Monthly Environmental Monitoring Report

Yancoal Mt Thorley Warkworth

December 2021

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Revision History

Version No.	Person Responsible	Document Status	Date
1.0	**Environment and Community Advisor**	**Final**	**18/05/2022**

1.0 INTRODUCTION

This report has been compiled to provide a monthly summary of environmental monitoring results for Mount Thorley Warkworth (MTW). This report includes all monitoring data collected for the period 1 December to 31 December 2021.

2.0 AIR QUALITY

2.1 Meteorological Monitoring

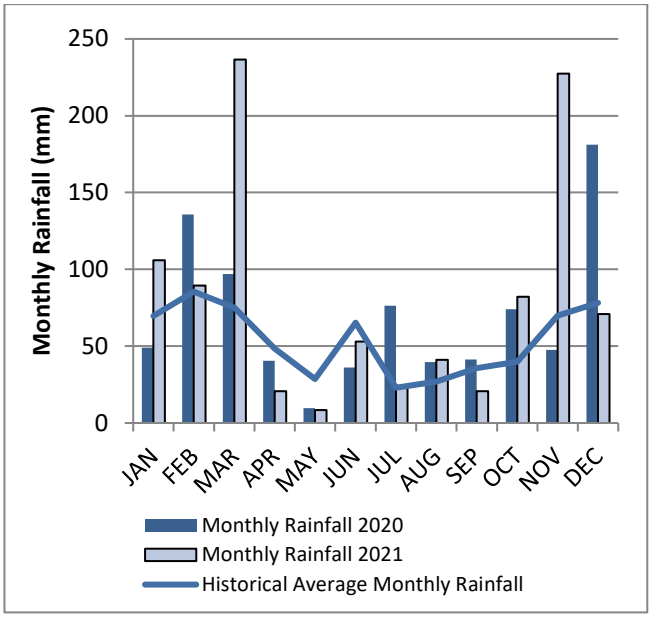
Meteorological data is collected at MTW's 'Charlton Ridge' meteorological station (refer to **Figure 3**).

2.1.1 Rainfall

Rainfall for the period is summarised in **Table 1**, the year-to-date trend and historical trend are shown in **Figure 1**.

Table 1: Monthly Rainfall MTW

2021	Monthly Rainfall (mm)	Cumulative Rainfall (mm)
December	71	979.6



Note: The historical average monthly rainfall is calculated from 2007 to 2021 monthly totals

Figure 2: Rainfall Trend YTD

2.1.2 Wind Speed and Direction

Winds from the south were dominant throughout the reporting period as shown in **Figure 2**.

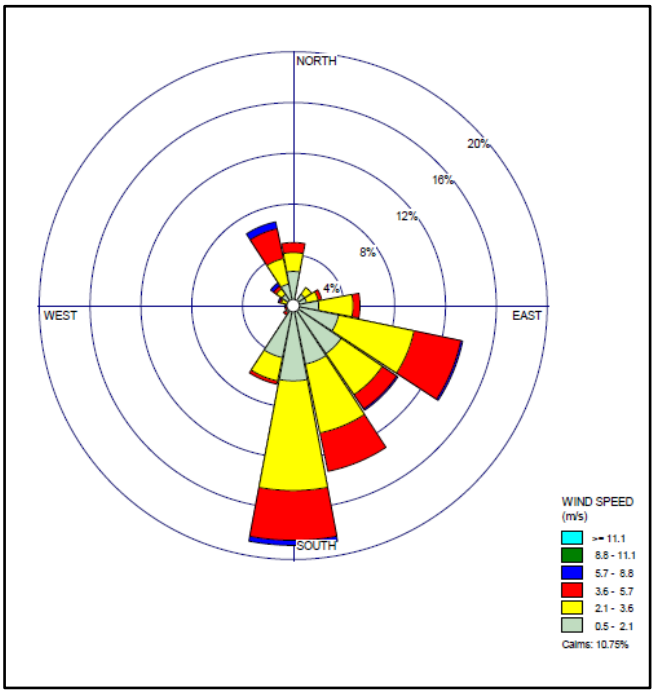


Figure 3: Charlton Ridge Wind Rose – December 2021

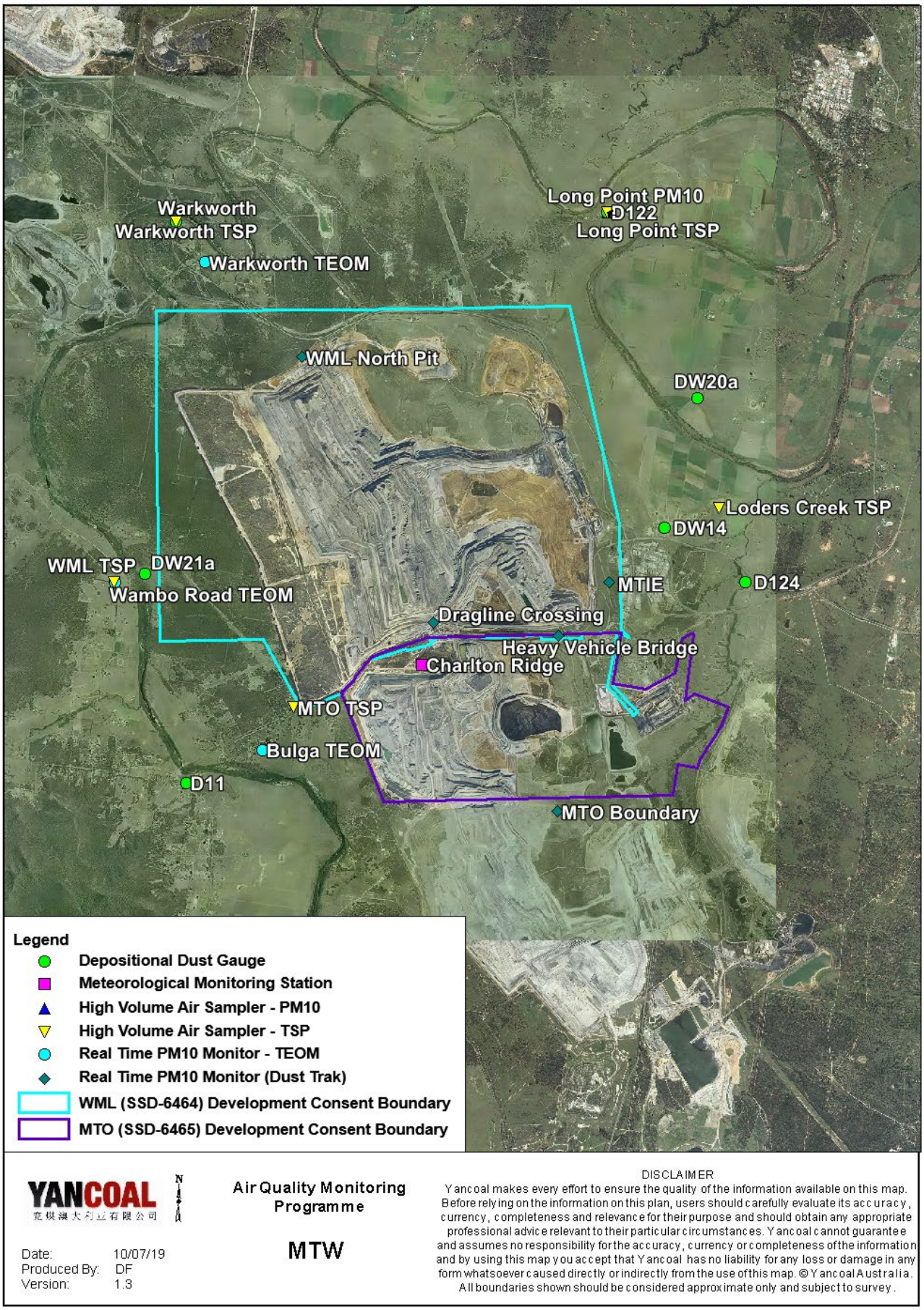


Figure 4: Air Quality Monitoring Locations

2.2 Depositional Dust

To monitor regional air quality, MTW operates and maintains a network of seven depositional dust gauges, situated on private and mine owned land surrounding MTW.

Figure 4 displays insoluble solids results from depositional dust gauges during the reporting period compared against the year-to-date average and the annual impact assessment criteria.

During the reporting period the Warkworth and D122 monitor recorded a monthly result above the long-term impact assessment criteria of 4.0 g/m^2 per month. There is no evidence to suggest that the Warkworth or D122 results are contaminated. Accordingly, the results will be included in the annual average calculation.

An annual assessment of MTW's compliance with the Long-Term Impact Assessment Criteria will be provided in the 2021 Annual Review Report.

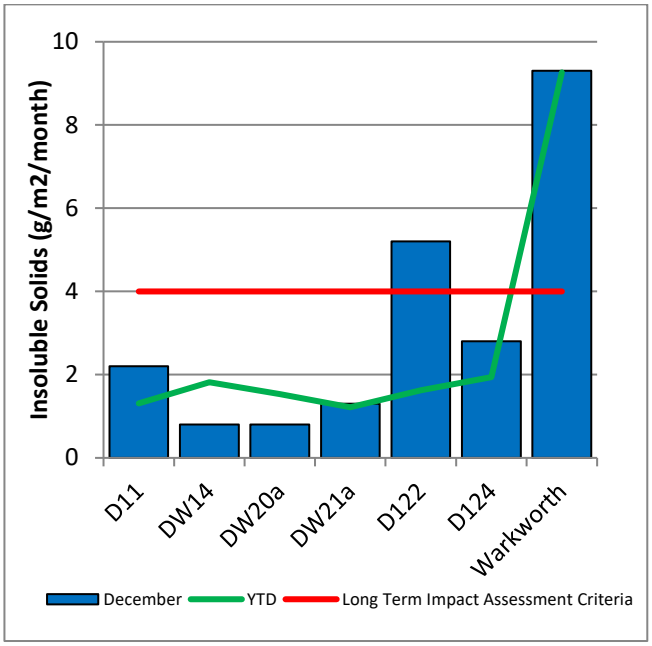


Figure 5: Depositional Dust – December 2021

Particulates (TSP) and Particulate Matter <10µm (PM_{10}). The location of these monitors can be found in **Figure 3**. Each HVAS was run for 24 hours on a six-day cycle in accordance with EPA requirements.

2.3.1 HVAS PM_{10} Results

Figure 5 shows the individual PM_{10} results at the monitoring station against the short-term impact assessment criteria of 50µg/m^3.

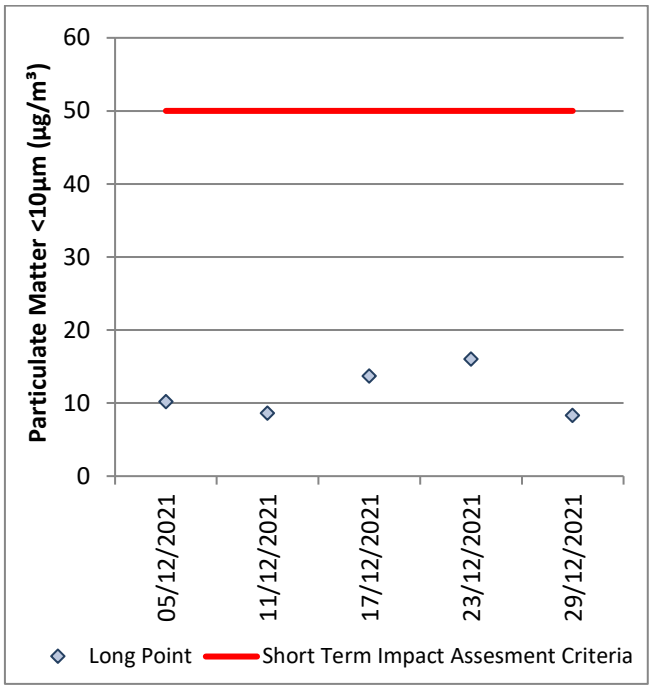


Figure 6: Individual PM_{10} Results – December 2021

Figure 6 shows the annual average PM_{10} results against the long-term impact assessment criteria.

An annual assessment of MTW's compliance with the Long-Term Impact Assessment Criteria will be provided in the 2021 Annual Review Report.

2.3 Suspended Particulates

Suspended particulates are measured by a network of High Volume Air Samplers (HVAS) measuring Total Suspended

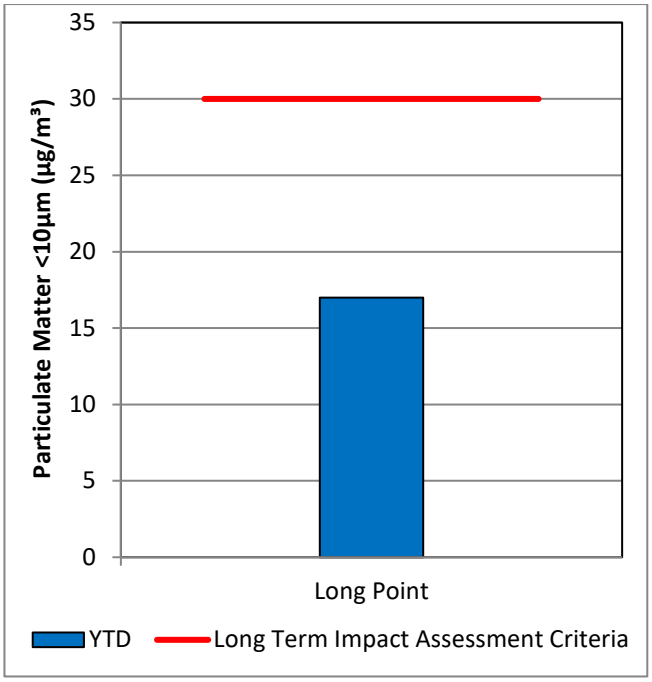


Figure 7: Annual Average PM_{10} – December 2021

2.3.2 TSP Results

Figure 7 shows the annual average TSP results compared against the long-term impact assessment criteria of 90µg/m³.

An annual assessment of MTW's compliance with the Long-Term Impact Assessment Criteria will be provided in the 2021 Annual Review Report.

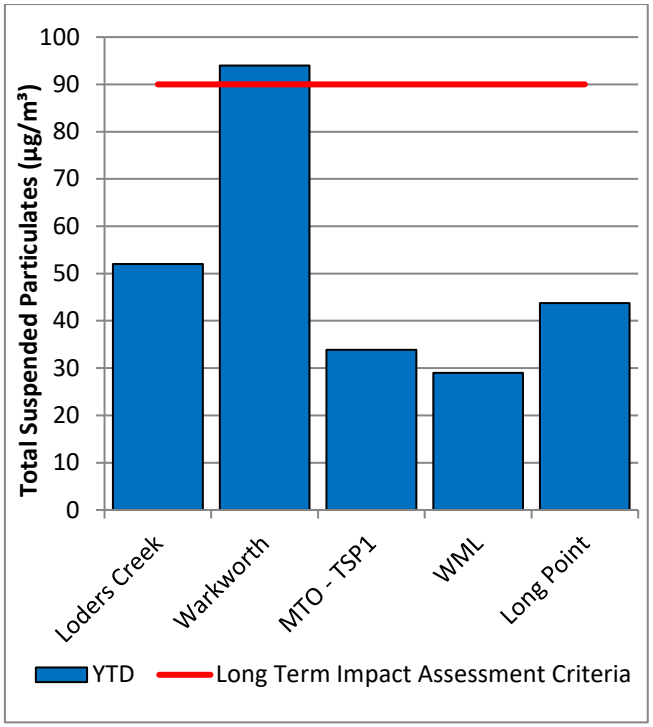


Figure 8: Annual Average Total Suspended Particulates – December 2021

2.3.3 Real Time PM_{10} Results

Mount Thorley Warkworth maintains a network of real time PM_{10} monitors. The real-time air quality monitoring stations continuously log information and transmit data to a central database, generating alarms when particulate matter levels exceed internal trigger limits.

Results for real time dust sampling are shown in **Figure 8**, including the daily 24-hour average PM_{10} result and the annual PM_{10} average.

Data was not available on 9 and 10 December 2021 from the Warkworth TEOM and 8 and 30 December 2021 from the Wambo Road TEOM due to equipment or communications issues.

2.3.4 Real Time Alarms for Air Quality

During December, the real-time monitoring system generated 15 automated air quality related alerts, including 6 alerts for adverse meteorological conditions and 9 alerts for elevated PM_{10} levels.

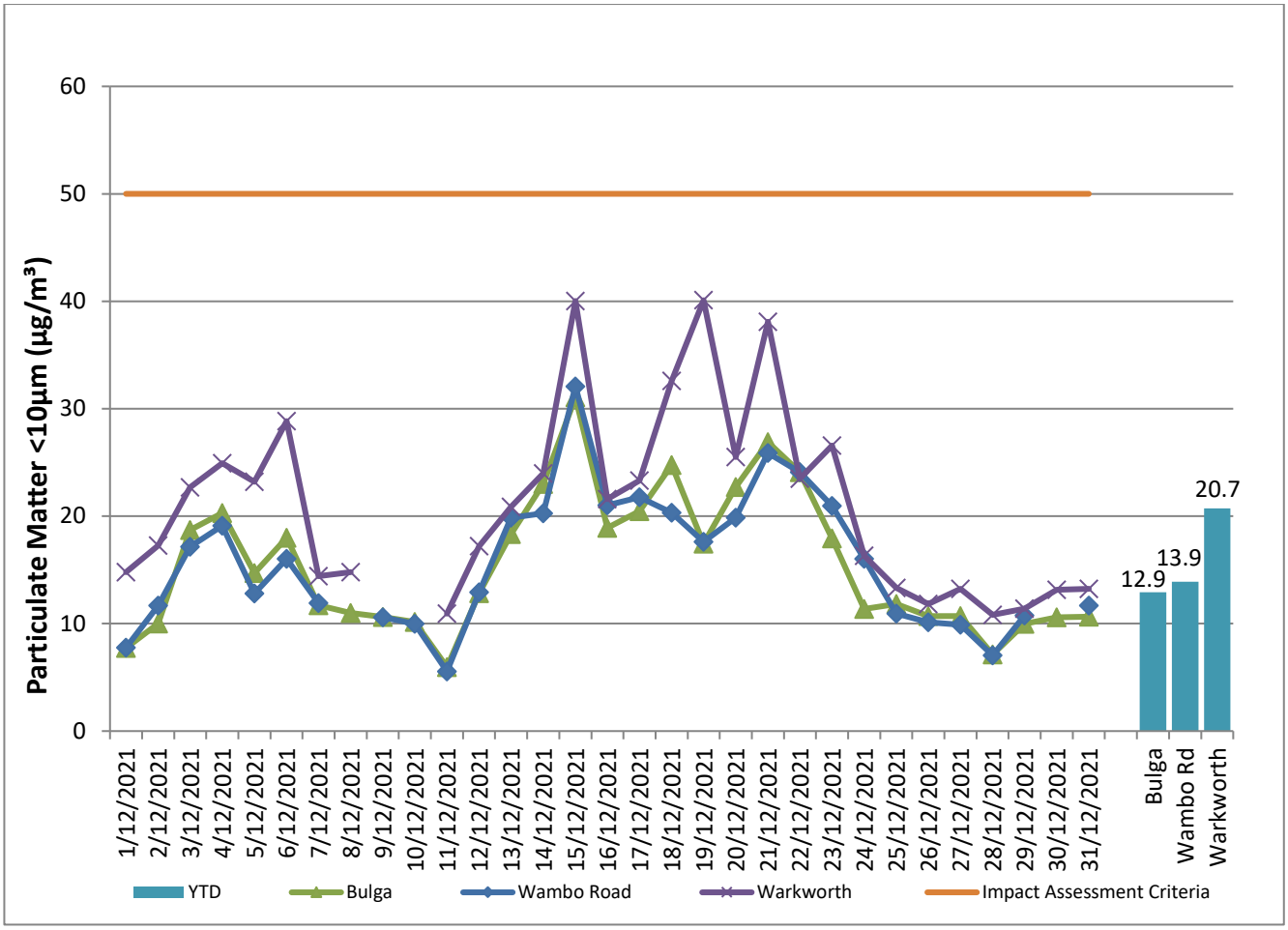


Figure 9: Real Time PM_{10} 24hr average and Year-to-date average – December 2021

3.0 WATER QUALITY

MTW maintains a network of surface water and groundwater monitoring sites.

3.1 Surface Water

Monitoring is conducted at mine site dams and surrounding natural watercourses. The surface water monitoring locations are outlined in **Figure 15**.

Surface water courses are sampled on a monthly or quarterly sampling regime. Water quality is evaluated through the parameters of pH, Electrical Conductivity (EC) and Total Suspended Solids (TSS). The Hunter River and the Wollombi Brook are sampled both upstream and downstream of mining operations, to monitor the potential impact of mining. Other Hunter River tributaries are also monitored.

3.1.1 Surface Water Monitoring Results

Figure 9 to **Figure 11** show the long-term surface water trend (2018 – current) within MTW mine dams. **Figure 12** to **Figure 14** show the long-term surface water trend (2018 - current) in surrounding watercourses.

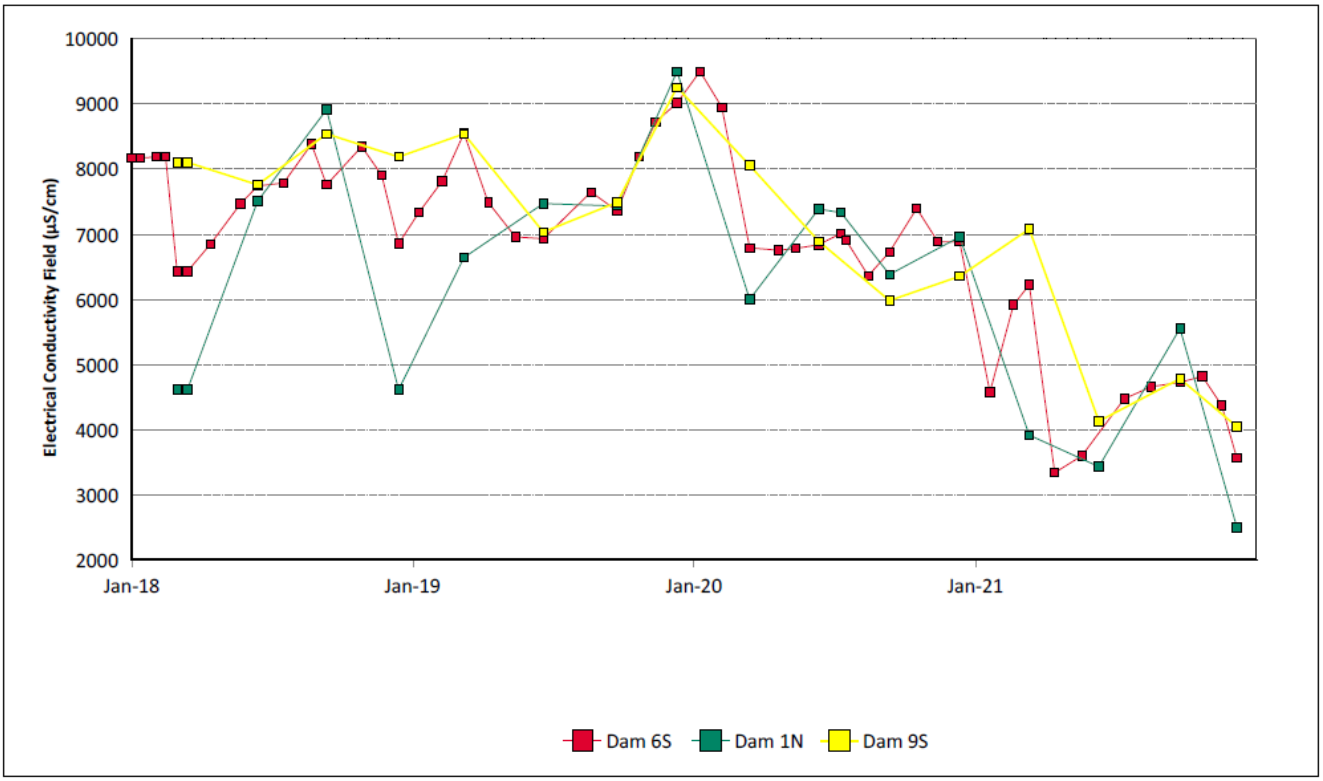


Figure 10: Site Dams Electrical Conductivity Trend – December 2021

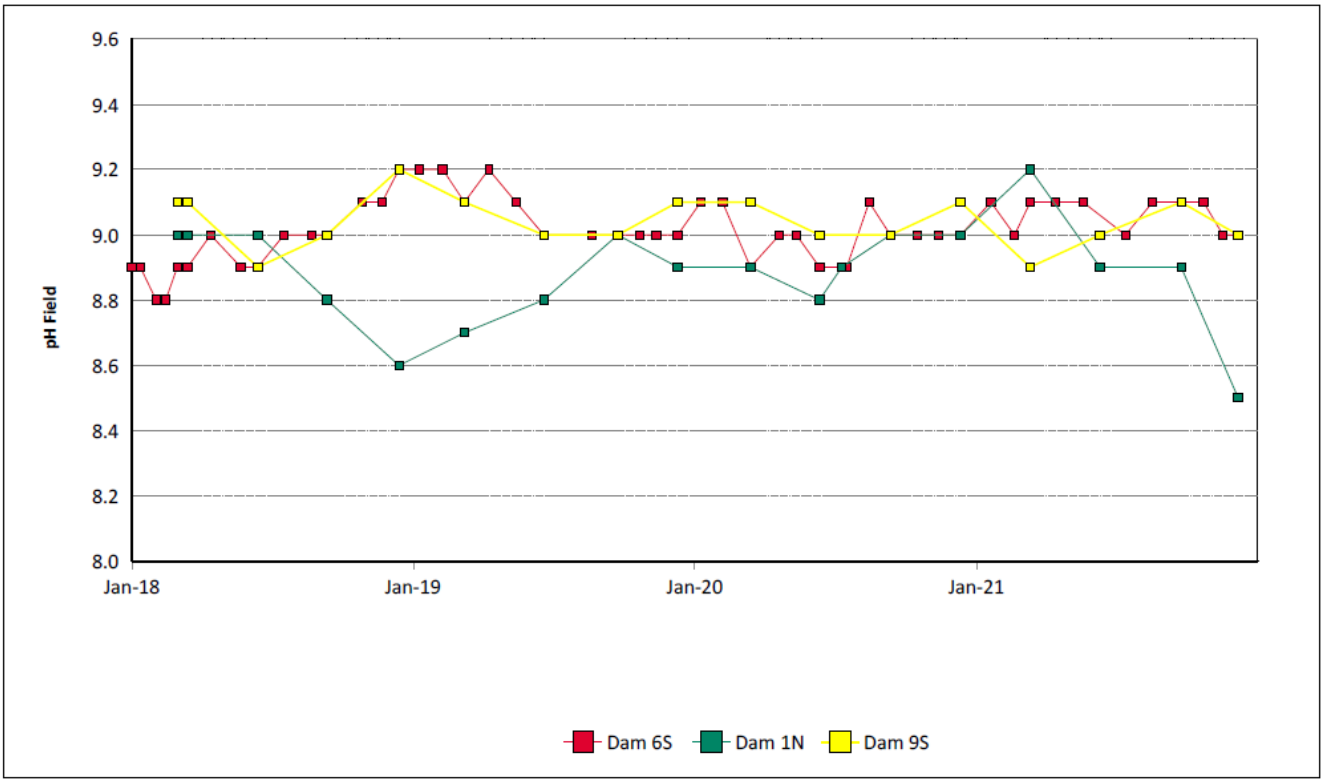


Figure 11: Site Dams pH Trend – December 2021

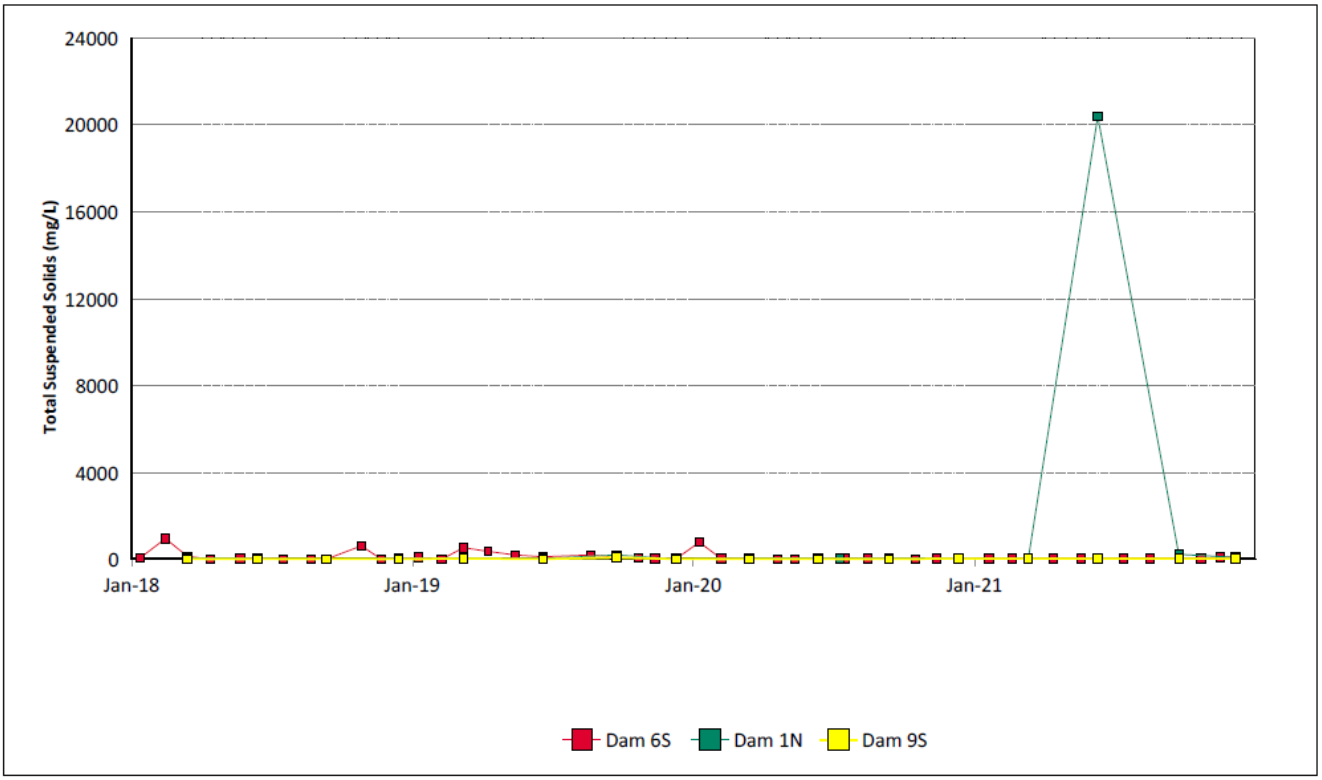
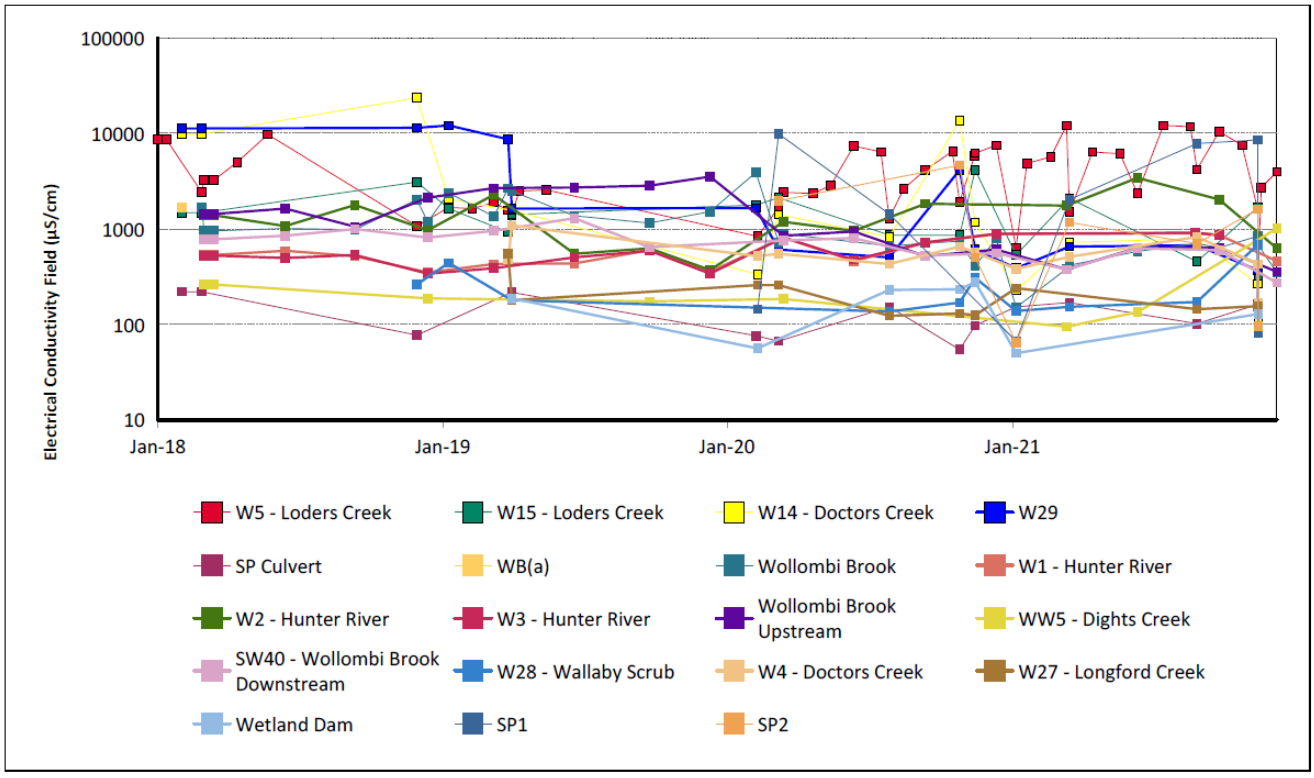
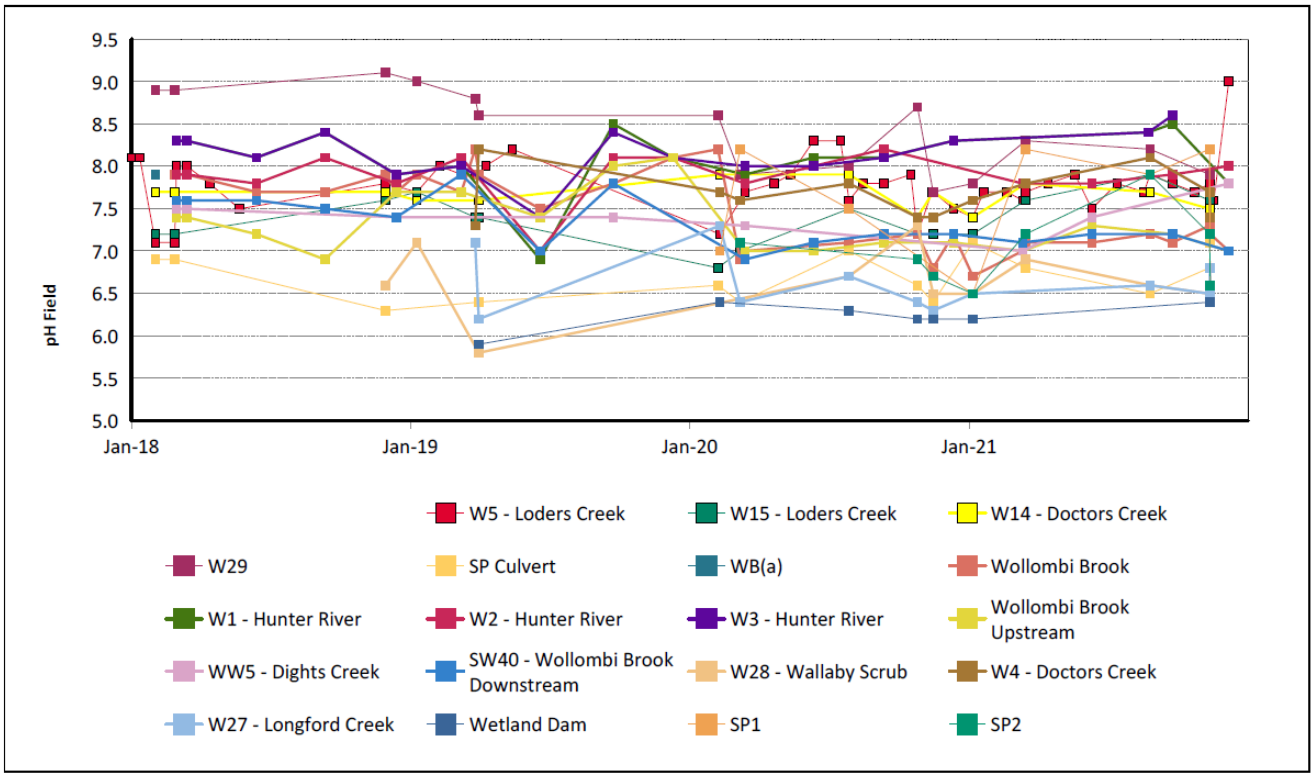


Figure 12: Site Dams Total Suspended Solids Trend – December 2021



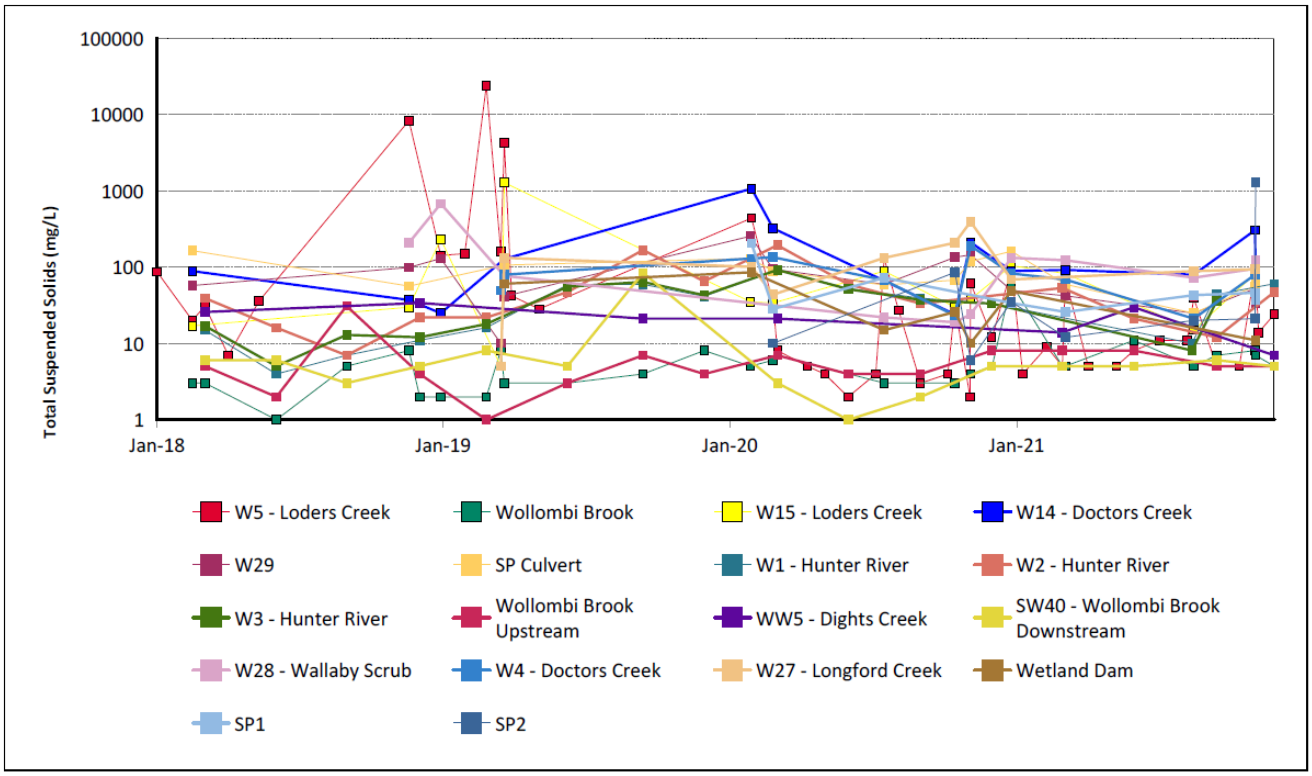
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 13: Watercourse Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 14: Watercourse pH Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 15: Watercourse Total Suspended Solids Trend – December 2021

3.1.2 Surface Water Trigger Tracking

Internal trigger limits have been developed to assess monitoring data on an on-going basis, and to highlight potentially adverse surface water impacts. The process for evaluating monitoring results against the internal triggers and subsequent responses are outlined in the MTW Water Management Plan.

Current internal surface water trigger limit breaches are summarised in **Table 2**.

Table 2: Surface Water Trigger Tracking – December YTD 2021

Site	Date	Trigger Limit Breached	Action Taken in Response
SP1	05/01/2021	pH –5th Percentile	Monitoring results back within trigger limits for March and August 2021 sample rounds. No follow up required.
SP1	12/11/2021	pH –5th Percentile	Watching Brief*
W5	05/01/2021	pH –5th Percentile	Monitoring results back within trigger limits for February 2021. No follow up required.
W5	12/11/2021	pH –5th Percentile	Watching Brief*
W5	6/12/2021	pH –95th Percentile	Watching Brief*
W15	05/01/2021	pH –5th Percentile	Cyclical lower-pH measurements are consistently seen in the historical trend for this Loders Creek monitoring location. Monitoring results back within trigger limits for March 2021 sample round. No follow up required.
W29	05/01/2021	pH –5th Percentile	Monitoring results back within trigger limits for March and August 2021 sample rounds. No follow up required.
W29	11/11/2021	pH –5th Percentile	Watching Brief*
W29	12/11/2021	pH –5th Percentile	Watching Brief*
W3	23/09/2021	pH –5th Percentile	Watching Brief*
W28	11/11/2021	EC – 95th Percentile	Watching Brief*
WW5	6/12/2021	EC – 95th Percentile	Watching Brief*

Site	Date	Trigger Limit Breached	Action Taken in Response
W1	6/12/2021	TSS – 50mg/L (ANZECC criteria)	Watching Brief* Note: Unlikely to be associated with MTW mining related impacts. Elevated TSS results most likely attributable to regional rainfall.
W2	11/03/2021	TSS – 50mg/L (ANZECC criteria)	Unlikely to be associated with MTW mining related impacts. Elevated TSS results most likely attributable to sampling from water with no flow. Note: Result is not considered to be a valid representation given that there was no flow at the time of sampling. Monitoring results back within trigger limits for June sample round. No follow up required.
W4	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Watching Brief*. Elevated TSS associated with high runoff due to rainfall event (79.4mm on 4 January). Consistent with and higher than upstream sample W29 (which is closer to MTW); no mine site sources of sediment identified (no dam overtopping and/or site discharges recorded during the event).
W4	15/03/2021	TSS – 50mg/L (ANZECC criteria)	Watching Brief*. Elevated TSS associated with rainfall event (36.2mm on 14 March) and is considered related to sampling from slow flowing water. Consistent with and higher than upstream sample W29 (which is closer to MTW); no mine site sources of sediment identified. Monitoring results back within trigger limits for August 2021 sample round. No follow up required.
W4	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with high runoff due to rainfall event (51.4mm on 10 November and 25.8mm on 11 November). Consistent with and higher than upstream sample W29 (which is closer to MTW). No MTW site sources of sediment identified.
W5	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with high runoff due to rainfall event (79.4mm on 4 January), resulting in mobilisation of sediment in Loders Creek. No MTW site sources of sediment identified. No follow up required.
W5	15/03/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (36.2mm on 14 March), resulting in mobilisation of sediment in Loders Creek. No MTW site sources of sediment identified. Monitoring results back within trigger limits for August 2021 sample round. No follow up required.

Site	Date	Trigger Limit Breached	Action Taken in Response
W5	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with high runoff due to rainfall event (51.4mm on 10 November and 25.8mm on 11 November), resulting in mobilisation of sediment in Loders Creek. No MTW site sources of sediment identified.
W5	12/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with high runoff due to rainfall event (51.4mm on 10 November, 25.8mm on 11 November and 33.4mm on 12 November), resulting in mobilisation of sediment in Loders Creek. No MTW site sources of sediment identified.
W14	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with high runoff due to rainfall event (79.4mm on 4 January). No mine site sources of sediment identified. Upstream sample W29 (which is closer to MTW) indicates source of sediment may be partially attributable to runoff from downstream farming properties. No follow up required.
W14	15/03/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (36.2mm on 14 March), resulting in mobilisation of sediment in Doctors Creek. No mine site sources of sediment identified. Upstream sample W29 (which is closer to MTW) indicates source of sediment may be partially attributable to runoff from downstream farming properties. No follow up required.
W14	25/08/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (31.4mm on 24 August), resulting in mobilisation of sediment in Doctors Creek. No mine site sources of sediment identified. Upstream sample W29 (which is closer to MTW) indicates source of sediment may be partially attributable to runoff from downstream farming properties. No follow up required.
W14	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (51.4mm on 10 November and 25.8mm on 11 November), resulting in mobilisation of sediment in Doctors Creek. No mine site sources of sediment identified.
W14	12/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (51.4mm on 10 November, 25.8mm on 11 November and 33.4mm on 12 November), resulting in mobilisation of sediment in Doctors Creek. No mine site sources of sediment identified.

Site	Date	Trigger Limit Breached	Action Taken in Response
W15	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS results most likely attributable to high runoff due to rainfall event (79.4mm on 4 January), resulting in mobilisation of sediment in Loders Creek. In addition, TSS results were potentially affected by turbid water associated with the overtopping of one mine water dam at MTO and several MTCL dams/catchment basins which were reported to EPA and DPIE.
W15	15/03/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (36.2mm on 14 March), resulting in mobilisation of sediment in Loders Creek. No mine site sources of sediment identified. Monitoring results back within trigger limits for August 2021 sample round. No follow up required.
W15	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (51.4mm on 10 November and 25.8mm on 11 November), resulting in mobilisation of sediment in Loders Creek. No mine site sources of sediment identified.
W15	12/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (51.4mm on 10 November, 25.8mm on 11 November and 33.4mm on 12 November), resulting in mobilisation of sediment in Loders Creek. No mine site sources of sediment identified.
W27	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken. Note: Elevated TSS results most likely attributable to high runoff due to rainfall event (79.4mm on 4 January). In addition, TSS results were potentially affected by turbid water associated with the overtopping of an MTW mine water dam as a result of the rainfall event which was reported to EPA and DPIE.
W27	25/08/2021	TSS – 50mg/L (ANZECC criteria)	Watching Brief* Elevated TSS results most likely attributable to high runoff due to rainfall event (31.4mm on 24 August). Note: location was too shallow to sample in March 2021 sample round.
W27	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS results most likely attributable to high runoff due to rainfall event (51.4mm on 10 November and 25.8mm on 11 November). No mine site sources of sediment identified.
W28	05/01/2021	TSS – 50mg/L (ANZECC criteria)	Investigation undertaken.

Site	Date	Trigger Limit Breached	Action Taken in Response
			Note: Elevated TSS results most likely attributable to high runoff due to rainfall event (79.4mm on 4 January). In addition, TSS results were potentially affected by turbid water associated with the overtopping of MTW sediment dams as a result of greater than design rainfall, which were reported to EPA and DPIE.
W28	15/03/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (36.2mm on 14 March). No mine site sources of sediment identified. No follow up required.
W28	25/08/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS associated with rainfall event (31.4mm on 24 August). No mine site sources of sediment identified.
W28	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS results most likely attributable to high runoff due to rainfall event (51.4mm on 10 November and 25.8mm on 11 November). No mine site sources of sediment identified.
W28	12/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS results most likely attributable to high runoff due to rainfall event (51.4mm on 10 November, 25.8mm on 11 November and 33.4mm on 12 November). In addition, TSS results were potentially affected by turbid water associated with the overtopping of two MTW sediment dams as a result of greater than design rainfall, which were reported to EPA and DPE.
W29	11/11/2021	TSS – 50mg/L (ANZECC criteria)	Elevated TSS results most likely attributable to high runoff due to rainfall event (51.4mm on 10 November).

* = Watching brief established pending outcomes of subsequent monitoring events.

3.2 HRSTS Discharge

MTW participates in the Hunter River Salinity Trading Scheme (HRSTS), allowing discharge from licensed discharge points located at Dam 1N and Dam 9S. Discharges can only take place subject to HRSTS regulations.

During the reporting period licenced HRSTS discharge from Dam 9S (EPL 1976 Point 4) occurred from the 1 December to 17 December 2021 discharging a total of 551ML.

Note: Reported discharge volume data is based on HRSTS 24-hour discharge block totals, at the discharge point. The first discharge block for this December report started at 5pm on 1 December 2021.

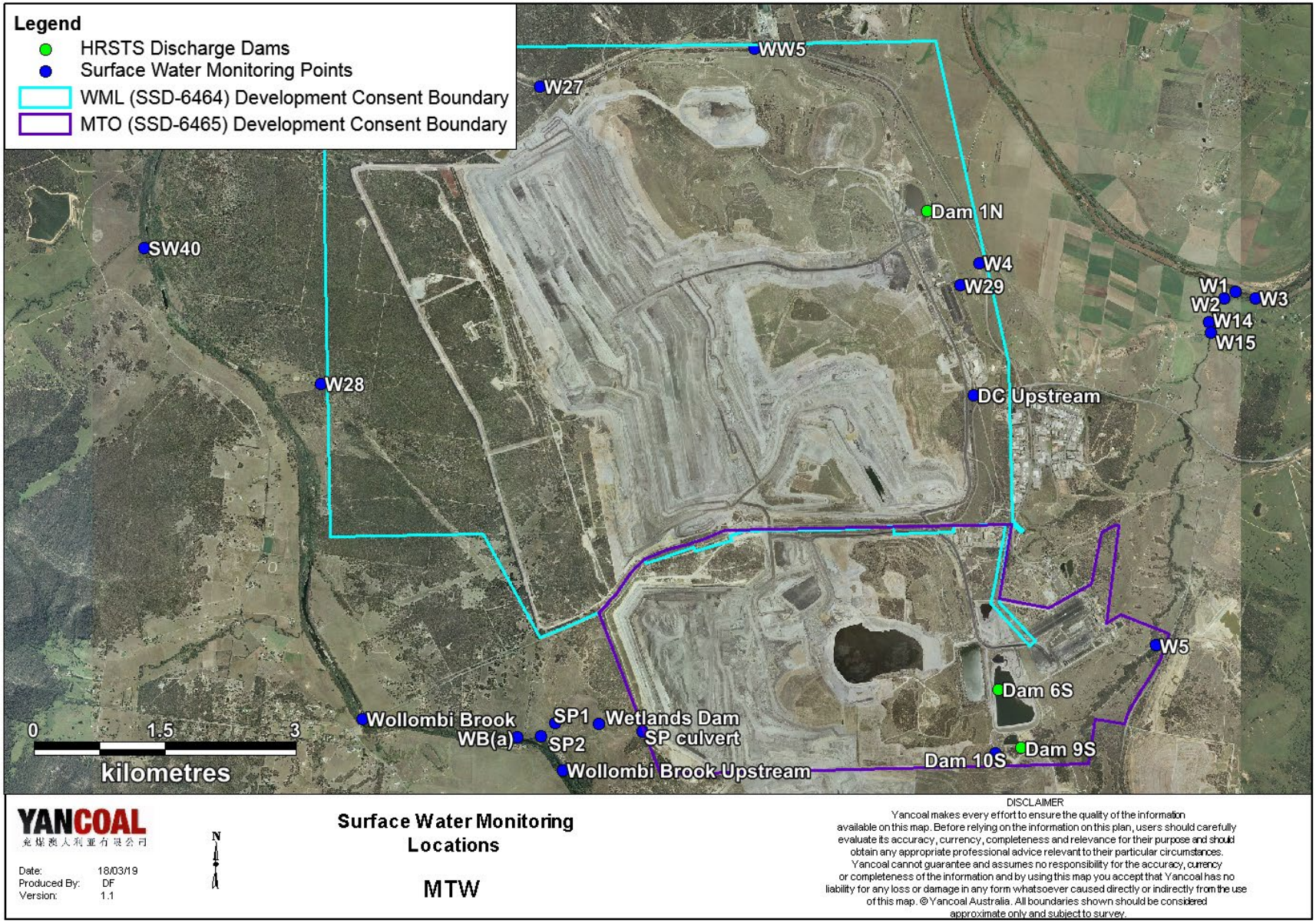
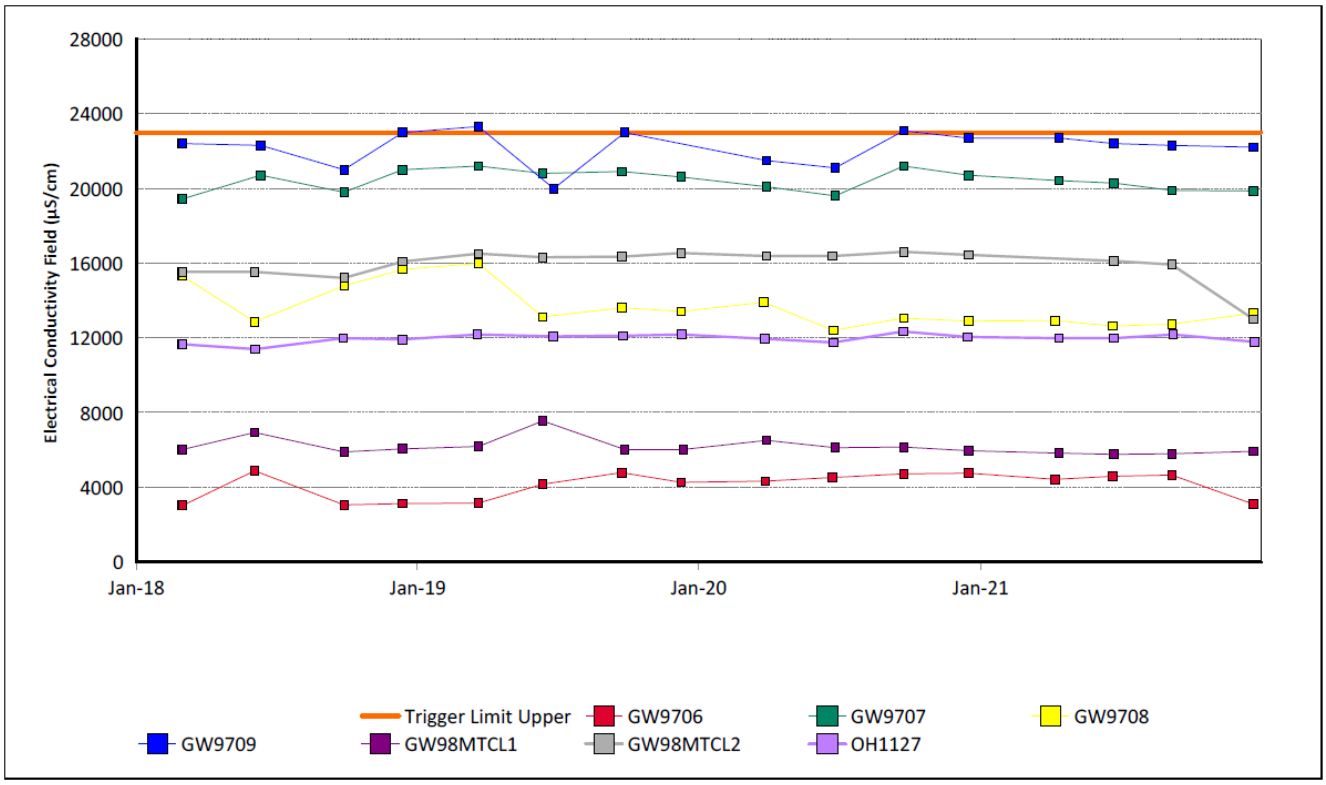


Figure 16: Surface Water Monitoring Location Plan

3.3 Groundwater Monitoring

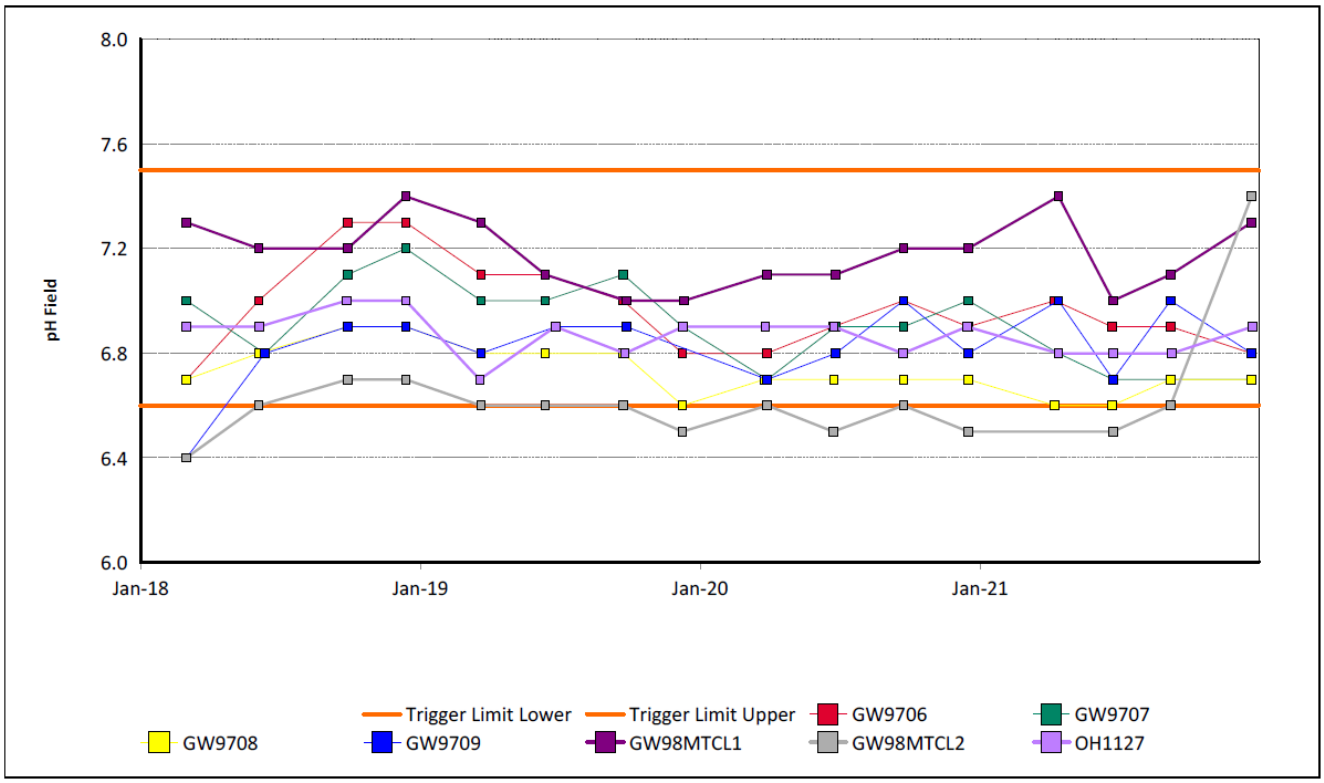
Groundwater monitoring is undertaken on a quarterly basis in accordance with the MTW Groundwater Monitoring Programme.

Figure 16 to **Figure 614** show the long-term water quality trends (2018 – current) for groundwater bores monitored at MTW. Note: The pH and EC trigger limits shown are based on the Water Management Plan V5.1, approved 15 November 2021.



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 17: Bayswater Seam Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 18: Bayswater Seam pH Trend – December 2021

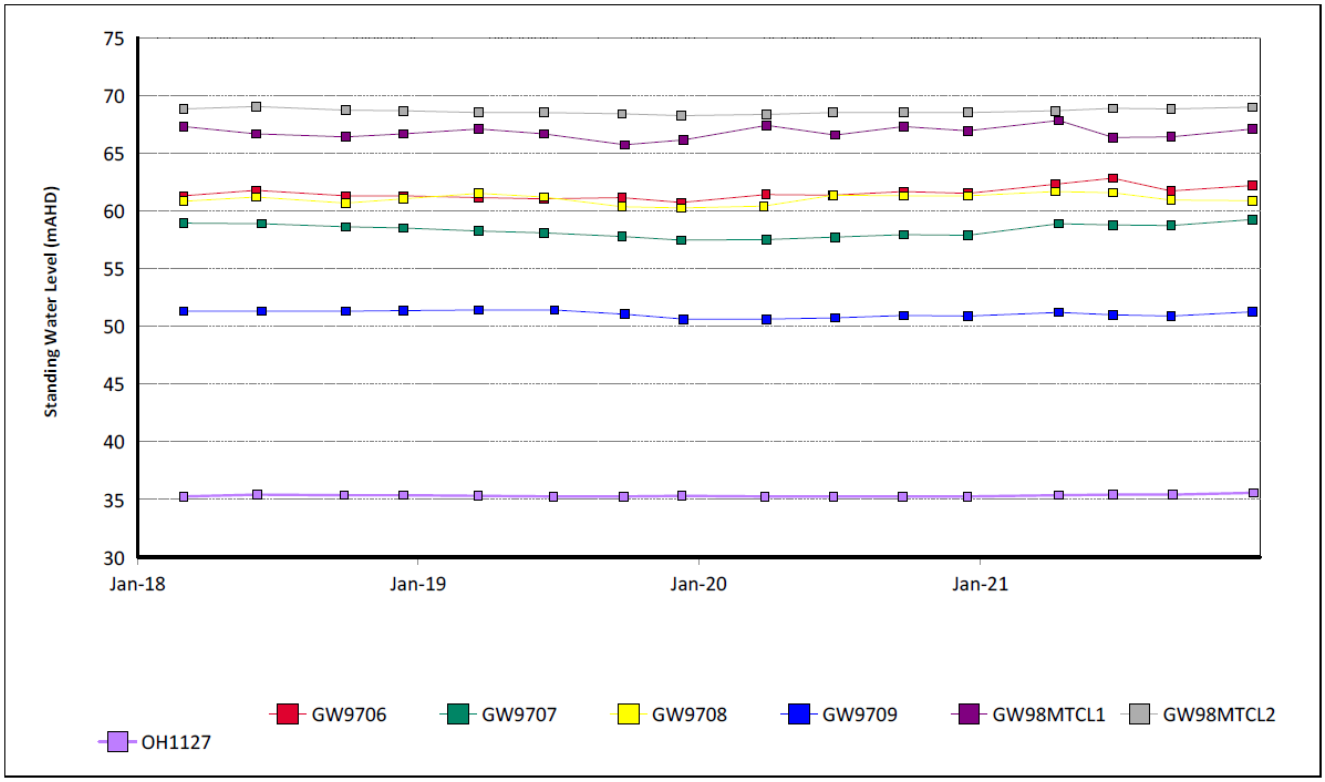
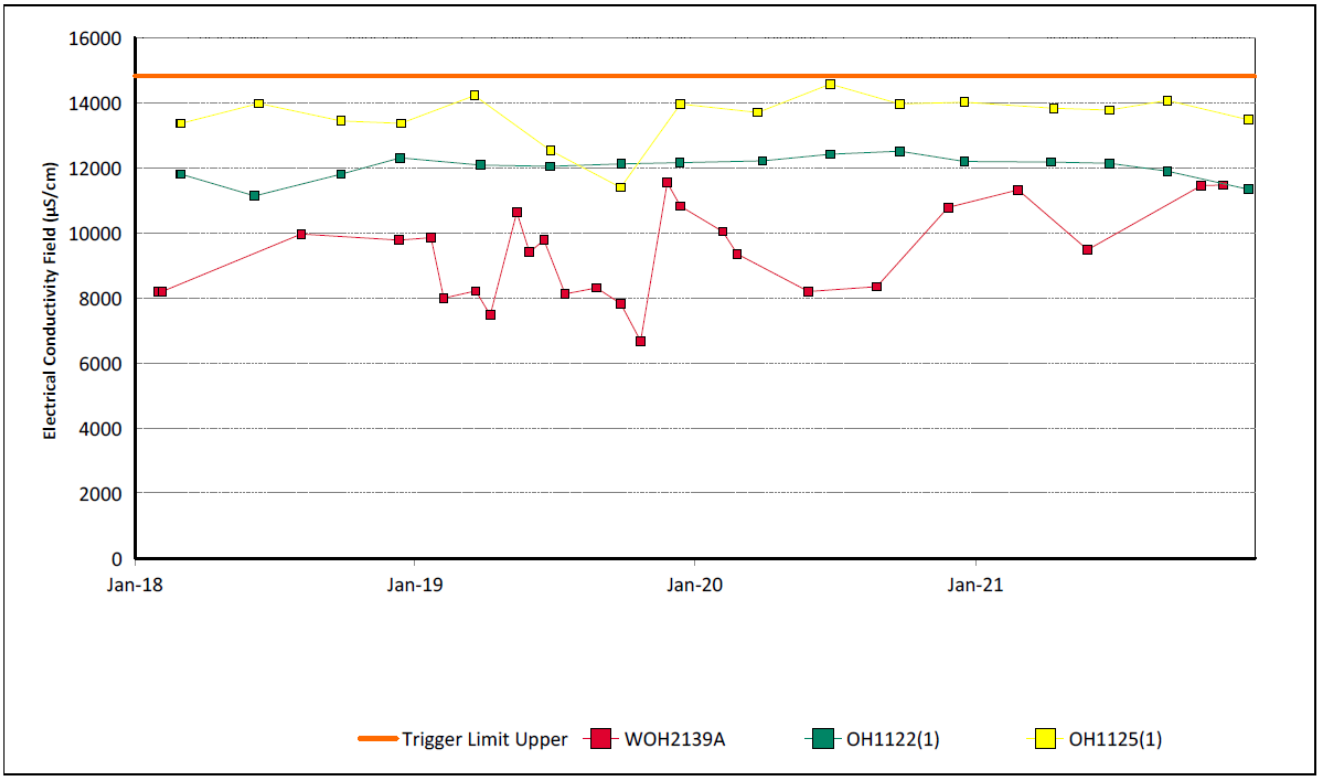
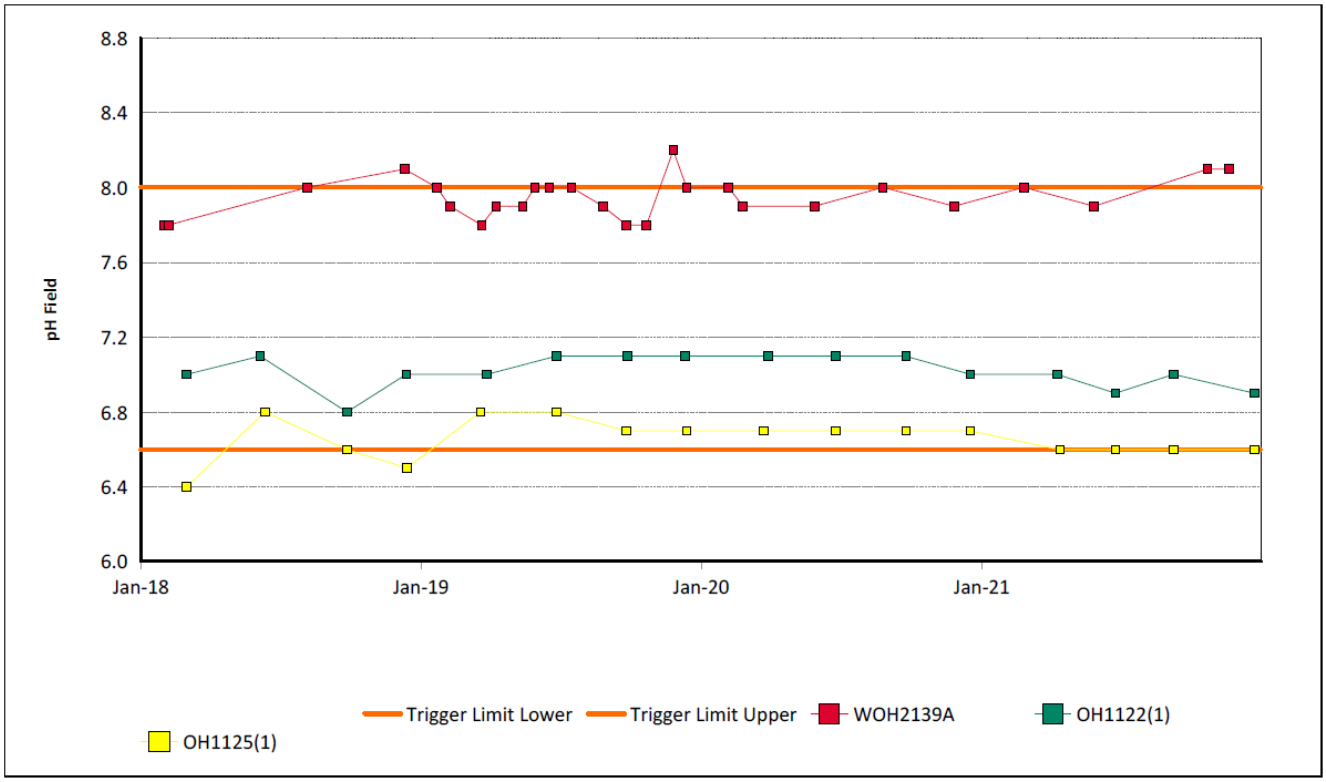


Figure 19: Bayswater Seam Standing Water Level Trend – December 2021



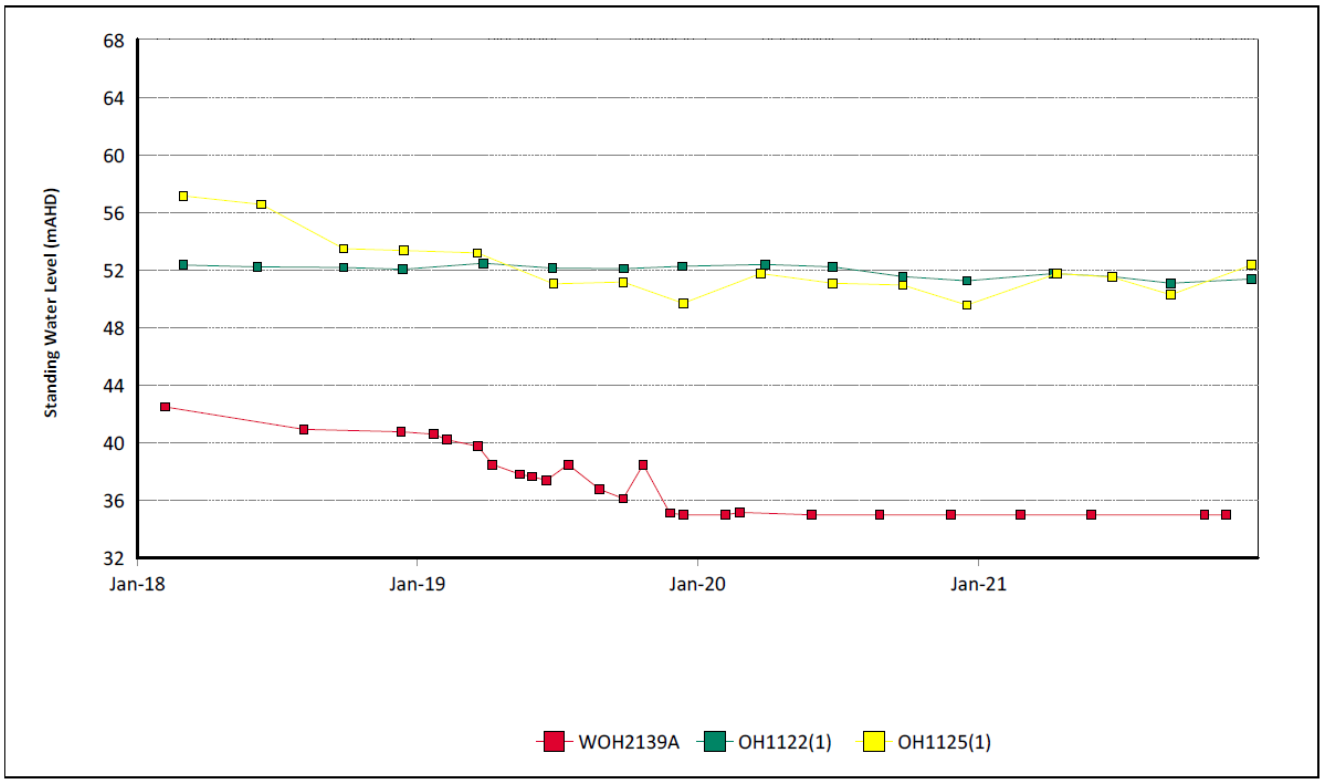
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 20: Blakefield Seam Electrical Conductivity Trend – December 2021



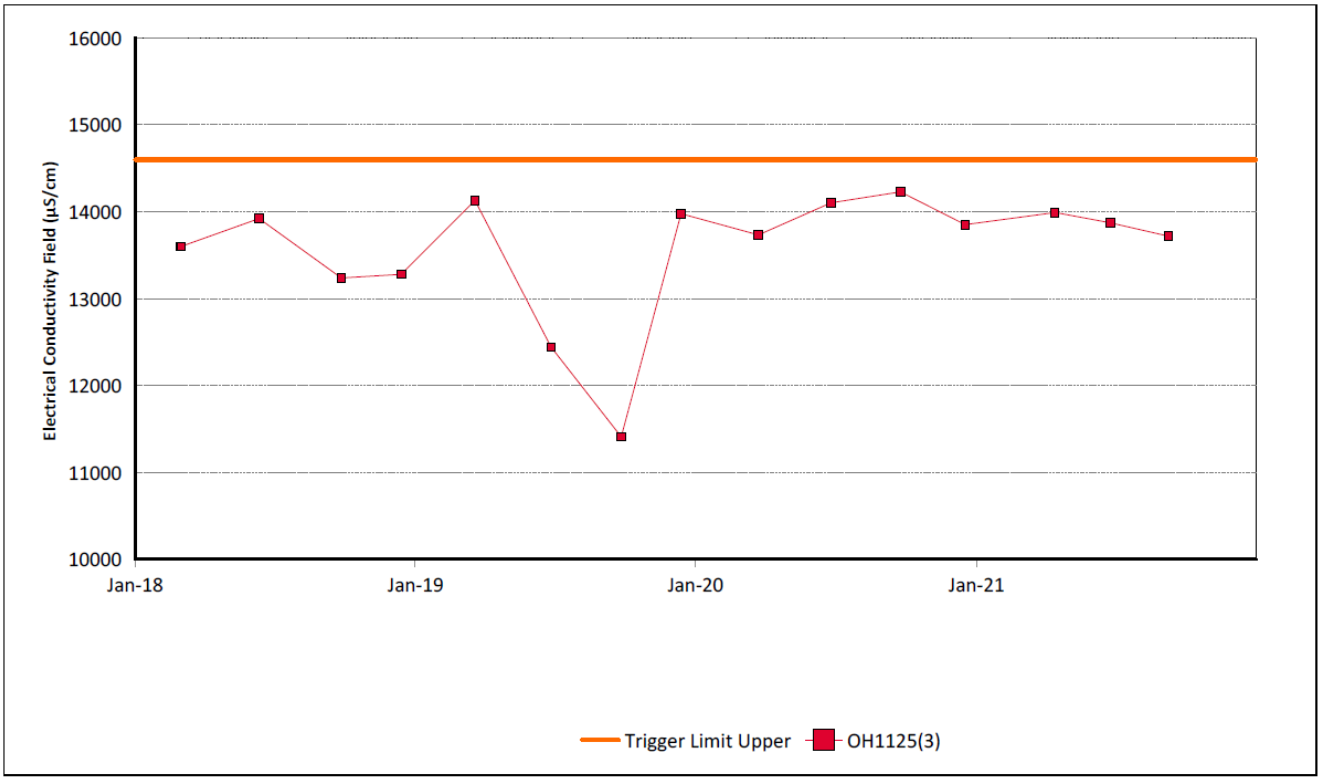
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 21: Blakefield Seam pH Trend – December 2021



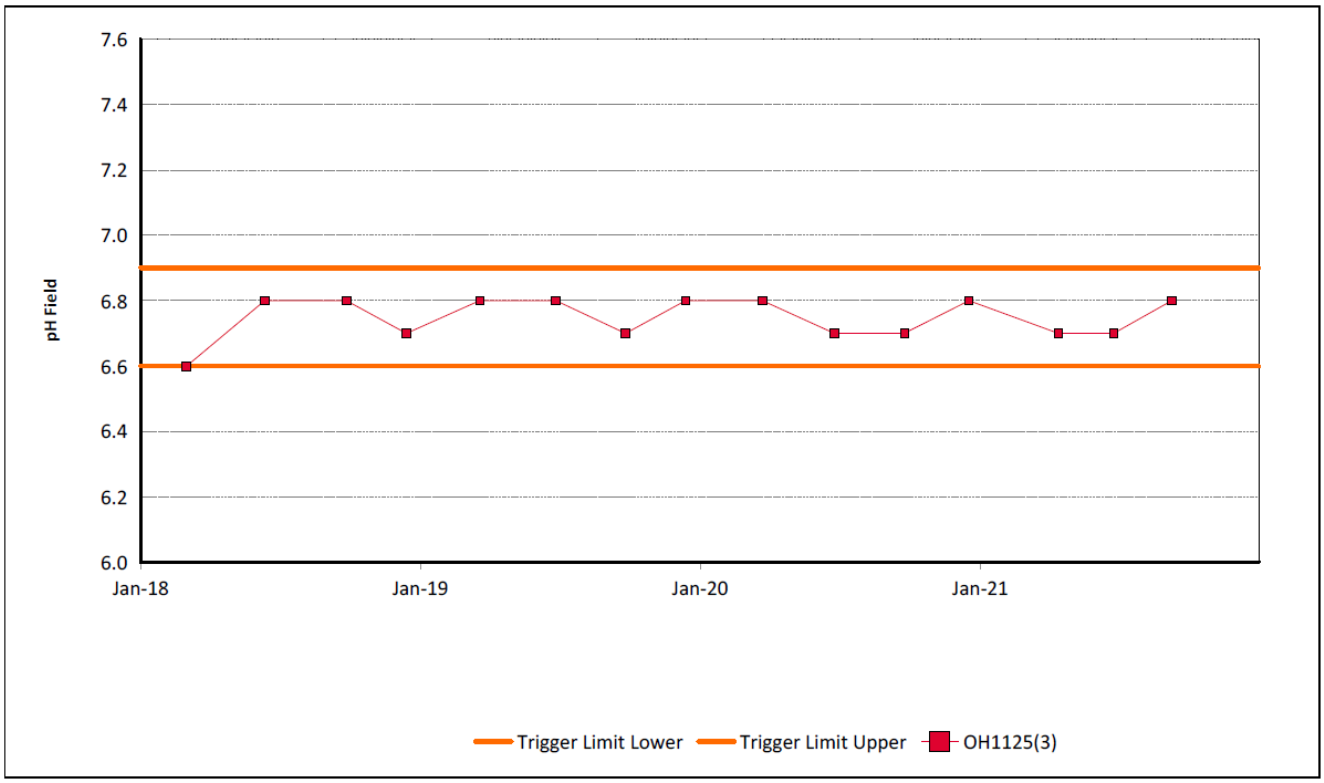
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 22: Blakefield Seam Standing Water Level Trend – December 2021



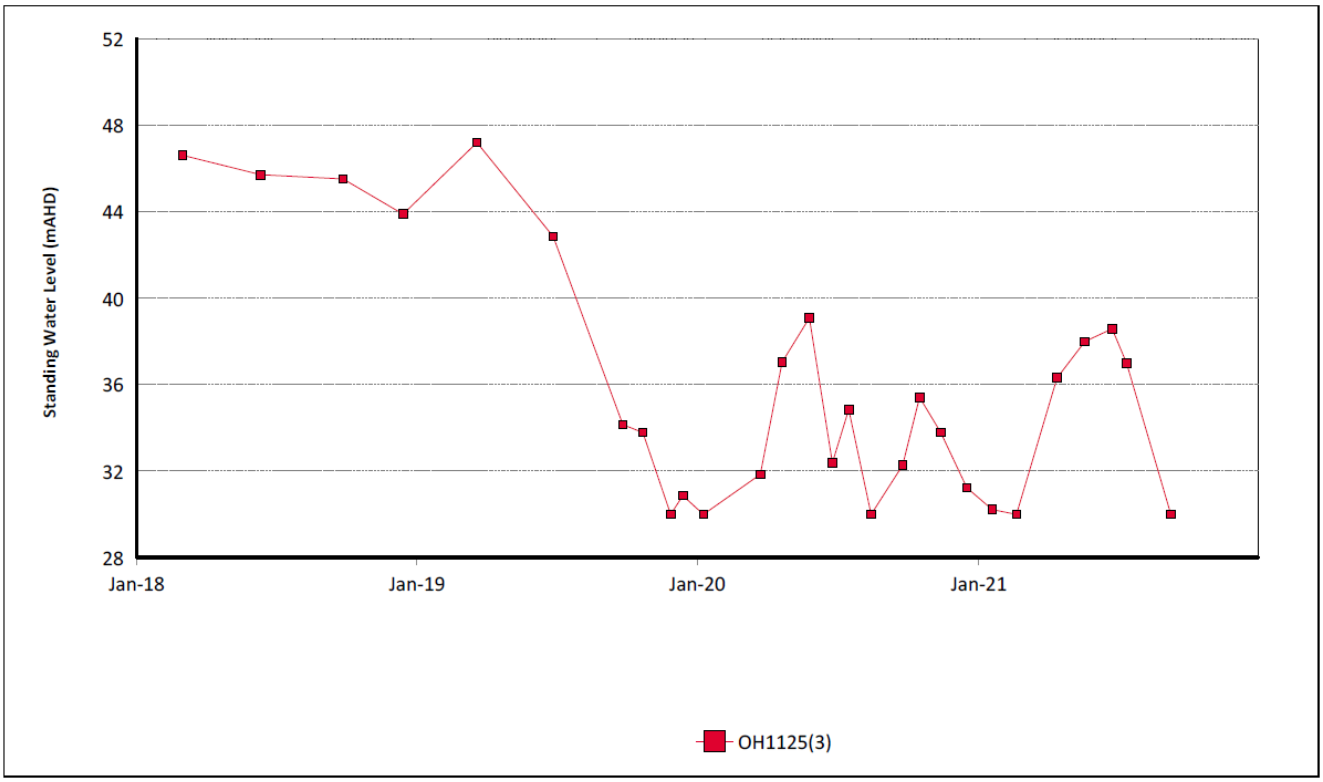
Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 23: Bowfield Seam Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 24: Bowfield Seam pH Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample, or that there was no safe access.

Figure 25: Bowfield Seam Standing Water Level Trend – December 2021

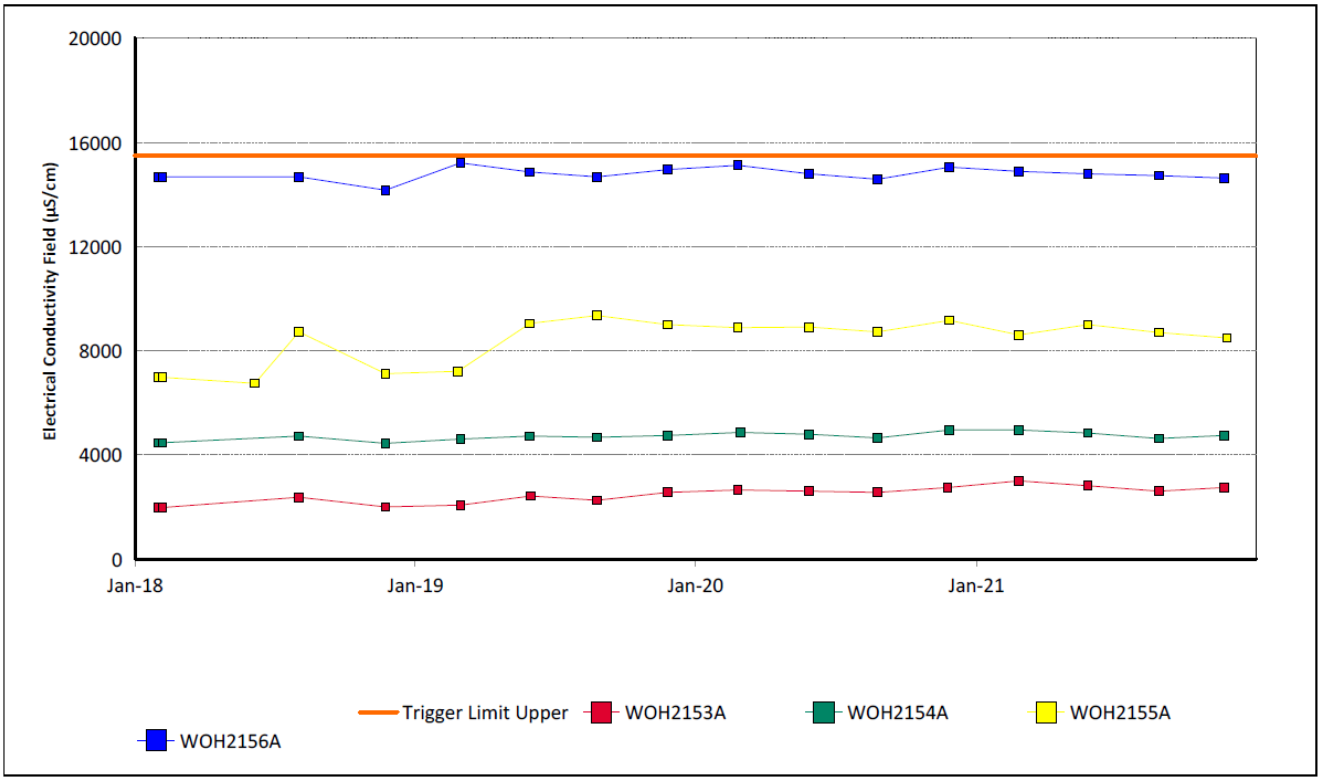


Figure 26: Redbank Seam Electrical Conductivity Trend – December 2021

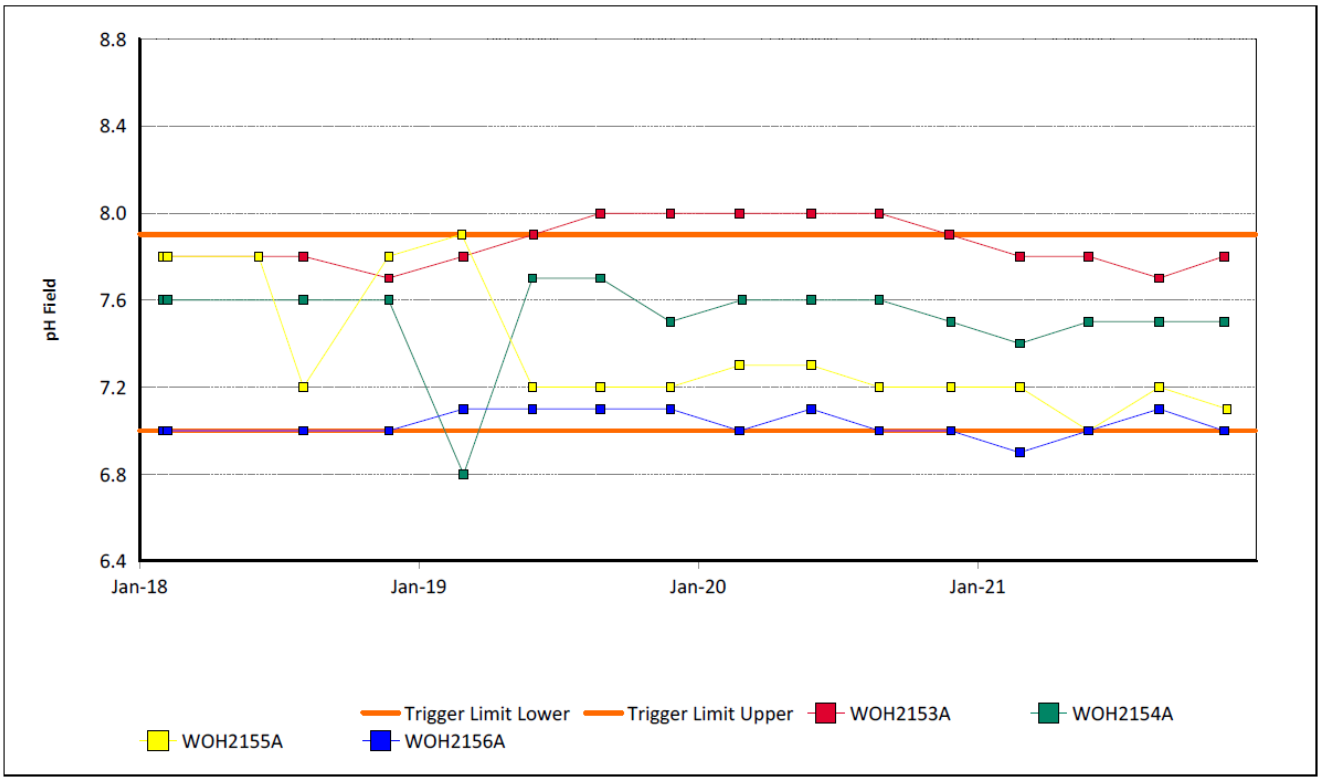


Figure 27: Redbank Seam pH Trend – December 2021

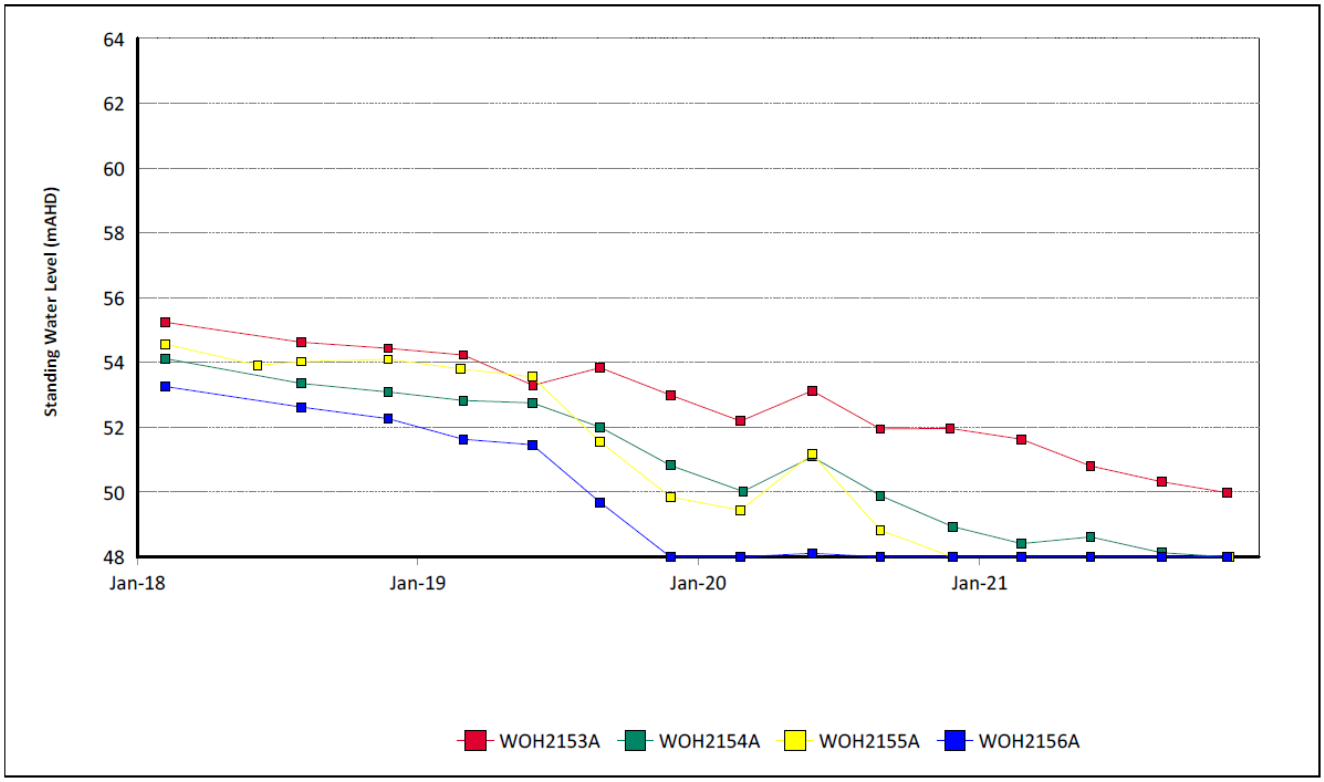


Figure 28: Redbank Seam Standing Water Level Trend – December 2021

D

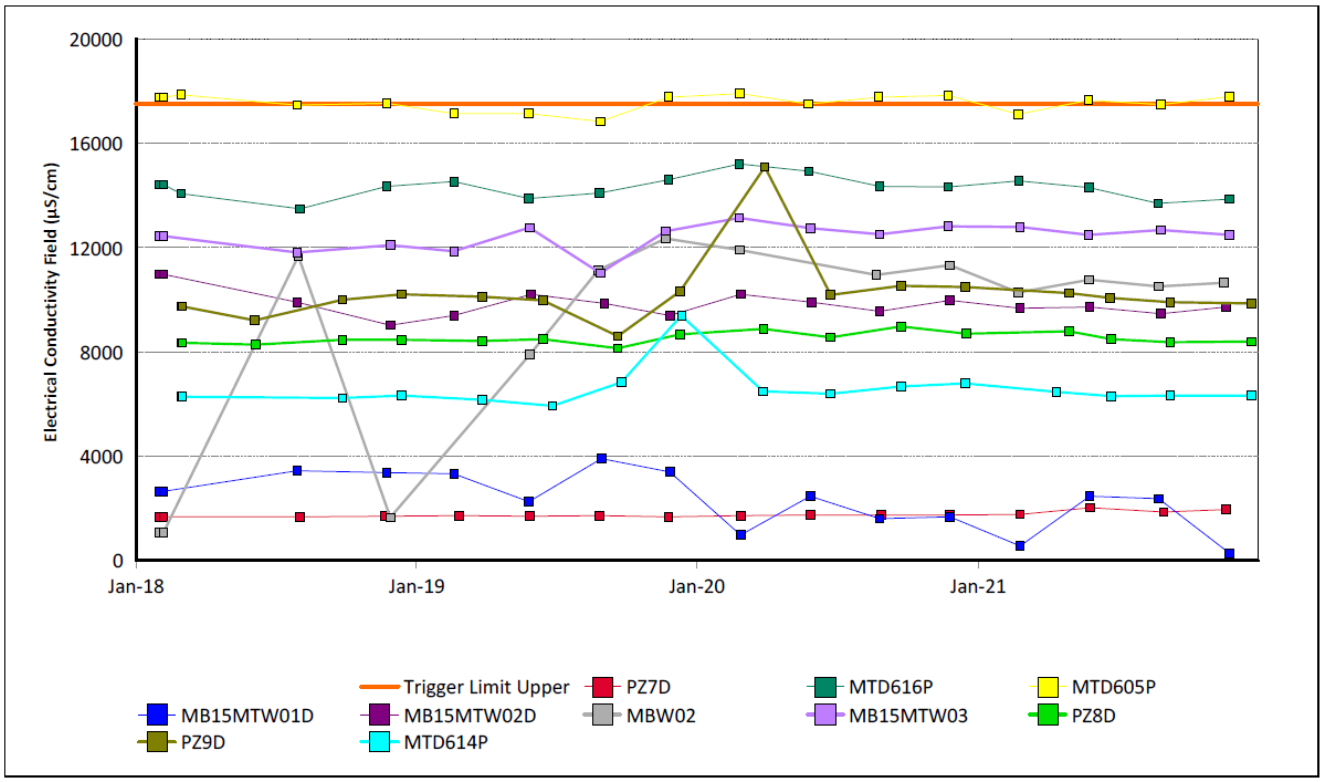


Figure 29: Shallow Overburden Electrical Conductivity Trend – December 2021

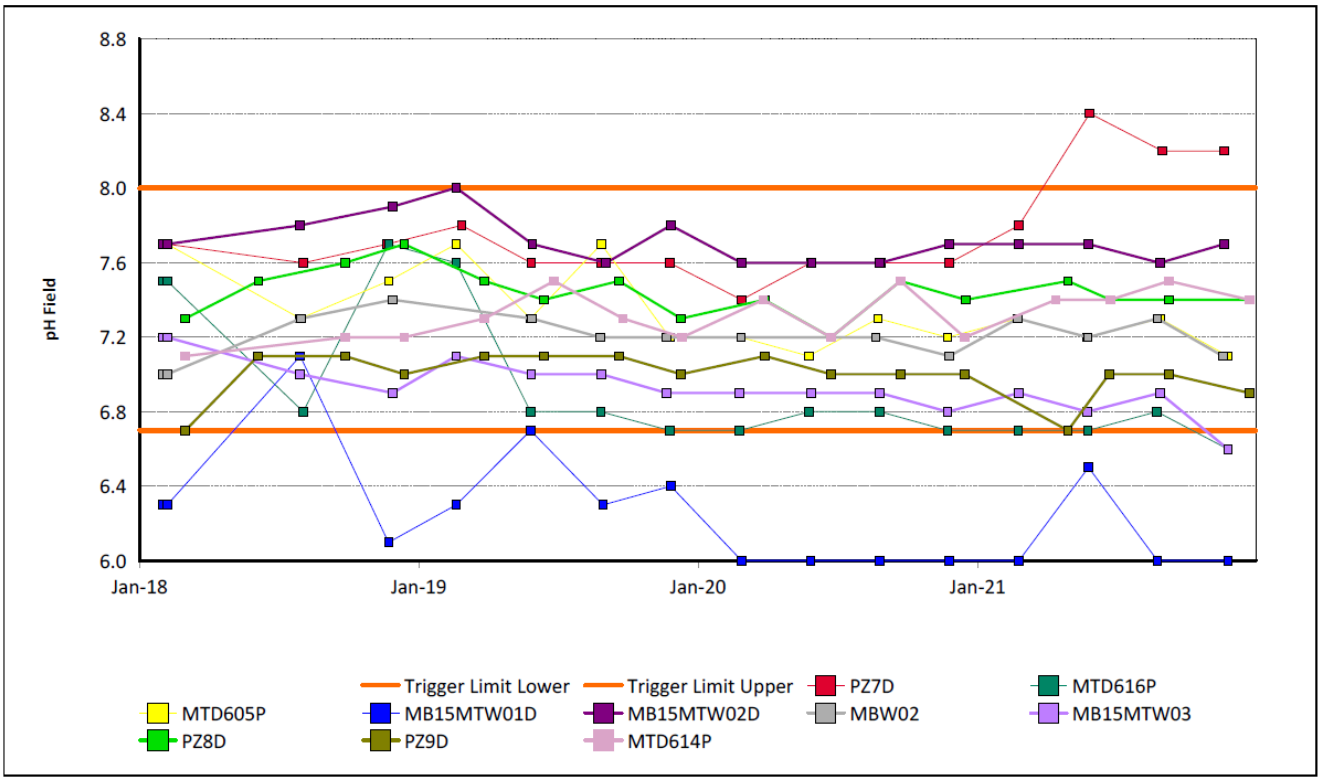


Figure 30: Shallow Overburden pH Trend – December 2021

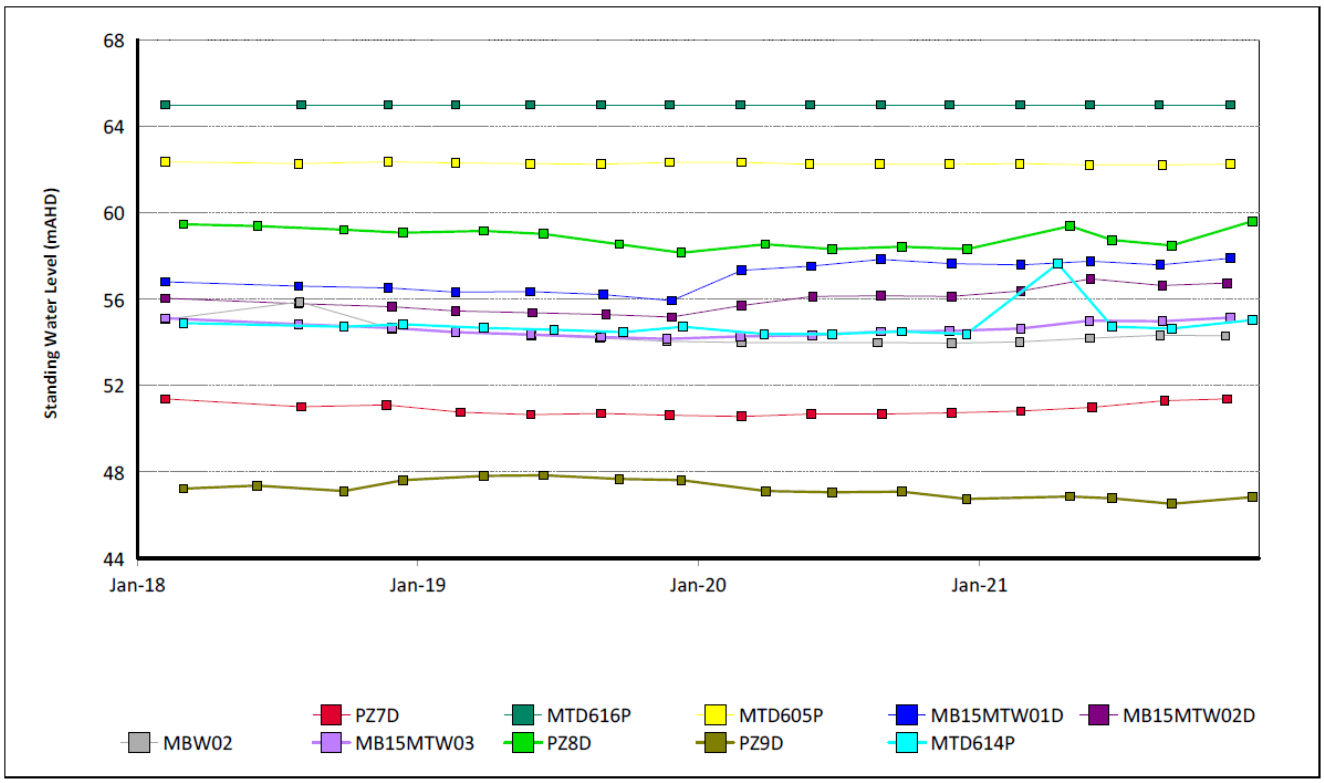
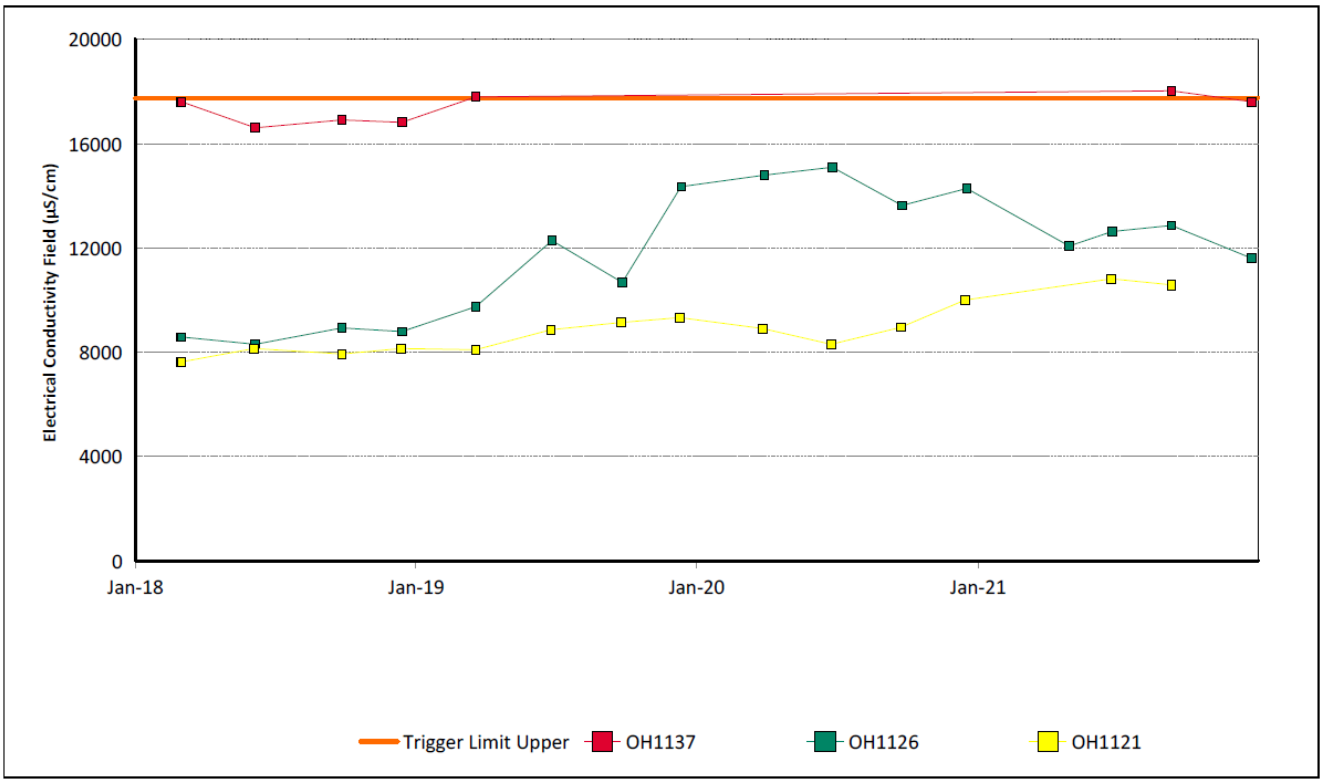
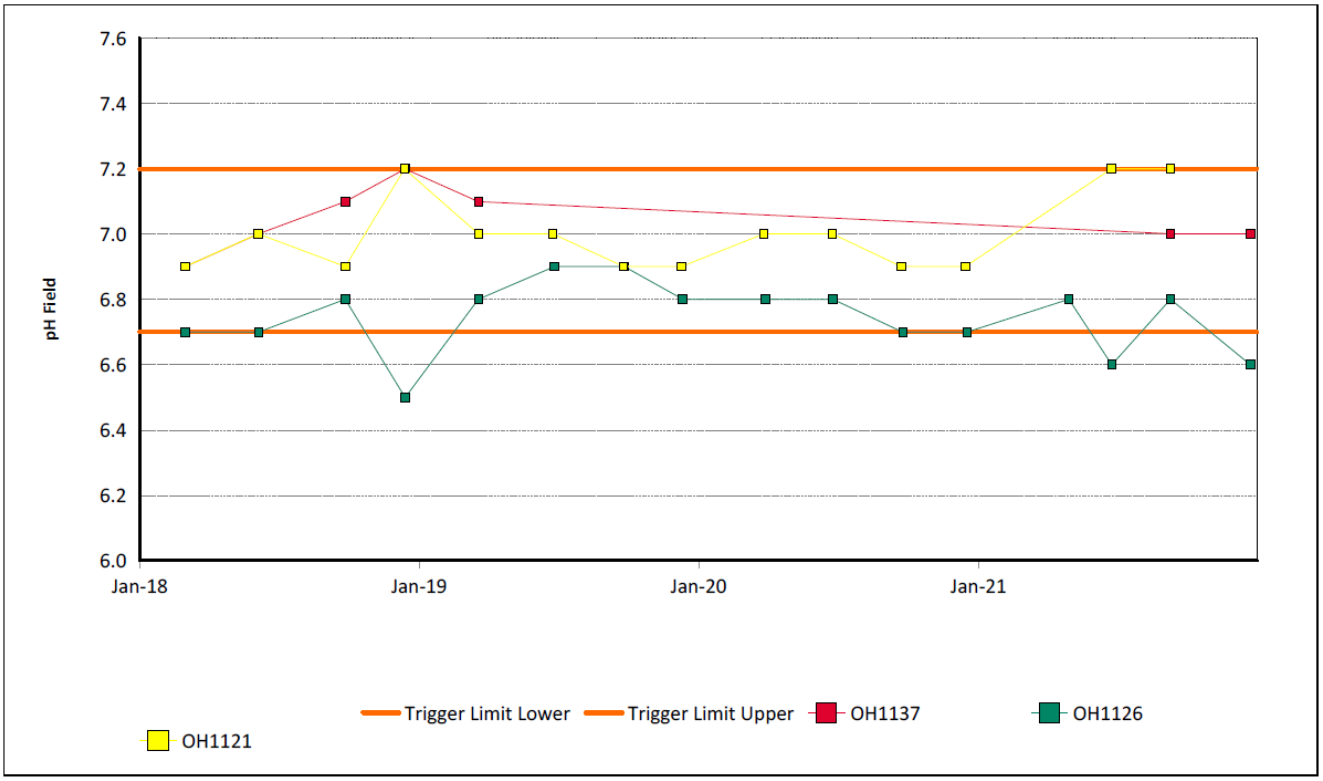


Figure 31: Shallow Overburden Standing Water Level Trend – December 2021



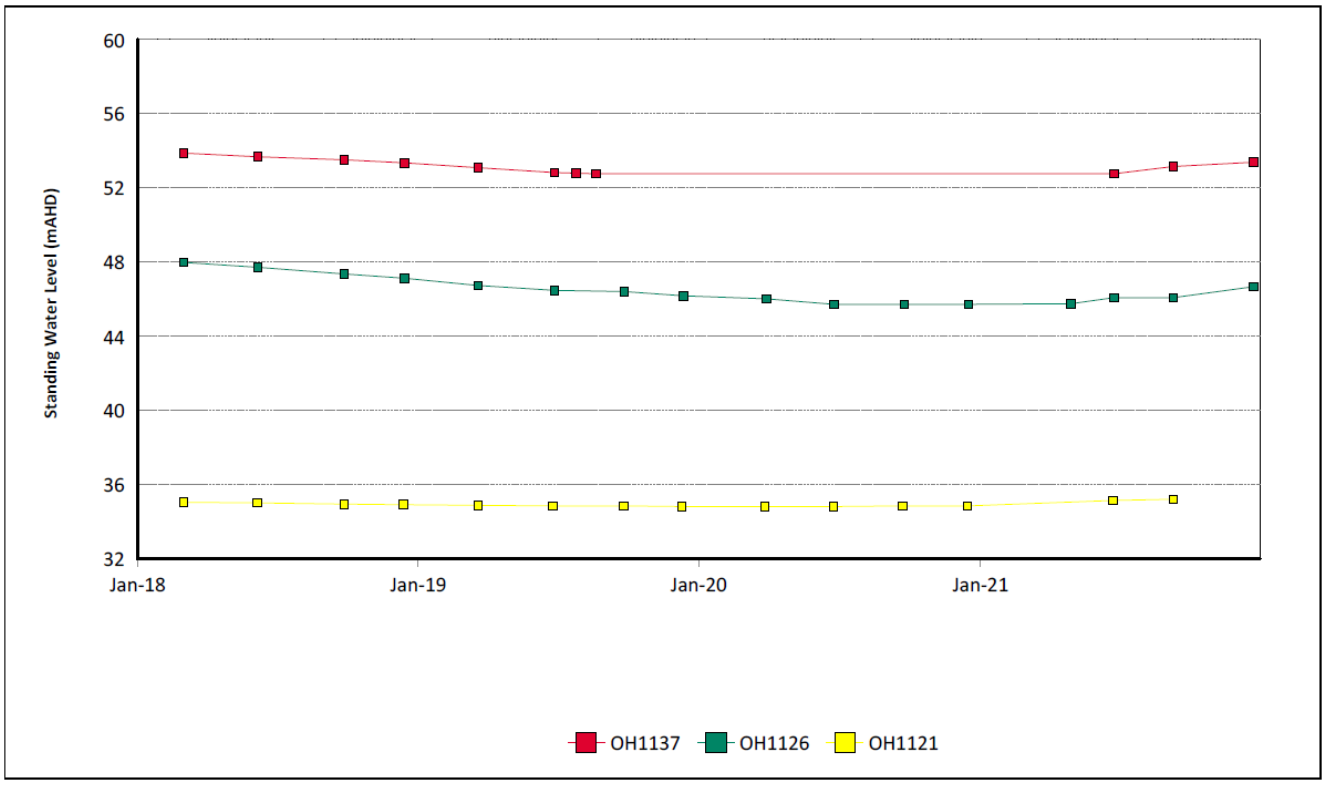
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 32: Vaux Seam Electrical Conductivity Trend – December 2021



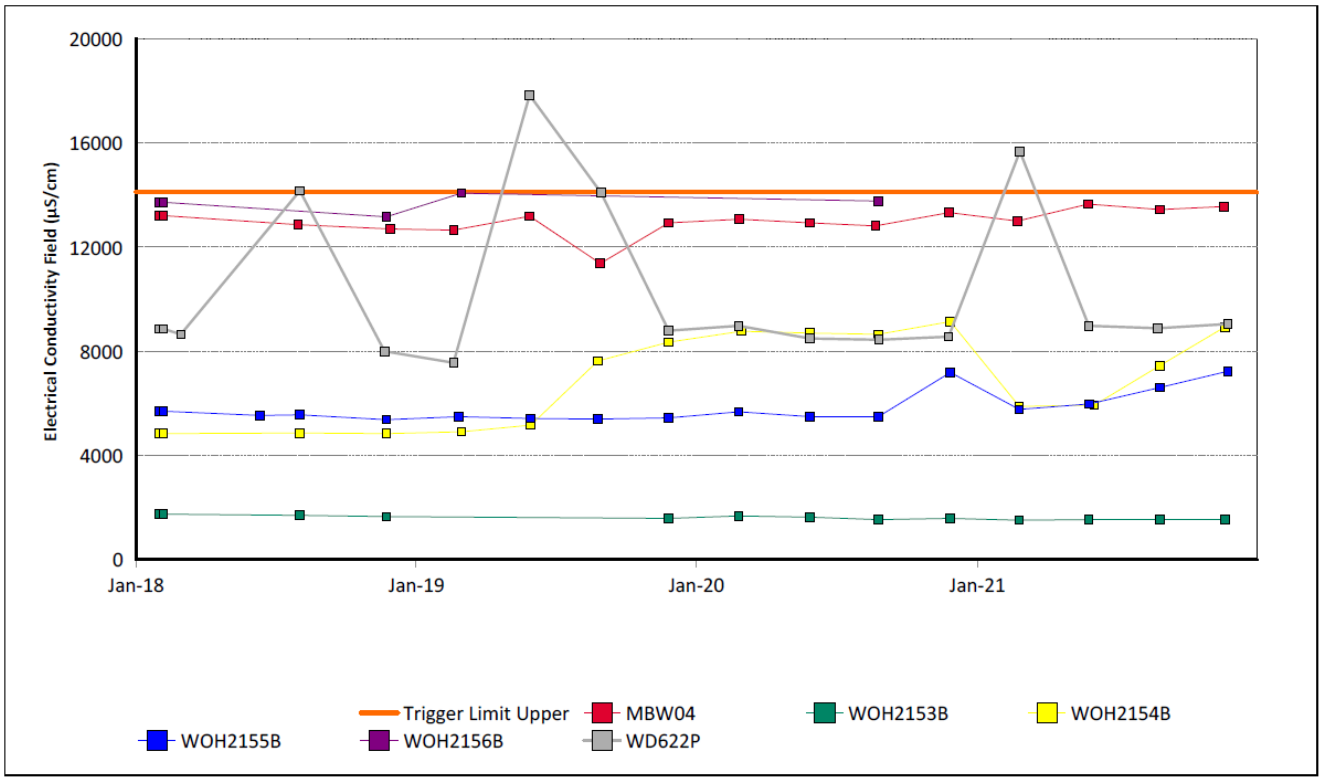
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 33: Vaux Seam pH Trend – December 2021



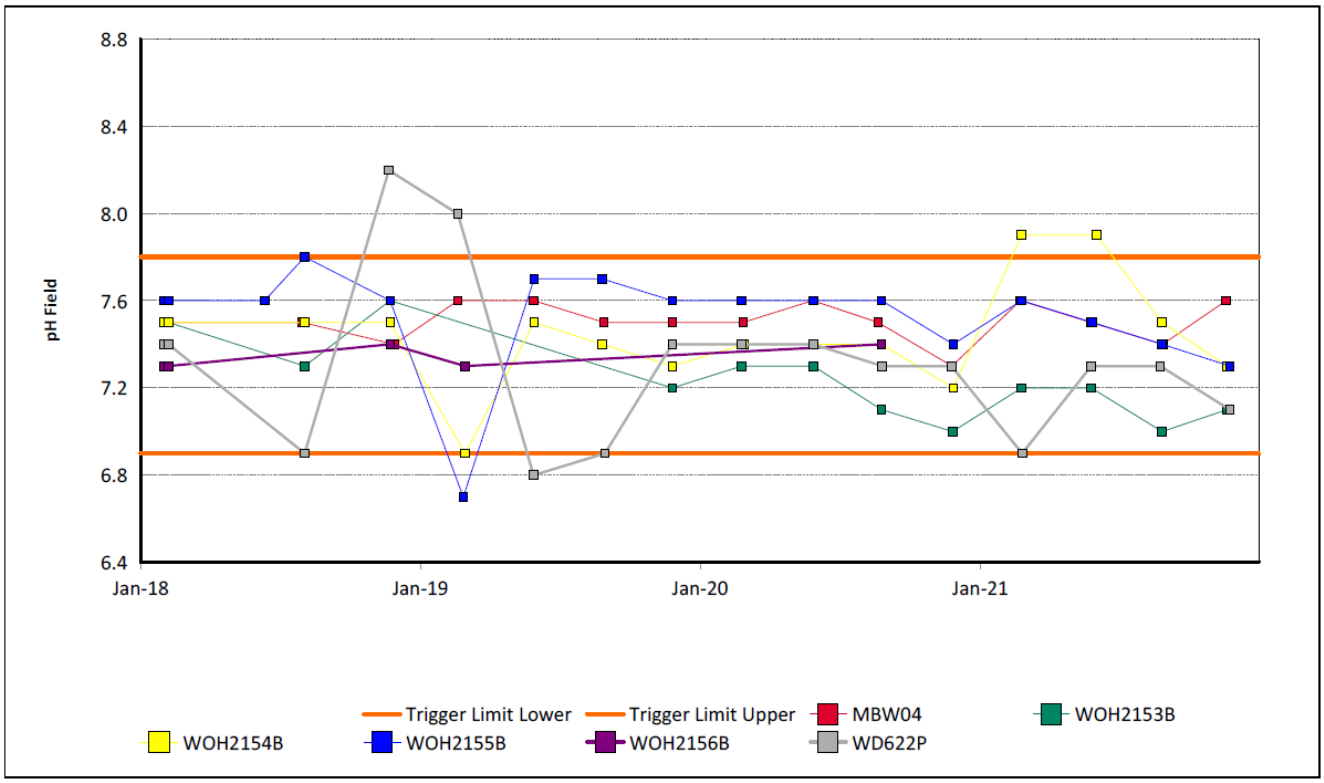
Note: Missing data indicates that there was insufficient water to take a sample.

Figure 34: Vaux Seam Standing Water Level Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 35: Wambo Seam Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 36: Wambo Seam pH Trend – December 2021

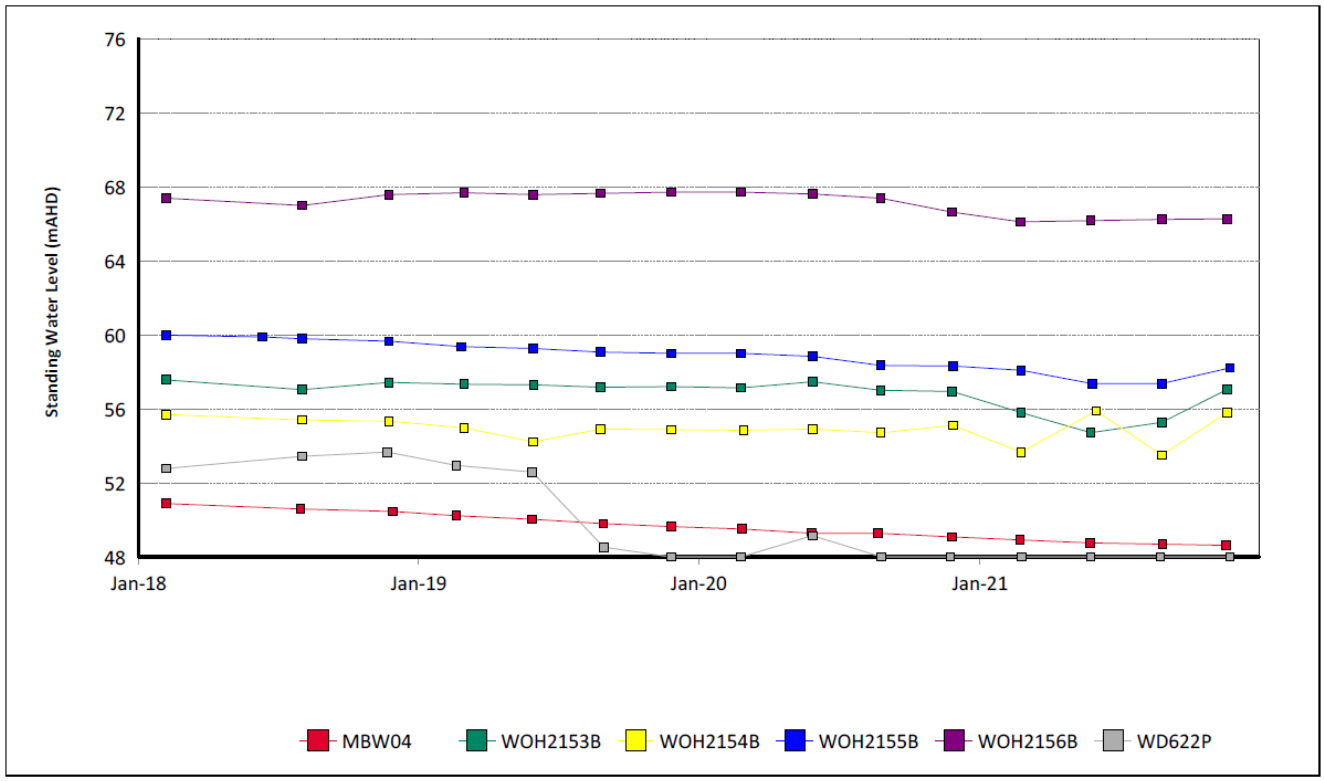


Figure 37: Wambo Seam Standing Water Level Trend – December 2021

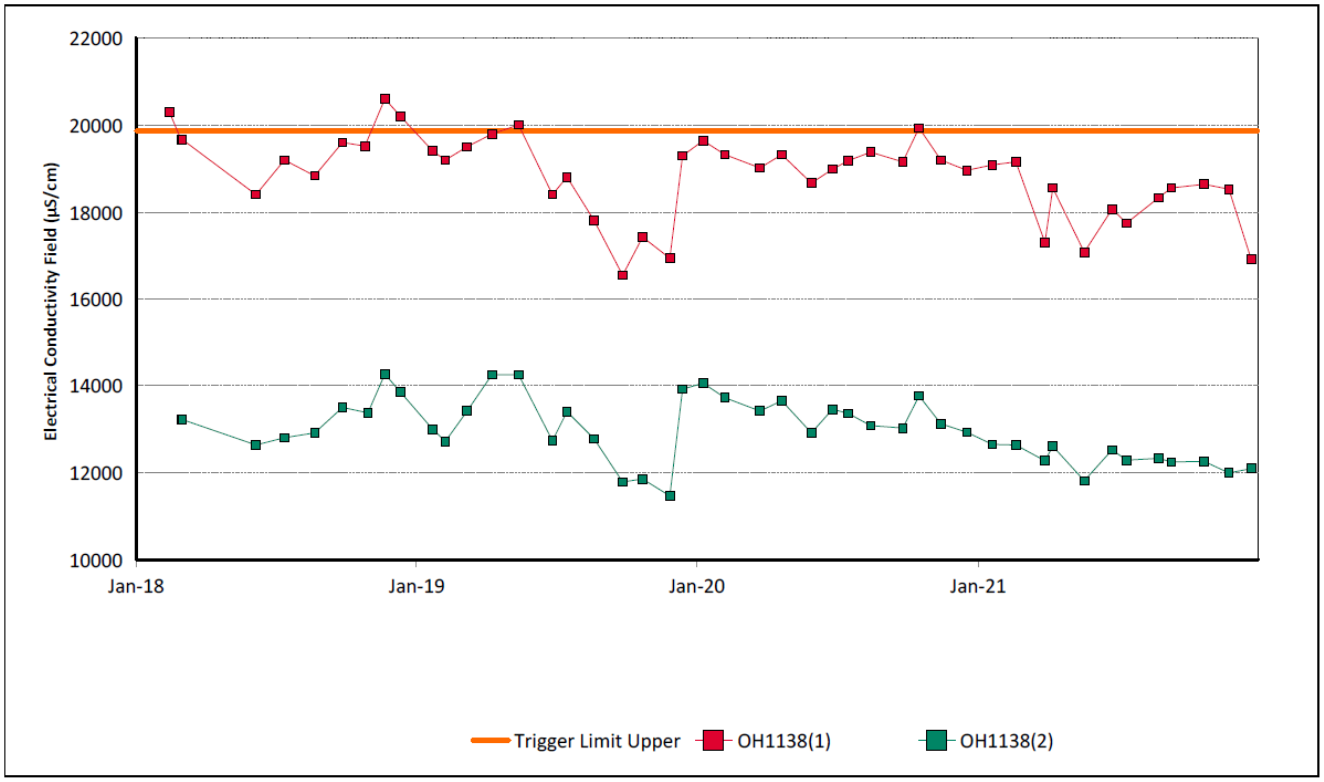


Figure 38: Warkworth Seam Electrical Conductivity Trend – December 2021

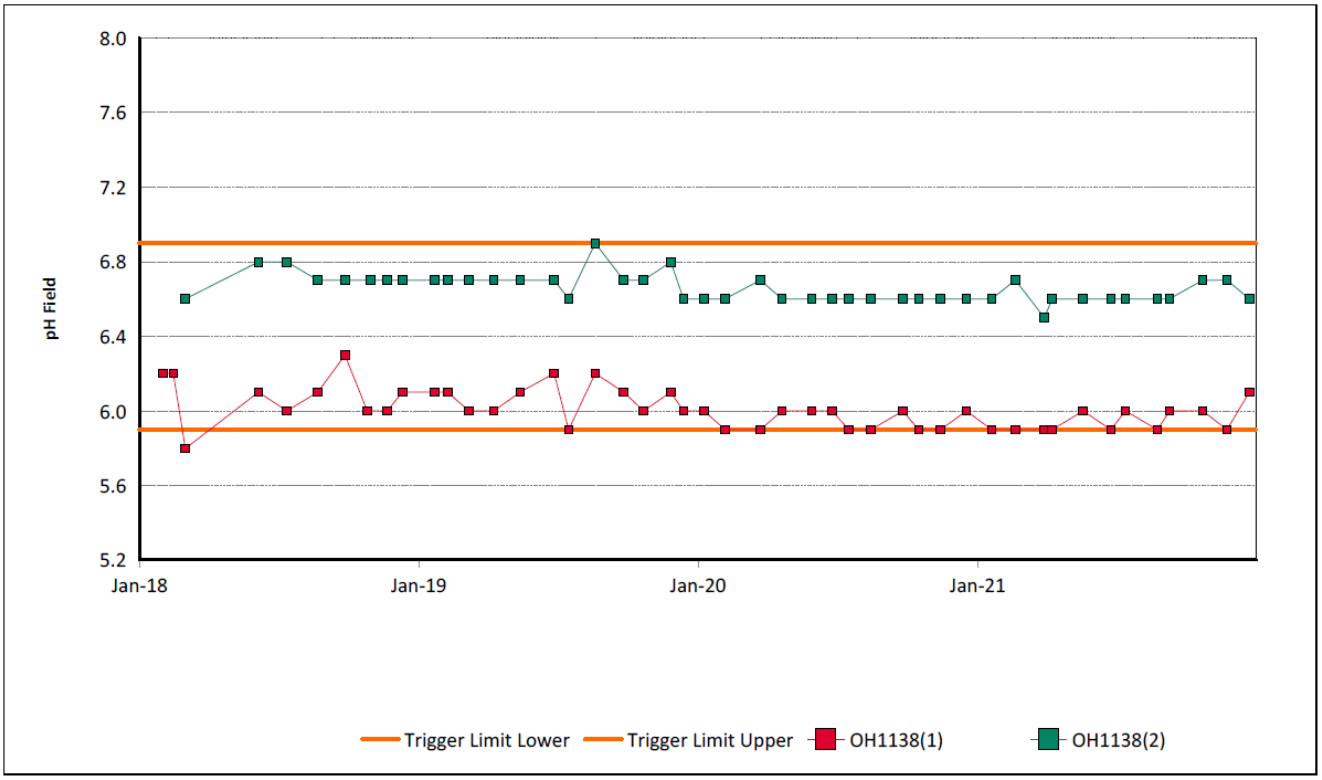


Figure 39: Warkworth Seam pH Trend – December 2021

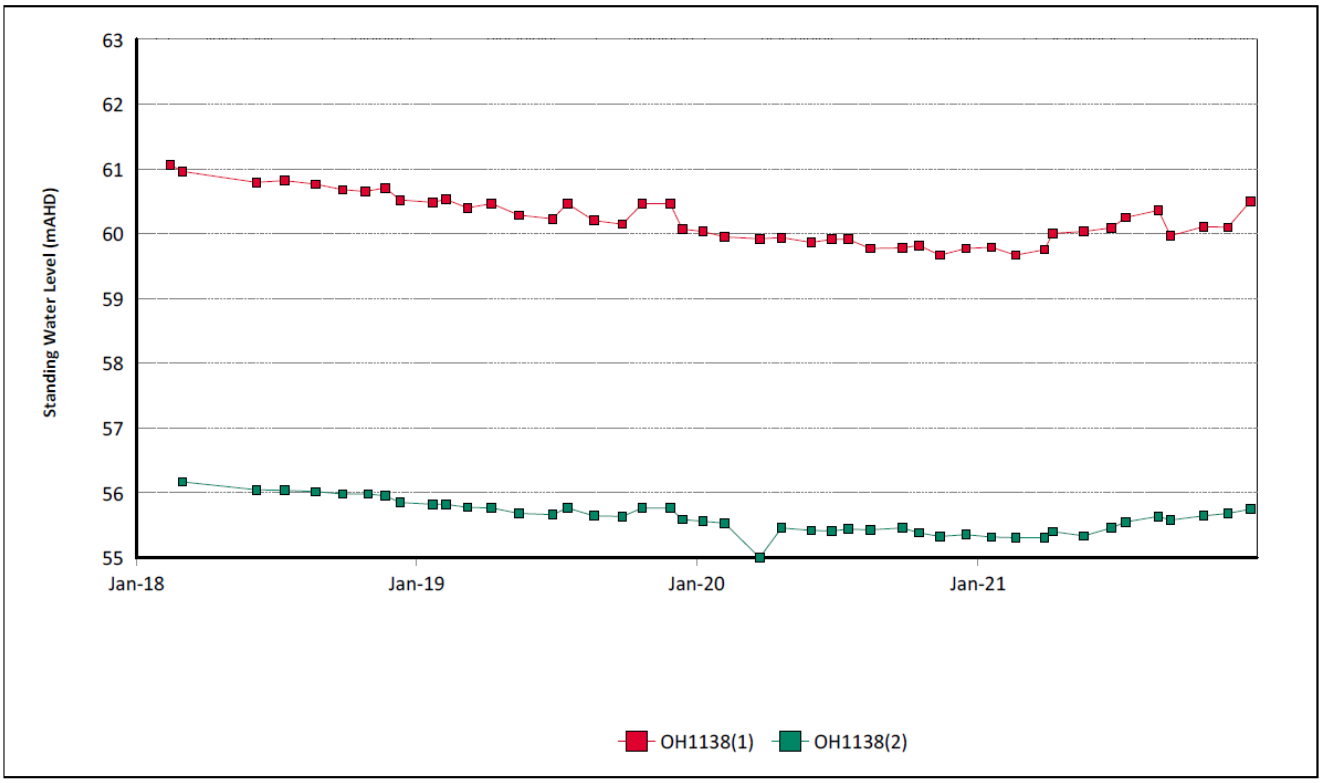


Figure 40: Warkworth Seam Standing Water Level Trend – December 2021

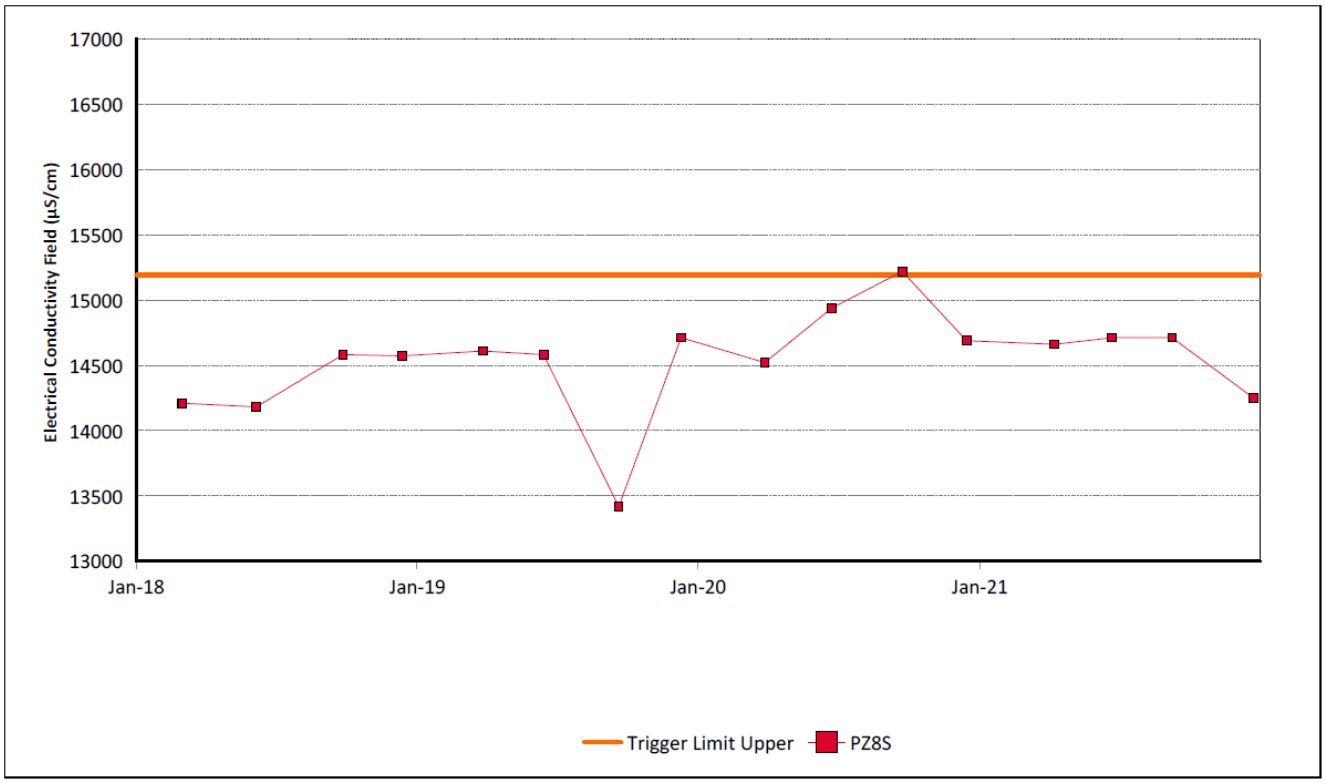


Figure 41: Wollombi Alluvium Electrical Conductivity Trend – December 2021

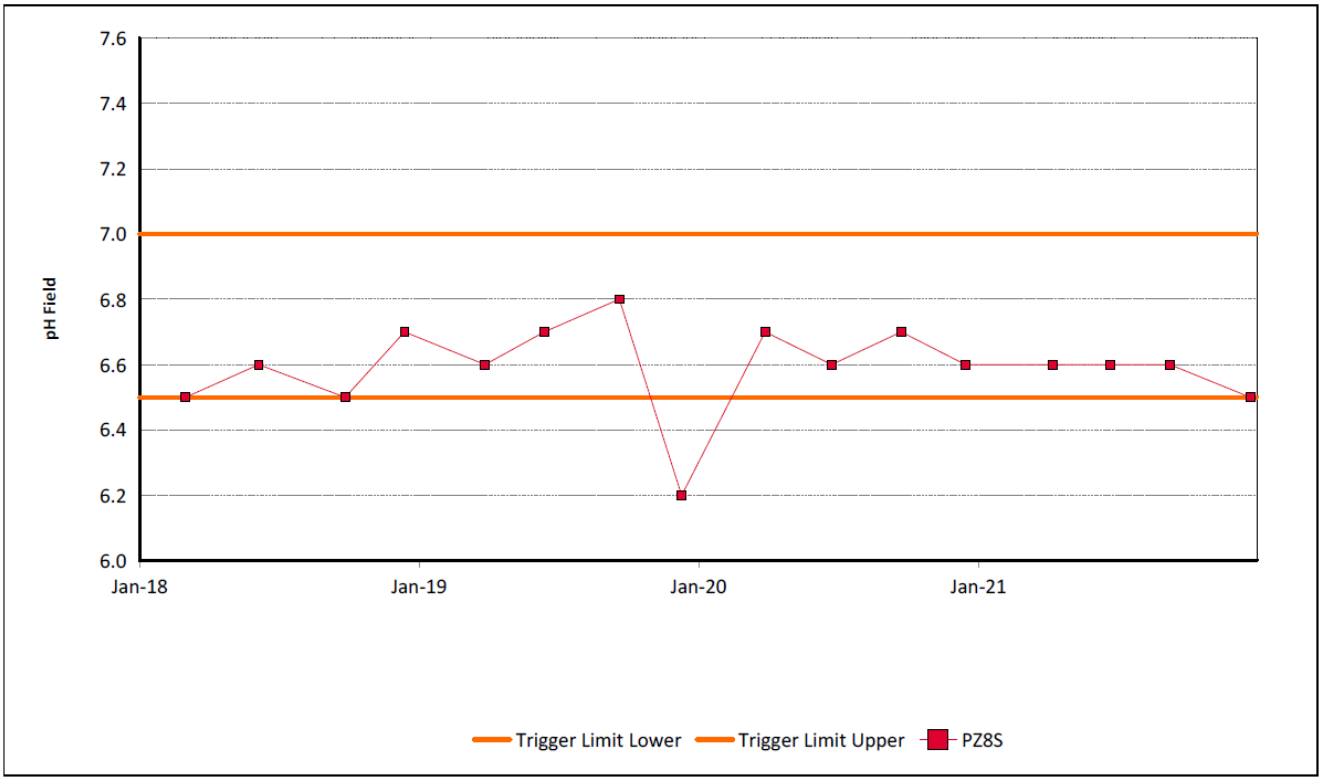
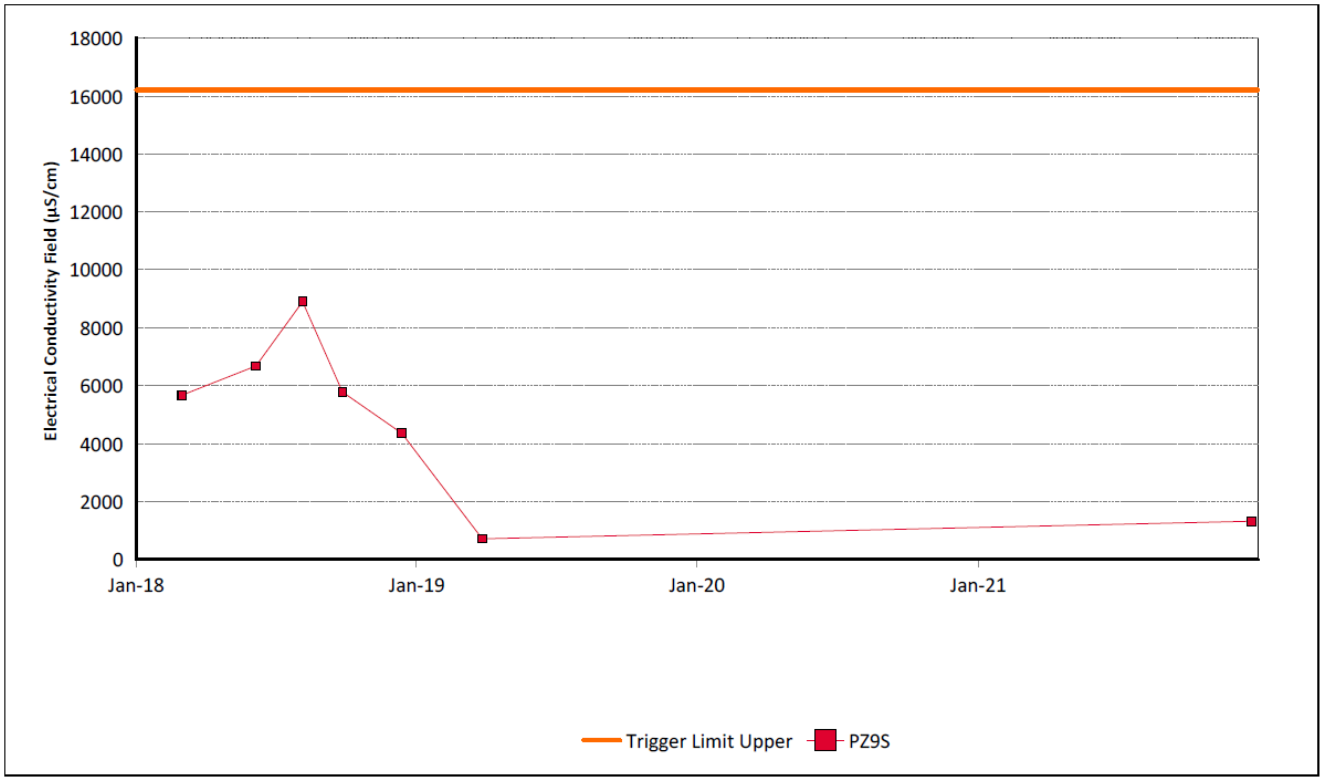
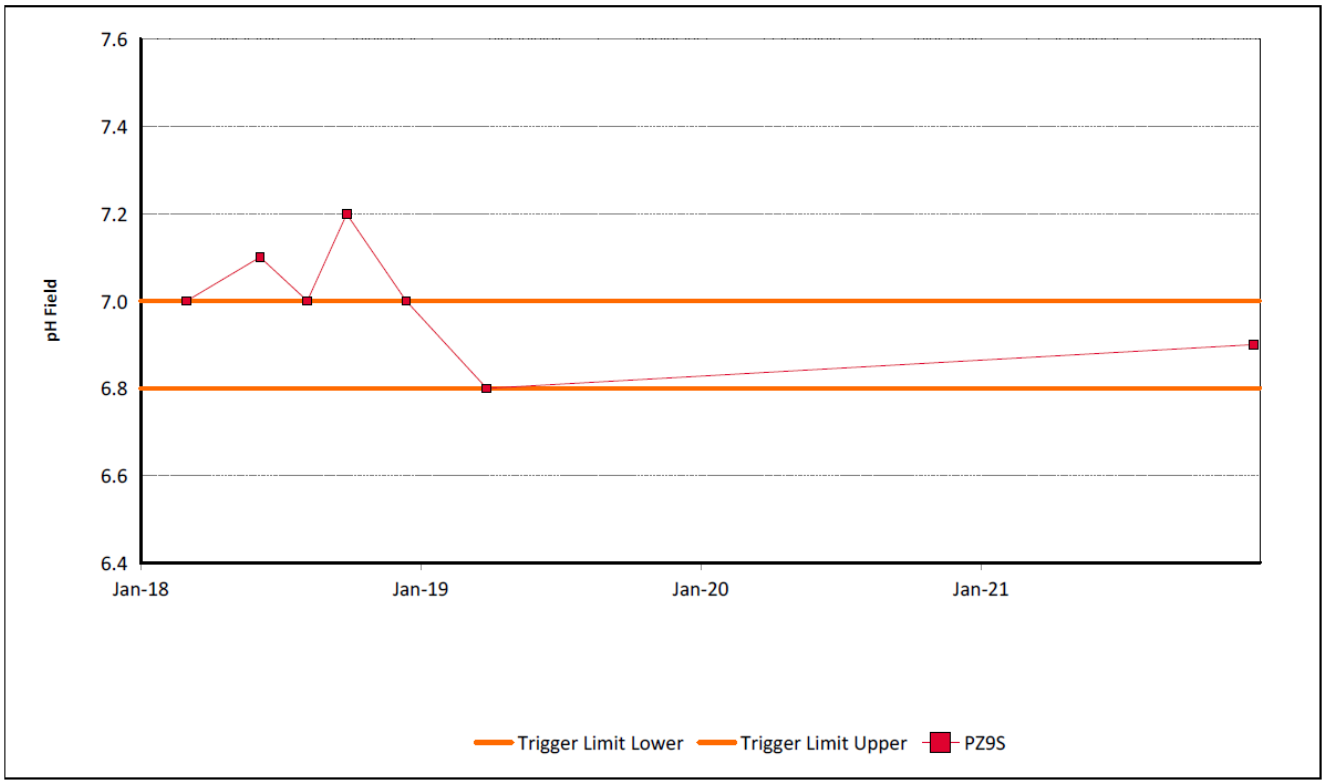


Figure 42: Wollombi Alluvium pH Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 43: Wollombi Alluvium 2 Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 44: Wollombi Alluvium 2 pH Trend – December 2021

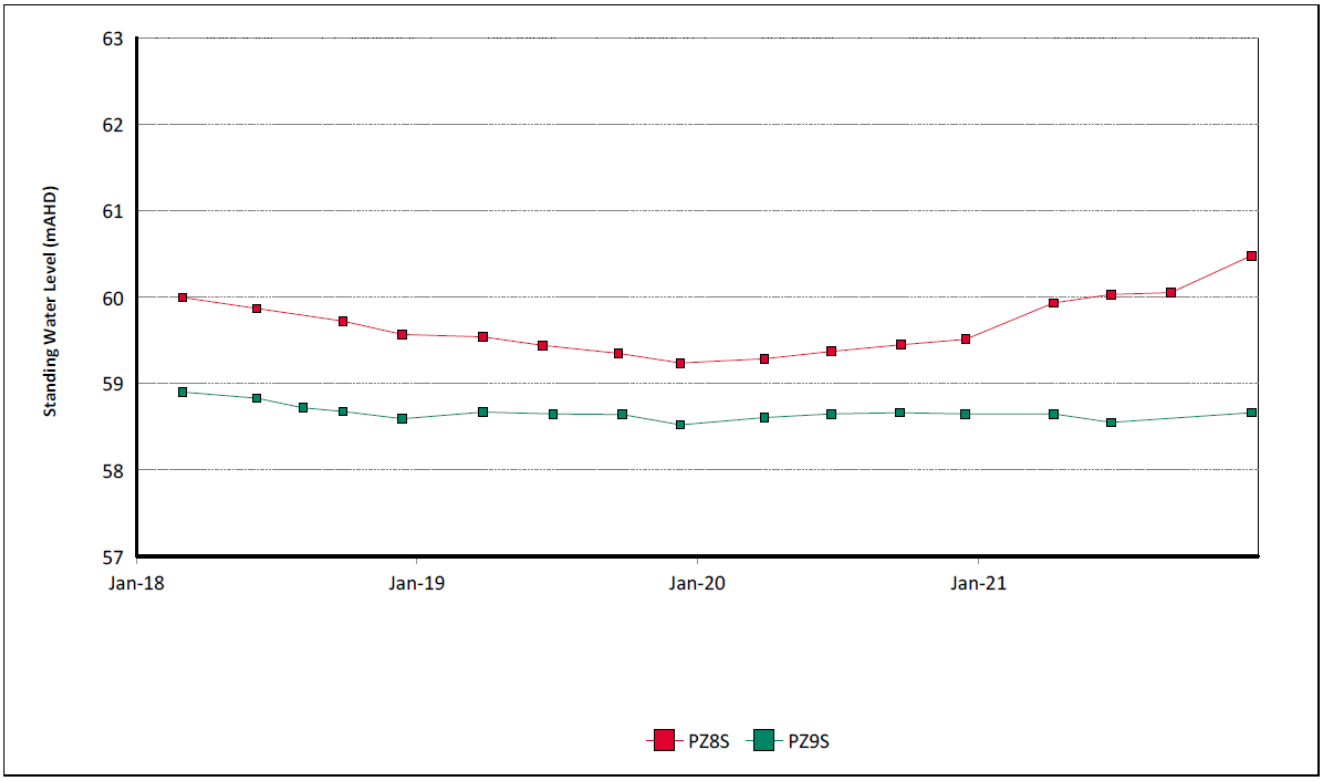


Figure 45: Wollombi Alluvium Standing Water Level Trend – December 2021

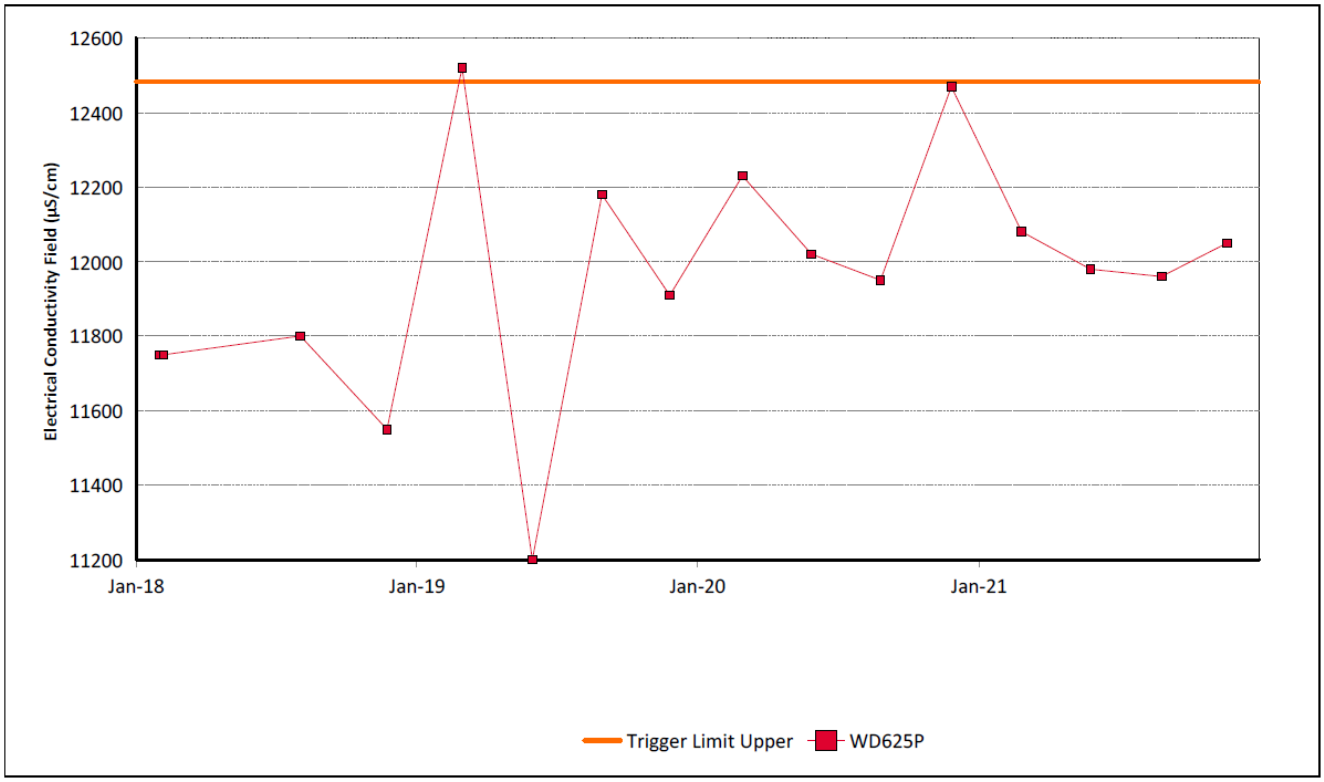


Figure 46: Woodlands Hill Seam Electrical Conductivity Trend - December 2021

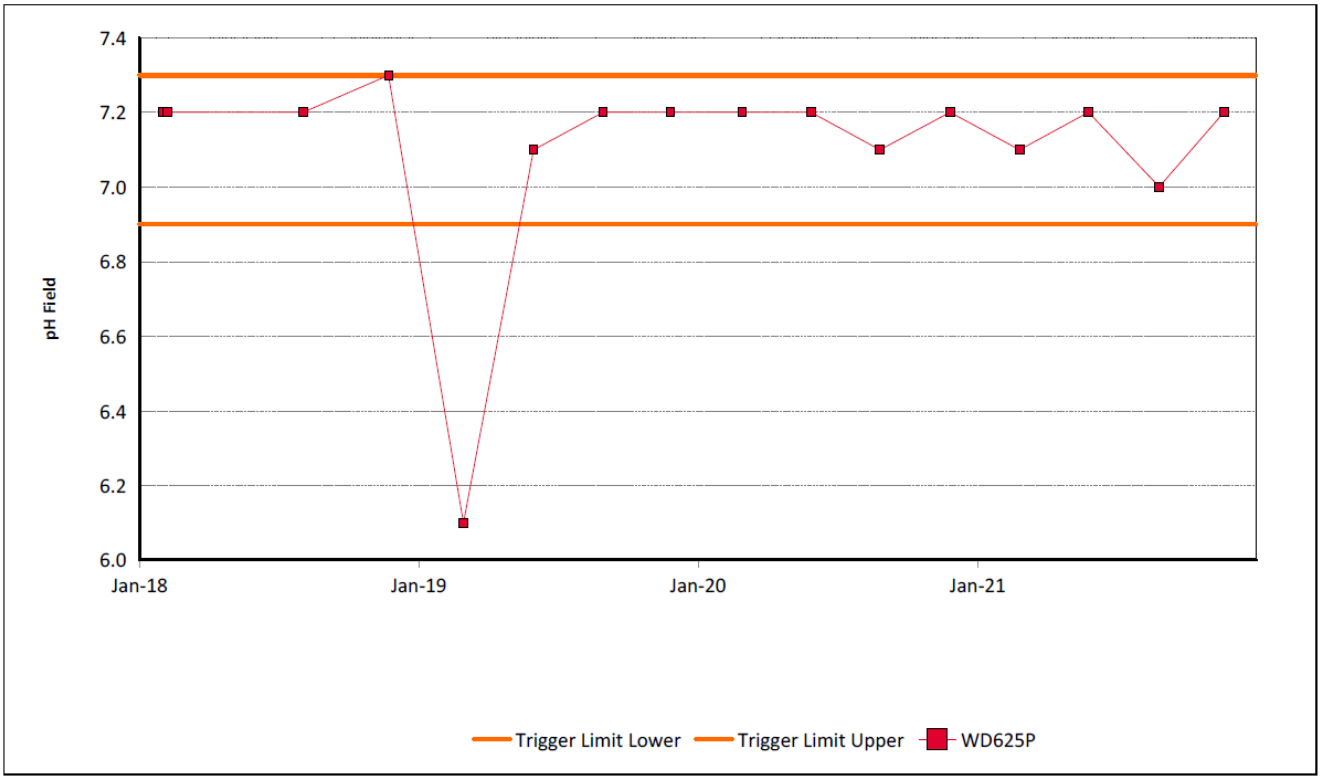


Figure 47: Woodlands Hill Seam pH Trend - December 2021

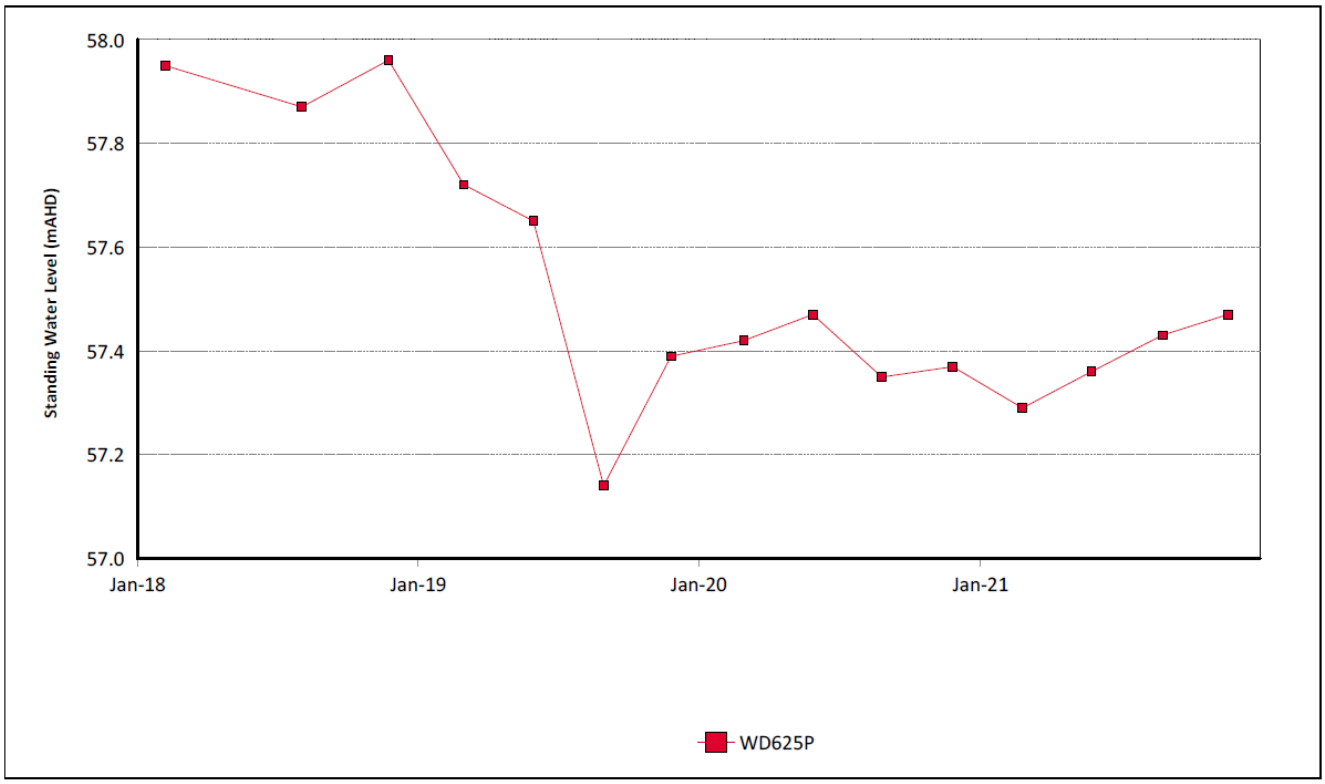


Figure 48: Woodlands Hill Seam Standing Water Level Trend - December 2021

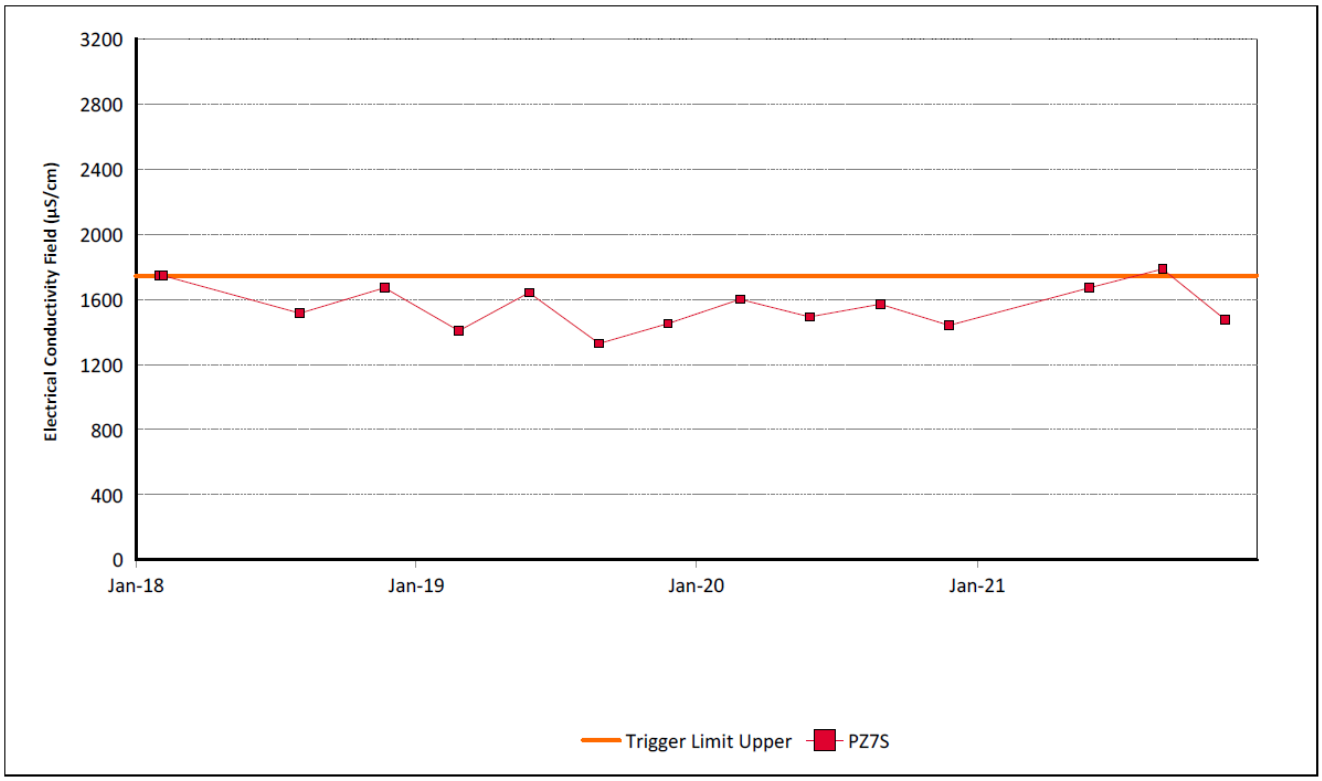


Figure 49: Aeolian Warkworth Sands Electrical Conductivity Trend – December 2021

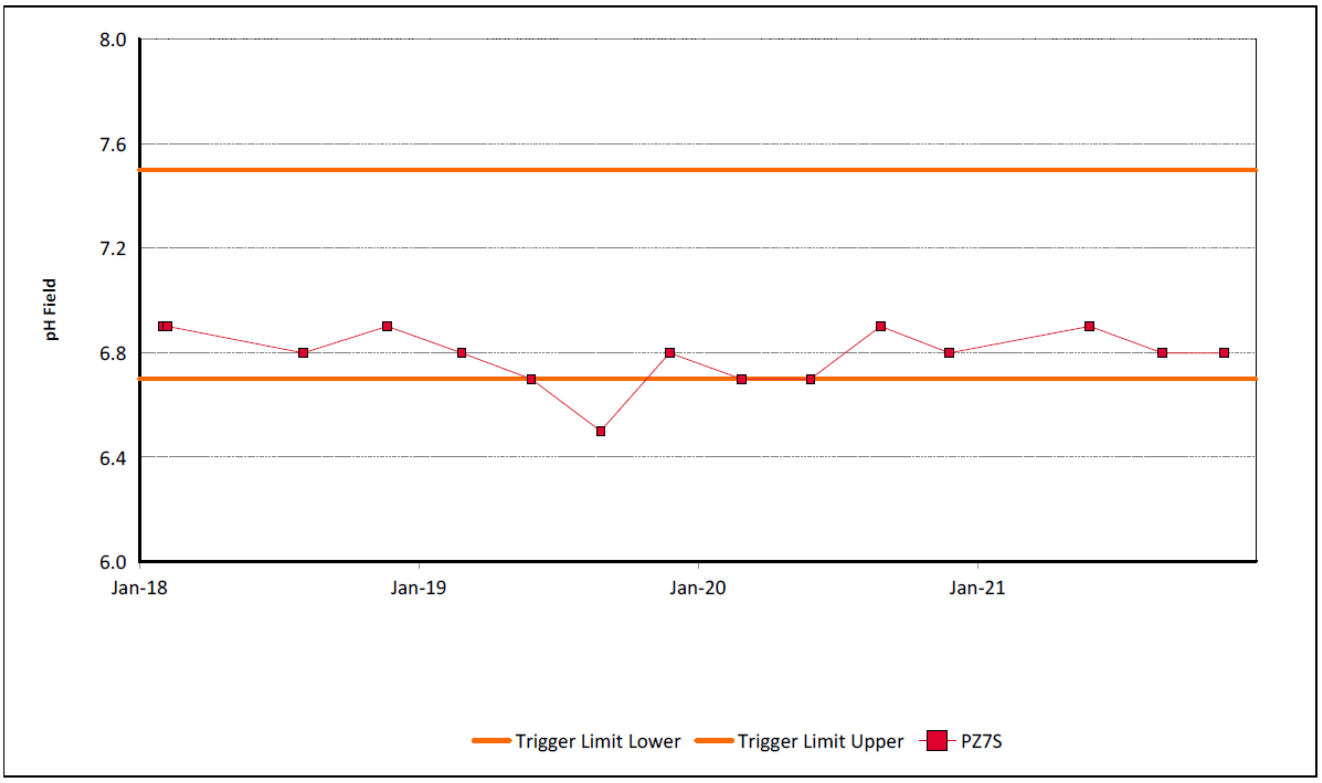


Figure 50: Aeolian Warkworth Sands pH Trend – December 2021

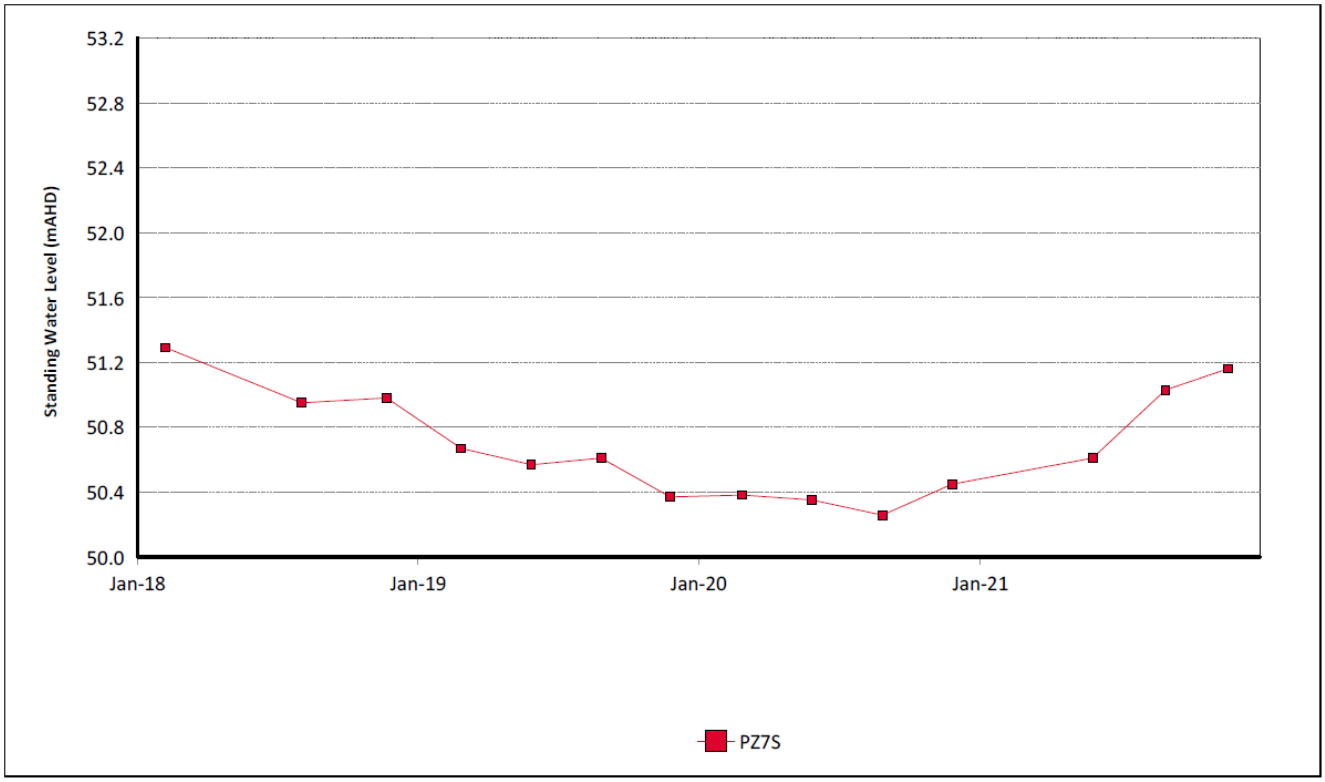


Figure 51: Aeolian Warkworth Sands Standing Water Level Trend – December 2021

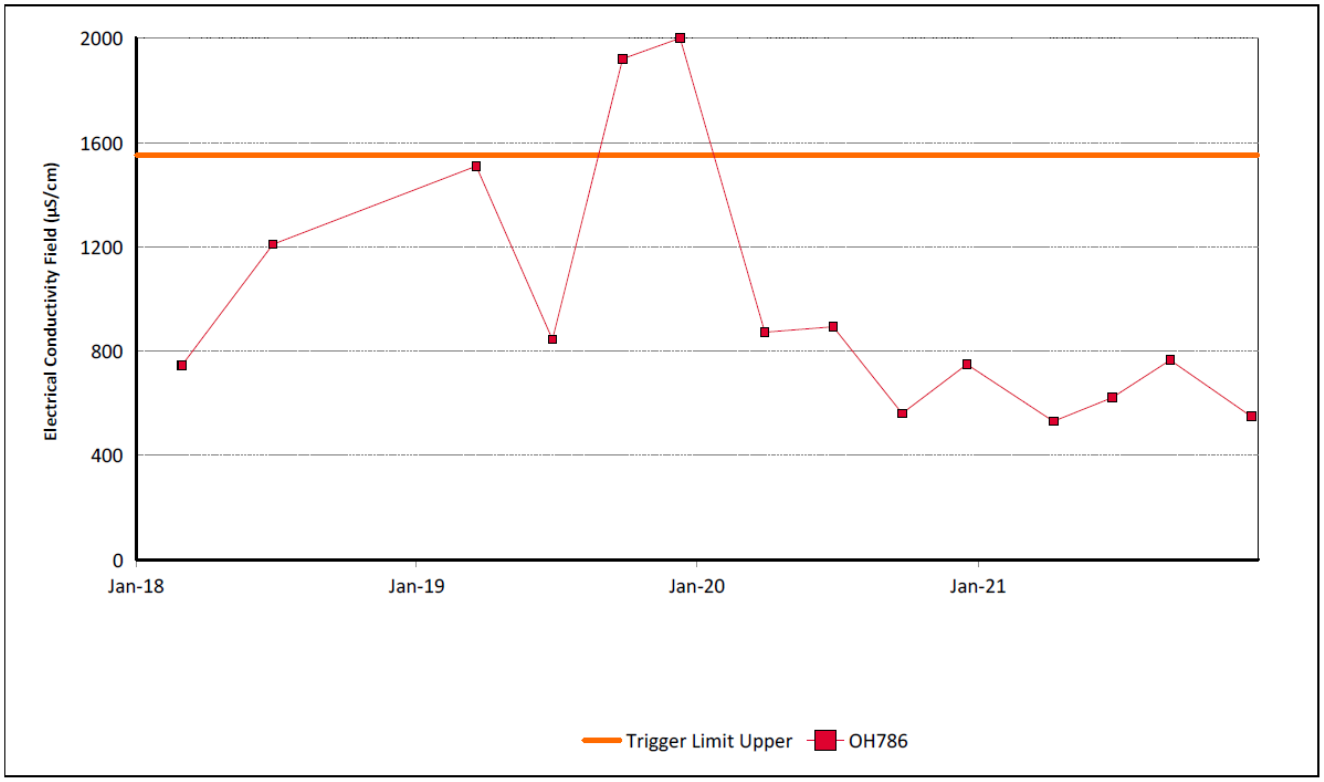


Figure 52: Hunter River Alluvium 1 Electrical Conductivity Trend – December 2021

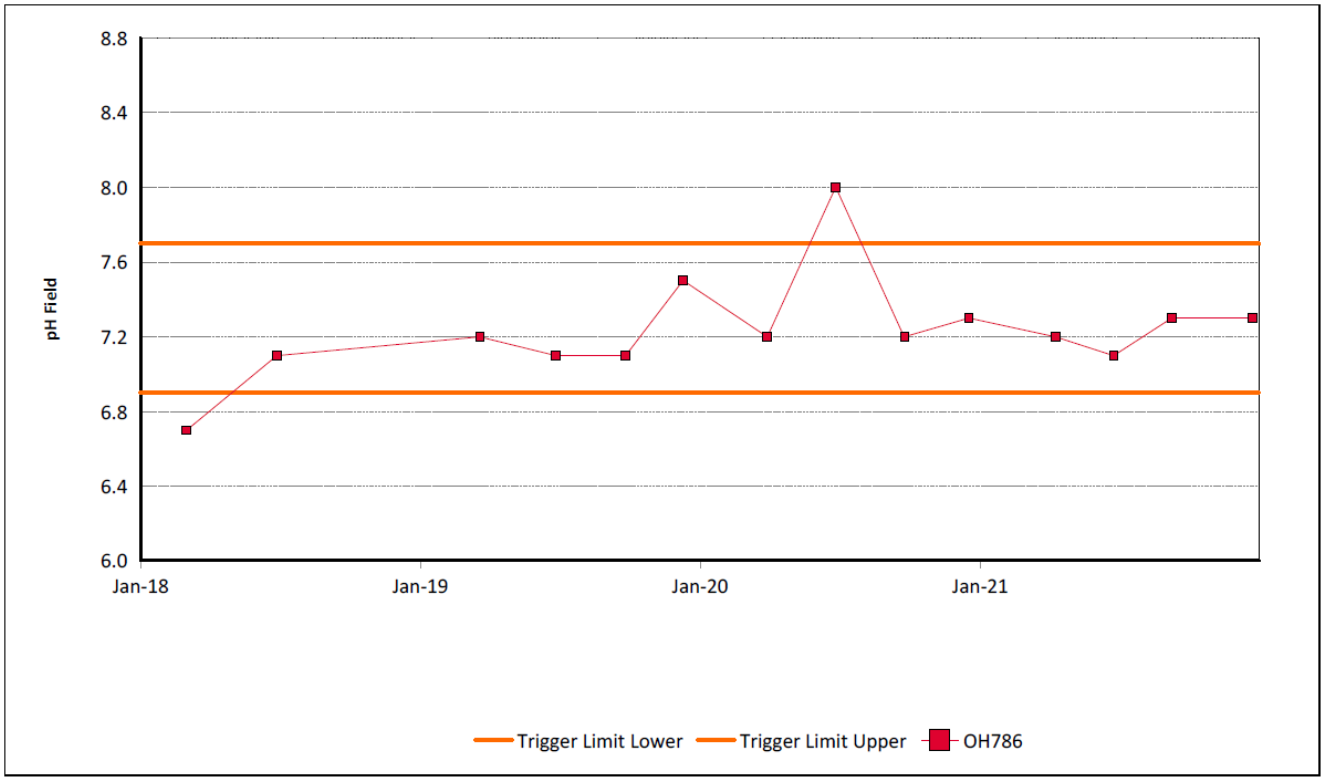


Figure 53: Hunter River Alluvium 1 pH Trend – December 2021

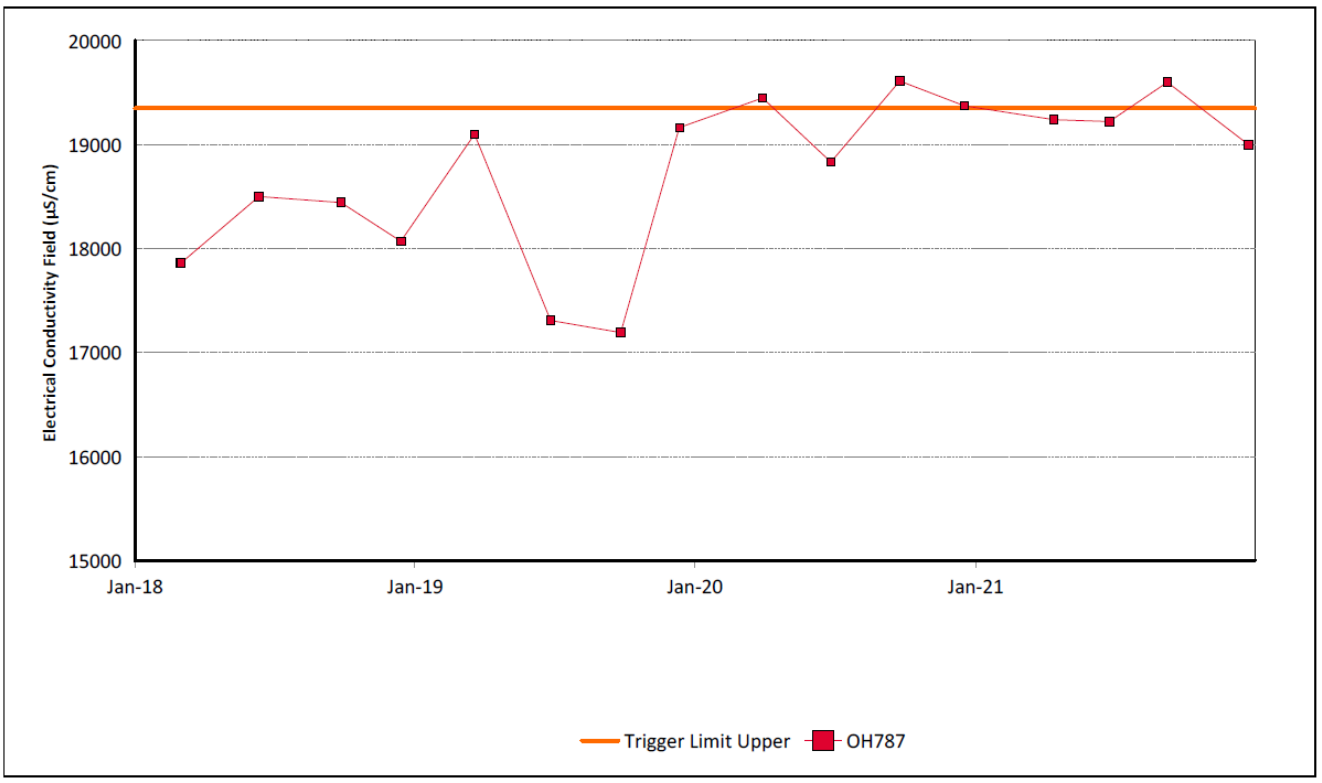


Figure 54: Hunter River Alluvium 2 Electrical Conductivity Trend – December 2021

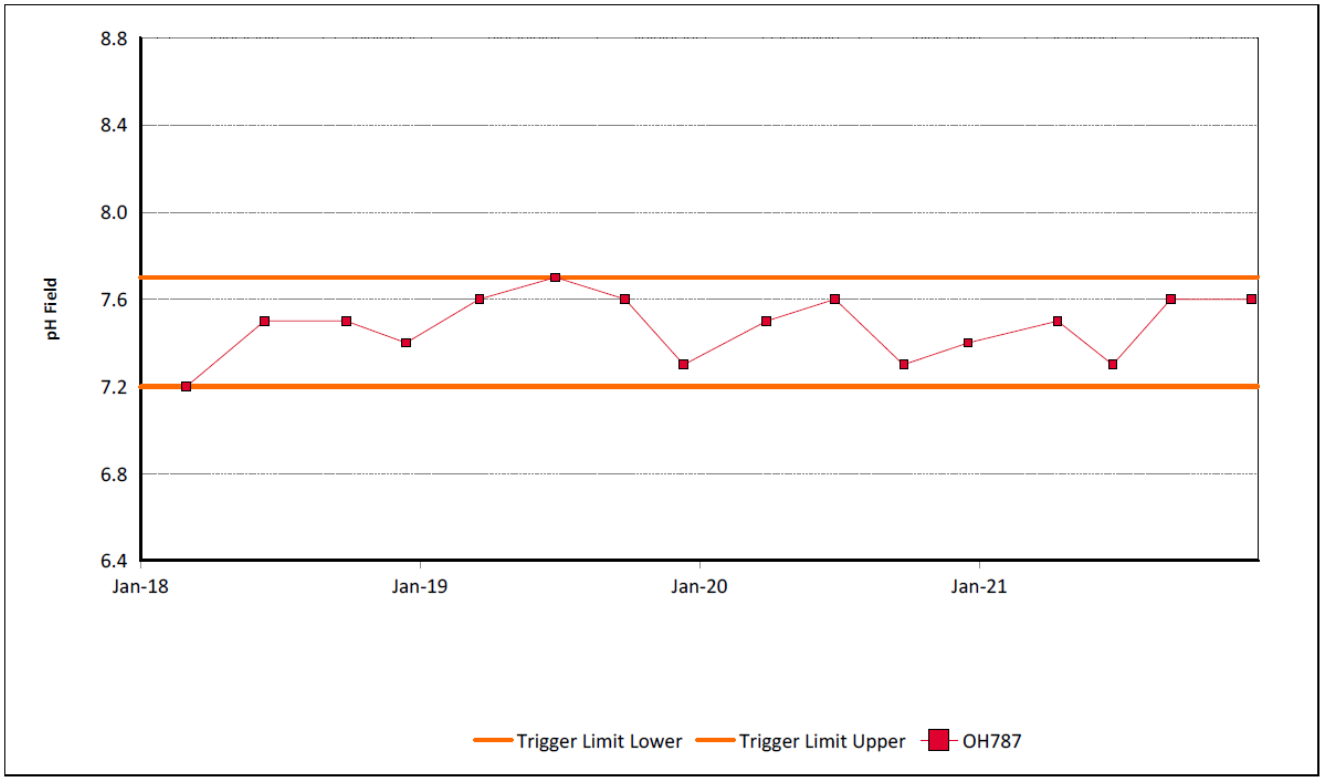


Figure 55: Hunter River Alluvium 2 pH Trend – December 2021

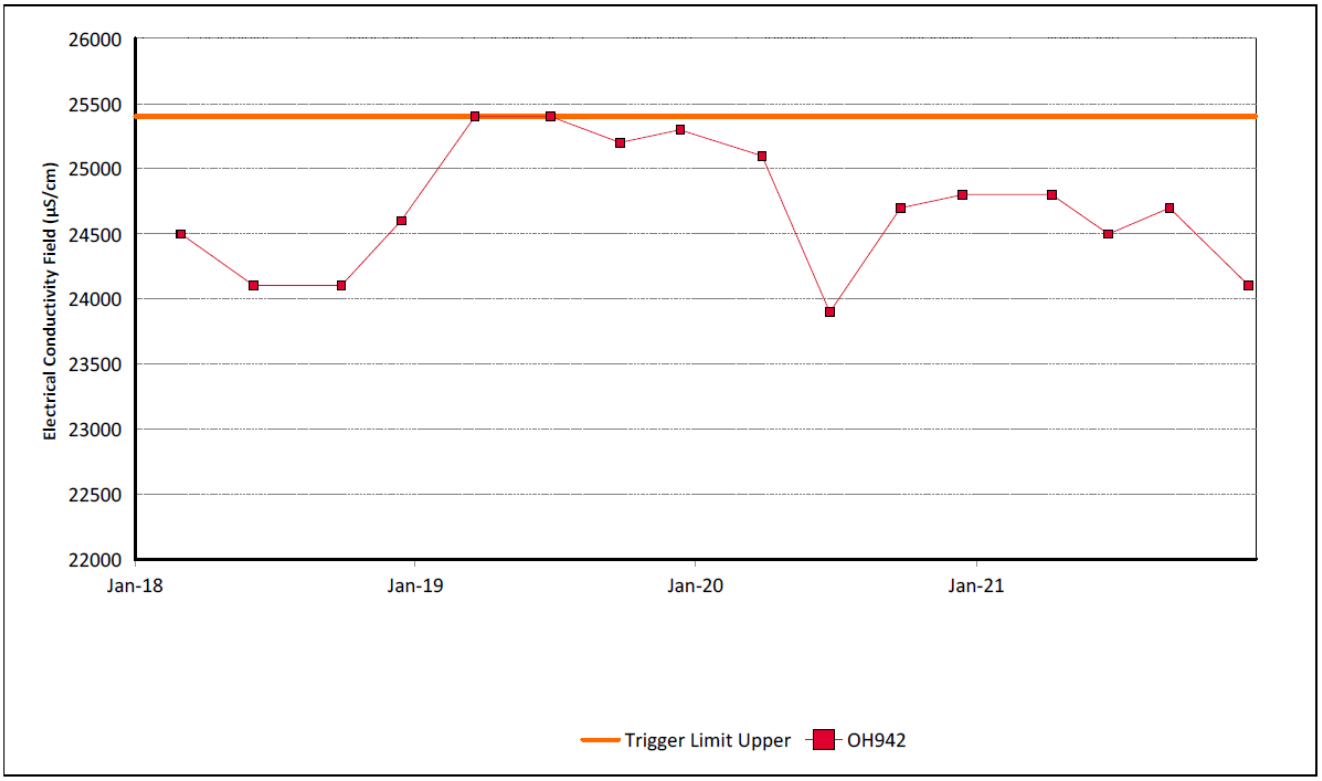


Figure 56: Hunter River Alluvium 3 Electrical Conductivity Trend – December 2021

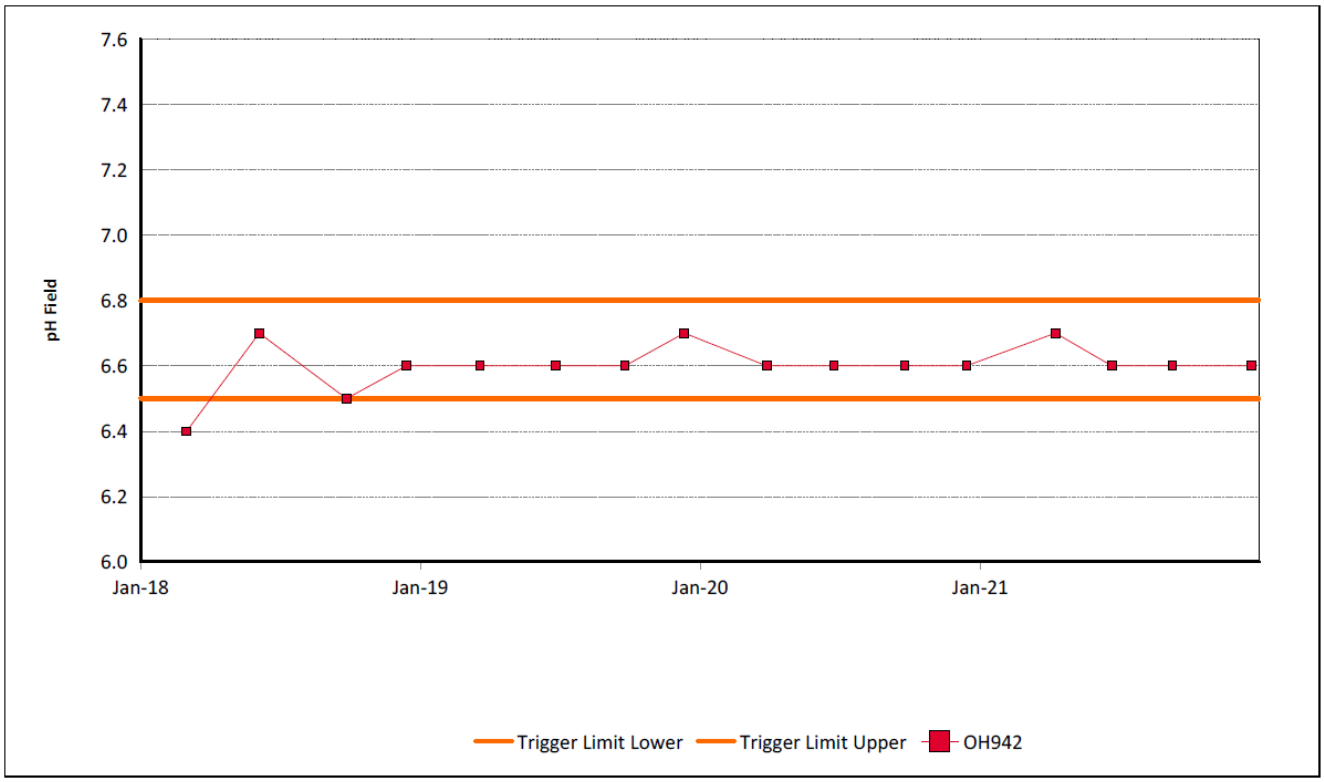
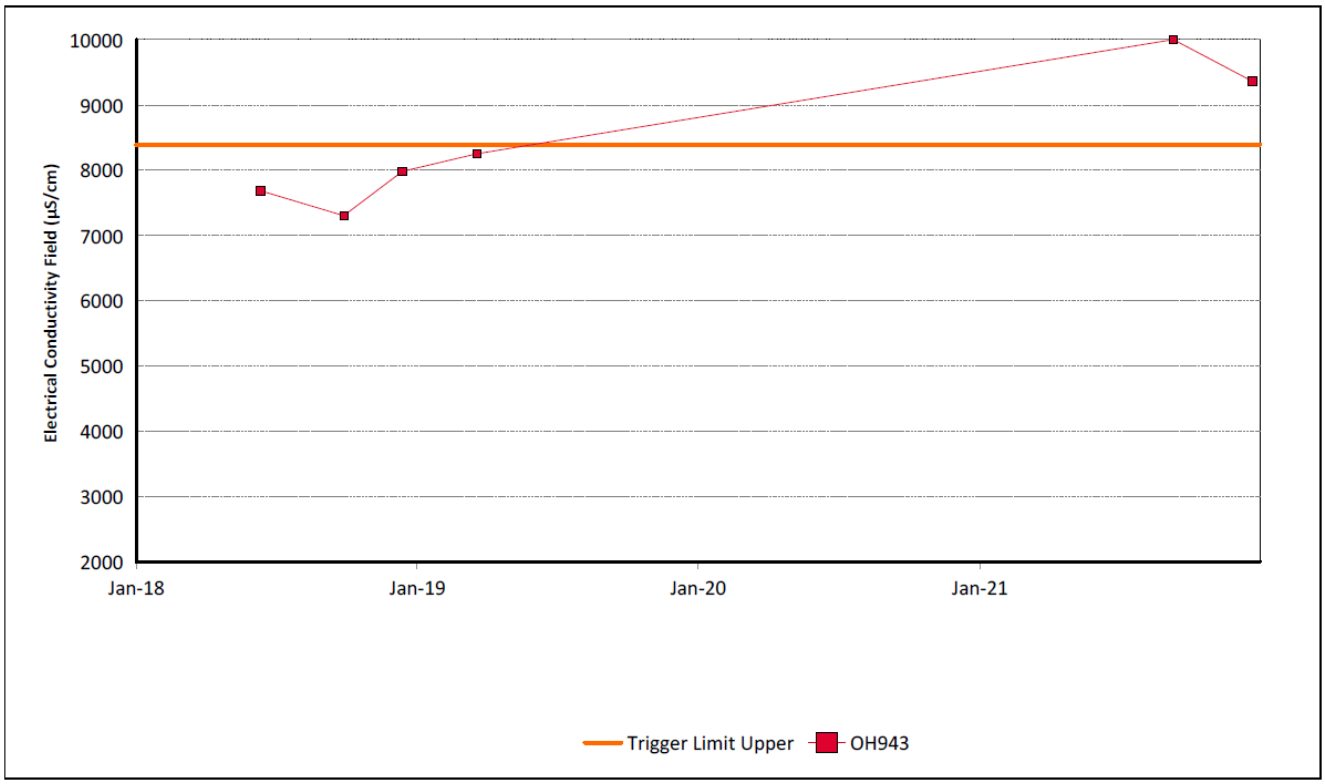
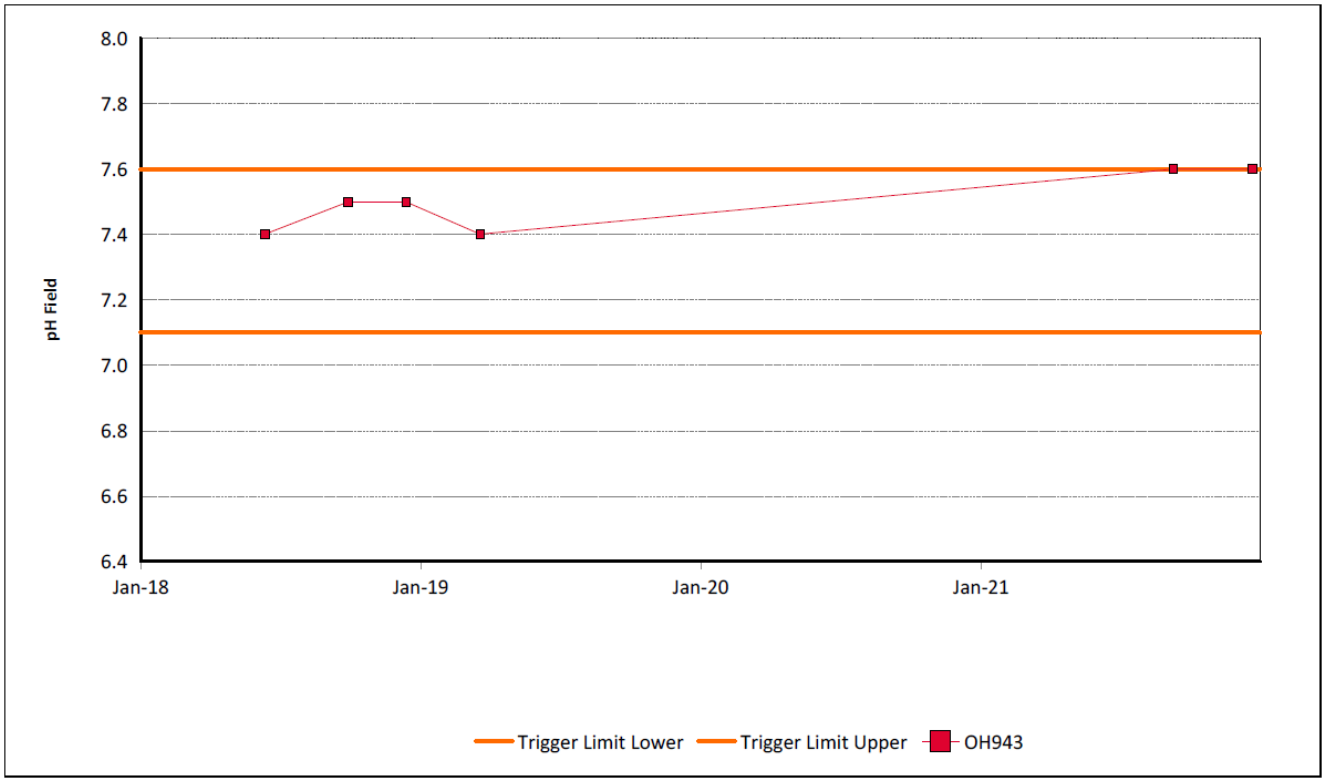


Figure 57: Hunter River Alluvium 3 pH Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 58: Hunter River Alluvium 4 Electrical Conductivity Trend – December 2021



Note: Missing data indicates that there was insufficient water to take a sample.

Figure 59: Hunter River Alluvium 4 pH Trend – December 2021

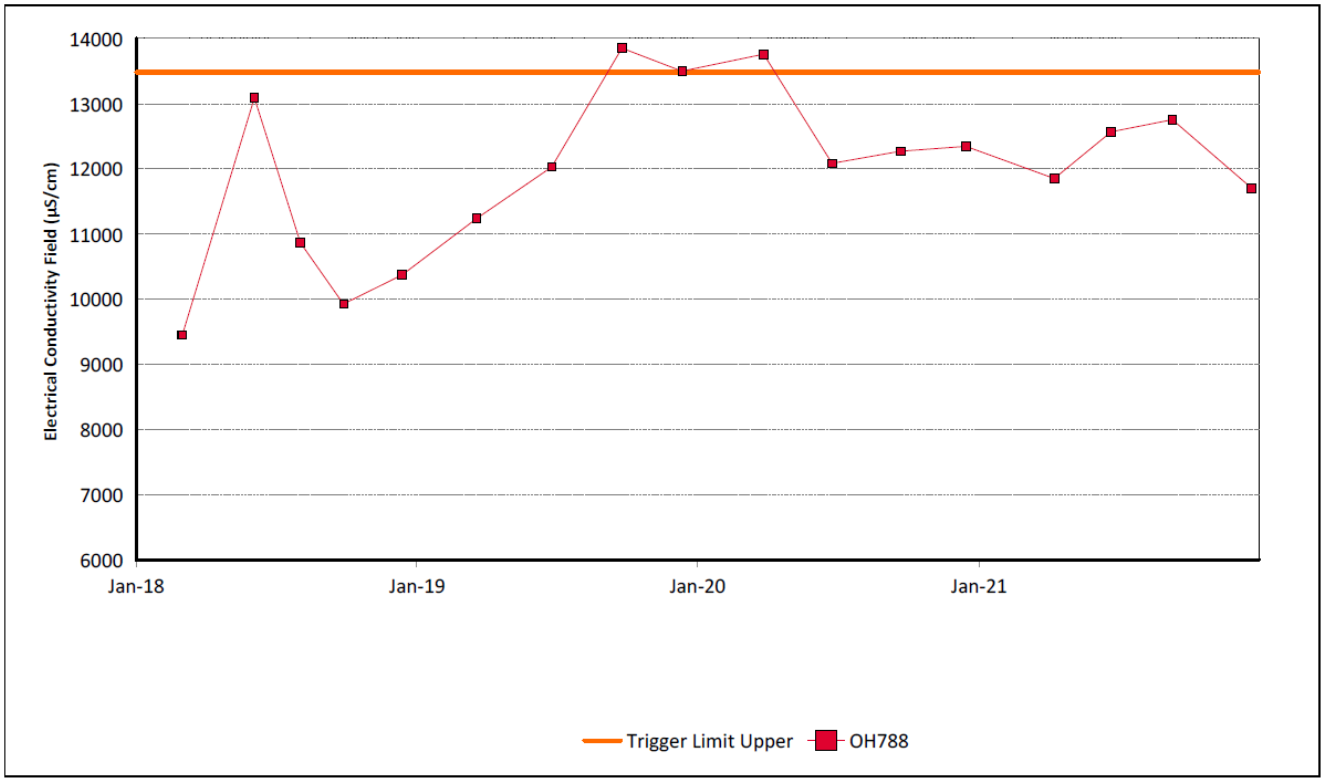


Figure 60: Hunter River Alluvium 5 Electrical Conductivity – December 2021

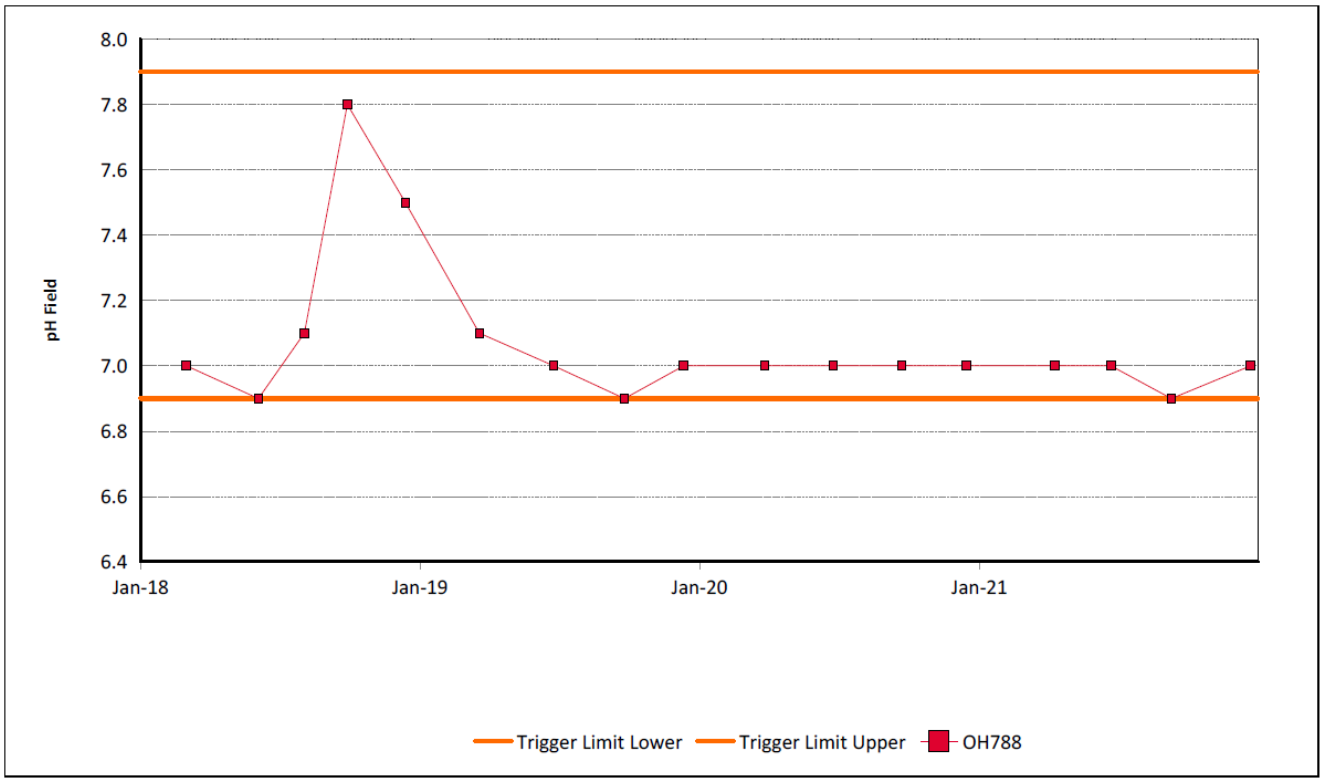


Figure 61: Hunter River Alluvium 5 pH Trend – December 2021

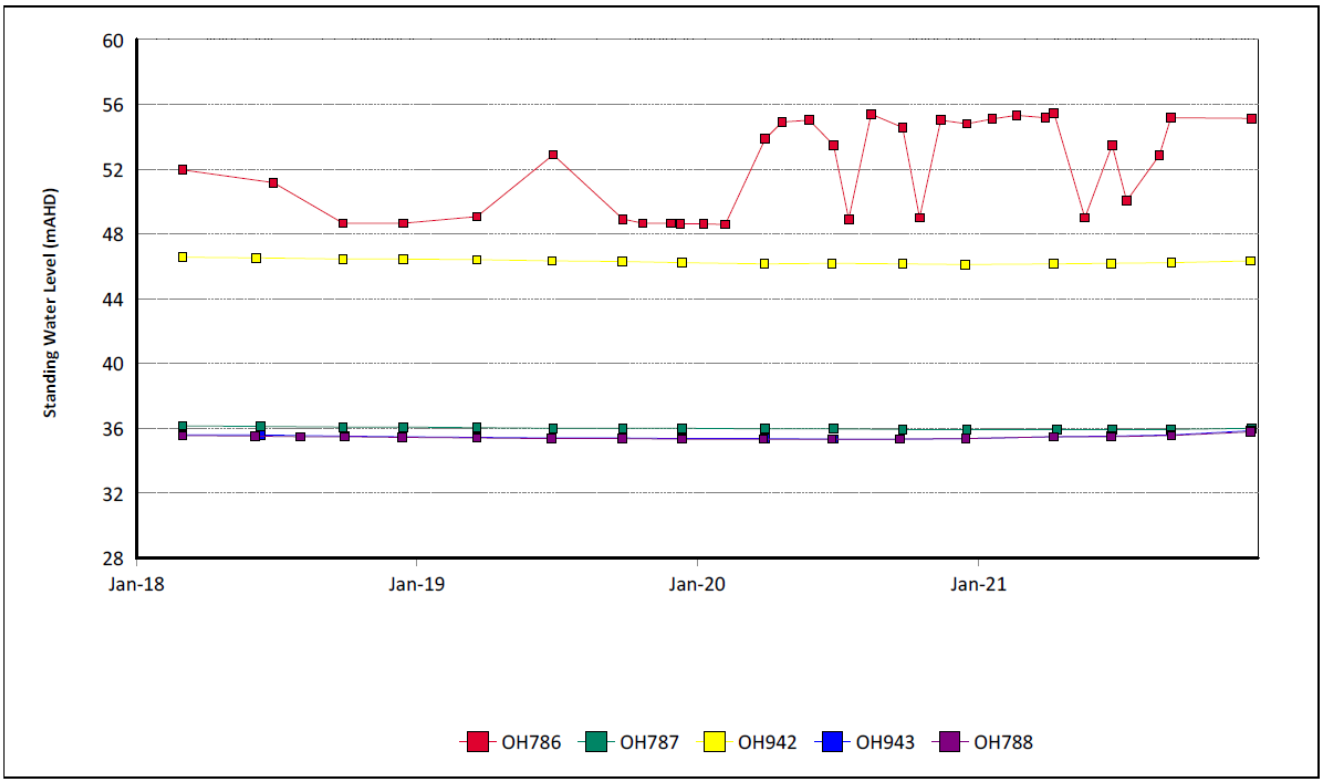


Figure 62: Hunter River Alluvium Standing Water Level Trend – December 2021

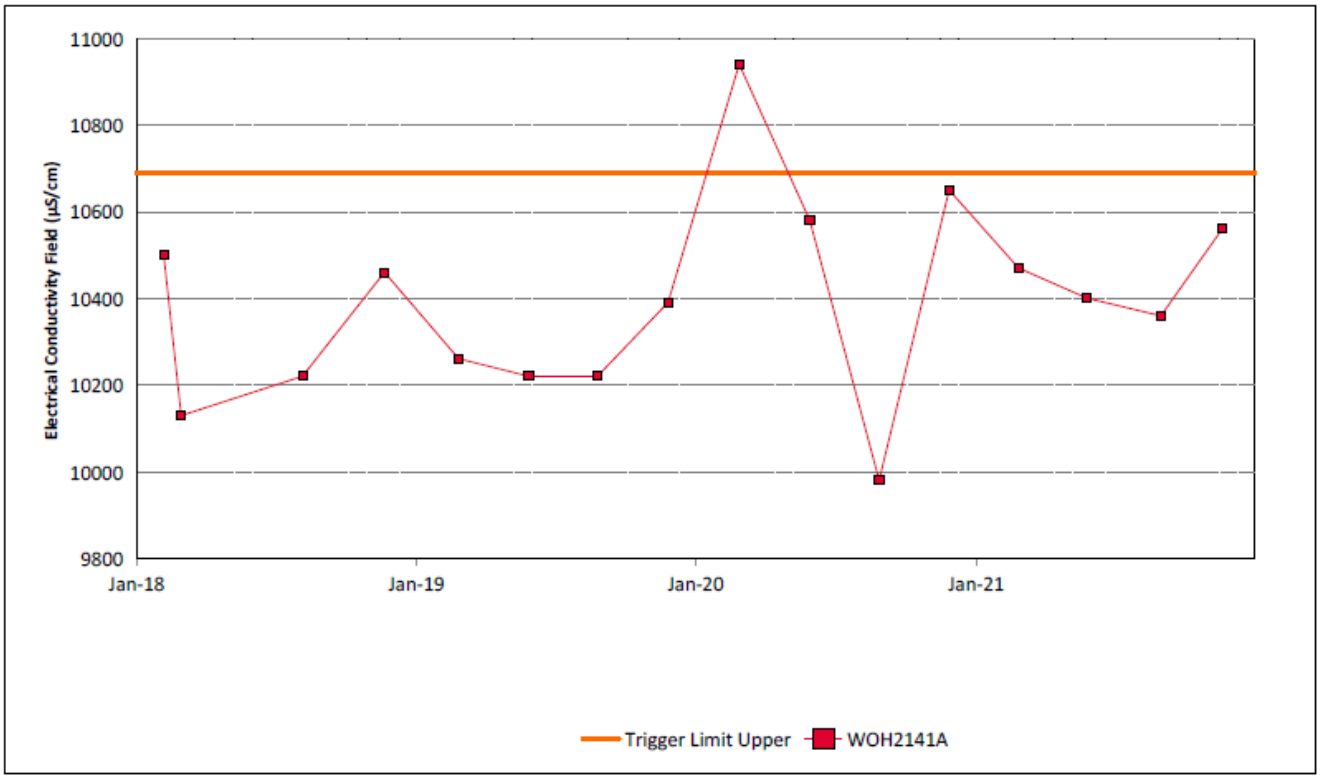


Figure 63: Whynot Seam Electrical Conductivity Field Trend - December 2021

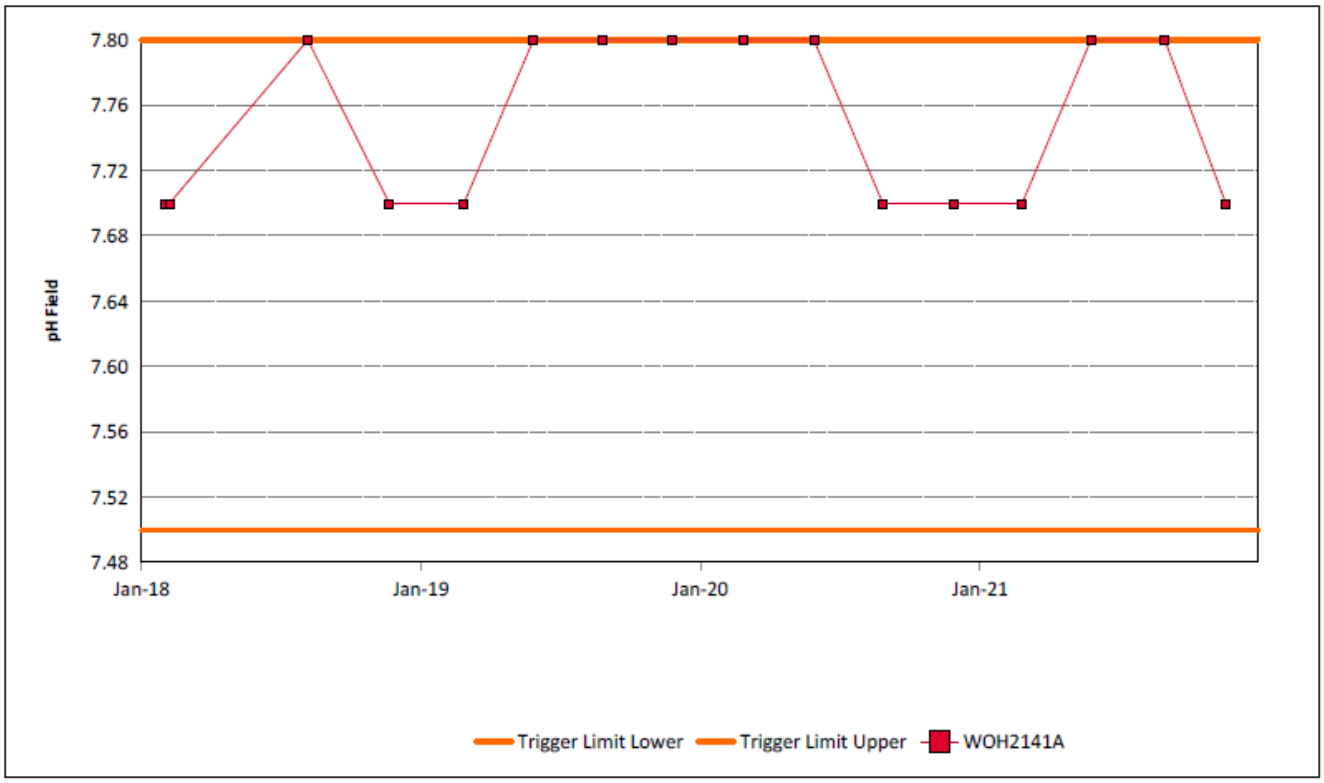


Figure 64: Whynot Seam pH Field Trend - December 2021

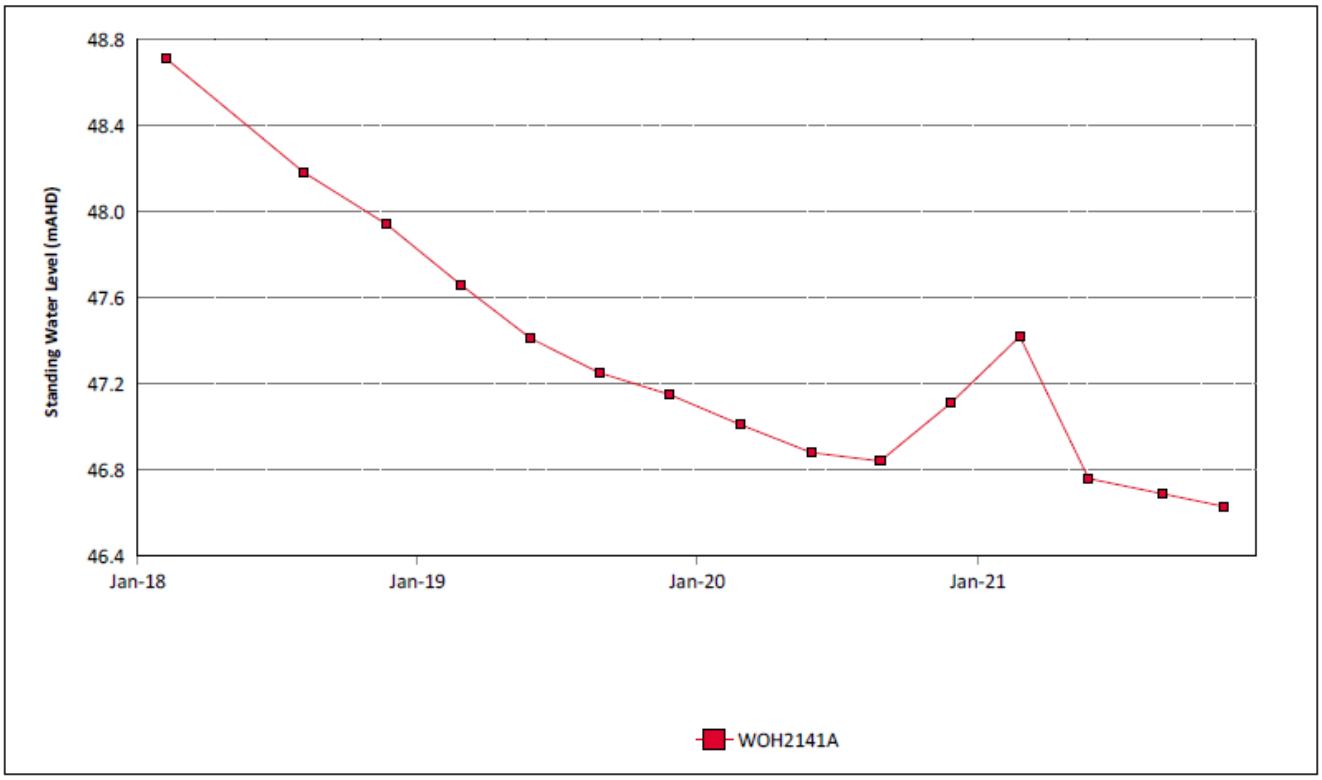


Figure 65: Whynot Seam Standing Water Level Trend - December 2021

3.2.1 Groundwater Trigger Tracking

Internal trigger limits have been developed to assess monitoring data on an on-going basis, and to highlight potentially adverse groundwater impacts. The process for evaluating monitoring results against the internal triggers and subsequent responses are outlined in the MTW Water Management Plan. Locations of groundwater bores are shown in **Figure 65**.

Current internal groundwater trigger limit breaches are summarised in **Table 3**.

Table 3: Groundwater Triggers – 2021

Site	Date	Trigger Limit Breached	Action Taken in Response
OH787	13/04/2021	EC – 95th Percentile	Watching Brief* A change to the sampling methodology implemented in 2019 i.e. low flow pumping/purging prior to all sampling and analysis, is considered the cause of the measured increase in EC since then.
OH787	24/06/2021	EC – 95th Percentile	Watching Brief*
OH787	8/09/2021	EC – 95th Percentile	Continue Watching Brief* In field investigation completed, no water interaction with surface observed. Considering engaging consultant for further investigation. Note EC only marginally above 95th trigger limit. Returned to within 95th percentile for 22/12/2021 sample result.
OH788	22/06/2021	EC – 95th Percentile	Watching Brief*
OH788	9/09/2021	EC – 95th Percentile	Watching Brief*
OH943	9/09/2021	EC – 95th Percentile	Watching Brief*
OH943	21/12/2021	EC – 95th Percentile	Watching Brief*
OH1137	9/09/2021	EC – 95th Percentile	Watching Brief* Returned to within 95th percentile for 22/12/21 sample result.
MTD605P	24/05/2021	EC – 95th Percentile	Watching Brief* Returned to within 95th percentile for 27/08/21 sample result.
MTD605P	24/11/2021	EC – 95th Percentile	Watching Brief*
WD622P	25/02/2021	EC – 95th Percentile	Watching Brief* Returned to within 95th percentile for 26/5/21 sample result.
PZ7S	30/08/2021	EC – 95th Percentile	Watching Brief* Returned to within 95th percentile for 19/11/21 sample result
WOH2139A	25/02/2021	pH – 95th Percentile	Watching Brief* Returned to within 95th percentile for 27/5/21 sample result.
WOH2139A	22/10/2021	pH – 95th Percentile	Watching Brief* Continue to monitor, prior sample within trigger limit. Only slightly above trigger limits.
WOH2139A	19/11/2021	pH – 95th Percentile	Watching Brief*
WOH2154B	24/02/2021	pH – 95th Percentile	Watching Brief*
WOH2154B	2/06/2021	pH – 95th Percentile	Watching Brief* Returned to above 95th percentile for 26/08/2021 sample result.
PZ9D	29/04/2021	pH – 5th Percentile	Watching Brief* Returned to above 5th percentile for 22/6/21 sample result.
PZ7D	27/05/2021	pH – 95th Percentile	Watching Brief*

Site	Date	Trigger Limit Breached	Action Taken in Response
PZ7D	30/08/2021	pH – 95th Percentile	Watching Brief*
PZ7D	19/11/2021	pH – 95th Percentile	Investigation required.
GW98MTCL2	23/06/2021	pH – 5th Percentile	Watching Brief* Returned to within 5th percentile for 6/09/2021 sample result.
WOH2156A	25/02/2021	pH – 5th Percentile	Watching Brief* Returned to within 5th percentile for 26/05/2021 sample result.
MB15MTW01D	25/02/2021	pH – 5th Percentile	Watching Brief* A change to the sampling methodology implemented in 2019 i.e. low flow pumping/purging prior to all sampling and analysis, is possibly considered the cause of the measured drop in pH results below 5th percentile trigger level since then.
MB15MTW01D	26/05/2021	pH – 5th Percentile	Watching Brief* A change to the sampling methodology implemented in 2019 i.e. low flow pumping/purging prior to all sampling and analysis, is possibly considered the cause of the measured drop in pH results below 5th percentile trigger level since then.
MB15MTW01D	24/8/2021	pH – 5th Percentile	Watching Brief* A change to the sampling methodology implemented in 2019 i.e. low flow pumping/purging prior to all sampling and analysis, is possibly considered the cause of the measured drop in pH results below 5th percentile trigger level since then.
MB15MTW01D	24/11/2021	pH – 5th Percentile	Investigation required.
MB15MTW03	24/11/2021	pH – 5th Percentile	Watching Brief*
MTD616P	25/02/2021	pH – 5th Percentile	Watching Brief*
MTD616P	25/05/2021	pH – 5th Percentile	Watching Brief* Returned to within trigger limit for 23/08/2021 sample.
MTD616P	24/11/2021	pH – 5th Percentile	Watching Brief*
WD622P	25/02/2021	pH – 5th Percentile	Watching Brief* Returned to above 5th percentile for 26/5/21 sample result.
OH788	9/09/2021	pH – 5th Percentile	Watching Brief* Returned to within trigger limit for 21/12/2021 sample.
OH1138(1)	19/01/2021	pH – 5th Percentile	Watching Brief*
OH1138(1)	19/02/2021	pH – 5th Percentile	Watching Brief*
OH1138(1)	29/03/2021	pH – 5th Percentile	Results were investigated in the MTW 2020 Annual Groundwater Review. pH results for monitoring bore OH1138 likely to be attributable to the regional drawdown associated within the active mining in North Pit and the potential influences from the abstraction of water from the Lemington underground workings. Continue Watching Brief*

Site	Date	Trigger Limit Breached	Action Taken in Response
OH1138(1)	8/04/2021	pH – 5th Percentile	See March comment re investigation at this location. Returned to the 5th percentile for 19/5/21 sample result. Continue Watching Brief*
OH1138(1)	24/06/2021	pH – 5th Percentile	See March comment re investigation at this location. Continue Watching Brief*
OH1138(1)	24/08/2021	pH – 5th Percentile	See March comment re investigation at this location. Continue Watching Brief* Returned to above 5th percentile for 23/11/2021 sample result
OH1126	24/06/2021	pH – 5th Percentile	Watching Brief* Returned to within trigger limits for 9/09/21 sample result.
OH1126	22/12/2021	pH – 5th Percentile	Watching Brief*
* = Watching brief established pending outcomes of subsequent monitoring events. No specific actions required.			

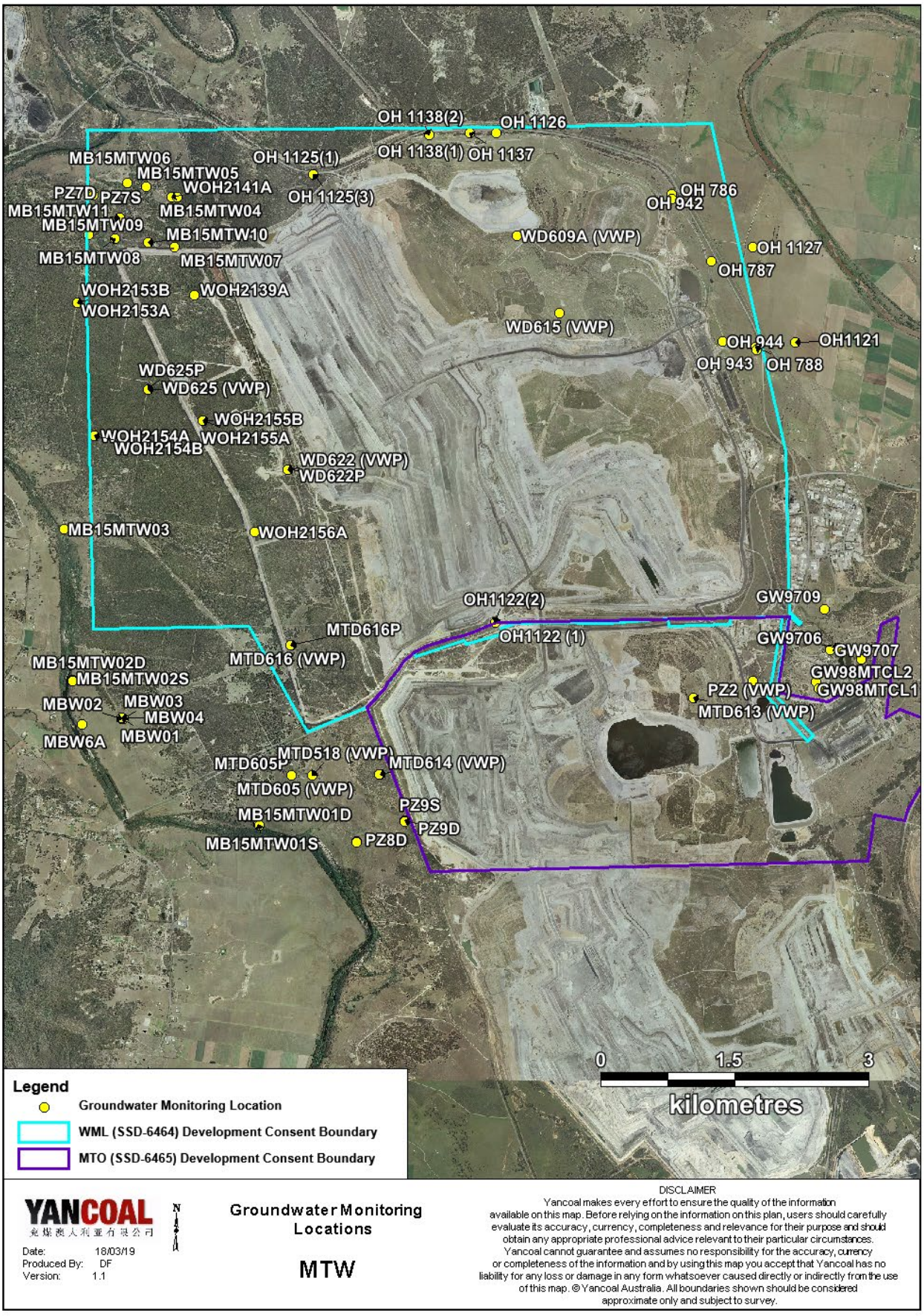


Figure 66: Groundwater Monitoring Location Plan

4.0 BLAST MONITORING

MTW have a network of six blast monitoring units. These are located at nearby privately-owned residences and function as regulatory compliance monitors.

The location of these monitors can be found in **Figure 72**.

4.1 Blast Monitoring Results

During December 2021, 20 blasts were initiated at MTW. **Figure 66** to **Figure 71** show the blast monitoring results for the reporting period against the impact assessment criteria. The criteria are summarised in **Table 4**.

Table 4: Blasting Limits

Airblast Overpressure (dB(L))	Comments
115	5% of the total number of blasts in a 12-month period
120	0%
Ground Vibration (mm/s)	**Comments**
5	5% of the total number of blasts in a 12-month period
10	0%

During the reporting period no blasts exceeded the 115 dB(L) 5% threshold for airblast overpressure or 5mm/s 5% threshold for ground vibration.

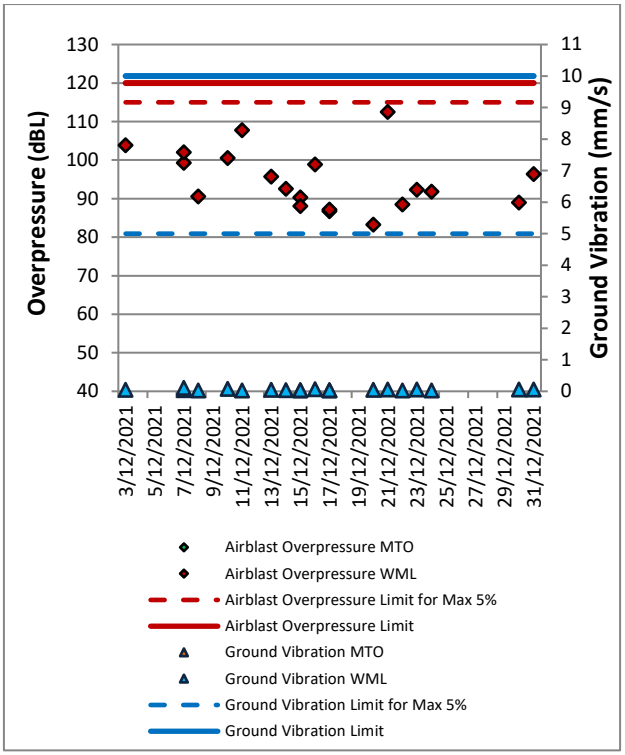


Figure 67: Abbey Green Blast Monitoring Results – December 2021

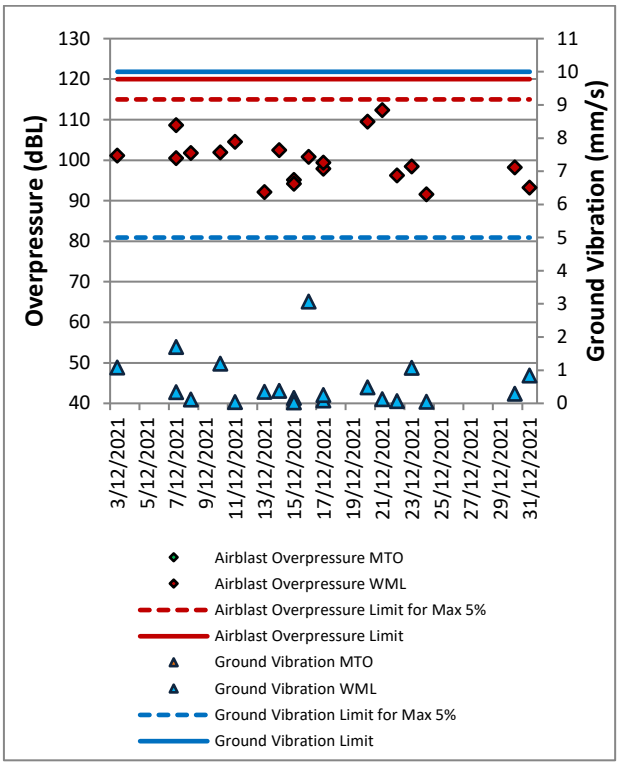


Figure 68: Bulga Village Blast Monitoring Results – December 2021

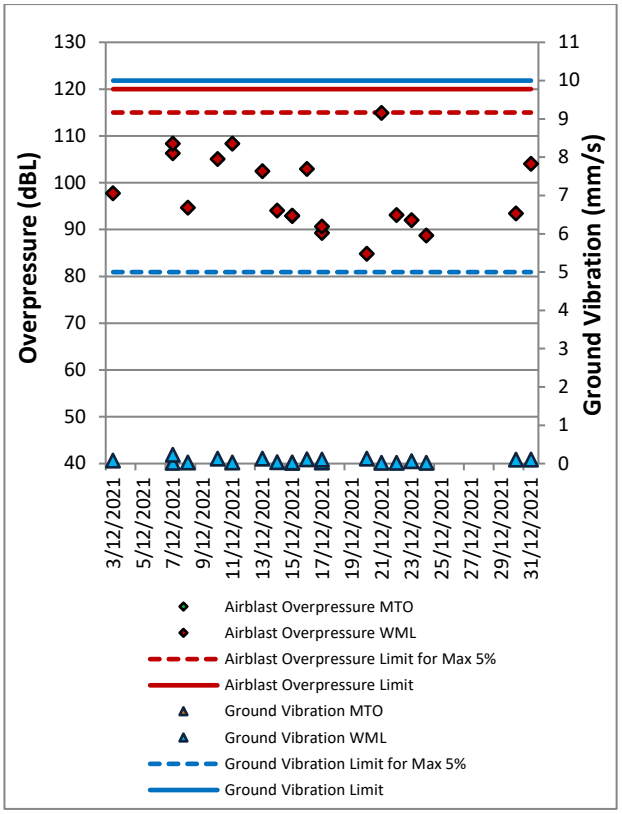


Figure 69: MTIE Blast Monitoring Results – December

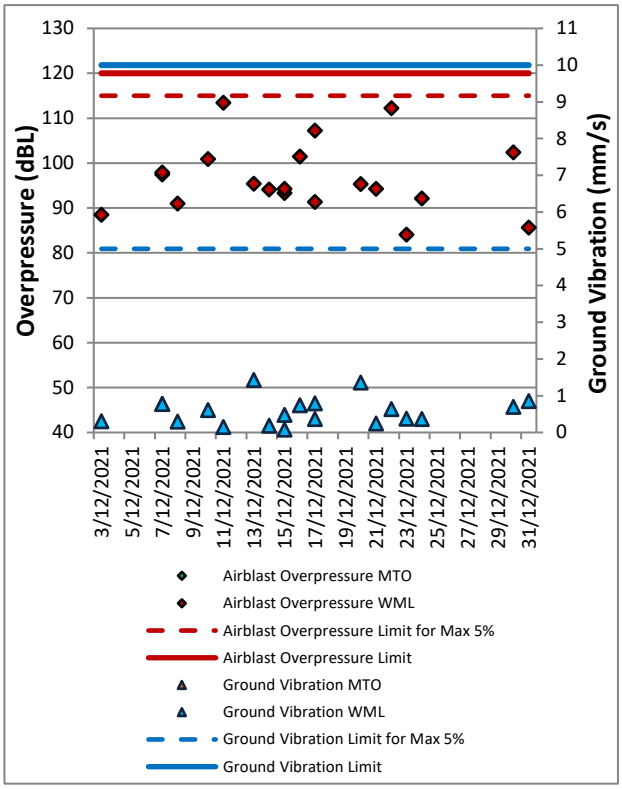


Figure 70: Warkworth Blast Monitoring Results - December 2021

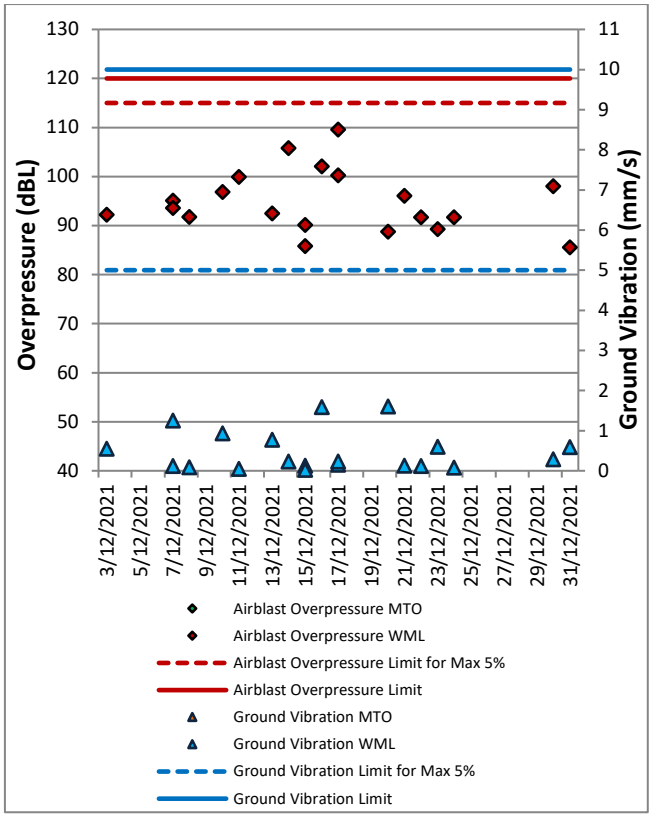


Figure 71: Wambo Road Blast Monitoring Results – December 2021

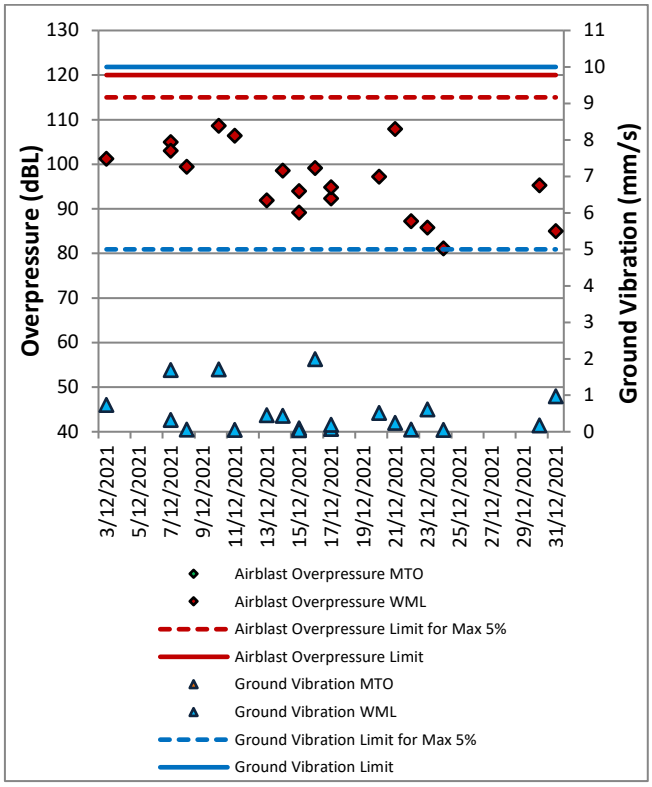


Figure 72: Wollemi Peak Road Blast Monitoring Results - December 2021

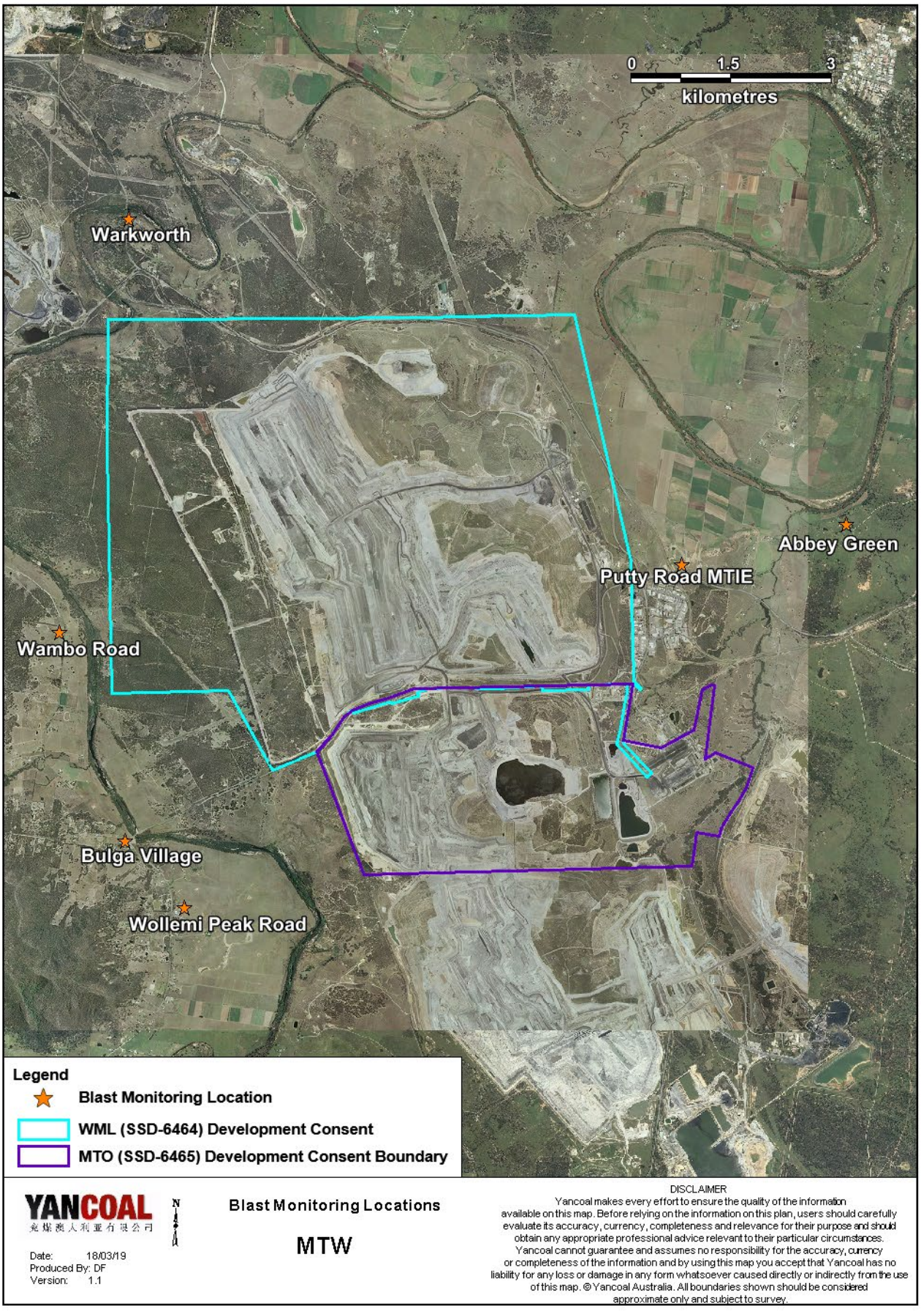


Figure 73: Blast and Vibration Monitoring Location Plan

5.0 NOISE

Routine attended noise monitoring is carried out in accordance with the MTW Noise Management Plan. A review against EIS predictions will be reported in the Annual Review Report. The purpose of the noise surveys is to quantify and describe the acoustic environment around the site and compare results with specified limits. Unattended monitoring (real time noise monitoring) also occurs at five sites surrounding MTW. The attended noise monitoring locations are displayed in **Figure 73.**

5.1 Attended Noise Monitoring Results

Attended monitoring was conducted at receiver locations surrounding MTW on the night of 20 December 2021. All measurements complied with the relevant criteria. Results are detailed in **Table 5** to **Table 8**.

5.1.1 WML Noise Assessment

Compliance assessments undertaken against the WML noise criteria are presented in **Table 5** and **Table 6**.

Table 5: $L_{Aeq,\ 15\ minute}$ Warkworth Impact Assessment Criteria – December 2021

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion (dB(A))	Criterion Applies?[1]	WML L_{Aeq} dB[2,3,4,5]	Exceedance[3,6]
Bulga RFS	20/12/2021 22:53	0.2	F	37	Yes	30	Nil
Bulga Village	20/12/2021 22:14	1	F	38	Yes	28	Nil
Gouldsville	20/12/2021 21:28	2.3	F	38	No	<25	NA
Inlet Rd	20/12/2021 21:23	2.3	F	37	No	35	NA
Inlet Rd West	20/12/2021 21:00	1.1	F	35	Yes	32	Nil
Long Point	20/12/2021 21:05	1.1	F	35	Yes	IA	Nil
South Bulga	20/12/2021 23:33	0.2	D	35	Yes	IA	Nil
Wambo Road	20/12/2021 21:50	2.4	D	38	Yes	37	Nil

Notes:
Notes:
1. Noise criteria apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Site-only LAeq,15minute attributed to WML, including modifying factors if applicable;
3. Bold results in red indicate exceedance of relevant criterion; and
4. NA in exceedance column means atmospheric conditions outside conditions specified in consent, therefore criterion was not applicable.

Table 6: $L_{A1,\ 1\ minute}$ Warkworth Impact Assessment Criteria – December 2021

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion (dB(A))	Criterion Applies?[1]	WML L_{Aeq} dB[2,3,4,5]	Exceedance[3,6]
Bulga RFS	20/12/2021 22:53	0.2	F	47	Yes	35	Nil
Bulga Village	20/12/2021 22:14	1	F	48	Yes	30	Nil
Gouldsville	20/12/2021 21:28	2.3	F	48	No	<25	NA
Inlet Rd	20/12/2021 21:23	2.3	F	47	No	39	NA
Inlet Rd West	20/12/2021 21:00	1.1	F	45	Yes	37	Nil
Long Point	20/12/2021 21:05	1.1	F	45	Yes	IA	Nil
South Bulga	20/12/2021 23:33	0.2	D	45	Yes	IA	Nil
Wambo Road	20/12/2021 21:50	2.4	D	48	Yes	39	Nil

Notes:
1. Noise criteria apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Site-only LA1,1minute attributed to WML;
3. Bold results in red indicate exceedance of relevant criterion; and
4. NA in exceedance column means atmospheric conditions outside conditions specified in consent, therefore criterion was not applicable.

5.1.2 MTO Noise Assessment

Compliance assessments undertaken against the MTO noise criteria are presented in **Table 7** and **Table 8**.

Table 7: $L_{Aeq,\ 15minute}$ Mount Thorley Operations - Impact Assessment Criteria – December 2021

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion dB	Criterion Applies?[1]	MTO L_{Aeq} dB[2,3]	Exceedance[3,4]
Bulga RFS	20/12/2021 22:53	0.2	F	37	Yes	NM	Nil
Bulga Village	20/12/2021 22:14	1	F	38	Yes	28	Nil
Gouldsville	20/12/2021 21:28	2.3	F	35	No	IA	NA
Inlet Rd	20/12/2021 21:23	2.3	F	37	No	30	NA
Inlet Rd West	20/12/2021 21:00	1.1	F	35	Yes	IA	Nil
Long Point	20/12/2021 21:05	1.1	F	35	Yes	IA	Nil
South Bulga	20/12/2021 23:33	0.2	D	36	Yes	25	Nil
Wambo Road	20/12/2021 21:50	2.4	D	38	Yes	IA	Nil

Notes:
1. Noise criteria apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;
2. Site-only LAeq,15minute attributed to MTO, including modifying factors if applicable;
3. Bold results in red indicate exceedance of relevant criterion; and
4. NA in exceedance column means atmospheric conditions outside conditions specified in consent, therefore criterion was not applicable.

Table 8: $L_{A1, 1Minute}$ Mount Thorley Operations - Impact Assessment Criteria – December 2021

Location	Date and Time	Wind Speed (m/s)	Stability Class	Criterion dB	Criterion Applies?[1]	MTO $L_{A1, 1min}$ dB[2,3]	Exceedance[3,4]
Bulga RFS	20/12/2021 22:53	0.2	F	47	Yes	NM	Nil
Bulga Village	20/12/2021 22:14	1	F	48	Yes	31	Nil
Gouldsville	20/12/2021 21:28	2.3	F	45	No	IA	NA
Inlet Rd	20/12/2021 21:23	2.3	F	47	No	30	NA
Inlet Rd West	20/12/2021 21:00	1.1	F	45	Yes	IA	Nil
Long Point	20/12/2021 21:05	1.1	F	45	Yes	IA	Nil
South Bulga	20/12/2021 23:33	0.2	D	46	Yes	30	Nil
Wambo Road	20/12/2021 21:50	2.4	D	48	Yes	IA	Nil

Notes:

1. Noise criteria apply during all meteorological conditions except the following: during periods of rain or hail; average wind speed at microphone height exceeds 5 m/s; wind speeds greater than 3 m/s measured at 10 metres above ground level; stability category F temperature inversion conditions and wind speeds greater than 2m/s at 10m above ground level; or stability category G temperature inversion conditions. Criterion may or may not apply due to rounding of meteorological data values;

2. Site-only LA1,1minute attributed to MTO;

3. Bold results in red indicate exceedance of relevant criterion; and

4. NA in exceedance column means atmospheric conditions outside conditions specified in consent, therefore criterion was not applicable.

5.1.3 Low Frequency Assessment

In accordance with the requirements of the EPA's Noise Policy for Industry (NPfI), the applicability of the low frequency modification penalty has been assessed. This resulted in the application of a 2dB penalty to the site only LAeq for the measurements taken at Wambo Road on 20 December 2021. Resulting LAeq noise levels did not exceed the WML impact assessment criteria at Wambo Road. The WML assessment for low frequency noise is shown in **Table 9** and the MTO assessment for low frequency noise is shown in **Table 10.**

Table 9: Warkworth Low Frequency Noise Assessment – December 2021

Location	Date and Time	Measured WML LAeq dB[1,2]	Criterion Applies?	Intermittency Modifying Factor?	Tonality Modifying Factor?	Frequency of Tonality[3]	Low-frequency Modifying Factor?	Maximum Exceedance of Reference Spectrum [3,4]	Penalty dB[4]	Exceedance
Bulga RFS	20/12/2021 22:53	30	Yes	No	No	NA	No	NA	Nil	NA
Bulga Village	20/12/2021 22:14	28	Yes	No	No	NA	No	NA	Nil	NA
Gouldsville	20/12/2021 21:28	<25	No	No	No	NA	No	NA	Nil	NA
Inlet Rd	20/12/2021 21:23	35	No	No	No	NA	No	NA	Nil	NA
Inlet Rd West	20/12/2021 21:00	32	Yes	No	No	NA	No	NA	Nil	NA
Long Point	20/12/2021 21:05	IA	Yes	No	No	NA	No	NA	Nil	NA
South Bulga	20/12/2021 23:33	IA	Yes	No	No	NA	No	NA	Nil	NA
Wambo Road	20/12/2021 21:50	35	Yes	No	No	NA	Yes	1dB @ 80Hz	(+)2	NA

Notes:
1. NA denotes 'not applicable'; and
2. Bold results indicate that application of NPfI modifying factor/s is required.

Table 10: Mount Thorley Operations Low Frequency Noise Assessment – December 2021

Location	Date and Time	Measured WML LAeq dB[1,2]	Criterion Applies?	Intermittency Modifying Factor?	Tonality Modifying Factor?	Frequency of Tonality[3]	Low-frequency Modifying Factor?	Maximum Exceedance of Reference Spectrum [3,4]	Penalty dB[4]	Exceedance
Bulga RFS	20/12/2021 22:53	NM	Yes	No	No	NA	No	NA	Nil	NA
Bulga Village	20/12/2021 22:14	28	Yes	No	No	NA	No	NA	Nil	NA
Gouldsville	20/12/2021 21:28	IA	No	No	No	NA	No	NA	Nil	NA
Inlet Rd	20/12/2021 21:23	30	No	No	No	NA	No	NA	Nil	NA
Inlet Rd West	20/12/2021 21:00	IA	Yes	No	No	NA	No	NA	Nil	NA
Long Point	20/12/2021 21:05	IA	Yes	No	No	NA	No	NA	Nil	NA
South Bulga	20/12/2021 23:33	25	Yes	No	No	NA	No	NA	Nil	NA
Wambo Road	20/12/2021 21:50	IA	Yes	No	No	NA	No	NA	Nil	NA

Notes:
1. NA denotes 'not applicable'; and
2. Bold results indicate that application of NPfI modifying factor/s is required.

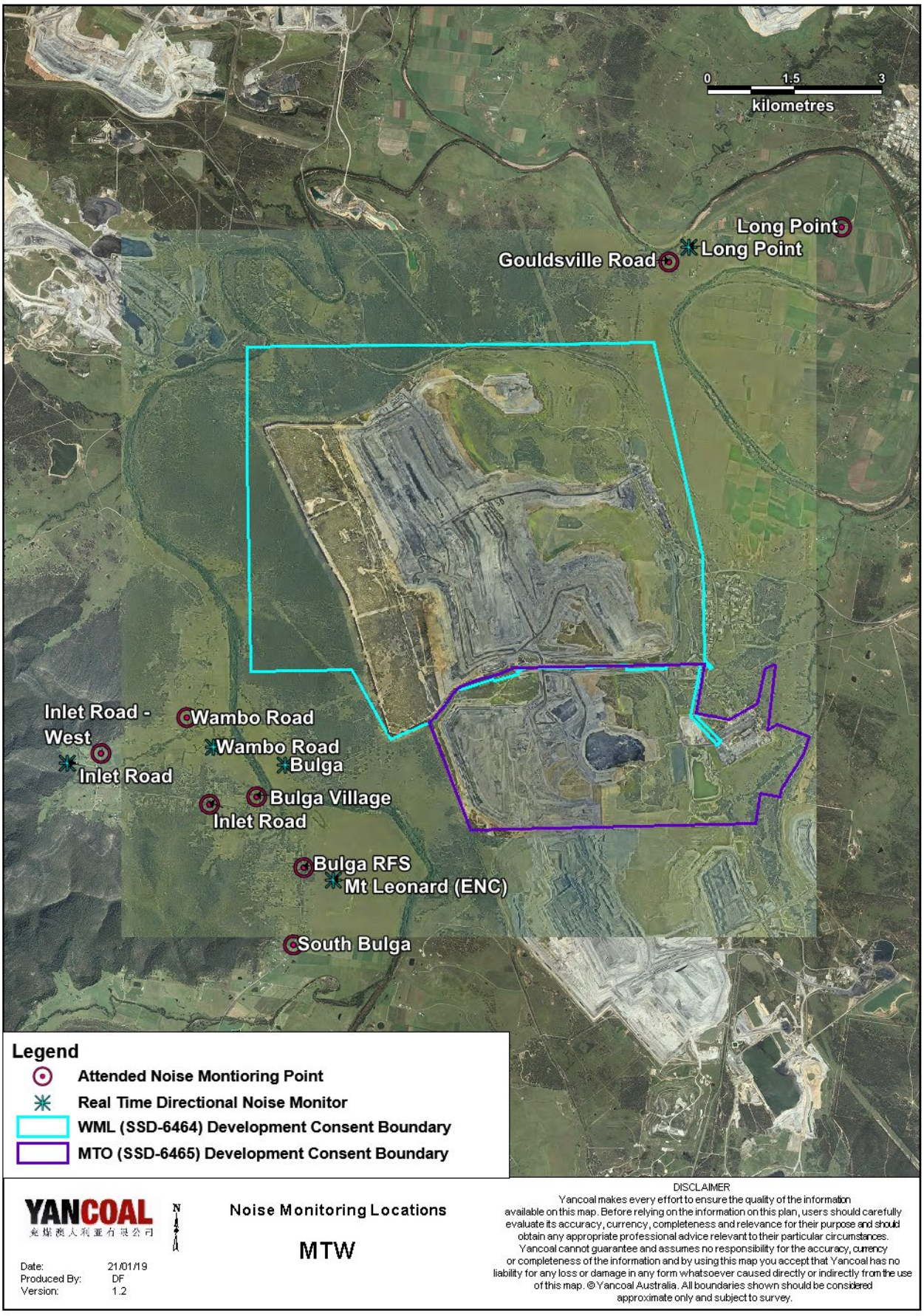


Figure 74: Noise Monitoring Location Plan

5.2 Noise Management Measures

A program of targeted supplementary attended noise monitoring is in place at MTW, supported by the real-time directional monitoring network and ensuring the highest level of noise management is maintained. The supplementary program is undertaken by MTW personnel and involves:

- Routine inspections from both inside and outside the mine boundary;
- Routine and as-required handheld noise assessments (undertaken in response to noise alarm and/or community complaint), comparing measured levels against consent noise limits; and
- Validation monitoring following operational modifications to assess the adequacy of the modifications.

Where a noise assessment identifies noise emissions which are exceeding the relevant noise limit(s) for any particular residence, modifications will be made so as to ensure that the noise event is resolved within 75 minutes of identification. The actions taken are commensurate with the nature and severity of the noise event, but can include:

- Changing the haul route to a less noise sensitive haul;
- Changing dump locations (in-pit or less exposed dump option)
- Reducing equipment numbers;
- Shut down of task; or
- Site shut down.

A summary of these assessments undertaken during December are provided in **Table 11**.

Table 11: Supplementary Attended Noise Monitoring Data – December 2021

No. of assessments	No. of assessments > trigger	No. of nights where assessments > trigger	% greater than trigger
503	4	2	0.80

: Measurements are taken under all meteorological conditions, including conditions under which the consent noise criteria do not apply.

6.0 OPERATIONAL DOWNTIME

During December a total of 94 hours of equipment downtime was logged in response to environmental events such as dust, noise and adverse meteorological conditions. Operational downtime by equipment type is shown in **Figure 74**.

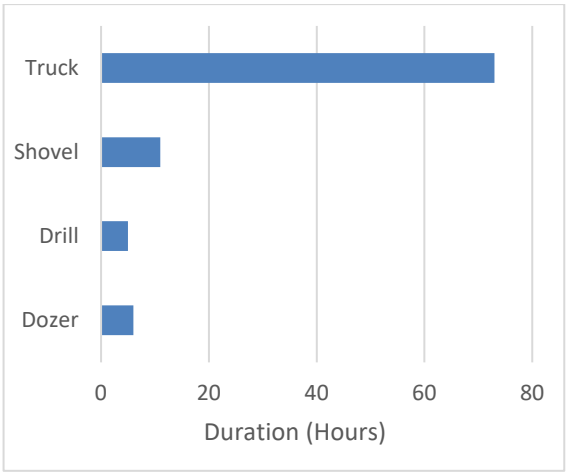


Figure 75: Operational Downtime by Equipment Type – December 2021

7.0 REHABILITATION

During December, 0.5 Ha of land was released for rehabilitation, 2.6 Ha was bulk shaped, 5.7 Ha of land topsoiled and 11.4 Ha of land Rehabilitated during the reporting period. Year-to-date progress can be viewed in **Figure 75.**

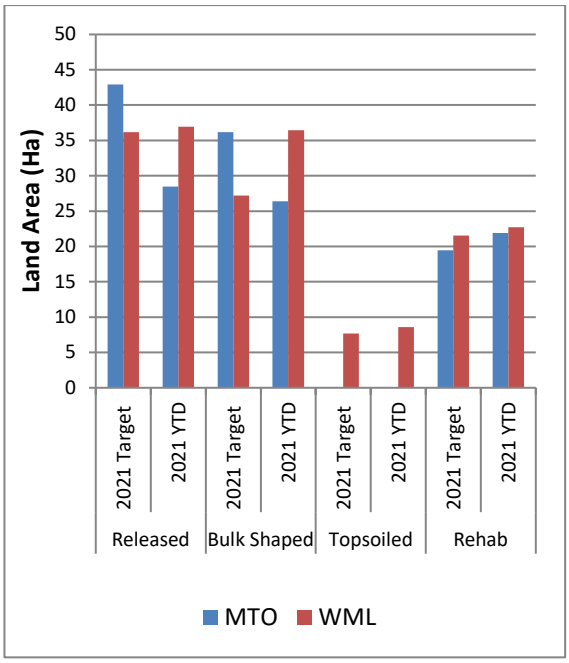


Figure 76: Rehabilitation YTD – December 2021

8.0 ENVIRONMENTAL INCIDENTS

There were no reportable environmental incidents recorded during the reporting period.

9.0 COMPLAINTS

During the reporting period 7 complaints were received, details of these complaints are displayed in **Table 12** below.

Table 12: Complaints Summary - YTD

	Noise	Dust	Blast	Lighting	Other	Total
January	1	0	6	4	1	12
February	4	0	3	0	0	7
March	5	0	3	3	1	12
April	6	2	1	10	0	19
May	3	1	10	5	0	19
June	2	0	4	0	0	6
July	1	0	5	3	1	10
August	12	8	5	1	0	26
September	3	11	7	8	1	30
October	4	8	1	0	0	13
November	5	2	9	0	0	16
December	3	0	4	0	0	7
Total	49	32	58	34	4	177

Appendix A: Meteorological Data

Table 13: Meteorological Data – Charlton Ridge Meteorological Station – December 2021

Date	Air Temperature Maximum (°C)	Air Temperature Minimum (°C)	Relative Humidity Maximum (%)	Relative Humidity Minimum (%)	Wind Direction Average (°)	Wind Speed Average (m/sec)	Rainfall(mm)
1/12/2021	26	13	99	58	128	2.6	0.2
2/12/2021	29	13	96	43	136	2.2	0.0
3/12/2021	34	11	99	31	186	2.0	21.2
4/12/2021	28	17	98	51	161	2.6	1.2
5/12/2021	23	14	84	50	148	4.3	0.0
6/12/2021	-	-	-	-	-	-	-
7/12/2021	28	12	100	54	205	3.1	0.0
8/12/2021	27	11	100	49	160	2.6	31.4
9/12/2021	25	10	100	53	139	2.3	2.8
10/12/2021	24	8	94	28	252	4.0	0.2
11/12/2021	22	10	80	47	168	3.2	0.0
12/12/2021	25	9	83	36	153	2.8	0.0
13/12/2021	28	10	89	38	139	2.2	0.0
14/12/2021	29	9	96	26	151	2.0	0.0
15/12/2021	33	9	98	23	170	2.0	0.0
16/12/2021	29	14	95	46	141	2.8	1.2
17/12/2021	28	13	82	48	141	2.8	0.0
18/12/2021	35	12	96	35	237	2.7	0.0
19/12/2021	34	15	90	32	235	3.3	2.2
20/12/2021	35	14	96	34	178	1.4	0.2
21/12/2021	37	16	94	29	196	1.5	0.0
22/12/2021	32	18	94	41	175	1.1	0.0
23/12/2021	28	17	91	53	141	1.2	0.0
24/12/2021	30	16	96	42	142	1.5	0.2
25/12/2021	33	15	92	25	151	1.2	0.0
26/12/2021	32	15	97	34	149	1.7	5.4
27/12/2021	23	11	98	60	165	4.2	3.6
28/12/2021	23	13	96	47	165	2.9	1.0
29/12/2021	25	12	90	43	152	2.2	0.2
30/12/2021	28	9	92	37	148	1.7	0.0
31/12/2021	31	10	94	28	146	1.6	0.0

"-" Indicates that data was not available due to technical issues.