



REPORT

Metropolitan Coal Surface Water Review 1 January to 31 December 2020

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1.0 INTRODUCTION AND BACKGROUND

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). The Metropolitan Coal Project (the Project) comprises the continuation, upgrade and extension of underground coal mining operations and surface facilities at Metropolitan Coal. The current underground mining longwall layout is shown on Figure 1.

This report documents a review undertaken by Hydro Engineering & Consulting Pty Ltd (HEC) of the environmental performance of the Project in relation to surface water (water resources and watercourses) in the Metropolitan Coal underground mining area and surrounds for the reporting period (1 January to 31 December 2020), consistent with the Metropolitan Coal Longwall 304 Water Management Plan (2019), Metropolitan Coal Longwalls 305-307 Water Management Plan¹ (2020) and Metropolitan Coal Catchment Monitoring Program (2014). During the review period, the Longwall 304 Water Management Plan applied from 1 January 2020 to 11 April 2020 (inclusive) and the Longwalls 305-307 Water Management Plan applied from 12 April 2020 to 31 December 2020 (inclusive).

2.0 CATCHMENT MONITORING AND SURFACE WATER MODELLING

2.1 BACKGROUND

The Metropolitan Coal Catchment Monitoring Program, Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan include a program to monitor and assess impacts on surface water resources and watercourses. The meteorological sites, surface water quantity sites (i.e. streamflow gauging stations and pool water level monitoring) and surface water quality sites at which baseline data is available for the Metropolitan Coal underground mining area are shown on Figure 1 to Figure 3, respectively.

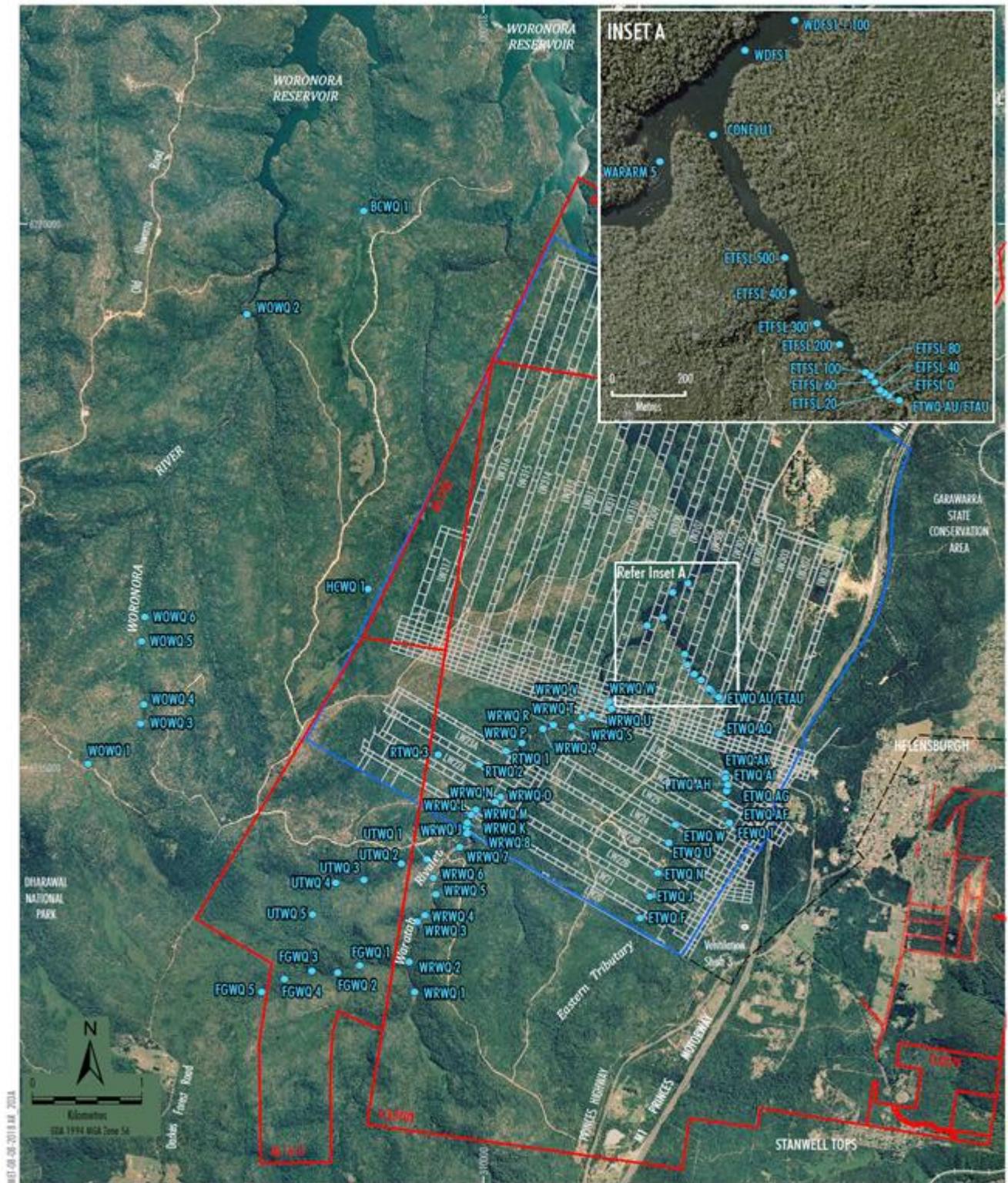
The Metropolitan Coal Catchment Monitoring Program also includes a program for the development, calibration and verification of catchment flow models.

2.2 STREAMFLOW

Surface water flow monitoring is conducted at the following sites:

- the WaterNSW gauging station on the Waratah Rivulet, close to the inundation limits of the Woronora Reservoir (GS 2132102);
- the WaterNSW gauging station on the Woronora River (GS 2132101), close to the inundation limits of the Woronora Reservoir (control site);
- the WaterNSW gauging station on O'Hares Creek at Wedderburn (GS 213200) (control site);
- the Metropolitan Coal gauging station on the Eastern Tributary (GS 300078) close to the inundation limits of the Woronora Reservoir;

¹ The Metropolitan Coal Longwalls 305-307 Water Management Plan includes post-mining monitoring and management of water resources and watercourses for Longwalls 20-27, 301-303 and 304.



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- 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); Data of Aerial Photography 1998; Department of Industry (2015); Metropolitan Coal (2019); MSEC (2019)

Peabody
METROPOLITAN COAL
Surface Water Quality Sites

Figure 3 Surface Water Quality Sites

- the Metropolitan Coal gauging station on Honeysuckle Creek (GS 300077) - control site;
- the Sub-Catchment I gauging station on a tributary to the east of the Woronora Reservoir (GS 300092); and
- the Sub-Catchment K gauging station on a tributary to the east of the Woronora Reservoir (GS 300093).

Flow records from the Waratah Rivulet (GS 2132102) and O'Hares Creek at Wedderburn (GS 213200) gauging stations were regenerated using amended rating relationships developed by Gilbert & Associates (2015a) on behalf of Metropolitan Coal (as described in HEC, 2016).

Numerical catchment models for the Waratah Rivulet and O'Hares Creek catchments have been developed based on the nationally recognised Australian Water Balance Model (AWBM) (Boughton, 2004). The AWBM is a catchment-scale water balance model that estimates streamflow from rainfall and evaporation. Revised and re-calibrated catchment models (Gilbert & Associates, 2015b) have been used to assess potential subsidence impacts on the quantity of water resources reaching the Woronora Reservoir (as described in HEC, 2016).

2.3 POOL WATER LEVELS

Water levels in a number of pools on the Waratah Rivulet (Pools A, B, C, E, F, G, G1, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V and W), Eastern Tributary (Pools ETG, ETJ, ETM, ETU, ETW, ETAF, ETAG, ETAH, ETAI/ETAJ/ETAK², ETAL, ETAM, ETAN, ETAO, ETAP, ETAQ, ETAR, ETAS/ETAT³ and ETAU), Tributary B/Reference Tributary (Pools RTP1 and RTP2) and Woronora River (Pools WRP1, WRP2, WRP3 and WRP4) have been either manually monitored on a daily basis or monitored using a continuous water level sensor and logger. Recorded pool water level hydrographs are provided as a series of charts in Appendix A.

Pool water levels are controlled by different forms of natural controls with different hydraulic characteristics. Conceptually these can be grouped into the following three types:

1. An 'effectively impermeable' rock-bar control with limited continuous jointing and fracturing resulting in negligible flow either through or under the rock-bar;
2. A 'permeable' rock-bar control where the presence of fractures and open joints in the rock-bar permits significant flow through or under the rock-bar; and
3. A boulder-field which constricts downstream flow but where a significant flow occurs through the interstices between the boulder rock elements (i.e. braided flow).

A description of the water level behaviour for each pool during the 1 January to 31 December 2020 review period is provided in Table 1.

In summary, all pools on Waratah Rivulet remained above the cease to flow level or historical minimum except for Pool A, Pool B and Pool N. 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 in January 2020 (refer Chart A47 to Chart A50, Appendix A). Water level records for control pools WRP1, WRP2,

² 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.

³ Due to the nature of rock bar ETAS, Pool ETAS and Pool ETAT typically record the same water level.

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.

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. Following a significant rainfall event in February 2020, the water level in all pools rose substantially. The water level of pool ETM fell below the sensor for a short period in late October 2020. The water level of pool ETAH fell below the sensor from late September to late October 2020. Pool ETAI/ETAJ/ETAK and Pool ETAL water levels rose intermittently with rainfall events during the review period and subsequently declined to the level of the sensor. The water level of 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. The water level of 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.

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 and remaining elevated for the remainder of the review period.

Table 1 Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
<i>Monitored Pools on Waratah Rivulet</i>			
A	Effectively impermeable rock bar. (Pool A impacted by previous mine subsidence and subject to previous stream remediation activities)	The water level of Pool A was below the cease to flow level from 1 January to 18 January and again from 28 January to 7 February. The water level rose substantially above the cease to flow level following a significant rainfall event in early February. Thereafter, the water level remained consistently above the cease to flow level with water level rise occurring in response to subsequent rainfall events (Chart A1 [manual observations] and Chart A2 [logger data] in Appendix A). The reduced water level at Pool A prior to 7 February 2020 is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool A was not flowing from 1 January to 18 January and from 28 January to 7 February. On 7 February, and on all subsequent inspection occasions, the pool was observed to be flowing.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
B	Effectively impermeable rock bar. (Pool B impacted by previous mine subsidence)	Water level records for Pool B indicate that the pool ceased to flow from 1 January to 16 January (Chart A3 in Appendix A [manual observations]). From 17 January to 30 June, the water level records indicate that the pool was flowing continuously. The reduced water level at Pool B prior to 17 January is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool B ceased to flow from 1 January to 16 January 2020. Thereafter, the pool was observed to be flowing on all subsequent inspection occasions.
C	Effectively impermeable rock bar. (Pool C impacted by previous mine subsidence)	Pool C water level records were consistent with natural behaviour, with data indicating that the pool continued to flow for the duration of the review period (Chart A4 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool C was overflowing the rock bar on all inspection occasions.
E	Effectively impermeable rock bar. (Pool E impacted by previous mine subsidence)	Water level records for Pool E were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A5 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
F	Effectively impermeable rock bar. (Pool F impacted by previous mine subsidence and subject to previous stream remediation activities)	Water level records for Pool F were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A6 [manual observations] and Chart A7 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool F was overflowing the rock bar on all inspection occasions.
G	Effectively impermeable rock bar. (Pool G impacted by previous mine subsidence and subject to previous stream remediation activities)	Water level records for Pool G were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A8 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool G was overflowing the rock bar on all inspection occasions.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
G1	Effectively impermeable rock bar. (Pool G1 impacted by previous mine subsidence)	Water level records for Pool G1 were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A9 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool G1 was overflowing the rock bar on all inspection occasions.
H	Effectively impermeable rock bar.	Water level records for Pool H were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A10 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool H was overflowing the rock bar on all inspection occasions.
I	Effectively impermeable rock bar.	Water level records for Pool I were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A11 in Appendix A [manual observations]).	Metropolitan Coal's visual inspections indicate that Pool I was overflowing the rock bar on all inspection occasions.
J	Effectively impermeable rock bar.	Pool water level records (stage levels from GS 300017) indicate that the pool continued to flow for the duration of the review period and were consistent with natural behaviour (Chart A12 in Appendix A [stage levels from the Metropolitan Coal gauging station]).	Metropolitan Coal's visual inspections indicate Pool J was overflowing the rock bar on all inspection occasions.
K	Effectively impermeable rock bar.	Pool K water level records were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A13 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool K was overflowing the rock bar on all inspection occasions.
L	Effectively impermeable rock bar.	Pool L water level records were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A14 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool L was overflowing the rock bar on all inspection occasions.
M	Effectively impermeable rock bar.	Pool M water level records were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A15 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool M was overflowing the rock bar on all inspection occasions.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
N	Effectively impermeable rock bar. (Pool N impacted by mine subsidence; first ceased to overflow the rock bar in September 2012)	The recorded water level of Pool N was below the cease to flow level from 1 January to 16 January and again on 5 February. The water level rose substantially above the cease to flow level following a significant rainfall event in February. Thereafter, the water level remained consistently above the cease to flow level with small rises and falls occurring in response to subsequent rainfall events (Chart A16 in Appendix A [logger data]). The reduced water level at Pool N prior to 6 February is consistent with a reduction in water level recorded at control pools WRP1, WRP2, WRP3 and WRP4 on the Woronora River during the same periods (Chart A47 to Chart A50 [logger data] in Appendix A).	Metropolitan Coal's visual inspections indicate that Pool N ceased to flow from 1 January to 16 January and again on 5 February. The pool was observed to be flowing on all other inspection occasions.
O	Boulder field.	Pool O recorded water levels were consistent with natural behaviour for the duration of the review period (Chart A17 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
P	Permeable rock bar.	The recorded water level of Pool P was near the historically low recorded water level from 1 January to 7 February. The water level rose following a significant rainfall event in early February and remained elevated until early March 2020. The water level records were consistent with historical conditions for the remainder of the review period (Chart A18 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool P water levels appeared consistent with natural behaviour on all inspection occasions.
Q	Effectively impermeable rock bar.	Pool Q recorded water levels were consistent with natural behaviour and indicate that the pool continued to flow for the duration of the review period (Chart A19 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate Pool Q water levels appeared consistent with natural behaviour on all inspection occasions.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
R	Effectively impermeable rock bar.	Recorded pool water levels were above the cease to flow level and consistent with natural behaviour for the duration of the review period (Chart A20 in Appendix A [logger data]) ¹ .	Metropolitan Coal's visual inspections support the analysis of pool water level data.
S	Effectively impermeable rock bar.	Recorded pool water levels were at or above the cease to flow level and consistent with natural behaviour for the duration of the review period (Chart A21 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
T	Permeable rock bar.	The recorded water level of Pool T was near the historically low recorded water level in early January although the level rose on 7 January following a rainfall event. Following a significant rainfall event in early February the water level rose substantially and remained above the historically low recorded water level for the remainder of the review period. Three periods of anomalous data are evident during the review period, with apparent rapid and transient declines in water level occurring during periods of substantial rainfall. The anomalous data is due to errors in recorded water level which occur during periods of high rainfall ² (Chart A22 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

¹ The water level sensor malfunctioned between 1 June 2020 and 4 June 2020. As such, no data was recorded during this period.

² During periods of high rainfall the logger stand creates an eddy which reduces pressure and causes low level pressure readings to be recorded.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
U	Boulder field.	The Pool U recorded water level was slightly above the previously recorded minimum water level at the start of January. Between 7 January and 18 February 2020, no water level data were recorded ³ . Following the significant rainfall event in February, the water level rose substantially above the previously recorded minimum and remained elevated for the duration of the review period (Chart A23 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
V	Permeable rock bar.	The Pool V recorded water level was near the historically low recorded water level from 1 January to 7 February. The water level rose following a significant rainfall event in early February 2020 and remained above the historically low recorded water level until late August 2020. The water level sensor lost pressure from late August 2020 until early October 2020 and has since been replaced (Chart A24 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
W	Boulder field (underlain by a rock bar).	The Pool W recorded water level was near the historically low recorded water level from 1 January to 7 February although the level rose following a significant rainfall event in early February. Thereafter, the water level rose and fell intermittently in response to subsequent smaller rainfall events (Chart A25 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

³ The water level sensor malfunctioned between 7 January 2020 and 18 February 2020. As such, no data was recorded during this period.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
<i>Monitored Pools on Eastern Tributary</i>			
ETG	Effectively impermeable rock bar. (Pool ETG impacted by previous mine subsidence)	The recorded pool water level was at the cease to flow level from 1 January to 7 February although the level rose substantially following a significant rainfall event in early February. Thereafter, the water level rose and fell intermittently in response to subsequent smaller rainfall events, returning to the cease to flow level during low rainfall periods (Chart A26 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETJ	Effectively impermeable rock bar. (Pool ETJ impacted by previous mine subsidence)	The recorded water level was below the pool sensor level from 1 January to 20 January and from 31 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A27 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETJ was dry on 6 January, above the sensor level on 21 January and flowing on all other inspection occasions.
ETM	Permeable rock bar. (Pool ETM impacted by previous mine subsidence)	The recorded water level was below the pool sensor level from 1 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period except for a short period in late October 2020 where the water level declined to just above the sensor level (Chart A28 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETM was dry on 6 January and 21 January and flowing on all other inspection occasions.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
ETU	Boulder field. (Pool ETU impacted by previous mine subsidence)	The recorded water level at Pool ETU was below the sensor level from 1 January to 21 January. The water level rose above the sensor level in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the sensor level and continued to rise and fell intermittently in response to subsequent smaller rainfall events ⁴ (Chart A29 in Appendix A [logger data]).	Metropolitan Coal’s visual inspections indicate that Pool ETU was dry on 6 January although the water level was above the sensor level on all other inspection occasions.
ETW	Effectively impermeable rock bar. (Pool ETW impacted by previous mine subsidence)	The recorded water level at Pool ETW declined in early to mid-January although the level rose in mid to late-January in response to a rainfall event. The water level rose substantially in response to a significant rainfall event in early February. Thereafter, the water level continued to rise and fell intermittently in response to subsequent smaller rainfall events (Chart A30 in Appendix A [logger data]).	Metropolitan Coal’s visual inspections support the analysis of pool water level data.
ETAF	Permeable rock bar before boulder field. (Pool ETAF impacted by previous mine subsidence)	The recorded water level was below the sensor level from 1 January to 17 January. The water level rose above the sensor level in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the sensor level and continued to rise and fell intermittently in response to subsequent smaller rainfall events. The water level sensor failed in late August 2020 and was replaced in late September 2020 (Chart A31 in Appendix A [logger data]).	Metropolitan Coal’s visual inspections indicate that Pool ETAF was dry on 6 January although the water level was above the sensor level on all other inspection occasions.

⁴ Due to a failure during data download, data was lost from 5 June 2020 until the end of the review period.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
ETAG	Boulder field. (Pool ETAG impacted by previous mine subsidence)	The recorded water level was below the pool sensor level from 1 January to 17 January and from 24 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated for the duration of the review period (Chart A32 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAG was dry on 6 January although the water level was above the sensor level on all other inspection occasions.
ETAH	Permeable rock bar. (Pool ETAH impacted by previous mine subsidence).	The recorded water level was below the pool sensor level for the majority of January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated until late September. The water level fell below the pool sensor level from late September to late October before rising again in response to a rainfall event. For the remainder of the review period, the water level was above the sensor level (Chart A33 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAH was dry on 6 January although the water level was above the sensor level on all other inspection occasions.
ETAI/ ETAJ/ ETAK	Effectively impermeable rock bar. (Pool ETAI/ETAJ/ETAK impacted by previous mine subsidence).	The recorded water level was below the pool sensor level for the majority of January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained above the sensor level until March. For the remainder of the review period, the water level rose and fell intermittently in response to rainfall events and declined intermittently to the level of the sensor (Chart A34 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAI was dry in for parts of January and September 2020.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
ETAL	Boulder field/alluvial deposit. (Pool ETAL impacted by previous mine subsidence).	The recorded water level was below the pool sensor level for the majority of January to 7 February. The water level rose in response to a significant rainfall event in early February and remained above the sensor level until March. For the remainder of the review period, the water level rose and fell intermittently in response to rainfall events and declined intermittently to the level of the sensor (Chart A35 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAL was dry for parts of January, July, September, November and December 2020.
ETAM	Boulder field/ alluvial deposit. (Pool ETAM impacted by previous mine subsidence).	The recorded water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated until late September. Following this period, the water level was below the pool sensor level except from late October to late November and for a short period in late December 2020 (Chart A36 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAM was dry for parts of January, September, November and December 2020.
ETAN	Permeable rock bar. (Pool ETAN impacted by previous mine subsidence).	The recorded water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated until late September. Following this period, the water level was below the pool sensor level except from late October to late November and for a short period in late December 2020 (Chart A37 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAN was dry for parts of January, September, November and December 2020.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
ETAO	Permeable rock bar. (Pool ETAO impacted by previous mine subsidence).	The recorded water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated until late September. Following this period, the water level was below the pool sensor level except from late October to late November and for a short period in late December 2020 (Chart A38 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAO was dry for parts of January, September, November and December 2020.
ETAP	Boulder field. (Pool ETAP impacted by previous mine subsidence).	The recorded water level was below the pool sensor level from 1 to 17 January, 19 to 20 January and from 23 January to 7 February. The water level rose substantially in response to a significant rainfall event in early February and remained elevated until late September. Following this period, the water level was below the pool sensor level except from late October to late November and for a short period in late December 2020 (Chart A39 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAO was dry for parts of January, November and December 2020.
ETAQ	Effectively impermeable rock bar. (Pool ETAQ impacted by previous mine subsidence).	The Pool ETAQ recorded water level was below the cease to flow level from 1 to 17 January and from 31 January to 7 February 2020. The water level rose in response to a significant rainfall event in early February and remained above the cease except between 4 and 25 October 2020 (Chart A40 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAQ was dry on 6 January.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
ETAR	Permeable rock bar. (Pool ETAR impacted by previous mine subsidence).	The recorded water level was below the sensor level from 1 January to 17 January. The water level rose in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained predominately elevated for the remainder of the review period (Chart A41 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool ETAQ was dry on 6 January.
ETAS/ ETAT	Effectively impermeable rock bar.	The recorded I water level was near the historically low recorded water level from 1 to 17 January. The water level rose in response to a rainfall event in January before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained above the historically low recorded water level, rising in response to subsequent smaller rainfall events (Chart A42 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.
ETAU	Pool ETAU flows through Eastern Tributary gauging station, then over a rock bar and waterfall.	Pool ETAU recorded water levels were consistent with natural behaviour during the review period (Chart A43 in Appendix A [stage data] and Chart A44 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

Table 1 (Cont.) Summary of Pool Water Level Monitoring Results

Pool	Natural Control Characteristics	Recorded Water Level During 1 Jan to 31 Dec 2020	Comments
<i>Monitored Pools on Reference Tributary/Tributary B</i>			
RTP1	Effectively impermeable rock bar. (Pool RTP1 previously impacted by mine subsidence).	Records indicate that Pool RTP1 is typically dry with overflow events limited to significant rainfall periods. The recorded water level of Pool RTP1 was below the sensor level for the majority of the review period except following rainfall events in February, March, July, August and November. The pool was dry from 2 December 2020 and, as such, water level records were not recorded for the majority of December 2020 (Chart A45 in Appendix A [logger data]).	Metropolitan Coal's visual inspections indicate that Pool RTP1 was dry on all inspection occasions.
RTP2	Effectively impermeable rock bar.	Records indicate that the water level of Pool RTP2 on Tributary B regularly falls to low levels except during and following rainfall events. The recorded water level was low from 1 to 17 January. From 18 January the water level rose in response to a rainfall event before rising substantially in response to a significant rainfall event in early February. Thereafter, the water level remained elevated for the remainder of the review period (Chart A46 in Appendix A [logger data]).	Metropolitan Coal's visual inspections support the analysis of pool water level data.

2.4 STREAM WATER QUALITY

Surface water quality monitoring and sampling has been conducted at the following sites – refer Figure 3:

- sites WRWQ 2, WRWQ 6, WRWQ 8, WRWQ 9, WRWQ M, WRWQ N, WRWQ P, WRWQ R, WRWQ T and WRWQ W on the Waratah Rivulet;
- site RTWQ 1 on Tributary B;
- site UTWQ 1 on Tributary D;
- sites ETWQ F, ETWQ J, ETWQ N, ETWQ U, ETWQ W, ETWQ AF, ETWQ AH, ETWQ AQ and ETWQ AU on the Eastern Tributary;
- site FEWQ 1 on the Far Eastern Tributary;
- site HCWQ 1 on Honeysuckle Creek;
- site BCWQ 1 on Bee Creek; and
- control sites WOWQ 1 and WOWQ 2 on the Woronora River.

Water quality parameters recorded include electrical conductivity (EC), pH, redox potential (Eh), dissolved oxygen (DO), turbidity, calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), sulphate (SO₄), bicarbonate (HCO₃), total nitrogen (N_{tot}), total phosphorus (P_{tot}), nitrate (NO₃), barium (Ba), strontium (Sr), manganese (Mn), iron (Fe), zinc (Zn), cobalt (Co) and aluminium (Al). Samples collected for metals analysis have been field filtered. Unfiltered water quality samples were also collected at a select number of sites on the Waratah Rivulet, Eastern Tributary and Woronora River and analysed for total iron.

Key monitoring results for the sites listed above are shown on a series of charts in Appendix B.

2.4.1 Waratah Rivulet

Water quality patterns at monitoring sites over the 1 January to 31 December 2020 review period have generally been consistent with historical water quality data. Upstream sites on Waratah Rivulet (sites WRWQ 2 and WRWQ 6) recorded slightly acidic to neutral pH values, with higher (slightly alkaline) values being recorded at middle and lower reach sites (e.g. at sites WRWQ 8, WRWQ T and WRWQ W). The pH values at sites WRWQ 8 and WRWQ T have shown a generally increasing trend since mid-2016. The pH values at sites WRWQ W have shown a generally increasing trend since mid-2017. Compared to historical data, high pH values (field) were recorded at WRWQ 8 (8.96) and WRWQ T (9.47) in January 2020 prior to a significant rainfall event in February. Following the significant rainfall event, the pH values recorded at these sites returned to within the range of historical values.

Electrical conductivity values were notably lower than those recorded in 2018/2019 although were consistent with pre-2018 values. There were no historically high electrical conductivity values (laboratory) recorded during the review period.

Dissolved iron concentrations were typically below 0.4 mg/L during the reporting period with the exception of WRWQ 2 and WRWQ M for which concentrations of 0.58 mg/L and 0.42 mg/L were recorded in January 2020 respectively. A historically high concentration of 0.09 mg/L dissolved aluminium was recorded at WRWQ P, WRWQ R and WRWQ T in February and a historically high concentration of 0.07 mg/L dissolved aluminium was recorded at WRWQ M and WRWQ N in March. 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). Dissolved manganese

concentrations at the upper, middle and lower reach sites on Waratah Rivulet were generally consistent with previously recorded levels except at WRWQ 2 where a historically high concentration of 0.41 mg/L dissolved manganese was recorded in January prior to the significant rainfall event in February.

2.4.2 *Woronora River*

The field pH levels recorded at sampling sites WOWQ 1 and WOWQ 2 during the review period indicated acidic to slightly acidic conditions. The pH levels recorded at both sites were lower than recent years (i.e. post-2015) but generally within the range of historical values, except at WOWQ 2 where a historically low value of pH 4.1 (field) was recorded in February 2020. The electrical conductivity values recorded at WOWQ 2 have increased in variability since 2016 and have tended to be more elevated, with the second highest field electrical conductivity value recorded at WOWQ2 in December (554 $\mu\text{S}/\text{cm}$). However, the electrical conductivity values recorded during the review period did not exceed previously recorded maximum values.

Dissolved iron concentrations were generally low and within the range of historical concentrations. Slightly elevated dissolved aluminium concentrations were recorded at WOWQ 1 although the concentrations were below the historical recorded maximum. Dissolved aluminium concentrations were notably elevated at WOWQ 1 and WOWQ 2 in the first half of 2020, with a historically high concentration level of 0.56 mg/L recorded at WOWQ 2 in February 2020. In the latter half of 2020, the dissolved aluminium concentrations declined to within the historical range. Dissolved manganese concentrations were consistent with historical values at WOWQ 1. Dissolved manganese concentrations recorded at WOWQ 2 were slightly elevated for the duration of the review period with a historically high concentration level of 0.226 mg/L recorded in March 2020.

2.4.3 *Eastern Tributary*

The pH values recorded during the review period for the Eastern Tributary indicate slightly acidic to neutral conditions and were consistent with historical values. The majority of the electrical conductivity values recorded in 2020 have returned to the lower concentrations recorded pre-2016 with the exception of values recorded at ETWQ AQ which are consistent with post-2016 historical values.

Variably elevated concentrations of dissolved iron have been recorded in the Eastern Tributary since mid-2016, with similar concentrations reported for the review period. ETWQ AQ in particular recorded elevated dissolved iron concentrations ranging from 0.009 mg/L to 9.35 mg/L, although the highest historically recorded values were not exceeded during the review period. A historically high concentration of 1.19 mg/L dissolved iron was recorded at ETWQ F in February 2020. For other sites in the Eastern Tributary, the highest historically recorded dissolved iron concentration was not exceeded during the review period.

Variable dissolved aluminium concentrations were recorded at all sites during the review period. A historically high concentration of dissolved aluminium was recorded at ETWQ U (0.18 mg/L) in February 2020, although at other sites the dissolved aluminium concentrations recorded during the review period did not exceed the previously recorded maximum.

Elevated concentrations of dissolved manganese have been recorded in the Eastern Tributary since mid-2016. During the review period the dissolved manganese concentrations recorded at most sites were less than 1 mg/L, with the exception of ETWQ AQ. At ETWQ AQ, a dissolved manganese 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 in the Eastern Tributary during the review period.

2.4.4 Bee Creek, Honeysuckle Creek, Far Eastern Creek and Tributaries B and D

During the monitoring period, the pH levels recorded at Bee Creek (BCWQ 1) and Honeysuckle Creek (HCWQ 1) indicated slightly acidic conditions, while pH levels in Far Eastern Tributary (FEWQ 1), Tributary B/Reference Tributary (RTWQ 1) and Tributary D/Un-named Tributary (UTWQ 1) were generally near neutral. The pH levels recorded during the monitoring period were consistent with historical values.

The electrical conductivity values recorded during the reporting period were consistent with historical values. Values recorded at RTWQ 1 have tended to be more elevated and variable relative to pre-2013 values, however this is less apparent during this reporting period.

Dissolved iron concentrations recorded during the review period were consistent with historical concentrations and there were no exceedances of the historical maximum values at any site. Dissolved aluminium concentrations rose at FEWQ 1, HCWQ 1 and BCWQ 1 following the significant rainfall event in February 2020 and remained relatively elevated at HCWQ 1 and BCWQ 1 for the remainder of the review period. A historically high concentration of dissolved aluminium was recorded at BCWQ 1 (1.35 mg/L) and HCWQ 1 (0.87 mg/L) in May 2020.

Dissolved manganese concentrations recorded during the review period were generally consistent with historical values. A spike in dissolved manganese of 0.75 mg/L was recorded at UTWQ 1 in January 2020 although this concentration did not exceed the historical maximum recorded at this site.

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 are presented in Chart 1 to Chart 3 below.

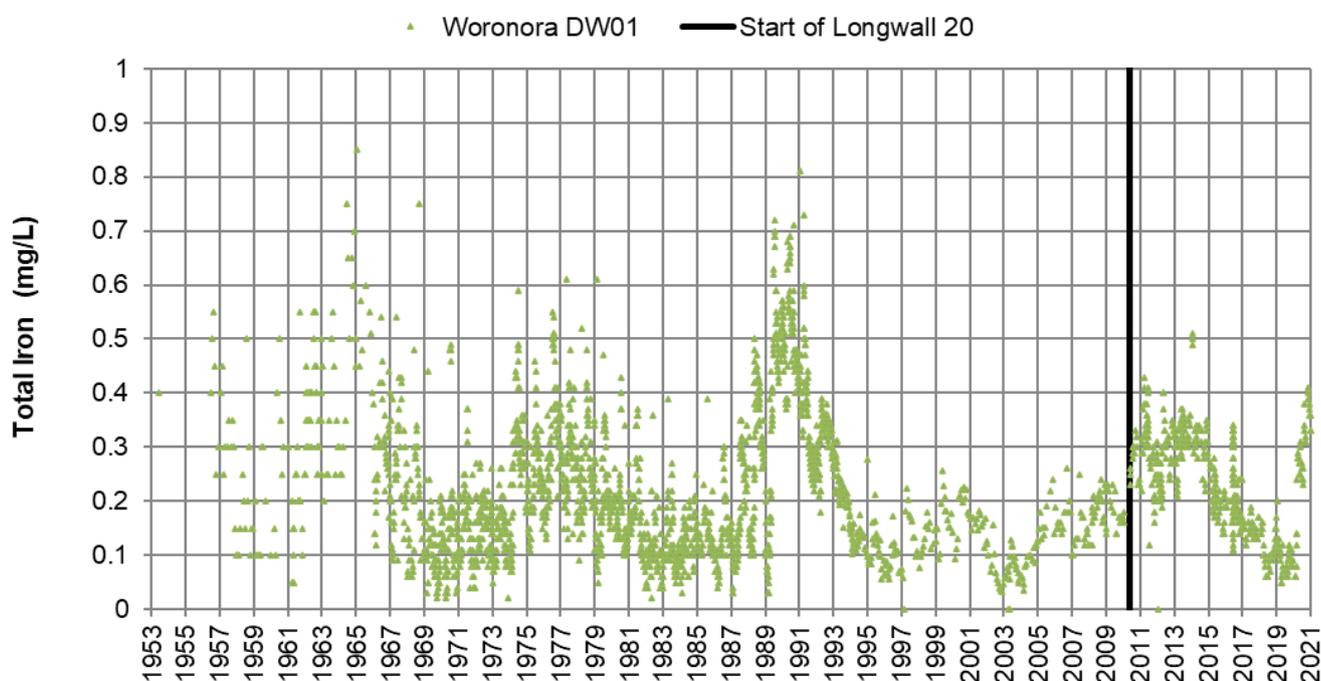


Chart 1 Total Iron Concentration Woronora Reservoir

The data presented in Chart 1 to Chart 3 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. Similar, 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. It is noteworthy that the previous period of elevated total aluminium concentrations (in mid-2016) followed a period of high rainfall.

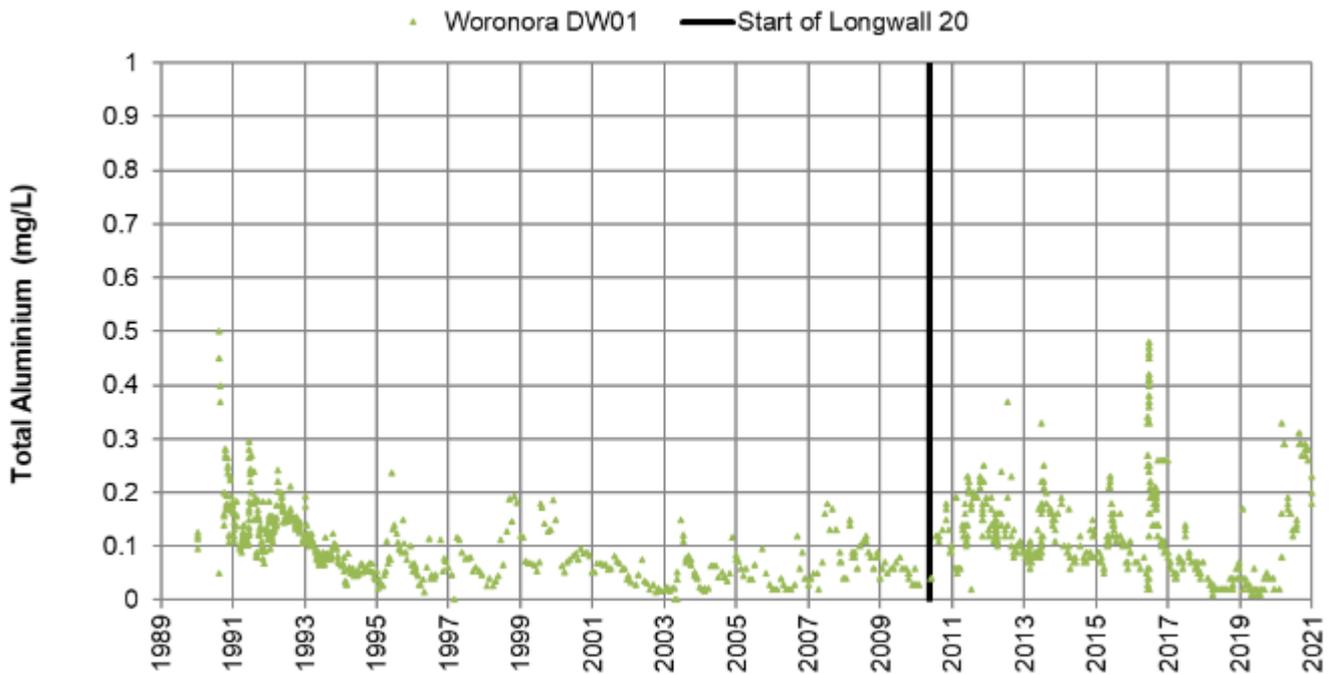


Chart 2 Total Aluminium Concentration Woronora Reservoir

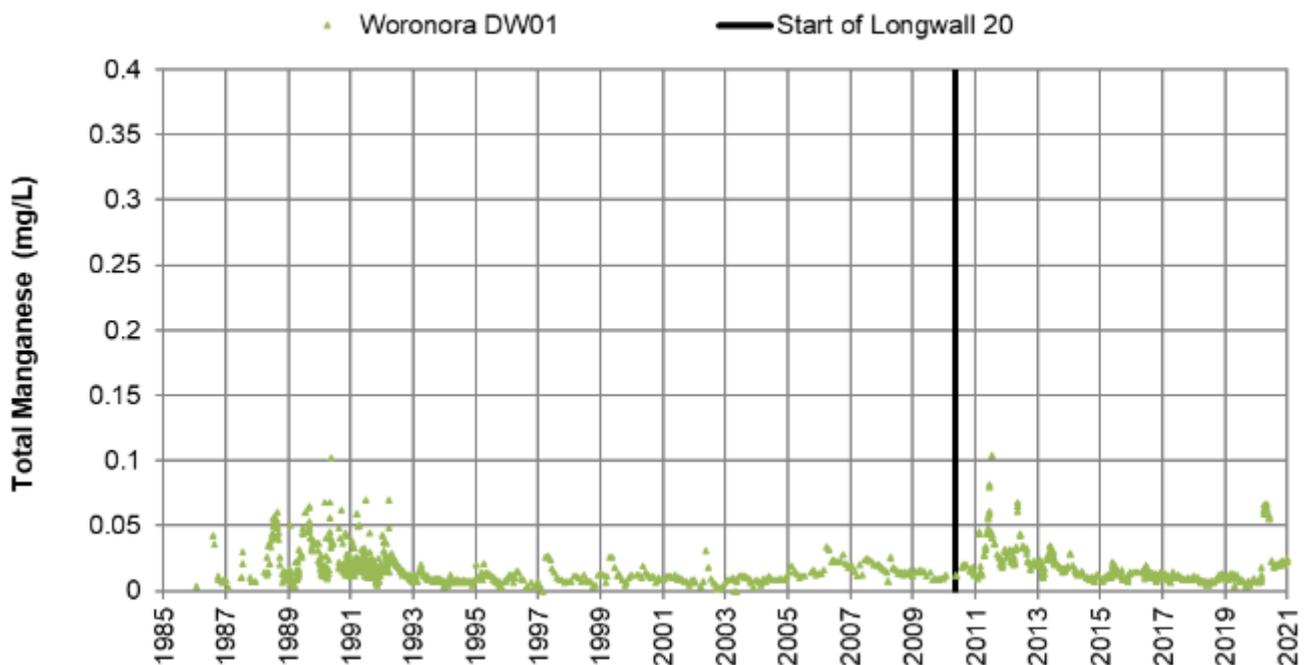


Chart 3 Total Manganese Concentration Woronora Reservoir

3.0 ASSESSMENT AGAINST SURFACE WATER SUBSIDENCE IMPACT PERFORMANCE INDICATORS AND MEASURES

The performance indicators and subsidence impact performance measures described below have been developed to address the predictions of subsidence impacts and environmental consequences on water resources and watercourses included in the Project Environmental Assessment (Helensburgh Coal, 2008), Preferred Project Report (PPR) (Helensburgh Coal, 2009) and Metropolitan Coal Extraction Plans (Metropolitan Coal, 2010; 2014; 2016; 2019a; 2020a).

3.1 QUANTITY OF WATER RESOURCES REACHING THE WORONORA RESERVOIR

Performance Indicator:

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).

3.1.1 Assessment of Flow Reaching Woronora Reservoir from Waratah Rivulet at GS 2132102

Streamflow data has been 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).

Measured flows versus modelled flows in Waratah Rivulet have been analysed using a catchment model (a modified version of the AWBM), specifically:

- monitored flows have been filtered in order to assess low flows (i.e. flows of 1 millimetre/day [mm/day] or less⁴) by setting monitored flows that are greater than 1 mm/day to equal modelled flows;
- the filtered monitored flows on Waratah Rivulet have been integrated over successive 14 day periods to produce a smoothed set of data for comparison with the corresponding integrated flows (14 day totals) predicted by the modified AWBM for Waratah Rivulet; and
- the ratio of filtered monitored flows to the modified AWBM predicted flows has been calculated at 14 day intervals commencing at the beginning of the baseline period and advancing beyond the commencement of Longwall 20 secondary extraction - the median of the ratios has then been calculated and analysed over a moving window of 1 year.

The results have been assessed against the significance levels/triggers from the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan⁵ (below):

Significance Levels/Triggers	
Negligible Reduction to the Quantity of Water Resources Reaching the Woronora Reservoir	
Level 1	The median of the ratios does not fall below the 35 th percentile of the baseline data
Level 2	The median of the ratios falls below the 35 th percentile but does not fall below the 20 th percentile of the baseline data
Level 3	The median of the ratios falls below the 20 th percentile of the baseline data

⁴ Equivalent to a daily flow of 20.5 ML/day at the Waratah Rivulet gauging station.

⁵ The Longwall 304 Water Management Plan applies to the period from 1 July 2019 to 11 April 2020 and the Longwalls 305-307 Water Management Plan applies to the period from 12 April 2020 to 31 December 2020. The significance levels/triggers for the performance measure "Negligible reduction to the quantity of water resources reaching the Woronora Reservoir" are the same for the two management plans.

Chart 4 shows a plot of the sliding 12 month median of the ratio of 14 day sums of monitored flow at Waratah Rivulet (GS 2132102) and flows simulated via the modified AWBM to 31 December 2020.

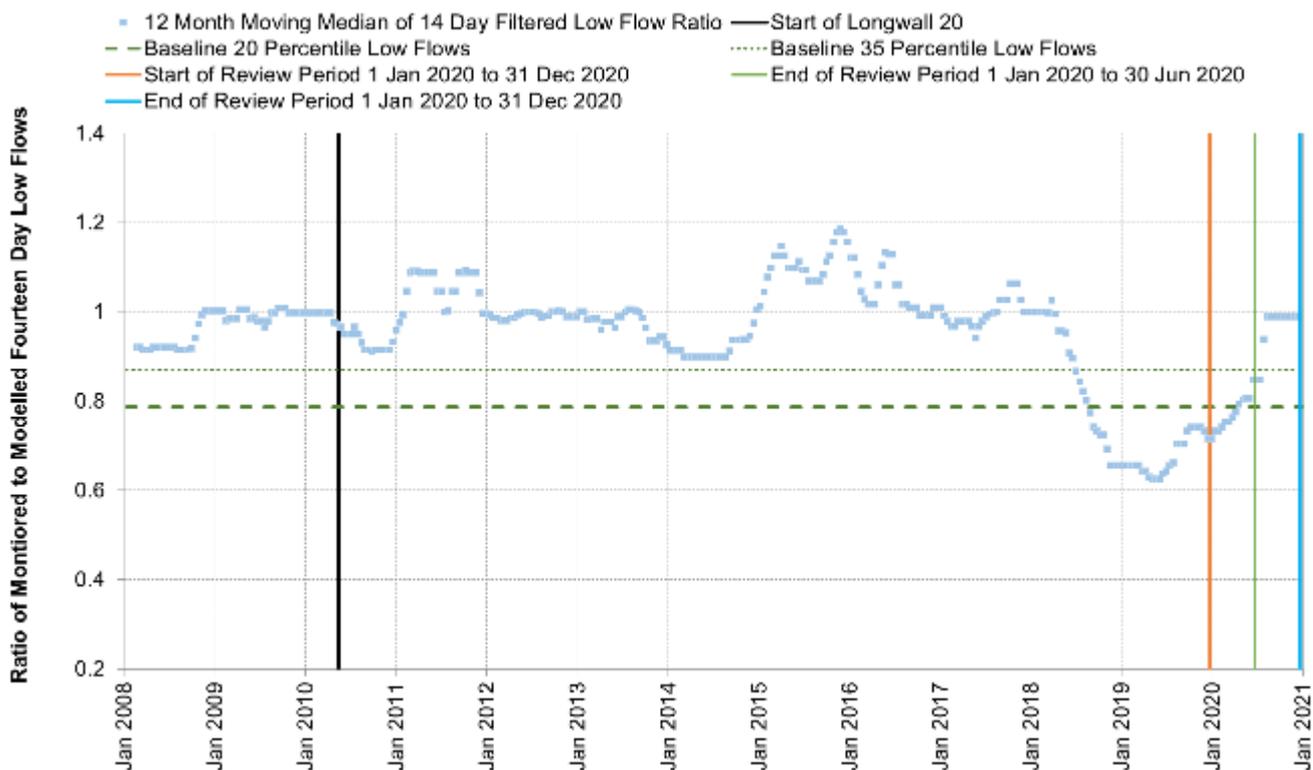


Chart 4 One Year Sliding Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at Waratah Rivulet (GS 2132102)⁶

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 Water Management Plan and Longwalls 305-307 Water Management Plan Trigger Action Response Plan (TARP), 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.

A catchment model was previously developed and calibrated for O'Hares Creek using a modified version of the AWBM. The modified catchment model was calibrated to streamflow records for O'Hares Creek for the period February 2007 to December 2009 (Gilbert & Associates, 2015b). During the re-calibration process, it was identified that the main limitation of the O'Hares Creek model calibration was likely to be the representativeness of the rainfall data adopted in the modelling because there were

⁶ It is noted that an error was found in Chart 4 in the Hydro Engineering & Consulting (2018) Metropolitan Coal Surface Water Review, 1 July to 31 December 2017. However, the error did not affect the conclusion made in relation to the quantity of flows to the Woronora Reservoir.

limited rainfall gauges in the vicinity of the O'Hares Creek catchment during the period of model calibration (Gilbert & Associates, 2015b).

Additional rainfall data recorded in the vicinity of the O'Hares Creek catchment has since become available to enable model re-calibration, in addition to an extended record of streamflow data for GS 213200 (January 2007 to December 2020). The O'Hares Creek catchment model has subsequently been re-calibrated thereby reducing the variability between the recorded and modelled flows and improving the performance of the model as a control against which to assess streamflow reaching the Woronora Reservoir (HEC, 2020). The re-calibrated AWBM has been used to generate Chart 5 which shows a plot of the moving 12 month median of the ratio of 14 day sums of monitored flow at O'Hares Creek at Wedderburn (GS 213200) and flows simulated with the modified AWBM to 31 December 2020.

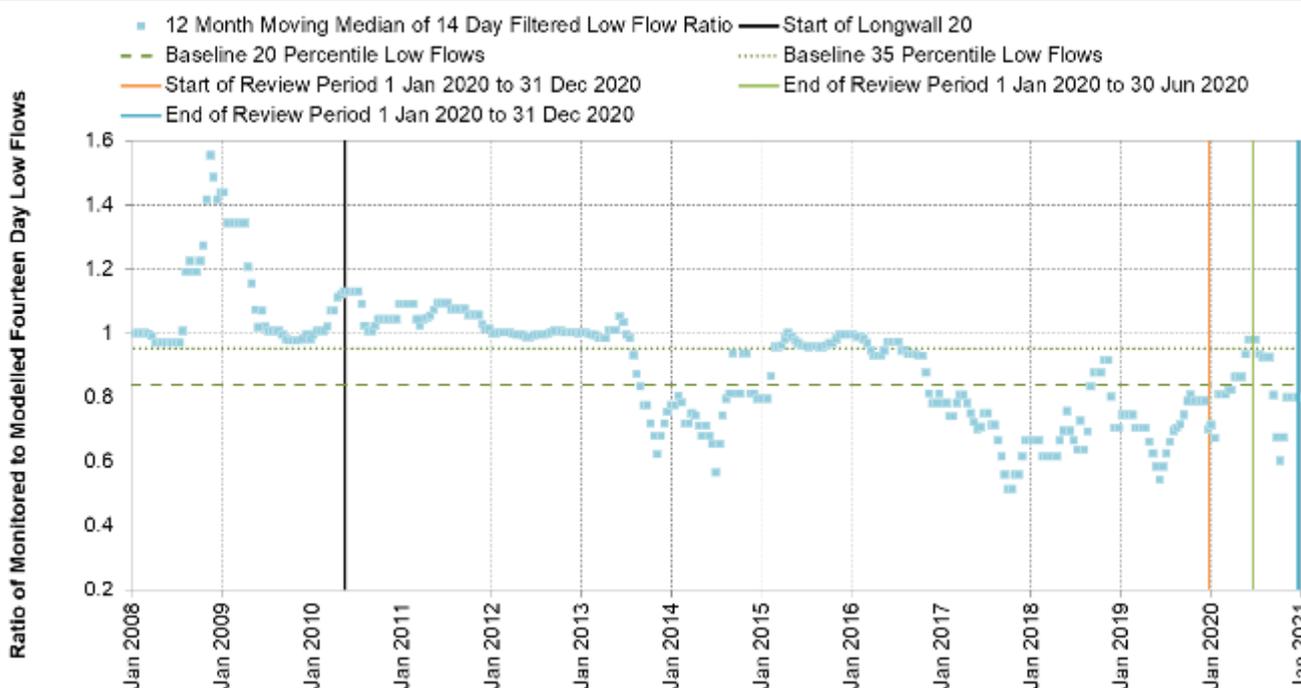


Chart 5 One Year Moving Median for the Ratios of the 14 Day Sums of Monitored and Modelled Flow Rates at O'Hares Creek at Wedderburn (GS 213200)

The results in Chart 5 show that the moving 12 month median of the 14 day filtered low flow ratio at O'Hares Creek at Wedderburn (GS 213200) also remained below the 20th percentile of the baseline data 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 just above the 35th percentile. This illustrates that similar conditions occurred at both Waratah Rivulet and the control site (O'Hares Creek at Wedderburn) during this period. As such, while the Metropolitan Coal Longwalls 304 Water Management Plan Trigger Action Response Plan (TARP) reached Level 3 from January to April 2020, 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.

3.1.2 Assessment of Flow Reaching Woronora Reservoir from Eastern Tributary at GS 300078

Flow data up to 31 December 2020 has been provided from gauging station 300078 – Eastern Tributary upstream of Woronora Reservoir. Flow data is available from station establishment on 23 September 2012. The available data is shown on Chart 5 below as a hydrograph together with model predicted results. Note that in this and subsequent hydrographs, streamflow is plotted on a per unit catchment area basis in mm/d.

Results show that streamflow recorded at the gauging station has been continuous and has generally been consistent with or above model predictions. This indicates that flows reaching the Woronora Reservoir have not been reduced by mining.

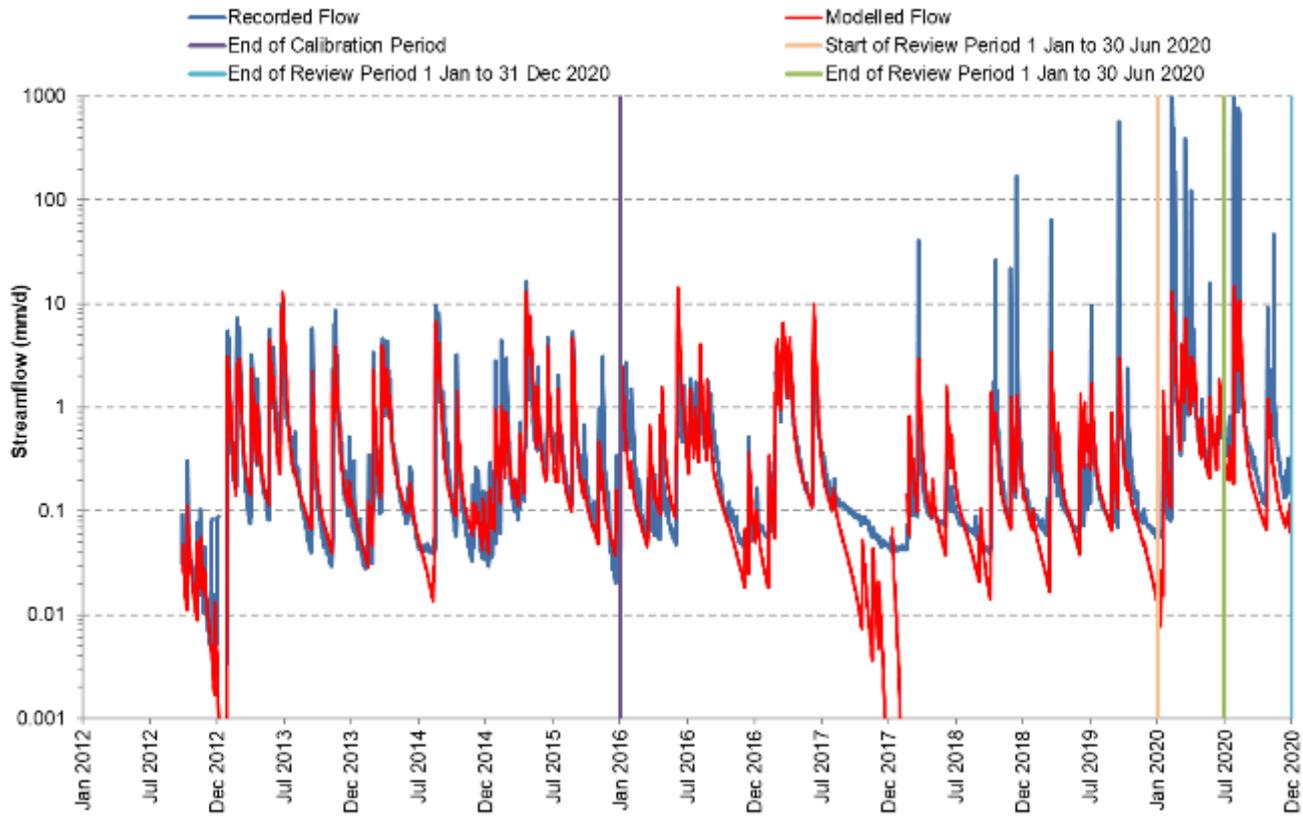


Chart 6 Monitored and Model Predicted Flows – Eastern Tributary Upstream of Woronora Reservoir

3.1.3 Assessment of Flow for Sub-Catchment I (GS 300092) and Sub-Catchment K (GS 300093)

Following recommendations made in the *Woronora Reservoir Impact Strategy – Stage 1 Report* (Hebblewhite et al, 2017), streamflow gauging stations were installed on small tributary catchments, Sub-Catchment I and Sub-Catchment K, on the eastern side of the Woronora Reservoir (refer Figure 2). Sub-catchment I overlies Longwall 301 to Longwall 305 and therefore may be impacted by associated subsidence movements, specifically upsidence. Sub-Catchment K is located north of the predicted subsidence zone of Longwall 301 to Longwall 304 and forms a control for the assessment of potential impacts to streamflow in Sub-Catchment I associated with secondary extraction from Longwall 301 to Longwall 304. Sub-Catchment K predominately overlies Longwall 306 and Longwall 307 (from which secondary extraction did not occur during the review period), with a small proportion overlying the northern end of Longwall 305 (from which secondary extraction did occur during the review period). As such, Sub-Catchment K may also be progressively influenced by subsidence movements associated with Longwall 305 to Longwall 307. Metropolitan Coal will continue to monitor the Sub-Catchment I and Sub-Catchment K streamflow gauging stations until such time as mine subsidence influences are recorded (Metropolitan Coal, 2020).

Secondary extraction from Longwall 302 was occurring at the commencement of monitoring at these gauging stations and continued to 6 October 2018. Secondary extraction of Longwall 303 commenced in November 2018 and was completed in June 2019, while mining of Longwall 304 commenced in July 2019 and was completed in January 2020. Mining of Longwall 305 commenced on 12 April 2020 and was completed on 21 November 2020. Mining of Longwall 306 has not yet commenced.

The recorded stage data and the cease to flow level for Sub-Catchment I and Sub-Catchment K are presented in Chart 7 and the streamflow records presented in Chart 8.

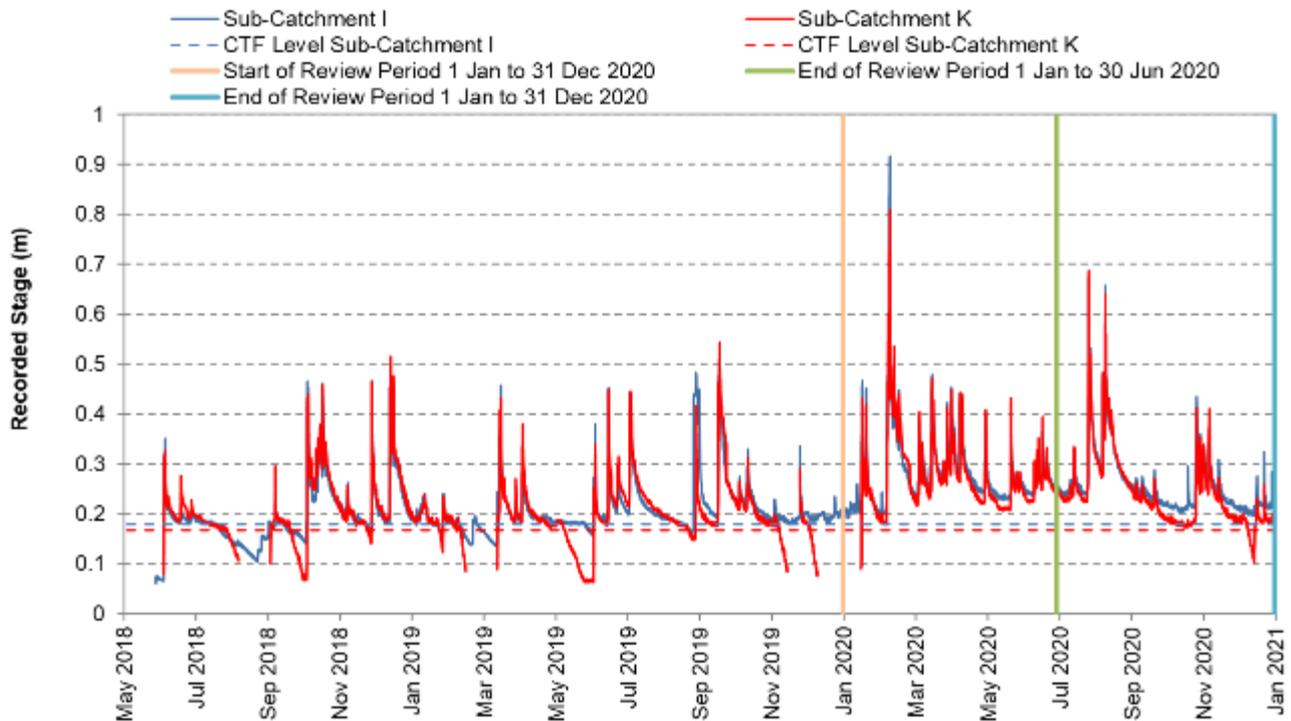


Chart 7 Sub-Catchment I and Sub-Catchment K Recorded Stage and Cease to Flow Levels

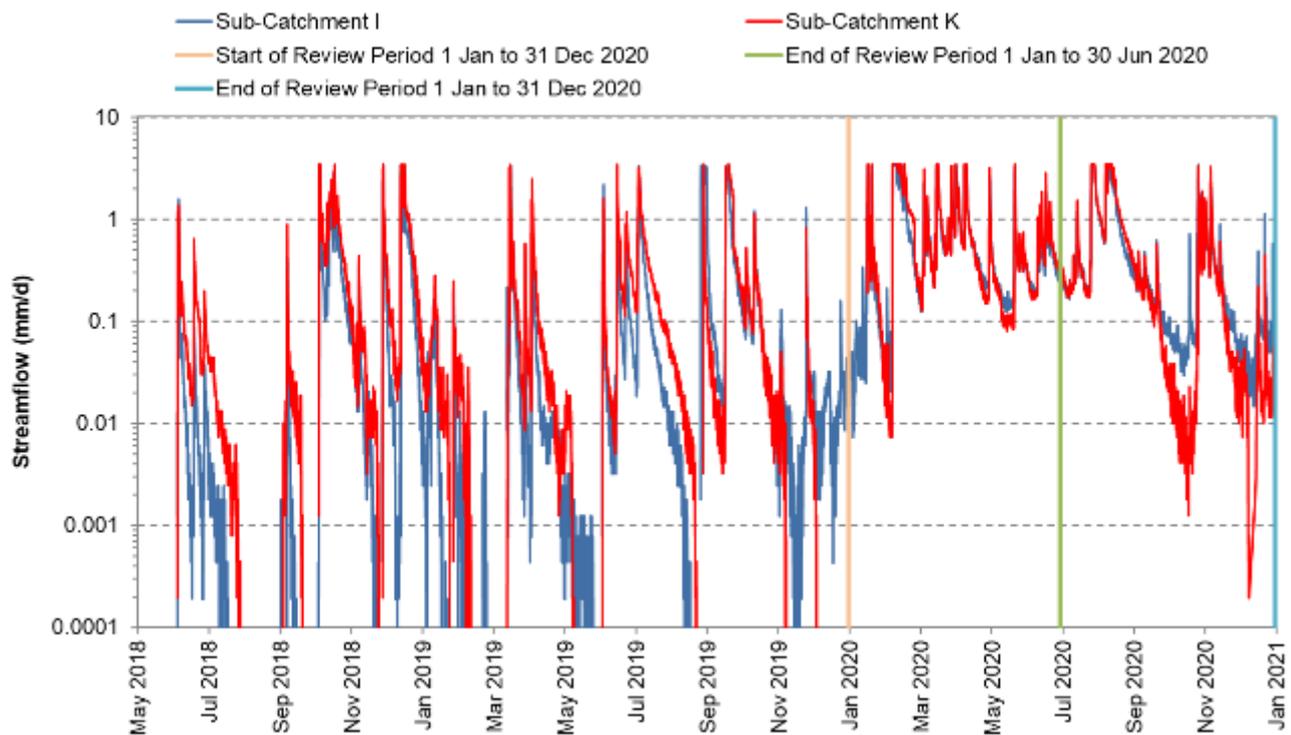


Chart 8 Sub-Catchment I and Sub-Catchment K Recorded Streamflow Rates

The recorded runoff recession during low flow periods was found to be more rapid at the gauging station for Sub-Catchment K than for Sub-Catchment I during various periods throughout the duration of monitoring. The water level records (refer Chart 7) illustrate that the water level at Sub-Catchment I was above the cease to flow level for the duration of the review period. Sub-Catchment K was below

the cease to flow level for the first half of January and for a brief period in mid-December but was above the cease to flow for the majority of the review period. There is no visual indication of a change in recessionary behaviour (i.e. rate of recession) for Sub-Catchment I (refer Chart 8) and no indication from the recorded stage and streamflow data that mining of Longwall 301 to Longwall 305 has impacted streamflow at the Sub-Catchment I gauging station. Additionally, there is no visual indication of a change in recessionary behaviour (i.e. rate of recession) for Sub-Catchment K (refer Chart 8) and no indication from the recorded stage and streamflow data that mining of Longwall 305 has impacted streamflow at the Sub-Catchment K gauging station to date.

3.1.4 Analysis against Subsidence Impact Performance Measure

Subsidence Impact Performance Measure:

Negligible reduction to the quantity of water resources reaching the Woronora Reservoir.

The subsidence impact performance measure is considered to have been exceeded if analysis of the monitoring and modelling results confirms that the Project has resulted in a greater than negligible reduction in the quantity of water resources reaching the Woronora Reservoir.

The performance measure of negligible reduction to the quantity of water resources reaching the Woronora Reservoir has been met.

3.2 QUALITY OF WATER RESOURCES REACHING THE WORONORA RESERVOIR

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 WOWQ 2.

Water quality data has been analysed for key water quality parameters of relevance to water supply and the effects of subsidence, namely dissolved (field filtered) iron, manganese and aluminium at site WRWQ 9 on Waratah Rivulet, site ETWQ AU on Eastern Tributary and at control site WOWQ 2 on the Woronora River.

The results have been assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan significance levels/triggers (below):

Significance Levels/Triggers	
Negligible Reduction to the Quality of Water Resources Reaching the Woronora Reservoir	
Level 1	Data analysis indicates no water quality parameter exceeds the adjusted baseline mean plus two standard deviations.
Level 2	Data analysis indicates any water quality parameter exceeds the adjusted baseline mean plus two standard deviations for one month.
Level 3	Data analysis indicates: <ul style="list-style-type: none"> • 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.

The performance indicator is exceeded if the results indicate a Level 3 significance level/trigger.

3.2.1 Assessment of Water Quality at Site WRWQ 9

Plots showing the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at sampling site WRWQ 9 in relation to the adjusted baseline mean plus one and two standard deviations are shown on Chart 9 to Chart 11 below.

Chart 12 to Chart 14 show the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at control site WOWQ 2 in comparison to the adjusted baseline mean plus one and two standard deviations.

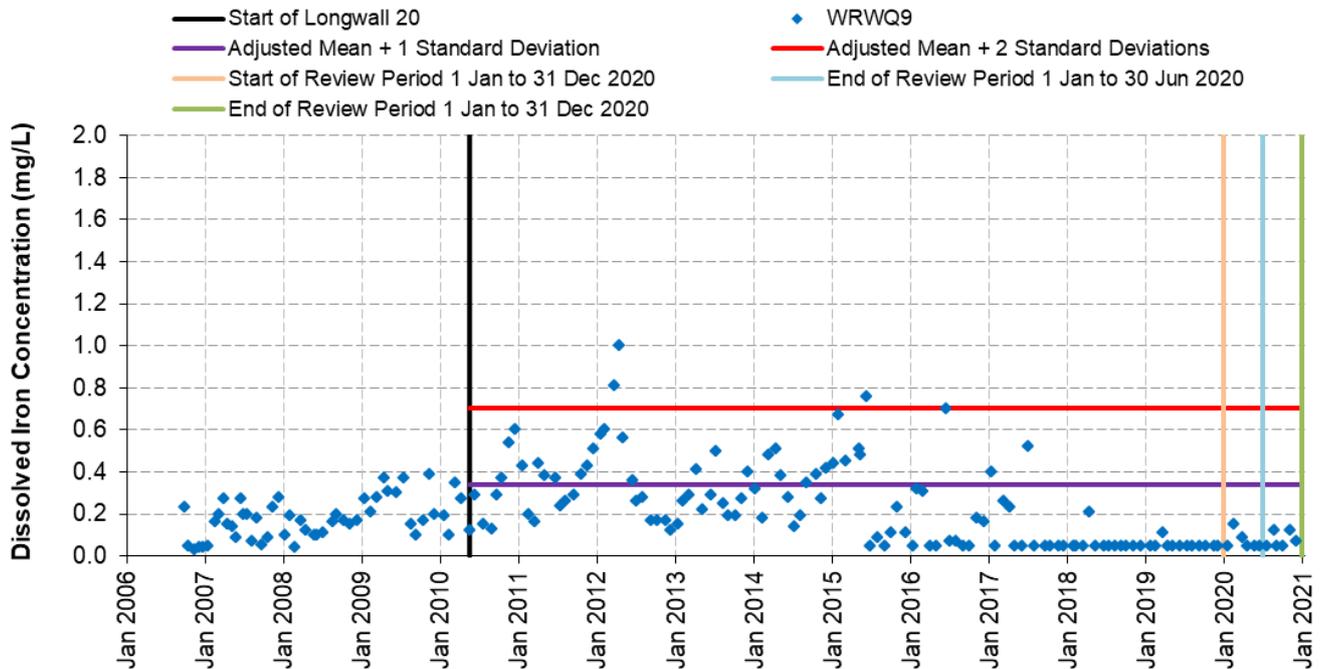


Chart 9 Dissolved Iron Concentrations in Waratah Rivulet at WRWQ 9

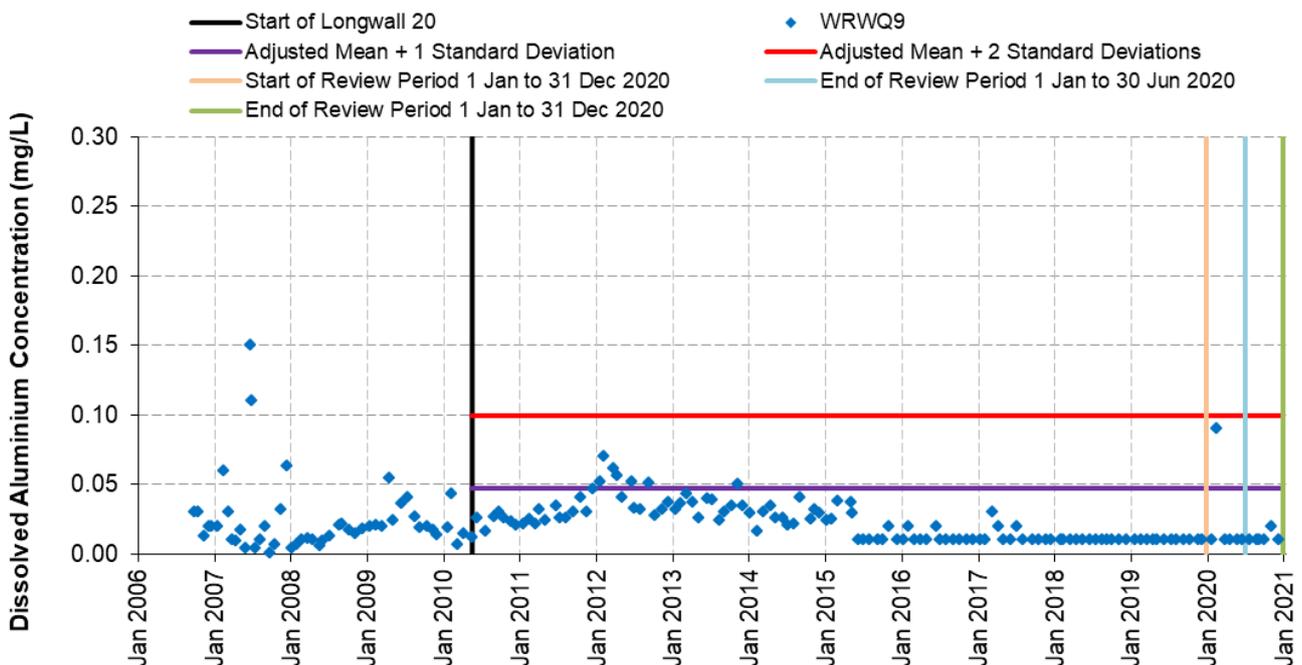


Chart 10 Dissolved Aluminium Concentrations in Waratah Rivulet at WRWQ 9

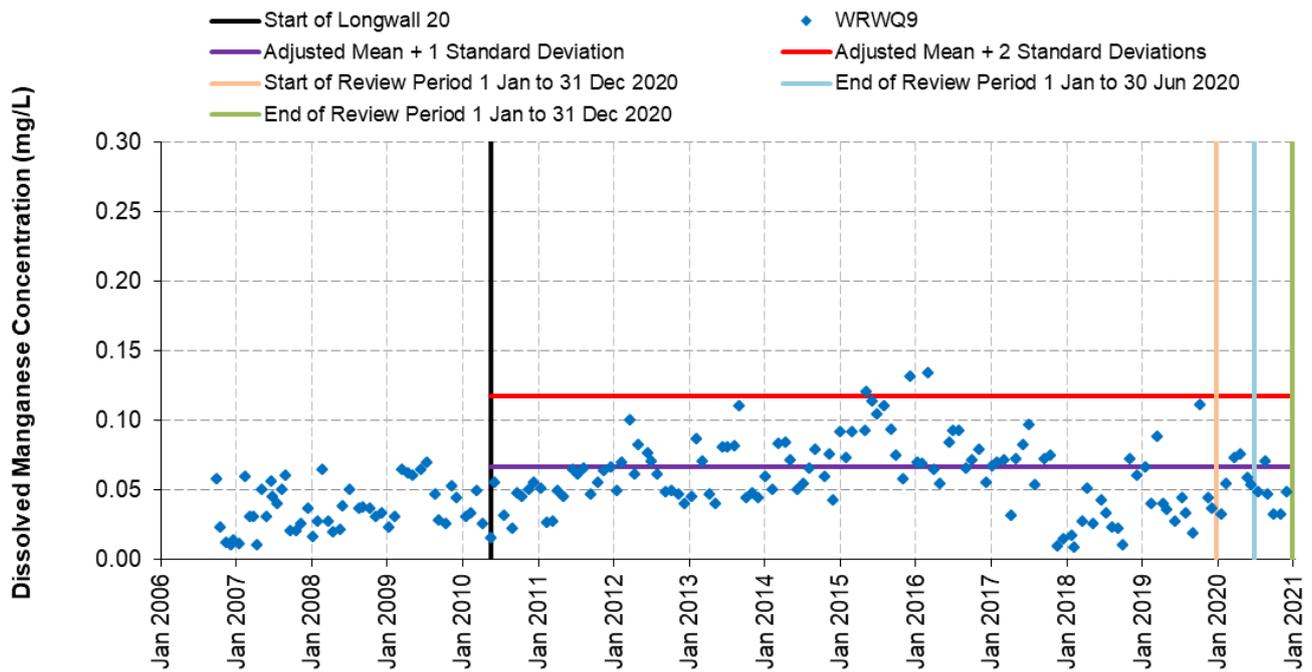


Chart 11 Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ 9

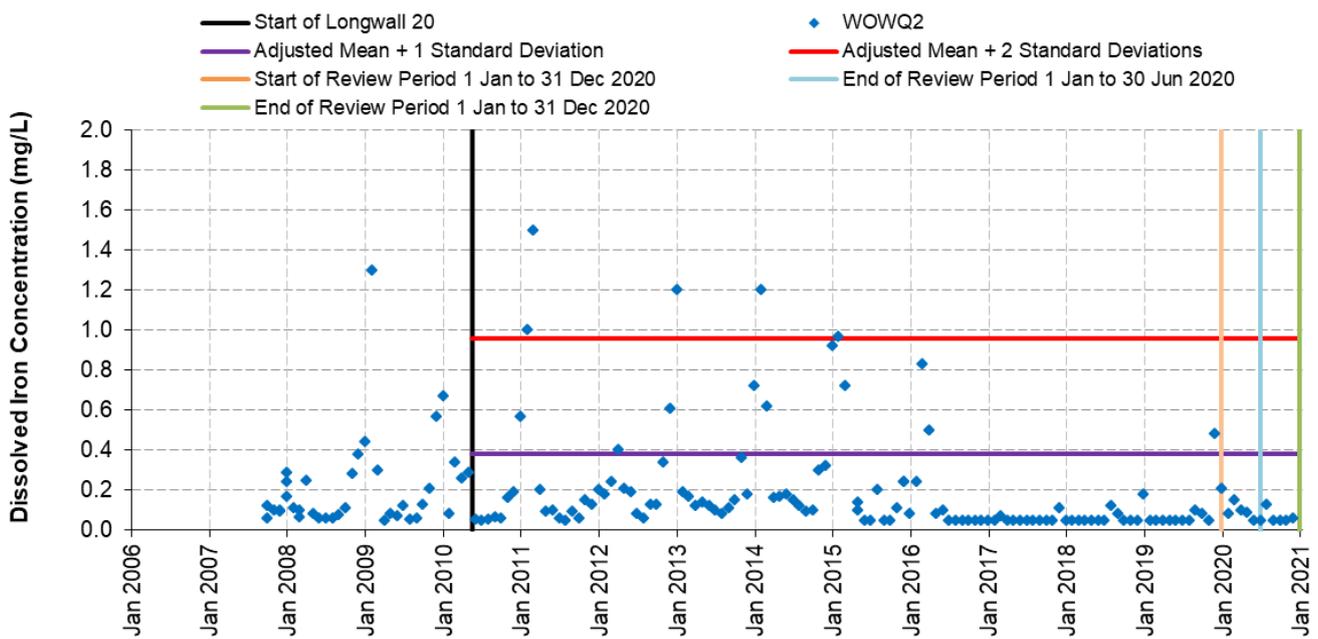


Chart 12 Dissolved Iron Concentrations in Woronora River at WOWQ 2

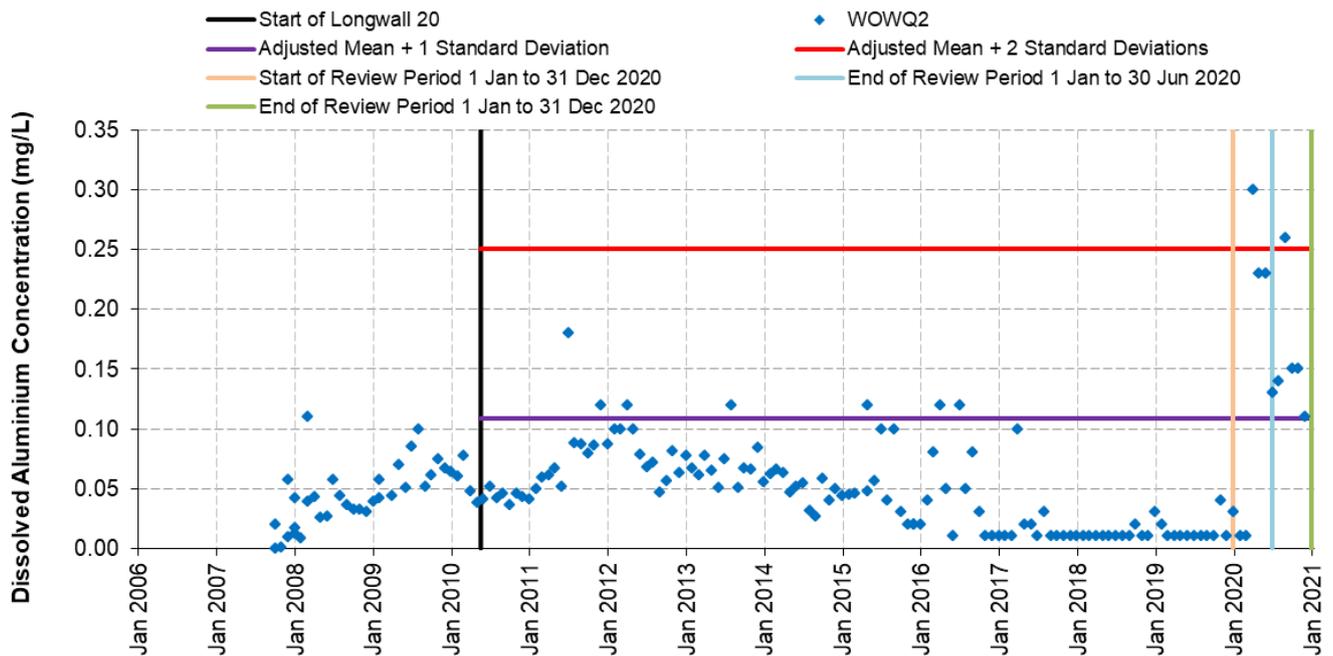


Chart 13 Dissolved Aluminium Concentrations in Woronora River at WOWQ 2

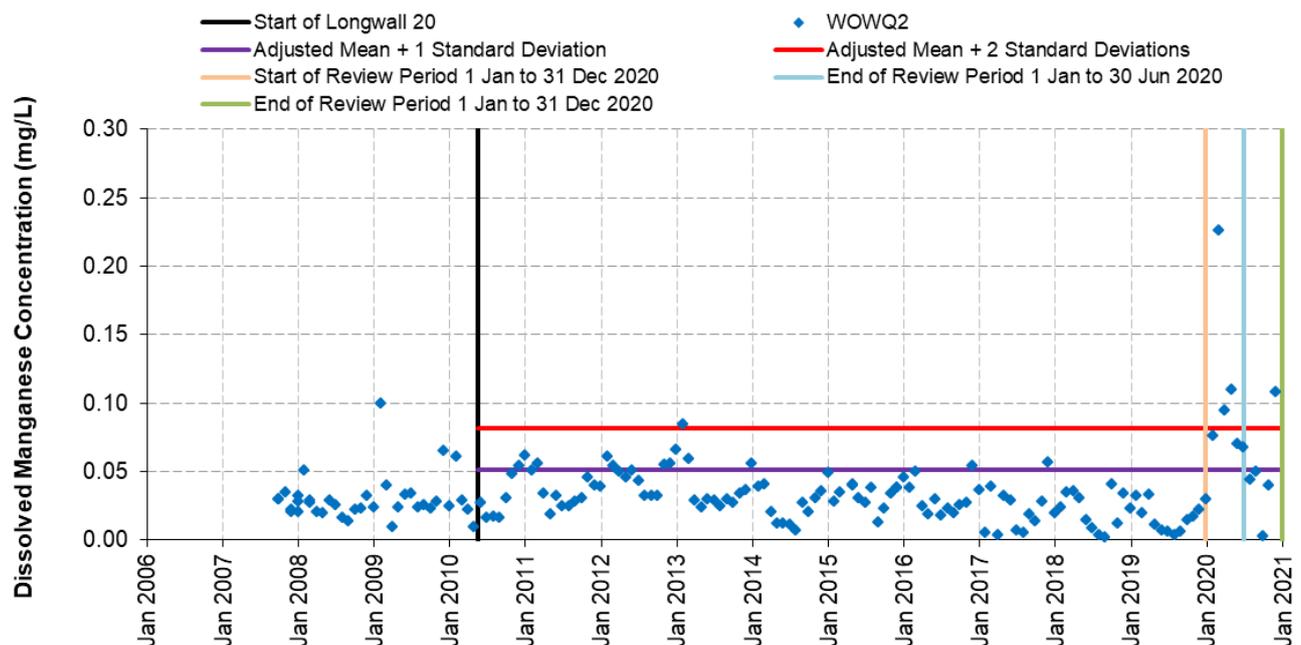


Chart 14 Dissolved Manganese Concentrations in Woronora River at WOWQ 2

Chart 9 to Chart 11 indicate that there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved iron, dissolved aluminium or dissolved manganese in Waratah Rivulet at site WRWQ 9 during the reporting period. The results equate to a Level 1 significance level. There were no exceedances of the adjusted baseline mean plus two standard deviations at control site WOWQ 2 on the Woronora River for dissolved iron (Chart 12). There were however exceedances of the adjusted baseline mean plus two standard deviations for dissolved aluminium and dissolved manganese at control site WOWQ 2 on the Woronora River (Chart 13 and Chart 14).

Plots showing the six month mean concentrations for dissolved iron, dissolved aluminium and dissolved manganese recorded at site WRWQ 9 are shown on Chart 15 to Chart 17. For comparison, plots showing the six month mean concentrations for the same water quality parameters at control site

WOWQ 2 are shown on Chart 18 to Chart 20. Each plot shows the adjusted baseline mean plus one standard deviation value.

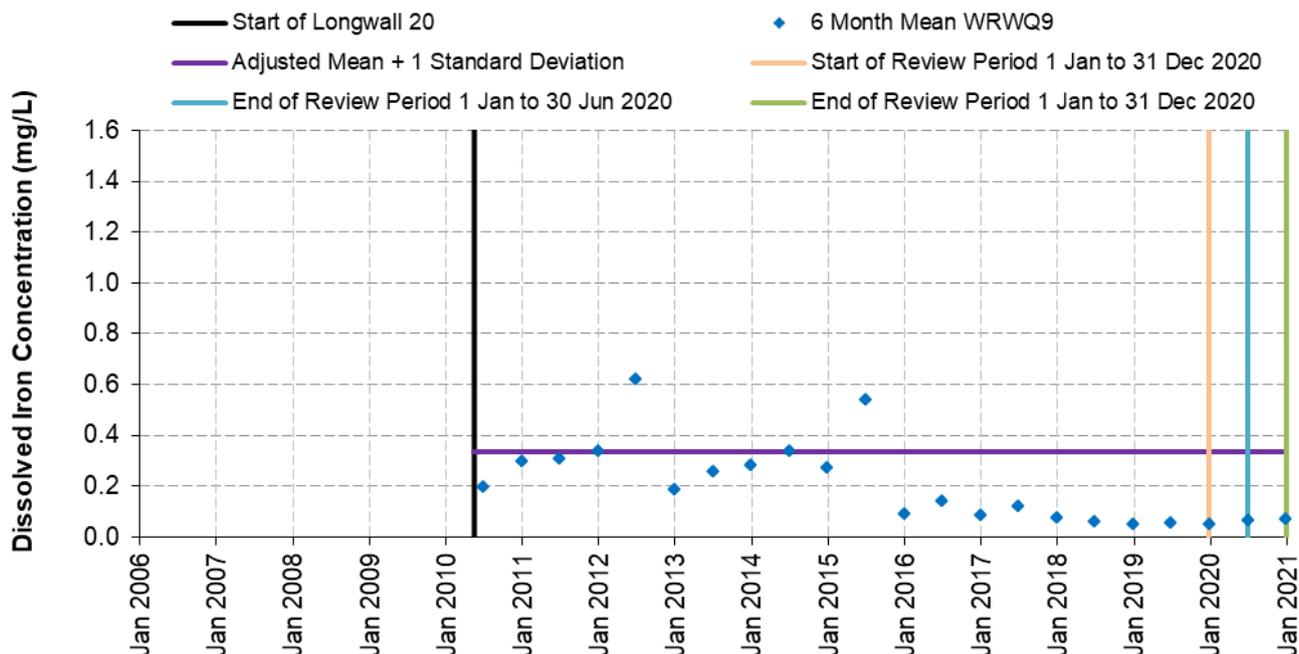


Chart 15 Six Month Means of Dissolved Iron Concentrations in Waratah Rivulet at WRWQ 9

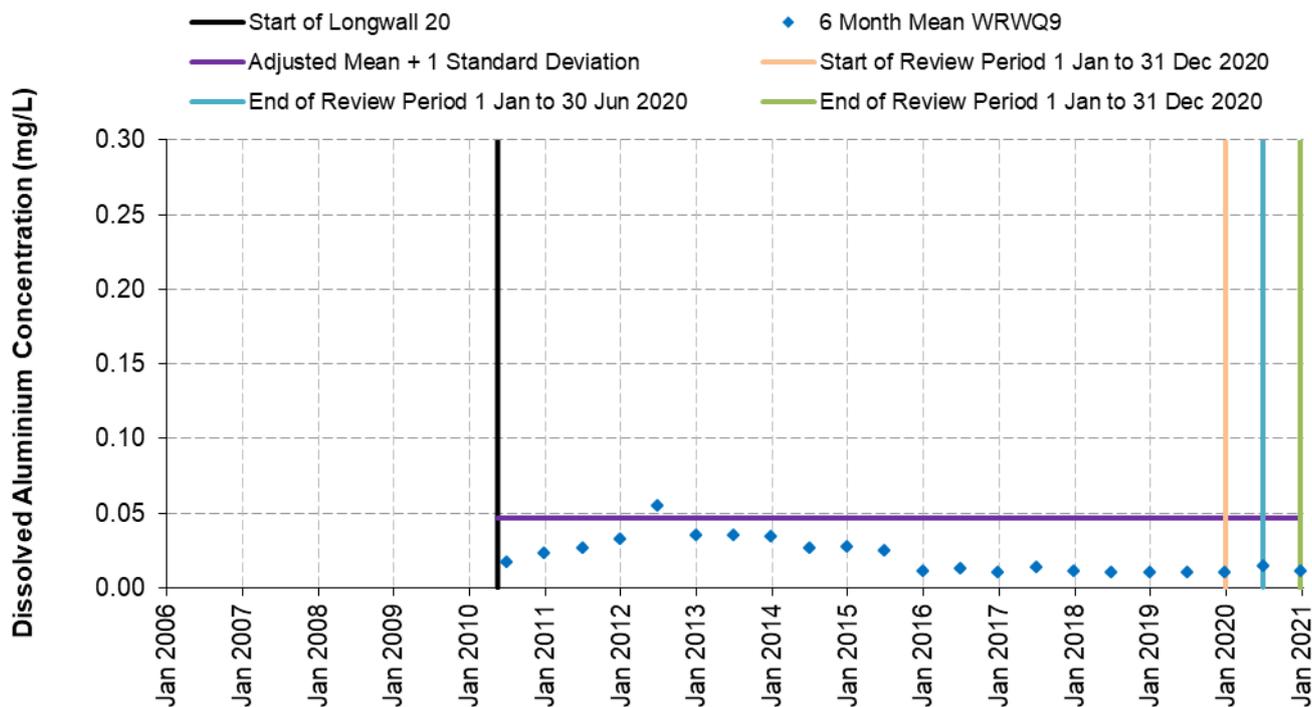


Chart 16 Six Month Means of Dissolved Aluminium Concentrations in Waratah Rivulet at WRWQ 9

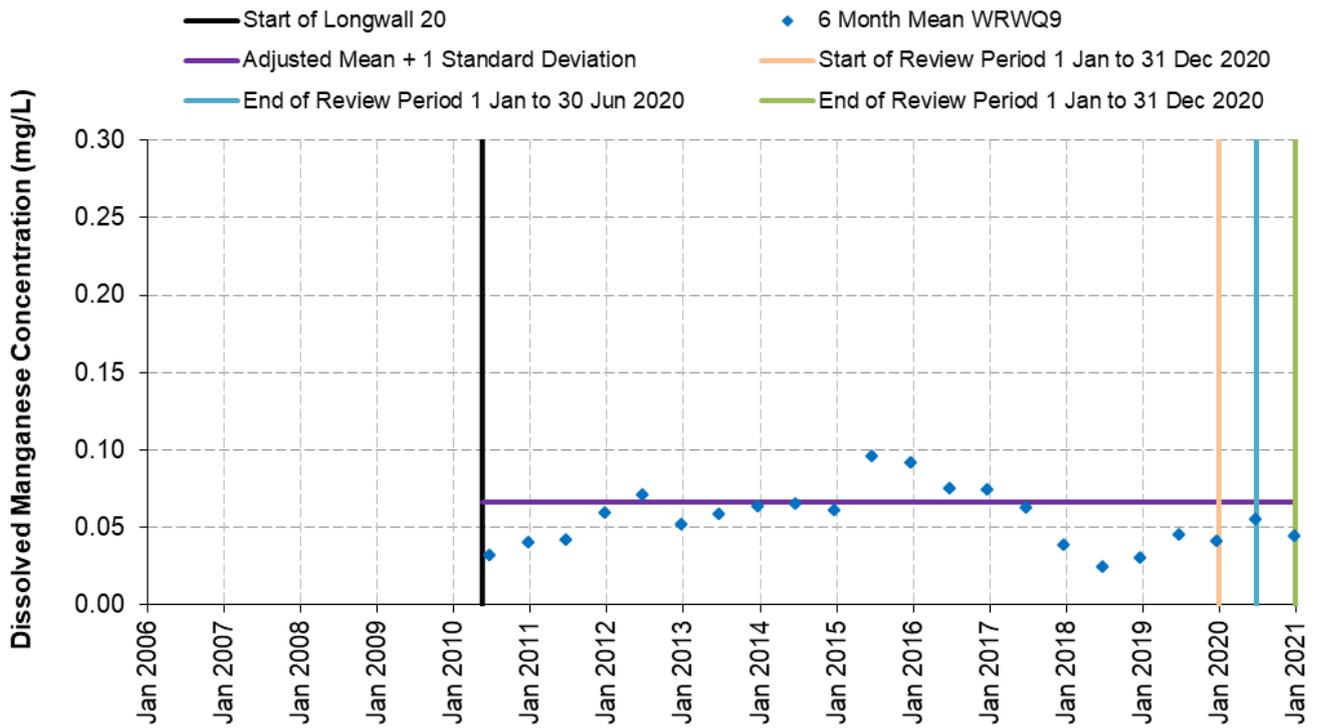


Chart 17 Six Month Means of Dissolved Manganese Concentrations in Waratah Rivulet at WRWQ 9

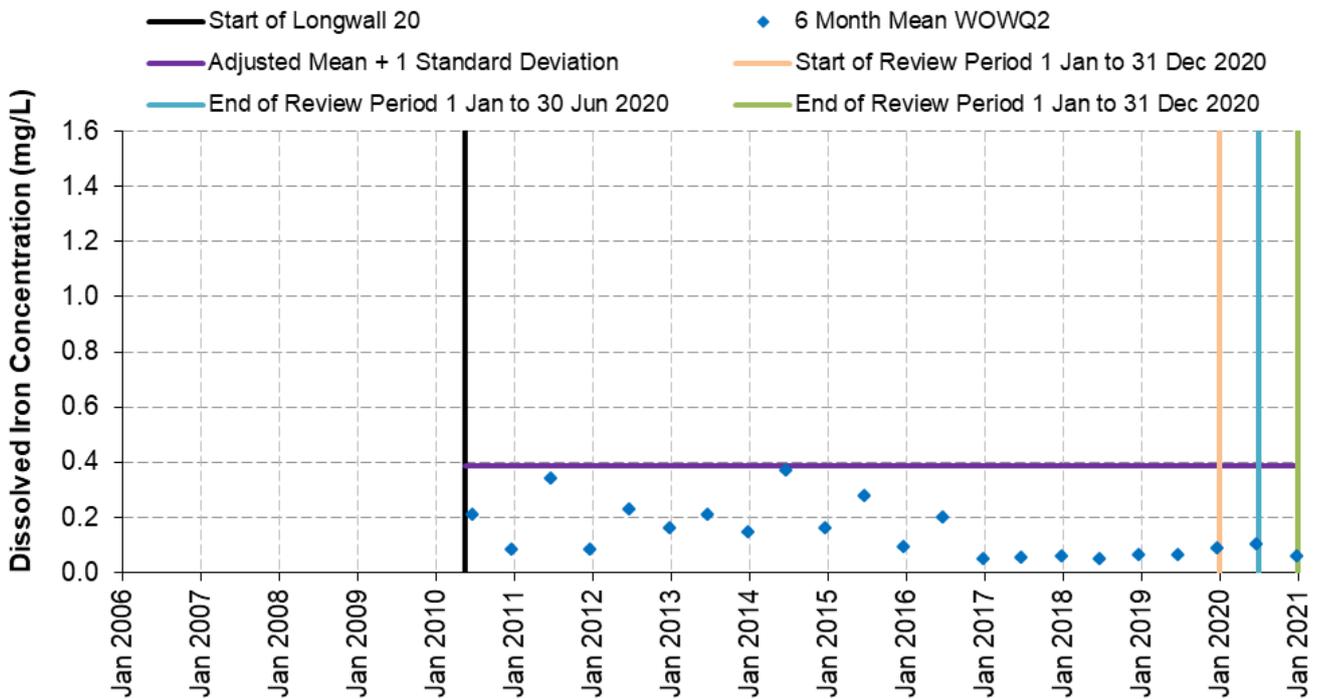


Chart 18 Six Month Means of Dissolved Iron Concentrations in Woronora River at WOWQ 2

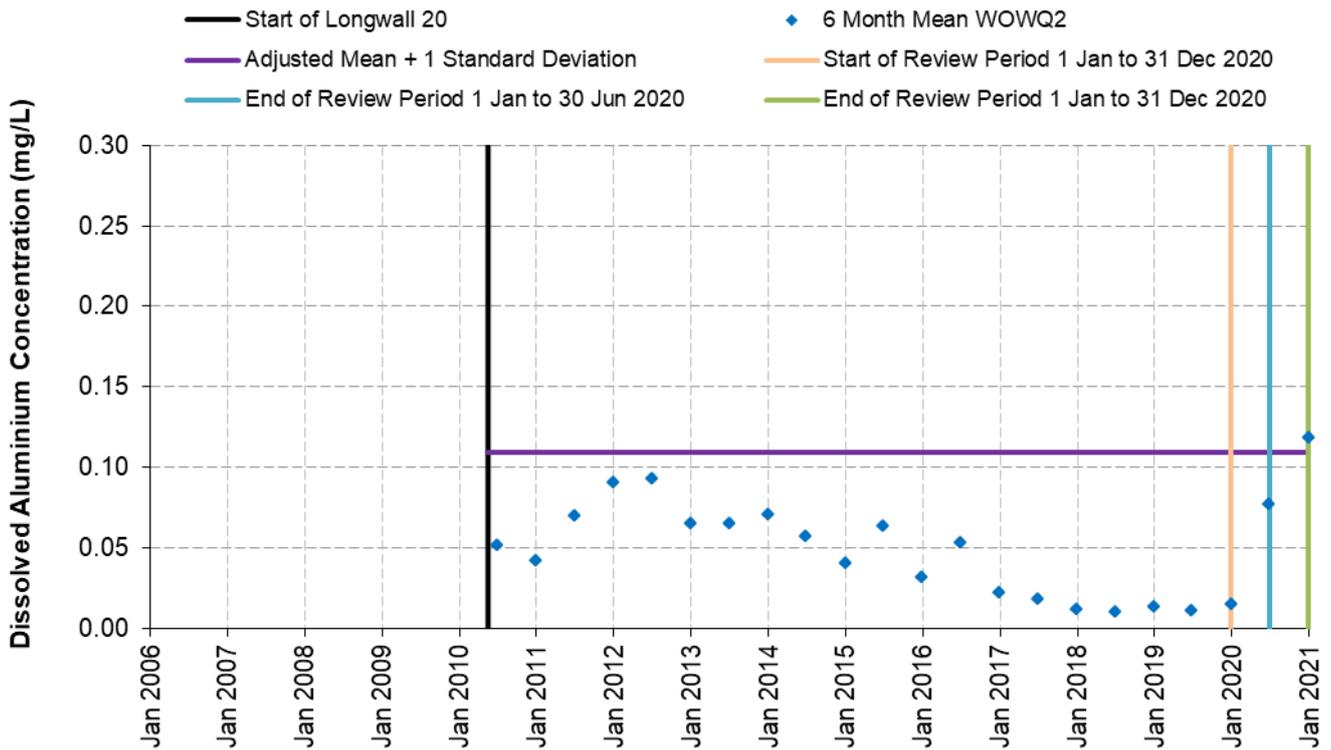


Chart 19 Six Month Means of Dissolved Aluminium Concentrations in Woronora River at WOWQ 2

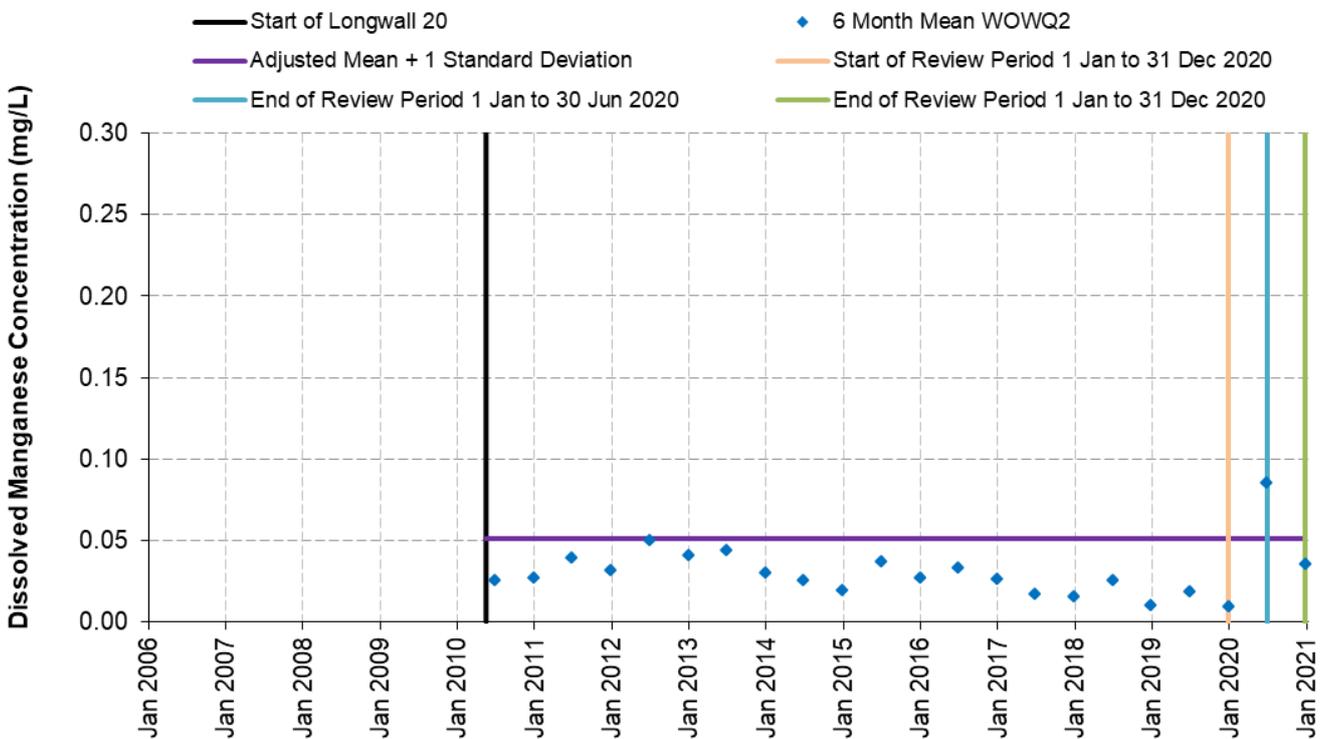


Chart 20 Six Month Means of Dissolved Manganese Concentrations in Woronora River at WOWQ 2

There were no exceedances of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved iron, dissolved aluminium or dissolved manganese in Waratah Rivulet at site WRWQ 9 (Chart 15 to Chart 17) or dissolved iron in Woronora River at site

WOWQ 2 (Chart 18) during the reporting period. There was an exceedance of the adjusted baseline mean plus one standard deviation for dissolved aluminium (June to December 2020) and dissolved manganese (January to June 2020) in Woronora River at site WOWQ 2 (Chart 19 and Chart 20) during the reporting period.

3.2.2 Assessment of Water Quality at Site ETWQ AU

Plots showing the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at site ETWQ AU are shown on Chart 21 to Chart 23 in relation to the adjusted baseline mean plus one and two standard deviations calculated using data prior to potential subsidence effects from Longwall 20 on the Eastern Tributary.

Chart 24 to Chart 26 show the concentrations of dissolved iron, dissolved aluminium and dissolved manganese recorded at control site WOWQ 2 in comparison to the adjusted baseline mean plus one and two standard deviations calculated using data collected prior to potential subsidence effects from Longwall 20 on the Eastern Tributary.

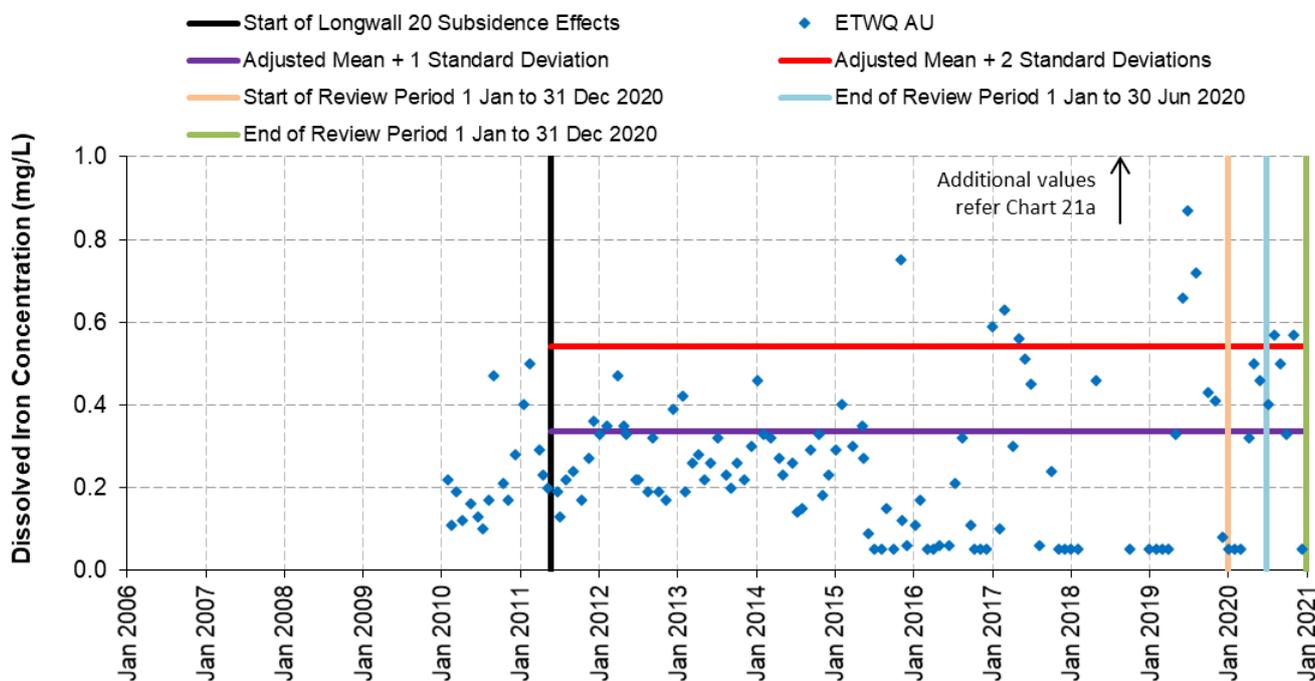


Chart 21 Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

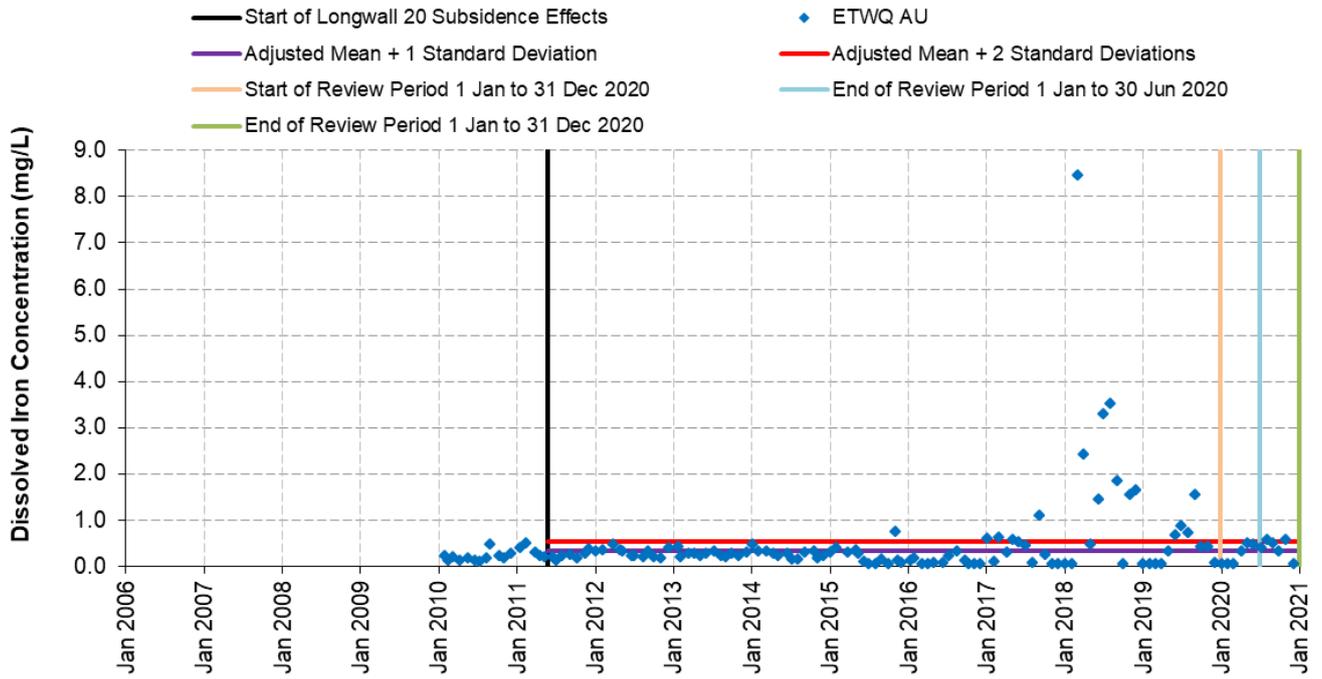


Chart 21a Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

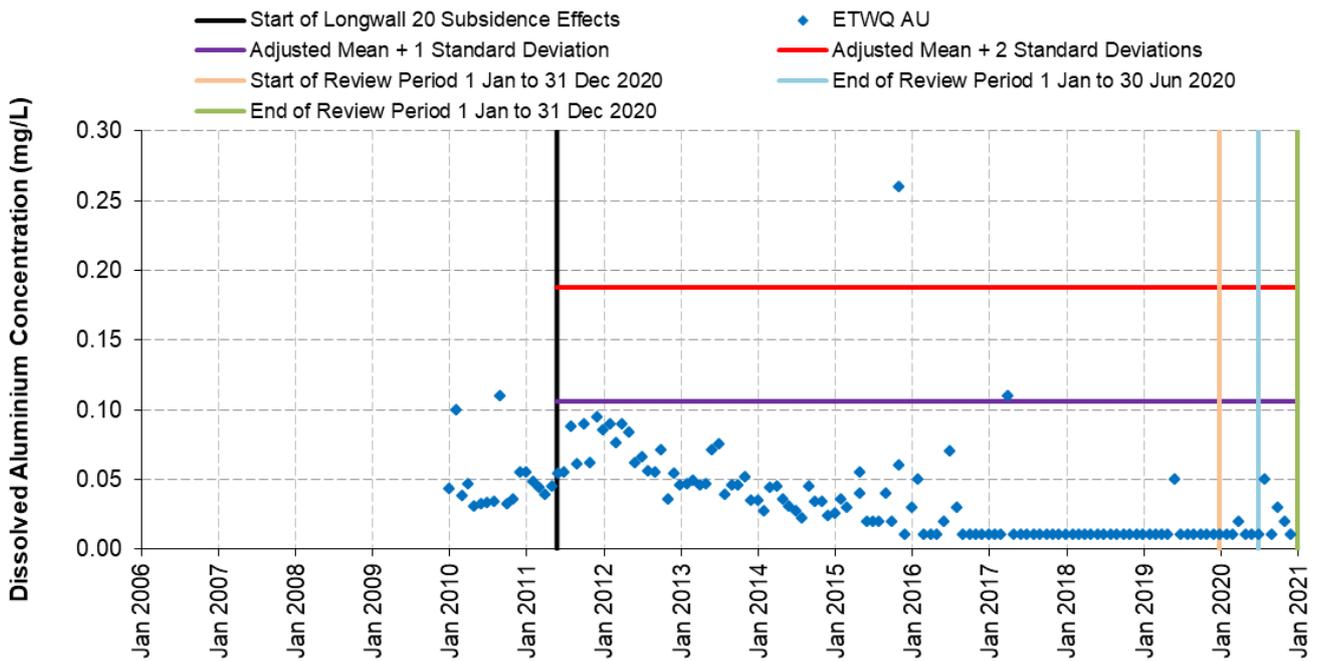


Chart 22 Dissolved Aluminium Concentrations in Eastern Tributary at ETWQ AU

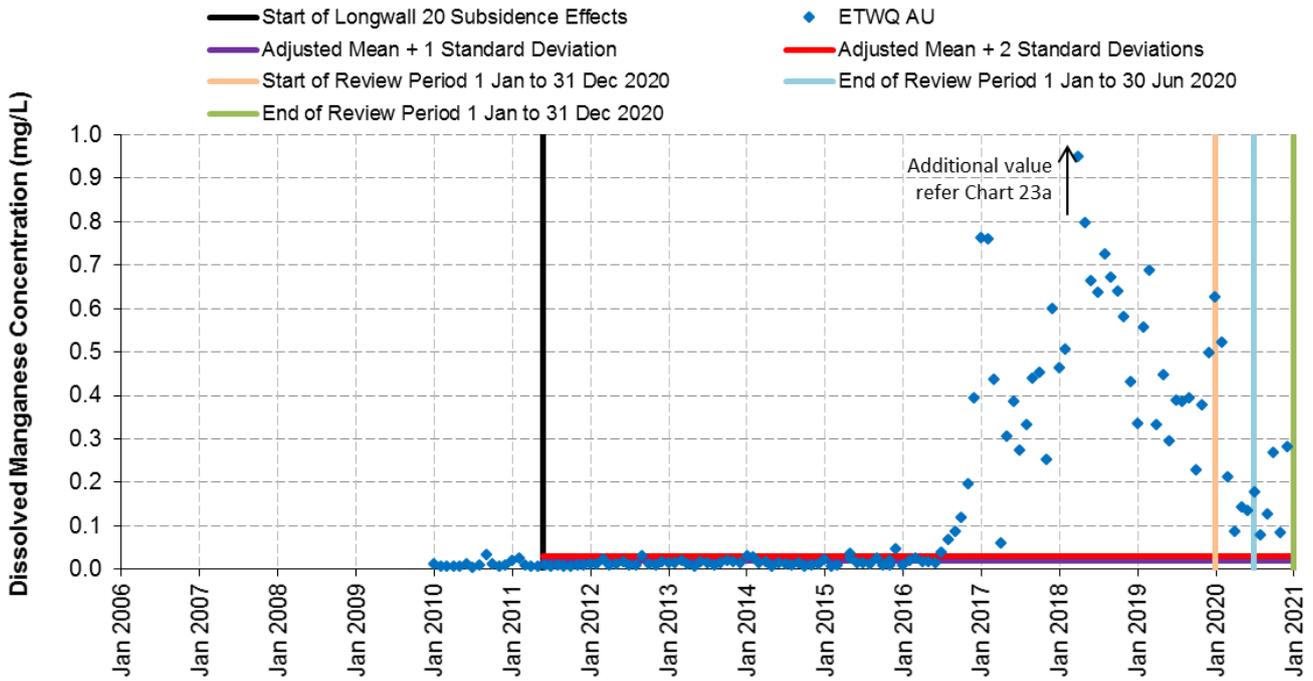


Chart 23 Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

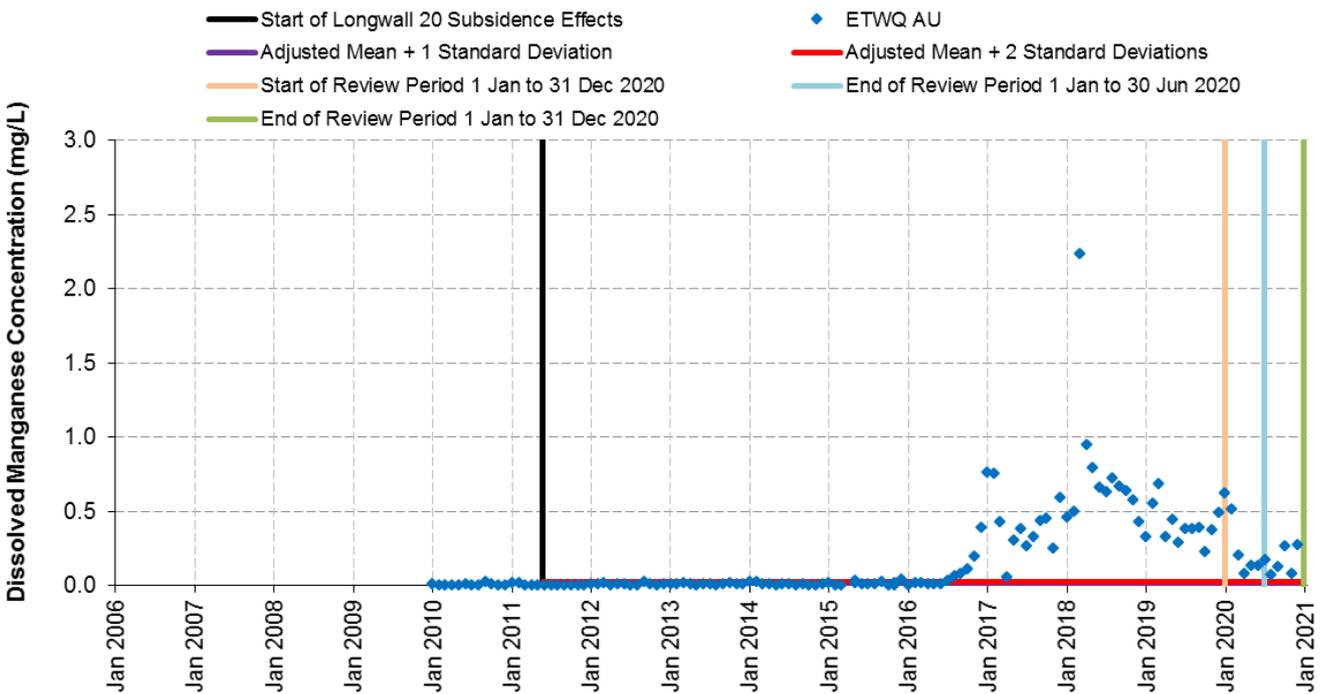


Chart 23a Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

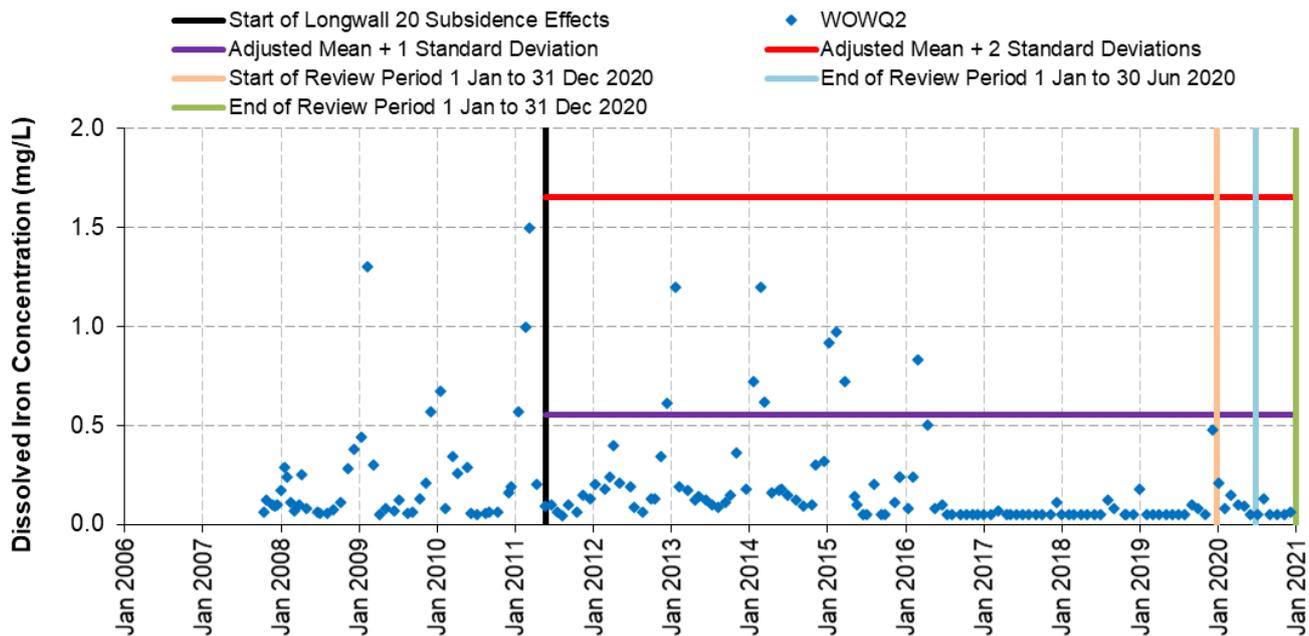


Chart 24 Dissolved Iron Concentrations in Woronora River at WOWQ 2

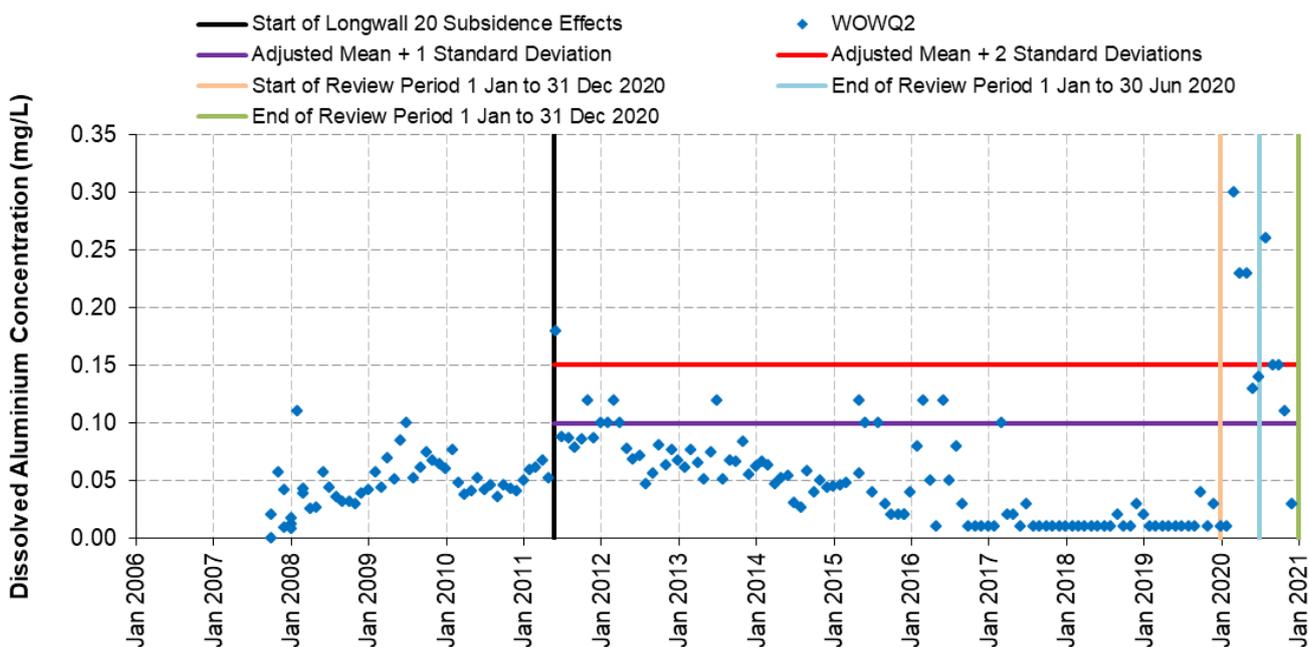


Chart 25 Dissolved Aluminium Concentrations in Woronora River at WOWQ 2

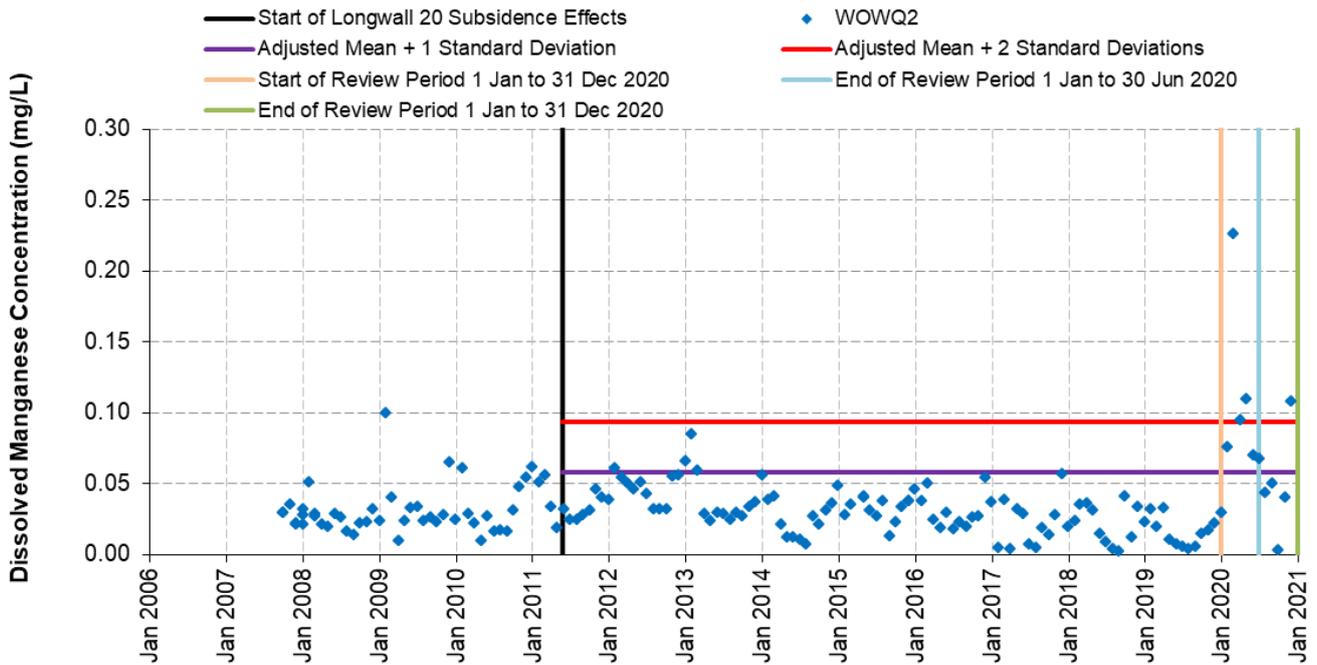


Chart 26 Dissolved Manganese Concentrations in Woronora River at WOWQ 2

Chart 21/21a indicate that 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. 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) but 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 (Chart 24), 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.

Chart 22 indicates there were no exceedances of the adjusted baseline mean plus two standard deviations for dissolved aluminium at sampling site ETWQ AU during the reporting period. The results for dissolved aluminium equate to a Level 1 significance level. In comparison, there was an exceedance of the adjusted baseline mean plus two standard deviations for dissolved aluminium at control site WOWQ 2 on the Woronora River from March to May and in August 2020 (Chart 25).

The dissolved manganese concentrations continued to exceed the adjusted baseline mean plus two standard deviations at site ETWQ AU from January to December 2020 (Chart 23/23a). Dissolved manganese concentrations 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 throughout the reporting period.

The monthly dissolved manganese concentration at the control site WOWQ 2 on the Woronora River also exceeded the adjusted baseline mean plus two standard deviations for two consecutive months in March and April and also in April and May (refer Chart 26). Likewise there was an exceedance of the adjusted mean plus two standard deviations in the first month (March), followed by an exceedance of 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). Because there was a similar exceedance of these triggers at the control site WOWQ 2 on the Woronora River, the results for dissolved manganese at site ETWQ AU equate to a Level 2 significance level for March to May 2020. However, at the control site WOWQ 2 on the Woronora River, there was not an exceedance of the adjusted mean plus two standard deviations in the first month, followed by an exceedance of the adjusted mean plus one

standard deviation in the next month and the adjusted mean plus two standard deviations in the third month throughout the remaining reporting period. Likewise, there was not an exceedance of the adjusted mean plus two standard deviations for two consecutive months throughout the remaining reporting period. Because there was not a similar exceedance of these triggers at the control site WOWQ 2 on the Woronora River, the results for dissolved manganese at site ETWQ AU equate to a Level 3 significance level for January to February and June to December 2020.

Plots showing the six month mean concentrations for dissolved iron, dissolved aluminium and dissolved manganese recorded at site ETWQ AU are shown on Chart 27 to Chart 29. For comparison, plots showing the six month mean concentrations for the same water quality parameters at control site WOWQ 2 are shown on Chart 30 to Chart 32. Each plot shows the adjusted baseline mean plus one standard deviation value.

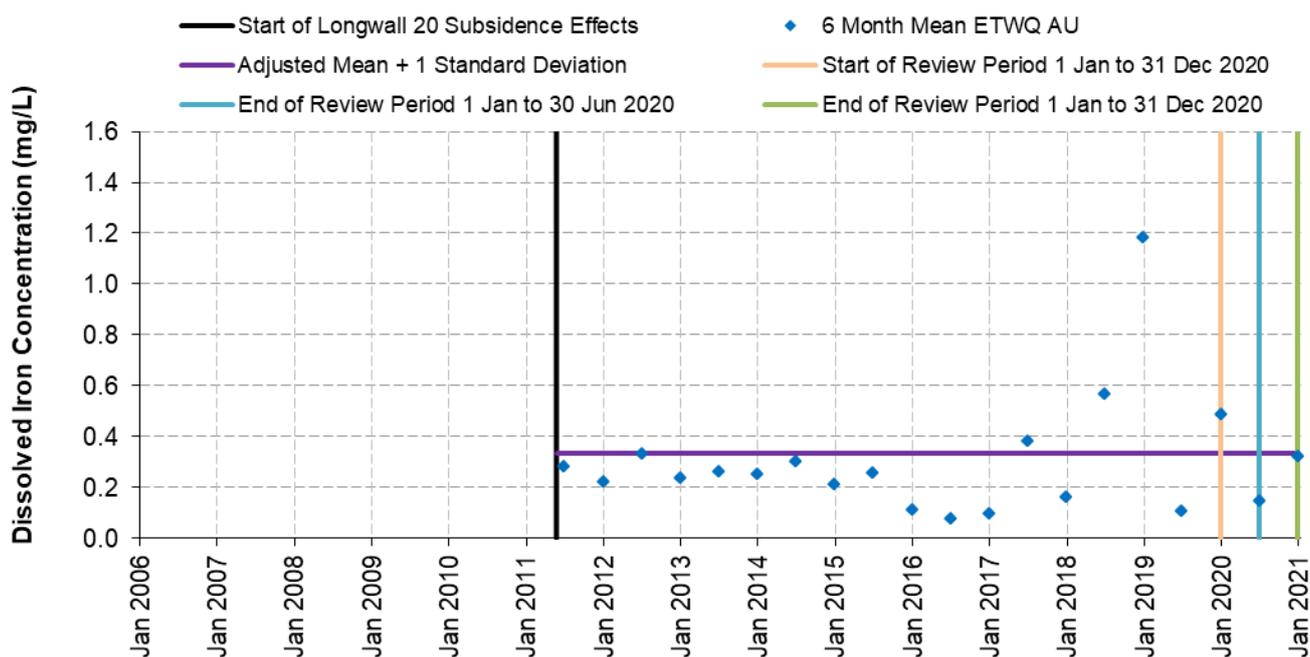


Chart 27 Six Month Means of Dissolved Iron Concentrations in Eastern Tributary at ETWQ AU

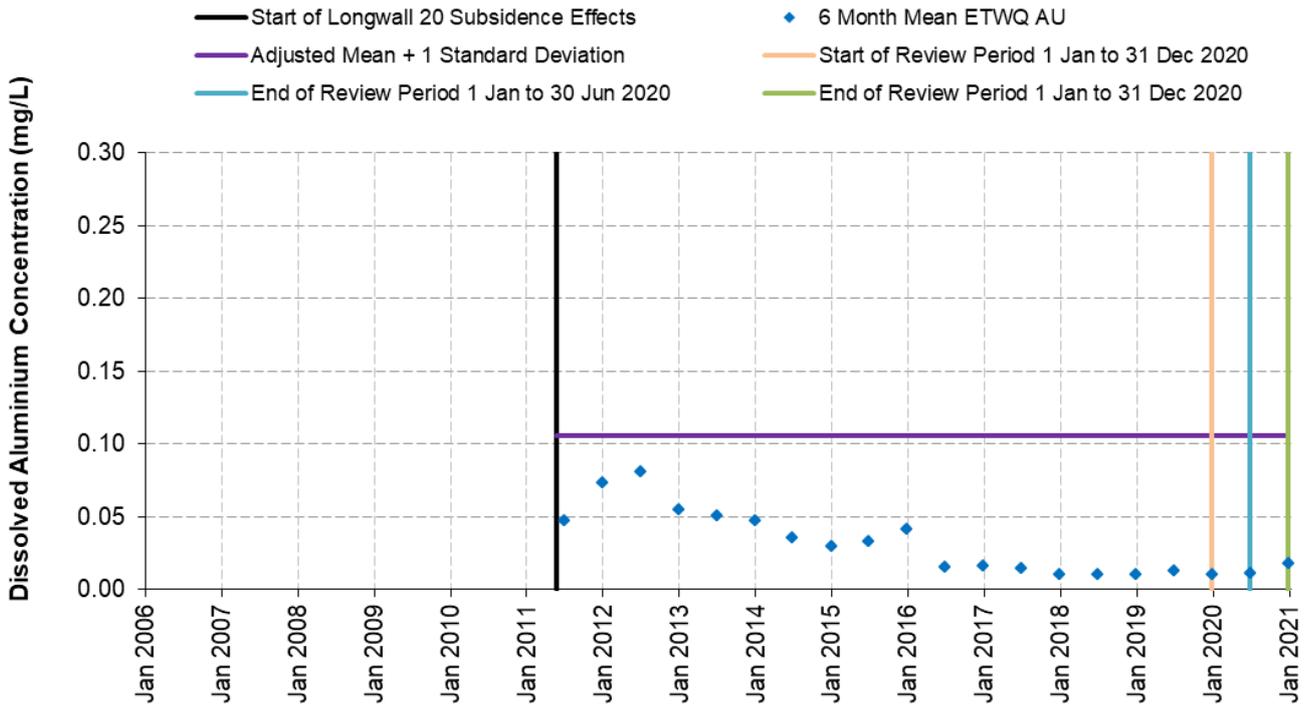


Chart 28 Six Month Means of Dissolved Aluminium Concentrations in Eastern Tributary at ETWQ AU

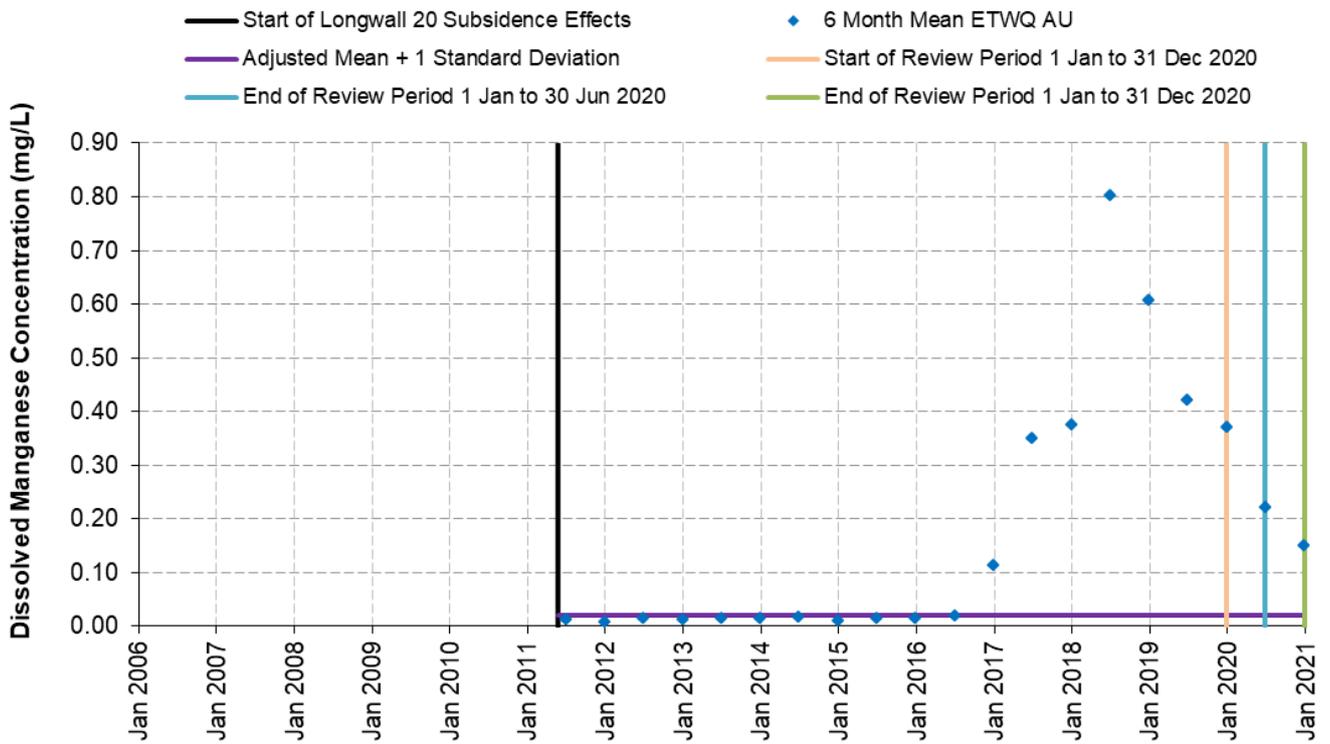


Chart 29 Six Month Means of Dissolved Manganese Concentrations in Eastern Tributary at ETWQ AU

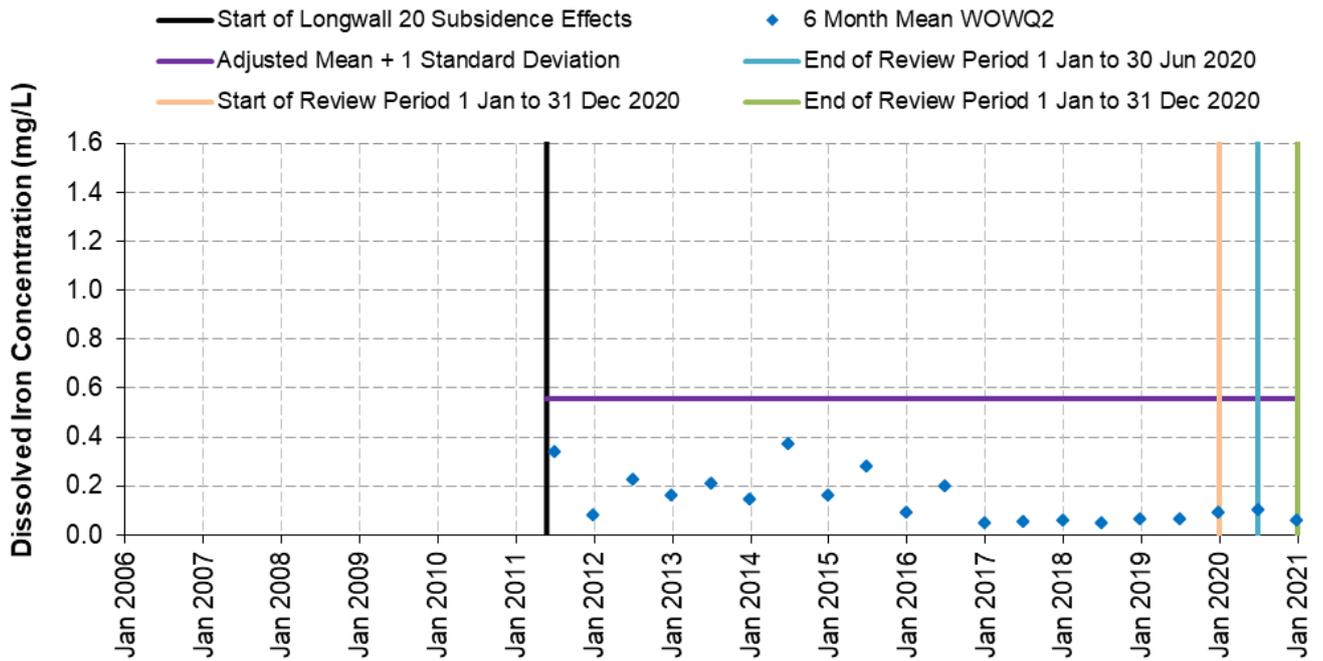


Chart 30 Six Month Means of Dissolved Iron Concentrations in Woronora River at WOWQ 2

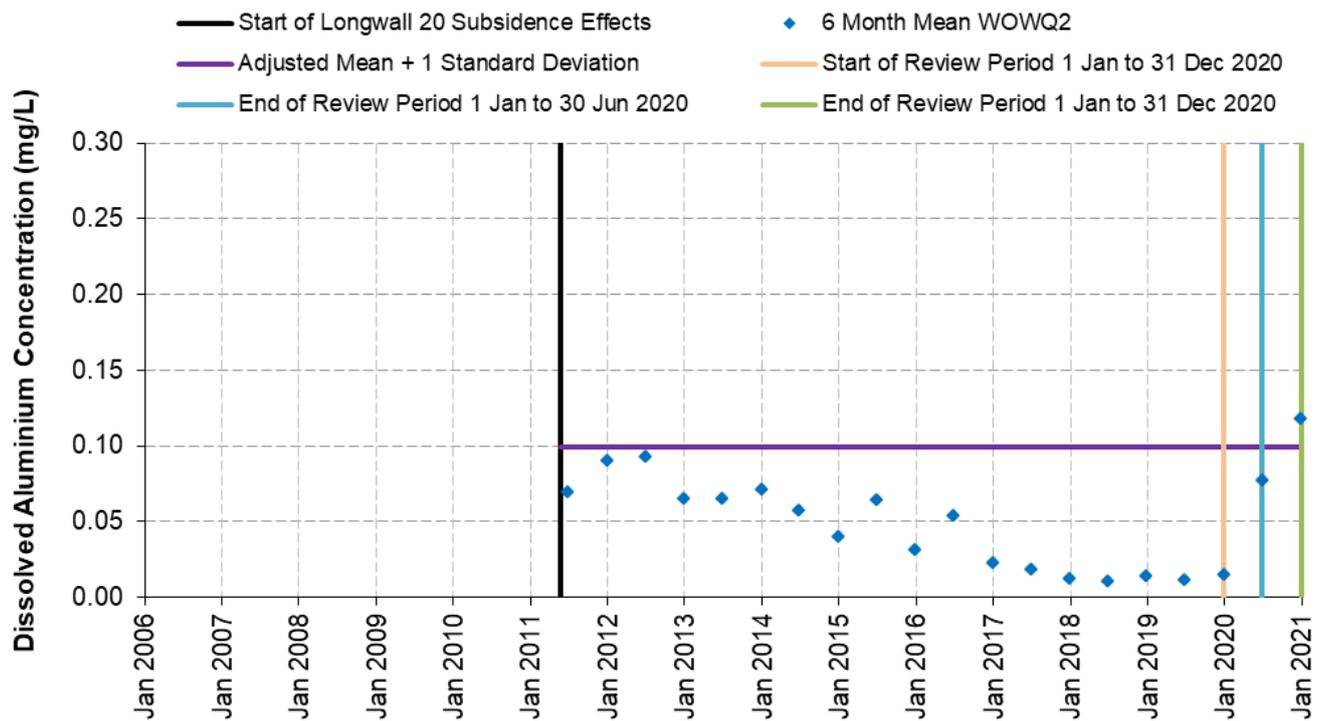


Chart 31 Six Month Means of Dissolved Aluminium Concentrations in Woronora River at WOWQ 2

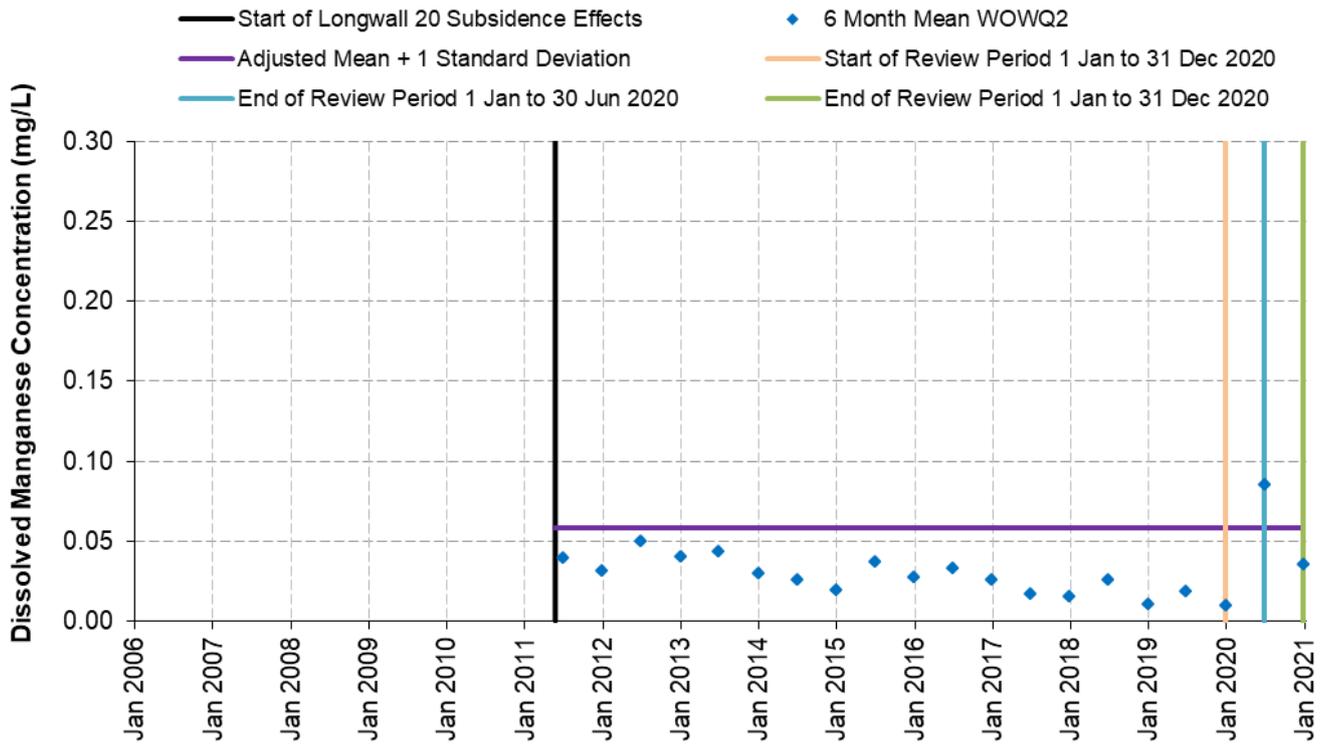


Chart 32 Six Month Means of Dissolved Manganese Concentrations in Woronora River at WOWQ 2

There were no exceedances of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved iron or dissolved aluminium in Eastern Tributary at site ETWQ AU (Chart 27 and Chart 28). There continued to be an exceedance of the adjusted baseline mean plus one standard deviation for two consecutive six month means for dissolved manganese in Eastern Tributary at site ETWQ AU for the reporting period (Chart 29). At control site WOWQ 2 on the Woronora River the adjusted baseline mean plus one standard deviation for dissolved manganese was exceeded in one six month period only (January to June 2020 - Chart 32). Accordingly, the results for dissolved manganese in the Eastern Tributary at site ETWQ AU equate to a Level 3 significance level. It is worth noting that there has been a steady decline in the six month mean for dissolved manganese at ETWQ AU from the peak value of 0.8 mg/L in mid-2018 to 0.151 mg/L at the end of the review period.

There were no exceedances on the Woronora River at control site WOWQ 2 for dissolved iron during the review period (Chart 30), however, there was one exceedance of the dissolved aluminium six month mean (July to December 2020, refer Chart 31) and one exceedance of the dissolved manganese six month mean (January to June 2020, refer Chart 32).

3.2.3 Analysis against Subsidence Impact Performance Measure – Eastern Tributary

Subsidence Impact Performance Measure:

Negligible reduction to the quality of water resources reaching the Woronora Reservoir.

The exceedance of the performance indicator in relation to dissolved manganese (for January and February and from June to December 2020) has triggered assessments of whether the subsidence impact performance measure for catchment yield to the Woronora Reservoir has been exceeded in relation to water quality (i.e. whether the Project has resulted in a greater than negligible reduction in the quality of water resources reaching the Woronora Reservoir). These assessments have been / are being undertaken by an environmental water quality expert: Professor Barry Noller from The University of Queensland.

3.3 WORONORA RESERVOIR WATER QUALITY

3.3.1 Assessment of Water Quality in Woronora Reservoir

Performance Indicator:

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

Metropolitan Coal has sourced surface water quality data for the Woronora Reservoir (site DWO1) from WaterNSW in accordance with a data exchange agreement. Consistent with the monitoring of water reaching the Woronora Reservoir (Section 3.2), the 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.

The analysis of water quality data involves:

- Water quality data analysed annually, following the receipt of data from WaterNSW.
- Water quality parameters, measured in the same location on the same day are geometrically averaged.
- The parameter records are interpolated to provide daily records.

- Concentration exceedance duration curves are calculated for each parameter by determining the concentration exceeded at each location by percentages of days of the year covering the full range from 0% to 100%, at 5% intervals.
- Baseline data is analysed in an annual format to determine concentration exceeded with an estimated average recurrence interval (ARI⁷) curve of 20 years by percentages of days in the year from 0% to 100%. For each percentage of time selected from this range, an ARI curve is calculated by fitting a log Generalised Extreme Value distribution to the concentration exceeded each year of the baseline record by that percentage of days.
- For each water quality parameter, the concentration exceedance curve for the current year of monitoring and the 20 year ARI exceedance curve calculated from the baseline records is plotted on a graph.

The results are assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan significance levels/triggers (below):

Significance Levels/Triggers	
Negligible Reduction to the Quality of Water Resources in the Woronora Reservoir	
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%.
Level 2	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 10 year ARI but below the baseline 20 year ARI exceedance curve for any range of the duration percentages from 0% to 75%.
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%.

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 ARI exceedance curve for any range of the duration percentages from 0% to 75%.

Results of this assessment over the 2020 Annual Review period at the Woronora Reservoir are shown in Chart 33 to Chart 35 below.

⁷ Average Recurrence Interval. This term has been used here for consistency with previous Annual Reviews. Based on recommendations by the Institution of Engineers Australia, the preferred terminology now involves the term Annual Exceedance Probability (AEP) expressed as a percentage probability. This is to avoid confusion that the term ARI has caused within the industry, community and other stakeholders. A 20 year ARI is equivalent to a 5% AEP.

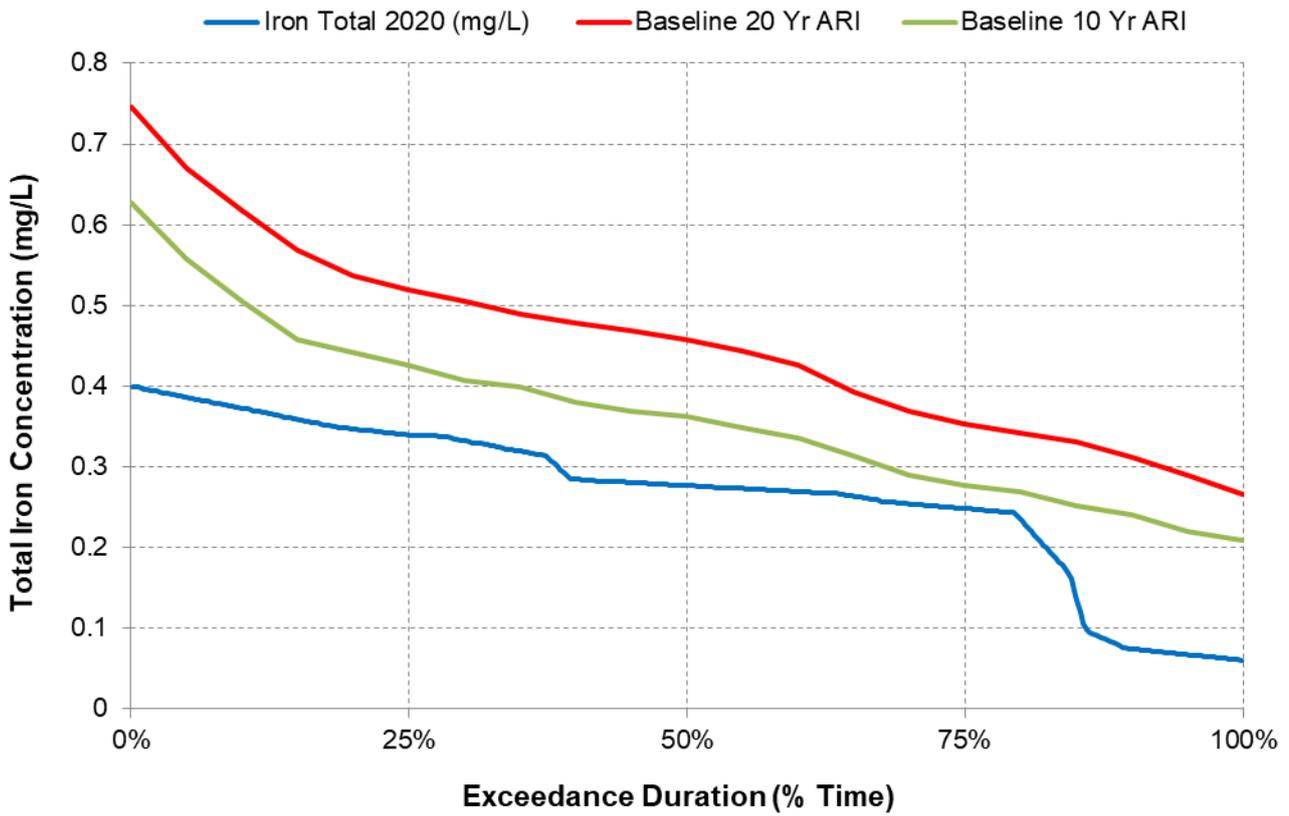


Chart 33 Total Iron Performance Indicator Woronora Reservoir 2020

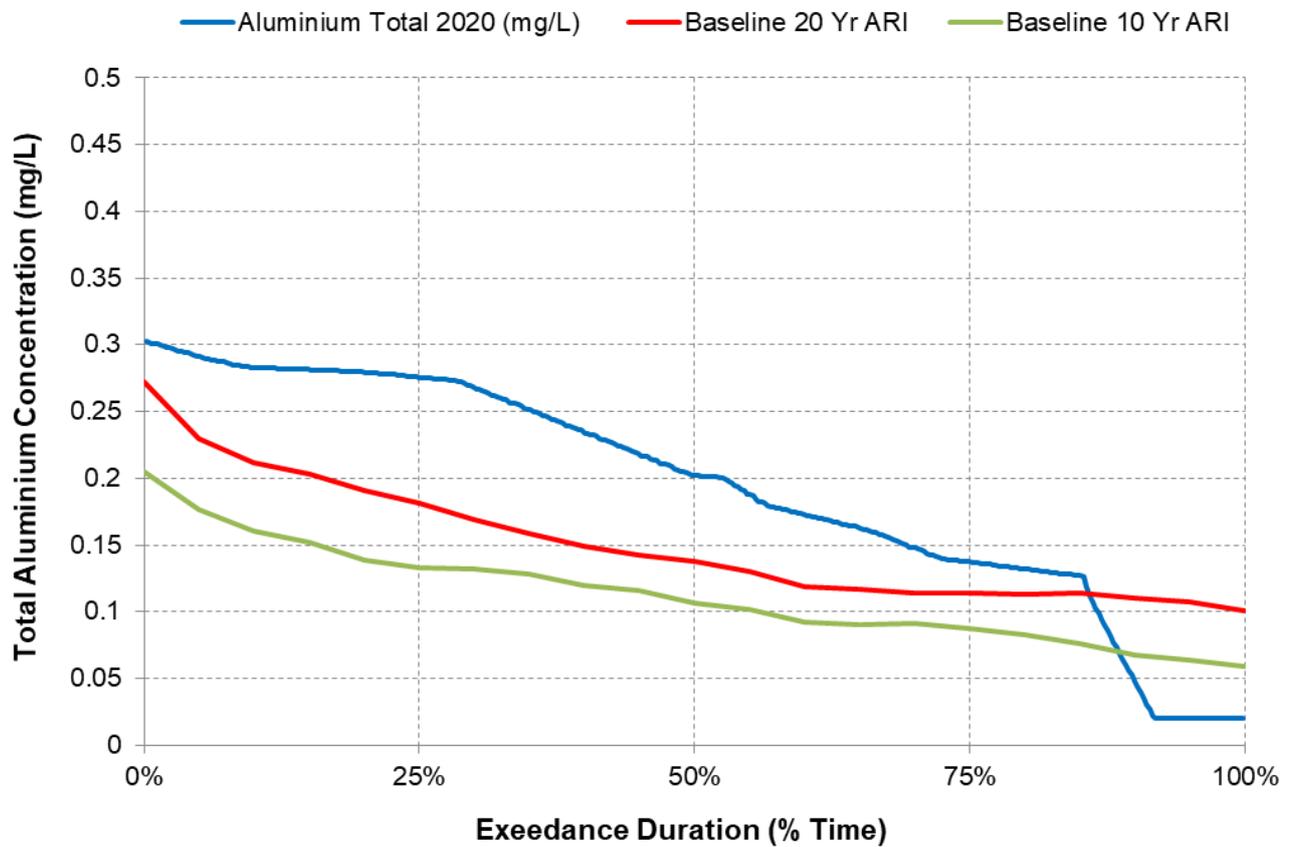


Chart 34 Total Aluminium Performance Indicator Woronora Reservoir 2020

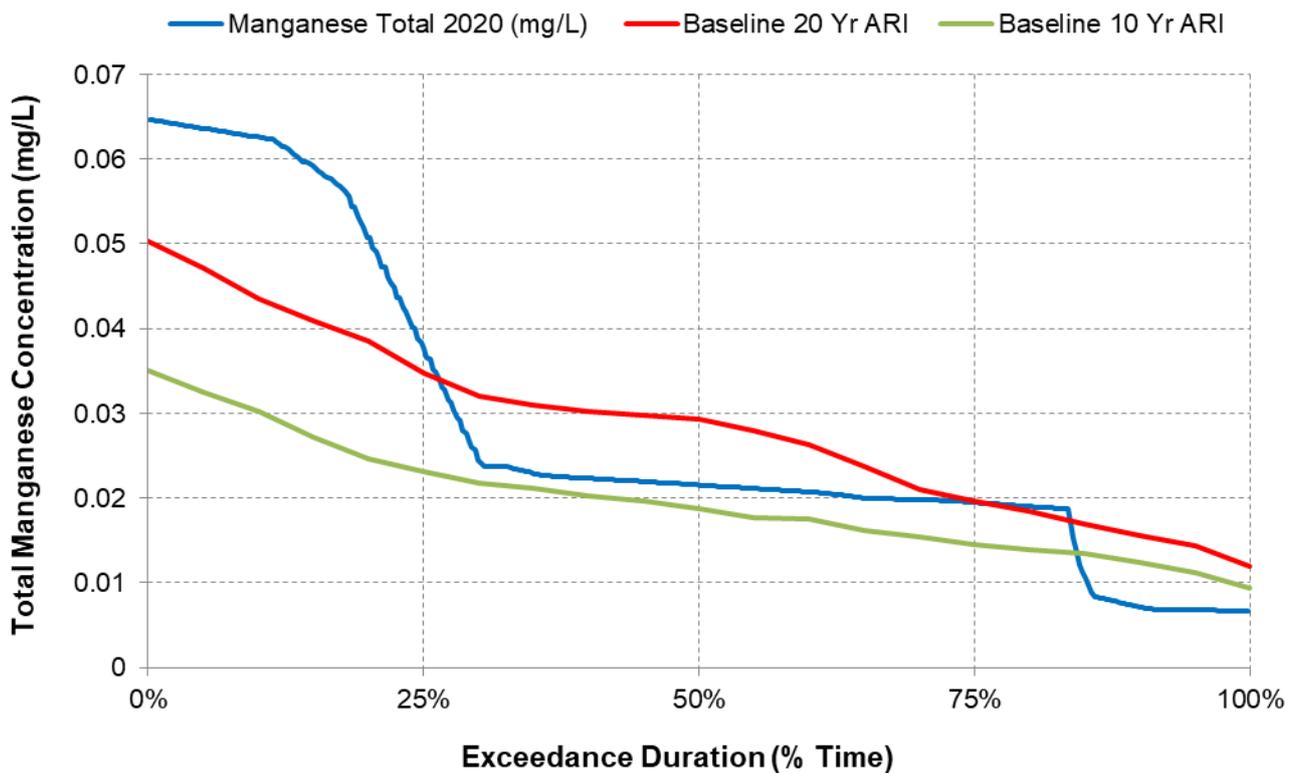


Chart 35 Total Manganese Performance Indicator Woronora Reservoir 2020

There were no exceedances of the 10 Year or 20 year ARI exceedance curve for total iron (refer Chart 33). Total aluminium exceeded the 10 Year and 20 Year ARI exceedance curves for 90% and 85% of the review period respectively (Chart 34). 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 35). The results for total aluminium and total manganese equate to a Level 3 significance.

3.3.2 Analysis against Subsidence Impact Performance Measure – Woronora Reservoir

The assessment of whether the performance measure in relation to the quality of water resources in the Woronora Reservoir has been exceeded has been based on the following considerations:

- whether there have been elevated aluminium and manganese concentrations detected in monitored inflows which could link the elevated levels to mining activities;
- whether there have been elevated aluminium and manganese levels reported in other WaterNSW water supply dams (Nepean Reservoir and Cataract Reservoir); and
- whether the elevated aluminium levels exceed relevant drinking water standards including the Bulk Water Supply Agreement.

Assessment of Concurrent Aluminium and Manganese Concentrations in Reservoir Inflows

Water quality in surface water systems directly upstream of the Woronora Reservoir is monitored by Metropolitan Coal at site WRWQ 9 on Waratah Rivulet, WOWQ 2 on Woronora River, ETWQ AU on Eastern Tributary, BCWQ 1 on Bee Creek and HCWQ 1 on Honeysuckle Creek (refer Figure 3 for site locations). Site WRWQ 9 on Waratah Rivulet and site ETWQ AU on Eastern Tributary are within the Mining Lease Boundary while sites WOWQ 2 on Woronora River, BCWQ 1 on Bee Creek and HCWQ 1 on Honeysuckle Creek are located in catchments outside of the potential influence of mining.

It should be noted that the water quality analyses for aluminium and manganese in streams within and adjacent to the Metropolitan Coal Mine are conducted using field filtered samples. This has the effect

of removing the component of aluminium and manganese in the sample associated with sediment i.e. aluminium or manganese which is adsorbed or otherwise attached to sediment particles in the sample which is retained on the filter during the filtering process. In contrast, the available data for the Woronora Reservoir provided by WaterNSW is based on analyses of unfiltered samples (i.e. total aluminium and total manganese).

The dissolved aluminium concentrations in inflow sites to the Woronora Reservoir over the period January 2019 to December 2020 are shown in Chart 36 below in comparison with Woronora Reservoir total aluminium concentrations. Note that the total aluminium concentration for the Woronora Reservoir presented for each sampling day has been calculated as the geometric mean⁸ of all samples collected on that day. The cumulative residual rainfall⁹ for pluviometers PV5 and PV8 (refer Figure 1 for locations) is also plotted for the period 2019 to 2020 to show periods of low and high rainfall.

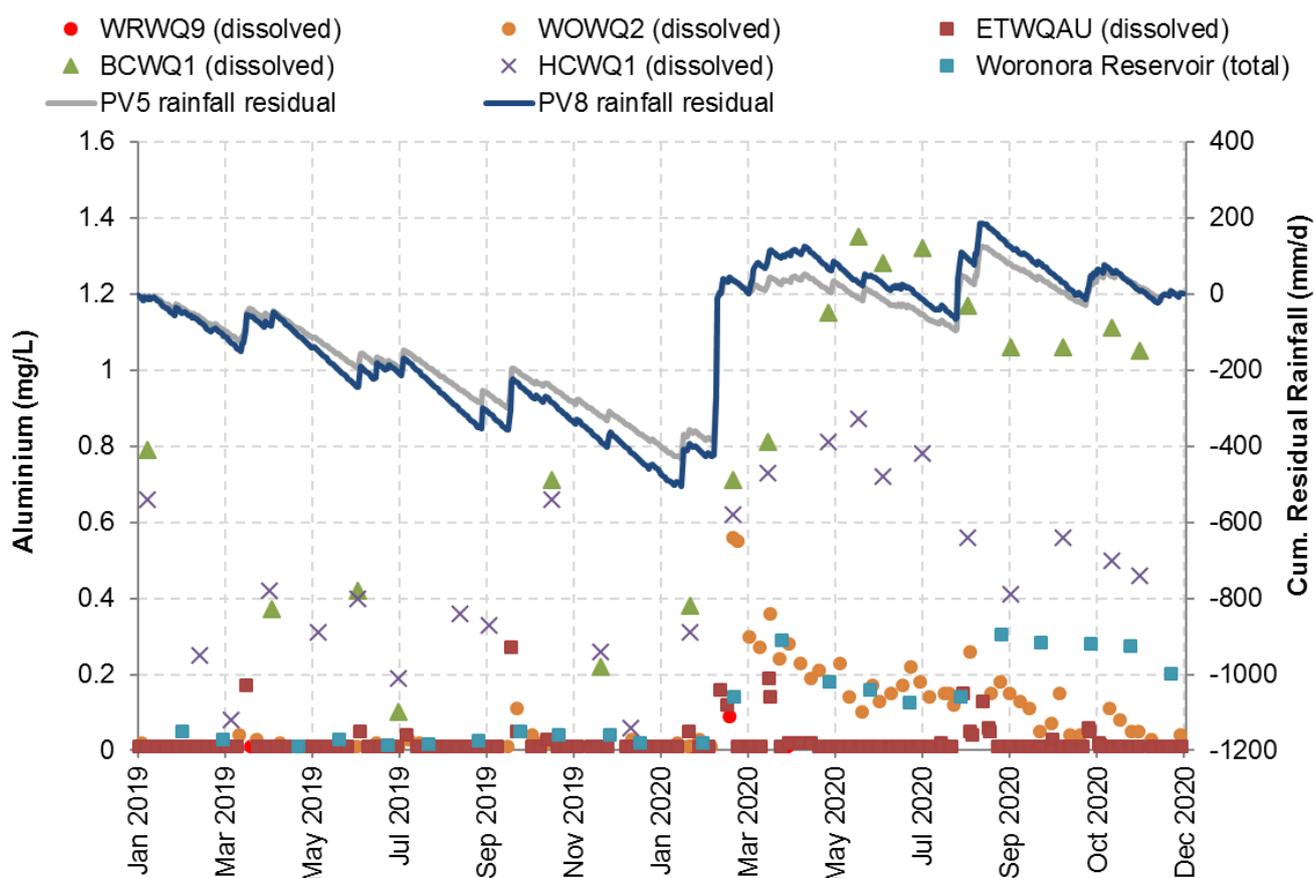


Chart 36 Aluminium Concentrations in Woronora Reservoir and Inflow to Woronora Reservoir (2019 – 2020)

Whilst accepting the limitations of the comparison between dissolved and total aluminium concentrations, it is evident from Chart 36 that aluminium concentrations in inflow from Bee Creek (BCWQ 1), Honeysuckle Creek (HCWQ 1) and the Woronora River (WOWQ 2) were elevated in comparison with aluminium concentrations in inflow from Waratah Rivulet (WRWQ 9) and Eastern Tributary (ETWQ AU). Woronora Reservoir aluminium concentrations increased initially in February and March 2020 during and following substantial rainfall which occurred after a prolonged period of below average rainfall in 2019. The aluminium concentrations in inflow from Bee Creek (BCWQ 1)

⁸ The geometric mean is a mean of a set of numbers by using the product of their values (as opposed to the arithmetic mean which uses their sum).

⁹ Cumulative residual rainfall calculates the cumulative amount of rainfall relative to the long-term daily average rainfall. Positive slopes are indicative of periods of high rainfall and negative slopes of dry or drought periods.

remained elevated for the duration of 2020 while aluminium concentrations in inflow from Honeysuckle Creek (HCWQ 1) and Woronora River (WOWQ 2) declined over the duration of 2020. As noted in Section 2.4, a historically high concentration of dissolved aluminium was recorded at BCWQ 1 (1.35 mg/L) and HCWQ 1 (0.87 mg/L) in May 2020 and a historically high concentration of 0.56 mg/L dissolved aluminium was recorded at WOWQ 2 in February 2020.

The elevated aluminium concentrations in inflow from Bee Creek (BCWQ 1), Honeysuckle Creek (HCWQ 1) and Woronora River (WOWQ 2) in February and March 2020 correlate with elevated concentrations recorded in the Woronora Reservoir during the same period. Elevated aluminium concentrations in the Woronora Reservoir were again recorded in August to December 2020, following a period of above average rainfall.

The data in Chart 36 indicates that dissolved aluminium concentrations have been relatively low at both WRWQ 9 (Waratah Rivulet) and ETWQ AU (Eastern Tributary) and that there was no change evident in the dissolved aluminium concentrations recorded in the period prior to, during or after, the reported elevated total aluminium levels in the Woronora Reservoir to suggest potential mining-related influences.

The dissolved manganese concentrations in inflow sites to the Woronora Reservoir over the period January 2019 to December 2020 are shown on Chart 37 below in comparison with Woronora Reservoir total aluminium concentrations. Note that the total manganese concentration for Woronora Reservoir presented for each sampling day has been calculated as the geometric mean of all samples collected on that day. The cumulative residual rainfall for pluviometers PV5 and PV8 (refer Figure 1 for locations) are also plotted for the period 2019 to 2020.

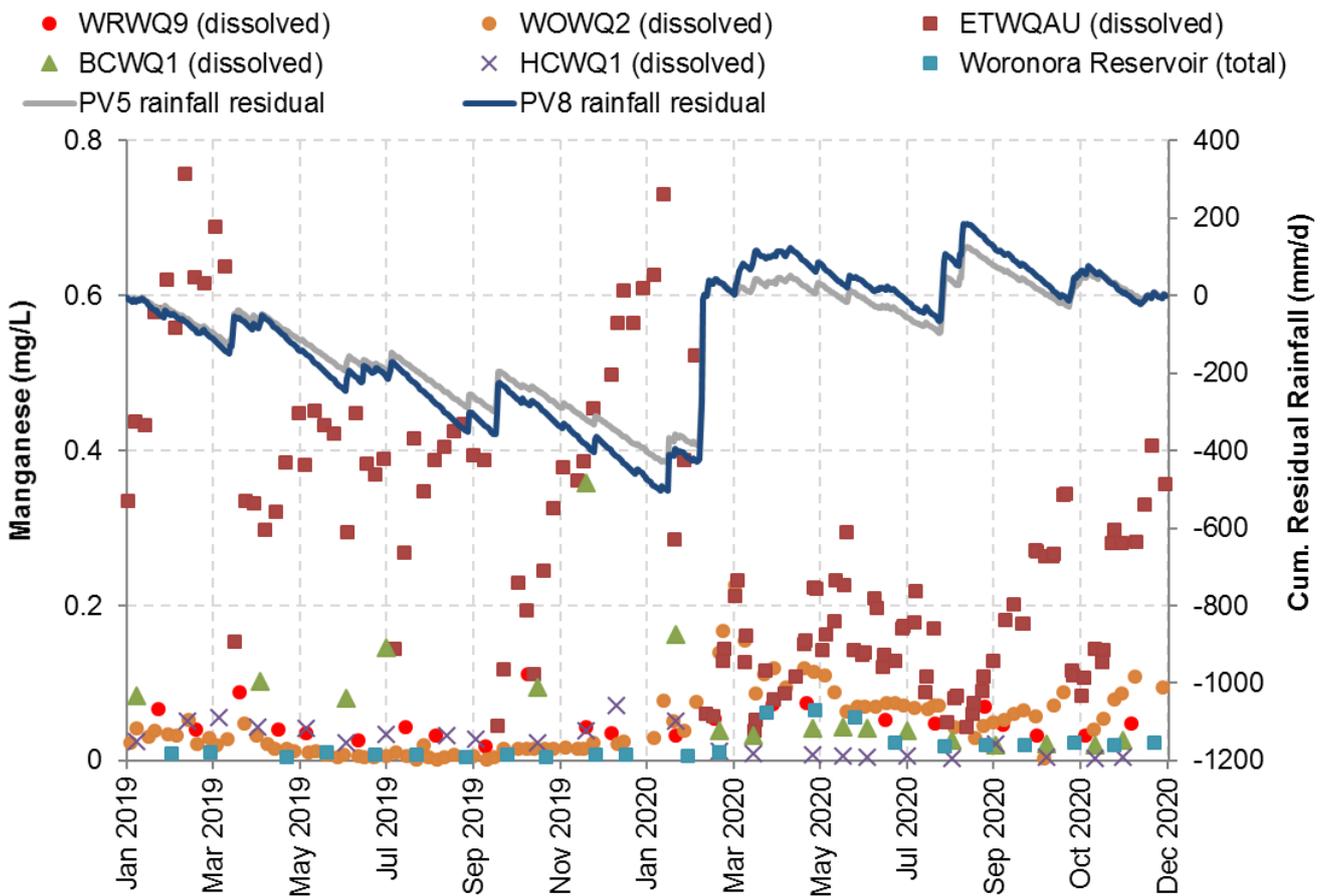


Chart 37 Manganese Concentrations in Woronora Reservoir and Inflow to Woronora Reservoir (2019 – 2020)

The data presented in Chart 37 indicates that manganese concentrations in inflow from all surface water systems were elevated during and following the substantial rainfall period in February 2020. As noted in Section 2.4, a historically high concentration of 0.226 mg/L dissolved manganese was recorded in March 2020 at WOWQ 2 in Woronora River. After this period, elevated total manganese concentrations were recorded in the Woronora Reservoir until approximately May 2020. Dissolved manganese concentrations were particularly elevated in inflow from the Eastern Tributary (ETWQ AU) in the period prior to the substantial rainfall in early 2020. However, the dissolved manganese concentrations in inflow from the Eastern Tributary (ETWQ AU) were also elevated at similar levels in early 2019, with no significant increase in total manganese concentrations in the Woronora Reservoir at this time. Dissolved manganese concentrations at ETWQ AU fell following the substantial rainfall period in February but generally remained elevated compared with other monitoring sites.

The data in Chart 37 indicates that while the dissolved manganese concentrations in inflow from the Eastern Tributary (ETWQ AU) in the period prior to, during or after the reported elevated total manganese levels in the Woronora Reservoir are likely to have contributed somewhat to an increase in manganese in the Woronora Reservoir, it is unlikely that this was the sole cause. The elevated total manganese concentrations in the Woronora Reservoir recorded between March and May 2020, were likely also contributed to by elevated manganese concentrations in inflow from numerous other surface water systems (from catchments outside of the potential influence of mining) which occurred during and following the substantial increase in rainfall after a prolonged low rainfall period.

Comparison of Total Aluminium and Total Manganese Concentrations in Woronora Reservoir, Nepean Reservoir and Cataract Reservoir

Chart 38 and Chart 39 present comparative total aluminium and total manganese concentrations recorded in the Nepean, Cataract and Woronora Reservoirs. Also plotted is cumulative rainfall recorded at PV1 (refer Figure 1).

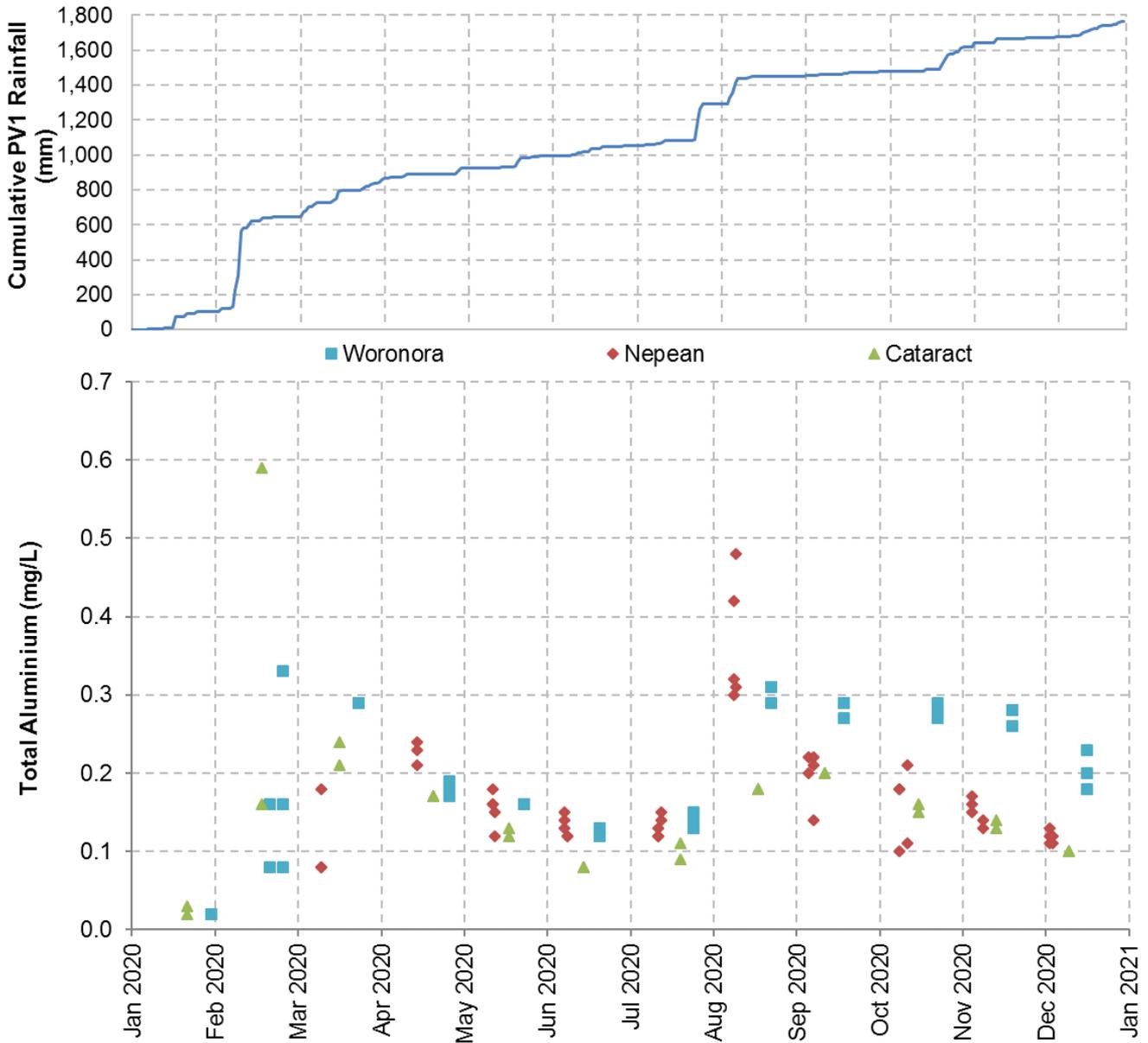


Chart 38 Total Aluminium in Woronora, Nepean and Cataract Reservoirs – 2020

The data presented in Chart 38 shows that there was a similarity in total aluminium concentration patterns and levels for the three storages during 2020, with higher concentrations of total aluminium recorded in the Nepean Reservoir in some months in comparison with the records for Woronora Reservoir and Cataract Reservoir. The total aluminium concentrations rose in all three reservoirs during the substantial rainfall in early February 2020, although data for the Nepean Reservoir was not available until early March. The total aluminium concentrations increased again in August 2020 following substantial rainfall (with data from the Nepean Reservoir available immediately after the August rainfall event), although the total aluminium concentrations recorded in the Nepean and Cataract Reservoirs declined more rapidly in November and December 2020 in comparison with the Woronora Reservoir.

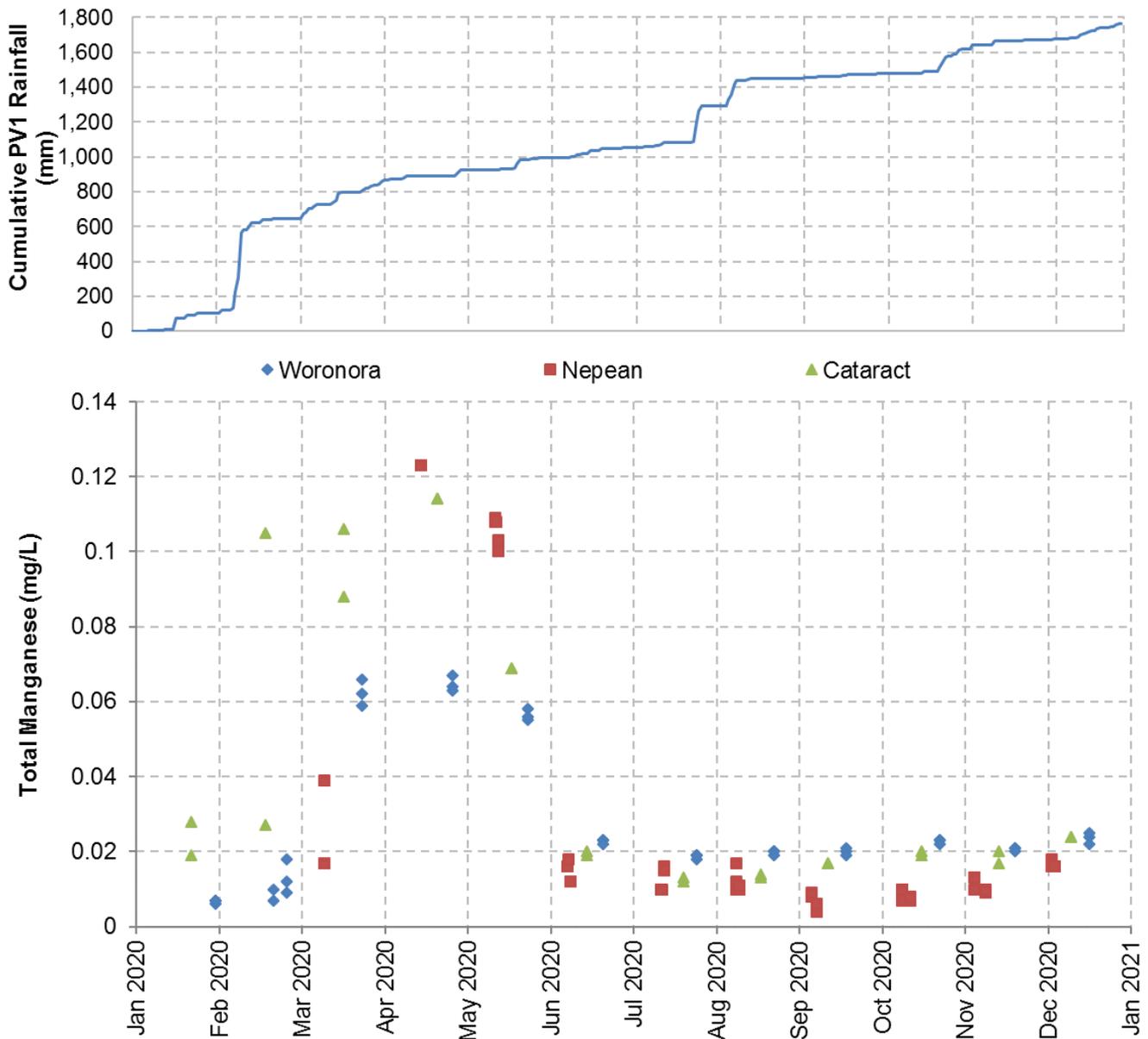


Chart 39 Total Manganese in Woronora, Nepean and Cataract Reservoirs - 2020

The data presented in Chart 39 shows that there was a similarity in concentration patterns and levels for the three storages throughout 2020, although the concentrations of total manganese recorded in the Woronora Reservoir were slightly lower between March and May 2020 compared with the other two reservoirs, following the substantial rainfall in February, than that recorded in the Nepean and Cataract Reservoirs. The total manganese concentrations were elevated in all three reservoirs during and following the substantial rainfall in February and remained low for the period June to December 2020.

Comparison with Bulk Water Supply Agreement

The water quality standard applicable for aluminium (assumed to be for total concentration) in accordance with the Sydney Catchment Authority and Sydney Water Corporation Raw Water Supply Agreement is 0.4 mg/L (WaterNSW, 2013). The available monitoring data indicates that the elevated total aluminium concentrations recorded in the Woronora Reservoir during 2020 did not exceed the water quality standard. A maximum total aluminium concentration of 0.33 mg/L was recorded in the Woronora Reservoir in February 2020 (refer Chart 38). As can be seen in Chart 2 of Section 2.5, total

aluminium concentrations of 0.4 mg/L have rarely been exceeded previously in the Woronora Reservoir.

The water quality standard applicable for manganese (assumed to be total) in accordance with WaterNSW (2013) is 0.1 mg/L. The available monitoring data indicates that this concentration was not exceeded in the Woronora Reservoir for the duration of the review period. A maximum total manganese concentration of 0.067 mg/L was recorded in April 2020 (refer Chart 39). As can be seen in Chart 3 of Section 2.5, total manganese concentrations of 0.1 mg/L have rarely been exceeded previously in the Woronora Reservoir.

Conclusion

It is concluded that the Performance Measure:

Negligible reduction in the water quality of Woronora Reservoir

has not been exceeded. The elevated concentrations of total aluminium at sampling site DW01 in the Woronora Reservoir during the review period are unlikely to be related to mining activity and are more likely to be related to elevated concentrations of aluminium 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 elevated concentrations of total manganese at sampling 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 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.

3.4 FLOW DIVERSION AND NATURAL DRAINAGE BEHAVIOUR OF DOWNSTREAM POOLS

3.4.1 Waratah Rivulet Downstream of Maingate of Longwall 23

Performance Indicators:

No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.

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.

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.

The results are assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan significance levels/triggers (below):

Negligible Environmental Consequences on Waratah Rivulet: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	Significance Levels/Triggers	
<i>No change to the natural drainage behaviour of Pools P, Q, R, S, T, U, V and W.</i>	Level 1	No mine-induced surface cracking or impacts to natural drainage behaviour observed
	Level 2	Mine-induced surface cracking observed. No impacts to natural drainage behaviour observed.
	Level 3	There appear to be impacts to natural drainage behaviour such that: <ul style="list-style-type: none"> - a pool does not continue to flow over, through and/or below the rock bars (where relevant); or - surface flow is not evident along the length of Pools P or T prior to flowing through/below the rock bars; - surface flow is not evident along the length of Pools Q, R or S prior to flowing over the rock bars; - surface flow is not evident along the length of Pool V prior to flowing over/through/below the rock bar; and - surface flow is not evident along the length of Pools U or W prior to flowing through the downstream boulder field.
<i>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.</i>	Level 1	The water level in Pools P, T, U, V or W has not been below the pool's previous minimum.
	Level 2	The water level in Pools P, T, U, V or W has been below the pool's previous minimum, however, is considered to be due to an error type.
	Level 3	The water level in Pools P, T, U, V or W has been below the pool's previous minimum and does not appear to be due to an error type; and the same is not occurring in control pool(s).
<i>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.</i>	Level 1	The water level in Pools Q, R or S has been above that required to maintain water over the downstream rock bar.
	Level 2	The water level in Pools Q, R or S has been below that required to maintain water over the downstream rock bar, however, appears to be due to an error type.
	Level 3	The water level in Pools Q, R or S has been below that required to maintain water over the downstream rock bar and does not appear to be due to an error type and the same is not occurring in control pool(s).

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.

The recorded water levels in Pools P, T, U, V and W have remained at or above the pools' previously recorded minimums. The recorded water levels in Pools Q, R and S have remained above that required to maintain water over the downstream rock bar. The results equate to a Level 1 significance level for these pools.

3.4.2 Analysis against Subsidence Impact Performance Measure – Waratah Rivulet Downstream of Maingate of Longwall 23

Subsidence Impact Performance Measure:

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).

Assessment against Performance Measure

The performance measure, *negligible environmental consequences (that is, no diversion of flows, no change in the natural drainage behaviour of pools)*, has been met.

3.4.3 Eastern Tributary Downstream of Maingate 26

Pools ETAG to ETAU on the Eastern Tributary are situated between the full supply level of the Woronora Reservoir and the maingate of Longwall 26. Pools ETAG and ETAH are situated above Longwall 27, Pools ETAI, ETAJ and ETAK are situated above the maingate of Longwall 27 and Pools ETAL to ETAU are situated downstream of the maingate of Longwall 27.

As reported in the Metropolitan Coal 2017 Annual Review, the natural drainage behaviour of Pools ETAG, ETAH, ETAI, ETAJ, ETAK, ETAL, ETAM, ETAN, ETAO, ETAQ and ETAR have been impacted by mine subsidence (Metropolitan Coal, 2018). The observed impacts to the Eastern Tributary pools in December 2016/January 2017 resulted in the exceedance of the negligible environmental consequences performance measure for the Eastern Tributary in relation to diversion of flows and drainage behaviour.

Performance indicators have been developed for the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan for Pools ETAS, ETAT and ETAU and the results for the reporting period are assessed below.

Performance Indicators:

No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.

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.

The results are assessed against the Longwall 304 Water Management Plan and Longwalls 305-307 Water Management Plan significance levels/triggers (below):

Negligible Environmental Consequences on Eastern Tributary: No Diversion of Flows, No Change in the Natural Drainage Behaviour		
Performance Indicator	Significance Levels/Triggers	
<i>No change to the natural drainage behaviour of Pools ETAS, ETAT and ETAU.</i>	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.
	Level 2	Mine-induced surface cracking observed at Pool ETAS or Pool ETAT, or increase observed in previous cracking at Pool ETAU. No impacts to natural drainage behaviour observed.
	Level 3	There appear to be impacts to natural drainage behaviour such that there is not continual surface flow along the length of Pools ETAS, ETAT or ETAU.
<i>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.</i>	Level 1	The water levels in Pool ETAS/ETAT and Pool ETAU have been above that required to maintain water over the downstream rock bar.
	Level 2	The water levels in Pool ETAS/ETAT and Pool ETAU has been below that required to maintain water over the downstream rock bar, however, appears to be due to an error type.
	Level 3	The water levels in Pool ETAS/ETAT and Pool ETAU has been below that required to maintain water over the downstream rock bar and does not appear to be due to an error type.

Metropolitan Coal's visual inspections of Pools ETAS, ETAT and ETAU (and associated rock bars) indicate no mine-induced surface cracking has been observed at Pools ETAS and ETAT during the reporting period, and no increase in the occurrence of cracking has been observed at Pool ETAU. There have been no observed changes to the natural drainage behaviour of Pools ETAS, ETAT or ETAU during the reporting period (Metropolitan Coal, pers. comm.). The visual inspection results equate to a Level 1 significance level for Pools ETAS, ETAT and ETAU.

The recorded water level hydrograph for Pool ETAU indicates that the water level in Pool ETAU has been above that required to maintain water over the downstream rock bar. The water level results equate to a Level 1 significance level for Pool ETAU.

The recorded water level hydrograph for Pool ETAS/ETAT indicates that the water level in Pool ETAS/ETAT has been above that required to maintain water over the downstream rock bar. The water level results equate to a Level 1 significance level for Pool ETAS/ETAT.

3.4.4 Analysis against Subsidence Impact Performance Measure – Eastern Tributary Downstream of Maingate 26

Subsidence Impact Performance Measure:

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.

Assessment against Performance Measure

The above performance measure for no diversion of flows or change in the natural drainage behaviour of pools has been exceeded during previous reporting periods and has been reported to the Department of Planning, Industry and Environment (DPIE) and other relevant agencies. The natural drainage behaviour of Pool ETAS, Pool ETAT and Pool ETAU has not been impacted by mine subsidence.

3.5 SUMMARY OF ASSESSMENT AGAINST SUBSIDENCE IMPACT PERFORMANCE INDICATORS AND PERFORMANCE MEASURES

The subsidence impact performance indicators and performance measures in Table 2 were developed to address the predictions of subsidence impacts and environmental consequences on surface water included in the Project Environmental Assessment, PPR and Metropolitan Coal Extraction Plans. Assessments against the subsidence impact performance indicators and performance measures have been conducted for the reporting period (1 January to 31 December 2020) in Table 2.

Table 2 Summary of Surface Water Environmental Performance Assessment

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible reduction to the quantity of water resources reaching the Woronora Reservoir	<i>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).</i>	WaterNSW gauging station on Waratah Rivulet (GS 2132102)	Surface water flow.	Level 1	The median of the ratios does not fall below the 35 th percentile of the baseline data.	Surface water flow was at Level 1 from 4 August to December 2020.	No	Yes
				Level 2	The median of the ratios falls below the 35 th percentile but does not fall below the 20 th percentile of the baseline data.	Surface water flow was at Level 2 from 28 April to 3 August 2020, however the same was also occurring in the control catchment	No	No
				Level 3	The median of the ratios falls below the 20 th percentile of the baseline data.	Surface water flow was at Level 3 from 1 January to 27 April 2020, however the same was also occurring in the control catchment.	No	No
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	<i>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 WOWQ 2.</i>	Site WRWQ 9 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

Table 2 (Cont.) Summary of Surface Water Environmental Performance Assessment

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible reduction in the water quality of Woronora Reservoir	<i>Changes in the quality of water in the Woronora Reservoir are not significantly different post-mining compared to pre-mining concentrations.</i>	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 – further assessment has indicated that the elevated concentrations of total aluminium and total manganese at sampling site DW01 in the Woronora Reservoir are unlikely to be related to mining activity and more likely to be related to elevated concentrations in surface water system inflows from catchments outside of the potential influence of mining during and following a period of substantial rainfall which occurred after a prolonged period of low rainfall.

Table 2 (Cont.) Summary of Surface Water Environmental Performance Assessment

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
Negligible reduction to the quality of water resources reaching the Woronora Reservoir	<i>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 WOWQ 2.</i>	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 parameters exceeds the adjusted baseline mean plus two standard deviations for one month.	Dissolved manganese was at Level 2 from March to May 2020. Dissolved iron was at Level 2 in August and November 2020.	No	No
				Level 3	Data analysis indicates: <ul style="list-style-type: none"> 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 for January and February and from June to December 2020.	Yes	Assessment to be conducted by Associate Professor Barry Noller.

Table 2 (Cont.)

Summary of Surface Water Environmental Performance Assessment

Performance Measure	Performance Indicator	Monitoring Site(s) being Assessed	Parameters	Significance Level/Trigger		Comment	Subsidence Impact Performance Indicator Exceeded?	Subsidence Impact Performance Measure Exceeded?
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 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	Refer Note 1
	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 ETAS/ETAT and Pool ETAU were at Level 1 throughout the reporting period.	No	Refer Note 1
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 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

¹ 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 includes monitoring of pools not impacted during the mining of Longwalls 23-27. 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 305-307.

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APPENDICES

Appendix A Monitored Pool Water Level Hydrographs Pools on Waratah Rivulet

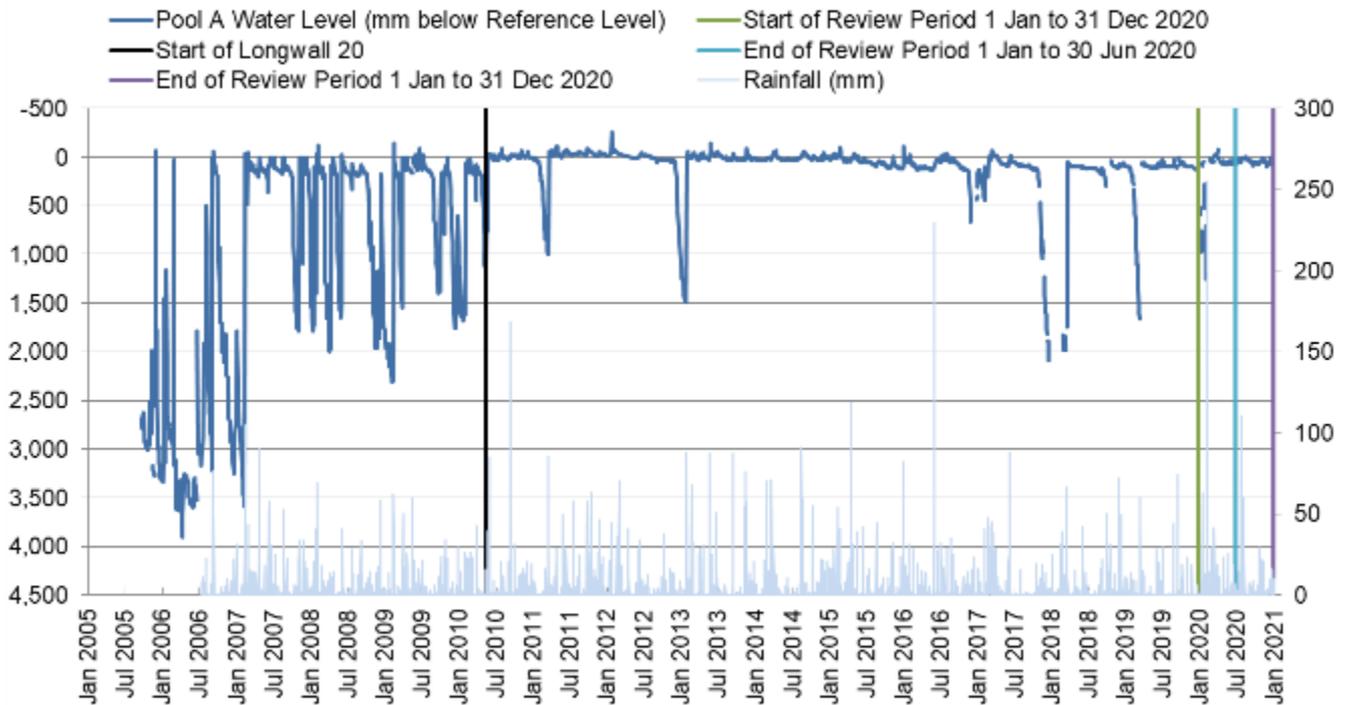


Chart A1 Pool A Waratah Rivulet (Manual Observations)

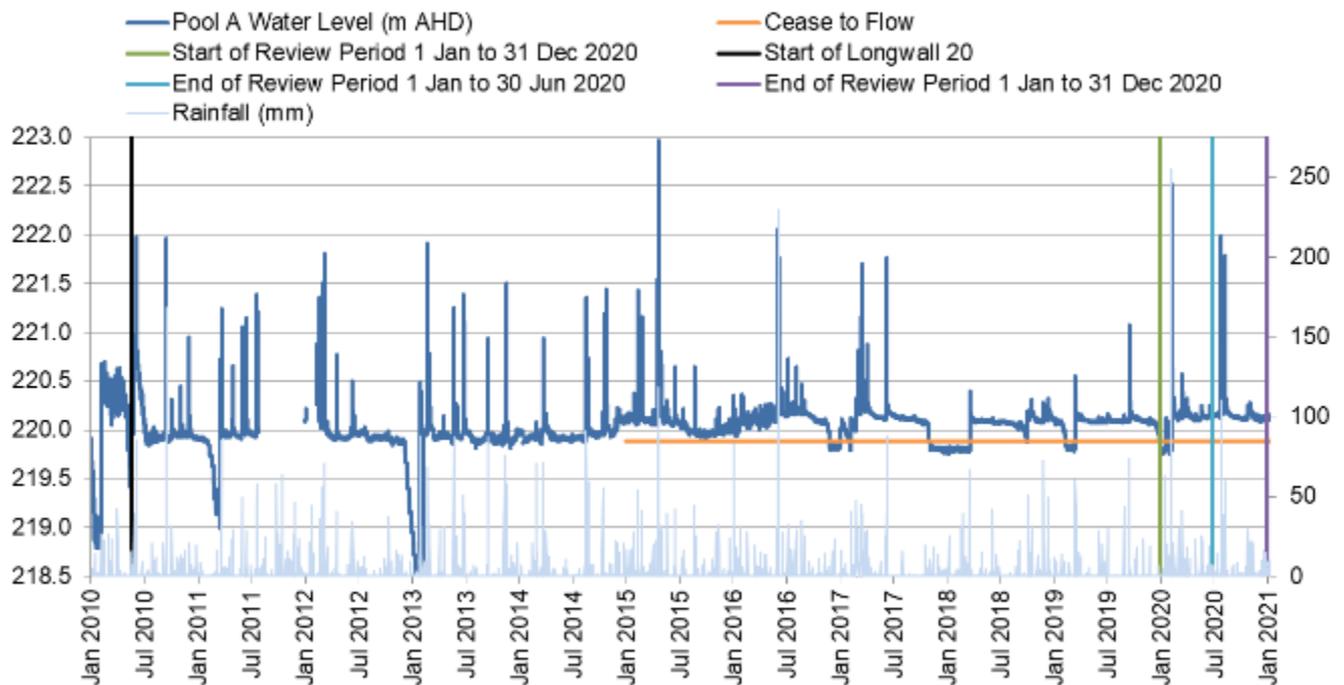


Chart A2 Pool A Waratah Rivulet

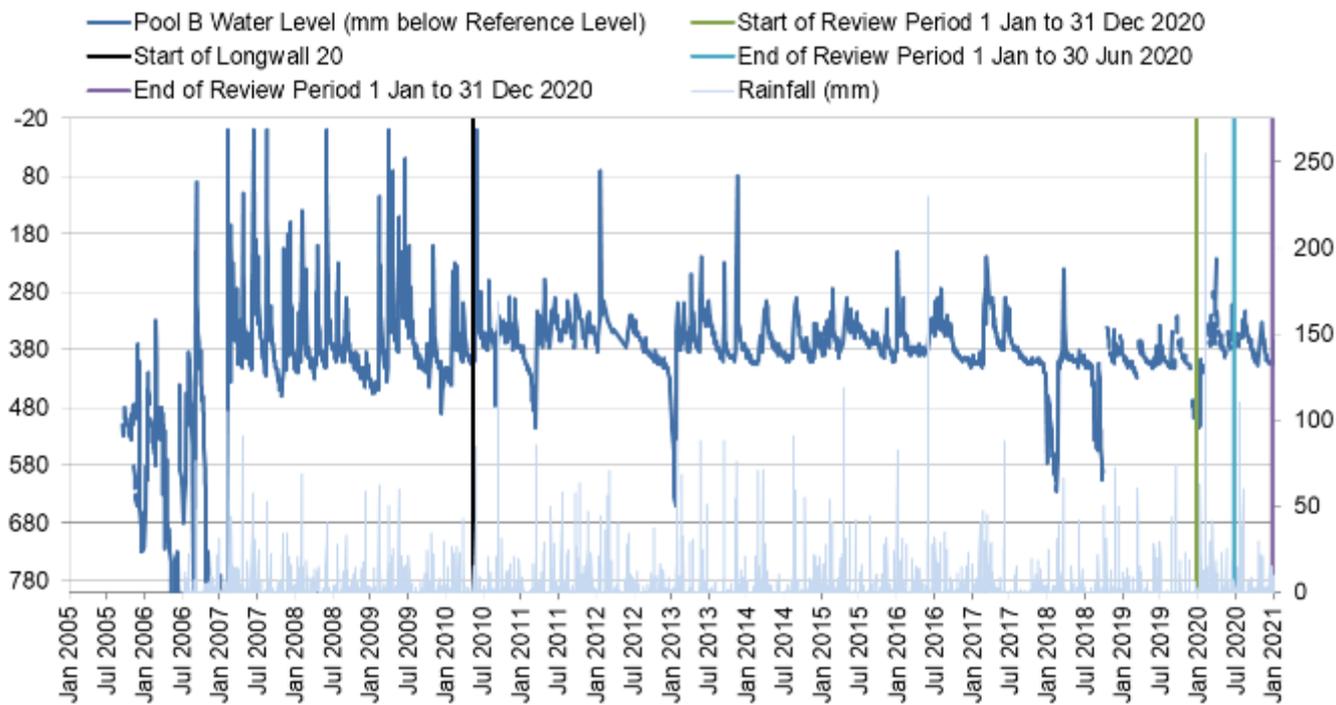


Chart A3 Pool B Waratah Rivulet (Manual Observations)

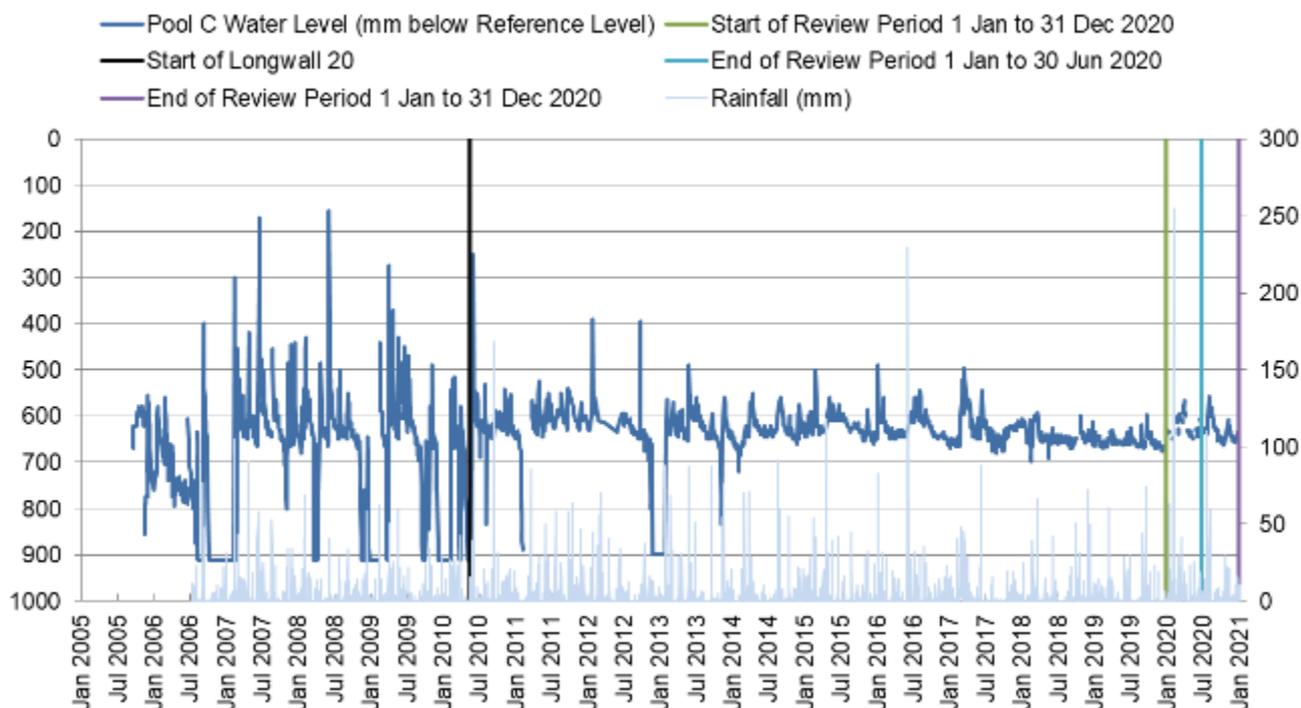


Chart A4 Pool C Waratah Rivulet (Manual Observations)

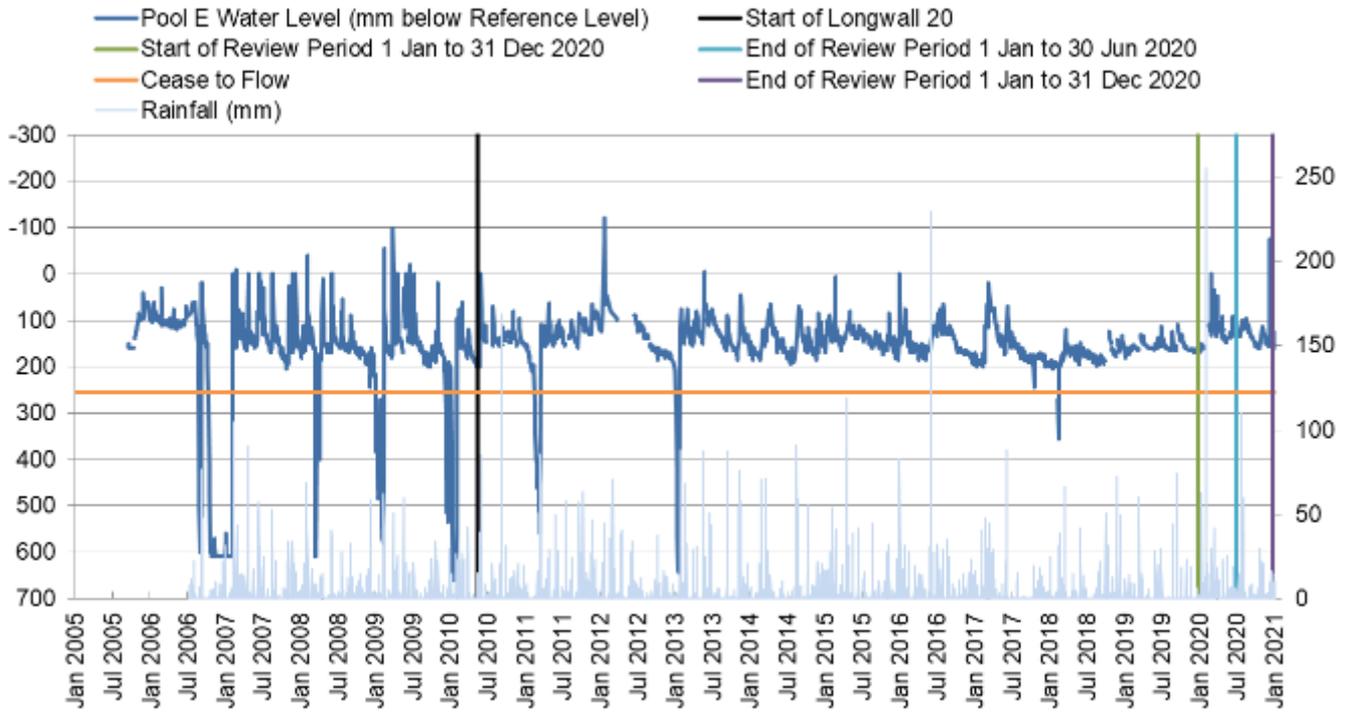


Chart A5 Pool E Waratah Rivulet (Manual Observations)

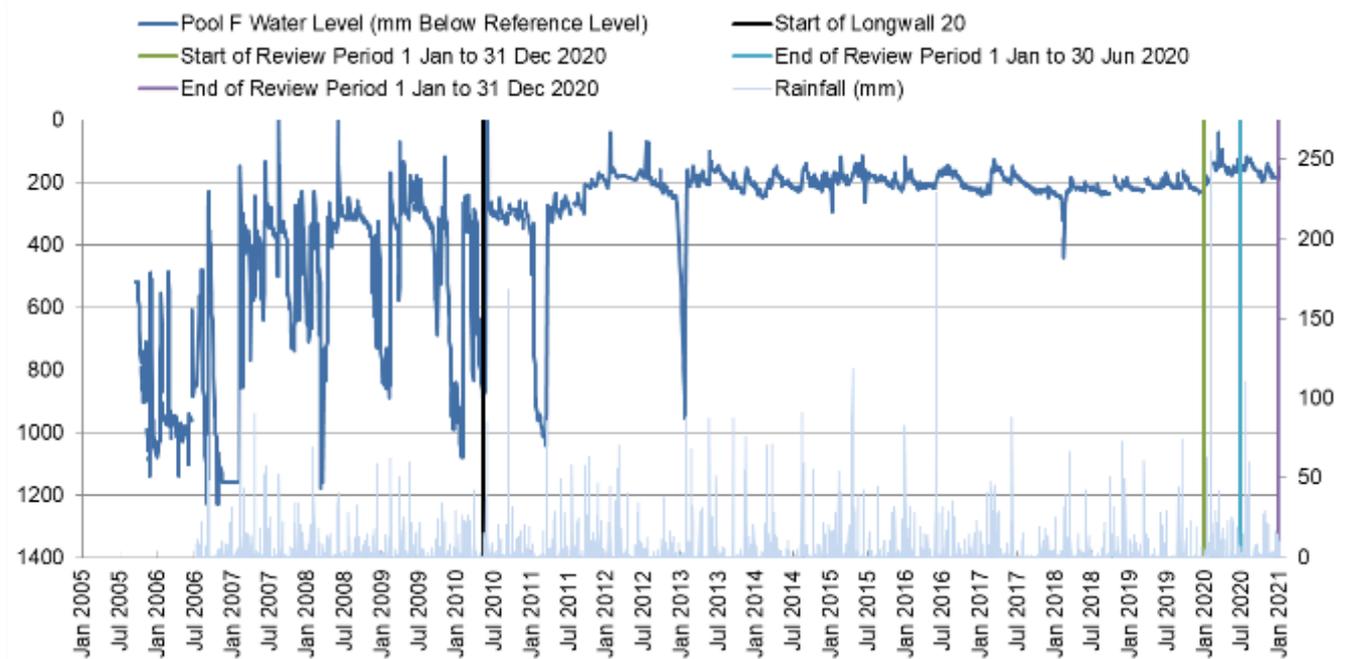


Chart A6 Pool F Waratah Rivulet (Manual Observations)

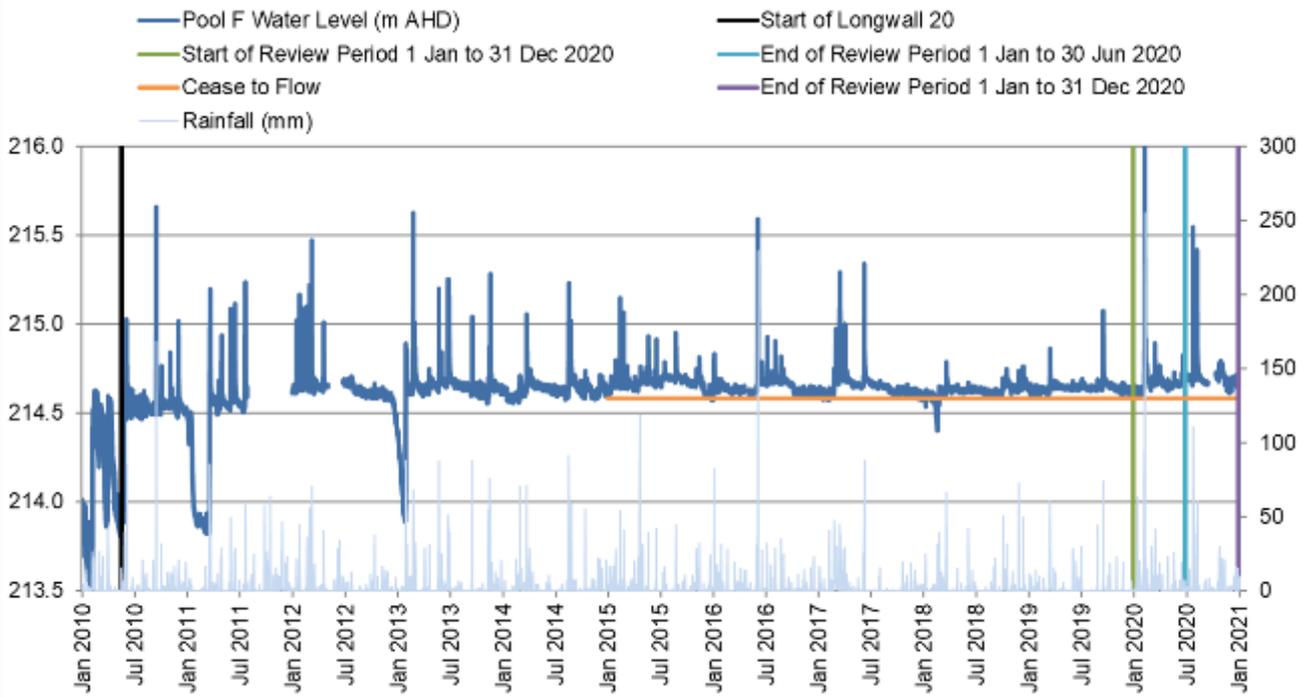


Chart A7 Pool F Waratah Rivulet

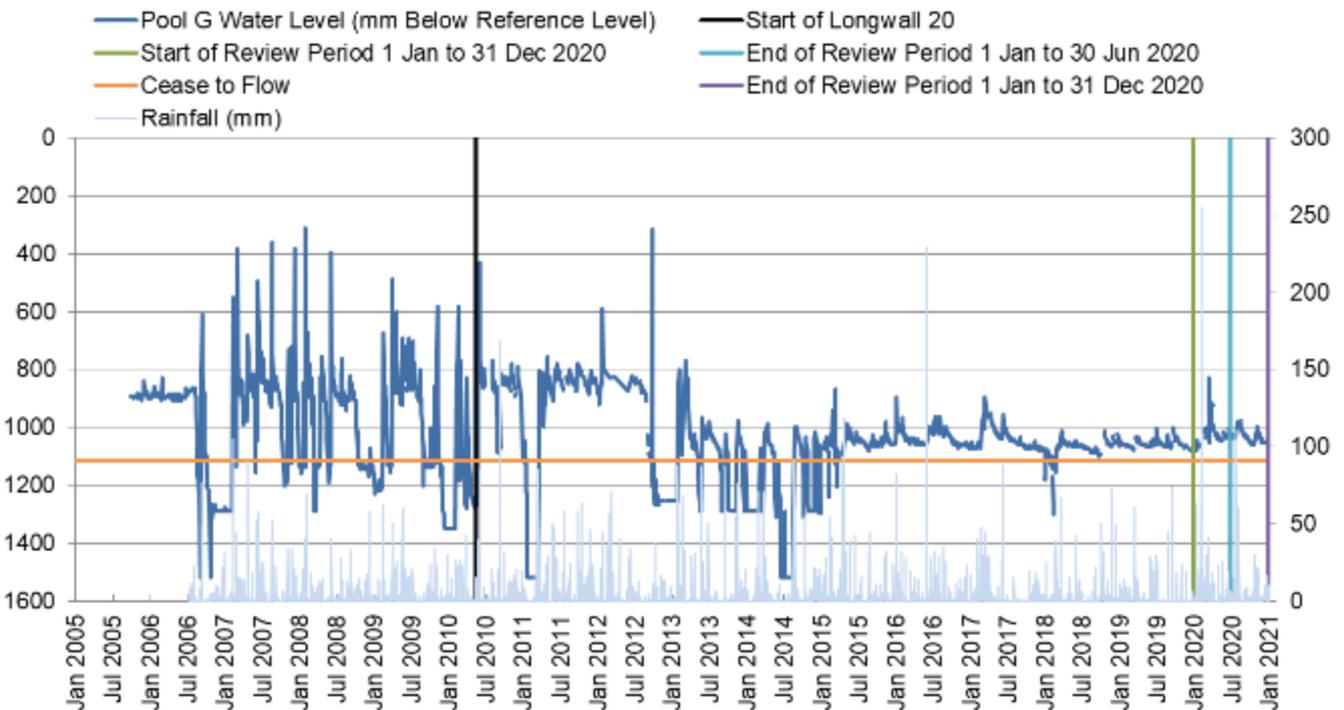


Chart A8 Pool G Waratah Rivulet (Manual Observations)

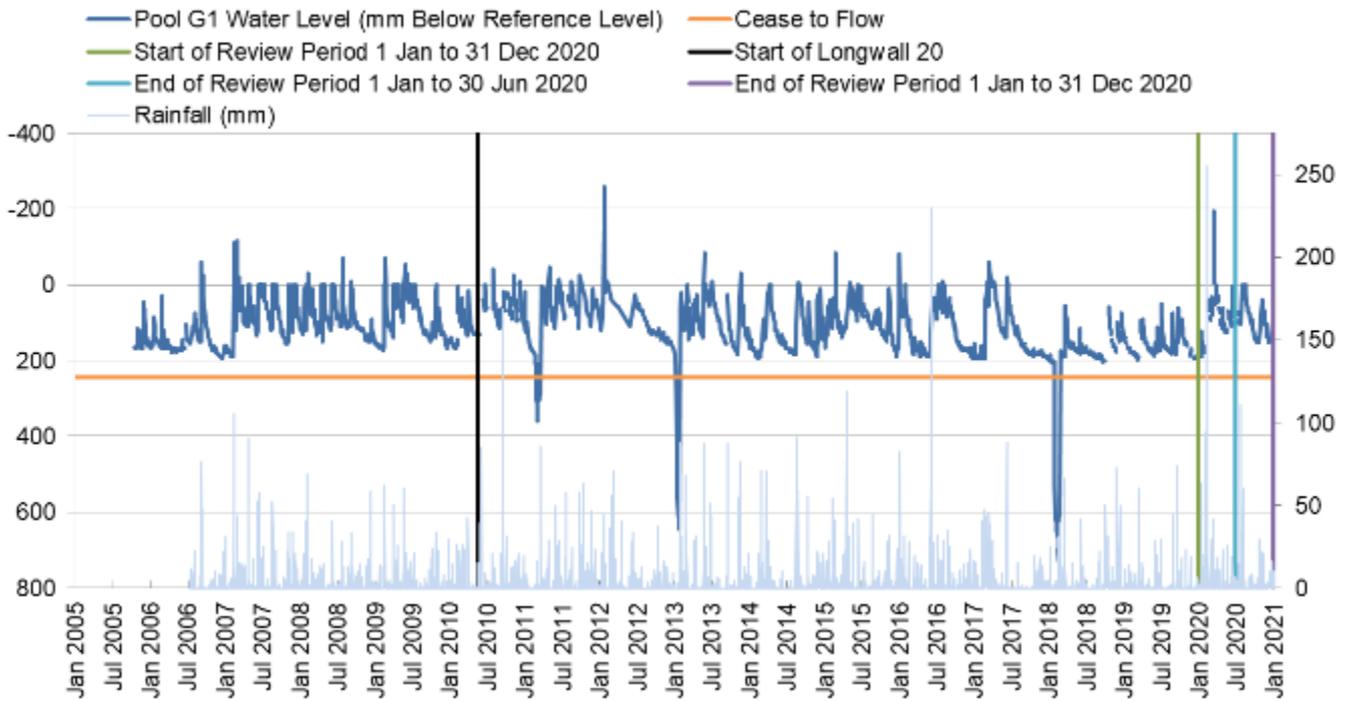


Chart A9 Pool G1 Waratah Rivulet (Manual Observations)

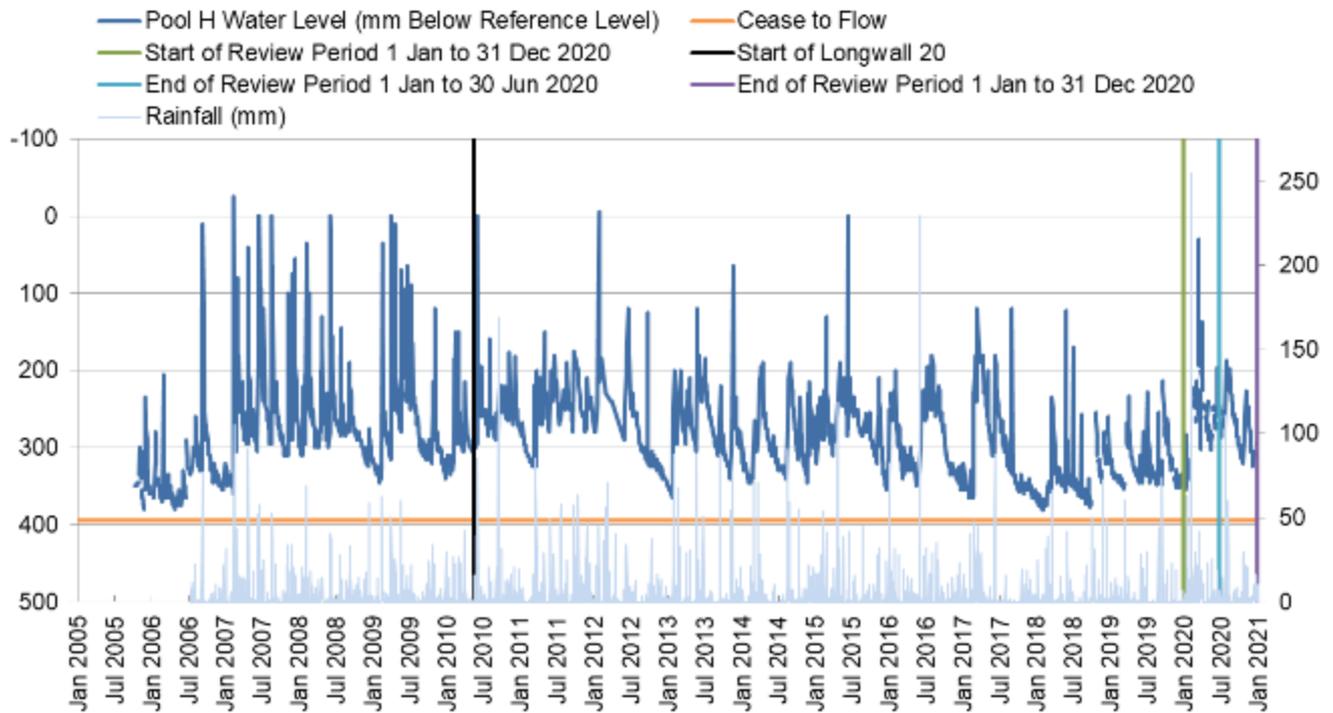


Chart A10 Pool H Waratah Rivulet (Manual Observations)

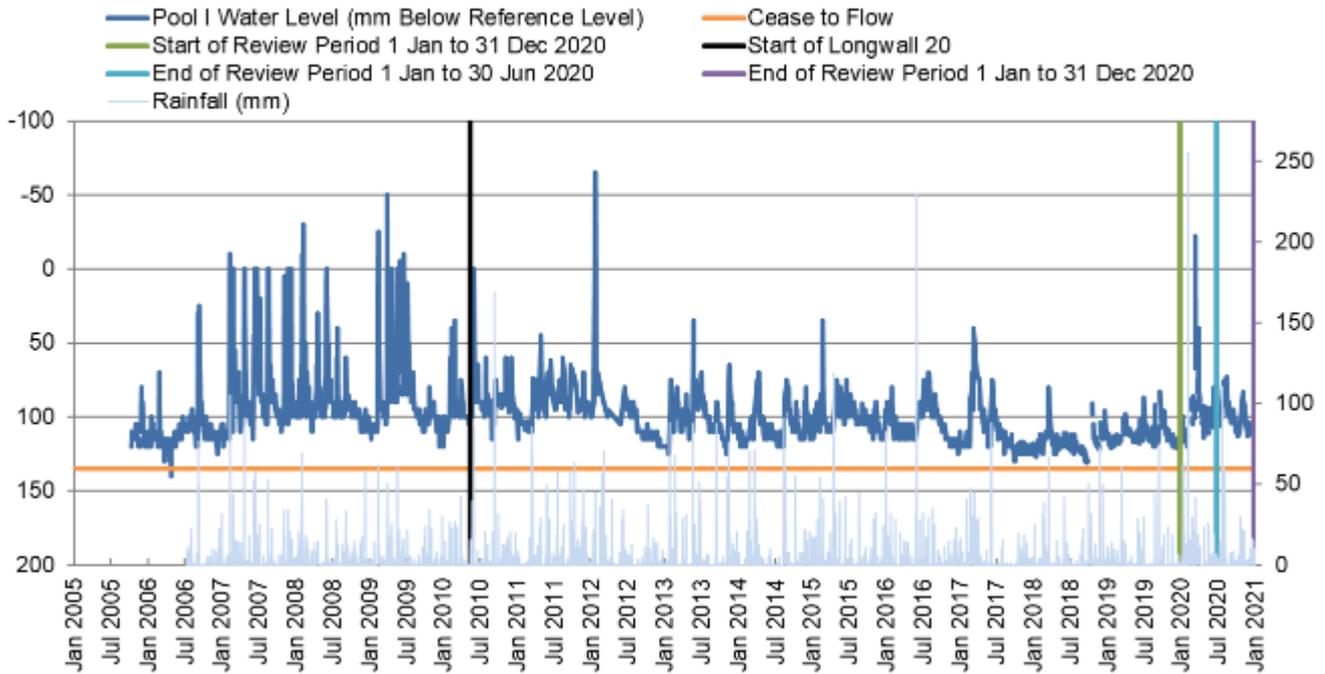


Chart A11 Pool I Waratah Rivulet (Manual Observations)

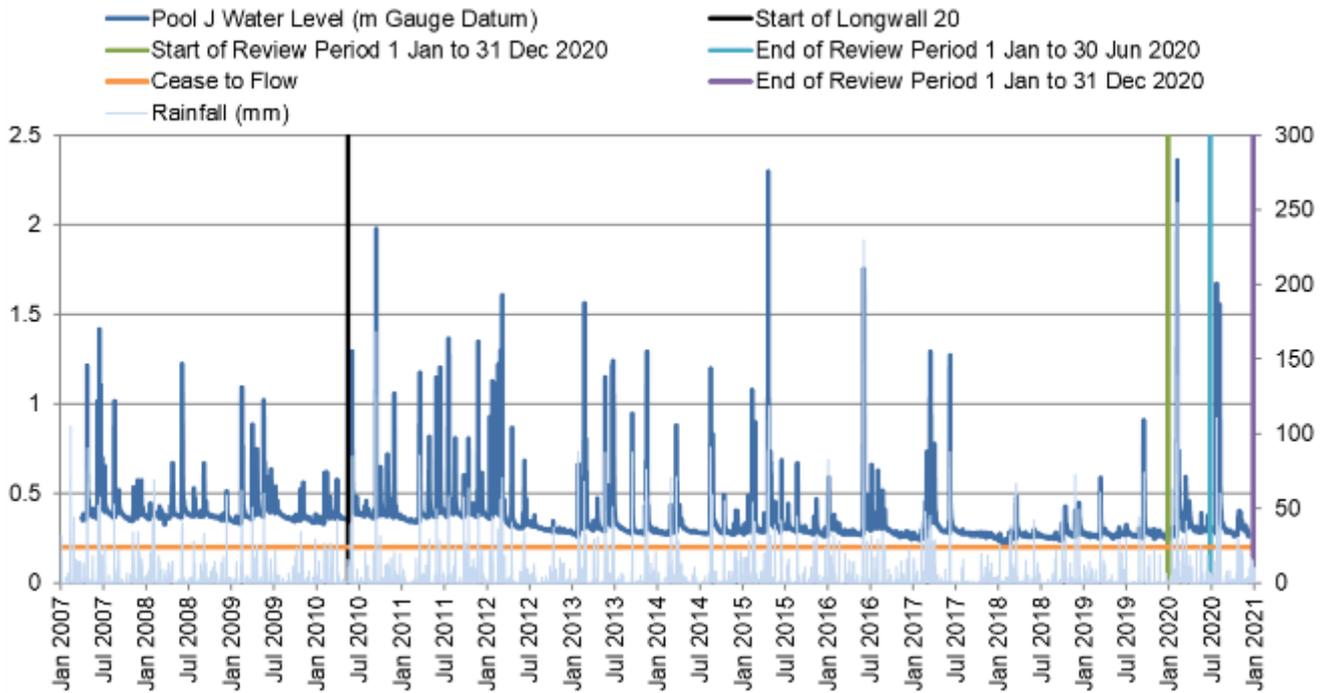


Chart A12 Pool J Waratah Rivulet

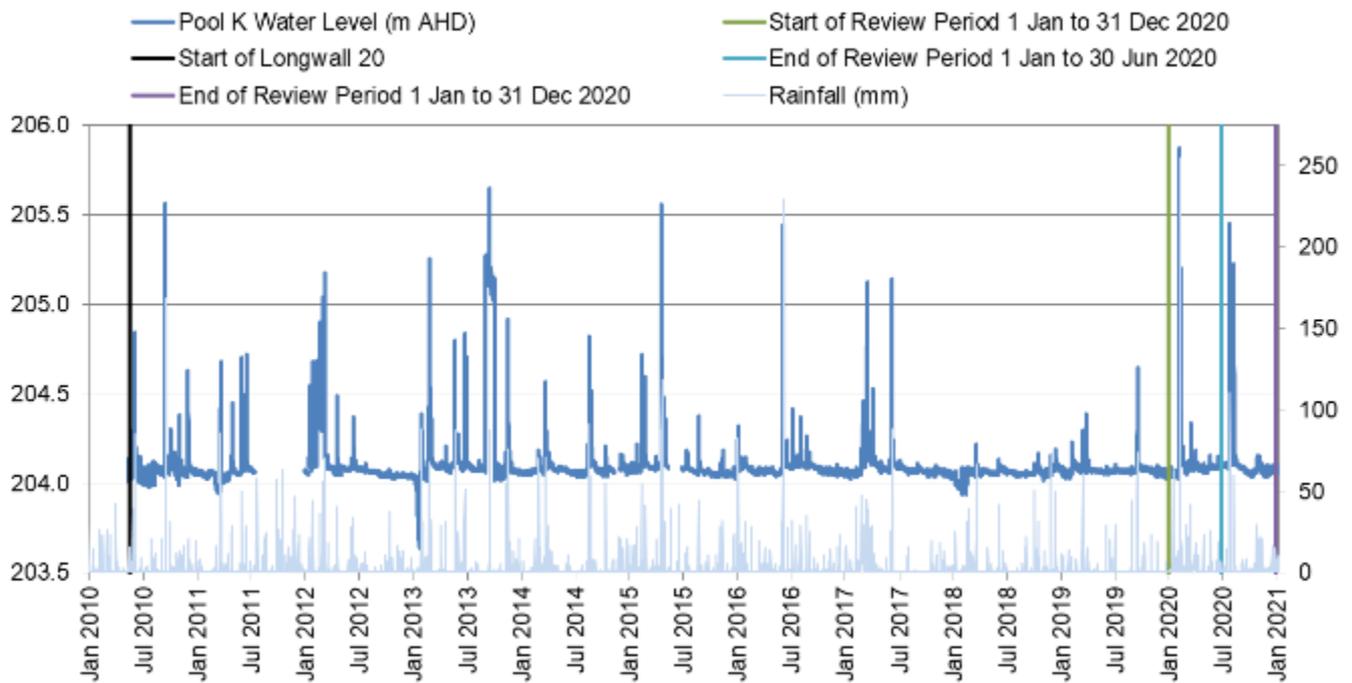


Chart A13 Pool K Waratah Rivulet

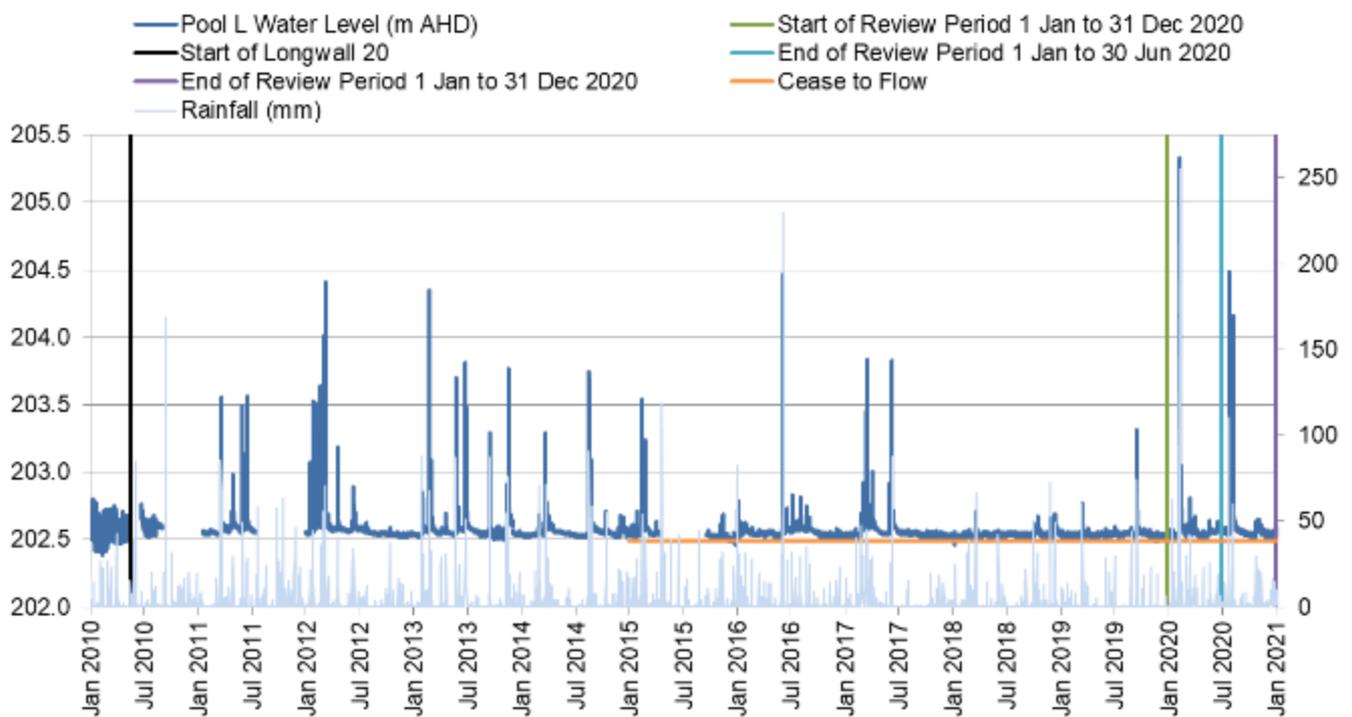


Chart A14 Pool L Waratah Rivulet

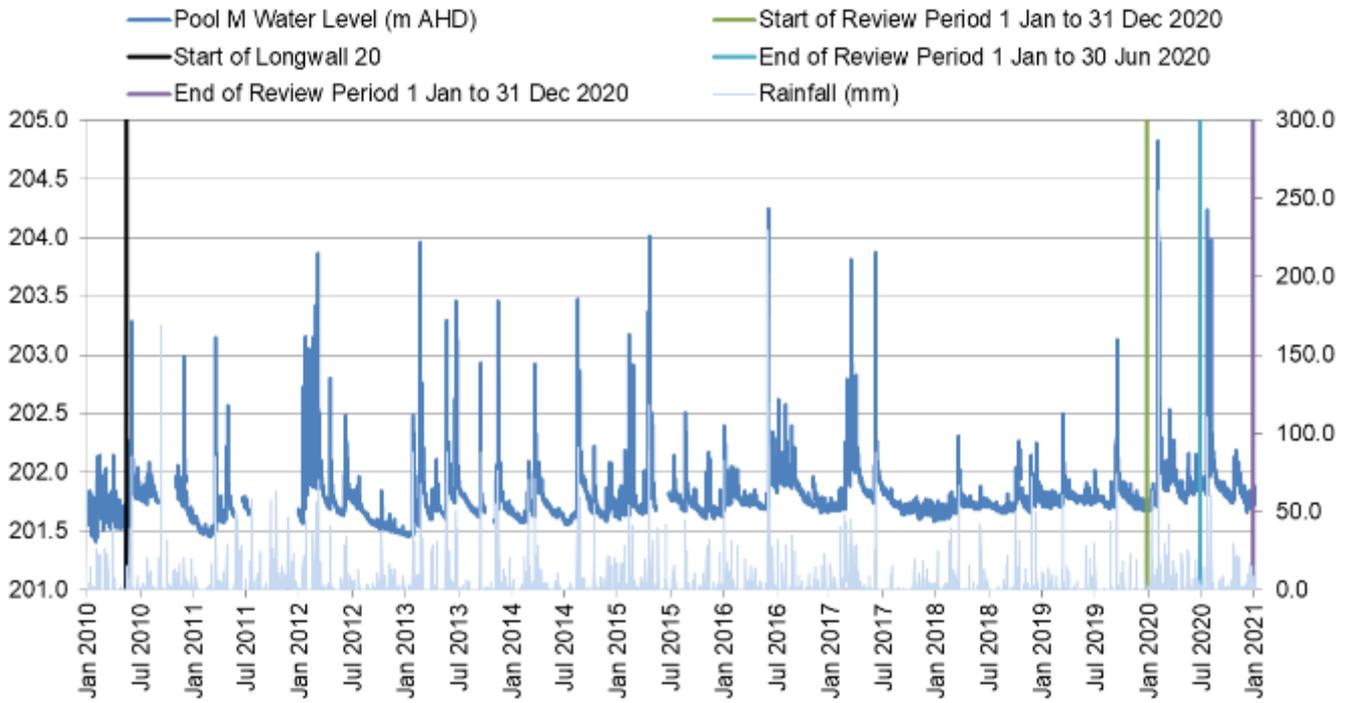


Chart A15 Pool M Waratah Rivulet

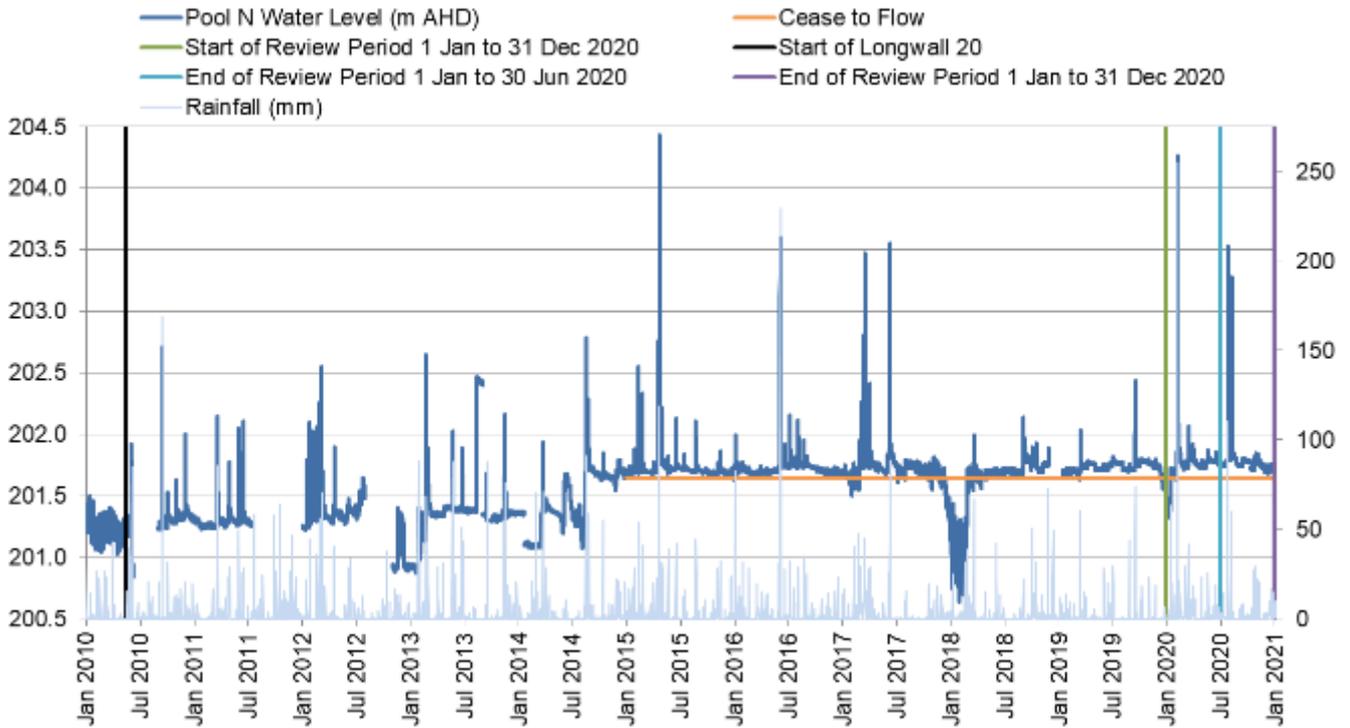


Chart A16 Pool N Waratah Rivulet

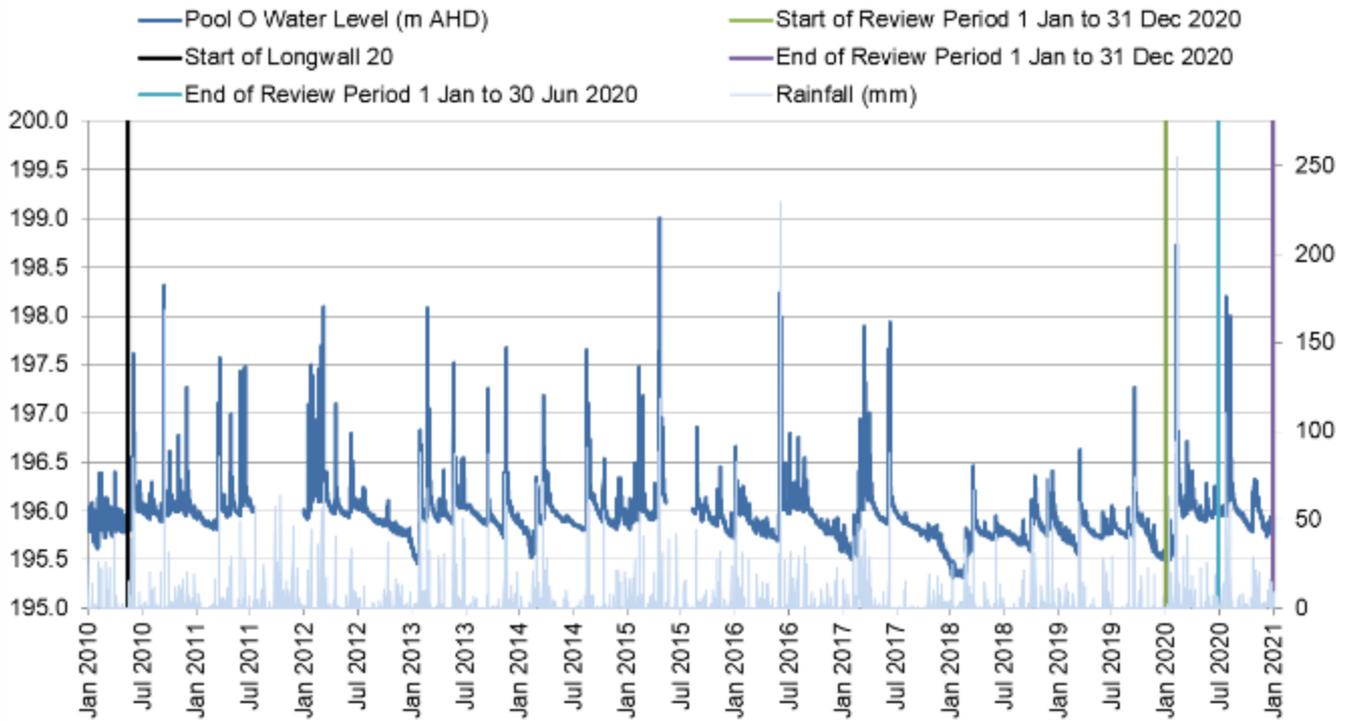


Chart A17 Pool O Waratah Rivulet

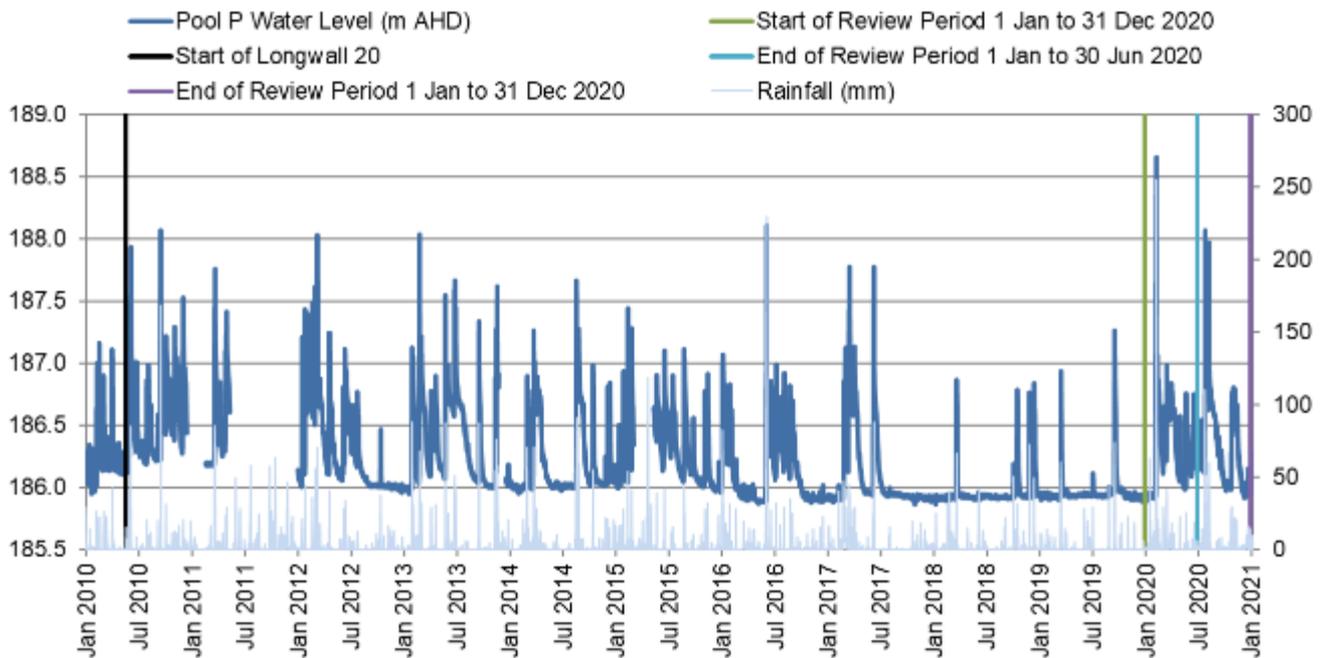


Chart A18 Pool P Waratah Rivulet

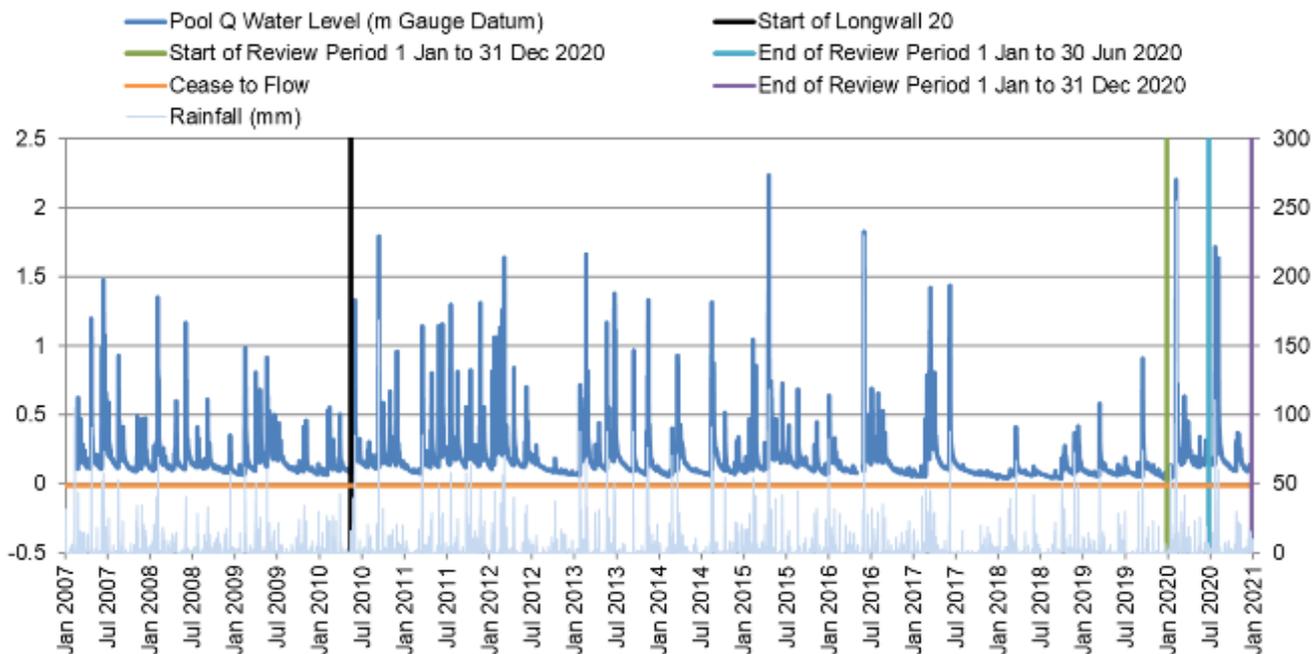


Chart A19 Pool Q Waratah Rivulet

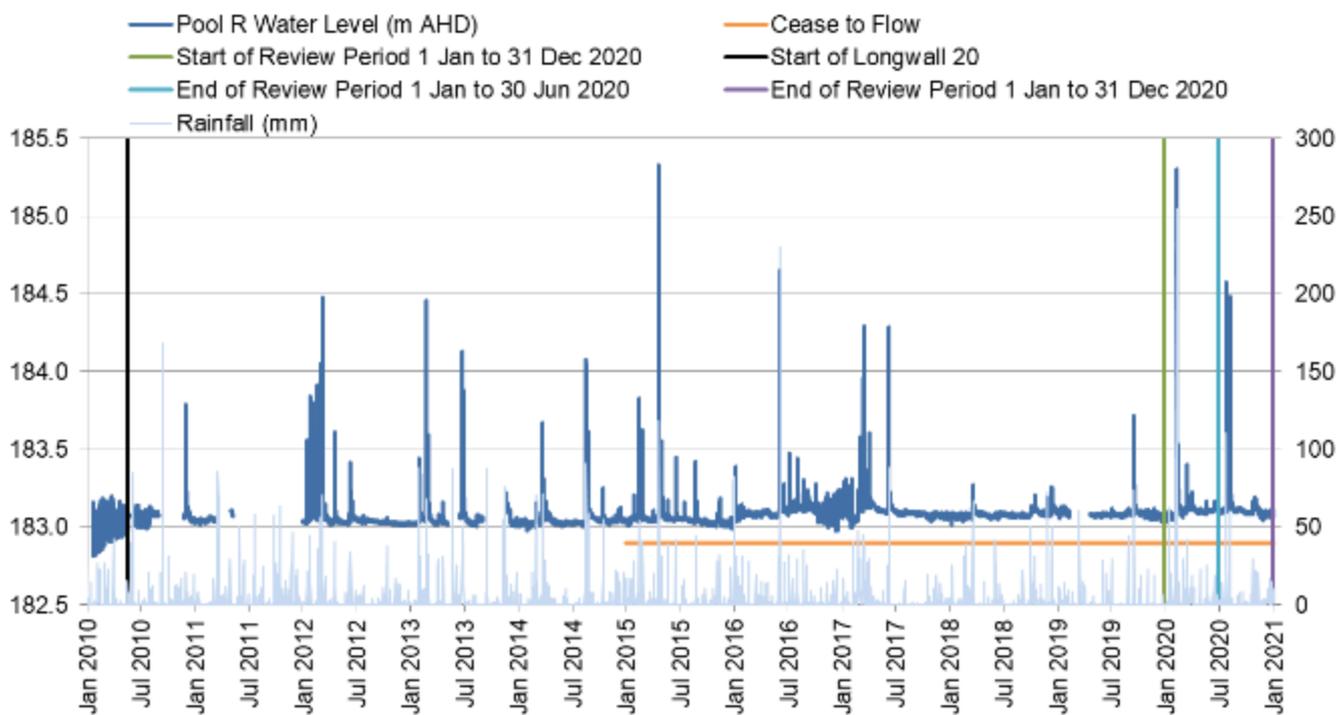


Chart A20 Pool R Waratah Rivulet¹⁰

¹⁰ The water level sensor malfunctioned between 1 June 2020 and 4 June 2020. As such, no data was recorded during this period.

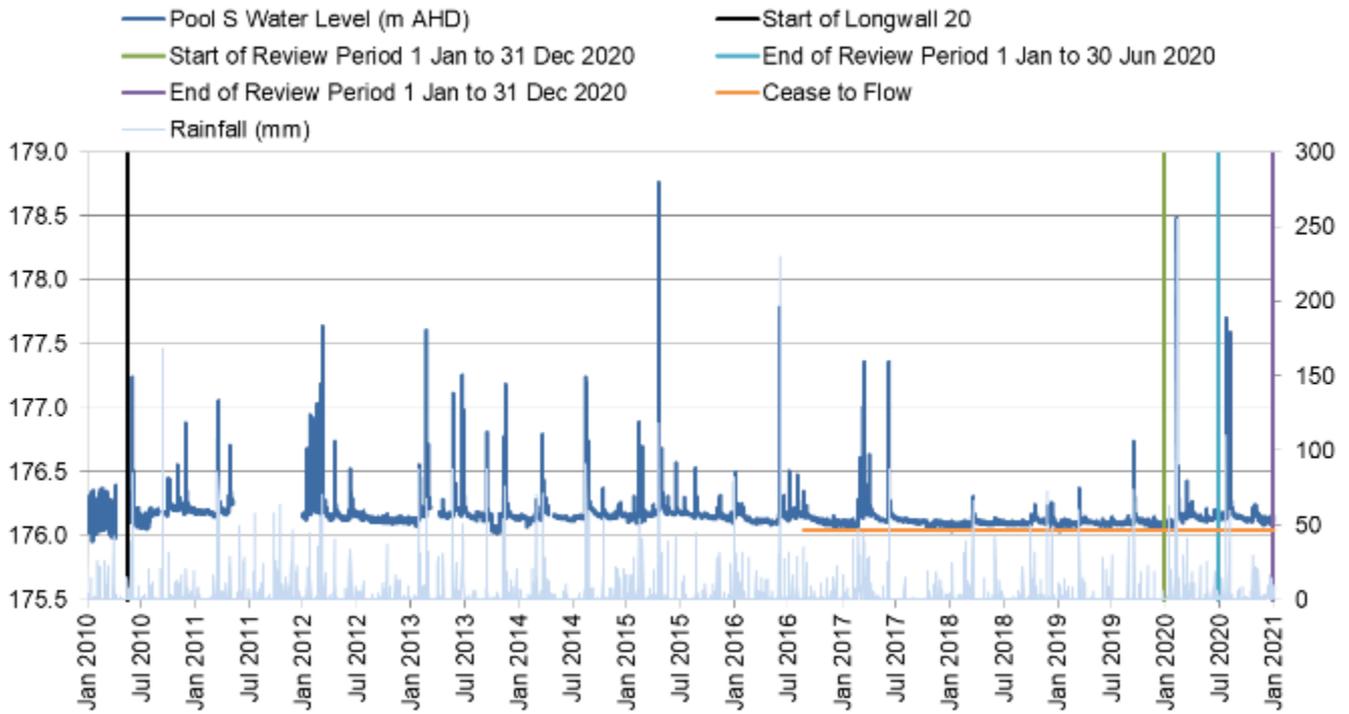


Chart A21 Pool S Waratah Rivulet

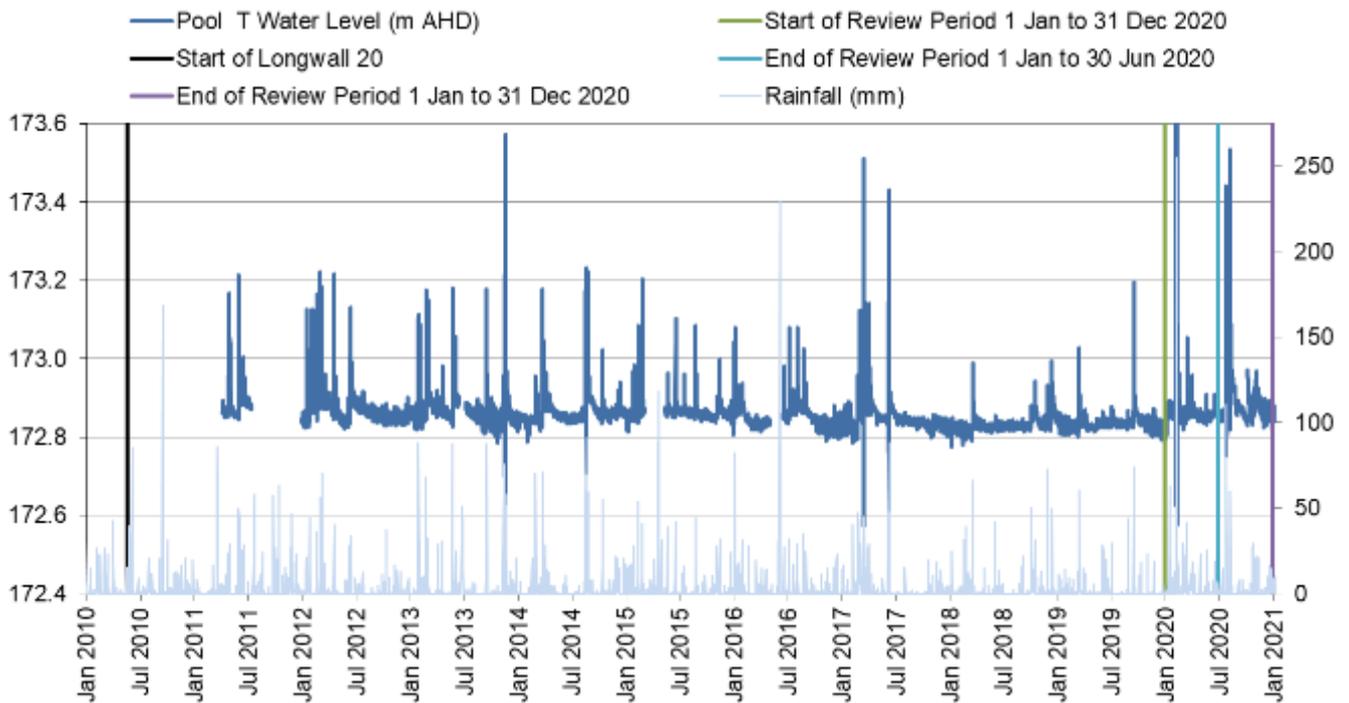


Chart A22 Pool T Waratah Rivulet¹¹

¹¹ During periods of high rainfall the logger stand creates an eddy which reduces pressure and causes low level pressure readings to be recorded during periods of high rainfall.

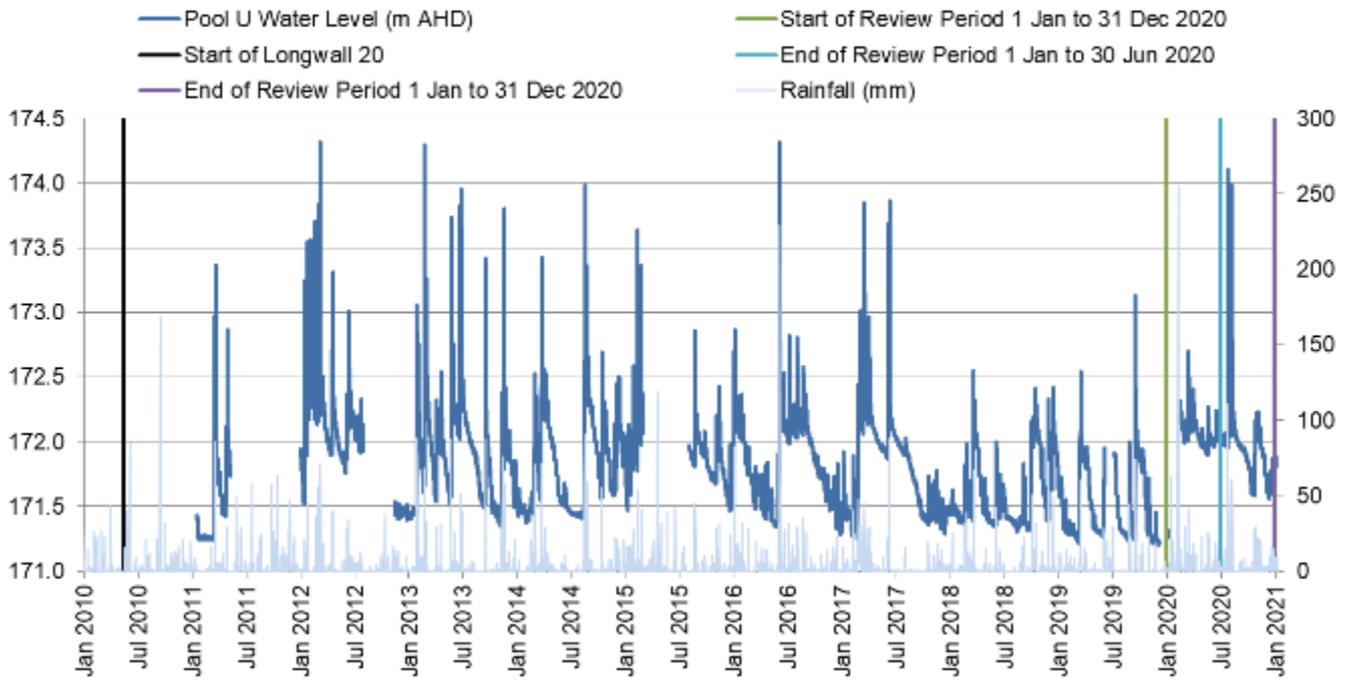


Chart A23 Pool U Waratah Rivulet¹²

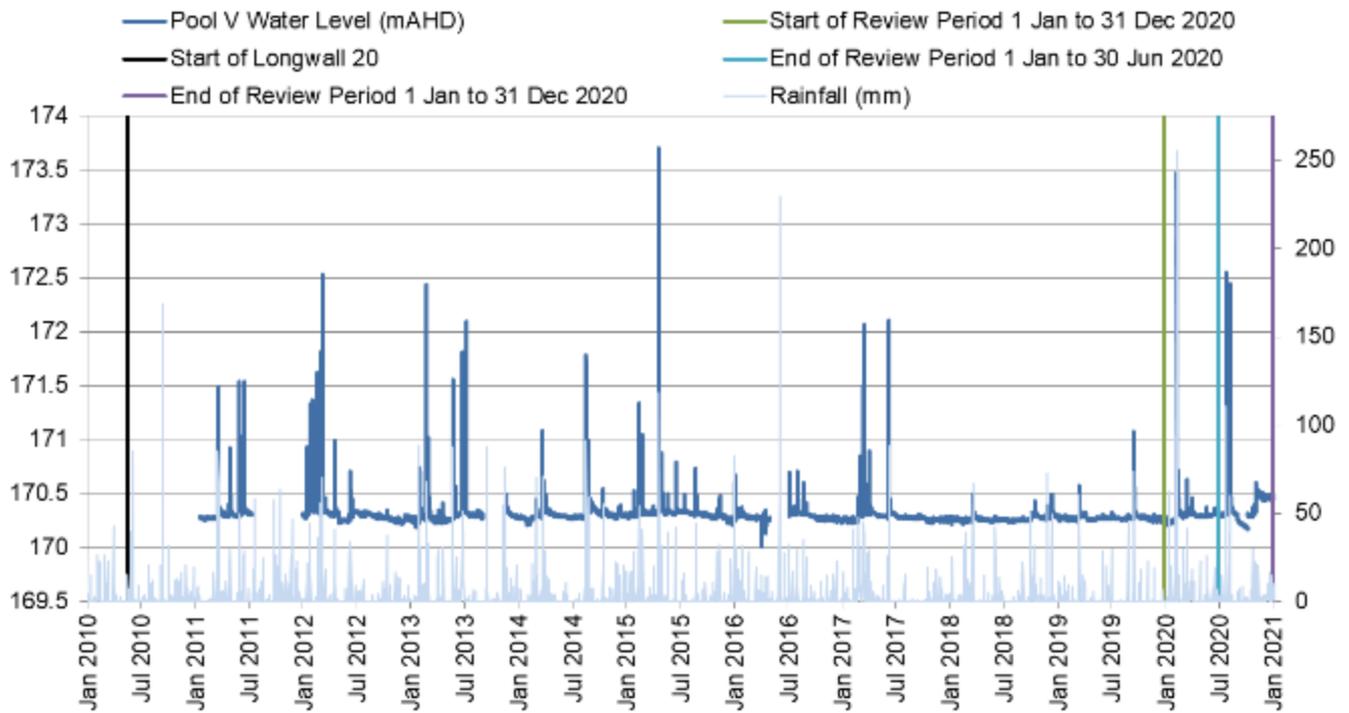


Chart A24 Pool V Waratah Rivulet¹³

¹² The water level sensor was not recording data from 7 January 2020 until 18 February 2020.

¹³ The water level sensor lost pressure from late August 2020 until early October 2020 and has since been replaced.

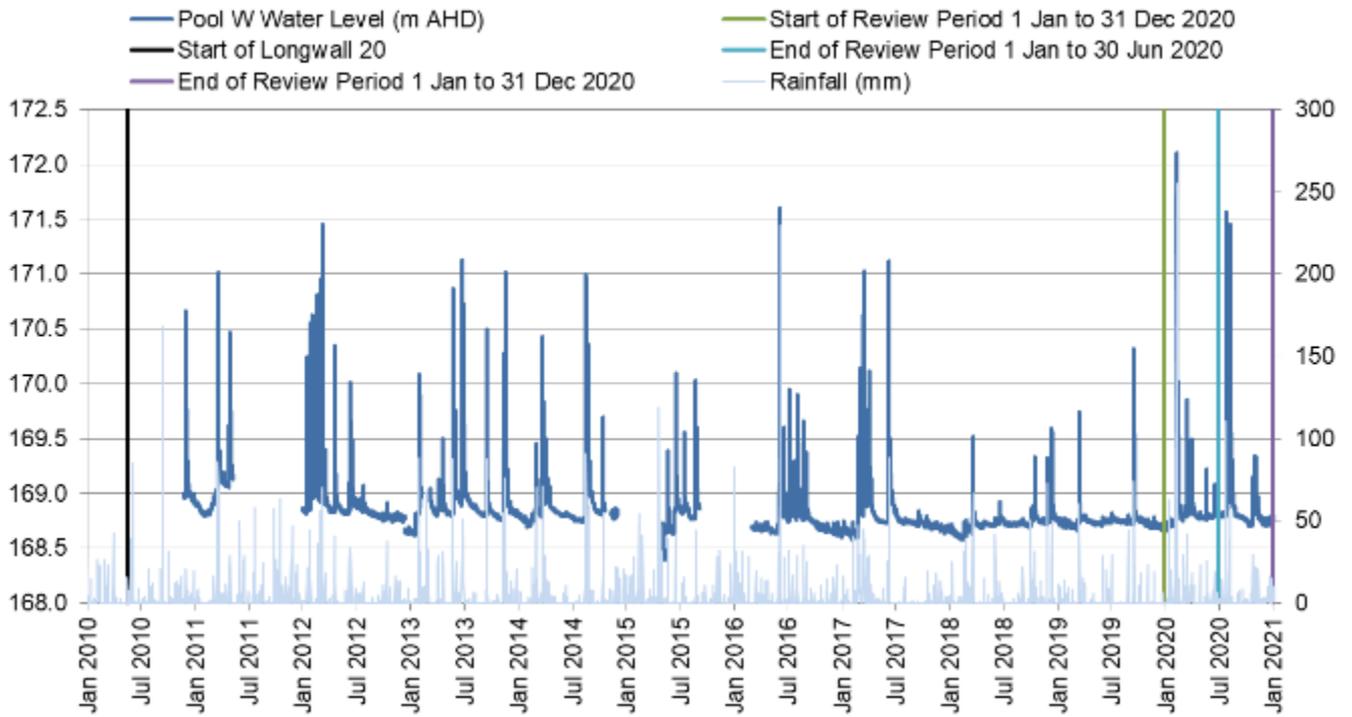


Chart A25 Pool W Waratah Rivulet

Pools on Eastern Tributary

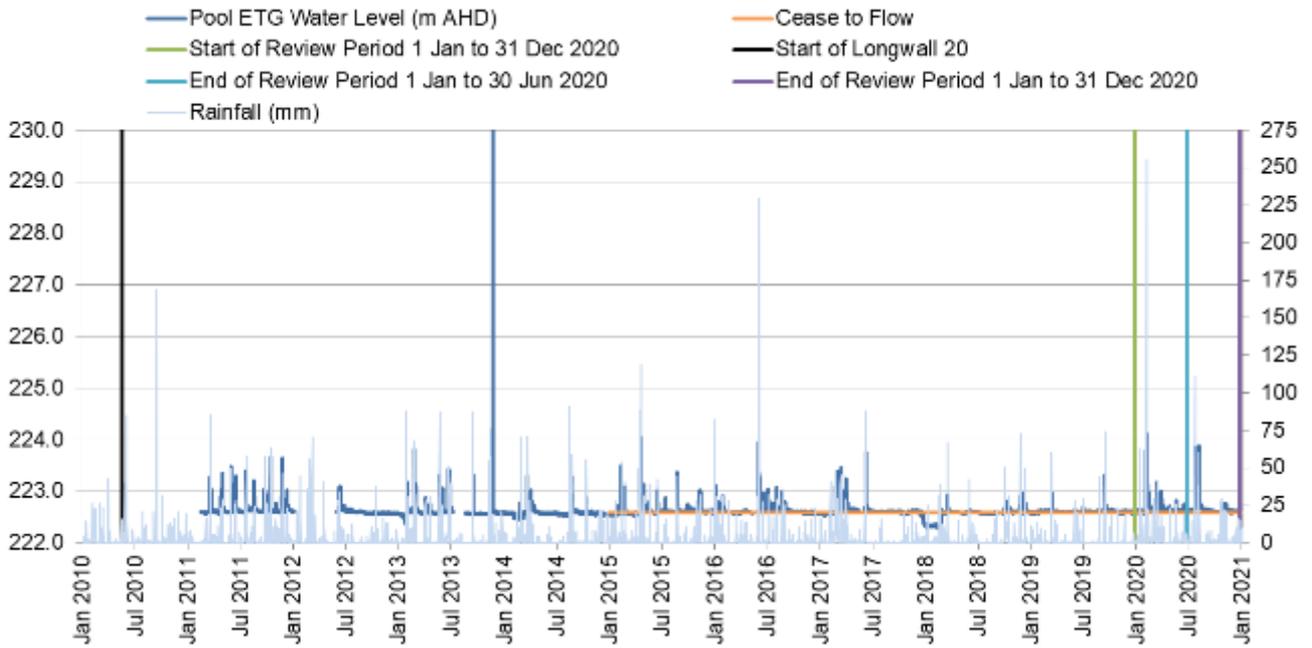


Chart A26 Pool ETG

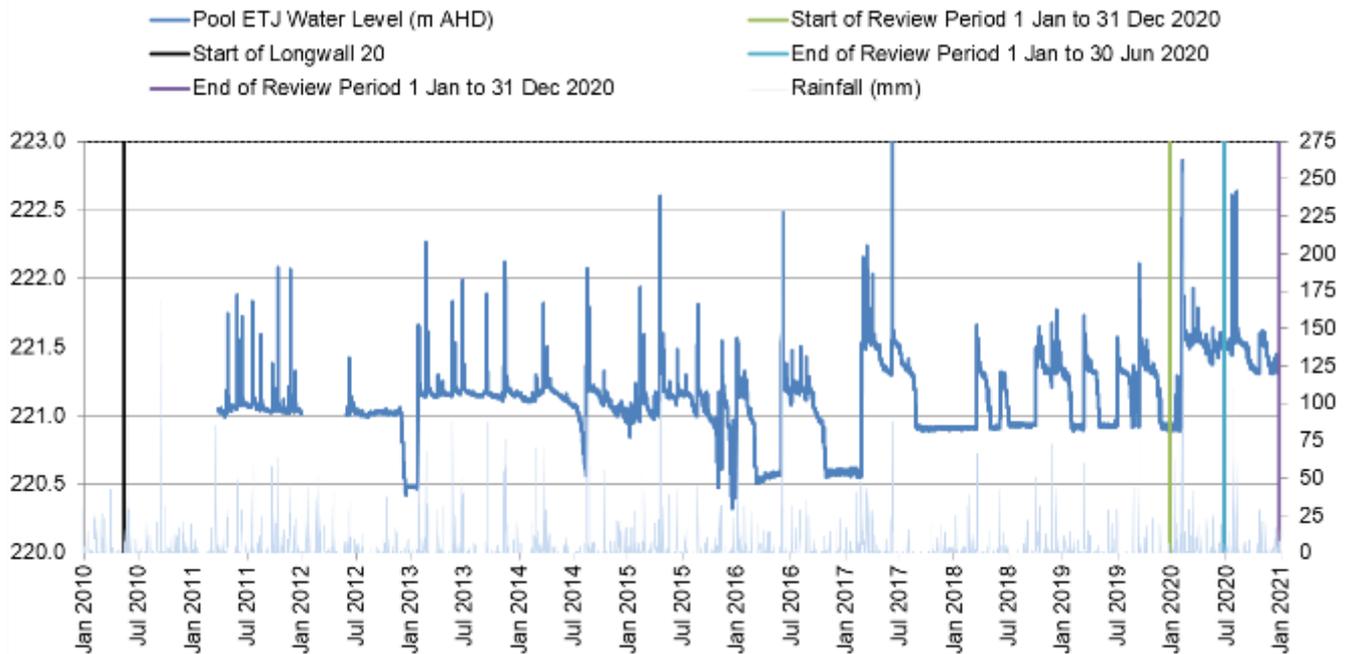


Chart A27 Pool ETJ

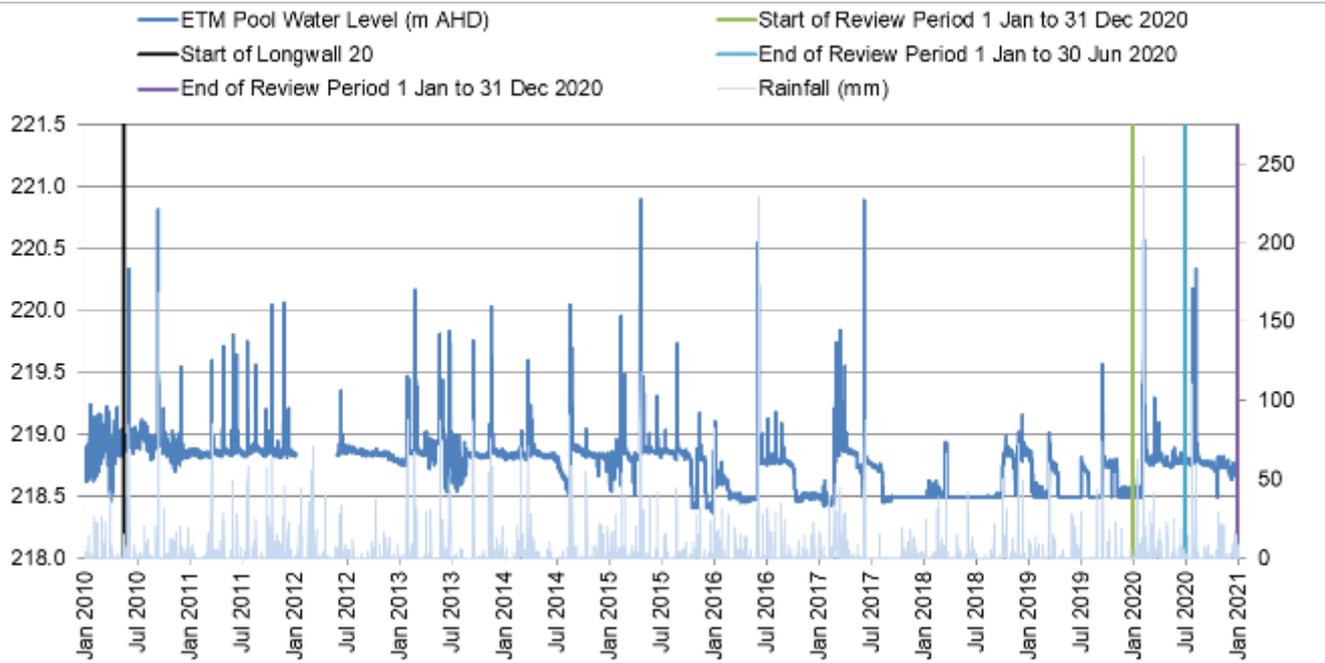


Chart A28 Pool ETM

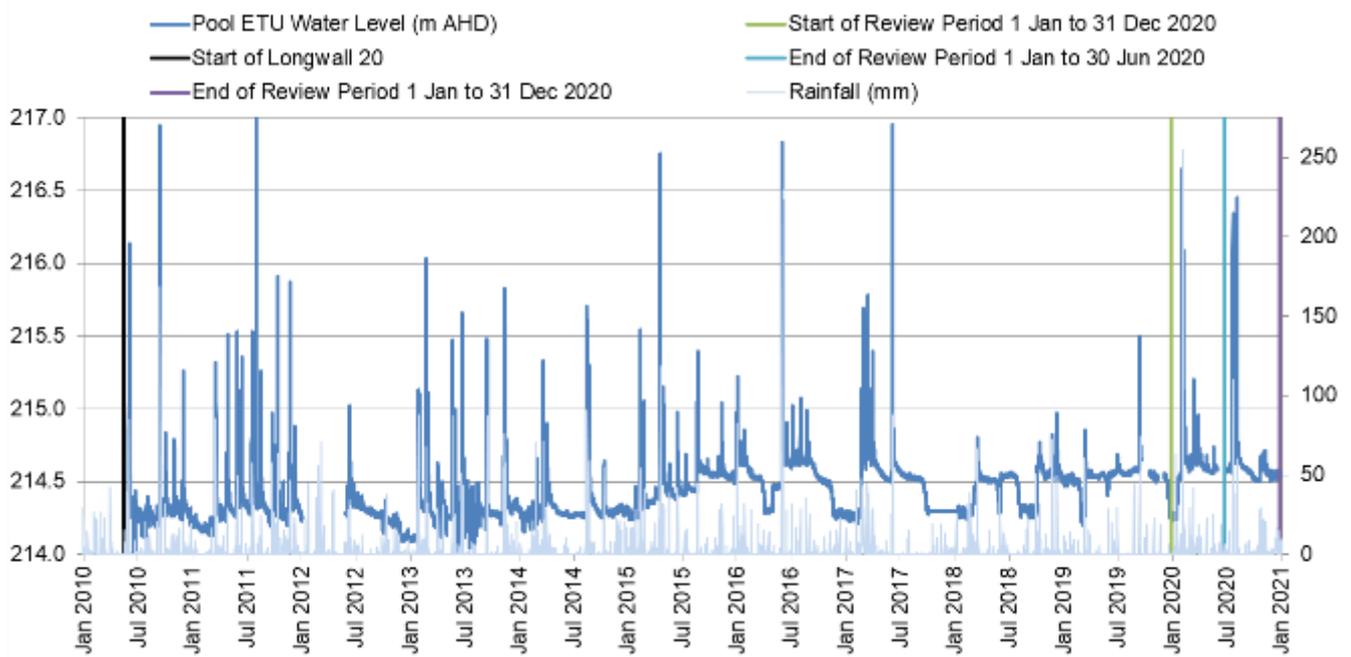


Chart A29 Pool ETU¹⁴

¹⁴ Due to a failure during data download, data was lost from 5 June 2020 to 30 June 2020.

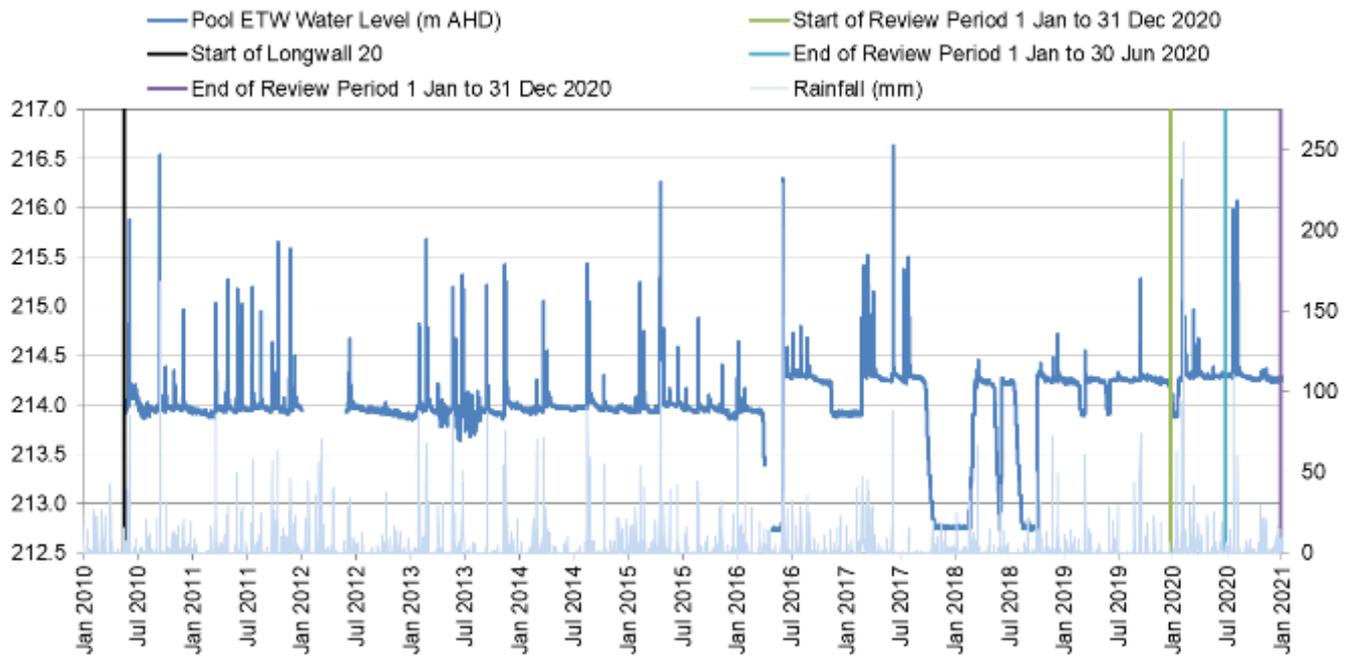


Chart A30 Pool ETW

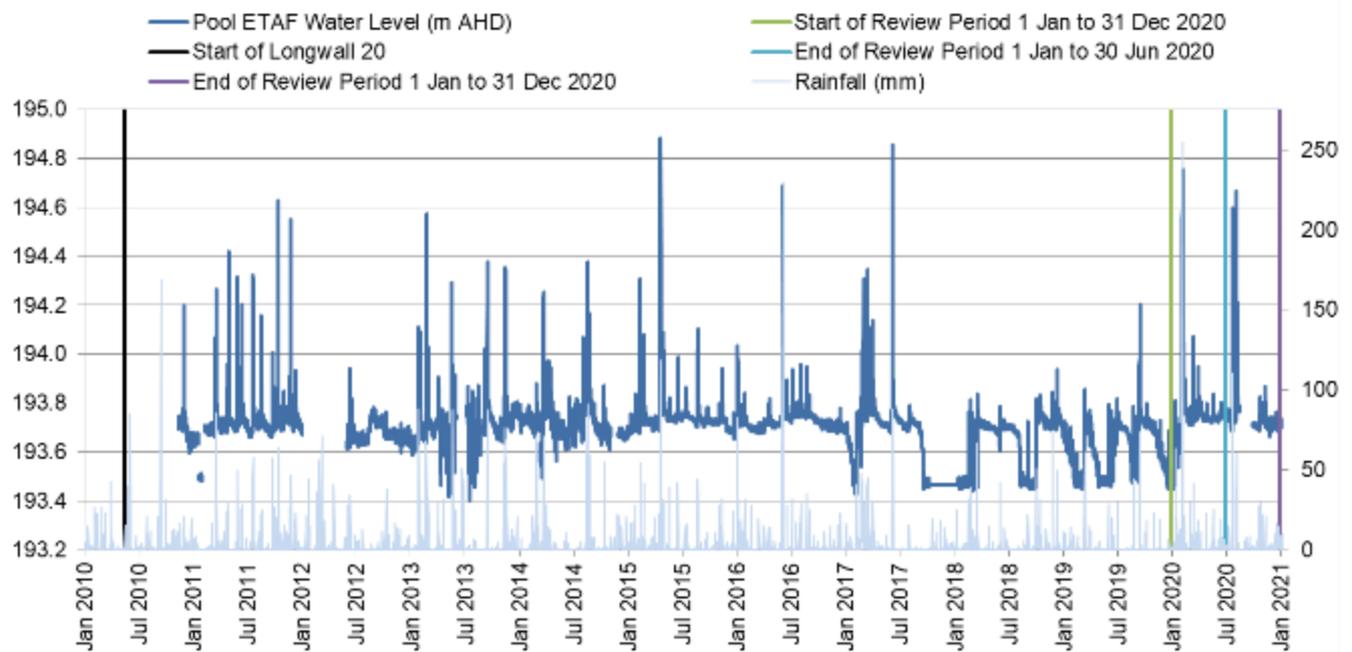


Chart A31 Pool ETAF¹⁵

¹⁵ The water level sensor failed late August 2020 and was replaced in late September 2020.

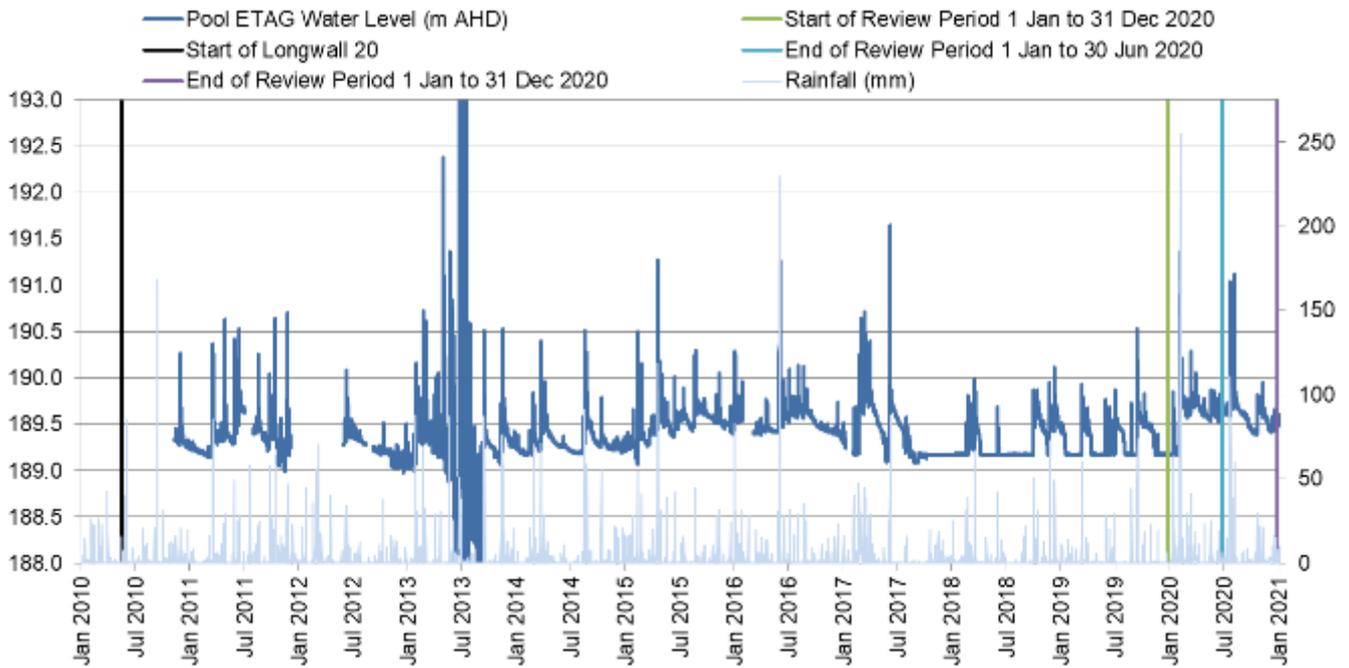


Chart A32 Pool ETAG

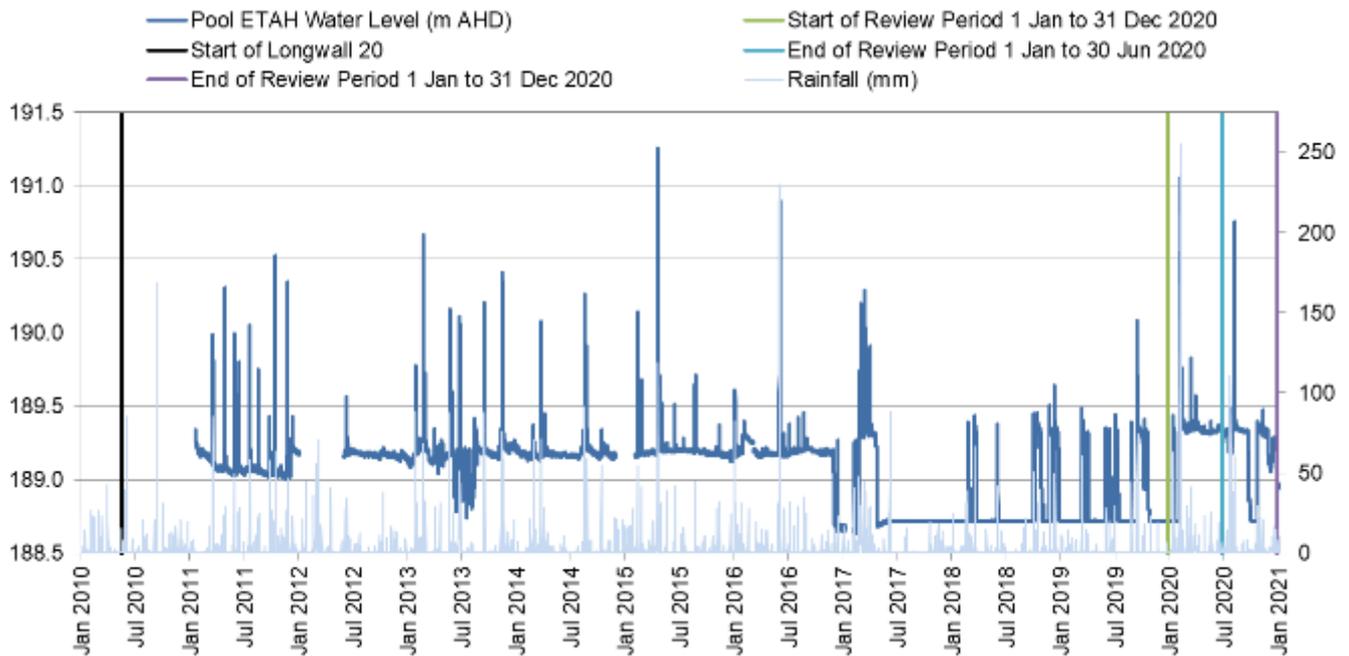


Chart A33 Pool ETAH

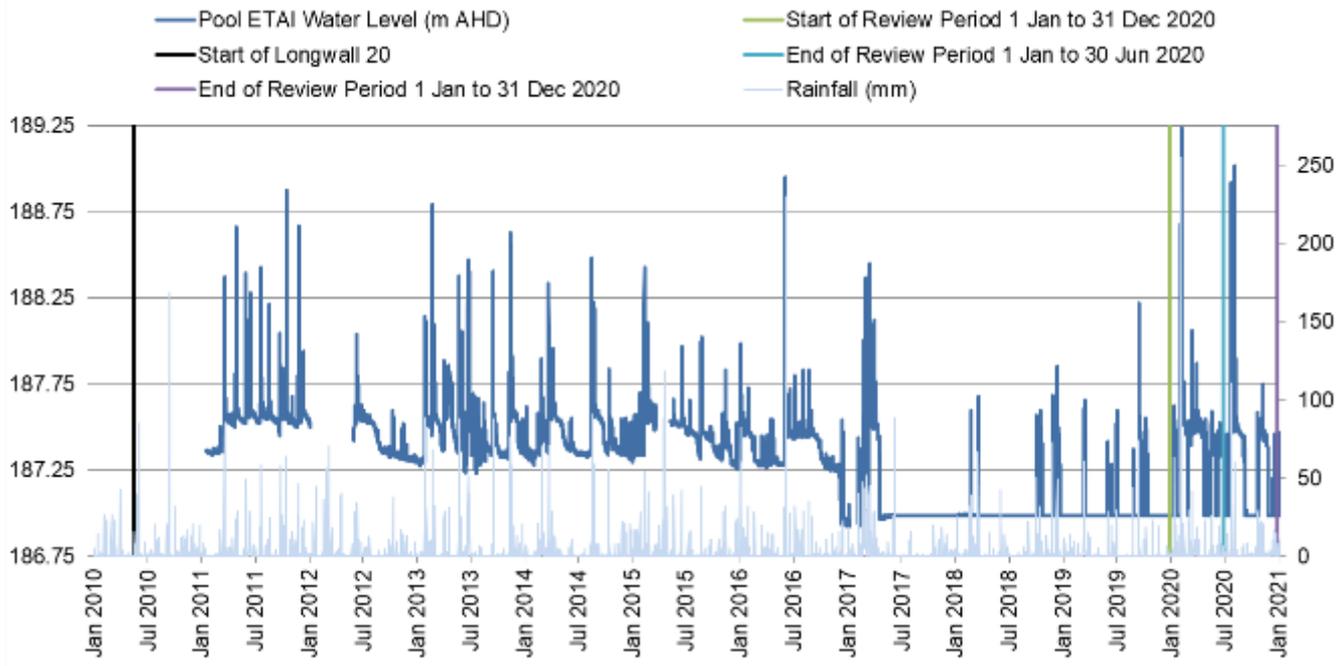


Chart A34 Pool ETAI

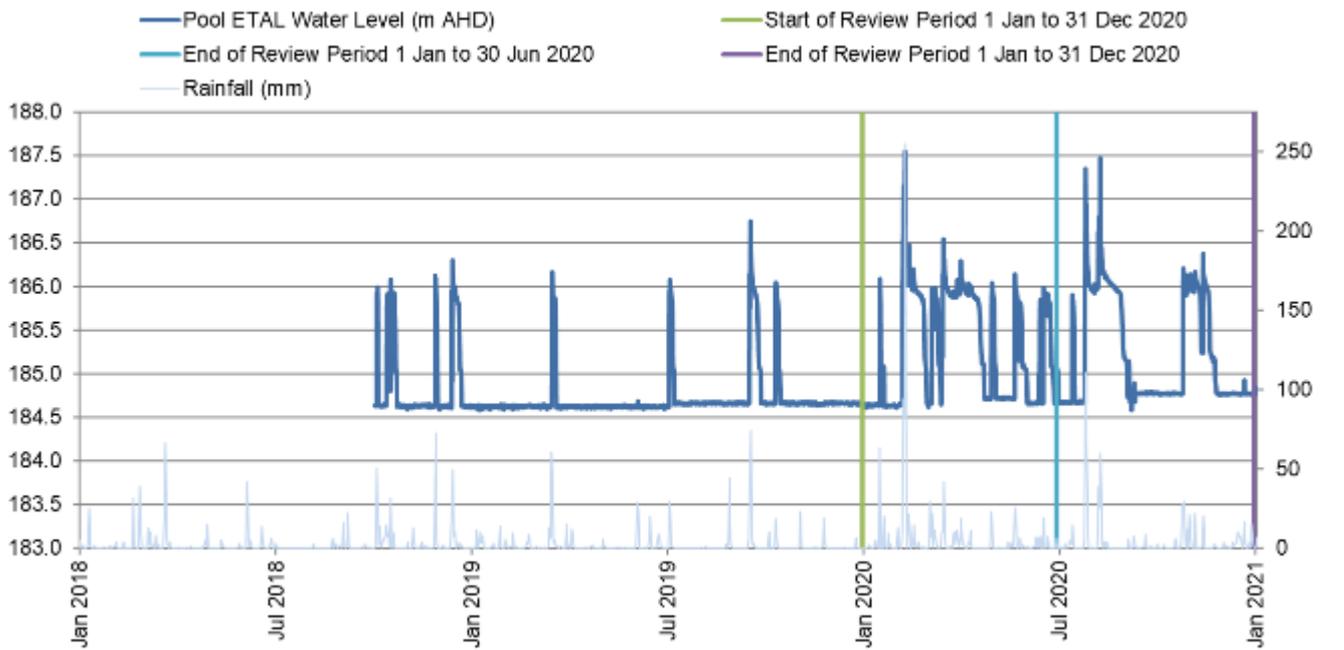


Chart A35 Pool ETAL

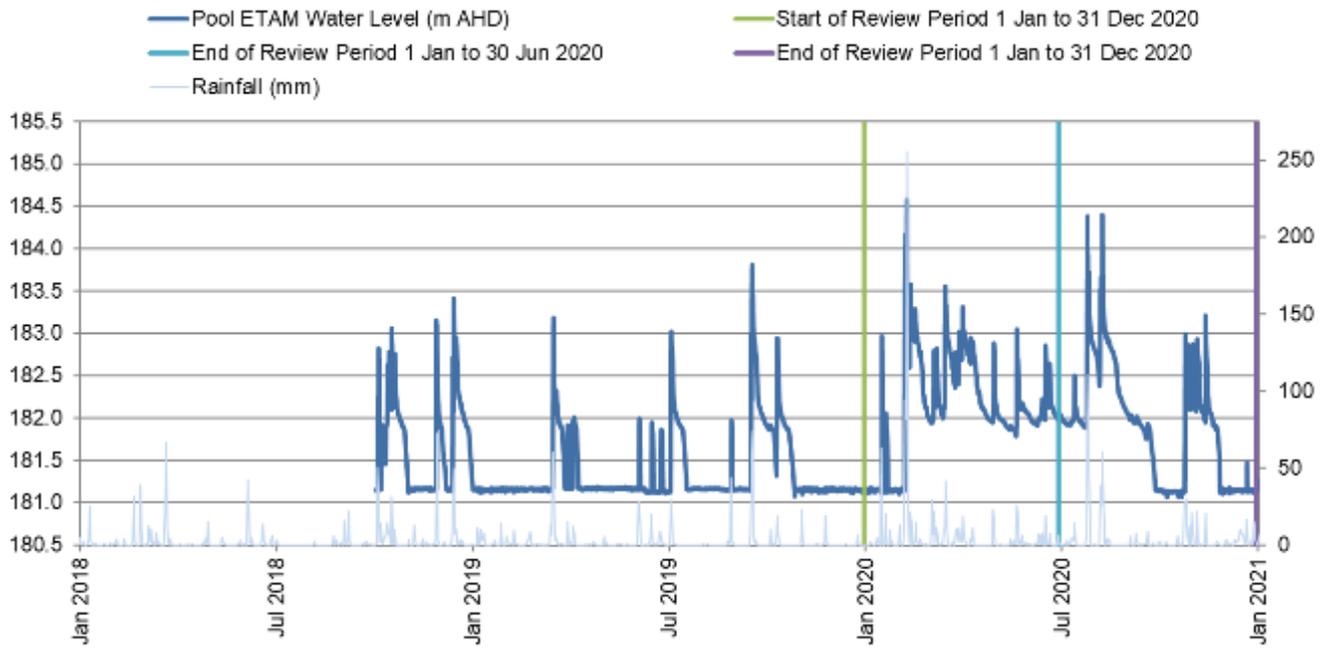


Chart A36 Pool ETAM

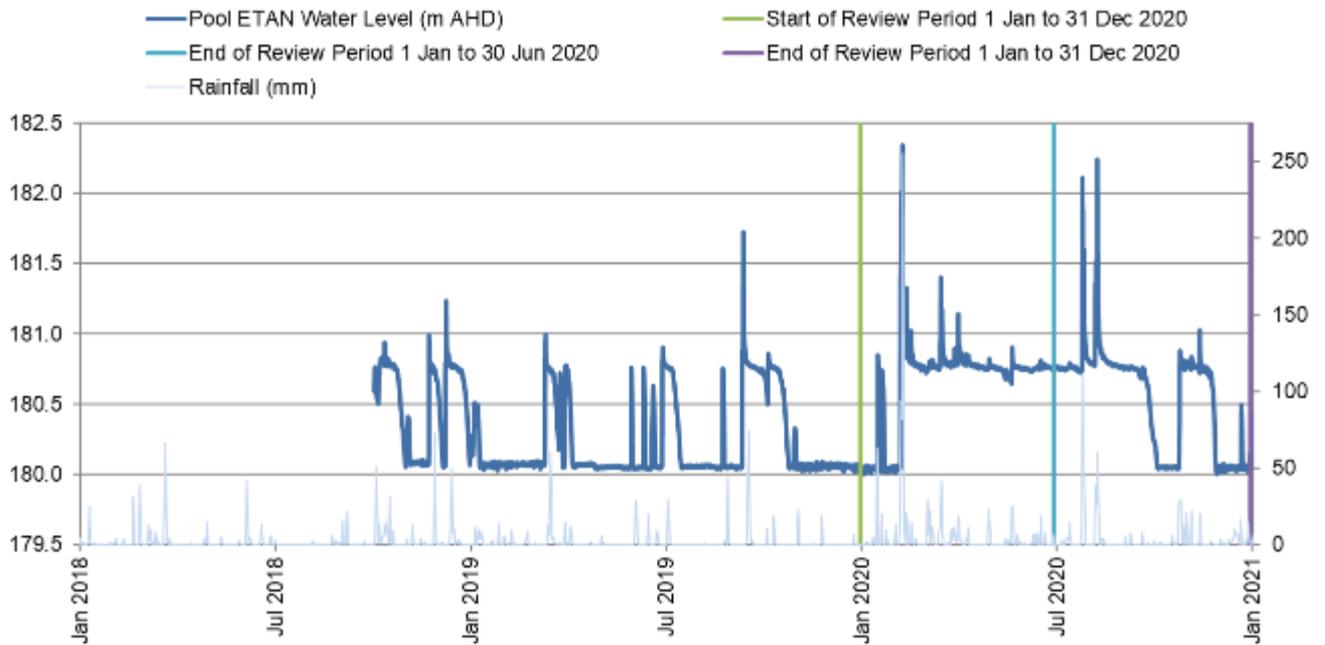


Chart A37 Pool ETAN

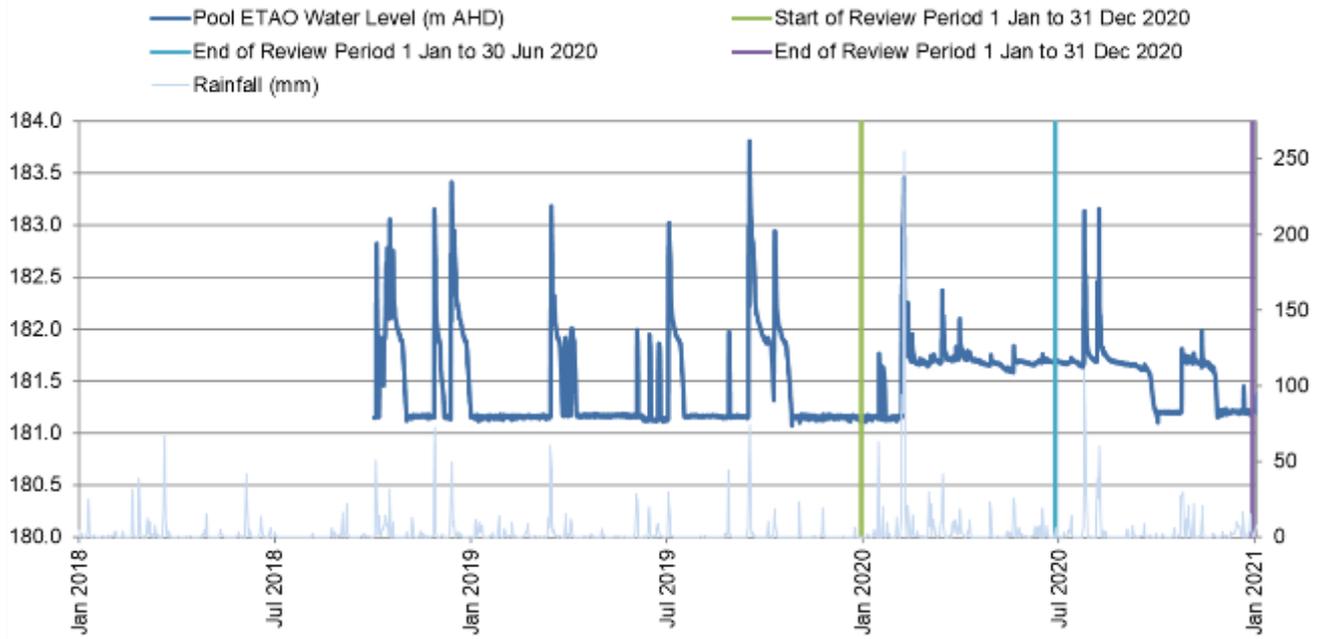


Chart A38 Pool ETAO

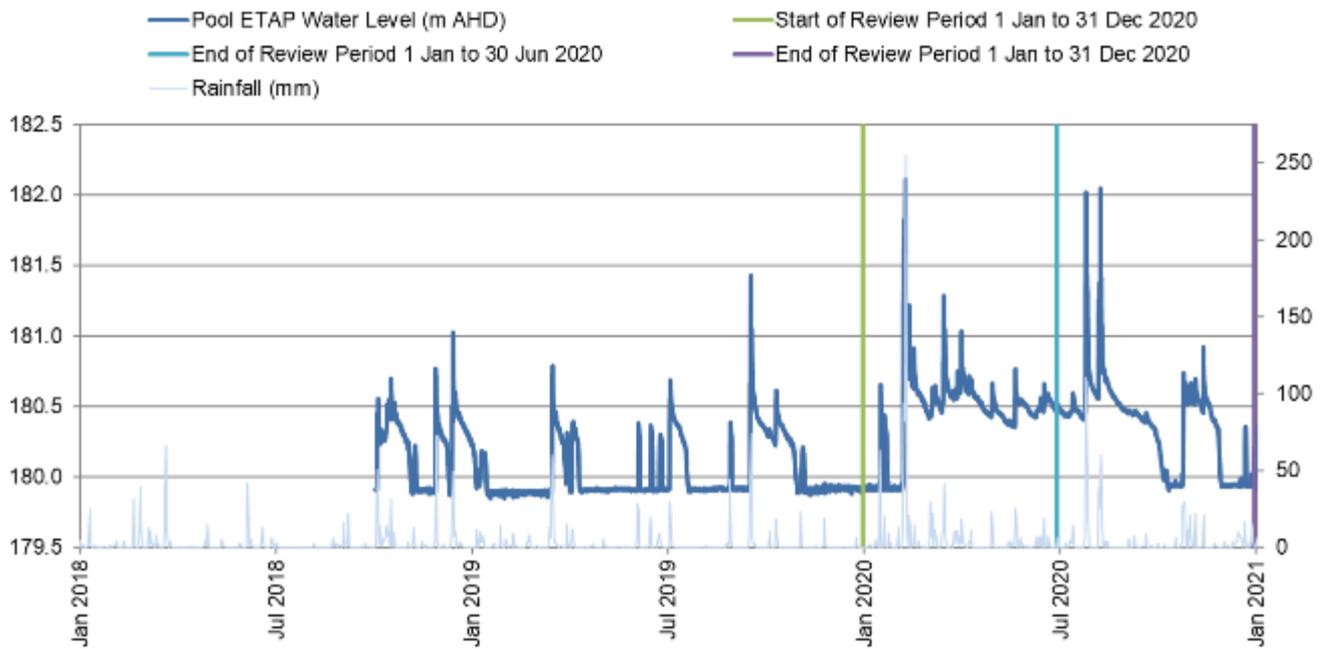


Chart A39 Pool ETAP

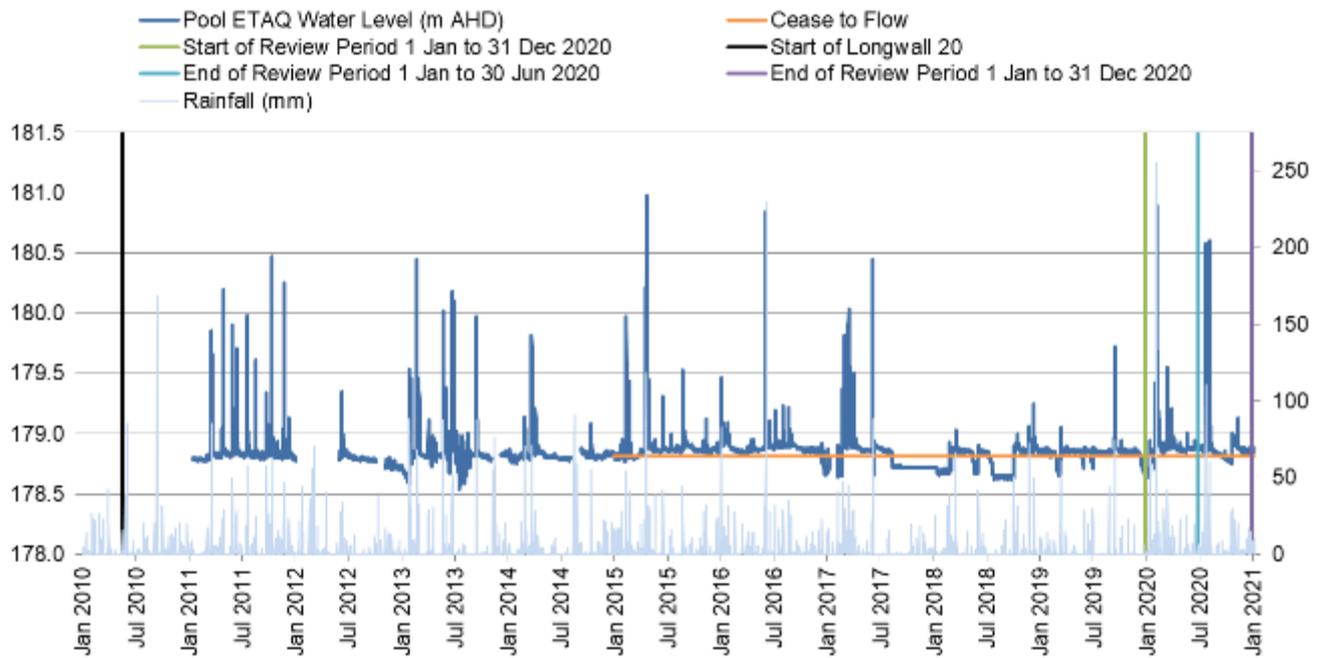


Chart A40 Pool ETAQ

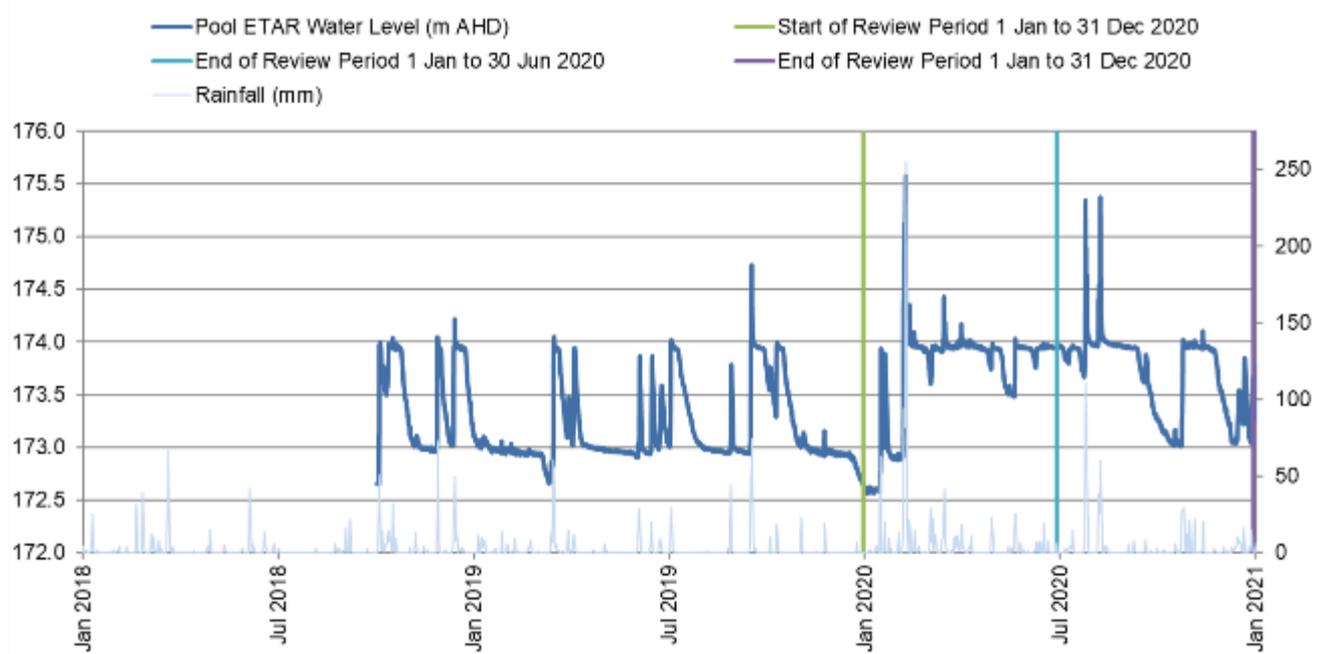


Chart A41 Pool ETAR

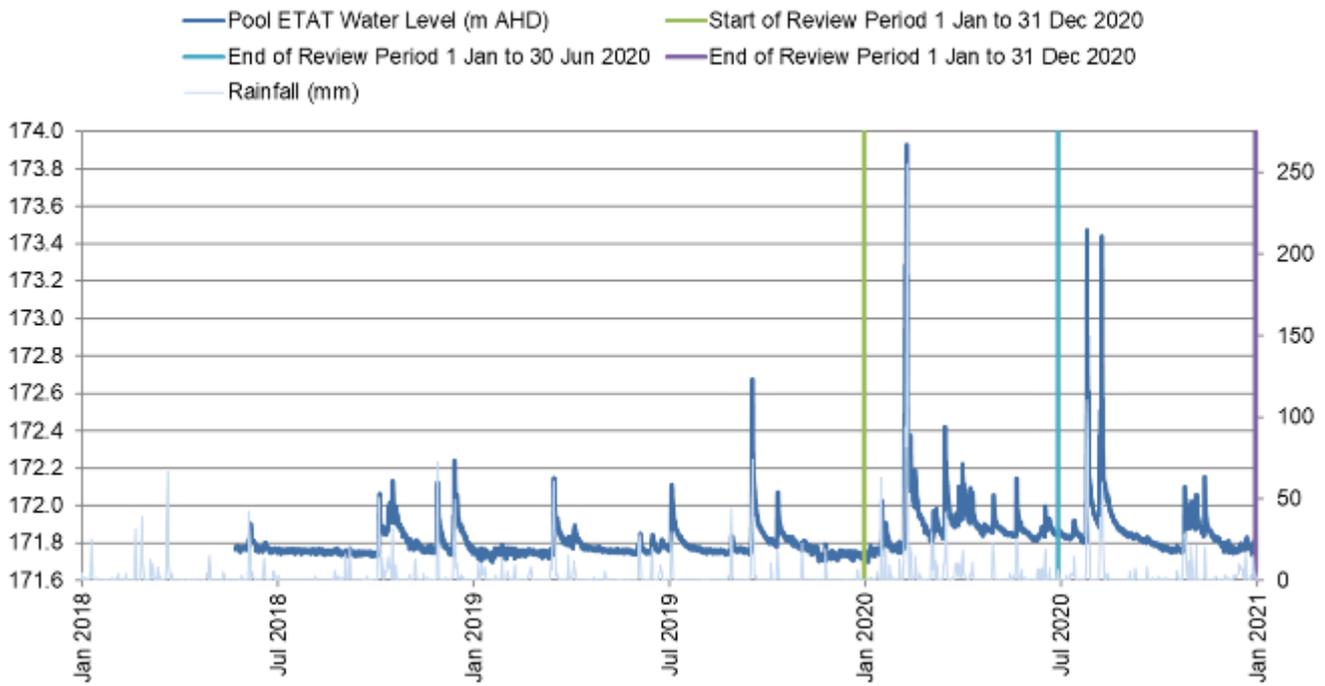


Chart A42 Pool ETAT

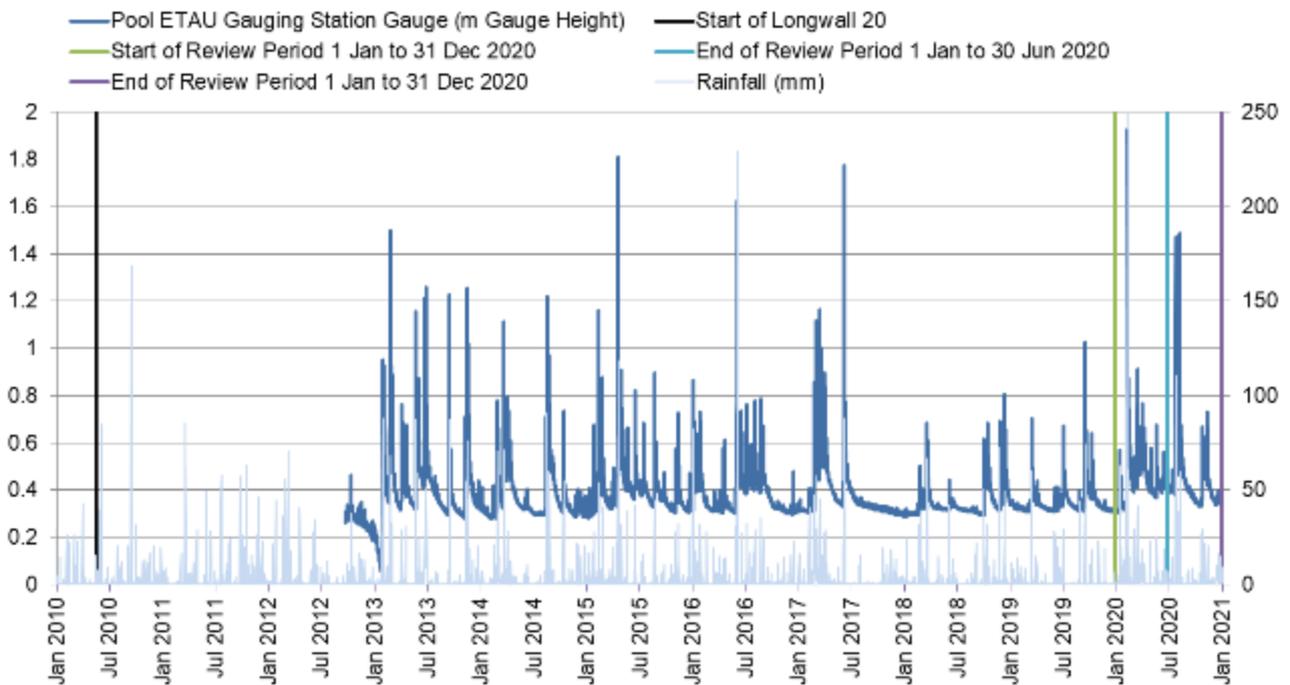


Chart A43 Pool ETAU (Stage data)

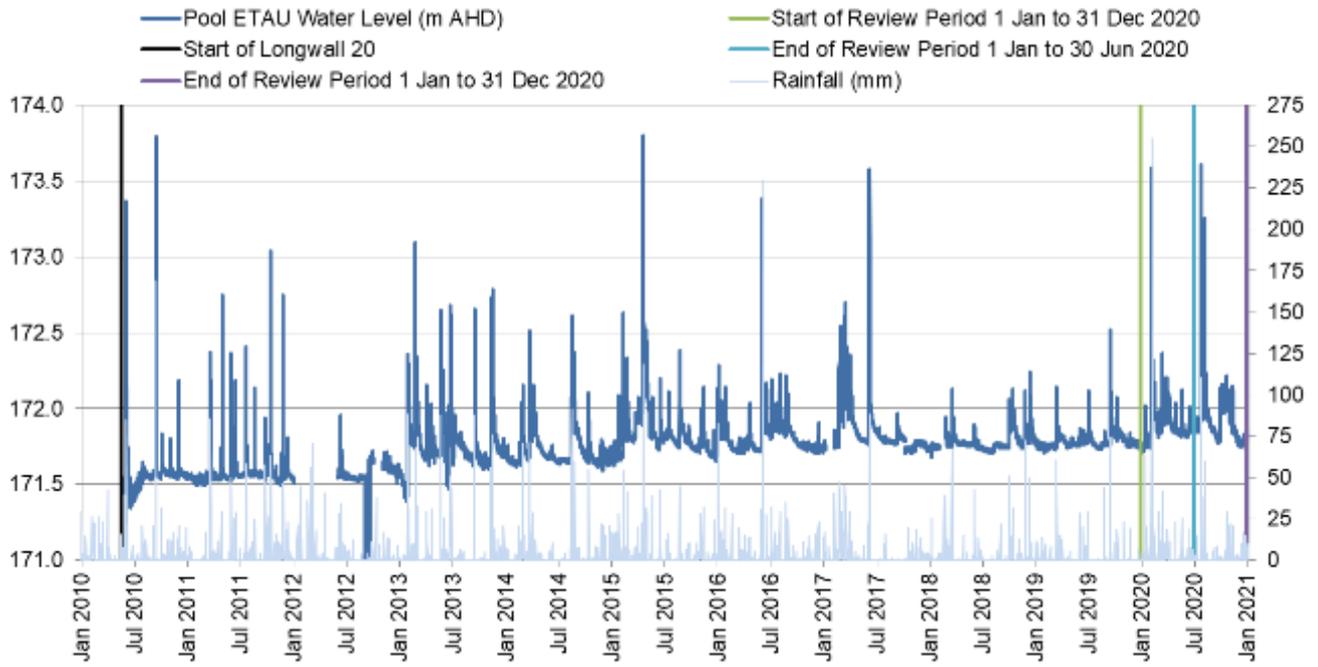


Chart A44 Pool ETAU

Pools on Tributary B/Reference Tributary

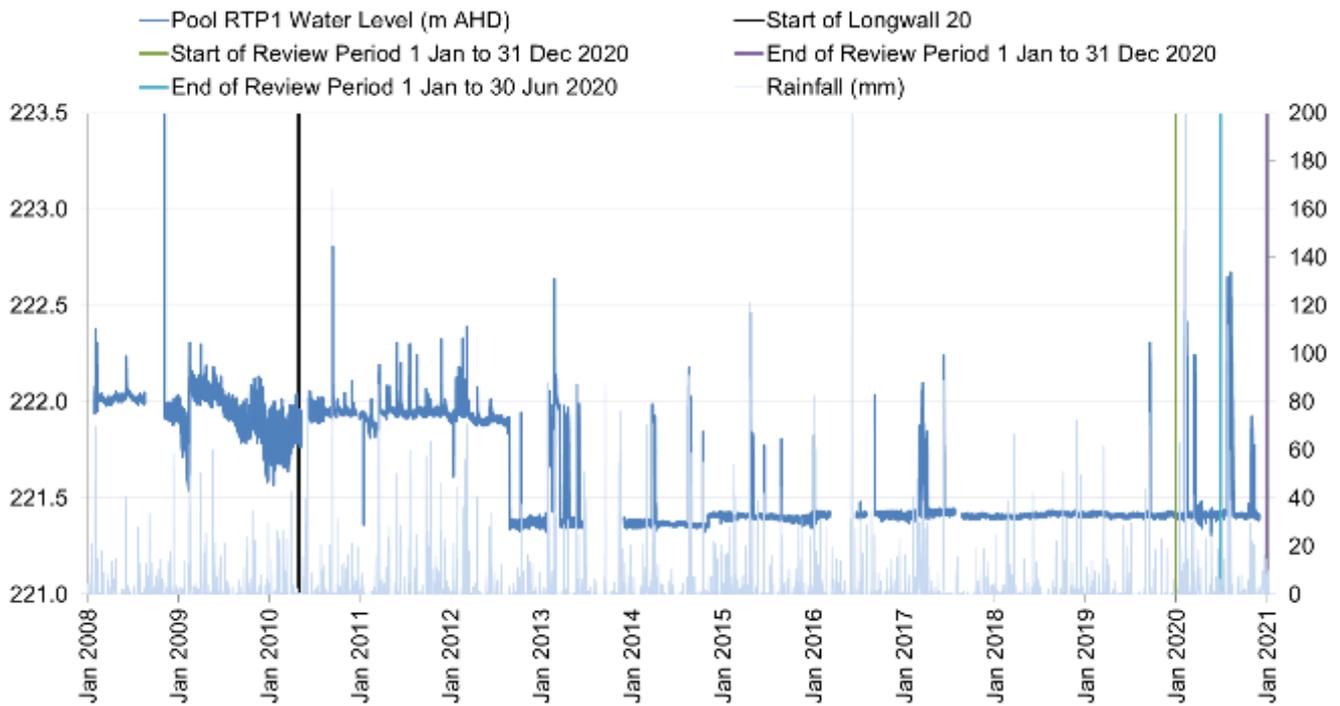


Chart A45 Pool RTP1

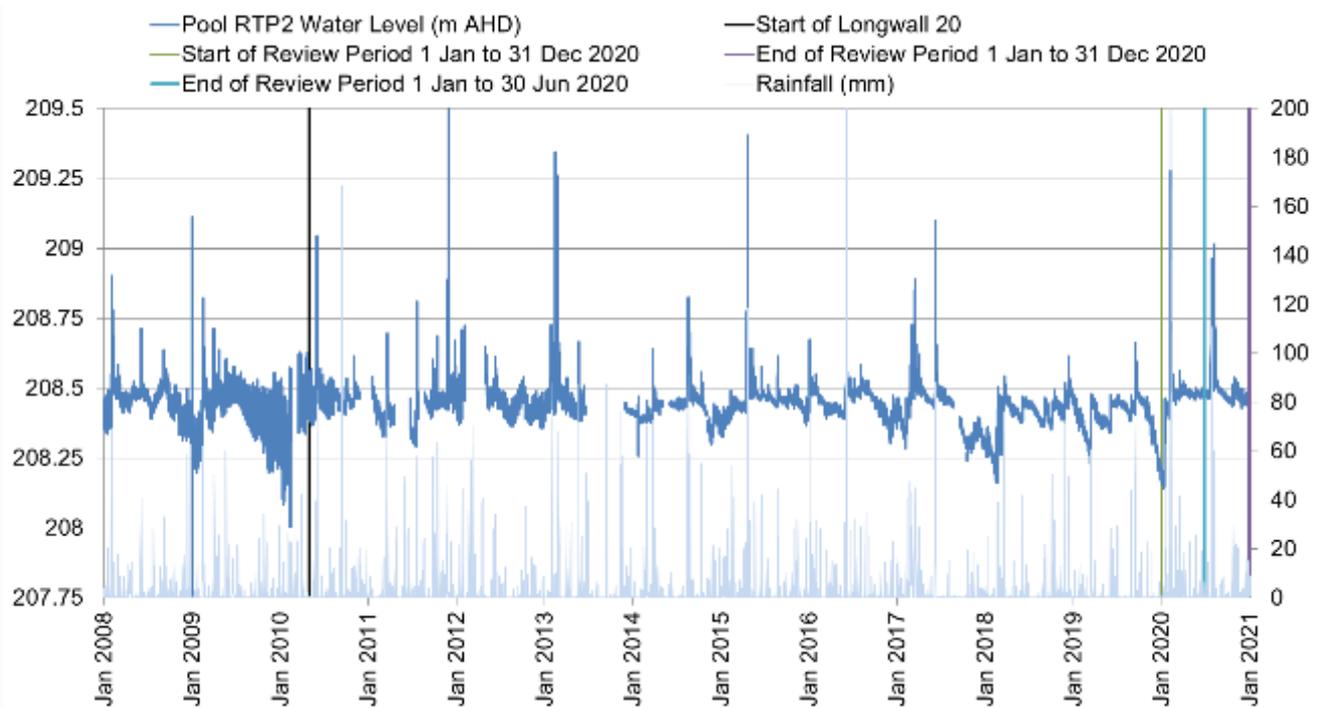


Chart A46 Pool RTP2

Pools on Woronora River¹⁶

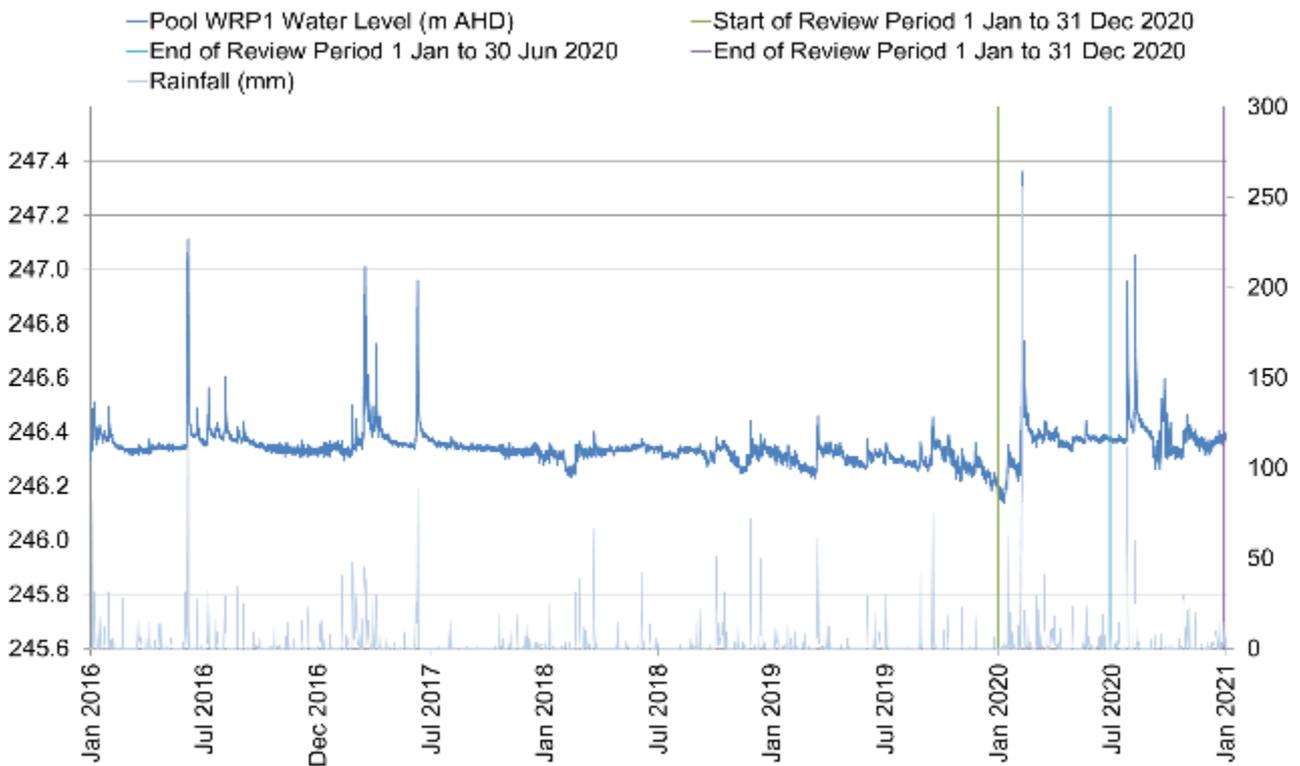


Chart A47 Pool WRP1

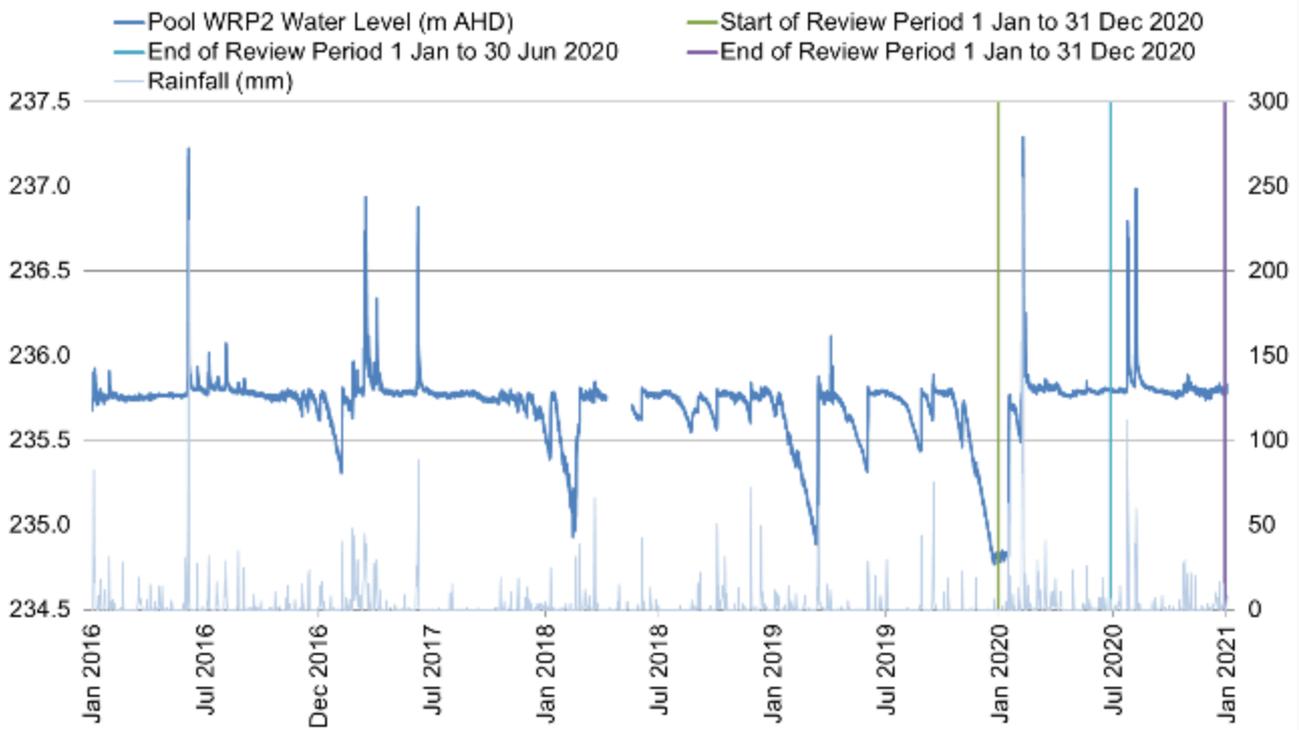


Chart A48 Pool WRP2

¹⁶ Pool water level data for the Woronora River pools prior to January 2016 is considered to be largely erroneous as a result of water level sensor issues and is not shown.

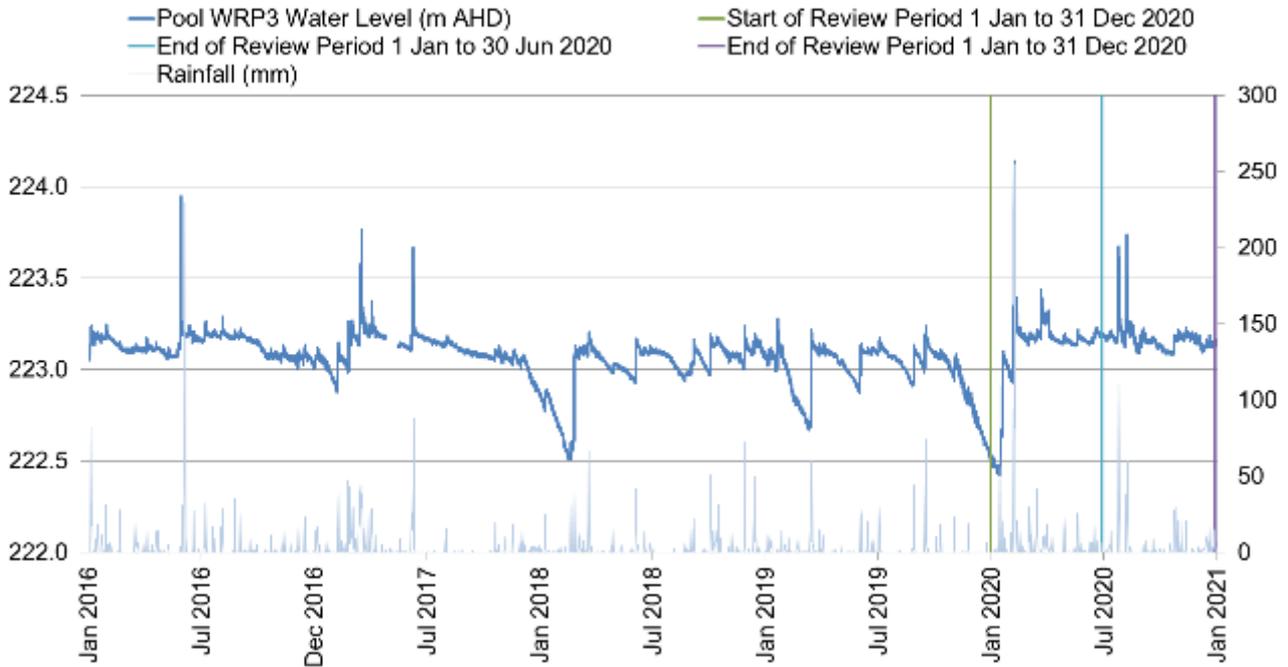


Chart A49 Pool WRP3

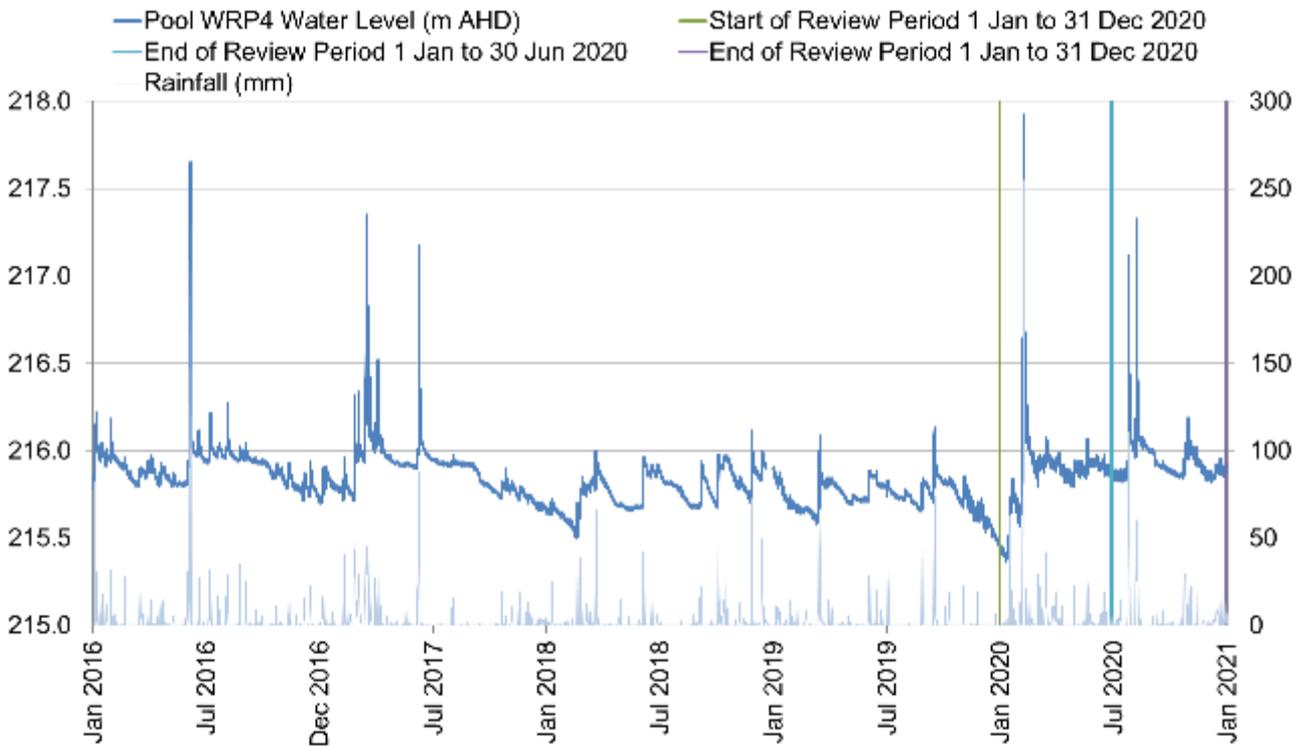


Chart A50 Pool WRP4¹⁷

¹⁷ Pool water level data for WRP4 was erroneous from 20 December 2018 to 1 January 2019 and removed from the dataset. The erroneous data was a result of a logger positioning error.

Appendix B

Surface Water Quality Monitoring Results for Select Sites – pH, Electrical Conductivity, Dissolved Iron, Dissolved Manganese and Dissolved Aluminium

Waratah Rivulet

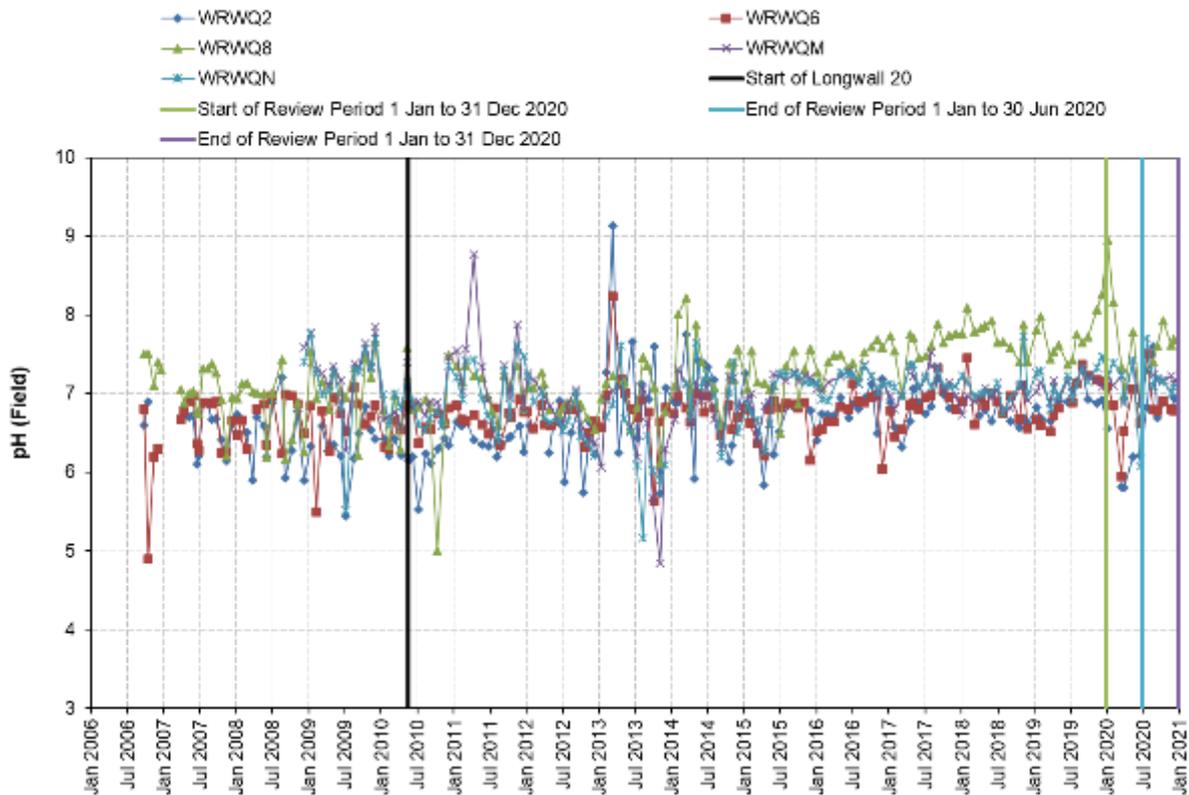


Chart B1 pH Levels Waratah Rivulet – Upper to Middle Reach Sites

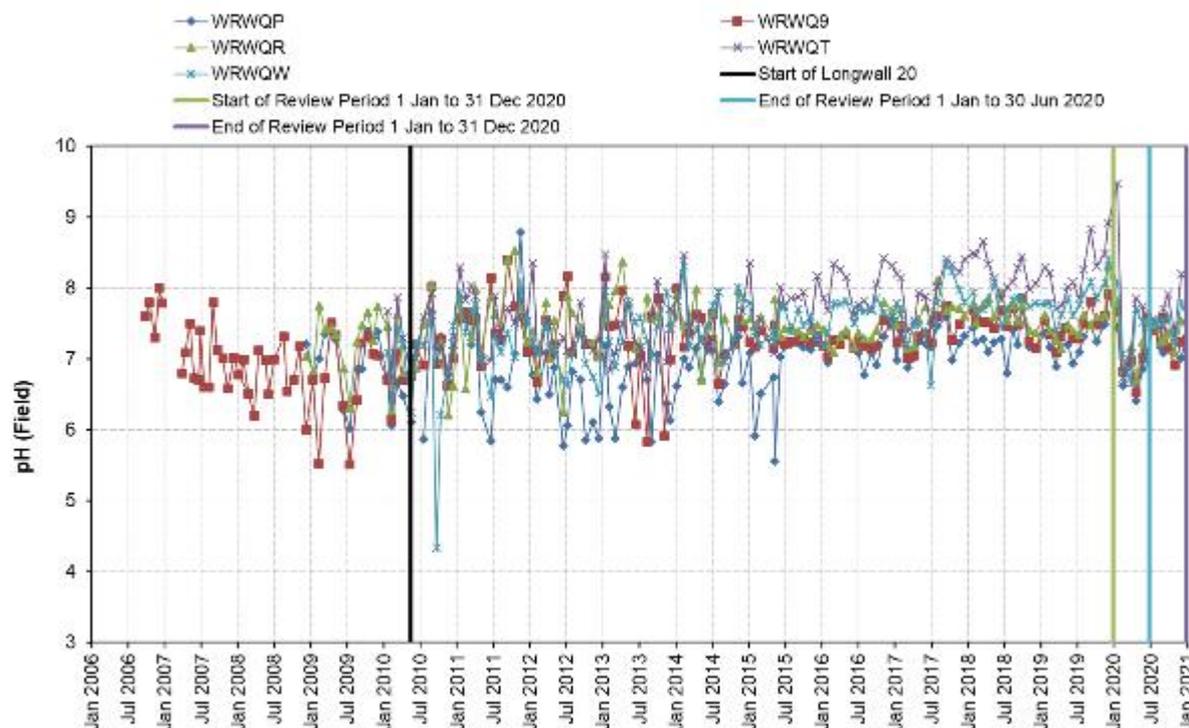


Chart B2 pH Levels Waratah Rivulet – Lower Reach Sites

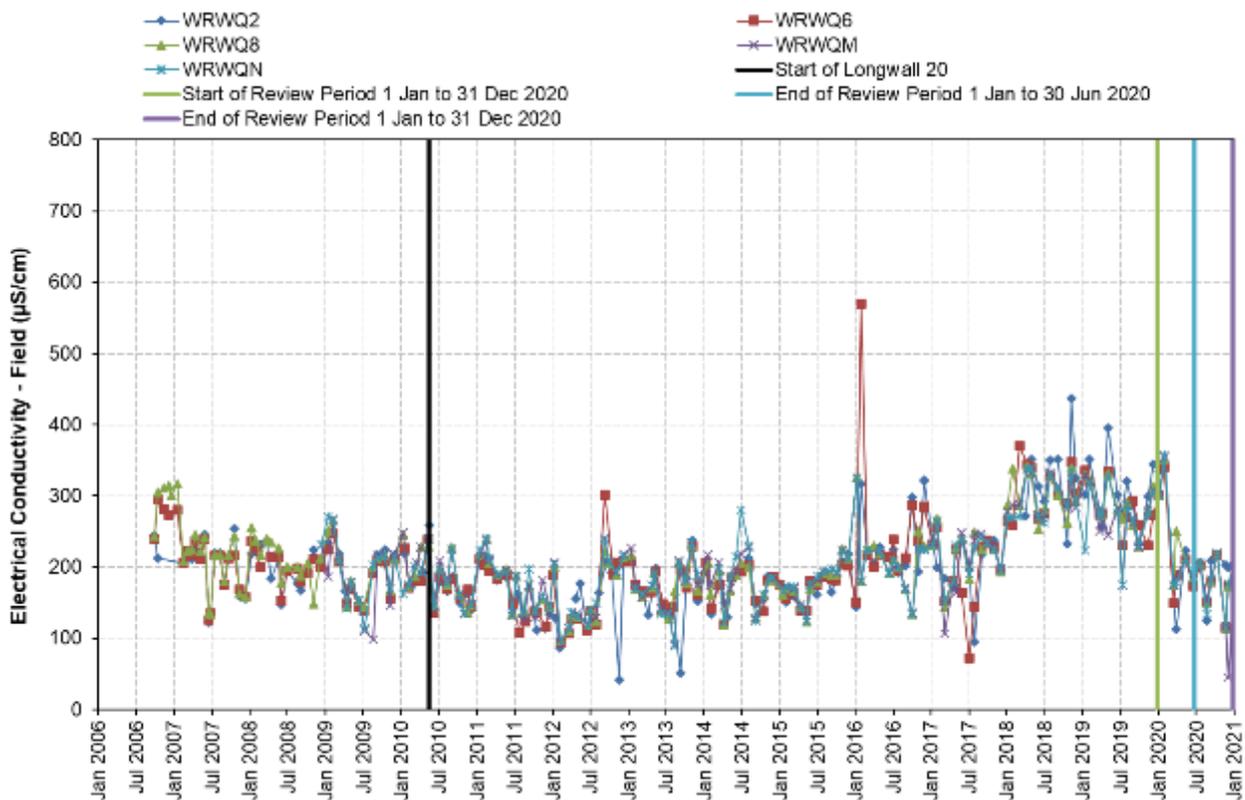


Chart B3 Electrical Conductivity (EC) Waratah Rivulet – Upper to Middle Reach Sites¹⁸

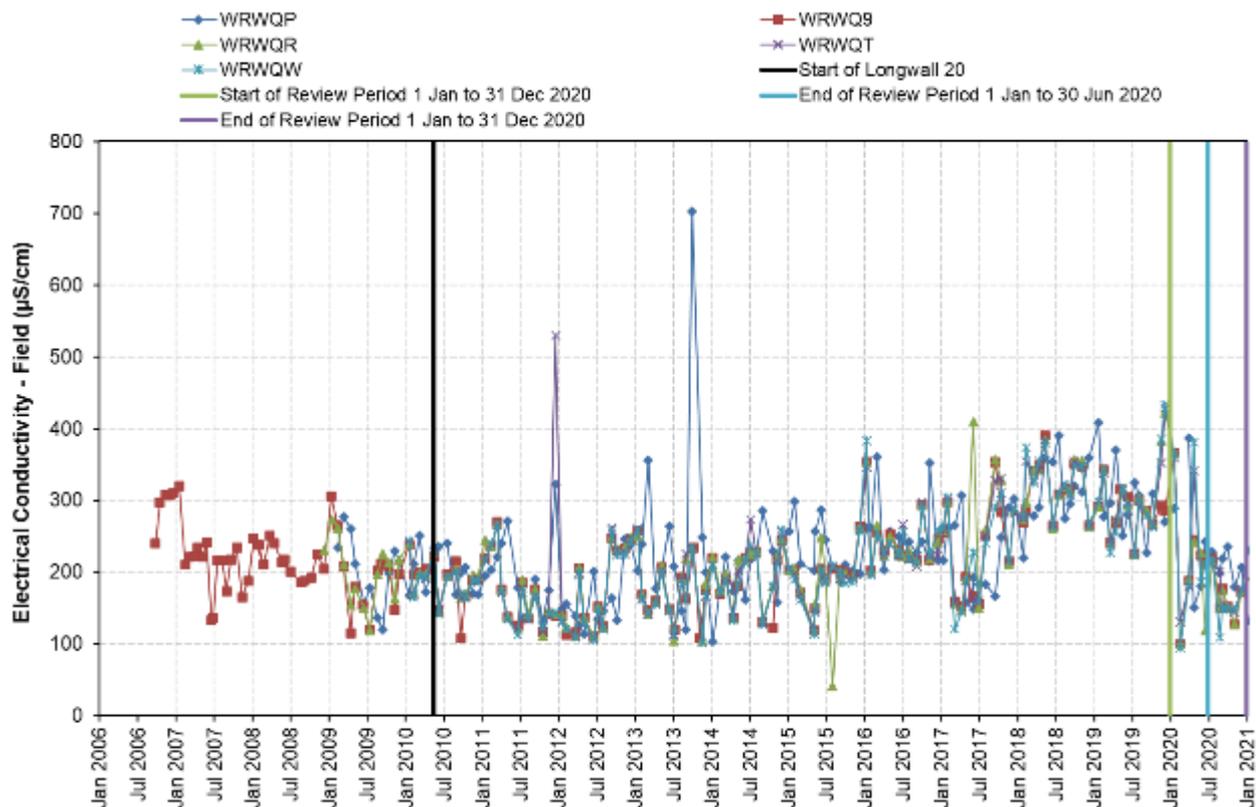


Chart B4 Electrical Conductivity (EC) Waratah Rivulet – Lower Reach Sites

¹⁸ The water quality meter was calibrated to a much lower temperature of water than that recorded in the Waratah Rivulet during the June to December 2019 review period and, as such, the field recorded electrical conductivity values were found to be inaccurate. Consequently, the laboratory values for electrical conductivity have been presented for this period rather than field recorded electrical conductivity values.

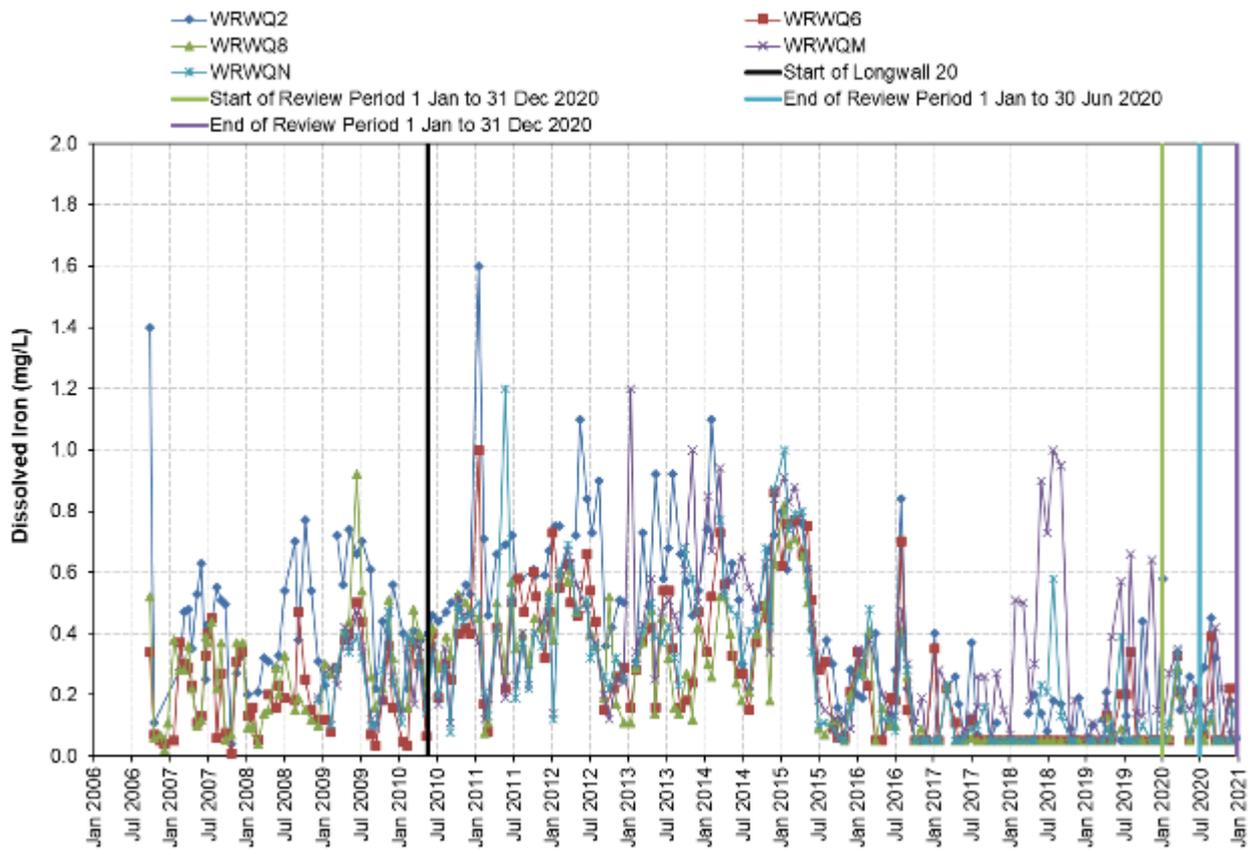


Chart B5 Dissolved Iron Waratah Rivulet – Upper and Middle Reach Sites

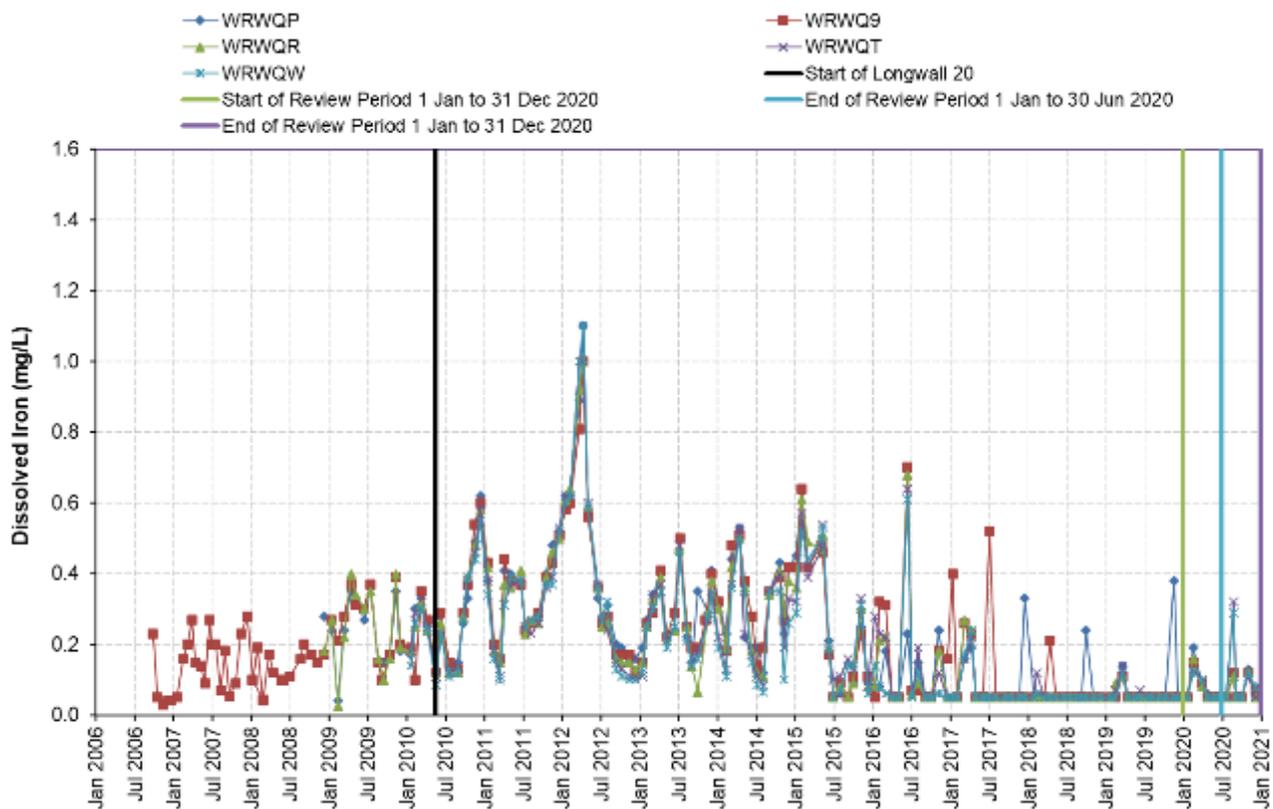


Chart B6 Dissolved Iron Waratah Rivulet – Lower Reach Sites

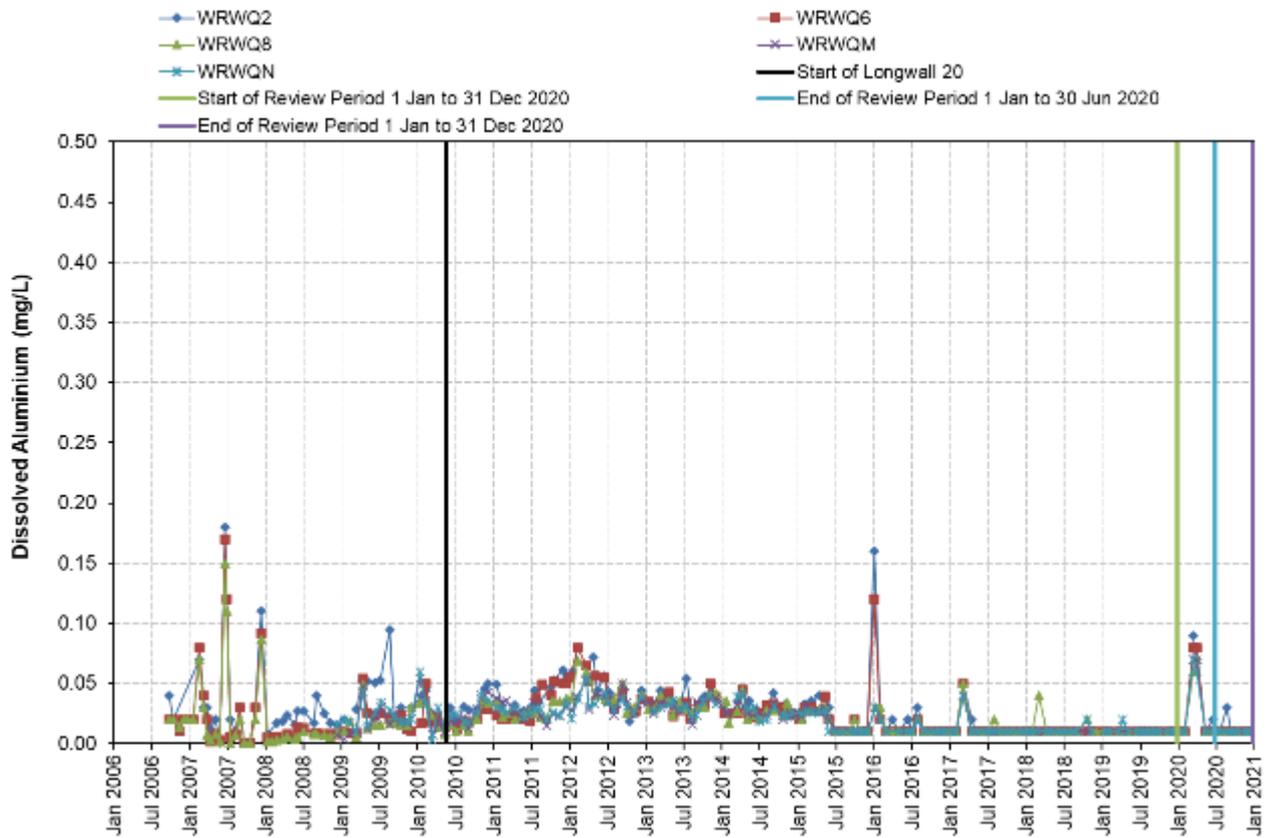


Chart B7 Dissolved Aluminium Waratah Rivulet – Upper to Middle Reach Sites

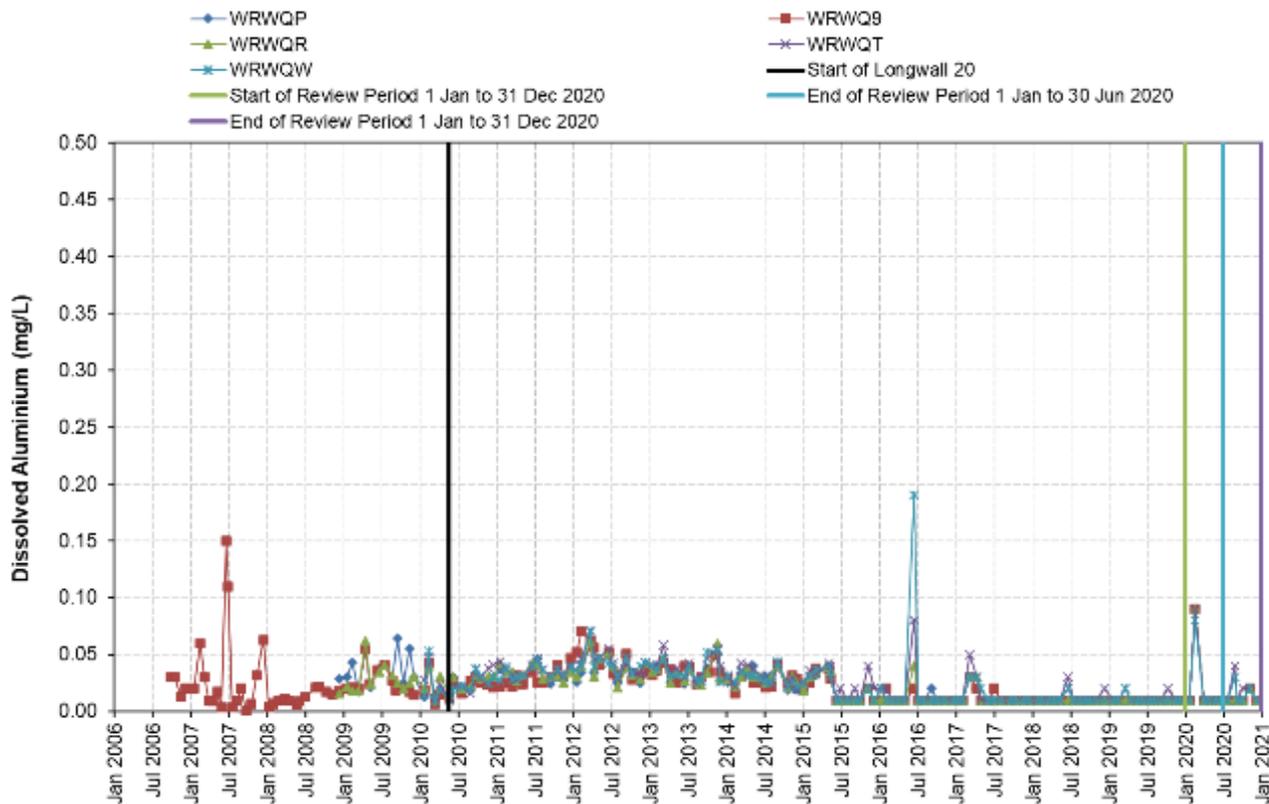


Chart B8 Dissolved Aluminium Waratah Rivulet – Lower Reach Sites

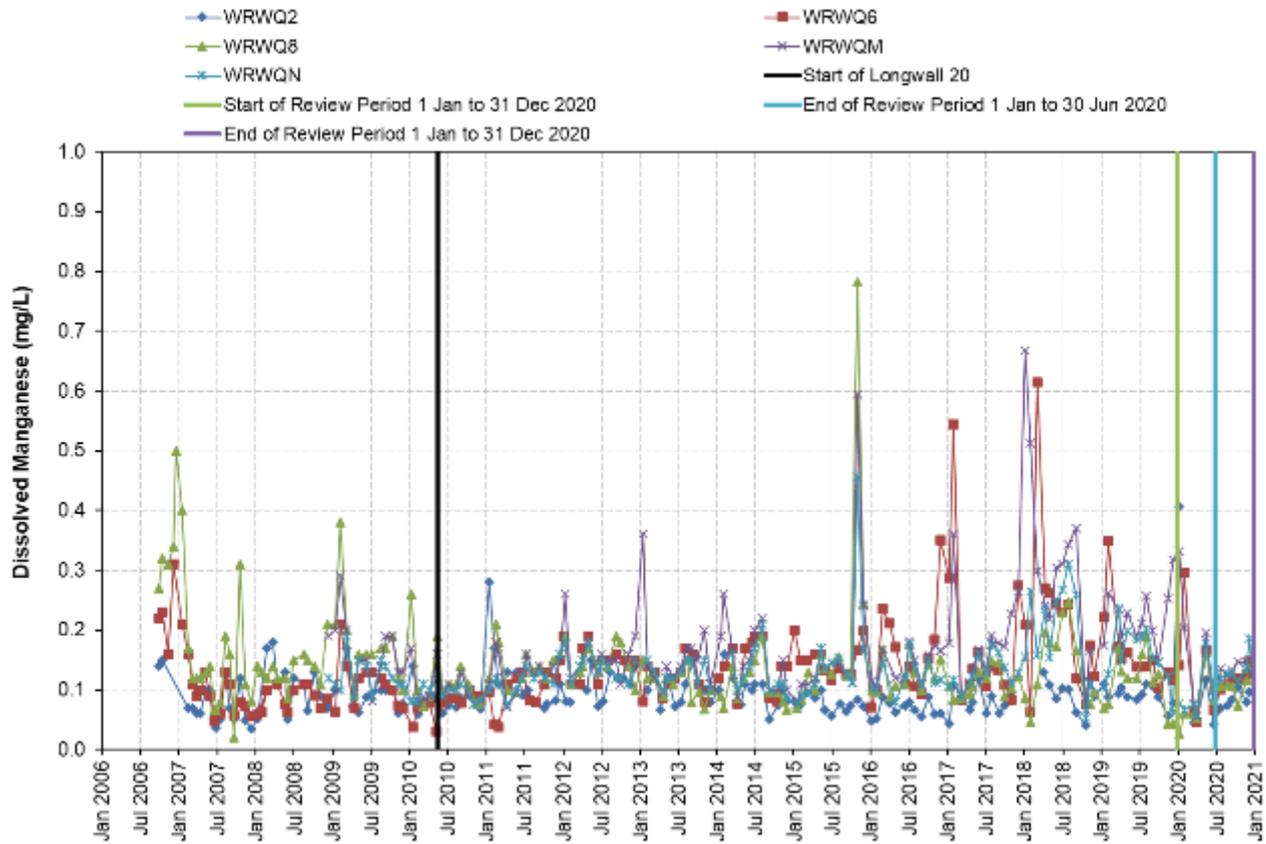


Chart B9 Dissolved Manganese Waratah Rivulet – Upper to Middle Reach Sites

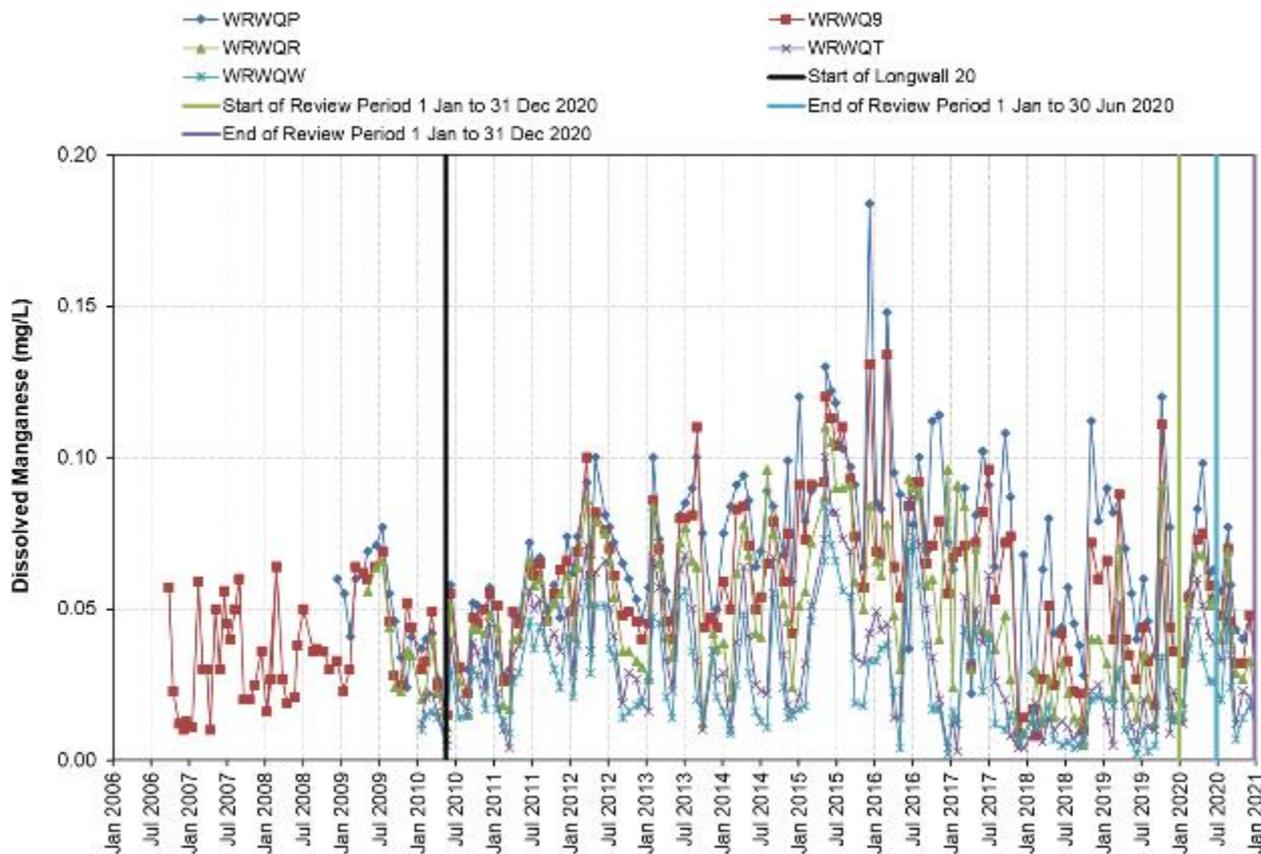


Chart B10 Dissolved Manganese Waratah Rivulet – Lower Reach Sites

Woronora River

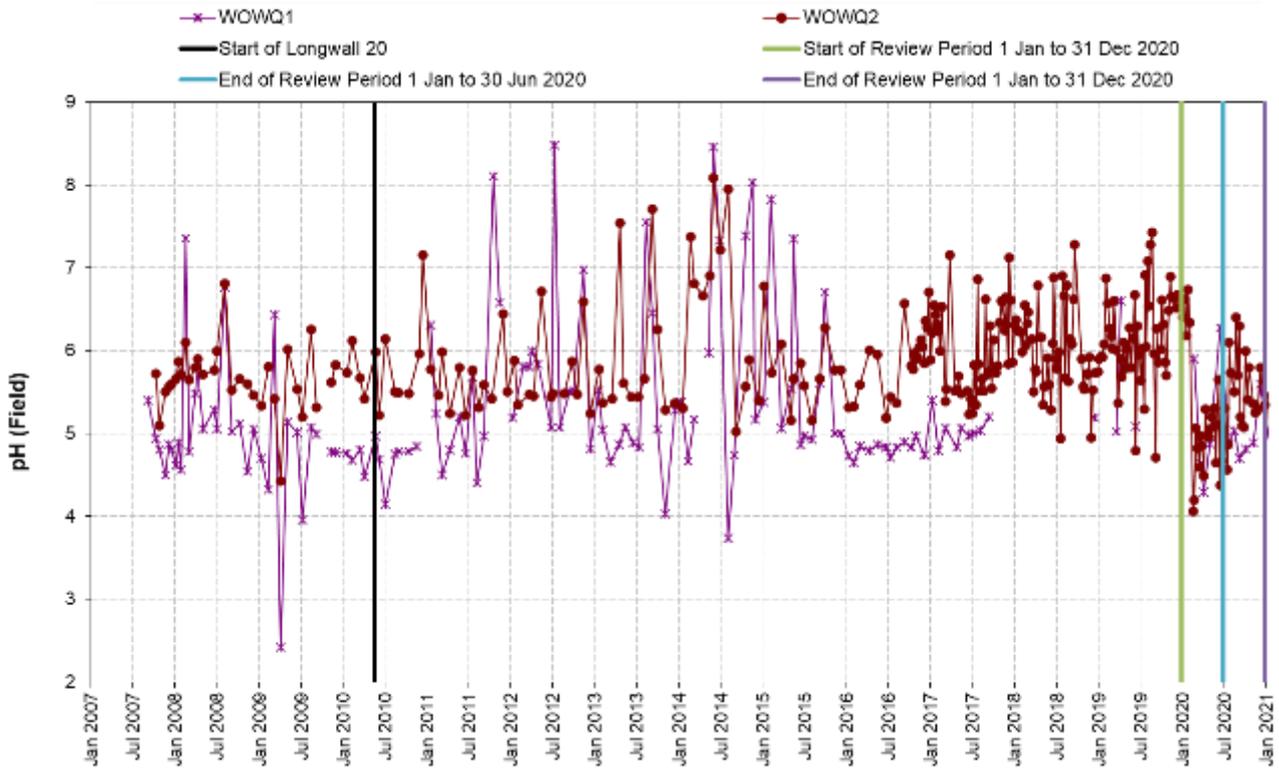


Chart B11 pH Levels Woronora River¹⁹

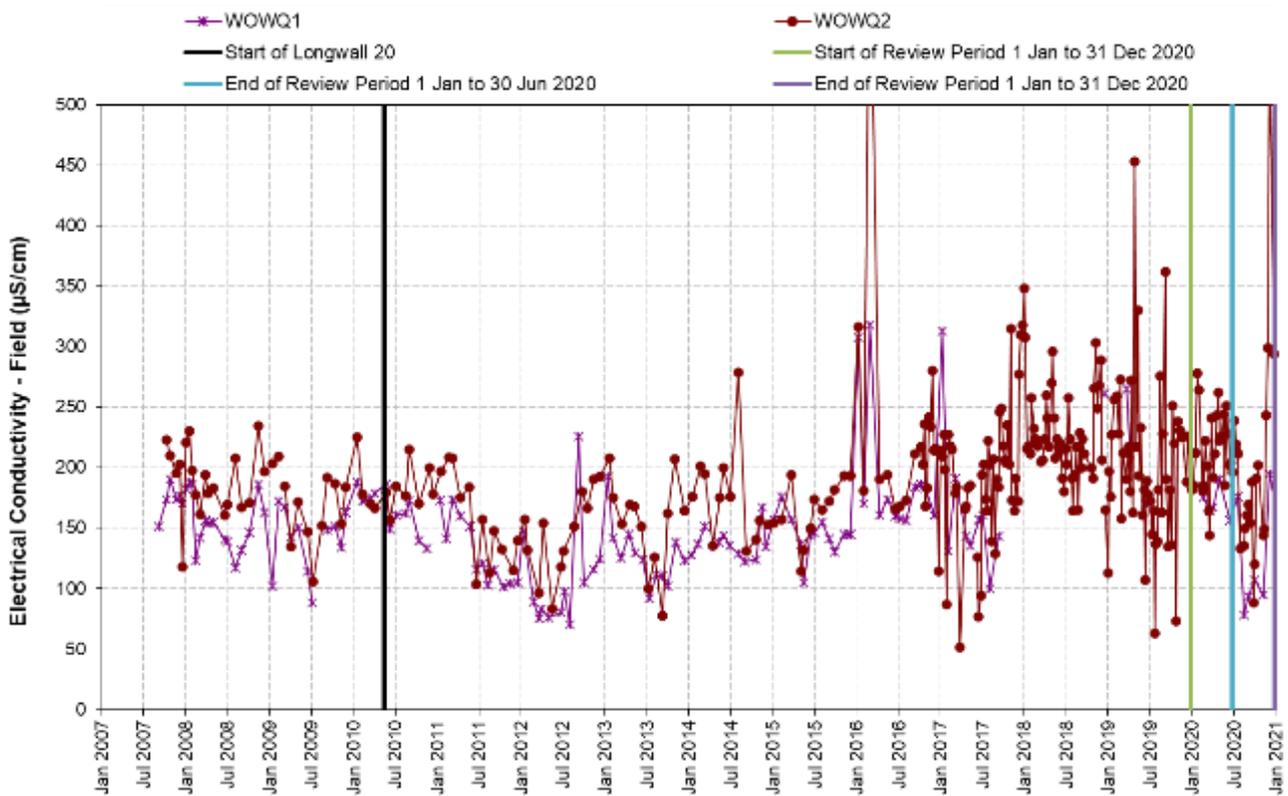


Chart B12 Electrical Conductivity (EC) Woronora River¹⁸

¹⁹ WOWQ 1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

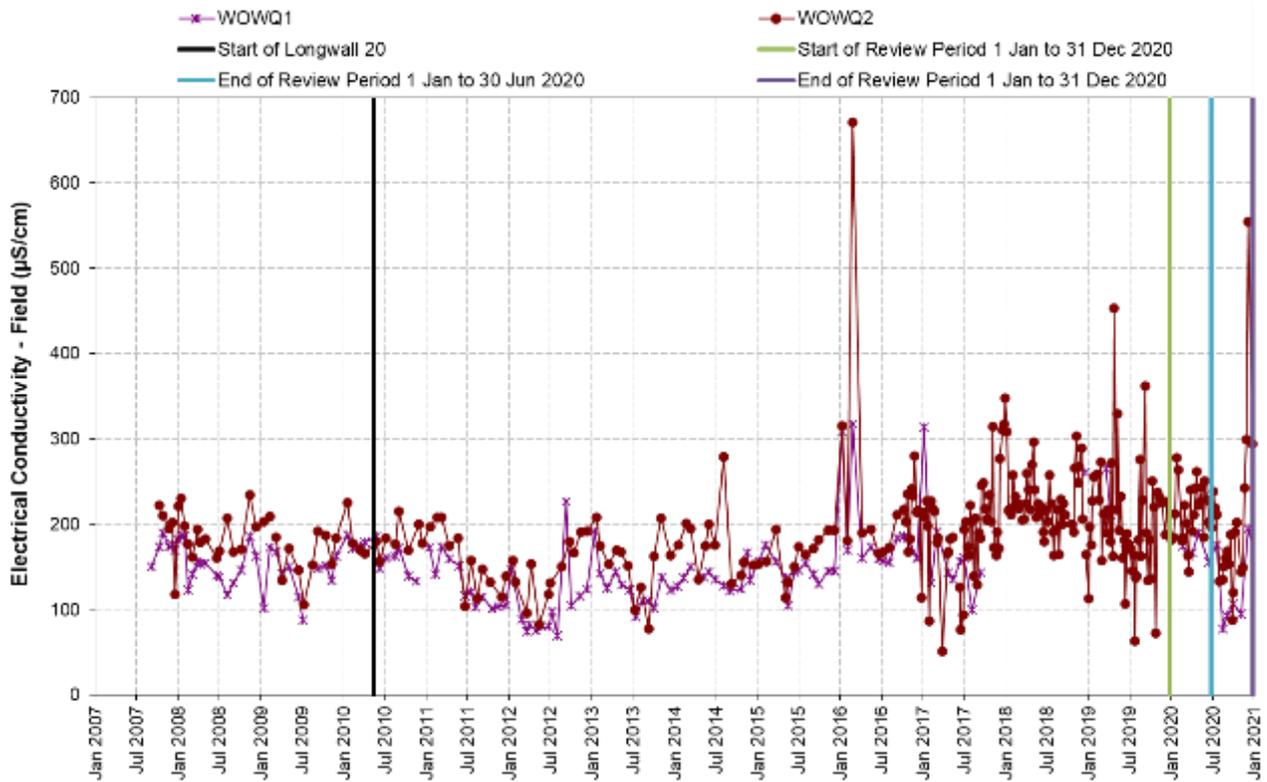


Chart B12a Electrical Conductivity (EC) Woronora River²⁰

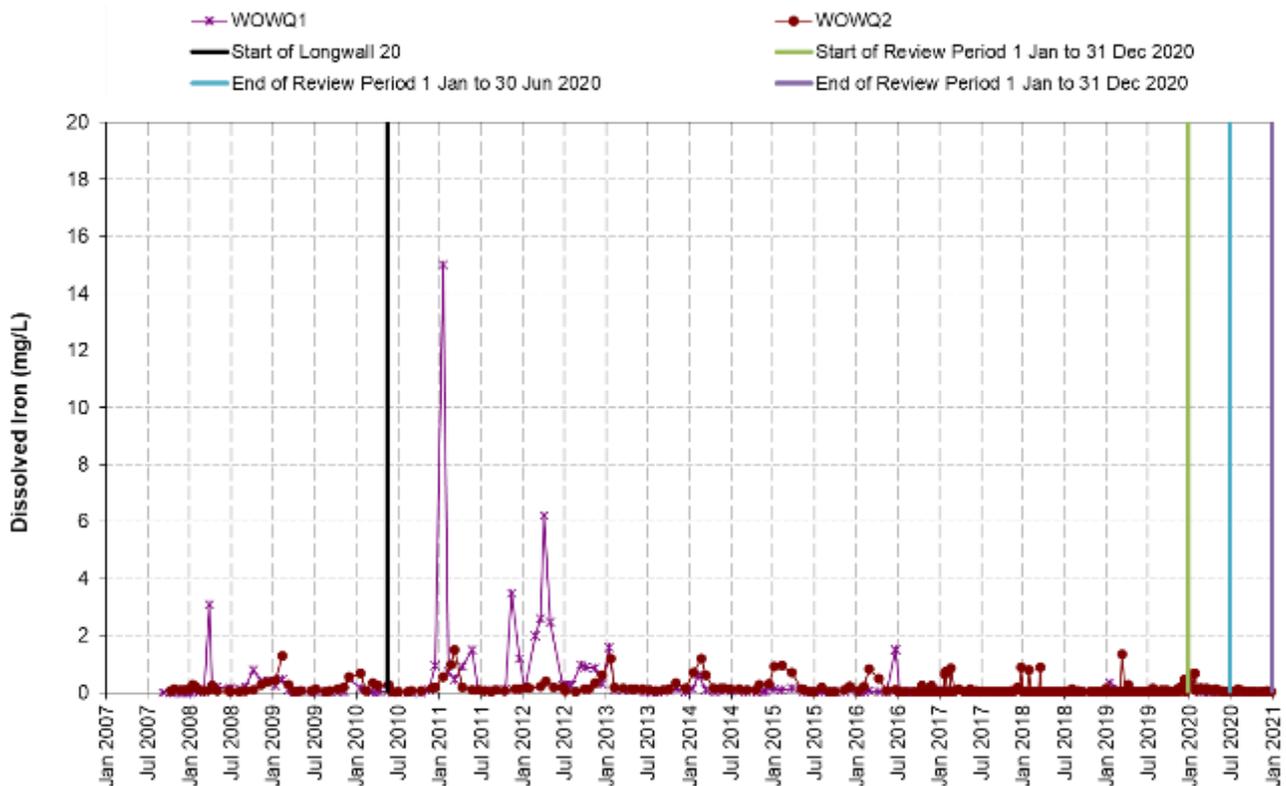


Chart B13 Dissolved Iron Woronora River²⁰

²⁰ WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

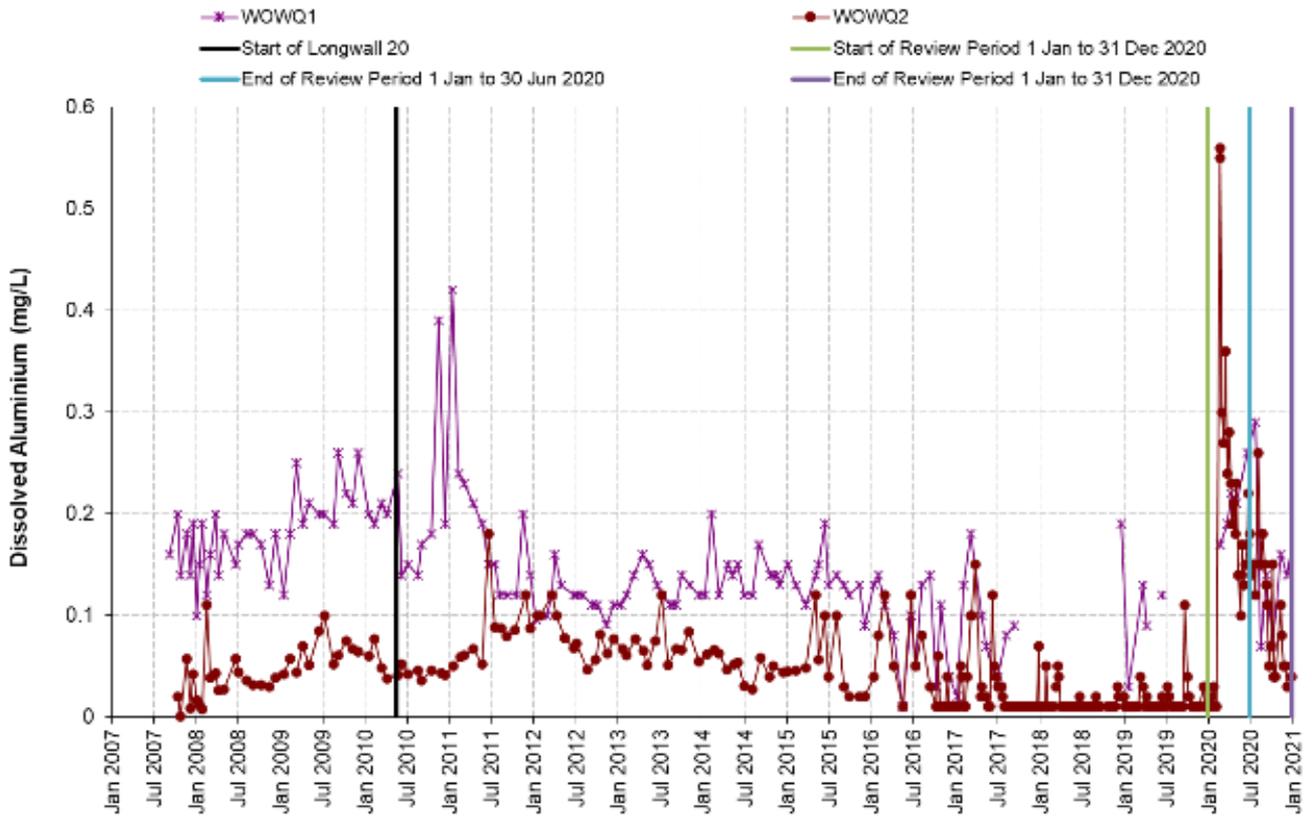


Chart B14 Dissolved Aluminium Woronora River²¹

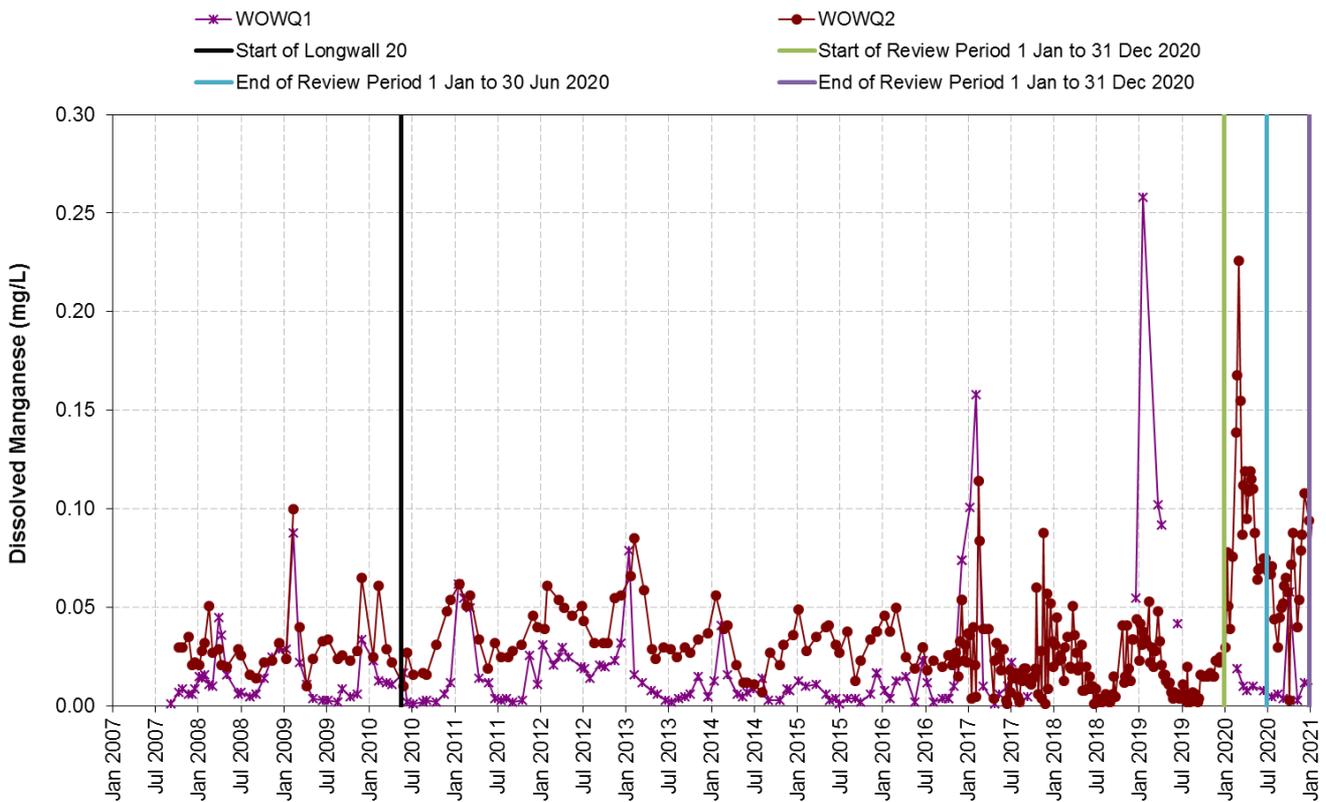


Chart B15 Dissolved Manganese Woronora River²¹

²¹WOWQ1 was dry between 23 October 2017 and 20 December 2018, in May 2019 and between 3 July 2019 and 20 January 2020 and hence no water quality samples were collected.

Eastern Tributary

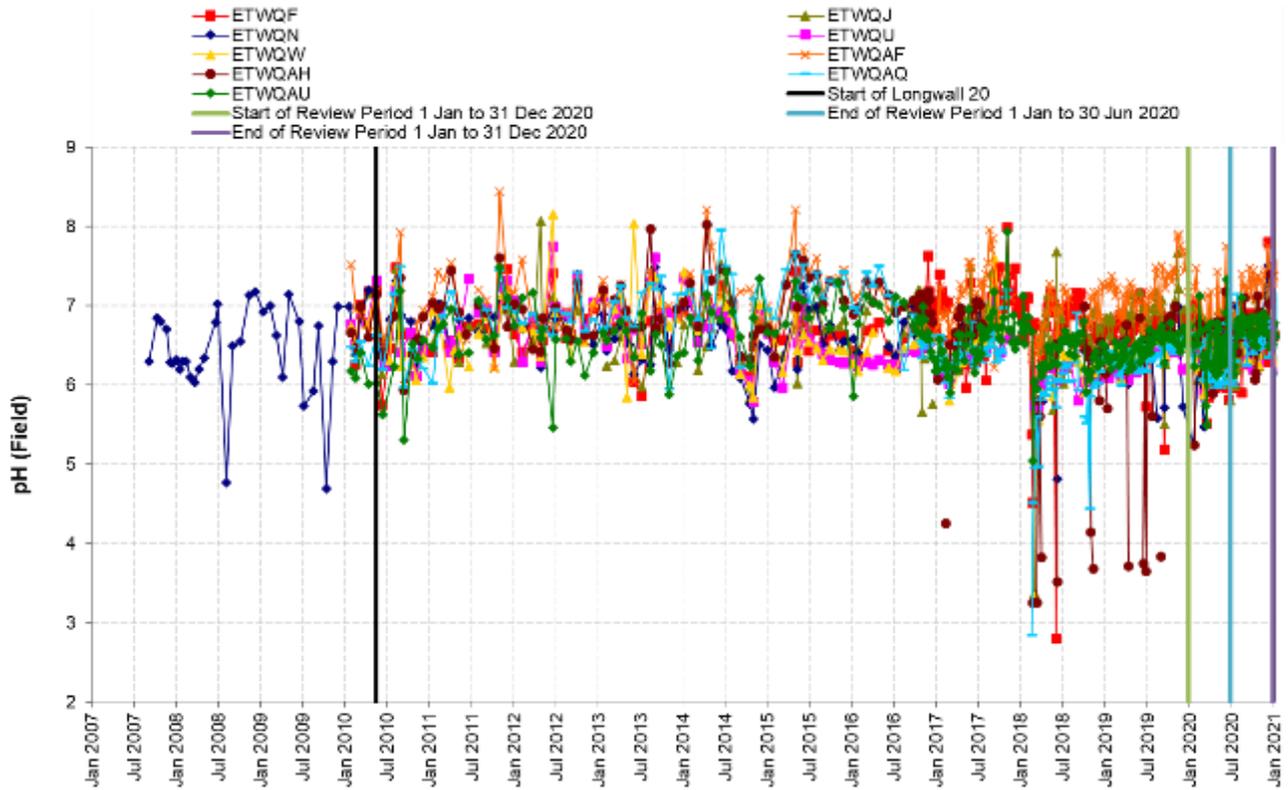


Chart B16 pH Levels Eastern Tributary

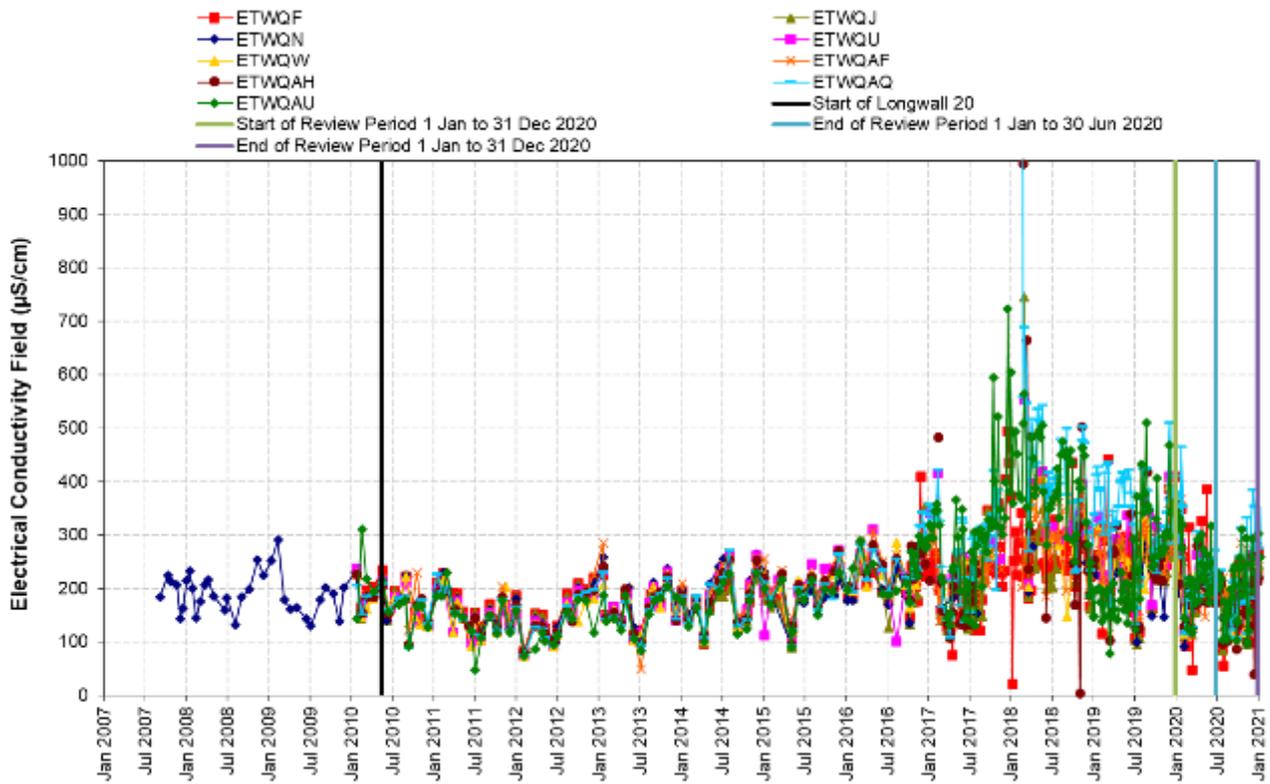


Chart B17 Electrical Conductivity (EC) Eastern Tributary

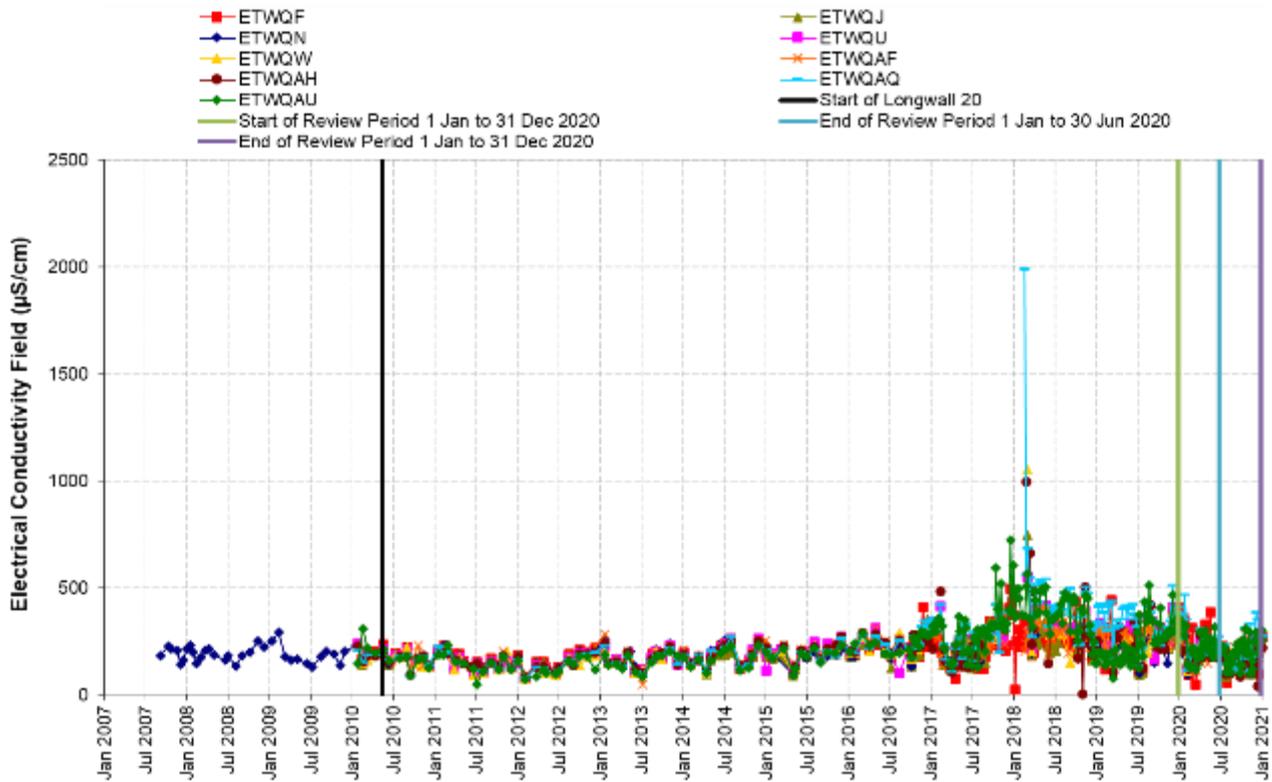


Chart B17a Electrical Conductivity (EC) Eastern Tributary

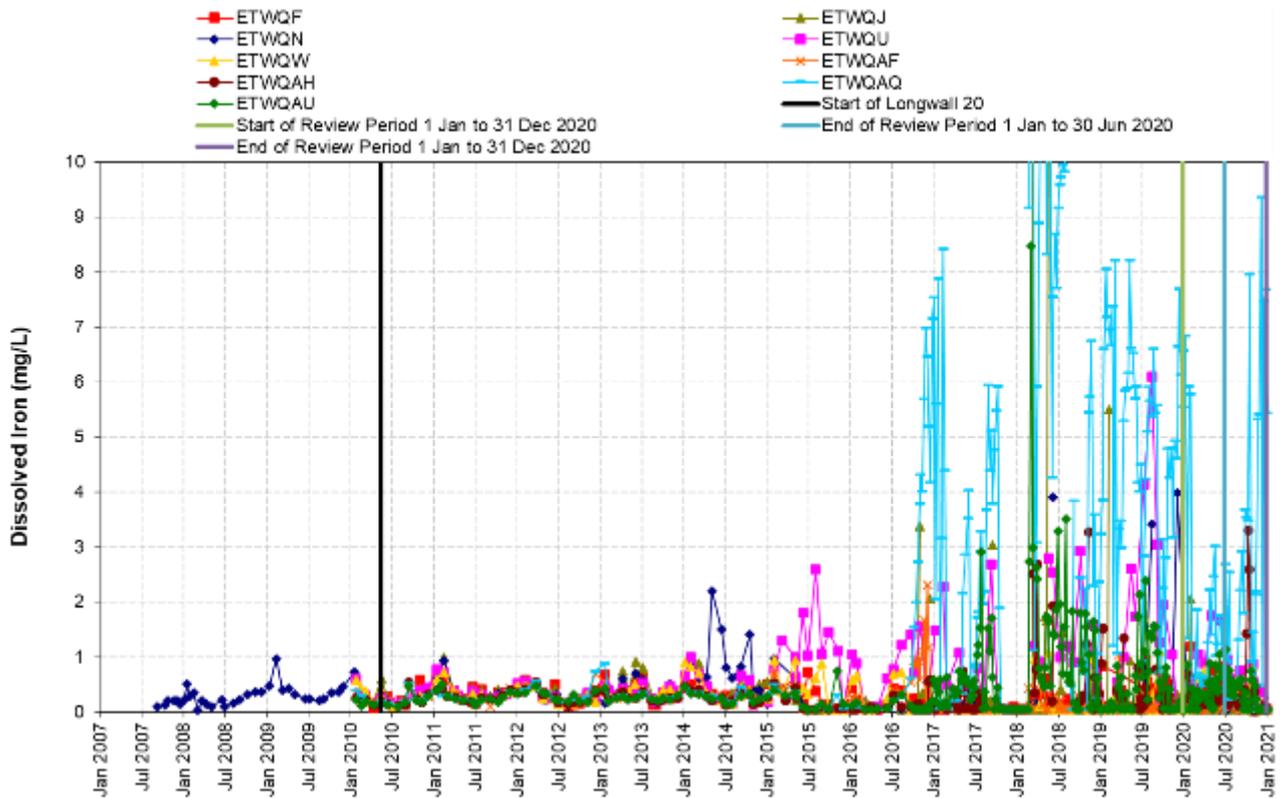


Chart B18 Dissolved Iron Eastern Tributary

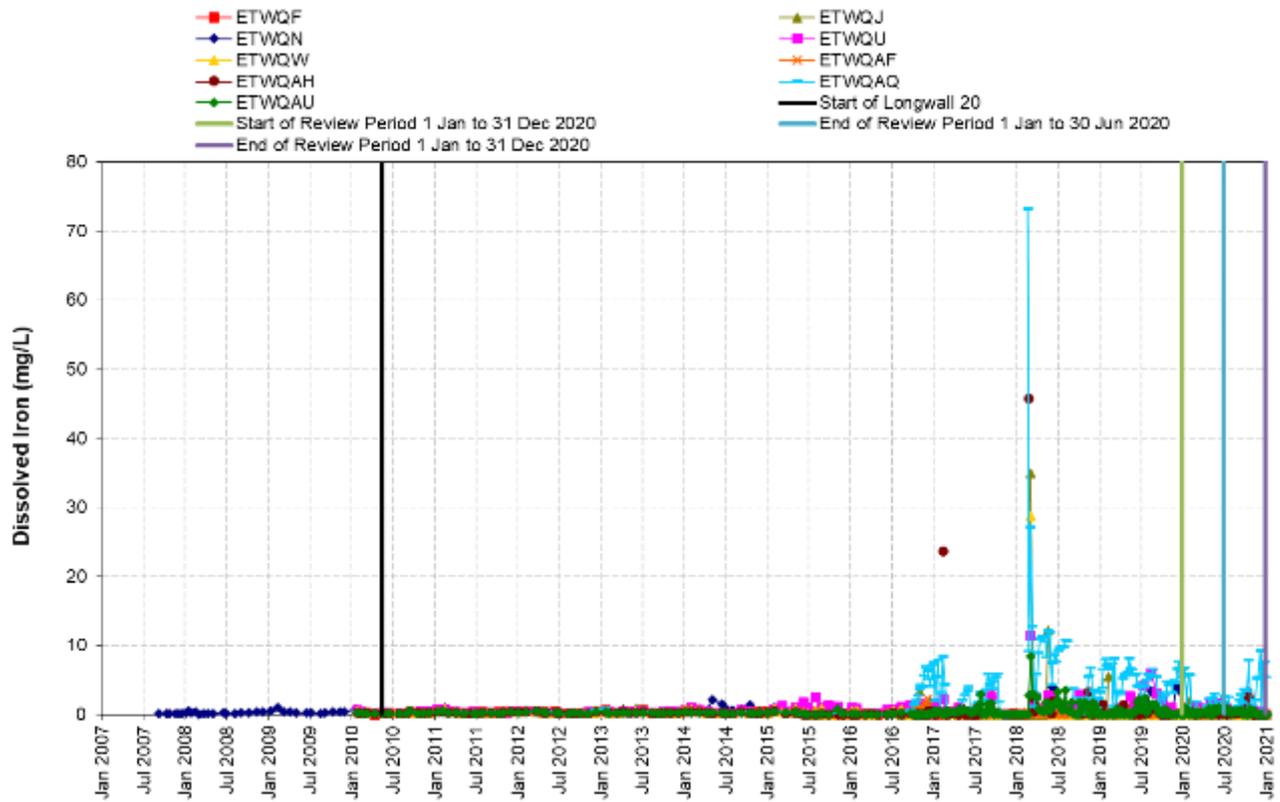


Chart B18a Dissolved Iron Eastern Tributary

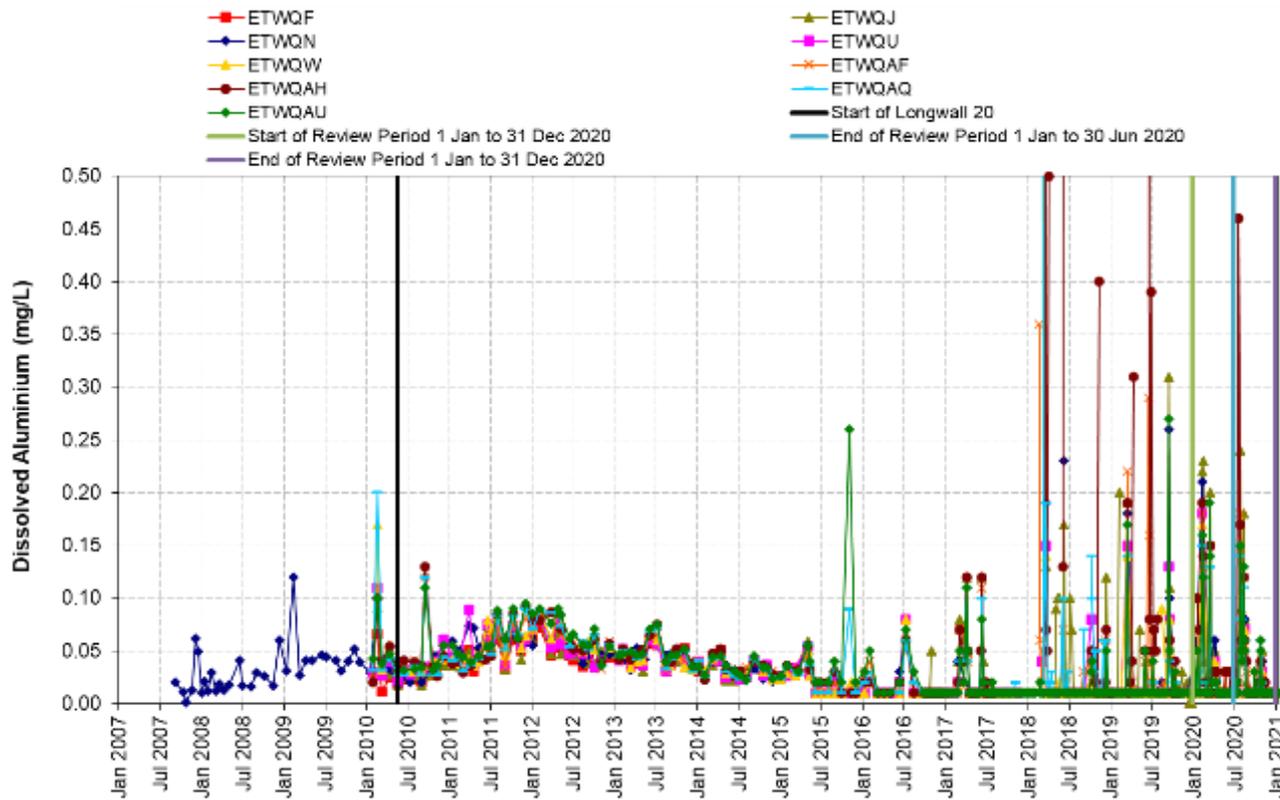


Chart B19 Dissolved Aluminium Eastern Tributary

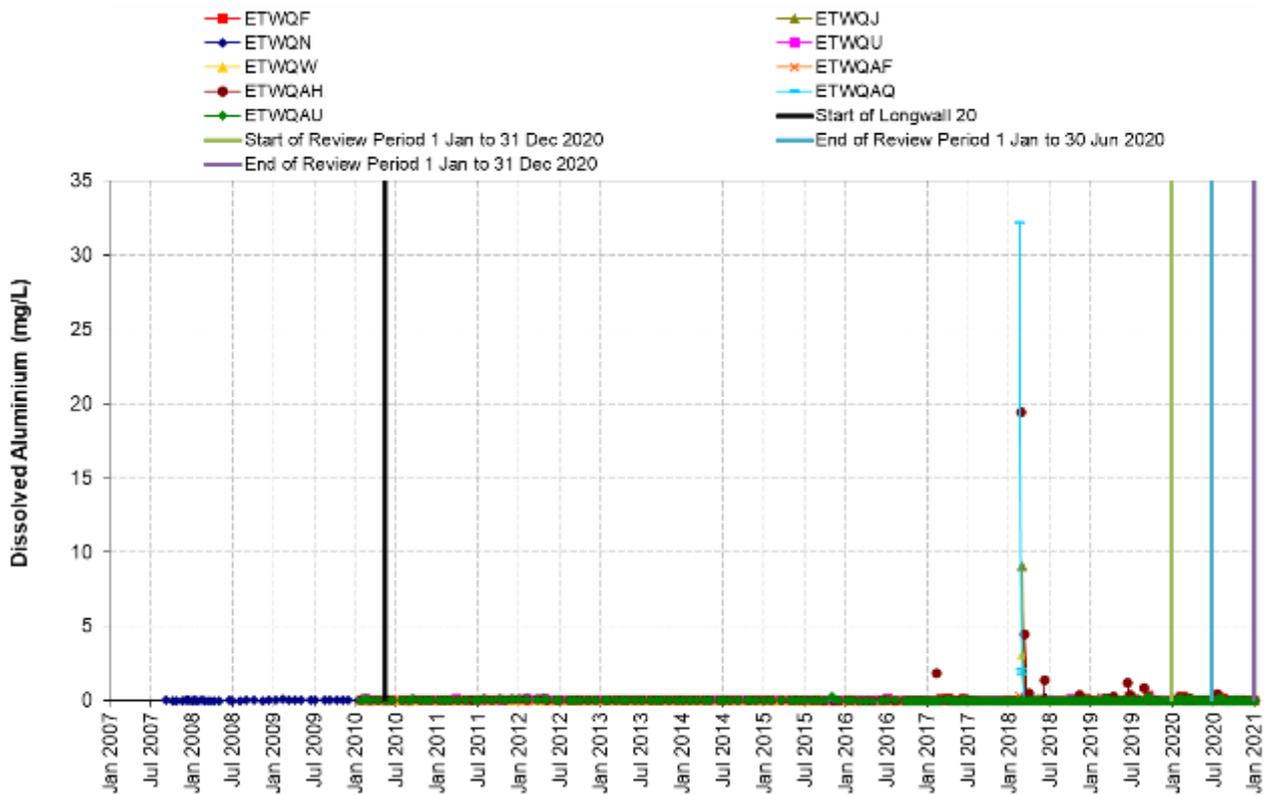


Chart B19a Dissolved Aluminium Eastern Tributary

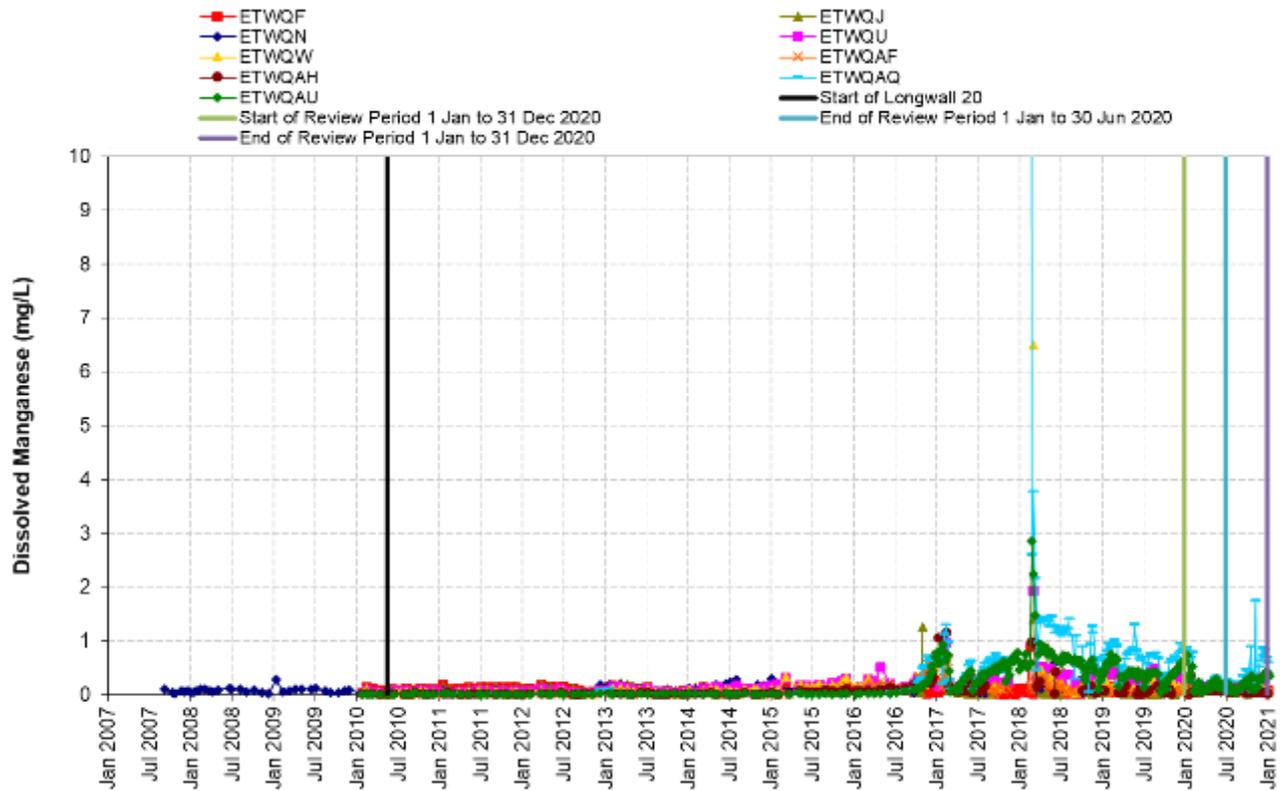


Chart B20 Dissolved Manganese Eastern Tributary

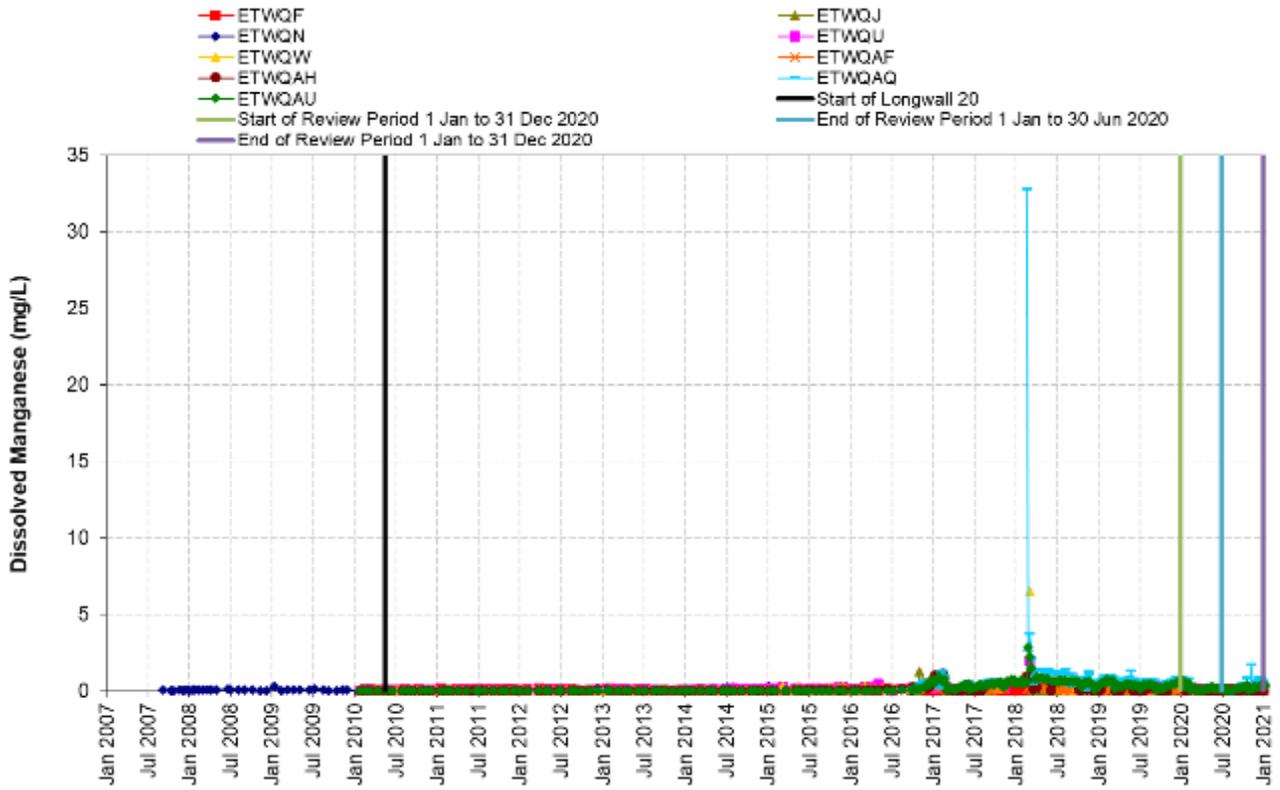


Chart B20a Dissolved Manganese Eastern Tributary

Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

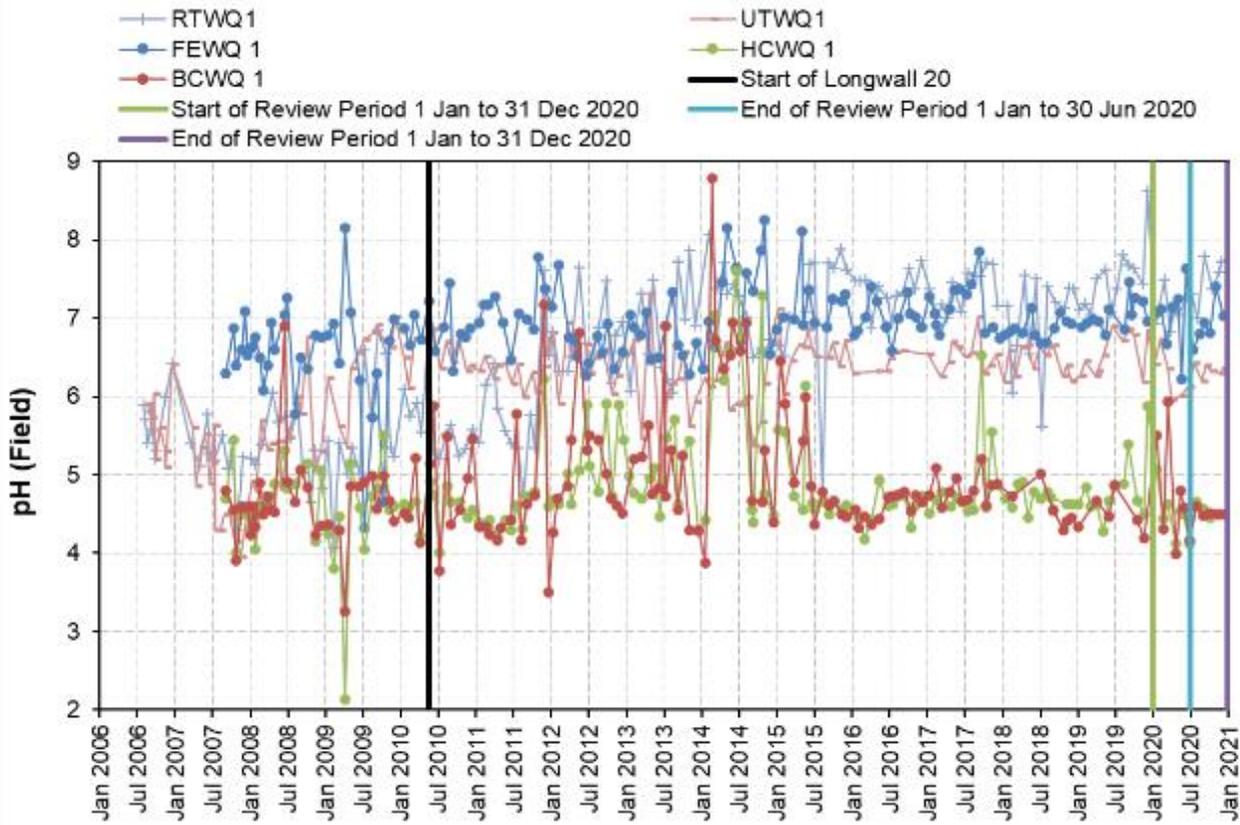


Chart B21 pH Levels Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

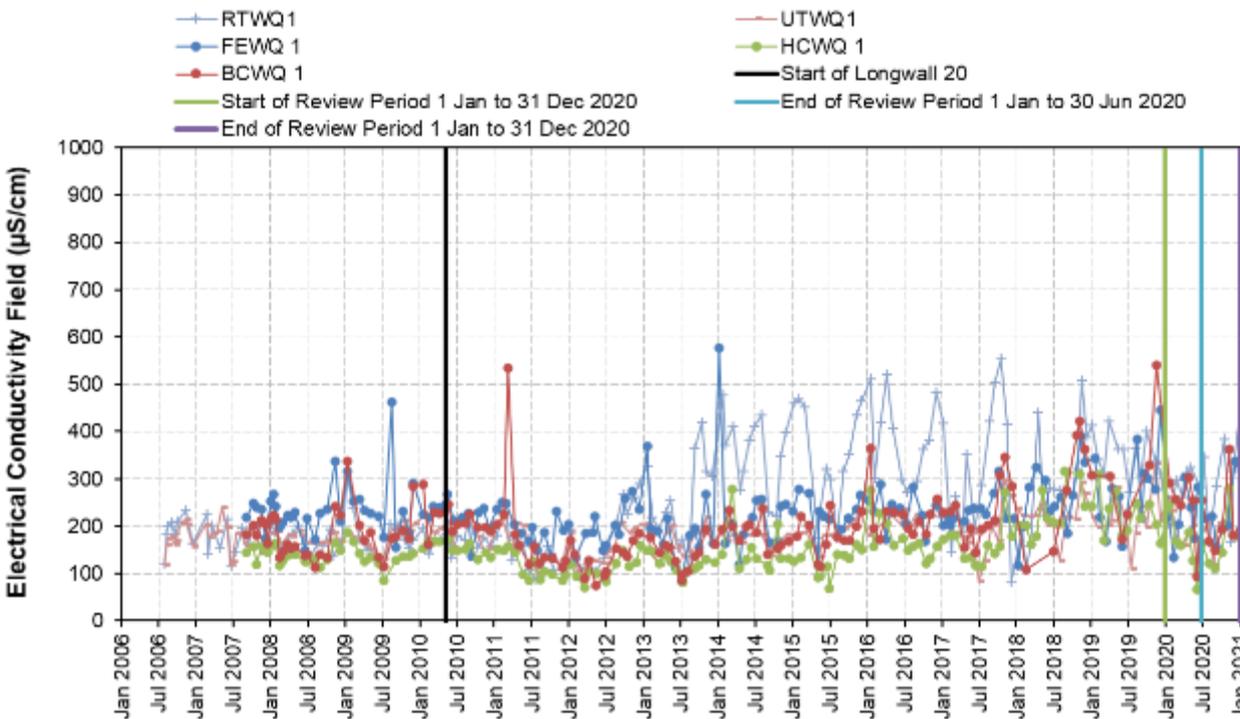


Chart B22 Electrical Conductivity (EC) Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

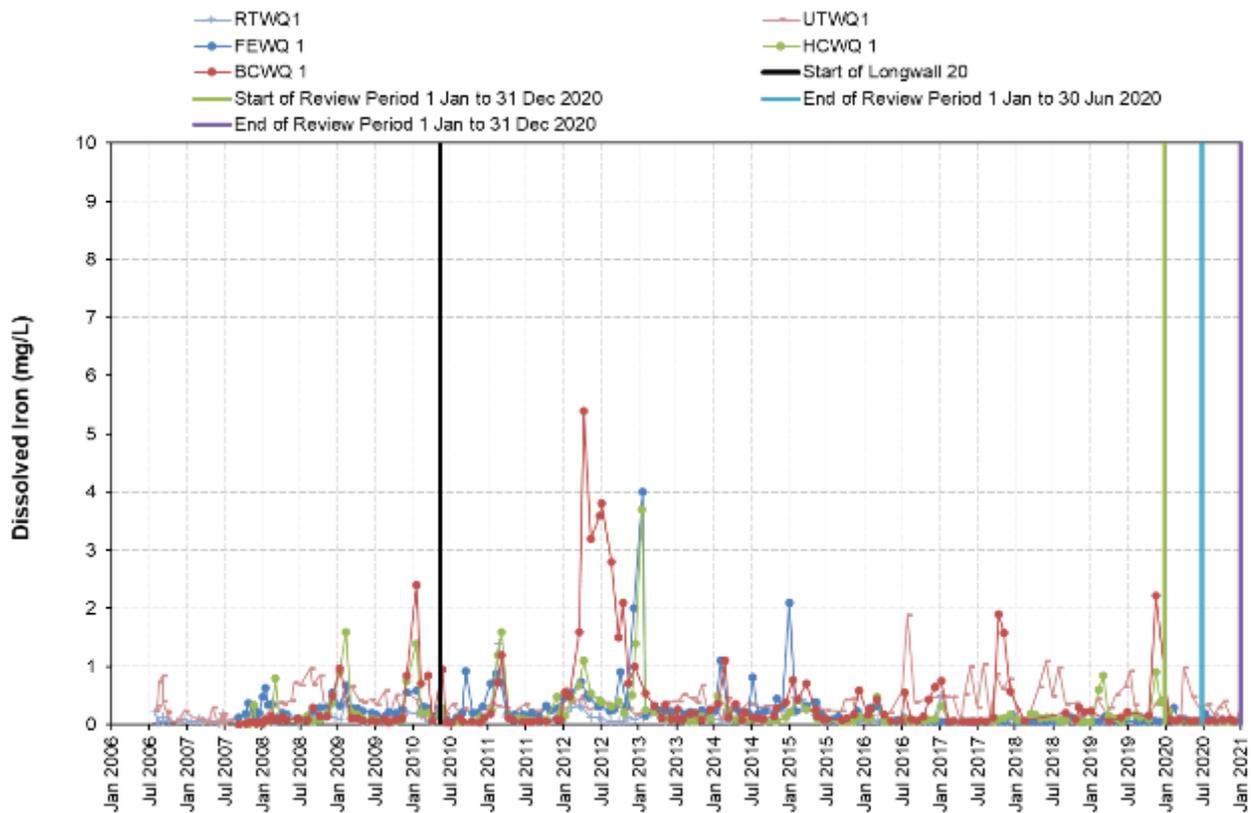


Chart B23 Dissolved Iron Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

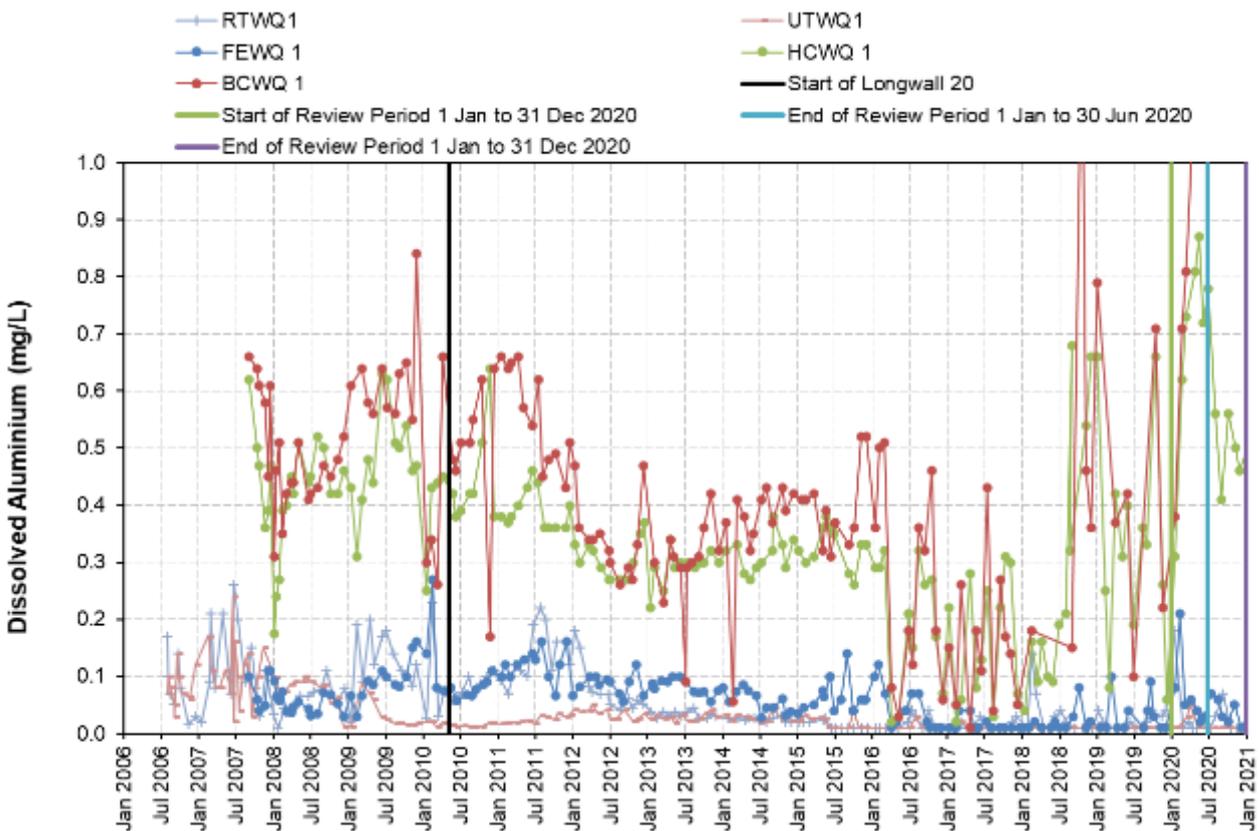


Chart B24 Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

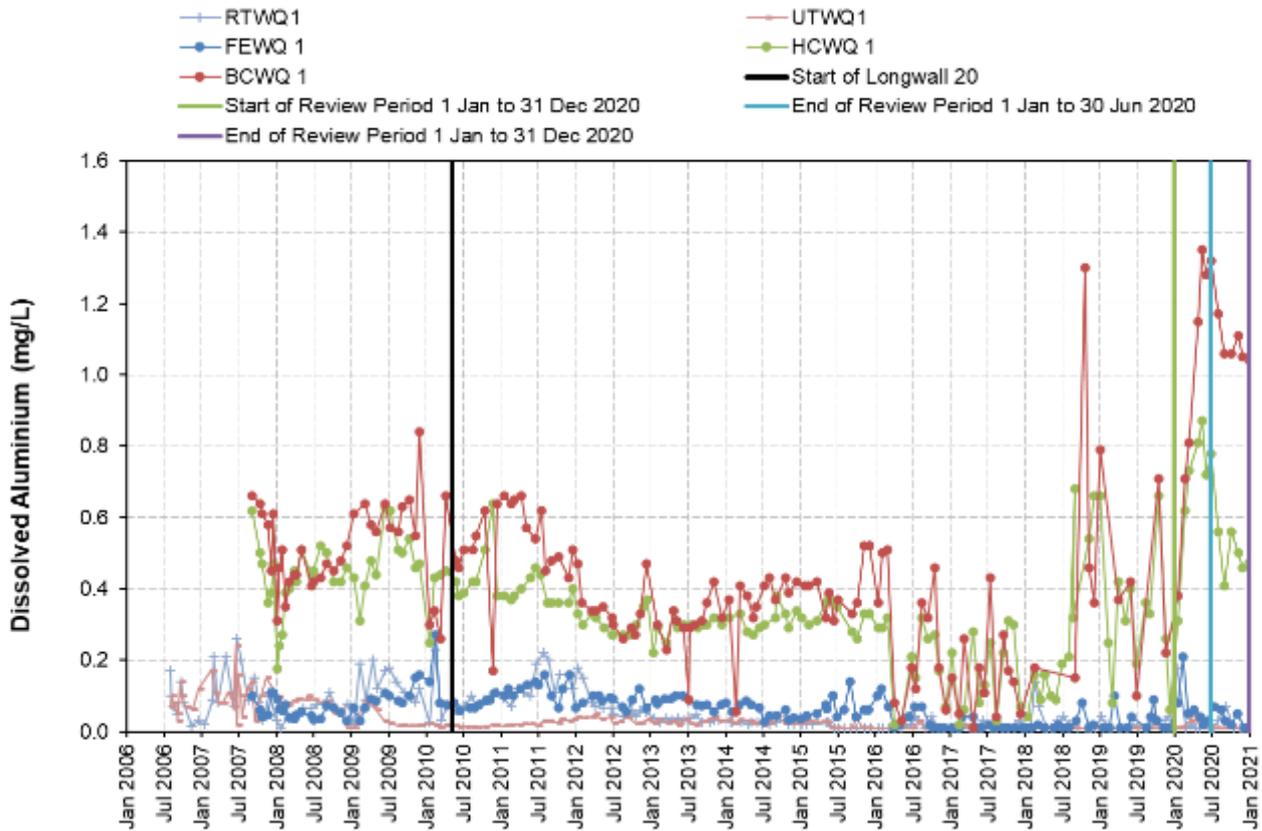


Chart B24a Dissolved Aluminium Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek

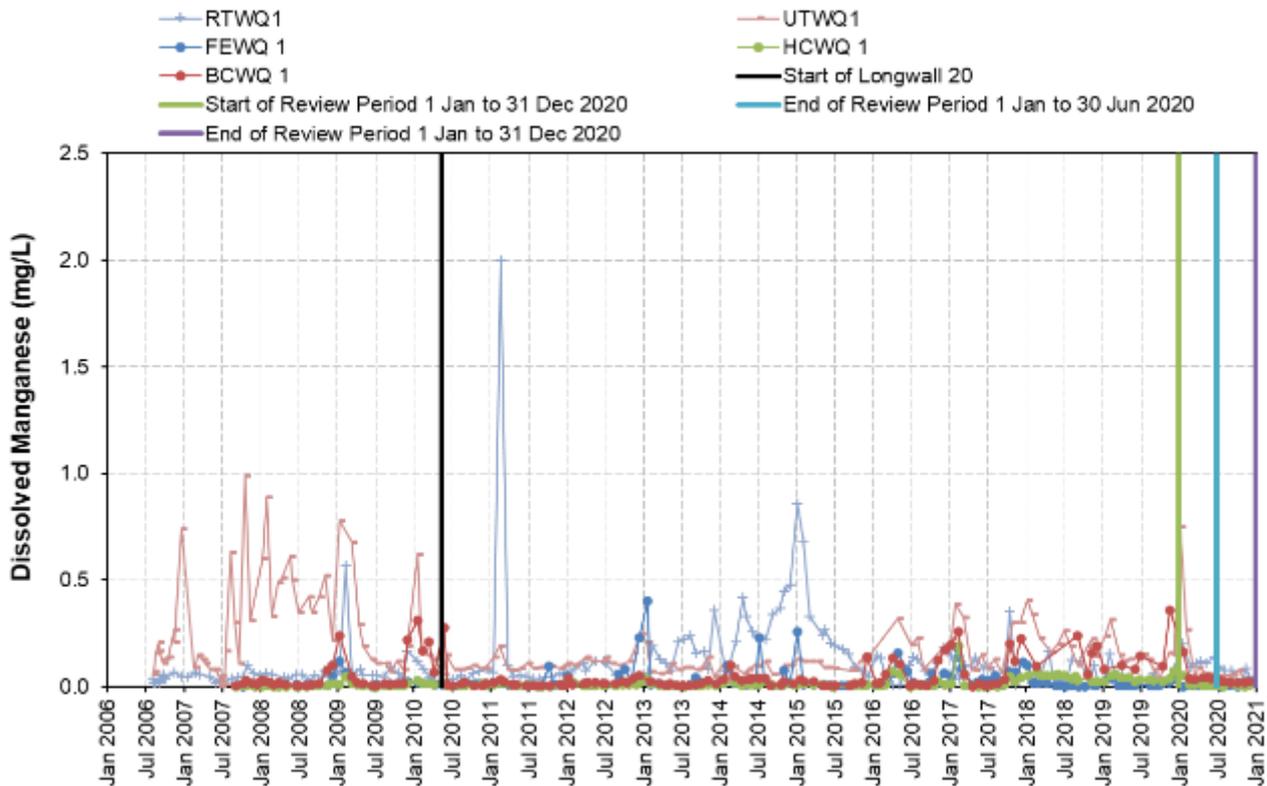


Chart B25 Dissolved Manganese Tributary B, Tributary D, Far Eastern Tributary, Bee Creek and Honeysuckle Creek