | 6.10 | 7.21 | 6.83 | 7.07 | NS | 6.58 |
| Electrical Conductivity (µS/cm | 361 | 313 | 391 | 355 | 372 | 428 | | 428 |
| Nitrite (mg/L) | <0.05 | <0.05 | <0.05 | <0.01 | <0.01 | 0.01 | | <0.01 |
| Total Oxidised Nitrogen (mg/L) | 0.05 | <0.05 | 0.16 | 0.02 | 0.38 | 0.21 | | <0.01 |
| Chloride (mg/L) | 16 | 20 | 16 | 16 | 20 | 21 | | 20 |
| Nitrate (mg/L) | 0.05 | <0.05 | 0.16 | 0.02 | 0.38 | 0.21 | | <0.01 |
| Sulphate (mg/L) | 40 | 46 | 54 | 44 | 58 | 50 | | 87 |
| Alkalinity (mg/L) | 110 | 104 | 124 | 104 | 98 | 120 | | 116 |
| Calcium (mg/L) | 26 | 28 | 28 | 29 | 31 | 44 | | 32 |
| Magnesium (mg/L) | 13 | 14 | 13 | 15 | 14 | 16 | | 16 |
| Sodium (mg/L) | 12 | 14 | 14 | 15 | 15 | 15 | | 13 |
| Potassium (mg/L) | 6 | 7 | 6 | 6 | 7 | 8 | | 7 |
| Total Hardness (mg CaCO3/L) | 118 | 128 | 123 | 134 | 135 | 176 | | 146 |
| Aluminium (µg/L) | 10 | <10 | <0.01 | 80 | <10 | 40 | | <10 |
| Arsenic (µg/L) | <1 | <1 | <1 | <1 | <1 | <1 | | <1 |
| Cadmium (µg/L) | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | | <0.1 |
| Chromium (µg/L) | 1 | <1 | <1 | 1 | <1 | <1 | | <1 |
| Copper (µg/L) | <1 | <1 | <1 | <1 | <1 | <1 | | <1 |
| Iron (µg/L) | 11800 | 12000 | 10200 | 14500 | 9530 | 550 | | 13300 |
| Lead (µg/L) | <1 | <1 | <1 | <1 | <1 | <1 | | <1 |
| Manganese (µg/L) | 561 | 562 | 551 | 553 | 645 | 703 | | 593 |
| Molybdenum (µg/L) | 2 | <1 | <1 | <1 | <1 | <1 | | <1 |
| Nickel (µg/L) | 2 | 1 | 1 | 2 | 3 | 3 | | ***<1*** |
| Selenium (µg/L) | <10 | <10 | <10 | <10 | <10 | <10 | | <10 |
| Zinc (µg/L) | 105 | 19 | 56 | 5 | 143 | 37 | | ***14*** |
| Mercury (mg/L) | <0.0001 | <0.0001 | <0.0001 | Removed from monitoring program | Removed from monitoring program | <0.0001 | | <0.0001 |

*NS – No sample required (annual monitoring only)*

| Sample Site | CP131 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | NS | 864.85 | NS | 862.75 | 865.1 | 863.9 | No sample able to be taken due to access restriction to bore | 863.69 |
| Depth to aquifer (m) | | 74.37 | | 76.35 | 74.09 | 75.5 | | 75.5 |
| pH | | * | | * | WL | | | * |
| Electrical Conductivity (µS/cm | | | | | | | | |
| Nitrite (mg/L) | | | | | | | | |
| Total Oxidised Nitrogen (mg/L) | | | | | | | | |
| Chloride (mg/L) | | | | | | | | |
| Nitrate (mg/L) | | | | | | | | |
| Sulphate (mg/L) | | | | | | | | |
| Alkalinity (mg/L) | | | | | | | | |
| Calcium (mg/L) | | | | | | | | |
| Magnesium (mg/L) | | | | | | | | |
| Sodium (mg/L) | | | | | | | | |
| Potassium (mg/L) | | | | | | | | |
| Total Hardness (mg CaCO3/L) | | | | | | | | |
| Aluminium (µg/L) | | | | | | | | |
| Arsenic (µg/L) | | | | | | | | |
| Cadmium (µg/L) | | | | | | | | |
| Chromium (µg/L) | | | | | | | | |
| Copper (µg/L) | | | | | | | | |
| Iron (µg/L) | | | | | | | | |
| Lead (µg/L) | | | | | | | | |
| Manganese (µg/L) | | | | | | | | |
| Molybdenum (µg/L) | | | | | | | | |
| Nickel (µg/L) | | | | | | | | |
| Selenium (µg/L) | | | | | | | | |
| Zinc (µg/L) | | | | | | | | |
| Mercury (mg/L) | | | | | | | | |

** - Insufficient water available to sample or bore dry*

| Sample Site | CP132 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | 887.23 | 886.981 | 886.79 | 886.56 | 886.58 | 886.33 | 886.38 | 886.52 |
| Depth to aquifer (m) | 18.53 | 18.78 | 18.97 | 19.20 | 19.8 | 19.43 | 41.38 | 18.24 |
| pH | 6.21 | 5.94 | 6.39 | 7.02 | NS | 7.49 | NS | 6.79 |
| Electrical Conductivity (µS/cm | 521 | 375 | 494 | 536 | | 510 | | 492 |
| Nitrite (mg/L) | <0.05 | <0.05 | - | <0.1 | | <0.01 | | <0.01 |
| Total Oxidised Nitrogen (mg/L) | <0.05 | <0.05 | - | 0.06 | | 0.03 | | <0.01 |
| Chloride (mg/L) | 32 | 36 | 32 | 26 | | 33 | | 40 |
| Nitrate (mg/L) | <0.05 | <0.05 | - | 0.06 | | 0.03 | | <0.01 |
| Sulphate (mg/L) | 103 | 68 | 74 | 145 | | 73 | | 79 |
| Alkalinity (mg/L) | 104 | 108 | 140 | 86 | | 134 | | 117 |
| Calcium (mg/L) | 42 | 12 | 401 | 48 | | 54 | | 42 |
| Magnesium (mg/L) | 19 | 4 | 18 | 22 | | 19 | | 20 |
| Sodium (mg/L) | 13 | 6 | 14 | 19 | | 15 | | 15 |
| Potassium (mg/L) | 9 | 7 | 9 | 10 | | 11 | | 9 |
| Total Hardness (mg CaCO3/L) | 183 | 46 | 174 | 210 | | 213 | | 187 |
| Aluminium (µg/L) | <10 | <10 | - | <10 | | <10 | | <10 |
| Arsenic (µg/L) | <1 | <1 | - | <1 | | <1 | | <1 |
| Cadmium (µg/L) | <0.1 | <0.1 | - | <0.1 | | <0.1 | | <0.1 |
| Chromium (µg/L) | <1 | <1 | - | <1 | | <1 | | <1 |
| Copper (µg/L) | <1 | <1 | - | <1 | | <1 | | <1 |
| Iron (µg/L) | 8430 | 7250 | - | 9820 | | 50 | | 6020 |
| Lead (µg/L) | <1 | <1 | - | <1 | | <1 | | <1 |
| Manganese (µg/L) | 267 | 222 | - | 303 | | 340 | | 215 |
| Molybdenum (µg/L) | 1 | <1 | - | <1 | | <1 | | <1 |
| Nickel (µg/L) | <1 | <1 | - | 1 | | 2 | | <1 |
| Selenium (µg/L) | <10 | <10 | - | <10 | | <10 | | <10 |
| Zinc (µg/L) | 14 | <5 | - | 5 | | 15 | | <5 |
| Mercury (mg/L) | <0.0001 | <0.0001 | - | Removed from monitoring program | | <0.0001 | | <0.0001 |

| Sample Site | LD001 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | NS | 890.88 | NS | 889.73 | NS | 889.14 | No sample able to be taken due to access restrictions to bore | No sample able to be taken due to access restrictions to bore |
| Depth to aquifer (m) | | 49.25 | | 50.40 | | 50.99 | | |
| pH | | 6.16 | | 7.55 | | 7.67 | | |
| Electrical Conductivity (µS/cm | | 125 | | 166 | | 175 | | |
| Nitrite (mg/L) | | <0.05 | | <0.01 | | <0.01 | | |
| Total Oxidised Nitrogen (mg/L) | | 0.22 | | 0.26 | | 0.34 | | |
| Chloride (mg/L) | | 6 | | 5 | | 9 | | |
| Nitrate (mg/L) | | 0.22 | | 0.26 | | 0.34 | | |
| Sulphate (mg/L) | | 13 | | 12 | | 13 | | |
| Alkalinity (mg/L) | | 56 | | 63 | | 67 | | |
| Calcium (mg/L) | | 13 | | 13 | | 14 | | |
| Magnesium (mg/L) | | 5 | | 4 | | 5 | | |
| Sodium (mg/L) | | 6 | | 8 | | 7 | | |
| Potassium (mg/L) | | 8 | | 8 | | 8 | | |
| Total Hardness (mg CaCO3/L) | | 53 | | 49 | | 56 | | |
| Aluminium (µg/L) | | <10 | | <10 | | <10 | | |
| Arsenic (µg/L) | | <1 | | <1 | | <1 | | |
| Cadmium (µg/L) | | <0.1 | | <0.1 | | <0.1 | | |
| Chromium (µg/L) | | <1 | | <1 | | <1 | | |
| Copper (µg/L) | | 10 | | 6 | | <1 | | |
| Iron (µg/L) | | <50 | | <50 | | <50 | | |
| Lead (µg/L) | | <1 | | <1 | | <1 | | |
| Manganese (µg/L) | | 4 | | <1 | | 2 | | |
| Molybdenum (µg/L) | | <1 | | <1 | | <1 | | |
| Nickel (µg/L) | | 8 | | 8 | | 7 | | |
| Selenium (µg/L) | | <10 | | <10 | | <10 | | |
| Zinc (µg/L) | | 138 | | 150 | | 142 | | |
| Mercury (mg/L) | | <0.0001 | | Removed from monitoring program | | <0.0001 | | |

*NS – No sample required (annual monitoring only)*

| Sample Site | GW01 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | NS | N/A (Tap) | NS | N/A (Tap) | NS | N/A (Tap) | NS | N/A (Tap) |
| Depth to aquifer (m) | | N/A (Tap) | | N/A (Tap) | | N/A (Tap) | | N/A (Tap) |
| pH | | 6.23 | | 6.68 | | 7.09 | | 6.67 |
| Electrical Conductivity (µS/cm | | 629 | | 779 | | 778 | | 805 |
| Nitrite (mg/L) | | <0.05 | | <0.01 | | <0.01 | | <0.01 |
| Total Oxidised Nitrogen (mg/L) | | <0.05 | | 0.5 | | 0.1 | | <0.01 |
| Chloride (mg/L) | | 22 | | 18 | | 22 | | 23 |
| Nitrate (mg/L) | | <0.05 | | 0.05 | | 0.1 | | <0.01 |
| Sulphate (mg/L) | | 287 | | 276 | | 315 | | 298 |
| Alkalinity (mg/L) | | 84 | | 68 | | 80 | | 101 |
| Calcium (mg/L) | | 64 | | 64 | | 70 | | 64 |
| Magnesium (mg/L) | | 42 | | 41 | | 44 | | 41 |
| Sodium (mg/L) | | 19 | | 22 | | 21 | | 19 |
| Potassium (mg/L) | | 13 | | 13 | | 13 | | 13 |
| Total Hardness (mg CaCO3/L) | | 333 | | 329 | | 356 | | 329 |
| Aluminium (µg/L) | | <10 | | <10 | | <10 | | 10 |
| Arsenic (µg/L) | | <1 | | <1 | | <1 | | <1 |
| Cadmium (µg/L) | | <0.1 | | 0.1 | | 0.1 | | <0.1 |
| Chromium (µg/L) | | <1 | | <1 | | <1 | | <1 |
| Copper (µg/L) | | <1 | | <1 | | <1 | | <1 |
| Iron (µg/L) | | 7780 | | 310 | | 8600 | | 8260 |
| Lead (µg/L) | | <1 | | <1 | | <1 | | <1 |
| Manganese (µg/L) | | 1960 | | 2060 | | 2020 | | 1900 |
| Molybdenum (µg/L) | | <1 | | <1 | | <1 | | <1 |
| Nickel (µg/L) | | 24 | | 16 | | 20 | | 13 |
| Selenium (µg/L) | | <10 | | <10 | | <10 | | <10 |
| Zinc (µg/L) | | 38 | | 29 | | 42 | | 15 |
| Mercury (mg/L) | | <0.0001 | | - | | <0.0001 | | <0.0001 |

*NS – No sample required (annual monitoring only)*

| Sample Site | BHW1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Date | 5/5/2017 | 13/12/2017 | 26/4/2018 | 6/11/2018 | 6/5/2019 | 6/11/2019 | 6/5/2020 | 4/11/2020 |
| AHD (RL) (m) | 894.52 | NS | 894.29 | 894.72 | 894.44 | 894.52 | 894.68 | 895.05 |
| Depth to aquifer (m) | 44.28 | WL | 44.51 | 44.08 | 44.36 | 44.28 | 52.55 | 43.75 |
| pH | WL | WL | WL | WL | WL | WL | WL | WL |
| Electrical Conductivity (µS/cm | | | | | | | | |
| Nitrite (mg/L) | | | | | | | | |
| Total Oxidised Nitrogen (mg/L) | | | | | | | | |
| Chloride (mg/L) | | | | | | | | |
| Nitrate (mg/L) | | | | | | | | |
| Sulphate (mg/L) | | | | | | | | |
| Alkalinity (mg/L) | | | | | | | | |
| Calcium (mg/L) | | | | | | | | |
| Magnesium (mg/L) | | | | | | | | |
| Sodium (mg/L) | | | | | | | | |
| Potassium (mg/L) | | | | | | | | |
| Total Hardness (mg CaCO3/L) | | | | | | | | |
| Aluminium (µg/L) | | | | | | | | |
| Arsenic (µg/L) | | | | | | | | |
| Cadmium (µg/L) | | | | | | | | |
| Chromium (µg/L) | | | | | | | | |
| Copper (µg/L) | | | | | | | | |
| Iron (µg/L) | | | | | | | | |
| Lead (µg/L) | | | | | | | | |
| Manganese (µg/L) | | | | | | | | |
| Molybdenum (µg/L) | | | | | | | | |
| Nickel (µg/L) | | | | | | | | |
| Selenium (µg/L) | | | | | | | | |
| Zinc (µg/L) | | | | | | | | |
| Mercury (mg/L) | | | | | | | | |

*WL – Water level only*

# APPENDIX 4

**Noise Monitoring Results**

Historical Noise monitoring results for years 2011, 2012, 2015 - 2020 are shown in **Tables A to G**. Contribution from CVM was inaudible for all monitoring undertaken for 2013, and 2014.

**Table A 2020 Quarterly Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 44 (IA) | 35 (IA) | 43 (IA) | 42 (IA) |
| Hillcroft (N08) | 35 | 41 (IA) | 33 (IA) | 30 (IA) | 33 (IA) |
| Forest Lodge (N10) | 40 | 44 (IA) | 38 (IA) | 26 (IA) | 38 (IA) |
| Doble Gate (N09) | 43 | 52 (IA) | 52 (IA) | 60 (IA) | 54 (IA) |
| Tilley (N06) | 43 | 61 (IA) | 66 (IA) | 68 (IA) | 63 (IA) |

**Table B 2019 Quarterly Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 39 (IA) | 44 (IA) | 41 (IA) | 43 (IA) |
| Hillcroft (N08) | 35 | 40 (IA) | 44 (IA) | 39 (IA) | 38 (IA) |
| Forest Lodge (N10) | 40 | 36 (IA) | 43 (IA) | 43 (IA) | 32 (IA) |
| Doble Gate (N09) | 43 | 62 (IA) | 54 (IA) | 63 (IA) | 59 (IA) |
| Tilley (N06) | 43 | 72 (IA) | 67 (IA) | 64 (IA) | 68 (IA) |

**Table C 2018 Quarterly Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 34 (IA) | 38 (IA) | 33 (IA) | 40 (IA) |
| Hillcroft (N08) | 35 | 35 (<20) | 39 (IA) | 40 (IA) | 33 (IA) |
| Forest Lodge (N10) | 40 | 50 (IA) | 27 (IA) | 43 (IA) | 33 (IA) |
| Doble Gate (N09) | 43 | 47 (IA) | 49 (IA) | 50 (IA) | 49 (IA) |
| Tilley (N06) | 43 | 66 (IA) | 62 (IA) | 68 (IA) | 67 (IA) |

**Table D 2017 Quarterly Noise Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 44 (IA) | 33 (IA) | 34 (IA) | 34 (IA) |
| Hillcroft (N08) | 35 | 42 (IA) | 37 (IA) | 29 (IA) | 29 (IA) |
| Forest Lodge (N10) | 40 | 33 (IA) | 34 (IA) | 31 (IA) | 31 (IA) |
| Doble Gate (N09) | 43 | 47 (IA) | 50 (IA) | 45 (IA) | 45 (IA) |
| Tilley (N06) | 43 | 65 (IA) | 68 (IA) | 67 (IA) | 67 (IA) |

**Table E 2016 Quarterly Noise Monitoring Results***

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 32 (IA) | 37 (IA) | 36 (IA) | 36 (IA) |
| Hillcroft (N08) | 35 | 40 (IA) | 37 (IA) | 35 (IA) | 35 (IA) |
| Forest Lodge (N10) | 40 | 32 (IA) | 33 (IA) | 30 (IA) | 36 (IA) |
| Doble Gate (N09) | 43 | 46 (IA) | 52 (IA) | 49 (IA) | 48 (IA) |
| Tilley (N06) | 43 | 67 (IA) | 66 (IA) | 67 (IA) | 66 (IA) |

**Table E 2015 Quarterly Noise Monitoring Results***

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq}$) | Quarter 2 ($L_{Aeq}$) | Quarter 3 ($L_{Aeq}$) | Quarter 4 ($L_{Aeq}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 42 (IA) | 32 | 43 (IA) | 41 (IA) |
| Hillcroft (N08) | 35 | 34 | 39 (IA) # | 35 | 38 (IA) |
| Forest Lodge (N10) | 40 | 40 | 28 | 40 | 42 (IA) |
| Doble Gate (N09) | 43 | 64 (IA) | 49 (IA) # | 51 (IA) # | 49 (IA) |
| Tilley (N06) | 43 | 66 (IA) | 69 (IA) # | 66 (IA) # | 69 (IA) |

*IA – noise from the mine was inaudible therefore criteria do not apply*

*# – these measurements were affected by wind speeds > 3m/s2 therefore criteria do not apply*

**Table F 2012 Quarterly Noise Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq\ 15min}$) | Quarter 2 ($L_{Aeq\ 15min}$) | Quarter 3 ($L_{Aeq\ 15min}$) | Quarter 4 ($L_{Aeq\ 15min}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | 33 | 35 | 30 | 32 |
| Hillcroft (N08) | 35 | 35 | 39 | 32 | 33 |
| Forest Lodge (N10) | 40 | <25 | 30 | <25 | NM |
| Doble Gate (N09) | 43 | IA | IA | IA | IA |
| Tilley (N06) | 43 | IA | IA | IA | IA |

*IA – noise from the mine was inaudible therefore criteria do not apply*

*NM – noise was not measurable*

**Table G 2011 Quarterly Noise Monitoring Results**

| Location | Criterion (dB) | Quarter 1 ($L_{Aeq\ 15min}$) | Quarter 2 ($L_{Aeq\ 15min}$) | Quarter 3 ($L_{Aeq\ 15min}$) | Quarter 4 ($L_{Aeq\ 15min}$) |
|---|---|---|---|---|---|
| Red Springs (N07) | 37 | IA | 33 | <20 | IA |
| Hillcroft (N08) | 35 | 31 | 37 | 30 | <20 |
| Forest Lodge (N10) | 40 | 26 | <30 | <25 | <25 |
| Doble Gate (N09) | 43 | IA | IA | IA | IA |
| Tilley (N06) | 43 | IA | IA | IA | IA |

*IA – noise from the mine was inaudible therefore criteria do not apply*