METROPOLITAN COAL

2020 ANNUAL REVIEW




Peabody

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Project No. MET-21-24
Document No. 01078829

Name of Operation	Metropolitan Coal
Name of Operator	Peabody Energy Australia Pty Ltd
Project Approval	Project Approval 08_0149
Name of Holder of Project Approval	Metropolitan Collieries Pty Ltd
Mining Leases	Consolidated Coal Lease 703 Mining Lease 1610 Mining Lease 1702 Mining Purpose Lease 320 Coal Lease 379
Name of Holder of Mining Leases	Metropolitan Collieries Pty Ltd
Water Licence	Water Access Licence – WAL25410 Bore Licence Certificate – 10BL603595
Name of Holder of Water Licence	Metropolitan Collieries Pty Ltd
MOP Start Date	October 2012
MOP End Date	September 2021
Annual Review Start Date	1 January 2020
Annual Review End Date	31 December 2020

I, Jon Degotardi, certify that this audit report is a true and accurate record of the compliance status of Metropolitan Coal for the period 1 January to 31 December 2020 and that I am authorised to make this statement on behalf of Peabody Energy Australia Pty Ltd.

Note.

a) The Annual Review is an 'environmental audit' for the purposes of section 9.39(2) of the Environmental Planning and Assessment Act 1979. Section 9.42 provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.

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

Name of Authorised Reporting Officer	Jon Degotardi
Title of Authorised Reporting Officer	Manager – Technical Services
Signature of Authorised Reporting Officer	
Date	31/03/2021

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1 STATEMENT OF COMPLIANCE

The compliance status of the Metropolitan Coal Mine with its relevant approval conditions at the end of the review period (31 December 2020) is provided in Table 1.

Table 1
Statement of Compliance

Were all conditions of the relevant approval(s) complied with?	
Project Approval 08_0149	No
Development Consent D90/832	Yes
Consolidated Coal Lease 703	Yes
Mining Lease 1610	Yes
Mining Lease 1702	Yes
Coal Lease 379	Yes
Mining Purpose Lease 320	Yes
Environment Protection Licence No. 767	Yes

Table 2 summarises the non-compliances with the approval conditions.

Table 2
Summary of Non-Compliances

Relevant Approval	Condition Number	Condition Description	Compliance Status	Comment	Report Section
Project Approval 08_0149	Condition 1, Schedule 3	Subsidence Impact Performance Measures (Table 1 of Project Approval)	Non-compliant	Exceedance of the Eastern Tributary watercourse subsidence impact performance measure in relation to iron staining and pool flow/drainage behaviour downstream of the Longwall 26 maingate.	6.2 and 13.1
Project Approval 08_0149	Condition 1, Schedule 4	Noise Impact Assessment Criteria (Table 2 of Project Approval)	Non-compliant	Noise monitoring has identified sustained non-compliances during the review period.	7.1 and 13.2

Compliance Status Key for Table 2 – Non-Compliances

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

2 INTRODUCTION

Metropolitan Coal is wholly owned by Peabody Energy Australia Pty Ltd (Peabody), and is located adjacent to the township of Helensburgh and approximately 30 kilometres (km) north of Wollongong in New South Wales (NSW) (Figure 1). Metropolitan Coal is located within Consolidated Coal Lease (CCL) 703, Mining Lease (ML) 1610 and ML 1702. Metropolitan Coal is one of the earliest established and longest continually running coal mining operations in Australia, with a history dating back to the 1880s.

Metropolitan Coal was granted approval for the Metropolitan Coal Project (the Project) by the Minister for Planning under section 75J of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act) on 22 June 2009. A copy of Project Approval (08_0149) is available on the Peabody website (http://www.peabodyenergy.com). The Project comprises the continuation, upgrade and extension of underground coal mining operations and surface facilities at Metropolitan Coal. The underground mining longwall layout is shown on Figure 1. The extent of the mine's surface facilities area is shown on Figure 2.

The surface facilities include administration buildings, workshops, bath houses, ablution facilities, haul roads, access roads, fuel and consumables storages, hardstand areas, a coal handling and preparation plant (CHPP), stockpiles (including run-of-mine [ROM] coal, product coal and coal reject stockpiles), underground coal reject emplacement plant and associated coal handling infrastructure (e.g. conveyors, transfer points and buffer bins).

Coal extracted from the underground mining operations is transferred by conveyor to the surface facilities area. ROM coal is crushed, screened and washed at the CHPP. The majority of product coal is transported by train to the Port Kembla Coal Terminal (PKCT) (in Wollongong) for domestic and overseas customers. CHPP coal reject material is transported by rail and truck to the PKCT, emplaced in unused workings, or transported to offsite locations for beneficial reuse.

The Environmental Management Structure of the Project is shown on Figure 3. It includes the Metropolitan Coal Environmental Management Strategy, developed to provide the strategic context for environmental management at Metropolitan Coal, and management plans and monitoring programs applicable to the underground mining area or mine's surface facilities area.

Metropolitan Coal submitted the Longwalls 305-307 Extraction Plan to the Department of Planning, Industry and Environment (DPIE) in October 2019. The Longwalls 305-307 Extraction Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences, subject to the previously approved Metropolitan Coal Extraction Plans for Longwalls 20-22, 23-27, 301-303 and 304. The DPIE approved the Longwalls 305-307 Extraction Plan in March 2020 and mining of Longwall 305 commenced on 12 April 2020. Under this annual review, environmental performance for the period 1 January 2020 to 11 April 2020 is reported against the Longwall 304 Extraction Plan and the environmental performance for the period 12 April 2020 to 31 December 2020 is reported against the Longwalls 305-307 Extraction Plan.

In accordance with the mining lease conditions, Metropolitan Coal has also prepared the *Metropolitan Coal Mining Operations Plan, 2012 – 2021* (herein referred to as the Metropolitan Coal MOP).

2.1 PURPOSE AND SCOPE

Metropolitan Coal's environmental reporting requirements include an Annual Review, which is to be prepared in accordance with Condition 3, Schedule 7 of the Project Approval, an Annual Environmental Management Report, to be prepared in accordance with CCL 703, and an Annual Rehabilitation Report, to be prepared in accordance with ML 1610, ML 1702, MPL 320 and CL 379.

The Metropolitan Coal 2020 Annual Review has been prepared to meet the above reporting requirements and to review the environmental performance of the Project during the review period (i.e. 1 January to 31 December 2020), consistent with the NSW Government (2015) *Annual Review Guideline for State Significant Mining Developments*.

2.2 MINE CONTACTS

Contact details for key Metropolitan Coal employees are provided below:

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3 APPROVALS

Metropolitan Coal operates under a number of statutory approvals, leases and licences granted by the NSW Government as outlined in Table 3.

Table 3
Consent, Lease and Licence Details

Consent/Lease/Licence	Authority	Grant/Renewal	Expiry Date
Project Approval 08_0149	DPIE	22/6/2009	22/6/2032
Project Approval 08_0149 – Mod 1	DPIE	8/9/2010	22/6/2032
Project Approval 08_0149 – Mod 2	DPIE	2/7/2011	22/6/2032
Project Approval 08_0149 – Mod 3	DPIE	3/10/2013	22/6/2032
Development Consent D90/832	WCC	5/1/1995	-
Consolidated Coal Lease 703	MEG	1/4/2004	26/1/2024
Mining Lease 1610	MEG	19/5/2014	18/12/2031
Coal Lease 379	MEG	14/11/2013*	4/10/2033
Mining Purpose Lease 320	MEG	16/6/2014	9/12/2035
Mining Lease 1702	MEG	13/10/2014	13/10/2035
Bore Licence Certificate 10BL603595	DPIE-Water	25/1/2013	24/1/2028
Camp Creek Weir Surface Water Certificate of Title	DPIE-Water	28/11/2012	-
Environment Protection Licence (EPL) No. 767	EPA	9/9/2002	-
Radiation Licence – Radiation Management Licence 5063985	EPA	27/9/2020	27/9/2021
Licence to store explosives and/or security sensitive dangerous substances – Licence XSTR200082	SafeWork NSW	15/06/2017	15/06/2022

Note: DPIE = NSW Department of Planning, Industry and Environment; DRG = NSW Division of Mining, Energy and Geoscience; EPA = NSW Environment Protection Authority; WCC = Wollongong City Council.

* Date lease offer was signed.

4 OPERATIONS SUMMARY

4.1 MINING OPERATIONS

Metropolitan Coal submitted the Longwall 304 Extraction Plan to the DP&E in April 2019. On 16 July 2019, the DPIE granted approval for Longwall 304 Extraction Plan with conditions.

Prior to the review period, the extraction of Longwall 303 was completed on 2 June 2019 (Figure 4). The extraction of Longwall 304 commenced on 28 July 2019 and was completed on 28 January 2020.

Metropolitan Coal submitted the Longwalls 305-307 Extraction Plan to the DPIE on 9 October 2019, with revisions submitted 30 January 2020, 15 February 2020 and 11 March 2020. The Longwalls 305-307 Extraction Plan was subsequently approved by DPIE with conditions on 16 March 2020. During the review period, the extraction of Longwall 305 commenced on 12 April 2020 and was completed on 21 November 2020. It is expected that extraction of Longwall 306 will commence in May 2021.

The amount of waste rock/overburden, ROM coal, coal reject and product coal produced in the previous reporting period, current reporting period and forecast for the next reporting period is provided in Table 4.

Table 4
Production Summary

Material	Approval Limit	2019 Reporting Period (Actual)	2020 Reporting Period (Actual)	2021 Reporting Period (Forecast)
Waste Rock/Overburden	N/A	N/A	N/A	N/A
ROM Coal	3.2 Mt per calendar year[1]	1,851,831 t	1,276,496 t	1,014,394 t
Coal Reject[2]	N/A	368,873 t[3]	290,107 t[4]	237,608 t
Saleable Product[2,5]	2.8 Mt per calendar year[1]	1,456,847 t	981,100 t	776,786 t

N/A = not applicable; Mt = million tonnes; t = tonnes.

1 Condition 6, Schedule 2 of the Project Approval states:

The Proponent shall not:

(a) extract more than 3.2 million tonnes of ROM coal from the mining area in a calendar year, or

(b) transport more than 2.8 million tonnes of product coal from the site in a calendar year.

2 Coal rejects and saleable product out of the CHPP.

3 Of the 368,873 t of coal reject produced in 2019, 63,669 t was transported to the Glenlee Washery for disposal, 259,411 t was beneficially re-used as engineered fill material at the Albion Park Bypass project, and 45,793 t was blended with 12,026 t of product coal to meet end use specifications, and delivered to PKCT via rail.

4 Of the 290,107 t of coal reject produced in 2020 and 31,536 t previously stockpiled during 2019, 256,106 t was blended with product coal and transported via rail to PKCT, 2,618 t was transported by road to PKCT (with DPIE approval) and blended with product coal, 794 t was transported by road to Boral at Berrima for beneficial reuse, and approximately 62,125 t was emplaced underground.

5 Note, there is no Approval limit for saleable product itself. The only Approval limit relating to saleable product is the amount of product coal transported from the site in a calendar year. Note that the quantities presented in Table 4 reflect the saleable product produced by Metropolitan Coal and are therefore not consistent with the quantities dispatched from site that are reported on the Peabody website in the Truck and Rail Register.

4.2 OTHER OPERATIONS – METROPOLITAN COAL SURFACE FACILITIES AREA

In addition to the Project Approval limits detailed in Table 4, other relevant operational conditions are described in Table 5 and primarily relate to the Metropolitan Coal surface facilities area.

During the review period, Metropolitan Coal continued the coal reject backfill emplacement project. Metropolitan Coal also continued its consultation with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill and commenced a final round of Coal Washery Rejects (CWR) sampling to confirm suitability of the material for capping at the landfill.

Table 5
Other Relevant Operational Conditions

Operational Condition		Operational Condition Met?	Comment
Limits on Approval (Project Approval Conditions 5, 7 and 8, Schedule 2)	5. *The Proponent may undertake mining operations in the mining area for up to 23 years from the date of this approval.* *Note: Under this approval, the Proponent is required to rehabilitate the site and perform additional undertakings to the satisfaction of the Director-General. Consequently, this approval will continue to apply in all other respects other than the right to conduct mining operations until the site has been properly rehabilitated.*	Yes	Metropolitan Coal was granted approval for the Project in June 2009.
	7. *The Proponent shall not export any coal reject from the site after 2021 without the written approval of the Director-General.*	Yes	-
	8. *The Proponent shall not emplace coal reject on the surface of the site without the written approval of the Director-General.* *Note: This condition applies to the Camp Gully Emplacement Area, as well as to the rest of the surface of the site. It does not apply to the proposed additional coal reject stockpile shown in Appendix 4.*	Yes	Metropolitan Coal has DPIE approval to emplace coal reject on the site when used for construction purposes (e.g. as engineered fill material). No construction activities requiring fill were undertaken and no coal reject was emplaced on the surface of the site during the review period.
Structural Adequacy (Project Approval Condition 9, Schedule 2)	• *The Proponent shall ensure that all new buildings and structures, and any alterations or additions to existing buildings and structure, are constructed in accordance with:* *(a) the relevant requirements of the BCA; and* *(b) any additional requirements of the MSB in areas where subsidence effects are likely to occur.* *Notes:* • *Under Part 4A of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for the proposed building works.* • *Part 8 of the EP&A Regulation sets out the requirements for the certification of the project.*	Yes	Building construction activities during the reporting period included the completion of construction of a new gas drainage plant at Metropolitan's Vent Shaft No. 3. Building Code of Australia requirements were stipulated for all buildings.
Demolition (Project Approval Condition 10, Schedule 2)	• *The Proponent shall ensure that all demolition work is carried out in accordance with Australian Standard AS 2601-2001: The Demolition of Structures, or its latest version.*	Yes	Metropolitan Coal did not undertake any demolition activities during the review period.
Operation of Plant and Equipment (Project Approval Condition 11, Schedule 2)	• *The Proponent shall ensure that all plant and equipment used at the site is:* *(a) maintained in a proper and efficient condition; and* *(b) operated in a proper and efficient manner.*	Yes	All plant and equipment in use at Metropolitan Coal is regularly serviced in accordance with the relevant Industry & Investment NSW *Mining Design Guidelines* to ensure plant and equipment is maintained in proper and efficient condition. All plant and equipment are operated in a proper and efficient manner.

Table 5
Other Relevant Operational Conditions (continued)

Operational Condition		Operational Condition Met?	Comment
Rail Noise (Project Approval Condition 4, Schedule 4)	4. *The Proponent shall only use locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208) and ARTC's EPL (No. 3142) or a Pollution Control Approval issued under the former Pollution Control Act 1970.*	Yes	All locomotives used by Metropolitan Coal are approved to operate on the NSW rail network in accordance with the relevant noise limits.
Blasting (Project Approval Condition 7, Schedule 4)	• *The Proponent shall not undertake blasting operations at the surface facilities area without the written approval of the Director-General.*	Yes	No blasting activities were carried out at the surface facilities area during the review period. Minor blasting underground is necessary at times when geological structures are encountered that cannot be excavated by the continuous miner or the longwall mining machine and when a section of the longwall roof falls ahead of the hydraulic supports of the longwall mining machine.

4.3 OPERATIONAL ACTIVITIES IN THE NEXT REPORTING PERIOD

Longwall 304 commenced extraction on 28 July 2019 and was completed on 28 January 2020. Longwall 305 commenced extraction on 12 April 2020 and was completed on 21 November 2020. The figures presented in this Annual Review show the approved Longwalls 305-307 Extraction Plan layout. In the next reporting period, Longwall 306 is anticipated to commence extraction in May 2021 (Figure 5).

The amount of waste rock/overburden, ROM coal, coal reject and product coal forecast for the next reporting period is provided in Table 4.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

WaterNSW provided comments on the 2019 Annual Review in its letter dated 17 July 2020. Comments raised by WaterNSW related to potential water quality impacts on Eastern Tributary, leakage from the Woronora Reservoir and height of fracturing.

WaterNSW's comments have been considered in this Annual Review where appropriate. Previous works completed by the Woronora Reservoir Impact Strategy (WRIS) also address matters raised by WaterNSW, namely under its *Woronora Reservoir Impact Strategy – Stage 2 Report* prepared by Professor Bruce Hebblewhite of B K Hebblewhite Consulting, Doctor Frans Kalf of Kalf and Associates Pty Ltd and Professor Emeritus Thomas McMahon of the University of Melbourne (WRIS, 2019). Works completed by the Independent Expert Panel for Mining in the Catchment (IEPMC) also address matters raised by WaterNSW, namely under its *Report of the Independent Expert Panel for Mining in the Catchment: Part 2 Coal Mining Impacts in the Special Areas of the Greater Sydney Water Catchment* (IEPMC, 2019). The findings of these reports were considered in the preparation and approval of the Longwalls 305-307 Extraction Plan.

6 ENVIRONMENTAL PERFORMANCE – UNDERGROUND MINING AREA AND SURROUNDS

This section provides a summary of the key environmental monitoring results for subsidence, surface water, groundwater, biodiversity, land, heritage, built features and public safety in the underground mining area, an assessment of environmental performance and a description of the management measures implemented during the review period.

Each section indicates the relevant management plan or monitoring program where details of the underground mining management and monitoring are available. The Metropolitan Coal management plans/monitoring programs are available on the Peabody website (http://www.peabodyenergy.com).

The Longwalls 305-307 Extraction Plan includes post-mining monitoring and management of potential subsidence impacts and environmental consequences, subject to the previously approved Metropolitan Coal Extraction Plans for Longwalls 20-22, 23-27, 301-303 and 304.

6.1 SUBSIDENCE MONITORING

The Metropolitan Coal Longwall 304 and Longwalls 305-307 Subsidence Monitoring Programs were prepared to validate subsidence predictions and analyse the relationship between the subsidence effects and subsidence impacts of the Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans in accordance with Condition 6(e), Schedule 3 of the Project Approval.

Subsidence movements are surveyed in three dimensions using a total station survey instrument and real time Global Navigation Satellite System units. The subsidence parameter monitoring locations are shown on Figure 6.

A review of the subsidence survey results and comparison between the predicted and observed subsidence movements for the review period has been conducted by Mine Subsidence Engineering Consultants (MSEC). The report prepared by MSEC is provided in Appendix A. A summary of the key findings is provided below.

6.1.1 Predicted and Observed Subsidence Movements

The review period included the completion of Longwalls 304 and 305. Details of the observed and predicted subsidence movements at the subsidence monitoring locations (300 XL Line, Princes Highway Line, Optic Water Line, M1 North Bound Line, Transmission Line, Transmission Towers, Telecommunication Towers, Railway Culverts, Bridge 2 [Old Princes Highway Underpass], Cawley Road Overbridge, Eastern Tributary Cross Lines, Waratah Rivulet Cross Lines, and Ridge Top Survey Stations) are provided in Appendix A. The monitoring locations are shown on Figure 6.

The observed subsidence profile shapes and subsidence parameters were generally similar to those predicted or within limits of accuracy of the predicted subsidence parameters. The maximum observed total conventional subsidence along the 300 XL Line and Optic Water Line was greater than predicted. The greater than predicted subsidence at the northern end of the longwalls is believed to have been influenced by variation in extracted seam thickness due to operational and geotechnical reasons at the northern end of Longwall 301 (Appendix A).

During the reporting period, Metropolitan Coal also continued its trial of the effectiveness of LiDAR as a subsidence survey technique compared to traditional subsidence survey techniques. The most recent LiDAR survey was carried out on 17th December 2020, after the completion of Longwall 305. The ground movements measured using the LiDAR surveys are generally consistent with the predictions and observed survey data along the monitoring lines (Appendix A).

Metropolitan Coal used a Trigger Action Response Plan (TARP) designed to monitor valley closure movements on the Eastern Tributary. The Eastern Tributary Valley Closure TARP has been successfully implemented by Metropolitan Coal for Longwall 304 and 305.

Subsidence monitoring results were reviewed by a Technical Committee, comprising industry and technical representatives, in accordance with the TARP. Metropolitan Coal made a decision to cease mining of Longwall 305 based on the increasing rate of closure observed at site ETAU. Longwall 305 was completed 21 November 2020 at chainage 120 metres (m) with no observed impact to the pool upstream of rockbar ETAU.

Condition 3, Schedule 3 of the Project Approval states:

3. *If the subsidence effects and subsidence impacts of the project exceed the relevant predictions by more than 15% at any time after mining has progressed beyond the halfway mark of Longwall 21, or if the profile of vertical displacement does not reflect predictions, then the Proponent shall use appropriate numerical modelling to supplement the subsequent predictions of subsidence effects and subsidence impacts for the project to the satisfaction of the Director-General.*

A comparison of the maximum observed and maximum predicted total conventional subsidence for the Project after each longwall for Longwalls 3 to 27 and Longwalls 301 to 305 is shown in Chart 1. The comparison of conventional subsidence effects excludes the valley cross lines which represent non-conventional subsidence movements.

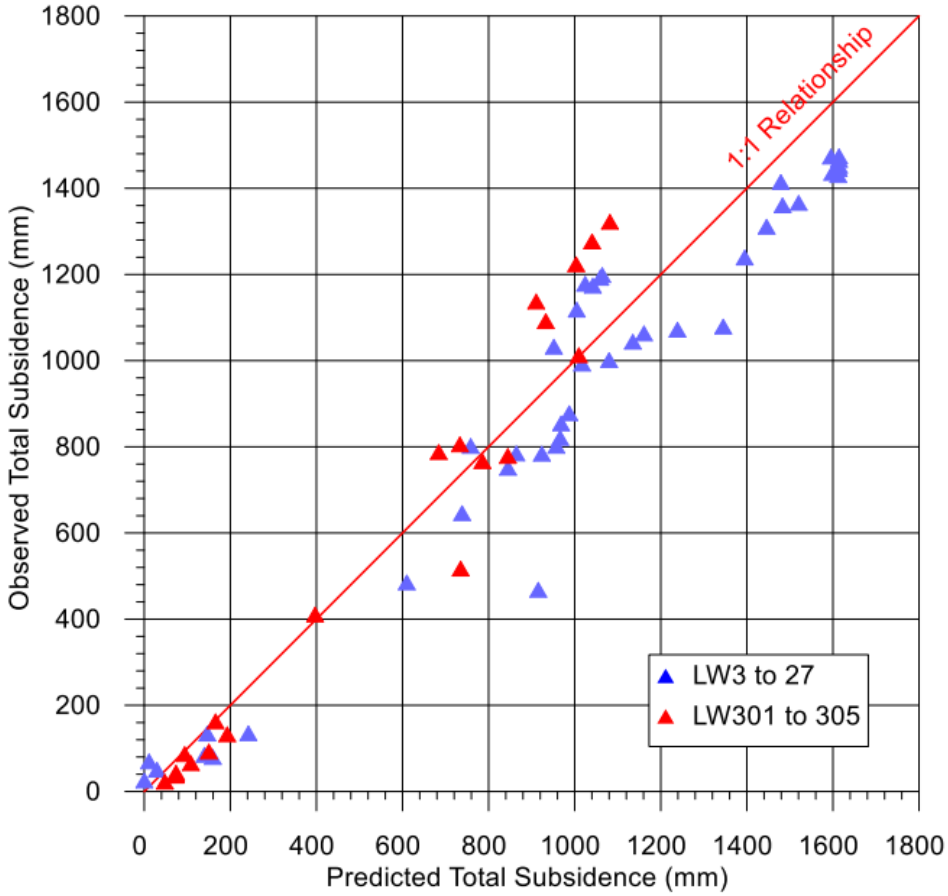


Chart 1 Comparison Between the Maximum Observed and Maximum Predicted Total Conventional Subsidence for Longwalls 3 to 27 and Longwalls 301 to 305 at Metropolitan Colliery

An analysis of the maximum observed versus maximum predicted vertical subsidence was undertaken by MSEC (Appendix A). Based on the results of survey data to date and comparison with predicted conventional subsidence parameters, the profiles of vertical displacement adequately reflect the predictions. The overall subsidence effects of the project do not exceed predictions by more than 15% (Appendix A).

6.2 WATER MANAGEMENT

The Metropolitan Coal Longwall 304 and Longwalls 305-307 Water Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans on watercourses (including the Woronora Reservoir), aquifers and catchment yield in accordance with Condition 6, Schedule 3 of the Project Approval. During the reporting period, the Longwall 304 Water Management Plan was in force from 1 January 2020 to 11 April 2020 (inclusive) and the Longwalls 305-307 Water Management Plan was in force from 12 April 2020 to 31 December 2020 (inclusive).

Both Water Management Plans include post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303.

Hydro Engineering & Consulting (HEC) (Appendices B1 and B2) and SLR Consulting Australia Pty Ltd (SLR) (Appendices C1 and C2) have reviewed the environmental performance of the Project in relation to surface water and groundwater in the underground mining area and surrounds for the reporting period.

The surface water, groundwater and meteorological monitoring locations are shown on Figures 7 to 12.

Sections 6.2.1 to 6.2.11 provide a summary of the surface water and groundwater assessments for the reporting period.

Section 6.8 provides a summary of the assessments against the water resource and watercourse subsidence impact performance indicators and measures for the reporting period.

6.2.1 Stream Features

Visual inspections and photographic surveys of Waratah Rivulet (from Pool P [downstream of Longwall 23] to the full supply level of the Woronora Reservoir) were conducted within three months of the completion of Longwall 304. Visual inspections and photographic surveys of the Eastern Tributary (from the full supply level of the Woronora Reservoir to the maingate of Longwall 26) were conducted within three months of the completion of Longwalls 304 and 305.

The visual and photographic surveys conducted at the completion of each longwall provide a detailed photographic record of stream features. The visual and photographic surveys have recorded observations of mining impacts including surface cracking, iron staining, gas releases and water discoloration/opacity. A summary of the observations for the reporting period is provided for the Waratah Rivulet (Table 6) and Eastern Tributary (Table 7). The location of mapped pools on the Waratah Rivulet and Eastern Tributary are provided in Appendix D.

During the reporting period, weekly inspections have also been undertaken where gas releases occur, and monthly inspections have been undertaken of the Eastern Tributary between the full supply level of the Woronora Reservoir and the Longwall 26 maingate to document surface cracking and iron staining. The results of these inspections are included in Table 7.

Table 6
Monitoring of Stream Features – Waratah Rivulet Downstream of the Longwall 23 Maingate

Stream Feature	Summary of Observations
Surface Cracking and Drainage Behaviour	No surface cracking was observed downstream of the Longwall 23 maingate on the Waratah Rivulet during the Longwall 304 inspection. The performance indicator, *No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W*, was not exceeded during the reporting period.
Surface Flow/ Pool Water Levels	During the Longwall 304 visual inspections in February 2020, the surface flow/pool water levels were noted to be higher than the May 2019 inspection (following the completion of Longwall 303). Water levels in pools on the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir (i.e. in Pools P, Q, R, S, T, U, V and W) have been monitored using a continuous water level sensor and logger (Figure 7 and Appendix D). The monitoring results for the reporting period are discussed in Section 6.2.3 and Appendices B1 and B2. The performance indicators, *Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum*, and *Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar*, were not exceeded during the reporting period.
Iron Staining/ Flocculent	No change in iron staining was observed between Pools P to W on the Waratah Rivulet as a result of mining during the reporting period. Natural seeps and associated iron staining (as recorded by baseline mapping) continue to be recorded within this reach. The performance indicator, *Visual inspection of the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir does not show significant changes in the extent or nature of iron staining that isn't also occurring in the Woronora River (control site)*, was not exceeded during the reporting period.
Gas Releases	Gas releases continued to be observed and monitored on the Waratah Rivulet at Pool P (from January to December 2020) and Pool U (in January, April, and October to December 2020). No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed. The performance indicator, *Gas releases in Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir have not increased beyond those observed up to the commencement of Longwall 301 extraction*, was exceeded at Pool P in January, April, and October to December 2020, and at Pool U in October to December 2020. Assessments against the performance measure have been undertaken by Dr Barry Noller (The University of Queensland) (Appendix E) and found the performance measure had not been exceeded.
Water Discoloration/ Opacity	Pools along the Waratah Rivulet continue to be observed with a green opacity.

Table 7
Monitoring of Stream Features – Eastern Tributary Downstream of the Longwall 26 Maingate

Stream Feature	Summary of Observations
Surface Cracking and Drainage Behaviour	Inspections undertaken following the completion of Longwalls 304 and 305 identified new cracking at Rock Bar ETAF, Pool ETAH, Rock Bar ETAH, Rock Bar ETAK, Pool ETAL, Rock Bar ETAL, Pool ETAM, Pool ETAN, Pool ETAO, Rock Bar ETAQ. No cracking has been recorded at Pool ETAS or Pool ETAT to date. No changes to the existing cracking at Pool ETAU were observed during the reporting period. The performance indicator, *No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU*, was not exceeded during the reporting period.
Surface Flow/ Pool Water Levels	As previously reported in the 2016 to 2019 Metropolitan Coal Annual Reviews, mine subsidence resulted in the diversion of flows or change to the natural drainage behaviour of Pools ETAG to ETAR between the full supply level of the Woronora Reservoir and the Longwall 26 maingate, (Figure 7 and Appendix D). As at December 2020, mining had not resulted in the diversion of flows or change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU (Figure 7 and Appendix D). Water levels in Pool ETAU and in Pools ETAS/ETAT (since May 2018) have been monitored using a continuous water level sensor and logger (Figure 7 and Appendix D). The monitoring results are discussed in Section 6.2.3 and in Appendices B1 and B2 and indicate the natural drainage behaviour of Pools ETAS/ETAT and ETAU have not been impacted by mine subsidence. The performance indicator, *Analysis of water level data for Pool ETAS/ETAT and Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar*, was not exceeded during the reporting period.

Table 7 (Continued)
Monitoring of Stream Features – Eastern Tributary Downstream of the Longwall 26 Maingate

Stream Feature	Summary of Observations
Iron Staining/ Flocculent	As previously reported in the 2016 to 2019 Metropolitan Coal Annual Reviews, mine subsidence resulted in the exceedance of the Eastern Tributary performance measure in relation to iron staining (emphasis added): *Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, **minimal iron staining** and minimal gas releases).* During the reporting period, iron staining continued to be observed along the reach of the Eastern Tributary between the full supply level of the Woronora Reservoir and the Longwall 26 maingate, and was most evident in the reach from Pool ETAQ to Boulderfield ETAU.
Gas Releases	No gas releases were observed on the Eastern Tributary during the reporting period. No environmental effects resulting from the gas releases (such as riparian vegetation dieback or dead fish) have been observed. The performance indicator, *Gas releases in Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 have not increased beyond those observed up to the commencement of Longwall 301 extraction*, was not exceeded during the reporting period.
Water Discoloration/ Opacity	Orange in colour where iron staining occurred. Pools along the Eastern Tributary observed with a green opacity.

Visual inspections and photographic surveys of the Eastern Tributary (from the Woronora Reservoir full supply level to the Longwall 26 maingate) will be conducted monthly when extraction of Longwall 306 is within 450 m of the stream (i.e. during the next reporting period), and within three months of the completion of Longwall 306.

The results of the stream inspections (Tables 6 and 7) are consistent with the potential subsidence impacts described in the Metropolitan Coal Project Environmental Assessment (Project EA) (Helensburgh Coal Pty Ltd [HCPL], 2008), the Preferred Project Report (HCPL, 2009) and the Metropolitan Coal Water Management Plans, including cracking and dilation of bedrock which has resulted in the localised diversion of a portion of the surface flow through either:

- **diversion into subterranean flows**, where water travels via new mining induced fractures and opened natural joints in the bedrock into near-surface dilated strata beneath the bedrock, ultimately re-emerging at the surface downstream; or
- **leakage through rock bars**, where the rate of leakage from pools through rock bars to the downstream reaches of the stream is increased by new mining induced fractures.

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans indicated that the effects of underflow would be localised to the subsidence affected reaches of streams. Underflow has been observed to result in lower water levels in pools as they become hydraulically connected with the fracture network. During prolonged dry periods when flows recede to low levels, the number of instances where loss of flow continuity between pools occurs increases with a greater proportion of the flow being conveyed entirely in the subsurface fracture network.

The Preferred Project Report and Metropolitan Coal Water Management Plan indicated that valley closure values of greater than 200 mm were predicted at pools/rock bars on the Waratah Rivulet upstream of the maingate of Longwall 23, downstream to rock bar ETAL on the Eastern Tributary, and on Tributary B. The NSW Planning Assessment Commission's Report for the Metropolitan Coal Project (NSW Planning Assessment Commission, 2009) indicates the Panel considered 'negligible consequence' for a watercourse to mean, *'no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases'*, and was assumed to be achieved in circumstances where predicted valley closure was less than 200 mm.

Up until December 2016, the monitoring of water levels/drainage behaviour of pools on the Eastern Tributary between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir was consistent with predictions. In the Longwalls 20-22 Extraction Plan Subsidence Assessment it was recognised that fracturing resulting in surface flow diversion could be observed at a site where the predicted total closure is less than 200 mm, although none had been observed to date. The report also noted that reference to the 200 mm predicted total closure value should be viewed as an indication of low probability (10%) of impact rather than certainty. In the Longwalls 23-27 Extraction Plan Subsidence Assessment, additional case studies were added to the pool impact model, including cases where loss of pool water levels had occurred at less than 200 mm predicted total closure. Similar to the previous database for Longwalls 20-22, the updated database showed that based on a maximum predicted total closure of 200 mm, the proportion of pools that experienced loss of pool water levels was around 10%.

In December 2016 and January 2017, a number of pools with predicted closure values of less than 200 mm experienced loss of pool water levels. This resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour. The impacts are considered to be anomalous in that more than 15% of pools on the Eastern Tributary have experienced loss of pool water levels at predicted closure values of less than 200 mm. However, the combined data that is available to MSEC for the Southern Coalfield (including the Waratah Rivulet and Eastern Tributary results) indicates that less than 10% of all pools have experienced the diversion of flow at predicted closure values of less than 200 mm, consistent with previous assessments of potential pool impacts. On their own, the impacts for the Eastern Tributary are outside of the predictions of the empirical based model.

Metropolitan Coal's actions in relation to the Eastern Tributary Incident are described in Section 13.1. No additional pools downstream of the Longwall 26 maingate to those identified previously as being impacted (in terms of drainage behaviour) have been impacted during the review period.

The key potential subsidence impacts and environmental consequences in relation to bed gradients, scouring and stream alignment described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans included:

- Potential changes in bed gradients could occur, however, were anticipated to be small relative to the existing grades.
- An increased potential for scouring of the stream bed and banks (at locations where the predicted tilts considerably increase the natural pre-mining stream gradients). The potential for scouring is greatest in stream sections with alluvial deposits. Since the streambed of the Waratah Rivulet and the Eastern Tributary is predominantly erosion-resistant Hawkesbury Sandstone, scouring was expected to be very low.
- Subsidence fracturing of bedrock has the potential to cause dislodgement of rock fragments during high flow events.
- The potential for changes to stream alignment as a result of mine subsidence effects was considered to be low.
- Minor stream bank erosion, where changes in channel gradients result in increases in flow energy. It would be expected that bank erosion would be relatively minor and comprise a slow retreat of the bank until a new dynamic equilibrium is reached.

The results of the stream inspections have generally been consistent with these predictions. On the Waratah Rivulet (in a section of the stream over Longwall 21) and Eastern Tributary (in a section of the stream over Longwalls 20 and 21) increased ponding from changes in bed gradients has previously resulted in the prolonged inundation of the adjacent riparian vegetation which has resulted in some vegetation dieback on a local scale as described in Section 6.3.3.

As described in the Southern Coalfield Panel Report (Department of Planning [DoP], 2008) and the NSW Planning Assessment Commission's Report for the Metropolitan Coal Project (NSW Planning Assessment Commission, 2009), under certain conditions the cracking of stream beds and underlying strata has the potential to result in changes in water quality, particularly ferruginous springs and/or development of iron bacterial mats. Experience at Metropolitan Coal prior to Project Approval indicated that areas of the substratum can be covered by iron flocculent material for several hundred metres downstream of mine subsidence fractures.

Metropolitan Coal has monitored the extent of iron staining through visual and photographic surveys and assessed the extent of iron staining against the subsidence impact performance measures as follows:

- *Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P).*
- *Negligible environmental consequences over at least 70% of the stream length (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26.*

From January to December 2020, iron staining continued to be observed along the reach of the Eastern Tributary between the full supply level of the Woronora Reservoir and the Longwall 26 maingate, and was most evident in the reach from Pool ETAQ to Boulderfield ETAU.

Prior to approval of the Project in 2009, no gas releases had been observed along the Waratah Rivulet, Eastern Tributary or other tributaries over the Metropolitan Coal lease, either before or during mining. Notwithstanding, the Project EA, Preferred Project Report, and Metropolitan Coal Water Management Plans recognised there was the potential for gas releases to occur.

Monitoring of gas releases undertaken during the reporting period in accordance with the Metropolitan Coal Longwall 304 and Longwalls 305-307 Water Management Plans identified an exceedance of the performance indicator (with regard to free carbon dioxide concentrations) at Pool P in January, April, and October to December 2020, and at Pool U in October to December 2020. No other gas releases observed on the Eastern Tributary or Waratah Rivulet exceeded the performance indicator. Assessments against the performance measure have been undertaken by Dr Barry Noller (The University of Queensland) (Appendix E) and found the performance measure had not been exceeded.

6.2.2 Surface Water Flow

Waratah Rivulet stream flow data (GS 2132102, Figure 7) is analysed to assess whether a statistically significant reduction in the quantity of water entering Woronora Reservoir in the post-mine period relative to the pre-mine period has occurred, that has not also occurred in the control catchment(s).

The quantity of water entering the Woronora Reservoir is not considered to be significantly different post-mining compared to pre-mining if the median of the ratios (of 14 day sums of monitored flow) for the 'sliding' 12 month period does not fall below the 20th percentile of the baseline data.

Chart 2 shows a plot of the sliding 12 month median of the ratio of 14 day sums of monitored and modelled flow at Waratah Rivulet (GS 2132102) to 31 December 2020.

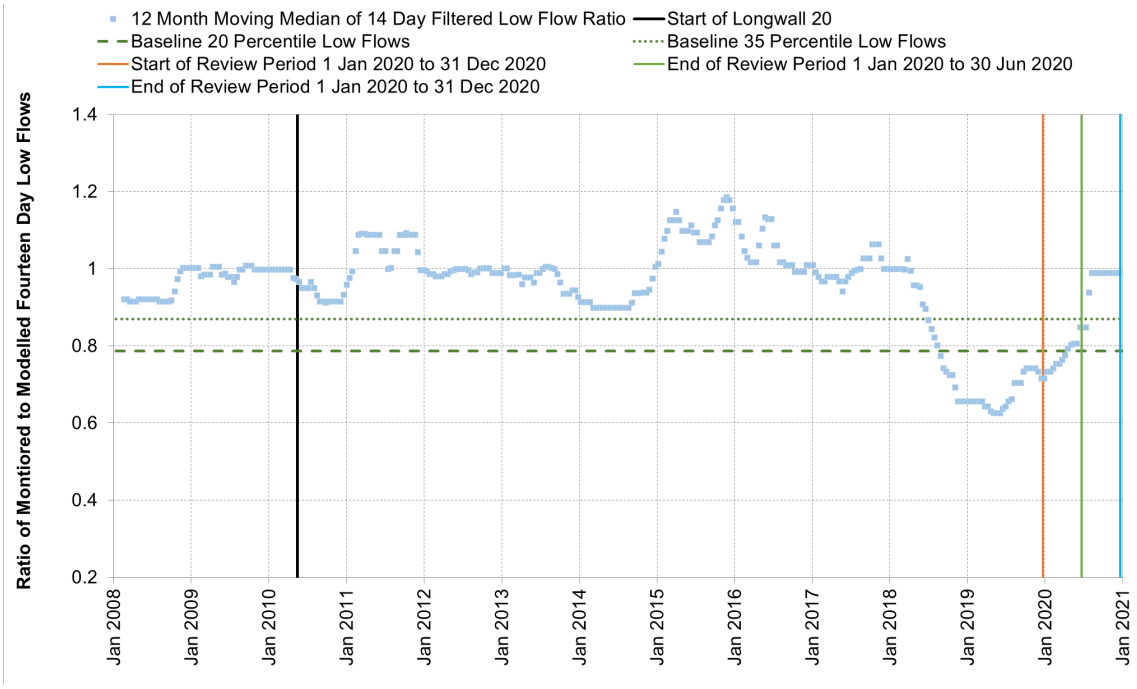


Chart 2 One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Waratah Rivulet (GS 2132102)

For the Project EA, a comprehensive analysis of stream flow data and data on the yield behaviour of Woronora Reservoir indicated that past mining at Metropolitan Coal had no discernible effect on the inflow to, or yield from, the reservoir. Surface water flow monitoring indicates there has been a negligible reduction in the quantity of water resources reaching the Woronora Reservoir during the review period.

The results show that the moving 12 month median of the 14 day filtered low flow ratio fell below the 20th percentile of the baseline data during 2018 and remained below the 20th percentile until late April 2020. From late April 2020, the moving 12 month median of the 14 day filtered low flow ratio increased from the 20th percentile to above the 35th percentile in August 2020. The 14 day filtered low flow ratio remained about the 35th percentile for the remainder of the review period. In accordance with the Metropolitan Coal Longwall 304 and Longwalls 305-307 Water Management Plans TARPs, this equates to a Level 3 significance from 1 January to 27 April 2020, a Level 2 significance from 28 April to 3 August 2020 and a Level 1 significance from 4 August 2020 to the end of the review period.

To assess if similar conditions have been observed at the control site in the region during the period in which a Level 2 and Level 3 significance occurred at Waratah Rivulet (GS 2132102), a comparison of the 12 month median of the ratio of 14 day sums of monitored flow at a control site on O'Hares Creek at Wedderburn (GS 213200) and flows simulated via the modified AWBM have been assessed (Appendices B1 and B2).

It was found that similar conditions occurred at both Waratah Rivulet and the control site (O'Hares Creek at Wedderburn) during the reporting period. As such, it is considered that the performance indicator relating to the quantity of water entering Woronora Reservoir from Waratah Rivulet has not been exceeded and an assessment against the performance measure is not required.

Chart 3 shows the flow monitoring data that is available since gauging station construction on the Eastern Tributary (GS 300078; Figure 7) in September 2012 compared to model predictions. The results for the reporting period indicate that flow has been continuous at the gauging station and that it has been generally consistent with, or above, model predictions (Chart 3). This indicates that flows reaching the Woronora Reservoir have not been reduced by mining (Appendices B1 and B2).

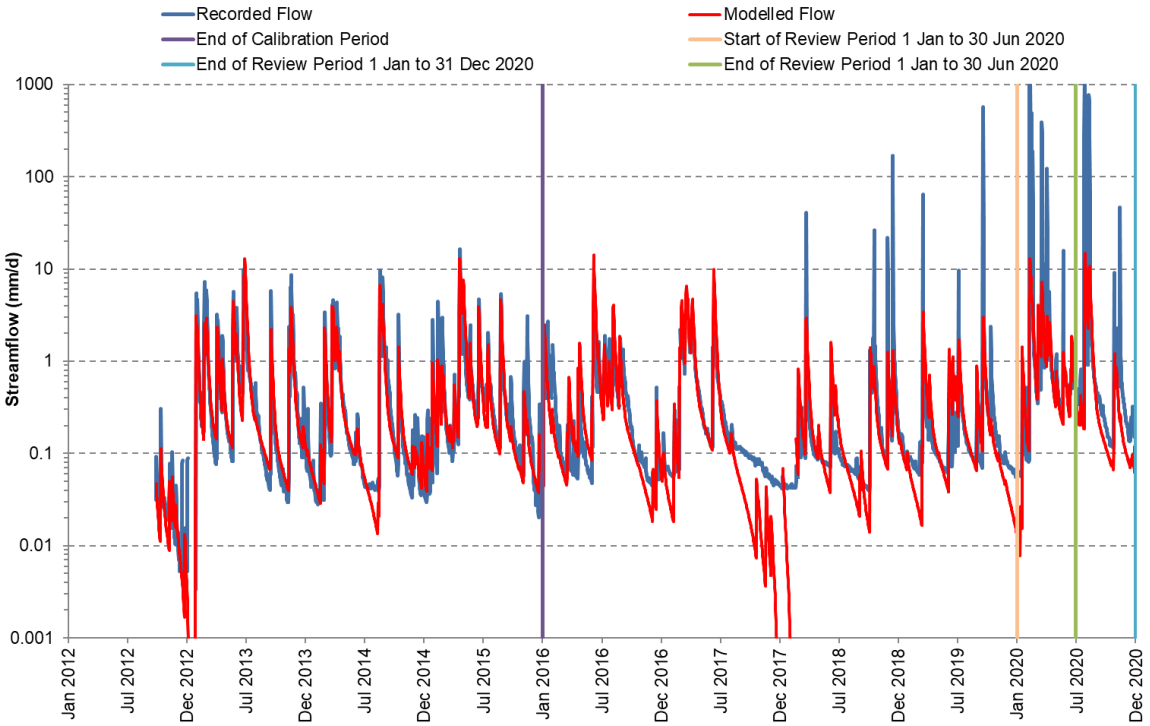


Chart 3 Monitored and Model Predicted Flows – Eastern Tributary Upstream of Woronora Reservoir

6.2.3 Pool Water Levels

The water level in a number of pools on the Waratah Rivulet, Eastern Tributary, Tributary B and Woronora River (Figure 7) has been either manually monitored on a daily basis[1] or monitored using a continuous water level sensor and logger.

During the reporting period, Waratah Rivulet Pools C, D, E, F, G, G1, H, I, J, K, L, M, O, P, Q, R, S, T, U, V and W remained above their cease to flow levels or historical minimums. Pools A, B and N on the Waratah Rivulet (Charts 4 to 6) fell below their cease to flow levels. Pool A was below the cease to flow level from 1 January to 18 January and again from 28 January to 7 February 2020. Pool B was below the cease to flow level from 1 January to 16 January and Pool N was below the cease to flow level from 1 January to 16 January and on 5 February 2020. The reduced water level at these pools is consistent with a reduction in water level observed at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River (Charts 7 to 10) in January 2020 (Appendices B1 and B2). Water level records for control pools WRP1, WRP2, WRP3 and WRP4 indicate that the pool water levels declined during these periods, with a substantial decline recorded between November and December 2019. Water level records for control pools WRP1, WRP2, WRP3 and WRP4 indicate that the pool water levels at each of these pools declined below the historically recorded minimum in the first half of January 2020.

There were no exceedances of the performance indicator *Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum* from January to December 2020. Metropolitan Coal's visual inspections of Pools P, Q, R, S, T, U, V and W downstream of the maingate of Longwall 23 indicate no mine-induced surface cracking and no observed changes to the natural drainage behaviour of the pools (Metropolitan Coal, pers. comm). The visual inspection results equate to a Level 1 significance level.

[1] Specifically, Pools B, C, E, G, G1, H and I on Waratah Rivulet.

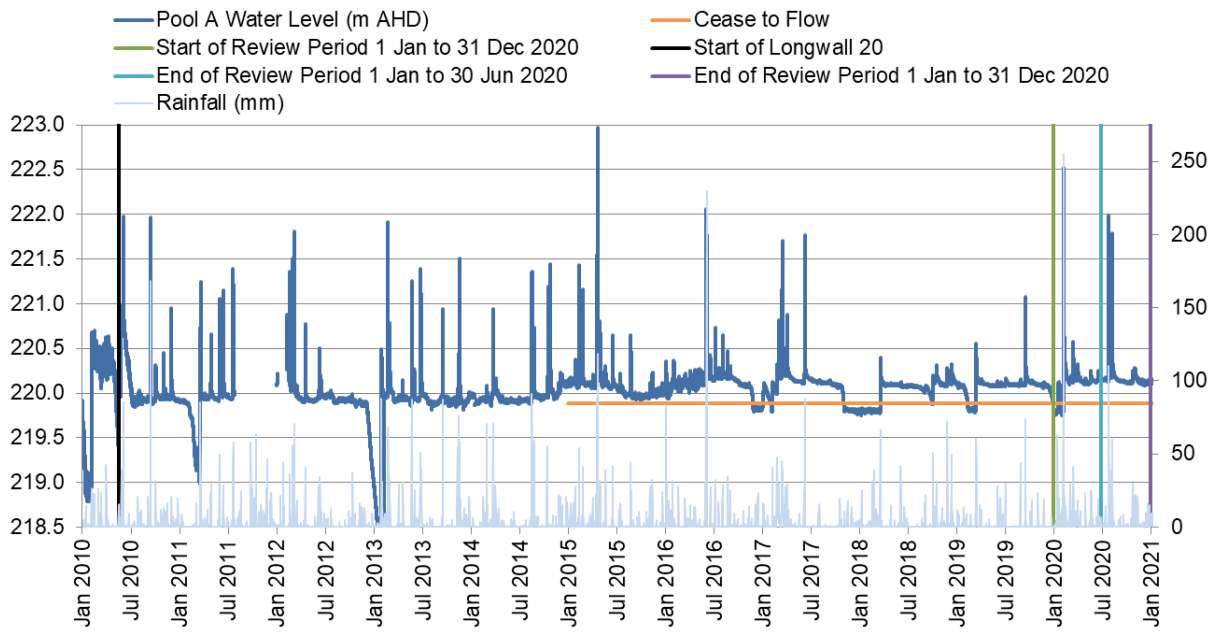


Chart 4 Pool A Waratah Rivulet

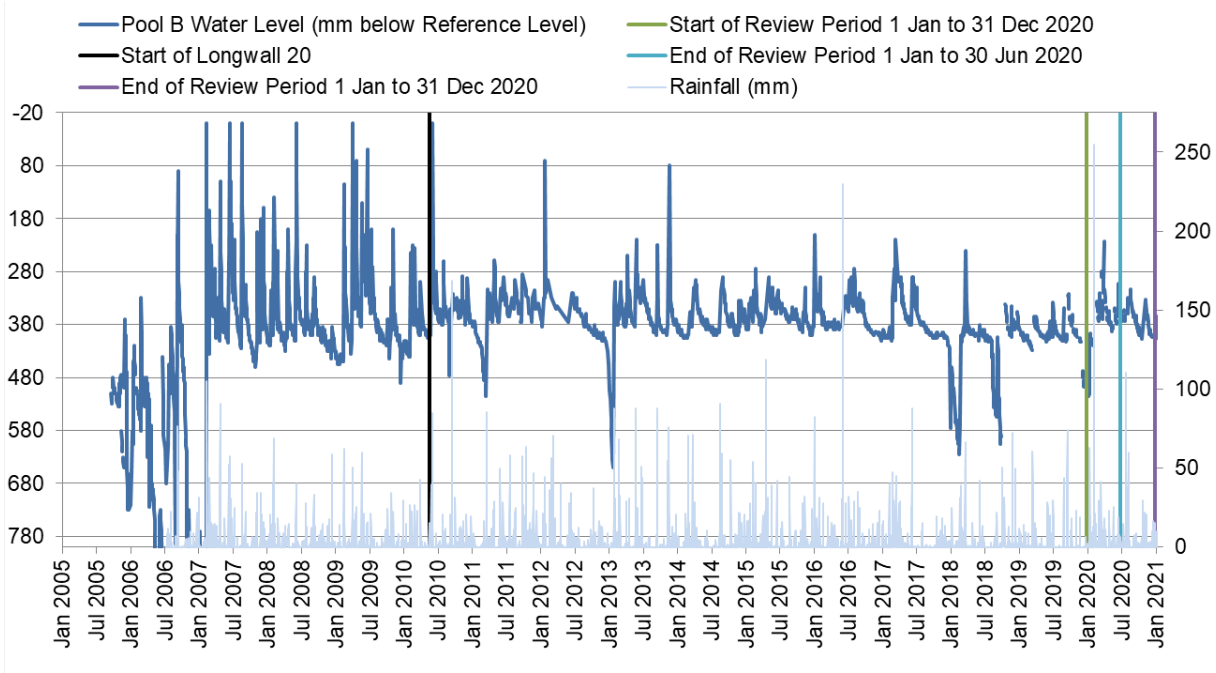


Chart 5 Pool B Waratah Rivulet (Manual Observations)[2]

[2] Data gaps in the manual measurements for Pool B during the review period are due to periods in which high rainfall or fire restrictions prevented access to the monitoring site.

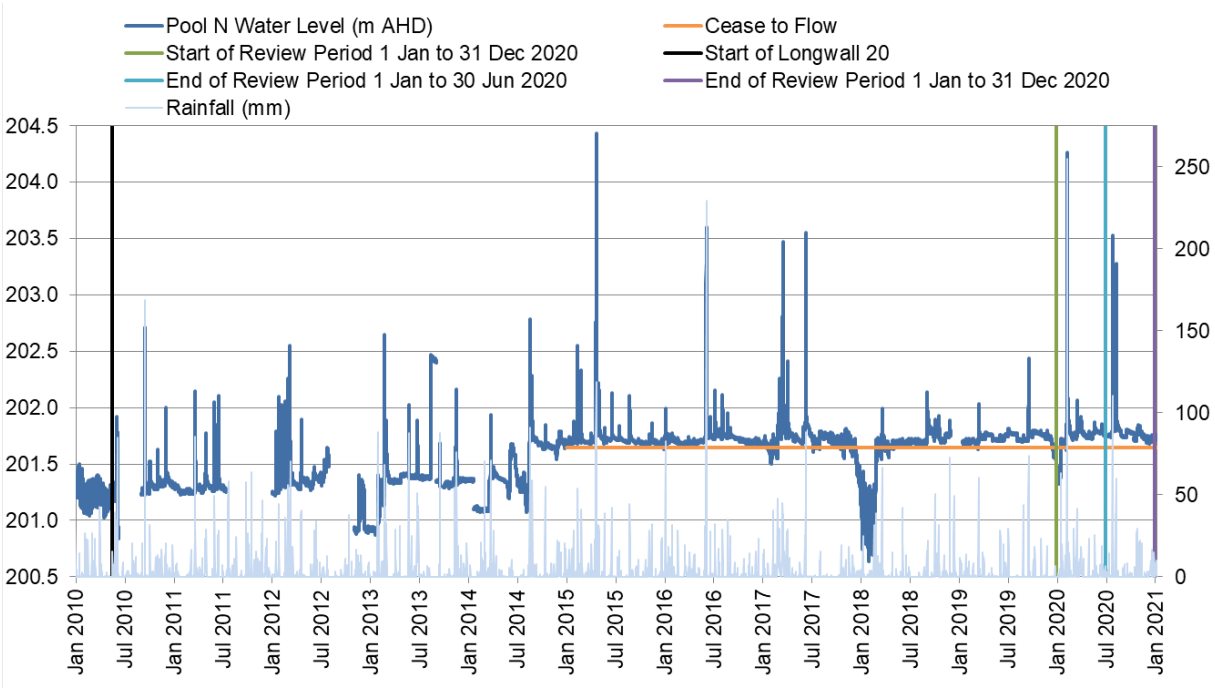


Chart 6 Pool N Waratah Rivulet[3]

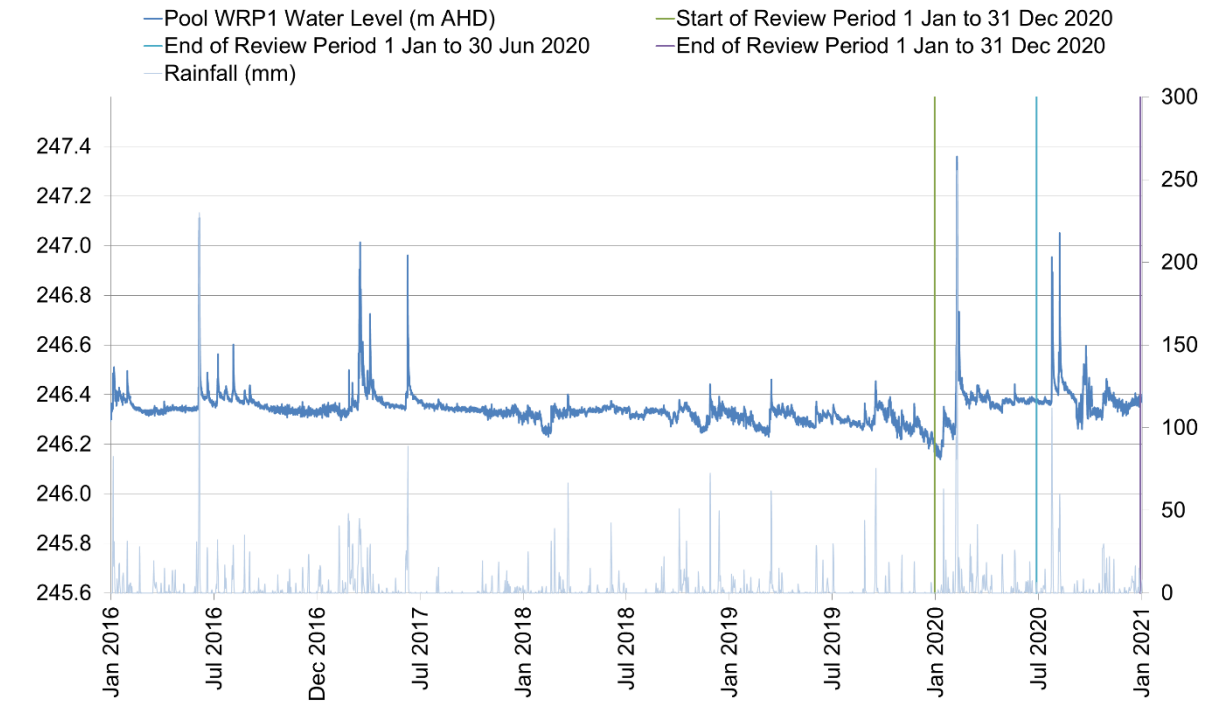


Chart 7 Pool WRP1

[3] Pool N water level sensor did not record any data during December 2018. Subsequently, the sensor was replaced in January 2019.

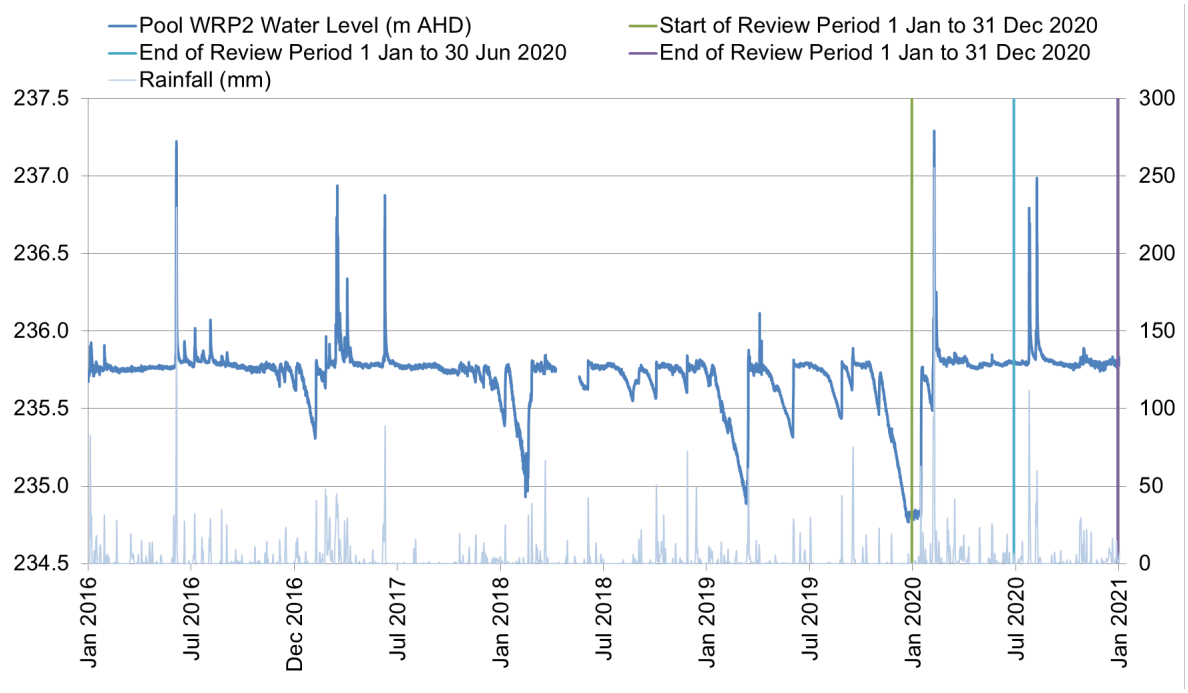


Chart 8 Pool WRP2

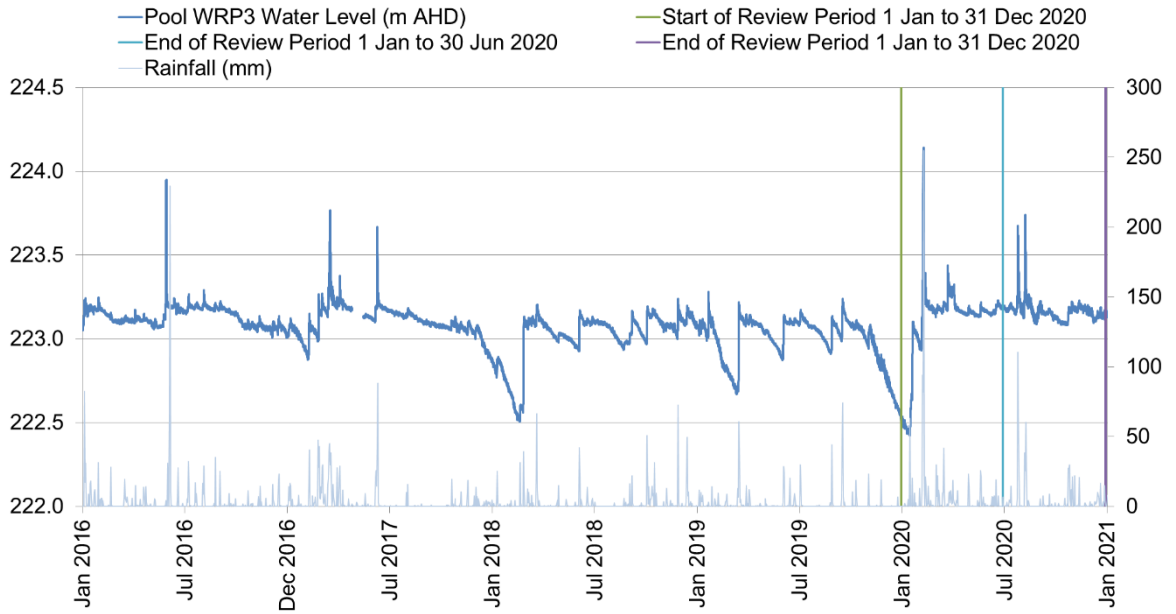


Chart 9 Pool WRP3

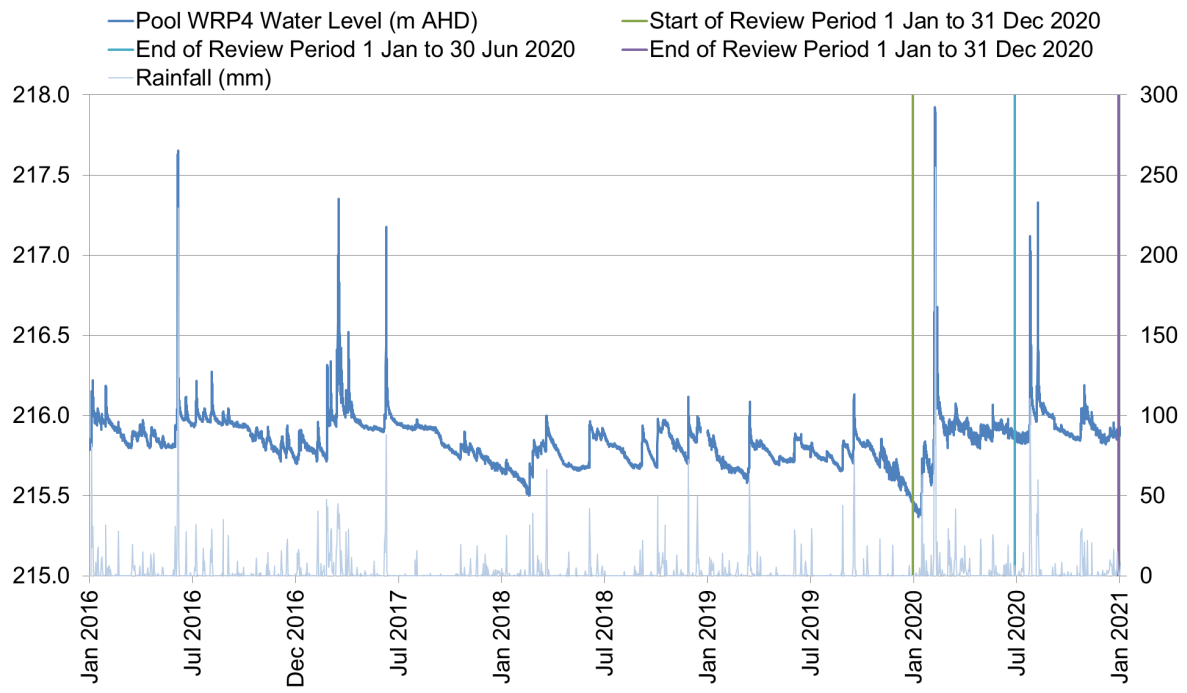


Chart 10 Pool WRP4

On the Eastern Tributary, water levels in Pools ETG, ETJ, ETM, ETU, ETW, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK[4], ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT[5] and ETAU are monitored using a continuous water level sensor and logger (Figure 7).

Water levels in Pools ETJ, ETM, ETU, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ and ETAR on the Eastern Tributary fell below the cease to flow level or sensor level for parts of January and February 2020 (Charts 11 to 24). Following a significant rainfall event in February 2020, the water level in all pools rose substantially. Pool ETM fell below the sensor for a short period in late October 2020. Pool ETAH fell below the sensor from late September to late October 2020. Pool ETAI/ETAJ/ETAK and Pool ETAL water level rose intermittently with rainfall events and declined intermittently to the level of the sensor. Pools ETAM, ETAN, ETAO and ETAP were below the sensor level from late October to late November and for a short period in late December 2020. Pool ETAQ fell below the cease to flow level from 4 to 25 October 2020. The water level of Pool ETAS/ETAT and Pool ETAU did not fall below the cease to flow level or sensor level during the review period (Appendices B1 to B2).

Consistent with historical behaviour, the water level at Pool RTP1 on Tributary B was below the sensor level for the majority of the review period except following rainfall events in February, March, July, August and November. Pool RTP1 was dry from 2 December 2020 until the end of the reporting period. Pool RTP2 water level was low from 1 to 17 January 2020 before rising in response to the February rainfall event (Appendices B1 and B2).

[4] Only small rock bars separate Pools ETAI, ETAJ and ETAK, with the pools joining to become the one large pool as water levels rise. Pool ETAK is controlled by a more substantial rock bar. Readings from the water level sensor situated in Pool ETAI is considered to also be representative of the water level in Pools ETAJ and ETAK.

[5] Due to the nature of rock bar ETAS, Pool ETAS and Pool ETAT typically record the same level. A continuous water level sensor and logger was installed at Pool ETAT during the reporting period. Water level data for Pools ETAS/ETAT is available from 24 May 2018.

As described in Section 6.2.1, the Eastern Tributary pool water level monitoring results for the review period were consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans in that data that is available to MSEC for the Southern Coalfield (including the Waratah Rivulet and Eastern Tributary results) indicates that less than 10% of all pools have experienced the diversion of flow at predicted closure values of less than 200 mm, consistent with previous assessments of potential pool impacts. On their own, the impacts for the Eastern Tributary are outside of the predictions of the empirical based model.

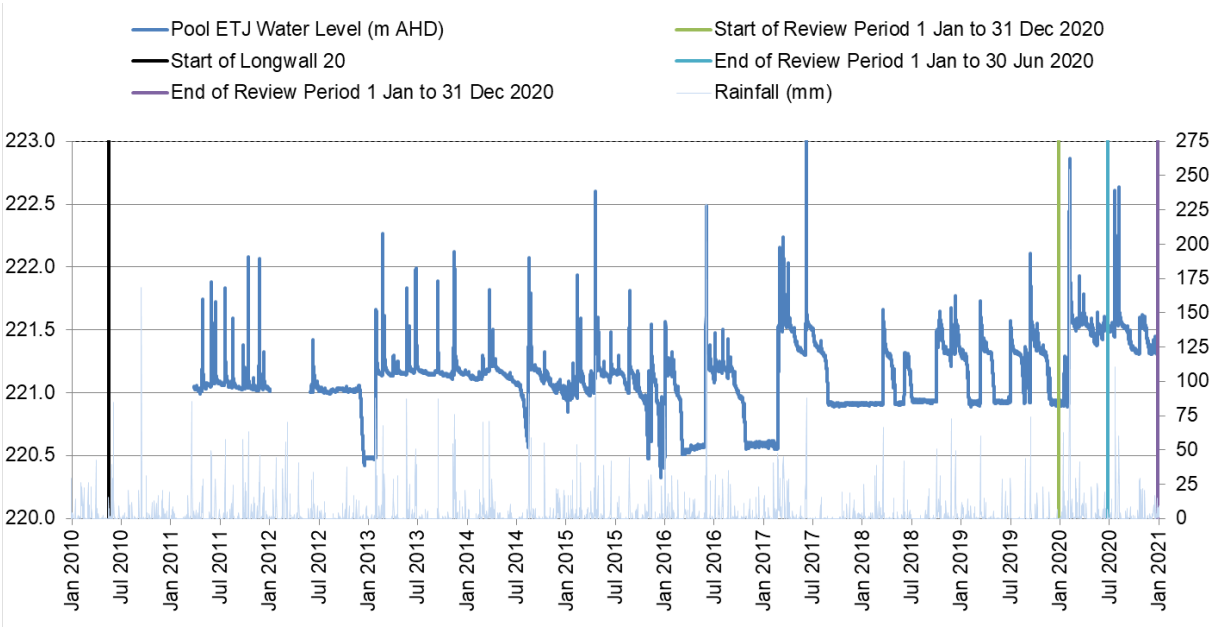


Chart 11 Pool ETJ

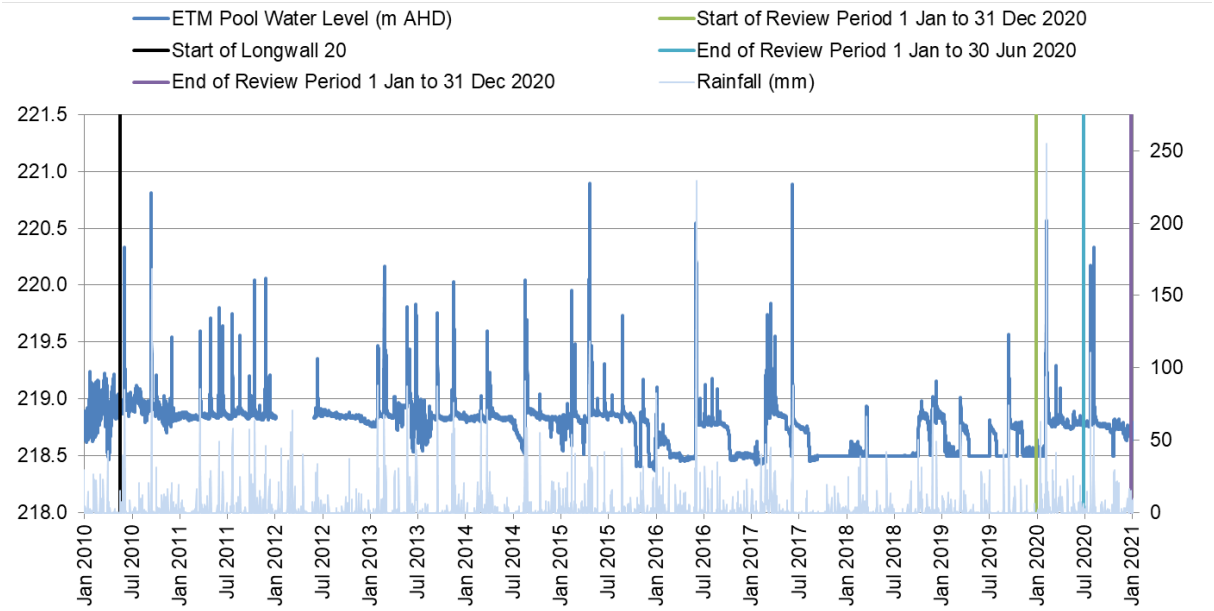


Chart 12 Pool ETM

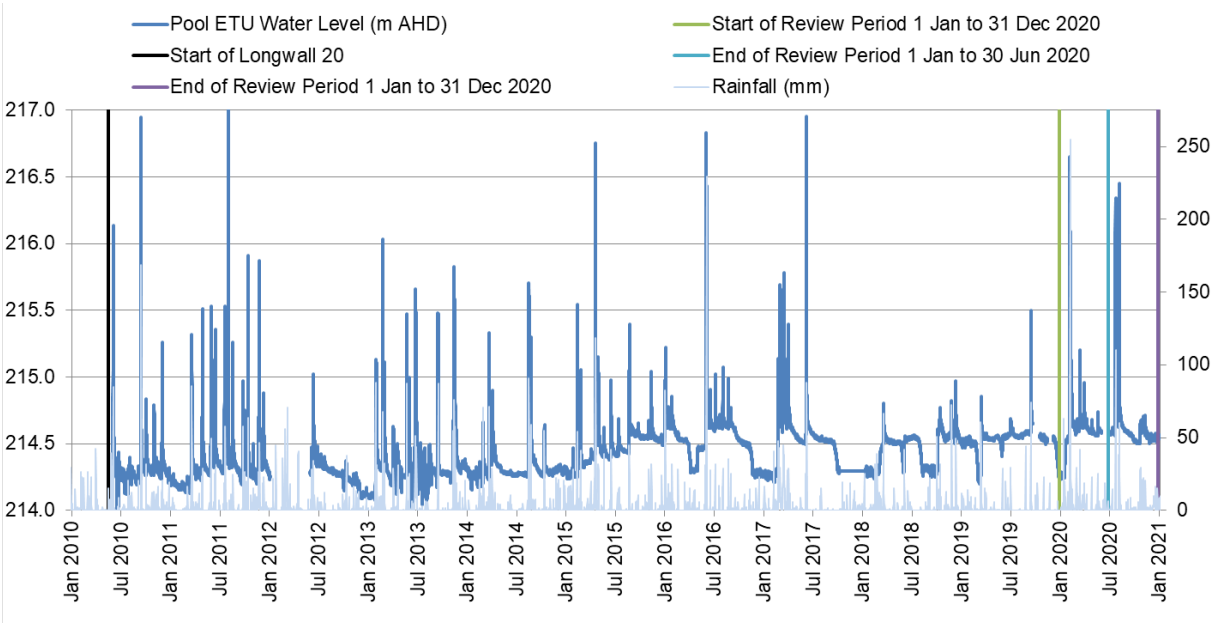


Chart 13 Pool ETU[6]

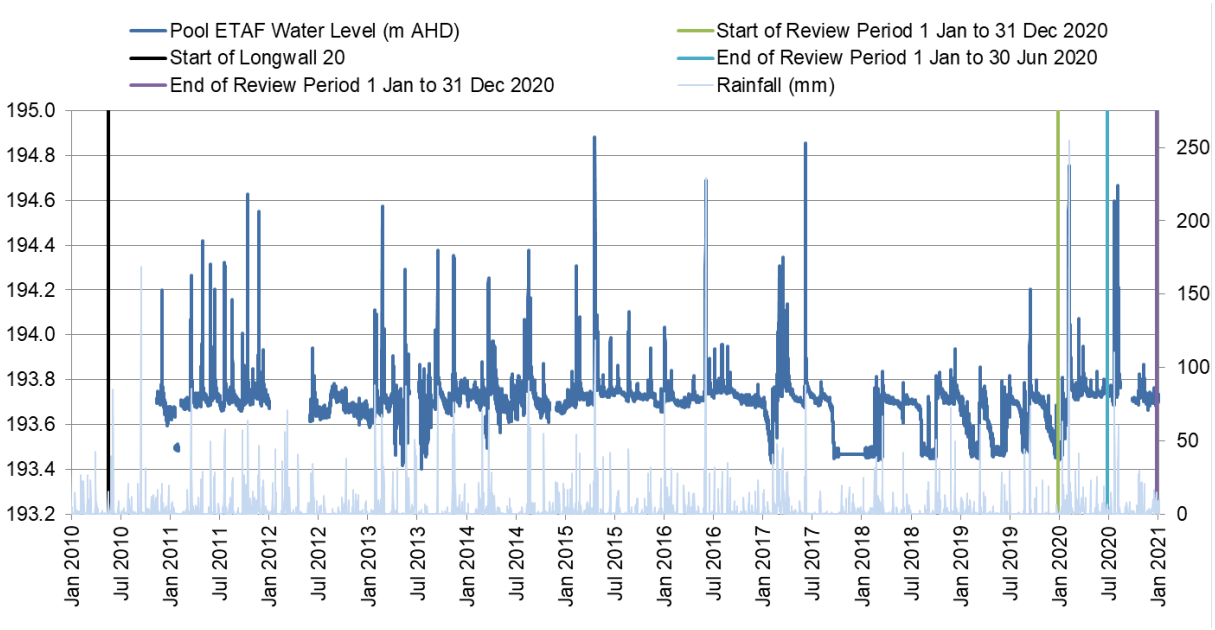


Chart 14 Pool ETAF

[6] The water level sensor was not restarted and hence data was not recorded between 23 September 2019 and 21 October 2019. A communication error with the sensor occurred resulting in lost data between 18 November 2019 and 8 December 2019.

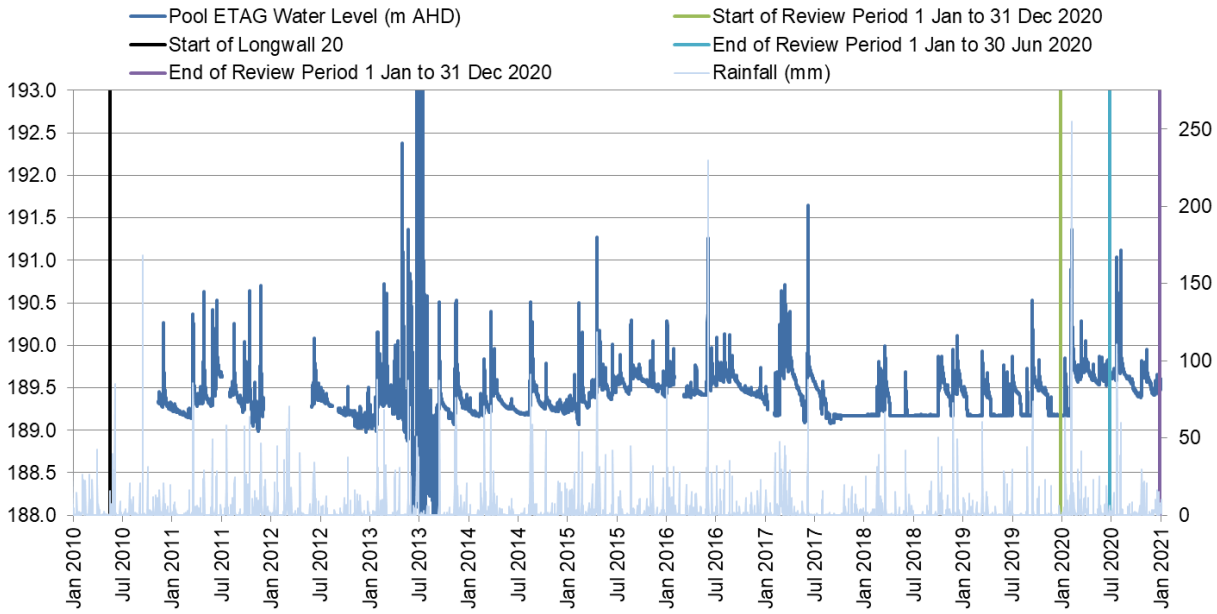


Chart 15 Pool ETAG

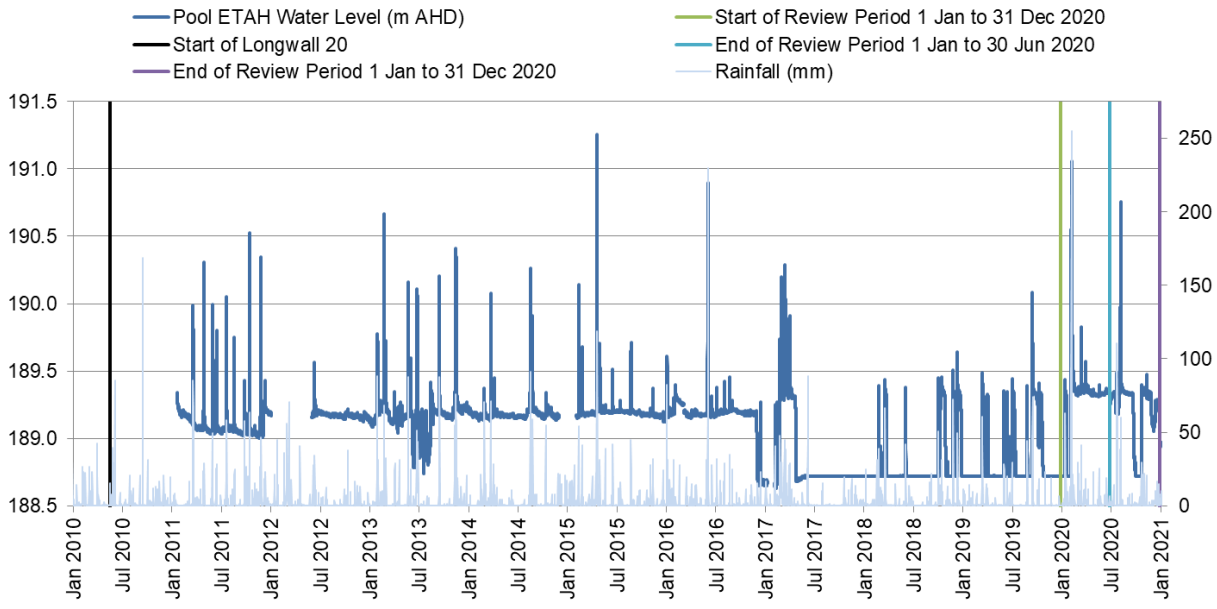


Chart 16 Pool ETAH[7]

[7] Water level was below measurable levels for ETAH from the 10 December 2018 to the 31 December 2018.

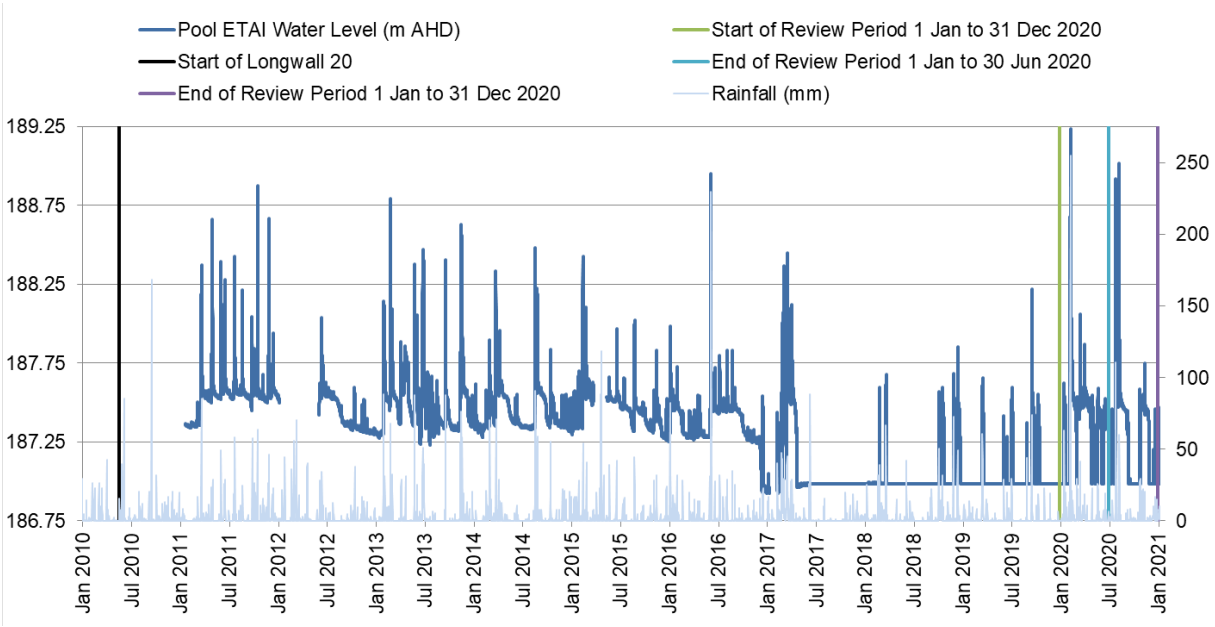


Chart 17 Pool ETAI[8]

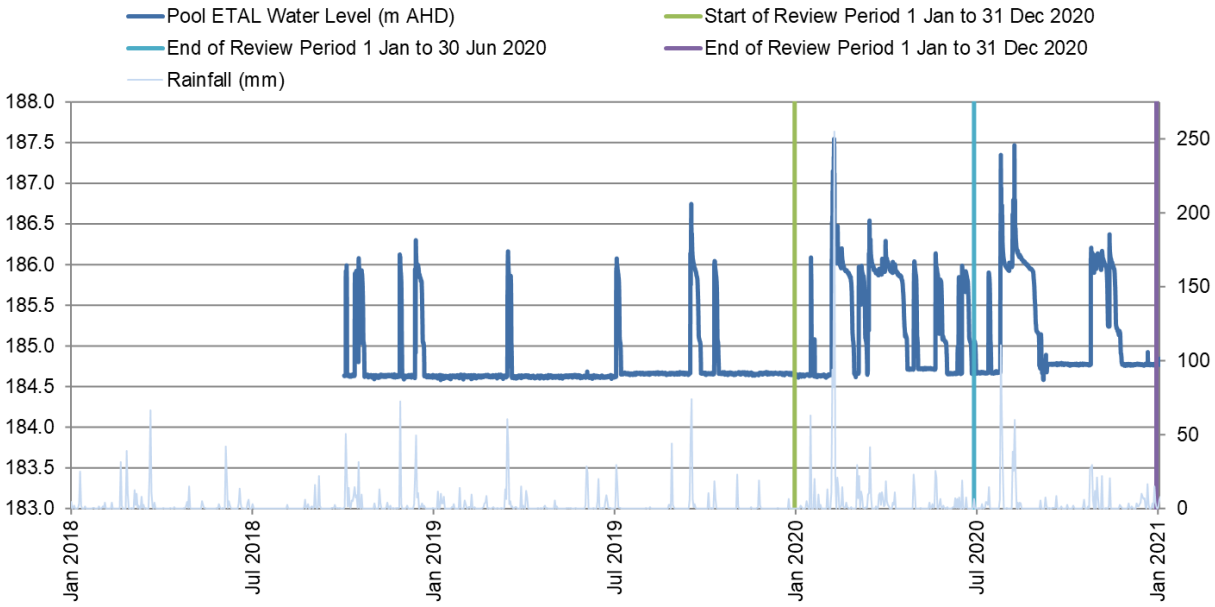


Chart 18 Pool ETAL

[8] Water level was below measurable levels for ETAI from the 10 December 2018 to the 31 December 2018.

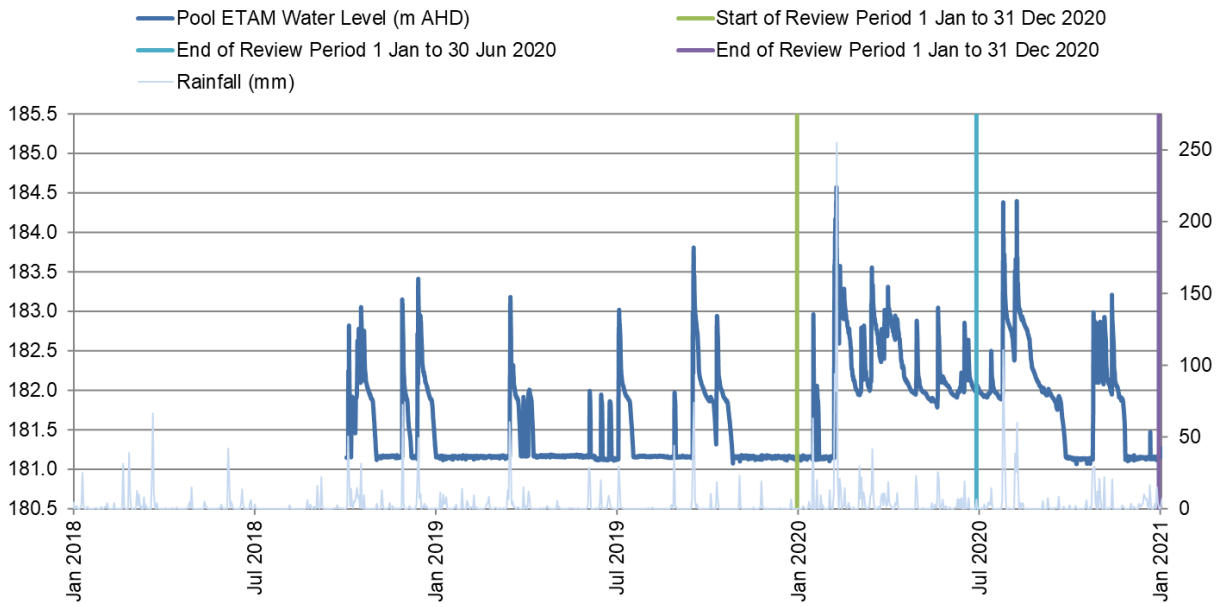


Chart 19 Pool ETAM

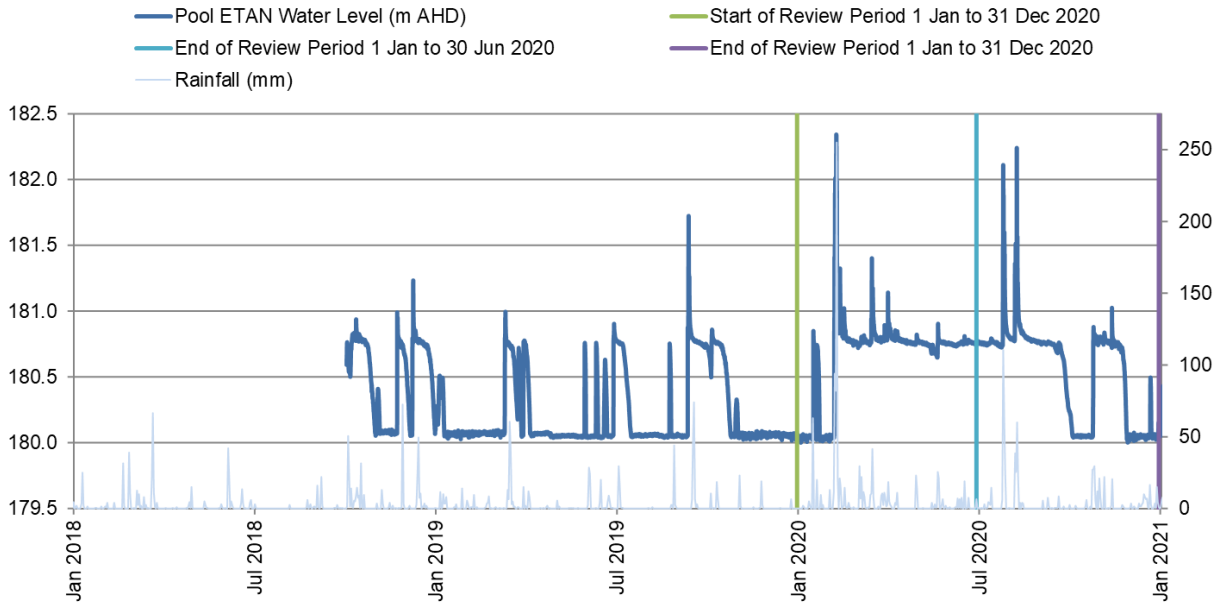


Chart 20 Pool ETAN

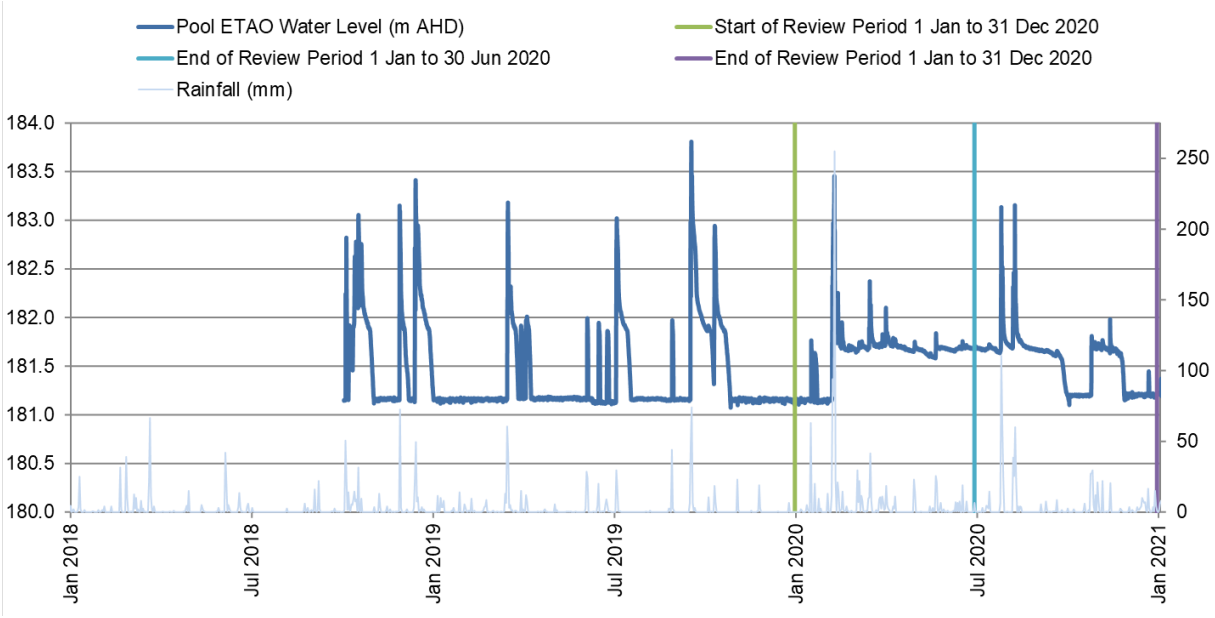


Chart 21 Pool ETAO

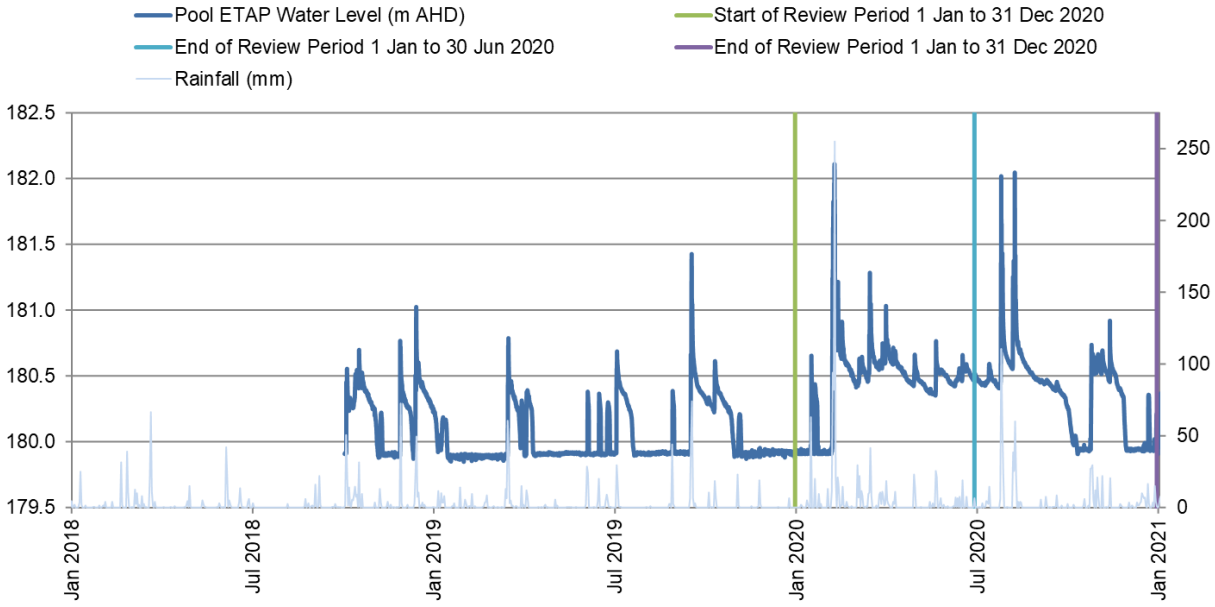


Chart 22 Pool ETAP

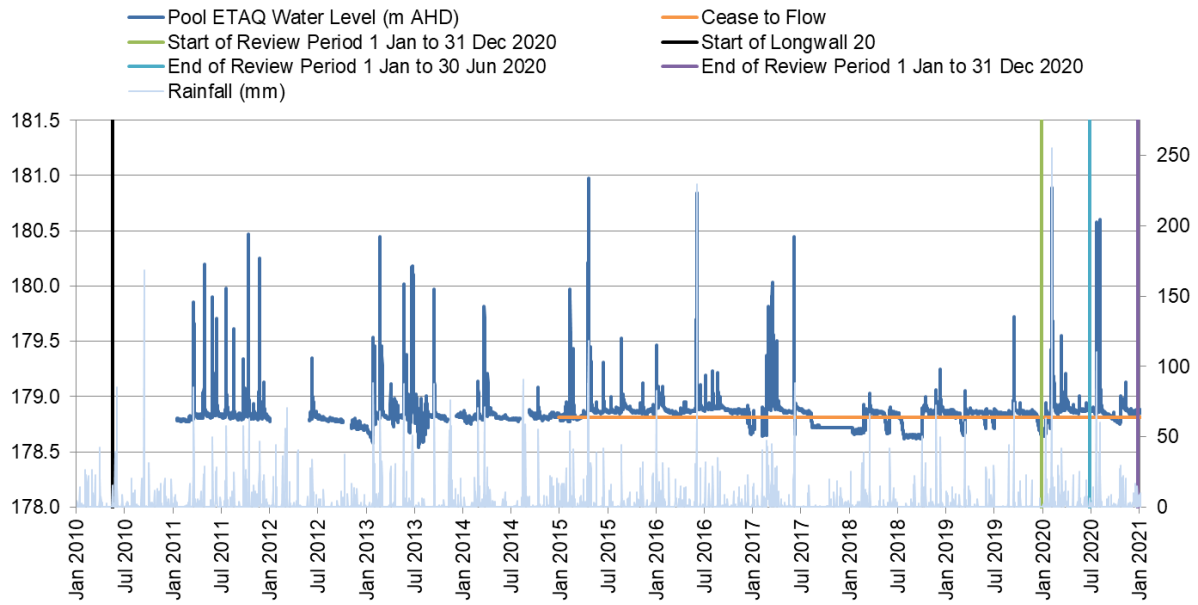


Chart 23 Pool ETAQ

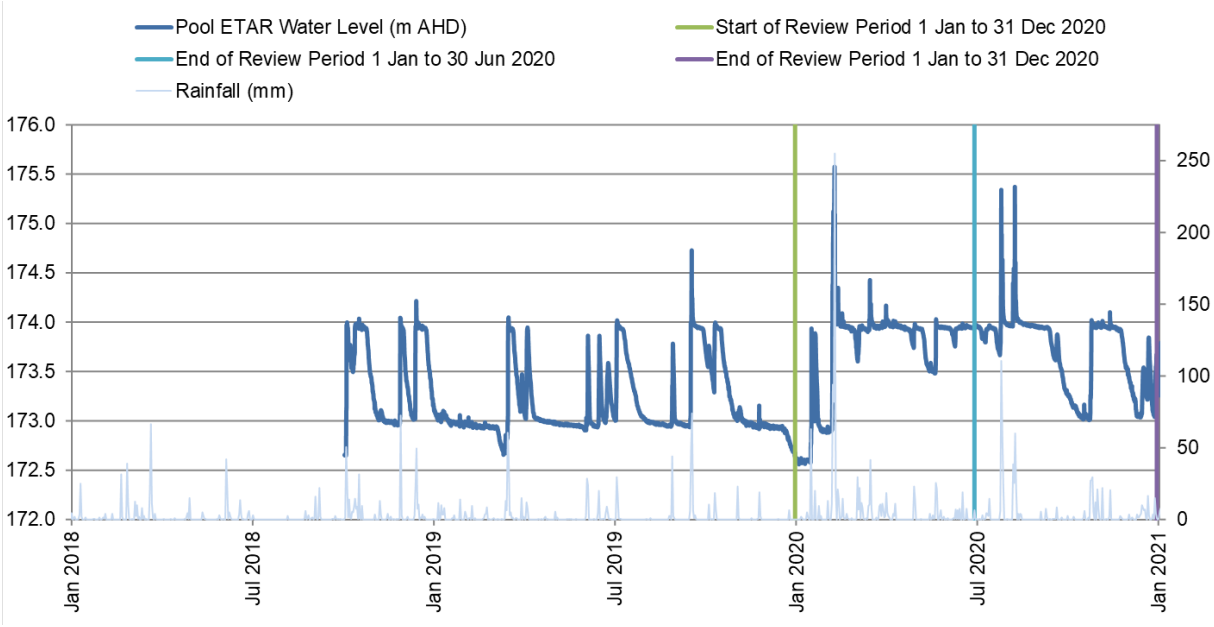


Chart 24 Pool ETAR

6.2.4 Stream Water Quality

Surface water quality sampling has been conducted monthly in the Waratah Rivulet (sites WRWQ2, WRWQ6, WRWQ8, WRWQ9, WRWQM, WRWQN, WRWQP, WRWQR, WRWQT, WRWQW), Eastern Tributary (sites ETWQF, ETWQJ, ETWQN, ETWQU, ETWQW, ETWQAF, ETWQAH, ETWQAQ, ETWQAU), Tributary B (site RTWQ1), Tributary D (site UTWQ1), Far Eastern Tributary (site FEWQ1), Honeysuckle Creek (site HCWQ1), Bee Creek (site BCWQ1) and Woronora River (WOWQ1 and WOWQ2) (Figure 8) in accordance with the Metropolitan Coal Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan.

In October 2016, Metropolitan Coal increased the frequency of water quality sampling at select sites on the Eastern Tributary (sites ETWQF, ETWQN, ETWQAF, ETWQAG, ETWQAH, ETWQAI, ETWQAK, ETWQAQ and ETWQAU) and at site WOWQ2 on the Woronora Reservoir from monthly to weekly in response to the Eastern Tributary Incident. Weekly sampling continued throughout the reporting period.

Trends in the monitoring data to date for key parameters (pH, electrical conductivity [EC], dissolved iron, dissolved manganese and dissolved aluminium) are summarised in Table 8 and shown on Charts 25 to 49 (Appendices B1 and B2).

Water quality data has been analysed for key water quality parameters of relevance to water supply and the effects of subsidence, namely iron, manganese and aluminium at site WRWQ9 on Waratah Rivulet, site ETWQ AU on Eastern Tributary and at control site WOWQ2 on the Woronora River.

The performance indicator, *Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ2,* is considered to have been exceeded if data analysis indicates a significant change in the quality of water post-mining of Longwall 20. Specifically, if[9]:

- any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or
- over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or
- the six month mean of the water quality parameter exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e. over two six monthly reports); and
- there was not a similar exceedance of the trigger at the control site.

Assessment of Water Quality at Site WRWQ9

There was no exceedance of the performance indicator as a result of the assessment methods for dissolved iron, dissolved aluminium or dissolved manganese at site WRWQ9 on the Waratah Rivulet during the reporting period. There were no exceedances of the same triggers at control site WOWQ2 on Woronora River (Appendices B1 and B2).

Assessment of Water Quality at Site ETWQ AU

There were no exceedances of the performance indicator as a result of the assessment methods for dissolved aluminium and iron during the reporting period. There were exceedances of the performance indicator as a result of the assessment methods for dissolved manganese during the reporting period (Appendices B1 and B2).

[9] Note each 'mean' is calculated as a geometric mean.

Table 8
Summary of Results for Key Water Quality Parameters During the Reporting Period

Stream(s)	pH	EC	Dissolved Iron	Dissolved Manganese	Dissolved Aluminium
Waratah Rivulet (sites WRWQ2, WRWQ6, WRWQ8, WRWQ9, WRWQM, WRWQN, WRWQP, WRWQR, WRWQT and WRWQW) (Charts 25 to 34)	• Upstream sites (e.g. sites WRWQ2 and WRWQ6) were slightly acidic to near neutral. • Middle and lower reach sites (e.g. sites WRWQ8, WRWQT and WRWQW) were higher (slightly alkaline). • WRWQ8 and WRWQT have shown a generally increasing trend in pH since mid-2016. • Historically high pH values (field) were recorded at WRWQ8 (8.96) and WRWQT (9.47) in January 2020. • Following the significant rainfall event in February 2020, the pH values recorded at these sites returned to within the range of historical values.	• Notably lower than those recorded in 2018/2019, though were consistent with pre-2018 values. • No historically high values were recorded during the reporting period.	• Concentrations at all sites were typically below 0.4 milligrams per litre (mg/L). • WRWQ2 and WRWQM, which recorded concentrations of 0.58 mg/L and 0.42 mg/L in January 2020.	• Concentrations at the upper, middle and lower reach sites on the Waratah Rivulet were generally consistent with previously recorded levels. • WRWQ2 recorded a historically high concentration of 0.41 mg/L in January prior to the significant rainfall event in February 2020.	• From April to December, the dissolved aluminium concentrations recorded at all sites were within the range of historical concentrations or below the limit of detection (0.01 mg/L) • A historically high concentration of 0.09 mg/L was recorded at WRWQP, WRWQR and WRWQT in February and 0.07 mg/L at WRWQM and WRWQN in March 2020.
Woronora River (sites WOWQ1 and WOWQ2, control stream) (Charts 34 to 39)	• Acidic to slightly acidic pH levels. • pH levels at both site were lower than recent years (i.e. post-2015), but generally within the range of historical values. • WOWQ2 recorded a historically low value of 0.56 mg/L in February 2020.	• Values recorded at WOWQ2 have increased in variability since 2016 and tend to be more elevated. • No historically high values were recorded during the reporting period.	• Generally low and within the range of historical concentrations.	• Consistent with historical values at WOWQ1. • Slightly elevated at WOWQ2 during the review period with a historically high concentration level of 0.226 mg/L recorded in March 2020.	• Slightly elevated concentrations recorded at WOWQ1 though consistent with historical values. • Notably elevated at both sites in the first half of 2020, with a historically high concentration of 0.56 mg/L at WOWQ2 in February 2020. • Declined to within historical conditions in the latter half.

Table 8 (Continued)
Summary of Results for Key Water Quality Parameters During the Reporting Period

Stream(s)	pH	EC	Dissolved Iron	Dissolved Manganese	Dissolved Aluminium
Eastern Tributary (sites ETWQF, ETWQJ, ETWQN, ETWQU, ETWQW, ETWQAF, ETWQAH, ETWQAQ and ETWQAU)[1] (Charts 40 to 44)	• Slightly acidic to slightly alkaline conditions. • Consistent with historical values.	• The majority of values recorded in 2020 have returned to the lower concentrations recorded pre-2016, except for ETWQAQ which is consistent with post-2016 historical values. • The highest historically recorded values were not exceeded.	• Elevated concentrations have been recorded in the Eastern Tributary since mid-2016, with similar concentrations for the reporting period. • Elevated concentrations ranging from 0.009 to 9.35 mg/L were recorded at ETWQAQ, though the highest historically recorded values were not exceeded. • A historically high dissolved iron concentration was recorded at EWQF in February 2020 (1.19 mg/L), for all other sites, the highest historically recorded values were not exceeded.	• Elevated concentrations of dissolved manganese have been recorded in the Eastern Tributary since mid-2016. • Concentrations of less than 1 mg/L recorded at all other sites, except for ETWQAQ. • At ETWQAQ, a concentration of 1.75 mg/L was recorded in November 2020, however, no exceedances of historically high dissolved manganese concentrations were recorded at any site.	• Variable concentrations were recorded at all sites during the reporting period. • A historically high concentration of 0.18 mg/L was recorded at ETWQU in February 2020. • For all other sites, the highest historically recorded values were not exceeded.
Bee Creek (site BCWQ1, control stream), Honeysuckle Creek (site HCWQ1, control stream), Far Eastern Tributary (site FEWQ1), Tributary B (site RTWQ1) and Tributary D (site UTWQ1) (Charts 44 to 49)	• Bee Creek and Honeysuckle Creek had slightly acidic pH levels. • Far Eastern Tributary, Tributary B and Tributary D had near neutral pH levels. • Overall, the pH levels were consistent with historical values.	• The values recorded during the reporting period were consistent with historical values. • Values at RTWQ1 have tended to be more elevated and variable relative to pre-2013 values, however this is less apparent during this reporting period.	• Consistent with historical values. • The highest historically recorded values were not exceeded.	• Generally consistent with historical values. • A spike of 0.75 mg/L was recorded at UTWQ1 in January 2020 although this concentration did not exceed the historical maximum recorded at this site.	• Concentrations rose at FEWQ1, HCWQ1 and BCWQ1 following the significant rainfall event in February 2020 and remained relatively elevated at HCWQ1 And BCWQ1 for the remainder of the review period. • Historically high concentrations were recorded at BCWQ1 (1.35 mg/L) and HCWQ1 (0.87 mg/L) in May 2020.

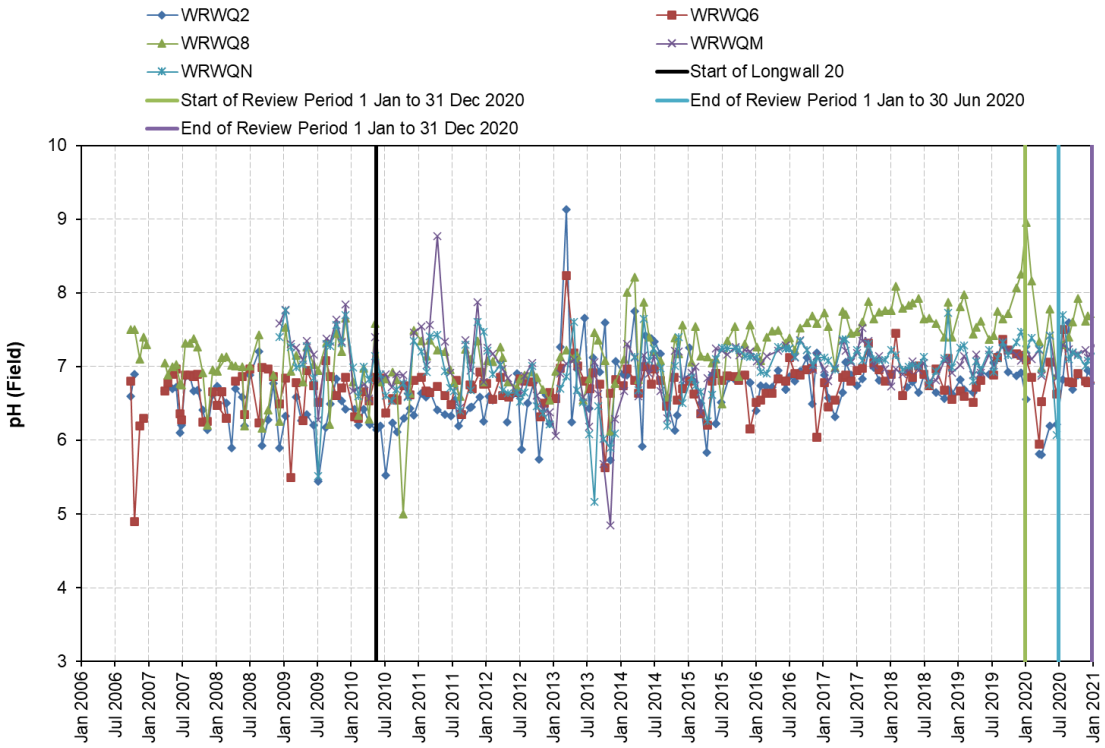


Chart 25 pH Levels Waratah Rivulet – Upper to Middle Reach Sites

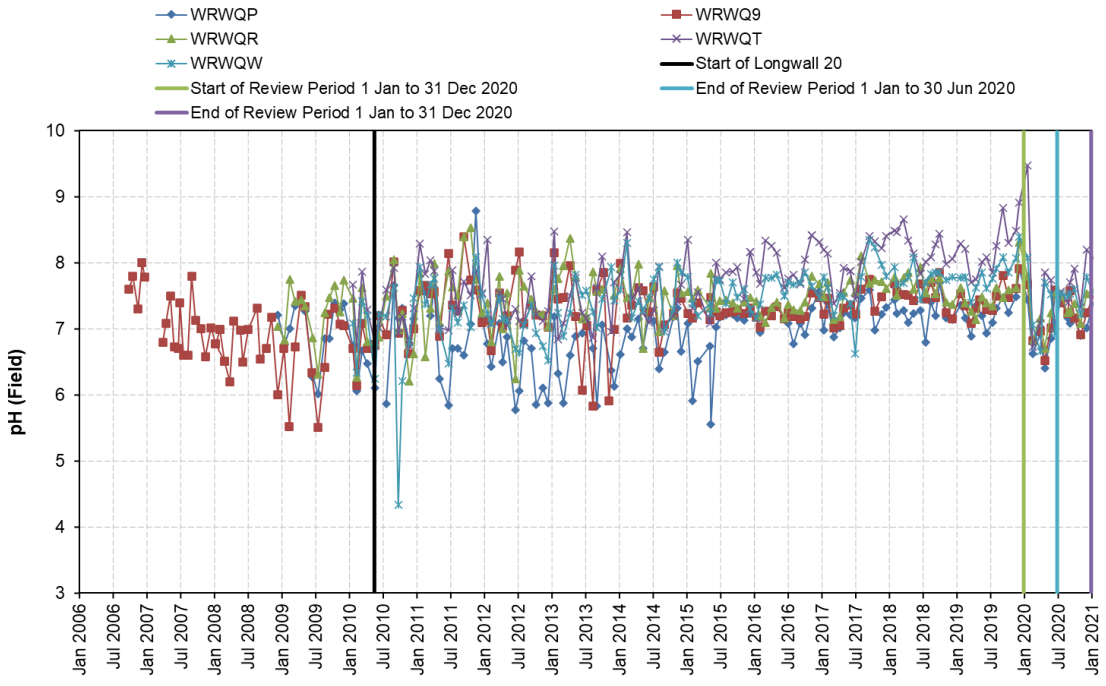


Chart 26 pH Levels Waratah Rivulet – Lower Reach Sites

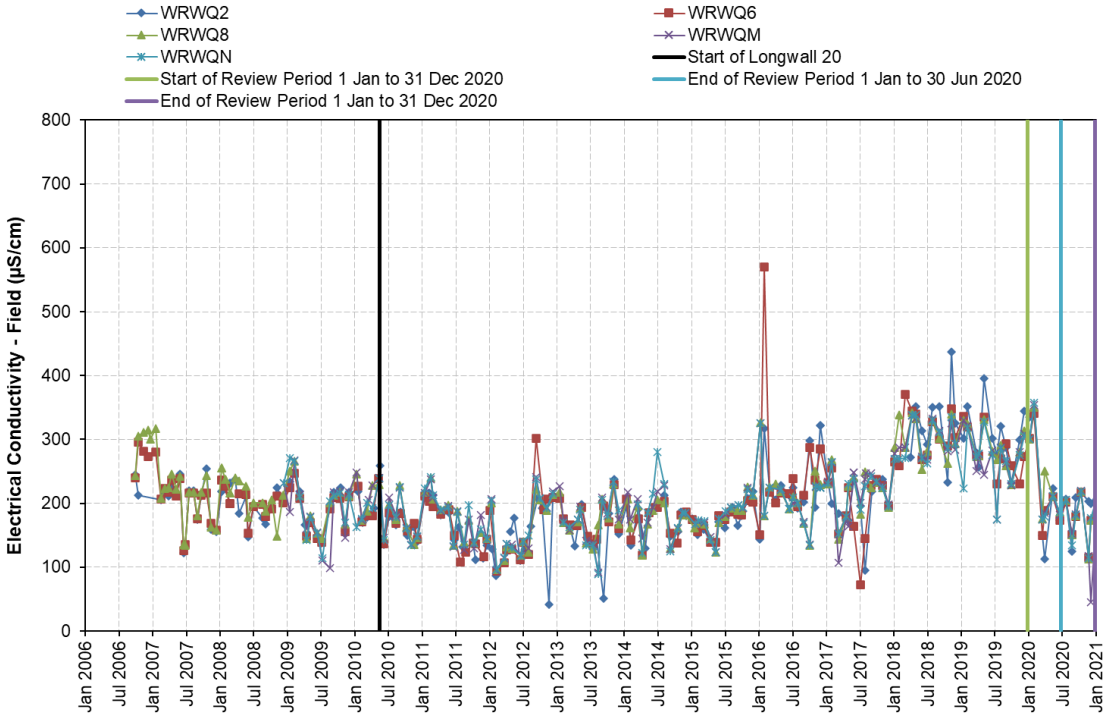


Chart 27 EC Waratah Rivulet – Upper to Middle Reach Sites

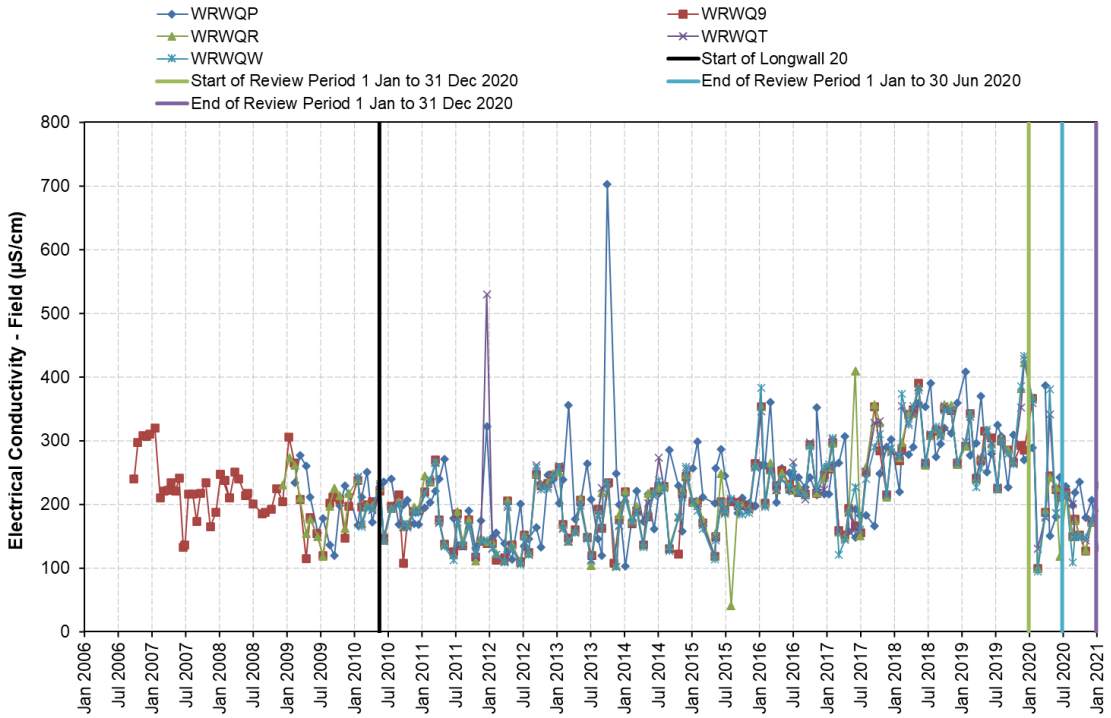


Chart 28 EC Waratah Rivulet – Lower Reach Sites

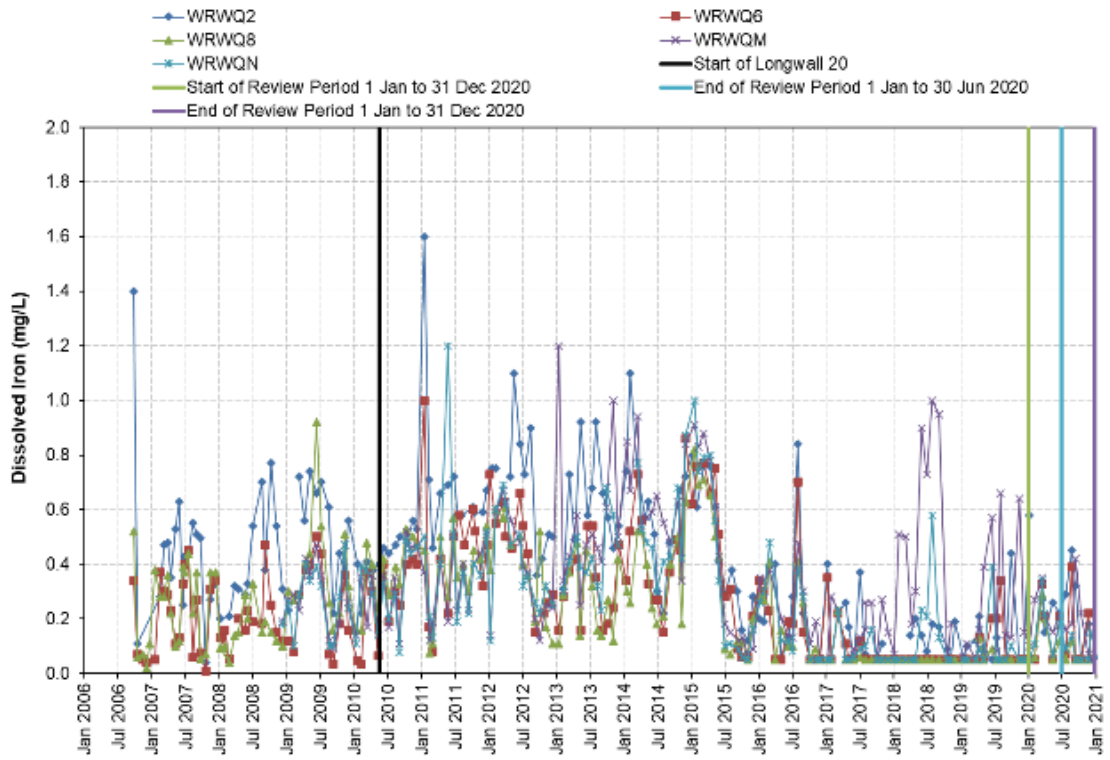


Chart 29 Dissolved Iron Waratah Rivulet – Upper and Middle Reach Sites

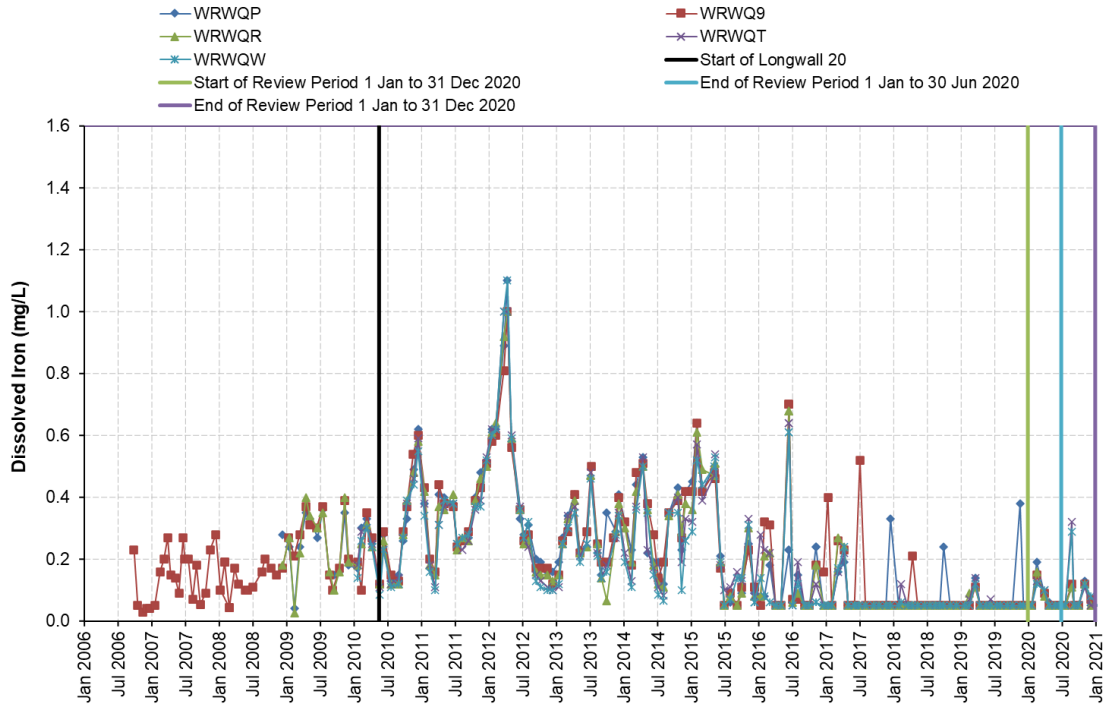


Chart 30 Dissolved Iron Waratah Rivulet – Lower Reach Sites

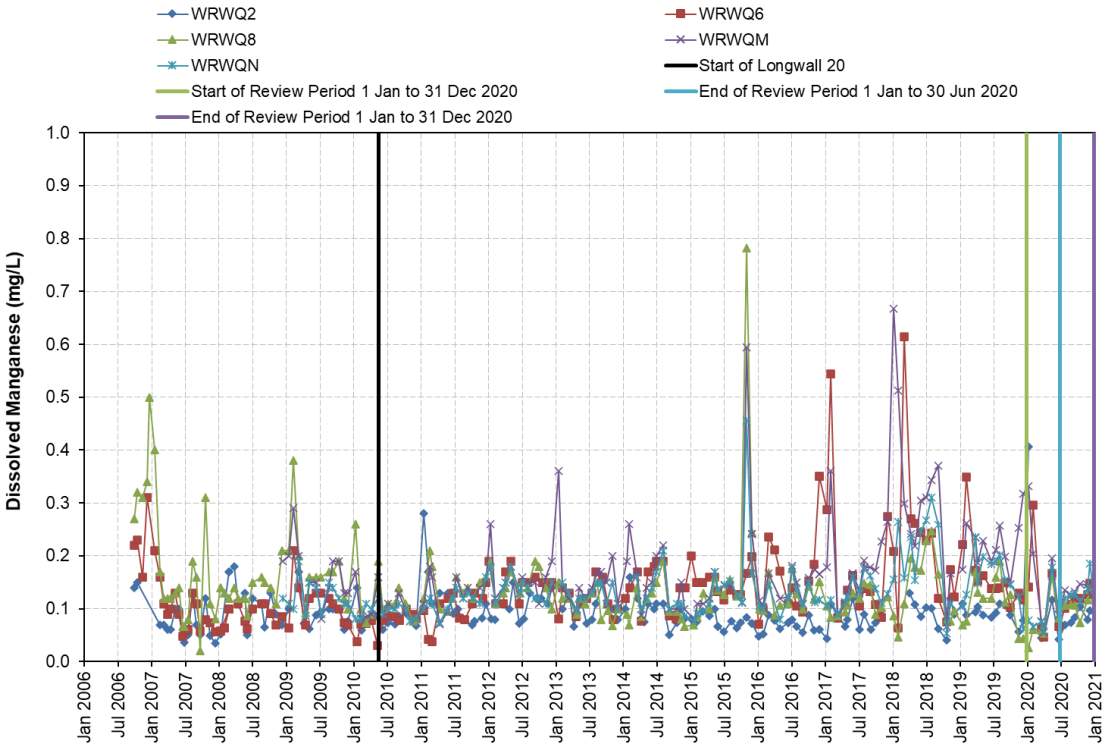


Chart 31 Dissolved Manganese Waratah Rivulet – Upper to Middle Reach Sites

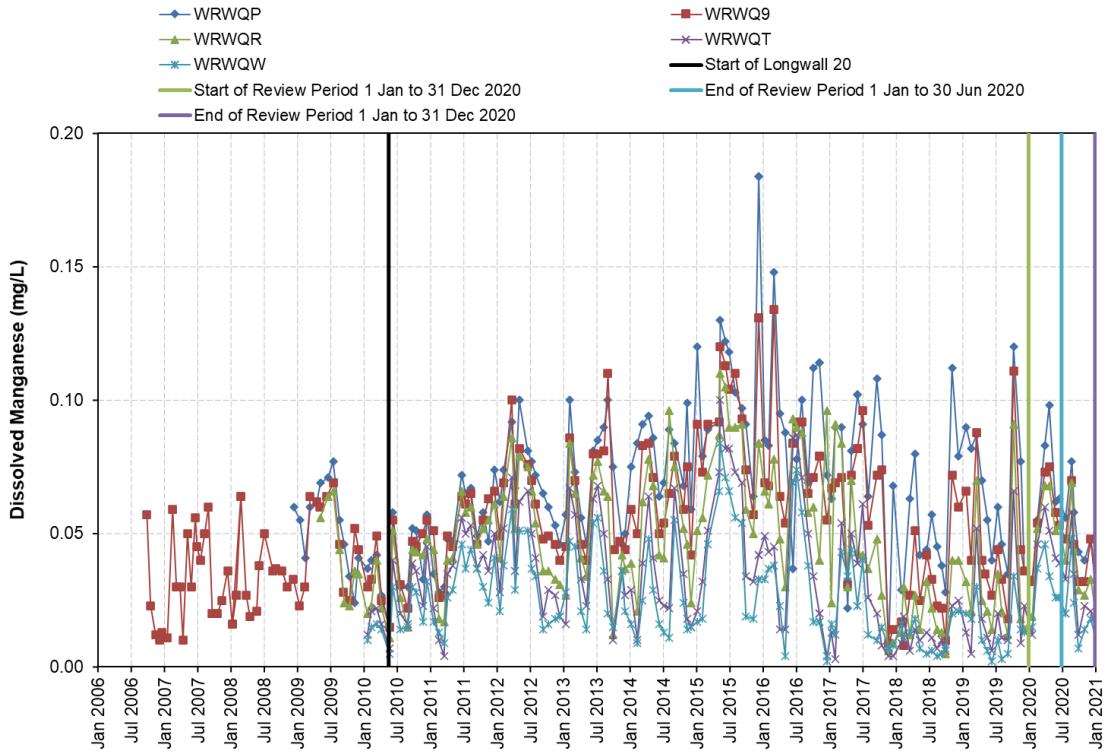


Chart 32 Dissolved Manganese Waratah Rivulet – Lower Reach Sites

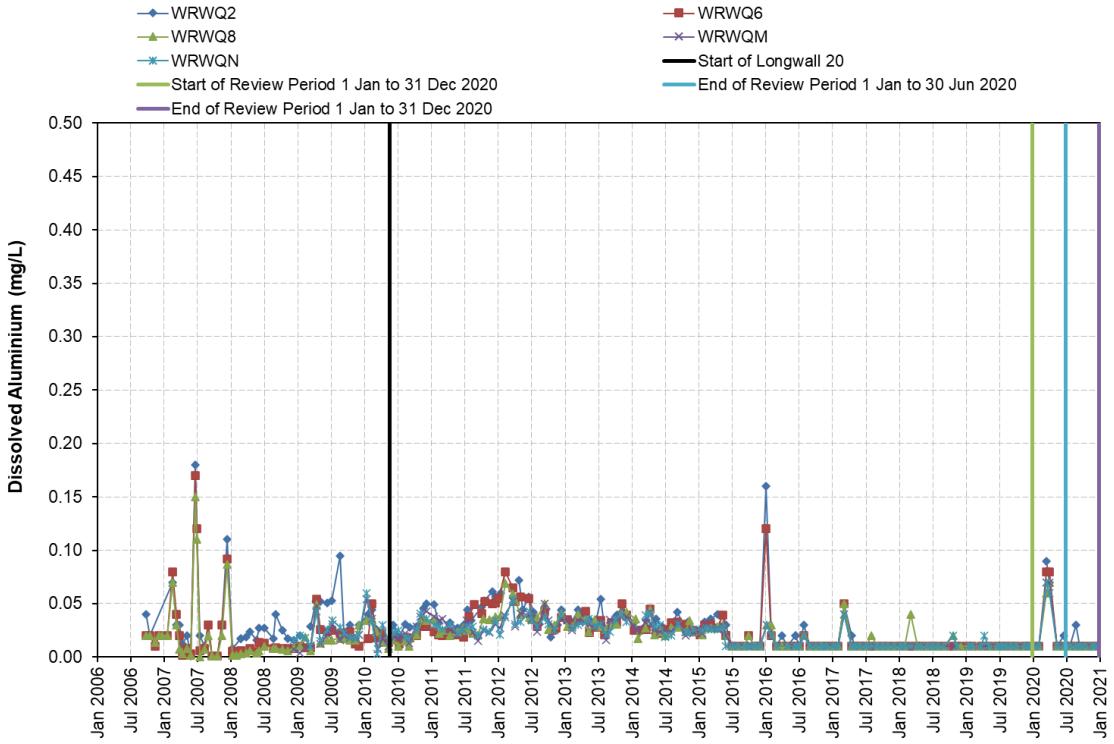


Chart 33 Dissolved Aluminium Waratah Rivulet – Upper to Middle Reach Sites

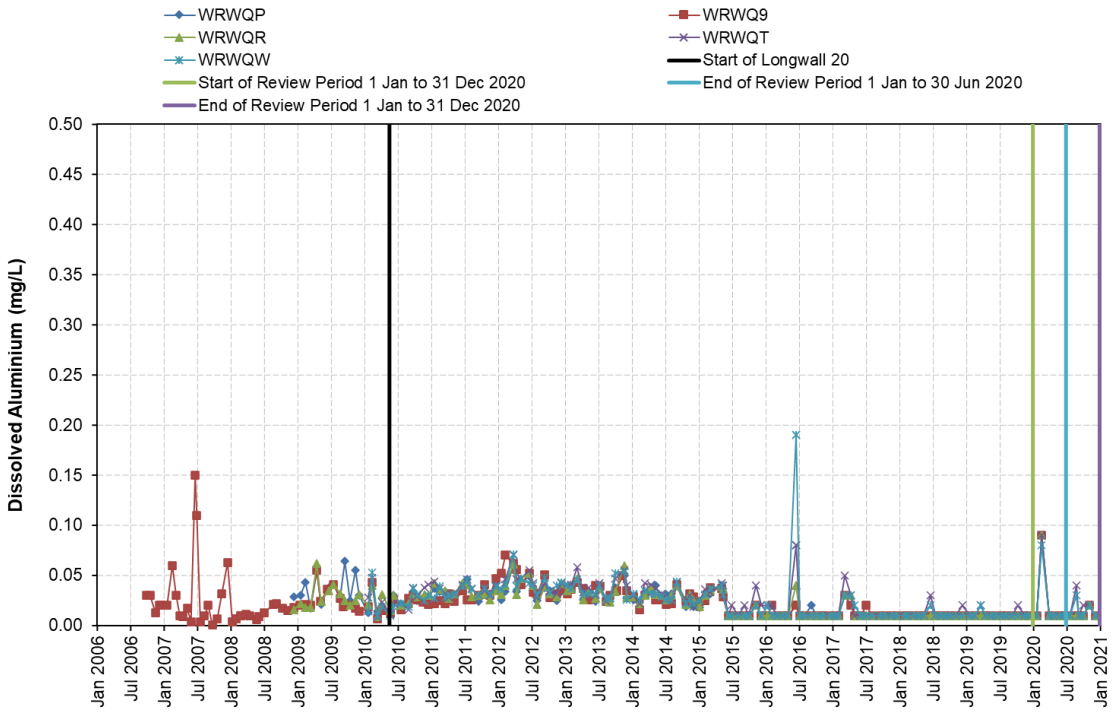


Chart 34 Dissolved Aluminium Waratah Rivulet – Lower Reach Sites

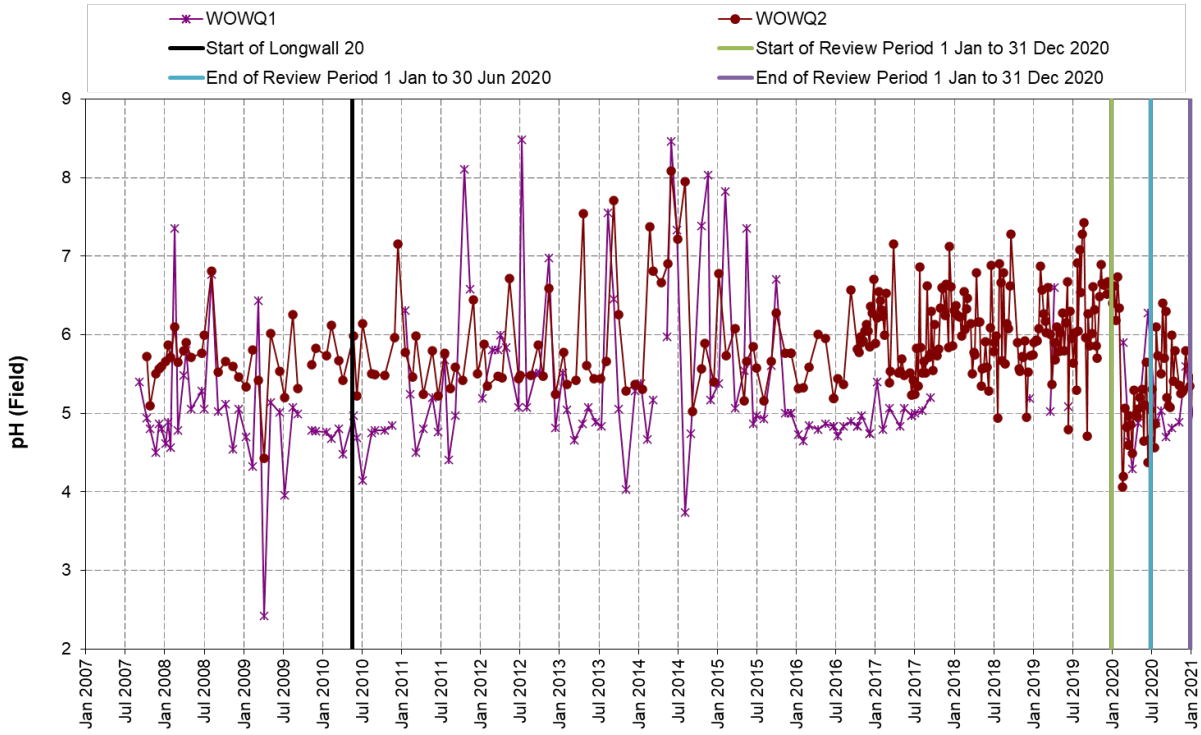


Chart 35 pH Levels Woronora River[10]

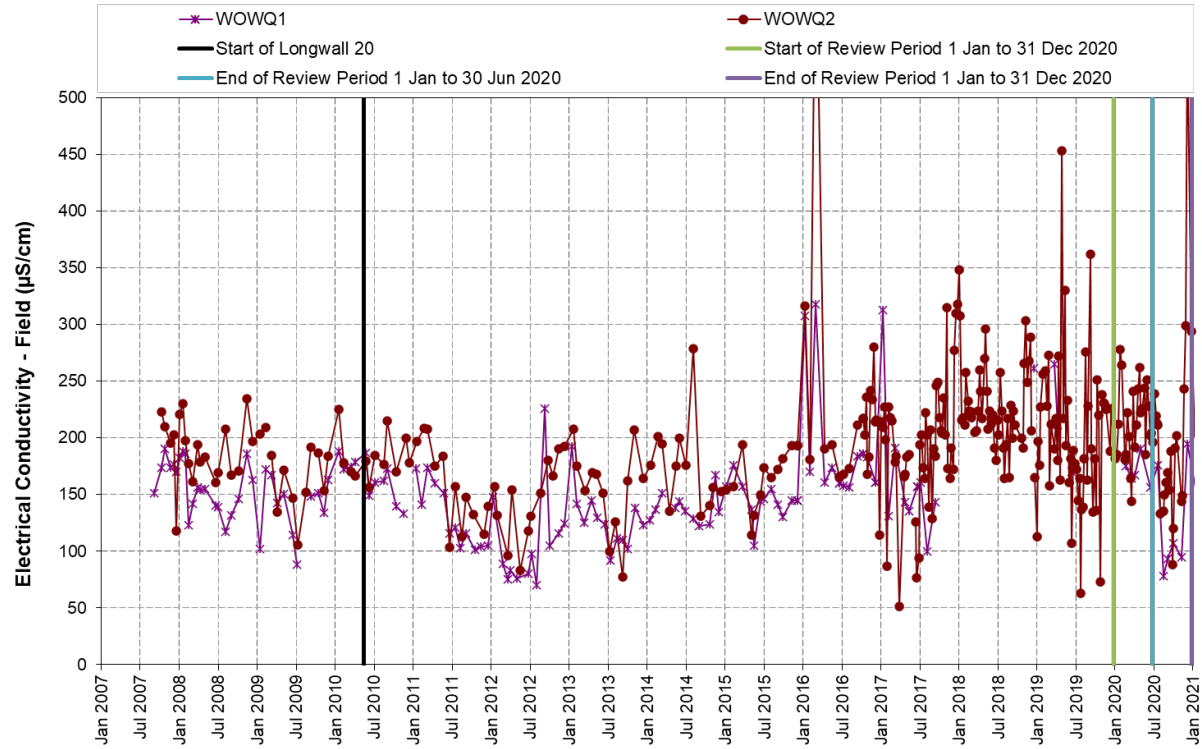


Chart 36 EC Woronora River

[10] WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 12 December 2019 and hence no water quality samples were collected.

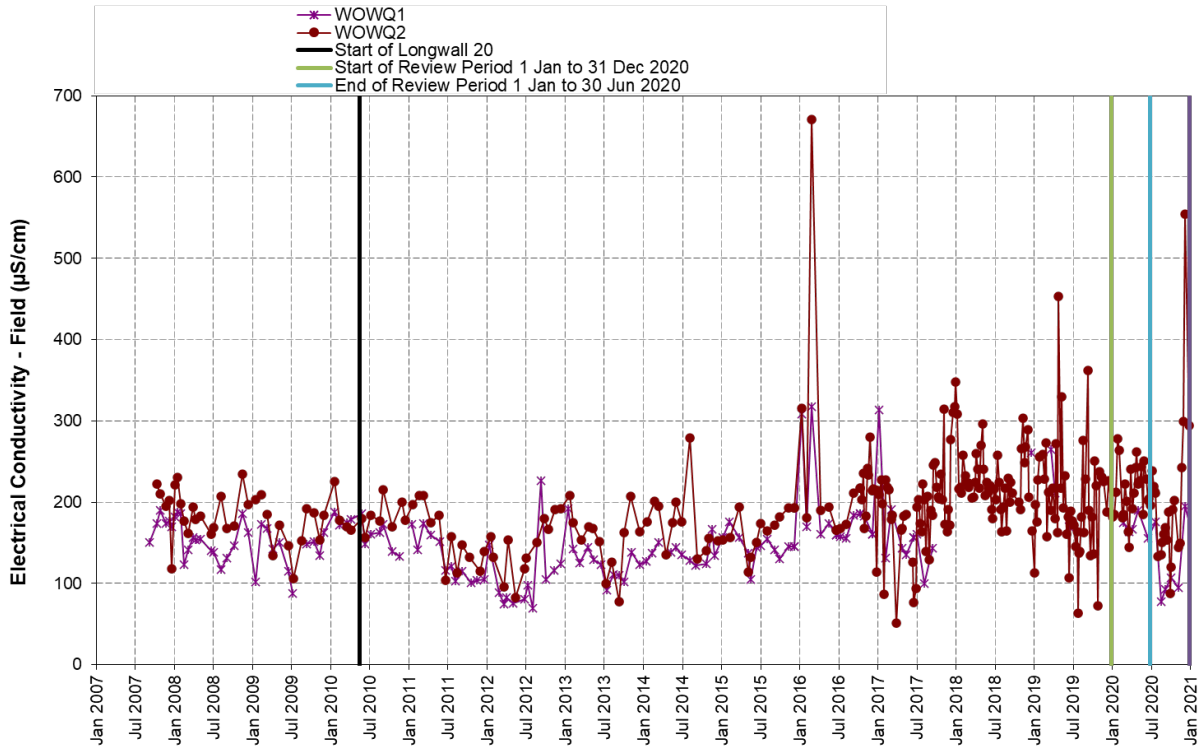


Chart 36a EC Woronora River

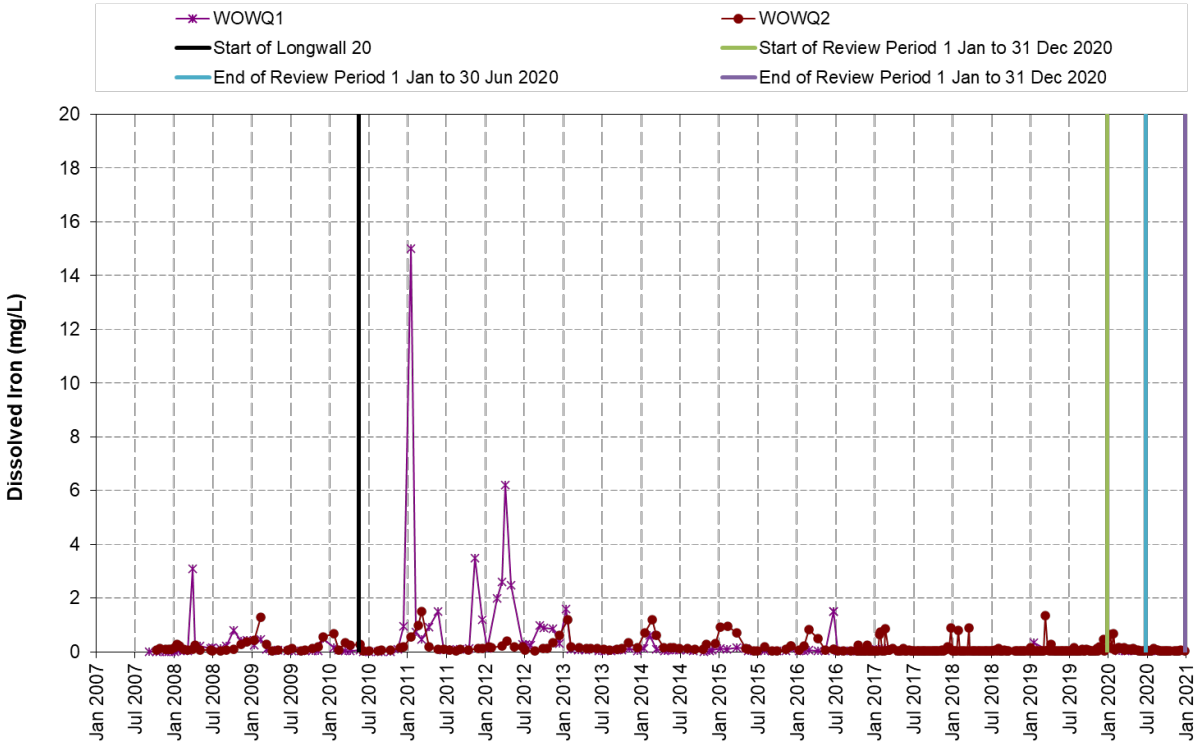


Chart 37 Dissolved Iron Woronora River

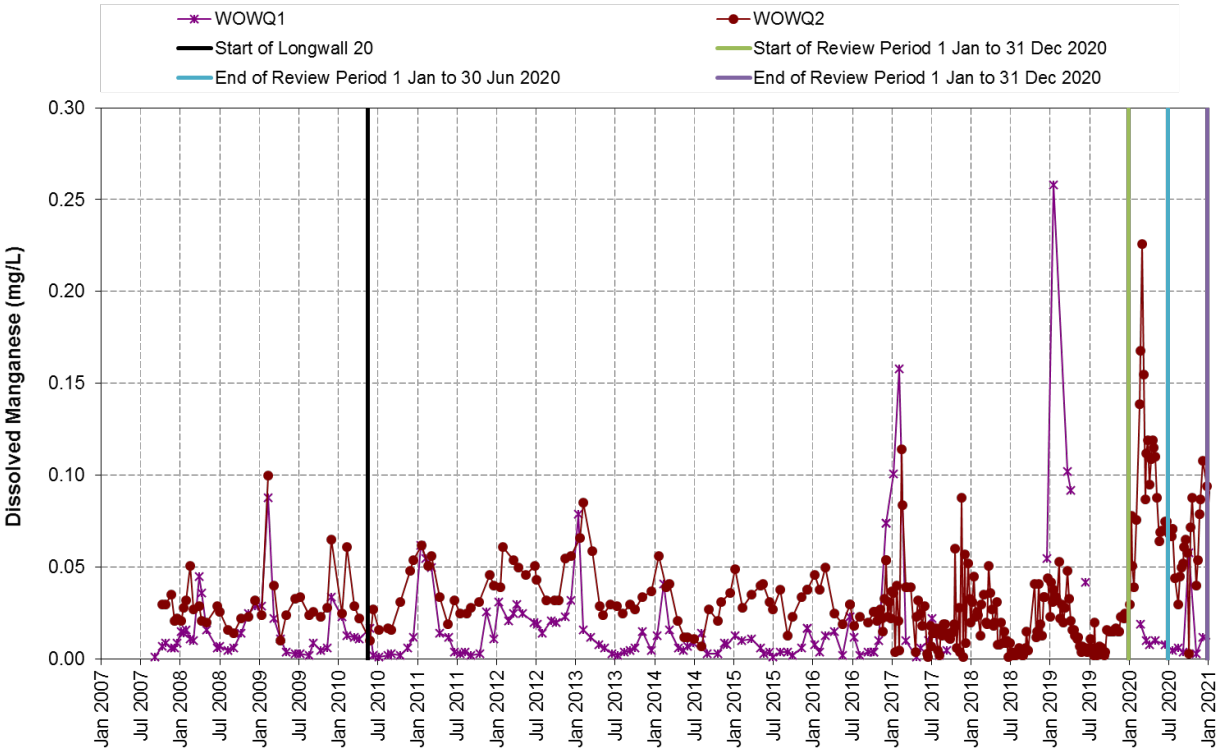


Chart 38 Dissolved Manganese Woronora River

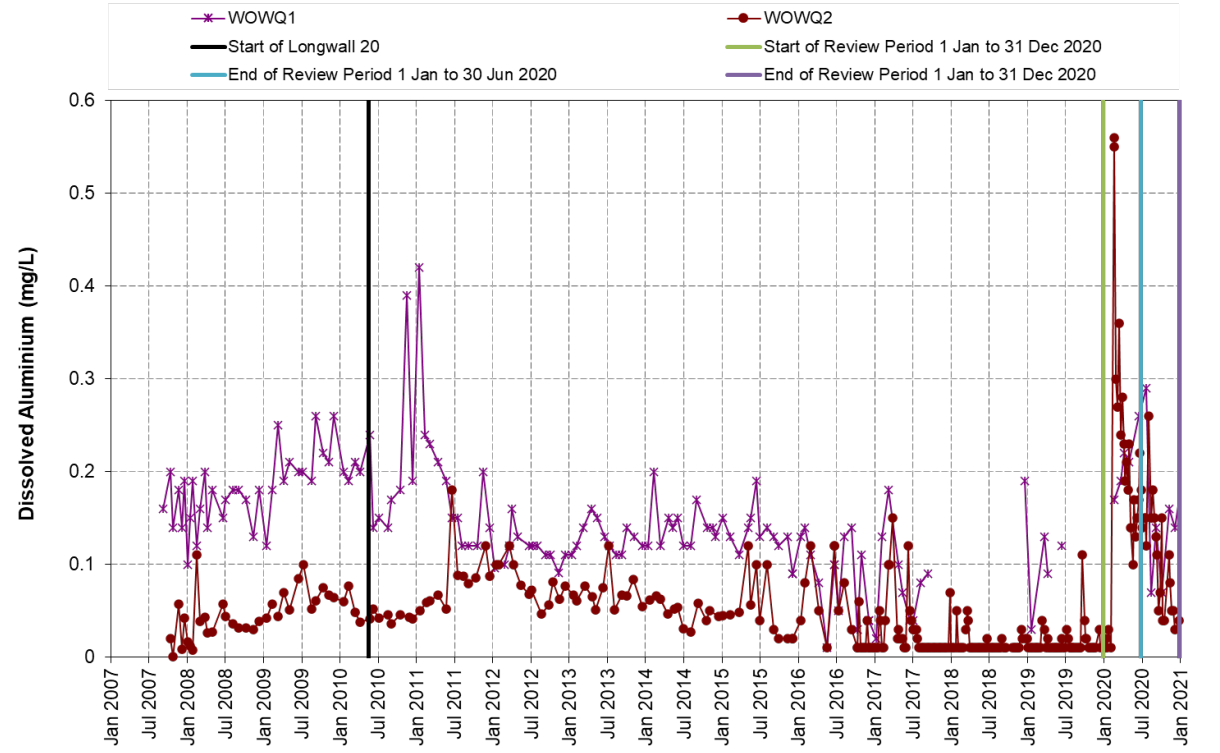


Chart 39 Dissolved Aluminium Woronora River

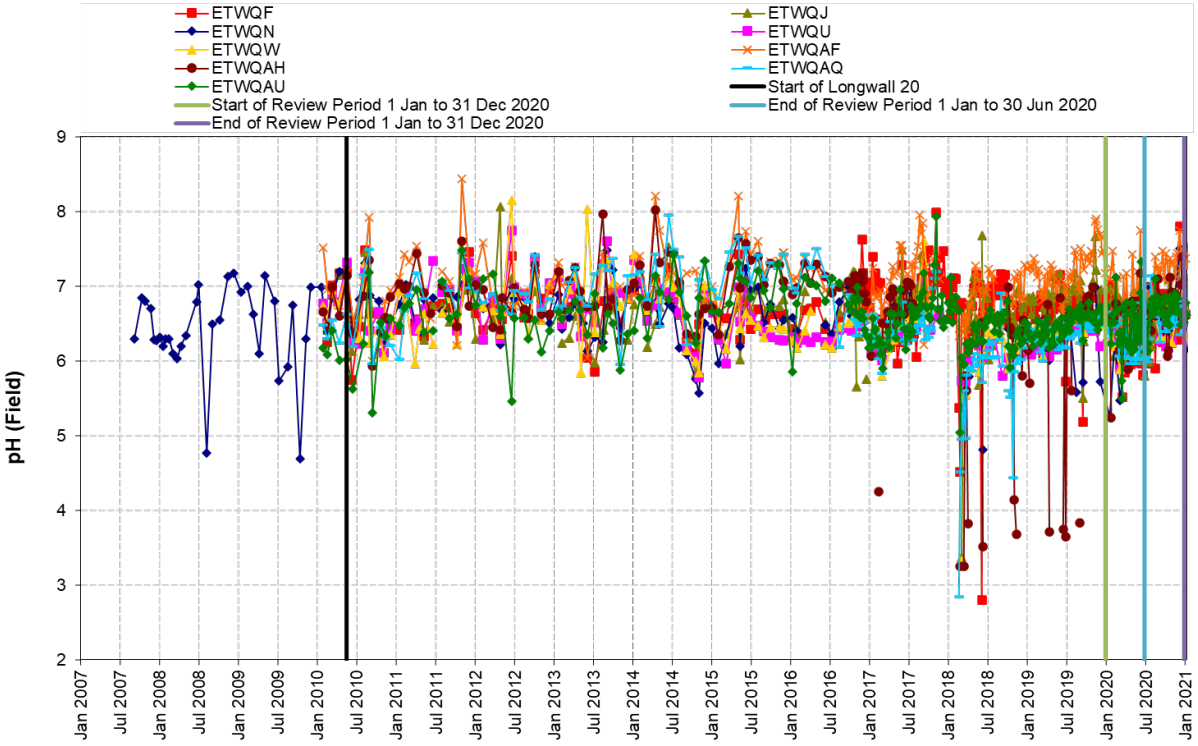


Chart 40 pH Levels Eastern Tributary

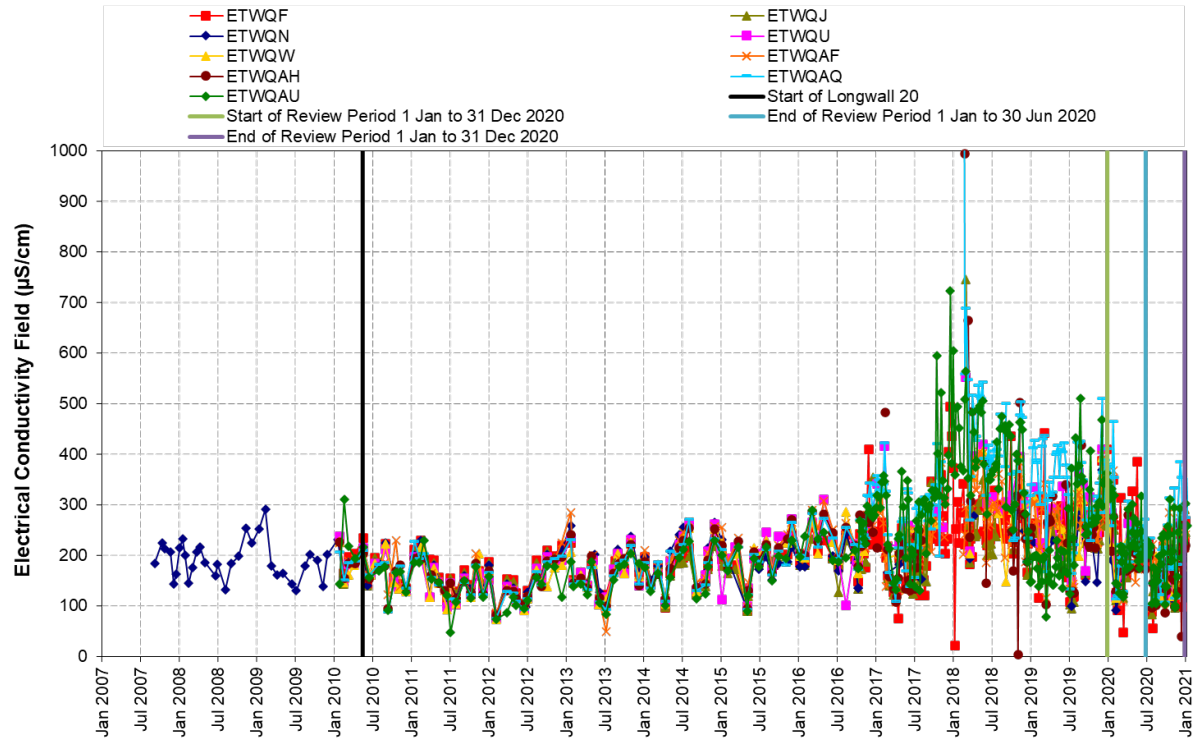


Chart 41 EC Eastern Tributary

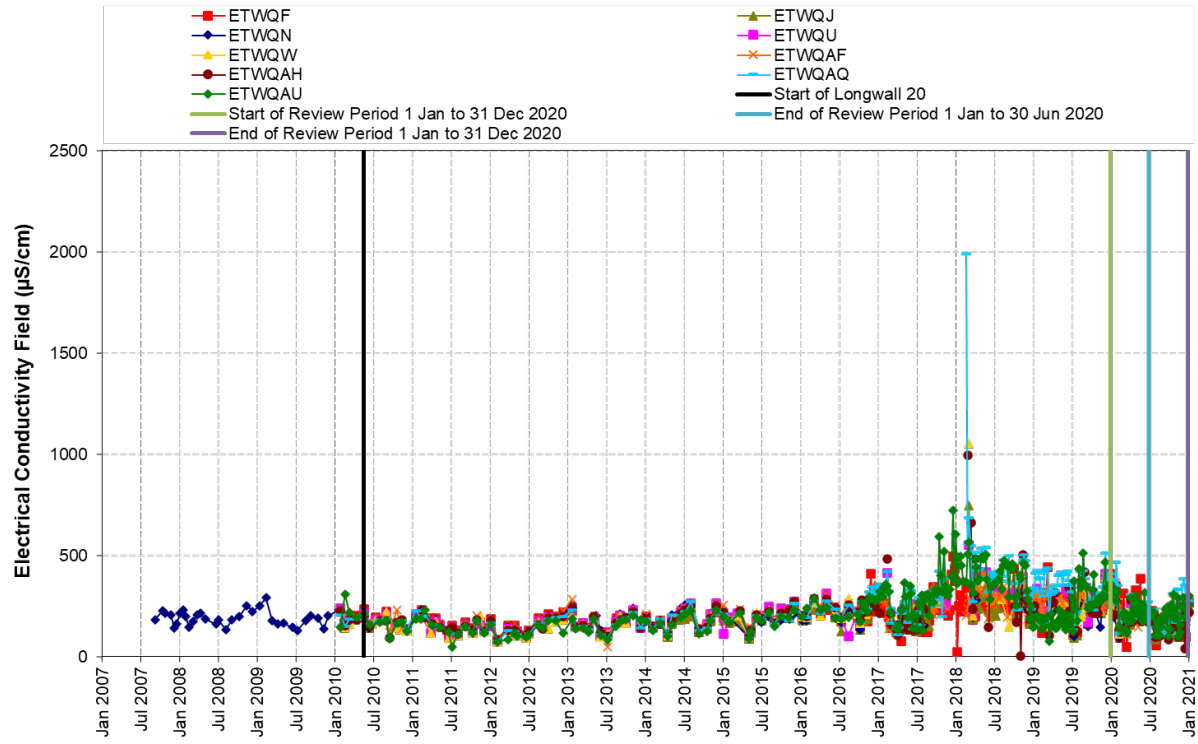


Chart 41a EC Eastern Tributary

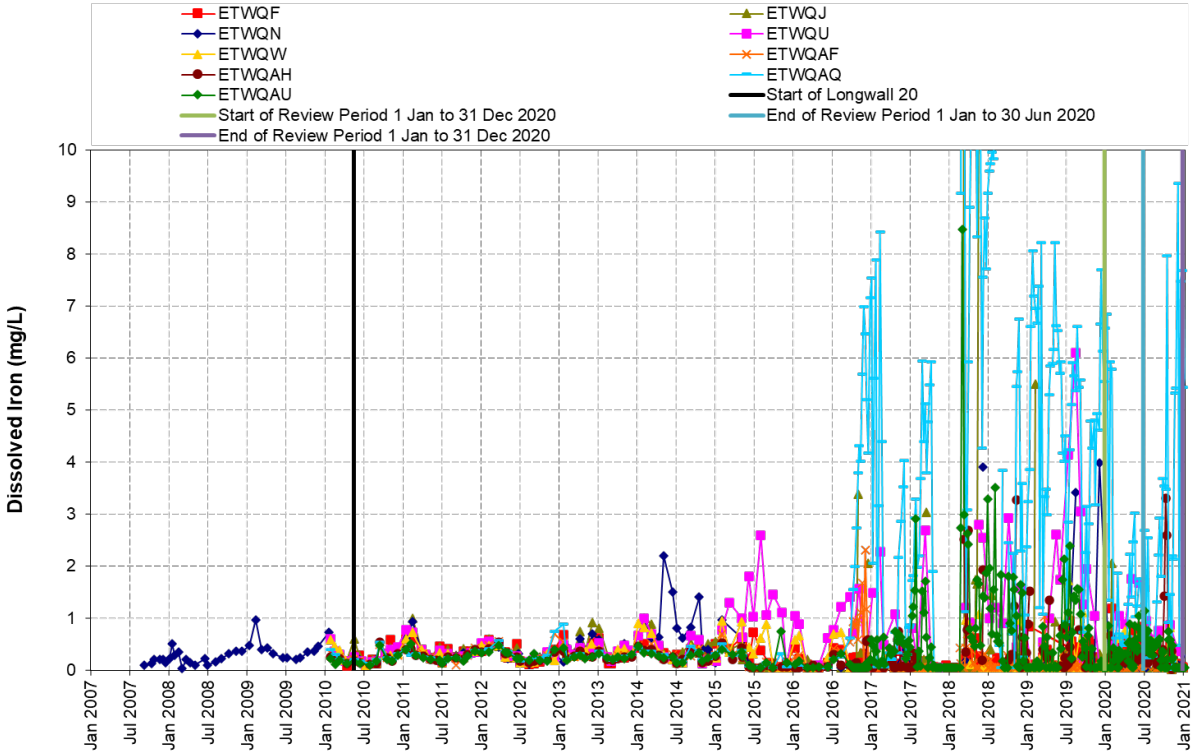


Chart 42 Dissolved Iron Eastern Tributary

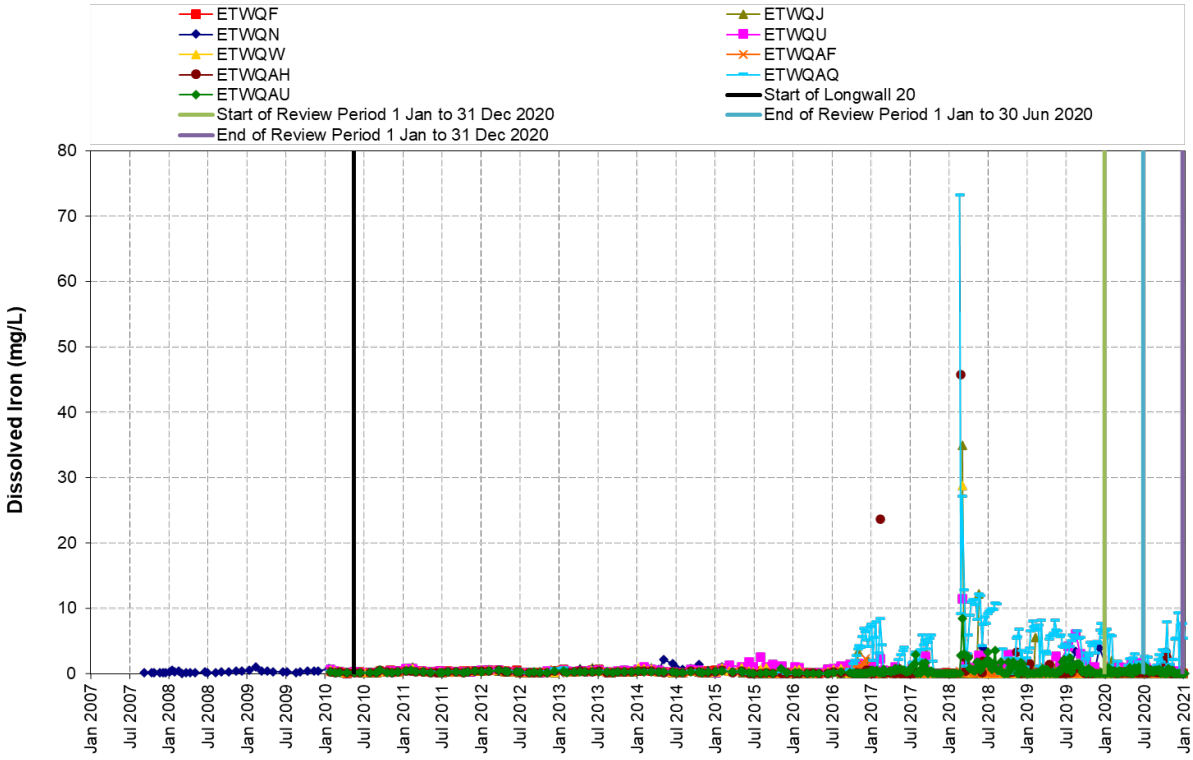


Chart 42a Dissolved Iron Eastern Tributary

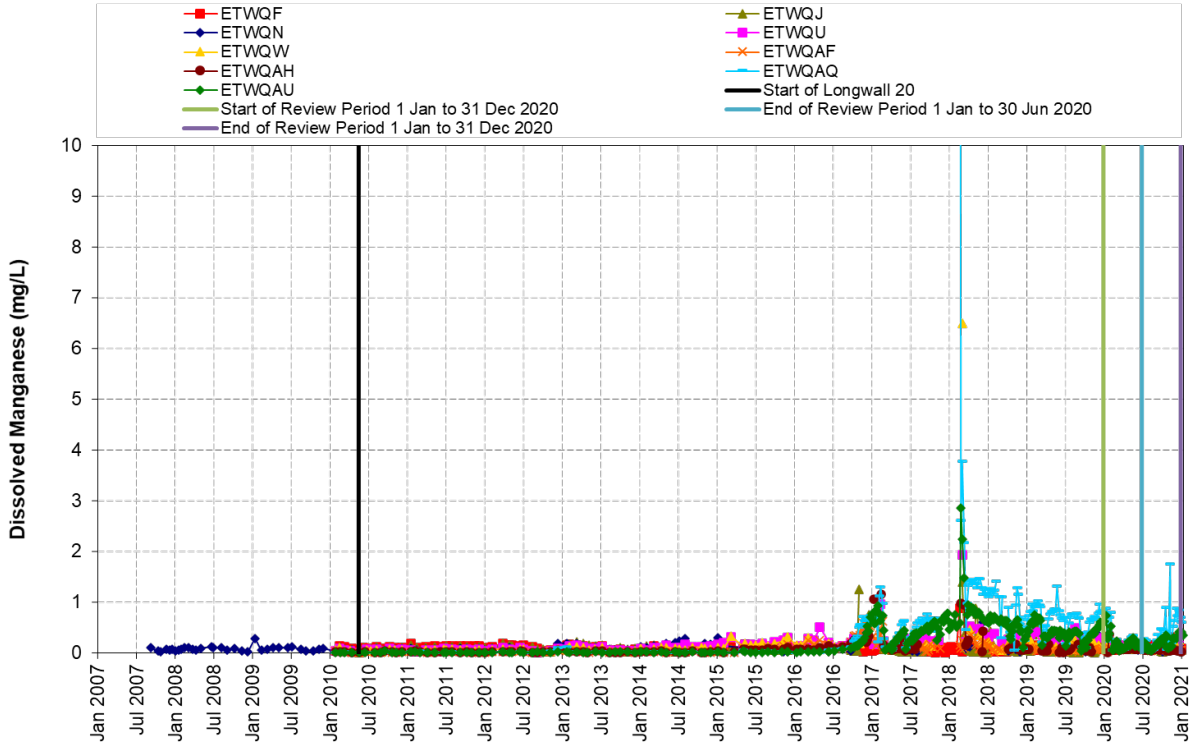


Chart 43 Dissolved Manganese Eastern Tributary

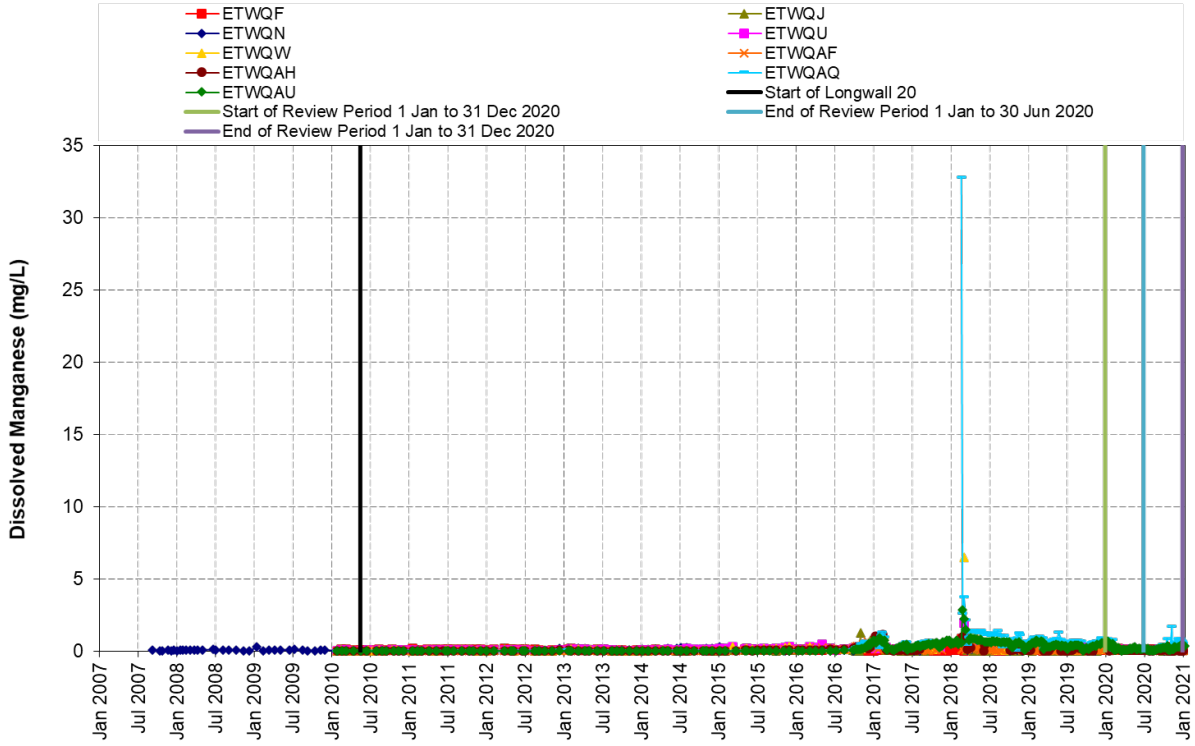


Chart 43a Dissolved Manganese Eastern Tributary

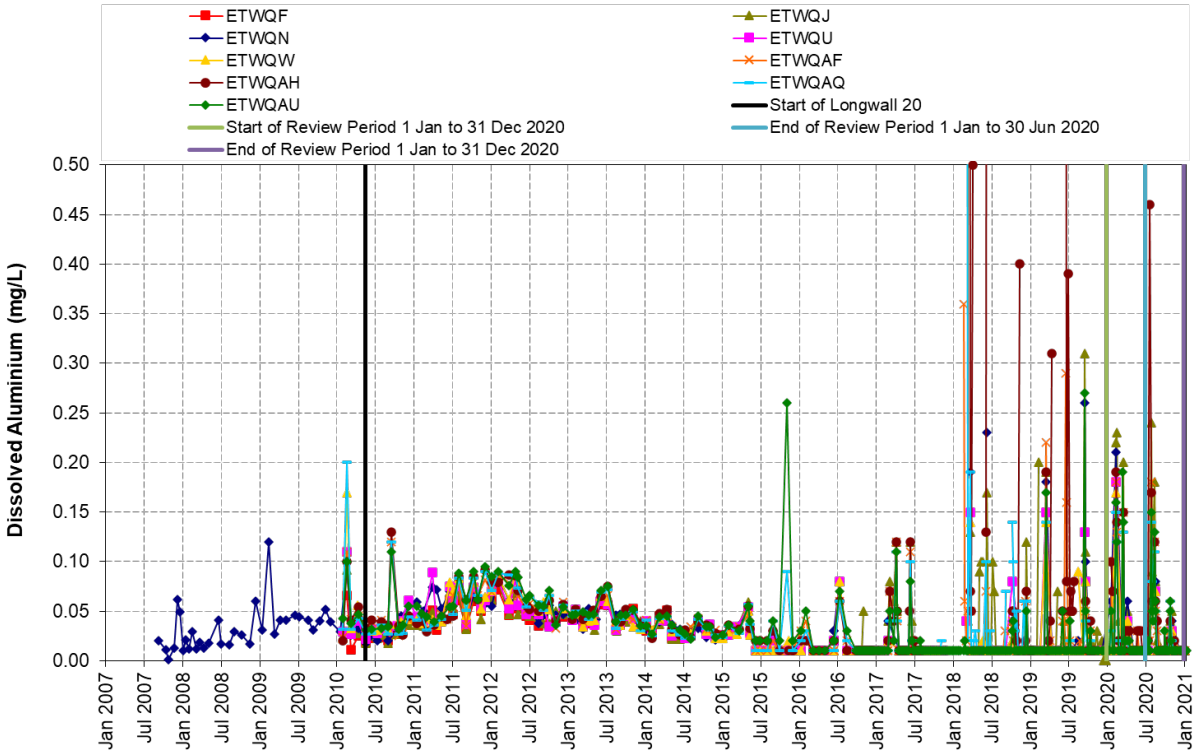


Chart 44 Dissolved Aluminium Eastern Tributary

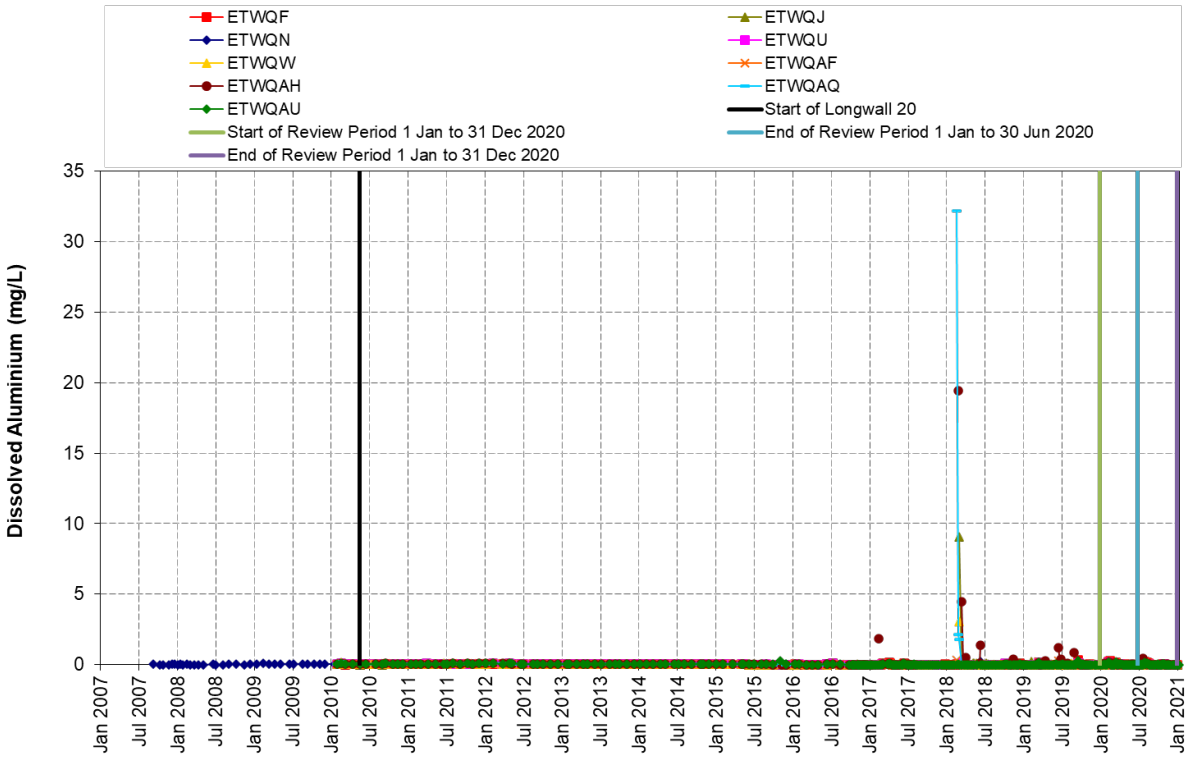


Chart 44a Dissolved Aluminium Eastern Tributary

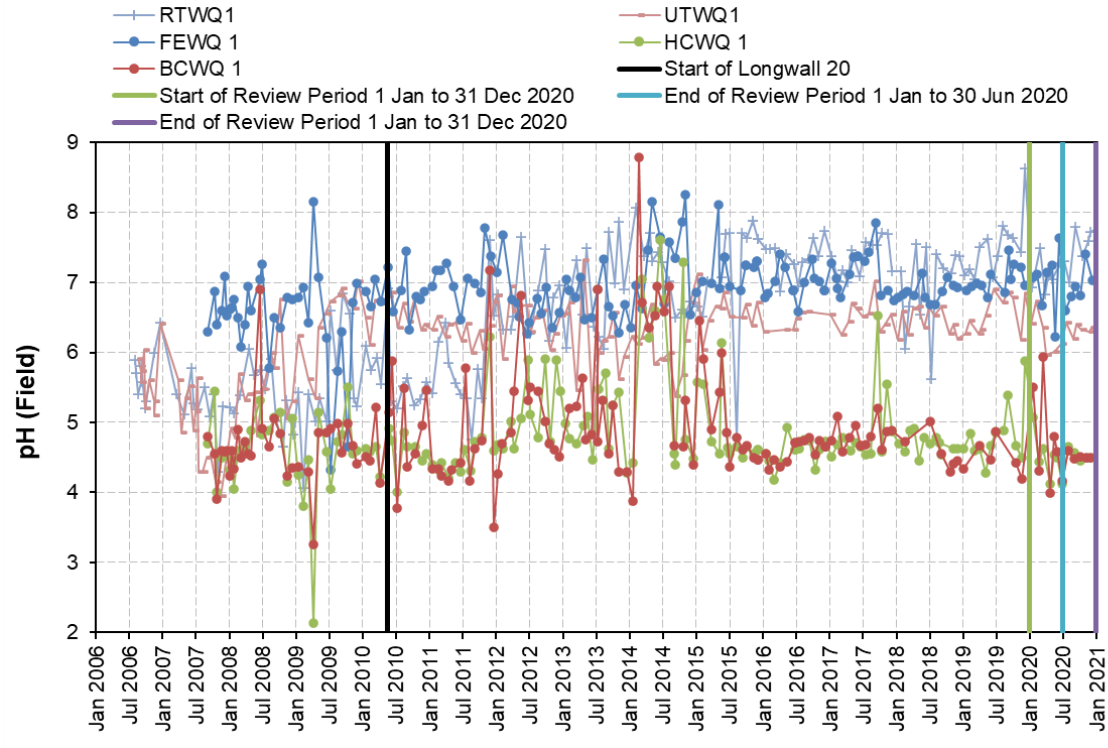


Chart 45 pH Levels Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

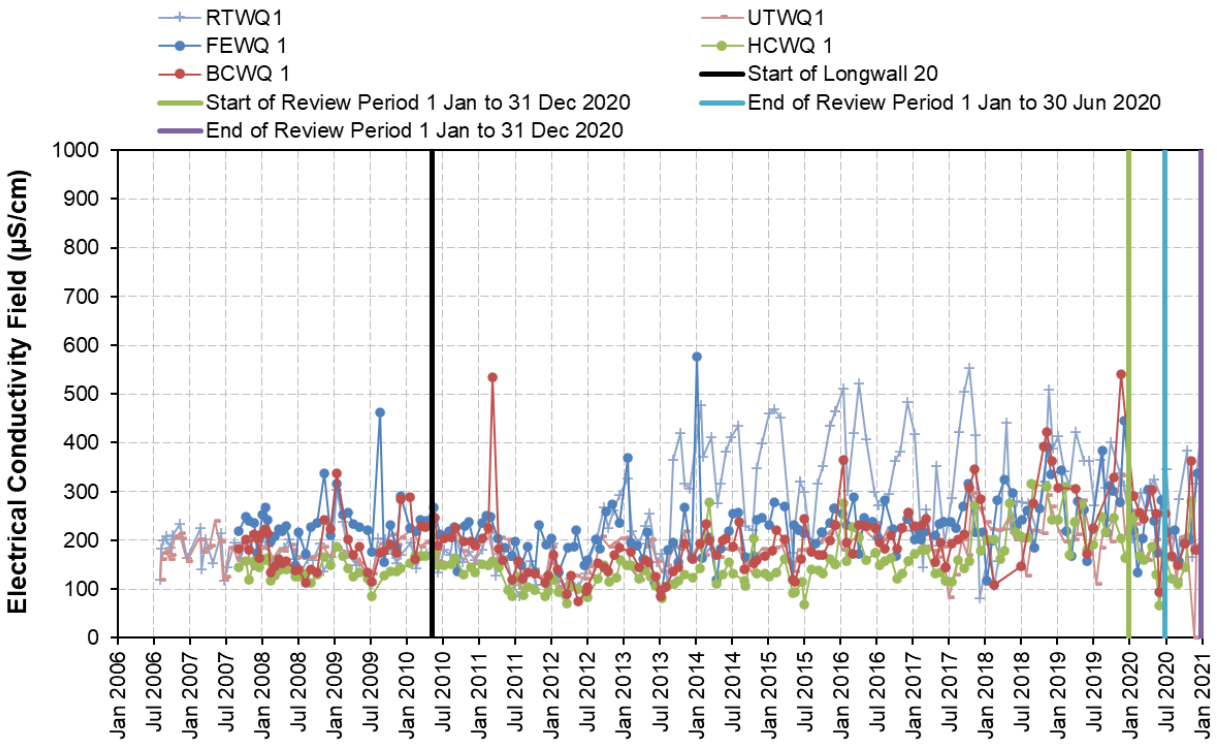


Chart 46 EC Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

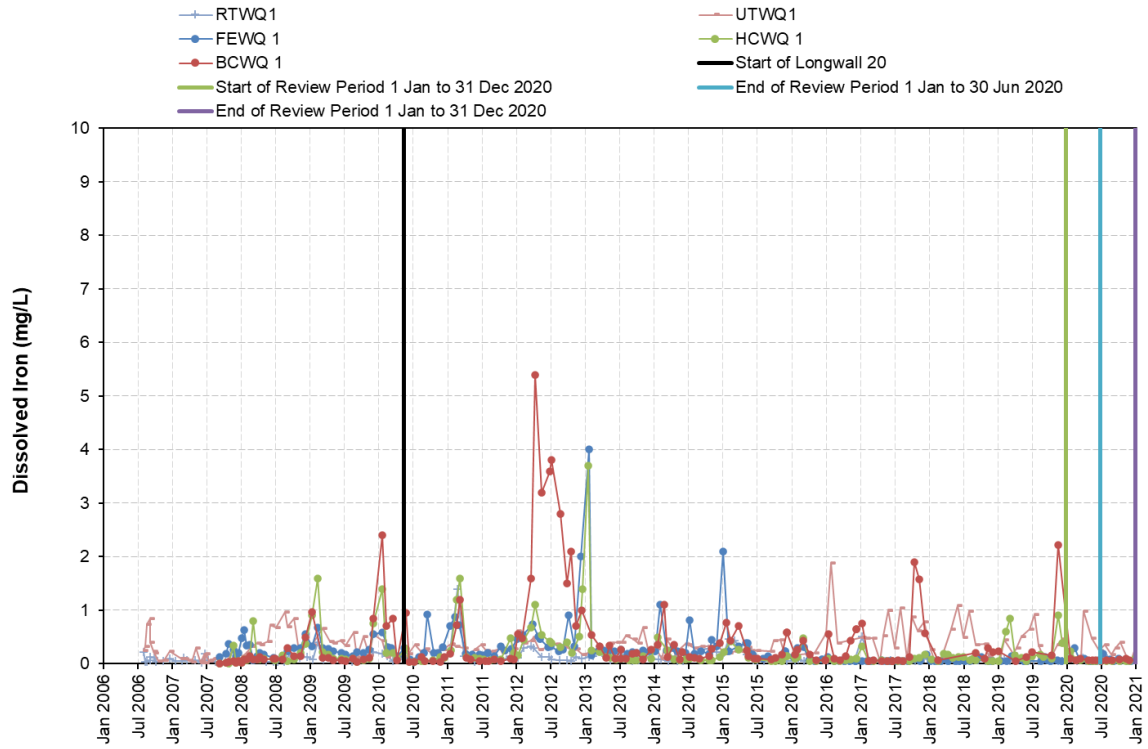


Chart 47 Dissolved Iron Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

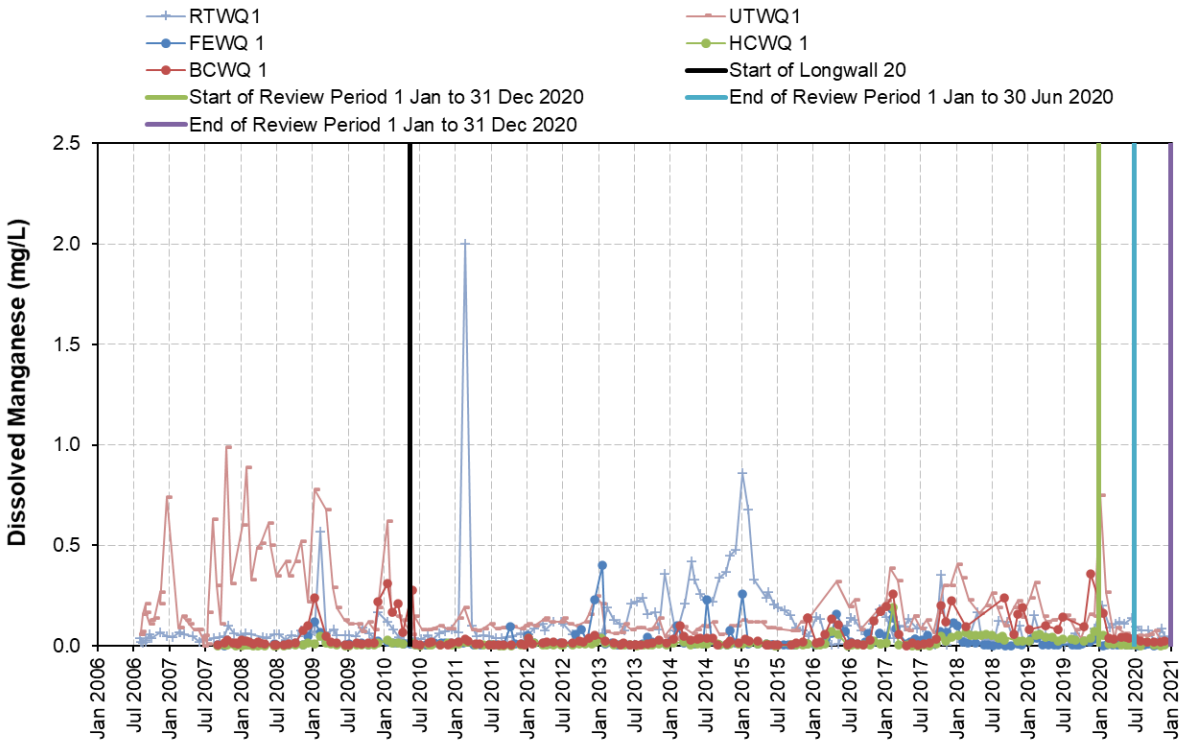


Chart 48 Dissolved Manganese Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

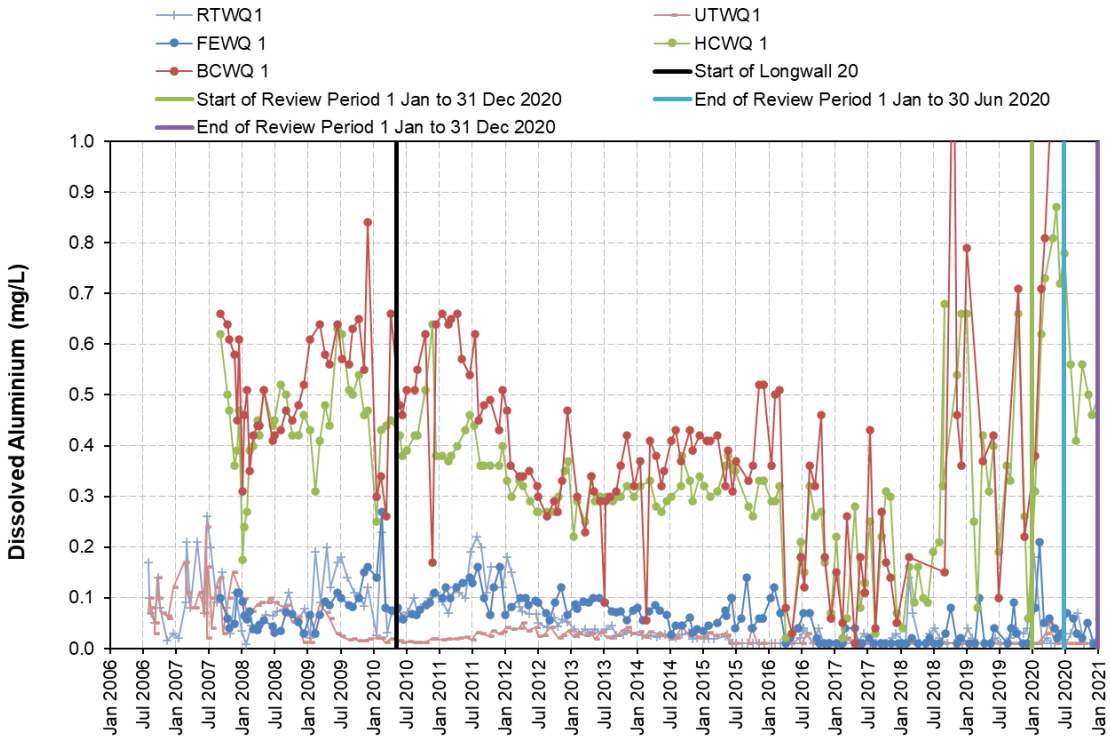


Chart 49 Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

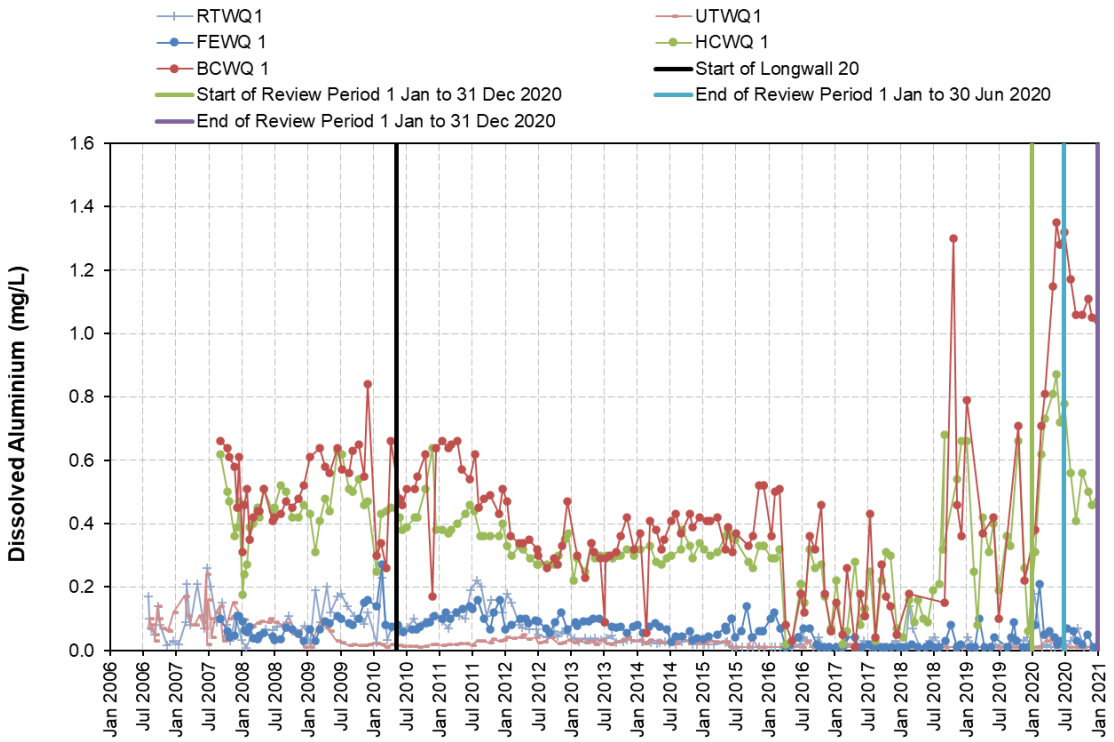


Chart 49a Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

There was an exceedance of the adjusted mean plus two standard deviations for dissolved iron at sampling site ETWQ AU in August and November 2020 (Chart 50). Dissolved iron concentrations exceeded the adjusted mean plus two standard deviations in one month (August), the adjusted mean plus one standard deviation in the second month (September) though did not exceed the adjusted mean plus two standard deviations in the third month (October). As there was not a similar exceedance of these triggers at the control site WOWQ 2 on the Woronora River (37), the results equate to a Level 2 significance level in August and November 2020 and a Level 1 significance level in January to July, September, October and December 2020.

Dissolved manganese concentrations continued to exceed the adjusted baseline mean plus two standard deviations at sampling site ETWQAU from January to December 2020 (Chart 52). Dissolved manganese concentrations at ETWQAU exceeded the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month from January to December 2020 (Chart 52).

There was also an exceedance of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved manganese at sampling site ETWQAU (Chart 53).

Dissolved manganese concentrations at the control site WOWQ2 on the Woronora River exceeded the adjusted mean plus two standard deviations in the first month (March), the adjusted mean plus one standard deviation in the next month (April) and the adjusted mean plus two standard deviations in the third month (May) Between June and December 2020, the dissolved manganese concentrations at the control site WOWQ2 on the Woronora River only exceeded the adjusted mean plus two standard deviations in one month (December 2020) (Appendices B1 and B2).

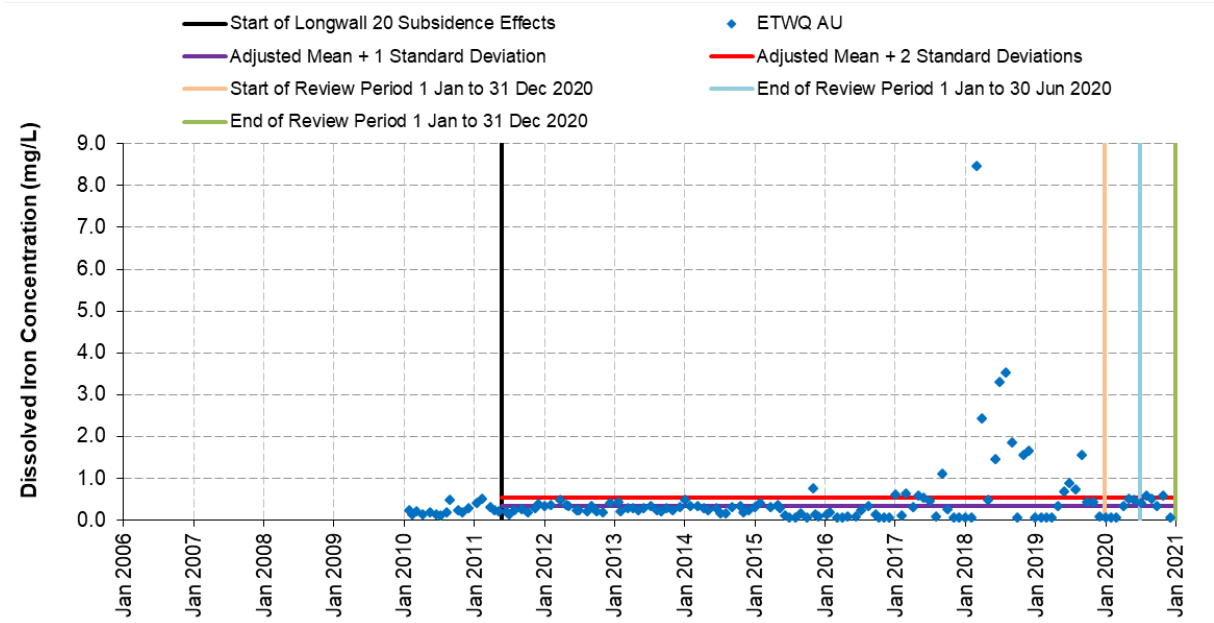


Chart 50 Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

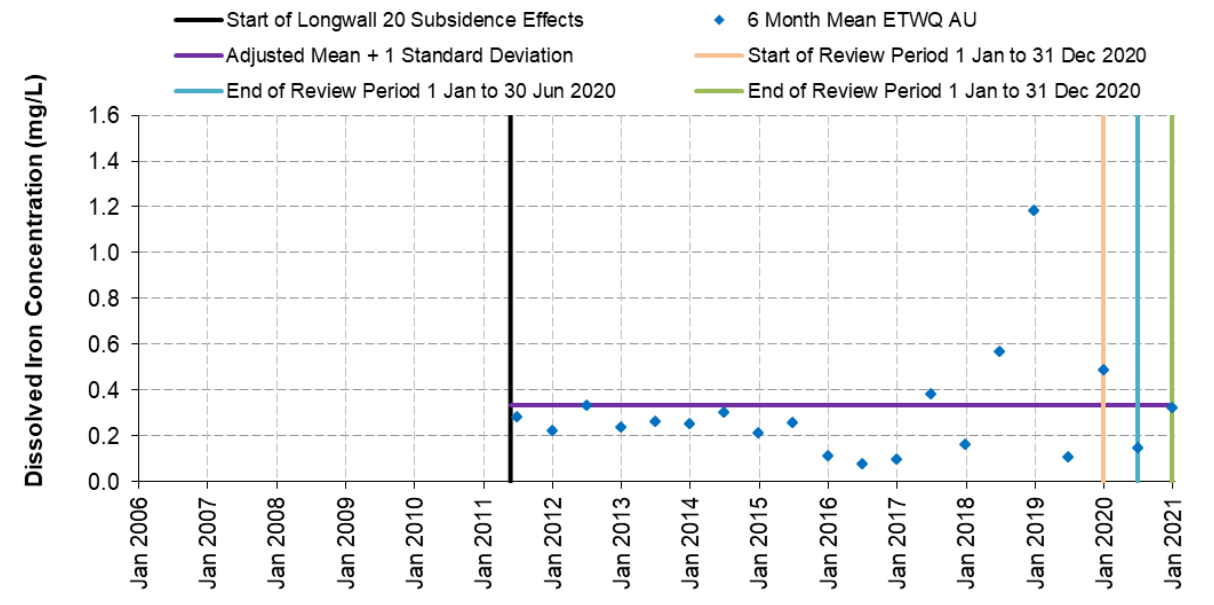


Chart 51 Six Month Means of Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

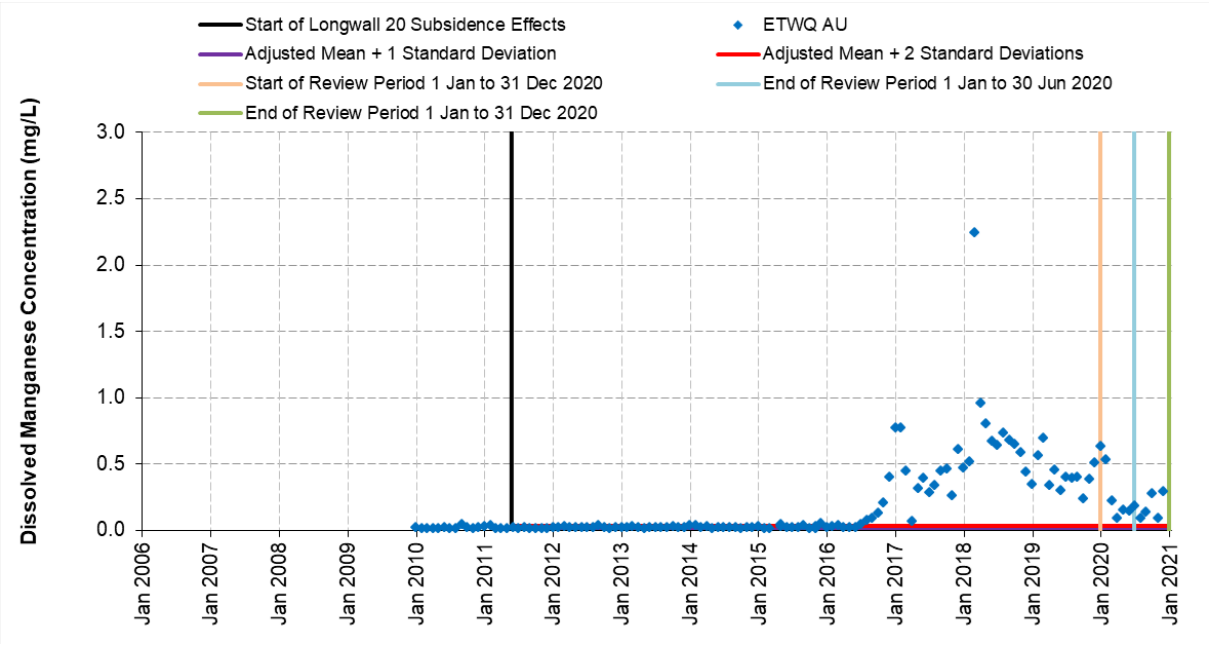


Chart 52 Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

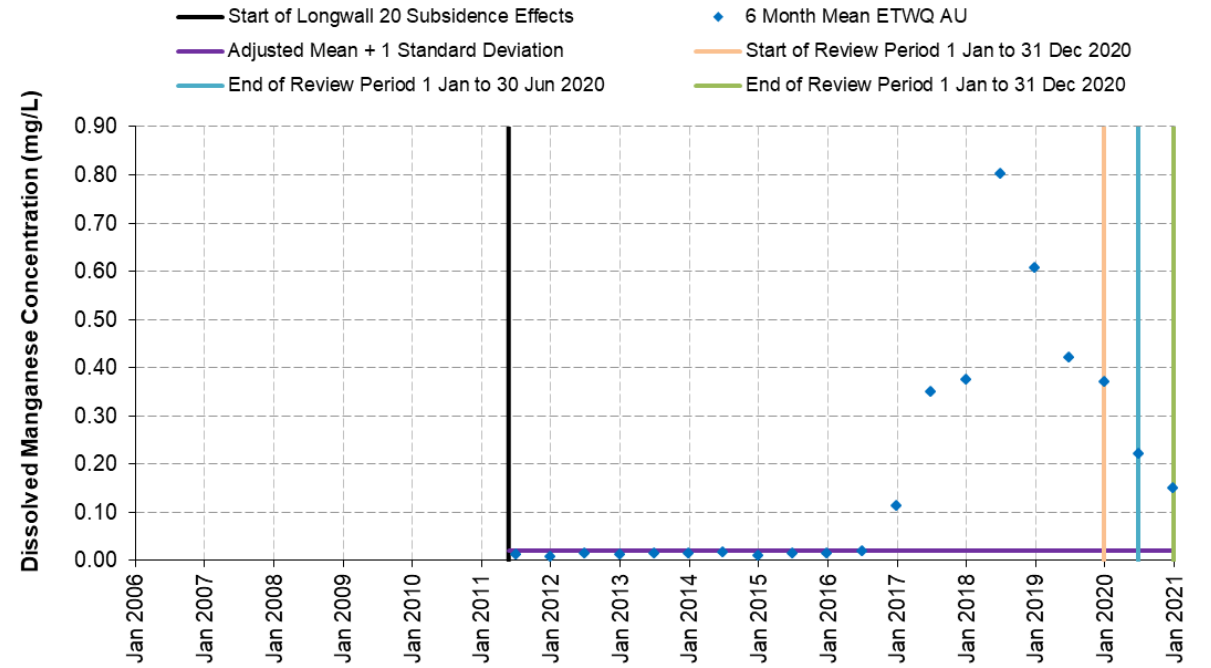


Chart 53 Six Month Means of Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

The cracking and dilation of bedrock and associated diversion of surface flow and leakage of water through rock bars at pools which has occurred on the Eastern Tributary, including at the location of the stream which was the subject of the exceedance of the Eastern Tributary watercourse performance measure (the Eastern Tributary Incident), has resulted in increases in dissolved manganese and iron.

As a result of the performance indicator exceedances for dissolved manganese at site ETWQ AU on the Eastern Tributary in January to December 2020 (except May 2020), assessments were made against the subsidence impact performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir.* The assessments were undertaken by Associate Professor Barry Noller and are provided in Appendix F, and consider the manganese concentrations reaching the Woronora Reservoir. These assessments found there has been a negligible reduction in the quality of water resources reaching the Woronora Reservoir. The watercourse performance measure, *Negligible reduction to the quality of water resources reaching the Woronora Reservoir,* is not considered to have been exceeded (Appendix F).

The environmental consequences of subsidence impacts on water quality were predicted by the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans to be similar to that previously observed at Metropolitan Coal, specifically, transient pulses of iron, manganese and aluminium, which would likely occur following fresh cracking of the stream bed.

Monitoring and analysis of water quality data will continue in accordance with the Longwalls 305-307 Water Management Plan. Metropolitan Coal is committed to the remediation of pools on the Eastern Tributary. It is anticipated that ongoing stream remediation activities (described in Section 10.3.2) will reduce the transfer of iron and manganese from the groundwater to the Eastern Tributary. Metropolitan Coal commenced stream remediation in Q2 2020 in accordance with the approved Metropolitan Coal Stream Remediation Plan.

6.2.5 Woronora Reservoir Water Quality

Metropolitan Coal has sourced water quality data for the Woronora Reservoir (at sampling location DWO1) from WaterNSW in accordance with a data exchange agreement. Results in relation to total iron, aluminium and manganese at levels from 0 m to 9 m below the reservoir surface for Woronora Reservoir throughout the period of record are presented in Charts 54 to 56.

The data presented in Charts 54 to 56 indicate an increase in the concentration of total iron, total aluminium and total manganese recorded in the Woronora Reservoir (0 m to 9 m below the reservoir surface) during the review period. Similarly, intermittent increases are evident over the period of record, including during the baseline period prior to the start of Longwall 20. The maximum concentration of total iron, total aluminium and total manganese recorded during the review period did not exceed the maximum concentration of these constituents recorded during the baseline period prior to the start of Longwall 20.

Water quality data in the Woronora Reservoir is analysed annually and assessed against the following performance indicator:

> *Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations.*

The performance indicator is considered to have been exceeded if data analysis indicates a significant change in the quality of water post-mining, specifically if the current year's duration exceedance curve for a water quality parameter in Woronora Reservoir (total iron, total manganese and total aluminium) is above the baseline 20 year average recurrence interval (ARI) exceedance curve for any range of the duration percentages from 0% to 75%. The results of this assessment are shown on Chart 57, Chart 58 and Chart 59, respectively.

There were no exceedances of the 10 Year or 20 year ARI exceedance curve for total iron (Chart 57). Total aluminium exceeded the 10 Year and 20 Year ARI exceedance curves for 90% and 85% of the review period respectively (Chart 58). Total manganese exceeded the 10 Year ARI exceedance curve for 85% of the review period and the 20 Year ARI for 40% of the review period (Chart 59).

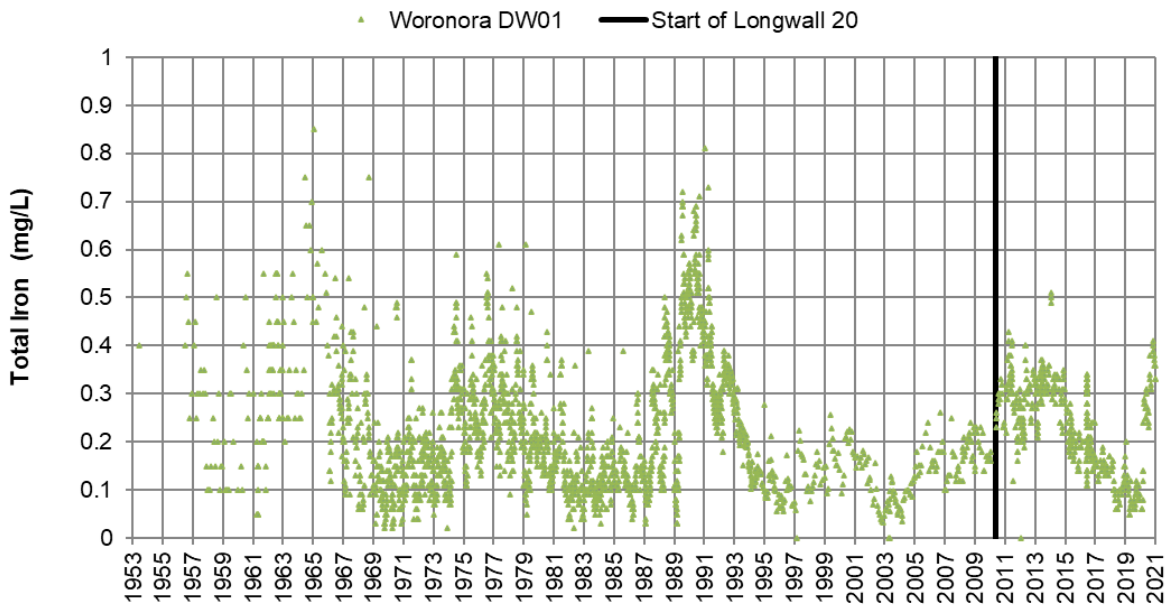


Chart 54 Total Iron Concentration Woronora Reservoir

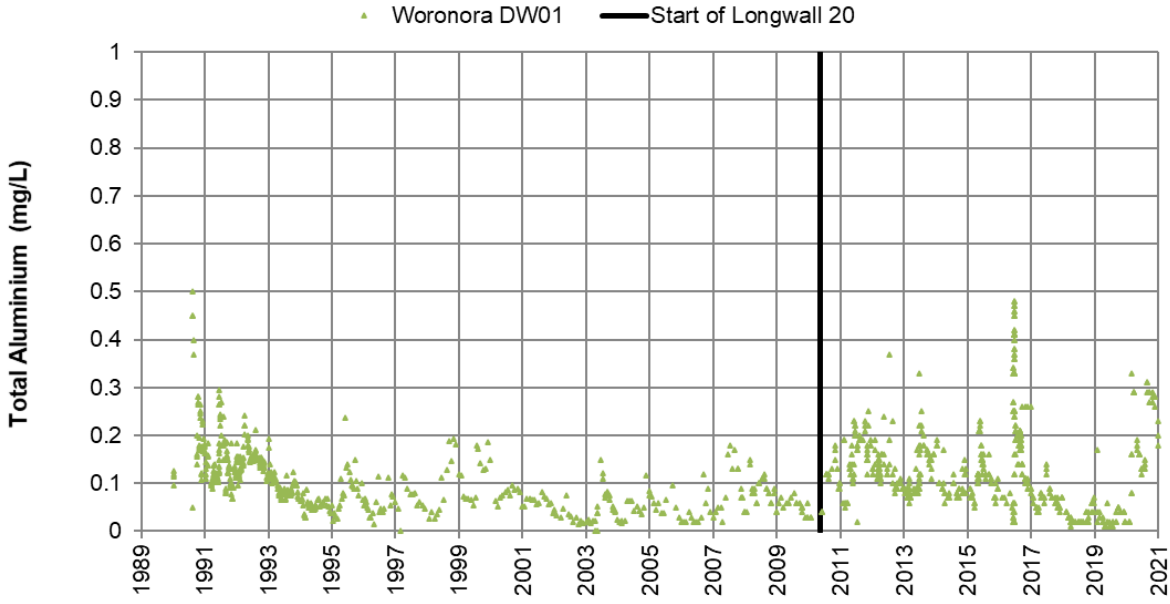


Chart 55 Total Aluminium Concentration Woronora Reservoir

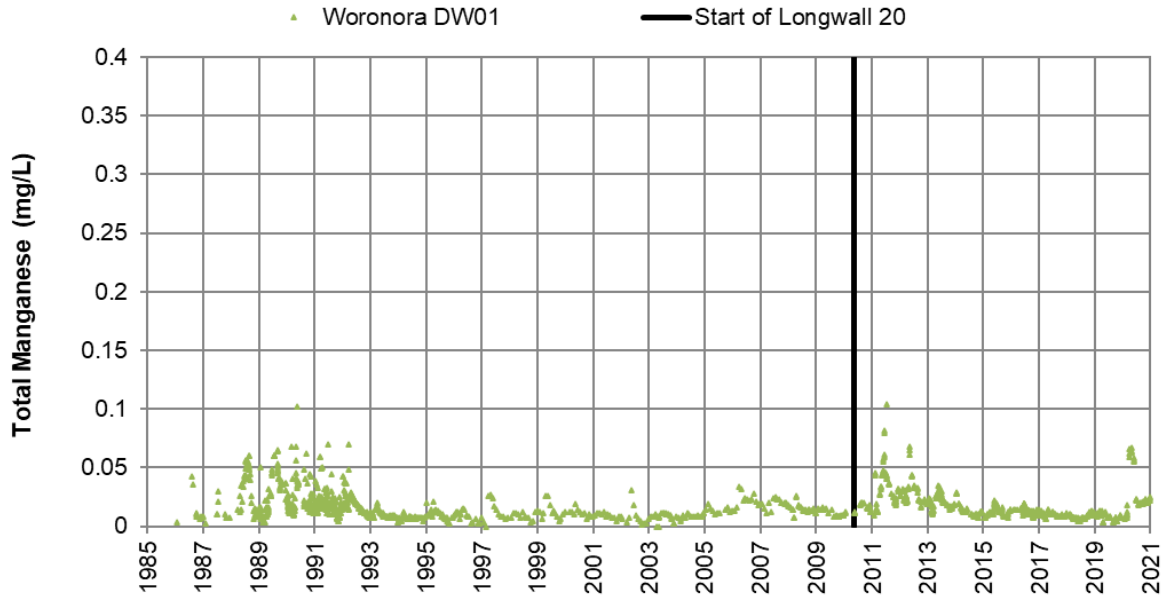


Chart 56 Total Manganese Concentration Woronora Reservoir

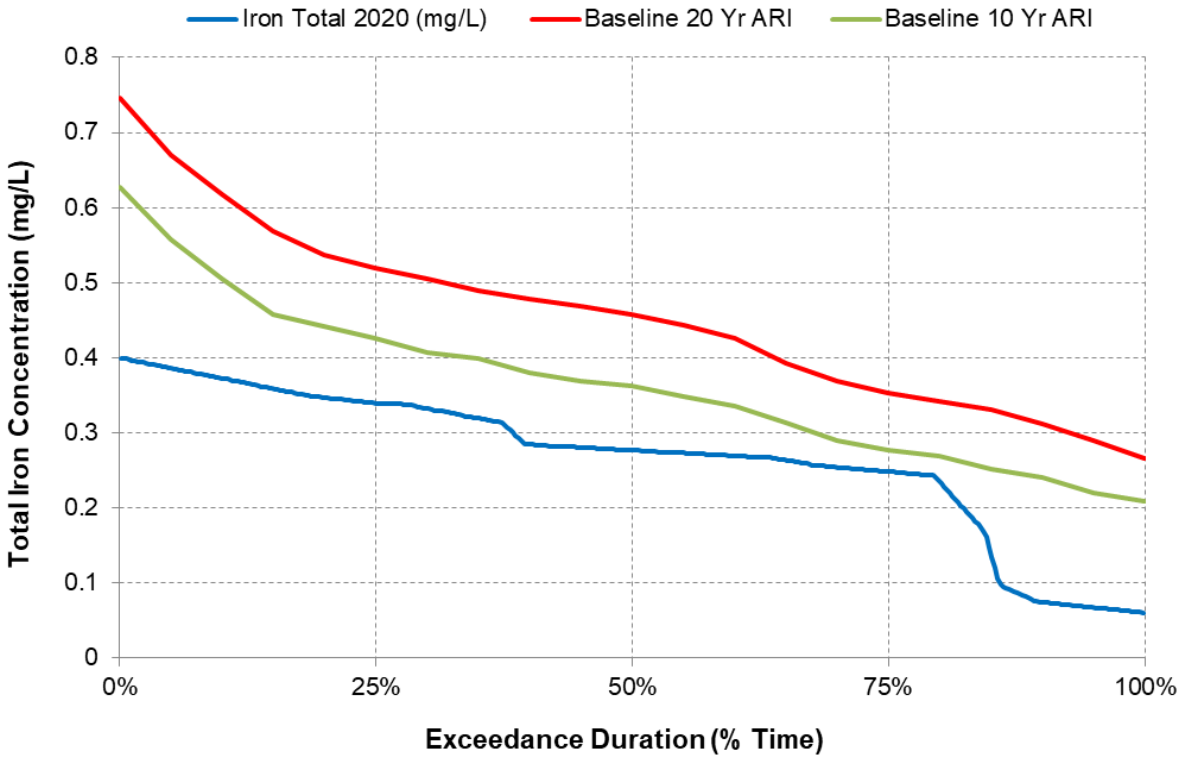


Chart 57 Total Iron Performance Indicator Woronora Reservoir 2020

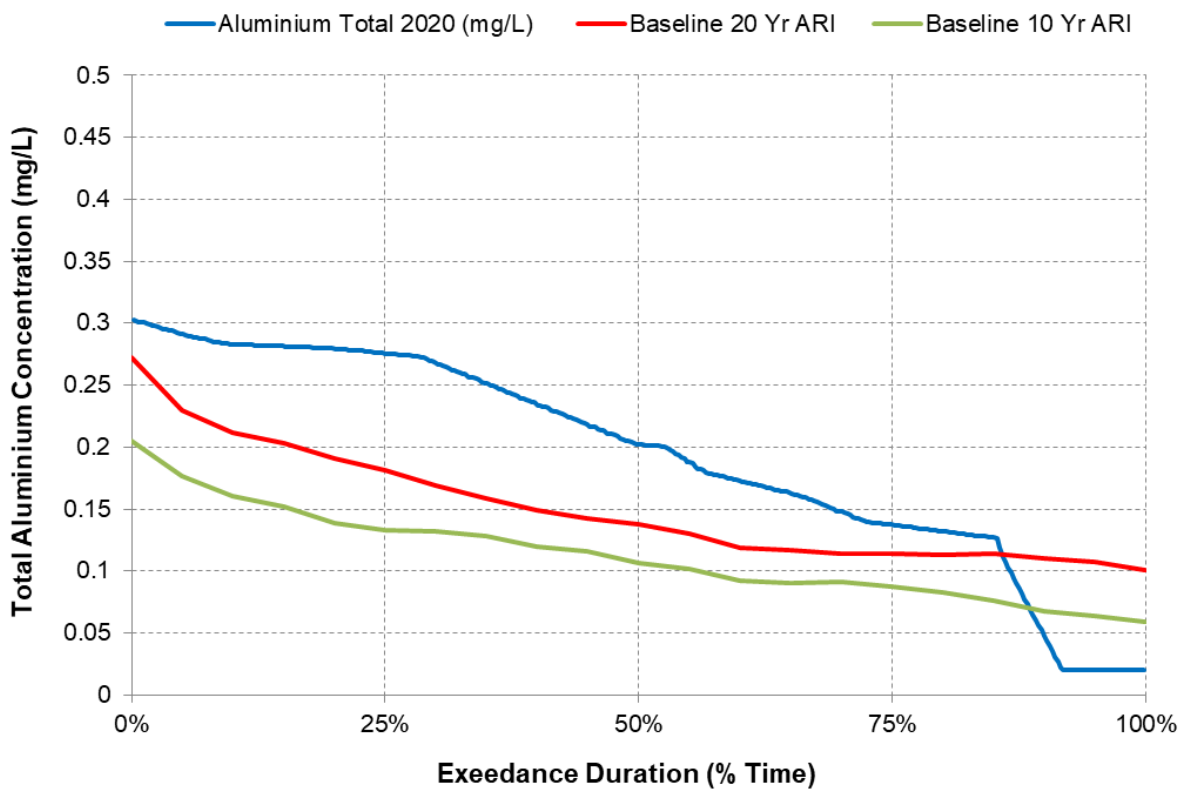


Chart 58 Total Aluminium Performance Indicator Woronora Reservoir 2020

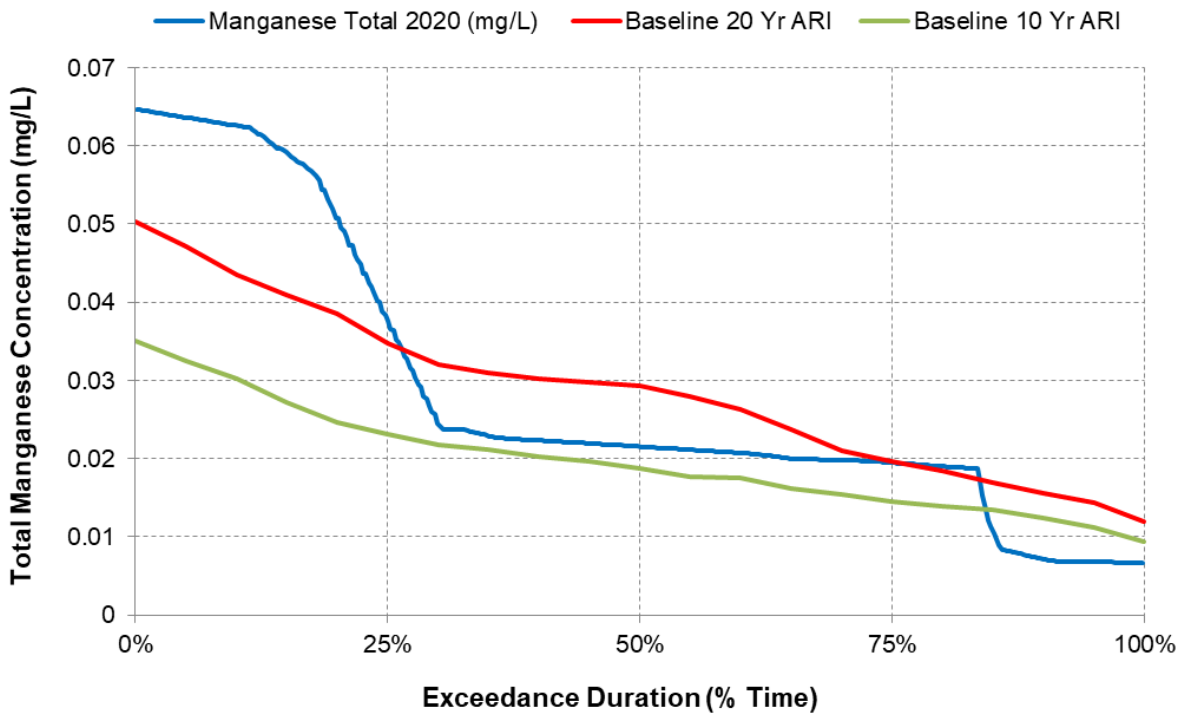


Chart 59 Total Manganese Performance Indicator Woronora Reservoir 2020

The results for total iron equate to a Level 1 significance, while the results for total aluminium and manganese equates to a Level 3 significance.

It is noteworthy that historically high concentrations of dissolved aluminium were recorded at reference sites BCWQ 1 and HCWQ 1 upstream of the Woronora Reservoir during the review period. Historically high concentrations of dissolved aluminium and dissolved manganese were also recorded at control site WOWQ 2 on the Woronora River during the review period.

In accordance with Longwalls 305-307 Water Management Plan, an assessment against the Performance Measure was completed by Hydro Engineering & Consulting and is provided in Appendix B2. The assessment concluded that the performance measure, *Negligible reduction in the water quality of Woronora Reservoir,* has not been exceeded as, the elevated concentrations of total aluminium and manganese at site DW01 in the Woronora Reservoir are unlikely to be related to mining activity and are more likely to be related to elevated concentrations of aluminium and manganese in surface water system inflows from catchments that are outside of the potential influence of mining during and following a period of substantial rainfall which occurred after a prolonged period of low rainfall.

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans predicted the Project would not impact on the performance of the Woronora Reservoir and would have a neutral effect on water quality. The water quality monitoring results are consistent with the predictions.

6.2.6 Swamp Groundwater Levels

Groundwater monitoring of upland swamps has involved the use, where practicable, of paired piezometers, one in the swamp substrate (at approximately 1 m depth) and one in the underlying sandstone (at a depth of approximately 10 m) (Figure 9). Data shows that water levels within the swamps over longwalls are typically perched above those of the local Hawkesbury Sandstone groundwater levels and indicates a separate control on swamp water levels. That is, the swamps are primarily surface water fed systems and generally water infiltrates downwards from the swamps to the groundwater.

Swamp substrate water levels at Swamps 25, 30, 33, 35, 40, 41, 46, 50, 51, 52, 53, 71a, 72, 101, 137a and 137b are used to assess the impact on threatened species, populations, or ecological communities in accordance with the Longwalls 305-307 Biodiversity Management Plan. Swamp substrate water levels are assessed against the following upland swamp groundwater performance indicator:

> *Surface cracking within upland swamps resulting from mine subsidence is not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*.

Swamp Monitoring for Longwalls 20-27

Paired piezometers have been monitored in Swamp 25 overlying Longwalls 20-22, Swamps 28, 30, 33 and 35 overlying Longwalls 23-27, and in control swamps 101, 137a, 137b and Bee Creek Swamp (Figure 9). At Swamp 20 (overlying Longwall 21) and at control swamp Woronora River Swamp 1, multiple piezometers have been monitored (i.e. one swamp substrate piezometer to a depth of approximately 1 m and two sandstone piezometers to depths of approximately 4 and 10 m) (Figure 9).

The upland swamp groundwater performance indicator has been exceeded at Swamp 20 since 2012. Swamp 20 substrate water levels changed from being permanently saturated to being periodically saturated as a result of the passing of Longwall 21 (Chart 60 and Appendices C1 and C2). There is a very strong correlation with rainfall trend at Swamp 20 and control swamp Woronora River Swamp 1 over the period of record. As the rate of decline in the two piezometers is similar from 2013, but different in 2012, it is considered that Longwall 21 caused a mining effect at Swamp 20, but the effects have not been exacerbated by Longwalls 22-27 or Longwalls 301-304 (Appendices C1 and C2). The water levels in both Swamp 20 and control swamp Woronora River Swamp 1 were at the base of the dataloggers for the entirety of 2019, except for a response to rainfall in Swamp 20 in September 2019. During the current reporting period, rainfall events in February and July 2020 saw the substrate piezometer return briefly to within the two standard deviation range, however, water levels decreased below the two standard deviation limit shortly after both events (Chart 60 and Appendices C1 and C2).

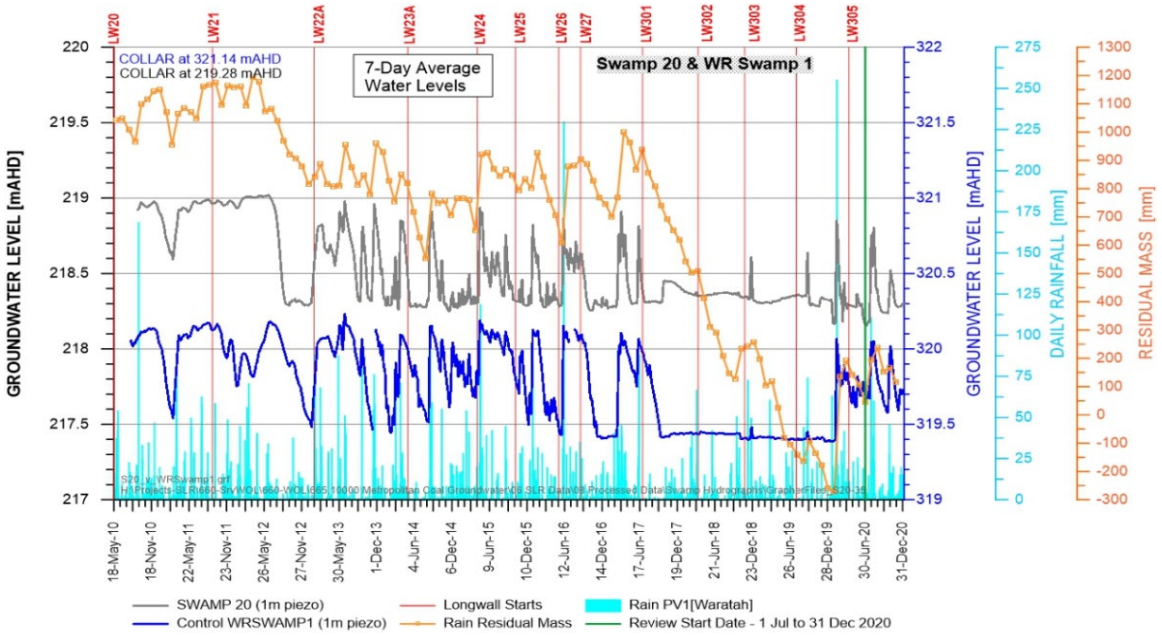


Chart 60 Comparison of Piezometer Responses at Swamp 20 and Woronora River 1 Control Swamp

A mining effect to the substrate water levels of Swamp 28 (overlying Longwall 24) was identified in 2016 based on the incomplete recovery of substrate water levels following rainfall events (Chart 61 and Appendices C1 and C2). Swamp 28 is considered to have an impact from mining of Longwall 25, although no effect on swamp substrate water levels occurred when Longwall 24 passed directly beneath the monitoring site (Appendices C1 and C2). The substrate piezometer at Swamp 28 returned to dry conditions from September 2017, remaining so until the end of December 2019, as did the two control swamp piezometers (Swamps 137a and 137b; Chart 61). With the large rain in February 2020, the water level in both the substrate and the shallow piezometer recovered. The substrate recorded saturated conditions until the end of the reporting period in December 2020, placing the substate groundwater levels above the two standard deviation limit.

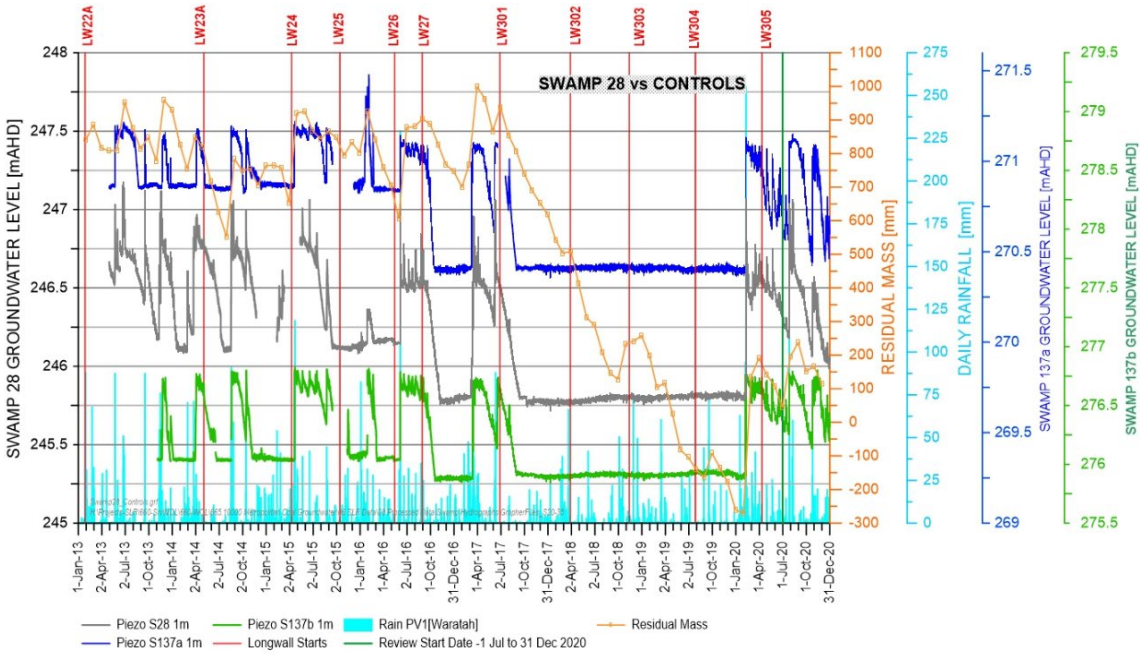


Chart 61 Groundwater Hydrographs at Swamp 28 and Two Control Swamps (137a and 137b)

Swamps Monitoring for Longwalls 301-304

Paired piezometers (i.e. one swamp substrate piezometer and one sandstone piezometer) have been monitored in Swamps 40, 41, 46, 50, 51, 52 and 53 overlying Longwalls 301-304 (Figure 9). As indicated in Section 4.1, Longwall 303 was completed on 2 June 2019 and the extraction of Longwall 304 commenced on 27 July 2019 and was completed on 28 January 2020.

The swamp substrate hydrographs for Swamps 40, 41, 46, 50, 51, 52 and 53 indicate that the correlation of swamp substrate with the rainfall trend is strong (Appendices C1 and C2). Data analysis for the reporting period indicates the seven day moving averages for all swamps was at or above the minimum established for the swamp's length of record (Appendices C1 and C2).

Data analysis for the reporting period indicates the seven-day moving average for all swamps was at or above the minimum established for the swamp's full length of record (Appendices C1 and C2).

Between October 2019 and January 2020 the Swamp 50 10 m piezometer displayed a pronounced decline in water level coinciding with the passage of Longwall 304. After January 2020, groundwater levels have increased in response to increased regional rainfall; however, the maximum recorded groundwater levels during this period are approximately 3 to 4 m below those recorded prior to October 2019. This is an apparent mining affect considered to be related to mine subsidence. The Swamp 50 performance indicator relates to the substrate piezometer and not the shallow sandstone (10 m) piezometer. The seven-day moving average for Swamp 50 was at the minimum established for the swamp's full length of record, below sensor level, during the reporting period (Appendices C1 and C2).

Swamps Monitoring for Longwalls 305-307

Paired piezometers (i.e. one swamp substrate piezometer and one sandstone piezometer) have been monitored in Swamps 71a and 72, relating to Longwalls 305-307 (Figure 9). Mining of Longwall 305 commenced on 12 April 2020 and ceased on 21 November 2020. Mining of Longwalls 306 and 307 has not yet commenced.

Semi-quantitative comparisons of the swamp substrate water levels of Swamps 71a and 72 with control swamps and rainfall records during the review period do not show a definitive mining effect and the dry conditions are regarded as a natural response to reduced rainfall (Appendices C1 and C2).

The key potential subsidence impacts and environmental consequences on perched groundwater systems described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans and Biodiversity Management Plans, included:

- Any cracking of the bedrock within upland swamps is expected to be isolated and of a minor nature, due to the relatively low magnitudes of the predicted strains and the relatively high depths of cover.
- Surface cracking resulting from mine subsidence within the upland swamps is not expected to result in an increase in the vertical movement of water from the perched water table into the regional aquifer as the sandstone bedrock is massive in structure and permeability decreases with depth.
- It is expected that any surface cracking that may occur would be superficial in nature (i.e. would be relatively shallow) and would terminate within the unsaturated part of the low permeability sandstone. Any changes in swamp water levels as a result of cracking are expected to be immeasurable when compared to the scale of seasonal and even individual rainfall event based changes in swamp groundwater levels.
- Whilst swamp grades vary naturally, the predicted maximum mining-induced tilts are generally orders of magnitude lower than the existing natural grades within the swamps. The predicted tilts would not have any significant effect on the localised or overall gradient of the swamps or the flow of water. Any minor mining-induced tilting of the scale and nature predicted is not expected to significantly increase lateral surface water movements which are small in relation to the other components in the swamp water balance.

No change to the fundamental surface hydrological processes and upland swamp vegetation were expected within upland swamps associated with Longwalls 301-307.

In relation to impacts of the Project on upland swamps, the NSW Planning Assessment Commission (2009) concluded that the mining parameters were such that:

- for most swamps in the Project Area, there was low risk of negative environmental consequences; and
- that there was a very low risk that a significant number of swamps would suffer such consequences.

While the water lost from Swamp 20 and Swamp 28 was retained in the unsaturated sandstone above the regional water table, the changes in swamp water levels as a result of cracking are measurable when compared to seasonal individual rainfall event based changes in swamp groundwater levels. There is currently no sign that the vegetation in Swamp 20 is being impacted by the changed hydrological conditions, however, the vegetation monitoring results suggest that the changes in vegetation occurring in Swamp 28 were significantly different to changes in the control swamps from autumn 2017 to spring 2019 (refer Section 6.3.1).

6.2.7 Shallow Groundwater Levels

Shallow Groundwater Level Sites near Streams

Continuous water level monitoring of shallow groundwater levels has been conducted at sites WRGW1, WRGW2 and WRGW7 along Waratah Rivulet and sites ETGW1[11] and ETGW2 on the Eastern Tributary (Figure 10).

[11] Site ETGW1 was unable to be sampled since August 2017.

At the time of passage of the Longwall 21 mining face past the piezometer sites WRGW1 and WRGW2 on the Waratah Rivulet (March 2012), the groundwater levels dropped by approximately 1 m (Chart 62). Since March 2012, groundwater levels recorded at WRGW1 and WRGW2 have fluctuated in response to seasonal rainfall variations with a seasonal (dry) minimum that is approximately 0.75 m below previous levels (Chart 62 and Appendices C1 and C2). From January to June 2018 the rainfall residual mass continued to decline and water levels at WRGW1 and WRGW2 spiked following rainfall in March 2018. From July 2018, the water level trend followed the rainfall residual mass trend, declining from July to September 2018 and increasing from October to December 2018. During January to June 2019, the water level correlated with the daily rainfall including a large spike following the March rainfall event, and generally correlated with the residual mass curve except for January and February, when following rainfall in December 2018 the water level increased while the monthly rainfall was below average. The water levels have not returned to pre-March 2012 levels.

The water levels at both WRGW1 and WRGW2 sites during the reporting period displayed the usual correlation with the monthly rainfall with a large spike at the large rain event in February 2020.

Shallow groundwater levels at site WRGW7 remained correlated with rainfall trends and unaffected by mining during the reporting period (Chart 63; Appendices C1 and C2).

At the Eastern Tributary sites ETGW1 and ETGW2, shallow groundwater levels have previously followed the rainfall trends closely (Chart 64) and have continued to show a close correlation during the reporting period. The variations at these sites are unrelated to mining (Appendices C1 and C2). Although Woronora Reservoir water levels also respond to rainfall with a similar pattern, a groundwater hydraulic gradient is maintained towards the reservoir because the groundwater levels are 3-8 m higher than the dynamic reservoir levels, which were observed to be 160-165 mAHD during the reporting period (Appendices C1 and C2).

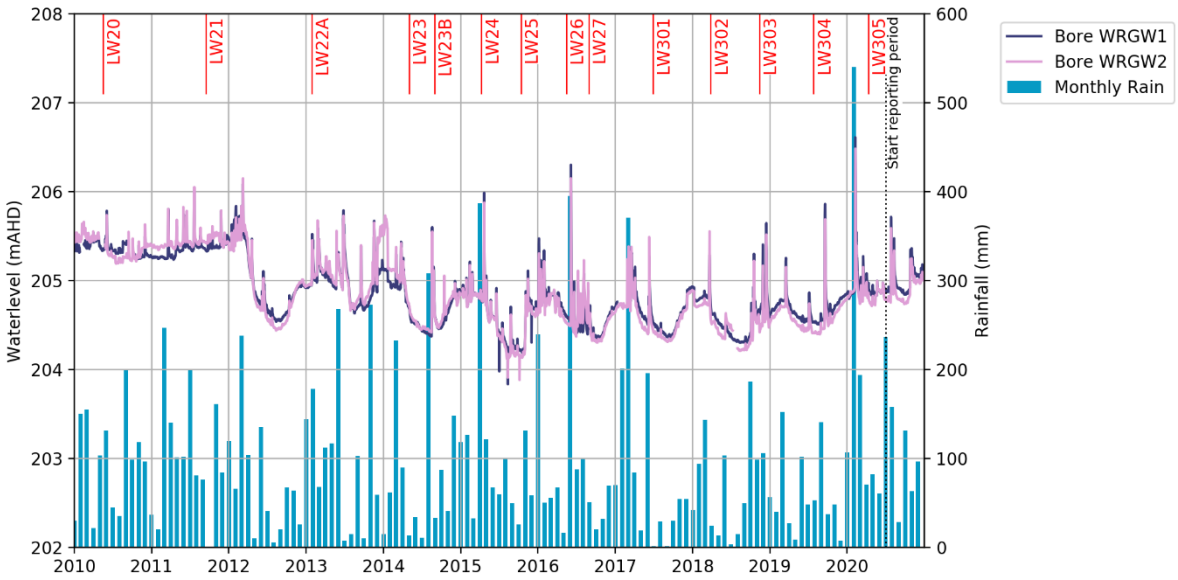


Chart 62 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW1 and WRGW2

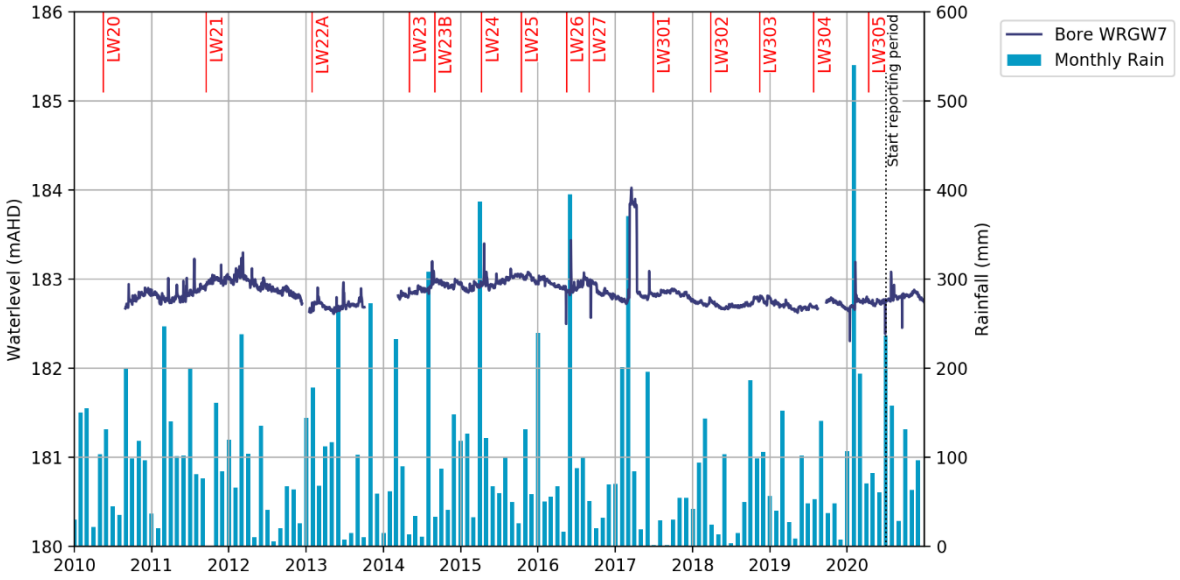


Chart 63 Shallow Groundwater Hydrographs on Waratah Rivulet at WRGW7

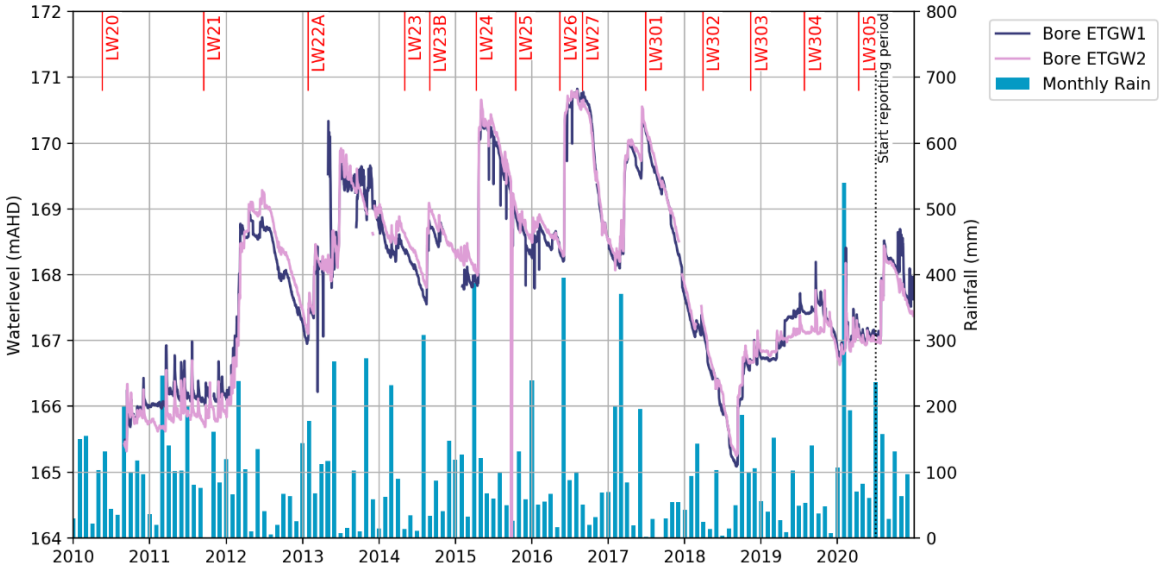


Chart 64 Shallow Groundwater Hydrographs on Eastern Tributary at ETGW1 and ETGW2

Shallow Groundwater Transect

Continuous groundwater level monitoring has also been conducted at an approximately east-west transect of bores (sites T1, T2, T3, T4, T5 and T6) located above Longwalls 305-307 (T1-T5) and to the west on the other side of Woronora reservoir (T6). The water levels of the six bores, the Woronora Reservoir Level (WRL) and the monthly rainfall are shown in Chart 65.

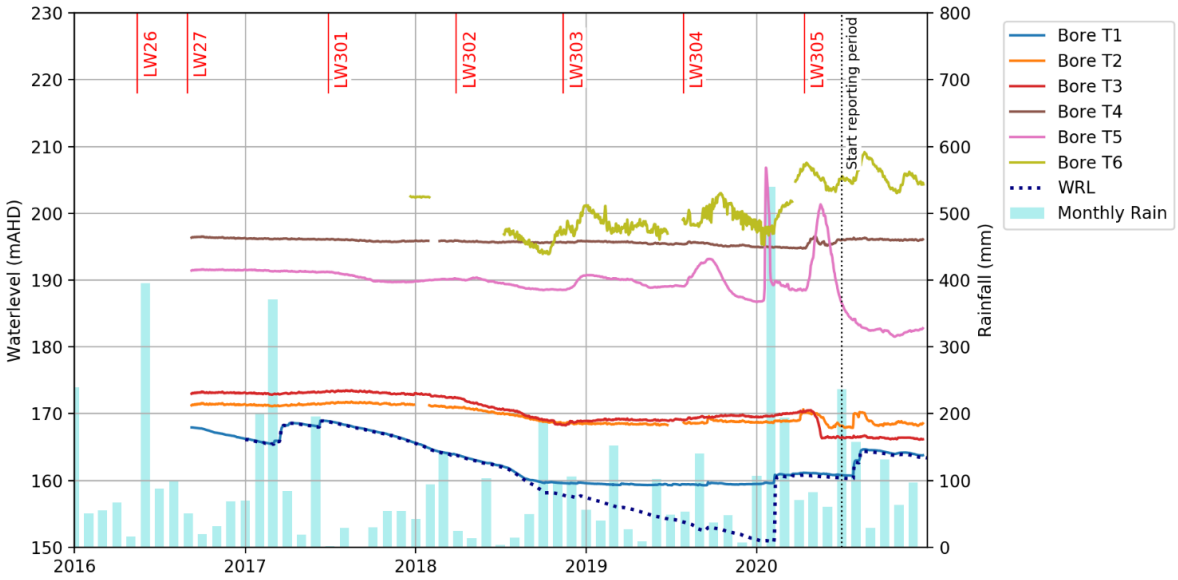


Chart 65 Groundwater Level in Bores T1 to T6

Bore T1, the closest of the five bores to Woronora Reservoir, has almost identical water levels to those measured in the reservoir, until an old weir across the rivulet is exposed at low water levels. In that case, T1 water levels are maintained a little below the water level in the weir pool, but above the WRL (Appendices C1 and C2).

Bores T2 and T3 showed fairly stable water levels in line with previous observations at the start of the reporting period. Water levels in both bores started decreasing in May 2020, with an abrupt drop at T3, due to the passage of the Longwall 305 mining face at that time. Bore T2 has since recovered a little with the rainfall in August 2020. However, the bore T3 has been dry since May 2020. Although there appears to be a permanent lowering of the water table at T3 due to mining, a positive hydraulic gradient towards the reservoir is maintained (Appendices C1 and C2).

Bore T4 remains anomalous, as its head has always been higher than the head at upgradient site T5. This is unlikely to be a groundwater divide as it is not related to the topographic ridge well upgradient (Appendices C1 and C2).

In the first half of 2020, the water levels at T5 showed a high variability. The water level increased by 15 m in early January 2020 and decreased in late January 2020. This spike in water level was unrelated to the large rainfall event in February 2020. Since April 2020, the water levels increased again, this time over a longer period and have again decreased. The second spike is reflected in the observations for T4, which shows a lower rise and fall at the same time. The broad rises in T5 water levels in 2019 and 2020 are compressive effects associated with the passage of Longwalls 304 and 305, respectively. During this reporting period, the water levels at T5 further declined in July and August 2020 and have since been stable at a level of approximately 182 mAHD, with evidence of slight recovery coincident with rainfall events. Although there appears to be a permanent lowering of the water table at this site due to mining, a positive hydraulic gradient towards the reservoir is maintained (Appendices C1 and C2).

Bore T6 lies on the western side of Woronora Reservoir at a higher elevation than the eastern transect. Unlike the eastern bores T1 to T5, it responds readily to rainfall recharge and its dynamics closely correlate with the rainfall trends (Appendices C1 and C2).

The hydraulic gradient at transect bores T2, T3 and T5 has been assessed against the performance indicators below in accordance with the Longwalls 305-307 Water Management Plan:

> *The hydraulic gradient to the Woronora Reservoir from transect bore T2 is reduced by no more than 10% from that measured on 30 June 2017.*
>
> *The hydraulic gradient to the Woronora Reservoir from transect bore T3 is reduced by no more than 10% from that measured on 30 June 2017.*
>
> *The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017.*

The performance indicators are designed to provide an early warning for assessment of negligible leakage from the Woronora Reservoir. Leakage from the Woronora Reservoir to the surrounding groundwater environment would occur if there is a reversal of hydraulic gradient (i.e. when the water table in surrounding piezometers is below the water level in the Woronora Reservoir).

The hydraulic gradient from transect bores T2 and T3 to the WRL over the reporting period is presented on Charts 66 and 67, respectively. The hydraulic gradient is compared to the relevant trigger level in the Longwalls 305-307 Water Management Plan TARP for no connective cracking between the surface and the mine and negligible leakage from Woronora Reservoir. For T2, the performance can be classified in Level 1 during the entire reporting period, while T3 can be classified as Level 1 at the start of the reporting period, before a steep descent into Level 3 during late-July to early-August 2020, where the performance has remained since (Chart 67).

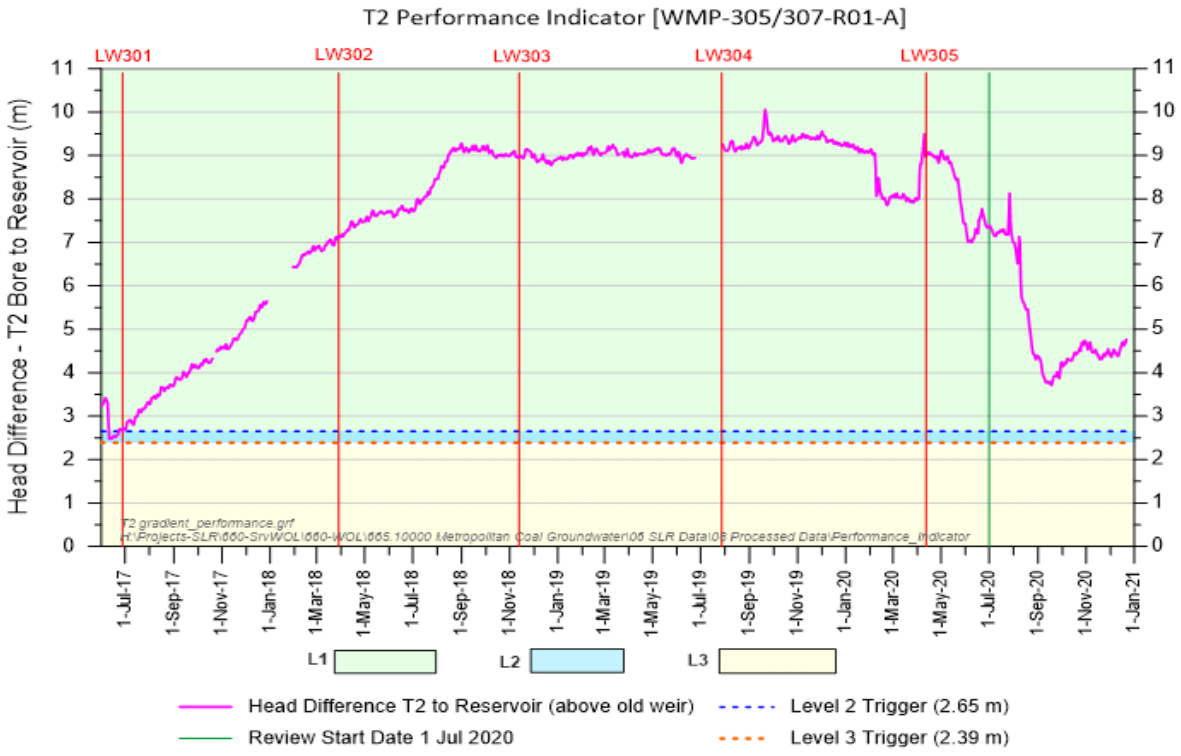


Chart 66 Hydraulic Gradient Measured from Bore T2 to WRL

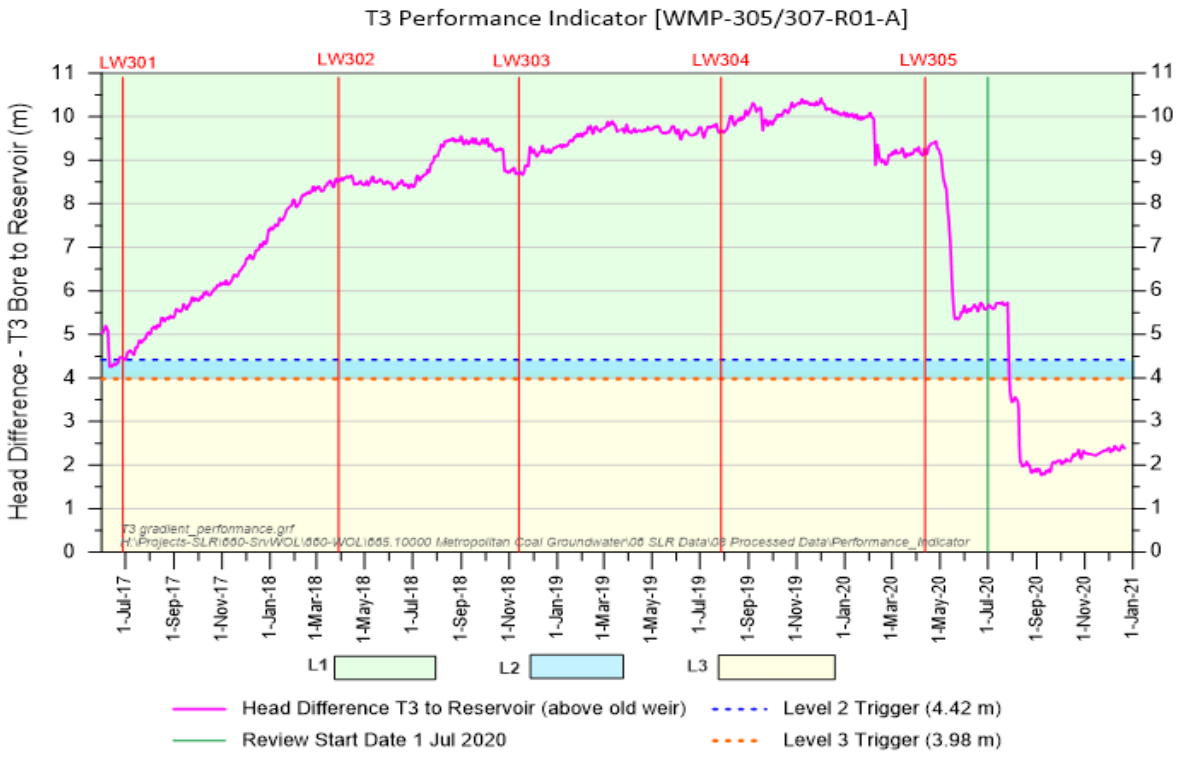


Chart 67 Hydraulic Gradient Measured from Bore T3 to WRL

The hydraulic gradient from transect bore T5 to transect bore T3 over the reporting period is presented on Chart 68. The hydraulic gradient indicator started within the Level 1 trigger (green area) at the start of the reporting period and subsequently continued further decreasing from the end of the last reporting period into the Level 2 and Level 3 trigger (blue and yellow areas respectively), fluctuating between the two trigger levels until the indicator started to rise back again in early November 2020, ending the 2020 reporting period at the Level 2 trigger.

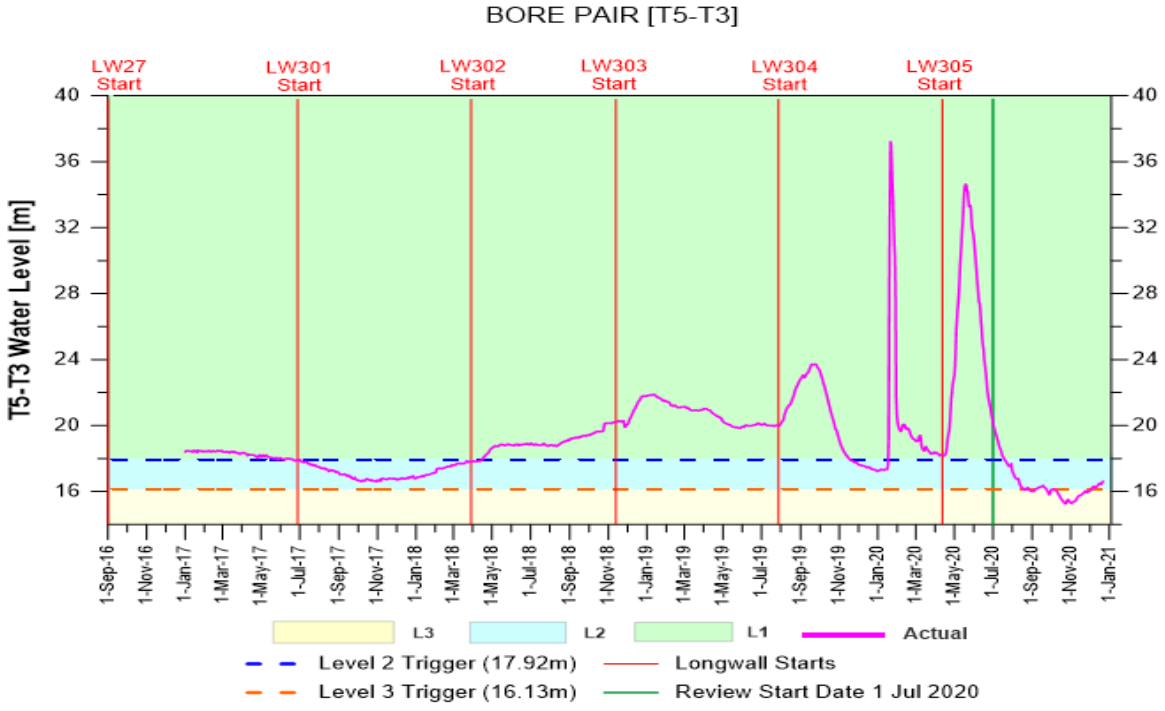


Chart 68 Hydraulic Gradient Measured from Bore T5 to T3

The exceedance of the Level 3 TARP performance indicators for both bore T3 and bores T5 toT3 has been assessed by SLR (2020), and is provided as Appendix G. In accordance with the Longwalls 305-307 Water Management Plan, a copy of this assessment was provided to the DPIE, WaterNSW and the Natural Resources Access Regulator on 8 October 2020.

The findings of SLR (2020) are summarised below:

- Although an exceedance has occurred for the gradient between bore T3 and the reservoir, there has not been a reversal of gradient from T3 to the Woronora Reservoir that would induce leakage from the reservoir (the performance measure) because the intervening bore T2 still shows a hydraulic gradient towards the reservoir. This suggests the depressurisation at bore T3 is localised.
- The exceedance of the Level 3 trigger for the bores T5 to T3 performance indicator is a result of a slow decline of water levels in T5, coupled with the depressurisation observed in T3, causing the head difference between the two bores to slowly decline. From the behaviour observed at F6GW4A following undermining, it is to be expected that the water level at T5 should rise gradually over the next 6 to 9 months, thereby increasing the bores T5 to T3 head difference and restoring the performance indicator to Level 2 or Level 1.

The key potential subsidence impacts and environmental consequences on shallow groundwater systems and inflows to the Woronora Reservoir described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans included:

- Permanent mining-induced changes in the groundwater levels of shallow aquifers in connection with streams and ecosystems at Metropolitan Coal would not occur to any significant degree (i.e. the direction of shallow groundwater system flow [i.e. in the Hawkesbury Sandstone] has not been altered by mining).
- As there is an alternation of thick sandstone/claystone lithologies, there is a constrained zone in the overburden that remains rigid and acts as a bridge which isolates shallow and deep aquifers. At the substantial depths of cover of the Project, there would not be connective cracking from the mined seam to the surface.
- The depressurisation effects described below for the deep groundwater system would not propagate to the Hawkesbury Sandstone where the shallow groundwater system is located. As a result, no measurable impacts on registered bores in the wider Project area and surrounds would be expected.

Based on the analysis of the conceptual groundwater system, there would be negligible loss of groundwater yield to the Woronora Reservoir. This is reinforced by the groundwater modelling which indicates negligible reduction in cumulative average inflows to the Woronora Reservoir. In relation to the potential loss of catchment yield, the NSW Planning Assessment Commission (2009) was of the view that the risk of any significant loss is very low unless a major geological discontinuity is encountered during mining that provides a direct hydraulic connection between the surface and the mine workings.

The groundwater monitoring results are consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report, and the Metropolitan Coal Water Management Plans.

6.2.8 Deep Groundwater Levels

Immediately above a mined coal seam, rocks collapse into the void created by the removal of coal to form a caved zone and a fractured zone develops above the caved zone. This causes aquifer properties to change (e.g. permeability and porosity) and results in a higher vertical permeability as a result of mining.

A three-dimensional numerical model of groundwater flow was developed in 2008 for the Project EA. The groundwater model was recalibrated in December 2012 for the Preferred Project Layout by revising the hydraulic conductivities in the Hawkesbury Sandstone and the Bald Hill Claystone. At this time, two extra layers were added to the Hawkesbury Sandstone section to improve resolution of the vertical hydraulic gradient in the shallow groundwater system. The model simulations are based on initial conditions at the end of Longwall 14, consistent with the Project EA assessment (Heritage Computing, 2008).

Transient calibration was undertaken to incorporate Metropolitan Coal updates to the geological model. The revised model includes an update of the topographical surface and geological interfaces, the addition of two model layers below the Bulli Seam and updated estimates of the fractured zone height. A report for the updated model has been prepared (HydroSimulations, 2018a) and this model has been used for the assessment of Longwall 304 and Longwalls 305-307. Model outputs have been examined every six months for review of environmental performance.

6.2.8.1 Time Series Head Variations and Vertical Head Differences

Continuous deep groundwater level monitoring is conducted at bores 9HGW0 (Longwall 10 Goaf Hole), 9EGW1B, 9FGW1A, 9GGW1-80, 9GGW2B, 9HGW1B, PM02, PM01, 9EGW2A, PM03, PHGW1B, PHGW2A, F6GW3, F6GW4, 302GW01, TBS02 and TBS03 (Figure 10) in accordance with the Longwalls 305-307 Water Management Plan. The time-series head variations and vertical head differences for these bores have been examined (Appendices C1 and C2).

The time-series head variations and vertical head differences for these bores have been examined, with the following outcomes:

- sites close to current mining show significant depressurisation with depth, consistent with the Project EA (Helensburgh Coal Pty Ltd, 2008); and
- sites close to old workings at Helensburgh show substantial depressurisation with depth, consistent with the Project EA.

The closest monitoring sites are located within 600 m from Longwalls 305-307 Secondary Extraction, and include bores F6GW4A, TBS03, 302GW01 and TB02 (east of Longwall 305), bore PHGW2A (north of Longwall 305), bore 9GGW2B (above 300-series mains and to the south of Longwall 305) and 9EGW2A (west of Longwall 305). Located outside of that area, but still in proximity are bores PHGW1B (north) and F6GW3A (east). (Figure 10 and Appendices C1 and C2).

Bore F6GW4A

The time-series record for bore F6GW4A is shown on Chart 69. Bore F6GW4A overlies the chain pillars between Longwalls 303 and 304. This bore is two panel widths from Longwall 301 and one panel width from Longwall 302. The respective mining faces came closest to the bore in late-September 2017 and late-May 2018, at which times distinct features are evident on all hydrographs. The passage of Longwall 301 caused mild responses, generally short-term increases in head, while the passage of Longwall 302 caused sharp cusp-like features on the Hawkesbury Sandstone hydrographs, sustained rises in the upper and mid Bulgo Sandstone, and strong declines in the three deepest piezometers. In January 2019, F6GW4A was undermined by Longwall 303 causing the depressurisation and disabling of the six deepest sensors (i.e. 139 metres below ground level [mbgl], 201 mbgl, 278 mbgl, 362 mbgl, 440 mbgl and 512 mbgl). The upper and mid Hawkesbury Sandstone piezometers (50 mbgl and 90 mbgl) also displayed a lowering of groundwater head following the passage of Longwall 303; however, they showed no significant decline after the passage of Longwall 304 and 305.

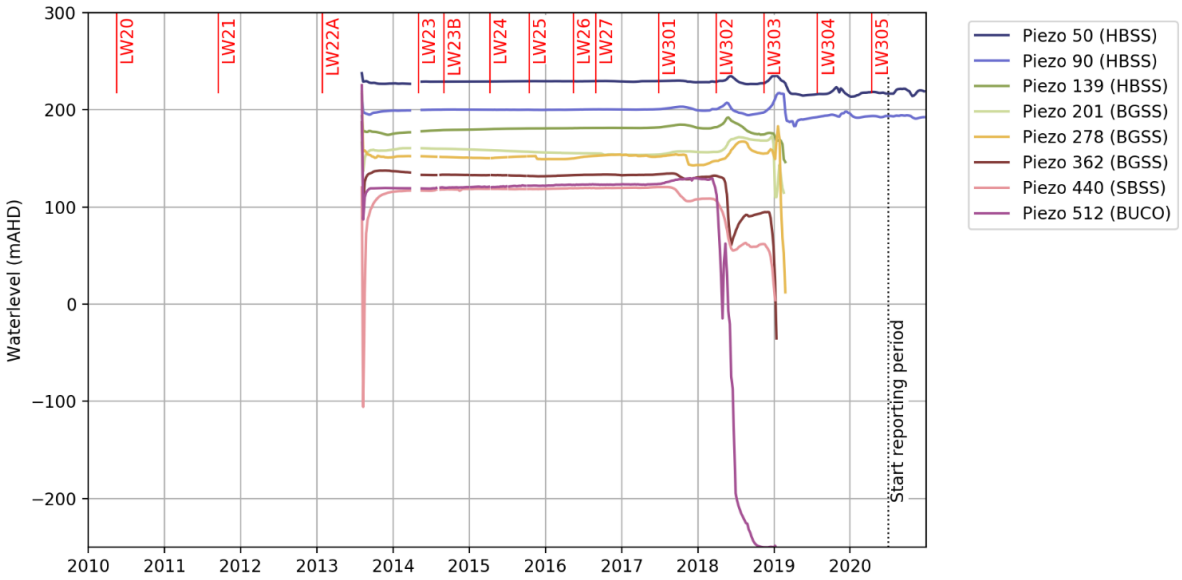


Chart 69 Time Variations in Potentiometric Heads at F6GW4A

Bores 302GW01, TBS02 and TBS03

Additional groundwater monitoring bores were installed in the third quarter of 2017 as a component of the WRIS including a goaf hole over Longwall 302 (302GW01). Metropolitan Coal installed five copper wire and four optical fibre piezometers in hole 302GW01 to monitor groundwater as longwall extraction progressed. Unfortunately, most of the sensor cables were severed by ground movement as Longwall 302 passed under the site.

Metropolitan Coal also installed additional bores over Longwall 302 (TBS02 80, TBS02 250 and TBS02 15) and Longwall 303 (TBS03 230 and TBS03 15). The two deep holes each have vibrating wire piezometers installed 15 m above and below the Bald Hill Claystone (192 mbgl and 243 mbgl at TBS02 250, 250 mbgl, 162 mbgl and 213 mbgl at TBS03 230) (Chart 70). Two standpipes at 90 mbgl and 190 mbgl were installed in February 2019 over Longwall 302; currently both are recording data (Chart 70).

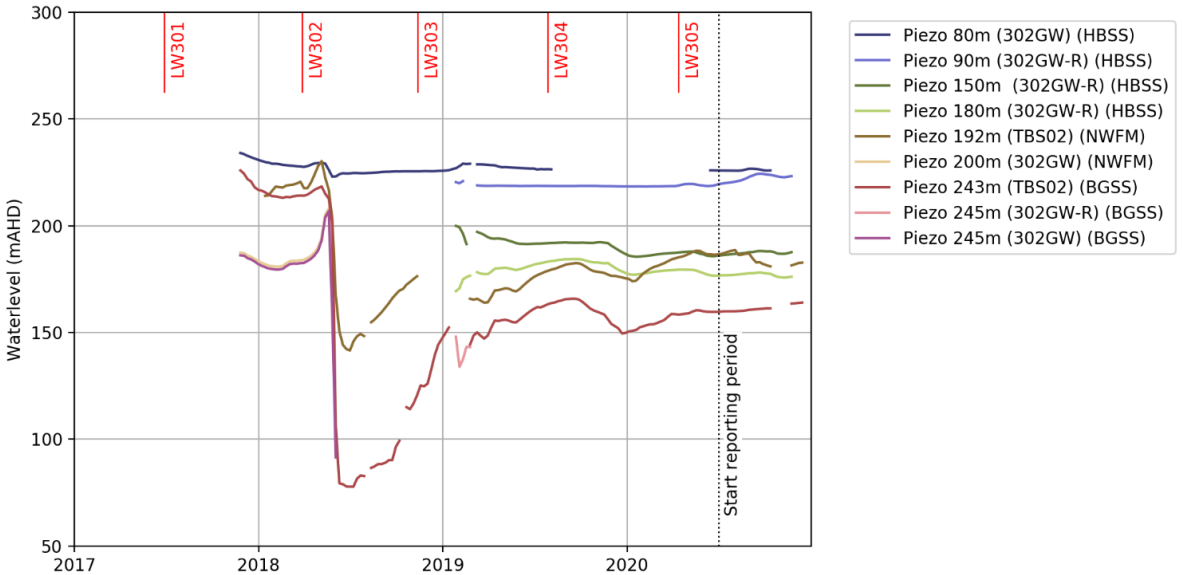


Chart 70 Time Variations in Potentiometric Heads at 302GW01 and TB02

The TBS02 piezometer at 192 mbgl failed in November 2018 (following passing of Longwall 302) and the piezometer at 243 mbgl failed in January 2019 (following passing of Longwall 303). The TBS02 replacement bore (piezometers at 90 mbgl, 150 mbgl, 180 mbgl and 245 mbgl) was installed and commenced monitoring on 24 January 2019; three of the four piezometers are recording data. The VWP piezometer at 245 mbgl failed in February 2019. In June 2020, the original TBS02 bore was found to have resumed reporting measurements from the two sensors downhole.

The time-series record for the monitoring bores 302GW01 and TBS02 is shown in Chart 70. Groundwater pressures were first recorded at bore 302GW01 in November 2017 when the mining face was 450 m to the south in the adjacent Longwall 301, heading away from 302GW01. During the extraction of Longwall 302, the heads in 302GW01 commenced rising in all but the shallowest piezometer (at 80 m) when the mining face was about 300 m from the bore. The rises of 10-60 m are expected to be due to dynamic compression of the rock matrix as the mining face approached the bore. About a week before the mining face passed beneath the bore on 25 May 2018, the groundwater heads declined substantially, except for the shallowest piezometer at 80 m depth. About a week after the crossing, eight of the nine sensors ceased to function. The active vibrating wire piezometer (VWP) at 80 mbgl piezometer lost communication at the end of July 2019. It is probable that the sensor cables sheared off at the shear planes identified by the TBS02 inclinometer surveys. However, the two corresponding sensors in bore TBS02, 20 m away, survived the crossing and continued to record meaningful data. The observed drawdowns were about 80 m at the base of the Hawkesbury Sandstone and about 140 m at the top of the Bulgo Sandstone to June 2018.

The water levels of the remaining active sensors showed slightly increasing trends, except for Piezo 192 (Newport Formation), which showed a small decrease.

Bore PHGW2A

Chart 71 shows the groundwater levels at site PHGW2A. A connection failure prevented upload of data for sensors in PHGW2A in 2016. Sensors have now been reinstated. At the start of the reporting period, all of the deeper piezometers had come out of a period of an increase. With the start of Longwall 305, all piezometers showed a sudden increase, more pronounced with depth. This is likely a compression effect from mining Longwall 305, similar to the effects observed at bore T5 about 400 m to the south-east. The increasing water levels continued on from the last reporting period; however, the rate of increase was smaller during this reporting period. Piezometers at 97.5 mbgl and 135 mbgl (both Hawkesbury Sandstone) showed a small increase after the start of LW305 and have since decreased.

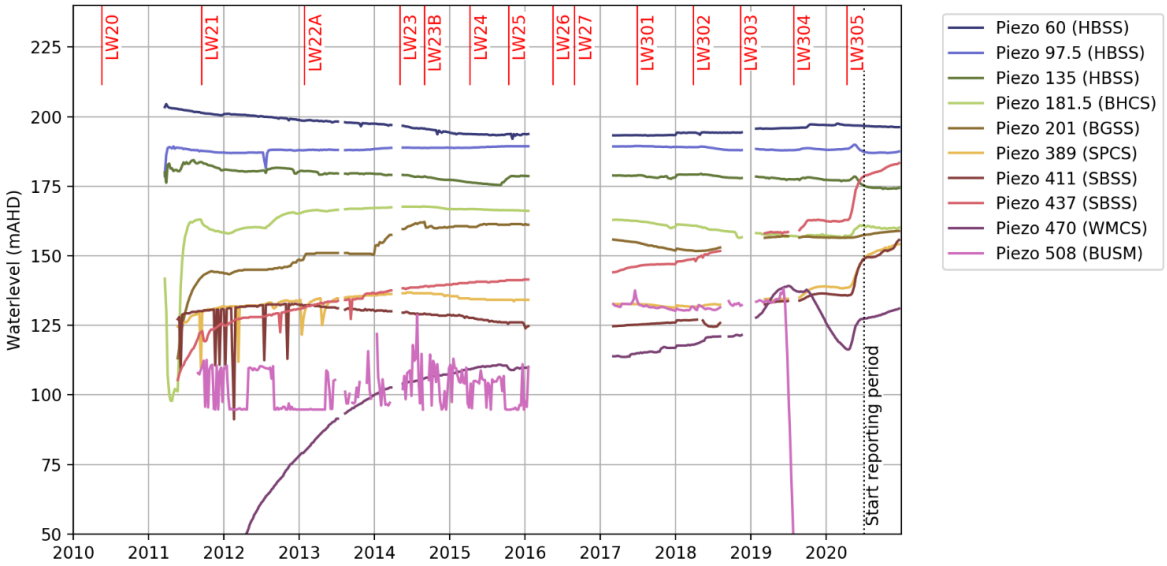


Chart 71 Time Variations in Potentiometric Heads at PHGW2A

Bore 9GGW2B

The time-series record for bore 9GGW2B is shown on Chart 72. As the hydrographs show inconsistent head variations with depth, some of the piezometers are unreliable. During the passage of Longwall 24 (>600 m away), minor drawdowns were observed in the Bulli Coal Seam and the Scarborough Sandstone, but other sensors exhibited no effect or a rise in head. The passage of Longwall 25 (>400 m away) caused distinct drawdowns in the Scarborough Sandstone, Wombarra Claystone, Stanwell Park Claystone and upper Bulgo Sandstone. Characteristic arcuate segments between cusps associated with subsequent longwall crossings are evident in the Scarborough Sandstone, Wombarra Claystone and Stanwell Park Claystone, but not in the Bulli Coal Seam. The lower Bulgo Sandstone shows rising head arcuate segments for Longwall 26 and Longwall 27 crossings, due to compression at that level. Sympathetic drawdowns are also exhibited in the three Hawkesbury Sandstone piezometers at the times of the Longwall 26 and Longwall 27 crossings. The 138 mbgl, 163 mbgl, 304 mbgl and 474 mbgl piezometers have not recorded data since the end of 2016. The 340 mbgl piezometer has not recorded data since June 2017. The upper, mid and lower Hawkesbury Sandstone piezometers (55 mbgl, 80 mbgl and 106 mbgl) remained stable during the reporting period. The same is true for the two deep piezometers at 393 mbgl and 437 mbgl.

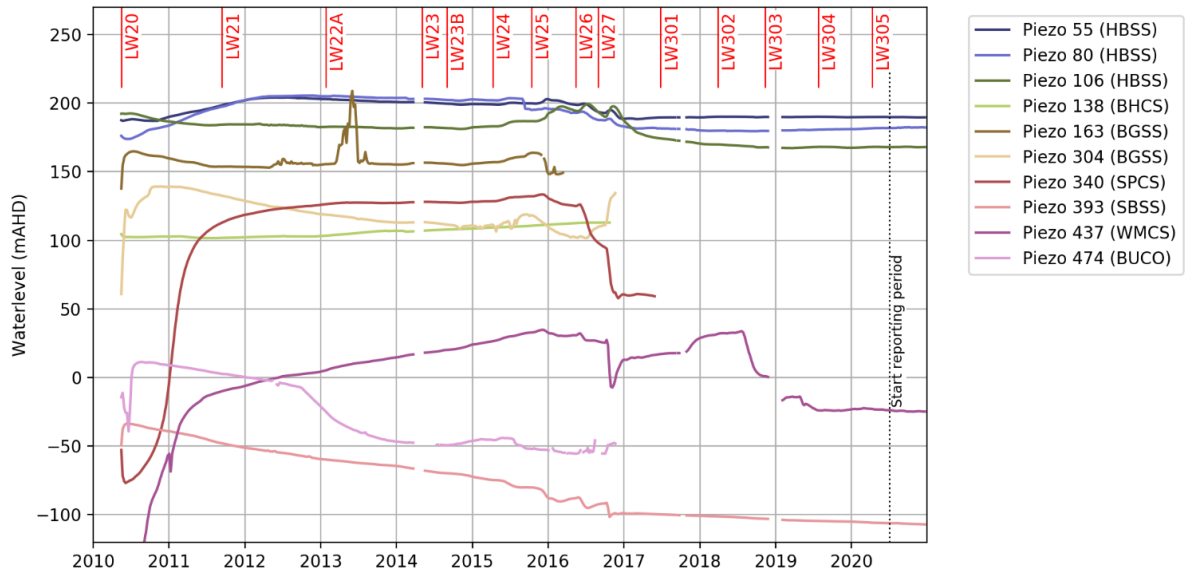


Chart 72 Time Variations in Potentiometric Heads at 9GGW2B

Bores 9EGW2A and 9EG2A-4

Chart 74 shows the potentiometric heads for bores 9EGW2A and 9EG2A-4. The upper piezometers (60 mbgl to 454 mbgl) showed stable water level during the reporting period. The piezometers at 484 mbgl and 517 mbgl showed initially a small decrease and have been stable since around September 2020. The piezometer at 557 mbgl (in the Bulli Coal Seam) showed a continual decline.

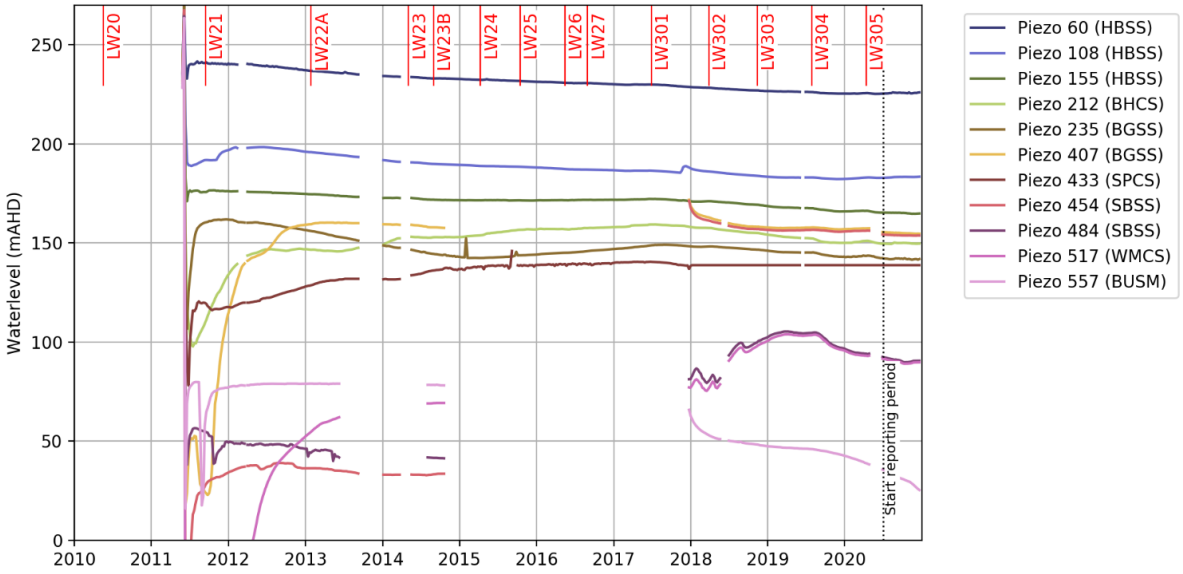


Chart 73 Time Variations in Potentiometric Heads at 9EGW2A and 9EGW2-4

Bore PHGW1B

Chart 74 shows the water levels at bore PHGW1B. The bore is located approximately 750 m north of Longwall 305. The piezometers at 216 mbgl and 554 mbgl showed a slight increase in water pressures since 2018. During the reporting period, all piezometers showed steady water pressures and no impact from mining of Longwall 305.

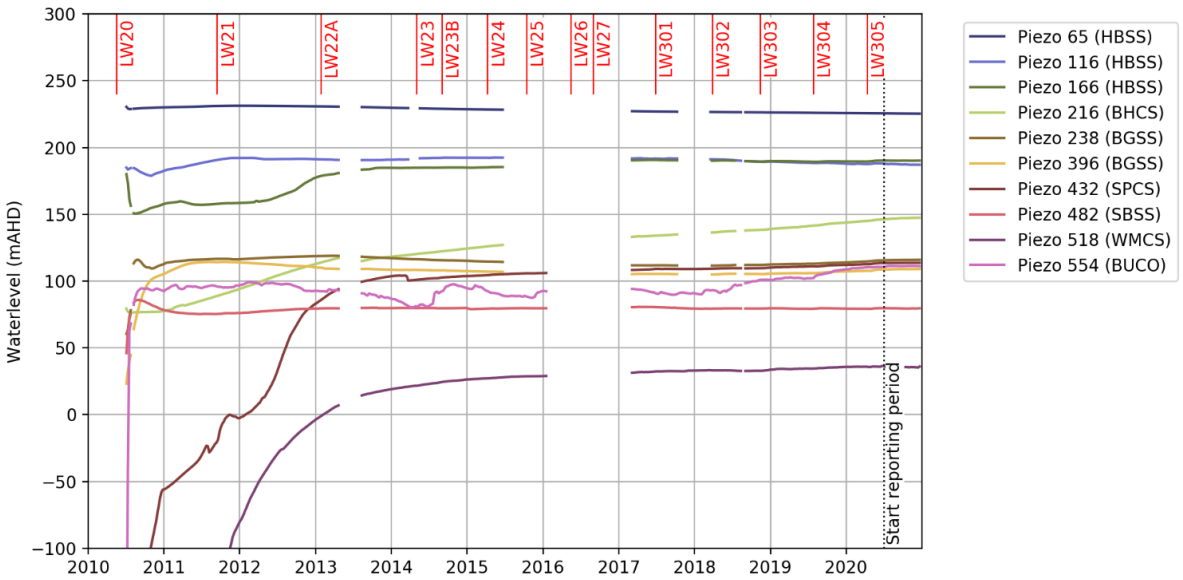


Chart 74 Time Variations in Potentiometric Heads at PHGW1B

Bore F6GW3A

Chart 75 shows the groundwater levels at bore F6GW3A. Bore F6GW3A is located adjacent to Longwall 301 about 150 m beyond its southern end, and at about 800 m from Longwall 27. Significant depressurisation has occurred from historical workings to the east at about 500 m distance. The 450 mbgl deep piezometer at the base of the Coal Cliff Sandstone displays significant depressurisation continuing from the mining of the first heading in the 300 mains in November 2013. The rise in pressure in the 380 mbgl piezometer, noted in the previous reporting periods as potentially related to compression from the adjacent Longwall 302 beginning in March 2018, continued at a slight rate during the current reporting period. However, communications were lost due to the vandalised aerial cable for four piezometers at 220 mbgl, 308 mbgl, 380 mbgl and 450 mbgl on 22 September 2019. The cables have since been re-instated. In this reporting period, five piezometers (50 mbgl, 70 mbgl, 100 mbgl, 135 mbgl and 450 mbgl) showed stable water levels during this reporting period. The piezometers at 220 mbgl and 308 mbgl showed a continuous decrease, with the piezometer at 308 mbgl showing an impulse increase in pressure when Longwall 305 commenced. The piezometer at 380 mbgl continued to increase in water levels over the reporting period.

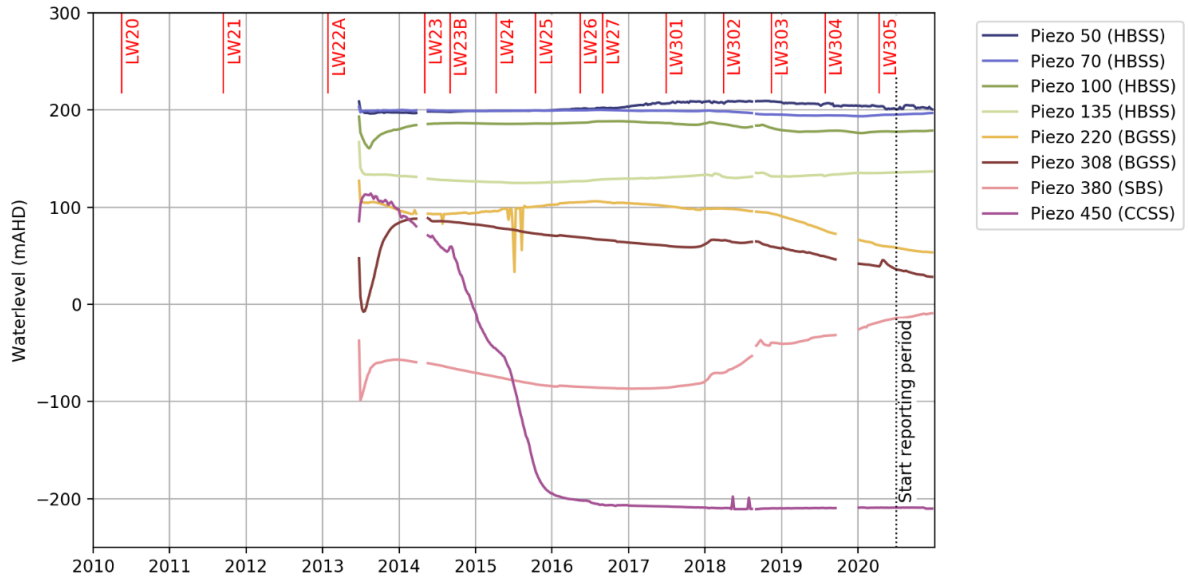


Chart 75 Time Variations in Potentiometric Heads at F6GW3A

6.2.8.2 Assessment of Vertical Potentiometric Head Profiles

Vertical potentiometric head profiles at Bores 9GGW2B and F6GW3A are used to assess connective cracking between the surface and the mine in accordance with the Longwalls 305-307 Water Management Plan.

The vertical potentiometric head profiles have been assessed against the following performance indicators:

Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur.

Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore F6GW3A does not occur.

The performance indicators were not exceeded during the reporting period because the measured potentiometric head profiles are consistent in shape and do not lie significantly to the left of the predicted model curves (Appendices C1 and C2).

6.2.8.3 Assessment of Hydraulic Gradient to the Woronora Reservoir

The groundwater head of Bores PHGW2A, F6GW4A, 9GGW2B, 9EGW2A and PM02 are compared to the full supply level of the Woronora Reservoir to assess reductions in hydraulic gradient from the bores to the Woronora Reservoir in accordance with the Longwalls 305-307 Water Management Plan.

The results have been assessed against the following performance indicators:

> *The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PHGW2A is reduced by no more than 40% from that measured to 30 June 2017.*
>
> *The groundwater head of Bore F6GW4A is greater than 10 m above the Woronora Reservoir full supply level.*
>
> *The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9GGW2B is reduced by no more than 40% from that measured to 30 June 2017.*
>
> *The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9EGW2A is reduced by no more than 40% from that measured to 30 June 2017.*
>
> *The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PM02 is reduced by no more than 40% from that measured to 30 June 2017.*

The performance indicators for bores 9GGW2B, PHGW2A, F6GW4A, 9EGW2A and PM02 were not exceeded during the reporting period (Appendices C1 and C2).

The key potential subsidence impacts and environmental consequences on the deep groundwater system described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans, included:

- Based on experience at Metropolitan Coal, substantial depressurisation of the deep aquifers in the fractured zone above the goaf is restricted to a height of less than 130 m from the top of the goaf, while transient pressure effects have been observed to propagate to a height of about 300 m above the goaf. That is, there is a pronounced increase in vertical hydraulic gradient in the deep groundwater system over the Metropolitan Coal longwalls.
- Above goaf zones there would be substantial changes in fracture porosity and permeability, due to opening up of existing joints, new fractures and bed separation. Permeability increases would have accompanying reductions in lateral hydraulic gradients, with associated changes in groundwater levels and pressures. Pronounced changes in groundwater levels can occur without any significant drainage into a mine, particularly from the Narrabeen Group sandstones.
- Groundwater discharge to the mined seam would occur from above and below the seam in proportion to local permeabilities. Based on earlier modelling, the water make (i.e. groundwater inflow) was expected to be in the order of 0.1 megalitres per day (ML/day) for Longwalls 20-27 and from 0.045 to 0.6 ML/day for Longwalls 301-303. Modelling indicated that the inflow could be up to 0.5 ML/day from the deep groundwater system during mining of Longwall 24 and up to 0.6 ML/day during the mining of Longwall 302. The revised groundwater model (that was used for Longwall 30) predicted that inflow for Longwalls 301-303 would be in the order of 0.003 to 0.10 ML/day. The revised groundwater model predicts that inflow for Longwalls 301-304 is expected to lie in the range 0.003-0.14 ML/day.

- Due to the substantial depths of cover at the Project, there would not be connective cracking from the mined seam to the surface. Groundwater modelling for the Project indicates that there is expected to be eventual recovery of deep groundwater system pressures over many decades following the cessation of mining.

The NSW Planning Assessment Commission (2009) concluded that given the considerable depth of mining and the restricted panel width in the Project area, that, in the absence of geological structures such as faults and igneous intrusions (sills, dykes and diatremes), there is a very high probability that a constrained zone will be associated with the mine layout proposed over the Project area, thereby preventing direct hydraulic connections between mine workings and surface water bodies.

The groundwater monitoring results are consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans.

6.2.9 Groundwater Quality

Waratah Rivulet

Groundwater quality at sites WRGW1 to WRGW7[12] on Waratah Rivulet (Figure 11) is shown on Charts 76 to 78 for iron, manganese and pH, respectively.

Groundwater quality monitoring at sites WRGW1 to WRGW7 indicates dissolved iron concentrations are usually in the 1-10 mg/L range, with the exception of sites WRGW1 and WRGW2 which peaked at 14 mg/L in earlier years (2010-2011) (Chart 76). Dissolved iron concentrations have remained below 11 mg/L during reporting period (Chart 76, Appendices C1 and C2).

Dissolved manganese concentrations at the Waratah Rivulet sites have typically been less than 1 mg/L. Higher concentrations of manganese were reported for WRGW3 in June 2015 (3.36 mg/L), September 2015 (1.47 mg/L), March 2017 (1.31 mg/L) and April 2017 (1.65 mg/L) and for WRGW6 in April 2017 (1.77 mg/L) (Chart 77). During the reporting period, all sites ranged between 0.5 and 0.75 mg/L (Chart 77, Appendices C1 and C2).

Dissolved aluminium concentrations have been low, and largely below the detection limit; except for one reading of 0.1 mg/L at bore WRGW2 and two readings of 0.2 mg/L and 0.1 mg/L in October and November 2020 respectively at bore WRGW3 (Appendices C1 and C2).

The pH level at the Waratah Rivulet sites has been generally acidic and usually between pH 5.5 and 7. Occasional excursions in excess of pH 9 and less than pH 5 in prior reporting periods are unsustained outliers. The pH level at all sites remained within the historical range during the reporting period, with a slight shift to neutral conditions with pH observed between 6.1 and 7.8 (Chart 78, Appendices C1 and C2).

[12] WRGW4 has been sheared and no longer sampled since 2011.

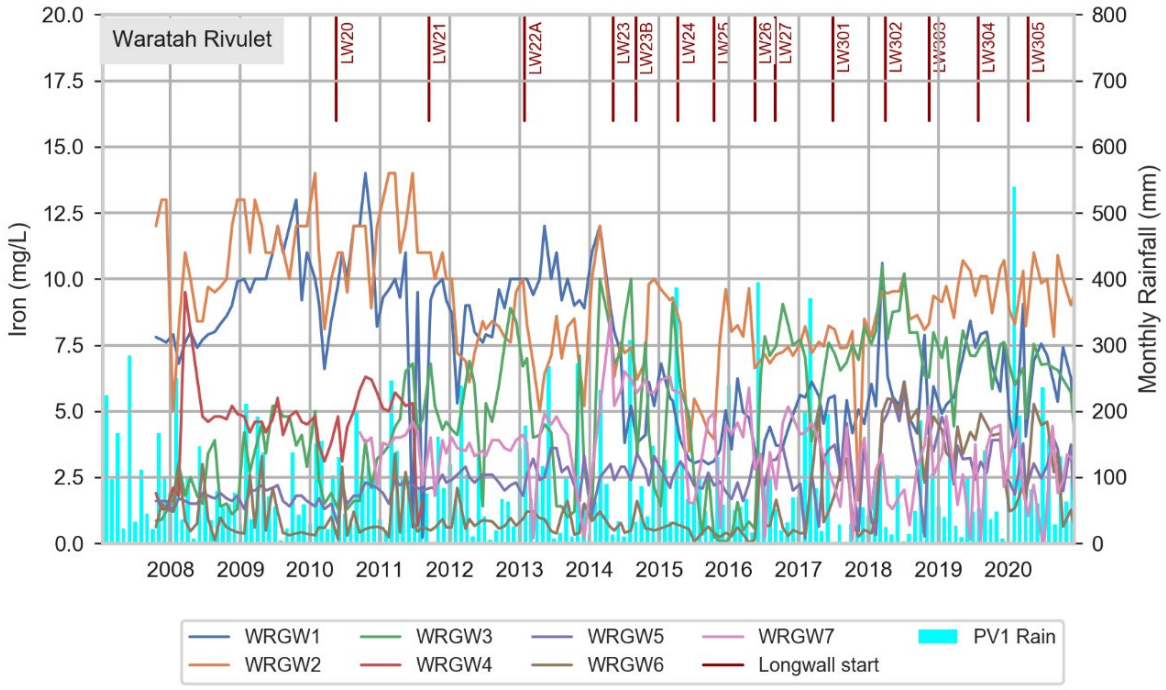


Chart 76 Iron Concentrations at WRGW1 to WRGW7

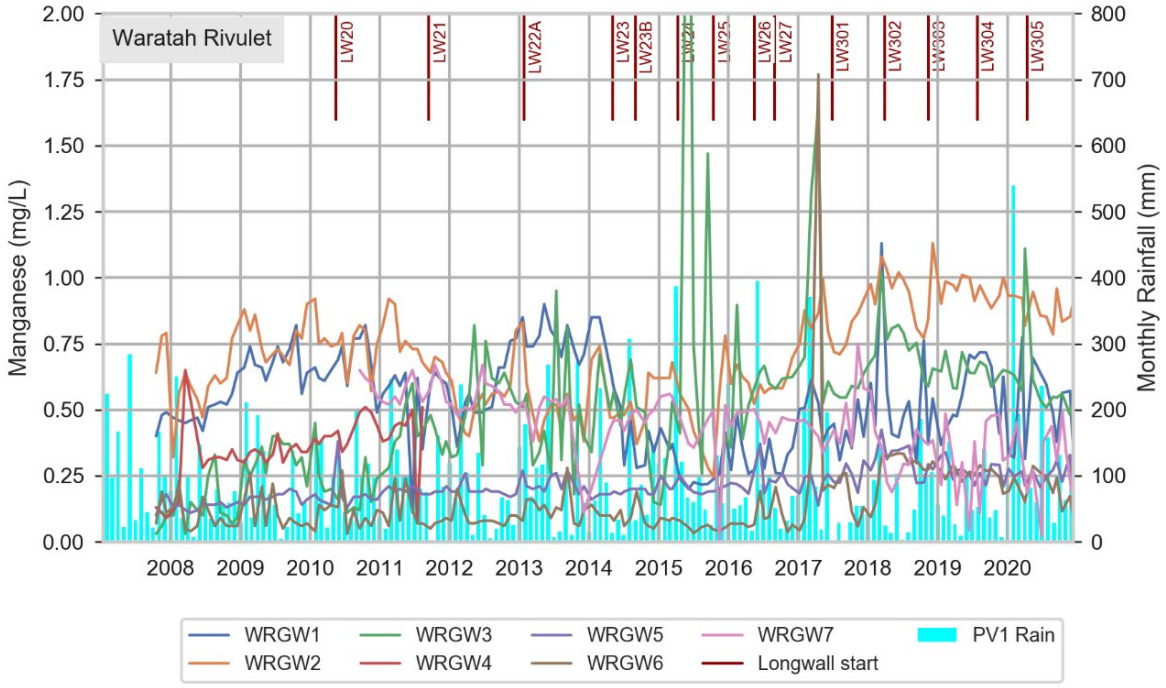


Chart 77 Manganese Concentrations at WRGW1 to WRGW7

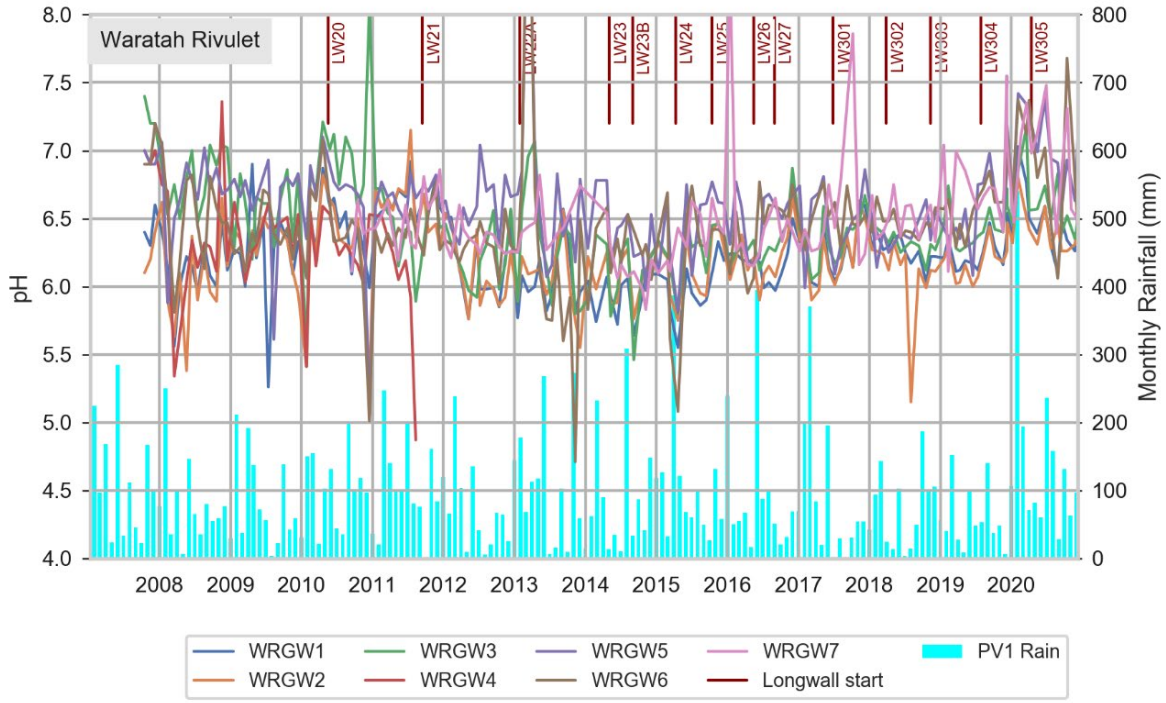


Chart 78 pH Levels at WRGW1 to WRGW7

Eastern Tributary

Groundwater quality at Eastern Tributary sites ETGW1 and ETGW2 (Figures 10 and 11) is shown on Charts 79 to 81 for iron, manganese and pH, respectively. Bore ETGW1 was unable to be sampled for groundwater quality from January to March 2017 and since August 2017. Bore ETGW2 was also unable to be sampled from August to October 2018.

Groundwater quality monitoring on the Eastern Tributary (Figure 11) indicates high iron concentrations with an increasing trend, and larger variability than recorded in the period 2010–2015, persisted until July 2017 when the concentration decreased. During 2019, ETGW2 displayed a variable trend and recorded the maximum recorded concentration of 21.8 mg/L in October 2019 and the historical minimum of 0.4 mg/L in March 2019. Iron concentrations were less variable during this reporting period with a lowest value of 15.4 mg/L and highest value of 19.6 mg/L (Chart 79).

During the reporting period, manganese concentrations in samples collected continue to be consistently higher than the historically recorded manganese concentrations at ETGW2. Up to 2017, ETGW2 recorded manganese concentrations below 0.6 mg/L, but these have increased to a range of 0.6 to 1 mg/L since then. During the current reporting period manganese concentrations were recorded between 0.75 mg/L and 0.94 mg/L. The manganese concentrations seem to have stabilised at this range of concentrations, which has been observed since 2017. The increasing trend in iron and manganese concentrations in the Eastern Tributary sites has been occurring since December 2015 and appears to be continuing.

Aluminium was below 0.01 mg/L in all samples during the reporting period (Appendices C1 and C2).

The groundwater at the Eastern Tributary sites is generally acidic, ranging between pH 5.5 and pH 6.5 for most of the monitoring record (since 2010). At ETGW2, pH remained between pH 6.2 and pH 6.6 during the reporting period (Chart 81) (Appendices C1 and C2).

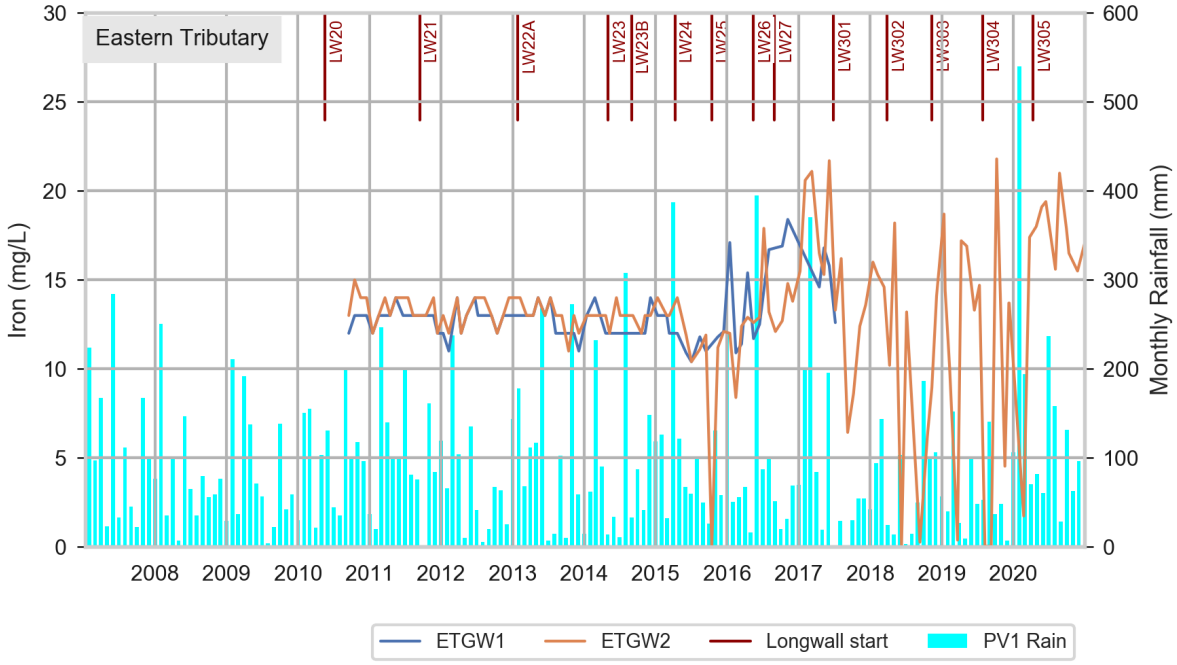


Chart 79 Iron Concentrations at ETGW1[13] and ETGW2

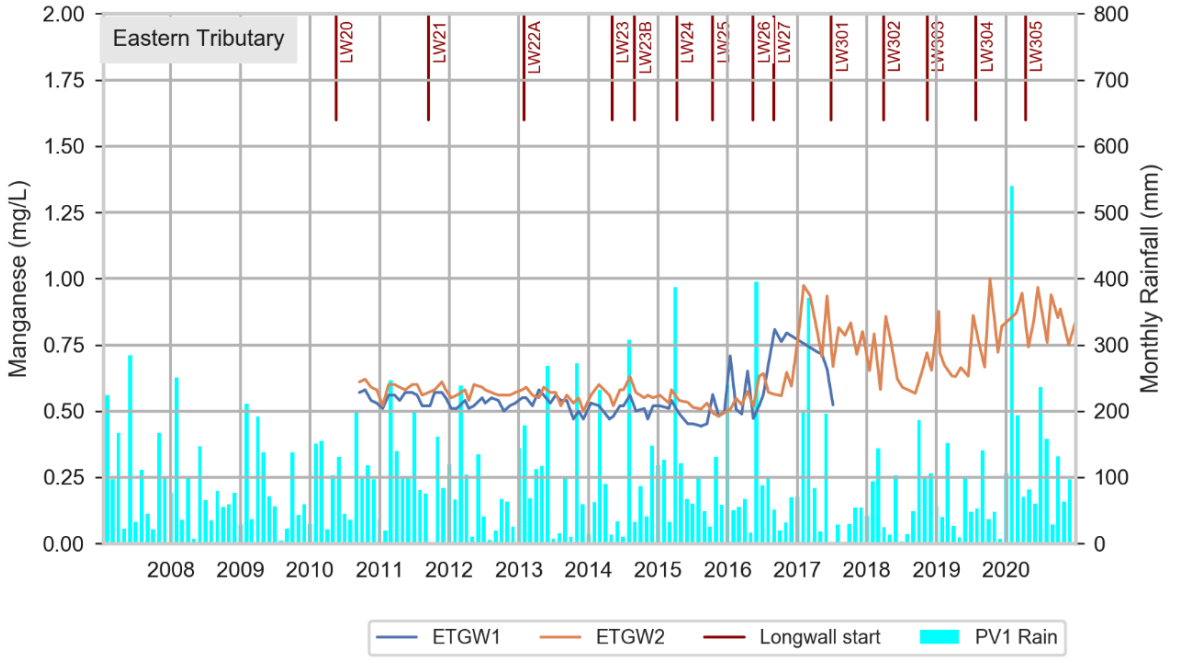


Chart 80 Manganese Concentrations at ETGW1 and ETGW2

[13] Site ETGW1 was unable to be sampled from January to March 2017, and since August 2017.

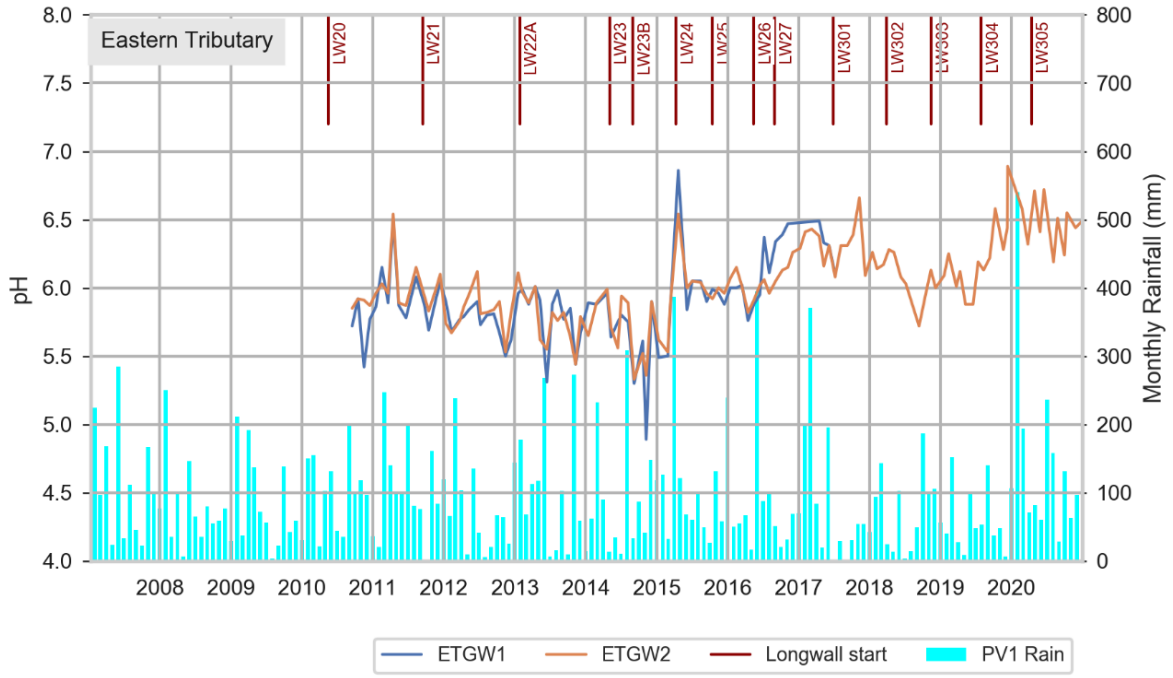


Chart 80 pH Levels at ETGW1 and ETGW2

The Project EA, Preferred Project Report and Metropolitan Coal Water Management Plans predicted local surface water quality impacts as a result of enhanced groundwater-surface water interactions (as described for surface water quality above). The groundwater quality monitoring results are considered to be consistent with the predictions.

6.2.10 Inspections of Mine Workings

Mine inspections did not identify any abnormal water flows from the goaf, geological structure, or strata generally during the reporting period.

6.2.11 Mine Water Intake

Monitoring of the mine water balance comprises:

- Metered water reticulated into the mine (recorded continuously and downloaded monthly).
- Backfill water used to assist pumping into the mine (recorded continuously and downloaded monthly).
- Metered water reticulated out of the mine (recorded continuously and downloaded monthly).
- Manual measurement of moisture content into and out of the mine through the mine ventilation system using a digital psychrometer. The frequency of readings is as follows:
  - every hour over a 9 hour period on two occasions during a 12 month period;
  - daily (week day) except public holidays or other circumstances (access, fan maintenance, etc.) that prevent readings to be taken; and
  - once per week as a minimum.

- Measurement of the *in-situ* moisture content of the coal during channel sampling for coal quality.
- Measurement of the moisture content of ROM coal conveyed out of the mine at the drift portal using an automated moisture scanner. A fully automated data acquisition system records and stores the data.

The inferred water make (i.e. groundwater that has seeped into the mine from the strata) is calculated from the difference between total mine inflows (reticulated water into the mine, moisture in the downcast ventilation, and the *in-situ* coal moisture content) and total mine outflows (reticulated water out of the mine, moisture in the exhaust ventilation, and moisture in the ROM coal). Given the large fluctuations in daily water usage and the cycle period for water entering the mine, a 20 day average is used to provide a more reliable estimate of water make.

The 20 day average daily mine water make was approximately 0.06 ML/day during the reporting period (i.e. well below the 0.5 ML/day TARP trigger) (Chart 81).

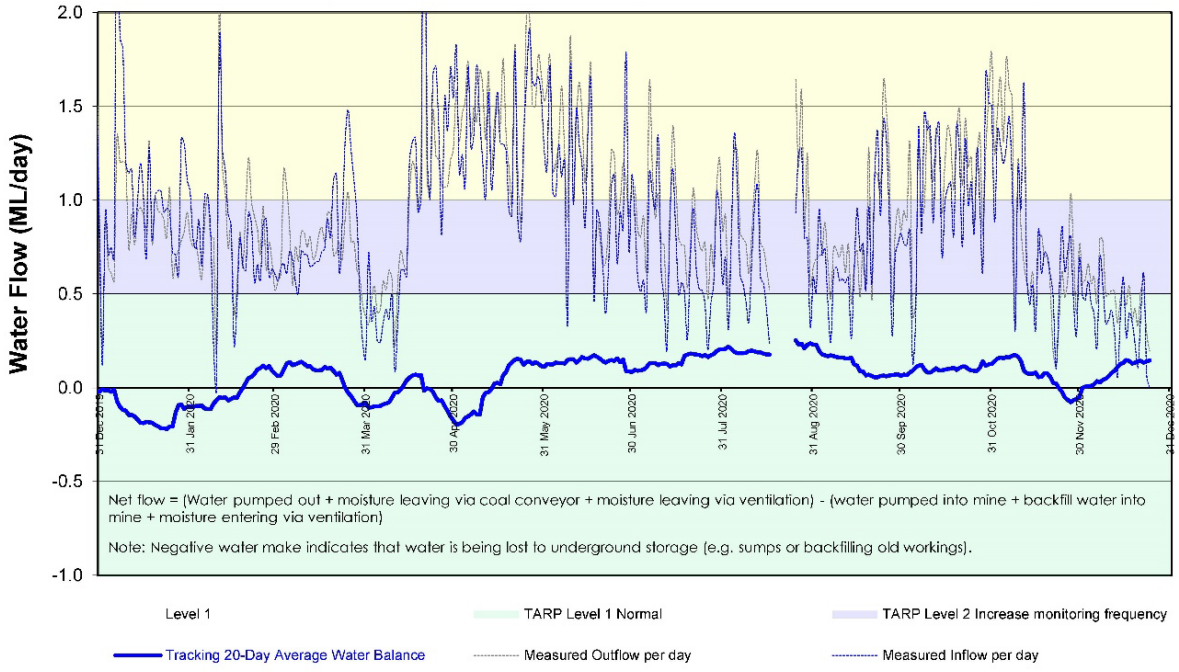


Chart 81 Estimated Daily Mine Water Make

6.3 BIODIVERSITY MANAGEMENT

The Metropolitan Coal Longwall 304 Biodiversity Management Plan and Longwalls 305-307 Biodiversity Management Plan were prepared to manage the potential environmental consequences of the Longwall 304 Extraction Plan and Longwalls 305-307 Extraction Plan, respectively, on aquatic and terrestrial flora and fauna, with a specific focus on swamps, in accordance with Condition 6, Schedule 3 of the Project Approval.

During the reporting period, the Longwall 304 Biodiversity Management Plan was in force from 1 January 2020 to 11 April 2020 (inclusive) and the Longwalls 305-307 Biodiversity Management Plan was in force from 12 April 2020 to 31 December 2020 (inclusive).

Both Biodiversity Management Plans include post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303.

Sections 6.3.1 to 6.3.5 provide a summary of the biodiversity assessments for the reporting period. Section 6.8 provides a summary of the assessments against the biodiversity subsidence impact performance indicators and measures for the reporting period.

6.3.1 Upland Swamp Vegetation Monitoring

6.3.1.1 Longwalls 20-22 and Longwalls 23-27

Upland swamp vegetation monitoring is conducted biannually (in autumn and spring) at a number of swamps overlying or adjacent to Longwalls 20-22 and Longwalls 23-27 and at a number of control swamps (Figure 9).

In autumn 2020, visual inspections were conducted in Swamps 16, 17, 18, 19, 20, 24, 25, 28, 30, 31, 32, 33, 34, 35, 36 and 94 overlying or adjacent to Longwalls 20-27 and in control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.

Transect/quadrat monitoring was conducted in Swamps 16, 17, 18, 20, 24 and 25 overlying or adjacent to Longwalls 20-22, in Swamps 28, 30, 33, 35 and 94 overlying or adjacent to Longwalls 23-27 and in control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp.

Indicator species monitoring for Longwalls 20-22 includes 20 tagged individuals of *Epacris obtusifolia* (in Swamps 18, 24, 25, 101, 111a and 125), *Sprengelia incarnata* (in Swamps 24, 101 and 125) and *Pultenaea aristata* (in Swamps 18, 24, 25, 101 and 111a). Three indicator species characteristic of the Tea Tree Thicket vegetation community, namely *Banksia robur, Callistemon citrinus* and *Leptospermum juniperinum* are monitored in Swamp 20 and at control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.

Indicator species monitoring for Longwalls 23-27 includes 20 tagged individuals of *Epacris obtusifolia* (in Swamps 19, 30, 33, 35, 94, 101, 111a, 125, 135, 136, 137a, 137b and 138), *Pultenaea aristata* (in Swamps 19, 30, 33, 35, 94, 101, 111a, 135, 136, 137a and 138), *Sprengelia incarnata* (in Swamps 19, 33, 35, 94, 101, 125, 135, 136, 137a and 138) and *Banksia robur* and *Callistemon citrinus* in Swamp 28 and control Swamps Woronora River 1, Woronora River south arm and Dahlia Swamp.

The vegetation survey results for spring 2019 and autumn 2020 have been assessed in accordance with the Longwalls 305-307 Biodiversity Management Plan. The results of the spring 2019 and autumn 2020 survey in relation to the Biodiversity Management Plan TARP are summarised in Section 6.8.

The spring 2019 and autumn 2020 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical Australia (Eco Logical) describe the results of these surveys, and are provided as Appendices H1, H2, H3 and H4, respectively.

6.3.1.2 Longwalls 301-304

The upland swamp vegetation monitoring program used for Longwalls 301-304 (visual, transect/quadrat and indicator species monitoring) is consistent with those used for the Longwalls 20-22 and Longwalls 23-27 upland swamp vegetation monitoring programs. Upland swamp vegetation monitoring is conducted biannually (in autumn and spring) at a number of swamps overlying or adjacent to Longwalls 301-304 and at a number of control swamps (Figure 9).

In autumn 2020, visual inspections were conducted for swamps overlying or adjacent to Longwalls 301-304 (Swamps 40, 41, 46, 47, 48, 49, 50, 51/52, 53 and 58) and in control Swamps 101, 111a, 125, 135, 136, 137a, 137b and 138 to record evidence of potential subsidence impacts. Transect/quadrat monitoring was also conducted in autumn 2020 at Swamps 40, 41, 46, 48, 50, 51/52 and 53. Control Swamps 101, 111a, 125, 135, 136, 137a, 137b and 138, were selected for comparison and the same transect/quadrat monitoring methodology was used to survey each of these swamps. Swamps 46 and 51/52 were subject to WaterNSW hazard reduction burns following the autumn 2017 baseline survey and prior to the spring 2017 survey, resulting in vegetation along transects in these swamps no longer being comparable to the control swamps.

Indicator species monitoring for Longwalls 301-304 previously included 20 tagged individuals of *Epacris obtusifolia* (in Swamps 40, 51/52, 53, 101, 136 and 137a) and *Sprengelia incarnata* (in Swamps 40, 51/52, 53, 101, 136 and 137b). However, subsequent to the autumn 2017 baseline survey and prior to the spring 2017 survey, Swamp 51/52 was subject to WaterNSW hazard reduction burns, resulting in the death of indicator species in Swamp 51/52. As a result, indicator species monitoring in Swamp 51/52 was removed from the monitoring program.

The vegetation survey results for autumn 2020 have been assessed in accordance with the Longwalls 305-307 Biodiversity Management Plan. The results of the autumn 2020 survey in relation to the Biodiversity Management Plan TARP are summarised in Section 6.8. The results of the Longwalls 301-304 upland swamp vegetation monitoring program (up to and including the autumn 2020 survey) can be summarised as follows:

- Visual inspections did not identify any cracking of exposed bedrock areas or swamp sediments in longwall swamps as a result of mine subsidence.
- Areas in which active erosion was observed were minor and limited to sheet/surface wash in Swamps 46, 48, 53, 101 and 138, with major erosion along the creek adjacent to Transect 2 in control Swamp 125.
- The autumn 2020 survey was conducted following an extremely dry period from July 2017. Throughout this period, monthly rainfall has remained below average for most month, with isolated exceptions including February 2020, which had well above average rainfall. During the autumn 2020 survey, rainfall for the month of March was close to average but remained below average in April and May. The limited rainfall leading up to, and the intense rainfall immediately prior to the survey season is reflected in the variability of seepage recorded in the longwall valley side swamps.
- Vegetation at both longwall and control sites was found to be in an improved condition, compared to previous surveys with no unusual areas of vegetation senescence observed. In previous seasons, vegetation condition has been observed varying from healthy to stressed, with a number of shrubs and ground layer species recorded with leaf yellowing and dieback. In the current autumn 2020 survey, healthy individuals of all species previously noted with dieback were observed within all swamps, with new growth commonly recorded. Few swamps (Swamps 41, 46 and 125) were observed with occasional, isolated individuals with yellowing foliage and dieback.

- Species richness within individual valley side swamps in autumn 2020 was similar to the range recorded in previous seasons for most longwall and control swamps and was consistent with the fluctuations observed within the baseline monitoring period. The exception to this was longwall Swamp 40 and control Swamp 136 where species richness declined below previously recorded levels. All observed changes in species richness are considered to be within the range of natural fluctuations in response to weather, population dynamics, seasonality of survey and natural disturbances including grazing by fauna species.
- Fluctuations in species cover/abundance and condition were recorded across all sites throughout the baseline monitoring period. No patterns of increasing or decreasing cover/abundance, or declines in vegetation condition, were identified during the autumn 2020 monitoring in relation to individual species across sites or groups of species (i.e. swamp indicator species, generalist species, shrubs, ground covers) within sites.
- In autumn 2020 the proportion of upland swamp indicator species which were dead was greater at longwall sites than control sites for *Epacris obtusifolia*, whilst the proportion of dead *Sprengelia incarnata* individuals was greater at control sites. This trend has been observed within the baseline monitoring period. Since the large increase in the proportion of dead indicator species observed for control sites in autumn 2018, the seasonal increases have been consistent in control sites. Mortality of tagged indicator species may be attributed to environmental conditions including the stress associated with drying out of shallow soils during periods of below-average rainfall.
- In autumn 2020, the mean vegetation condition of tagged *Sprengelia incarnata* and *Epacris obtusifolia* individuals was lower than the range observed across the baseline monitoring seasons for both longwall and control sites. As these declines have occurred at both longwall and control swamps it is considered to reflect the natural fluctuations in plant health associated with herbivory, resource competition, ageing plants and, in particular, the ongoing drought conditions.
- The flowering status of tagged indicator species, as recorded in the mean reproductive status shows that across all seasons, flowering has been highly variable, particularly within control sites. The mean reproductive status of tagged indicator species has also been variable between longwall and control swamps in individual seasons.
- The upland swamp performance indicator '*The vegetation in upland swamps is not expected to experience changes significantly different to changes in control swamp*s' has not been exceeded for any of the Longwalls 301-304 upland swamps to date.

The spring 2019 Longwalls 301-303 Vegetation Monitoring Report and autumn 2020 Longwalls 301-304 Vegetation Monitoring Reports prepared by Eco Logical are provided as Appendices H5 and H6, respectively.

6.3.2 Upland Swamp Groundwater Monitoring

Swamp substrate water levels are assessed against the following upland swamp groundwater performance indicator:

> *Surface cracking within upland swamps resulting from mine subsidence is not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*.

As described in Section 6.2.6, semi-quantitative comparisons of the swamp substrate water levels of Swamps 25, 30, 33 and 35 with control swamps and rainfall records do not show a definitive mining effect and the dry conditions are regarded as a natural response to reduced rainfall (Appendices C1 and C2).

The swamp substrate hydrographs for Swamps 40, 41, 46, 50, 51, 52 and 53 indicate that the correlation of swamp substrate with the rainfall trend is strong (Appendices C1 and C2). Data analysis for the reporting period indicates the seven day moving averages for all swamps were at or above the swamp's minimum recorded in the baseline period (Appendices C1 and C2).

The upland swamp groundwater performance indicator has been exceeded at Swamp 20 since 2012. Swamp 20 substrate water levels changed from being permanently saturated to being periodically saturated as a result of the passing of Longwall 21 (Chart 61 and Appendices C1 and C2). During the reporting period, rainfall events in February and July 2020 saw the substrate piezometer return briefly to within the two standard deviation range, however, water levels decreased below the two standard deviation limit shortly after both events.

A mining effect to the substrate water levels of Swamp 28 (overlying Longwall 24) was identified in 2016 based on the incomplete recovery of substrate water levels following rainfall events (Chart 61 and Appendices C1 and C2). Swamp 28 is considered to have an impact from mining of Longwall 25, although no effect on swamp substrate water levels occurred when Longwall 24 passed directly beneath the monitoring site (Appendices C1 and C2). The substrate piezometer at Swamp 28 returned to dry conditions from September 2017, remaining so until the end of December 2019, as did the two control swamp piezometers (Swamps 137a and 137b; Chart 61). With the large rain in February 2020, the water level in both the substrate and the shallow piezometer recovered. The substrate recorded saturated conditions until the end of the reporting period in December 2020.

The subsidence impacts on the substrate water levels of Swamp 20 and Swamp 28 have triggered assessments against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations, or ecological communities*. The Swamp 20 and Swamp 28 threatened flora and fauna assessments by Ecoplanning and Cenwest Environmental Services are provided in Appendices I1 and I3, respectively. The assessments conclude that the subsidence impact performance measure has been met.

6.3.3 Riparian Vegetation Monitoring

Riparian vegetation monitoring is conducted at a number of sites on the Waratah Rivulet and Eastern Tributary, overlying Longwalls 20-27 and downstream of Longwalls 20-27 (Figure 13).

The vegetation survey results for autumn 2020 have been assessed in accordance with the Longwalls 305-307 Biodiversity Management Plan. The results of the autumn 2020 survey in relation to the Biodiversity Management Plan Trigger Action Response Plan are summarised in Table 9 in Section 6.8. The results of the Longwalls 20-22 and Longwalls 23-27 autumn 2020 riparian vegetation monitoring surveys can be summarised as follows:

- Water levels across all riparian sites along both Waratah Rivulet and Eastern Tributary were observed to be higher than those observed during the previous spring 2019 survey, following the heavy rainfall in February 2020.
- All riparian sites were subject to high water flows in March 2017 and again in February 2020. In both instances, high water flows resulted in impacts including flood-swept and prone vegetation, loss of individual plants, burial of vegetation by adjacent vegetation, and burial by woody flood debris and sediment. In autumn 2020, the extent of bank scouring and undercutting ranged from minor (MRIP01) to major (MRIP02), commonly occurring throughout the entirety of the monitoring sites although often associated with sandy areas where vegetation was lost during high water flows (MRIP02, MRIP05 and MRIP09).
- Vegetation was generally observed in good condition across and adjacent to all riparian monitoring sites in autumn 2020. Exceptions to the generally good condition of vegetation within these riparian sites was limited to isolated and scattered individuals observed with dieback and flood impacts including prone vegetation and burial by flood debris.

- In autumn 2020, the percent cover and height of the structural layers was generally similar to that recorded for spring 2019. Across all seasons (since the surveys commenced in spring 2008), the vegetation structure, dominant species and estimated cover for each stratum has varied between sites and between seasons within sites, with no clear trends in vegetation cover across sites.
- Species richness in autumn 2020 was generally similar to previous seasons with all values within the range of previous seasons for individual sites (Charts 82 and 83). The exception was one control site, MRIP03, where species richness was lower than the previously recorded for this site.
- Up to and including the autumn 2020 survey, mean vegetation condition has decreased over the entire survey period for the three riparian indicator species *Lomatia myricoides*, *Prostanthera linearis* and *Schoenus melanostachys*, within both longwall and control sites.
- In autumn 2020, the mean reproductive status for tagged riparian indicator species was similar, and minimal, at longwall and control sites for *Lomatia myricoides* and *Schoenus melanostachys.* For *Prostanthera linearis*, mean reproductive status was higher at control sites than at longwall sites (Figure 22). The mean reproductive status of *Prostanthera linearis* and *Schoenus melanostachys* has been considerably more variable between seasons, and between longwall and control sites within seasons, than for *Lomatia myricoides*, preventing any discernible trend from being detected.
- Two species of conservation significance were recorded at riparian vegetation monitoring sites in autumn 2020, namely *Hibbertia nitida* and *Lomandra fluviatilis*. *Both species were* recorded in a good condition, which represents an improvement in the overall condition of these species relative to previous seasons.
- Six introduced species were observed within riparian monitoring sites in autumn 2020, namely *Aster subulatus* (Wild Aster) (MRIP01), *Conyza sp*. (Fleabane) (MRIP01), *Cyperus gracilis* (Slender Flat-sedge) (MRIP01), *Gamochaeta sp*. (Cudweed) (MRIP01), *Hypochaeris radicata* (Catsear) (MRIP01 and MRIP02) and *Paspalum dilatatum* (Paspalum) (MRIP01).

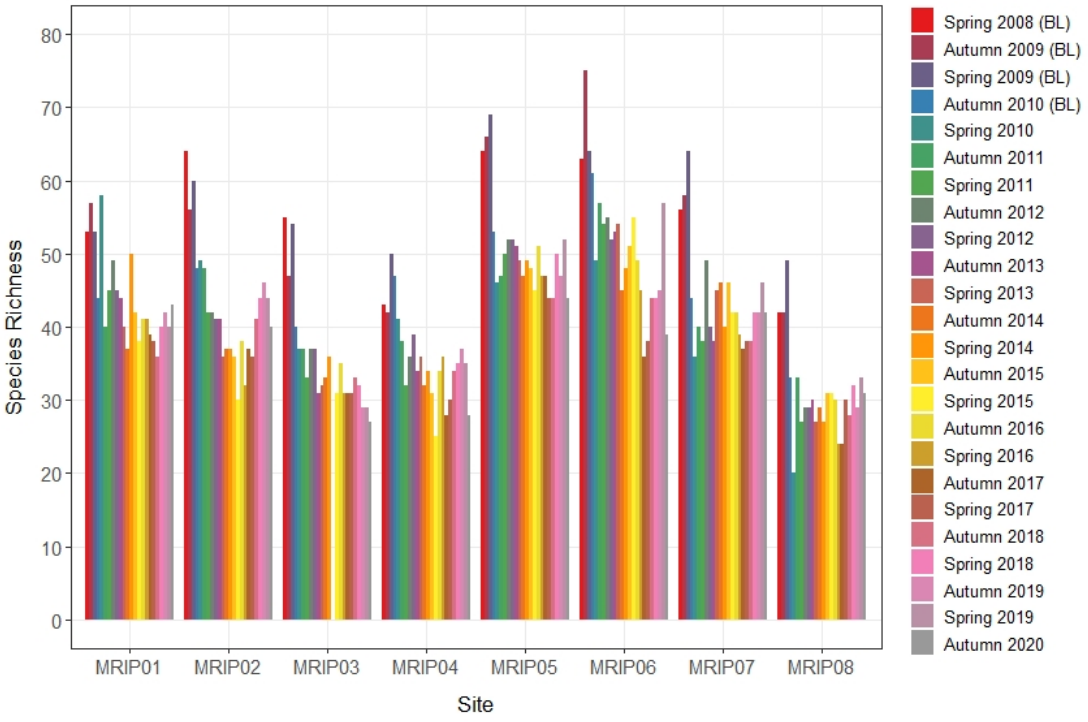


Chart 82 Native Species Richness within Riparian Monitoring Sites across All Seasons – Longwalls 20-22 Monitoring Program

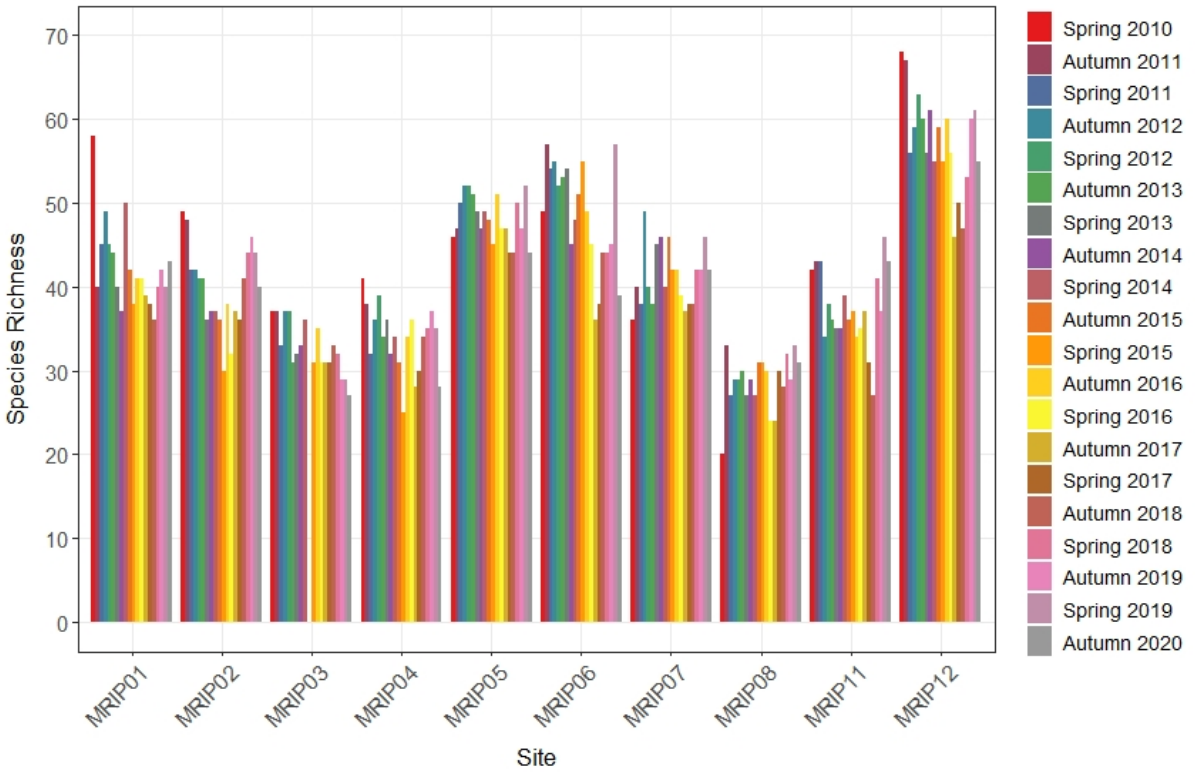


Chart 83 Native Species Richness within Riparian Monitoring Sites across All Seasons – Longwalls 23-27 Monitoring Program

The spring 2019 and autumn 2020 Longwalls 20-22 and Longwalls 23-27 Vegetation Monitoring Reports prepared by Eco Logical are provided in Appendices H1, H2, H3 and H4, respectively.

6.3.4 Aquatic Biota and Their Habitats

The aquatic ecology monitoring programs for Longwalls 20-22 and Longwalls 23-27 were designed to monitor subsidence-induced impacts on aquatic ecology (referred to as stream monitoring) and the response of aquatic ecosystems to the implementation of potential future stream remediation works (referred to as pool monitoring). The locations of the monitoring sites are shown on Figure 14.

The Longwall 304 and Longwalls 305-307 Biodiversity Management Plans include post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22 and Longwalls 23-27. No additional aquatic ecology monitoring sites have been established for Longwalls 301-307.

Multivariate and univariate statistical procedures (Permutational Multivariate Analyses of Variance [PERMANOVA] and Plymouth Routines in Multivariate Ecological research [PRIMER] software packages) are used to examine temporal and spatial patterns in macroinvertebrates and macrophytes sampled within the study area. Specifically, PERMANOVA's are used to test hypotheses related to differential changes (e.g. before-vs-after commencement of mining) in multivariate and univariate (e.g. total number of taxa, total abundance and abundances of the most important taxonomic groups identified from the samples) estimates occurring in streams or pools subject to mining (i.e. potential 'impact' streams) in comparison to independent streams or pools that are not subject to mine subsidence (i.e. control places).

The spring 2019 Longwalls 20-22, Longwalls 23-27 and autumn Longwalls 20-27 Aquatic Ecology Monitoring Reports prepared by Bio-Analysis Pty Ltd are provided in Appendices (J1, J2 and J3, respectively).

The results of the Longwalls 20-22 and Longwalls 23-27 aquatic ecology programs (up to and including the autumn 2020 survey) are summarised below.

6.3.4.1 Stream Monitoring Program

Eastern Tributary

The results of the Longwalls 20-27 riparian vegetation monitoring surveys on the Eastern Tributary[14] in autumn 2020 can be summarised as follows:

- At Location C1 a significant change in the structure of the assemblage of aquatic macroinvertebrates has been detected in spring 2016, autumn 2019, spring 2019 and autumn 2020 in relation to the control locations. Mean numbers of the mayfly family, Leptophlebiidae, have been significantly more variable within the after-period at Location C1 between autumn 2015 and autumn 2019 and in autumn 2020. Assemblages of macrophytes at Location C1 appear to have experienced a degree of environmental stress (desiccation) since spring 2017 as a result of mining activities.
- At Location C2, a significant change in assemblages of macroinvertebrates indicative of a mining impact was detected at Location C2 in autumn and spring 2019 and autumn 2020. The total abundance of macroinvertebrates differed significantly in spring 2018, autumn and spring 2019 but not in autumn 2020. Mean numbers of the freshwater shrimp family, Atyidae, collected between autumn 2016 and 2018 and in autumn 2020 were significantly fewer than in the before mining period. The structure of assemblages of macrophytes at Location C2 in spring 2014 and from autumn 2016 to autumn 2020 differed significantly from assemblages sampled within the before-mining period. Changes in components of the macrophyte assemblage prior to the spring 2017 survey however, do not appear to be related to mining activities.
- At Location C3, analyses have not detected significant changes in aquatic macroinvertebrate or aquatic macrophyte indicators sampled at Location C3 that would indicate an impact from mining to date.
- At Location C4, analyses show that the structure of the macroinvertebrate assemblage sampled at the time of the spring 2019 and autumn 2020 surveys differed significantly from assemblages collected within the before-period. Temporal patterns in diversity of macroinvertebrates at Location C4 have differed significantly between periods since autumn 2018, in relation to the control locations. Significantly fewer Atyidae were collected at Location C4 in autumn 2016, spring 2018, spring 2019 and autumn 2020 than within the before-period. The structure of the aquatic macrophyte assemblage at Location C4 has differed significantly from assemblages within the before-period since autumn 2018.

The subsidence impacts at Locations C1 and C2 have triggered an assessment against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations, or ecological communities,* which have been undertaken by Ecoplanning and Cenwest Environmental Services (Appendices I2 and I3). The assessments conclude that the subsidence impact performance measure has been met.

[14] The Eastern Tributary is also known as Tributary C. Locations ET1 to ET4 shown on Figure 14 are the same as Locations C1 to C4 discussed in this section of the Annual Review, and in Appendices J1 to J3.

Waratah Rivulet

The results of the Longwalls 20-27 riparian vegetation monitoring surveys on the Waratah Rivulet in autumn 2020 can be summarised as follows:

- An iron precipitate/micro-organism complex has commonly been observed at Locations WT3, WT4 and WT5 since sampling commenced in spring 2008. Cracking of bedrock in the stream channel due to subsidence was first noted at Location WT3 in spring 2013.
- To date, analyses comparing temporal changes in components of assemblages of macroinvertebrates and macrophytes at Locations WT3, WT4 and WT5 on the Waratah Rivulet with control locations have not detected significant changes from before- to after mining of the Longwalls 20-22 underground mining area.
- Univariate analyses however, have detected a significant change in mean diversity of macroinvertebrates at Location WT3 in spring 2016, autumn 2018 and subsequent surveys (spring 2018, autumn 2019, spring 2019 and autumn 2020). Differences appear to be related to diversity decreasing at Location WT3 within the after-mining period, whereas there was an increase at the control locations.
- There were no conspicuous differences in mean diversity at Locations WT4 or WT5 in relation to the control locations. Mean abundance of macroinvertebrates and mean numbers of Leptophlebiidae and Atyidae did not differ at locations WT3, WT4 or WT5 in relation to the control locations between the before- and after-mining periods.
- There were no detectable changes to aquatic macrophytes at the Waratah Rivulet locations in relation to the control locations that could be associated with mining.

6.3.4.2 Pool Monitoring Program

Eastern Tributary

As described in the Longwalls 305-307 Biodiversity Management Plan, Pools ETAG, ETAH, ETAI and ETAK on the Eastern Tributary monitored by the previous pool monitoring program were impacted by mine subsidence in late 2016 or early 2017. Since that time, Pools ETAG, ETAH, ETAI and ETAK have often been dry or contained insufficient aquatic habitat for sampling as a result of the mine subsidence impacts. As described in Section 10.3.2, Metropolitan Coal is conducting stream remediation activities on the Eastern Tributary in accordance with the Metropolitan Coal Stream Remediation Plan.

Monitoring of Pools ETAG and ETAH will recommence subsequent to the conduct of stream remediation activities at Pool ETAH and will be conducted bi-annually[15]. Monitoring of Pools ETAI and ETAK will recommence subsequent to the conduct of stream remediation activities at Pool ETAK and will be conducted bi-annually[16].

The relevant control pools on the Woronora River (larger Pool WP and/or smaller Pools WP-A, WP-B and WP-C) and O'Hares Creek (larger Pool OC and/or smaller Pools OC-A, OC-B and OC-C) will be monitored bi-annually when sampling of the pools described above recommences.

[15] Monitoring will commence after the first stream remediation campaign at Pool ETAH has been completed (i.e. once the stream remediation activities have moved from the site).

[16] Monitoring will commence after the first stream remediation campaign at Pool ETAK has been conducted (i.e. once the stream remediation activities have moved from the site).

Waratah Rivulet

Monitoring of large and small pools on the Waratah Rivulet (large pools J, M1 and N; small pools K, L and M) and Eastern Tributary (large pool ETAH; small pools ETAG, ETAI and ETAK) (i.e. the pool monitoring) has been established to monitor the response of aquatic ecosystems to the implementation of future potential stream remediation works.

Multivariate data analyses for Pools J, K, L, M1, M and N on the Waratah Rivulet have found no evidence to suggest that assemblages of aquatic macroinvertebrates or macrophytes at the Waratah Rivulet pools have changed significantly before- vs after-mining of the Longwalls 20-27 mining area in relation to the control pools.

Univariate analyses for pools on the Waratah Rivulet found:

- a significant increase in mean diversity of macroinvertebrates in Pool J (from autumn 2015 to autumn 2017) and Pool M1 (from autumn 2015 to spring 2017) within the after-mining period in relation to the control pools;
- mean cover of macrophytes appears to have decreased significantly at Pool M1 in relation to the control pools within the after-period since autumn 2016;
- the diversity of macrophytes appears to have decreased significantly at Pool N within the after period (since autumn 2016); and
- patterns of temporal change in mean diversity of aquatic macroinvertebrates in Pools K, L and M have changed significantly in relation to the control locations since autumn 2015.

6.3.4.3 Assessment of Subsidence Impacts and Environmental Consequences on Aquatic Habitats and Biodiversity

The key potential subsidence impacts and environmental consequences for streams described in the Project EA, Preferred Project Report and Metropolitan Coal Biodiversity Management Plans include impacts on aquatic habitats (e.g. alteration of hydrology, pool habitat, in-stream connectivity and water quality), and on biodiversity (e.g. aquatic macrophytes, macroinvertebrates, fish and riparian vegetation). In summary, the key potential environmental consequences described in the Project EA, Preferred Project Report, and Metropolitan Coal Biodiversity Management Plans include:

- Changes in stream flows as a result of fracturing of bedrock and the consequent diversion of a portion of the total stream flow as underflow. The effects of underflow would be most noticeable during periods of low flow and on the frequency of no flow, while the effects on the frequency and magnitude of high flows would be negligible.
- Changes in pool water levels and in-stream connectivity - underflow has been observed to result in lower water levels in pools as they become hydraulically connected with the fracture network. During prolonged dry periods when flows recede to low levels, the number of instances where loss of flow continuity between pools occurs increases with a greater proportion of these lower flows being conveyed entirely in the subsurface fracture network.
- Impacts on water quality following cracking of the stream bed that can reduce the quality of habitat for aquatic biota (e.g. generation of iron flocculent material).
- Minor stream bank erosion, where changes in channel gradients result in increases in flow energy.
- Impacts on aquatic macrophytes plants (e.g. as a result of changes in hydrology described above) resulting in exposure and desiccation or smothering of plants by iron flocculent material. Aquatic macrophytes have evolved reproductive strategies to cope with the variable nature of flow in streams and wetlands within Australia. Obligate water plants generally require permanent water, however they can recolonise once water becomes available again.

- Localised impacts on aquatic macroinvertebrates as a result of changes in aquatic habitat/hydrology described above. The Project is unlikely to have any significant long-term impacts on assemblages of macroinvertebrates.
- The conveyance of surface water flows to sub-surface fractures in the area affected by subsidence has the potential to reduce available habitat for fish and connectivity among sections of the stream channel, impeding fish passage.

The results of aquatic ecology monitoring are considered to be consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and the Metropolitan Coal Water Management Plans and Biodiversity Management Plans.

The subsidence impacts on Locations C1 and C2 during the reporting period on the Eastern Tributary have triggered assessments against the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations, or ecological communities*. The threatened flora and fauna assessments prepared by Ecoplanning and Cenwest Environmental Services are provided in Appendices I1 and I2, respectively. The assessments conclude that the subsidence impact performance measure has been met.

Subsidence impacts on Tributary B have resulted in no surface flow along the stream in the vicinity of Location B1 for an extended period of time. This change in aquatic habitat/hydrology has resulted in long term impacts to the aquatic macroinvertebrate assemblage at this location (Location B1) and downstream at Location B2. This has not resulted in an exceedance of the biodiversity subsidence impact performance measure, *Negligible impact on threatened species, populations or ecological communities*.

Metropolitan Coal will continue to conduct stream remediation of pools on the Eastern Tributary in accordance with the Metropolitan Coal Stream Remediation Plan (Section 10.3.2.).

6.3.5 Amphibian Surveys

Monitoring programs have been developed for Longwalls 20-22, Longwalls 23-27 and Longwalls 301-307[17] to monitor amphibian species, with a focus on the habitats of the Giant Burrowing Frog (*Heleiporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*) associated with tributaries. The locations of the monitoring sites are shown on Figure 15.

Sites are surveyed annually in spring/summer (i.e. October to February) during suitable weather conditions. The spring/summer 2019 survey was carried out over two six day / six night periods in January 2020 (22 to 27 January) and February / March 2020 (26 February to 2 March).

6.3.5.1 Longwalls 20-22 Amphibian Monitoring

The spring/summer 2019 Longwalls 20-22 Amphibian Monitoring Report prepared by Cenwest Environmental Services (Cenwest) is provided as Appendix K1.

The spring/summer 2019 survey is the tenth amphibian survey for Longwalls 20-22. All six test sites above Longwalls 20-22 have been undermined for periods ranging from six to eight years (Figure 15). Habitats of five test sites (1, 2, 4, 5 and 6) have been impacted by longwall mining.

[17] The two amphibian monitoring sites established for Longwalls 305-307 are reported in Appendix K3, along with the six test sites established for Longwalls 301-303.

Eight amphibian species were recorded by the spring/summer 2019 survey, including five in test sites and seven in control sites, being representatives from the two families Myobatrachidae and Hylidae. The most species-diverse sites with five species present, were Sites 4, 6 and 8, followed by Site 2 with 4 species, Sites 5 and 10 each with three species, Sites 3 and 7 each with two species, and one species at sites 9, 11 and 12. The Red-crowned Toadlet was located at five test sites (sites 2, 3, 4, 5 and 6), and two control sites (7 and 10). The Giant Burrowing Frog was not recorded during the spring/summer 2019 survey. Individuals of the Giant Burrowing Frog have only been recorded during the 2009 (1 control site), 2011 (1 test site, 1 control site) and 2016 (1 control site) surveys. Littlejohn's Tree Frog (*Litoria littlejohni) was recorded for the first time for Longwalls 20-22, during the spring/summer 2017 survey at control site 10, and was again recorded at control site 10 during the spring/summer 2018 survey.*

Four breeding events were recorded by the spring/summer 2019 survey in both test and control sites. Two breeding events were recorded at sites 4 and 8 for the Adult Southern Rocket, one breeding event for the Adult Smooth Toadlet at site 8 and one small breeding event for the Peron's Tree Frog also at site 8. No breeding events were recorded for the Red-crowned Toadlet, Giant Burrowing Frog or Littlejohn's Tree Frog.

Since the commencement of the Longwalls 20-22 amphibian monitoring program, species diversity across all sites has varied between five (2013) and 11 (2009). At test sites, species diversity has varied between 3-9 species and at control sites, between 2-9 species.

6.3.5.2 Longwalls 23-27 Amphibian Monitoring

The spring/summer 2019 Longwalls 23-27 Amphibian Monitoring Report prepared by Cenwest Environmental Services is provided in Appendix K2.

The spring/summer 2019 survey is the tenth amphibian survey for Longwalls 23-27. All test sites above Longwalls 23-27 had been undermined prior to the commencement of the spring/summer 2016 survey. Habitats of two sites (13 and 14) have been impacted by longwall mining. However, both sites 13 and 14 have usually demonstrated the highest amphibian species diversity of the ten survey sites over ten survey years, with the exception of 2016, 2017, and 2018, 2017-2018 being an exceptionally dry period.

Eight amphibian species were recorded by the spring/summer 2019 survey, including five in test sites (13, 14 and 16) and three in control sites (19, 21 and 22), also being representatives from the two families Myobatrachidae and Hylidae. The most widespread frog was the Common Eastern Froglet (*Crinia signifera*), recorded at test sites 13, 14, 15 and 16, and all control sites. The Giant Burrowing Frog was not located during the survey. The Red-crowned Toadlet was recorded at test sites 14 and 15 and all control sites. Littlejohn's Tree Frog *was recorded for the first time for Longwalls 23-27 during the spring/summer 2017 survey at control site 18.* Littlejohn's Tree Frog *was recorded during the spring/summer 2019 survey at control site 18.*

Six species (the Common Eastern Froglet, the Red-Crowned Toadlet, The Blue Mountains Tree frog, the Southern Rocket Frog, the Jervis Bay Tree Frog and the Peron's Tree Frog) were observed breeding in the spring/summer 2019 survey. The most species-diverse sites with five species present was site 18 (with five species), site 14 (with four species), sites 20 and 22 (with three species), sites 15, 19 and 21 each with two species, and sites 13 and 16 each with one species.

Since the commencement of the Longwalls 23-27 amphibian monitoring program, species diversity across all sites has varied between three (2017) and eight (2010 and 2019). At test sites and control sites species diversity has varied between two and seven.

6.3.5.3 Longwalls 301-307 Amphibian Monitoring

Baseline amphibian surveys were conducted in spring/summer 2015 and 2016 at six test sites (23, 24, 25, 26, 27 and 28) overlying Longwalls 301-303, and in spring/summer 2018 and 2019 at two test sites overlying Longwalls 305-307. (Figure 15). The control sites for Longwalls 301-307 consist of the 11 existing sites associated with Longwalls 20-22 (Sites 7-12) and Longwalls 23-27 (Sites 18-22). The spring/summer 2019 survey was the fifth spring/summer survey for Longwalls 301-303, and the third survey conducted since the commencement of Longwalls 301-303.

The spring/summer 2019 Longwalls 301-307 Amphibian Monitoring Report prepared by Cenwest Environmental Services is provided in Appendix K3.

At the time of the spring/summer 2019 survey, all test sites (i.e. sites 23 to 28) had been undermined by Longwalls 301-303. Test sites 29 and 30 had not been undermined at the time of the spring/summer 2019 survey, as Longwall 305 commenced on 12 April 2020 after the spring/summer 2019 surveys had been completed. No longwall test sites were adversely impacted by mining at the time of the spring/summer 2019 survey.

In the spring/summer 2019 survey, eight amphibian species were recorded at test sites, including two threatened species and six non-threatened species. The Red-crowned Toadlet was located at six sites and the Littlejohn's Tee Frog was located at one site. The six non-threatened species recorded included the Common Eastern Froglet (all sites), the Brown Striped Frog (sites 23 and 30), the Spotted Grass Grog (site 26), the Smooth Toadlet (site 27), the Peron's Tree Frog (site 27) and the Green Stream Frog (site 29). Adults of the Common Eastern Froglet were found breeding at three sites and adults of the Brown Striped Frog were found breeding at one site in the spring/summer 2019 survey. The Spotted Grass Frog was observed for the first time breeding at site 26 and the Peron's Tree Frog was observed breeding at site 27.

6.3.5.4 Statistical Analysis of Amphibian Monitoring Results

A feature of the amphibian surveys to date is the high numbers of zero records that dominate the data, indicating a non-normal distribution (i.e. a skewed distribution of data). This means that the results of the amphibian surveys cannot be analysed by simple parametric statistics such as Chi^2 or an analysis of variance (ANOVA). A Poisson regression[18] analysis has been carried out by Dr Bernard Ellem for Cenwest Environmental Services to analyse the amphibian survey results obtained to date (i.e. to spring/summer 2019). The four data sets (Longwalls 20-22, 23-27, 301-307 and 309-317) have been analysed together to increase the resolution of the analyses.

No adverse impact from mining has been detected for the amphibian assemblage at the 95% confidence level for Longwalls 20-27 and Longwalls 301-307.

[18] Poisson regression is a generalised linear model form of regression analysis used to model count data and contingency tables.

6.4 LAND MANAGEMENT

The Metropolitan Coal Longwall 304 and Longwalls 305-307 Land Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans on cliffs, overhangs, steep slopes and land in general, in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwall 304 and Longwalls 305-307 Land Management Plans include post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22, Longwalls 23-27and Longwalls 301-303.

Sections 6.4.1 and 6.4.2 provide a summary of the land assessments for the review period. Section 6.8 provides a summary of the assessments against the cliffs and overhangs, steep slopes and land in general subsidence impact performance indicators and measures for the reporting period.

6.4.1 Cliffs and Overhangs

Visual inspections of cliffs and overhangs were conducted monthly when mining of Longwalls 20-22 and/or Longwalls 23-27 was within 400 m of sites COH1, COH2, COH3, COH4, COH5, COH6, COH6A, COH7, COH8, COH9, COH10, COH14, COH15 and COH16 (Figure 16) and following the completion of each longwall to record evidence of subsidence impacts. A vertical tension crack (approximately 50 mm wide and 15 m long) on the cliff face and a small rock fall (approximately 1.5 m long, 0.5 m wide and 0.5 cubic metres) were recorded at site COH2 (Figure 15) in December 2013 during the mining of Longwall 22. No additional subsidence impacts at the cliff or overhang sites were recorded following the completion of Longwall 27.

A new cliff and overhang site (COH17) was identified below the full supply level on the Eastern Tributary arm of the Woronora Reservoir in August 2018 (Figure 16). Detailed baseline recording for this site was conducted prior to commencement of Longwall 303 extraction.

Visual inspections of site COH17 were conducted monthly when mining of Longwall 304 and Longwall 305 was within 400 m of the site, and following the completion of Longwalls 304 and 305. No subsidence impacts on site COH17 were identified during the reporting period.

Visual inspections for subsidence impacts will be conducted at sites COH11, COH12, COH13, COH16 and COH17 during and after the extraction of Longwalls 306 and 307, in accordance with the Longwalls 305-307 Land Management Plan.

The Project EA, Preferred Project Report and Metropolitan Coal Land Management Plans predicted that the length of potential cliff instabilities would be expected to be less than 3% of the lengths of the cliffs. The total length of cliffs and associated overhangs within the Project underground mining area is approximately 924 m. Less than 3% of the total length of cliffs (and associated overhangs) within the mining area have experienced mining-induced rock fall.

6.4.2 Steep Slopes and Land in General

Visual inspections for subsidence impacts on steep slopes and land in general are conducted by Metropolitan Coal and its contractors as part of routine works conducted in the catchment.

No subsidence impacts on steep slopes or land in general were identified by Metropolitan Coal or its contractors during the reporting period. No management measures were required to be implemented.

The recorded subsidence impacts are consistent with the potential subsidence impacts described in the Project EA, Preferred Project Report and Metropolitan Coal Land Management Plans, specifically that the size and extent of surface cracking at the steep slopes and land in general would be similar to that observed previously at Metropolitan Coal, and that the maximum predicted systematic strains would be of sufficient magnitude to result in the fracturing of sandstone and, hence, there is potential for rock falls, particularly where rock ledges are marginally stable.

6.5 HERITAGE MANAGEMENT

The Metropolitan Coal Longwall 304 and Longwalls 305-307 Heritage Management Plans were prepared to manage the potential environmental consequences of the Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans on Aboriginal heritage sites or values in accordance with Condition 6, Schedule 3 of the Project Approval.

The Longwall 304 and Longwalls 305-307 Heritage Management Plans include post-mining monitoring and management of potential subsidence impacts and environmental consequences associated with Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303.

Sections 6.5.1 and 6.5.2 provides a summary of the heritage assessments for the review period. Section 6.8 provides a summary of the assessments against the Aboriginal heritage sites subsidence impact performance indicators and measures.

6.5.1 Longwalls 20-22, 23-27 and 301-303

Aboriginal heritage monitoring programs have been implemented at Metropolitan Coal for Longwalls 20-22, Longwalls 23-27 and Longwalls 301-303 to monitor the impacts and environmental consequences of Project related subsidence on Aboriginal heritage sites. The monitoring programs have been undertaken by a suitably qualified archaeologist (with experience in rock art recording and management) and representatives of the Aboriginal stakeholders.

Of the 72 Aboriginal heritage sites that have been subject to monitoring for Longwalls 20-22, Longwalls 23-27 and/or Longwalls 301-303, 13 have been determined to have changes due to mining induced subsidence.

Five Aboriginal heritage sites (FRC 15, FRC 281, FRC 283, FRC 284 and MET 1) have been determined to have changes due to mining induced subsidence from Longwalls 20-22 (Figure 17). The observed impacts at each site were as follows:

- Site FRC 15 – vertical cracking, not coincident with any art.
- Site FRC 281 – multiple cracks running either through or adjacent to the motifs (although the majority of art showed no damage or changes).
- Site FRC 283 – cracking of the rear wall of the shelter, not coincident with any art.
- Site FRC 284 – fracturing of the rear wall of the shelter and exfoliation, not coincident with any art.
- Site MET 1 – two vertical cracks along the rear wall and ceiling of the shelter, not coincident with any art.

Seven Aboriginal heritage sites (FRC 28, FRC 29, FRC 34, FRC 60, FRC 176, FRC 275 and FRC 301) have been determined to have changes due to mining induced subsidence from Longwalls 23-27 (Figure 17). The observed impacts at each site were as follows:

- Site FRC 28 – vertical cracking of the rear shelter wall, opening of horizontal planes/joints and movement of the rock shelf that is part of the shelter floor, not coincident with any art.
- Site FRC 29 – horizontal crack along the back wall and a joining vertical crack, not coincident with any art.
- Site FRC 34 – horizontal cracking along the roof of the shelter and cracking over the most southern hand stencil on the back panel.
- Site FRC 60 – three vertical cracks along the back wall of the shelter, no art recorded at this shelter, the artefacts could not be relocated.
- Site FRC 176 – where vertical cracking along the northern and southern ends of the shelter was observed, not coincident with art.
- Site FRC 275 – opening of horizontal bedding plane at rear of the shelter, five vertical hairline cracks along the back wall of the shelter, not coincident with any art.
- Site FRC 301 – surface cracking on the rock platform, not coincident with the grinding grooves.

One Aboriginal heritage site, FRC 76, was determined to have changes due to mining induced subsidence from Longwalls 301-303. The observed impacts were as follows:

- Site FRC 76 - opening of the horizontal bedding plane along the back wall, not coincident with any art.

Aboriginal heritage site monitoring results for Longwalls 20-27 and Longwalls 301-303 have been assessed against the Aboriginal heritage subsidence impact performance measure:

> *Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.*

For the purpose of measuring performance against the Aboriginal heritage subsidence impact performance measure, sites are considered to be “affected by subsidence impacts” if they exhibit one or more of the following consequences that cannot be attributed to natural weathering or deterioration:

- overhang collapse;
- cracking of sandstone that coincides with Aboriginal art or grinding grooves; and
- rock fall that damages Aboriginal art.

The mining area is defined by the Project Approval and is shown on Figure 1 of this report (labelled as Project Underground Mining Area Longwalls 20-27 and 301-317). There are 143 Aboriginal heritage sites within the mining area.

Of the sites at which changes due to mining induced subsidence have occurred, sites FRC 34 and FRC 281 have been affected by subsidence impacts as a result of cracking of sandstone that coincides with Aboriginal art. This means that less than 2% of sites within the mining area have been affected by subsidence impacts. In addition to the changes recorded as a result of mining induced subsidence, natural weathering processes can also result in changes/deterioration of Aboriginal heritage sites.

Metropolitan Coal acknowledges that all Aboriginal heritage sites are considered to be culturally significant to the Aboriginal people who have a traditional connection to Country.

The Aboriginal heritage monitoring results are consistent with the potential subsidence impacts and environmental consequences described in the Project EA, Preferred Project Report and Metropolitan Coal Heritage Management Plans, including the potential for open sites and overhang sites to be impacted by the cracking of sandstone resulting from mine subsidence. The observed rate of subsidence effects at the time of the Project EA and Preferred Project Report was that up to 10% of sites experience an effect such as cracking, accelerated weathering or blockfall. It was expected that the majority of identified Aboriginal heritage sites would experience no significant change, particularly when compared to natural deteriorating processes unrelated to mining.

6.5.2 Longwall 304

In accordance with the Metropolitan Coal Longwall 304 Heritage Management Plan, monitoring of Aboriginal heritage sites FRC 76, FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309 (Figure 17) was undertaken within three months of the completion of Longwall 304.

The Longwall 304 monitoring survey found there were no further changes from mining observed at FRC 76, which had been previously recorded as having subsidence related changes due to the extraction of Longwalls 301–303.

No subsidence related changes were observed at sites Aboriginal heritage sites FRC 77, FRC 78, FRC 86, FRC 90 and FRC 309 during the Longwall 304 monitoring survey.

6.5.3 Longwalls 305-307

In accordance with the Metropolitan Coal Longwalls 305-307 Heritage Management Plan, monitoring of Aboriginal heritage sites FRC 67, FRC 68, FRC 70, FRC 71, FRC 76, FRC 77, FRC 78, FRC 85, FRC 86, FRC 87, FRC 90, FRC 91, FRC 93, FRC 117, FRC 309, FRC 310 and FRC 325 (Figure 17) was undertaken in 2021 (i.e. within three months of the completion of Longwall 305). The results of this survey will be reported in the 2021 Metropolitan Coal Six-Monthly Review.

6.6 BUILT FEATURES MANAGEMENT

The Metropolitan Coal Longwalls 305-307 Built Features Management Plan was prepared to manage the potential environmental consequences of the Metropolitan Coal Longwalls 20-22, Longwalls 23-27 Longwalls 301-303 and Longwall 304 Extraction Plans on built features in accordance with Condition 6, Schedule 3 of the Project Approval.

During the review period, Metropolitan Coal continued subsidence monitoring for infrastructure in consultation with the infrastructure owners. The maximum observed total conventional subsidence along sections of the 300 XL Line and Optic Water Line was greater than predicted for the review period.

As a result, and as reported in the Metropolitan Coal 2020 Six-Monthly Review, the Sydney Water pipeline and Telstra optical fibre cable were at Level 2 significance, and the Old Princes Highway and Optus Fibre Cable were at Level 3 significance at the end of June 2020 in accordance with the relevant Metropolitan Coal Longwalls 305-307 Built Features Management Plan TARP.

At the end of the review period, sections of the Sydney Water pipeline and Optus optical fibre cable were at Level 3 significance, and the Old Princes Highway and Telstra optical fibre cable had returned to Level 1 in accordance with the relevant Metropolitan Coal Longwalls 305-307 Built Features Management Plan TARP (Table 9).

Metropolitan Coal have completed all actions to address the Level 2 and 3 triggers as outlined in the relevant Metropolitan Coal Longwalls 305-307 Built Features Management Plan TARPs.

During the review period, the following non-survey monitoring occurred:

- M1 Motorway – inspection and audit of pavement condition, cutting risk ranking, bridge audits and culvert condition inspection.
- Optic Fibre Cables – Telstra Optical Time Domain Reflectometer routine cable analysis completed.
- Water pipeline – visual inspections of pipeline route for moisture when longwall face in proximity to pipe.
- Princes Highway – weekly visual inspections of pavement, culverts and road furniture nearby longwall operations.
- Railway – railway culverts post mining structural and condition inspection.

Monitoring of infrastructure owned by Axicom, Endeavour Energy, TransGrid, Optus, Telstra, Roads and Maritime Services, SESLHD, Sydney Trains, Sydney Water and Wollongong City Council was conducted during the review period for subsidence impacts.

Visual inspections of the Old Princes Highway in June and July 2020 identified fine cracking of the pavement that did not pose a safety issue, rather it created a potential for water to seep through to the subbase. In consultation with Wollongong City Council crack sealant was applied in August and September 2020 to prevent water ingress.

The Project Approval requires Metropolitan Coal not to exceed the following built features subsidence impact performance measure:

> *Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing.*

The built features subsidence impact performance measure was not exceeded during the reporting period.

The Project Approval also requires Metropolitan Coal not to exceed the subsidence impact performance measure for items of heritage or historical significance at the Garrawarra Centre:

> *Negligible damage (fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing.*

The subsidence impact performance measure for items of heritage or historical significance at the Garrawarra Centre was not exceeded during the reporting period.

6.7 PUBLIC SAFETY MANAGEMENT

The Metropolitan Coal Longwall 304 and Longwalls 305-307 Public Safety Management Plans were prepared to manage the potential consequences of the Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans on public safety within the underground mining areas in accordance with Condition 6, Schedule 3 of the Project Approval.

Monitoring of cliffs and overhangs, steep slopes and land in general has been conducted for subsidence impacts in accordance with the Metropolitan Coal Longwall 304 and Longwalls 305-307 Land Management Plans. Monitoring of infrastructure items has been conducted in accordance with the Metropolitan Coal Built Features Management Plans. No subsidence impacts were identified during the reporting period that were considered to pose a risk to public safety.

Further, no subsidence safety incidents were reported by visitors, personnel or contractors to Metropolitan Coal in the underground mining area during the reporting period.

6.8 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

The subsidence impact performance indicators and performance measures in Table 9 were developed to address the predictions of subsidence impacts and environmental consequences on water resources, watercourses, biodiversity, land, heritage, built features and public safety included in the Project Environmental Assessment, Preferred Project Report, and Metropolitan Coal Longwall 304 and Longwalls 305-307 Extraction Plans.

Assessments against the subsidence impact performance indicators and performance measures have been conducted for the reporting period in Table 9.

Table 9
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT								
Negligible Reduction to the Quantity of Water Resources Reaching the Woronora Reservoir								
Negligible reduction to the quantity of water resources reaching the Woronora Reservoir	*Changes in the quantity of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining, that are not also occurring in the control catchment(s)*	WaterNSW gauging station on Waratah Rivulet (GS 2132102)	Surface water flow	Level 1	The median of the ratios does not fall below the 35th percentile of the baseline data.	Surface water flow was at Level 1 from July to December 2020.	No	No
				Level 2	The median of the ratios falls below the 35th percentile but does not fall below the 20th percentile of the baseline data.	Surface water flow was at Level 2 from 28 April to 30 June 2020.	No	No
				Level 3	The median of the ratios falls below the 20th percentile of the baseline data.	Surface water flow was at Level 3 from 1 January to 27 April 2020, though the same was also occurring in the control catchment. As above, flows were at Level 1 from July to December 2020.	No	No
Negligible Reduction to the Quality of Water Resources Reaching the Woronora Reservoir								
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	*Changes in the quality of water entering Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations that are not also occurring at control site WOWQ2*	Site WRWQ9 on the Waratah Rivulet	Iron (Fe) Manganese (Mn) Aluminium (Al) [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.	Dissolved iron, aluminium and manganese were at Level 1 throughout the reporting period.	No	No
		Site ETWQ AU on the Eastern Tributary	Iron (Fe) Manganese (Mn) Aluminium (Al) [Field filtered]	Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.	Dissolved aluminium was at Level 1 throughout the reporting period. Dissolved iron was at Level 1 from January to July, September, October, and December 2020.	No	No
				Level 2	Data analysis indicates any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for one month.	Dissolved manganese was at Level 2 in May 2020. Dissolved iron was at Level 2 in August and November 2020.	No	No
				Level 3	Data analysis indicates: • any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for two consecutive months; or • over a three month period the water quality parameter exceeds the adjusted mean plus two standard deviations in the first month, the adjusted mean plus one standard deviation in the next month and the adjusted mean plus two standard deviations in the third month; or • the six month mean exceeds the adjusted baseline mean plus one standard deviation for two consecutive assessment periods (i.e. over two six monthly reports); and • there was not a similar exceedance of the trigger at the control site.	Dissolved manganese was at Level 3 from January to April and June to December 2020.	Yes	No Assessments conducted by Associate Professor Barry Noller (Appendix F)
No Connective Cracking Between the Surface and the Mine and Negligible Leakage from Woronora Reservoir								
No connective cracking between the surface and the mine	*Visual inspection does not identify abnormal water flow from the goaf, geological structure, or the strata generally*	Underground	Inspections of development workings for water accumulation	Level 1	Normal water flow identified from the goaf, geological structure, or the strata generally.	-	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
No Connective Cracking Between the Surface and the Mine and Negligible Leakage from Woronora Reservoir (Continued)								
No connective cracking between the surface and the mine	*The 20-day average mine water make does not exceed 1 ML/day*	Underground	• Metered water reticulated into the mine (mine inflow) • Metered water reticulated out of the mine (mine outflow) • Moisture content into and out of the mine through the mine ventilation system (mine inflow and outflow) • *In-situ* moisture content of the coal (mine inflow) • Moisture content of ROM coal conveyed out of the mine at the drift portal (mine outflow)	Level 1	20-day average mine water make is less than or equal to 0.5 ML/day.	The 20-day average daily mine water make was approximately 0.06 ML/day during the reporting period	No	No
	Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore 9GGW2B does not occur.	Bore 9GGW2B	Groundwater pressures/levels	Level 2	9GGW2B Head Profile is consistent with the shape of, and does not lie significantly to the left of the predicted High Inflow Model Curve.	-	No	No
	Significant departure from the predicted envelope of the vertical potentiometric head profile at Bore F6GW3A does not occur	Bore F6GW3A	Groundwater pressures/levels	Level 2	F6GW3A Head Profile is consistent with the shape of, and does not lie significantly to the left of the predicted High Inflow Model Curve.	-	No	No
No connective cracking between the surface and the mine **Negligible leakage from the Woronora Reservoir**	*The groundwater head of Bore F6GW4A is greater than 10 m above the Woronora Reservoir full supply level.*	Bore F6GW4A (90.0 m)	Groundwater pressures/levels	Level 2	F6GW4A < 199.92 m AHD and > 178.90 m AHD	-	No	No
	The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PHGW2A is reduced by no more than 40% from that measured to 30 June 2017.	Bore PHGW2A (97.5 m)	Groundwater pressures/levels	Level 1	PHGW2A >= 186.92 m AHD.	-	No	No
Negligible leakage from the Woronora Reservoir	*The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9GGW2B is reduced by no more than 40% from that measured to 30 June 2017.*	Bore 9GGW2B (80.3 m)	Groundwater pressures/levels	Level 1	9GGW2B >= 181.38 m AHD	-	No	No
	The hydraulic gradient to the Woronora Reservoir at full supply level from Bore 9EGW2A is reduced by no more than 40% from that measured to 30 June 2017.	Bore 9EGW2A (107.5 m)	Groundwater pressures/levels	Level 2	9EGW2A < 186.32 m AHD and > 179.35 m AHD	-	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
No Connective Cracking Between the Surface and the Mine and Negligible Leakage from Woronora Reservoir (Continued)								
Negligible leakage from the Woronora Reservoir	*The hydraulic gradient to the Woronora Reservoir at full supply level from Bore PM02 is reduced by no more than 40% from that measured to 30 June 2017.*	Bore PM02 (100 m)	Groundwater pressures/levels	Level 1	PM02 ≥ 183.86 m AHD.	-	No	No
	The hydraulic gradient to the Woronora Reservoir from transect bore T2 is reduced by no more than 10% from that measured on 30 June 2017.	Bore T2	Groundwater levels	Level 1	T2-WRL >= 2.65 m	-	No	No
	The hydraulic gradient to the Woronora Reservoir from transect bore T3 is reduced by no more than 10% from that measured on 30 June 2017.	Bore T3	Groundwater levels	Level 3	T3-WRL =< 3.98 m	Increase the frequency of data analysis to monthly (until such time that data analysis indicates a return to Level 1). Report provided to DPIE, WaterNSW, DPIE – Water and BCD within one month of assessment completion.	Yes	No Assessment against the performance measure conducted by SLR (2020) (Appendix G)
	The hydraulic gradient from transect bore T5 to bore T3 is reduced by no more than 10% from that measured on 30 June 2017	Bores T5 to T3	Groundwater levels	Level 3	T5-T3 < 17.92 m and > 16.13 m Note: the six-months reporting period started out with Level 1, decreased to Level 3 and has returned to Level 2 by the end of reporting.	Increase the frequency of data analysis to monthly (until such time that data analysis indicates a return to Level 1). Report provided to DPIE, WaterNSW, DPIE – Water and BCD within one month of assessment completion.	Yes	No Assessment against the performance measure conducted by SLR (2020) (Appendix G)
Negligible Reduction to the Quality of Water Resources in the Woronora Reservoir								
Negligible reduction in the water quality of Woronora Reservoir	*Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations*	Woronora Reservoir (site DW01) (subject to data availability from WaterNSW)	Total Iron (Fe) Total Manganese (Mn) Total Aluminium (Al)	Level 1	The current year's duration exceedance curve for a water quality parameter in Woronora Reservoir (total iron, total manganese and total aluminium) is below the baseline 10 year ARI exceedance curve for any range of the duration percentages from 0% to 75%.	Total iron was at Level 1 throughout the reporting period.	No	No
				Level 3	The current year's duration exceedance curve for a water quality parameter in Woronora Reservoir (total iron, total manganese and total aluminium) is above the baseline 20 year ARI exceedance curve for any range of the duration percentages from 0% to 75%.	Total aluminium and manganese were above the baseline 20 year ARI exceedance curve.	Yes	No Assessment against the performance measure conducted by HEC (2020) (Appendix B2)
Negligible Environmental Consequences on Waratah Rivulet								
Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	***No Diversion of Flows, No Change in the Natural Drainage Behaviour***							
	No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W	Pools P to W on Waratah Rivulet	Streambed cracking and drainage behaviour	Level 1	No mine-induced surface cracking or impacts to natural drainage behaviour observed.	Pools P to W were at Level 1 throughout the reporting period.	No	No
	Analysis of water level data for Pools P, T, U, V and W indicates the water level is at or above the pool's previous minimum	Pools P, T, U, V and W on Waratah Rivulet	Pool water level	Level 1	The water level in Pools P, T, U, V or W has not been below the pool's previous minimum.	Pools P to W were at Level 1 throughout the reporting period.	No	No
	Analysis of water level data for Pools Q, R and S indicates the water levels are above that required to maintain water over the downstream rock bar	Pools Q, R and S on the Waratah Rivulet	Pool water level	Level 1	The water level in Pools Q, R or S has been above that required to maintain water over the downstream rock bar.	Pools Q, R and S were at Level 1 throughout the reporting period.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
Negligible Environmental Consequences on Waratah Rivulet								
Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	***Minimal Iron Staining***							
	Visual inspection of the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir does not show significant changes in the extent or nature of iron staining that isn't also occurring in the Woronora River (control site).	Waratah Rivulet, from Pool P to the full supply level of the Woronora Reservoir	Nature and extent of iron staining	Level 1	The extent or nature of iron staining in the Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir has not changed.	-	No	No
	Minimal Gas Releases							
	Gas releases in Waratah Rivulet from Pool P to the full supply level of the Woronora Reservoir have not increased beyond those observed up to the commencement of Longwall 301 extraction.	Waratah Rivulet, from Pool P to the full supply level of the Woronora Reservoir	Free Carbon Dioxide as CO_2 (mg/L) Methane (mg/L)	Level 1	Free carbon dioxide concentrations are equal to or less than 4 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir. Methane concentrations are equal to or less than 0.159 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir.	Pool P was at Level 1 in February, March, May, July and August 2020 (free carbon dioxide concentrations), and January to March and June to December 2020 (free methane concentrations). Pool U was at Level 1 in February to October 2020 (free carbon dioxide concentrations) and January to December 2020 (free methane concentrations). Pools Q, R, S, T, V and W were at Level 1 from January to December 2020 free carbon dioxide and methane concentrations).	No	No
				Level 2	Free carbon dioxide concentrations are above 4 mg/L and equal to or less than 13 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir. Methane concentrations are above 0.159 mg/L and equal to or less than 0.478 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir.	Pool P was at Level 2 in June, September and October 2020 (free carbon dioxide concentrations). Pool U was at Level 2 in January 2020 (free methane concentrations).	No	No
				Level 3	Free carbon dioxide concentrations are above 13 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir. Methane concentrations are above 0.478 mg/L in Waratah Rivulet pools from Pool P to the full supply level of the Woronora Reservoir.	Pool P was at Level 3 in January, April, and October to December 2020 (free carbon dioxide concentrations). Pool U was at Level 3 in October to December 2020 ((free carbon dioxide concentrations).	Yes	No Assessments conducted by Professor Barry Noller (Appendix E)

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
WATER MANAGEMENT (Continued)								
Negligible Environmental Consequences on Eastern Tributary								
Negligible environmental consequences over at least 70% of the stream length (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases) on the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	***No Diversion of Flows, No Change in the Natural Drainage Behaviour***							
	No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.	Pools ETAS, ETAT and ETAU on the Eastern Tributary.	Stream cracking and drainage behaviour.	Level 1	No mine-induced surface cracking at Pool ETAS or Pool ETAT; no increase in previous cracking at Pool ETAU. No impacts to natural drainage behaviour observed.	Pools ETAS, ETAT and ETAU were at Level 1 throughout the reporting period.	No	No
	Analysis of water level data for Pool ETAU indicates the water levels are above that required to maintain water over the downstream rock bar.	Pool ETAU on the Eastern Tributary.	Pool water level.	Level 1	The water level in Pool ETAU has been above that required to maintain water over the downstream rock bar.	Pool ETAU was at Level 1 throughout the reporting period.	No	No
	Minimal Iron Staining							
	N/A	Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Nature and extent of iron staining	On 14 October 2016, Metropolitan Coal reported the exceedance of the Eastern Tributary performance measure in relation to iron staining to the DP&E (now DPIE) and other relevant agencies. Iron staining/flocculent is present at a number of stream features between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir. Metropolitan Coal to monitor the nature and extent of iron staining on the Eastern Tributary during the mining of Longwalls 305-3037 Metropolitan Coal to implement contingency measures (stream remediation measures) in accordance with the Project Approval.		-	N/A	Yes
	Minimal Gas Releases							
	Gas releases in Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 have not increased beyond those observed up to the commencement of Longwall 301 extraction	Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	Free Carbon Dioxide as CO_2 (mg/L) Methane (mg/L)	Level 1	Free carbon dioxide concentrations are equal to or less than 4 mg/L in Eastern Tributary pools between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. Methane concentrations are equal to or less than 0.159 mg/L in Eastern Tributary pools between the full supply level of the Woronora Reservoir and the maingate of Longwall 26.	Pools ETAG, ETAH, ETAI, ETAJ, ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS, ETAT, ETAU were at Level 1 throughout the reporting period.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT								
Upland Swamp Vegetation Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The vegetation in upland swamps is not expected to experience changes significantly different to vegetation in control swamps*	Swamps 16, 17, 18, 20, 24 and 25 overlying or adjacent to Longwalls 20-22 Swamps 19, 28, 30, 31, 32, 33, 34, 35, 36 and 94 overlying or adjacent to Longwalls 23-27 Swamps 40, 41, 47, 48, 49, 50, 53 and 58 overlying or adjacent to Longwalls 301-303 and Longwall 304 Control Swamps 101, 111a, 125, 135, 136, 137a, 137b, 138, Bee Creek Swamp, Woronora River 1, Woronora River south arm and Dahlia Swamp	Visual inspections Transect/ quadrat data Population monitoring of indicator species	Level 1	Data analysis indicates: • there is not a declining trend in the condition of longwall swamp vegetation; and • there are no significant changes in vegetation between the mined and control swamps.	Swamps 16, 17, 18, 20, 24, 25, 30, 32, 33, 34, 35, 36, 47, 48, 49, 50, and 58.	No	No
				Level 2	Data analysis indicates: • there is a declining trend in the condition of longwall swamp vegetation over time, however a similar trend is occurring in control swamp vegetation; or • there are significant differences in vegetation between the mined and control swamps, however, the data indicates longwall swamp vegetation is consistent with the baseline monitoring results.	Swamps 19, 28, 31, and 94: Vegetation condition at Swamps 19, 31 and 94 appears to have stabilised following a declining trend which commenced in autumn 2015. Further monitoring will determine if this is a change from the previous declining trend. The ongoing decline in the vegetation condition of the Tea Tree Thicket component of Swamp 28 with regards to condition of understorey species and loss of species richness appears to have stabilised, although species richness continues to fluctuate. Similar trends are apparent in the vegetation of some control sites. Continue close monitoring of trends in vegetation to assess the contribution of dry climatic condition versus mine subsidence impacts. Swamps 40, 41 and 53: Species richness and indicator species vegetation monitoring results indicate a declining trend in the condition of swamp vegetation in autumn 2020 in Swamp 40, however a similar trend is occurring in control swamp vegetation. Vegetation monitoring indicates a significant difference in vegetation condition between longwall (Swamps 40, 41 and 53) and control swamps in autumn 2020, however swamp vegetation is consistent with the baseline monitoring results. Continue close monitoring of trends in vegetation to assess the contribution of dry climatic conditions versus mine subsidence impacts.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT (Continued)								
Upland Swamp Groundwater Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*Surface cracking within upland swamps resulting from mine subsidence is not expected to result in measurable changes to swamp groundwater levels when compared to control swamps or seasonal variations in water levels experienced by upland swamps prior to mining*[5]	Swamp 20 Swamp 28	Swamp substrate groundwater levels	N/A	N/A	Previously assessed as being impacted by mine subsidence	Yes	To be assessed annually by relevant specialists
		• Swamp 25 overlying Longwalls (LW) 20-22. • Swamps 30, 33 and 35 overlying LW23-27. • Swamps 40, 41, 46, 51, 52 and 53 overlying LW301-303. • Swamp 50 overlying LW304. • Swamps 71a and 72 within the 35° angle of draw and/or predicted 20 mm subsidence contour of LW305-307. • Control Swamps 101, 137a and 137b.		Level 1	Data analysis for LW20-27 swamps indicates: - the seven day moving average for Swamps 25, 30 and 33 is within the 5th percentile established for the swamp's full length of record; and - the seven day moving average for Swamp 35 is within two standard deviations below the mean established for the swamp's full length of record. Data analysis for Longwalls 301-307 swamps indicates: - the seven day moving average for Swamps 40, 41, 46, 50, 51, 52, 53, 71a and 72 is at or above the minimum established for the swamp's full length of record.	Swamps 33, 40, 41, 46, 50, 51, 52, 53, 71a and 72. Continue monitoring. Six-monthly reporting.	No	No
				Level 2	Data analysis of swamp substrate water levels indicates: - the seven day moving average for Swamps 25 and 30 is below the 5th percentile established for the swamp's full length of record; - the seven day moving average for Swamp 35 lie outside two standard deviations below the mean established for the swamp's full length of record; - The seven-day moving average for Swamp 50 and 72 is below the baseline minimum, and - semi-quantitative comparisons with control swamps and rainfall record indicates that dry swamp conditions are natural.	Swamps 25, 30 and 35. Quarterly data analysis required.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT (Continued)								
Riparian Vegetation Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*Impacts to riparian vegetation are expected to be localised and limited in extent, similar to the impacts previously experienced at Metropolitan Coal*	Locations adjacent to riparian vegetation monitoring sites (MRIP01 to MRIP12) and areas traversed whilst accessing the monitoring sites: • sites MRIP01, MRIP02, MRIP05, MRIP06 and MRIP09 overlying Longwalls 20-22; • sites MRIP11 and MRIP12 overlying Longwalls 23-27; • sites MRIP03, MRIP04 and MRIP10 downstream of Longwall 23A; and • sites MRIP07 and MRIP08 downstream of Longwalls 23-27 and within the 35° angle of draw and/or predicted 20 mm subsidence contour for Longwalls 301-303.	The extent of vegetation subject to vegetation dieback	Level 1	No dieback of riparian vegetation greater than 50 cm from the stream as a result of mine subsidence.	Sites MRIP01, MRIP03, MRIP04, MRIP06, MRIP07, MRIP08, MRIP10 and MRIP11. None of the sites have previously been observed with riparian vegetation dieback greater than 50 cm from the stream.	No	No
				Level 2	Vegetation monitoring: • does not identify an increase in the extent of vegetation dieback compared to that observed at site MRIP02 on the Waratah Rivulet and between sites MRIP05 and MRIP09 on the Eastern Tributary; and • does not identify vegetation dieback greater than 50 cm from the stream at sites MRIP01, MRIP03, MRIP04, MRIP06, MRIP07, MRIP08 or MRIP10, as a result of mine subsidence.	Sites MRIP02, MRIP05, MRIP09 and MRIP12. Scouring of the stream bank and erosion resulting from high water flows following heavy rain events. The extent of dieback at sites previously observed with riparian vegetation dieback (MRIP02, MRIP05, MRIP09 and MRIP12) had not increased in the current survey and vegetation recovery was apparent.	No	No
Monitoring of Aquatic Biota, Stream Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence.*	Two sampling sites (approximately 100 m in length) at the following locations: • Location WT3 on Waratah Rivulet, Locations ET1, ET3 and ET4 on the Eastern Tributary overlying Longwalls 20-27. • Locations WT4 and WT5 on the Waratah Rivulet, downstream of Longwalls 20-27. • Location ET2 on the Eastern Tributary, downstream of Longwalls 20-27 and within the Longwalls 301-303 35° angle of draw and/or predicted 20 mm subsidence contour. • Control Locations: WR1 on Woronora River; and OC on O'Hares Creek.	Aquatic macroinvertebrates Aquatic macrophytes	Level 1	Data analysis indicates no significant changes in relation to control places pre-mining compared to post-extraction: - occur in the aquatic macroinvertebrate and macrophyte assemblages in Waratah Rivulet or the Eastern Tributary at Locations WT3, ET1, ET3 or ET4, located within the LW20-22 and LW23-27 mining areas during the mining of LW301-303; or - occur in the aquatic macroinvertebrate and macrophyte assemblages in the Eastern Tributary at Location ET2 during the mining of LW301-303.	Locations ET3, WT4 and WT5. Locations ET1, ET2, ET4 and WT3 (all parameters excluding those listed in Level 2 below).	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BIODIVERSITY MANAGEMENT (Continued)								
Monitoring of Aquatic Biota, Stream Monitoring (Continued)								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence.*	Two sampling sites (approximately 100 m in length) at the following locations: • Location WT3 on Waratah Rivulet, Locations ET1, ET3 and ET4 on the Eastern Tributary overlying Longwalls 20-27. • Locations WT4 and WT5 on the Waratah Rivulet, downstream of Longwalls 20-27. • Location ET2 on the Eastern Tributary, downstream of Longwalls 20-27 and within the Longwalls 301-303 35° angle of draw and/or predicted 20 mm subsidence contour. • Control Locations: WR1 on Woronora River; and OC on O'Hares Creek.	Aquatic macroinvertebrates Aquatic macrophytes	Level 2	Data analysis indicates significant (not long-term), changes in relation to control places pre-mining compared to post-extraction: - occur in the aquatic macroinvertebrate and macrophyte assemblages in Waratah Rivulet or the Eastern Tributary at Locations WT3, ET1, ET3 or ET4, located within the LW20-22 and LW23-27 mining areas during the mining of LW301-303; or - occur in the aquatic macroinvertebrate and macrophyte assemblages in the Eastern Tributary at Location ET2 within the LW301-303 mining area after the completion of Longwall 306.	Location ET1 (significant change in assemblage of macroinvertebrates recorded in spring 2016, autumn 2019 and spring 2019; altered macrophyte assemblage within the after-period however, changes prior to spring 2017 do not appear to be related to mining). Location ET2 (significant change in assemblage of macroinvertebrates in autumn and spring 2019; and abundance of macroinvertebrates in spring 2018, autumn and spring 2019). Location ET4 (significant change in assemblage of macroinvertebrates in spring 2019; altered patterns of diversity of macroinvertebrates since autumn 2018; decreased numbers of Atyidae in autumn 2016, spring 2018 and spring 2019; altered macrophyte assemblage within the after-period in autumn 2018, spring 2018, spring 2019 and autumn 2020). Location WT3 (change in macroinvertebrate diversity in spring 2016, autumn 2018, spring 2018, autumn 2019, spring 2019 and autumn 2020).	No	No
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The aquatic macroinvertebrate and macrophyte assemblages in streams are not expected to experience long-term impacts as a result of mine subsidence.*	Two sampling sites (approximately 100 m in length) at the following locations: • Location WT3 on Waratah Rivulet, Locations ET1, ET3 and ET4 on the Eastern Tributary overlying Longwalls 20-27. • Locations WT4 and WT5 on the Waratah Rivulet, downstream of Longwalls 20-27. • Location ET2 on the Eastern Tributary, downstream of Longwalls 20-27 and within the Longwalls 301-303 35° angle of draw and/or predicted 20 mm subsidence contour. Control Locations: WR1 on Woronora River; and OC on O'Hares Creek.	Aquatic macroinvertebrates Aquatic macrophytes	Level 3	Data analysis indicates significant long-term changes[6] in relation to control places pre-mining compared to post-extraction: - occur in the aquatic macroinvertebrate and macrophyte assemblages in Waratah Rivulet or the Eastern Tributary at Locations WT3, ET1, ET3 or ET4, located within the LW20-22 and LW23-27 mining areas during the mining of LW301-303; or - occur in the aquatic macroinvertebrate and macrophyte assemblages in the Eastern Tributary at Location ET2 within the LW301-303 mining area after the completion of Longwall 306.	Location ET1 (increased variability in numbers of Leptophlebiidae between autumn 2015 and autumn 2019 but not in spring 2019) Location ET2 (altered numbers of Atyidae between autumn 2016 and autumn 2019 but not in spring 2019; altered assemblage of aquatic plants within the after-period since autumn 2016).	Yes	No Assessment undertaken by Ecoplanning and Cenwest Environmental Services (Appendices I2 and I3)

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Comments	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Amphibian Monitoring								
Negligible impact on Threatened Species, Populations, or Ecological Communities	*The amphibian assemblage is not expected to experience changes significantly different to the amphibian assemblage at control sites*	Test sites 1 to 6 overlying Longwalls 20-22 Test sites 13 to 17 overlying Longwalls 23-27 Test sites 23 to 28 overlying Longwalls 301-303 Test sites 29 and 30 overlying LW305-307 Control sites 7 to 12 and 18 to 22.	Amphibian species diversity and relative abundance	Level 1	Data analysis does not identify a significant change in the amphibian population.	Spring/summer 2019 survey results: – Sites 1 to 6, sites 13 to 17, and sites 23 to 30.	No	No
LAND MANAGEMENT								
Cliffs and Overhangs, Steep Slopes and Land in General								
Less than 3% of the total length of cliffs (and associated overhangs) within the mining area experience mining-induced rock fall	*Cliff sites COH11, COH12, COH13, COH16 and/or COH17 experience cliff instabilities that do not require management measures to be implemented.*	Cliff sites COH11, COH12, COH13, COH16 and COH17	Cliff instabilities	Level 1	No subsidence impacts (i.e. cliff instabilities) recorded.		No	No
	Steep slopes and land in general experience sandstone fracturing/cracking and rock falls that do not require management measures to be implemented	Steep slopes and land in general within 600 m of Longwalls 20-27 and Longwalls 301-303	Sandstone fracturing/cracking and rock falls	Level 1	No subsidence impacts (i.e. sandstone fracturing/cracking and rock falls) recorded on steep slopes or land in general not previously recorded within 600 m of LW20-27 or LW301-307 (after LW305 commencement).	-	No	No
HERITAGE MANAGEMENT								
Aboriginal Heritage Sites Monitoring								
Less than 10% of Aboriginal heritage sites within the mining area are affected by subsidence impacts	*Less than 7% of Aboriginal heritage sites within the mining area are affected by subsidence impacts.*	Monitoring of Aboriginal heritage sites with the potential to be impacted by subsidence related to the extraction of LW305-307.	Cracking of sandstone at open sites Cracking and/or exfoliation of sandstone, blockfall, displacement, breakage and/or collapse of sandstone overhang sites Damage or deterioration of art motifs	Level 1	Monitoring results indicate sites FRC 281 and FRC 34 have been affected by subsidence impacts.	Survey of Aboriginal heritage sites following the completion of Longwall 304 and Longwall 305 indicated no sites have been affected by subsidence impacts.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – GARRAWARRA CENTRE COMPLEX							
Negligible damage (that is fine or hairline cracks that do not require repair), unless the owner of the item and the appropriate heritage authority agree otherwise in writing **Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing**	• *No greater tilt impact to buildings than Category A or B (i.e. mining induced ground tilt of less than 7 mm/m) for items of historical or heritage significance (i.e. either 'high' or 'exceptional' in the Conservation Plan for the Garrawarra Centre for Aged Care [Howard Tanner & Associates, 1993])* • *No greater strain impact to buildings than Category 0 or 1 (i.e. crack width of less than 1 mm) for items of historical or heritage significance (i.e. either 'high' or 'exceptional' in the Conservation Plan for the Garrawarra Centre for Aged Care [Howard Tanner & Associates, 1993])* • *No more than repairable (minor) defects (cracks, etc.) in the structural integrity for all other buildings, houses, structures and other services (including telecommunications towers and compounds, powerlines, pipelines and associated connections) due to mining* • *The electrical clearance from vegetation is maintained* • *Serviceability of the private roads and access roads/tracks has been maintained* • *The land in general is expected to experience minor cracking consistent with that observed during the extraction of previous longwalls at Metropolitan Coal (i.e. no more than minor cracking)*	Garrawarra Centre Complex Buildings/Structures (Excluding Services)	Subsidence effects parameters, fine or hair line cracks, cracking at pre-existing rock joints, columns, opening and closing of joints, or tilting of piers, water tank leaks and structural integrity	Level 1	Expected subsidence conditions	No	No
		Garrawarra Centre Complex Services	Subsidence effects parameters, ground tension cracks and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – ENDEAVOUR ENERGY							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *The structural integrity of the 132 kV transmission lines and towers is maintained* • *The structural integrity of the timber poles and high voltage powerlines is maintained* • *The electrical clearance from vegetation is maintained* • *The serviceability of the access roads/tracks is maintained*	132 kV Towers	Subsidence effects parameters, differential movements, ground deformations, observable surface cracking, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – TRANSGRID							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *The structural integrity of the transmission line and towers is maintained* • *The electrical clearance from vegetation is maintained* • *The serviceability of the access roads/tracks is maintained*	330 kV Towers	Subsidence effects parameters, differential movements, ground deformations, observable surface cracking, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – VOCUS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Negligible transmission loss in fibre optic cables from mine subsidence impacts* • *The structural integrity of the cable line and associated joint housing pit is maintained* • *The serviceability of the access roads/tracks is maintained*	Optical Fibre Cable – Major Interstate Trunk Cable: SM1 *Waterfall to Corrimal Section*	Subsidence effects parameters, OTDR (OTDR) signal loss, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – OPTUS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Negligible transmission loss from mine subsidence impacts* • *The structural integrity of the cable lines and associated facilities is maintained* • *The serviceability of the access roads/tracks is maintained*	Optical Fibre Cable – Trunk: IOF SYD-MEL 2 *(Coastal Inter Office Fibre two sections known as WAT-WOL 2 and WAT-WOL 3)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Optical Fibre Cable – Cable: 36S SMOF *(In leased Telstra Conduit and Manholes/pits. Cable manufacturer: MM Olex. Heavy polyethylene sheath, manufactured prior to 1993 and installation completed 1993)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 3	Subsidence 15% greater than predicted. No signal degradation in the Optus optical fibre cable has been reported.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – TELSTRA							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Negligible transmission loss in fibre optic cables from mine subsidence impacts* • *The structural integrity of the cable line and associated facilities is maintained* • *The structural integrity of the telecommunications tower and compound is maintained* • *The serviceability of the access roads/tracks is maintained*	Trunk Cable F KNST 2005 ENGA-HBGH 80f Sydney-Melbourne No.3 Optical Fibre Cable (*Labelled as Cable 1)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Customer Access Network (CAN) Cables: F ENGA 3001 6f Engadine-Garrawarra-Mobile Phone Tower optical fibre cable / F ENGA 3005 12f Engadine-Garrawarra-RIM and Garrawarra Hospital customer cable *(Labelled as Cable 2)*	Subsidence effects parameters, OTDR signal loss, and faults	Level 1	Expected subsidence conditions	No	No
		Customer Access Network (CAN) Copper Cables	Subsidence effects parameters, anomalous service condition, complaints and faults	Level 1	Expected subsidence conditions	No	No
		Telecommunications Tower (and Compound)	Subsidence effects parameters and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – RMS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	*<u>Bridge Distortion and Cracking</u>* • *absolute 3D horizontal movement of survey lines (M1 Northbound Line and Transmission Line) of 50 mm or more at key points on the ground near the bridge;* • *relative movement of 5 mm or more between any two points monitored by the conventional survey system;* • *relative movement of 2 mm or more between any two points monitored by the FBG sensor system; and* • *crack in concrete elements exceeding 0.2 mm width* *<u>M1 Princes Motorway Pavement Deformation</u>* • *a measured compressive ground strain of greater than 0.5 mm/m;* • *pavement cracking;* • *deterioration in ride quality; and* • *defects in minor structures such as kerbs and gutters, pits, etc.* *<u>Cuttings and Faults</u>* • *a measured ground strain of greater than 0.5 mm/m;* • *rock falls;* • *cracking or visual deterioration at the rock face; and* • *visual displacement at joints* *<u>Culverts</u>* • *visual displacement at joints;* • *cracks in culverts; and* • *ponding*	Bridge 2 (Old Princes Highway Underpass)	Subsidence effects parameters, absolute horizontal movements, incremental relative movement, structural cracks, observable subsidence ground deformations, and faults	Level 1	Expected subsidence conditions	No	No
		Cawley Road Overpass	Subsidence effects parameters, absolute horizontal movements, incremental relative movement, structural cracks, observable subsidence ground deformations, and faults	Level 1	Expected subsidence conditions	No	No
		Pavements	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformations, pavement cracking, deterioration in ride quality, defects in structure, and faults	Level 1	Expected subsidence conditions	No	No
		Cuttings	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformation, rock fall, cracking or visual deterioration at the rock face, visual displacement at joints, and faults	Level 1	Expected subsidence conditions	No	No
		Culverts	Subsidence effects parameters, absolute horizontal movements, observable subsidence ground deformations, cracking in culverts, visual displacement at joints, ponding, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – WOLLONGONG CITY COUNCIL OLD PRINCES HIGHWAY							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *No pavement cracking exceeding 5 mm, or other defects of the road pavement resulting in deterioration of ride quality* • *No ponding of water on the road surface as a result of changes in grade from subsidence associated with Longwalls 301-303* • *No joint displacement or cracking or other defects of the drainage structure (e.g. pipes/culverts) in excess of 5 mm* • *Serviceability of guard rails, marker posts and signage is maintained*	Pavements, Drainage Structures and Furniture	Subsidence effects parameters, observable subsidence ground deformations including ponding, pavement cracking, joint displacement or cracking/defects of drainage structures, defects in minor structures, and faults	Level 3	Visible subsidence effect observed. Fine pavement cracks not affecting the functionality of the highway with no steps or anomalous movements recorded. Cracks were repaired after observation.	No	No

Table 9 (Continued)
Assessment of Environmental Performance – Underground Mining Area and Surrounds

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Highest Significance Level/Trigger Recorded		Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
BUILT FEATURES MANAGEMENT – SYDNEY WATER							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *No more than repairable (minor) leakages of the water pipelines occur due to mining* • *No more than repairable (minor) defects (cracks, etc.) in the structural integrity of the pipes and associated connections occur due to mining*	Pipelines	Subsidence effects parameters, observable subsidence ground deformations or surface cracks, cracks or leaks, loss of flow/pressure, and faults	Level 2	Elevated subsidence recorded	No	No
BUILT FEATURES MANAGEMENT – SYDNEY TRAINS							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *The structural integrity of the telecommunications tower (and compound) is maintained*	Telecommunications Tower (and Compound)	Subsidence effects parameters, anomalous service condition, and faults	Level 1	Expected subsidence conditions	No	No
BUILT FEATURES MANAGEMENT – AXICOM							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	• *Structural integrity of the telecommunications towers and compounds has been maintained* • *Serviceability of the access roads/tracks has been maintained*	Telecommunications Towers (and Compounds)	Subsidence effects parameters, differential horizontal movement, and faults	Level 1	Expected subsidence conditions	No	No
PUBLIC SAFETY MANAGEMENT							
Safe, serviceable and repairable, unless the owner and the MSB agree otherwise in writing	*Public safety will be ensured in the event that any hazard to the general public arising from subsidence effects becomes evident.*	Cliffs and overhangs, steep slopes and land in general Built features	Public safety	Level 1	Expected subsidence conditions	No	No

1 The streamflow records for GS 2132102 provided by WaterNSW were incomplete for the reporting period and, as such, assessment of the results for the review period, 1 July to 31 December 2019, against the Longwall 304 Water Management Plan significance levels/triggers was unable to be conducted at the time of reporting. Assessment against the performance indicator for the review period, 1 July to 31 December 2019, will be undertaken in the next review period.

2 The no diversion of flows, no change in natural drainage behaviour component of this performance measure was exceeded during the mining of Longwalls 23-27, triggering contingency measures for the impacted pools. This TARP monitors pools not impacted during the mining of Longwalls 23-27.

3 The minimal iron staining component of this performance measure was exceeded during the mining of Longwalls 23-27, triggering contingency measures for the impacted pools. The nature and extent of iron staining on the Eastern Tributary will continue to be monitored during the mining of Longwalls 301-304.

4 Subsequent to the autumn 2017 baseline survey and prior to the spring 2017 survey, Swamp 46 and Swamp 51/52 were subject to WaterNSW hazard reduction burns.

5 This performance indicator has been exceeded at Swamp 20 since 2012 and at Swamp 28 since 2016. Swamp water levels at Swamp 20 and Swamp 28 will continue to be analysed on a six monthly basis and assessments against the performance measure will be conducted annually.

7 The performance indicator *The aquatic macroinvertebrate and macrophyte assemblages in pools are not expected to experience long-term impacts as a result of mine subsidence* has not been exceeded at Pools ETAG, ETAH, ETAI and ETAK. In accordance with the Longwalls 301-303 Biodiversity Management Plan, assessment against the performance indicator at these pools will be undertaken after one year of the completion of stream remediation on the Eastern Tributary.

7 ENVIRONMENTAL PEFORMANCE – SURFACE FACILITIES AREA

This section provides a summary of the key environmental monitoring results for noise, air quality, traffic and waste at the surface facilities area, an assessment of environmental performance and a description of the management measures implemented during the review period.

The environmental performance of surface facilities water management is described in Section 8.

Each section indicates which management plan contains details of the surface facilities management and monitoring. The Metropolitan Coal management plans are available on the Peabody website (http://www.peabodyenergy.com).

7.1 NOISE MANAGEMENT

The Metropolitan Coal Noise Management Plan has been prepared for the surface facilities area in accordance with Condition 8, Schedule 4 of the Project Approval.

Real-time Noise Monitoring

Real-time noise monitoring for the Project is undertaken using an unattended statistical noise logger located at the northern boundary of 16 Oxley Place (Figure 18). Real-time noise monitoring is used as an internal noise management tool and not for compliance purposes.

The real-time noise monitor records noise levels 24 hours a day, 7 days a week, and a graphical summary of the previous 24 hours of noise is sent to mine staff via email on a daily basis.

A real-time noise performance indicator, *The $L_{Aeq(5\ minute)}$ night-time noise level does not exceed 50 dB(A) for six consecutive 5 minute samples*, has been developed in consideration of façade reflection and as an alert to the potential exceedance of the noise acquisition criteria.

Real-time noise monitoring includes an audio function which allows the monitor to record audio of the noise signal and an 'alarm' function whereby noise data is processed and compared against the real-time noise performance indicator. The audio of these events can then be reviewed to see if the cause is Project related, allowing Metropolitan Coal to investigate the causes and potential controls for high Project related noise events.

The real-time noise performance indicator is considered to be exceeded if the $L_{Aeq(5\ minute)}$ night-time noise level exceeds 50 A-weighted decibels (dB[A]) for six consecutive 5 minute samples.

The real-time noise performance indicator was triggered 55 times during the review period, compared to 53 times in 2019, 125 times in 2018 and 178 times in 2017. Reviews conducted following these triggers typically indicated that the source was overflying aircraft, birds, bats, insects, deer, vehicles on Parkes Street, thunder, wind and/or rain.

Attended Noise Monitoring

Consistent with the Metropolitan Coal Noise Management Plan, attended noise monitoring for the Project has consisted of quarterly monitoring at 16 Oxley Place, 53 Parkes Street, 50 Parkes Street and 36 Old Station Road (sites representative of the nearest residences to the Project [Figure 18]) to quantify the intrusive noise emissions from the mine, including coal processing and transportation operations that contribute to the overall level of ambient noise.

Noise monitoring is conducted for 15 minute periods during the daytime, evening and night-time over two consecutive days and nights and compared to applicable Noise Impact Assessment Criteria, Noise Mitigation Criteria and Noise Acquisition Criteria (refer Section 7.5 and Appendix L).

The attended quarterly noise monitoring and compliance results for the review period are available in the quarterly monitoring reports prepared by SLR (Appendix L). A comparison of the quarterly attended monitoring results at each location for the period September 2010 to December 2020 is provided in Figures 19a to 19d.

In summary, during 2020, attended monitoring indicated exceedances of the noise criteria detailed in Conditions 1, 2 and 3, Schedule 4 of Project Approval (08_0149) as follows:

- Daytime (L_{Aeq}):
  - No exceedances of the Daytime Noise Impact Assessment Criterion (50 dBA), Noise Mitigation Assessment Criterion (53 dBA) or Noise Acquisition Criterion (55 dBA) were recorded.
- Evening (L_{Aeq}):
  - Monitoring at 16 Oxley Place in Quarter 2 measured levels of 46 dBA and 47 dBA which were conditionally compliant with the Noise Impact Assessment Criterion (45 dBA).
  - No exceedances of the Evening/Night-time Noise Mitigation Criterion (48 dBA) or Noise Acquisition Criterion (50 dBA) were recorded.
- Night-time (L_{Aeq}):
  - No exceedances of the Night-time Noise Impact Assessment Criterion (45 dBA), Noise Mitigation Criterion (48 dBA) or Noise Acquisition Criterion (50 dBA) were recorded.
- Night-time (L_{A1}):
  - Monitoring at 16 Oxley Place in Quarter 1 measured a noise level of 54 dBA which was conditionally[19] non-compliant with the Night-time L_{A1} Noise Impact Assessment Criterion (50 dBA).
  - Monitoring at 53 Parkes Street in Quarter 4 measured a noise level of 52 dBA which was conditionally compliant with the Night-time L_{A1} Noise Impact Assessment Criterion (50 dBA).
  - Monitoring at 50 Parkes Street in Quarter 4 measured a noise level of 51 dBA which was conditionally compliant with the Night-time L_{A1} Noise Impact Assessment Criterion (50 dBA)

Identification of Sustained Non-compliances – Attended Noise Monitoring

A conditional sustained non-compliance has been defined as two consecutive quarters of non-compliant noise monitoring results at the same representative attended noise monitoring location, coinciding with normal mine operations.

No sustained non-compliances with respect to the intrusive (L_{Aeq}) Noise Impact Assessment Criteria (Table 2, Condition 1, Schedule 4 of the Project Approval) have been identified during 2020.

[19] A conditional non-compliance with Condition 1 or Condition 3, Schedule 4 of the Project Approval. Stability Class F or absence of Stability Class corresponds to an estimated Environmental Lapse Rate (ELR) ranging from 1.5°C/100m to 4.0°C/100m. PA 08_0149 limits temperature inversions up to 3.0°C/100m. In the absence of direct measurement of the ELR, it cannot be certain if the actual temperature inversion was less than 3.0°C/100m for this period. Accordingly, where the Mine Noise Level is measured to be above the Impact Criteria, a conditional non-compliance has been nominated since the relevance of the recorded noise level for the survey period for compliance purposes is not certain.

A sustained non-compliance with respect to the night-time maximum (L_{A1}) Noise Impact Assessment Criteria (Table 2, Condition 1, Schedule 4 of the Project Approval) was identified during 2020 at 16 Oxley Place in Quarter 1 (Appendix L).

Further details are provided in Section 7.4.

Identification of Non-compliances – Noise Modelling

Metropolitan Coal, in consultation with its noise specialist (SLR), has continued to review and evaluate appropriate contingency measures and conduct further technical evaluation of the implementation of these measures during 2020.

This has included ongoing noise modelling of predicted noise levels at nearby residences in order to determine the remaining reasonable and feasible noise mitigation measures that could be implemented in consultation with the DPIE.

The noise modelling predicted non-compliances with the Noise Impact Assessment Criteria at seven residences in Oxley Place during the day-time, evening and night-time. Exceedances of the Noise Mitigation Criteria were also predicted at the seven residences in Oxley Place during the day-time, evening and night-time. The modelling also predicted compliance with the Noise Acquisition Criteria at all residences (Appendix M).

Further details are provided in Section 7.4.

It should be noted that all of the residences modelled to be experiencing exceedances of the Noise Mitigation Criteria have previously been offered noise mitigation measures on a voluntary basis by Metropolitan Coal (in the form of double glazing). Of the nine residences predicted to exceed the Noise Mitigation Criteria, only two did not accept the previous offer by Metropolitan Coal (Appendix M). In 2018, one of the two remaining residences accepted an offer of noise mitigation.

Reporting and Notification of Noise Exceedances

In September 2020 (i.e. following conclusive identification of a sustained non-compliance and review of associated noise modelling), Metropolitan Coal notified three nearby residents that the most recent noise modelling continues to predict noise levels exceeding the Noise Impact Assessment Criteria contained in the Project Approval. Residences predicted to experience non-compliances or conditional compliances based on the most recent noise modelling were notified. The notifications also advised the residents of the current process underway to re-assess noise impacts (Section 14).

Noise Management

Operational noise levels from the Metropolitan Coal Mine were materially higher prior to the approval of the Metropolitan Coal Project in June 2009.

A range of operational noise control measures have been implemented since that time, in association with extensive upgrades of existing infrastructure at the surface facilities area, including the upgrade of the CHPP. Extensive noise reduction works have been implemented progressively and noise monitoring and modelling has been used to identify areas where additional reasonable and feasible noise attenuation measures could be implemented. The Metropolitan Coal 2010 to 2019 Annual Reviews describe the noise mitigation measures implemented prior to 2020.

The extensive and long running noise control program has reduced noise emissions at nearby residences. However, Metropolitan Coal has found the number of remaining, reasonable and feasible noise controls is diminishing.

During 2017, in consultation with the DP&E, Metropolitan Coal prepared a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options (the Noise Mitigation Assessment) (SLR, 2017). This assessment was independently peer reviewed by Hatch. The reasonable and feasible contingency mitigation measures identified by Metropolitan Coal included:

- Ensuring all crusher and washer doors are closed at all times (except when being accessed).
- Progressively replacing the idlers on all surface conveyors with low noise idlers.

Following DP&E's review of the Noise Mitigation Assessment, Metropolitan Coal signed a Voluntary Undertaking which formalised the implementation of the mitigation measures identified by the 2017 Noise Mitigation Assessment. This included a timeframe for implementation of the identified mitigation measures (i.e. all existing conveyor idlers were replaced with low noise idlers by 31 December 2018), subsequent remodelling of noise levels and consultation with residents with predicted residual noise exceedances above the noise mitigation criteria who had not previously accepted noise mitigation was undertaken in 2019.

In accordance with the Voluntary Undertaking, Metropolitan Coal completed an assessment in 2018 of Metropolitan's noise levels under the Noise Policy for Industry (released in 2017) and provided to DP&E in April 2018.

In 2020 Metropolitan Coal met with DPIE to discuss the findings of the assessment of Metropolitan's noise levels under the Noise Policy for Industry. DPIE requested that Metropolitan Coal commission a peer review of all noise mitigation and monitoring to date which was completed by Recognition Research in June 2020. In 2021, Metropolitan Coal will meet with DPIE to discuss the findings of the peer review.

Metropolitan Coal will continue to implement noise monitoring, management and modelling in accordance with the Metropolitan Coal Noise Management Plan.

It is noted that Metropolitan Coal did not receive any requests for at-receiver noise mitigation in accordance with Condition 3, Schedule 4 of Project Approval (08_0149) in 2020. Metropolitan Coal has previously offered double glazing noise mitigation voluntarily to a number of the nearest private residences.

Operational Noise Complaints

During the review period, no complaints were received. Any complaint received by Metropolitan Coal is investigated and actions to eliminate or reduce the noise source is implemented, where possible, with these actions communicated to the resident.

7.2 AIR QUALITY AND GREENHOUSE GASES MANAGEMENT

The Metropolitan Coal Air Quality and Greenhouse Gas Management Plan has been prepared for the surface facilities area in accordance with Condition 13, Schedule 4 of the Project Approval.

Environmental Resource Management (ERM) has reviewed the environmental performance of the Project in relation to air quality for the review period. The report prepared in support of this Metropolitan Coal 2020 Annual Review is provided in Appendix N.

Dust Deposition

Metropolitan Coal monitors monthly dust deposition rates at ten dust gauges (DG1 to DG10, Figure 20), consistent with EPL No. 767 and the Metropolitan Coal Air Quality and Greenhouse Gas Management Plan.

Sampling during the review period was conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767. During 2020, all of the potential 120 samples (10 sites over 12 months) were deployed during the period and therefore represents 100% data capture.

The results of the dust deposition monitoring are assessed against air quality performance indicators and air quality impact assessment criteria. The results of the assessment are provided in Section 7.5 and key aspects are summarised below.

The performance indicator for annual average deposited dust of 3 grams per square metre per month (g/m^2/month) was met at all the dust deposition gauges (D1-D10) during the reporting period.

The annual average dust deposition rate at all dust gauges did not exceed 4 g/m^2/month. Compliance was thus achieved with the annual average performance criterion for dust deposition during the reporting period (Chart 84).

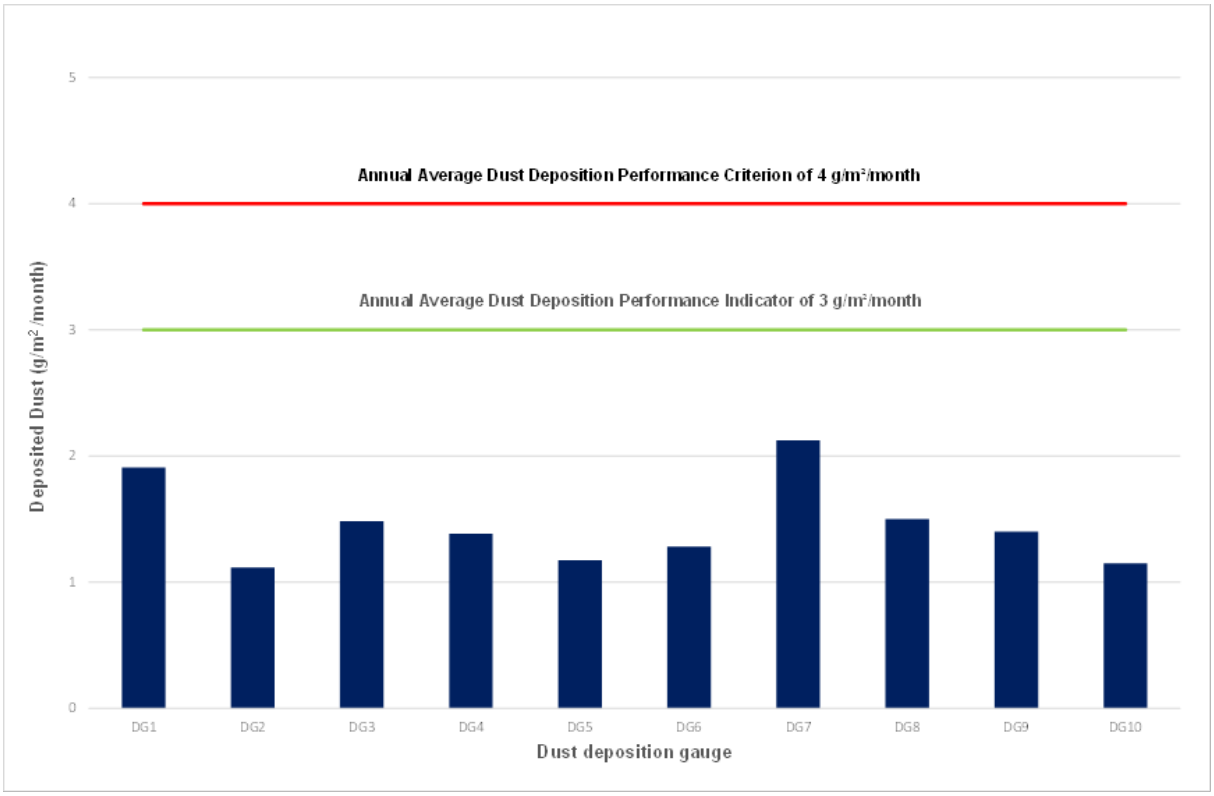


Chart 84 Annual Average Dust Deposition Rates Measured at Dust Gauges (DG1 to DG10)

Annual average dust deposition rates at each gauge from 2003 to 2020 are shown in Chart 85 and Chart 85a. From 2003 to 2020, there were no clear trends in dust deposition rates; however, relatively higher dust deposition rates were recorded exceeding the annual average performance indicator of 3 g/m^2/month at DG3 in 2009, 2011, 2015 and 2019, at DG4 in 2009 and 2015, and at DG6 in 2009. There were exceedances of the annual average performance criterion of 4 g/m^2/month at DG3 in 2009 and 2011, and at DG6 in 2009. The annual average dust deposition rate at each gauge in 2020 was within or below the range previously recorded for the dust gauges.

The Project EA (modelling for Years 3 and 15) predicted that the annual average dust deposition due to the Project plus background would not be above the applicable 4 g/m^2/month amenity criterion at any receiver (modelling for Years 3 and 15). The air quality monitoring results are consistent with the Project EA predictions in relation to dust deposition.

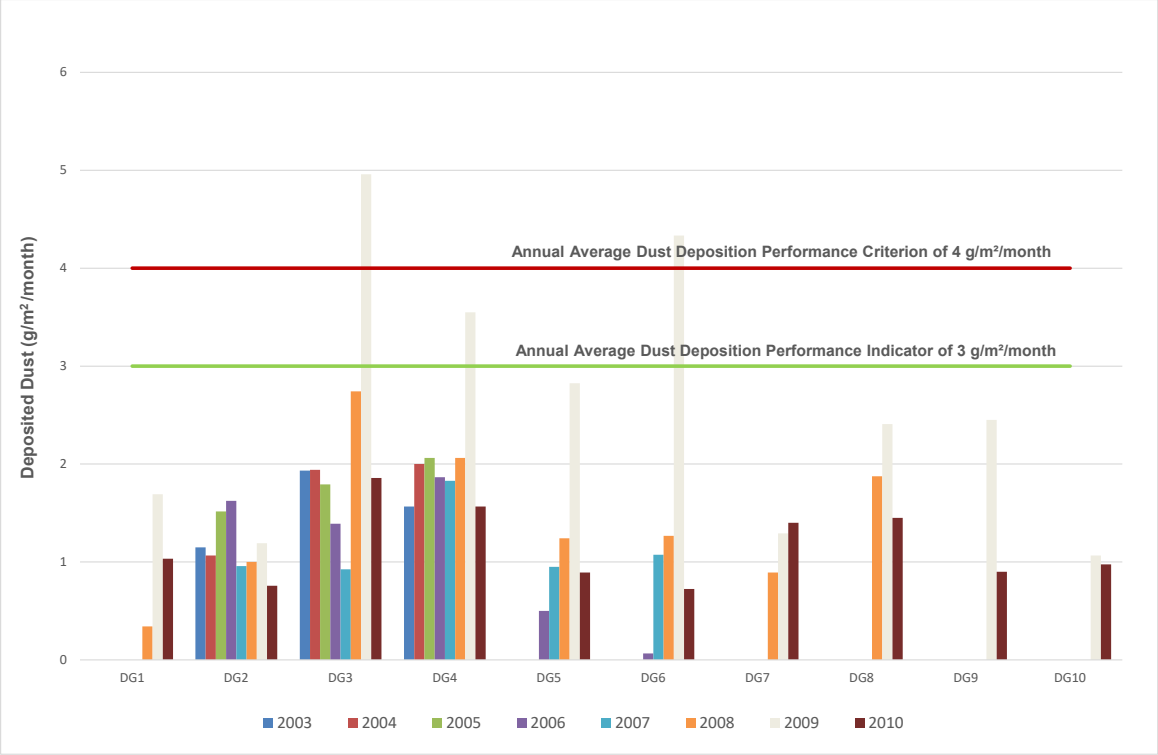


Chart 85 Annual Average Dust Deposition Rates at DG1 to DG10 from 2003 to 2010

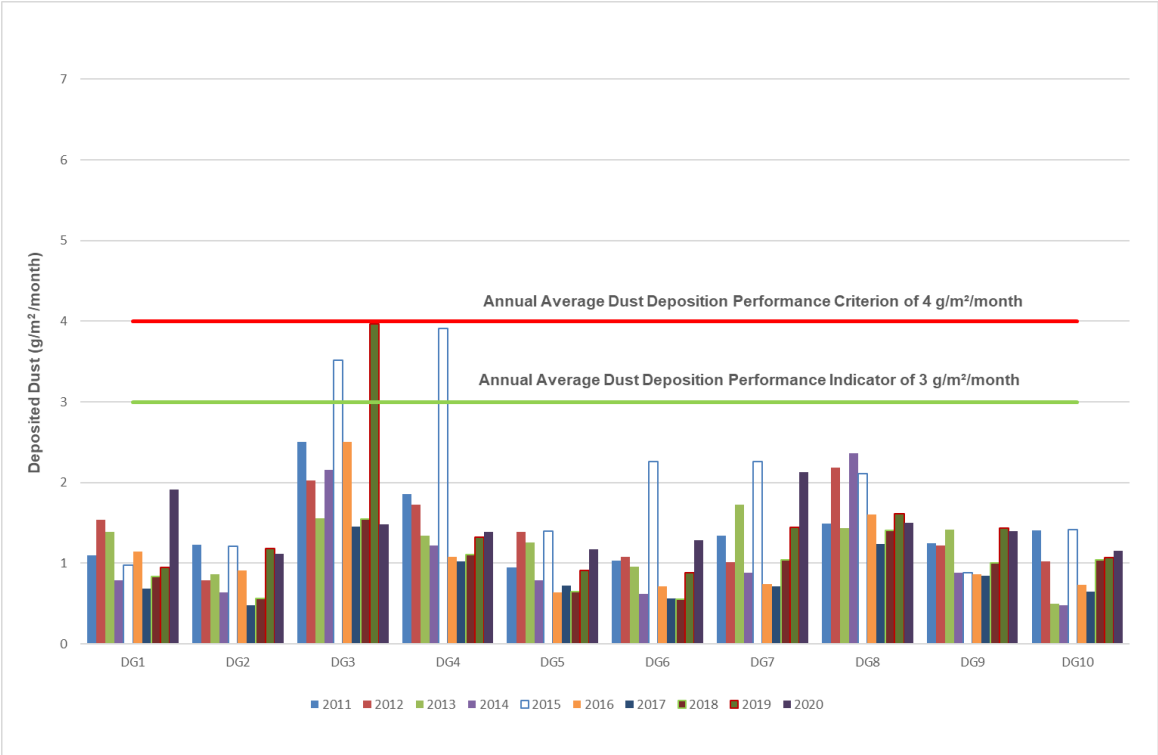


Chart 85a Annual Average Dust Deposition Rates at DG1 to DG10 from 2011 to 2020

Particulate Matter

One Tapered Element Oscillating Microbalance (TEOM) and one High Volume Air Sampler (HVAS) are located near the surface facilities area (Figure 20). The TEOM allows for continuous measurement of particulate matter less than 10 micrometres in diameter (PM_{10}) concentrations at ten-minute intervals, while the HVAS provides an average PM_{10} concentration for a specific 24-hour period, on a one-day-in-six cycle.

Sampling of PM_{10} during the review period was conducted at all monitoring points at the frequencies described in Conditions M2.1 and M2.2 of EPL No. 767. The results of the PM_{10} monitoring are assessed against air quality performance indicators and air quality impact assessment criteria. The results of the assessment are provided in Section 7.5 and key aspects are summarised below.

The annual average PM_{10} concentrations (measured by the HVAS) from 2007 to 2020 are shown on Chart 86. The annual average PM_{10} concentration measured at the HVAS for the review period was 15.3 micrograms per cubic metre (µg/m^3), which is lower than the annual average PM_{10} performance indicator of 25 µg/m^3 and well below the annual average PM_{10} air quality impact assessment criterion of 30 µg/m^3 (Chart 86).

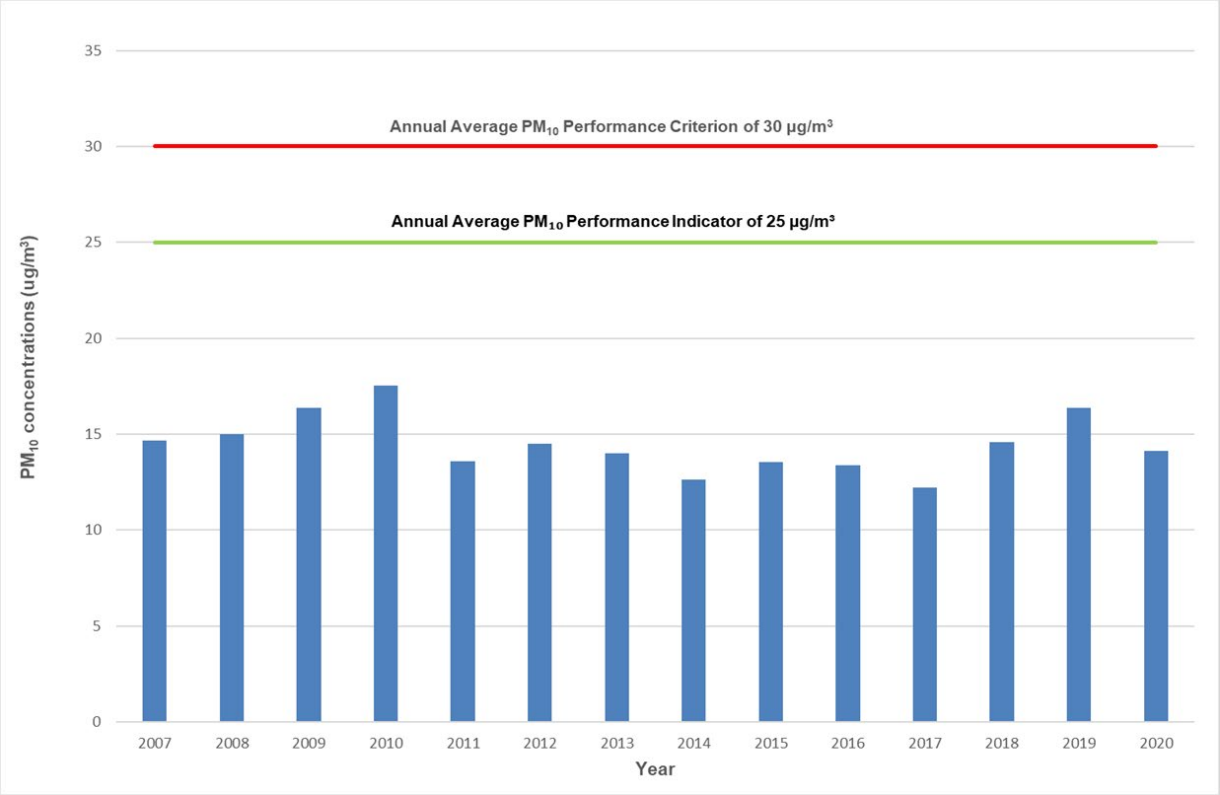


Chart 86 Annual Average PM_{10} Concentrations from 2007 to 2020 (measured by the HVAS)

There were nine exceedances of the PM_{10} 24-hour average performance indicator concentration (37.5 µg/m^3) recorded by the TEOM during 2020 (Chart 87). Exceedances are documented as being related to severe bushfire events that persisted throughout NSW from late 2019 into early 2020.

There were seven exceedances of the 24-hour average performance indicator concentration in the month of January 2020 (2, 4, 8, 12, 23, 24 and 25 January). It is anticipated that these exceedances are as a result of regional bushfire activity during this month and are unrelated to mine activity.

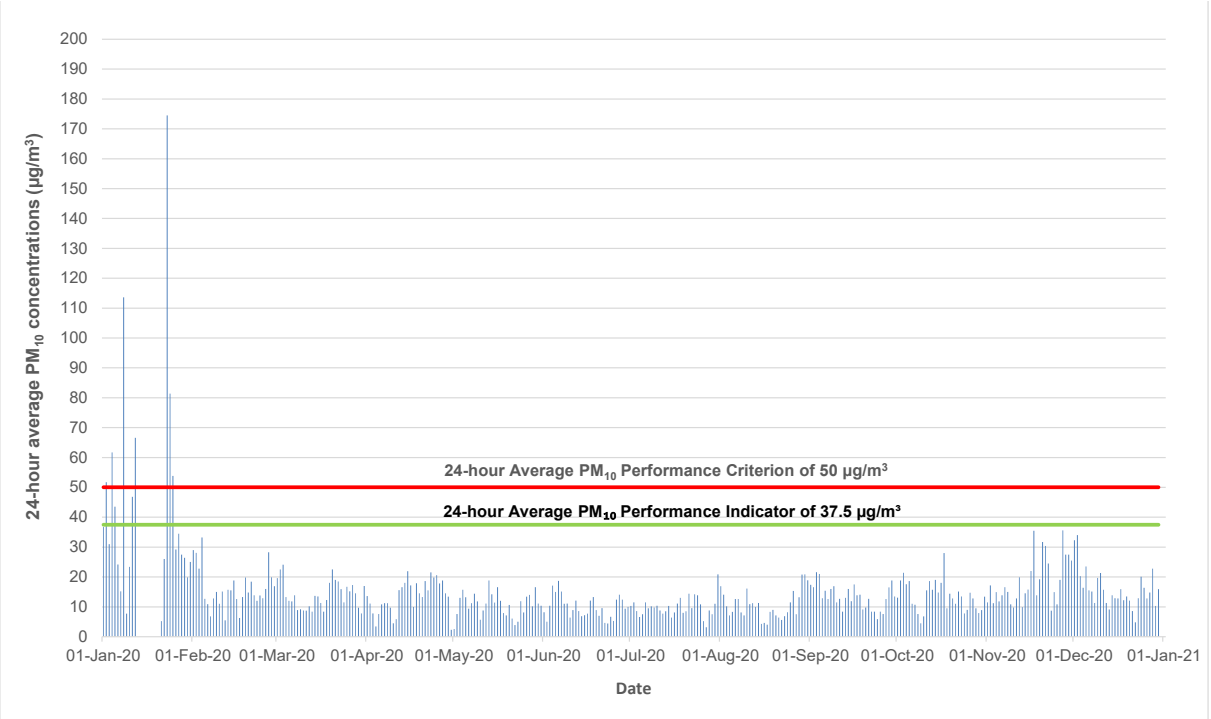


Chart 87 24-hour Average PM_{10} Concentrations (measured by the TEOM)

Chart 88 indicates that there was an exceedance of the PM_{10} 24-hour average performance indicator concentration recorded by the HVAS. An exceedance on 27 January 2020 coincided with bushfire events across NSW.

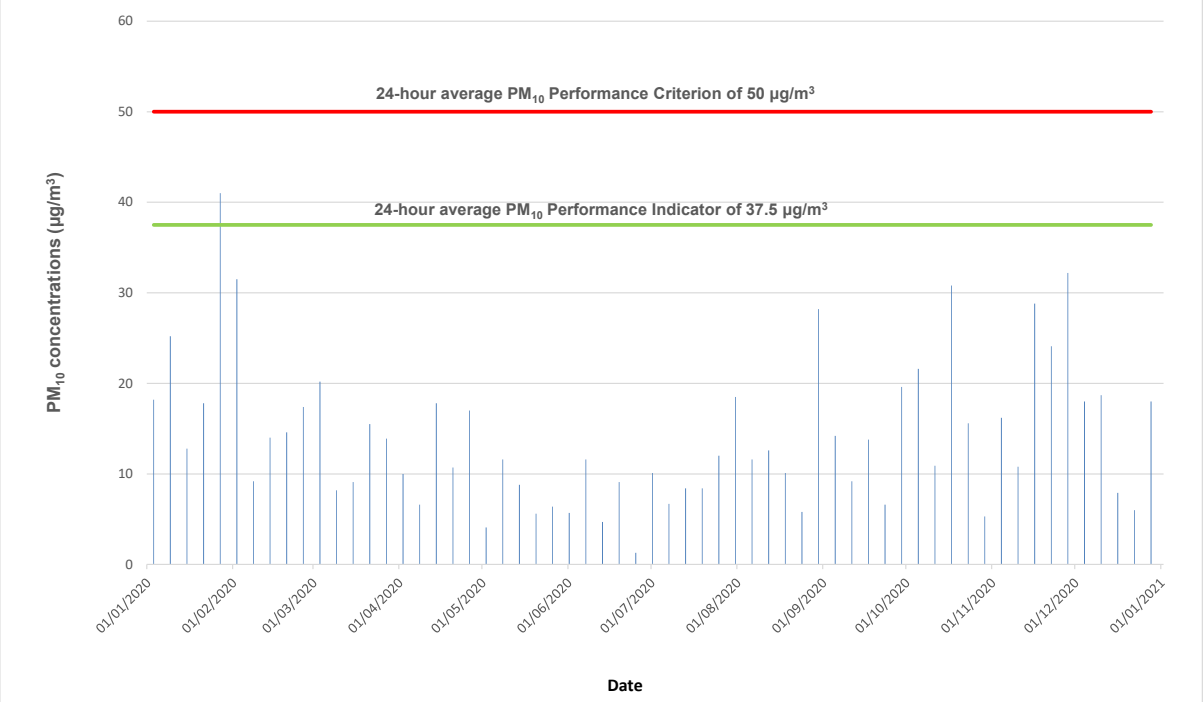


Chart 88 24-hour Average PM_{10} Concentrations (measured by the HVAS)

The highest 10-minute average PM_{10} concentration measured at the TEOM for the review period was 690.5 µg/m^3 on 23 January 2020. These values exceeded the air quality performance indicator for the 10-minute average PM_{10} concentration of 150 µg/m^3. However, these observations were noted to coincide with bushfire events within NSW and, as a result, the exceedance of the performance indicator is not considered to be a result of the Project.

There were several exceedances during the months of January and February 2020 of 10-minute average PM_{10} concentration due to bushfire events.

The predicted annual average PM_{10} (Project plus background) concentrations modelled for Years 3 and 15 in the Project EA were not predicted to be above the 30 µg/m^3 assessment criterion at any receiver. The maximum 24-hour average PM_{10} concentrations modelled for Years 3 and 15 by the Project EA were not predicted to exceed the assessment criterion (Project only) of 50 µg/m^3 at any receiver. Residences located in close proximity to the major surface facilities area on Parkes Street were predicted to experience maximum 24-hour average PM_{10} concentrations close to the criteria (i.e. 49 µg/m^3) in Year 15 due to their close proximity to the coal stockpiles and train loading activities.

The monitoring results in 2020 are thus considered to be lower than the Project EA predictions in relation to particulate matter.

Management Measures

A number of ongoing air quality management measures were implemented at Metropolitan Coal to manage and mitigate air quality impacts, as reported in previous Annual Reviews. During the review period, Metropolitan Coal installed upgraded stockpile sprays and plumbing infrastructure, providing greater spray coverage and dust suppression to the main stockpile area.

7.3 WASTE MANAGEMENT

The Metropolitan Coal Waste Management Plan has been prepared for the surface facilities area in accordance with Condition 25, Schedule 4 of the Project Approval to identify waste streams and monitor the quantities generated, identify waste management measures to minimise waste generation, and ensure that waste generated by Metropolitan Coal is appropriately stored, handled and disposed.

Waste generated by Metropolitan Coal can include tyres, oil, sewage effluent, paint, lead acid batteries, coal rejects, waste rock, office waste (e.g. paper, plastics, and cardboard), scrap metal, general inert waste (e.g. concrete, timber, pipe, rope and rags), underground waste (e.g. packaging, cloths and pipe), oil/fuel filters, aerosol cans, absorbents (e.g. spent oil spill material) and food waste.

Metropolitan Coal monitors waste generated on a monthly basis through waste disposal receipts provided by Metropolitan Coal's waste contractors. Figure 21(a) shows the amount of general waste disposed of in 2020 compared with previous calendar years. Approximately 830,312 kilograms (kg) of general waste was disposed of at a licensed landfill facility in 2020. Approximately 65,830 kg of diesel particulate filters from underground mine equipment, was also disposed of at a licensed landfill facility during the review period.

Waste recycled by Metropolitan Coal during the review period included waste oil (14,200 kg), scrap metal (230,770 kg) and paper and cardboard (6,260 kg). Figure 21(b-e) shows the amount of waste oil, scrap wood, scrap metal and office waste recycled in 2020, respectively, compared with previous calendar years.

Figure 21(f) and Figure 21(g) show the amount of coal reject emplaced by Metropolitan Coal in underground workings and disposed of at the Glenlee Washery, respectively, during the 2012 to 2020 calendar years.

The coal reject backfill emplacement project continued in 2020 emplacing 62,125 t of coal reject underground. In addition, 3,412 t of coal reject was transported to locations in the Illawarra region for beneficial reuse during the reporting period.

The Wollongong City Council is continuing works to confirm the suitability of Metropolitan Coal rejects to be beneficially re-used at the Helensburgh Landfill in consultation with the NSW EPA.

Metropolitan Coal is also continuing to investigate use of CWR in the production of chailings, a bio-char like product used to increase nutrient and moisture holding capacity in soils.

The education program continued to be implemented during the review period to increase the awareness of mine site personnel in relation to waste management and measures to minimise the generation of waste. Metropolitan Coal will continue to seek opportunities for additional waste minimisation and for the recycling and re-use of materials at the site.

7.4 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

The performance indicators, impact assessment criteria and Project Approval conditions in Table 10 assess the performance of environmental management at the surface facilities area including those related to noise, air quality, greenhouse gases, odour, traffic, waste and visual impacts for the review period and reflect the predictions included in the Project EA, Preferred Project Report and the surface facilities management plans (Noise Management Plan, Air Quality and Greenhouse Gas Management Plan, Traffic Management Plan, Surface Facilities Water Management Plan and Waste Management Plan).

Table 10
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE			
Real-time Noise Performance Indicator	*The $L_{Aeq(5\ minute)}$ night-time noise level does not exceed 50 dB(A) for six consecutive 5 minute samples.*	No	The Real Time Noise Performance Indicator was triggered 55 times during the review period. In all cases, source was determined to be non-mine related.
Noise Impact Assessment Criteria (Project Approval Table 2, Condition 1, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 50 dBA	Yes	No exceedances of the Daytime Noise Impact Assessment Criterion was recorded during the review period (Appendix L). No sustained exceedances of the Daytime Noise Impact Assessment Criterion were identified by monitoring during the review period (Appendix L).
	Evening $L_{Aeq(15\ minute)}$ – 45 dBA	Yes	Two conditionally compliant exceedances of the Noise Impact Assessment Criterion were recorded at 16 Oxley Place during the review period (Appendix L). No sustained exceedances of the evening Noise Impact Assessment Criterion were identified by monitoring during the review period (Appendix L).
	Night $L_{Aeq(15\ minute)}$ – 45 dBA	Yes	No sustained exceedances of the night Noise Impact Assessment Criterion were identified by monitoring during the review period (Appendix L).
	Night $L_{A1(1\ minute)}$ – 50 dBA	No	A sustained non-compliance with respect to the night-time maximum Noise Impact Assessment Criterion was identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 1 2020 (Appendix L). A conditional sustained non-compliance with respect to the night-time maximum Noise Impact Assessment Criterion was identified by noise monitoring at 16 Oxley Place as a result of consecutive exceedances in Quarter 4 2019 and Quarter 1, 2020 (Appendix M).

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE (Continued)			
Noise Mitigation Criteria (Project Approval Table 4, Condition 3, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 53 dBA	Yes	No sustained exceedances of the day Noise Mitigation Criterion were identified by monitoring during the review period (Appendix L).
	Evening $L_{Aeq(15\ minute)}$ – 48 dBA	Yes	No sustained exceedances of the evening Noise Mitigation Criterion were identified by monitoring during the review period (Appendix L).
	Night $L_{Aeq(15\ minute)}$ – 48 dBA	Yes	No sustained exceedances of the night Noise Mitigation Criterion were identified by monitoring during the review period (Appendix L).
Noise Acquisition Criteria (Project Approval Table 3, Condition 2, Schedule 4)	Day $L_{Aeq(15\ minute)}$ – 55 dBA	Yes	No sustained exceedances of the day, evening or night-time Noise Acquisition Criterion were identified by monitoring during the review period (Appendix L).
	Evening $L_{Aeq(15\ minute)}$ – 50 dBA	Yes	
	Night $L_{Aeq(15\ minute)}$ – 50 dBA	Yes	
Rail Noise (Project Approval Conditions 4, 5 and 6, Schedule 4)	*4. The Proponent shall only use locomotives that are approved to operate on the NSW rail network in accordance with noise limits L6.1 to L6.4 in RailCorp's EPL (No. 12208) and ARTC's EPL (No. 3142) or a Pollution Control Approval issued under the former Pollution Control Act 1970.*	Yes	All locomotives used by Metropolitan Coal are approved for operations in accordance with the noise limits in the relevant EPL.
	5. The Proponent shall use its best endeavours to minimise night-time movements of rolling stock on the Metropolitan rail spur.	Yes	Metropolitan Coal has endeavoured to minimise night-time movements of rolling stock on the Metropolitan rail spur.
Rail Noise (Project Approval Conditions 4, 5 and 6, Schedule 4) (Continued)	*6. In the event of any rail noise or vibration issues that may arise from the haulage of coal over the life of the Project, the Proponent shall liaise with the CCC and the rail service provider to facilitate resolution of these issues and implement additional noise reduction measures where appropriate.*	Yes	No issues with rail noise or vibration were identified during the review period.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
NOISE (Continued)			
Notification of Landowners (Project Approval Condition 1, Schedule 5)	1. *If the results of the monitoring required in schedule 4 identify that impacts generated by the project are greater than the relevant impact assessment criteria in schedule 4, except where a negotiated agreement has been entered into in relation to that impact, then the Proponent shall, within 2 weeks of obtaining the monitoring results, notify the Executive Director Mineral Resources, the affected landowners and tenants (including tenants of mine owned properties) accordingly, and provide quarterly monitoring results to each of these parties until the results show that the project is complying with the criteria in schedule 4.*	Yes	In September 2020 (i.e. following conclusive identification of the sustained non-compliances and review of associated noise modelling), Metropolitan Coal notified three nearby residents that the most recent noise modelling continues to predict are experiencing noise levels exceeding the Noise Impact Assessment Criteria contained in the Project Approval. The notifications also advised the residents of the current process underway to re-assess noise impacts (Section 13.2).
AIR QUALITY			
Air Quality Performance Indicators [1,2]	PM_{10} indicator = 150 µg/m^3 (10 minute averaging period assessed using TEOM data)	Yes	The maximum 10-minute average PM_{10} concentration recorded by the TEOM was 690.5 µg/m^3 on 23 January 2020. There were 120 exceedances during the month of January. These concentrations occurred during a month where there were a number of bushfire events across NSW. There are no exceedances of the indicator after January 2020.
	PM_{10} indicator = 37.5 µg/m^3 (24-hour averaging period assessed using TEOM data)	Yes	All observed exceedances of the performance indicator concentration noted to have coincided with bushfire events and as such are not considered to be a result of the Project.
	PM_{10} indicator = 37.5 µg/m^3 (24-hour averaging period assessed using HVAS data)	Yes	All observed exceedances of the performance indicator concentration noted to have coincided with bushfire events and as such are not considered to be a result of the Project.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
AIR QUALITY (Continued)			
Air Quality Performance Indicators [1,2] (Continued)	PM10 indicator = 25 µg/m^3 (Annual averaging period assessed using HVAS data)	Yes	An annual average of PM_{10} concentration of 14.1 µg/m^3 was recorded by the HVAS.
	Maximum total deposited dust level = 3 g/m^2/month (Annual averaging period)[3]	Yes	The annual average dust deposition rates for all monitoring sites indicate that compliance with the performance indicator was achieved at every one of the dust gauges during the reporting period.
Air Quality Impact Assessment Criteria (Project Approval Condition 11, Schedule 4)	TSP Criteria[4] = 90 µg/m^3 (Annual averaging period)	Yes	Based on the annual average PM_{10} concentrations recorded by the HVAS, the annual average TSP is estimated to be less than 28.2 µg/m^3
	PM_{10} Criteria[4] = 30 µg/m^3 (Annual averaging period)	Yes	An annual average of PM_{10} concentration of 14.2 µg/m^3 was recorded by the HVAS.
	PM_{10} Criteria[4] = 50 µg/m^3 (24 hour averaging period)	Yes	Eight exceedances of the 24-hour average PM_{10} impact assessment criterion of 50 µg/m^3 were observed using the TEOM instrument. However, all of these events are noted to be associated with bushfires in the NSW. Compliance with the 24-hour average PM_{10} impact assessment criterion was observed using the HVAS instrument during the reporting period.
	Maximum total deposited dust level = 4 g/m^2/month (Annual averaging period)	Yes	The maximum annual average dust deposition rate was below 4 g/m^2/month or less during the reporting period at all dust gauges.
ODOUR			
Odour (Project Approval Condition 9, Schedule 4)	*9. The Proponent shall not cause or permit the emission of offensive odours from the site, as defined under Section 129 of the POEO Act.*	Yes	No odour complaints were received during the review period.
GREENHOUSE GASES			
Greenhouse Gas Emissions (Project Approval Condition 10, Schedule 4)	*10. The Proponent shall implement all reasonable and feasible measures to minimise:* *(a) energy use on site; and* *(b) the scope 1, 2 and 3 greenhouse gas emissions produced on site,* *to the satisfaction of the Director-General.*	Yes	Metropolitan Coal has implemented the viable energy saving measures contained within their Energy Savings Action Plan.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
TRAFFIC			
Annual Road Maintenance Performance Indicators	*When annual road maintenance contribution negotiations are required, the negotiations should commence with the relevant councils and/or DP&I by 31 August.*	Yes	No negotiations with the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council were required during the review period.
	Annual road maintenance contributions to relevant councils are made by 30 November.	Yes	Metropolitan Coal made contributions to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council by 30 November 2020.
Coal Transport Off-site Performance Indicators	*Coal transported off-site by road in a calendar year does not reach 150,000 tonnes prior to 31 October.*	Yes	Metropolitan Coal did not transport any product coal from the site by road in the 2020 calendar year.
Coal Transport Off-site Performance Indicators (Continued)	*Product coal truck movements to the Corrimal Cokeworks and Coalcliff Cokeworks do not exceed 22 and 27 movements respectively in any one day.*	Yes	Metropolitan Coal has ceased the transport of product coal to Corrimal Cokeworks and Coalcliff Cokeworks. No product coal was transported by road during the review period.
Limits on Approval (Project Approval Condition 6[b], Schedule 2)	• *The Proponent shall not:* *(a) ...* *(b) transport more than 2.8 million tonnes of product coal from the site in a calendar year.*	Yes	Metropolitan Coal transported a total of 929,453 t of product coal from site by rail in the 2020 calendar year.
Transport (Project Approval Conditions 17, 18, 19, 20 and 21, Schedule 4)	*17. By the end of 2010, the Proponent shall:* *(a) undertake a road safety audit of the Parkes Street and Colliery Road intersection, in consultation with the RTA and WCC; and* *(b) implement any recommendations of this audit,* *to the satisfaction of the Director-General[5].*	Yes, the road safety audit has been undertaken. Further actions required in relation to the audit recommendations.	The Road Safety Audit of the Mine Access Road and Parkes Street intersection was conducted in September 2010 in accordance with Condition 17(a), Schedule 4 of the Project Approval. The Road Safety Audit recommended an upgrade of the Parkes Street and Colliery Road intersection. However, Metropolitan Coal was unable to address all of the recommended intersection upgrades due to the inability to obtain a mutually acceptable outcome with the Wollongong City Council. Metropolitan Coal engaged a road safety expert to review whether the works undertaken are sufficient to address the original risk identified, or whether alternative/additional actions can be undertaken to address the risk. The review indicated that the civil works associated with the full intersection upgrade were not achievable within the Colliery Road Crown Land lease area. Metropolitan Coal met with Wollongong City Council in 2019 to continue discussions regarding Council's previous position and will continue to consult further in relation to the intersection upgrade.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
TRAFFIC (Continued)			
Transport (Project Approval Conditions 17, 18, 19, 20 and 21, Schedule 4) (Continued)	18. *From the end of 2009, the Proponent shall make a suitable annual contribution to WCC, WSC, and CC for the maintenance of local roads that are used as haulage routes by the project. If there is any dispute over the amount of the contribution, the matter must be referred to the Director-General[5] for resolution.*	Yes	Metropolitan Coal has made a suitable annual contribution to the Wollongong City Council, Campbelltown City Council and Wollondilly Shire Council.
	19. *The Proponent shall not:* *(a) load coal or coal reject onto trucks, or transport it off site by road, outside the hours of 7am and 6pm Monday to Friday;* *(b) transport more than 170,000 tonnes of coal off site by road in a calendar year;* *(c) transport any coal off site to the Port Kembla Coal Terminal by road;* *(d) permit the departure of more than 25 trucks containing product coal for delivery to the Corrimal Cokeworks on any given day; or* *(e) permit the departure of more than 30 trucks containing product coal for delivery to the Coalcliff Cokeworks on any given day.*	Yes	The loading and transport of coal product and coal reject has been undertaken in accordance with Condition 19, Schedule 4 of the Project Approval.
	20. *During emergencies (such as the disruption of rail services) the Proponent may exceed the restrictions in condition 19 above with the written approval of the Director-General[5].*	Yes	Metropolitan Coal sought and received approval to transport CWR by road to PKCT between 28 September 2020 and 12 October 2020 due to rail maintenance activities disrupting access to PKCT. Metropolitan transported 2,618 t of CWR by road to PKCT during this period.
	21. *The Proponent shall monitor the amount of coal and coal reject transported from the site by road and rail each year, and report the results of this monitoring on its website every six months.*	Yes	The results of coal and coal reject transport monitoring have been provided on Metropolitan Coal's website and updated every six months.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
WASTE			
Waste Generation Performance Indicator	*Waste generation has been minimised, as evidenced by:* • *an increase in the amount or type of waste recycled;* • *a decrease in the amount of waste generated that is disposed of to licensed landfill facilities; and/or* • *no practicable opportunities for additional waste minimisation have been identified to those currently being implemented.*	Yes	Metropolitan Coal has minimised waste generation during the review period. The underground emplacement project reduced the off-site disposal of coal reject by approximately 62,125 t during the review period. Beneficial reuse of coal reject in the Illawarra region reduced the disposal of coal reject by 3,412 t during the review period. No further practicable opportunities for waste minimisation were identified.
Storage of Waste Performance Indicator	*Waste has been separated and stored according to type in appropriate storage facilities (e.g. sealed containers for liquid waste).*	Yes	Waste on-site is adequately sorted and stored according to waste type prior to collection. Weekly site inspections are conducted by the Metropolitan Environment Department to ensure waste is separated and stored in accordance with the Metropolitan Coal Waste Management Plan.
Handling and Disposal of Waste Performance Indicator	*The transport of particular waste types has been tracked in accordance with NSW EPA waste tracking requirements.* *Metropolitan Coal's waste management contracts, where relevant, specify that the waste is to be transported by an appropriately licensed contractor and disposed of at an appropriately licensed facility.*	Yes	All transport of waste from the Metropolitan Coal site has been tracked in accordance with the NSW Office of Environment and Heritage waste tracking requirements. Metropolitan Coal's waste management contracts specify waste is to be removed by an appropriately licensed contractor and disposed of at an appropriately licensed facility.
Waste Generation (Project Approval Condition 24, Schedule 4)	*24. The Proponent shall:* *(a) minimise the waste (including coal reject) generated by the project; and* *(b) ensure that the waste generated by the project is appropriately stored, handled, and disposed of,* *to the satisfaction of the Director-General.*	Yes	Metropolitan Coal has minimised waste (including coal reject) generated during the review period. The underground emplacement project had reduced the off-site transport of coal reject by approximately 62,125 t during the review period. Beneficial reuse of coal reject in the Illawarra region reduced the disposal of coal reject by 3,412 t during the review period. Waste on-site is adequately sorted and stored according to waste type prior to collection. Weekly site inspections are conducted by the site Environment Department to ensure waste is separated and stored in accordance with the Metropolitan Coal Waste Management Plan. Metropolitan Coal's waste management contracts specify waste is to be removed by an appropriately licensed contractor and disposed of at an appropriately licensed facility.

Table 10 (Continued)
Assessment of Environmental Performance – Surface Facilities Area

Monitoring Aspect	Performance Indicator, Impact Assessment Criteria and/or Project Approval Condition	Indicator, Criteria or Condition Met?	Comments
VISUAL			
Visual Impacts (Project Approval Condition 23, Schedule 4)	23. *The Proponent shall minimise the visual impacts, and particularly the off-site lighting impacts, of the surface facilities area and two ventilation shaft sites to the satisfaction of the Director-General.*	Yes	N/A

Note: $L_{Aeq(15\ minute)}$ = intrusive equivalent noise level; $L_{A1(1\ minute)}$ = short-term noise level; dBA = A-weighted decibels; PM_{10} = Particulate matter less than 10 microns; HVAS1 = High Volume Air Sampler 1; TEOM1 = Tapered Element Oscillating Microbalance 1; $\mu g/m^3$ = micrograms per cubic metre; g/m^2/month = grams per square metre per month; TSP = total suspended particulate matter.

1 Total measured level excluding extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities.

2 Background PM_{10} concentrations due to all other sources plus the incremental increase in PM_{10} concentrations due to the mine alone.

3 Dust deposition assessment criteria are to be measured using DG1 to DG10 excluding DG4, which is a control dust gauge that is located at the Helensburgh Golf Course some 2 km from the mine's surface facilities area.

4 PM_{10} air quality impact assessment criteria are to be measured using HVAS data.

8 WATER MANAGEMENT

A Metropolitan Coal Surface Facilities Water Management Plan has been prepared for the surface facilities area and ventilation shaft site in accordance with Condition 15, Schedule 4 of the Project Approval.

This section details the water use, licensed discharge and water quality monitoring results for the surface facilities area and the management measures implemented during the review period. The environmental performance of water management in the underground mining area and surrounds is described in Section 6.2.

The surface facilities area is located in a steep-sided valley adjacent to the town of Helensburgh and next to Camp Gully (Figure 2). The site water management system comprises a series of collection dams, sumps and treatment systems. The system is operated to avoid the mixing of clean water runoff and mine water, minimise off-site release of runoff, and to provide water supply requirements on-site.

Water Use

The main uses of water on site are to supply underground mining operations and the coal washery. Metropolitan Coal draws its water from three main sources, namely, Camp Gully, the potable town water supply and water captured on-site.

Camp Gully runs adjacent to the southern edge of Metropolitan Coal's surface facilities area (Figure 22). Metropolitan Coal's extraction of water from Camp Gully is specifically regulated by the Camp Creek Weir Surface Water Certificate of Title and more generally by the *Water Act, 1912* and the *Water Management Act, 2000*.

Metropolitan Coal's annual entitlement under the Camp Gully extraction licence is 130 megalitres (ML). A concrete weir was historically constructed on Camp Gully (approximately 1930s) to facilitate the extraction of water for the mine. Metropolitan Coal did not source any water from Camp Gully during the review period. In comparison, Metropolitan Coal sourced 0 ML of water from Camp Gully in 2019, 0 ML of water in 2018 calendar year, 39 ML of water in the 2017 calendar year, 70 ML of water in the 2016 calendar year, 47 ML of water in the 2015 calendar year, 77 ML of water in the 2014 calendar year, 99 ML in the 2013 calendar year and 94 ML in the 2012 calendar year.

The use of potable water (sourced from Sydney Water) for mine purposes occurs when insufficient water is available from Camp Gully and/or on-site harvesting. Potable water is sourced from two mains, one of which supplies the bathhouses and drinking water utilities and one that supplements water supplies for mining purposes. Use of potable water is recorded and minimised in accordance with the site's commitments under the Water Savings Action Plan. Metropolitan Coal used approximately 301 ML of potable town water (as recorded by the Sydney Water meters) during 2020 (a monthly average of approximately 25 ML), in comparison to 387 ML in 2019, 365 ML in 2018, 513 ML in 2017, 386 ML in 2016, 378 ML in 2015 and 388 ML in 2014.

The use of potable water per tonne of ROM coal produced is variable and is generally higher during periods of low rainfall (Chart 89). Ongoing site auditing during the review period has not identified incidences of potable water being used where there is a viable alternative. In 2020 potable water consumption correlated well with ROM production throughout the year.

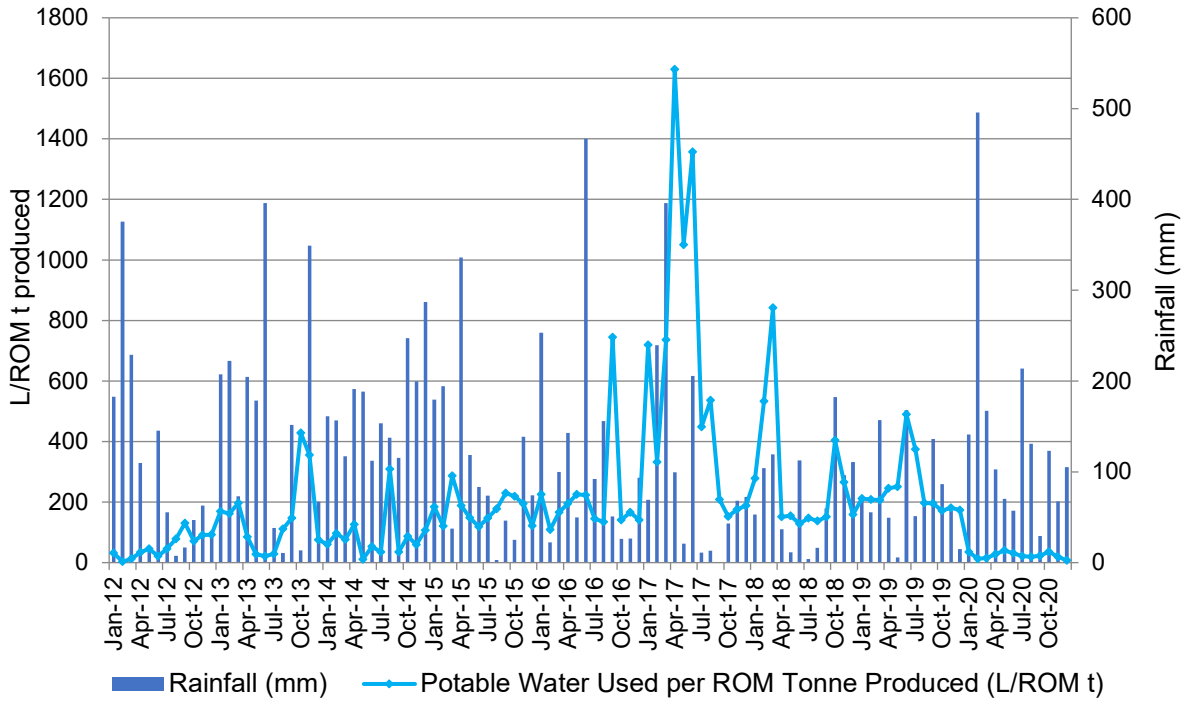


Chart 89 Potable Water Used per ROM Tonne Produced vs Rainfall

Licensed Discharge

Water discharged from the Water Treatment Plant to Camp Gully is monitored in accordance with EPL No. 767, which requires Metropolitan Coal to continuously monitor the volume (kilolitres per day) of water discharged from the clean water tank in the Water Treatment Plant to Camp Gully. The total amount of water discharged from the Water Treatment Plant to Camp Gully during the review period was approximately 120 ML, in comparison to 55 ML in 2019, 67 ML in 2018, 133 ML in 2017, 166 ML in 2016, 96 ML in 2015, 109 ML in 2014, 151 ML in 2013 and 98 ML in 2012.

Water Quality

Surface water quality monitoring of pH, oil and grease and total suspended solids is conducted at the Water Treatment Plant in accordance with EPL No. 767.

The water quality monitoring results indicate that pH levels (7.81 pH), oil and grease (less than 5 mg/L) and total suspended solids (12.25 mg/L) were within the water quality limits prescribed by EPL No. 767 (i.e. 6.5 to 8.5 pH, less than 10 mg/L for oil and grease, and less than 30 mg/L for total suspended solids) during the review period. Similarly, no exceedances of the EPL No. 767 concentration limits were recorded by Metropolitan Coal in the 2011 to 2019 calendar years.

The Project EA predicted there would be no material effect to downstream water quality as a result of water releases from the major surface facilities area to Camp Gully (which are constrained by EPL No. 767). The monitoring results are consistent with the Project EA predictions in relation to water quality.

Overall System Integrity

Surface facilities water management items (such as pipelines and pumps, bunded areas, main water storages, signs of discharge of site runoff, upslope diversions and erosion control measures) are visually inspected by Metropolitan Coal and reported in accordance with the mine's maintenance system.

During the review period, erosion and sediment controls continued to be maintained around the perimeter of the Turkey's Nest Dam (which was upgraded during the 2016 review period) while revegetation works of the Turkey's Nest outer batters have continued. Erosion and sediment controls will continue until the revegetation works have been completed.

The Turkey's Nest Dam was de-silted during the review period to increase the available water capacity of the storages. De-silting of the storages will continue in the next reporting period.

Assessment of Environmental Performance

In accordance with the Metropolitan Coal Surface Facilities Water Management Plan, an assessment of the environmental performance of water management at the surface facilities area is provided in Table 11.

Table 11
Assessment of Environmental Performance – Surface Facilities Water Management

Monitoring Aspect	Performance Indicator or Project Approval Condition	Indicator or Condition Met?	Comments
SURFACE FACILITIES WATER MANAGEMENT			
Water Use Performance Indicator	*The use of potable water (i.e. megalitres of town water used per tonne of coal produced) does not increase over time, after taking into consideration climatic conditions.* *Potable water has not been used in circumstances where there is a viable alternative.*	Yes	Ongoing site auditing during the review period has not identified incidences of potable water being used where there is a viable alternative.
Erosion Control Performance Indicator	*Inspections of the major surface facilities area and ventilation shaft(s) indicate the measures implemented are effectively controlling erosion.*	Yes	Weekly inspections of the surface facilities area and ventilation shaft(s) indicate that the erosion control measures implemented during the review period have effectively controlled erosion.
Containment of Contaminants Performance Indicator	*Effective containment and/or isolation measures are in place for potential contaminants on site.*	Yes	Weekly inspections have confirmed that effective containment and isolation measures have been in place for potential contaminants on-site.
Licensed Discharge Performance Indicator	*Surface water discharges comply with the requirements of EPL No. 767.*	Yes	All water discharge criteria were met during the review period.
System Integrity Performance Indicator	*Inspections of system components indicate the integrity of the system is not at risk of being compromised.*	Yes	Daily and weekly inspections of the water management system confirmed the integrity of the system was not at risk.
Discharges (Project Approval Condition 14, Schedule 4)	*14. The Proponent shall ensure that all surface water discharges from the site comply with the discharge limits (both volume and quality) set for the project in any EPL.*	Yes	The water discharge volume and quality limits were met during the review period.

9 CONSTRUCTION MANAGEMENT

A Metropolitan Coal Construction Management Plan has been prepared for surface construction works (excluding remediation or rehabilitation works) in the Woronora Special Area in accordance with Condition 11, Schedule 3 of the Project Approval. During the review period, Metropolitan Coal commenced the review and revision of the Metropolitan Coal Construction Management Plan to be consistent with the Longwalls 305-307 Extraction Plan.

As the requirement for surface construction works arise, Metropolitan Coal provide the specific details of the proposed surface construction works (in the form of a completed Surface Works Assessment Form) to the DPIE and WaterNSW for comment. The Surface Works Assessment Form details the specific management measures that will be implemented to minimise potential impacts associated with surface construction works, including management measures relevant to vegetation, Aboriginal heritage, erosion and sediment control, fuel and spill management, transport, waste, bushfire preparedness, pest management and site clean-up.

During the reporting period, Metropolitan Coal submitted a Construction Management Plan Surface Works Assessment Form (SWAF) to the DPIE for the proposed drilling of two exploration boreholes (2020EX01 and 2020EX02) in the Woronora Special Area, and extension of the 300XL subsidence monitoring line. The SWAF was subsequently approved by DPIE in February 2020. During the remainder of the review period drilling of borehole 2020EX02 and the extension of the 300XL survey monitoring line was completed.

Metropolitan Coal also submitted a SWAF to the DPIE for the proposed installation of piezometers and moisture probes at Swamps 76, 77, 81, 82, 89 and 92 and small surface water flow gauges at Swamps 76 and 92. The SWAF was subsequently approved by DPIE in April 2020 and all proposed works were completed in 2020.

A third SWAF was submitted to the DPIE in November 2020 for the proposed replacement of transect piezometer T3 on the eastern side of the Woronora Reservoir. The SWAF was approved by DPIE in November 2020 and the replacement piezometer will be installed in 2021.

No other construction activities in the underground mining area were conducted during the review period.

In the next reporting period, Metropolitan Coal will complete drilling of Borehole 2020EX01.

10 REHABILITATION

10.1 REHABILITATION SUMMARY

Metropolitan Coal has prepared a Rehabilitation Strategy for the surface facilities area in accordance with Condition 2, Schedule 6 of the Project Approval. The surface facilities area includes roads, facilities (e.g. the CHPP, administration buildings and workshops), stockpiles (coal and reject stockpiles), railroads, water storages and infrastructure. Rehabilitation of the surface facilities area is described in Section 10.2.

A Metropolitan Coal Rehabilitation Management Plan has been prepared for underground mining areas requiring rehabilitation or remediation measures, in accordance with Condition 4, Schedule 6 of the Project Approval. Rehabilitation of the underground mining area is described in Section 10.3. In addition, the Metropolitan Coal Stream Remediation Plan has been prepared specifically for stream pool/rock bar remediation activities and was approved by the DPIE on 1 November 2019. The Stream Remediation Plan superseded the pool/rock bar remediation aspects of the RMP (Section 10.3.2).

A summary of the rehabilitation status at Metropolitan Coal for the previous, current and forecast review periods is provided in Table 12.

An assessment of rehabilitation environmental performance is provided in Section 10.5.

Table 12
Rehabilitation Status

Mine Area Type	As at December 2018	As at December 2019	As at December 2020 (Forecast)
A. Total mine footprint[1]	~ 17 ha	~ 17 ha	~ 17 ha
B. Total active disturbance[2]	~ 17 ha	~ 17 ha	~ 17 ha
C. Land being prepared for rehabilitation[3]	0	0	0
D. Land under active rehabilitation[4]	0	0	0
E. Completed rehabilitation[5]	0	0	0

1 ***Total mine footprint:*** *includes all areas within a mining lease that either have at some point in time, or continue to, pose a rehabilitation liability due to mining and associated activities. As such, it is the sum of total active disturbance, decommissioning, landform establishment, growth medium development, ecosystem establishment, ecosystem development and relinquished lands (as defined in the DRE (now DRG) MOP/RMP Guidelines). Please note that subsidence remediation areas are excluded.*

2 ***Total active disturbance:*** *includes all areas ultimately requiring rehabilitation such as: on-lease exploration areas, stripped areas ahead of mining, infrastructure areas, water management infrastructure, sewage treatment facilities, topsoil stockpile areas, access tracks and haul roads, active mining areas, waste emplacements (active/unshaped/in or out-of-pit), and tailings dams (active/unshaped/uncapped).*

3 ***Land being prepared for rehabilitation:*** *includes the sum of mine disturbed land that is under the following rehabilitation phases – decommissioning, landform establishment and growth medium development (as defined in the Resources Regulator MOP/RMP Guidelines).*

4 ***Land under active rehabilitation:*** *includes areas under rehabilitation and being managed to achieve relinquishment – includes the following rehabilitation phases as described in the DRE (now DRG) MOP/RMP Guidelines – "ecosystem and land use establishment" (area seeded OR surface developed in accordance with final land use) and "ecosystem and land use sustainability" (revegetation assessed as showing signs of trending towards relinquishment OR infrastructure development).*

5 ***Completed rehabilitation:*** *requires formal sign-off by DRE (now DRG) that the area has successfully met the rehabilitation land use objectives and completion criteria.*

The total mine footprint includes the Metropolitan Coal surface facilities, the No. 3 Ventilation Shaft facilities, the temporary cable runway and electricity cable, disturbance associated with exploration boreholes and monitoring equipment installation in the underground mining area.

Two Catchment Improvement Works Projects have been conducted in accordance with Condition 5(b), Schedule 6 of the Project Approval, which requires Metropolitan Coal to carry out catchment improvement works in the Woronora catchment area. Catchment improvement works conducted in the review period are described in Section 10.4.

10.2 REHABILITATION STRATEGY – SURFACE FACILITIES AREA

The Metropolitan Coal Rehabilitation Strategy has been developed to be a concise framework document which describes the development of rehabilitation objectives and completion criteria for the preferred future landuse for the surface facilities area following the completion of mining activities. Detailed rehabilitation plans for the surface facilities area will be developed over the life of the Project and will be presented in the Mine Closure Plan and future revisions of the Rehabilitation Strategy.

As various factors will influence the landuse options available for the surface facilities area following the completion of mining activities, it is not possible for Metropolitan Coal to define a final landuse option (and associated final rehabilitation objectives and completion criteria) at this stage of the Project life. The final landuse and associated final rehabilitation objectives and completion criteria will be documented in future Metropolitan Coal MOP and the Mine Closure Plan as part of the Mining, Rehabilitation and Environmental Management Process. The Metropolitan Coal MOP has been prepared for the operating period 2012 to 2021.

Disturbance areas at the Metropolitan Coal surface facilities area are minimal and have remained relatively unchanged for many years. The surface facilities area includes roads, facilities (e.g. the CHPP, administration buildings and workshops), stockpiles (coal and reject stockpiles), railroads, water storages and infrastructure. The surface facilities area is an active operational area which will be required for the entire mine life.

Figure 23 shows the designated rehabilitation zones (1 to 7) that are currently available for rehabilitation at the surface facilities area. Rehabilitation activities undertaken during the review period included control of introduced and environmental weeds across the designated rehabilitation zones (in particular Lantana [*Lantana camara*], Ginger Lily [*Hedychium gardnerianum*], Crofton Weed [*Agerantina adenophora*] and Mistflower [*Ageratina riparia]*). Control works were also undertaken on noxious weeds identified on Camp Creek (namely Pampas Grass [*Cortaderia selloana*] and Senegal Tea Plant [*Gymnocoronis spilanthoides*]).

No buildings were renovated or removed during the review period.

10.3 REHABILITATION MANAGEMENT – UNDERGROUND MINING AREA

10.3.1 Rehabilitation of Surface Disturbance Areas

Some surface disturbance areas will be able to be rehabilitated during the life of the Project (e.g. monitoring sites no longer required), while other surface disturbance areas will likely remain until after the completion of mining operations.

No surface disturbance areas in the underground mining area were rehabilitated during the review period as the majority of disturbance pertains to the installation and ongoing maintenance of environmental monitoring sites which are a life of mine asset. These sites will be rehabilitated to appropriate standards following cessation of mining.

10.3.2 Stream Remediation Measures

Metropolitan Coal is required to achieve the rehabilitation objective specified in Table 11 of Condition 1, Schedule 6 of the Project Approval for the Waratah Rivulet and the Eastern Tributary watercourses.

Table 11: Rehabilitation Objectives

Domain	*Rehabilitation Objective*
Waratah Rivulet, between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir *Eastern Tributary, between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir*	*Restore surface flow and pool holding capacity as soon as reasonably practicable*

Metropolitan Coal is also required to achieve the subsidence impact performance measures specified in Table 1 of Condition 1, Schedule 3 of the Project Approval in relation to the Waratah Rivulet and Eastern Tributary watercourses.

Table 1: Subsidence Impact Performance Measures

Watercourses	
Waratah Rivulet between the full supply level of the Woronora Reservoir and the maingate of Longwall 23 (upstream of Pool P)	*Negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining, and minimal gas releases)*
Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26	*Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases)*

Waratah Rivulet

Stream remediation is initiated at pools/rock bars on Waratah Rivulet between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir (i.e. Pools A to W) if the water level in a pool falls below its cease to overflow level (i.e. stops overflowing), except as a result of climatic conditions.

As a result of previous mining, the water levels in pools upstream of Flat Rock Crossing (i.e. Pools A to G) and immediately downstream of Flat Rock Crossing (Pool G1) have previously been impacted by mine subsidence (i.e. the pool water level has fallen below its cease to flow level). Metropolitan Coal identified that the water level in Pool N fell below its cease to flow level in early September 2012.

Stream remediation activities have been undertaken at Pools A, F and G. The rock bars at Pools A and F are considered to largely control the pools located upstream of these rock bars. As a result, Metropolitan Coal anticipated that the restoration of surface flow and pool holding capacity at Pools A, and F would restore the surface flow and pool holding capacity of pools between Flat Rock Swamp and Pool F. Metropolitan considers the pool remediation efforts to have largely been successful but continues to monitor the performance of these works.

Mining has not resulted in the diversion of flows or change to the natural drainage behaviour of pools on the Waratah Rivulet downstream of the maingate of Longwall 23 (i.e. Pools P to W).

Eastern Tributary

Monitoring conducted in accordance with the Metropolitan Coal Longwalls 23-27 Water Management Plan identified that the Eastern Tributary watercourse performance measure was exceeded in relation to *minimal iron staining* and *no diversion of flows, no change in the natural drainage behaviour of pools*. The exceedance of the Eastern Tributary watercourse performance measure (referred to as the Eastern Tributary Incident) was reported to the DP&E and other relevant agencies in October 2016.

Metropolitan Coal provided the DP&E with a proposed course of action in relation to the exceedance of the Eastern Tributary subsidence impact performance measure, focused on the implementation of stream remediation measures.

Metropolitan Coal is committed to stream remediation at the earliest opportunity. Metropolitan Coal will conduct stream remediation works in accordance with the Metropolitan Coal Stream Remediation Plan. The Metropolitan Coal Stream Remediation Plan was provided to the DP&E and relevant agencies in November 2018 and approved on 1 November 2019. The Metropolitan Coal Stream Remediation Plan outlines the process for assessing remediation success, which involves utilising a weight of evidence approach to enable a determination of whether surface flows and pool holding capacity has been restored.

During the reporting period, Metropolitan Coal conducted stream remediation on the Eastern Tributary at Pools ETAH and ETAK, located within the Eastern Tributary watercourse performance measure zone. Works consisted of drilling and installation of a polyurethane (PUR) grout curtain at the downstream rock bar of both pools to a depth of approximately 7 m in order to reduce rock bar permeability and restore surface water flow over the rock bar. Metropolitan continues to monitor the performance of these works.

10.4 CATCHMENT IMPROVEMENT WORKS

Two Catchment Improvement Works Projects in the Woronora catchment area have been conducted in accordance with Condition 5(b), Schedule 6 of the Project Approval. The catchment improvement works include:

- the rehabilitation of a former quarry on Fire Road 9H; and
- the rehabilitation of a disused access track to the Darkes Forest Mine (a historic mine located to the south of Metropolitan Coal).

Rehabilitation activities at the former quarry on Fire Road 9H during the review period included supplementary brush matting in areas of low regeneration potential and the direct seeding of local native plant species. Weed control activities at the former quarry and along Fire Road 9H were also undertaken.

Rehabilitation activities along the disused access track to the Darkes Forest Mine during the review period included supplementary brush matting and weed control measures targeting Crofton Weed (*Ageratina adenophora*), Fleabane (*Conyza spp.*), Whiskey Grass (*Andropogon virginicus*) and introduced grass species.

Additional catchment improvement works conducted by Metropolitan Coal during the review period included the implementation of weed control measures along Fire Road 9J targeting Crofton Weed, Fleabane, Scotch Thistle (*Onopordum acanthium*) and Whiskey Grass.

10.5 ASSESSMENT OF ENVIRONMENTAL PERFORMANCE

An assessment of the environmental performance of rehabilitation management during the review period is provided in Table 13.

Table 13
Assessment of Environmental Performance – Rehabilitation

Monitoring Component		Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Other land affected by the Project Performance Indicator		*Redundant equipment/infrastructure items have been removed.* *The site is neat and tidy (i.e. it does not contain any rubbish).* *No weed management measures are required.* *No erosion or sediment control measures are required.* *Where appropriate, native vegetation is naturally regenerating or active revegetation is establishing.* *No further active revegetation measures are required.*	Not currently applicable	Not applicable during the review period as no rehabilitation of surface distribution areas in the underground mining area has been conducted. Once a surface disturbance area is no longer being utilised, Metropolitan Coal will use the Rehabilitation Management Plan – Surface Disturbance Register to monitor the performance of the measures implemented to rehabilitate surface disturbance areas.
Stream Remediation Performance Indicator		*Analysis of water level recession rates for a pool indicates a similar pool behaviour to that which existed prior to being impacted by subsidence.*	To be determined	While stream remediation activities have been conducted at Pools A, F and G on the Waratah Rivulet, assessment against the rehabilitation performance indicator has not been made to date. Assessment following the stream remediation works was delayed until a significant period of drier climatic conditions had been experienced and an updated Stream Remediation Management Plan including proposed pool remediation success assessment criteria, which was approved in November 2019.
Rehabilitation Objectives (Project Approval Table 11, Condition 1 Schedule 6)	*Surface Facilities Area*	*Set through condition 2 below.*	Yes	The rehabilitation objective for the surface facilities area is addressed in the Metropolitan Coal Rehabilitation Strategy.
	Waratah Rivulet, between the downstream edge of Flat Rock Swamp and the full supply level of the Woronora Reservoir	*Restore surface flow and pool holding capacity as soon as reasonably practicable.*	To be determined	Metropolitan Coal will assess surface flow and pool holding capacity using the results of the assessment of the stream remediation performance indicator for the completed stream remediation activities at Pools A, F and G once a significant period of drier climatic conditions has been experienced.
	Eastern Tributary, between the maingate of Longwall 26 and the full supply level of the Woronora Reservoir		To be determined	Metropolitan commenced remediation of pools on Eastern Tributary in Q3 2020. Monitoring data will be collected throughout the program to inform assessment of the stream remediation performance indicator.
	Cliffs	*Ensure that there is no safety hazard beyond that existing prior to mining.*	Yes	No safety hazard associated with cliffs was identified during the review period.

Table 13 (Continued)
Assessment of Environmental Performance – Rehabilitation

Monitoring Component		Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Rehabilitation Objectives (Project Approval Table 11, Condition 1 Schedule 6) (Continued)	*Other land affected by the Project*	*Restore ecosystem function, including maintaining or establishing self sustaining native ecosystems:* • *comprised of local native plant species; with* • *a landform consistent with the surrounding environment.*	Not currently applicable	The Rehabilitation Management Plan – Surface Disturbance Register will be used to manage the implementation of rehabilitation measures. The performance indicator for other land affected by the Project will be used to monitor the performance of rehabilitation measures being implemented.
	Built features	*Repair/restore to pre-mining condition or equivalent.*	Yes	Assessed through the Metropolitan Coal Built Features Management Plans. No impacts to built features were recorded during the review period.
	Community	*Minimise the adverse socio-economic effects associated with mine closure including the reduction in local and regional employment.*	Not currently applicable	The socio-economic effects associated with mine closure will be addressed in the Metropolitan Coal Mine Closure Plan and will be considered in consultation with the local community (through the Community Consultative Committee [CCC]) when determining the final landuse option.
		Ensure public safety.	Yes	Assessed through the Metropolitan Coal Public Safety Management Plan for the underground mining area and in the Metropolitan Coal Rehabilitation Strategy for the surface facilities area.
Rehabilitation Strategy – Surface Facilities Area (Project Approval Condition 2, Schedule 6)		*2. By the end of October 2011, the Proponent shall prepare a Rehabilitation Strategy for the surface facilities area to the satisfaction of the Director-General. This strategy must:* *(a) be prepared by a team of suitably qualified and experienced experts whose appointment has been endorsed by the Director-General;* *(b) be prepared in consultation with relevant stakeholders, including the WCC and the CCC;* *(c) investigate options for the future use of the area upon the completion of mining;* *(d) describe and justify the proposed rehabilitation strategy for the area; and* *(e) define the rehabilitation objectives for the area, as well as the proposed completion criteria for this rehabilitation.*	Yes	-

Table 13 (Continued)
Assessment of Environmental Performance – Rehabilitation

Monitoring Component	Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Progressive Rehabilitation (Project Approval Condition 3, Schedule 6)	*3. To the extent that mining operations permit, the Proponent shall carry out rehabilitation progressively, that is, as soon as reasonably practicable following the disturbance.*	Yes	-
Rehabilitation Management Plan (Project Approval Condition 4, Schedule 6)	*4. The Proponent shall prepare and implement a Rehabilitation Management Plan for the project to the satisfaction of the Executive Director Mineral Resources. This plan must be prepared in consultation with the relevant stakeholders, and submitted to DRE for approval prior to carrying out any second workings in the mining area.* *Note: In accordance with condition 12 of schedule 2, the preparation and implementation of Rehabilitation Management Plans is likely to be staged, with each plan covering a defined area (or domain) for rehabilitation. In addition, while mining operations are being carried out, some of the proposed remediation or rehabilitation measures may be included in the detailed management plans that form part of the Extraction Plan. If this is the case, however, then the Proponent will be required to ensure that there is good cross-referencing between the various management plans.*	Yes	-
Catchment Improvement Works (Project Approval Condition 5, Schedule 6)	*5. The Proponent shall:* *(a) pay SCA $100,000 by the end of 2011 to carry out catchment improvement works within the Woronora catchment area; or* *(b) carry out catchment improvement works within this area that have an equivalent value to the satisfaction of SCA.*	Yes	Metropolitan Coal conducts catchment improvement works in the Woronora catchment area in accordance with Condition 5(b), Schedule 6 of the Project Approval (refer Section 10.4).

Table 13 (Continued)
Assessment of Environmental Performance – Rehabilitation

Monitoring Component	Performance Indicator, Rehabilitation Objective and/or Project Approval Condition	Indicator, Objective or Condition Met?	Comments
Offsets (Project Approval Condition 6, Schedule 6)	6. *If the Proponent exceeds the performance measures in Table 1 of this approval, and either* *(a) The contingency measures implemented by the Proponent have failed to remediate the impact; or* *(b) The Director-General determines that it is not reasonable or feasible to remediate the impact,* *then the Proponent shall provide a suitable offset to compensate for the impact to the satisfaction of the Director-General.* *Note: Any offsets required under this condition must be proportionate with the significance of the impact.*	To be determined	In October 2016 Metropolitan Coal identified the subsidence impact performance measure for the Eastern Tributary, between the full supply level of the Woronora Reservoir and the Longwall 26 maingate in Table 1, Condition 1, Schedule 3 of the Project Approval had been exceeded in relation to iron staining. In early 2017 the same performance measure was identified as being exceeded in relation to pool drainage behaviour (refer to Sections 6.2, 10.3 and 13.1). Metropolitan Coal proposed to conduct stream remediation measures on the Eastern Tributary in accordance with the Longwalls 23-27 Water Management Plan Contingency Plan. In 2018 Metropolitan submitted a Stream Remediation Plan to relevant stakeholders prior to commencement of any stream remediation. The plan was approved in November 2019 with remediation activities commencing Q3 2020.

11 COMMUNITY

Metropolitan Coal engages with the Helensburgh community and strives to maintain positive relationships with stakeholders given the extensive history shared between the mine and township. Generations of locals have worked at the mine and it is widely accepted that the operation is an integral component of the Helensburgh community.

The majority of workers reside in the local area or within 50 km of the mine. As far as practicable, the mine seeks to employ local contractors, supply companies and services during the course of its operations.

Metropolitan Coal has also continued to provide sponsorship and/or donations to the local community during the review period. Metropolitan Coal's proactive community engagement program aims to work in partnership with the community for mutually beneficial and sustainable outcomes achieving this through the development of specific community programs as discussed below.

11.1 COMMUNITY ENGAGEMENT ACTIVITIES AND INITIATIVES

Community Consultative Committee

Three CCC meetings were held during the review period (8 April, 5 August and 9 December 2020). These meetings facilitated Metropolitan Coal consultation and engagement with community members on matters of general business and the environmental performance of the operation. Discussions during the review period included the Longwalls 304 and 305-307 Extraction Plans, monitoring of the Eastern Tributary, COVID-19 Management, exploration application ELA5918, Resource Regulator Audit results, CWR management and community funding.

11.2 COMMUNITY CONTRIBUTIONS

In addition to the community engagement activities and initiatives discussed above, Metropolitan Coal has made a number of significant donations to support the community of Helensburgh and the greater Illawarra region throughout 2020. All donation requests were assessed on their individual merit and funding was distributed accordingly.

In total, community donations and sponsorship during 2020 amounted to over $100,000 and included the following:

- Donation to the Helensburgh & District Citizens Tennis Club.
- Donation to the Helensburgh Tigers Rugby League Club.
- Donation to the Helensburgh Tigers Junior Rugby League Club.
- Donation to Helensburgh Netball Club.
- Donation to Helensburgh Thistles Soccer Club.
- Ongoing sponsorship of the Helensburgh Public School and Holy Cross Primary School environment programs.
- Donation to the Rotary Club of Fairy Meadow for the Razzamatazz Annual Children's Festival.
- Donations to Helensburgh Lions Club.
- Donation to the Lions Club of Woonona for their World Festival of Magic fundraiser.
- Ongoing Sponsorship of local BMX athletes.

- Donation to Helensburgh Men's Shed.
- Donation to Helensburgh-Stanwell Park Surf Life Saving Club.
- Donation to i98 Illawarra 2020 CONVOY Cycle 1000.
- Donation to Helensburgh Hope Church Community Pantry.
- Donation to Stanwell Park CWA Mental Health First Aid training.

11.3 COMMUNITY COMPLAINTS

A protocol for the management and reporting of complaints has been developed as a component of Metropolitan Coal's Environmental Management Strategy. A dedicated telephone number for the provision of comments or complaints is maintained by Metropolitan Coal (1800 115 003) and is displayed on signage at an entrance to the mine. Metropolitan Coal records and responds to all complaints and maintains a complaints register on its website.

During the review period, no complaints were received in 2020.

A summary of community complaints received since January 2006 is provided on Figure 24. Very few complaints have been received on an annual basis since the Project was approved in June 2009, and have typically related to noise, dust and/or traffic.

12 INDEPENDENT ENVIRONMENTAL AUDIT

In accordance with Condition 8, Schedule 7 of the Project Approval, an Independent Environmental Audit of the Project is to be commissioned by the end of December 2011, and every three years thereafter, and be conducted by a team of experienced and independent experts endorsed by the Director-General (now Secretary) of the DPIE.

Metropolitan Coal commissioned the 2017 Independent Environmental Audit by 31 December 2017 and received the final report in June 2018. In accordance with Condition 9, Schedule 7 of the Project Approval, Metropolitan Coal provided a copy of the Independent Environmental Audit to the Secretary of the DPIE on 26 June 2018, with Metropolitan Coal's response to the Audit recommendations provided on 31 July 2018. All recommendations made in the 2017 Independent Environmental Audit have been closed out.

Three Independent Environmental Audits have been completed to date (as reported in previous Annual Reviews). The next Independent Environmental Audit was commissioned by 31 December 2020 and will be submitted to the DPIE by 30 June 2021.

13 INCIDENTS AND NON-COMPLIANCES DURING THE REPORTING PERIOD

13.1 EASTERN TRIBUTARY PERFORMANCE MEASURE

The Metropolitan Coal Project Approval (08_0149) requires Metropolitan Coal not to exceed the subsidence impact performance measures outlined in Table 1 of Condition 1, Schedule 3.

The subsidence impact performance measure for the Eastern Tributary watercourse is:

> *Negligible environmental consequences over at least 70% of the stream length (that is no diversion of flows, no change in the natural drainage behaviour of pools, minimal iron staining and minimal gas releases)*

Monitoring conducted in accordance with the Metropolitan Coal Longwalls 23-27 Water Management Plan in 2016 identified that the Eastern Tributary watercourse performance measure for the Eastern Tributary between the full supply level of the Woronora Reservoir and the maingate of Longwall 26 was exceeded in relation to *minimal iron staining* in October 2016. The exceedance was reported to the Secretary of the DP&E and other relevant agencies on 14 October 2016 in accordance with Condition 6, Schedule 7 of the Project Approval and the Metropolitan Coal Longwalls 23-27 Water Management Plan Contingency Plan.

The *no diversion of flows, no change in the natural drainage behaviour of pools* component of the Eastern Tributary subsidence impact performance measure was exceeded in January 2017 and reported to the DP&E and other relevant agencies.

Metropolitan Coal has conducted stream remediation works in accordance with the Metropolitan Coal Stream Remediation Plan during the 2020 reporting period at pools ETAH and ETAK in accordance with the Metropolitan Coal Stream Remediation Plan which was approved by DPIE in November 2019. Stream remediation will continue in 2021 once a planned hazard reduction burn for an area of the Woronora Special Area including the performance measure zone on Eastern Tributary has been completed by WaterNSW, currently scheduled for Autumn 2021.

13.2 NOISE

Sustained Non-compliances – Attended Noise Monitoring and Modelling

As described in Section 7.1, during 2020 Metropolitan Coal identified one sustained conditional non-compliances at one representative noise monitoring location (16 Oxley Place) with respect to the Noise Impact Assessment Criteria (Condition 1, Schedule 4 of the Project Approval).

As part of the Noise Mitigation Strategy and as a result of the continuation of the monitored non-compliances, modelling of predicted noise levels for nearby residences was conducted and identified non-compliances with the Noise Impact Assessment Criteria at seven residences in Oxley Place during the day-time, evening and night-time. Exceedances of the Noise Mitigation Criteria were also predicted at the seven residences in Oxley Place during the day-time, evening and night-time. The modelling also predicted compliance with the Noise Acquisition Criteria at all residences (Appendix M).

It is noted that the locations modelled to be experiencing exceedances were experiencing daytime, evening and night-time operational noise levels from the Metropolitan Coal Mine prior to the approval of the Project in June 2009 that were materially higher than the levels recorded in the current review period, and a range of operational noise control measures have been implemented since Project Approval (Section 7.1).

It should also be noted that all of the residences modelled to be experiencing sustained exceedances of the Noise Mitigation Criteria have previously been offered noise mitigation measures on a voluntary basis by Metropolitan Coal (in the form of double glazing). Of the nine residences predicted to exceed the Noise Mitigation Criteria, only one has not accepted an offer of noise mitigation by Metropolitan Coal (Appendix L).

The extensive and long running noise control program at Metropolitan Coal has reduced noise emissions at nearby residences, however, the number of remaining material, reasonable and feasible noise controls is diminishing and the Noise Impact Assessment Criteria may not be achievable in the medium to long term.

In 2017, in consultation with the DP&E, Metropolitan Coal prepared a technical review of remaining available feasible noise mitigation measures and an associated evaluation of the reasonableness of these options (Noise Mitigation Strategy). This assessment was independently peer reviewed.

Following DP&E's review of the Noise Mitigation Strategy, Metropolitan Coal signed a Voluntary Undertaking which formalised the implementation of the mitigation measures identified by the Mitigation Strategy. The Voluntary Undertaking also outlined a process for re-assessing predicted noise levels and reasonable and feasible noise controls in accordance with the Noise Policy for Industry released in 2017.

Metropolitan Coal completed an assessment of Metropolitan Coal's noise levels under the Noise Policy for Industry (released in 2017) and provided to DP&E in April 2018.

In 2020 Metropolitan Coal met with DPIE to discuss the findings of the assessment of Metropolitan's noise levels under the Noise Policy for Industry. DPIE requested that Metropolitan Coal commission a peer review of all noise mitigation and monitoring to date which was completed by Recognition Research in June 2020. In 2021, Metropolitan Coal will meet with DPIE to discuss the findings of the peer review.

Metropolitan Coal anticipates that, during implementation of the Voluntary Undertaking, sustained non-compliances with respect to the Noise Impact Assessment Criteria and, to a lesser extent, exceedances of the Noise Mitigation Criteria, will continue to be observed. Metropolitan Coal will continue to consult with the DPIE, the Resources Regulator, EPA and the local community and implement all identified reasonable and feasible mitigation options.

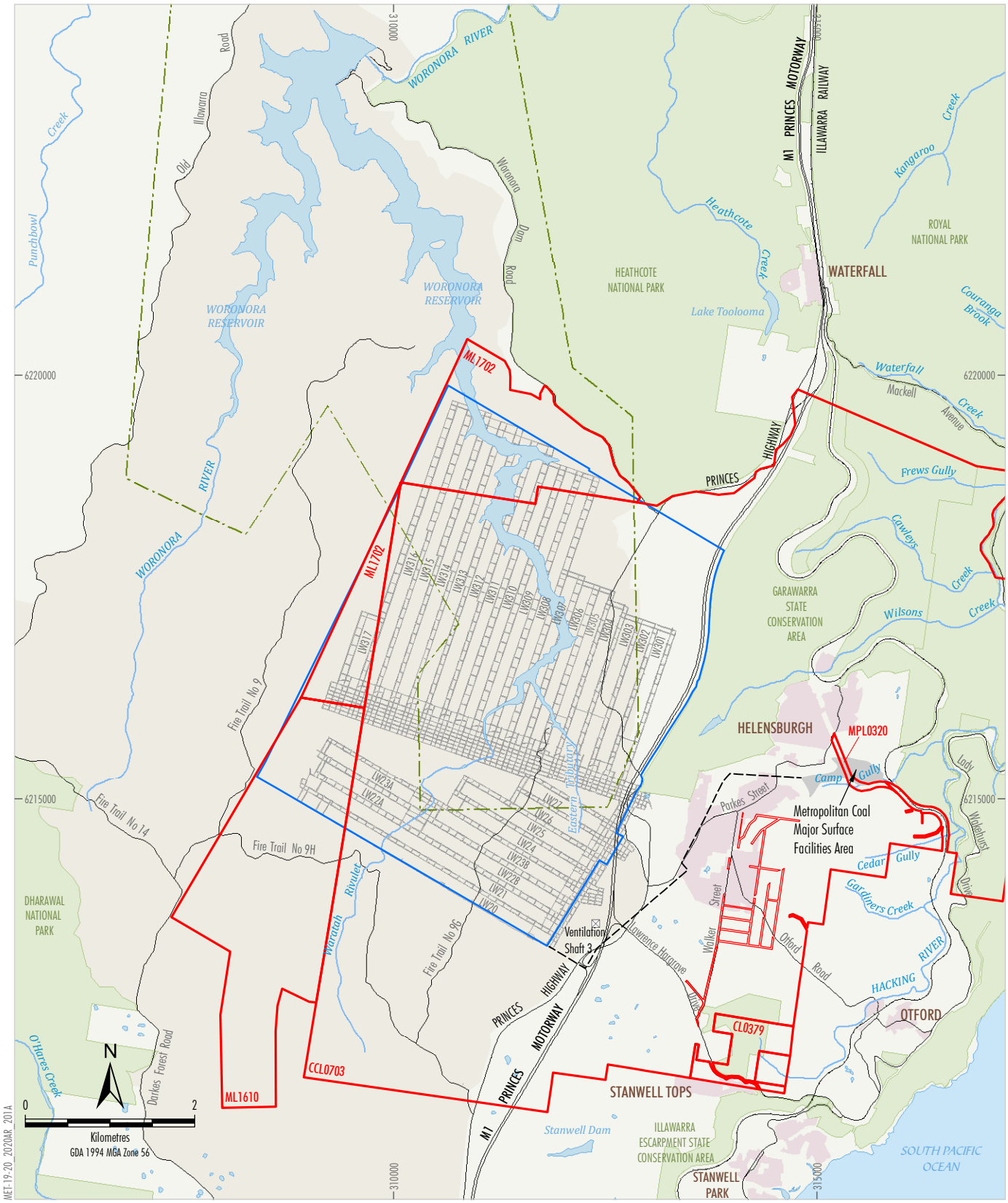
14 ACTIVITIES PROPOSED IN THE NEXT REPORTING PERIOD

In the next reporting period, Longwall 306 is anticipated to commence in May 2021 and be completed in 2022 (Figure 5).

In the next reporting period, the following activities will be conducted:

- Metropolitan Coal will continue to consult with stakeholders in relation to the next Extraction Plan.
- As a result of the Noise Mitigation Assessment and commencement of the Voluntary Undertaking throughout 2021:
  - All crusher and washer doors will be closed at all times (except when being accessed).
  - Metropolitan Coal will continue to consult with the DPIE, the Resources Regulator and EPA and to notify relevant residences of noise exceedances.
- Metropolitan Coal will continue its ongoing consultation with the Wollongong City Council regarding the potential for coal rejects to be beneficially re-used at the Helensburgh Landfill.
- The coal reject backfill emplacement project will also continue throughout 2021.
- Metropolitan Coal will continue to consult with the Wollongong City Council in relation to the upgrade of the Mine Access Road and Parkes Street intersection.
- Metropolitan Coal will continue works to vegetate/ the outer batters of the Turkey's Nest Dam.
- Metropolitan Coal will continue stream remediation on the Eastern Tributary at Pools ETAH and ETAK and downstream locations (once a planned hazard reduction burn for an area of the Woronora Special Area including the performance measure zone on Eastern Tributary has been completed by WaterNSW, and subject to prevailing weather conditions and access being granted by WaterNSW).
- Catchment improvement works will continue in the Woronora catchment area, namely, rehabilitation of the former quarry on Fire Road 9H and rehabilitation of the disused access track to the Darkes Forest Mine. Weather permitting, catchment improvement works in the Woronora catchment area will be undertaken as required throughout 2021.

FIGURES



LEGEND

- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2020)

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METROPOLITAN COAL

Project Longwalls 20-27 and Longwalls 301-317 Layout

Figure 1

MET-19-20_2020AR_001C

LEGEND

Additional/Upgraded Project Infrastructure

Approximate Extent of Major Surface Facilities Area

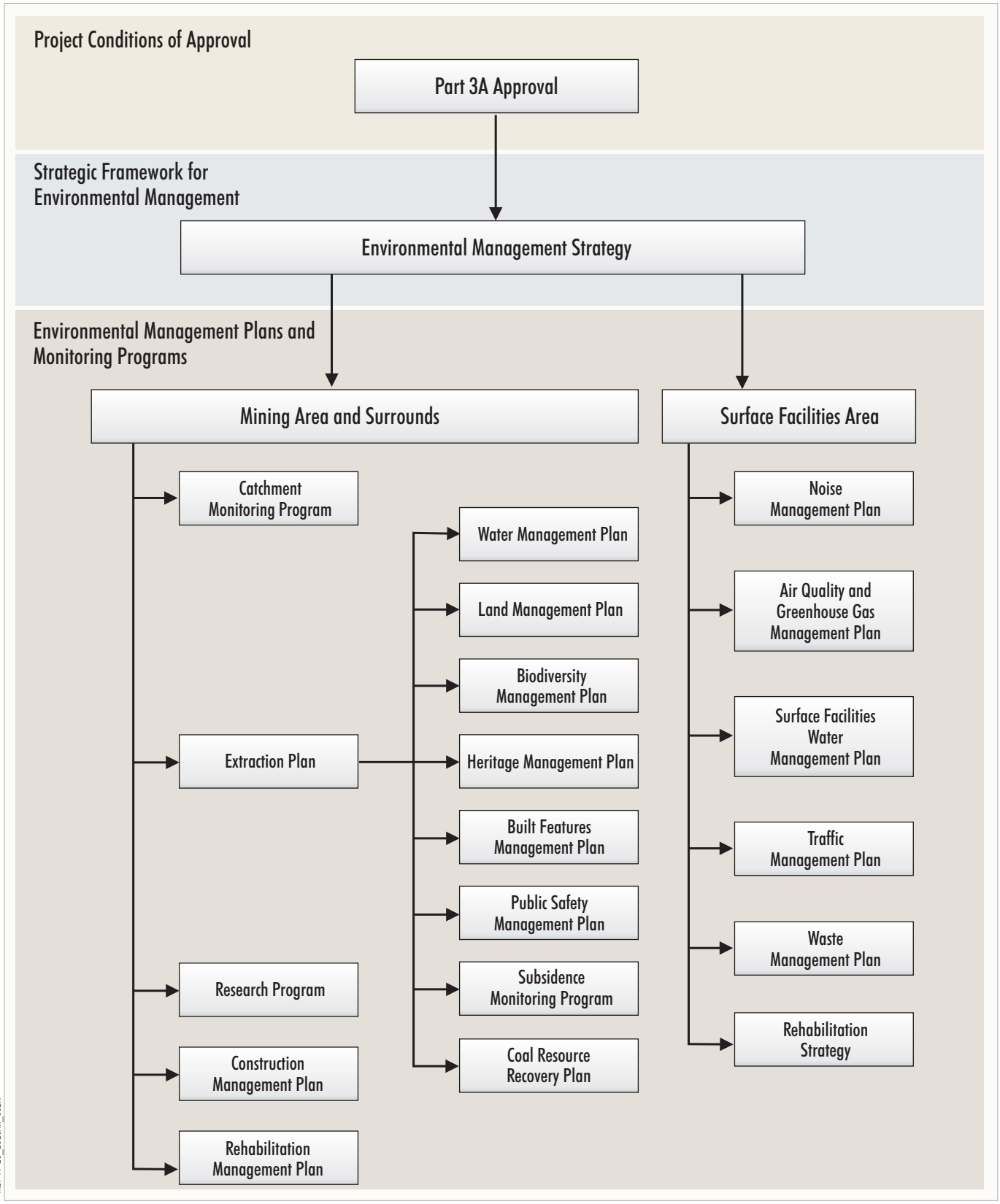
Source: Aerial Photography (2005)

Peabody

METROPOLITAN COAL

General Arrangement of the Major Surface Facilities Area

Figure 2

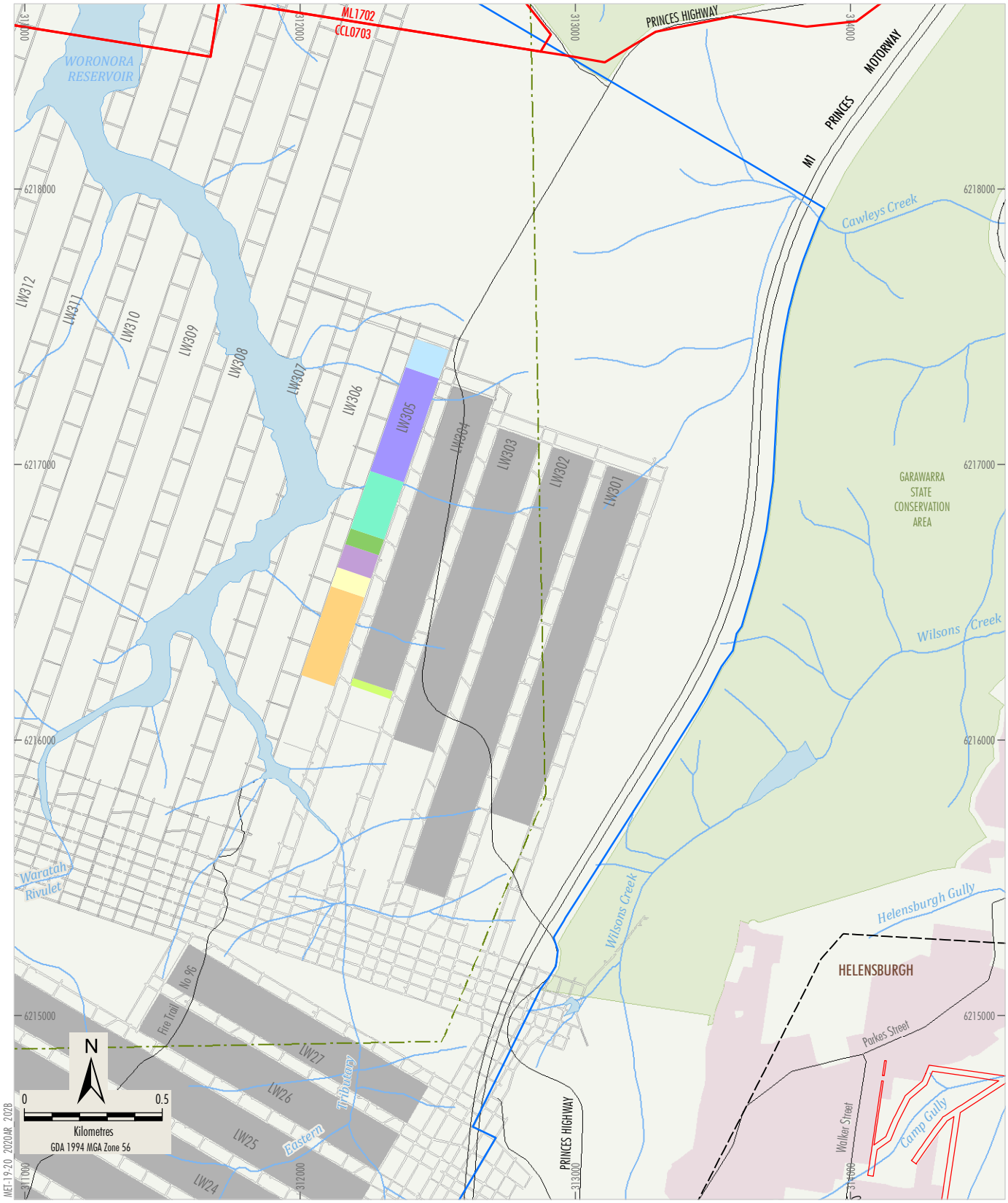


MET-19-20_2020AR_002A

Peabody
METROPOLITAN COAL

Environmental Management Structure

Figure 3



MET-19-20 2020AR 202B

LEGEND

- Mining Lease Boundary
- Previous Extraction
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Monthly Development 2020

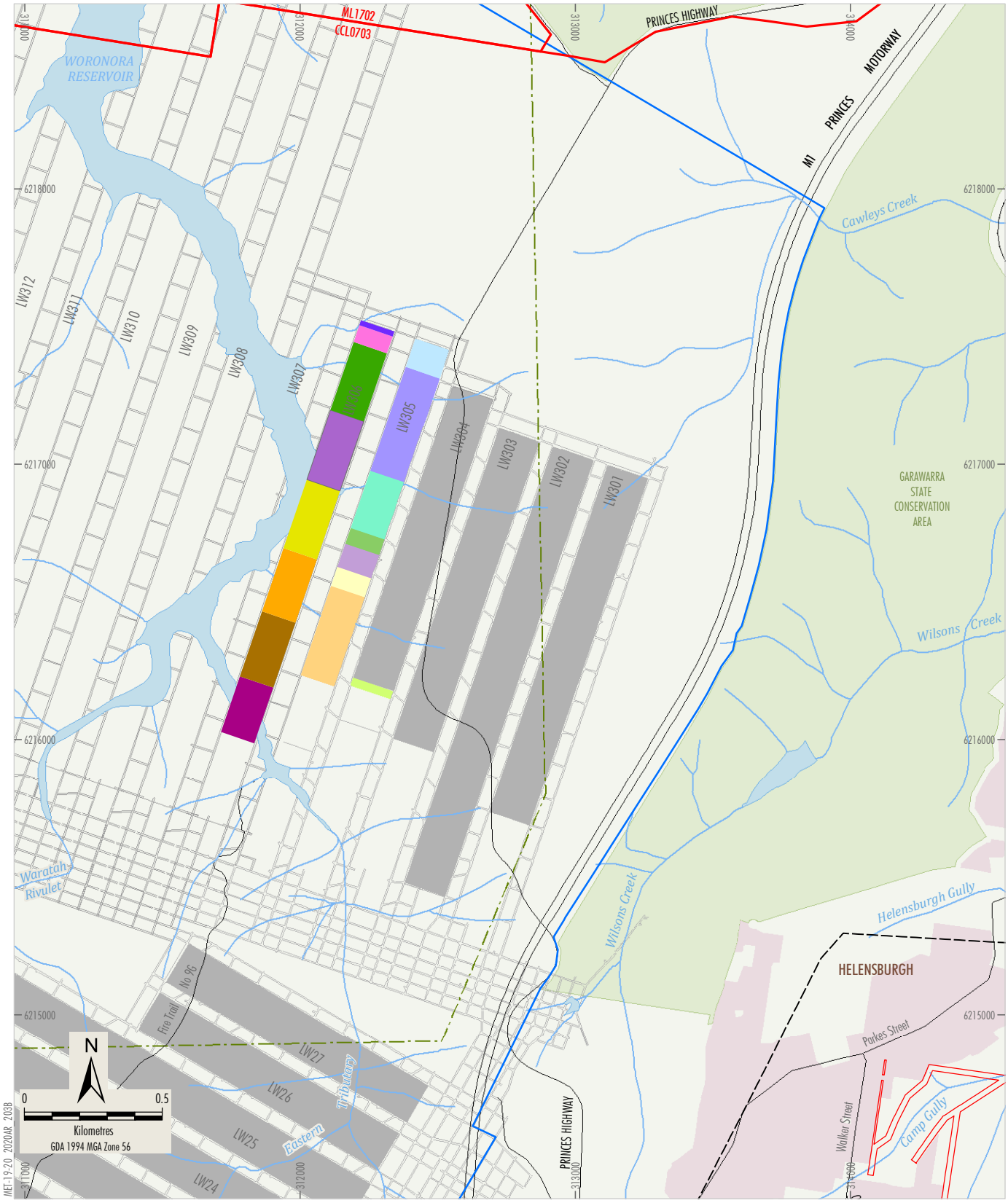
- January
- April
- May
- June
- July
- August
- September
- October

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016)

Peabody
METROPOLITAN COAL

Monthly Production Plan
January to December 2020

Figure 4



LEGEND

- Mining Lease Boundary
- Previous Extraction
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Woronora Notification Area
- Existing Underground Access Drive (Main Drift)

Monthly Development 2020

- January
- April
- May
- June
- July
- August
- September
- October

Monthly Development 2021

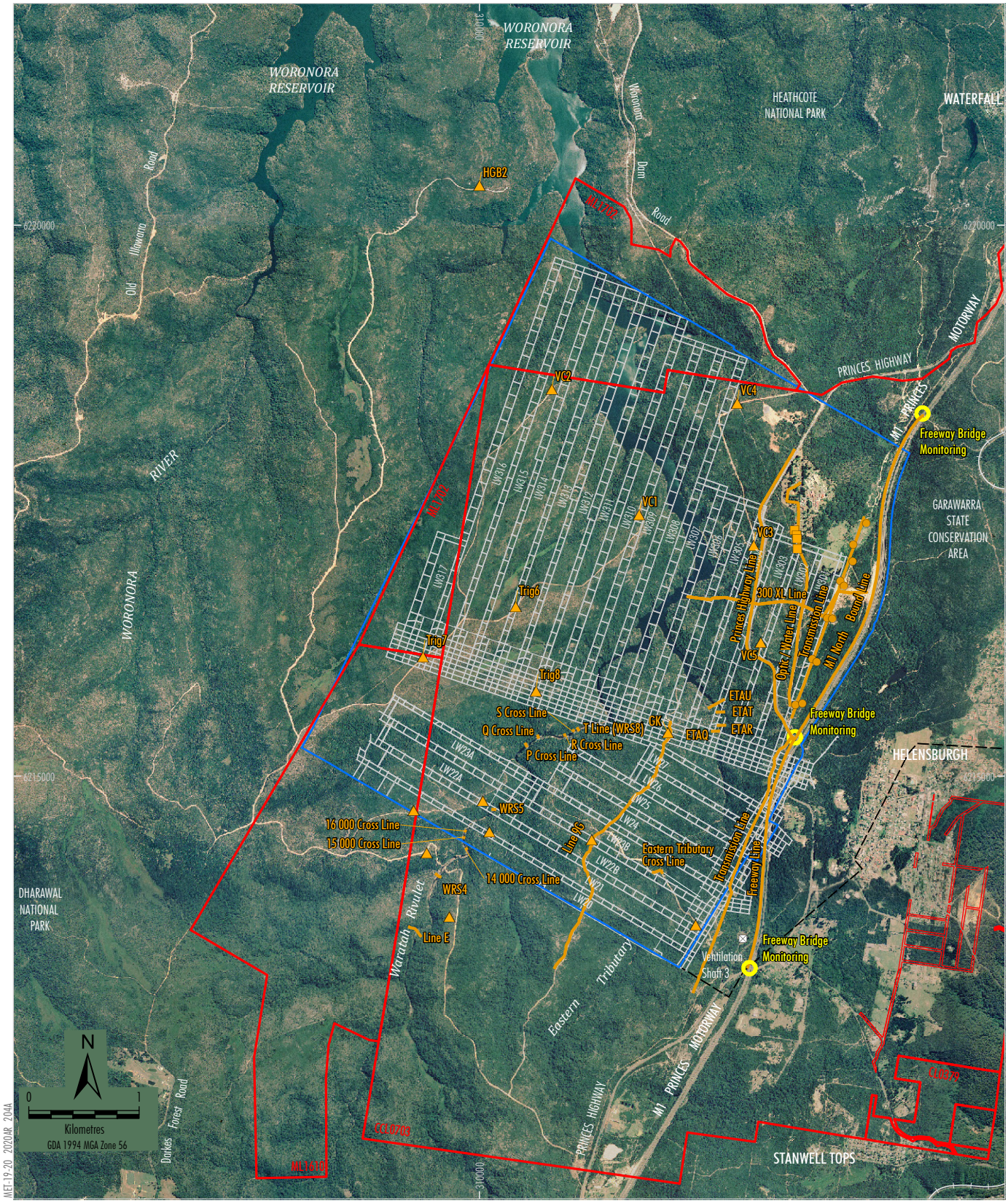
- May
- June
- July
- August
- September
- October
- November
- December

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2016)

Peabody
METROPOLITAN COAL

Production Plan Forecast
January to December 2021

Figure 5



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Ridge Survey Point
- Subsidence Line
- Transmission Towers - Endeavour Energy and TransGrid
- Communications Towers
- Freeway Bridge Subsidence Monitoring

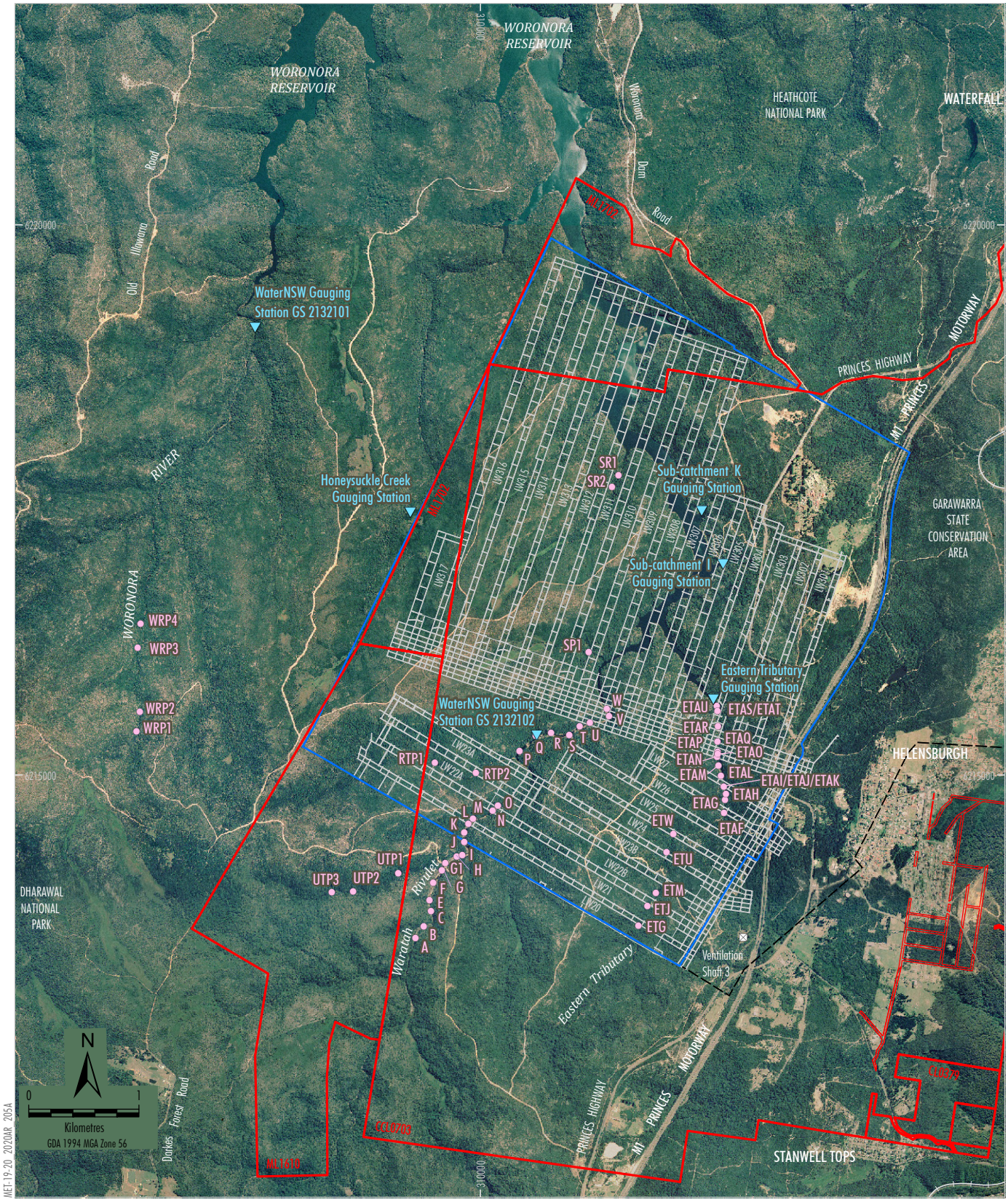
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020); MSEC (2018)

Peabody

METROPOLITAN COAL

Subsidence Monitoring Locations

Figure 6



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Gauging Station
- Pool Water Level Site

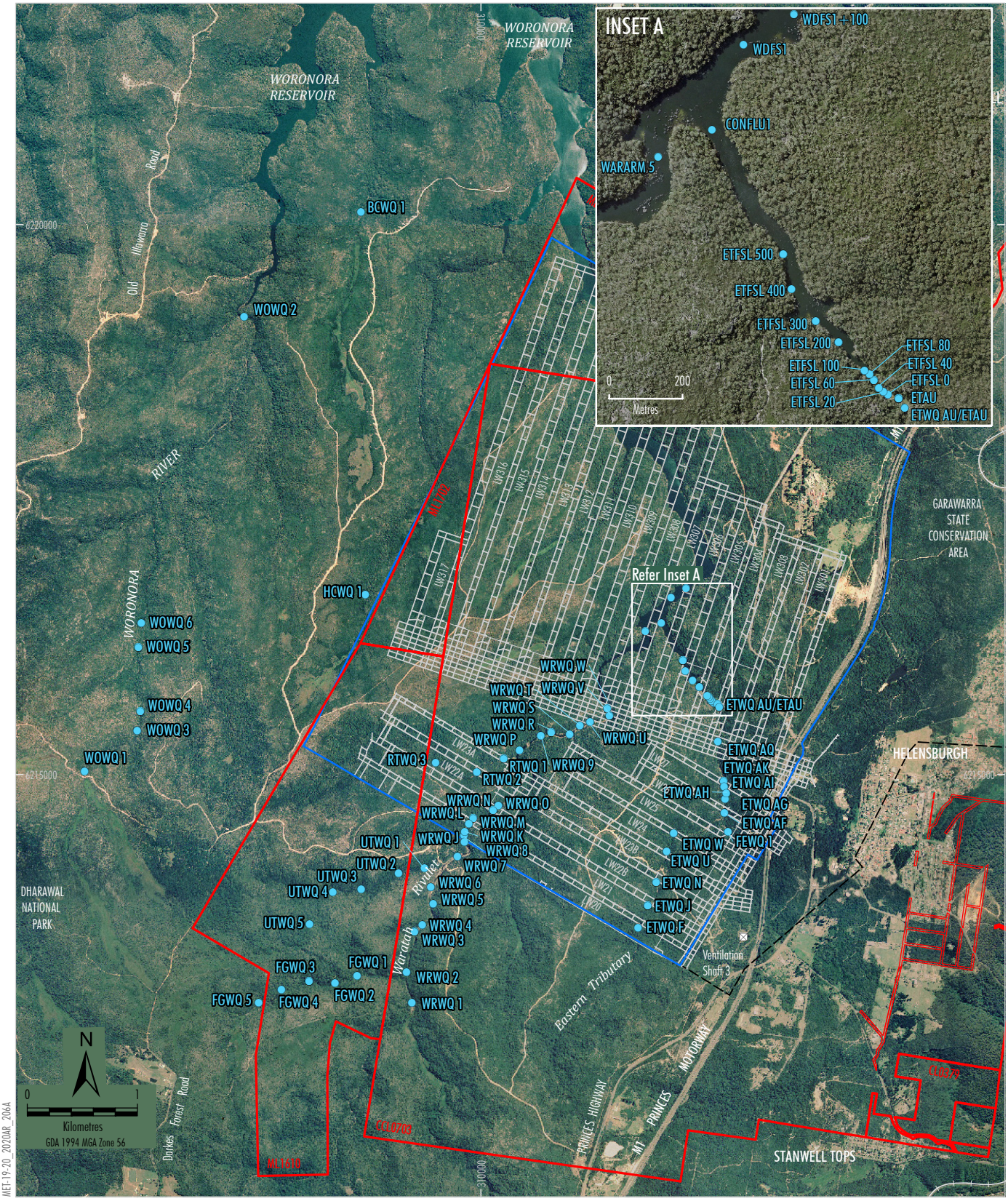
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Surface Water Quantity Sites

Figure 7



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Surface Water Quality Site

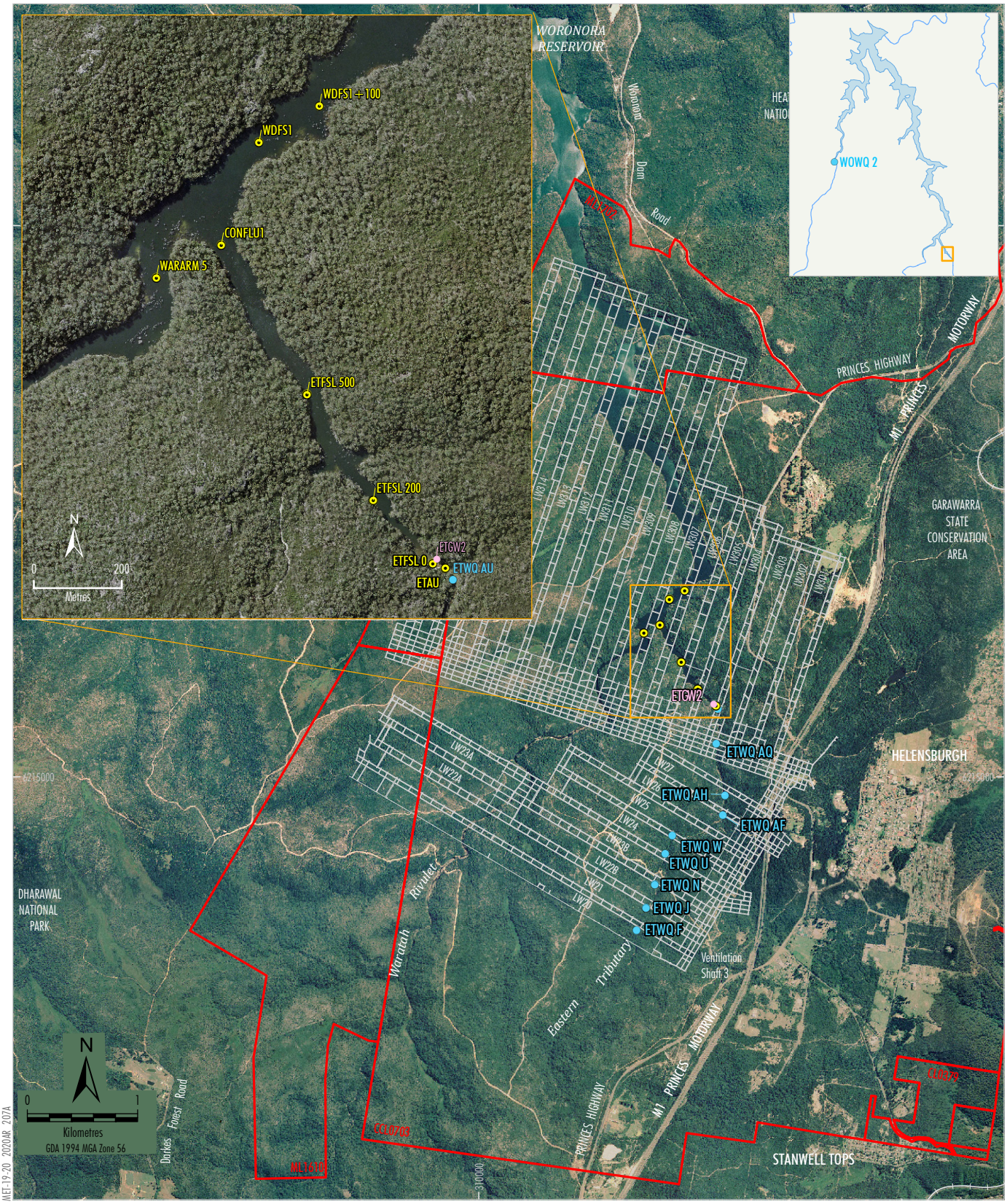
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Surface Water Quality Sites

Figure 8



MET-19-20 2020AR 207A

LEGEND

- Railway
- Surface Water Quality Site on Eastern Tributary
- Water Quality Site on Eastern Tributary and/or in Woronora Reservoir
- Groundwater Quality Site of Eastern Tributary

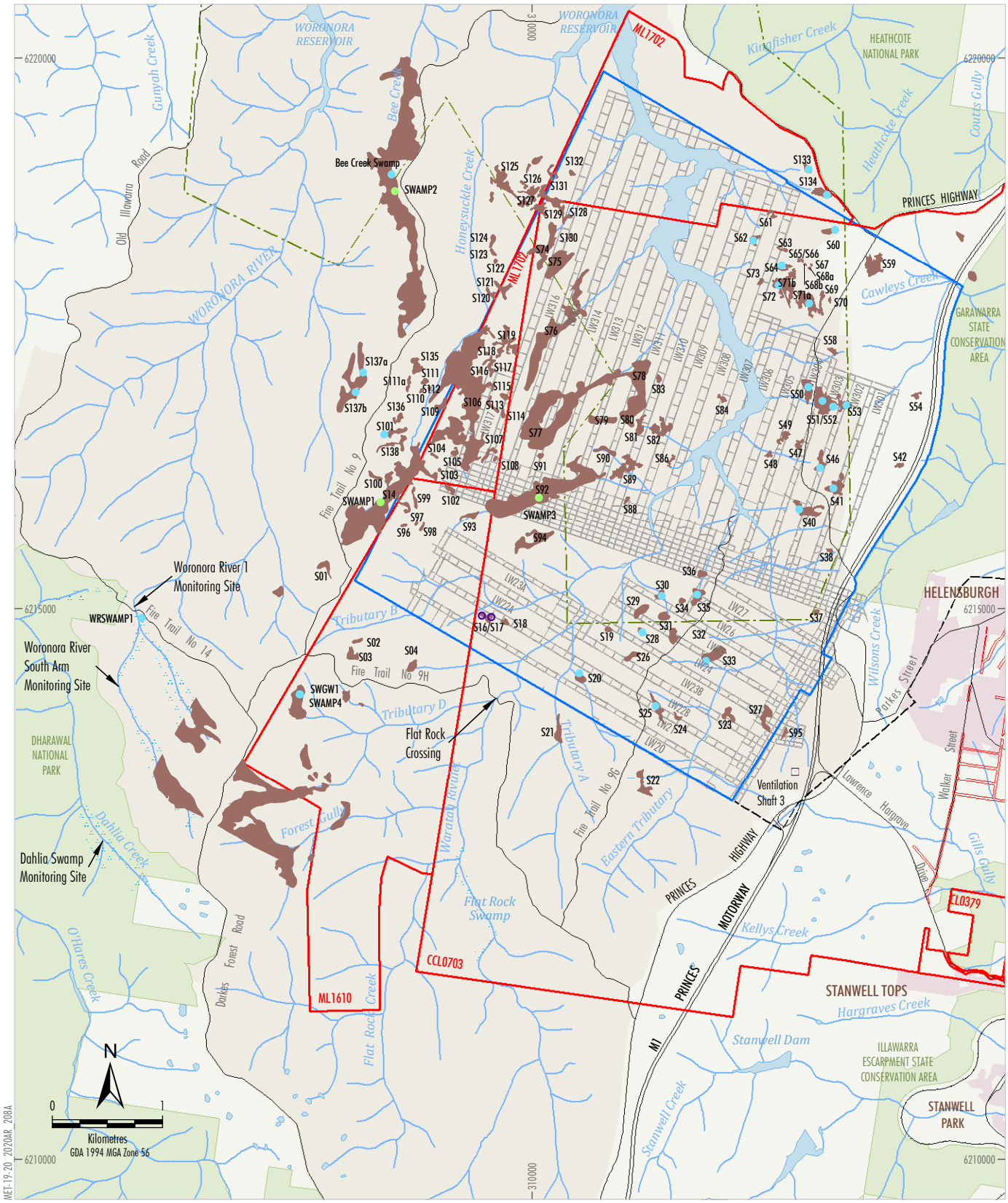
Source: Land and Property Information (2015); Date of Aerial Photography 1998 and 2017; Department of Industry (2015); Metropolitan Coal (2020); WaterNSW (2019)

Peabody

METROPOLITAN COAL

Surface Water Quality Sampling of Eastern Tributary Watercourse and Woronora Reservoir

Figure 8a



LEGEND

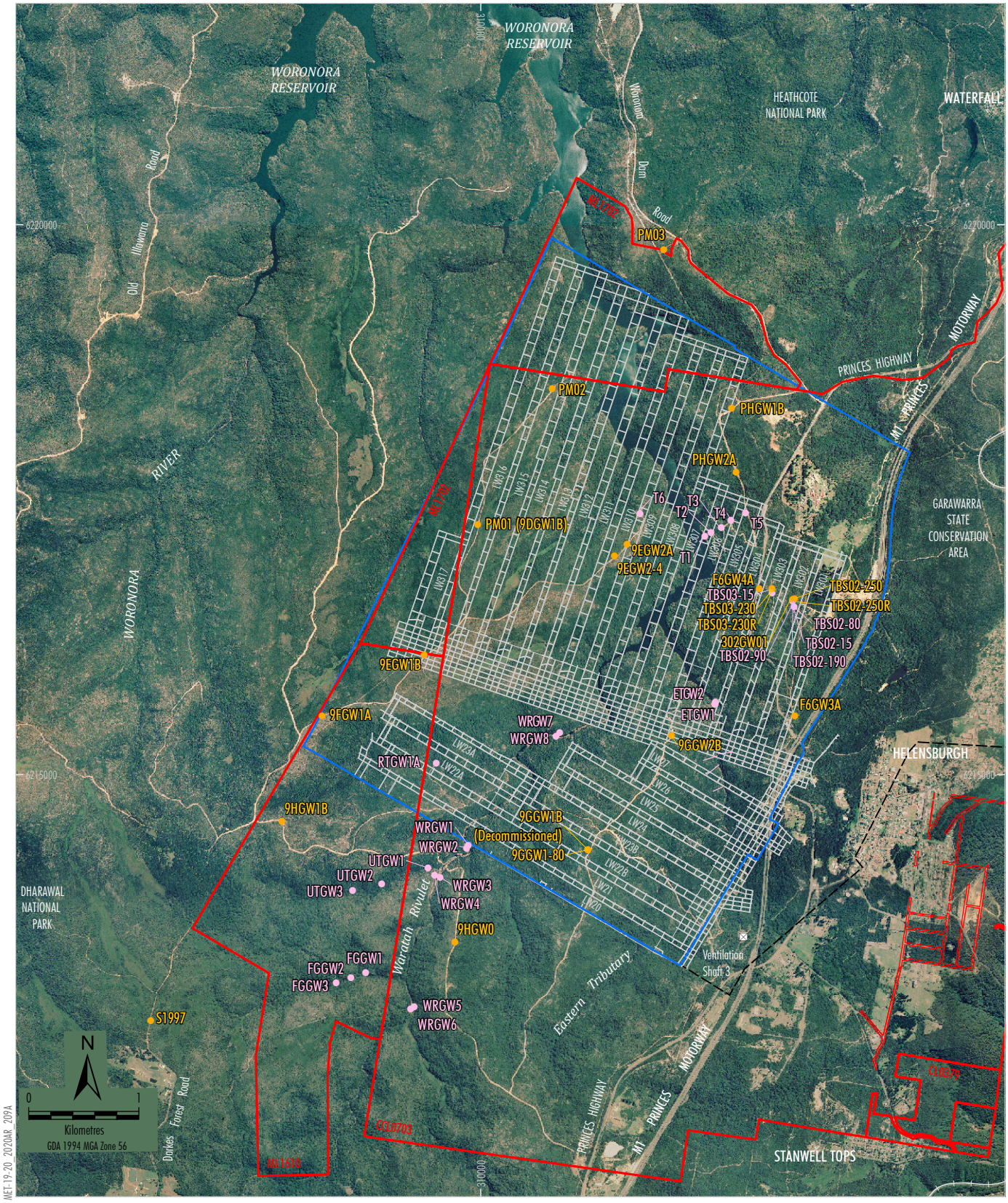
- Mining Lease Boundary
- Woronora Special Area
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Woronora Notification Area
- Upland Swamp
- Swamp Substrate and Shallow Groundwater Piezometer
- Swamp Substrate Groundwater Piezometer
- Swamp Shallow Groundwater Piezometer

Source: Land and Property Information (2015); Department of Industry (2015); Metropolitan Coal (2020); after NPWS (2003), Bangalay Botanical Surveys (2008) and Eco Logical Australia (2015; 2016; 2018)

Peabody
METROPOLITAN COAL

Upland Swamp Groundwater Piezometer Locations

Figure 9



LEGEND

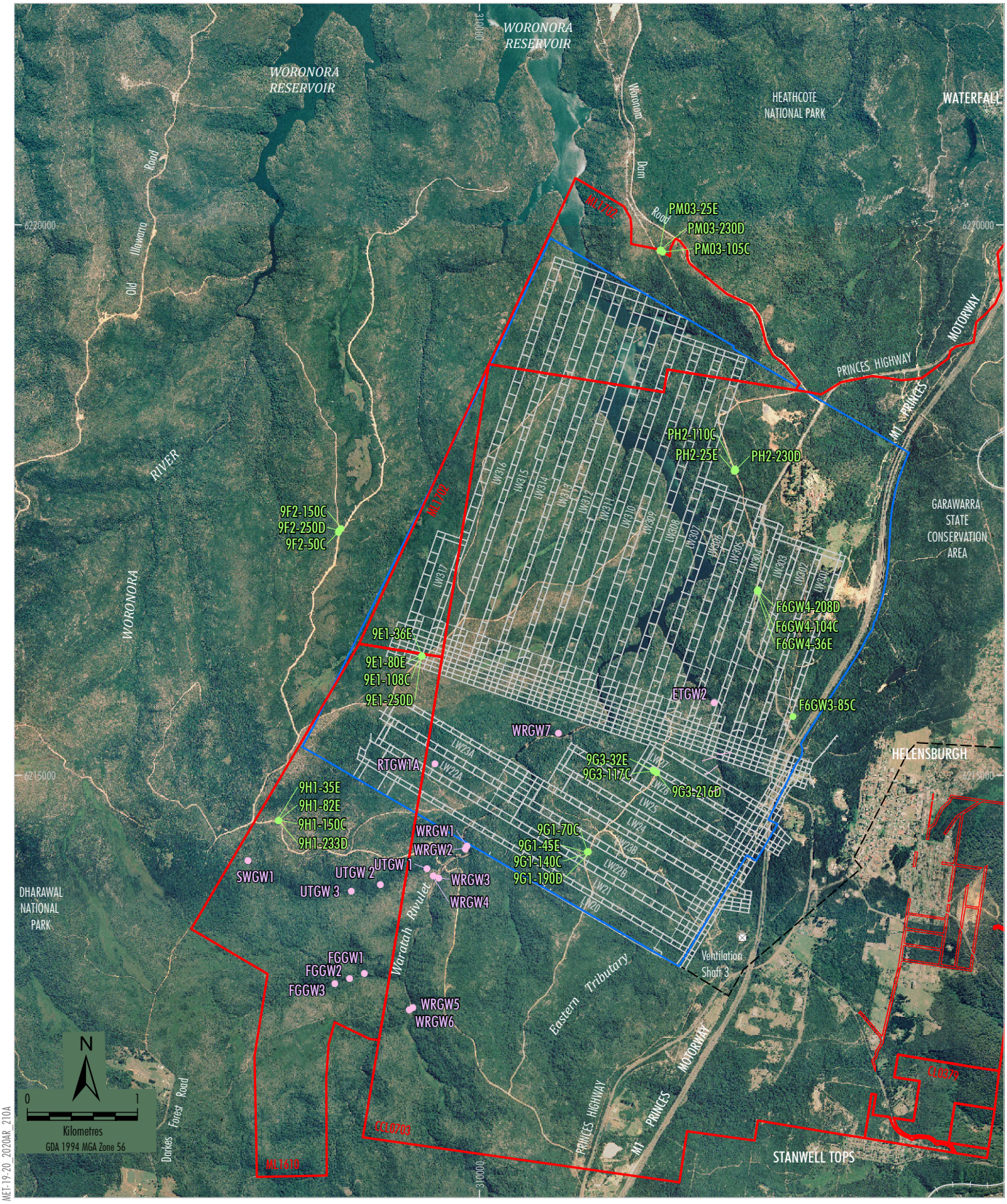
- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Groundwater Level/Pressure Bore
- Groundwater Level Bore

Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody
METROPOLITAN COAL

Groundwater Level
and/or Pressure Bore Locations

Figure 10



MEI 19-20_2020AR_210A

LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Deep Groundwater Chemistry Monitoring Site
- Stream Shallow Groundwater Quality Monitoring Site

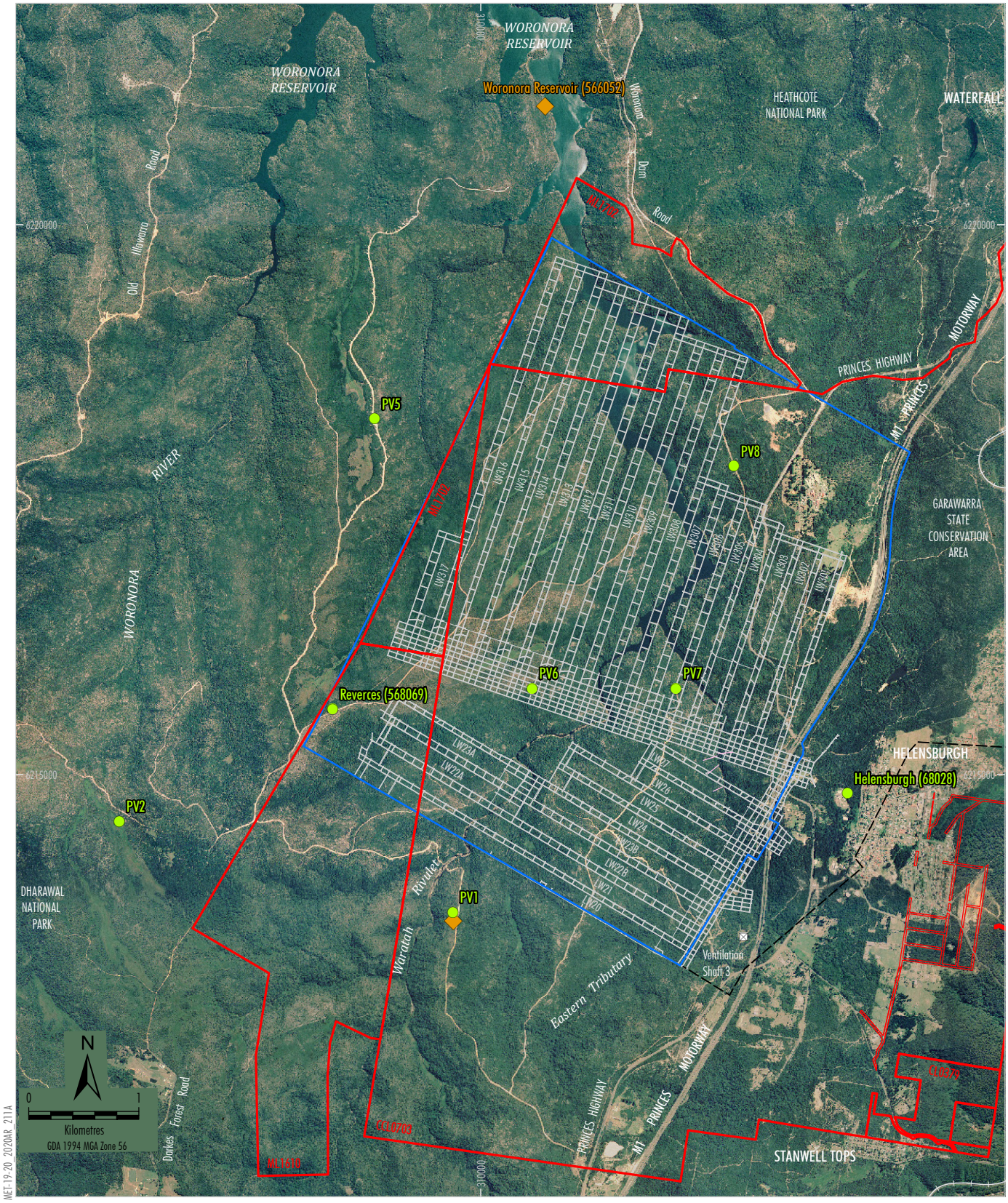
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Groundwater Quality Sites

Figure 11



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Evaporimeter
- Pluviometer

Notes:
1. The Bureau of Meteorology pluviometer at Darkes Forest (68024) is not shown. It is located approximately 3.75 km south of the Metropolitan Coal pluviometer (PV2).
2. The Bureau of Meteorology pluviometer at Lucas Heights (66078) is not shown. It is located approximately 12.5 km north of the Metropolitan Coal pluviometer (PV8).

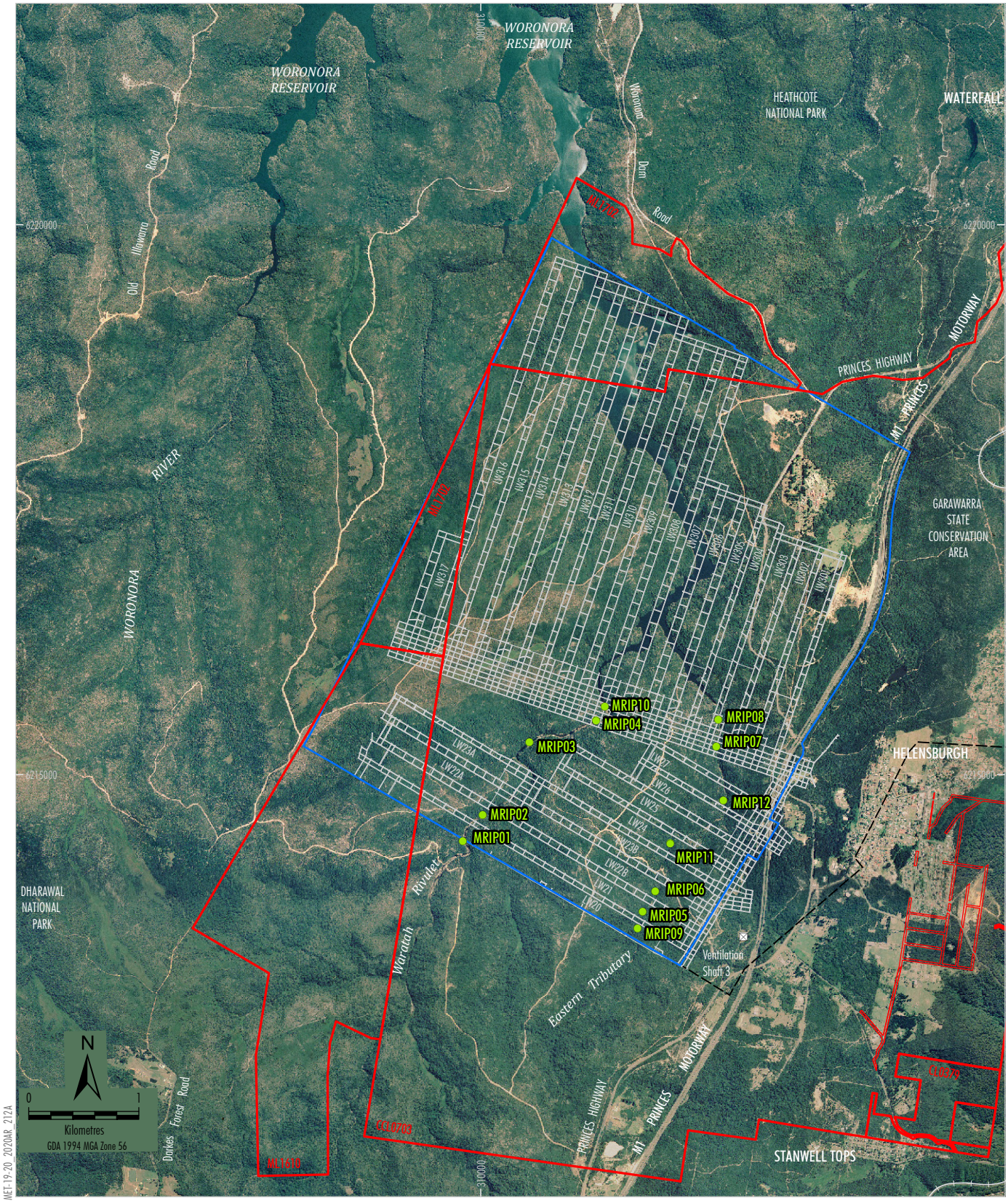
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Meteorological Sites

Figure 12



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)

Monitoring Site

- Riparian Vegetation Monitoring Site

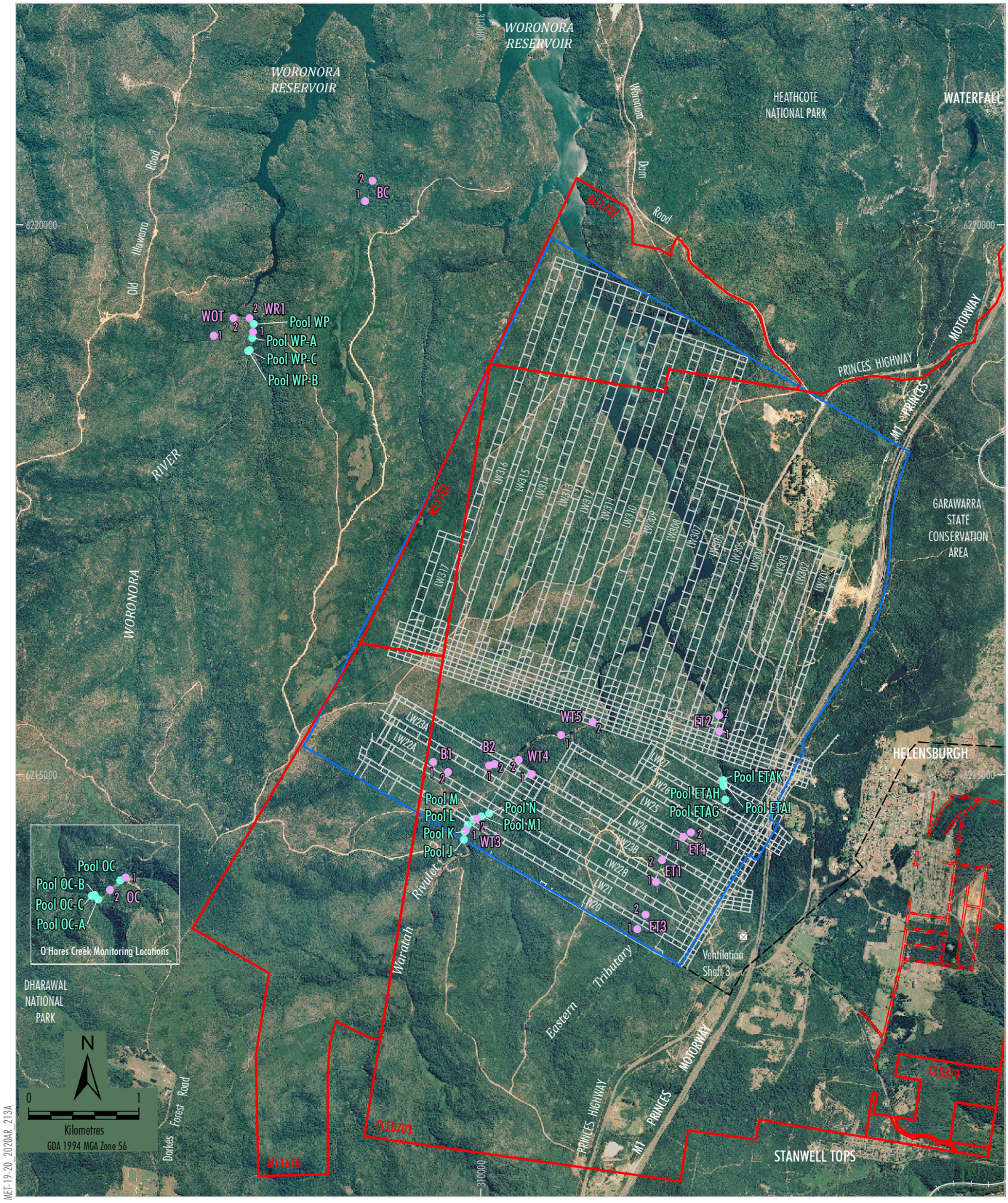
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Riparian Vegetation Monitoring Locations

Figure 13



MET-19-20_2020AR_213A

LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)

Monitoring

- Pool Aquatic Ecology Sampling Site
- Stream Aquatic Ecology Sampling Site

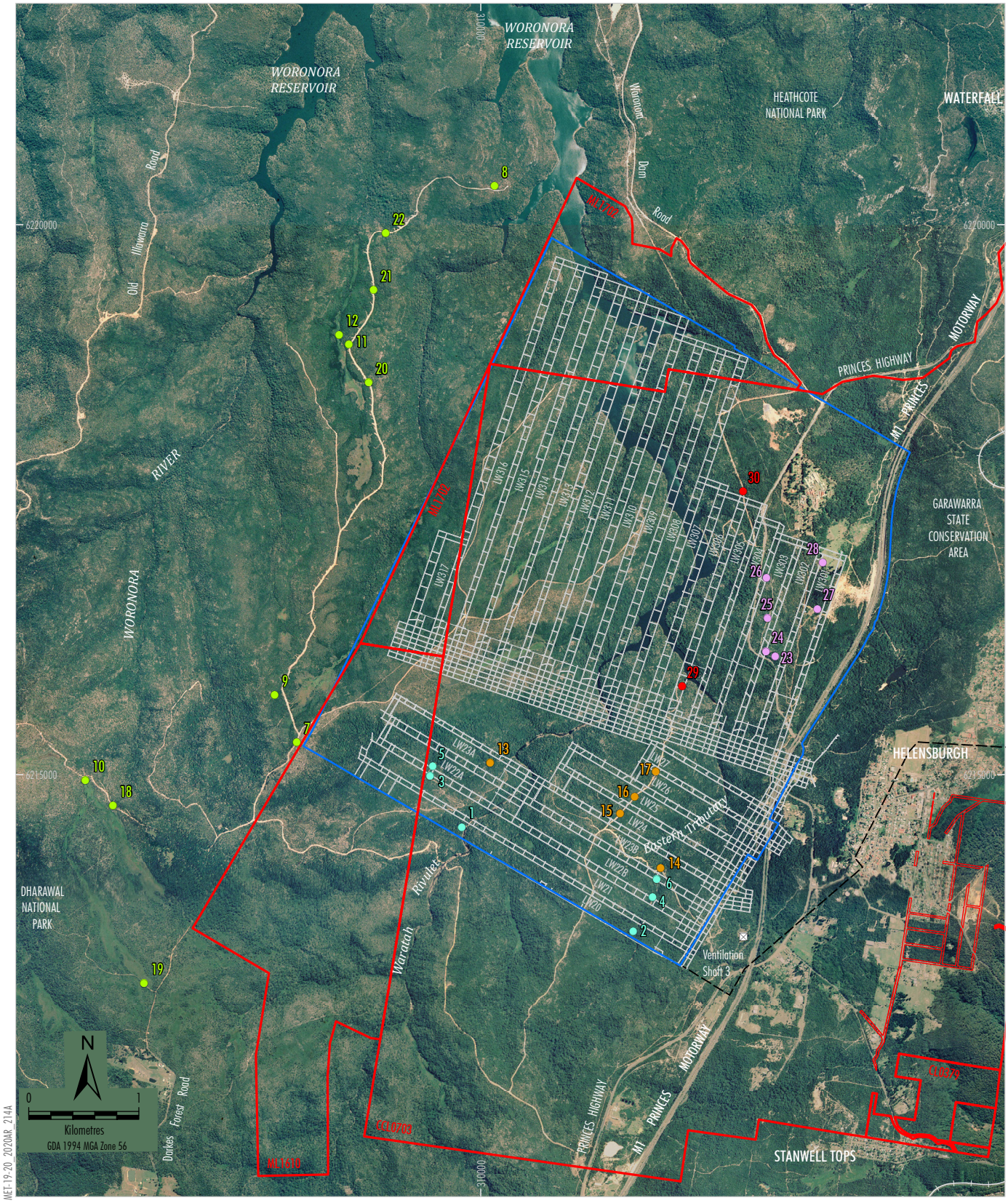
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Aquatic Ecology Monitoring Locations

Figure 14



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)

Monitoring Sites

- Longwalls 20-22 Amphibian Monitoring
- Longwalls 23-27 Amphibian Monitoring
- Longwalls 301-303 Amphibian Monitoring
- Longwalls 305-307 Amphibian Monitoring
- Control Site

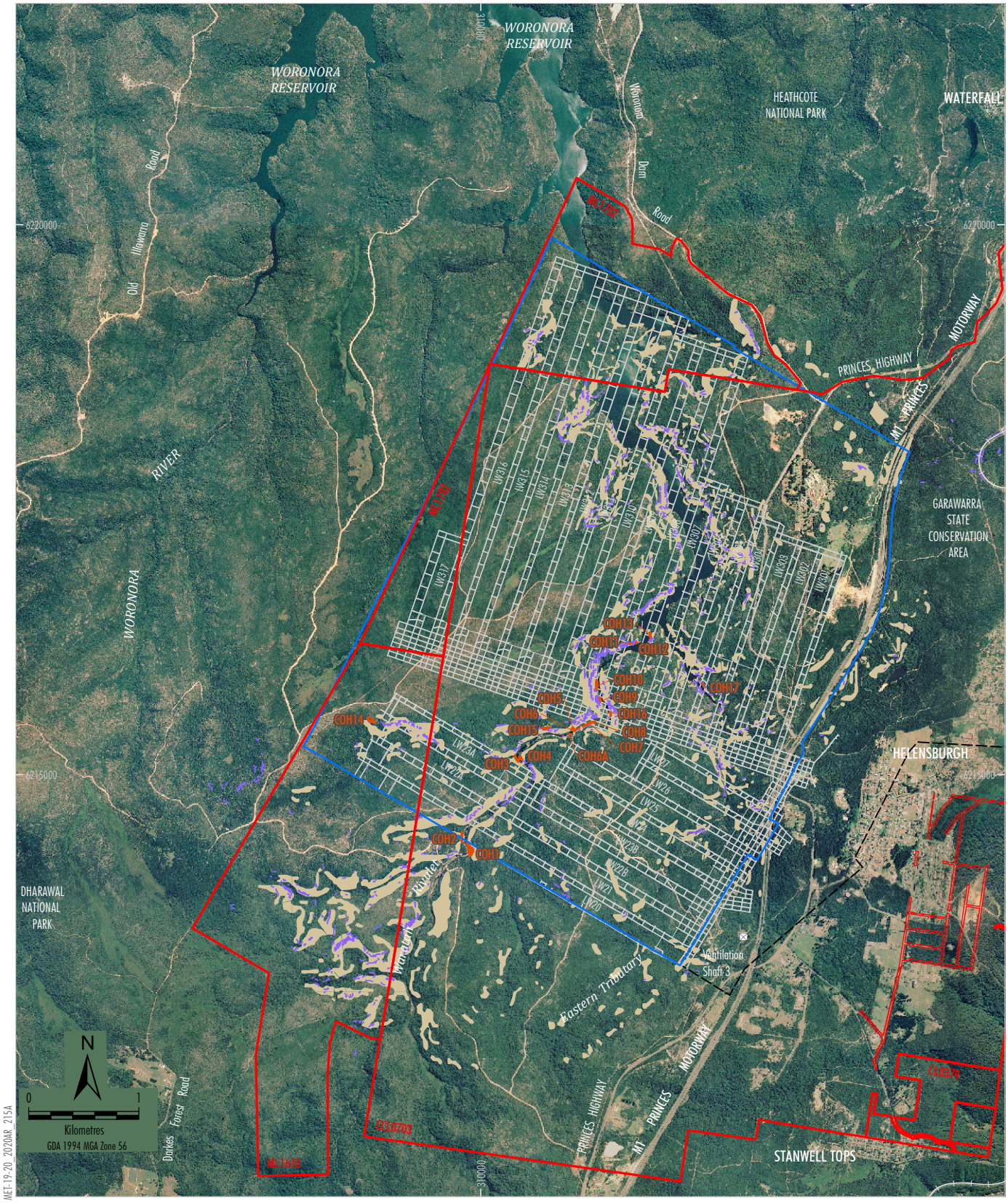
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020)

Peabody

METROPOLITAN COAL

Amphibian Monitoring Locations

Figure 15



MEI-19-20_2020AR_215A

LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Cliffs and Overhangs
- Steep Slopes (Project Approval)
- Steep Slopes (Project Environmental Assessment)

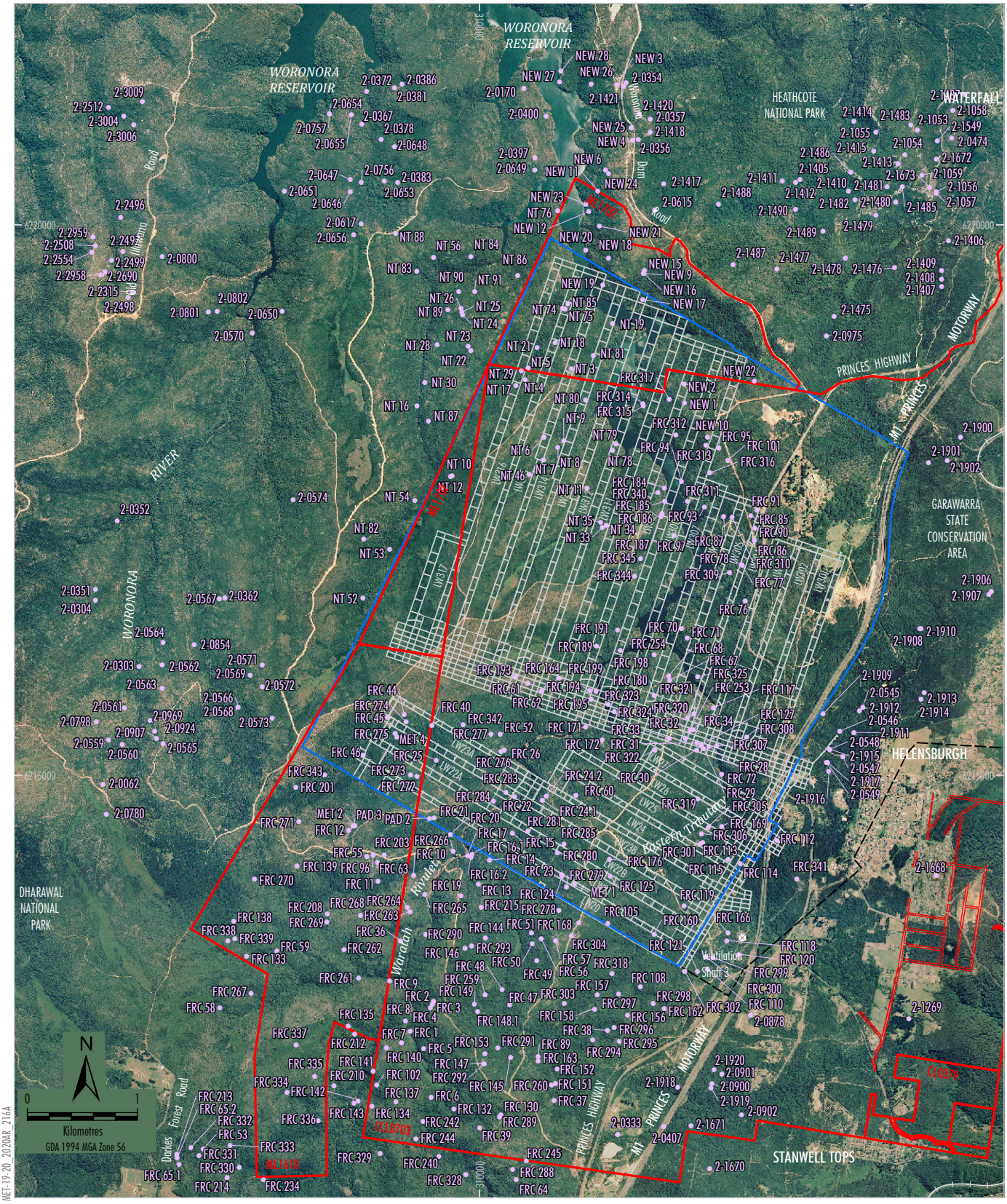
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020); MSEC (2008; 2019)

Peabody

METROPOLITAN COAL

Cliffs and Overhangs, Steep Slopes and Land in General within the Project Underground Mining Area and Surrounds

Figure 16



LEGEND

- Mining Lease Boundary
- Railway
- Project Underground Mining Area
  Longwalls 20-27 and 301-317
- Existing Underground Access Drive (Main Drift)
- Aboriginal Heritage Site

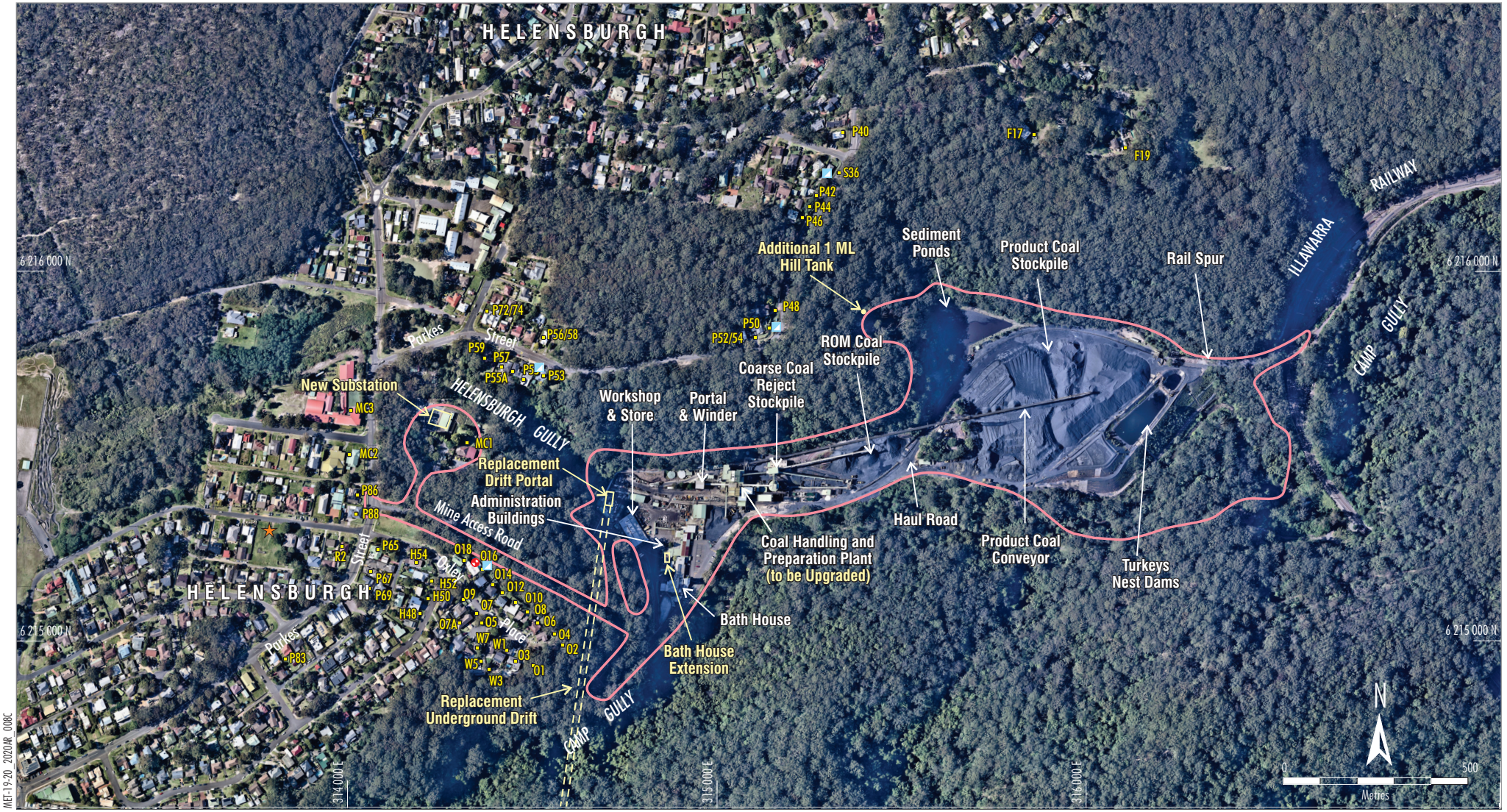
Source: Land and Property Information (2015); Date of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2020) Illawarra Prehistory Group (2007; 2008); AHIMS (2007); Kayandel Archaeological Services (2006; 2007; 2008); Niche Environment and Heritage (2013)

Peabody
METROPOLITAN COAL

Known Aboriginal Heritage Sites Within Project Underground Mining Area and Surrounds

Figure 17

MEI-19-20_2020AR_216A



MET-19-20_2020AR_008C

LEGEND

- P40 Receiver Location
- Approximate Extent of Major Surface Facilities Area
- Real-time Noise Monitoring Site
- Attended Noise Monitoring Site
- Automatic Weather Station

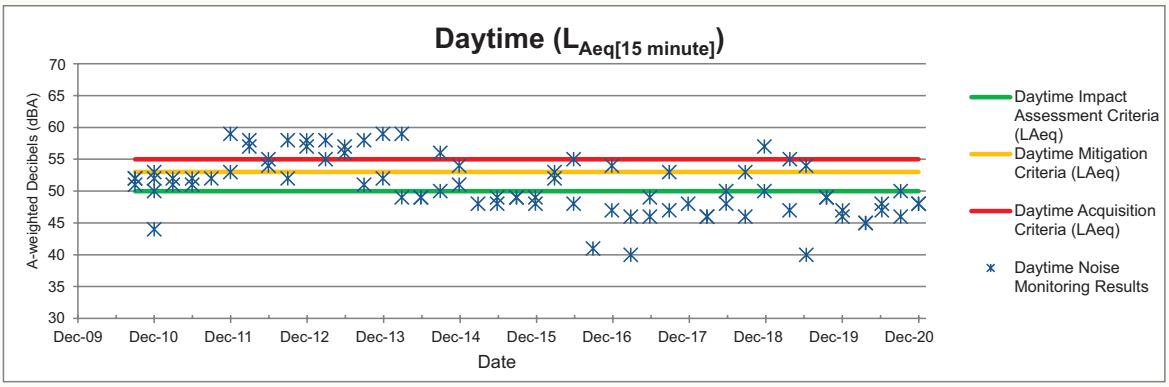
Peabody

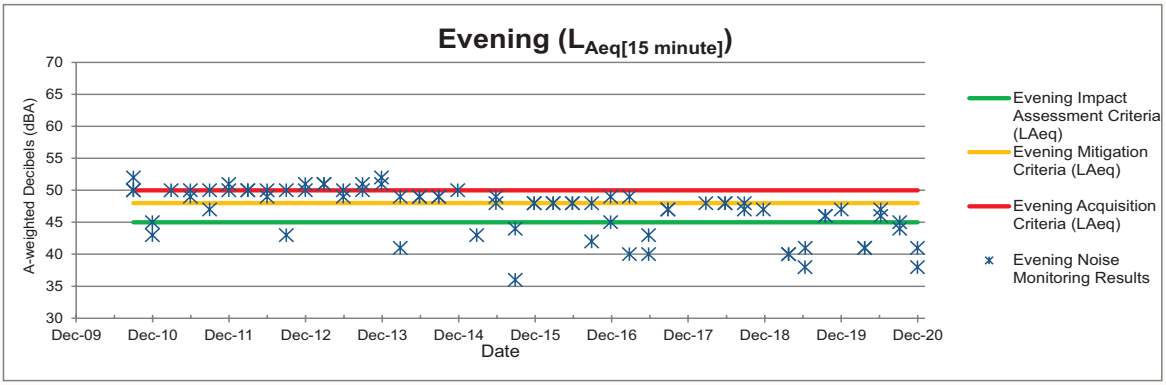
METROPOLITAN COAL

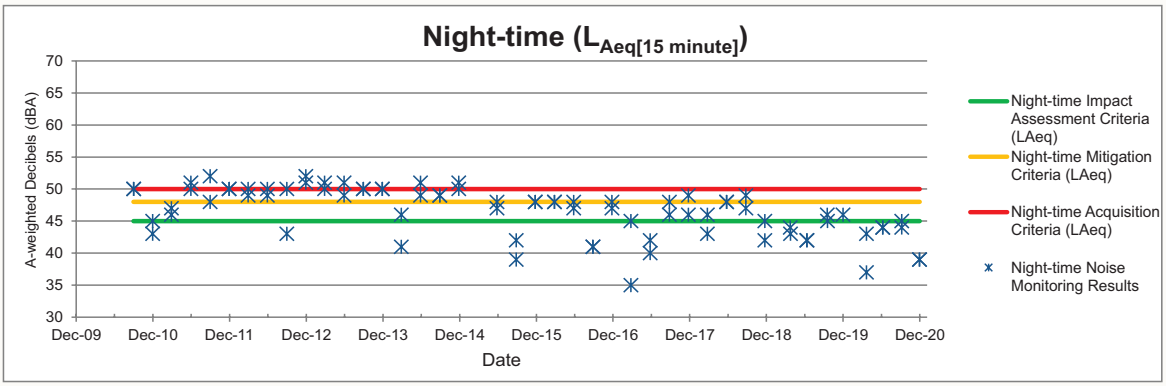
Noise Monitoring Locations

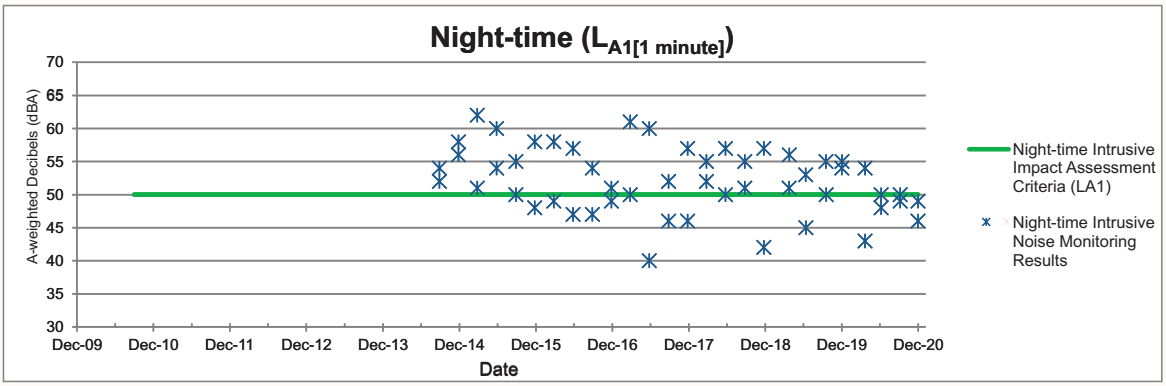
Source: Aerial Photography 2005

Figure 18









MET-19-20_2020AR_004A

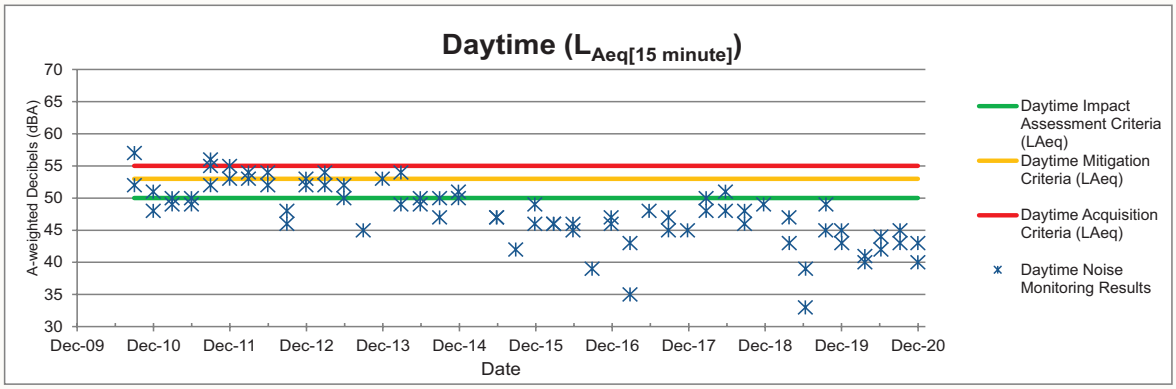
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

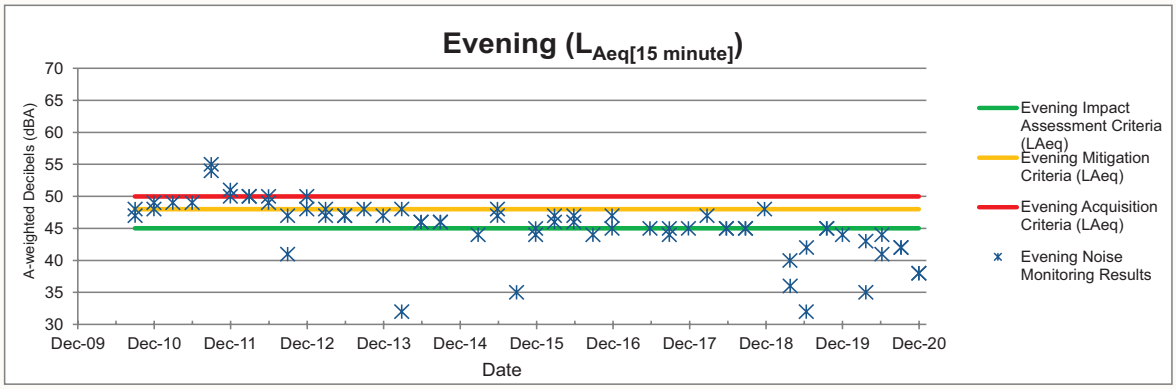
Peabody

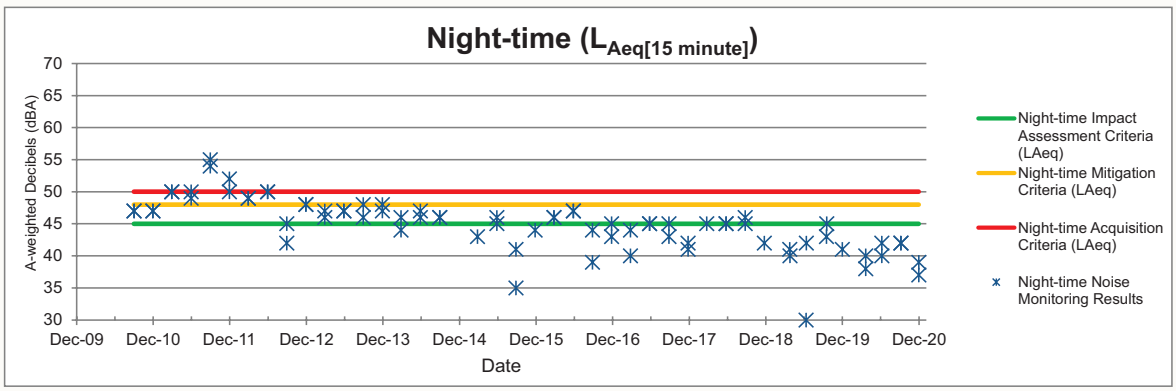
METROPOLITAN COAL

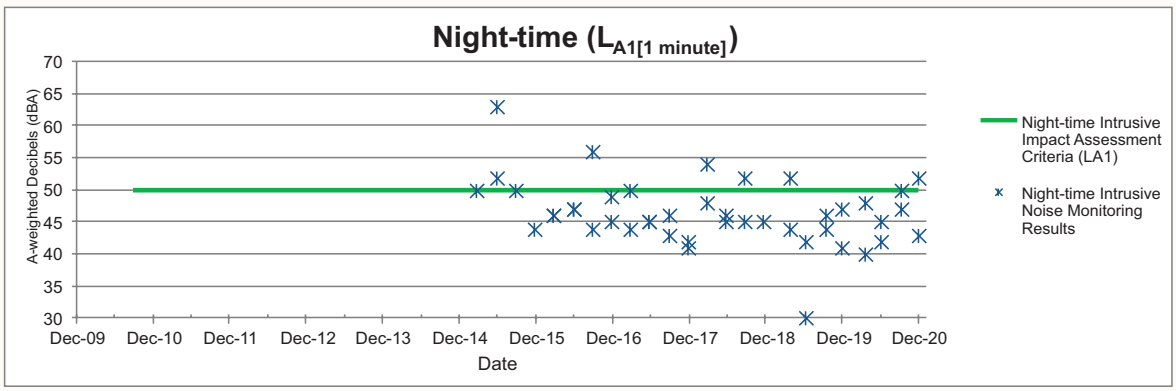
Quarterly Operator Attended Noise Monitoring Results at 16 Oxley Place (September 2010 to December 2020)

Figure 19a









MET-19-20_2020AR_005A

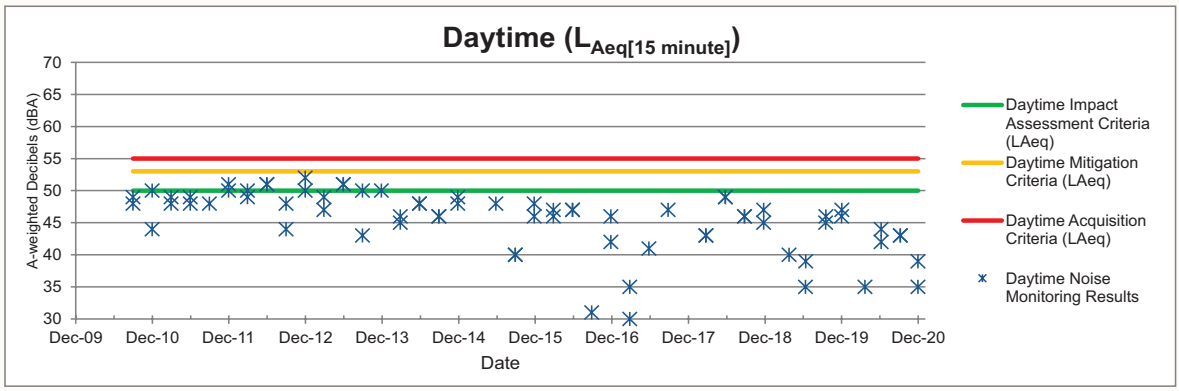
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

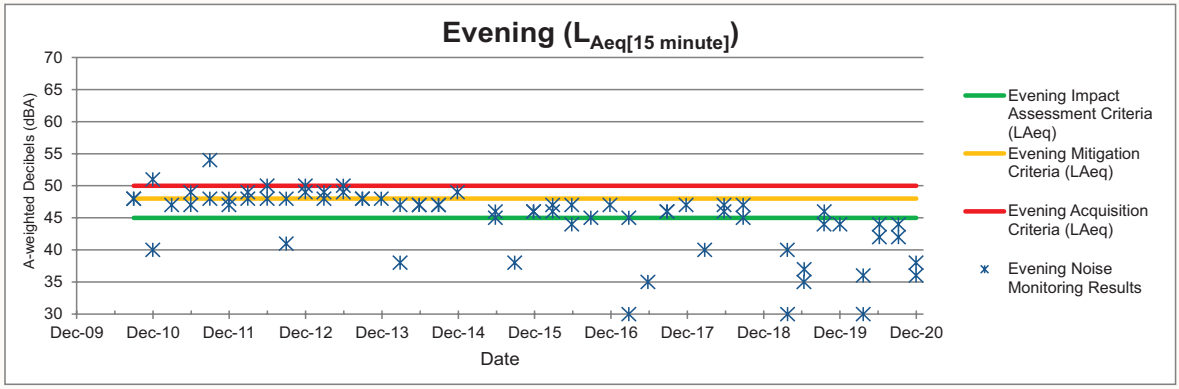
Peabody

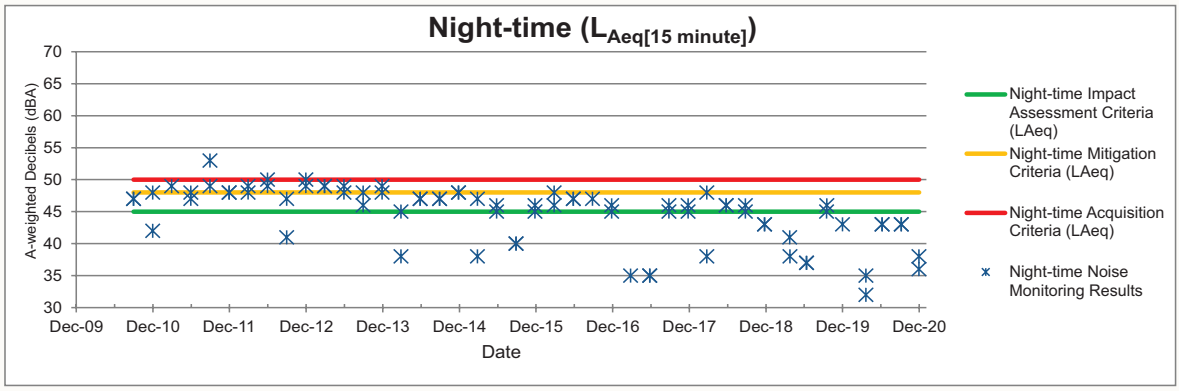
METROPOLITAN COAL

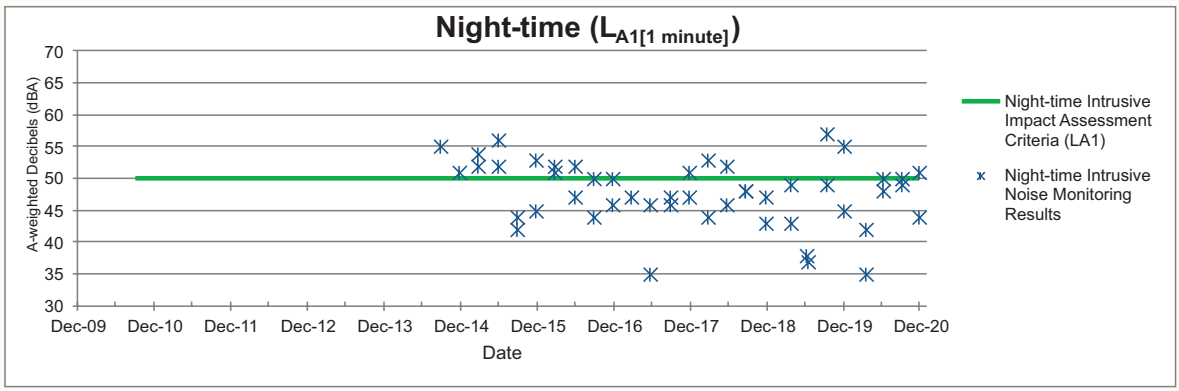
Quarterly Operator Attended Noise Monitoring Results at 53 Parkes Street (September 2010 to December 2020)

Figure 19b









MET-19-20_2020AR_006A

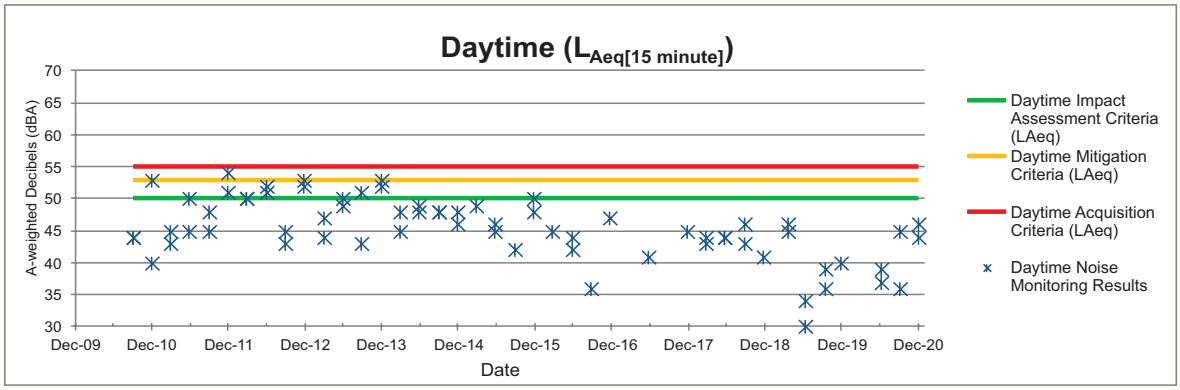
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

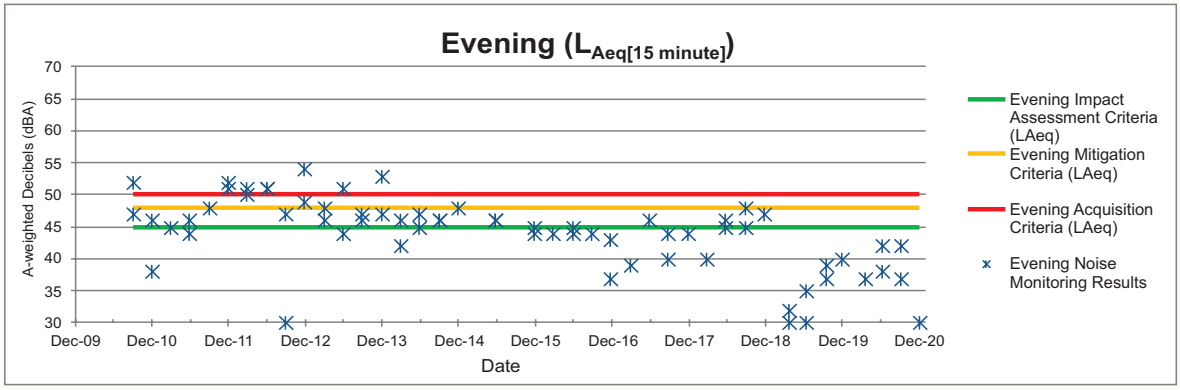
Peabody

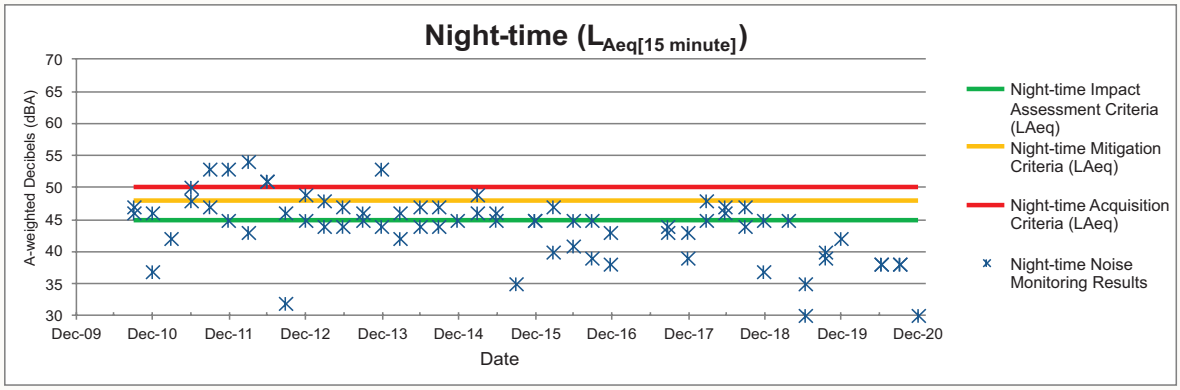
METROPOLITAN COAL

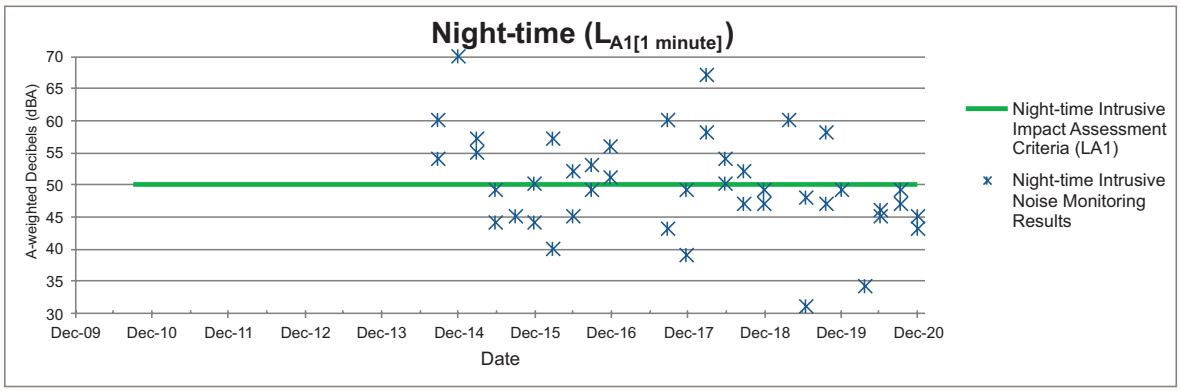
Quarterly Operator Attended Noise Monitoring Results at 50 Parkes Street (September 2010 to December 2019)

Figure 19c









MET-19-20_2020AR_007A

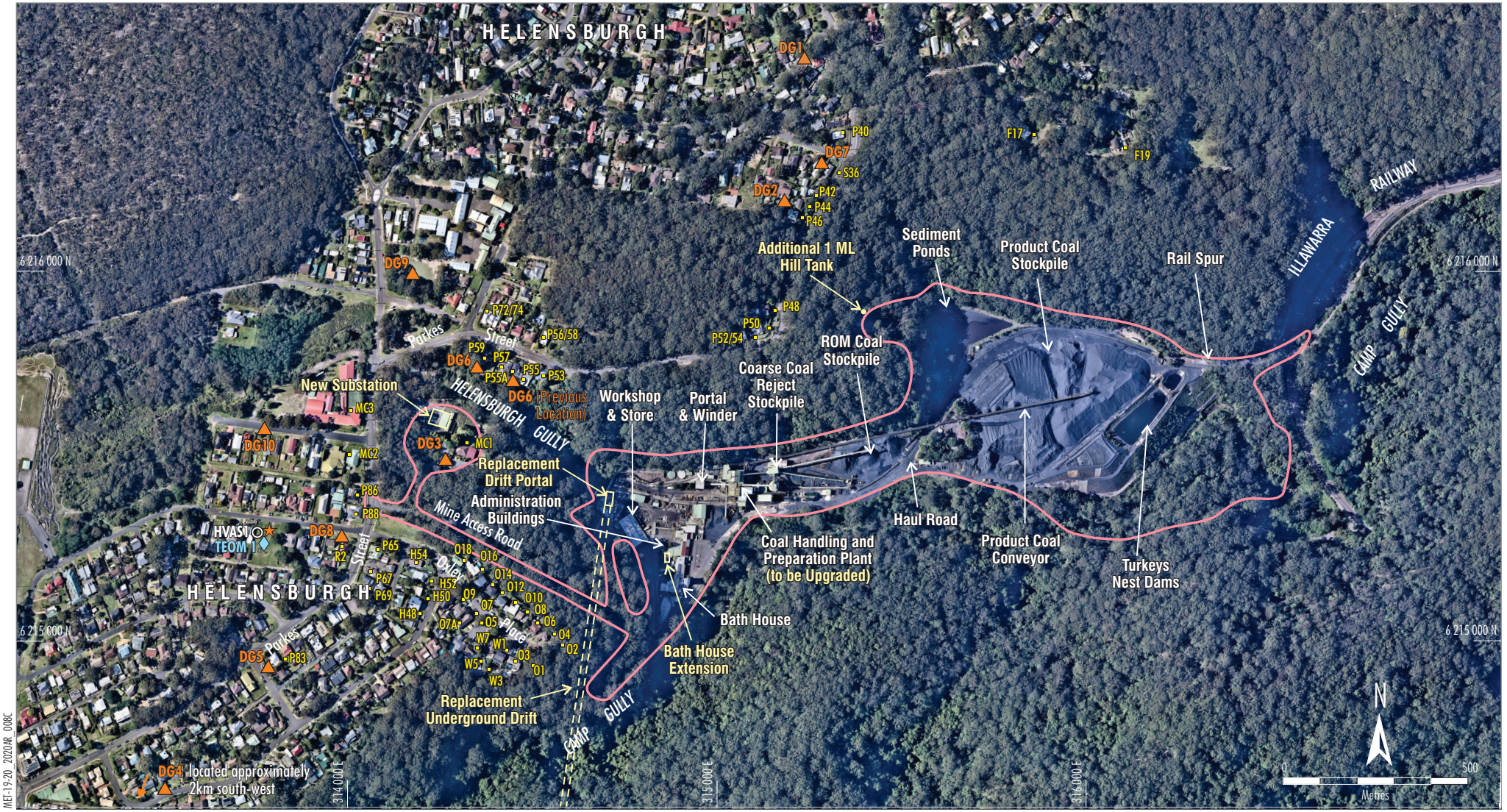
Note: In accordance with Conditions 1, 2 and 3, Schedule 4 of the Project Approval, the assessment, acquisition and mitigation criteria are only applicable from the end of 2014

Peabody

METROPOLITAN COAL

Quarterly Operator Attended Noise Monitoring Results at 36 Old Station Road (September 2010 to December 2020)

Figure 19d



MET-19-20_2020AR_008C

LEGEND

- Approximate Extent of Major Surface Facilities Area
- P40 Receiver Location
- EPA Licenced Dust Deposition Gauge
- Automatic Weather Station
- High Volume Air Sampler
- TEOM Real Time Dust Monitor

Peabody

METROPOLITAN COAL

Air Quality Monitoring Sites

Source: Aerial Photography 2005

Figure 20

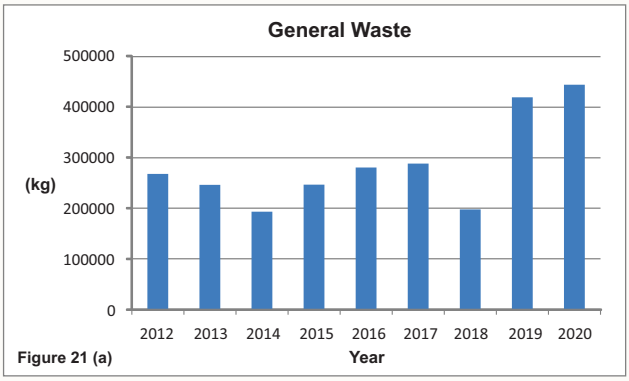


Figure 21 (a)

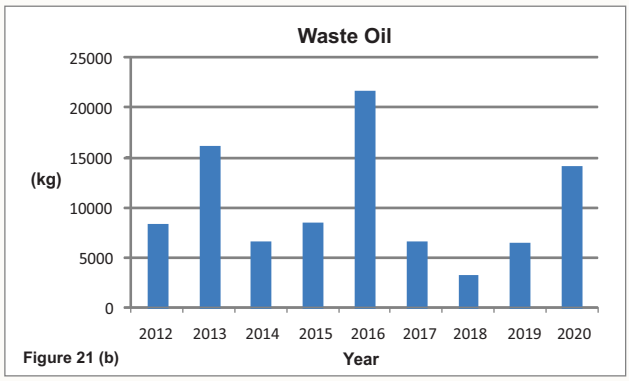


Figure 21 (b)

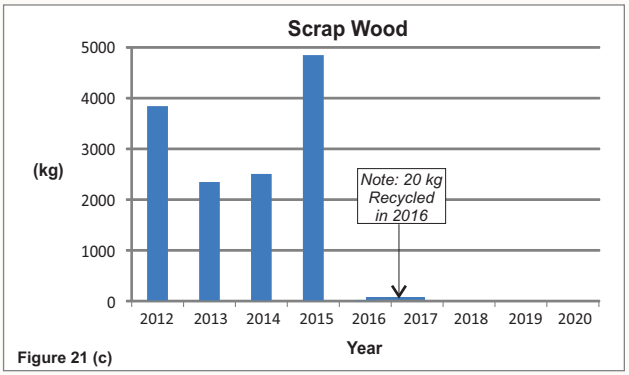


Figure 21 (c)

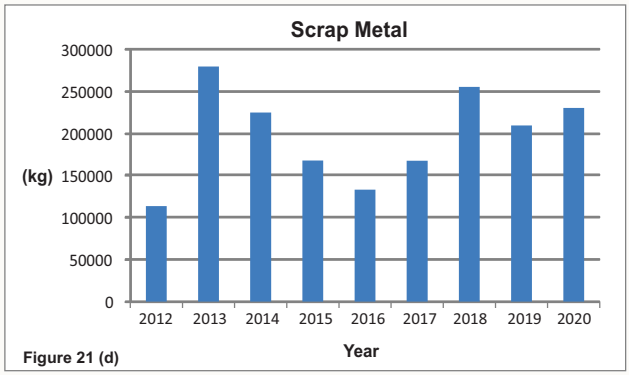


Figure 21 (d)

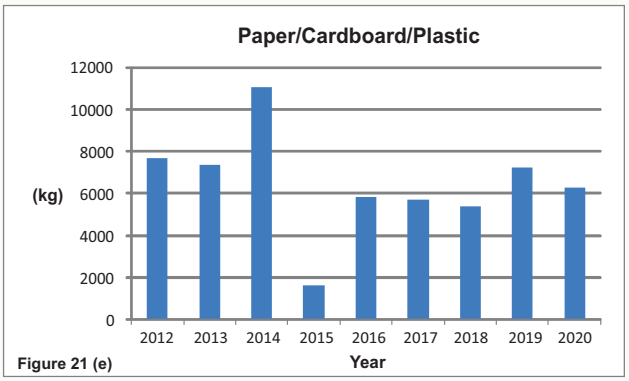


Figure 21 (e)

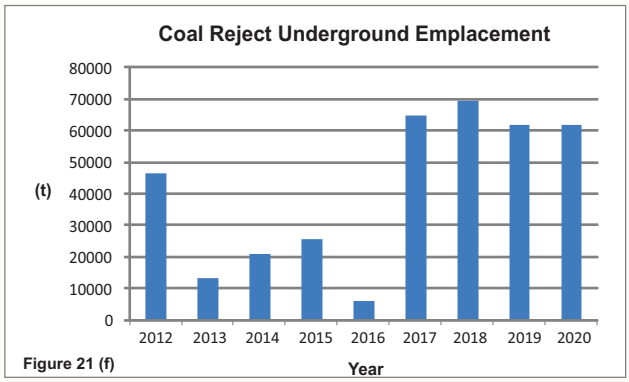


Figure 21 (f)

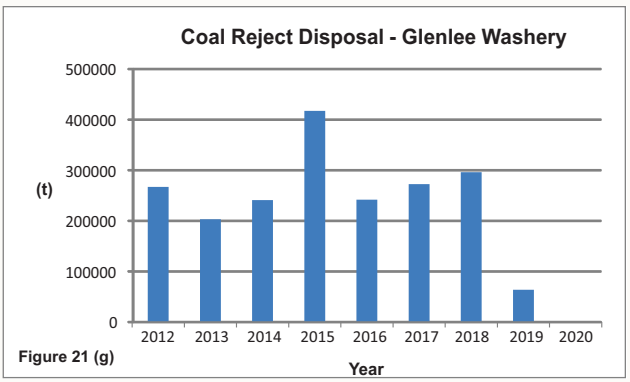


Figure 21 (g)

MET-19-20_2020AR_009A

Peabody

METROPOLITAN COAL

Comparison of Waste Generated and Recycled in 2020 with Previous Years

Figure 21

MET-19-20_2020AR_010B

LEGEND

- Water Pipeline
- Camp Gully Water Extraction Pipeline
- Licensed Discharge Point
- Water Quality Monitoring
- Volume Monitoring

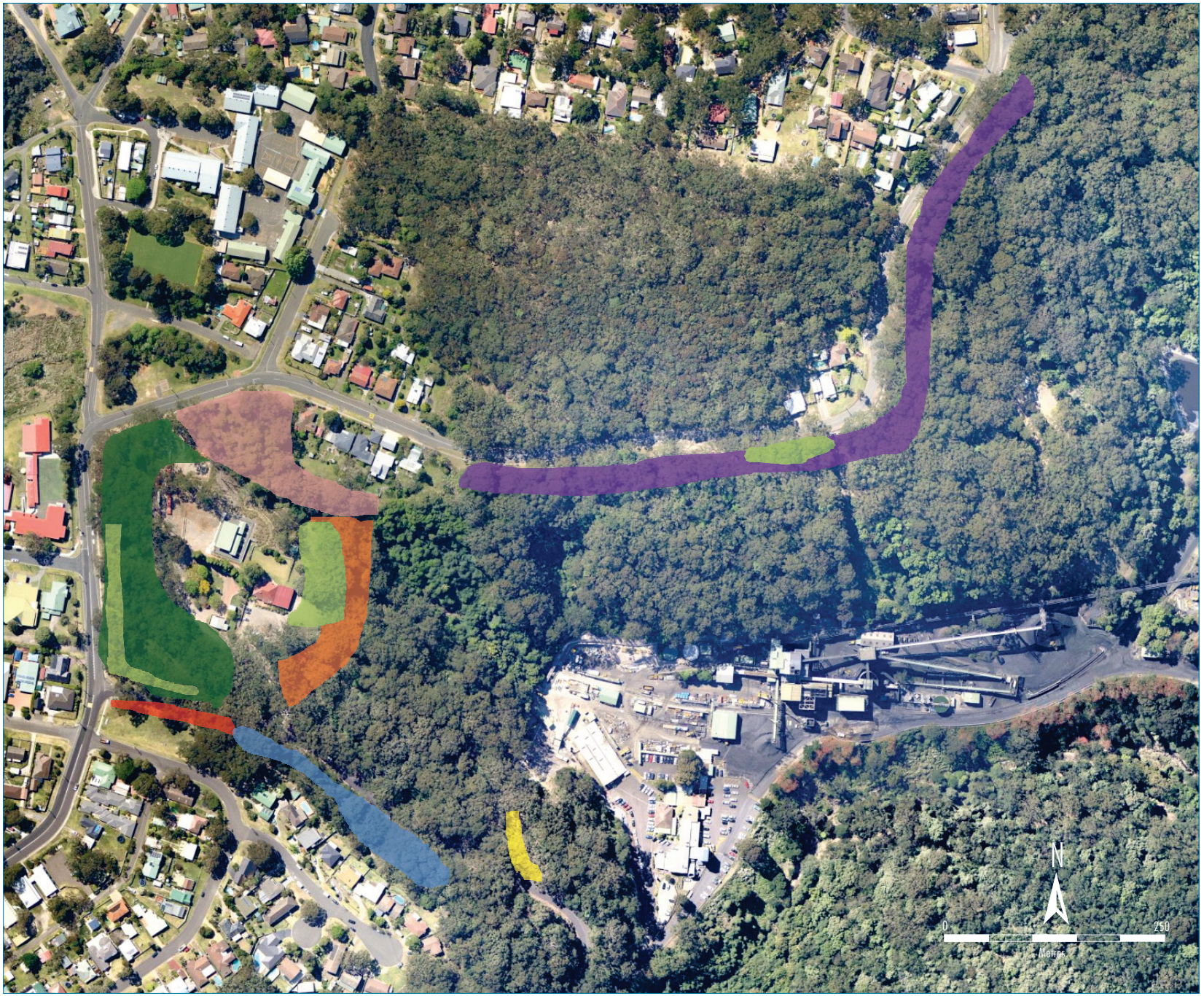
Note: Site D is located approximately 2.3 km upstream of Site A

Source: Metropolitan Coal (2014) Date of Aerial Photography October 2014

Peabody
METROPOLITAN COAL

Surface Facilities Area
Water Monitoring Sites

Figure 22



Peabody

METROPOLITAN COAL

Rehabilitation Zones Currently Available at the Surface Facilities Area

Figure 23

MET-19-20_2020AR_011A

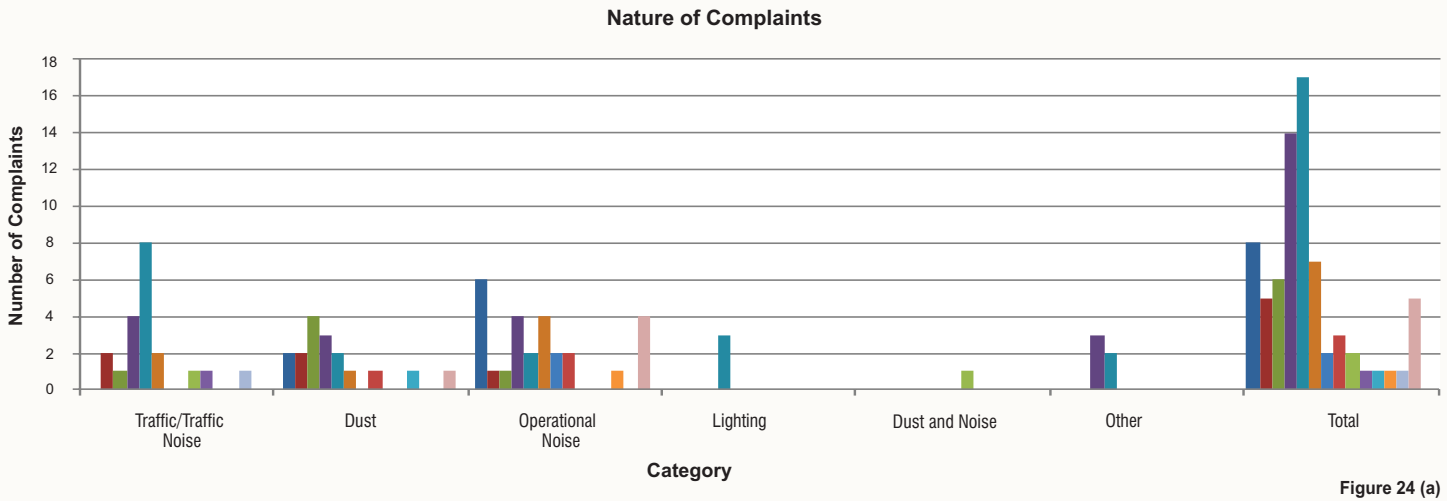


Figure 24 (a)

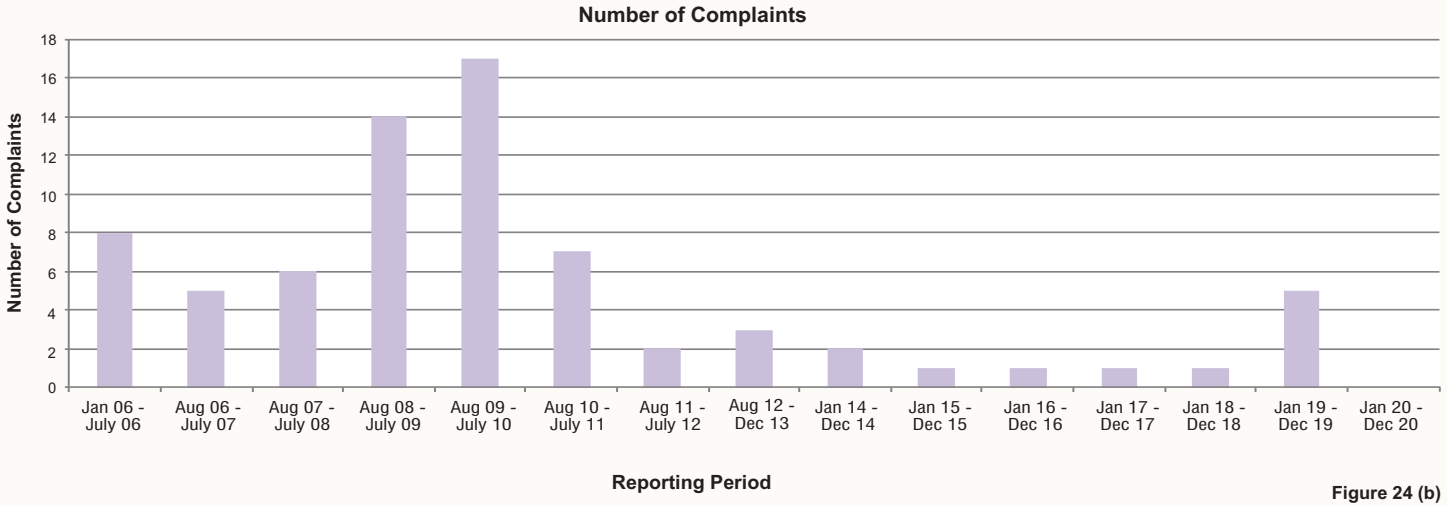


Figure 24 (b)

Note: No complaints in 2020

IMET-19-20_2020AR_012B

Peabody

METROPOLITAN COAL

Summary of Complaints Recorded,
January 2006 to December 2020

Figure 24

APPENDICES

APPENDICES A TO N ARE AVAILABLE ON USB (AS LISTED BELOW):

Appendix A	2020 Annual Review Subsidence Monitoring Results
Appendix B1	Surface Water Review 1 January to 30 June 2020
Appendix B2	Surface Water Review 1 January to 31 December 2020
Appendix C1	Groundwater Review 1 January to 30 June 2020
Appendix C2	Groundwater Review 1 July to 31 December 2020
Appendix D	Mapped Pool Locations on The Waratah Rivulet, Eastern Tributary, Tributary A and Tributary B
Appendix E	Assessments Against Performance Measure for Gas Releases at Pools P and U – January to December 2020
Appendix F	Assessments Against Water Quality Performance Measure for Dissolved Manganese – January to December 2020
Appendix G	Groundwater Investigation Report for Bores T3 to T5
Appendix H1	Longwalls 20-22 Spring 2019 Vegetation Monitoring Report
Appendix H2	Longwalls 20-22 Autumn 2020 Vegetation Monitoring Report
Appendix H3	Longwalls 23-27 Spring 2019 Vegetation Monitoring Report
Appendix H4	Longwalls 23-27 Autumn 2020 Vegetation Monitoring Report
Appendix H5	Longwalls 301-303 Spring 2019 Vegetation Monitoring Report
Appendix H6	Longwalls 301-304 Autumn 2020 Vegetation Monitoring Report
Appendix I1	Swamp 20 and Swamp 28 Threatened Flora Assessment
Appendix I2	Eastern Tributary Threatened Flora Assessment
Appendix I3	Swamp 20, Swamp 28 and Eastern Tributary Threatened Fauna Assessment
Appendix J1	Longwalls 20-22 Spring 2019 Aquatic Ecology Monitoring Report
Appendix J2	Longwalls 23-27 Spring 2019 Aquatic Ecology Monitoring Report
Appendix J3	Longwalls 20-27 Autumn 2020 Aquatic Ecology Monitoring Report
Appendix K1	Longwalls 20-22 Spring-Summer 2019 Amphibian Survey Report
Appendix K2	Longwalls 23-27 Spring-Summer 2019 Amphibian Survey Report
Appendix K3	Longwalls 301-307 Spring-Summer 2019 Amphibian Survey Report
Appendix L	2020 Quarterly Attended Noise Monitoring Results
Appendix M	2020 Quarterly Noise Modelling Predictions
Appendix N	Air Quality Monitoring and Environmental Performance Assessment Report